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**PROPOSED REALIGNMENT OF THE
WEST COAST HIGHWAY, CITY BEACH
PUBLIC ENVIRONMENTAL REVIEW**

for
City of Perth

Dames & Moore Job No. 15345-003-071

January 1992

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Public Environmental Review (PER) has been prepared in accordance with Western Australia Government procedures. The PER proposes the Realignment of the West Coast Highway, City Beach. The report will be available for comment until 1 May 1992.

Following receipt of comments from government agencies and the public, the EPA will prepare an assessment report with recommendations to government, taking into account issues raised in public submissions.

Why Write a Submission ?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless confidentiality is requested, and may be quoted either in full or in part in each report.

Why Not Join a Group ?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a Submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to Keep in Mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

YOUR NAME
ADDRESS
DATE

The closing date for submissions is 1 May 1992.

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
38 Mounts Bay Road
PERTH WA 6000

Attention: Mr Nicholas Wimbush

EXECUTIVE SUMMARY

DESCRIPTION OF PROPOSAL

The section of West Coast Highway between Rochdale Road and Helston Avenue, City Beach (Figures 1 and 2), has a history of accidents. The majority of these accidents involve only a single vehicle. Two accidents have been fatal. The frequency of accidents has a detrimental effect on the lives of the nearby residents, especially those who are called upon to assist at the scene of the accident. Extra road signs, hazard boards and "cats eyes" have been installed on this section of the highway with little effect. The City of Perth therefore proposes to realign this section of the Highway and to modify the intersection of Rochdale Road and West Coast Highway. The City of Perth and the Main Roads Department have identified four realignment options. A fifth option has been presented by the Friends of Bold Park and two additional options, including the "no project" option, have also been considered (Figure 3 and 4). A detailed evaluation process was undertaken and Option D, shown on Figure 6, was identified as the preferred realignment option. Construction of the highway realignment would also include the construction of a pedestrian underpass to facilitate access between Bold Park and the coastal side of the Highway.

EXISTING ENVIRONMENT

ENVIRONMENTAL

Geomorphologically, the project area is located in the northern section of the Swan Coastal Plain on the undulating sands of the Quindalup Dune Association. It is noted that the project area is the only intact example of the Quindalup Association within the M47 System 6 area. Soils are fine to medium-grained calcareous and siliceous sands which vary according to soil age and depth. No waterbodies or natural drainage channels occur in the project area. Groundwater depth varies between about 5m to 10m AHD.

The project area is located within the M46 and M47 areas recommended for conservation by the System 6 Green and Red Books. The area, which includes Bold Park, has high conservation value for both flora and fauna. Botanically, the vegetation of the project area is diverse and contains several significant species and vegetation communities. These communities are not present, or are poorly represented, in other parts of Bold Park. The vertebrate fauna of the project area is reasonably well documented and is considered diverse. The importance of the M46-M47 areas, and of Bold Park in particular as a conservation area for vertebrates lies in its relatively large size. It provides habitats for resident and migratory bird species and a rich assemblage of reptiles. Several of the faunal species in the M46 and M47 areas are rare in the metropolitan area.

SOCIAL

The project area is located west of Perth city, and includes the south western corner of the area known as Bold Park. To the west of the project area is the residential area of City Beach. The project area is separated from the residential area by West Coast Highway, a gazetted Important Regional Road. The major land use for Bold Park is recreation, with the public using the area for both formal and informal recreation. Walking tracks and bridle paths are present. As a consequence of Bold Park's high conservation value, it is also used for education purposes and scientific study.

There are no sites of European heritage within the project area. A limited survey has been carried out and the Department of Aboriginal Sites of the Western Australian Museum notes that no sites of Aboriginal heritage have been found within the project area although there is one site located near by just outside the project area.

COMMUNITY CONCERNS

A public consultation programme was undertaken as part of the preparation of this document. Whilst most respondents acknowledged the fact that measures need to be taken to reduce the number of accidents, a majority expressed concerns that this could be achieved by means other than realignment.

Conservation was a significant issue. There was a general consensus that the area has a high conservation value. Particular concern was expressed at the possible loss of an area rich in conservation and recreational value and which is easily accessible to the metropolitan area.

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT

The main environmental and social issues related to the project have been identified as the potential impacts on the Quindalup Association landform, loss of significant flora and fauna, the disturbance of areas within M46 and M47 System 6 areas, loss of recreational opportunities, a decrease in landscape amenity, and safety issues.

QUINDALUP ASSOCIATION

Realignment of the West Coast Highway would adversely impact on the Quindalup Association landform which is not represented in the remainder of M47, although it is present in M46. Disturbance of the landform would be kept to a minimum and the area of M47 alienated by the realignment would be linked to M46 west of the current highway alignment following rehabilitation.

SIGNIFICANT FLORA

Any realignment would produce adverse impacts on flora and some destruction of significant species and vegetation communities. Further adverse impacts would occur as a result of alienation of land between the old alignment and the new realignment. The impact on vegetation during construction would be minimised. It is also noted that construction of the realignment would increase the risk of the spread of dieback disease. A dieback disease hygiene programme would be implemented following procedures recommended by the Department of Conservation and Land Management. Vegetation would be left intact outside the minimum clearing width required for the highway. A comprehensive rehabilitation programme would be undertaken to link the alienated section of M47 with M46 west of the old highway alignment.

FAUNA

It is noted that a significant faunal assemblage may occur in the project area. Any loss or alienation of land which has native vegetation would cause a corresponding loss of faunal habitat. In addition, many fauna are also sensitive to disturbance. Thus, the proposed realignment would disrupt many local faunal territories and cause loss of fauna both within and adjacent to the easement. There is no way to avoid this general loss of fauna, however, minimisation of vegetation clearing and, ultimately, rehabilitation of the old alignment, will assist in reducing the long term impacts.

SYSTEM 6

It is recognised that the realignment of West Coast Highway would have adverse impacts on System 6 areas M46 and M47. The City of Perth has made a commitment to identify other proposals within M46 and M47 which will form part of an integrated long-term plan for these areas and to prepare a PER for public and EPA evaluation. This should ensure that road issues are not addressed in isolation from other proposals affecting the long-term values of these System 6 areas.

SAFETY

A large number of traffic accidents occur on the West Coast Highway at the bend between Challenger Parade and Helston Avenue. Local residents are also concerned about the effect these accidents are having upon their lives, especially those people who are called upon to assist at the scene of these accidents. The design of the highway at this point is below the standard of that of the remainder of West Coast Highway. It is proposed to realign this section of West Coast Highway in order to achieve a uniform standard of design.

RECREATION

Bold Park is used by many people both for formal and informal recreation. Any intrusion into the area would limit these recreational activities. This impact could be reduced through the incorporation of the alienated section of M47 with M46 west of West Coast Highway, access from Bold Park would be facilitated by a pedestrian underpass.

LANDSCAPE AMENITY

The new alignment would reduce visual impacts for the residents of City Beach, however, visual amenity would be decreased for some localised users of Bold Park. Rehabilitation of the alienated section of M47 would assist in reducing the impact on landscape amenity.

CONCLUSIONS

The section of highway under consideration does not meet the required safety standards of the Main Roads Department. Additional safety features, including signs, hazard boards and "cats eyes" have been installed but with little effect.

Dames & Moore was commissioned to examine the realignment options and to recommend an option which achieved safety requirements yet caused the minimal environmental damage and social disruption.

Option D is considered to be the realignment option which is the best possible compromise between the safety, environmental and social concerns. There will, however, be environmental impacts and careful management will be necessary to minimise these.

TABLE OF CONTENTS

	<u>Page No.</u>
EXECUTIVE SUMMARY	
1.0 INTRODUCTION	1
1.1 THE PROPOSAL	1
1.1.1 Background	1
1.2 THE PROPONENT	1
1.3 PURPOSE OF THIS PER	2
1.4 THE DECISION-MAKING PROCESS	2
1.5 PUBLIC INVOLVEMENT	3
2.0 NEED FOR PROPOSAL	4
2.1 OBJECTIVES	4
2.2 TRAFFIC VOLUMES AND ACCIDENT STATISTICS	4
2.3 BENEFITS AND COSTS	5
3.0 EVALUATION OF ALTERNATIVES	6
3.1 INTRODUCTION	6
3.2 COMPARISON OF OPTIONS	7
3.3 DISCUSSION OF OPTIONS	8
3.4 SELECTION OF PREFERRED OPTION	11
4.0 THE PROPOSAL (FOR OPTION D)	12
4.1 ROAD DESIGN CAPACITY	12
4.2 ROAD CHARACTERISTICS	12
4.3 STAGING AND OVERALL TIMEFRAME	13
4.4 CONSTRUCTION ACTIVITIES	13
4.5 APPEARANCE, LANDSCAPING AND REHABILITATION WORKS	14
4.6 PROVISIONS FOR PEDESTRIAN ACCESS	16
4.7 CONSEQUENCES OF DEVELOPMENT FOR THE LOCAL AREA	16

	<u>Page No.</u>	
5.0	EXISTING ENVIRONMENT	17
5.1	BIOPHYSICAL ENVIRONMENT	17
5.1.1	Climate	17
5.1.2	Landform	18
5.1.3	Soils	18
5.1.4	Hydrology	18
5.1.5	Vegetation and Flora	19
5.1.6	Fauna	25
5.1.6.1	General	25
5.1.6.2	Mammals	25
5.1.6.3	Birds	26
5.1.6.4	Herpetofauna	27
5.1.6.5	Invertebrates	28
5.1.6.6	Conclusions	28
5.1.7	Weeds and Diseases	28
5.1.8	Fire Management	29
5.2	SOCIO-CULTURAL ENVIRONMENT	30
5.2.1	Zoning, Land Use and Relationship to Other Land Uses	30
5.2.2	Recreation Values	30
5.2.3	Public Access and Safety	31
5.2.4	Landscape Values	31
5.2.5	Noise Levels	31
5.2.6	Aboriginal and European Heritage	32
5.2.7	Community Interest, Values and Expectations	32
5.3	SYSTEM SIX SCHEME	32
6.0	PUBLIC CONSULTATION	35
7.0	POTENTIAL IMPACTS AND IMPACT MANAGEMENT STRATEGIES	38
7.1	BIOPHYSICAL ENVIRONMENT	38
7.1.1	Landforms	38
7.1.2	Drainage	38
7.1.3	Vegetation and Flora	39

	<u>Page No.</u>
7.1.4 Fauna	40
7.1.5 Control of Weeds and Diseases	40
7.1.6 Fire Management	41
7.2 SOCIO-CULTURAL ENVIRONMENT	42
7.2.1 Land Use and Zoning	42
7.2.2 Recreational Values	43
7.2.3 Access and Safety	43
7.2.4 Landscape Amenity	44
7.2.5 Soils, Dust and Erosion	44
7.2.6 Noise	45
7.2.7 Aboriginal and European Heritage	45
7.2.8 Community Values and Expectations	46
7.3 SYSTEM 6 RECOMMENDED AREAS M46 AND M47	46
8.0 CONCLUSIONS	47
9.0 COMMITMENTS	48
10.0 ACKNOWLEDGMENTS	50
11.0 STUDY TEAM	51
12.0 GLOSSARY AND NOMENCLATURE	52
13.0 REFERENCES	53

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>
1	Vegetation of the Project Area
2	Significant Flora of Bold Park (M47) and Mount Claremont Bush (M46)
3	Endangered Flora (DRF) of the Metropolitan Region
4	Issues Raised in Written Response to Public Consultation Programme

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>
1	Locality Plan
2	Detail of Study Area
3	Proposed Re-alignment Options A-B
4	Proposed Re-alignment Options C-G
5	EPA Assessment Process - Public Environmental Review
6	Option D - Location
7	Vegetation of Study Area
8	Metropolitan Region Scheme Zoning Plan

LIST OF PLATES

<u>Plate No.</u>	<u>Title</u>
1	Vegetation of the Project Area

LIST OF APPENDICES

<u>Appendix</u>	<u>Title</u>
A	Guidelines Issued by the Environmental Protection Authority
B	Public Consultation Programme
C	Reported Accident Statistics - West Coast Highway (Rochdale Road/Helston Avenue), City Beach 01 January 1985 to 15 November 1990
D	Comparison of Options
E	Letter from Main Roads Department

**PROPOSED REALIGNMENT OF THE
WEST COAST HIGHWAY, CITY BEACH
PUBLIC ENVIRONMENTAL REVIEW**

1.0 INTRODUCTION

1.1 THE PROPOSAL

The City of Perth has been investigating the options for realigning a section of the West Coast Highway to remove a dangerous bend in that road. The section of road to be modified is near Challenger Parade, City Beach, to the south west of Bold Park (Figures 1 and 2).

1.1.1 Background

The original construction of West Coast Highway created an "S" bend, with design standards below that of the remainder of West Coast Highway (Figure 2). Since the opening of this section of West Coast Highway, the number of accidents occurring in the vicinity of Challenger Parade has increased significantly. The City of Perth considers the number of accidents to be unacceptable and proposes to realign the section of West Coast Highway between Rochdale Road and Helston Avenue to "flatten out" this "S" bend.

The City of Perth and the Main Roads Department identified four realignment options. A fifth option has since been presented by the Friends of Bold Park. Two additional "minimalist" options have also been considered, giving a total of seven options (Figures 3 and 4). As many of these options would impact on Bold Park, a significant conservation and recreation area, the City of Perth is required to produce a Public Environmental Review (PER) for review by the public and assessment by the Environmental Protection Authority.

1.2 THE PROPONENT

The proponent for the realignment of the West Coast Highway is the City of Perth, a local government authority which has its municipal offices at:

27 St George's Terrace
PERTH WA 6000

Dames & Moore was retained by the City of Perth to undertake environmental and social impact studies and public consultation for the PER. In the process of preparing this document, Dames & Moore consulted widely, especially for technical input and public opinion. A list of the organisations and individuals contacted is presented in Section 10.0.

1.3 PURPOSE OF THIS PER

This PER is designed to encourage formal submissions by the public through the provision of information on the West Coast Highway realignment. The information presented in the report, and the public comments received, will then be used to facilitate assessment of the project by the EPA.

The key to the successful realignment of the West Coast Highway, environmentally, socially and in terms of engineering/safety, is considered to be a detailed consideration of all feasible options based on a consistent set of criteria. The City of Perth wishes to examine all the implications of the realignment and to undertake the option which allows for the most sensitive solution to all issues.

1.4 THE DECISION-MAKING PROCESS

The Environmental Impact Assessment (EIA) procedure is a formalised process designed to provide information to the Environmental Protection Authority (EPA) and the public. The EIA examines proposed developments and their potential environmental impacts pursuant to the requirements of the Environmental Protection Act 1986 of Western Australia. The procedures formalise the review process and the enforcement of management commitments made by the proponent and are illustrated diagrammatically on Figure 5.

