PART 2

EXPLANATORY REPORT

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LOT 12 JINDALEE

LOCAL STRUCTURE PLAN

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SECTION 1

PLANNING BACKGROUND

PREPARED BY:

CHAPPELL AND LAMBERT

1.0 PLANNING BACKGROUND

1.1 Introduction

The Lot 12 Jindalee Local Structure Plan is prepared pursuant to Part 9 of the City of Wanneroo District Town Planning Scheme No. 2 wherein a Structure Plan is required over Urban Development zoned land, prior to the commencement of subdivision and / or development. Pursuant to Part 9 of the Scheme a Structure Plan comprises an Explanatory Report (Part 2) and a Statutory Planning Section (Part 1).

The Structure Plan is lodged pursuant to the Liveable Neighbourhoods Policy. Following advertising of this Structure Plan, it is the landowners intention to lodge an Application for Subdivision in accordance with the Local Structure Plan to secure a subdivision approval in 2002.

In summary this document;

(a) Applies the relevant statutory planning controls to Lot 12 to enable subdivision and development in accordance with the Structure Plan, and;

(b) Provides a comprehensive description and analysis of Structure Plan proposals to support the statutory outcomes and the subsequent subdivision application.

1.2 Description of Landholding

Lot 12 is an estate in fee simple on Certificate of Title Volume 1508, Folio 910 and is held in the name of;

- Carine Nominees Pty Ltd.

- Belgravia Nominees Pty Ltd.
- Penhurst Nominees Pty Ltd.

It comprises a total land area of 77.5797 hectares with 600 metres of frontage on its eastern boundary to Marmion Avenue. The western boundary of the property abuts Crown Foreshore reserve which varies in width from approximately 100 metres to 160 metres.

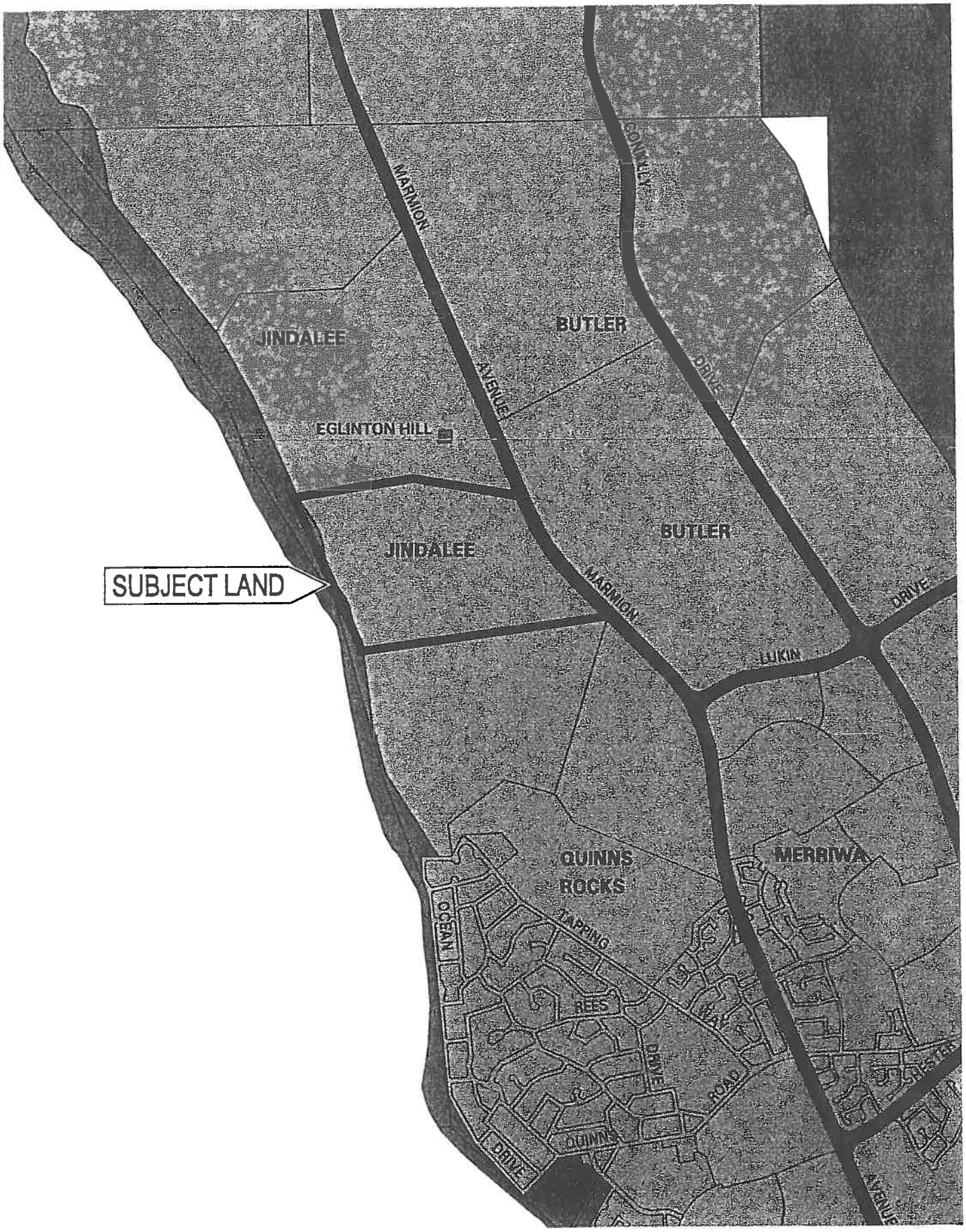
The subject land (refer Figure 1) is located approximately 2.5 kilometres north of Mindarie and the Clarkson District Centre in the North West Corridor. At this point of time, it immediately abuts the Quinns Rocks urban front and the developing Brighton Estate east of Marmion Avenue (refer Figure 6).

The landholding, whilst used extensively in the past for grazing purposes, remains essentially undeveloped, though it is traversed by numerous 4WD tracks which lead to the beach. Given its zoning and status in current planning documents, proximity to existing developments and infrastructure, the land is considered ripe for development, and hence the lodgement of this Structure Plan prior to seeking subdivision approvals.

1.3 Format of Report

This Structure Plan report comprises inputs from members of the Lot 12 Jindalee Project Team. The consultants responsible for preparation of the various report inputs are as follows;

- Planning & Urban Design: Chappell & Lambert.
- Traffic & Movement Network: ERM Mitchell McCotter.
- Engineering & Servicing: Wood & Grieve.



LOCATION PLAN

FIGURE 1

SOURCE: M.R.S.

- Landscape Strategy: McNally Newton.
- Coastal Processes: MP Rogers & Associates.
- Environmental: ATA Environmental.

Separate reports have been prepared by these consultants, and where appropriate, are either summarized or reproduced in full as part of this document. The Traffic Assessment and Environmental Report are reproduced in full as separate sections within the body of the Structure Plan Report.

The Explanatory Report consists of five main sections as follows;

- *Section 1.0 Planning Background*
  This provides an introduction and background to the landholding, the statutory framework and the project team.

- *Section 2.0 District Land Use Context*
  This examines the context of the landholding with respect to district planning initiatives, surrounding properties and development, and foreshore reserve considerations.

- *Section 3.0 Local Structure Plan – Urban Design and Land Use*
  This is the main section of the report describing the overall objectives, detailed urban design elements, proposed land uses, engineering and servicing considerations and the local road network.

- *Section 4.0 Transport Planning*
  Stand alone Report with attachments prepared by ERM Mitchell McCotter.

- *Section 5.0 Environmental Report*
  Stand alone Report with attachments prepared by ATA Environmental.

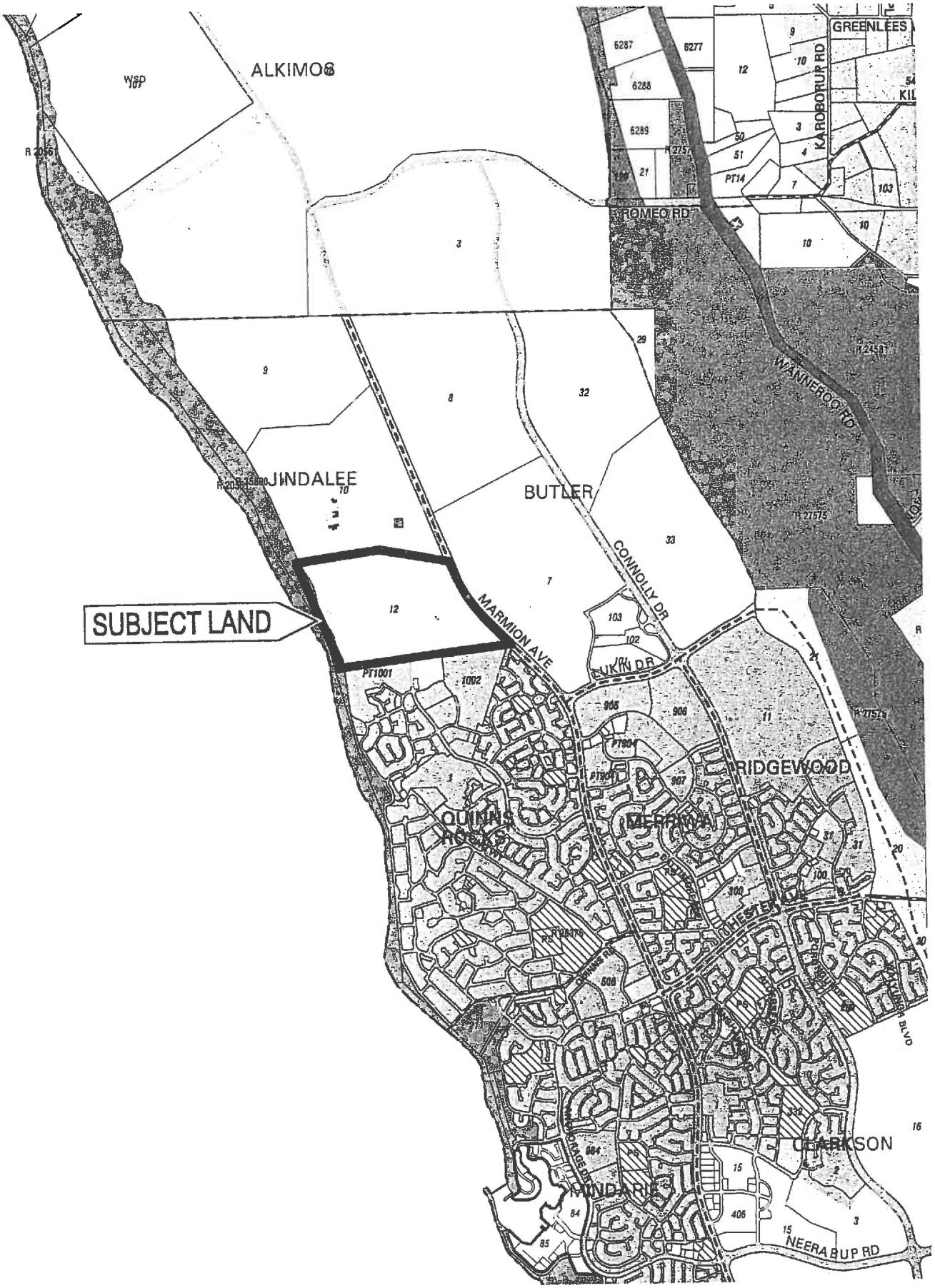
1.4 Town Planning Scheme Considerations

The land is zoned Urban in the Metropolitan Region Scheme (refer Figure 1).

The land is zoned Urban Development in the Wanneroo District Town Planning Scheme No. 2 (refer Figure 2). Portion of the small coastal node is included within the Commercial Zone. This will need to be rationalised, through a separate rezoning to include it in the Urban Development zone. The zoning plan in the Structure Plan assumes this will occur.

It should also be noted that within the Metropolitan Region Scheme and the Wanneroo District Town Planning Scheme No. 2 (DPS 2), a small portion along the western boundary of the property (6,097m^2) is affected by the Parks & Recreation Reservation. A copy of this Clause 42 Certificate is included within the Appendix.

As previously mentioned, this Structure Plan is lodged pursuant to Part 9 of DPS 2, wherein a Structure Plan is required to be prepared and submitted to Council, advertised for public comment, adopted by Council and the Commission, following consideration of any submissions, prior to approval of any subdivisional development. The bulk of this report constitutes Part 2 the Explanatory Report with the Statutory Planning component included within Part 1 and available as a separate document. Following adoption, the statutory portion of the Structure Plan will operate as though it were part of the Scheme.



EXTRACT FROM DISTRICT TOWN PLANNING SCHEME No. 2

FIGURE 2

SECTION 2

DISTRICT LAND USE CONTEXT

PREPARED BY:

CHAPPELL AND LAMBERT

2.0 DISTRICT LAND USE CONTEXT

2.1 North West Corridor Structure Plan

Whilst more recent district planning initiatives, in the form of the Jindalee Enquiry by Design exercises, are very pertinent to this landholding, it must be recognised that historically the site has long been earmarked for Urban development through the North West Corridor Structure Plan in its numerous iterations (refer Figure 3). This document, though outdated, still remains the only operational District Structure Plan for the North West Corridor and Lot 12 remains, nominated as Future Urban Category A1, although this depiction preceded its subsequent rezoning under the Metropolitan Region Scheme to Urban.

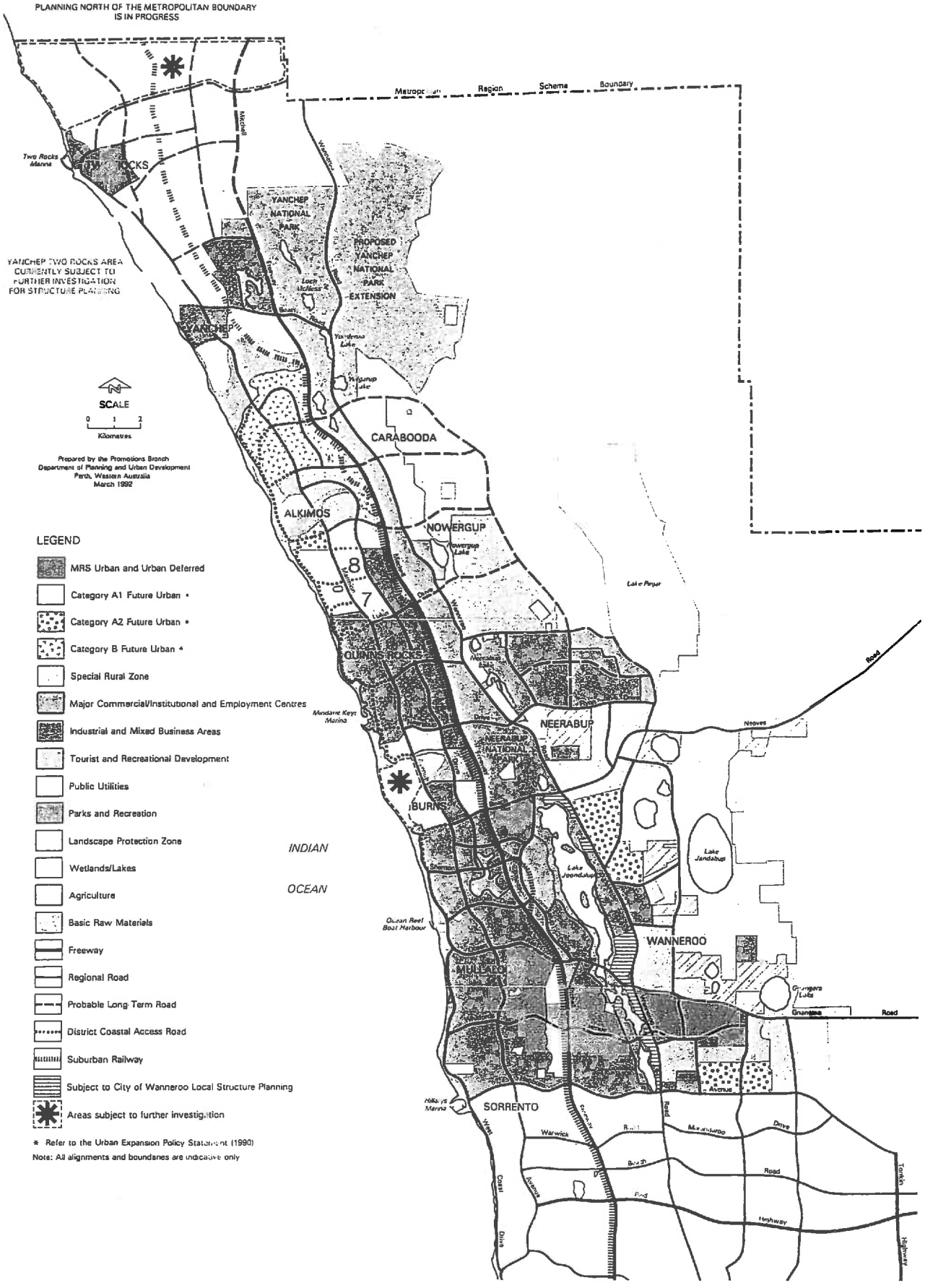
2.2 The Jindalee Enquiry by Design Workshops

Lot 12 and the general Butler / Jindalee area was the subject of the initial Ministry for Planning Enquiry by Design exercise conducted in 1996. As recently as August 2001, a further Enquiry by Design exercise was undertaken, involving landowners, their consultants, the City of Wanneroo, Ministry for Planning and others. Whilst the findings have yet to be made public, copies of the preferred Sub-Regional Context Plan and District Structure Plan are included at Figure 4 and 5. In essence however, the broader district context as it relates to Lot 12 remains unchanged with the key initiatives being;

(i) Residential development of Lot 12 at densities generally between R12.5 and R40.

(ii) A small beachside mixed use node.

(iii) A strong boulevard connection between Brighton and the coast.



NORTH WEST CORRIDOR STRUCTURE PLAN

FIGURE 3

SUB REGIONAL PLAN - DRAFT OUTCOME ONLY

SOURCE: BUTLER ENQUIRY BY DESIGN

FIGURE 4

DISTRICT STRUCTURE PLAN - DRAFT OUTCOME ONLY

SOURCE: BUTLER ENQUIRY BY DESIGN

FIGURE 5

(iv) Good connectivity and coordination between the EDC landholding to the north and the Quinns Beach Estate land to the south.

(v) Mixed Use development on Marmion Avenue, complementing the Village Centre at Brighton.

(vii) Design based on a modified road grid.

The 2001 Enquiry by Design endorsed the Structure Plan for Lot 12 in the form prepared by Chappell and Lambert as presented in this document. The current Structure Plan and the subsequent subdivision applications are lodged pursuant to Liveable Neighbourhoods and the principles and intent behind Liveable Neighbourhoods and the Enquiry by Design Exercises, with respect to those matters mentioned above, are reflected in this plan.

2.3 Marmion Avenue

The site fronts Marmion Avenue, which is currently designated as an Other Regional Road in the Metropolitan Region Scheme. As part of the investigative work done for the Brighton subdivision it has been determined by M.R.W.A that Marmion Avenue will ultimately comprise only four lanes. This provides opportunity for utilisation of the surplus road reserve for access streets. The Structure Plan itself provides for three key intersections onto Marmion Avenue which are explained in more detail in the ERM Transport Planning Assessment Study in Section 4.0. A Marmion Avenue Access Plan is included in the Appendix.

to the northern boundary of Lot 9 Marmion Avenue. The outcome is an Integrated Access Plan for this stretch of Marmion Avenue, which defines the location and type of the various intersections in accordance with the spacing requirements of the Main Roads Department and the Local Council. A copy of this plan is included in the Appendix.

2.5 District Context Plan

The District Context Plan at Figure 6 places the Structure Plan for Lot 12 within an overall context based on best available information and indicating current subdivision layouts on adjacent properties. Specifically, this plan can be referenced to examine the integration between the adjoining estates mentioned above. Many of the unresolved aspects of this District Context Plan, such as the alignment of the railway line, the future status of Connolly Drive and the final location of the Jindalee District Centre, do not in any case, impact upon structure planning considerations for this site as can be seen from Figure 6.

2.6 Existing Foreshore Reserve Considerations

2.6.1 Foreshore Management Plan

The coastal planning study "*Burns Beach to Jindalee*" prepared by Hames Sharley Australia for the City of Wanneroo, made specific recommendations with respect to the Foreshore Reserve abutting Lot 12. A copy of the recommended Strategy Plan from the Hames Sharley Report included at Figure 7. In essence, it recommends a local beach node to be developed on Lot 12, together with a large area of car parking to the north, which also extends into the adjoining Lot 12. The strategy acknowledges that development of the adjacent land parcels would logically create

2.4 Surrounding Land Use and Development

2.4.1 Quinns Beach Estate

Lot 12 abuts the Quinns Beach Estate to the south and the design integrates into the current plan. Two points to note are the extensions of St Anthony Drive and Santa Barbara Parade through Lot 12. A further key local traffic initiative is the extension of Hampshire Drive from the Quinns Beach Estate through the south eastern portion of Lot 12 to link to Marmion Avenue.

2.4.2 Brighton Estate

The Brighton Estate is presently being developed by the Butler Joint Venture on the eastern side of Marmion Avenue. The preparation of both Structure Plans has progressed in parallel to ensure a high level of coordination and cooperation between the two owners. Key elements are the extension of the Brighton Village Centre main street through Lot 12 linking to the beachside node, coordination of all access roads off Marmion Avenue and complimentary business uses along Marmion Avenue.

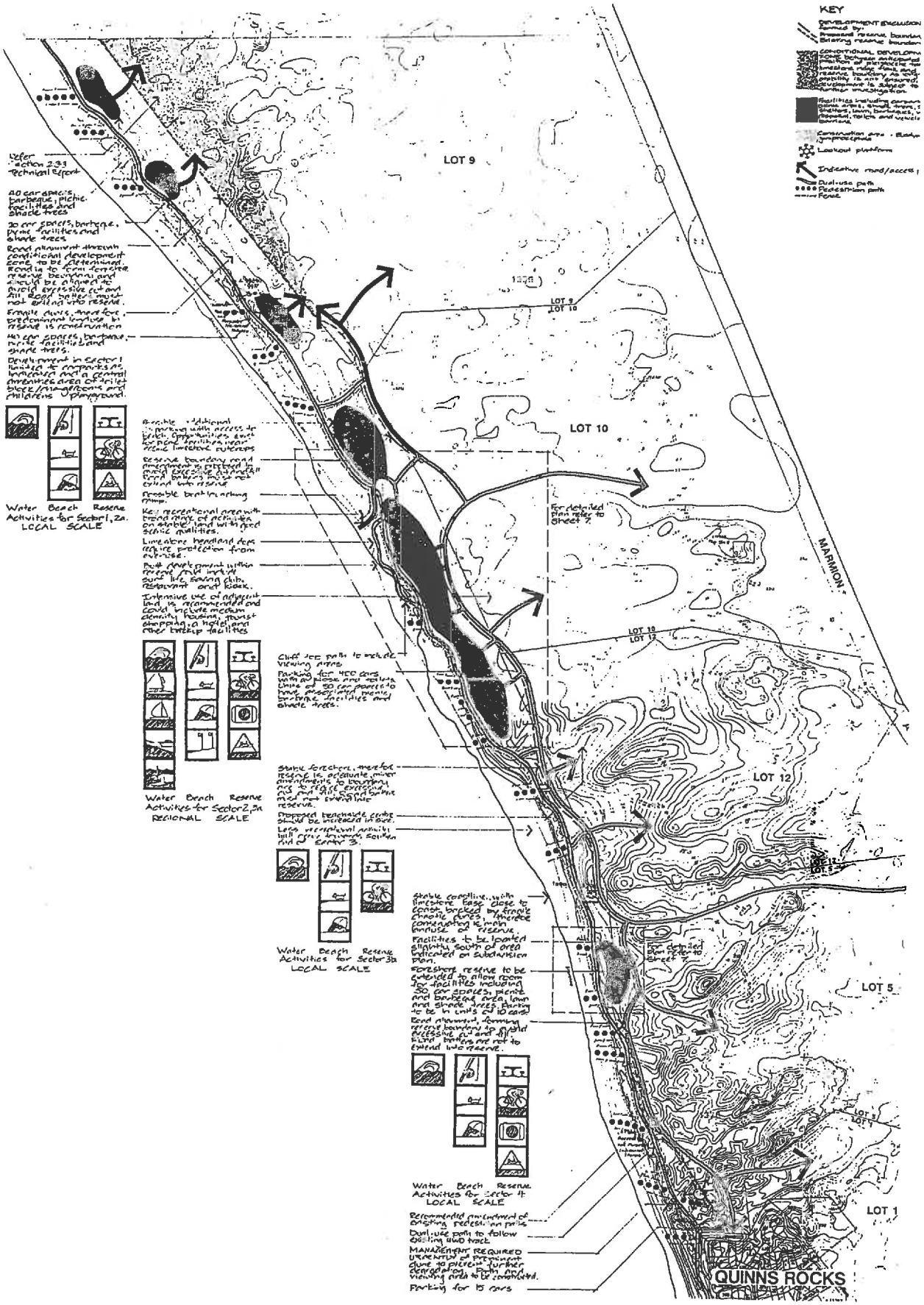
2.4.3 Lot 10 Marmion Avenue

The land immediately to the north is presently being planned for Estates Development Corporation, by the Roberts Day Group, as a residential estate. Lot 12 has been designed to integrate with this design. The Lot 10 Structure Plan makes provision for the primary school site which will service this area.

All of the landowners within the Brighton / Jindalee area have co-operated in preparing an overall Access Plan for Marmion Avenue from Lukin Drive up

JINDALEE - BRIGHTON DISTRICT CONTEXT PLAN

FIGURE 6



EXTRACT FROM HAMES SHARLEY COASTAL PLANNING STUDY - SECTION 3

FIGURE 7

pressure for beach use and that a rational approach to foreshore use, development and management was needed.

Recognising this initiative, significant work has been undertaken by the landowner in liaison with the Ministry for Planning and the City of Wanneroo to facilitate the maximum possible opportunity for public enjoyment of the coast, without compromising environmental values.

The landowner through ATA Environmental, McNally Newton Landscape Architects and Wood & Grieve Engineers, has prepared a draft Foreshore Management Plan and recently lodged it for consideration by the City of Wanneroo and Ministry for Planning (the draft Concept Plan is included in the Appendix). It outlines a configuration of landuses recognising conservation, recreation, commercial and car parking requirements. Whilst the current landowner is hopeful this represents an acceptable outcome, the current Structure Plan has been formulated to also allow for the eventuality that nothing will be permitted to occur in the Foreshore Reserve other than managed access to the beach. Importantly the layout is also structured to make allowance for the development in the Foreshore Reserve should this ultimately prove to be the objective.

The future of the Foreshore Reserve will be pursued with the Authorities and coordinated by the City of Wanneroo as a separate process.