The EPA has advised the City of Perth that this project will be assessed as a Public Environmental Review (PER) which is an intermediate level of formal assessment between Consultative Environmental Review (lowest) and Environmental Review and Management Programme (highest). A copy of the final guidelines issued by the EPA for the preparation of this PER are attached as Appendix A.

A PER is designed to document information about a development proposal in a publicly available, easily understood report with the aim of encouraging public discussion as to the merits and costs of the proposal. The report also serves as the means by which the EPA assesses the environmental acceptability of the proposal and makes recommendations to the Minister for the Environment as to whether the project is acceptable. The final decision for approval or rejection is made by the Minister. During the assessment process, public submissions are invited for a period of eight weeks. These submissions are taken into account by the EPA when framing recommendations.

Apart from environmental impact assessment, this proposal must satisfy other requirements and licensing from a variety of regulatory authorities. The requirements of the following Acts will need to be adhered to, where applicable:

- o Land Act 1933-1982.
- o Wildlife Conservation Act 1950-1980.
- o Main Roads Act 1930-1982.
- o Local Government Act 1960-1983.
- o Bush Fires Act 1954.
- o Soil and Land Conservation Act 1945-1982.
- o Aboriginal Heritage Act 1972-1980.

1.5 PUBLIC INVOLVEMENT

The PER is a level of assessment which allows for and encourages public involvement. A public involvement programme was undertaken as part of the process of preparing this PER (refer Section 6.0 and Appendix B).

When this PER is approved by the EPA for public release, the document will be distributed to libraries, local community groups, etc., and be made available at a number of locations such as the City of Perth offices. It will also be available for purchase by members of the public through the EPA offices. The document will be on display for a period of eight weeks, during which time the public is encouraged to provide written comment to the EPA. Only after all this information is reviewed will the EPA make recommendations on the project.

The project would commence subject to EPA and Ministerial approval and following funding allocations.

2.0 NEED FOR PROPOSAL

2.1 OBJECTIVES

The existing section of the West Coast Highway in the project area is considered by the City of Perth and the Main Roads Department to be unsatisfactory and dangerous. West Coast Highway has been designed to the standard of a high speed arterial road with the exception of the section between Rochdale Road and Helston Avenue, City Beach. The section under consideration falls below this design standard. The objective of this proposal is, therefore, to evaluate the alternative road designs and routes for the realignment of West Coast Highway between Rochdale Road and Helston Avenue, City Beach and, based on findings of the evaluation of alternatives, to select a preferred option. The impacts of the preferred option will be discussed in detail and a management programme recommended.

2.2 TRAFFIC VOLUMES AND ACCIDENT STATISTICS

Although traffic on this section of West Coast Highway is heavy and likely to increase in time; there is no congestion. The average weekday traffic figure for this section of road is 19,000 traffic movements and the road capacity for this design of road is approximately 25,000 traffic movements (Main Roads Department). The volume of traffic on the road is reported to make it difficult for pedestrians to cross in safety.

This section of West Coast Highway has a history of traffic accidents. Accident statistics are shown in Appendix C.

Over the period 1 January 1985 to 15 November 1990, 57 accidents have been reported on the section of road between Rochdale Road and Helston Avenue. Numerous unreported accidents are believed to have occurred over the same period. The frequency of these accidents, apart from the danger to motorists, causes stress and trauma to the residents of the adjacent area. Residents are frequently called upon to assist the victims of these accidents. There is also a concern that one of the uncontrolled vehicles will enter the gardens of the houses on Launceston Avenue with the possibility of injury to the residents.

3.0 EVALUATION OF ALTERNATIVES

3.1 INTRODUCTION

The key to the successful realignment of the West Coast Highway, environmentally, socially and in terms of engineering/safety, is considered to be a detailed evaluation of all feasible options based on a consistent set of criteria. Seven options were considered for the realignment of West Coast Highway.

o **Option A**

Status quo - the West Coast Highway would remain in its current position and further road improvements could be undertaken, e.g. improved signage (Figure 3).

o **Option B**

This option would involve adjustment of the camber of the highway, building of an earth bund to reduce traffic noise levels and to act as a crash barrier, construction of a possible pedestrian underpass and a possible cycleway (Figure 3). Only minor changes to the position of West Coast Highway would occur in this option.

o **Option C**

The Sinclair Knight and Partners option, as commissioned by the Friends of Bold Park. This option alienates 3.7ha of land and involves the construction of a two-lane highway, 30m wide and of approximately 290m radius. This option is shown on Figure 4 and was designed to meet the requirements of the relevant NAASRA¹ guidelines for a design speed of 90km/hr.

o **Option D**

Option D would alienate about 7ha of land. This option involves the construction of a dual carriageway of length 0.8kms and a possible pedestrian underpass. It would also involve the modification of the Rochdale Road intersection. Realignment of Rochdale Road would involve minor incursions into the Mount Claremont Bushland and some access would be necessary to the residential area near Launceston Avenue and onto Challenger Parade (Figures 4 and 6). The alignment of the existing cycleway would remain.

¹ NAASRA - National Association of Australian State Road Authorities.

o **Option E**

Option E involves a road curvature of radius 1400m and creates the largest incursion into Bold Park. A total area of approximately 12ha would be alienated. This option would involve the construction of a dual carriageway of 1km in length, a possible pedestrian underpass and a possible cycleway. Realignment of Rochdale Road would involve moderate incursions into the Mount Claremont Bushland and access would be necessary to the residential area near Launceston Avenue and onto Challenger Parade (Figure 4).

o **Option F**

This option would cause incursions into the City of Perth's land in the vicinity of the Commonwealth Rifle Range, Bold Park in the vicinity of Challenger Parade and the Mount Claremont Bushland. Option F would involve the construction of a dual carriageway, a possible pedestrian underpass and a possible cycleway. This option would involve the construction of 1.4km of roadway, a possible pedestrian underpass and a possible cycleway and would alienate approximately 8ha (Figure 4).

o **Option G**

As with Option F above, this option would cause incursions into the City of Perth's land in the vicinity of the Commonwealth Rifle Range, Bold Park in the vicinity of Challenger Parade and the Mount Claremont Bushland. Option G would involve the construction of 1.5km of roadway, a possible pedestrian underpass and a possible cycleway and would alienate approximately 7.4ha (Figure 4).

3.2 COMPARISON OF OPTIONS

The study considered three broad categories to compare the available options for the siting of the realignment of this section of the West Coast Highway. These categories are environmental impacts, socio-economic issues and safety concerns. The City of Perth wishes to examine all the implications of the realignment and to undertake the option which allows for the most sensitive solution to all issues.

Assessment of the options was carried out using a comparison matrix. This method is believed to provide an appropriate and semi-quantitative method of assessment and comparison between options. Similar assessment criteria have been used in previous studies and found to be appropriate. Methodology and results of the comparison matrix are presented in Appendix D.

3.3 DISCUSSION OF OPTIONS

It should be noted that the option comparison matrix (Appendix D) assumes that equal weighting should be given to environmental, social and safety concerns. A high score in the matrix equated to less desirable characteristics and a low score to more desirable characteristics. A brief discussion of the results for each option follows.

Option A

This option (no realignment but installation of additional safety features on the existing road) would have no adverse effect on the existing environment. However, maintaining the *status quo* would have implications for social concerns (particularly noise) and safety. This is reflected by the relatively high score in the matrix. The City of Perth and the Main Roads Department consider that the current accident rate in this section of the West Coast Highway is unacceptable. The Main Roads Department considers that it is not practical to install further safety features into the existing road. The matrix score of 1.00 for the safety category for this option indicates that this option must be discounted from a safety point of view (Appendix D).

Option B

Social and environmental impacts of Option B would be few as only a small section of existing vegetation would be cleared to make minor modifications to the existing alignment. Most of the area that would be affected carries little native vegetation and much of that which exists is in a degraded condition due to previous highway construction. The radius of this realignment would be less than the 400m recommended by the Main Roads Department for this type of road (Appendix E). A disadvantage of the construction of earth bunds to reduce noise is the size of the structure required. Recommended measurements are 14m wide at the base x 2m high (Main Roads Department, pers. comm.). Not only would a structure of this size increase the impact on the environment but would also have an adverse visual impact both for local residents and road users. Further, it is considered that most of the current safety issues would remain unresolved (Main Roads Department, pers. comm.). The low (more acceptable) scores for the social and environmental categories in the matrix are outweighed by a high score for safety, giving an overall score of 1.37 (Appendix D).

Option C

Like Option B above, social and environmental impacts would be minor as only approximately 4ha of native vegetation would be lost to make modifications to the existing alignment. This option would also include realignment of Rochdale Road, with the consequent loss of a small area of Mount Claremont Bushland. Some of the existing vegetation is in a degraded condition due to previous highway construction. The radius of this realignment is less than the 400m recommended by the Main Roads Department. Any further reduction in the minimum recommended radius would have an adverse impact on the level of safety (Appendix E). Although the score for the safety factor is lower than that for options A and B, a higher score for environmental and social factors gives an overall score of 1.35 (Appendix D).

Option D

Design of this option would meet the standards recommended by the Main Roads Department. Environmental and social impacts of Option D would be significant. An area of approximately 7ha would be alienated from Bold Park and the City of Perth Endowment land (Figure 1)². This option would also include realignment of Rochdale Road with the consequent loss of a small area of Mount Claremont Bushland. Some species of significant flora may be lost. Like Option E below, the conservation and recreational value of the alienated parkland would be diminished. The road would be removed from the view of the residents and noise levels affecting the residents would also be reduced. However, noise levels within the Park area would increase and there would also be increased visibility of the road from the park. This option would bring the road closer to some of the main tracks which are used extensively by walkers, joggers and horse riders. Although the overall scores for environmental and social factors are high (undesirable) for this option the low (desirable) score for safety gives an overall score of 1.29 for this option (Appendix D).

² For convenience the public generally refers to the whole bushland area as Bold Park. The land referred to herein as the City of Perth Endowment land is intended to refer to the southwestern portion of the western side of Bold Park in its broader sense.

Option E

This option involves the alienation of 12ha of land which is currently zoned "Parkland and Urban" in the City of Perth's Planning Scheme from the remainder of Bold Park and the native bushland which forms part of the City of Perth's Endowment land. This option would also include realignment of Rochdale Road, with the consequent loss of a small area of Mount Claremont Bushland. It is probable that the recreational value of the alienated land would be less than that of the adjoining park and Endowment land. The low score for safety in this option is offset by a high score for environmental and social factors resulting on an overall score of 1.56 for this option (Appendix D).

Option E has the greatest impact upon the users of Bold Park. The alignment would cut through many walking trails and bridle paths, the road would be visible from an increased area of the park and noise levels within the park would be increased. The longer length of roadway traversing the park could lead to a local increase of exhaust fumes and hence reduced air quality although this effect would be minimal. Safety factors would be adequate for this option and it is the realignment preferred by the Main Roads Department (Appendix E). However, this option is not preferred by the City of Perth due to unacceptable social and environmental impacts.

Option F

Alignment F alienates land on both sides of the existing roadway; Bold Park and the City of Perth Endowment land on the east of the roadway and City of Perth land adjoining the Commonwealth Rifle Range. This option would also include realignment of Rochdale Road, with the consequent loss of a small area of Mount Claremont Bushland, and the extension of Challenger Parade. Safety issues would be satisfied by this option but there would be high social and environmental costs. Due to the topography this alignment would have an adverse visual impact. High social and environmental costs are reflected in the high overall score of 1.56 on the matrix (Appendix D).

Option G

Like Option F this option would alienate land on both sides of the existing roadway and would also include realignment of Rochdale Road. The incursion into the area to the east of the present roadway would be small and have low impact upon the users of Bold Park. The southern section of the alignment to the west of the present alignment would involve alienation of a large section of land. It could also involve intrusion into the Commonwealth Department of Defence land. This alignment would traverse some of the highest land around the area and would involve extensive excavation and further disturbance. It would also be visible from the east and from the west. The amount of land alienated and the visual impact make this, and any options further to the west, unacceptable.

3.4 SELECTION OF PREFERRED OPTION

Based on the methodology outlined in Appendix D and assuming equal weighting of environmental, social and safety factors, Option D (shown on Figure 6) appears to be the most reasonable compromise between these concerns with a final overall score of 1.29. Hereinafter, all references to the realignment of the West Coast Highway refer to Option D. Consideration of potential impacts and their management (Section 7.0) also relate to Option D.

4.0 THE PROPOSAL (FOR OPTION D)

4.1 ROAD DESIGN CAPACITY

The existing road capacity is 25,000 vehicles per day. As the section under consideration would remain part of West Coast Highway, the capacity of any realignment would remain the same.

4.2 ROAD CHARACTERISTICS

Existing Alignment

The present road has a curvature of 180m radius and is bordered on the western side by housing and to the east by Bold Park and City of Perth Endowment land. The road is a four-lane dual carriageway with a wide, grassed median strip planted with trees and shrubs. The eastern lanes are slightly elevated. The section of road under consideration consists of a double bend and a junction at the crest of a hill. The speed limit on West Coast Highway when approaching from the south is 80km/hr, reducing to 70km/hr prior to the junction with Rochdale Road. There are three 70km/hr signs when approaching this junction from the south, as well as road signs showing bend in the road and hazard boards. From the north there are two 70km/hr signs. There is a wide nature strip between Launceston Avenue and the western carriageway. This nature strip is grassed and planted with shrubs and trees. The road also has "cats eyes" marking each lane of the dual carriageway, kerbing and street lighting.

Proposed Alignment

The new section of road would have curvatures of 500m and 400m radius, a length of approximately 0.8km and be 30m in width (Figure 6). It would consist of two carriageways with a median strip. It could also incorporate a pedestrian underpass and would have access to Challenger Parade via a section of the existing road. The junction of Rochdale Road would also be realigned. The existing cycleway would remain on its present alignment.

The surface of the road would be bitumen with painted lane markings with no "cats eyes". Kerbing and street lighting would be installed commensurate with that of the adjoining sections of the West Coast Highway. The appearance of the road would be similar to that of the new section immediately to the south of the proposed realignment.

4.3 STAGING AND OVERALL TIMEFRAME

It is proposed to construct the road in one stage. Construction would begin as soon as all approvals have been granted and is expected to take three months. Ideally the construction of the road should be completed prior to the start of the plant growing season. This timing would enable rehabilitation to commence in the most favourable period.

4.4 CONSTRUCTION ACTIVITIES

The pre-construction stage consists of surveying and preparation of the site by stripping of the vegetation. At this time topsoil would be retained for use in the rehabilitation programme. Any excavation material would be used as fill. It is recommended that all vegetation be retained other than that in the immediate minimum easement required for the road. The width of the easement would include the 30m required for the road plus that required for the cut and fill necessary for the construction of embankments due to the variance in the terrain. These variances are shown on Figure 6. During this stage there would be an increase in noise and dust levels and also an increase in heavy vehicles using the roads in the neighbourhood.