2.6.2 Coastal Processes

MP Rogers & Associates Pty Ltd have undertaken a Coastal Stability Study for the owners of Lots 9, 10 & 12 Jindalee. The recommendations with respect to Lot 12 were as follows;

(i) Analysis of the Shoreline Movement Plans for Lot 12 showed that the rocky coast along the Foreshore Reserve, adjacent to Lot 12, has remained quite stable over the 56 years between 1941 and 1997. In some areas there was a slight accretion.

(ii) It is recommended that any development at Lot 12 be set back at least 30 metres behind the limestone cliffs.

(iii) Results of an analysis of the potential beach use for Lot 12 show that it may be feasible to develop a local beach in the northern and southern portions and possibly a district beach in the central portion of Lot 12.

A copy of the relevant figure published within that report is included at Figure 8. A full copy of this Report is available upon request. It should be noted that the foreshore setback line recommended by MP Rogers & Associates is well within the current Crown Foreshore Reserve and presents no constraint to development on Lot 12.

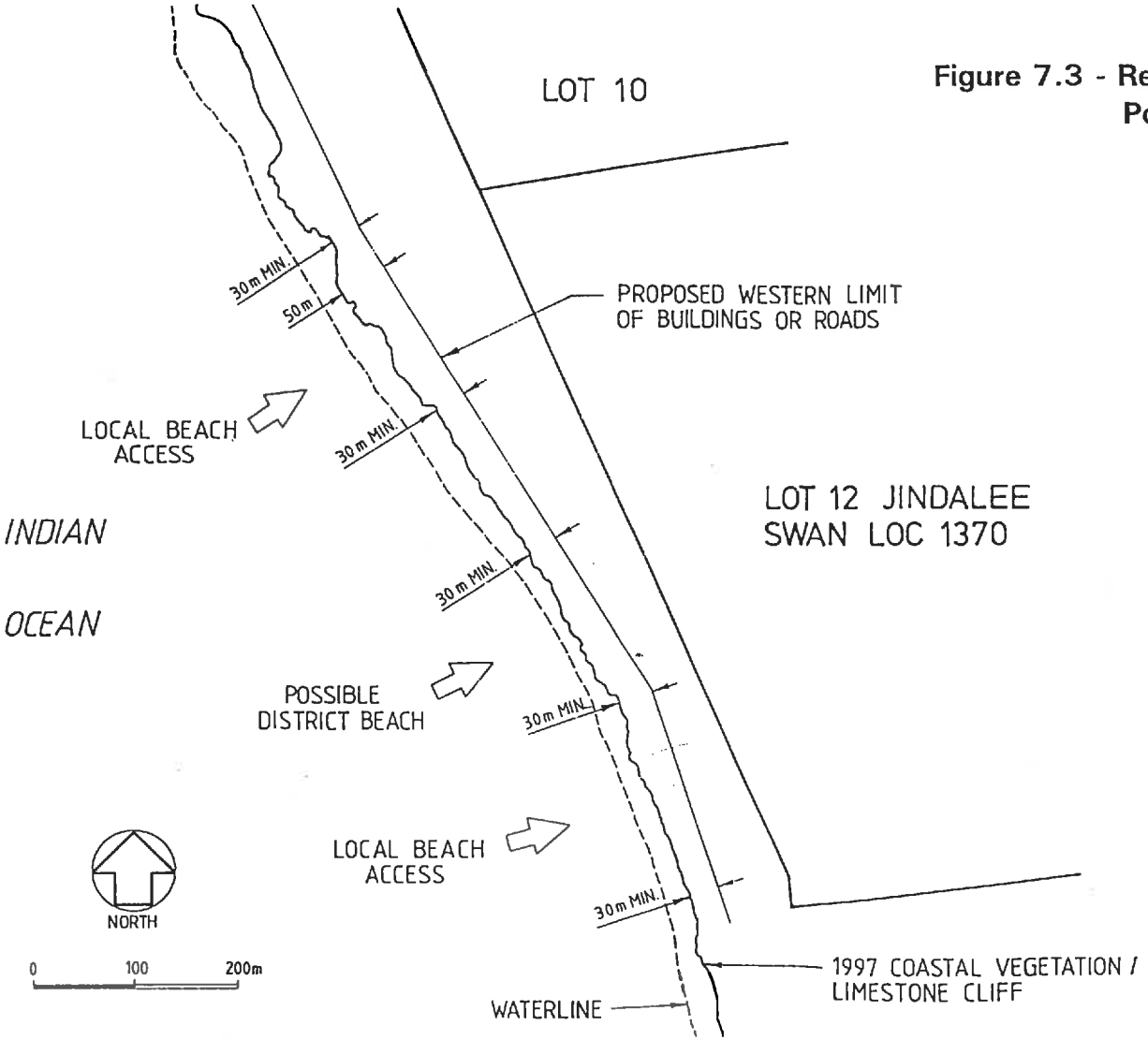


Figure 7.3 - Recommended Set-Back Distances and Potential Beach Use for Lot 12 Jindalee

LOCAL BEACHES
a) 200m × 0·5 PERSONS/m = 100 PEOPLE.
b) 80% BY CAR & 2 PERSONS/CAR = 40 CAR BAYS.
c) PROVIDE GOOD ACCESS TO BEACH AT EACH END OF CAR PARK.

DISTRICT BEACH
a) 400m × 0·5 PERSONS/m = 200 PEOPLE.
b) 80% BY CAR & 2 PERSONS/CAR = 80 CAR BAYS.
c) PROVIDE GOOD ACCESS TO BEACH AT EACH END OF CAR PARK.
d) ENHANCE AMENITY WITH COMMERCIAL FACILITIES & POSSIBLE GROYNE TO CREATE BETTER SWIMMING BEACH & FISHING PLATFORM (NEEDS FURTHER STUDY)

EXTRACT FROM MP ROGERS COASTAL STABILITY STUDY - FIGURE 7.3

SECTION 3

LOCAL STRUCTURE PLAN -

URBAN DESIGN AND LAND USE

PREPARED BY:

CHAPPELL AND LAMBERT

3.0 LOCAL STRUCTURE PLAN – URBAN DESIGN AND LAND USE

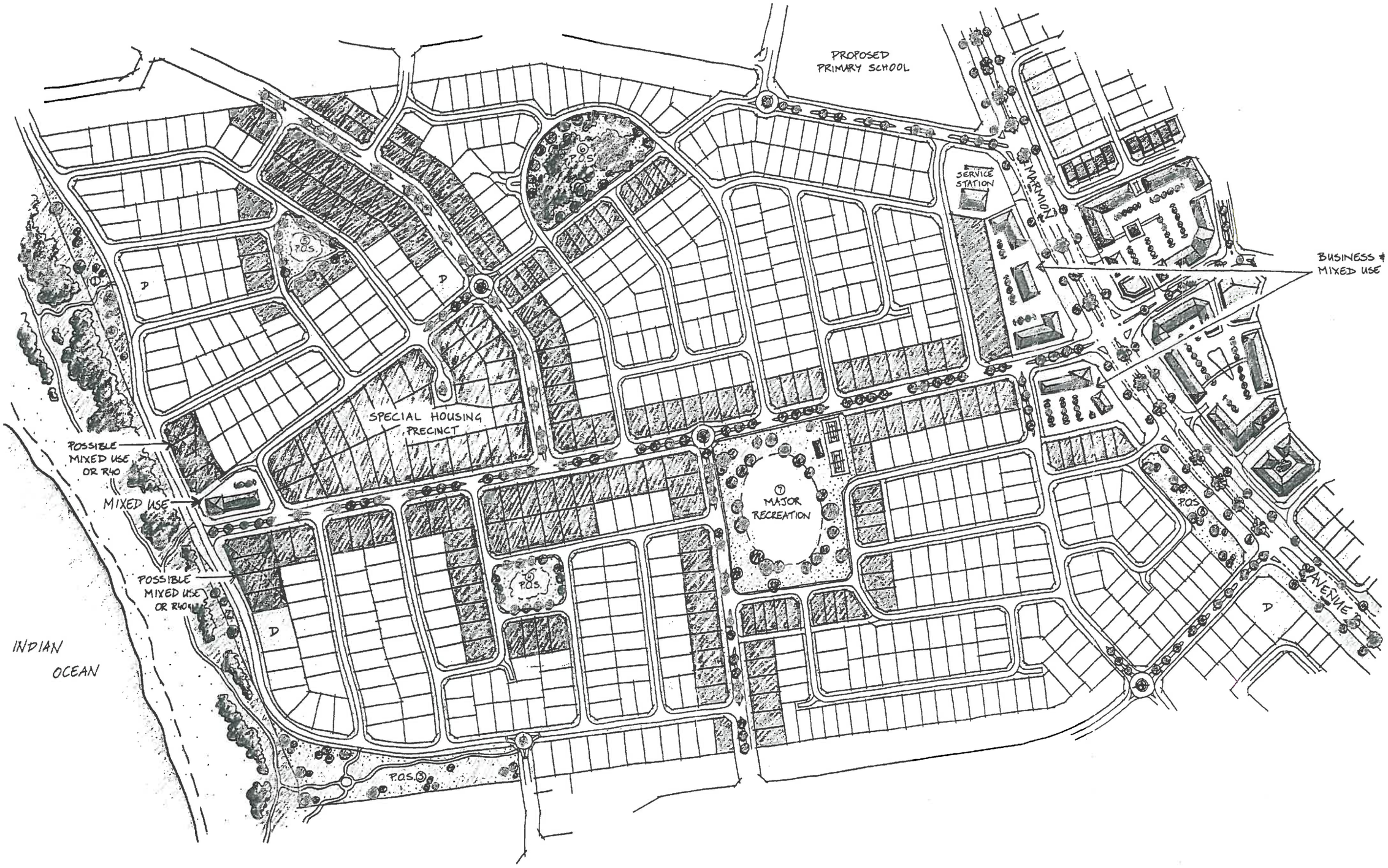
3.1 Structure Plan Objectives

The primary urban design objective in subdividing and developing this property is to recognise Liveable Neighbourhood objectives, but most importantly optimise the unique coastal location of the site, particularly with respect to retaining the beachside character of the address, through a sensitive response to landform. The City of Wanneroo, in particular, is keen to see a coastal development which blends the eclectic elements of old coastal settlements such as Quinns Rocks with new engineering standards and contemporary purchaser expectations.

Retaining the landform integrity and character and creating more three-dimensional interest into the final development, form and built landscape, can only ensue from a clever blend of urban design and engineering, which incorporates the engineering standards of the City of Wanneroo and the demands from lot purchasers, who would normally expect a flat building site. The Structure Plan and accompanying engineering / earthworks strategy achieves this outcome in a number ways;

(i) The general form and integrity of the topography is respected by the innovative application of engineering standards, with hills and valleys punctuating the landscape as an alternative to the more flat earth approach adopted elsewhere. The Wood & Grieve's long section of the entry boulevard (refer Section 3.7 and Appendix) graphically demonstrates this strategy.

(ii) Drainage is necessarily more spread throughout the development, generally in the form of small low impact basins to accommodate the



LOT 12 JINDALEE

DEVELOPMENT CONCEPT PLAN

CHAPPELL & LAMBERT
TOWN PLANNING URBAN DESIGN

SCALE 1:2 000 DATE 05.02.02 PLAN 254-14B

FIGURE 9

greater number of drainage catchments generated by this retention of natural landform patterns.

(iii) The main topographic landscape feature on the site, being a dominant landscape / dunal landform to the west, forms a key element in the overall landform objectives with the estate. As a feature it will be a focal point within the design through its designation as a special housing precinct. It is overlain with larger lots (R12.5), where special housing design guidelines will apply to encourage the development of innovative architectural forms, to reduce the need for excessive retaining walls.

(iv) Protection in Open Space of a dunal hilltop in the south west corner of the property, adjacent the foreshore.

(v) The application of a permeable road network over the undulating landscape, to maximise the potential for landform retention, from an engineering, drainage and access perspective.

(vi) The creation of a low key coastal access road along the foreshore which will follow natural contours, as far as is possible (and acceptable), and will avoid the need for earthworks within the existing Crown Reserve.

(vii) Creation of a strong coastal Boulevard Road following the landform and reinforcing the relationship with the beach.

(viii) Creation in the design of a Local Beach / Mixed Use node, overlooking the coast and providing a special feature within the estate.

(ix) Pursuit of an integrated foreshore development strategy which rationally recognises the enormous public demand for commercial and recreation facilities close to the beach.

A Development Concept Plan is included at Figure 9. It better demonstrates the strategy proposed in the Structure Plan. In summary, it can been seen that the key objective in producing this design has been to recognise and accommodate the coastal landform character and encourage the development of an estate which has very much a beachside node flavour, reflecting the character of older suburbs such as Cottesloe, City Beach and Quinns Rocks.

This application has been lodged under Liveable Neighbourhoods, and reflects the objectives of that document, insofar as the estate represents a modified grid, which maximises the potential for pedestrian movement and provides key focal points on Marmion Avenue and the coast, all within good walking distance of the local residents.

3.2 Land Use Summary

	HECTARES	HECTARES
1. Gross Area:		77.5797
2. Non Residential Land Uses		
(a) Mixed Business	1.7750	
(b) Drainage Basins	0.8000	
Total:		2.5750
3. Gross Residential Area		75.0000
4. Public Open Space @ 8% of GRA (as shown on Structure Plan)		6.0000
5. Nett Residential Area		**69.0000**

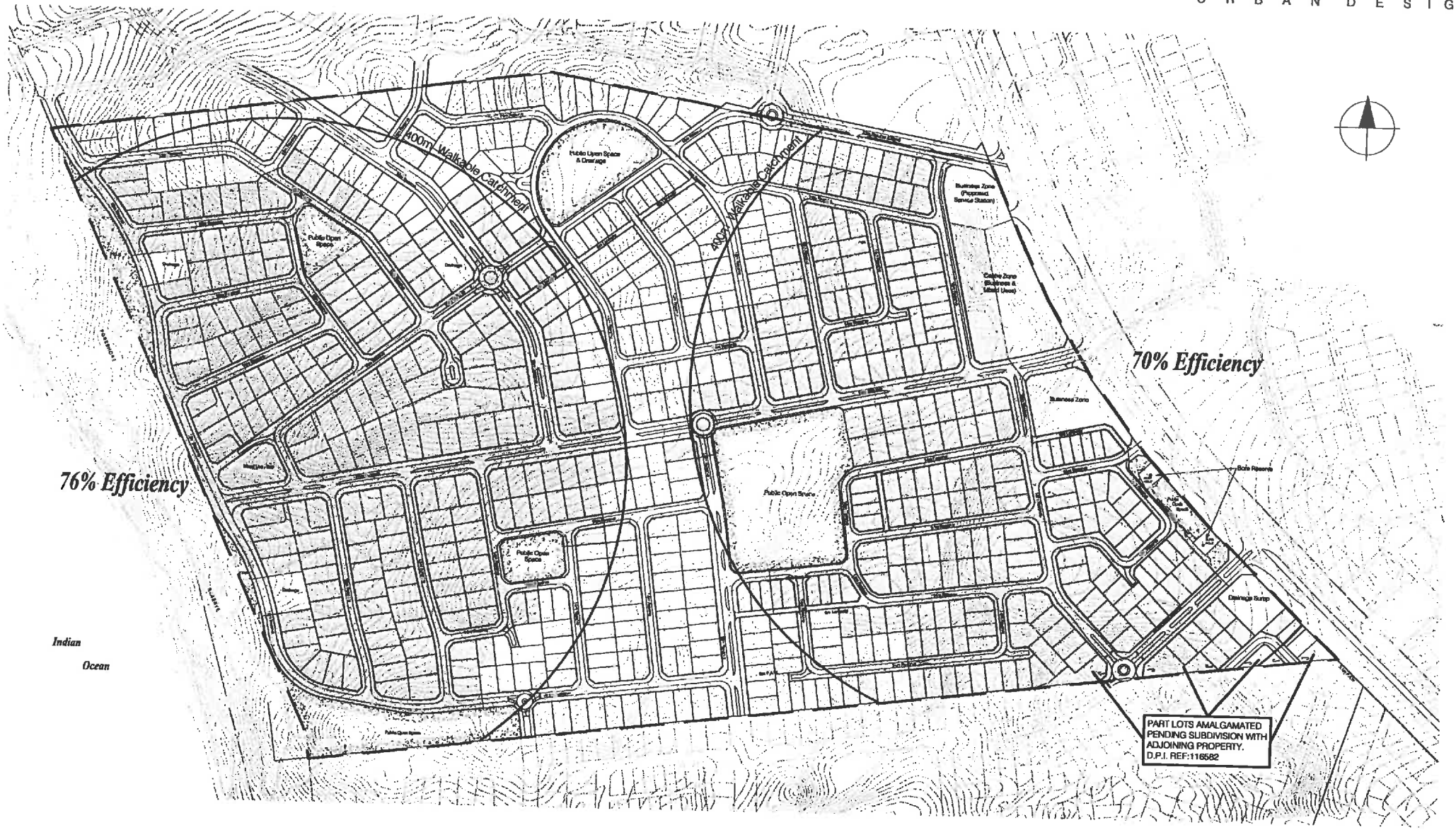
The Structure Plan provides for an 8% land contribution for local open space.

3.3 Roads, Transport and Pedestrians

A full Liveable Neighbourhood Transport Assessment is included in the Transport Planning Study prepared by ERM Mitchell McCotter in Section 5.0. That report addresses:

(i) Regional transport and Marmion Avenue
(ii) Local street network
(iii) Public transport
(iv) Pedestrian movement

Figure 10 is a ped shed analysis which indicates the movement efficiency of the layout.



PED SHED ANALYSIS
FIGURE 10

3.4 Recreation and Open Space

3.4.1 Foreshore Reserve

The future opportunities for the management and use of the foreshore reserve are presently being resolved as part of a separate Foreshore Management Plan process in consultation with council and the relevant authorities. This is discussed in detail in Section 2.6.

It is anticipated that as part of the subdivision process a formal agreement will be reached between all stakeholders, which will determine the final form of the foreshore reserve and the various land use elements which it will contain and implementation and management issues.

3.4.2 Regional Open Space

Approximately 6000m^2 of Lot 12 is reserved for parks and recreation in the Metropolitan Region Scheme adjoining the existing Crown Foreshore Reserve. There is considerable history behind the 6000m^2 which provides clear justification for it being included within the 8% local open space contribution.

Prior to 1991 Lot 12 was zoned Rural in the MRS and District Zoning Scheme. A Structure Plan was prepared by Chappell & Lambert (refer Appendix) to support a rezoning to Urban and Residential. As part of an agreement between the landowner, the Shire and the Department of Planning and Urban Development which was recorded in correspondence dated 21 December 1990 from the Shire of Wanneroo to Chappell & Lambert, the Structure Plan was amended to "facilitate an equal area land exchange along the coastal reserve boundary". In essence this change would permit

the foreshore road to better reflect landform by weaving in and out of the Foreshore Reserve. The exchange amounted to the subdivider giving up as open space an area equal to the land area within the Crown Reserve being utilised for the Foreshore access road.

This change to the Structure Plan was made and the agreement thereby reflected in both the MRS and Scheme Amendments (Amendments no. xxx). Over more recent times, however, it has become unacceptable to extend any form of development into these foreshore reserves, even public roads, and hence the exchange can no longer occur. Under these circumstances it would be extremely inequitable to now expect the subdivider to surrender the 6000m^2 of land initially created as part of this exchange arrangement, free of cost, when this was clearly never the intent of the agreement reached between the stakeholders.

3.4.3 Local Open Space

The local open space shown on the plan has been located and sized to comply with the City of Wanneroo Public Open Space Policy. Similarly, development of these areas by the landowner will be consistent with Council standards.

In providing open space the plan creates a range of recreational opportunities all well located to cater for local residents. In particular parks have been located to ensure that no resident is more than 400 metres walking distance from a park or the beach.

The parks are numbered on the Structure Plan and referenced in the Schedule below.

Parks 1 & 2

These are reserved for Parks and Recreation and have a history which permits their inclusion in the 8% open space contribution (refer previous section).

Park 3

This has been set aside to protect a dunal feature and extending that POS set aside by the landowner to the south.

Park 4 & 5

Larger pocket parks with a high amenity passive recreation role.

Park 6

One of the few areas on site where earthworking is not required and hence it will be left in its natural state. Importantly, however, it has been sized to accommodate a junior soccer field (55m x 75m) in the future if so desired.

Park 7

Larger active recreation area which can accommodate a sportsfield and other facilities.

Park 8

No open space credit sought given its role and location adjacent the Water Corporation bore sites.

No local park is less than the City of Wanneroo minimum size of 3500m^2. In addition to the pocket parks, which will focus on passive recreation and amenity, a more major centrally located facility is proposed on the entry boulevard. This larger recreational node of 2.5 hectares is situated on lower flatter land at the junction of two neighbourhood connectors and should

be developed as a larger recreational oval, for active pursuits. Once again the form and content of this park in particular will be resolved with Council as part of the subdivision process.

At this time it is not proposed to dispose of any drainage, (including the one in one hundred year event) within any area of open space shown on the plan.

OPEN SPACE SCHEDULE	
1	0.5036
2	0.1081
3	1.2293
4	0.3580
5	0.3500
6	1.0016
7	2.500
8	No credit
TOTAL	**6.0000 ha**

3.5 Residential Land Use

From a Residential land use point of view the Structure Plan provides for a range of product to meet market demand, provide for compatible land use and importantly to protect landform integrity. In essence four product types are proposed. Being;

Residential R20 - Traditional
Residential R30 - Cottage
Mixed Use R30 - Village
Residential R12.5 - Special Housing

Traditional Lots.

Generally these range from 450m² up to 800m² and form the bulk of the product. Anticipated yield is around 650 lots.

Cottage Lots.

There is an emerging demand for smaller residential lots with rear laneway access overlooking a park. These typically range from 350m² to 420m². The anticipated yield is around 30 home sites at this time.

Village.

Limited opportunity for residential mixed use where home based business will be encouraged, within the Village Centre adjacent the Business areas. Laneway product between 350m² to 420m² with a yield of around 12-15 lots.

Special Housing Precinct.

This precinct acknowledges the landform in the earthworks strategy and by providing for larger lots, generally between 800m² and 1200m². The integrity of the slope is retained throughout the lots to

encourage more innovative building forms and provide landscape interest and relief. At this stage 34 lots are proposed in this category.

The Structure Plan provides for an overall density of around 10 lots per gross hectare.

3.6 Retail and Mixed Use

Structure planning for the area, including the outcomes of the Jindalee Enquiry by Designs and the Butler Brighton District Structure Plan, focussed on two main commercial/mixed use based nodes for this property, being on the coastal side and adjacent Marmion Avenue.

3.6.1 Coastal Beachside Node

With the designation of this area as a local beach in the Hames Sharley Coastal Planning Study and encouragement of a beachside node in the Enquiry by Designs, and recognising the existing commercial zoning the Structure Plan proposes a small mixed use centre at the beachfront termination of the coastal boulevard. It is envisaged this precinct will comprise a mix of residential, small retail/café and possibly tourist uses in the longer term. The Structure Plan includes it within the Mixed Use zone with an R40 coding.

3.6.2 Marmion Avenue Centre

The City of Wanneroo Commerical Centre Strategy and the Butler Brighton District Structure Plan also identify this location (which straddles Marmion Avenue) for a future village centre.

Work done by Shrapnel Urban Planning, on behalf of the Brighton Joint Venture recommended a total retail floor space of 6000m^2 to this particular centre, plus supporting mixed business uses. The Centre Strategy nominates 2250m^2 and the draft District Structure Plan will review this figure possibly recommending a retail floorspace allocation of between 3000m^2 and 4500m^2.

Whilst the final composition of this centre, and it's retail floor space have yet to be finalised, it would appear that this particular village centre will include a retail floor space component of between 3000m^2 to 4500m^2, plus mixed business activities. It is also clear that the retail component will be located on the east side of Marmion Avenue, within the Brighton Estate, with this part of the Centre of Lot 12 comprising predominately mixed business uses.

As a result of this, the Lot 12 Jindalee Structure Plan essentially provides for mixed business opportunities on this side of Marmion Avenue, opposite the Brighton Village Centre with potential for a small component of residential mixed use. It is also possible that a small retail floor space component will be needed to service the day to day needs of local residents. This Centre has been included in the Centre Zone in the Structure Plan recognising the need for more detailed Structure Planning and land use definitions on this side of Marmion Avenue.

An access report specific to this Centre zoned superlot is included in the Appendix.

3.7 Engineering Report – Servicing Strategy

3.7.1 Introduction

This section has been prepared by Wood & Grieve Engineers and it summarises the results of an assessment of the engineering services which will be constructed as part of the subdivision. All plans related to this section are included in the Appendix.

3.7.2 Earthworks

The site is generally undulating with the majority of slopes varying from 1 in 3 (33%) to 1 in 6 (17%). Some areas have steeper slopes, typical of the Perth coastal dune system. The site has a highpoint at RL 55.0 approximately halfway between Marmion Avenue and the coast and falls towards the foreshore to RL 20.0 and towards Marmion Avenue to RL 24.0 approximately.

Ground conditions comprise sand overlying limestone to varying depths. Limestone outcrops are at the surface along some ridges and it can be expected that areas of harder capstone will be encountered. The existing topography is such that bulk earthworks will be required to provide acceptable grades for roads and building lots.

Although bulk earthworks will be carried out over the whole site, the natural landform within Lot 12 will be maintained. Considerable time and effort has been put into the design to ensure that the natural landform is kept as much as possible. In general, the high point in the middle of the site which is virtually the extension of Santa Barbara Parade will be kept, although to a

reduced level at RL 47.0 approximately. From that high point the ground will gradually fall towards Marmion Avenue and towards the foreshore.

An existing ridge which runs east west across the site from the foreshore reserve over a distance of approximately 300 metres will be kept as a special housing precinct, but reshaped and lowered to provide acceptable grades for building on. In general bulk earthworks will be carried out to ensure that no lots have a steeper slope than 1 in 8 (12.5% grade) which is a requirement of the City of Wanneroo.

Terracing of residential lots with retaining walls will be required on most lots to create level building lots, except for the special housing precinct where the natural landform will be kept intact. This approach will greatly reduce the cost of siteworks for lot purchasers, especially where work is encountered and will take advantage of the economics of scale of including such works within the overall subdivision construction costs.

Earthworks along the foreshore road will be carried out to meet the road design standard but no earthworks will be allowed to spill into the foreshore reserve beyond the foreshore reserve boundary. In some areas limestone retaining walls will be constructed to ensure that no earthworks takes place outside the foreshore reserve boundary.

Road design and earthworks will be carried out to ensure that no earthworks is required in Public Open Space areas on the south-west corner of the site and on the northern boundary in the middle of the site. Because of road design and steepness of existing ground, earthworks will be required in the Public Open Space off Santa Barbara Parade.