The construction stage would involve the laying of the road subsurface and surface materials, and the possible installation of the pedestrian underpass. It is suggested that the road realignment through the City of Perth Endowment land be completed prior to linking the new section with the existing road. This would be done in order to reduce as far as possible the inconvenience caused to traffic using West Coast Highway during the construction period. This stage would also involve the use of heavy vehicles and noise levels in the area could temporarily increase. A feeder road to the existing alignment and modification of access to Challenger Parade would be undertaken as part of the construction stage. Alteration of the intersection of Rochdale Road and West Coast Highway would be carried out.

The post-construction stage would involve clean up of the site, erection of signs, the painting of road markings, installation of street lighting and treatment and planting of the verges and other cleared areas. Rehabilitation would also involve removal of the existing road and restoration of this area to provide continuity of habitat between the alienated area of M47 and M46 west of West Coast Highway.

4.5 APPEARANCE, LANDSCAPING AND REHABILITATION WORKS

The appearance of the roadway would be similar to that section of West Coast Highway immediately to the south.

Landscape restructuring would be limited to the restoration of natural contours (where possible). The rehabilitation programme is discussed below:

The realignment of West Coast Highway would involve clearing an easement to accommodate the roadway and embankments. The width of the easement would vary according to the terrain and must include that area necessary to accommodate the cut and fill batters. It is recognised that the construction of the road will have significant impacts on the vegetation and fauna of the cleared and alienated areas. Where the width of the embankment could be reduced by stone-pitched steeper slopes, the stone-pitched area would be incapable of revegetation and is therefore not recommended. Some mitigation of these environmental impacts can be achieved by implementing a rehabilitation programme. This would involve the planting of local native plant species in the easement of the current West Coast Highway realignment and adjacent disturbed verges. On establishment of the rehabilitation this would provide some continuity of habitat.

On completion of construction of the realignment, the following would be undertaken:

- o removal of the existing road structure, kerbing, non-native vegetation and other effects of the road. The landscape would be restored to resemble as far as possible the natural contours;
- o deep ripping of soil; and
- o spreading of stockpiled topsoil.

The following restructuring and rehabilitation programme is recommended for the area of the new road alignment, adjacent verges and the median strip. The construction of the new alignment should be carried out in a manner that minimises vegetation and soil disturbance. Following vegetation clearance, topsoil should be removed and stockpiled on site for use in rehabilitation of the old alignment. This should be done even if the soil is infested with weeds. The importance of the topsoil is twofold. Firstly, it contains seeds of native plants which will regenerated naturally after respreading. More importantly, it contains spores and hyphae of

fungi which are vital to the successful growth of many native plants. These fungi, known as mycorrhizae, are used by many native plants to extract nutrients from the relatively low-nutrient sandy soils of the Swan Coastal Plain. Without these fungi, plant growth is slow and mortality high. Replacement of topsoil greatly enhances the success rate following replanting even if weeds do temporarily become a problem.

The following recommendations relate to the rehabilitation programme:

- o it is recommended that local plant species be used, preferably from seed collected from the M46 and M47 areas;
- o direct seeding is considered more appropriate than heavy planting as the resultant vegetation is better in appearance and easier to maintain. It is recognised that direct seeding may have to be supplemented with planting of shrubs, etc., if the community is not prepared to wait for natural revegetation. Hydromulching would aid in the control of weeds and dust and is recommended;
- o vegetation planted in the vicinity of the new alignment should be crash-flexible. Larger trees, such as *Agonis flexuosa*, should be planted back from the verge so as not to present a danger should motorists leave the road;
- o fertilisation should be minimal as many native plants are sensitive to fertilisers and may be either killed or retarded by them; and
- o fire, dieback disease and weed control should follow the management strategies outlined in Section 7.0.

To enable vehicles to pull off the road in an emergency it is recommended that the adjacent verges be planted with native ground cover or grasses. The median strip may be planted with crash-flexible native vegetation.

The aim of rehabilitation is considered to be the establishment of local native vegetation which has conservation value. This is in order to provide some continuity of habitat between the alienated section of M47 and M46 west of West Coast Highway.

4.6 PROVISIONS FOR PEDESTRIAN ACCESS

The design of the road incorporates a pedestrian underpass to enable the public to gain access to Bold Park from the west and allow park users access to City Beach. The traffic volume on the highway is reported to make it difficult for pedestrians to cross in safety and pedestrian access across the road would be discouraged.

The suggested location of the underpass is approximately 50m to the south of the intersection leading to Challenger Parade. The exact location is to be left as part of the management programme and the underpass to be constructed subject to public support.

4.7 CONSEQUENCES OF DEVELOPMENT FOR THE LOCAL AREA

The primary consequences of development are:

- o encroachment into and alienation of part of M46 and M47 (System 6 areas);
- o disturbance and loss of native flora and fauna;
- o temporary loss of recreation area and native bushland within easy reach of the local population;
- o a safer road and fewer accidents, hopefully resulting in fewer deaths and serious injuries; and
- o less traffic noise for local residents.

5.0 EXISTING ENVIRONMENT

5.1 BIOPHYSICAL ENVIRONMENT

5.1.1 Climate

The Bureau of Meteorology has been recording climatic data at Perth Regional Office, located approximately 8km east of the project area, since 1876. The project area is characterised by a temperate mediterranean climate, experiencing warm, dry summers and mild, wet winters. The seasonal rainfall results from westerly frontal systems bringing moist air from the ocean.

Lowest temperatures are normally experienced in July, when the average monthly minimum and maximum temperatures are 9.2°C and 17.7°C respectively. Maximum temperatures occur in February, when the average monthly minimum temperature is 18.6°C and the average monthly maximum temperature is 30.4°C.

Average evaporation exceeds rainfall for eight months of the year. Mean daily evaporation is highest during the summer months. Most of the rainfall is during the winter months, with 71% of the annual average falling between May and August. The period between November and March receives only 8.5% of the annual rainfall.

Based on records from the Perth Regional Office, the most common winds are south-westerlies, which are particularly prevalent in spring and summer. During summer, prevailing winds tend to be easterly in the mornings and southwesterly in the afternoons.

The climatic data suggest that rehabilitation should commence in late autumn to ensure rainfall during the period of plant establishment. It does, however, indicate that dust may occasionally blow towards the houses during the construction operation except in the afternoons.

5.1.2 Landform

The project area forms part of the northern portion of the Swan Coastal Plain. The Quindalup Association dunes, on which the project area is situated, are a unit of the Quindalup Dune System, consisting of undulating sands of wind-blown origin. All of these sands have a high permeability with low slope stability. Relief of the Quindalup Dunes are commonly between 0 and 60m and slopes are considered moderate to steep (10° to $>20^{\circ}$) (Geological Survey of Western Australia, 1986). Ridges and depressions are a common feature of the project area. As a result, the site is quite topographically variable, ranging from a low point of 9m AHD in the north of the project area to 35m AHD in the south. The vegetation and landform of the Quindalup Association forms a complex transition zone with the Spearwood Association which occupies most of Bold Park. Boundaries are therefore difficult to distinguish in the field. An approximation of the Quindalup Association location within M47 is shown on Figure 6.

It should be noted that the project area is the only example of the Quindalup Association within the M47 System 6 area (EPA, Bulletin 322, 1988). However, M46 does contain this geomorphological unit and it is widely represented elsewhere (e.g. Yalgorup National Park near Bunbury and Woodman's Point Reserve near Fremantle).

5.1.3 Soils

The soils are composed of fine to medium-grained sub-rounded quartz fragments and shell debris. Because of the different soil age and depths of soil, there is a local diversity of soil types. On higher ridges, deep unconsolidated calcareous sands occur while grey siliceous and pale yellow sands occur in the interdunal swales. Debris and organic matter tend to accumulate in the depressions between ridges.

The soils are low in nutrient and poor at holding moisture and so selection of drought-tolerant plant species for rehabilitation, and the time of seeding, are critical.

5.1.4 Hydrology

No waterbodies or natural drainage channels occur in the project area. The deep sands are highly permeable, allowing rapid infiltration of rainfall through the soil. Groundwater levels in the region, as indicated by water levels in local wetlands, vary from about 5m AHD to 10m AHD. Regional groundwater flow is to the south-west at an average rate of 50-100 m/yr (Water Authority, 1987).

The nearest wetlands to the project area are Camel Lake (Figure 1) and Perry Lakes. Camel Lake is a small, shallow, semi-permanent swamp located in Bold Park 1,400m east of the project area. Perry Lakes, two landscaped wetlands which are designed for passive recreation, are located 2,200m and 2,300m north east of the project area.

5.1.5 Vegetation and Flora

Description of Vegetation and Flora

The vegetation types and flora of the project area and nearby areas have been listed, described and discussed in a number of reports and publications. These include Dames & Moore (1986), Keighery *et al.* (1990), Weston (1987) and Scott and Furphy (1976). Dames & Moore (1986) and Scott and Furphy (1976) deal with the vegetation and flora of the Swanbourne Area, which includes, but is not limited to, all of the bushland in the project area outside Bold Park. The Dames & Moore (1986) report maps the vegetation of the project area at a scale of 1:10,000 using basic vegetation types defined by Scott & Furphy (1976). It also updates Scott & Furphy's list of plant species in the project area.

The types of native vegetation which are shown in Dames & Moore (1986) as occurring in the project area are stable dune, open woodland and closed scrub. The vegetation of the stable dunes is mostly of *Olearia axillaris*, smaller shrubs and herbaceous plants, including mats of *Loxycarya flexuosa*, with *Dryandra sessilis*, *Chamelaucium uncinatum* and *Allocasuarina humilis* dominant in some areas. The open woodland is dominated by tuart trees which, for the most part, were in poor condition and had degenerated between 1976 and 1985. There are also healthy younger tuarts and occasional *Banksia* trees in the woodland. The closed scrub is mainly dominated by *Acacia rostellifera* but with enclaves of *Dryandra sessilis*, *Olearis axillaris*, *Allocasuarina lehmanniana* with *Exocarpos sparteus* and *Agonis flexuosa*.

The Dames & Moore (1986) report lists 180 plant species for the project area but makes no claim that the list is complete. Of the 180 species, 67 are established aliens. A subjective abundance category is given for each species for each vegetation type in which the species was recorded.

Keighery *et al.* (1990) deal with the vegetation and flora of Bold Park, including all of the bushland in the project area not covered by Dames & Moore (1986) and Scott & Furphy (1976). Weston (1987) describes the vegetation and flora of Lot 1 Stephenson Avenue, which is contiguous with Bold Park but east of the project area. Keighery *et al.* (1990) map seven major structural vegetation formations at a scale of approximately 1:20,000, give detailed descriptions of 19 vegetation (or plant) associations and list 356 species of vascular plants growing naturally in Bold Park, of which 130 species are established aliens.

The types of native vegetation which are shown in Keighery *et al.* (1990) as occurring in the project area are *Banksia* woodland, *Acacia rostellifera* shrubland and dune heath. The Bold Park *Banksia* woodland is described as low woodland of *Banksia menziesii* predominating over *Banksia attenuata* on the western dunes, with scattered tuart trees emergent on valley slopes. *Banksia prionotes* occurs nearby. The only *Acacia rostellifera* shrubland shown on the Keighery *et al.* (1990) vegetation map is in the south western corner of Bold Park, in the project area. Dune heath, though scattered through Bold Park in relatively small stands, is, according to Keighery *et al.* (1990), the most variable vegetation formation in Bold Park. The heath at any particular site is dominated by *Olearis axillaris*, *Allocasuarina humilis*, *Dryandra sessilis* or *Chamelaucium uncinatum* and generally has a highly variable, species-rich, relatively weed-free understorey.

The "stable dune vegetation", "[*Acacia rostellifera*] closed scrub" and "open woodland" categories of Dames & Moore (1986) are roughly equivalent to the "dune heath", "*Acacia rostellifera* shrubland" and "tuart woodland (with *Banksia*)" of Keighery *et al.* (1990), respectively. Areas of disturbed sites which now support little or no native vegetation are also shown by Keighery *et al.* (1990) and Dames & Moore (1986) and occur in the project area.

Figure 7 is a 1:5000 scale map of the project area's vegetation based upon January 1991 field observations for the purpose of this study, aerial photograph interpretation and the vegetation maps and descriptions in Keighery *et al.* (1990) and Dames & Moore (1986). The vegetation categories used in the mapping are equivalent to those of Keighery *et al.* (1990) and Dames & Moore (1986) and use the terminology of Keighery *et al.* (1990). The symbols used in the map are listed and defined in Table 1.

TABLE 1
VEGETATION OF THE PROJECT AREA

Map Symbol	Vegetation Type	Sites	Plate Numbers	Conservation Significance ⁽¹⁾
1	Banksia woodland <i>Banksia attenuata</i> and <i>B. menziesii</i> trees, often only scattered, often with emergent tuart trees and a weedy heath understorey and merging with tuart woodland	F	1B	2
2B	Eucalyptus gomphocephala (Tuart) woodland Generally scattered tall trees, usually with weeds prominent and, in southern half to two-thirds of project area, peppermint (Af) trees (Site A), often extending as emergents into neighbouring communities.	A,H	1A,1B	2
3A	Acacia rostellifera shrubland Dense, young, low shrubland to dense, tall, old shrubland restricted to southern half to two-thirds of project area, often with peppermint (Af); merges with tuart woodland and, immediately south of the project area, with <i>Allocasuarina lehmanniana</i> shrubland (Type 3C, Plate 1D); the low shrubland often has areas of <i>Santalum acuminatum</i> to 1m tall.	G,L,M	1C,1D	1
4B	Dune heath Heath typically around 50cm tall and densely covered with <i>Cassitya flava</i> ; dominant shrubs include <i>Grevillea crithmifolia</i> , <i>Melaleuca acerosa</i> and <i>Acacia lasiocarpa</i> ; variants in project area include heaths dominated by (1) <i>Allocasuarina humilis</i> (Site E), (2) <i>Chamelaucium uncinatum</i> (Site C), (3) <i>Calothamnus quadrifidus</i> (Site B, Plate 1F) and <i>Santalum acuminatum</i> . Variations of dune heath extend into other communities as understoreys and enclaves.	B,C,D,E,K	1E,1F	2
4C	Dryandra sessilis heath Extensive and varying heath, to 3m tall in northern end of project area; dominant species include <i>Dryandra sessilis</i> , <i>Hakea trifurcata</i> , <i>Chamelaucium uncinatum</i> and <i>Hakea prostrata</i> ; with, in north east corner of project area, <i>Acacia truncata</i> and <i>Templetonia retusa</i> .	I,J	1G	2
6	Heavily disturbed area (roads, tracks, lawns, bare sand, weedy areas)	-	-	-
Af	Peppermint (<i>Agonis flexuosa</i>), in vegetation types 2B, 3A and, in one area, 4B.	-	-	2

Notes: (1) 1 - well conserved.
2 - reasonably conserved.
3 - moderately conserved.
4 - poorly conserved.
(Definitions conform to "excellent", "reasonable", "moderate" and "poor" of Specht, Roe and Boughton 1974, pp.10, 11).

All plant species found during the January 1991 vegetation survey of the Project Area, except *Eucalyptus* "petrensis", are listed by Keighery *et al.* (1990). The significant species and vegetation units found during the survey are discussed below. Table 2 outlines significant flora which may be found in the project area.

Significant Vegetation and Flora

Although the naturally-occurring vegetation of the project area outside of Bold Park is approximately the same as the portion inside Bold Park, there are a few differences which may be considered significant. These differences include larger stands of *Acacia rostellifera* shrubland and the presence of naturally occurring *Callitris preissii* and *Allocasuarina lehmanniana* in the project area outside Bold Park. Naturally occurring stands of these two latter species were not recorded in Bold Park by Keighery *et al.* (1990).

In the local context of Bold Park, the vegetation in the project area is unique in having *Acacia rostellifera* shrubland vegetation which does not occur elsewhere in Bold Park, and *Chamelaucium uncinatum* and *Agonis flexuosa* vegetation, which are rare elsewhere in Bold Park.

Sixteen significant plant species have been recorded in the vicinity of the project area, i.e. the Rifle Range and System 6 recommended areas M46 and M47; the part of Area M46 outside the coastal strip is referred to here as the Mount Claremont Bush, and Area M47 includes Bold Park. These 16 significant species and the reasons for their significance are listed in Table 2, including *Eucalyptus* "petrensis", a species not previously recorded in the area. Five of the species are Priority Species as defined by the Department of Conservation and Land Management. Five others are at or near their limits of geographical distribution. No Gazetted Endangered species is on the list or is expected to occur in the vicinity. Gazetted Endangered species of the Metropolitan region are listed in Table 3.

Five of the significant species listed in Table 2 were found in the project area, and nine of the others, or habitats for them, may occur there. All five of the species found, *Jacksonia sericea*, *Allocasuarina lehmanniana*, *Chamelaucium uncinatum*, *Eucalyptus* "petrensis" and *Agonis flexuosa*, are reasonably common in the project area, albeit in different parts of it. The *Jacksonia* is common in the north and central east; the *Chamelaucium* is most common in the centre, the *Eucalyptus* is common in a limited area near the bridle trail and the *Agonis* and *Allocasuarina* are common in the southern and south-central part. The *Eucalyptus* was probably planted (Keighery pers. comm.).

TABLE 2
SIGNIFICANT FLORA OF BOLD PARK (M47)
AND MOUNT CLAREMONT BUSH (M46)

Species	Family	Significance ¹	Habitat in Project Area	Nearest Locality ¹
<i>Acacia xanthina</i>	MIMOS	At or near southern limit of distribution	No	Limestone above quarry amphitheatre, Bold Park
<i>Agonis flexuosa</i>	MYRT	At or near northern limit of distribution	Yes	Valleys and slopes in project area, M46 and M47
<i>Allocasuarina lehmanniana</i>	CASU	At or near southern limit of distribution	Possible	Stable dunes and limestone bordering Rochdale Road and southern end of project area, M46
<i>Banksia menziesii</i> yellow flowered form	PROT	Uncommon form	Possible	Centre and eastern side of Bold Park
<i>Beyeria cygnorum</i>	EUPH	Priority 1 species; possible a limestone variant of <i>Beyeria cinerea</i>	No	Limestone in <i>Acacia xanthina</i> area, M47
<i>Callitris preissii</i>	CUPR	Rare in metropolitan area	Possible	Rifle Range and stable dune, M46, near project area
<i>Cartonema philydroides</i>	COMM	Priority 3 species	Possible	Rare in Bold Park <i>Banksia</i> woodland
<i>Chamelaucium uncinatum</i>	MYRT	At or near southern limit of distribution; although <i>C. uncinatum</i> (Geraldton Wax) is reasonably common in near-coastal areas between Perth and Kalbarri and is in existing and proposed national parks the Perth form is poorly conserved (Keighery pers. comm.)	Yes	Stable dunes in project area
<i>Eucalyptus decipiens</i>	MYRT	Especially sporadic on the Swan Coastal Plain and locally	Possible	South east of pine plantation, M47
<i>Eucalyptus foecunda</i>	MYRT	Priority 5 species; quite uncommon in the metropolitan area	Possible	Eastern side of Bold Park
<i>Eucalyptus "petrensis"</i>	MYRTA	Priority 3 species; undescribed eucalypt referred to by Brooker and Kleinig (1990) as <i>E. "petrensis"</i> , an unpublished name; an uncommon recently recognised species, occurring on limestone between Yalgorup National Park and Lancelin. The buds, flowers, nuts, leaves and stems of the Bold Park plants are shown in Plate 1H. The habit of the Bold Park plants is, however, much straighter and the substrate much sandier than Powell describes for <i>Eucalyptus "petrensis"</i> . The Bold Park plants have probably been planted (Keighery Pers. comm.)	Possible	At Site J and south of it a few metres east of the track there are a few small, smooth-trunked eucalypt trees with buds, flowers and nuts which match Western Australian Herbarium drawings and descriptions in Powell (1990) of <i>Eucalyptus "petrensis"</i> . The nearest locality of a natural populations is in Sorrento.
<i>Gyrostemon ramulosus</i>	GYRO	At or near southern limit of distribution	Possible	Tuart and <i>Banksia</i> woodlands, south eastern corner of M47
<i>Hakea ruscifolia</i>	PROT	Uncommon in Metropolitan area	Possible	M47, east of project area
<i>Jacksonia sericea</i>	PAPI	Priority 3 species	Yes	Widespread in project area
<i>Sonchus aff. asper</i>	ASTE	A form which is possibly a native <i>Sonchus</i> species recorded from only one locality	No	Camel Lake, M47
<i>Stylidium aff. affine</i>	STYL	Rare and restricted species	No	Under <i>Acacia xanthina</i> , M47

1. Keighery et al. (1990), Dames & Moore (1986), Weston (1987), EPA (1988), CALM (pers. comm.), Keighery (pers. comm.).

TABLE 3
 ENDANGERED FLORA (DRF) OF THE METROPOLITAN REGION
 (LIST OF SPECIES BASED ON GOVERNMENT GAZETTE, WA, 1 JUNE 1990)

Species and Family	Localities and Distribution ¹	Habitat ²	Flowering Times ¹
<i>Aponogeton hexatepalus</i> APONOGETONACEAE	>15: Kenwick-Darradup-Augusta	Shallow winter pools on clayey soils	(May-)Aug-Sep
<i>Caladenia huegelii</i> (=C. sp. (coastal plain)) ORCHIDACEAE	>15: Gnangara-Yallingup-Margaret River	Sandy soils in <i>Banksia</i> and eucalypt woodland, often with <i>Allocasuarina fraseriana</i> and usually low on the landscape	Aug-Oct(-Nov)
<i>Diuris drummondii</i> ORCHIDACEAE	3: Rocky Gully-Perth (near Jandakot)	Open swampy areas, particularly during the season following a summer fire	Nov-Dec
<i>Diuris purdiei</i> ORCHIDACEAE	9: southern Perth area-Harvey	Seasonal semi-swamp on sandy over clay soils, usually in <i>Regelia</i> and <i>Pericalymma</i> shrublands; flowers in habits which were burnt the previous dry season	Sep-Oct(-Nov)
<i>Diuris</i> sp. (Kwinana) aff. <i>laxiflora</i> A.P. Brown 10/9/84 ORCHIDACEAE	1(-2): Kwinana	Small shallow winter-wet swamps amongst short sedgeland, predominantly of <i>Lepidosperma longitudinale</i> , on sandy-clayey soils	Aug-Sep
<i>Drakaea elastica</i> (=D. <i>jeanensis</i>) ORCHIDACEAE	8: Gingin-Busselton	Sandy soils, often firm and very white, in <i>Kunzea ericifolia</i> tall shrubland and <i>Banksia</i> woodland, low on the landscape	(Sep-)Oct-Nov
<i>Drakaea</i> sp. (south west) ORCHIDACEAE	5: Canning Vale, Yarloop, Mowen, Bakers Junction	Sandy soils in scrub and woodlands, low in the landscape, often near swamps	Sep-Oct
<i>Drosera occidentalis</i> esp. <i>occidentalis</i> DROSERACEAE	>15(?): Gingin-Pinjarra; Darling Range ²	With short Centrolepidaceae sedges on peaty, sandy soils which are winter-inundated, usually shallowly, in swampy areas	(Oct-)Nov-Dec
<i>Dryandra mimica</i> (=D. sp. A in Flora of the Perth Region) PROTEACEAE	3(-4): Mogumber-Wattle Grove (-Whicher Range)	Flowers bright yellow; low sandy flat in heath or scrub in <i>Banksia</i> woodland or with <i>Kingia</i> and <i>Byblis</i>	(Sep-)Type: Dec 17)Jan-Feb
<i>Hydrocotyle lemnoides</i> APIACEAE	47: Kenwick-Upper Swan-Bolgart; Darling Range	Shallow winter pools on clayey soils	Sep-Oct

- Notes: 1. The information in this table was compiled from Rye and Hopper (1981), Hoffman and Brown (1984), Sainsbury (1985), Marchant *et al.* (1987), Lowrie (1989), Hopper *et al.* (1990), information provided by L. Mutter and botanists of the Western Australian Herbarium and the WAWRC, and field work by A.S. Weston during 1989 and 1990. There may be a few more localities for some of the species than the number given in the table, but some of the species are no longer found in some of the localities where they were previously recorded.
2. *Drosera occidentalis* is now believed to be more abundant and widespread than Western Australian Herbarium collections indicate (Atkins and Moore, pers. comm.; Lowrie (1989)).

5.1.6.5 Invertebrates

Invertebrate fauna in Bold Park, as is characteristic of many areas, has not received the same level of attention as that of the vertebrate fauna. Studies of invertebrates have been carried out at Reabold Hill (Koch & Majer, 1980; Majer & Koch, 1982). Pitfall trapping was undertaken at Manjimup, Dwellingup and Reabold Hill to determine the seasonal activity and phenology of invertebrates in these areas. The assemblage of invertebrates at Reabold Hill compares favourably to those found in the Dwellingup and Manjimup trapping sites, both in terms of numbers of species and the total number of individuals trapped at the site (Koch & Majer, 1980).

No invertebrate surveys have been carried out in the Mount Claremont Bush and thus nothing is known of invertebrate numbers or diversity in this area (Boyd Wykes, pers. comm.).

5.1.6.6 Conclusions

The importance of Bold Park bushland as a conservation area for vertebrates lies in its relatively large area that provides habitats for resident and migratory bird species and a rich assemblage of reptiles.

The Mount Claremont Bush contains one of the best examples of the fauna of the Quindalup Dune System. The bird community in this area has proven to be rich and to contain species which are otherwise rare in the urban area.

5.1.7 Weeds and Diseases

Weed invasion in the project area is significant, especially in areas which are in close proximity to roads (West Coast Highway, Rochdale Road). The most conspicuous weeds are the herbaceous perennials *Ehrharta calycina* (Veldt Grass) and *Pelargonium capitatum*, both of which are particularly well established in the *Banksia* woodland and Tuart woodland. Heath vegetation is comparatively free of weed invasion.

Vegetation can be radically altered by dieback disease caused by the root-rot fungus *Phytophthora cinnamomi*. This is a soil-borne pathogen that can be carried on the underbodies, wheels and tracks of vehicles, and in mud or soil on the feet of animals and humans. Once introduced to a site, the fungus spreads slowly through the soil and among the root systems of susceptible species. It may also be washed downslope with the soil water flow during rainfall.

Recent research has demonstrated variations in disease impact over time. The degree of impact depends on landscape position (downslope sites are more vulnerable), vegetation type and host susceptibility (myrtaceous and proteaceous species, such as occur in the project area, are more susceptible) and drainage characteristics (poorly drained sites in high rainfall areas are at greater risk).

Widespread visual evidence of *Phytophthora cinnamomi* dieback disease was noted in the Study Area during field surveys. It was particularly noted in the vicinity of the walk trails on the eastern boundary of the project area, south of the junction with the bridle path. This reinforces the importance of dieback disease hygiene management, as outlined in Section 7.1.5, in an effort to prevent its spread into uninfected areas.

5.1.8 Fire Management

The City of Perth prepared a set of "Draft Guidelines for Fire Protection Operations" in 1989. Advice was sought from the Environmental Protection Authority, who provided input and recommendations on the Council's plans. The programme, in essence, is as follows:

- o the development of fire buffers and the reduction of fuel loading of broad buffers between existing fire breaks and walking trails is provided in order to establish a system of low-fuel mosaics. ;
- o Parks and Gardens officers from the City of Perth are to undertake a rotational burn management programme to reduce the accumulation of fuel within the boundaries of Bold Park over a 6-10 year cycle;
- o the development of a trained fire control response team for Bold Park; and
- o controlled burning of the pine plantation in August/September in consultation with the Department of Conservation and Land Management;

5.2.3 Public Access and Safety

Public access to the park from Oceanic Drive, City Beach and Perry Lakes is unrestricted. Access from City Beach is across West Coast Highway which could be dangerous depending on the amount of traffic using the highway. There are traffic lights at the intersection of West Coast Highway and Oceanic Drive.

Access to Challenger Parade from West Coast Highway is at a junction on the crest of a hill entering the bend. Accidents have been reported at the junction involving traffic both entering and exiting the highway.

The safety record of this section of West Coast Highway is considered by MRD and COP to be unacceptable. Accident statistics for the period 1 January 1985 to 15 November 1990 are shown in Appendix C. Many of these accidents are the result of loss of control of the vehicle or the vehicle swinging wide on the bend. Most of the serious injuries and major damage are caused by the vehicle colliding with a fixed object, for example a SECWA pole.

5.2.4 Landscape Values

The existing road is partially hidden from the residents of Launceston Avenue by a barrier of trees and shrubs. The topography of Bold Park and the Endowment land makes Bold Park clearly visible from the residential area. The road has been landscaped with a wide median strip and planted with trees and shrubs. The intrinsic value of the area lies in the natural bushland.

5.2.5 Noise Levels

Noise levels from the existing road are reported by residents and park users to be high both in the adjacent residential area and also in the parkland. There have been complaints from nearby residents about the increase in noise since the installation of "cats eyes" in this section of West Coast Highway. Background noise sources include the proximity of the ocean and noise generated by the rifle range.