Earthworks on the southern boundary of the site to pad levels shown on the drawing have been designed to match in with earthworks which has taken place on Lot 5. As Wood & Grieve are also the engineers for Lot 10 north of this development the earthworks on the northern boundary of the site will be coordinated and carried out to satisfy both our clients.

3.7.3 Roadworks

Major Road Infrastructure

Major road access to the subdivision will be via Marmion Avenue from the east. Road access from the south will be via Santa Barbara Parade and Saint Anthony Avenue. Marmion Avenue has already been constructed as a single two-way carriageway from Hughie Edwards Drive to the proposed four-way intersection which will provide main road access to the Brighton subdivision to the east and to Lot 12 to the west.

The development of Lot 12 will include contributions to the cost of the design and construction of the important Regional Roads. Historically this has comprised the construction as part of the development of the full earthworks, one carriageway and dual use path and pedestrian underpasses and overpasses for the sections of the roads abutting, or located through a particular development area.

The City of Wanneroo has since developed an arrangement which is covered by an Amendment No. 821 of the City of Wanneroo's Town Planning Scheme No. 1 which is currently with the Minister for Planning for final determination. This alternative arrangement for the apportionment of the Important Regional Road cost contributions between the various landownership within the Clarkson – Butler area is based on the gross areas

of the respective landholdings for the road network provided for in the Metropolitan Region Scheme.

Internal Roads

All roads will be designed to Austroad Standards and to the City of Wanneroo requirements. No roads will have a longitudinal grade steeper than 10% and flatter than 0.6%. The major east west road through the development from Marmion Avenue to the foreshore reserve will be a boulevard type road and as will be the extension of Santa Barbara Parade and the north/south road connection into Lot 10. These roads will provide a north/south bus route link through the subdivision.

The road along the foreshore reserve has been carefully designed to minimise the extent of cut and fill along the foreshore boundary. Taking into account the topography of the land, the longitudinal section of the road has been designed to ensure that no earthworks will spill into the foreshore reserve. In some areas a retaining wall will be constructed to ensure that existing contours west of the foreshore reserve boundary are not altered. The foreshore road will be constructed to allow for parallel parking along the foreshore boundary.

Typically all road pavements will be constructed with asphalt finish with brick paving being used at some intersections to provide a low speed environment. Road widths will vary from 6.0m for rear access lanes to 7.4 metres on through roads, except for the boulevard type roads.

3.7.4 Drainage Strategies

The drainage strategy will be in accordance with the aim of water sensitive urban design, the design requirements of the Australian Rainfall and Runoff Guide and the requirements of the City of Wanneroo.

In general runoff from individual lots will be managed through on site infiltration from soakwells. Runoff from roadways and public areas will be via gullies/side entry pits and piped drainage system to infiltration sumps and basins located within the low areas of the landholding.

A drainage strategy has been prepared which documents the major drainage facilities required to service this application area. (Refer Appendix)

The subdivisional development is divided into two major drainage catchments by a natural ridge which runs north – south through Lot 12 in a direct line with the extension of existing Santa Barbara Parade in Lot 5 Quinns Rock. There is a small catchment to the west of the Santa Barbara Parade extension which can discharge into the existing drainage sump at the corner of Santa Barbara Parade and Cromwell Terrace.

Stormwater from the catchment on the eastern side of this ridge will be contained on site via discharge into a drainage infiltration basin, located in the south eastern corner of Lot 12, on Marmion Avenue at the intersection with Hampshire Drive (Basin 1).

The area to the west of the ridge is divided into two sub-catchments, one to the south of the main east-west road through the subdivision and the other to the north of that road. Both sub-catchments slope in a westerly direction

towards the foreshore reserve. The south-western sub-catchment drains to a low-point midway between the east-west road and the southern boundary of the site (Basin 4). The north-western sub-catchment drains to a low point midway between the east-west road and northern boundary of the site (Basin 3). In this north-western sub-catchment a drainage basin (Basin 2) has been located upstream of the low point to reduce the basin area required along the foreshore.

A number of options have been looked at to dispose of stormwater drainage in the western catchment towards the foreshore.

Because of the steep grades on lots and roads in the western catchment, and the need to try and keep with the natural landform as much as possible, the low points are along the foreshore road and there are no areas that can be made available for construction of flat swale-type drainage basins.

Possible construction of Atlantis type underground systems have been looked at, but are not favoured by the City of Wanneroo. Underground storage with concrete structure on top with provision for machinery access for maintenance purposes are being looked at in some areas, but have not yet been approved by the City of Wanneroo. The other option was to dispose of some of the drainage in the foreshore area, but this option was not acceptable to all departments involved at two workshops held at the City of Wanneroo.

Meetings have been held with officers of the Engineering Department at the City of Wanneroo to look at possible different options on disposal of stormwater, but because of the nature of the site, no new method of disposal was forthcoming. In any case even if any innovative method of

disposal could be agreed with the City of Wanneroo, they would still require land to be set aside to allow for construction of a soakage basin to meet their standard requirement for the specified catchment area should the system failed.

In this development the low points within the western catchment will always be along the foreshore road. We have therefore allowed for two fenced conventional open soakage basins along the foreshore road to meet the City of Wanneroo drainage standards as shown on the plan. Both these basins will accommodate the 1 in 100 year storm volume as required by Council with no overflow into the foreshore reserve.

The plan shows locations of all drainage basins with catchment boundaries, equivalent impervious areas, volume required for 1 in 100 year storm event and basin area required. All basins have been designed to provide overall storage at the catchment low point equivalent to the 24 hour duration for the 1 in 100 year storm event (1,330m^3 for 1 hectare effective).

Although these areas have been set aside for drainage disposal to meet the City of Wanneroo requirements, it is proposed that we will continue to investigate alternative disposal solutions such as underground tanks and the possibility of some discharge into the foreshore reserve, especially in the south-western catchment where drainage from that area could be combined with drainage from a proposed carpark in the foreshore area and discharge into a shallow swale-like drainage basin in the natural low point within the foreshore area.

3.7.5 Water Supply

Water supply for the area will be via the extension of existing distribution water main in Marmion Avenue and in Santa Barbara Parade. The main in Marmion Avenue is linked to the Water Corporation's Neerabup reservoir and water treatment plant, to the south which are in turn supplied from a series of existing and proposed groundwater bores located throughout the north-west corridor.

Two existing bores are located within Lot 12 along Marmion Avenue. These bores are linked by collector watermains located in Marmion Avenue and Lukin Drive.

The Water Corporation is about to start construction of the extension of the 600 diameter water main in Marmion Avenue up to Hampshire Drive to service the Brighton development. Extension of that main along Marmion Avenue to the East-West road within the development will be constructed at a later date and will be required to allow release of lots within this development.

A 400 diameter main will also be constructed by the Water Corporation along the extension of Santa Barbara Parade and along the east west road in this development to loop back and connect to the 600 diameter main in Marmion Avenue. PVC water pipes will be installed within the proposed road reserves off the distribution mains to serve all lots within the development area. The area will be served to normal subdivisional standards as required by the Water Corporation.

3.7.6 Sewerage

Sewerage disposal for this development falls within three separate catchment areas as shown on the plan.

Southern Catchment

A small area on the west side of Santa Barbara Parade extension up to the east-west road can discharge into an existing 150 diameter sewer located within Santa Barbara Parade which at present terminates on the southern boundary of the site.

The number of lots that could discharge into the existing main can only be defined after a study of that catchment is carried out to determine the capacity available at the pump station. In any case most of these lots could discharge to the west in what is called the western catchment if required.

Western catchment

The western catchment which is the area west of Santa Barbara Parade extension will discharge into a gravity sewer along the foreshore road into a proposed sewerage pump station just north of Lot 12 on the western boundary of Lot 10 – Marmion Avenue - Jindalee. Sewerage from this pump station will be pumped via a pressure main through Lot 10 and will discharge into a future 1050 trunk gravity main in Marmion Avenue to the proposed Alkimos wastewater treatment plant to the north. If development was to take place ahead of time within the western catchment, a temporary pump station could be constructed along the foreshore road with a temporary pressure main along the east-west road discharging into

the 225 diameter gravity main to the east within the Brighton development provided there was enough capacity in the downstream pump station at that time.

Eastern Catchment

The eastern catchment from the extension of existing Santa Barbara Parade towards Marmion Avenue will discharge via two sewer crossings already constructed across Marmion Avenue to a sewerage pump station being constructed as part of the Brighton Development.

The two sewer crossings are a 225 diameter main at the corner of east-west road and Marmion Avenue and a 150 diameter main at the corner of Hampshire Drive and Marmion Avenue.

3.7.5 Other Public Utility Services

Servicing authorities have indicated that underground electricity, gas and telephone services can all be provided to service this development via the extension of the existing systems and networks in Marmion Avenue and Santa Barbara Parade.

Western Power has already extended high voltage underground power for supply to the Water Corporations groundwater abstraction bores within the Marmion Avenue reserve. There is spare capacity in these HV feeds for a number of lots in that area.

SECTION 4

TRANSPORT PLANNING REPORT

PREPARED BY:

ERM MITCHELL McCOTTER

TRANSPORT PLANNING FOR LOT 12 JINDALEE STRUCTURE PLAN

Final Report- Revised

For:
HEATH DEVELOPMENT COMPANY

September 2002
299085A

Environmental Resources Management Australia Pty Ltd A.C.N. 002 773 248 www.erm.com

Report No. 299085A

This report has been prepared in accordance with the scope of services described in the contract or agreement between Environmental Resources Management Australia Pty Ltd ACN 002 773 248 (ERM) and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client and ERM accepts no responsibility for its use by other parties.

Approved by:	*Bruce Aulabaugh*
Position:	Project Director
Signed:	Bruce Aulabaugh
Date:	*20 September 2002*

Environmental Resources Management Australia Pty Ltd Quality System

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Chapter 1

INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was appointed on 4 August 2000 by Heath Development Company to undertake the traffic assessment and transport planning for the Lot 12 Jindalee Structure Plan. ERM submitted the original traffic report in October 2001.

This report updates the original ERM report to reflect changes to the street layout at the coastal foreshore and at the Centre Zone at Marmion Avenue. The revised subdivision layout is shown on the following page with the relevant areas highlighted.

The following diagrams have been updated to reflect the new subdivision planning:

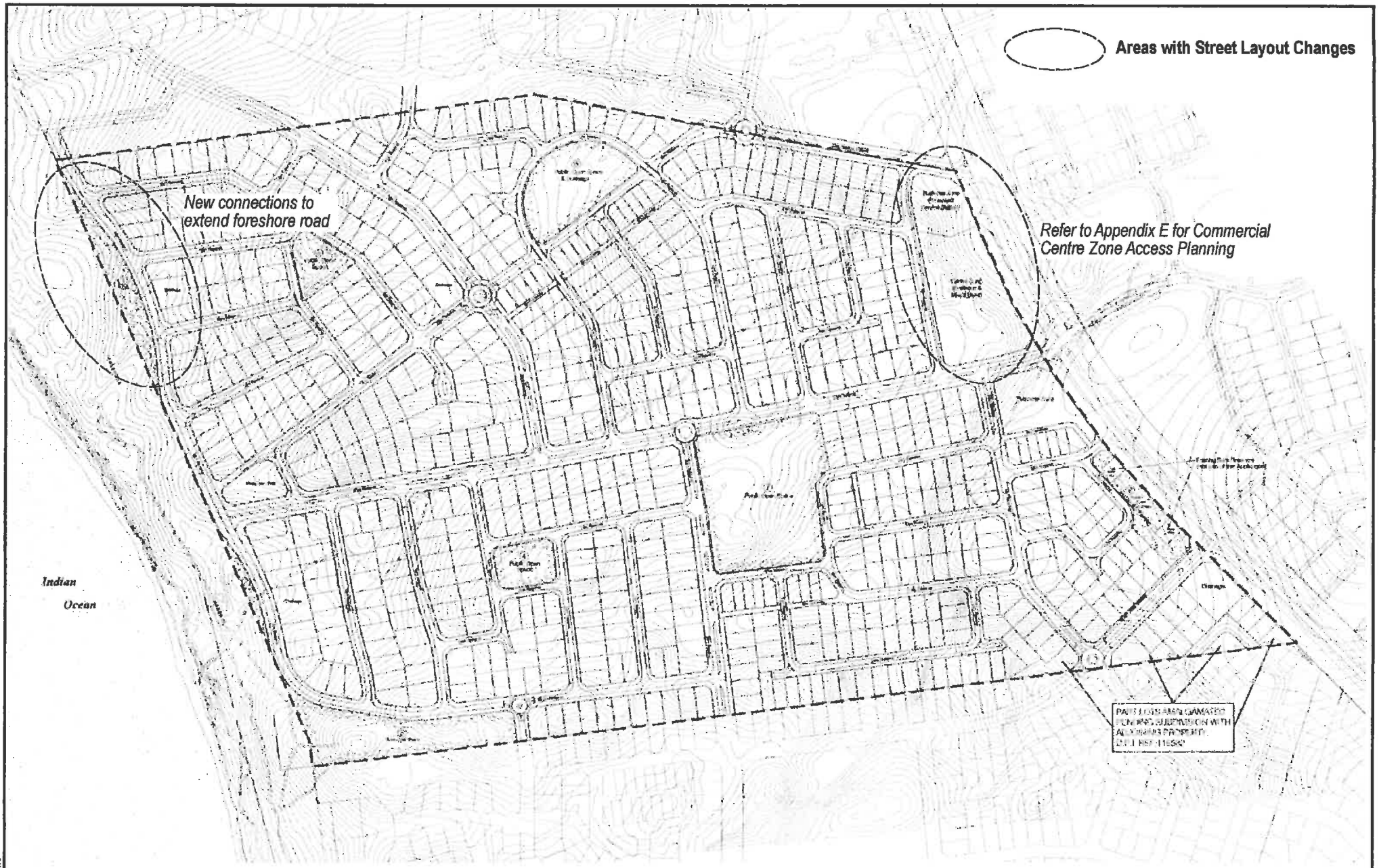
- *Figure 2*, Street Types Plan;
- *Figure 11*, Public Transport, Shared Paths and Footpaths; and
- *Figure 12*, Local Traffic Volume Forecast.

A new appendix has also been added to the report. *Appendix E* contains information on the proposed access planning for the Centre Zone at Marmion Avenue. The remainder of the report is unchanged.

The changes to the Lot 12 street layout at the coastal foreshore, will require some minor modifications to the street layout within Lot 10 to the north. Roberts Day Group and Estates Development Company have been notified of this requirement.

The layout of the report remains unchanged:

- Chapter 2: Current and planned regional road network in the Jindalee and Brighton region of the north west corridor;
- Chapter 3: Land use and street type plan for Lot 12 Jindalee;
- Chapter 4: Public transport, walking and cycling;
- Chapter 5: Local traffic estimates and access onto Marmion Avenue; and
- Chapter 6: Summary and conclusion.



REVISED SUBDIVISION APPLICATION PLAN : LOT 12 MARMION AVENUE, JINDALEE

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Chapter 2

REVIEW OF REGIONAL TRANSPORT PLANNING

2.1 INTRODUCTION

This chapter reviews the *North-West Corridor Structure Plan* road system, the *Metropolitan Region Scheme* road reservations, the *Jindalee Enquiry By Design Outcomes Report*, and the *Brighton Local Structure Plan*. These documents provide insight into the regional road and rail infrastructure that will provide access to Jindalee Lot 12.

2.2 NW CORRIDOR STRUCTURE PLAN

The *North-West Corridor Structure Plan* (Department of Planning and Urban Development, 1992) identified major east/west and north/south roads in the area between Quinns Rocks and Alkimos. Refer to *Appendix A* for a copy of *Figure 10*: Transport Strategy from the *North-West Corridor Structure Plan*. The following major roads were identified:

- E/W 10 Lukin Drive;
- E/W 11 Romeo Road;
- N/S 2 Marmion Avenue;
- N/S 3 Connolly Drive (terminating at Alkimos);
- N/S 4 Mitchell Freeway; and
- N/S 6 Wanneroo Road.

The structure plan also indicated a series of coastal access loops west of Marmion Avenue and a proposed railway adjacent to the freeway.

2.3 CURRENT METROPOLITAN REGION SCHEME ROAD RESERVATIONS

The Metropolitan Region Scheme (MRS) provides the following status to the major roads planned for the North-West Corridor:

Primary Regional Roads (red roads)

- Wanneroo Road
- Mitchell Freeway

Other Regional Roads (blue roads)

- Lukin Drive
- Romeo Road
- Marmion Avenue
- Connolly Drive

2.4 1996 JINDALEE ENQUIRY BY DESIGN WORKSHOP

In 1996 the Western Australian Planning Commission (WAPC), its consultants and the Ministry for Planning (MfP) undertook an investigation into an alternative planning approach for the Butler/Jindalee area of the North-West Corridor. A five-day workshop generated three options for subregional structuring based on what is now known as *Liveable Neighbourhoods Community Design Code* principles.

The three options are documented in the report titled *Results from the Jindalee Enquiry By Design Workshop* (1996, Taylor Burrell and Ecologically Sustainable Design). Please refer to *Appendix B* for a plan showing the three subregional planning options generated by the 1996 workshop.

The common elements of these options have been used in local structure planning in the study area (eg. Brighton Local Structure Plan, Chappell & Lambert July 2000) and also in this Jindalee Lot 12 Local Structure Plan. Section 2.5 and Section 2.6 describe how planning for the area has developed since 1996.

2.5 BRIGHTON LOCAL STRUCTURE PLAN

The Butler Joint Venture (Satterley Real Estate and Ministry of Housing) has recently been given subdivision approval for Stage 1 of the Brighton Development (located east of Jindalee Lot 12).

The *"Brighton Local Structure Plan: Traffic and Movement Network"* (ERM July 2000) reviews previous transport studies and provides an analysis of the road capacity and traffic demand for key arterial roads in the Jindalee/Brighton area. The information provided in that report is summarised in *Appendix C*.

The traffic estimates presented in that analysis assumed a road network that included both Marmion Avenue and Connolly Drive extending through the Jindalee/ Butler area. Possible changes to the regional road system that have arisen recently are discussed in Section 2.6 below.

2.6 2001 JINDALEE/ BUTLER ENQUIRY BY DESIGN WORKSHOP

The new Department of Planning & Infrastructure (DPI), the City of Wanneroo, landowners and numerous other stakeholders attended this workshop. The workshop generated a *draft Sub Regional Plan* and a *draft District Structure Plan*. These plans are reproduced in *Appendix D*.

The new plans retain Marmion Avenue as a major north – south regional traffic route but downgrade Connolly Drive north of Lukin Drive and terminate it at E-W 2. Other sub-arterial roads (Neighbourhood Connectors) aligned in the north- south direction provide support to Marmion Avenue in replacement for Connolly Drive.

A traffic report supporting this revised network is being prepared by TTM Consulting on behalf of the DPI. That report should be available in the next month or two.

2.7 MARMION AVENUE SIGNALISED INTERSECTIONS

2.7.1 Background

The following information is taken from the *Brighton Local Structure Plan: Traffic and Movement Network* (ERM, July 2000). The information is applicable to the Jindalee Lot 12 Structure Plan and the proposed signalised intersections along Marmion Avenue.

2.7.2 *Arterial Grid And Signal Spacing*

The proposed arterial road network in the Jindalee/ Brighton area (*Appendix D*) forms a basic grid with spacings in the order of one kilometre between north-south roads and 1.5-2.0 kilometres between east-west roads. It is expected that the intersections of these arterials will be signal controlled. For the purpose of this report these arterial/arterial intersections will be called primary signalised intersections.

Some additional signalised intersections are also proposed along the north-south arterials. These intersections are located at the junction of some of the more important east-west Neighbourhood Connectors (Local Distributors) with Marmion Avenue and with Connolly Drive. These additional signalised intersections will be referred to as secondary signalised intersections. Refer to *Appendix D* showing the road network and these signal locations.

A key feature of the regional structuring is the strong east-west links across this coastal strip of land to integrate the communities and provide ready access to commercial centres and beach facilities. The basic arterial grid of Romeo Road, E-W2 and Lukin Drive are supplemented with Neighbourhood Connectors such as E-W3. E-W3 links Connolly Drive to the Brighton Stage 1 commercial centre at Marmion Avenue and also to Lot 12 Jindalee.

With the additional signalised intersections, signal spacings on Marmion Avenue and Connolly Drive average approximately one kilometre. Investigation of signal spacing on similar arterial roads in Perth shows that this is the norm (refer to *Appendix No. 5* of the Brighton Local Structure Plan by Chappell & Lambert July 2000).

2.8 MARMION AVENUE CROSS-SECTION

2.8.1 *Ultimate Cross-Section*

Figure 1 illustrates the proposed cross-section for Marmion Avenue. Key features are:

- Design Standard: 4-lane divided with frontage roads in a 60 metre reserve; and
- Traffic capacity = 35,000 veh/day.

In the unlikely event that the Mitchell Freeway is not extended by year 2021 (refer to the discussion in *Appendix D*), the proposed cross-section would offer the opportunity to widen Marmion Avenue to a 6-lane divided standard. The facility could return to a 4-lane ultimate design standard when the freeway extension is completed.

2.9 EXTENSION OF MARMION AVENUE

2.9.1 *Immediate Extension of Marmion*

Marmion Avenue is currently constructed as a 4-lane dual carriageway arterial to Hester Avenue and then as a 2-lane single carriageway road north to Baltimore Parade. The City of Wanneroo have funding in place to upgrade this section to four lanes and are awaiting funding approval to extend the road to Lukin Drive (as a 4-lane road). It is expected that this work would be completed in 2002.

As part of the Brighton Stage 1 Development, Marmion Avenue is currently being constructed as a 2-lane divided boulevard from Lukin Drive to E/W 3.

PUBLIC TRANSPORT, SHARED PATHS, FOOTPATHS

FIGURE 11

REV A : 25.03.03 SOURCE: ERM

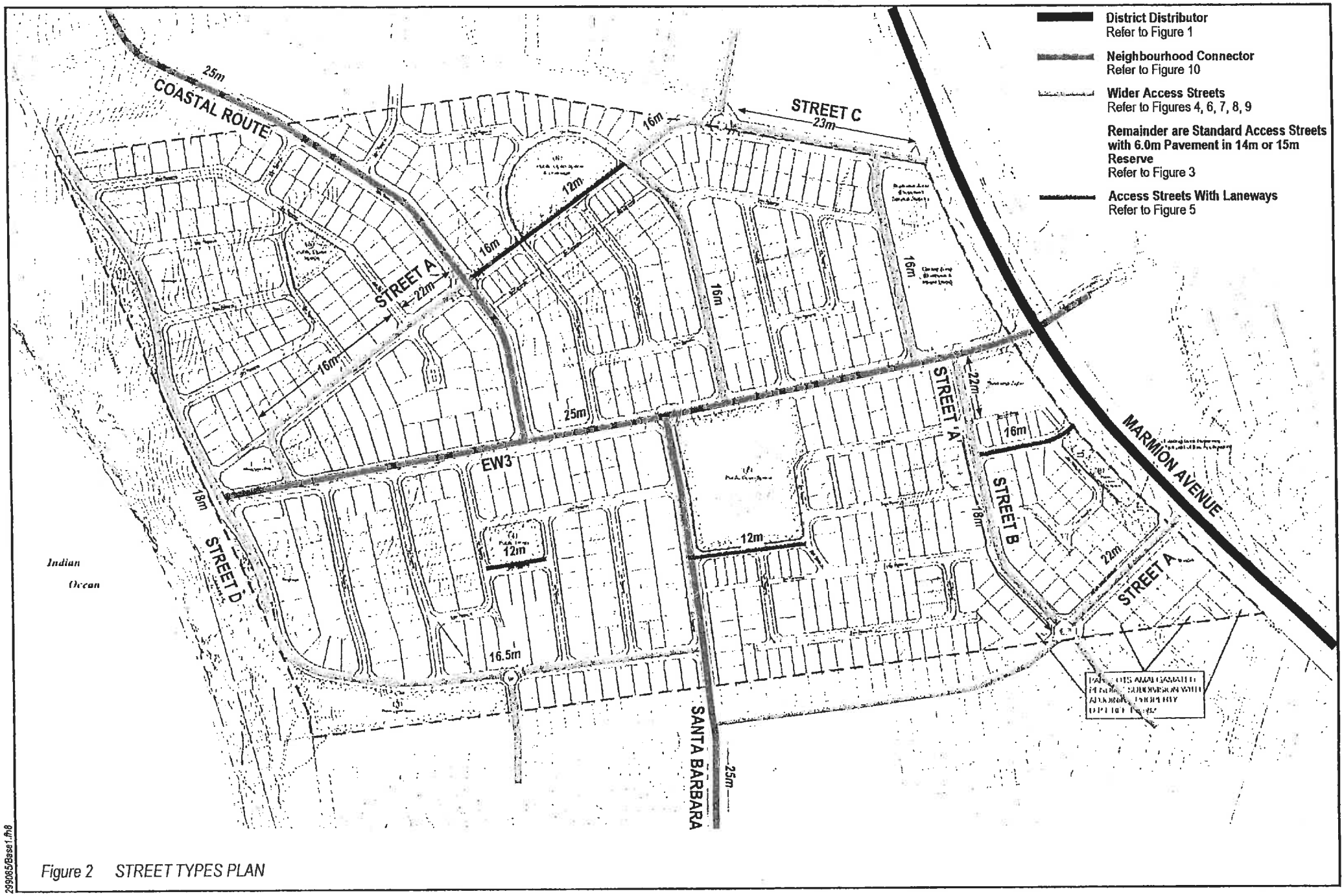

Figure 2 STREET TYPES PLAN

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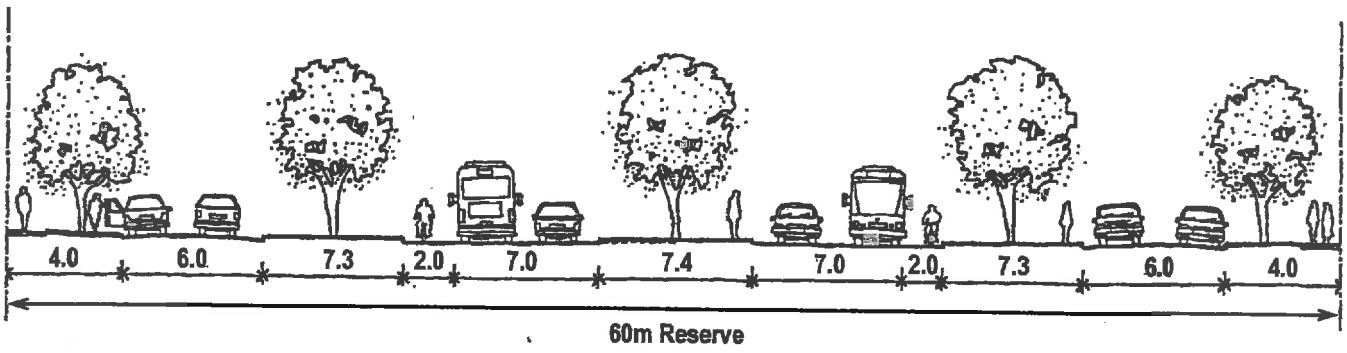

Figure 1 *MARMION AVE CROSS SECTION (Four lanes plus frontage roads: using 60m)*

2.9.2 *Tokyu Corporation and Road Access to Yanchep-Two Rocks*

Tokyu Corporation (Tokyu) is the owner of a large amount of land in the Yanchep-Two Rocks area. They have commissioned several large transport related studies in the early 1990's in the lead up to the Yanchep Structure Plan. They have also been instrumental in motivating a current study titled *"St. Andrews Transport & Access Study"*. That study began in December 2000 and is being conducted by BSD Consultants.