5.2.6 Aboriginal and European Heritage

Information was sought from the Department of Aboriginal Sites of the Western Australian Museum. Limited surveys have been carried out and identified only one site which was located outside of the project area near the junction of Rochdale Road and Stevenson Avenue.

Contact was made with the Western Australian Heritage Committee to identify any areas or items of European heritage significance in the vicinity of the project area. The area of Bold Park has never been developed and therefore has no European heritage value. The housing to the west of the roadway is recent and as such has no heritage value.

5.2.7 Community Interest, Values and Expectations

There are three major areas of community concern:

o **Safety**

The community acknowledges that the number of accidents, both reported and unreported, is high and that steps should be taken to try to reduce this number.

o **Conservation**

This area has high conservation value which should be preserved for future generations. Species richness is high and realignment of the road would lead to a loss of conservation value and a decrease in species richness.

o **Recreation**

A significant number of people use the area for recreation purposes and are concerned that their activities would be curtailed by any realignment.

5.3 SYSTEM SIX SCHEME

The following discussion is based on the recommendations of the EPA for the proposed Knightsbridge subdivision (EPA, Bulletin 322, 1988).

The whole of Western Australia has been divided into 12 regions or Systems for the purpose of balancing the needs of conservation and development. The Perth metropolitan area is part of System 6, an intensively-used area of Western Australia. The EPA appointed the Conservation Through Reserves Committee to identify opportunities to set aside areas of land in this intensively used region for conservation of natural areas and recreation in a natural setting.

The area of land in which most of the realignment options are situated is contained within the boundary of System 6 recommendations M46 and M47. Recommendations M46 and M47 have high value for conservation, recreation and education and form one of the largest areas of remnant bushland left on the coastal fringe of Perth. The value of M46 and M47 lies not only in their size but in their diversity of vegetation and fauna species (Section 5.1).

M46 south of Rochdale Road, part of which lies within the project area, is noted by the EPA (EPA, Bulletin 322, 1988) as having limited long-term viability. This is because of its severance from the main part of M46 by the Servetus Street extension. However, this study has noted several species in this part of M46 which are not recorded within M47.

Conservation Value

Conservation values are based on the relatively natural condition of the bush, the variety of vegetation communities and the presence of flora and fauna species which are rare, uncommon or otherwise of scientific interest.

Recreation Value

A user survey conducted in Bold Park bushland in October 1987 by Friends of Bold Park showed that the area is important for recreation at a regional level. People surveyed came from throughout the metropolitan area, with more than half from beyond the western suburbs. From the participants' responses, it appears that people perceive the recreational opportunities provided by Bold Park as being comparable to those offered by Kings Park (Friends of Bold Park, Proposal for Regional Park Status for August 1990, Bold Park and Adjacent Bushlands).

Education Value

The educational value of the M46 and M47 areas stems from the wide variety of species of fauna and flora found there and its location in close proximity to urban areas and schools.

Landscape Values

The Bold Park ridgeline is a prominent feature of the landscape, both from the west and from the east. There are few areas of coastal limestone or dune ridges remaining in their natural state in the metropolitan area. The many walking trails afford panoramic views of the city and ocean.

Social Values

Bold Park and its surrounding bushland is considered by many people as one of the last remaining areas of natural bush in the metropolitan area. It is used for recreation purposes by people from many different parts of the metropolitan area. The size of the area gives an impression of isolation from the surrounding development.

6.0 PUBLIC CONSULTATION

A public consultation programme helps to identify the potential impacts and issues of concern within the community. It can help to reduce the level of misconception and misinformation about a project and help to create a better understanding of the project and its objectives.

For the purposes of this PER, the following public participation programme was carried out:

- o a letter drop was carried out in the immediate project area. A total of 36 residences were involved:
 1. 1 - 47 (odd numbers) Launceston Avenue
 2. 105, 107, 109, 111, 118, 120 Branksome Gardens
 3. 1, 2, 3, 4, 5 Saltash Avenue
 4. 3 Helston Avenue
 5. 4, 6 Challenger Parade;
- o correspondence was sent to all those people who had communicated with the City of Perth in regard to West Coast Highway in this area and for whom addresses were available (a total of 73);
- o correspondence with organisations identified as users of the area (Appendix B);
- o a notice outlining the proposal and requesting public input was placed in the local/community newspapers (Appendix B); and
- o comments on the proposal were sought from people encountered during field studies.

Response to the survey was good and concerns expressed by respondents included the items below. The sections of this report which address the concerns are presented in brackets. Frequency of concerns is shown in Table 4.

- o The number of road traffic accidents both reported and unreported (7.2.3).
- o The stress and trauma suffered by the residents due to traffic accidents (7.2.3).
- o Realignment will result in the alienation of an area of high conservation value (7.1.3, 7.1.4, 7.1.5, 7.1.6).
- o Realignment will result in the loss of recreational facilities (7.2.2.).
- o Realignment will result in the loss of amenity, particularly noise levels, air quality and visual amenity within the park (7.2.4, 7.2.5, 7.2.6).
- o The parkland should be safeguarded for future generations (7.3).

- o Loss of habitat for mammals, birds and reptiles (7.1.3, 7.1.4).
- o Loss of species of flora and fauna (7.1.3, 7.1.4).
- o Only example of Quindalup Dune System in M47 (7.1.1).
- o Development would facilitate the spread of dieback through use of heavy machinery (7.1.3, 7.1.5).
- o Possible redevelopment of land between the existing road and the proposed realignment for residential purposes (7.2.1).
- o Repercussions for System 6 M46 and M47 (7.3).
- o The area excised for realignment should be minimised (7.1.1, 7.1.3).
- o Easier access to Bold Park for residents of City Beach (7.2.3).
- o The design of the present road is poor (assessed in Section 2.0).
- o The present speed limit is frequently exceeded (assessed in Section 2.0).
- o The driver is at fault not the road (assessed in Section 2.0).

Many respondents felt the number of accidents on the existing road could be reduced by:

- o lowering the speed limit;
- o increasing the number of danger and warning signs;
- o clearer indication of a hazardous stretch of road;
- o use of a Multanova camera to catch offending speeding motorists;
- o adjustments to the camber of the existing road;
- o installation of traffic lights at the Rochdale Road intersection; and
- o use of part of the rifle range for realignment.

It was considered by many respondents that speed is a significant factor in these accidents and that if motorists kept to the existing speed limit of 70km/hr the number of accidents would be reduced.

TABLE 4
REALIGNMENT OF WEST COAST HIGHWAY
FREQUENCY OF ISSUES RAISED IN
WRITTEN RESPONSE TO PUBLIC CONSULTATION PROGRAMME

<i>Issue Raised</i>	<i>Frequency</i>
Loss of bushland/habitat	17
Policing/Multanova/lower speed limit would alleviate problem	16
Recamber road	14
Increased signs and traffic lights would alleviate problem	13
Wilderness/natural values of the area will be lost	13
M47 (System 6) will be adversely affected	12
Minor adjustments only to road should be made	11
Flora/fauna/significant species will be lost	10
Alienation/isolation of Bold Park will increase by realignment	8
Loss of amenity	8
Not necessarily any safer after realignment	8
Noise within park/from highway is a problem	7
Quindalup Association - the project area is only example in M47	7
Why have alternatives to realignment not been undertaken	7
Accidents occur at bend	6
Future generations should be considered/heritage value	5
Recreational opportunities/access will be adversely affected	5
Species diversity would be diminished	5
Speeding/driver fault/education cause of accidents	5
Period of review timeframe	4
Bad engineering cause of accidents	3
Barriers would help to solve problem	3
Greenhouse effect/pollution	3
Intersections are a problem	3
Realignment must be undertaken	3

7.0 POTENTIAL IMPACTS AND IMPACT MANAGEMENT STRATEGIES

7.1 BIOPHYSICAL ENVIRONMENT

7.1.1 Landforms

Impact

It is noted that the part of the project area which falls into the System 6 M47 recommendation contains the only example of Quindalup Association within M47, although it is represented in M46. Most of M46, however, has no current conservation status apart from its System 6 recommendation and a small area which is zoned Parks and Recreation by the City of Perth. The land contained in M46 is part of the City of Perth Endowment land (south of Rochdale Road and the areas west of the highway which are not vested in the Commonwealth Department of Defence) and of the Department of Defence's Rifle Range (most of the land west of the West Coast Highway).

Management

A Public Environmental Review (Stage 2 of the City of Perth's proposals) will examine proposed land use in the M46 and M47 areas. It is considered that the issue of regional conservation of the Quindalup Association geomorphology should be examined within that document.

As part of the current proposal, it is recommended that landform disturbance be kept to a minimum and that the area of M47 alienated by the realignment should be linked by rehabilitation to M46 west of the current highway alignment.

7.1.2 Drainage

Impact

The proposed West Coast Highway will be kerbed and the runoff will be channelled off the carriageway and discharged into natural soil adjacent to the embankment.

Owing to the permeable nature of the sands and fractured limestone in the project area contaminants may be readily transported to the water table. However, the contaminant load carried in stormwater runoff from the realigned West Coast Highway is expected to be low and no greater than the existing load. No major public groundwater supplies exist in the area.

Management

Drainage will be managed to ensure that erosion does not occur and that flooding is not caused.

7.1.3 Vegetation and Flora

Impact

Although no Gazetted rare plant species were found during field surveys undertaken in January 1991, several significant species are recognised as occurring in the project area (Section 5.1.5). Realigning the West Coast Highway would impact on several of these species including *Agonis flexuosa*, *Jacksonia sericea*, *Eucalyptus* "petrensis" and *Chamelaucium uncinatum*. The area to be cleared of vegetation for the Option D realignment would be approximately 7ha and would vary in width according to the terrain (Figure 6).

Management

Some destruction of vegetation is inevitable with any realignment. All vegetation outside the clearing width required for the highway should be left intact and care would be taken to avoid unnecessary disturbance or destruction to surrounding vegetation. This could be achieved by:

- o restricting vehicular movement and creation of tracks in vegetation adjacent to the highway realignment; and
- o ensuring that weeds and dieback disease are not transported along the route (Section 7.1.5).

It is recommended that vegetation removed from the highway easement should be used as mulch for the rehabilitation of the old highway alignment and surrounding areas. Very large material, such as tree trunks, should be disposed of to an authorised landfill site. Burning on-site is not recommended due to the risk of fire spreading to Bold Park and the nuisance value of smoke for nearby residents, recreationists and road users.

It is recommended that the old highway alignment and surrounding areas be rehabilitated using local plant species.

Preliminary details of the proposed rehabilitation programme are contained in Section 4.5. A detailed rehabilitation programme, which would be submitted to the EPA for approval, would be prepared prior to the commencement of construction activities.

Criteria for satisfactory rehabilitation of this area are considered to be:

- o the establishment of native vegetation species with a canopy density of about 75% of the adjacent M46 and M47 areas within three years;
- o stability of landforms for a period of at least three years;
- o the presence of a variety of self-sustaining native species.

7.1.4 Fauna

Impact

It is noted that a significant faunal assemblage occurs in the project area. If a decision to realign the West Coast Highway is made, any loss or alienation of land which has native vegetation would cause a concomitant loss of faunal habitat. The key to fauna protection is therefore to avoid any unnecessary loss of vegetation. However, it should also be noted that many faunal species are very sensitive to disturbance. Many will not cross even minor tracks and certainly will not cross the highway. Thus, the existing highway and the proposed realignment would disrupt many local faunal territories and cause loss of fauna both within and adjacent to the easement.

Management

There is no way to avoid this general loss of fauna habitat and still have the realignment of West Coast Highway constructed. However, minimisation of clearing the vegetation and, ultimately, rehabilitation of the old alignment, will assist in reducing the long-term impacts.

7.1.5 Control of Weeds and Diseases

Impact

The risk of transport of dieback disease along the alignment and into adjacent bushland is high. This is especially true in winter when soil material may adhere to the wheels of vehicles. As the conservation value of most of the vegetation within the project area is high, the significance of any further distribution of dieback disease would be major.

The most common weeds in the project area are grasses. There are no long-term economic solutions to weed and grass encroachment.

Management

Normal dieback hygiene procedures, such as recommended by the Department of Conservation and Land Management and practised by the Main Roads Department, should be followed during the construction of the realignment. This would include such practices as washing down of earthmoving and transport machinery prior to commencement of work. This washdown is designed to remove all soil particles from machinery to avoid introducing the soil-borne pathogen to uninfected areas. The City of Perth should liaise with the Department of Conservation and Land Management to ensure that an adequate dieback disease management programme is designed and implemented.

Weed control within M47 is difficult without also damaging native species. It is considered important that the construction of the West Coast Highway realignment should not introduce further weeds into the area. Dieback washdowns will assist in this regard. A carefully planned weed control programme will also be needed.

7.1.6 Fire Management

Impact

Wildfire has the potential to severely impact on the area's conservation values and to threaten property. As outlined in Section 5.1.8, the City of Perth has prepared a draft Fire Management Plan for this land.

Management

It is recommended that the City of Perth's Fire Management Plan be adopted subject to the advice given by the Environmental Protection Authority. Annual control of weeds and grasses should be carried out on verges to prevent a build up of fuel and to reduce the fire hazard. This is probably best undertaken using a brushcutter, taking care to avoid seedlings of native plants.

7.2 SOCIO-CULTURAL ENVIRONMENT

7.2.1 Land Use and Zoning

Impact

There would be a short-term reduction in land available for recreation and education purposes. The removal of the existing road would create an opportunity to rehabilitate a similar area. Part of the western carriageway would be retained for use as an accessway to Challenger Parade.

Realignment would involve rezoning. West Coast Highway is currently zoned as an Important Regional Road in the Metropolitan Region Scheme. The land between the existing highway and the proposed realignment is currently zoned Urban in the MRS and Parks and Recreation in the City of Perth Planning Scheme. The area of Mount Claremont Bush is currently zoned Residential (R20).

Management

Changes to the zoning of the area would need to be made. The area currently zoned Important Regional Road would need to be rezoned, preferably to Parks and Recreation.

Modifications would be necessary to the section of road to be retained as access to Challenger Parade and at the junction with Challenger Parade. The old road and verges should be rehabilitated to native bushland for recreation and education purposes and to provide continuity between the alienated section of M47 and M46 west of West Coast Highway.

It is not recommended that the area between the realignment and Launceston Avenue be developed as residential. Noise and other problems associated with proximity to a highway will still exist if this were developed as residential. Any new development would have adverse impacts on the conservation values of both this area and Bold Park. Launceston Avenue and its adjoining verge should be retained in their present condition.

7.2.2 Recreational Values

Impact

There would be a loss of recreational value of the south-west corner of Bold Park (Endowment land). Some of the local trails would be disrupted and the local bridle path would be cut off. There would be an increase in traffic noise and a decrease in visual amenity for park users in this region. Walkers and joggers may experience discomfort from exhaust emissions although this could already occur. Access from west of the highway to the south-west portion of the park would be via the underpass.

Management

The walk trails and bridle path could be re-routed away from the roadway. However, this would result in a decrease in conservation values to some of the remainder of Bold Park and the Endowment land through the proliferation of tracks. Bridle paths are also significant routes for the introduction of dieback disease and weeds. A possible information area should be installed near the location of the pedestrian underpass to encourage people to use the designated walk trails. Incorporation of the alienated area with the reserve to the south of Challenger Parade could provide an area of recreational value extending to the ocean.

7.2.3 Access and Safety

Impact

It is considered that the upgrade in road design should provide for a safer road and fewer accidents. Minimal changes would occur to access to and from the West Coast Highway. The pedestrian underpass would provide a safe route for the public wishing to cross the highway.

Management

The road design should concur with safety standards for the type of road and traffic volume that is anticipated. Good signs, road markings and lighting would be necessary.

Traffic using the exit leading to Challenger Parade should be discouraged from cutting through the residential area. The nature strip should be retained and shrubs planted to prevent vehicles from cutting across onto Launceston Avenue for access to Saltash Avenue and Branksome Gardens.

The pedestrian underpass (if constructed) should be well lit and the public should be encouraged to use it.

7.2.4 Landscape Amenity

Impact

Due to the topography between the residential area and the preferred option route the new road would be less visible to some of the residents. The new road would be visible to some users of the south-west corner of Bold Park and the Endowment land.

Management

The area between the housing and the realignment should be rehabilitated as natural bushland, using the plant species already found in the area. The old road should be removed and this area rehabilitated and included in the bushland. Development as parkland would not mitigate the alienation of M47 and would require too much maintenance. Little can be done to improve the visual impact of the road on the users of the park.

7.2.5 Soils, Dust and Erosion

Impact

Dust generated during the construction phase, and in any unstable areas during the post-construction phase, could have an adverse impact on local residents and recreationists.

It was noted during site visits undertaken in January 1991 that the soils had a high dust component, particularly when disturbed. Several denuded areas were noted as generating windblown dust possibly in excess of Environmental Protection Authority standards. Earthworks for any of the alignments are in close proximity to residents on Launceston Avenue and users of the Bold Park and City of Perth Endowment lands. Careful management would be required to ensure that dust levels do not become a nuisance to residents and recreationists. Wind-generated erosion could have an impact during clearing and earthworks.

Management

The management of dust and soil erosion can be achieved by minimising the area of cleared land, watering down denuded areas which may generate dust, and stabilising slopes and cleared areas as soon as practicable after clearance. This should be done through rehabilitation with suitable local native species (Section 4.5). Construction during the winter months would help reduce the impacts of dust (Section 4.3).

7.2.6 Noise

Impact

Relocation of the highway to the east would decrease the noise level for people in the residential area but would increase noise levels for users of the south-west corner of Bold Park and the Endowment land.

Management

Noise from major roads is an inevitable consequence of urbanisation and no simple management procedure can eradicate this problem. It is noted, however, that noise levels for permanent residents would be lower as a consequence of the preferred option.

7.2.7 Aboriginal and European Heritage

Impact

There are no known sites of European heritage significance. One site of Aboriginal significance has been recorded nearby but not within the project area.

Management

Should any artefacts or material of cultural origin be located during road construction, the City of Perth would notify the Department of Aboriginal Sites in accordance with the requirements of the Aboriginal Heritage Act 1972-80. No Aboriginal sites or artefacts would be disturbed without the written permission of the Minister for Aboriginal Affairs.

7.2.8 Community Values and Expectations

Impacts

Negative impacts on community values and expectations as the result of the realignment of West Coast Highway would be:

- o loss and alienation of an area of land of high conservation value; and
- o temporary loss of a recreational and educational facility.

Management

Some conservation and recreational value could be restored to the alienated land through the rehabilitation of the existing alignment. However, it should be noted that the implementation of any realignment of West Coast Highway has inevitable consequences for loss of conservation, recreation and education values.

7.3 SYSTEM 6 RECOMMENDED AREAS M46 AND M47

Impact

It is recognised that the implementation of the preferred option (Option D) would have significant adverse impacts on M46 and M47.

Management

As the Main Roads Department judges that the safety standard of the existing road cannot be improved without realignment, then Option D represents the best compromise between environmental, social and safety factors. However, the City of Perth has made a commitment to develop an integrated long-term plan for M46 and M47 areas and to prepare a further PER for public and EPA evaluation. This should ensure that road issues are not addressed in isolation from other proposals affecting the long-term values of these System 6 areas.

8.0 CONCLUSIONS

The section of West Coast Highway between Rochdale Road and Helston Avenue has a history of traffic accidents. The engineering design of this section is indicated by the Main Roads Department as below that of the remainder of West Coast Highway. Extra warning signs and hazard boards have already been installed, with little effect on the number of accidents, and further improvements are considered impractical. As it cannot be rendered safe realignment seems necessary.

Based on available information, and taking full account of environmental, social and safety issues, a number of optional realignments have been considered. No one option was able to fully satisfy all requirements. Those that best satisfied safety criteria were poor in respect to environmental and recreational issues and *vice versa*. The best possible compromise is believed to be Option D, shown in detail on Figure 6.

Option D adequately satisfies the safety requirements recommended by the Main Roads Department. There will, however, be environmental and social impacts as a result of the chosen realignment (Section 7) as there will be with any realignment. Given that realignment is necessary, it is considered that Option D would have the least overall impact of the alternatives that satisfy the safety criteria as shown in the matrix (Appendix D). Careful management would be required to further minimise these impacts.

It is noted that Option D may not be the least expensive option and that Council should recognise this fact.

Subject to approval from the EPA, the City of Perth would take steps to proceed with the construction of Option D as described in this document.

9.0 COMMITMENTS

The City of Perth, as proponent, will fulfil the following commitments as part of the proposal.

1. System Six Areas.

1.1 Within 12 months of the release of the Public Environmental Review for the realignment of West Coast Highway, City Beach, plan a study on the management of long-term issues affecting System Six Recommendation Areas M46 and M47.

1.2 Subsequent to 1.1, and within 12 months of the release of the Public Environmental Review for the realignment of the West Coast Highway, City Beach implement the approved study and report on its findings.

2. Construction Plan.

2.1 Prior to any site works, prepare a Construction Plan for the realignment. The Plan will provide designs, specifications and locations and include, but not necessarily be limited to:

- o** management of vehicular movement in vegetation adjacent to the easement and cut and fill areas;
- o** management of disturbance to landforms and vegetation;
- o** erosion and dust control;
- o** pedestrian underpass (subject to public support); and
- o** induction of all personnel employed on the project in environmental management methods.

2.2 Subsequent to 2.1, implement the approved Construction Plan.

3. Rehabilitation Plan.

3.1 Prior to any site works, prepare a Rehabilitation Plan for the realignment and the old road alignment. The Plan will provide designs, specifications and locations and include, but not necessarily be limited to:

- o criteria for successful rehabilitation;
- o use of cleared vegetation for mulch;
- o topsoil removal, stockpiling and replacement;
- o direct seeding, planting and use of hydromulching;
- o replanting of local species from seed collected from M46 and M47;
- o road verge planting; and
- o use of fertilisers.

3.2 Subsequent to 3.1, implement the approved Rehabilitation Plan.

4. Dieback Management Plan.

4.1 Dieback hygiene procedures as recommended by the Department of Conservation and Land Management will be implemented to control the spread of dieback disease and weeds along the route.

5. Fire Management Plan.

5.1 The City of Perth's Fire Management Programme will be adopted subject to advice by the EPA. Weeds and grasses on verges will be controlled to reduce fire hazards.

10.0 ACKNOWLEDGMENTS

In the process of preparing this PER, Dames & Moore has consulted the following organisations/individuals. Their co-operation is gratefully acknowledged:

- o City Beach Highway Safety Action Group.
- o City of Nedlands.
- o Peter Luff - City of Perth, Parks and Gardens.
- o John Andrews - City of Perth, Recreation.
- o Robert Reynolds - Department of Aboriginal Sites.
- o Robert Powell - Department of Conservation and Land Management.
- o Boyd Wykes - Education Centre, Kings Park.
- o Friends of Bold Park.
- o Main Roads Department - Traffic Management.
- o Main Roads Department - Accident Statistics.
- o National Trust of Australia (Western Australia).
- o Wembley Ward Ratepayers and Residents Association.
- o Juliet Andrews - Western Australian Heritage Committee.
- o John Dell - Western Australian Museum.
- o Western Australian Wildflower Society (Inc).
- o Members of the public who responded to the programme.

Dames & Moore wish to acknowledge the cooperation of Wally Piscetek and Egon Pihu of the City of Perth Engineering Department in the provision of information required for the completion of this document.

11.0 STUDY TEAM

Barry Muir	Lead Consultant - overview, ecology, management options
Sandra Gray	Project Manager - social impacts, public consultation, management options
Arthur Weston	Botany
Sarah McEvoy	Ecology, management options

12.0 GLOSSARY AND NOMENCLATURE

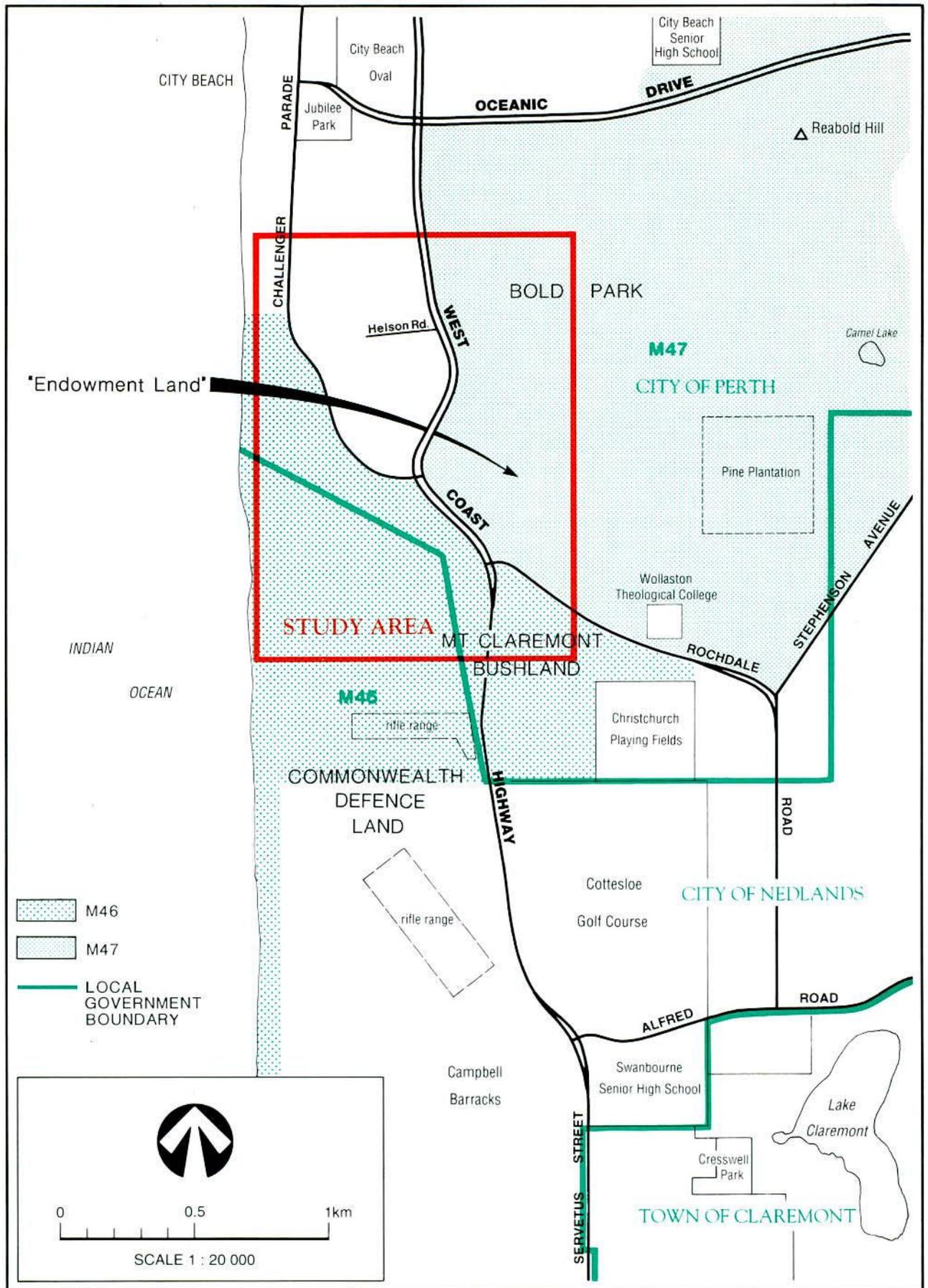
AHD	Australian Height Datum
Arboreal	Of or pertaining to tree-dwelling animals
Avian	Of or pertaining to the nature of birds
DRF	Declared Rare Flora
Epigeic	Of or pertaining to ground-dwelling animals
Fossorial	Of or pertaining to burrowing animals
Hydromulching	Use of a <i>papier-mache</i> mulch containing seeds to help reduce water loss and prevent weed establishment
Mycorrhizae	The association of a fungus with the roots of a higher plant. The presence of mycorrhizal fungus has been shown to be vital for growth of some plants.
NAASRA	National Association of Australian State Road Authorities
Pers. comm.	Personal communication
Swale	A depression or topographic low between dunal rises
Understorey	The layer of vegetation beneath the upper layer of (usually) trees
WAWRC	Western Australian Wildlife Research Centre