The Strategic Cooperation Agreement between the State Government and Tokyu require the study. The objective of the study is to determine the short, medium and long-term access requirements for the northern section of the North-West Corridor. Access will be important for employment generation and this will influence when Tokyu can proceed with further rezoning and residential development in the Yanchep-Two Rocks area.

Access to the Yanchep-Two Rocks area is currently only possible using Wanneroo Road to access Yanchep Beach Road or Breakwater Drive. Typically, the northerly extension of Marmion Avenue and Connolly Drive occurs as landowners develop their properties sequentially in a northward direction. The *"St. Andrews Transport and Access Study"* will be examining the need for, the timing of, and the financing for the extension of Marmion Avenue.

It is understood that new traffic modelling is being undertaken by Main Roads to assist with the project and that the Main Roads Traffic Model is being updated to reflect the new population levels for the St. Andrews area. It should be noted that the traffic modelling outputs in *Appendix D* of this report are based on the future population data in the Main Roads Model as at 1998 and do not incorporate the latest population forecasts for the St. Andrews area.

Chapter 3

STREET TYPE PLAN FOR LOT 12 JINDALEE DEVELOPMENT

3.1 INTRODUCTION

Figure 2 shows the street network and street types for the Jindalee Lot 12 Local Structure Plan.

The street network is a 'modified grid' as required by *Liveable Neighbourhoods Community Design Code* (Ministry for Planning, June 2000). It incorporates design features promoted in the supporting document titled *Street Layout, Design and Traffic Management Guidelines* (Ministry for Planning, June 2000). The result is a street network that is permeable, legible and robust.

The basic road hierarchy for Lot 12 Jindalee is as follows:

- District Distributor (Capacity of approximately 35,000 veh/day): Marmion Avenue;
- Neighbourhood Connectors (Capacity up to 7,000 veh/day): E/W3, Coastal Route, and Santa Barbara Parade (northerly extension from Quinns Rocks);
- Wider Access Streets (Capacity up to approximately 3,000 veh/day); and
- Standard Access Streets (Capacity up to approximately 1,000 veh/day).

These street types are suited to the specific traffic, parking and pedestrian needs of each location.

3.2 ACCESS STREETS

Figure 3 and *Figure 4* illustrates two basic types of Access Street:

- Narrower Access Street: 6.0 metre wide pavement in a 14-15 metre reserve; and
- Wider Access Street: 7.2 metre wide pavement in a 16 metre reserve.

Liveable Neighbourhoods Community Design Code and the accompanying *Street Layout, Street Design and Traffic Management Guidelines* provide guidance on the role, capacity and design for Access Streets in a 'modified grid' network.

The Narrower Access Street has a capacity up to 1,000 veh/day but in the Jindalee Lot 12 street network the volumes would typically be below 500 veh/day.

The Wider Access Street has a capacity up to 3,000 veh/day but in Jindalee Lot 12 the street network volumes would typically be below 1,500 veh/day. By way of comparison with the Narrower Access Street, the Wider Access Street is suited to situations with higher traffic levels, higher parking demand or a combination of both.

As can be seen from *Figure 2*, the Wider Access Streets have been indicated for the more prominent streets in the network where a traffic distribution function is also required. As such these streets provide a lower level of traffic distribution than the Local Distributors. *Figures 5* through *Figure 9* illustrate variations on the Wider Access Street to accommodate parking embayments or other special circumstances.

- Wider Access Street with embayed parking on one side (*Figure 5*): This access street uses a 6.0 metre pavement and embayed parking on the side with the medium/high density residential land and the rear lane access. A 15 metre wide reserve is employed with this street cross-section.
- Boulevard Treatment (Street A: *Figure 6*): This street is a boulevard in a 22 metre reserve. It has 2.3 metre parking lanes, 3.7 metre travel lanes and a 3.0 metre median. The combined kerb to kerb width of 6.0 metre is adequate for low/medium levels of cyclists and some larger vehicles in a 40-50km/hr environment. The street also features a 1.5m footpath on both sides.
- Wider Access Street in 18 metre reserve (Street B: *Figure 7*): This street has a 7.2 metre paved width. The wider reserve allows for more generous nature strips and larger street trees. The extra reserve also allows for splitter islands at intersections (without need for additional property truncation).
- School Frontage Street (Street C: *Figure 8*): This street has a median to control U-turns near the school and assist pedestrian crossings. The street has a 3.8 metre shared parking/cycle lane on the north side (school side) to cater for cyclists and short term parking at the school. The reserve is 23 metres wide and allows for a 2.5 metre shared path on the north side and a 1.5 metre footpath on the south side.
- Foreshore Access Street (Street D: *Figure 9*): This street provides for a 2.5 metre shared path and a 2.3 metre parking lane on the foreshore side. The travel way is 6 metres wide and the overall reserve is 18 metres wide.

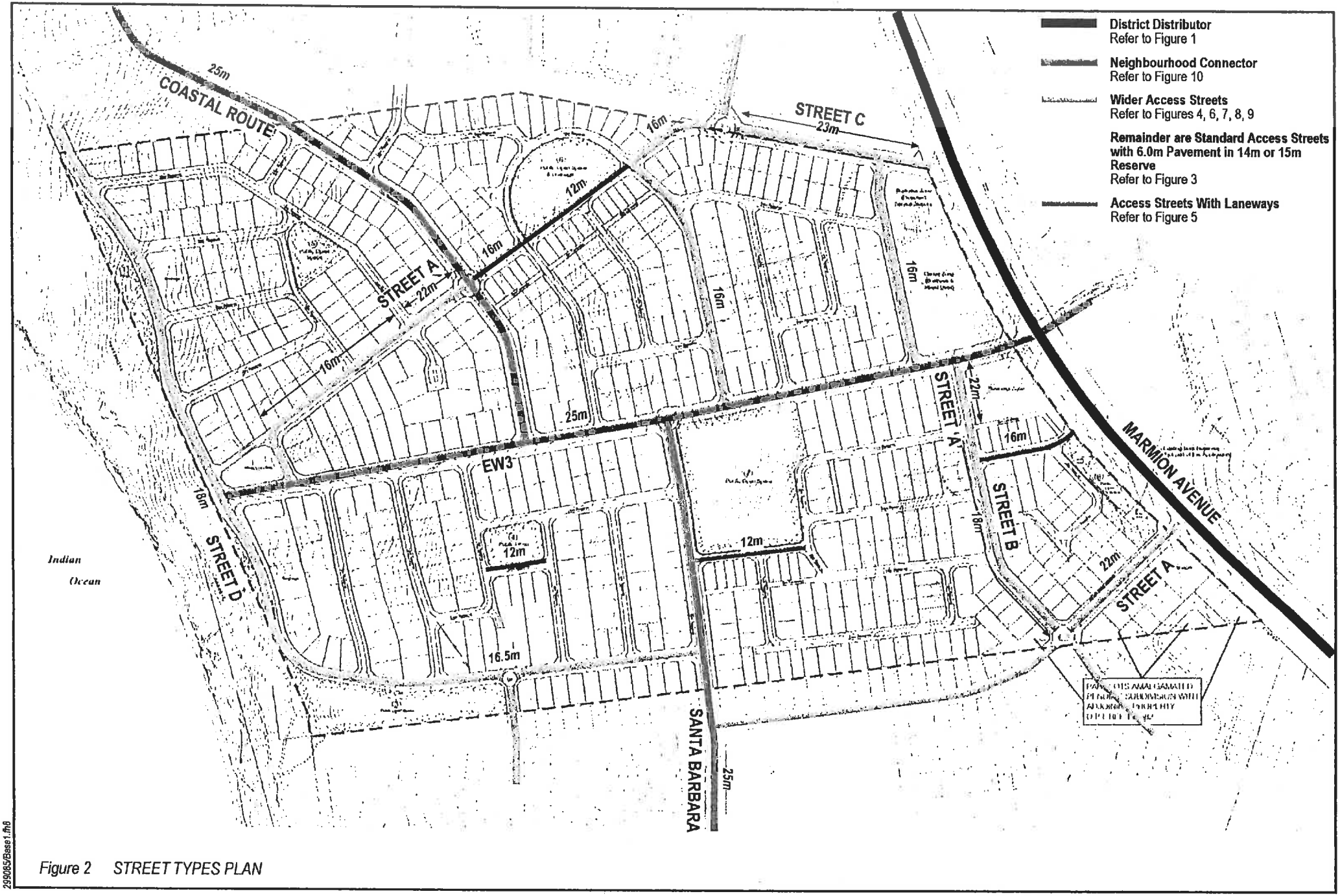

Figure 2 STREET TYPES PLAN

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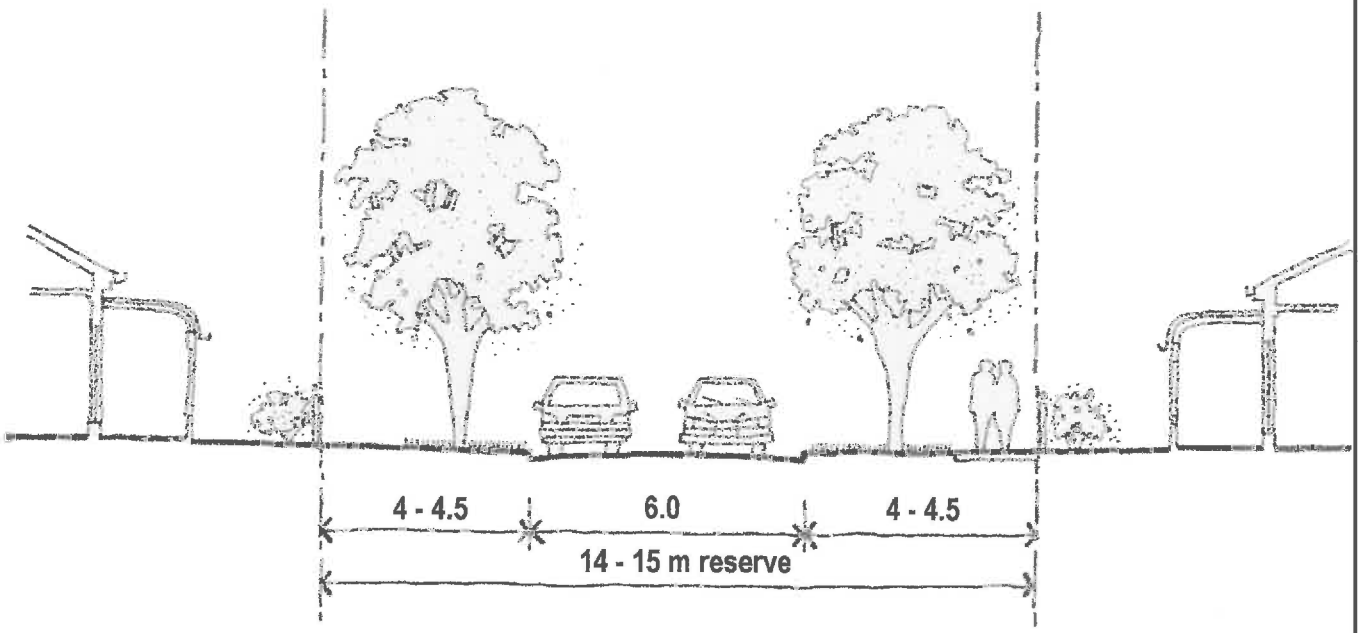

Access Street (6.0m pavement) in 14 -15m Reserve

Not to Scale

Figure 3 *ACCESS STREET (14 - 15m Reserve)*

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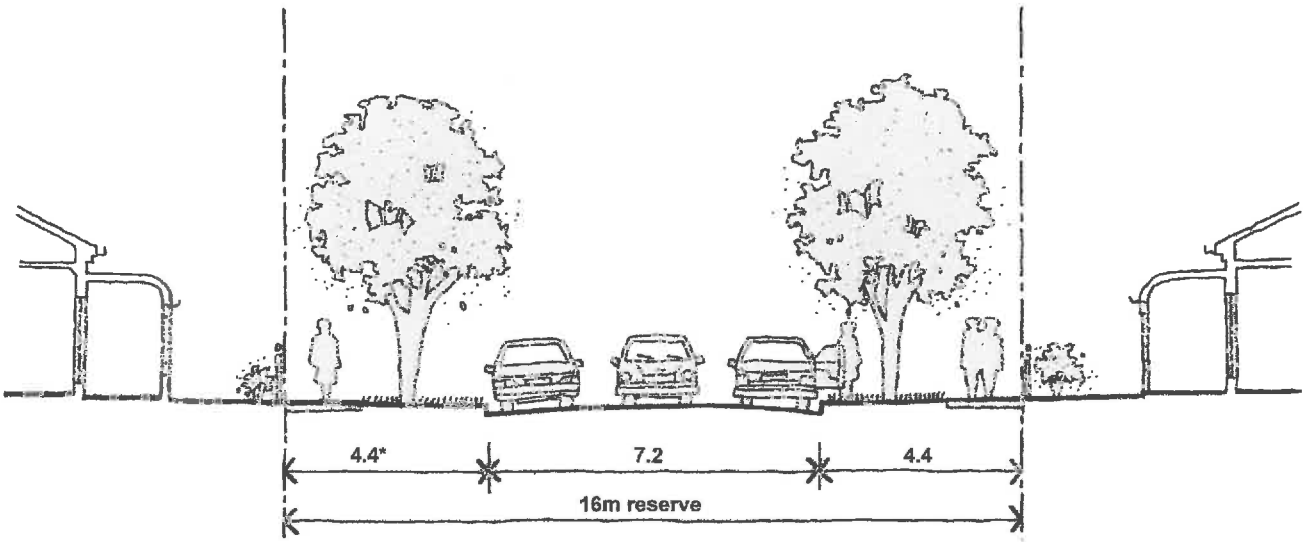
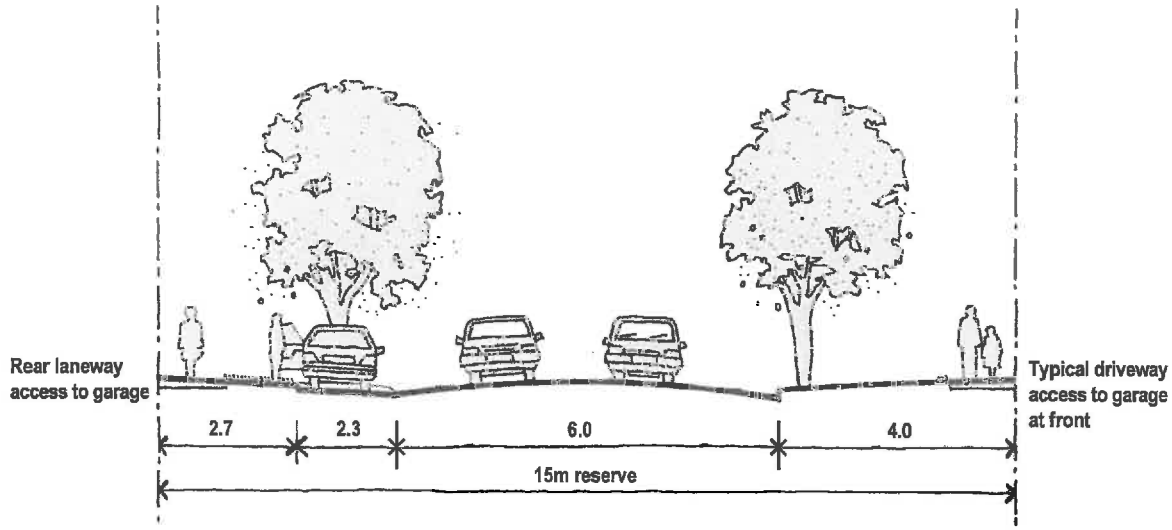


Wider Access Street (7.2m pavement) in 16m Reserve

Not to Scale

Figure 4 *WIDER ACCESS STREET (16m Reserve)*



NOTE: Verge reduced from 4.0m to 1.0m adjacent to Public Open Space and road reserve reduced to 12m.

Figure 5 *WIDER ACCESS STREET: REAR LANEWAY ON ONE SIDE*

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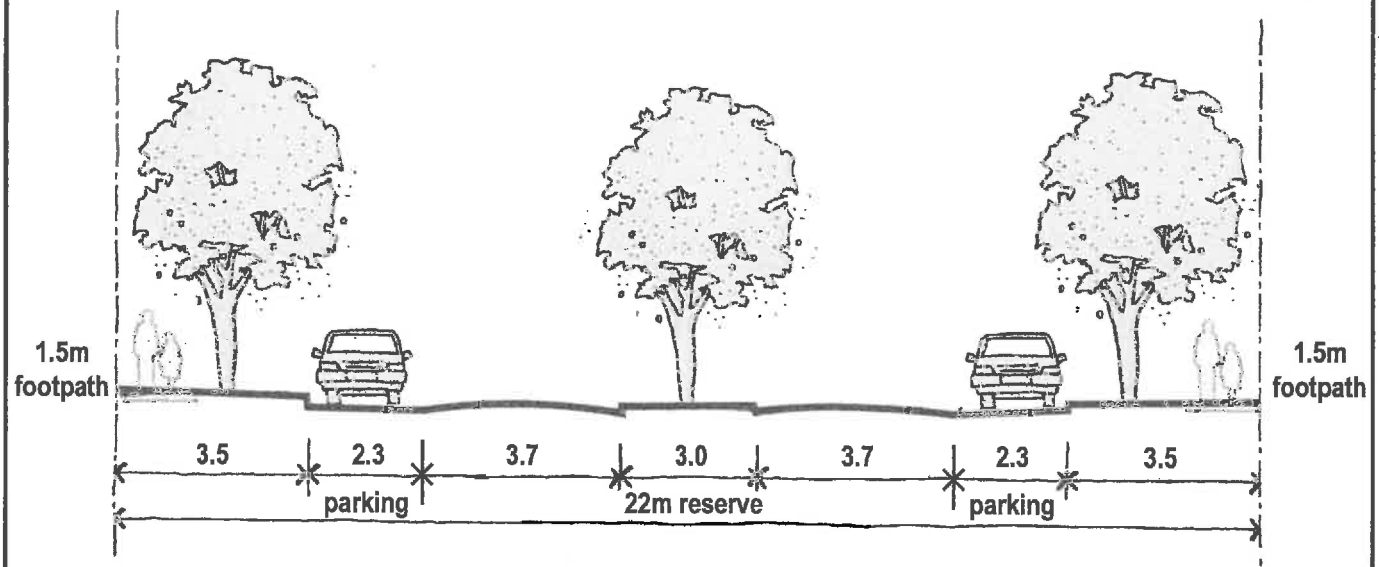
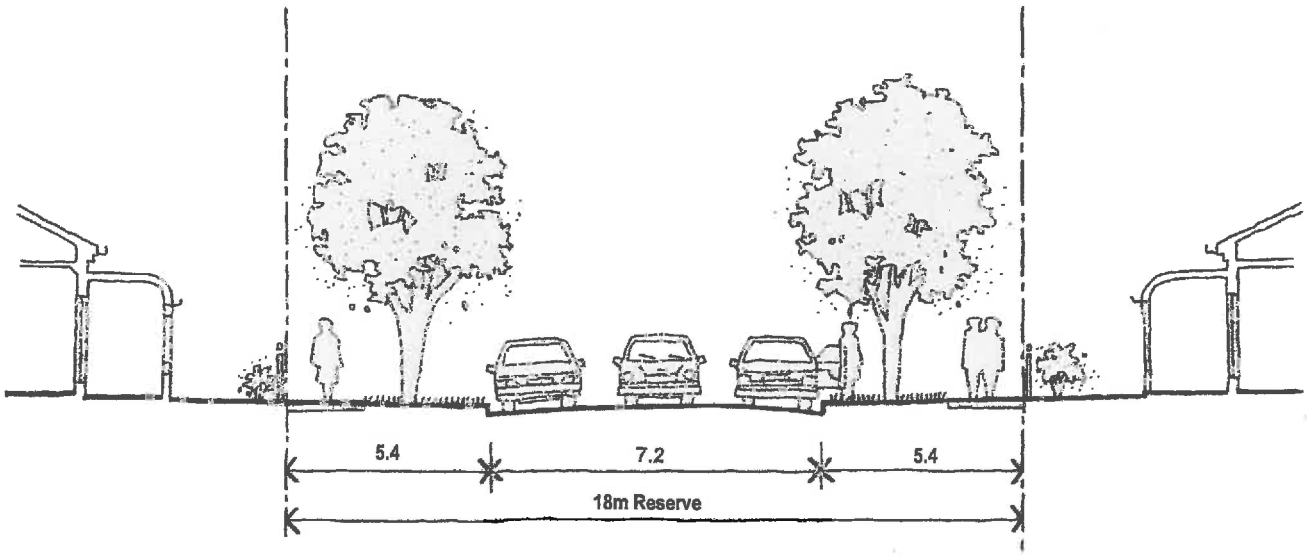


Not to Scale

Figure 6 *STREET 'A': WIDER ACCESS STREET, BOULEVARD (22m reserve)*

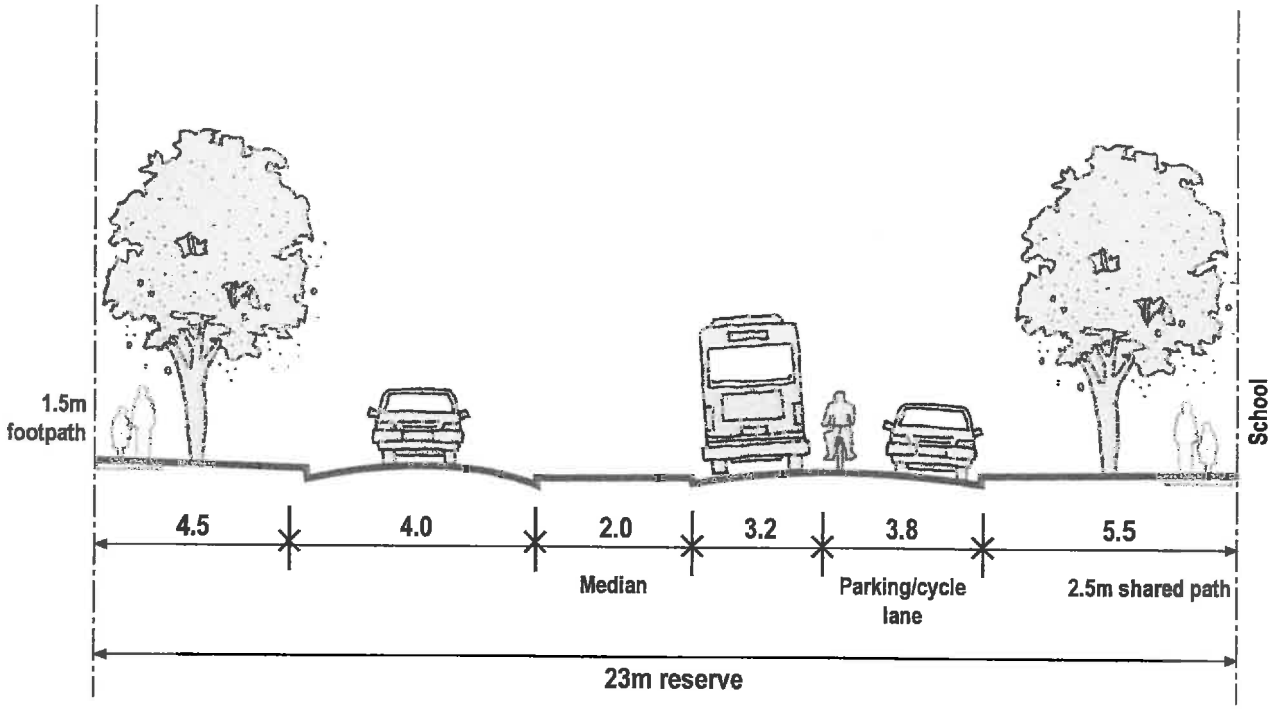
298085/Figure6.fh8



Wider Access Street (7.2m pavement) in 18m Reserve

Not to Scale

Figure 7 *STREET 'B': WIDER ACCESS STREET (18m Reserve)*



Not to Scale

Figure 8 *STREET 'C': STREET CROSS-SECTION AT SCHOOL SOUTHERN BOUNDARY (refer Figure 2)*

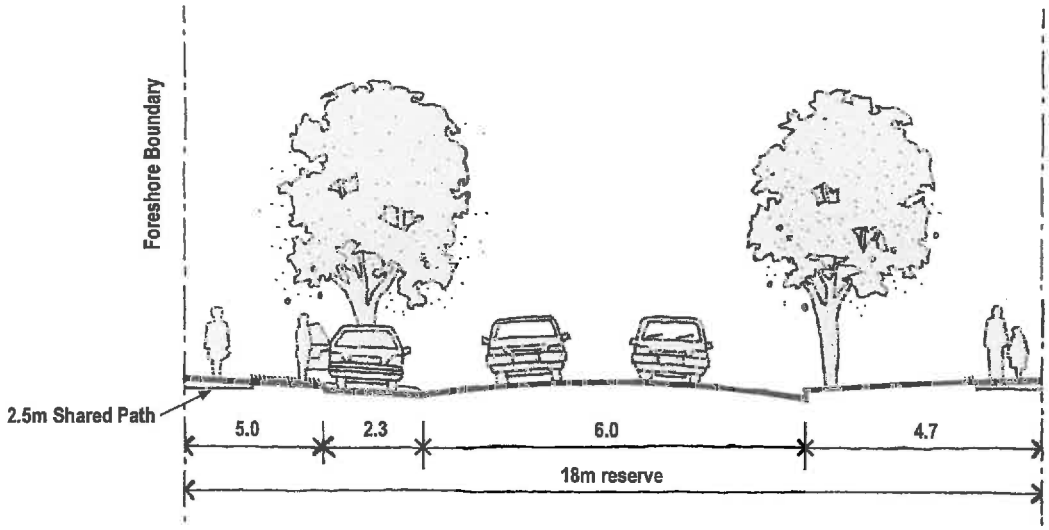
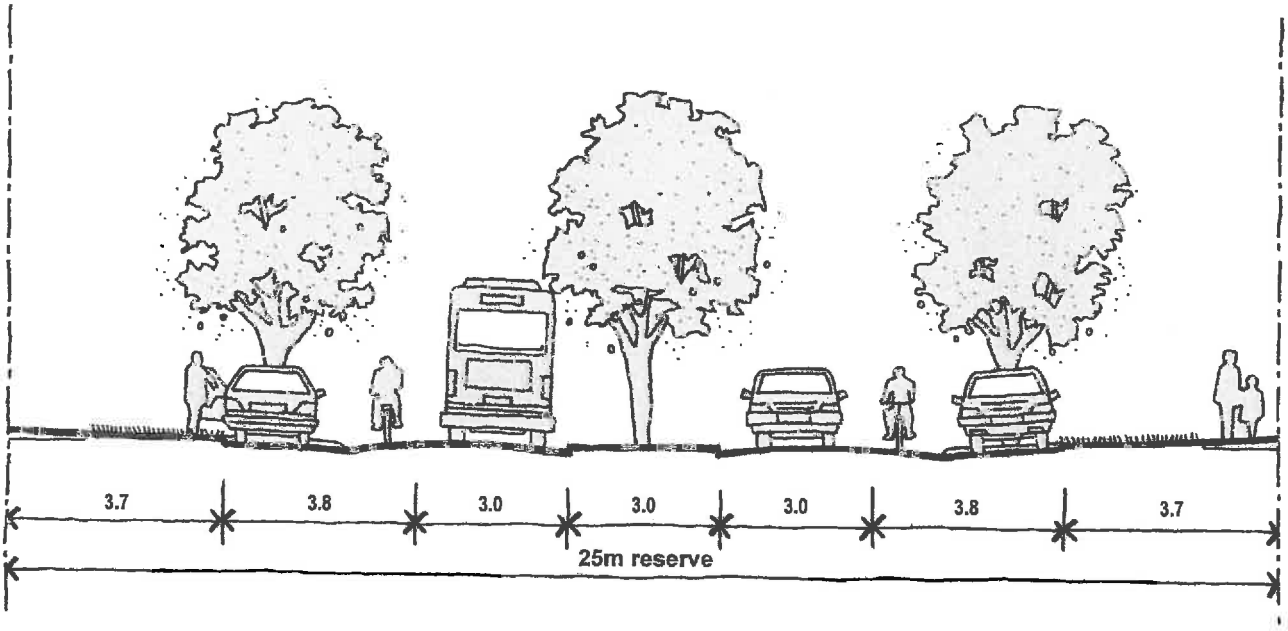


Figure 9 *STREET D: FORESHORE ACCESS STREET (18 RESERVE)*
(no median, with parking embayment on foreshore side)



Not to Scale

Note: *Travel lane width is 3.0m except for the northerly extension of Santa Barbara Road. Use 3.5m width to match the existing standard for that portion up to Neighbourhood Connector E/W3.*

Figure 10 *NEIGHBOURHOOD CONNECTOR: TRADITIONAL BOULEVARD IN 25m RESERVE*

3.3 REDUCED STREET VERGE ADJACENT TO PUBLIC OPEN SPACE

The verge adjacent to Public Open Space (P.O.S) frontage can often be reduced. Some services, trees and paths can be accommodated within the P.O.S thus allowing a narrower verge. For the Jindalee Lot 12 Structure Plan, the typical street reserve widths indicated in this report are thus reduced by 3 metres where the street is adjacent to P.O.S. For example, a typical 'Wider Access Street' adjacent to P.O.S is 13 metres wide instead of 16 metres wide. The reserve is not reduced, however, where embayed parking is required to serve P.O.S activities.

3.4 NEIGHBOURHOOD CONNECTOR: TRADITIONAL BOULEVARD STYLE

Figure 10 illustrates a boulevard style Neighbourhood Connector for use in circumstances where traffic volumes are between 3,000 veh/day and 7,000 veh/day:

- Traditional Boulevard: features 3.5 metre travel lanes, 3.8 metre combined parking/cycle lanes, and 3.0 metre median in a 25 metre reserve.

This street has been used in the Jindalee Lot 12 street layout where volumes are expected to exceed 3,000 veh/day. This design is favoured due to the pedestrian crossing benefits, the driveway access control benefits and the road narrowing effect created by the 'boulevard' design.

The travel lanes for this boulevard are typically 3.0 metre wide as shown in the *Liveable Neighbourhoods* cross section (*Figure 4*, page 29). An exception has been made for the extension of the existing Santa Barbara Road (linking to Jindalee Lot 12 from the south). This road has an existing 3.5 metre lane width that will be retained up to the Neighbourhood Connector named E/W 3. It is considered preferable to retain the existing lane width rather than alter the design standard at the Lot 12 southern boundary.

3.5 CONCLUSION ABOUT STREET TYPE PLAN AND CROSS-SECTIONS

The Street Type Plan (*Figure* 2) has used appropriate street types from *Liveable Neighbourhoods Edition* 2 and matched them to the traffic and parking demands associated with adjacent land uses. Special streets have also been designed to suit individual site circumstances.

Chapter 4

PUBLIC TRANSPORT, WALKING AND CYCLING

4.1 PUBLIC TRANSPORT

There is no existing bus service to the study area. Existing bus service extends to the north end of Quinns Rocks. The bus services in the area are typically designed as 'feeders' to the rail stations along the Mitchell Freeway. This is because Transperth expect long distance trips in the North-West Corridor to be undertaken by rail.

As development extends north, bus service will be extended into Jindalee. Transperth have indicated that the Neighbourhood Connector nearest the foreshore ('Santa Barbara' and 'Coastal Route') would be used for this north-south bus service. Buses would also run along Marmion Avenue.

At present, Transperth expect that the future Brighton (Butler) rail station will provide the bus/ rail interchange facility for the area and therefore that buses serving Jindalee Lot 12 will be directed to that station. The Brighton station is to be located near Lukin Drive at the Mitchell Freeway.

Due to the interconnected network of Neighbourhood Connectors proposed for Jindalee Lot 12, it will be easy to extend the bus route into the new community. Refer to *Figure 11* showing possible bus routes.

The interconnected streets also ensure that walkability to future bus stops will be good. Seating and shelter should be provided at as many stops as possible. Standard Transperth bus spacing is about 400 metres along local bus routes. Along Marmion Avenue the spacing of bus stops is expected to be greater.

4.2 WALKING AND CYCLING

4.2.1 Footpaths

The Jindalee Lot 12 development is designed to promote walking and cycling. Footpaths are provided on one side of Access Streets with low vehicle numbers and

slower speed. Footpaths are provided on both sides of higher traffic/higher speed Access Streets and also those leading to important activity points.

Street reserves (*Figure 2*) and cross-sections (*Figures 3-10*) have been designed to accommodate footpaths. *Figure 11* shows the streets that will have footpaths on both sides. Other streets will have footpaths on one side only, consistent with lower pedestrian demand, slow traffic speeds and low traffic volumes.

4.2.2 Shared Paths

Under the new Australian Road Rules, cycling will be allowed on footpaths (for cyclists under 12 years of age). Additionally, Jindalee Lot 12 Access Streets are also designed for safe on-road cycling.

In addition to safe on-road cycling, a network of shared paths is proposed. *Figure 11* shows the proposed network of 2.5 metre shared paths for Jindalee Lot 12. North-south shared paths are proposed along the foreshore and along the 'Coastal Route' within Lot 12 and along Marmion Avenue.

An east-west path is proposed on E/W3 between the foreshore and Marmion Avenue. The path at the boundary of Lot 12 and Lot 10 is provided to assist with access to the primary school.

4.2.3 Underpasses On Marmion Avenue

The City of Wanneroo Town Planning Scheme (Map 1 of Schedule 12) indicates the requirements for grade separated pedestrian crossings along Marmion Avenue. One crossing is shown to the south of the Lot 10/ Lot 12 property boundary and another is shown to the south of the Lot 9/Lot 10 boundary.

The Brighton Local Structure Plan has proposed traffic signals at the intersection of E/W3 and Marmion Avenue. Current MfP policy favours signalised crossings over grade separated crossings. For these reasons, it is proposed that the City of Wanneroo Town Planning Scheme requirements be reviewed as they relate to the requirement for a grade separated crossing near the Lot 10/ Lot 12 boundary.

PUBLIC TRANSPORT, SHARED PATHS, FOOTPATHS

REV A : 25.03.03 SOURCE: ERM

FIGURE 11

Chapter 5

LOCAL TRAFFIC ESTIMATES AND ACCESS ONTO MARMION AVENUE

5.1 TWO WAY DAILY TRAFFIC VOLUMES

Figure 12 shows estimated daily local traffic using the Lot 12 street system as generated from the three super lots (ie. Jindalee Lot 12, Lot 10, and Lot 9). The traffic estimate used the following land use data for the combined super lots:

- Approx. 3,100 residential dwellings including about 100 units of home-based business;
- Approx. 13,000 square metres commercial and community services;
- Approx. 3,600 square metres of mixed business;
- Approx. 2,700 square metres special use/ home business; and
- One primary school.

Table 1 contains some summary information on trip productions and attractions attributable to these land uses.

Table 1 DAILY VEHICLE TRIP GENERATION INFORMATION FOR JINDALEE SUPERLOTS 12, 10, 9

Trip Purpose	**Total Productions**	**Total Attractions**
Home based work	13,910	3,070
Home based other	12,880	4,200
Non-home based	2,860	3,290
% of local attractions satisfied by local productions		
Home based work	50%	
Home based other	65%	
Non-home based	50%	
Internal/ External Trip Making		
Internal-Internal	17%	
Internal-External (and return)	69%	
External-Internal (and return)	14%	

The assumed trip distribution to/from external areas summarised in *Table* 2.

Table 2 ASSUMED TRIP DISTRIBUTION TO EXTERNAL AREAS

North of Lot 9	25%
East of Marmion	40%
South of E/W 3	35%
West (no destination)	0%

Local traffic is in the range expected for the land uses and street network proposed for Jindalee Lot 12. Daily volumes range up to 6,500 veh/day on Neighbourhood Connectors and up to approximately 1,000 veh/day on more important Access Streets. Due to the simplification of the street system in the traffic model, the Access Street volumes shown in *Figure 12* are somewhat overstated and multiple route choice will allow traffic to disperse more than indicated.

Through traffic has not been modelled. However, the amount of through traffic using east-west routes will be very low since the street system terminates at the foreshore and there is no external destination to the west. To make the foreshore Neighbourhood Connector (named 'Coastal Route' in this report) less attractive to through traffic it is advisable to create a discontinuity at the northern border of Lot 9 and at the southern border of Lot 12. This has been achieved in the Lot 12 street network design by 'staggering' the alignments of 'Santa Barbara' and the 'Coastal Route'.

It is expected that weekend traffic may be higher than weekday traffic if/ when Jindalee beaches become highly attractive. It would not be desirable to sacrifice urban form and function to achieve 100% service to peak weekend traffic. As can be seen from the Cottesloe case, traffic congestion and parking congestion do occur but they are accepted and are manageable with an interconnected street layout and using street designs such as those proposed here.

Traffic generated from Quinns Rocks that uses streets in the southern part of Lot 12 (enroute to external destinations) has not been modelled and is not shown in *Figure 12*. The traffic volume shown on the 'Wider Access Street' (ie 440 veh/day) at the boundary with Quinns Rocks is thus only part of the total traffic this street will carry. Other streets in Lot 12 are unlikely to carry much through traffic from Quinns Rocks.

5.2 LOCAL STREET ACCESS ONTO THE ARTERIAL ROAD SYSTEM

Figure 12 also shows the access arrangements proposed along Marmion Avenue. The access configuration follows a hierarchy related to the intersection geometry and intersection control:

- Signalised 4-way intersections;
- Full access T-junctions (unsignalised); and
- Left in/left out T-junctions (unsignalised).

Frontage development and driveway or parking access occurs along frontage roads between the identified intersections. The frontage roads remove individual property driveways from the regional road and replace them with a small number of intersections.

5.2.1 Signalised 4-Ways

The location of signals has been covered in earlier sections. It is necessary, however to emphasise that the signals located at intersections between Neighbourhood Connectors and the regional roads (eg. EW3 and Marmion Avenue) provide high capacity and provide for safe crossing movements across the arterial roads. The signalised access points are supplemented by unsignalised T-junction intersections as described below.

5.2.2 Full Access T-Junctions

Between signalised intersections, full access T-junctions are located to serve local access needs and relieve traffic loading at signalised accesses.

A distance of 200-250 metres is recommended between full access T-junctions (page 9 of *Street Layout, Design and Traffic Management Guidelines for the Liveable Neighbourhoods Community Design Code*, MfP, June 2000). Full access T-junctions for the Jindalee Lot 12 Local Structure Plan have been identified at appropriate locations and provide the recommended spacing.

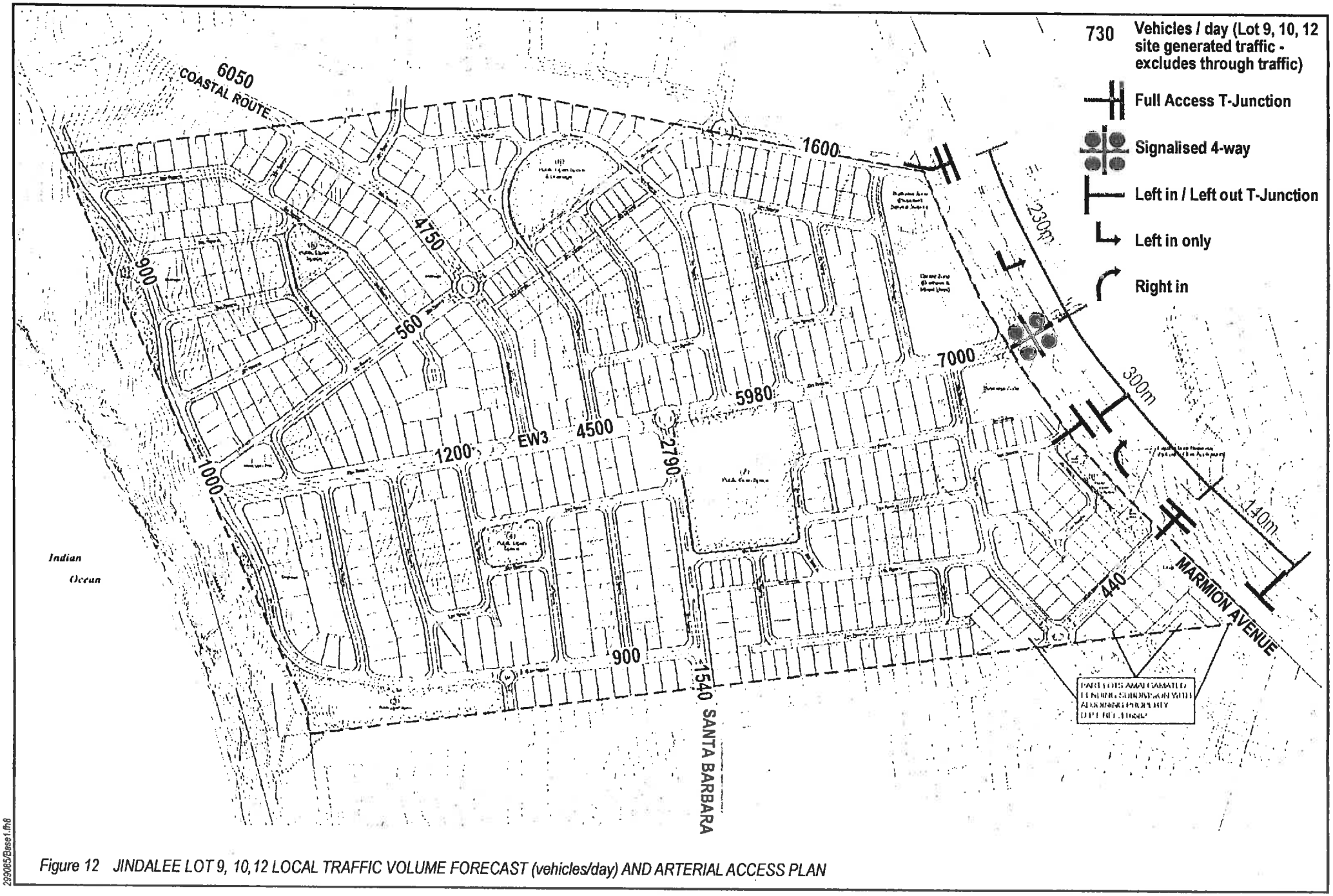


Figure 12 JINDALEE LOT 9, 10,12 LOCAL TRAFFIC VOLUME FORECAST (vehicles/day) AND ARTERIAL ACCESS PLAN

299085/base1.fh8

5.2.3 *Left In / Left Out Access*

Left in/left out accesses have the least impact on traffic efficiency and traffic safety along arterial roads because both crossing movements and right turns are eliminated. They can be used closer to signalised intersections than full access T-junctions and reduce the length of 'backtracking' that is necessary along frontage roads.

Several left in/left out accesses are proposed along Marmion Avenue. These are considered important to the viability of land development at the frontage and they also remove some left turn traffic from the full access T-junctions. This enables those intersections to cater more successfully for right turn movements.

The left in/left out accesses have been located relative to upstream intersections such that they can be designed with deceleration lanes, thus minimising disturbance to traffic on Marmion Avenue.

Chapter 6

SUMMARY AND CONCLUSION

This report has presented:

- A review of regional traffic issues in the vicinity of Jindalee Lot 12 including the proposed cross-section for Marmion Avenue (*Figure 1*) and the draft District Structure Plan (*Appendix D*).

- Street Types Plan (*Figure 2*) and street cross-sections (*Figure 3 through 10*) to suit the various land uses and their associated activities including vehicle, pedestrian and cyclist movement and access.

- A Footpaths, Shared Paths and Public Transport Plan (*Figure 11*). The interconnected street system provides multiple routes and a high level of pedestrian, cyclist and bus access within and beyond Lot 12 Jindalee. North-south shared paths are proposed along the foreshore reserve, Marmion Avenue, and along the 'Coastal Route' and 'Santa Barbara'. East-west shared paths are proposed along E/W3 and to the proposed primary school at the Lot 12/ Lot 10 boundary near Marmion Avenue.

  Traffic signals are proposed for the intersection of E/W3 and Marmion Avenue. These will facilitate safe pedestrian access across Marmion Avenue. It is proposed that the City of Wanneroo Town Planning Scheme Schedule No. 12 requirement for a grade separated pedestrian crossing near the Lot 10/ Lot 12 boundary be reviewed; and

- The results of local traffic modelling as well as access planning for Marmion Avenue (*Figure 12*). The traffic analysis shows that the planned street system will cater adequately for the typical weekday demand.

  Potential north-south through traffic should be controlled by directing it towards Marmion Avenue before the traffic penetrates the borders of the three Jindalee Super Lots. This will require further review and co-ordination with the structure planning of Lots 9 and 10 to the north. Weekend traffic to Jindalee beaches could exceed typical weekday levels but as with Cottesloe Beach the traffic and parking congestion is manageable with the same type of interconnected street system and active street design as proposed for Jindalee Lot 12.

APPENDICES

Appendix A

NORTH-WEST CORRIDOR STRUCTURE PLAN: FIGURE 10

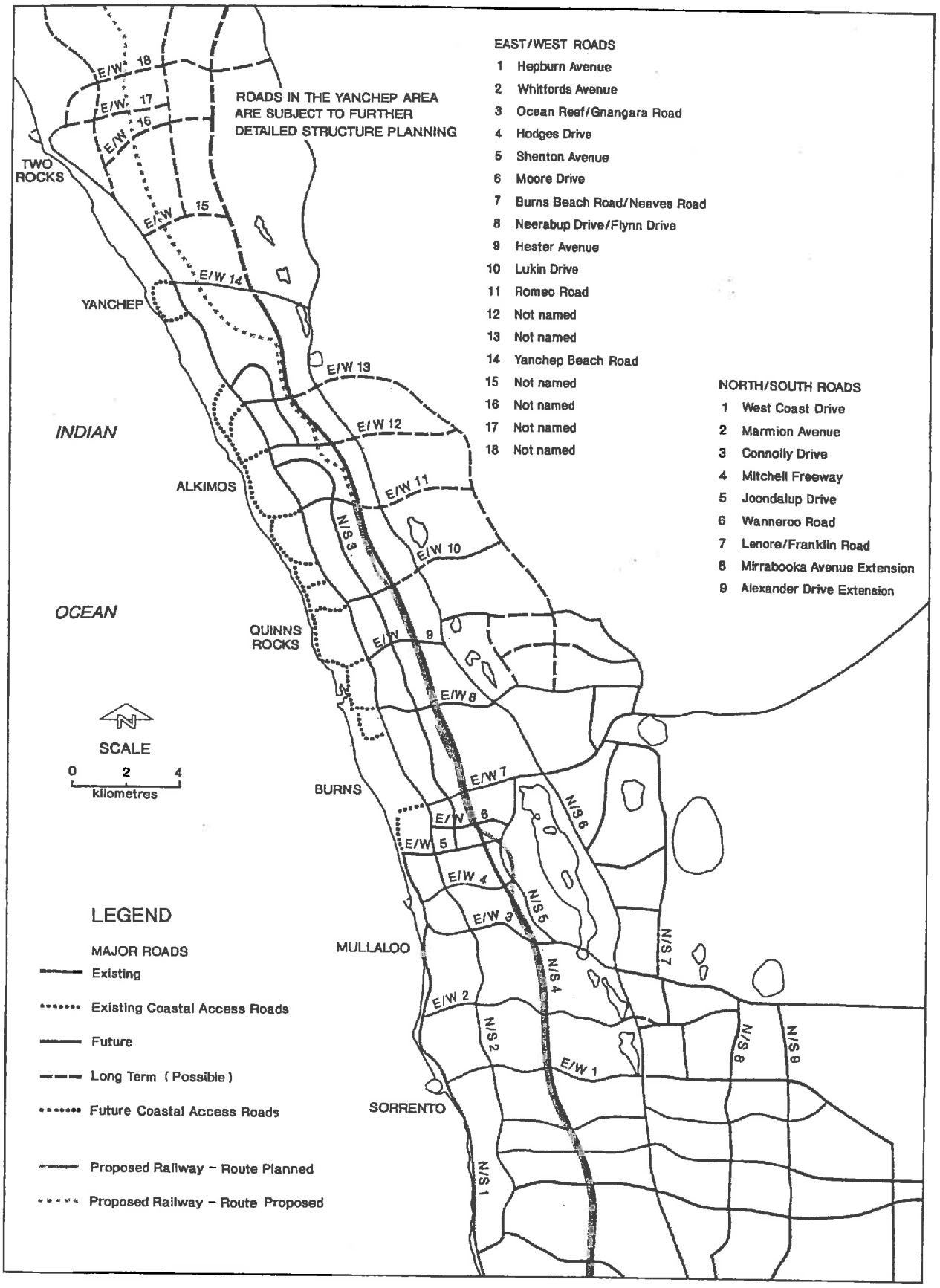
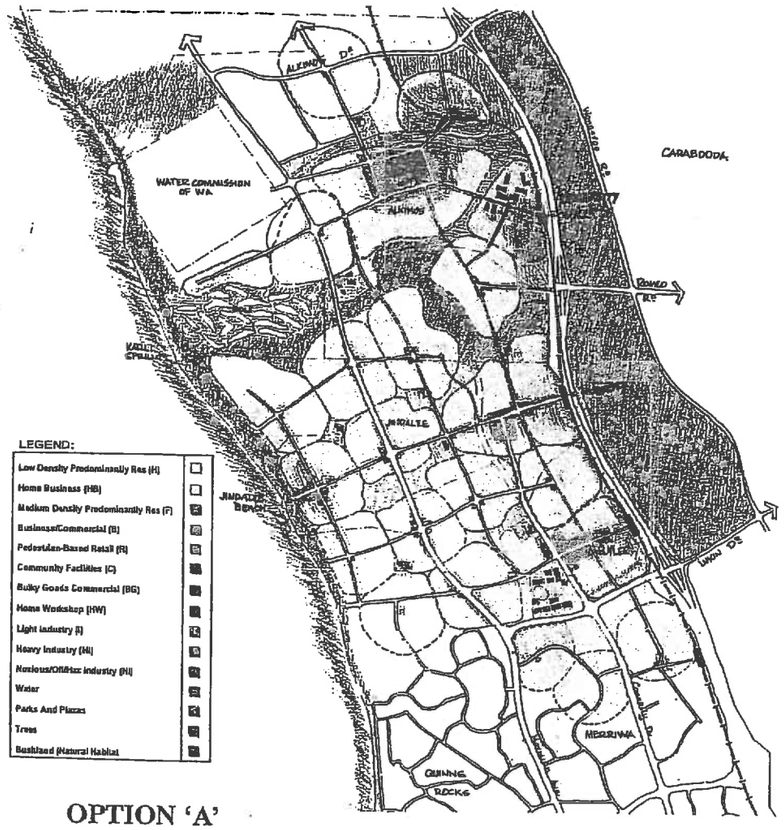


Figure 10 TRANSPORT STRATEGY

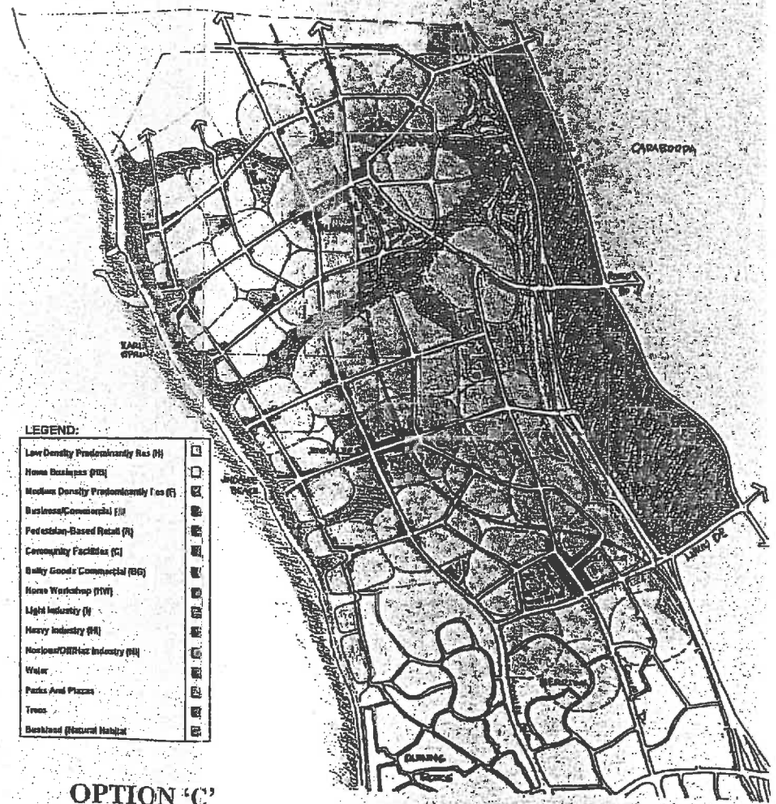
Appendix B

1996 JINDALEE ENQUIRY BY DESIGN WORKSHOP: THREE SUBREGIONAL PLANNING OPTIONS



OPTION 'A'
SUB - REGIONAL PLAN
WA COMMUNITY CODE

OPTION 'B'
SUB - REGIONAL PLAN
WA COMMUNITY CODE



OPTION 'C'
SUB - REGIONAL PLAN
WA COMMUNITY CODE

SOURCE : WESTERN AUSTRALIAN PLANNING COMMISSION

JINDALEE -ENQUIRY BY DESIGN - SUB REGIONAL PLANNING OUTCOME
FIGURE

Appendix C

ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/BRIGHTON

North- South Roads

Table 1 shows that the combined capacity for Marmion Avenue and Connolly Drive is approximately 70,000 veh/day. The Mitchell Freeway would add further capacity of approximately 60,000 or 90,000 veh/day when constructed to 4 lanes or 6 lanes, respectively.