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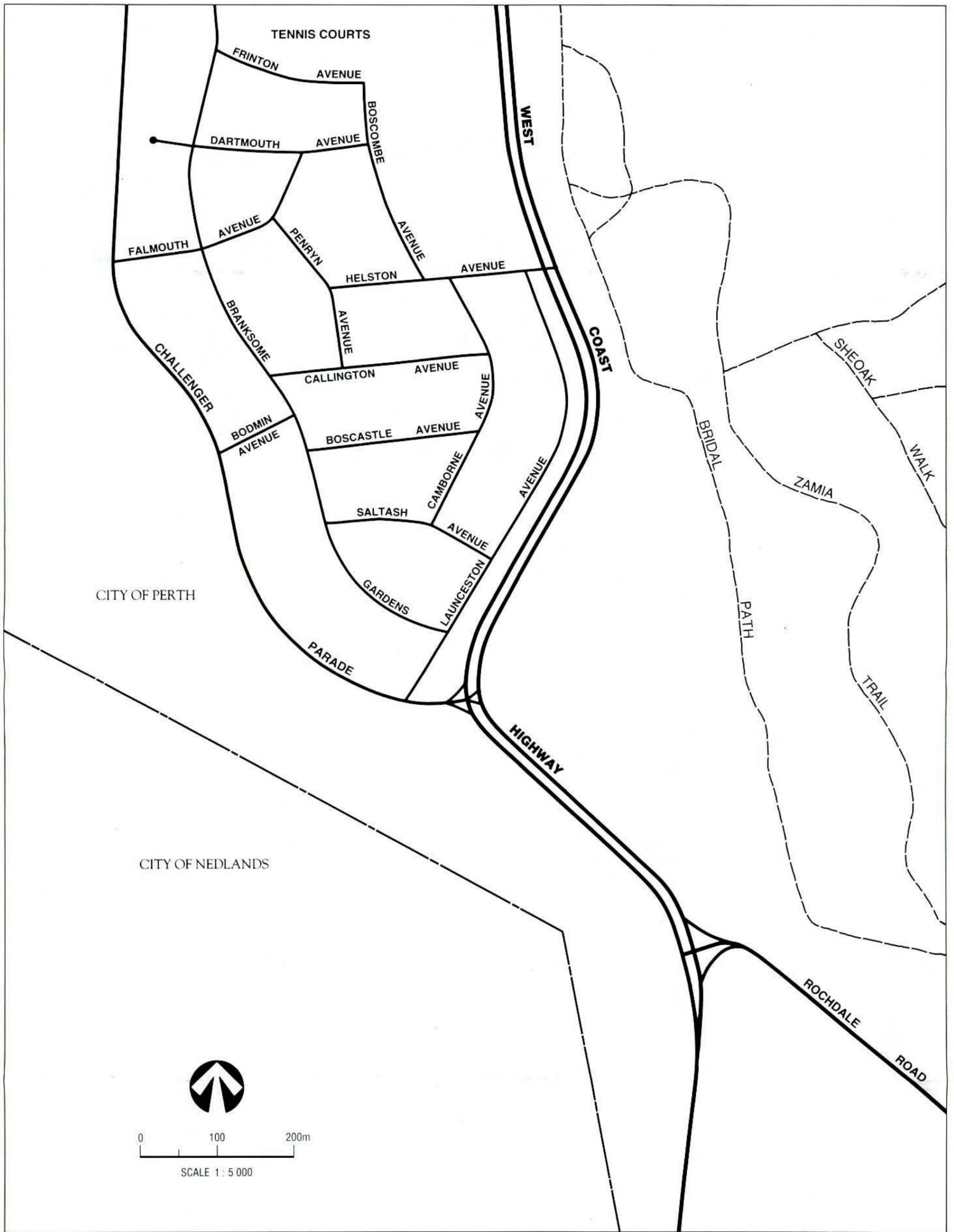
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Figures



LOCALITY PLAN

FIGURE 1
DAMES & MOORE



DETAIL OF STUDY AREA



OPTION B



OPTION A

PROPOSED RE-ALIGNMENT
OPTIONS A-B

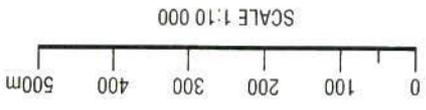
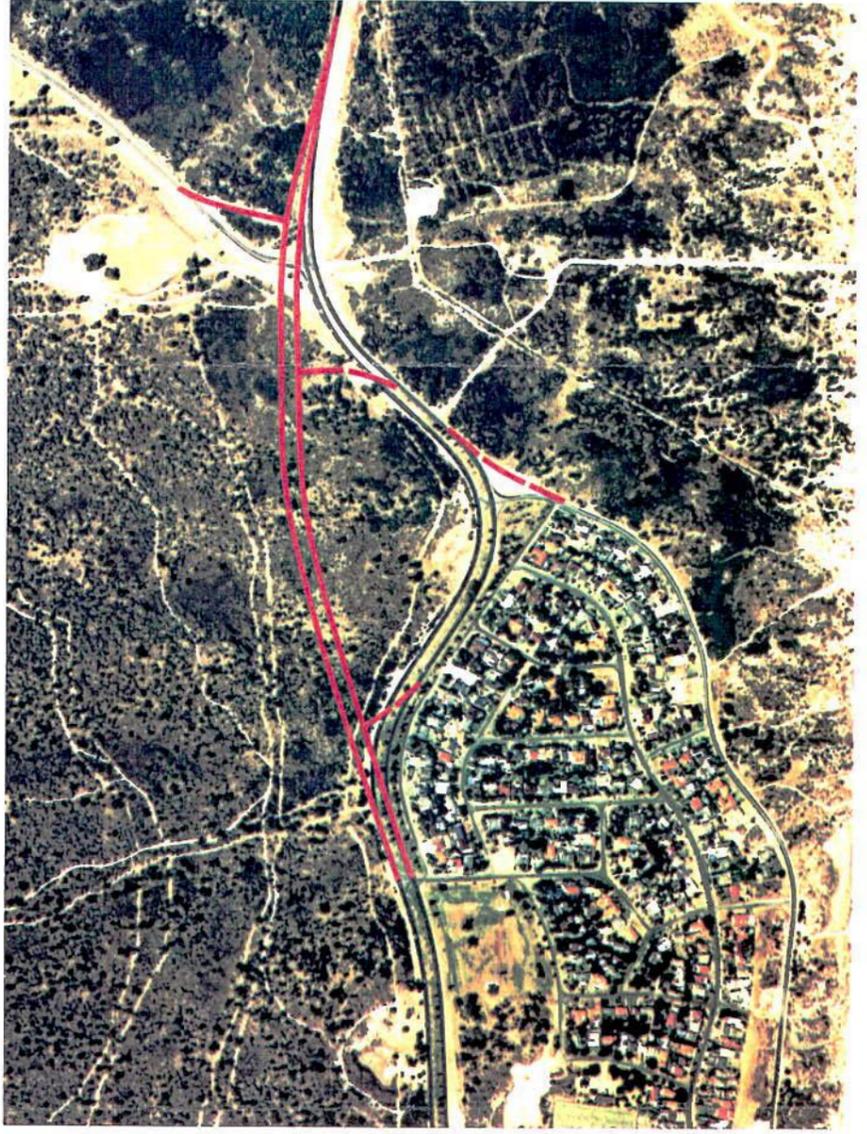


FIGURE 3
DAMES & MOORE

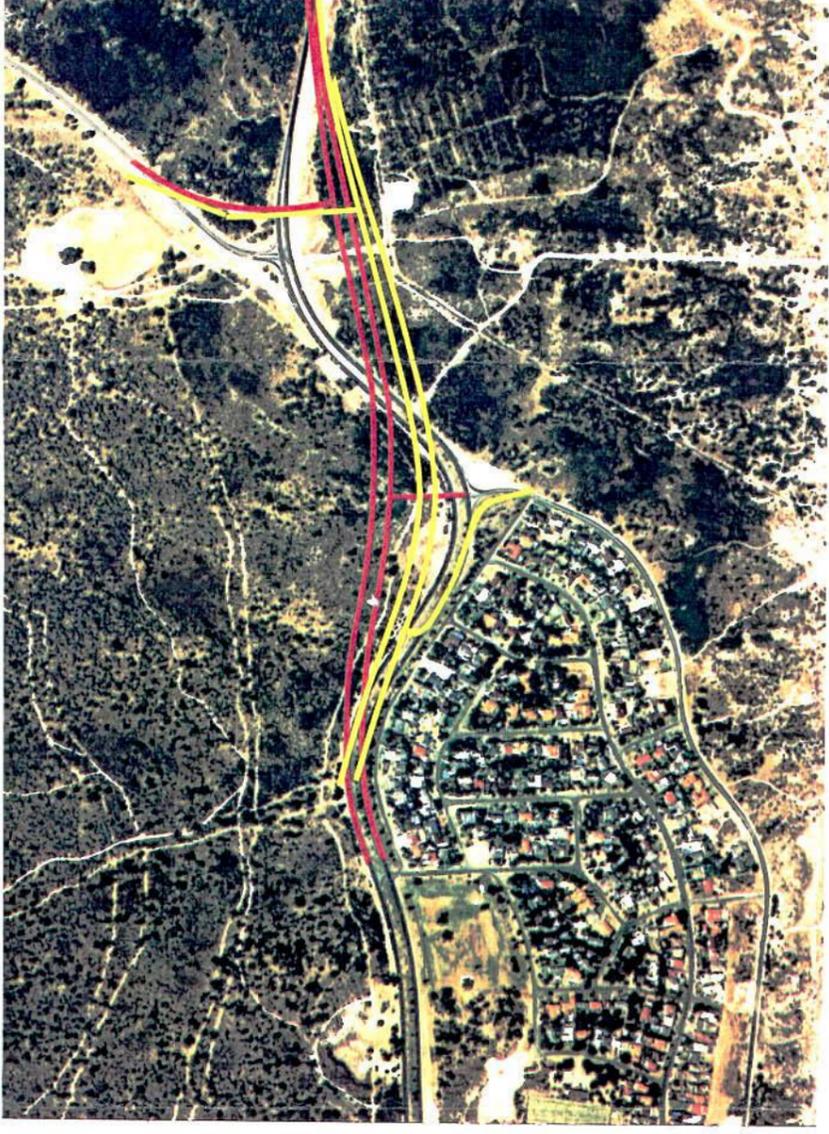
PROPOSED RE-ALIGNMENT
OPTIONS C-G



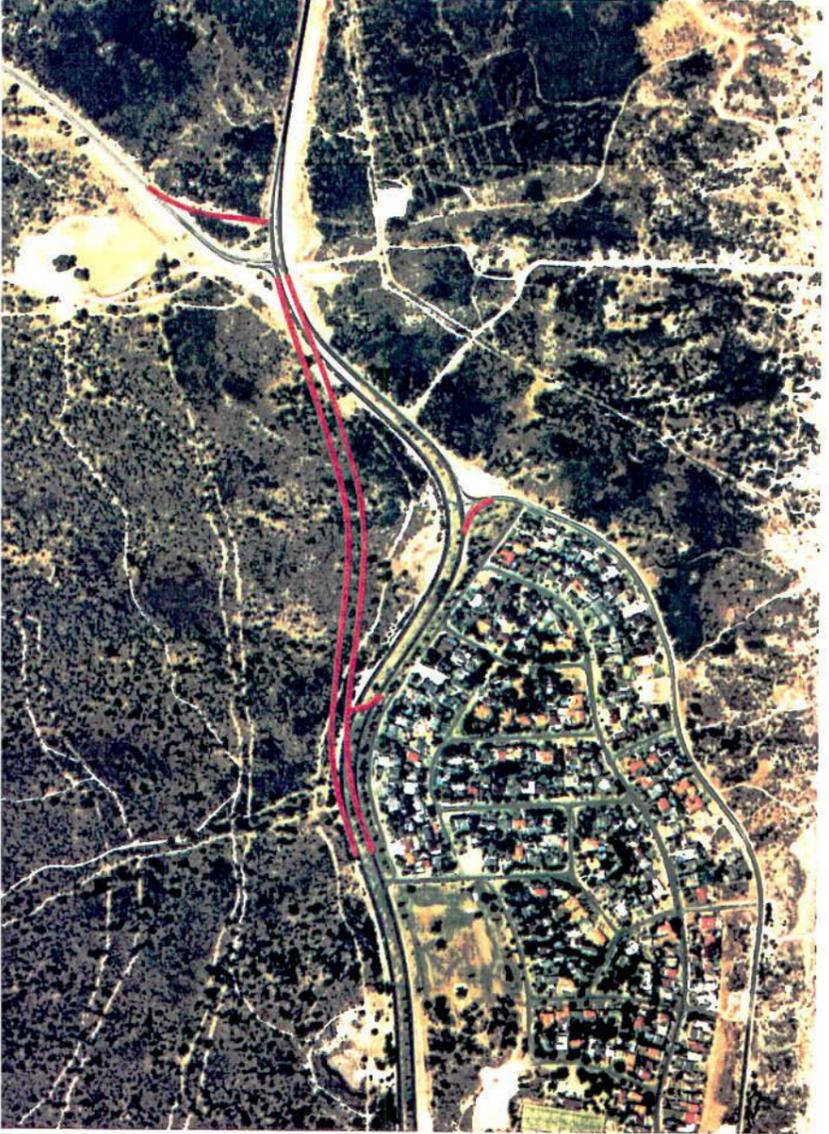
OPTION E



OPTION C



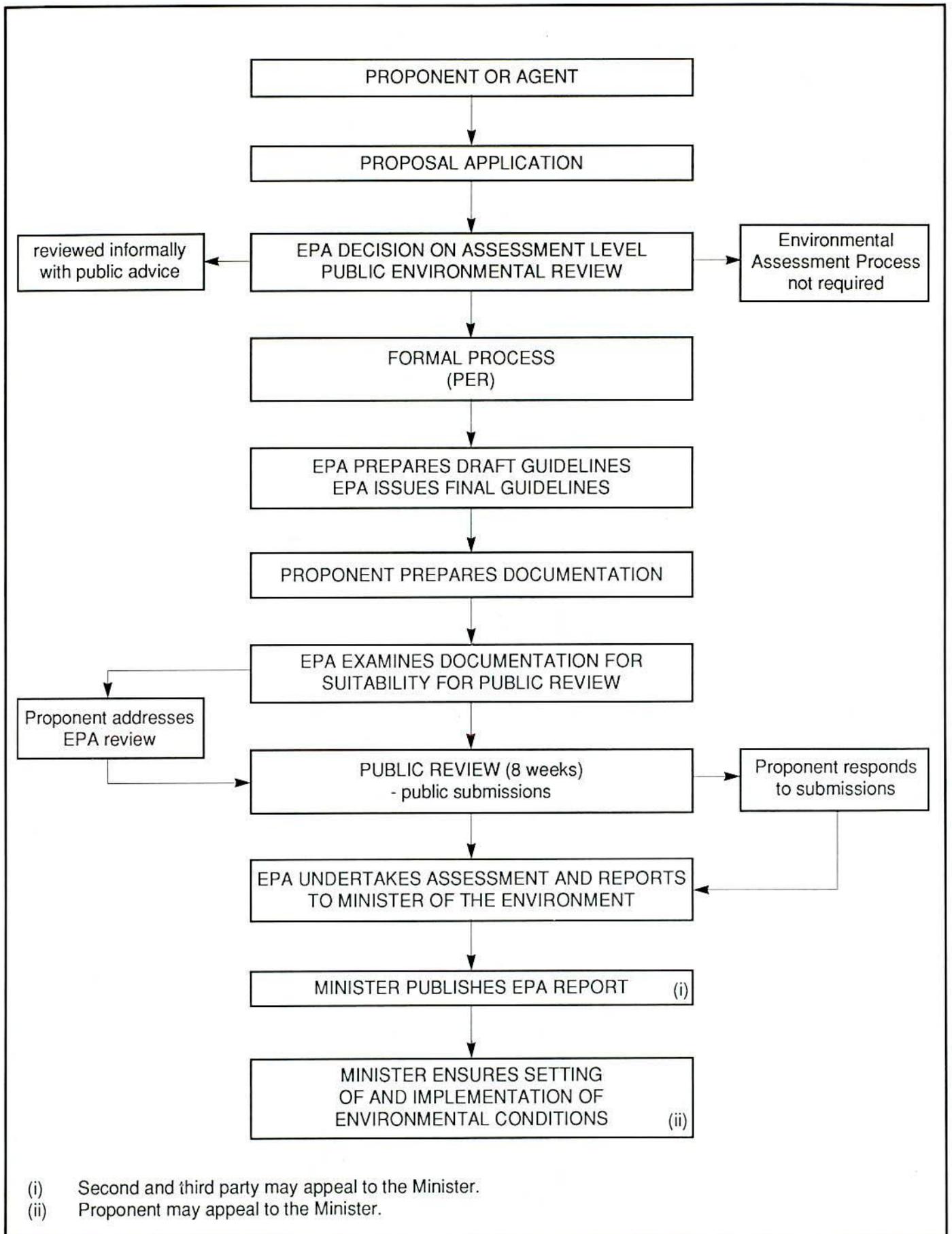
OPTIONS F & G (YELLOW)