Table 1 ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/ BRIGHTON (NORTH-SOUTH ROADS)

Road	Lanes and Road Reserve	Ultimate Potential Traffic Capacity (veh/day)
Connolly Drive	4 lane divided with frontage road / 60 metres	35,000
Marmion Avenue	4 lane divided with frontage road / 60 metres	35,000
Freeway	4-lane / 6-lane	60,000 - 96,000
Total at Screen Line		130,000 - 166,000

Source: Brighton Local Structure Plan: Traffic and Movement Network, ERM July 2000

Traffic demand estimates at year 2016, year 2021 and year 2036 are given in *Tables* 2, 3 and 4.

Table 2 YEAR 2016 TRAFFIC DEMAND FORECAST – (FREEWAY CONSTRUCTED TO HESTER AVENUE ONLY)

Road	Ultimate Traffic Demand Estimates (Year 2016) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway to Hester Avenue	N/A
Connolly Drive	15,000-16,000
Marmion Avenue	33,000
Total at Screen Line	**+- 49,000**

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz 1998).

Table 2 shows that Connolly Drive and Marmion Avenue can cater for traffic demand to year 2016 without the Mitchell Freeway (ie. 49,000 veh/day is less than the 70,000 veh/day capacity of Marmion Avenue and Connolly Drive).

Table 3 YEAR 2021 TRAFFIC DEMAND FORECAST – (FREEWAY CONSTRUCTED TO YANCHEP BEACH ROAD)

Road	Ultimate Traffic Demand Estimates (Year 2021) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway to Yanchep	60,000
Connolly Drive	8,000-13,000
Marmion Avenue	18,000
Total at Screen Line	**+- 90,000**

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz, 1998).

At year 2021, the total screen line demand is 90,000 veh/day (refer to *Table 3*). This total is larger than the 70,000-veh/day capacity of Connolly Drive and Marmion Avenue. For Marmion Avenue and Connolly Drive to be maintained as 4-lane divided arterial roads, the Mitchell Freeway would need to be constructed through the study area by year 2021. Note that the forecast traffic volumes on Marmion Avenue drop from 33,000 veh/day (Year 2016) to below 20,000 veh/day (Year 2021) when the freeway is included in the network in the northern part of the study area.

Table 4 ULTIMATE TRAFFIC DEMAND FORECAST (Year 2036)– (FREEWAY CONSTRUCTED TO BEYOND YANCHEP BEACH ROAD)

Road	Ultimate Traffic Demand Estimates (Year 2036 estimated date) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway (6-lanes)	96,000
Connolly Drive	15,500
Marmion Avenue	28,500
Total at Cordon	+- 140,000

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz, 1998).

Table 4 shows that when the freeway is constructed to an ultimate 6-lane design standard, the traffic demand on Marmion Avenue is less than 30,000 veh/day.

E-W Road Reservations And Capacity Potential

Table 5 ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/ BRIGHTON (EAST-WEST ROADS)

Road	Lanes and Road Reserve Width	Capacity (veh/day)
Lukin (E-W 1)	4 lane divided with frontage road/ 60 metres	30,000-35,000
E-W 2: ❑ Station to half diamond interchange at Freeway**	4 lane divided road in 32-42 metre reserve*	25,000-30,000*
❑ Marmion Avenue to Brighton North Rail Station	Integrator Arterial 'B' with Commercial frontage in 27-32 meter reserve*	12,000- 20,000*
❑ Regional Beach to Marmion Avenue	2 Lane Divided Neighbourhood Connector in 25 metre Reserve	7000
Romeo Road	4 lane divided assumed	25,000-30,000 assumed

Source: Brighton Local Structure Plan: Traffic and Movement Network, ERM July 2000

** Preliminary indication only.*

*** Half-diamond interchange is a possibility only and has not been confirmed in any regional planning studies.*

Table 5 provides a preliminary indication of the major east-west links in the Jindalee/ Brighton road network. Lukin Drive and Romeo Road will have full access, grade-separated

interchanges with the Mitchell Freeway and are thus the most important of the east-west roads. It is expected that these will be 4-lane divided roads capable of carrying approximately 30,000- 35,000 veh/day. E-W2 is the name given to the link between the Brighton North Rail station and the Jindalee regional beach. As a result of the different environments and the different traffic levels, three distinct cross-sections are likely along this road:

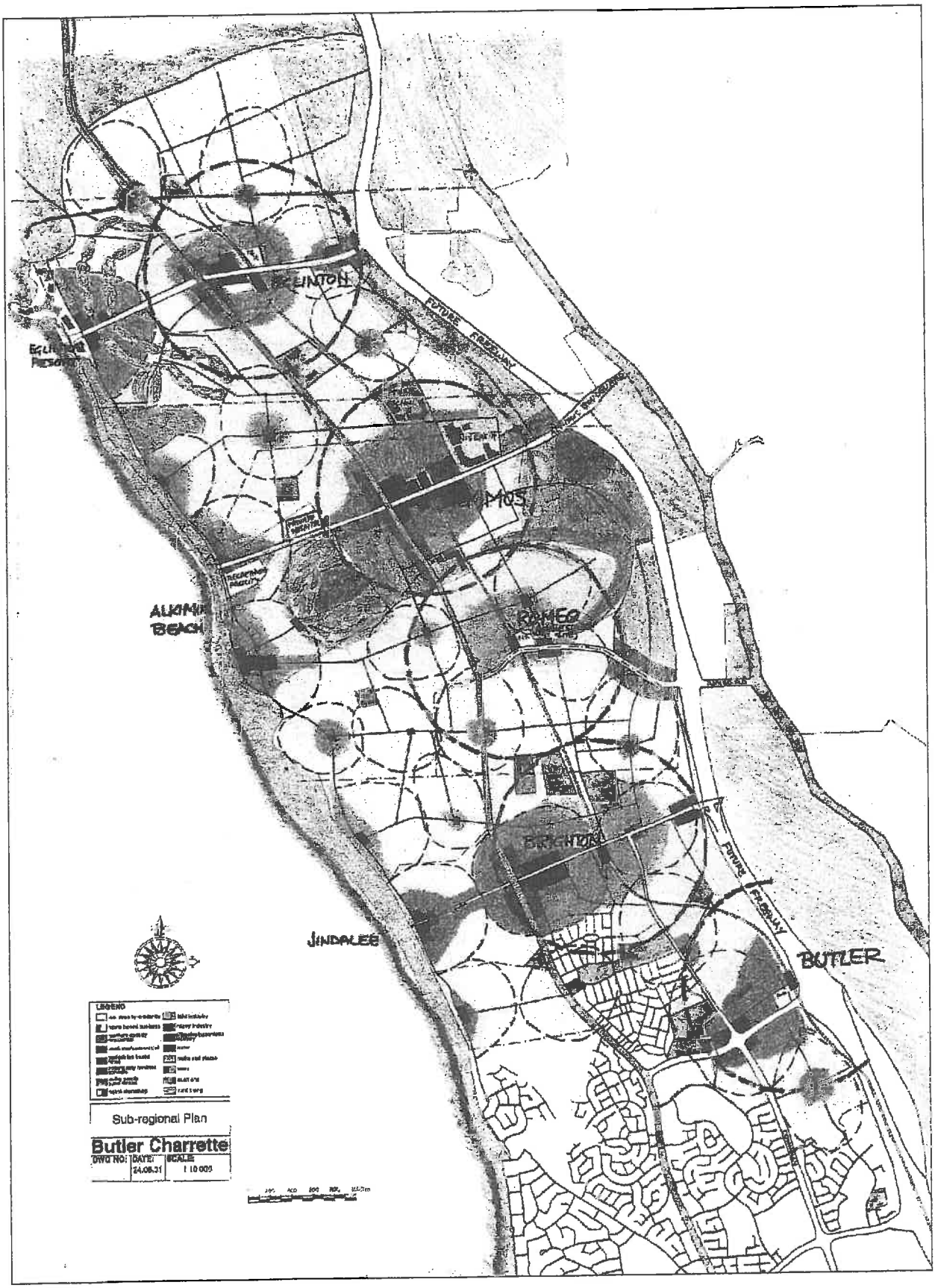
- Eastern Section: - 4-lane divided arterial connecting to the Mitchell Freeway at a half-diamond interchange. Mixed business frontage is anticipated. The proposed interchange is a possibility identified at the Jindalee Enquiry by Design Workshop and has no official status.

- Middle Section: - District Centre Main Street in between the Brighton North Rail Station/ Connolly Drive and Marmion Avenue. Retail/ mixed business uses are anticipated.

- Western Section: - 2-lane divided Neighbourhood Connector west of Marmion Avenue with predominantly residential frontage. A mixed business neighbourhood centre is to be located on the west side of Marmion Avenue and a regional beach mixed use centre located at the coast.

Appendix D

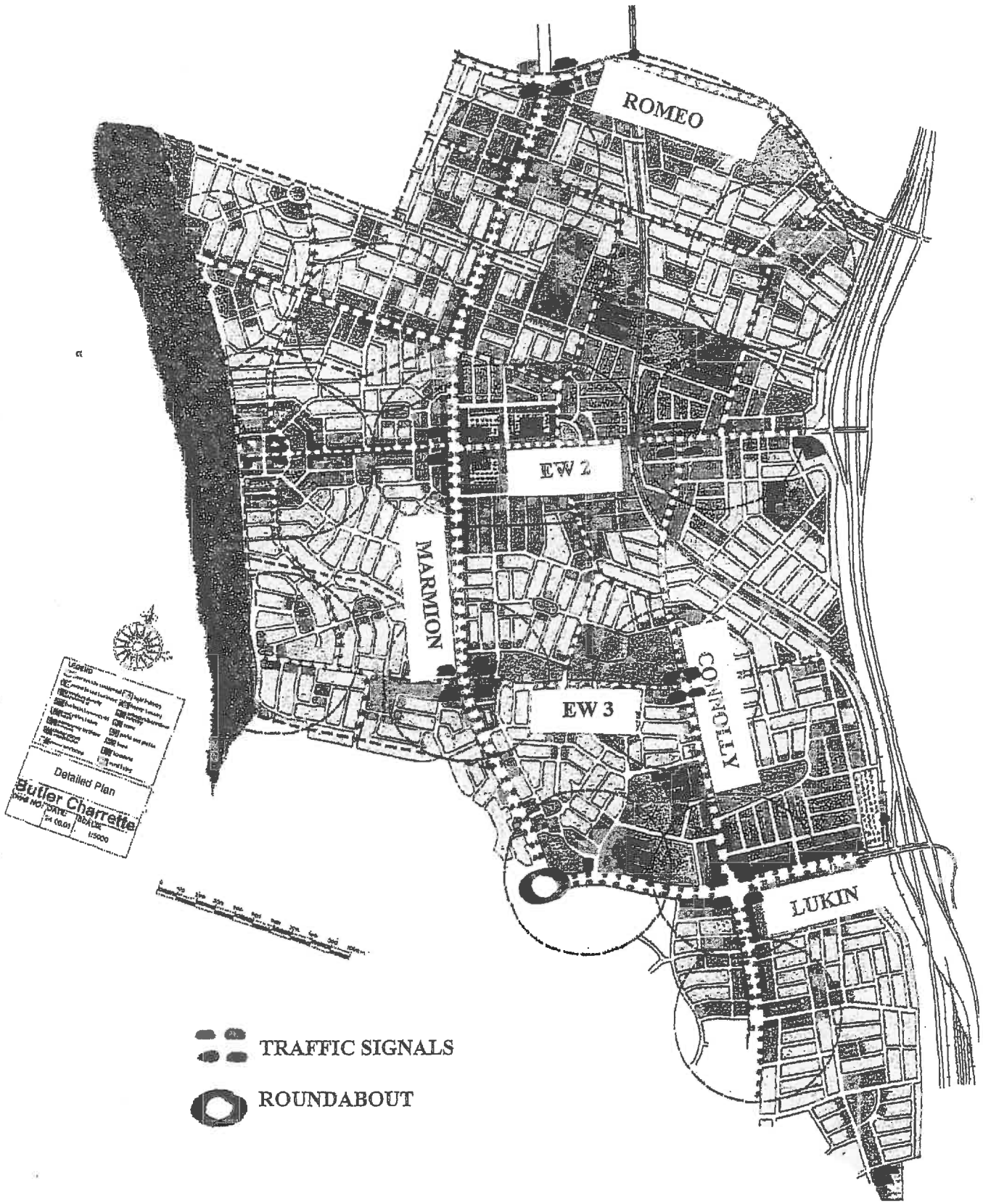
AUGUST 2001 ENQUIRY BY DESIGN WORKSHOP : DRAFT PLANS



SUB REGIONAL PLAN - DRAFT OUTCOME ONLY

SOURCE: BUTLER ENQUIRY BY DESIGN

FIGURE 4



DISTRICT STRUCTURE PLAN - DRAFT OUTCOME ONLY

IRCE: BUTLER ENQUIRY BY DESIGN

FIGURE 5

Appendix E

ACCESS PLANNING FOR COMMERCIAL CENTRE ZONE

Grain Pool Building
6th Floor
172 St Georges Terrace
Perth WA 6000
Telephone (08) 9321 5200
Facsimile (08) 9321 5262
PO Box 7338
Cloisters Square
WA 6850 Australia
www.erm.com

7 February 2002

Mr Ian Everett
Chappell & Lambert
PO Box 796
SUBIACO WA 6904

Our Reference: *299085a*

Dear Ian,

RE: LOT 12 JINDALEE
ACCESS PLANNING FOR MIXED BUSINESS PROPERTIES ALONG MARMION AVENUE

As requested please find attached *Figure 1* showing proposed access arrangements for the mixed business properties along Marmion Avenue.

The street names used below and shown in the plan (ie. Street C and E/W 3) are consistent with those presented in the ERM Report (Transport Planning for Lot 12 Jindalee Structure Plan, October 2001). The plan however reflects site layout changes made by Chappell & Lambert since the submission of the ERM report.

The plan shows six (6) access locations at the boundary of these properties:

- *Crossover No. 1 – 'Left in only' access from the left turn lane on Marmion Avenue.*

  The left turn lane on Marmion is extended southwards to also serve traffic turning into the proposed Service Station.

  This design approach has been approved for use on the opposite side of Marmion Avenue for the Brighton Village Centre where the southbound left turn lane has been extended to the north to allow a similar 'left in only' to the Village Centre commercial site. Please refer to Figure 2 attached.

  This access arrangement ensures that both the commercial viability of the site and the traffic efficiency / safety objectives for Marmion Avenue are realised.

- *Crossover No. 2 – left in/ left out access to the proposed Service Station from the Wider Access Street labelled 'Street C'.*

  A median on Street C will prevent right turns at this access due to the close proximity to the Marmion Avenue intersection. This access is important for those vehicles arriving at the Service Station from the north. Left in/ left out access ensures that traffic flow on Street C will not be disrupted.

- *Crossover No. 3 – Full access from the proposed Petrol Station to the north-south Access Street connecting to Street C.*

  This crossover provides the vital link to the median opening on Street C so that traffic entering from Marmion Avenue can return to Marmion Avenue. It also allows local traffic travelling eastbound on Street C to gain access to the site.

- *Access No.4 – 4-way intersection to a right-of-way (ROW) for public access at a point just south of the property boundary of the Service Station.*

  This access will form a 4-way intersection with the adjacent Access Street. It is suggested that the intersection be designed with brick paved threshold treatment and stop/ giveway signs on the east and west approaches.

  This access location, being at the property boundary, will minimise interference with site development and is thus very well suited to a possible future internal circulation road (ROW).

- *Crossover No. 5 – Full Access to the north-south Access Street at a point north of the intersection with the Neighbourhood Connector E/W 3.*

  This crossover will function in concert with Crossover No. 4 and No. 5 to provide adequate access to the Centre Zone and could be linked to a future internal circulation road or combined parking layout.

- *Access No. 6 – 4-way intersection to the ROW at E/W 3 to take advantage of the median break on E/W 3.*

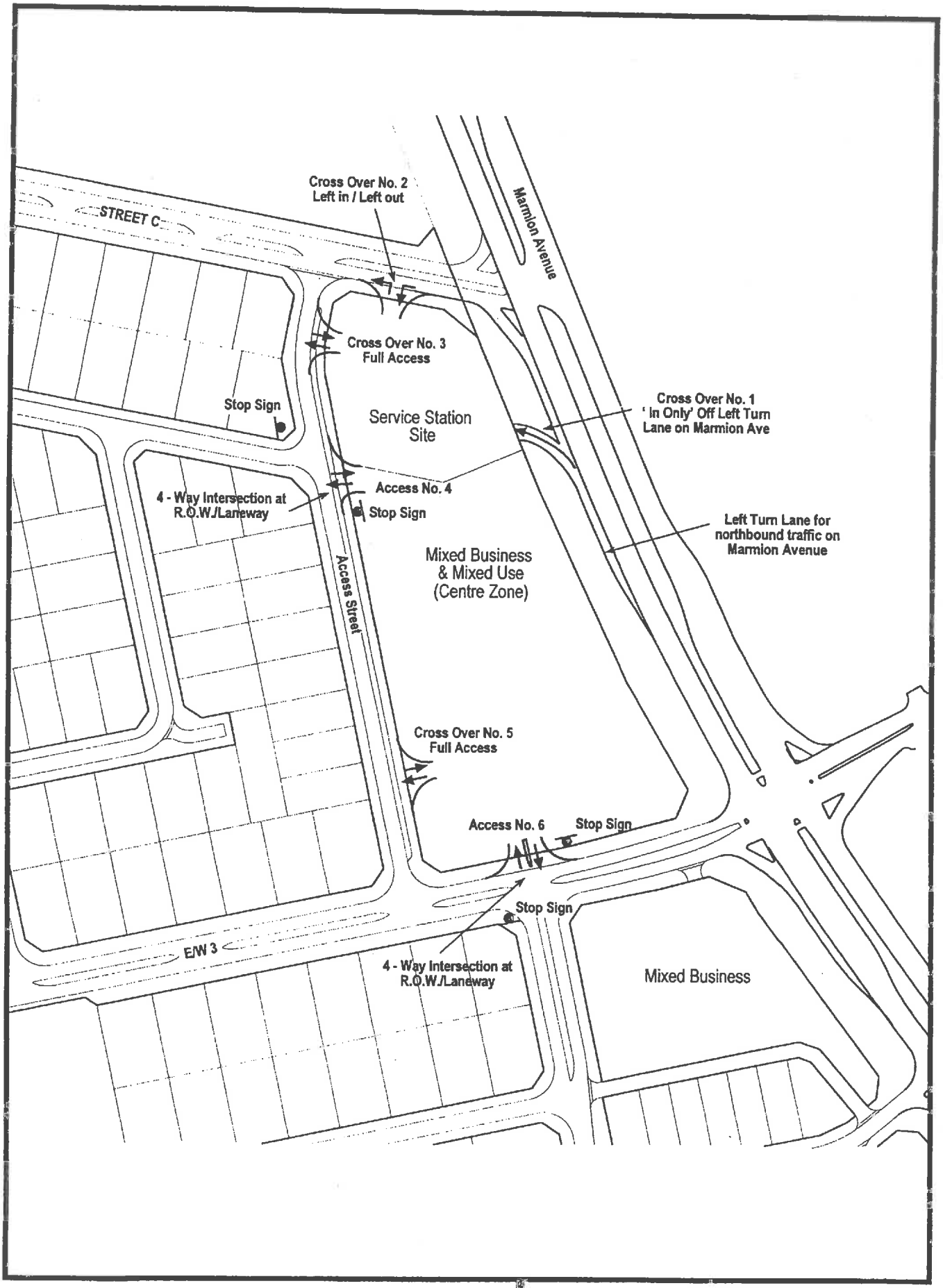
  This access is the most important one for the commercial viability of the site given that it provides access for northbound passing traffic on Marmion Avenue. The choice of location for this access is limited and a position closer to the future traffic signals on Marmion Avenue would not be suitable for a median break.

  The proposed 4-way intersection would obviously have the stop/giveway signs on the north and south approaches, with E/W 3 having priority.

I trust this information satisfies your requirements. Please submit a copy of this letter to the City of Wanneroo as part of your general submission on this matter.

Yours sincerely,
for Environmental Resources Management Australia Pty Ltd

Bruce Aulabaugh
Traffic/Transport Engineer



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ERM

Figure 1 Access Plan for Mixed Business Properties along Marmion Avenue

Lot 12 Jindalee

SECTION 5

ENVIRONMENTAL ASSESSMENT

PREPARED BY:

ATA ENVIRONMENTAL

LOT 12 JINDALEE LAND SYNDICATE

ENVIRONMENTAL ASSESSMENT

LOT 12 MARMION AVENUE JINDALEE

VERSION 2

SEPTEMBER 2001

REPORT NO: 2000/131

ATA Environmental
environmental scientists

TABLE OF CONTENTS

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1. INTRODUCTION

1.1 Background

Lot 12 Marmion Avenue, Jindalee, is largely zoned "Urban" under the Metropolitan Region Scheme (MRS) and Development Zone in the City of Wanneroo District Planning Scheme 2. A small section along the western boundary of the lot is reserved for Parks and Recreation in the MRS.

In order to progress development of this property a structure plan is currently being prepared. An assessment of the site's environmental characteristics and values was commissioned by Lot 12 Jindalee Land Syndicate, to enable key characteristics of the site to be considered during the development of the structure plan.

1.2 Purpose & Scope

This assessment has been undertaken to evaluate the environmental values of the property, identify any significant features, such as landforms, vegetation, habitat or cultural sites, and provide advice that will guide planning and future development of the property.

The assessment involved field investigations of landform, vegetation, flora and fauna habitats in August 2000 and included a review of relevant documents pertaining to environmental characteristics and planning within the area. This report outlines areas within the property considered to support the most significant attributes and values, and provides recommendations regarding development of the lot and appropriate management measures.

1.3 Location & Land Use

Lot 12 Marmion Avenue is situated on the coast in the locality of Jindalee, approximately 35km to the north of the Perth Central Business District. The property is bounded by Marmion Avenue to the east, and an existing coastal foreshore reserve to the west (Figure 1). The southern boundary of the property aligns with the boundary between the localities of Jindalee and Quinns Rocks. Lot 10 Marmion Avenue lies immediately to the north.

The property encompasses about 77ha of native vegetation. There is some evidence to suggest the property has supported low intensity cattle grazing in the past. Several tracks are evident within the property particularly within the near coastal portion of the lot adjacent to the Foreshore Reserve. These tracks are used regularly by 4WD enthusiasts and for access to the beach for recreational fishing.

1.4 Planning Context

The property is largely zoned "Urban" under the Metropolitan Region Scheme (MRS). The coastal strip is reserved as "Parks and Recreation" under this scheme.

The boundary of the coastal "Parks and Recreation" reservation generally follows the property boundary but also deviates slightly west and east of the property boundary. Areas east of the "Parks and Recreation" reservation within the existing coastal foreshore reserve area identified as "Urban".

The City of Wanneroo District Planning Scheme No 2 identifies the property as "Residential Development" with the exception of areas identified as "Parks and Recreation" along the western property boundary. A "Commercial" zone is also located close to the western boundary of the lot and "Mixed Use" toward the centre of the property.

2. EXISTING ENVIRONMENT

2.1 Landform & Topography

The property predominantly comprises parabolic and nested parabolic dunes of the Quindalup Dune System, aligned in a general east-west direction, and deflation plains and basins within the central portion of the site (Gozzard, 1982). Elements of the Spearwood Dune system occur along the eastern margin of the lot and in west-east ridges in the western portion of the lot.

The site includes two geomorphic units associated with the Quindalup system and two units of the Spearwood landform (McArthur & Bartle, 1975-76). The second phase of the Quindalup landform (Q2) and a unit with shallow sands overlying limestone and exposed rock outcrops (Qs) are represented at the site. Spearwood Dunes units present on the site include yellow Karrakatta Sands (Ky) and exposed limestone and shallow soils over limestone (Kls). The limestone units are interspersed with the Quindalup Units, occurring close to the western boundary of the site and within the foreshore reserve.

Dune crests within the property characteristically rise to above 40mAHD, with one dunal feature toward the northern boundary of the lot reaching in excess of 55mAHD (Figure 1). Low-lying portions of the property lie at around 15mAHD and occur in the southeastern corner and along the western boundary of the lot. A steep north-south aligned dunal ridge is prominent along the eastern margin of the site. The southern boundary of the lot is delineated by a prominent west-east ridge which represents the southern arm of a parabolic dune feature.

2.2 Geology & Soils

The geology at the property comprises calcareous Safety Bay Sands (S_2) and Tamala Limestone covered by a thin (<0.5m) veneer of calcareous sand (LS_3) (Gozzard, 1982). The eastern margin of the property consists of the sands derived from the Tamala Limestone (S_7) in the south-eastern corner together with minor amounts of limestone (LS_1) in the north-eastern corner.

The Q2 unit displays greater soil development than younger phases of the dunal system occurring within the coastal foreshore. The other Quindalup Dune unit within the site comprises shallow calcareous sand overlying limestone with extensive outcrops (Qs).

The Spearwood units include grey-brown sands over yellow Karrakatta sand, typically with limestone present within two metres of the surface (Ky), and exposed limestone and shallow brown soils over limestone (Kls).

No evidence of karstic features within the property was noted during the site inspection although a detailed assessment has not been undertaken. Karstic landform in this area typically occurs further east, near the interface of the Tamala Limestone and Bassendean Dune system.

2.3 Hydrology

Groundwater beneath the property occurs in several aquifers. The superficial aquifer has a highly permeable and approximately 35m thick. The superficial aquifer overlies the Leederville Formation, which overlies the Yarragadee Formation.

Regional groundwater information indicates estimated maximum groundwater levels lie between 1mAHD and 2mAHD along the eastern margins of the site and below 1mAHD further west (Water & Rivers Commission, 1997). Groundwater flow is generally perpendicular to the coast in a west-south-west direction.

This information, together with the topographical contours for the site, suggests that the watertable is typically more than 20m below the surface across the entire site. Groundwater is expected to be closest and within about 15m of the ground surface in the lowest portions of the site. This corresponds to there being no wetlands mapped on the property (Hill *et al.*, 1996), and none being located on site during the field investigations for this study.

The property lies within a Priority 3 Source Protection Area of the Perth Coastal Underground Water Pollution Control Area (UWPCA) that encompasses coastal land between south of Hillarys to Two Rocks. Impacts need to be minimised within Priority 3 areas because the groundwater is used for water supplies however, these areas are recognised as having land values that are more important than water protection.

2.4 Coastal Stability

Assessment of the coastal processes, stability and required development setback has been previously undertaken for the property (Hames Sharley Australia, 1992; MP Rogers & Associates, 1997 and 1998). These studies considered climatic factors, coastal processes and historical movements of the coastline, and assessed the extent of natural protection against the coastal processes and susceptibility to erosion during storm events and long-term trends.

The coastline fronting Lot 12 consists of a narrow sandy beach backed by limestone cliffs and outcrops. The sandy beach widens in the southern section of the coast at this location. Inshore shallow reefs occur commonly in this section of the coast. The reefs and presence of limestone cliffs and beach rock provides protection from coastal processes and stability of the coastline.

The earlier assessment suggested the coastline fronting Lot 12 has been stable between 1941 and 1987 with a small amount of accretion detected (Hames Sharley Australia, 1992). Shoreline mapping information confirmed the shoreline fronting Lot 12 has remained stable between 1941 and 1997 (MP Rogers & Associates, 1998).

A development setback of 30m from the top of the limestone cliffs or outcrops is considered appropriate to provide protection for the buildings against long-term trends, severe storms and provision for sea level rise (MP Rogers & Associates 1998).

Additional setbacks from the 30m line are usually required to provide for protection of coastal vegetation and to allow for facilities such as carparks and access tracks to be located.

2.5 Flora and Vegetation

Vegetation and flora surveys of Lot 12 were conducted on 25 August 2000 and 7 September 2000. Vehicle access was limited to a few tracks around the perimeter of the site. Therefore, much of the survey was conducted by foot traverse through all of the major landforms and vegetation types as identified using a 1:2000 colour orthophotograph.

The vegetation was described and mapped according to the structure and species composition of the dominant stratum (eg. *Dryandra sessilis* Closed Scrub) using the system of Specht as modified by Aplin (1979).

The survey did not include the foreshore reserve to the west of Lot 12.

2.5.1 Flora

A total of 95 species was recorded on the site (Appendix 1). The total includes one Gymnosperm (*Macrozamia fraseri*, Zamia Palm), 22 Monocotyledons and 72 Dicotyledons. Of the 95 species, 8 (8%) were introduced species.

The dominant plant families represented in the list were the Papilionaceae (Pea family - 10 species), Proteaceae (Banksia family, 7 species), Mimosaceae (Wattles, 7 species), Asteraceae (Daisy family, 6 species, including 2 introduced), and the Cyperaceae (Sedge family, 5 species). The Myrtaceae (Myrtle family) was under-represented in the species list. This is most likely due to the very small area of deep sandy soils of the Spearwood Dune system containing degraded vegetation.

The 95 native species is low compared with most surveys of nearby sites:

⇨	Pt Lot 2 Burns	148 native species	290ha
⇨	Alkimos	187 native species	1070ha
⇨	Eglinton (Ningana)	154 native species	540ha
⇨	Lot 9 Jindalee	109 native species	140ha

This lower species richness for Lot 12 can be explained by the much smaller size of the area (77ha) and predominance of Quindalup dune vegetation which is less species rich than Spearwood dune vegetation.

A search of the Department of Conservation & Land Management's Declared Rare or Priority Flora list (20 December 1999) suggests that 13 species of significance are known to occur in the region. These species are:

- *Eucalyptus argutifolia*
- *Conostephium minus*
- *Acacia benthamii*

- *Conostylis bracteata*
- *Conostylis pauciflora* subsp. *eurythipis*
- *Grevillea elongata*
- *Grevillea evanescens*
- *Jacksonia sericea*
- *Lepidium pseudotasmanicum*
- *Melaleuca* sp. Yanchep
- *Nemcia axillaris*
- *Sarcozona bicarinata*
- *Stachystemon axillaris*

None of these species was recorded in the survey. However, one Priority 3 species, *Hibbertia spicata* subspecies *leptotheca* was recorded at two locations.

Hibbertia spicata subspecies *leptotheca* is a low sprawling shrub to 0.3m high which occurs on near-coastal limestone from Yalgorup National Park through to Lancelin. In the Perth Metropolitan Area this species is known to occur in Yanchep National Park, Neerabup National Park, Burns Beach, Burns Beach - Hilarys, Bold Park and Henderson (Bush Forever). A large population was also recorded by the author of this report in the foreshore reserve immediately north of Mindarie Keys during investigations for this report.

Both populations on Lot 12 were located in limestone heath (*Melaleuca huegelii/Acacia truncata* Low Closed Heath) in the western part of the lot. One population of 13 plants was recorded on the western portion of the central prominent limestone ridge. The second population of 15 plants was recorded a short distance to the north on the northern mid-slope of a small limestone ridge.

Bush Forever (Government of WA, 2000) lists other species of significance which may not be Declared Rare or Priority Flora but may be geographically restricted or endemic to certain areas. *Melaleuca cardiophylla* is listed in Bush Forever as being at the southern limit of its geographic range. This species was found to be abundant on the western limestone ridges of Lot 12 and extending into the Foreshore Reserve.

2.5.2 Vegetation Description

The vegetation types on the property strongly reflect the underlying soils and landforms. The vegetation associations have been identified separately on the vegetation map (Figure 2) but for ease of reference have been grouped into three broad types, ie. vegetation on Quindalup dunes, Spearwood dunes (limestone soils) and Spearwood dunes (sand over limestone soils). The condition of the vegetation has been rated mostly as Excellent using the condition scale applied in Bush Forever, and is shown in Figure 2.

Vegetation on the Quindalup Dune System

MaLm *Melaleuca acerosa/Lomandra maritima* Shrubland

This unit occurs on the upper slopes and crests of the parabolic dune system which extends through the property. This unit is very open and low (up to 0.5m high).

Other common species include *Conostylis candicans, Acacia saligna, Acacia rostellifera, Senecio lautus, Acanthocarpus preissii* and *Lepidosperma angustatum.* This unit is in very good to excellent condition apart from the crest of the dune along the southern boundary which has been disturbed by heavy 4WD vehicle use.

MaAlLm *Melaleuca acerosa/Acacia lasiocarpa/Lomandra maritima* Low Shrubland

This unit is similar to the MaLm unit but occurs closer to the coast on dune slopes and ridges in the northern part of the site. The *Acacia lasiocarpa* shrubs are a dominant feature of the landscape when in full flower in early Spring. Other coastal shrubs such as *Spyridium globulosum, Olearia axillaris* and *Acacia saligna* can also be common in this unit.

MaOaLm

This unit is similar to the MaLm unit but also has *Olearia axillaris*, a common coastal plant, as a dominant species. The unit is located on the upper slopes of Quindalup dunes in the north-west portion of the lot.

SgMaLm *Spyridium globulosum/ Melaleuca acerosa/Lomandra maritima* Heath

This unit is a variation of the MaLm unit and occurs closer to the coast on the lower slopes and valleys in the central part of the site. These areas offer more protection from the coastal winds which allows the vegetation to become denser and taller (up to 1m).

Ac *Acacia cochlearis* Shrubland

Acacia cochlearis is occasionally dominant in an open Shrubland formation on the crests of dunes in the northern and central parts of the site. Other common shrubs include *Melaleuca acerosa, Lomandra maritima* and *Lepidosperma angustatum.*

Xp *Xanthorrhoea preissii* Shrubland

This unit is very common in the lower slopes and valleys of the inland Quindalup dune system. The vegetation is very open with scattered *Xanthorrhoea preissii* shrubs up to 1.5m often with *Acacia saligna* shrubs over a sub-shrub layer dominated by *Leucopogon parviflorus, Melaleuca acerosa* and *Lomandra maritima.*

As *Acacia saligna* High Shrubland

A small pocket of this unit occurs on a small knoll near the centre of the site. *Acacia saligna* shrubs occur up to 2-3m high. Other species include *Spyridium globulosum, Lepidosperma gladiatum* and *Olearia axillaris.*

Sg *Spyridium globulosum* Closed Heath

The valleys and lower slopes of dunes in the south-west corner of the site are dominated by a *Spyridium globulosum* Closed Heath. This vegetation type is dense

and grows up to 1-1.5m high and is associated with *Melaleuca acerosa, Lomandra maritima,* and *Acacia rostellifera.*

OaSgBp *Olearia axillaris/Spyridium globulosum/Brachyloma preissii* Low Heath

This unit occupies a small sandy hilltop between areas of Mc on limestone. The vegetation is only about 0.5m high and fairly open. *Melaleuca acerosa* and *Lomandra maritima* are also common.

BpLm *Brachyloma preissii/Lomandra maritima* Low Shrubland

This unit is located close to the previous OaSgBp unit and in similar in that it occurs on the top of a small sandy hilltop between limestone heath vegetation.

Vegetation on the Spearwood Dune System (limestone soils)

Ds *Dryandra sessilis* Closed Heath

Areas of outcropping limestone occur frequently throughout the site. In the central and eastern parts of the site areas with scattered limestone outcropping in yellow sand are dominated by a dense *Dryandra sessilis* Closed Heath 1-2m high. Other common plants in this unit include *Xanthorrhoea preissii, Desmocladus flexuosus, Jacksonia stricta* and *Dryandra lindleyana.*

DsSg *Dryandra sessilis/Spyridium globulosum* Open to Closed Heath

This Closed Heath association occurs in one small area in the north-west of the site in a swale with outcropping limestone. The vegetation is dense and 1.5-2m high and is intermixed with the Mc association.

MhAt *Melaleuca huegelii/Acacia truncata* Low Closed Heath

This vegetation type occurs in two locations on massive outcropping limestone ridges in the central western portion of the lot. The vegetation is low, 0.5-1.0m, and dense and contains a number of species restricted to Tamala limestone outcrops such as *Templetonia retusa, Thomasia triphylla, Grevillea thelemanniana* and *Hibbertia spicata* subsp. *leptotheca.*

Mc *Melaleuca cardiophylla* Low Closed Heath

This unit occurs on limestone soils on the mid- to upper-slopes in the northwestern portion of the site. The vegetation is very dense and about 0.5-1.0m high. Other shrubs common to this unit include *Dryandra sessilis* and *Spyridium globulosum.*

SgMc *Spyridium globulosum/Melaleuca cardiophylla* Closed Heath

This unit is similar to the previous Mc unit but contains *Spyridium globulosum* as a dominant species. It occurs on lower slopes and valleys in the central western part of the site. The more sheltered location and deeper sand soils allow the vegetation to attain heights up to 2m.

McOa *Melaleuca cardiophylla/Olearia axillaris* Low Closed Heath

This unit occurs in one small location in the central western portion of the site on the lower slopes of an exposed dune adjacent to the foreshore reserve.

Vegetation on the Spearwood Dune System (sand over limestone soils)

BaBm *Banksia attenuata/Banksia menziesii* Low Woodland

The south-east portion of the lot contains a *Banksia* Low Woodland located on deep sands. The *Banksia* trees are 5-6m high over low shrub layer containing *Hibbertia hypericoides, Xanthorrhoea preissii, Acacia pulchella* and *Alexgeorgea nitens* as dominant species. This woodland area is very disturbed and contains abundant weed species such as *Ehrharta calycina, Pelargonium capitatum* and *Poa annua.*

2.5.3 Significance

The vegetation of Lot 12 is mostly typical of near-coastal environments in the North-West Corridor with a mix of Quindalup and Spearwood vegetation types.

In a broad sense the vegetation types belong to the Quindalup Vegetation Complex (Quindalup dunes) and the Cottesloe Central and South Vegetation Complex (Spearwood dunes). According to Bush Forever the vegetation on the site is not considered regionally significant.

Areas that have been recognised as regionally significant with similar vegetation types and transitional areas to those on Lot 12 are the Burns Beach to Neerabup National Park area (Bush Forever Site 322, 323 and 383) and the Eglinton to Yanchep National Park area (Bush Forever Site 289).

The vegetation associations listed can also be described at a finer level according to their floristic composition (Gibson *et al.*, 1994). According to this system the following floristic community types occur on the property:

Type 24 - Northern Spearwood shrublands and woodlands
Type 26a - *Melaleuca huegelii - M.acerosa* shrublands of limestone ridges
Type 28 - Spearwood *B.attenuata* or *B.menziesii-Eucalyptus* woodlands
Type 29a - Coastal shrublands on shallow sands
Type S11 - Northern *Acacia rostellifera - Melaleuca acerosa* shrublands

None of these floristic community types is listed as a Threatened Ecological Community (English and Blyth, 1997) or is on the Commonwealth Endangered Community List.

The occurrence of limestone vegetation types containing *Melaleuca cardiophylla* and *Melaleuca huegelii* is not common in the Perth Metropolitan Area. However, similar vegetation is located in the Foreshore Reserve to the west of Lot 12 and is also reserved in the Foreshore Reserve between Yanchep and Two Rocks, Burns Beach Reserve and Beaumaris Beach.

2.6 Fauna

Fauna habitats on the site were assessed during an inspection of the property and a nearby coastal site to the north with similar habitats in late August 2000 and April 2001. Opportunistic observations or records of fauna during the site visit to both properties were noted. For a full account of the fauna report see ATA Environmental (2001).

The property broadly offers several habitats for fauna dominated by heath and scrub associated with limestone soils or outcrops, and shrublands and heath on coastal sands. A small area of highly modified *Banksia* woodland occurs in the southeastern section of the property, and a small stand of Tuarts is located in low point toward southern boundary of the property. The majority of the vegetation and habitats on site are in good condition with only limited evidence of localised disturbance. Locations adjacent to access tracks throughout the site and the *Banksia* woodland area showed the greatest signs of disturbance with substantial structural changes and weed infestation.

At present the property forms a portion of an extensive area of coastal land from Quinns Rocks to Yanchep and extending inland as far as the proposed extension to Mitchell Freeway. The size and contiguous and relatively undisturbed nature of the vegetation within this area suggests the fauna assemblage is likely to include species that often do not survive in highly fragmented and disturbed areas or within urban development.

A total 36 species were recorded, including evidence of species, during the inspections of Lot 12 in August 2000 and April 2001. This comprises 5 reptiles, 28 birds and 3 mammals. A list of the species recorded is presented in Appendix 2. Field investigations of coastal property nearby identified another 4 reptiles, 10 birds and 5 mammals in the area that could utilise similar habitats within Lot 12.

The Western Grey Kangaroo (*Macropus fuliginosus*) was observed and diggings consistent with those of the Southern Brown Bandicoot (*Isoodon obesulus fuscivetner*) and Short-beaked Echidna (*Tachyglossus aculeatus*) were detected within a nearby costal property and also could occur on Lot 12. Thirty bird species, including the Schedule 1 Short-billed Black-Cockatoo (*Calypthorhynchus latirostris*), were identified within the habitats of the properties assessed, all of which are typical of the habitats available and consistent with regional distributions. Two reptiles, the Bardick (*Echiopsis curta*) and South-western Crevice Egernia (*Egernia napoleonis*) were located with eastern portion of a nearby property in areas of *Banksia* woodland and both are likely to occur on Lot 12.

The site is also expected to be frequented and/or inhabited by foxes, domestic dogs, cats, rabbits and introduced mice. All of these animals have the capacity to affect native fauna populations at the site through disturbance, modification of habitat and/or predation.

Surveys of property at Burns Beach (Alan Tingay & Associates, 1999) and the coastal land between Alkimos and Eglinton (Alan Tingay & Associates, 1997) together with regional fauna distribution information suggests around 130 species of vertebrate

fauna could be expected to utilise habitats within the site. This includes 3 amphibians, over 41 reptiles, more than 72 birds and at least 14 native mammals. The assemblage occurring at the site however, is highly unlikely to consist of this entire suite of species. Many of the species may use the site only on a seasonal, periodic or opportunistic basis.

A search of the Department of Conservation and Land Management's database reveals three species specifically protected under provisions of the *Wildlife Conservation Act 1950*, and one species of Priority fauna are known to occur in the region. These are:

- Schedule 1
  Short-billed Black-Cockatoo (*Calyptorhynchus latirostris*)

- Schedule 4
  Peregrine Falcon (*Falco peregrinus*)
  Carpet Python (*Morelia spilota imbricata*)

- Priority 4
  Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)

The Short-billed Black-Cockatoo does not breed in the region but is noted as seasonal visitor. This species will occur predominantly within areas of the property by supporting *Banksia* and *Dryandra* species that provide suitable feeding resources primarily during the summer and autumn months.

The Peregrine Falcon is an infrequent visitor to the region and is likely to make only transient use of habitats within the property. Coastal heath and shrubland dominate the property with only small areas of woodland or emergent trees, and therefore limited opportunities for perching in comparison with locations east of the Marmion Avenue road reserve.

According to CALM's records, the Carpet Python occurs within coastal heath communities to the north-east and south of the Jindalee area. If present, this species is most likely to occur in association with limestone outcrops or near the Tuarts on the property that may provide the necessary refuge.

The Southern Brown Bandicoot is known to continue to occur within coastal heath vegetation at locations south of the property. This species is likely to be present within habitats that provide low dense cover and protection from predation, including areas of heath and shrubland throughout the property and within the foreshore reserve.

Recent fauna surveys of coastal properties at Burns and Alkimos-Eglinton the Western Brush Wallaby (*Macropus irma*) (Priority 4) may occur in the area. This species is more likely to occur in woodland east of the site such as within Neerabup National Park, but may occasionally venture onto eastern portions of the property.

2.7 Aboriginal Heritage

A search of the Aboriginal Site Register maintained by the Aboriginal Affairs Department revealed no recorded site occurs within the vicinity of the lot.

3. ENVIRONMENTAL ISSUES

3.1 Coastal Setback

The existing Foreshore Reserve varies in width between about 160m in the north and 100m in the south. This section of coast has been relatively stable with some evidence of minor accretion between 1941 and 1987 (Hames Sharley Australia, 1992). The coast fronting the property is protected by rocky cliffs in the north and is sandy along the southern section, although beach rock is common and limestone is close the coast along the entire length.

Previous coastal planning reports indicate the beach fronting Lot 12 is considered to a "regional" scale beach in the northern section and a "local" beach to the south (Hames Sharley Australia, 1992). A suitable location for a major recreational node has been identified in a large depression in the north to accommodate parking, picnic areas, shade trees, grassed areas, toilets and a kiosk. The southern portion of the foreshore was considered appropriate for a low level of activity and recreational use. The existing coastal reserve width was considered adequate.

Based on the coastal engineering assessment the existing foreshore reserve is adequate for the protection of the development from coastal processes. The foreshore reserve management should be addressed through the preparation of a Foreshore Management Plan as a condition of subdivision approval for the site.

3.2 Remnant Vegetation

The property supports native vegetation typical of the Quindalup and Spearwood Dune systems generally in excellent condition. The vegetation is not considered to be of regional significance according to the criteria used in Bush Forever. In addition, none of the individual vegetation types is listed as a threatened community.

Significant areas of nature reserve occur in the general vicinity of the property. Neerabup National Park is located within 4km east of the property and Yanchep National Park is situated within 10km to the north of the lot. Furthermore, the existing foreshore that forms the western boundary of the property provides a north-south corridor approximately 100-160m wide.

Areas of vegetation on Lot 12 may be suitable for retention within Public Open Space. However, the amount of native vegetation able to be retained in POS will be limited due to the requirement for earthworks on the site. Therefore the areas able to be retained will most likely be small pockets of bushland in the central northern POS area and in the southwestern POS area that abuts the foreshore reserve. Although these parcels will have limited environmental value they, nevertheless, will be of some benefit to native fauna.

3.3 Priority Flora

The two small populations of the Priority 3 species, *Hibbertia spicata* subspecies *leptotheca*, are located on elevated limestone ridges on the western portion of the site. While retention of these populations is a desirable objective, in this instance it is not feasible due to their elevated locations which will be required to be earthworked to create a fully serviced residential development that complies with engineering standards.

There is no statutory requirement to protect Priority species and it is noted that in the Perth Metropolitan Area this species is known to occur in secure reserves at Yanchep National Park, Neerabup National Park, Burns Beach Reserve, Bold Park and Henderson and Mindarie Keys Foreshore Reserve. The Mindarie Keys population itself is a particularly large population.

Nevertheless, in recognition of the Priority 3 classification the owners of Lot 12 have embarked on an alternative strategy of management by propagation and transplanting.

A horticultural specialist Mr Les Harry from Carramar Nursery who is proficient in the propagation of coastal plants including *Hibbertia* species, visited one of the populations on 20 August 2001. Four plants were excavated from the site and potted into plastic containers. Despite the species' preference for limestone outcrops, the plants were easily removed with the fine roots forming a small dense clump in the brown loamy sand that exists between the areas of outcropping limestone.

Sufficient plant material was cut from the plants on site to allow the propagation of approximately 300 stem cuttings. The cuttings were dipped in a rooting hormone and potted out into coarse river sand and placed in the shade house and mist tent at Carramar Nursery.

At the time of writing this report the results from the cuttings and transplanting experiments were encouraging (Plate 1). The final results of the cutting and transplant exercise will determine the most suitable strategy for managing this species.

It is envisaged that the propagated plants will be used for rehabilitation in suitable areas within the foreshore reserve fronting Lot 12. The species is also considered to be a suitable plant for landscaping within areas of Public Open Space.

3.4 Fauna Habitat

From a regional perspective Neerabup and Yanchep National Parks together with the coastal foreshore reserve will maintain fauna habitat and provide north-south linkages. Environmental east-west regional corridors are proposed from the coast at Burns Beach extending to connect with Neerabup National Park, and from the coast at Eglinton to Yanchep National Park.

In a local sense, fauna habitat is usually included within areas of POS. While woodlands often support a higher diversity of fauna than the other coastal habitats these areas are very limited or are in poor condition within Lot 12.

Retention of some of the shrubland and heath will maintain habitat for a variety of fauna. In this regard an area of POS is identified in the southwestern corner of the property which would connect with an existing area of POS within Quinns Beach Estate. A second area of POS in the central northern part of the property will be able to retain some *Dryandra* heath vegetation that would seasonally support a variety of nectar feeding birds such as honeyeaters, and provide feeding resources for the Short-billed Black-Cockatoo.

4. CONCLUSION

Lot 12 Marmion Avenue, Jindalee, presently supports native vegetation and fauna habitats that are mostly in excellent condition. The vegetation and habitats are mostly considered typical of near coastal areas within the region and landforms present within the site.

The vegetation on the property is not considered regionally significant bushland according to the criteria used in Bush Forever. No Threatened Ecological Communities occur on the site.

One Priority Flora species, *Hibbertia spicata* subsp. *leptotheca*, occurs in two small populations on the property. The two populations totalling 28 plants are not able to be protected within public open space due to their elevated positions and extent of earthworking required for the development. An alternative strategy of propagating plants from cuttings and by transplanting has commenced and the results are presently encouraging.

The site is not identified as an important corridor or environmental linkage, and is zoned for residential development under the MRS and DPS. Existing and proposed areas of Regional Open Space including nearby National Parks will provide long-term wildlife linkage from the coast to habitat inland of the property and between locations to the north and south of the Jindalee site.

Potential environmental impacts of the proposed future development of the property can be minimised by implementing management measures to protect natural features of the site. This includes preservation of some areas of vegetation, habitat and landform within the context of urban development and implementation of a management strategy for protecting the Priority flora species on the site.

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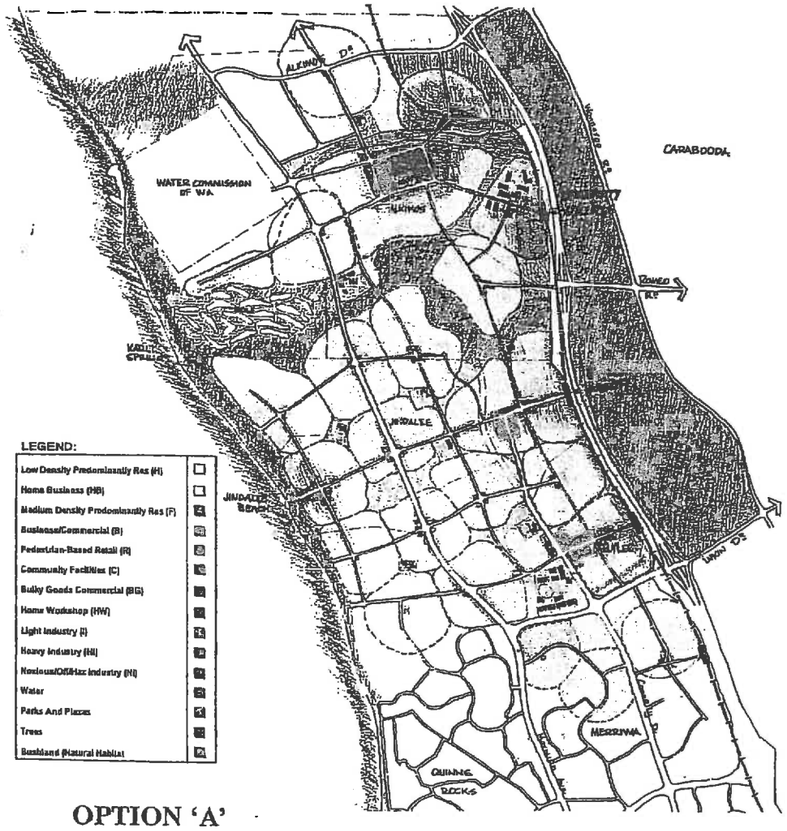
FIGURES



LEGEND:

Low Density Predominantly Res (H)	
Home Business (HB)	
Medium Density Predominantly Res (F)	
Business/Commercial (B)	
Pedestrian-Based Retail (R)	
Community Facilities (C)	
Bulky Goods Commercial (BG)	
Home Workshop (HW)	
Light Industry (I)	
Heavy Industry (HI)	
Noxious/Offensive Industry (NI)	
Water	
Parks And Places	
Trees	
Bushland (Natural Habitat	

OPTION 'A'
SUB - REGIONAL PLAN
WA COMMUNITY CODE

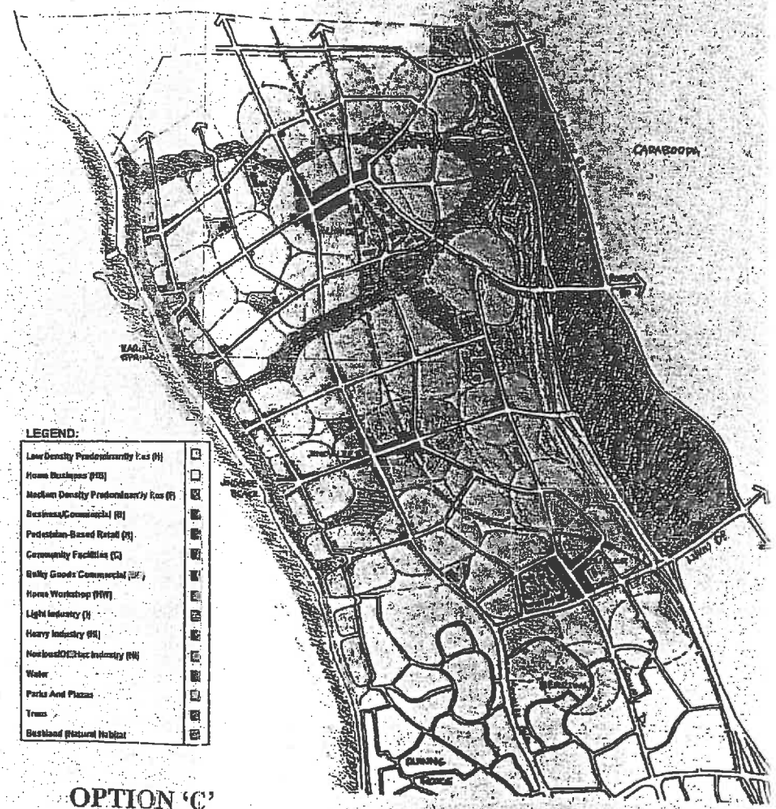
0 500 1000 1500 2000 N

LEGEND:

Low Density Predominantly Res (H)	
Home Business (HB)	
Medium Density Predominantly Res (F)	
Business/Commercial (B)	
Pedestrian-Based Retail (R)	
Community Facilities (C)	
Bulky Goods Commercial (BG)	
Home Workshop (HW)	
Light Industry (I)	
Heavy Industry (HI)	
Noxious/Offensive Industry (NI)	
Water	
Parks And Places	
Trees	
Bushland (Natural Habitat	

OPTION 'B'
SUB - REGIONAL PLAN
WA COMMUNITY CODE

0 500 1000 1500 2000 N



LEGEND:

Low Density Predominantly Res (H)	
Home Business (HB)	
Medium Density Predominantly Res (F)	
Business/Commercial (B)	
Pedestrian-Based Retail (R)	
Community Facilities (C)	
Bulky Goods Commercial (BG)	
Home Workshop (HW)	
Light Industry (I)	
Heavy Industry (HI)	
Noxious/Offensive Industry (NI)	
Water	
Parks And Places	
Trees	
Bushland (Natural Habitat	

OPTION 'C'
SUB - REGIONAL PLAN
WA COMMUNITY CODE

0 500 1000 1500 2000 N

SOURCE : WESTERN AUSTRALIAN PLANNING COMMISSION

JINDALEE -ENQUIRY BY DESIGN - SUB REGIONAL PLANNING OUTCOME
FIGURE

Appendix C

ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/BRIGHTON

i. North- South Roads

Table 1 shows that the combined capacity for Marmion Avenue and Connolly Drive is approximately 70,000 veh/day. The Mitchell Freeway would add further capacity of approximately 60,000 or 90,000 veh/day when constructed to 4 lanes or 6 lanes, respectively.

Table 1 ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/ BRIGHTON (NORTH-SOUTH ROADS)

Road	Lanes and Road Reserve	Ultimate Potential Traffic Capacity (veh/day)
Connolly Drive	4 lane divided with frontage road / 60 metres.	35,000
Marmion Avenue	4 lane divided with frontage road / 60 metres	35,000
Freeway	4-lane / 6-lane	60,000 - 96,000
Total at Screen Line		130,000 - 166,000

Source: Brighton Local Structure Plan: Traffic and Movement Network, ERM July 2000

Traffic demand estimates at year 2016, year 2021 and year 2036 are given in *Tables 2, 3* and *4*.

Table 2 YEAR 2016 TRAFFIC DEMAND FORECAST – (FREEWAY CONSTRUCTED TO HESTER AVENUE ONLY)

Road	Ultimate Traffic Demand Estimates (Year 2016) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway to Hester Avenue	N/A
Connolly Drive	15,000-16,000
Marmion Avenue	33,000
Total at Screen Line	**+- 49,000**

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz 1998).

Table 2 shows that Connolly Drive and Marmion Avenue can cater for traffic demand to year 2016 without the Mitchell Freeway (ie. 49,000 veh/day is less than the 70,000 veh/day capacity of Marmion Avenue and Connolly Drive).

Table 3 YEAR 2021 TRAFFIC DEMAND FORECAST – (FREEWAY CONSTRUCTED TO YANCHEP BEACH ROAD)

Road	Ultimate Traffic Demand Estimates (Year 2021) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway to Yanchep	60,000
Connolly Drive	8,000-13,000
Marmion Avenue	18,000
Total at Screen Line	**+- 90,000**

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz, 1998).

At year 2021, the total screen line demand is 90,000 veh/day (refer to *Table 3*). This total is larger than the 70,000-veh/day capacity of Connolly Drive and Marmion Avenue. For Marmion Avenue and Connolly Drive to be maintained as 4-lane divided arterial roads, the Mitchell Freeway would need to be constructed through the study area by year 2021. Note that the forecast traffic volumes on Marmion Avenue drop from 33,000 veh/day (Year 2016) to below 20,000 veh/day (Year 2021) when the freeway is included in the network in the northern part of the study area.

Table 4 ULTIMATE TRAFFIC DEMAND FORECAST (Year 2036)– (FREEWAY CONSTRUCTED TO BEYOND YANCHEP BEACH ROAD)

Road	Ultimate Traffic Demand Estimates (Year 2036 estimated date) Sinclair Knight Merz (Between Romeo Road and Lukin Drive)
Freeway (6-lanes)	96,000
Connolly Drive	15,500
Marmion Avenue	28,500
Total at Cordon	+- 140,000

Source (Transportation Staging Report for Alkimos Eglinton", Sinclair Knight Merz, 1998).

Table 4 shows that when the freeway is constructed to an ultimate 6-lane design standard, the traffic demand on Marmion Avenue is less than 30,000 veh/day.

ii. E-W Road Reservations And Capacity Potential

Table 5 ROAD TYPE AND CAPACITY IN NW CORRIDOR AT JINDALEE/ BRIGHTON (EAST-WEST ROADS)

Road	Lanes and Road Reserve Width	Capacity (veh/day)
Lukin (E-W 1)	4 lane divided with frontage road/ 60 metres	30,000-35,000
E-W 2: ❑ Station to half diamond interchange at Freeway**	4 lane divided road in 32-42 metre reserve*	25,000-30,000*
❑ Marmion Avenue to Brighton North Rail Station	Integrator Arterial 'B' with Commercial frontage in 27-32 meter reserve*	12,000- 20,000*
❑ Regional Beach to Marmion Avenue	2 Lane Divided Neighbourhood Connector in 25 metre Reserve	7000
Romeo Road	4 lane divided assumed	25,000-30,000 assumed

Source: Brighton Local Structure Plan: Traffic and Movement Network, ERM July 2000

* *Preliminary indication only.*

** *Half-diamond interchange is a possibility only and has not been confirmed in any regional planning studies.*

Table 5 provides a preliminary indication of the major east-west links in the Jindalee/ Brighton road network. Lukin Drive and Romeo Road will have full access, grade-separated interchanges with the Mitchell Freeway and are thus the most important of the east-west roads. It is expected that these will be 4-lane divided roads capable of carrying approximately 30,000- 35,000 veh/day. E-W2 is the name given to the link between the Brighton North Rail station and the Jindalee regional beach. As a result of the different environments and the different traffic levels, three distinct cross-sections are likely along this road:

- Eastern Section: - 4-lane divided arterial connecting to the Mitchell Freeway at a half-diamond interchange. Mixed business frontage is anticipated. The proposed interchange is a possibility identified at the Jindalee Enquiry by Design Workshop and has no official status.

- Middle Section: - District Centre Main Street in between the Brighton North Rail Station/ Connolly Drive and Marmion Avenue. Retail/ mixed business uses are anticipated.

- Western Section: - 2-lane divided Neighbourhood Connector west of Marmion Avenue with predominantly residential frontage. A mixed business neighbourhood centre is to be located on the west side of Marmion Avenue and a regional beach mixed use centre located at the coast.

Appendix D

AUGUST 2001 ENQUIRY BY DESIGN WORKSHOP : DRAFT PLANS

SUB REGIONAL PLAN - DRAFT OUTCOME ONLY

SOURCE: BUTLER ENQUIRY BY DESIGN

FIGURE 4

DISTRICT STRUCTURE PLAN - DRAFT OUTCOME ONLY

IRCE: BUTLER ENQUIRY BY DESIGN

FIGURE 5

APPENDIX 5

ENVIRONMENTAL ASSESSMENT APPENDICES

APPENDIX

FLORA LIST

LOT 12 JINDALEE FLORA LIST

GYMNOSPERMS

CYCADACEAE
Macrozamia fraseri

MONOCOTYLEDONS

ANTHERICACEAE
Sowerbaea laxiflora

CYPERACEAE
Isolepis nodosa
Lepidosperma angustatum
Lepidosperma leptostachyum
Mesomelaena pseudostygia
Schoenus grandiflorus

DASYPOGONACEAE
Lomandra maritima

HAEMODORACEAE
Conostylis aculeata
Conostylis pauciflora

IRIDACEAE
*Romulea rosea

ORCHIDACEAE
Caladenia flava
Caladenia latifolia

PHORMIACEAE
Dianella divaricata

POACEAE
*Ehrharta calycina
*Poa annua

RESTIONACEAE
Alexgeorgea nitens
Desmocladus flexuosa
Lyginia barbata

XANTHORRHOEACEAE
Xanthorrhoea preissii

DICOTYLEDONS

AIZOACEAE
*Carpobrotus edulis
Carpobrotus virescens

ASTERACEAE
*Hypochoeris glabra
Lagenifera huegelii
Olearia axillaris
Olearia rudis
Senecio lautus ssp dissectifolius
*Ursinia antlemoides

APIACEAE
Trachymene pilosa

APOCYNACEAE
Alyxia buxifolia

CASUARINACEAE
Allocasuarina humilis

CHENOPODIACEAE
Rhagodia baccata

DILLENIACEAE
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia spicata ssp leptotheca

DROSERACEAE
Drosera menziesii

EPACRIDACEAE
Brachyloma preissii
Leucopogon parviflorus

EUPHORBIACEAE
Phyllanthus calycinus

GERANIACEAE
*Geranium molle
Pelargonium capitatum

GOODENIACEAE
Scaevola nitida

LAMIACEAE
Hemiandra pungens

LAURACEAE
Cassytha racemosa

LORANTHACEAE
Nuytsia floribunda

MIMOSACEAE
Acacia saligna
Acacia pulchella
Acacia cochlearis
Acacia cyclops
Acacia rostellifera
Acacia lasiocarpa var. lasiocarpa
Acacia truncata

MYOPORACEAE
Eremophila glabra

MYRTACEAE
Melaleuca acerosa
Eucalyptus gomphocephala
Melaleuca cardiophylla
Melaleuca heugelii ssp. huegelii

PAPILIONACEAE
Daviesia triflora
Hardenbergia comptoniana
Kennedia prostrata
Isotropis cuneifolia
Jacksonia ? stricta
Jacksonia retusa
Jacksonia sternbergiana
Nemcia reticulata
Gompholobium tomentosum
Hovea trisperma

PRIMULACEAE
*Angallis arvensis

PROTEACEAE
Dryandra sessilis
Dryandra lindleyana
Petrophile serruriae
Hakea prostrata
Banksia attenuata
Banksia menziesii
Grevillea thelemanniana ssp.preissii

APPENDIX

LIST OF FAUNA RECORDED AUGUST 2000

APPENDIX 1
LIST OF FAUNA SPECIES

Legend:

X: Species recorded during field visits by ATA Environmental and Bamford Consulting Ecologists on 2 March 1992, 25 August 2000 and 10 April 2001 to Lot 9 Marmion Avenue and other coastal properties in Jindalee.

+: Species expected to occur.

Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
AMPHIBIANS			
MYOBATRACHIDAE			
Heleioporus eyrei	Moaning Frog	+	
Limnodynastes dorsalis	Western Banjo Frog/Pobblebonk	+	
Myobatrachus gouldii	Turtle Frog	+	
REPTILES			
GEKKONIDAE			
Diplodactylus alboguttatus	White-spotted Ground Gecko	+	
Diplodactylus polyophthalmus	Speckled Stone Gecko	+	
Strophurus spinigerus	South-western Spiny-tailed Gecko	+	
Phyllodactylus marmoratus	Marbled Gecko	+	
Underwoodisaurus milii	Barking Gecko	+	
PYGOPODIDAE			
Aclys concinna	Javelin Legless Lizard	+	
Aprasia repens	South-western Sandplain Worm Lizard	+	
Delma fraseri	Fraser's Legless Lizard	X	X
Delma grayii	Gray's Legless Lizard	+	
Lialis burtonis	Burton's Legless Lizard	X	X
Pletholax gracilis	Keeled Legless Lizard	+	
Pygopus lepidopodus	Common Scaly Foot	+	
AGAMIDAE			
Pogona minor	Western Bearded Dragon	+	
Tympanocryptis adelaidensis	Western Heath Dragon	+	
VARANIDAE			
Varanus gouldii	Gould's Monitor	+	
Varanus tristis	Black-tailed Monitor	+	
SCINCIDAE			
Cryptoblepharus plagiocephalus	Snake-eyed, Fence or Sun Skink	+	
Ctenotus australis	Western Limestone Ctenotus	+	
Ctenotus fallens	West Coast Ctenotus	+	
Ctenotus impar	South-western Odd-striped Ctenotus	+	

Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
Cyclodomorphus celatus	Western Slender Bluetongue	+	X
Egernia kingii	King's Skink	+	
Egernia napoleonis	South-western Crevice Egernia	X	X
Hemiergis quadrilineata	Two-toed Earless Skink	X	X
Lerista elegans	West coast Four-toed Lerista	X	X
Lerista lineopunctulata	West Coast Line-spotted Lerista	+	
Lerista praepedita	Western Worm Lerista	+	
Menetia greyii	Common Dwarf Skink	+	
Morethia lineoocellata	Western Pale-flecked Morethia	+	
Morethia obscura	Southern Pale-flecked Morethia	X	X
Tiliqua occipitalis	Western Bluetongue	+	
Tiliqua rugosa	Bobtail	X	X
TYPHLOPIDAE			
Ramphotyphlops australis	Southern Blind Snake	+	
BOIDAE			
Morelia spilota	Southern Carpet Python	+	
ELAPIDAE			
Demansia psammophis	Reticulated Whip Snake	+	
Echiopsis curta	Bardick	X	X
Neelaps bimaculatus	Black-naped Snake	+	
Neelaps calonotus	Black-striped Snake	+	
Notechis scutatus	Western Tiger Snake	+	
Pseudonaja affinis	Dugite	+	
Suta gouldii	Gould's Hooded Snake	+	
Simoselaps bertholdi	Jan's Banded Snake	+	
Simoselaps fasciolatus	Narrow-banded Snake	+	
Simoselaps semifasciatus	Southern Half-girdled Snake	+	
BIRDS			
CASUARIIDAE			
Dromaius novaehollandiae	Emu	X	X
PHASIANIDAE			
Coturnix pectoralis	Stubble Quail	+	
ACCIPITRIDAE			
Elanus axillaris	Black-shouldered Kite	X	X
Lophoictinia isura	Square-tailed Kite	+	
Accipiter fasciatus	Brown Goshawk	+	
Accipiter cirrhocephalus	Collared Sparrowhawk	+	
Aquila audax	Wedge-tailed Eagle	+	
Hieraaetus morphnoides	Little Eagle	+	X
FALCONIDAE			

Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
Falco berigora	Brown Falcon	+	
Falco longipennis	Australian Hobby	+	
Falco peregrinus	Peregrine Falcon	+	
Falco cenchroides	Nankeen Kestrel	X	X
TUNRICIDAE			
Turnix varia	Painted Button-quail	+	
CHARADRIIDAE			
Vanellus tricolor	Banded Lapwing	+	
COLUMBIDAE			
Columba livia	Rock Dove	+	
Streptopelia senegalensis	Laughing Turtle-Dove	X	X
Streptopelia chinensis	Spotted Turtle-Dove	+	
Phaps chalcoptera	Common Bronzewing	X	X
Ocyphaps lophotes	Crested Pigeon	+	
CACATUIDAE			
Calyptorhynchus latirostris	Short-billed Black Cockatoo	X	X
Cacatua roseicapilla	Galah	X	X
PSITTACIDAE			
Trichoglossus haematodus	Rainbow Lorikeet	+	
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	+	
Barnardius zonarius	Australian Ringneck	+	
Purpureicephalus spurius	Red-capped Parrot	+	
Neophema elegans	Elegant Parrot	+	
Neophema petrophila	Rock Parrot	+	
CUCULIDAE			
Cuculus pallidus	Pallid Cuckoo	+	
Cacomantis flabelliformis	Fan-tailed Cuckoo	+	
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	+	
Chrysococcyx lucidus	Shining Bronze-Cuckoo	+	
STRIGIDAE			
Ninox novaeseelandiae	Southern Boobook	+	
TYTONIDAE			
Tyto alba	Barn Owl	+	
PODARGIDAE			
Podargus strigoides	Tawny Frogmouth	X	X
APODIDAE			
Apus pacificus	Fork-tailed Swift	+	
HALCYONIDAE			

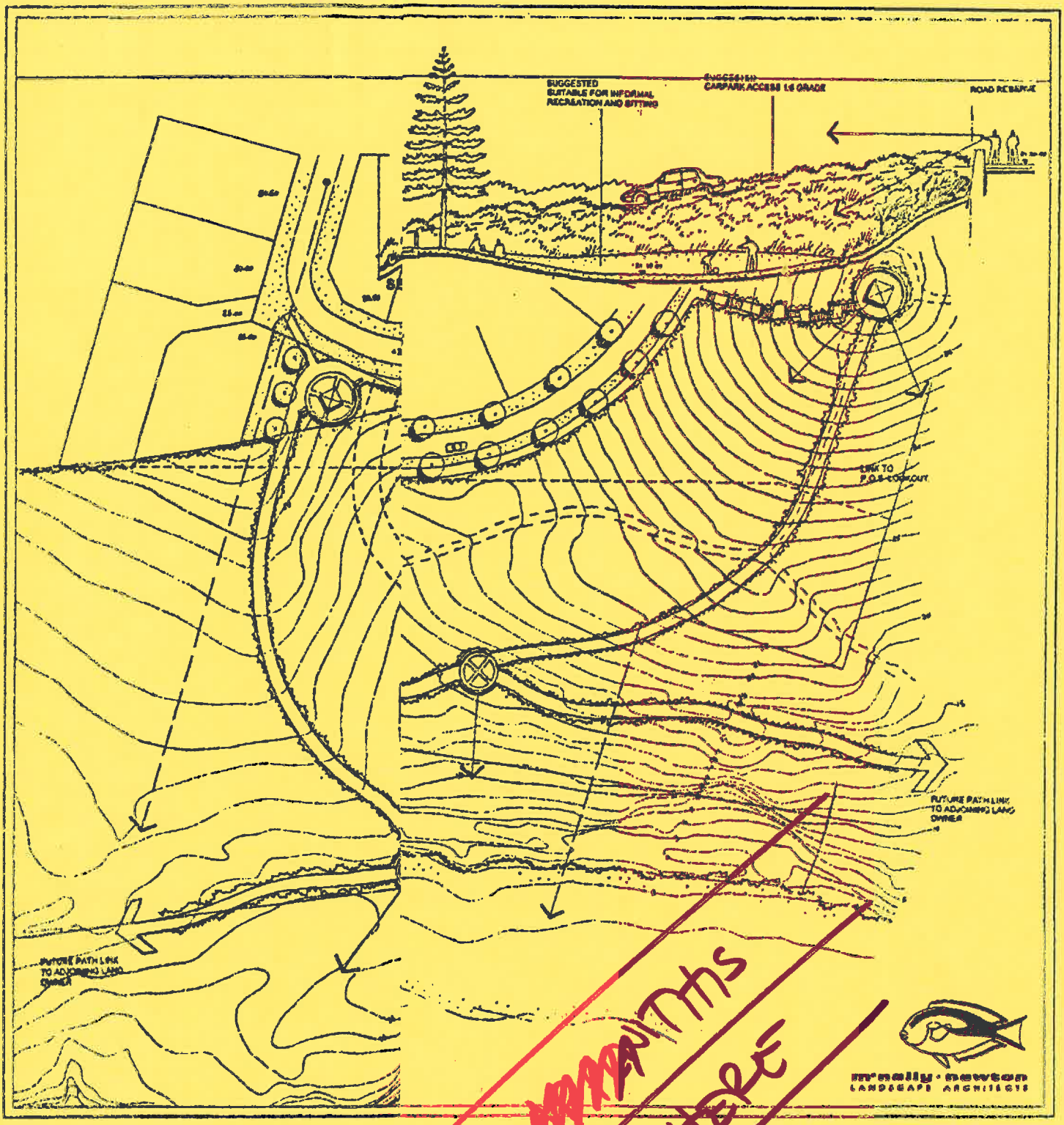
Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
Dacelo novaeguineae	Laughing Kookaburra	+	
Todiramphus sanctus	Sacred Kingfisher	+	
MEROPIDAE			
Merops ornatus	Rainbow Bee-eater	+	
MALURIDAE			
Malurus splendens	Splendid Fairy-wren	X	X
Malurus lamberti	Variegated Wren	X	X
Malurus leucopterus	White-winged Wren	X	X
Stipiturus malachurus	Southern Emu-wren	+	
ACANTHIZIDAE			
Sericornis frontalis	White-browed Scrubwren	X	X
Calamanthus campestris	Rufous Fieldwren	+	
Gerygone fusca	Western Gerygone	X	X
Acanthiza apicalis	Inland Thornbill	X	X
Acanthiza inornata	Western Thornbill	+	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	+	X
MELIPHAGIDAE			
Anthochaera carunculata	Red Wattlebird	X	X
Anthochaera chrysoptera	Little Wattlebird	X	X
Manorina flavigula	Yellow-throated miner	+	
Lichenostomus virescens	Singing Honeyeater	X	X
Melithreptus brevirostris	Brown-headed Honeyeater	+	
Lichmera indistincta	Brown Honeyeater	X	X
Phylidonyris novaehollandiae	New Holland Honeyeater	X	X
Phylidonyris nigra	White-cheeked Honeyeater	X	X
Phylidonyris melanops	Tawny-crowned Honeyeater	X	X
Acanthorhynchus superciliosus	Western Spinebill	+	
Epthianura albifrons	White-fronted Chat	+	
PETROICIDAE			
Petroica multicolor	Scarlet Robin	X	X
Petroica goodenovii	Red-capped Robin	+	
Melanodryas cucullata	Hooded Robin	+	
Eopsaltria georgiana	White-breasted Robin	+	
NEOSITTIDAE			
Daphoenositta chrysoptera	Varied Sitella	+	
PACHYCEPHALIDAE			
Oreoica gutturalis	Crested Bellbird	+	
Pachycephala rufiventris	Rufous Whistler	X	X
Colluricincla harmonica	Grey Shrike-thrush	X	X
DICRURIDAE			
Grallina cyanoleuca	Magpie-Lark	X	X
Rhipidura fuliginosa	Grey Fantail	X	X

Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
Rhipidura leucophrys	Willie Wagtail	X	X
CAMPEPHAGIDAE			
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	X	X
Lalage sueurii	White-winged Triller	+	
ARTAMIDAE			
Artamus cinereus	Black-faced Woodswallow	X	X
Artamus cyanopterus	Dusky Woodswallow	+	X
Cracticus torquatus	Grey Butcherbird	X	X
Gymnorhina tibicen	Australian Magpie	X	X
CORVIDAE			
Corvus coronoides	Australian Raven	X	X
MOTACILLIDAE			
Anthus novaeseelandiae	Richard's Pipit	X	X
DICAEIDAE			
Dicaeum hirundinaceum	Mistletoebird	+	
HIRUNDINIDAE			
Cheramoeca leucosternus	White-backed swallow	X	X
Hirundo neoxena	Welcome Swallow	+	
Hirundo nigricans	Tree Martin	+	X
Hirundo ariel	Fairy Martin		
ZOSTEROPIDAE			
Zosterops lateralis	Silvereye	X	X
MAMMALS			
TACHYGLOSSIDAE			
Tachyglossus aculeatus	Short-beaked Echidna	X	X
PERAMELIDAE			
Isoodon obesulus	Southern Brown Bandicoot	X	X
TARSIPEDIDAE			
Tarsipes rostratus	Honey Possum	+	
MACROPODIDAE			
Macropus fuliginosus	Western Grey Kangaroo	X	X
Macropus irma	Western Brush Wallaby	+	
MOLOSSIDAE			
Mormopterus planiceps	Southern Freetail-bat	+	
Nyctinomus australis	White-striped Freetail-bat	+	
VESPERTILIONIDAE			

Scientific Name	Common Name	Lot 9 Jindalee	Jindalee Area
Nyctophilus geoffroyi	Lesser Long-eared Bat	+	
Nyctophilus gouldi	Gould's Long-eared Bat	+	
Nyctophilus timoriensis	Greater Long-eared Bat	+	
Chalinolobus gouldii	Gould's Wattled Bat	+	
Chalinolobus morio	Chocolate Wattled Bat	+	
Vespadelus regulus	Southern Forest Bat	+	
MURIDAE			
Mus musculus	House Mouse	X	X
Rattus fuscipes	Bush Rat	+	
Rattus rattus	Black Rat	+	
CANIDAE			
Vulpes vulpes	Fox	X	X
Canis familiaris	Dog	X	X
FELIDAE			
Felis catus	Cat	+	
LEPORIDAE			
Oryctolagus cuniculus	Rabbit	X	X
BOVIDAE			
Bos taurus	Cow	X	X

APPENDIX 6

FORESHORE LANDSCAPE CONCEPT



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ATTACH MARMION PLAN HERE

ATA Environmental
environmental scientists

LOT 12 MARMION AVENUE, JINDALEE
FORESHORE MANAGEMENT PLAN

FORESHORE LANSCAPE CONCEPT

FIGURE 5