OPTION D

SCALE 1:10 000
0 100 200 300 400 500m

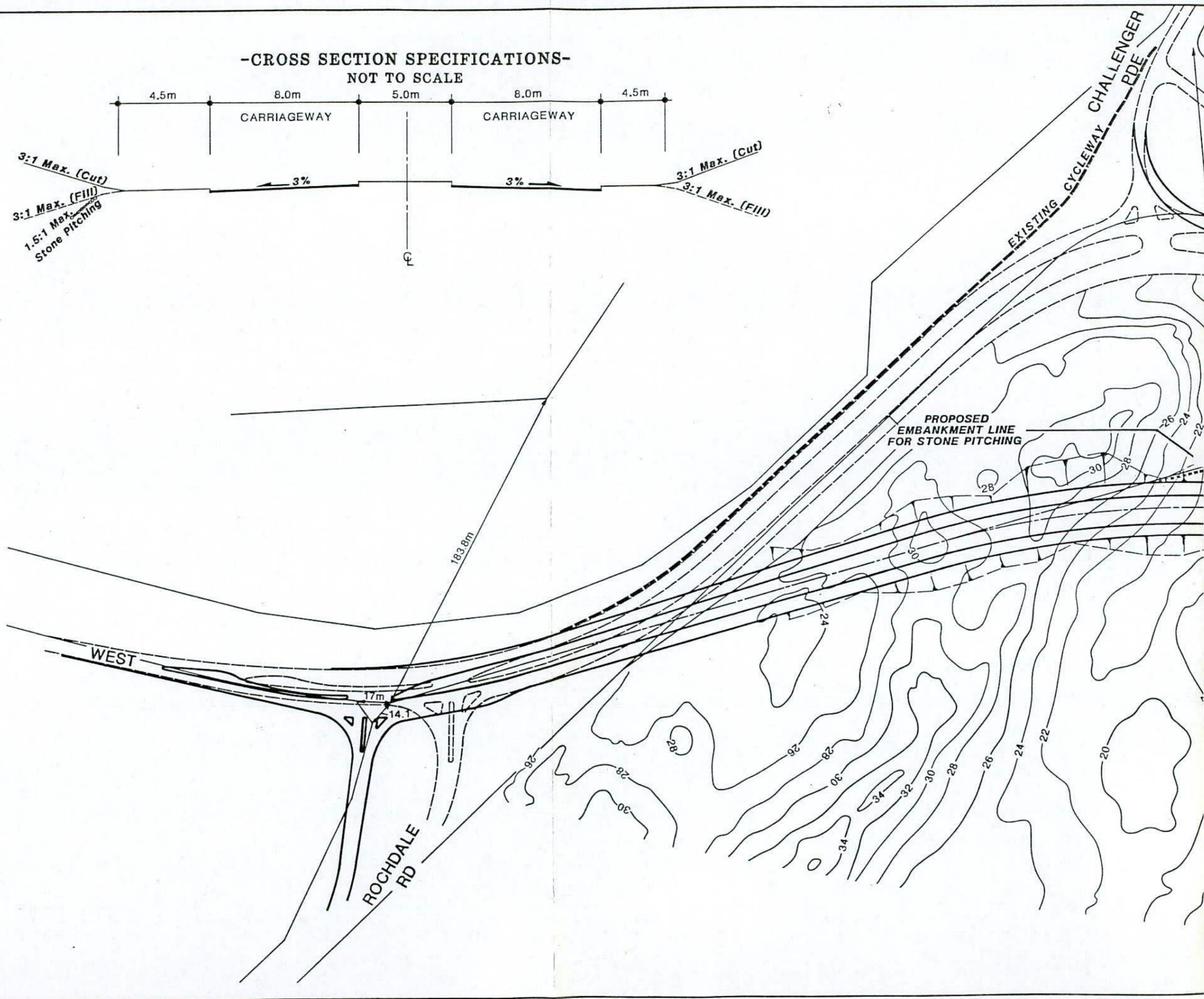
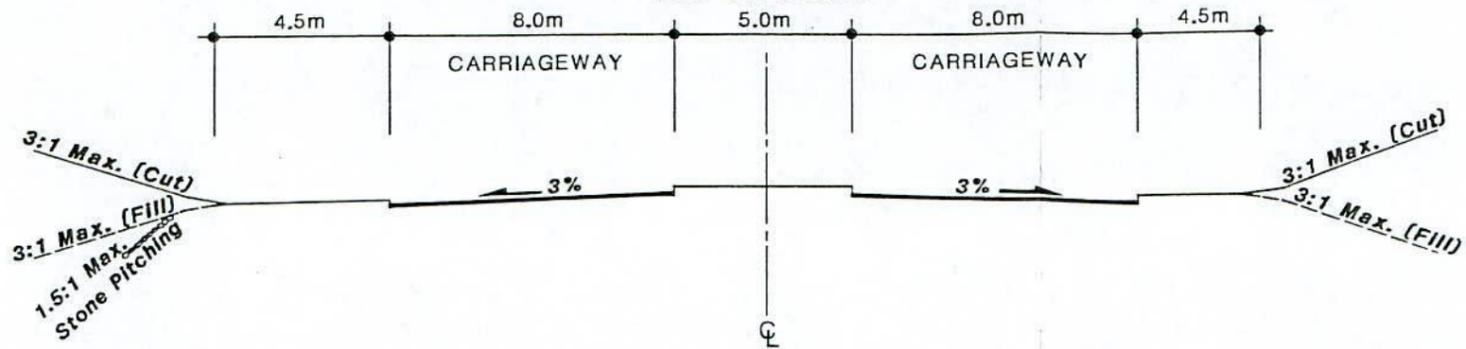


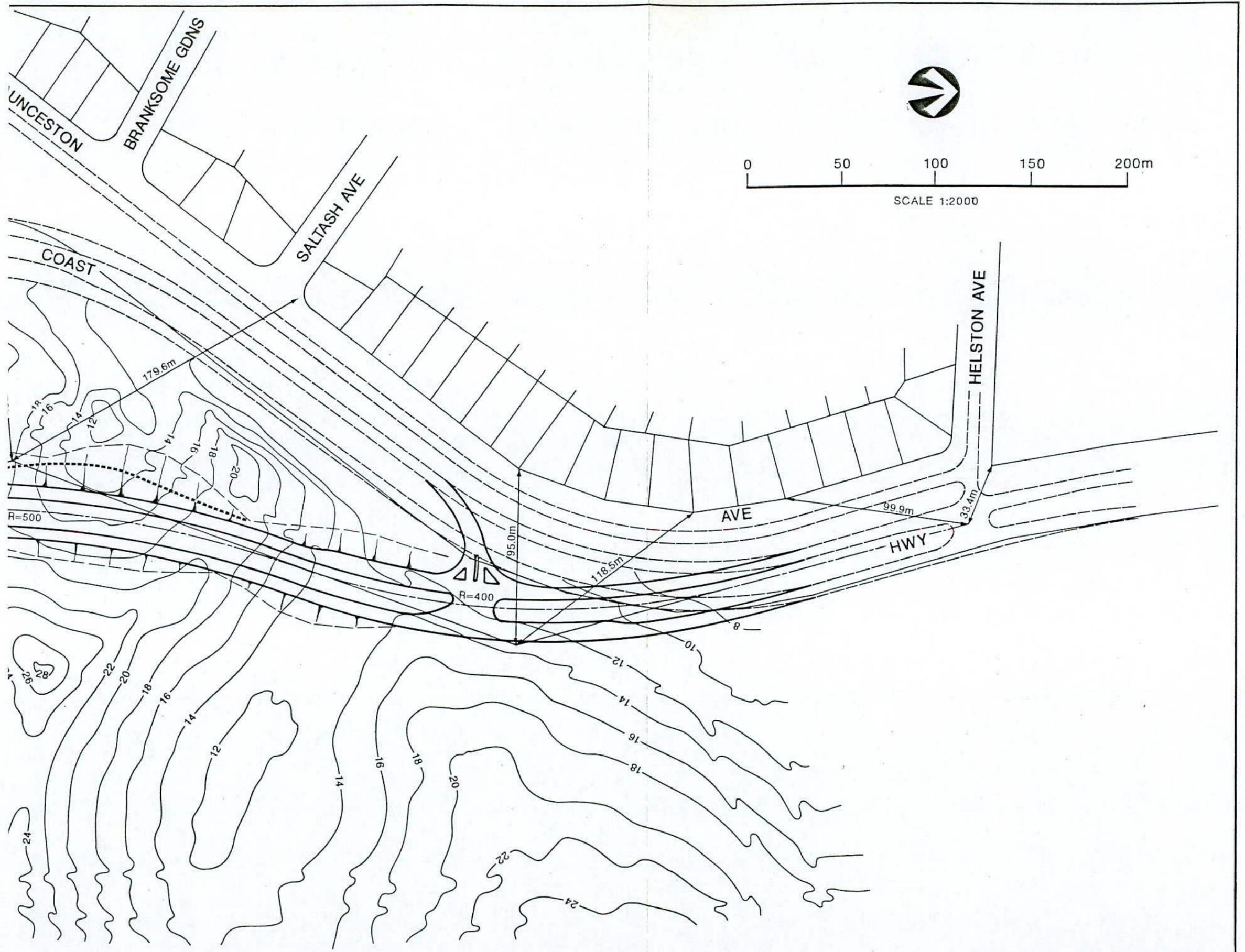


EPA ASSESSMENT PROCESS — PUBLIC ENVIRONMENTAL REVIEW

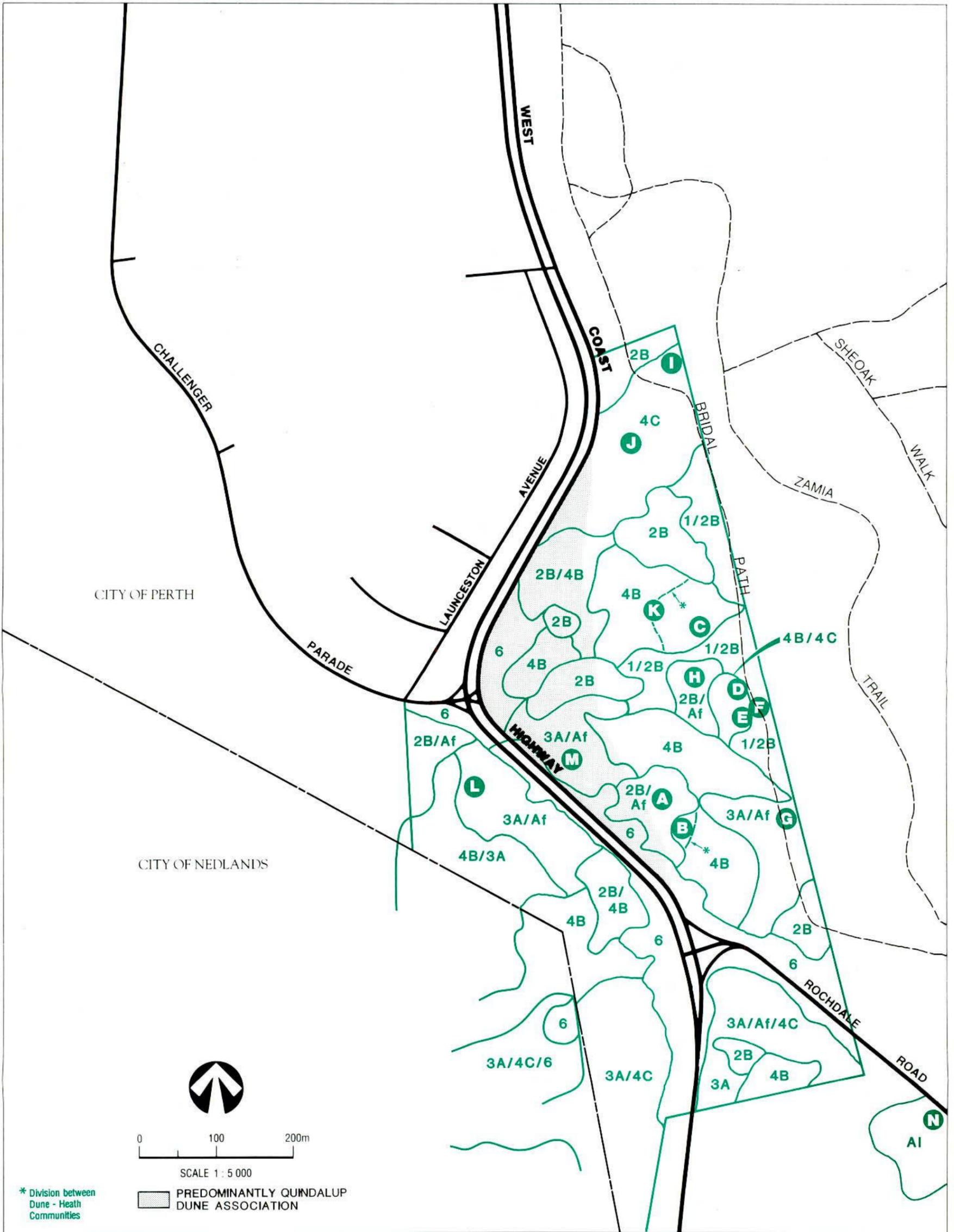
-CROSS SECTION SPECIFICATIONS-

NOT TO SCALE





OPTION D - LOCATION PLAN

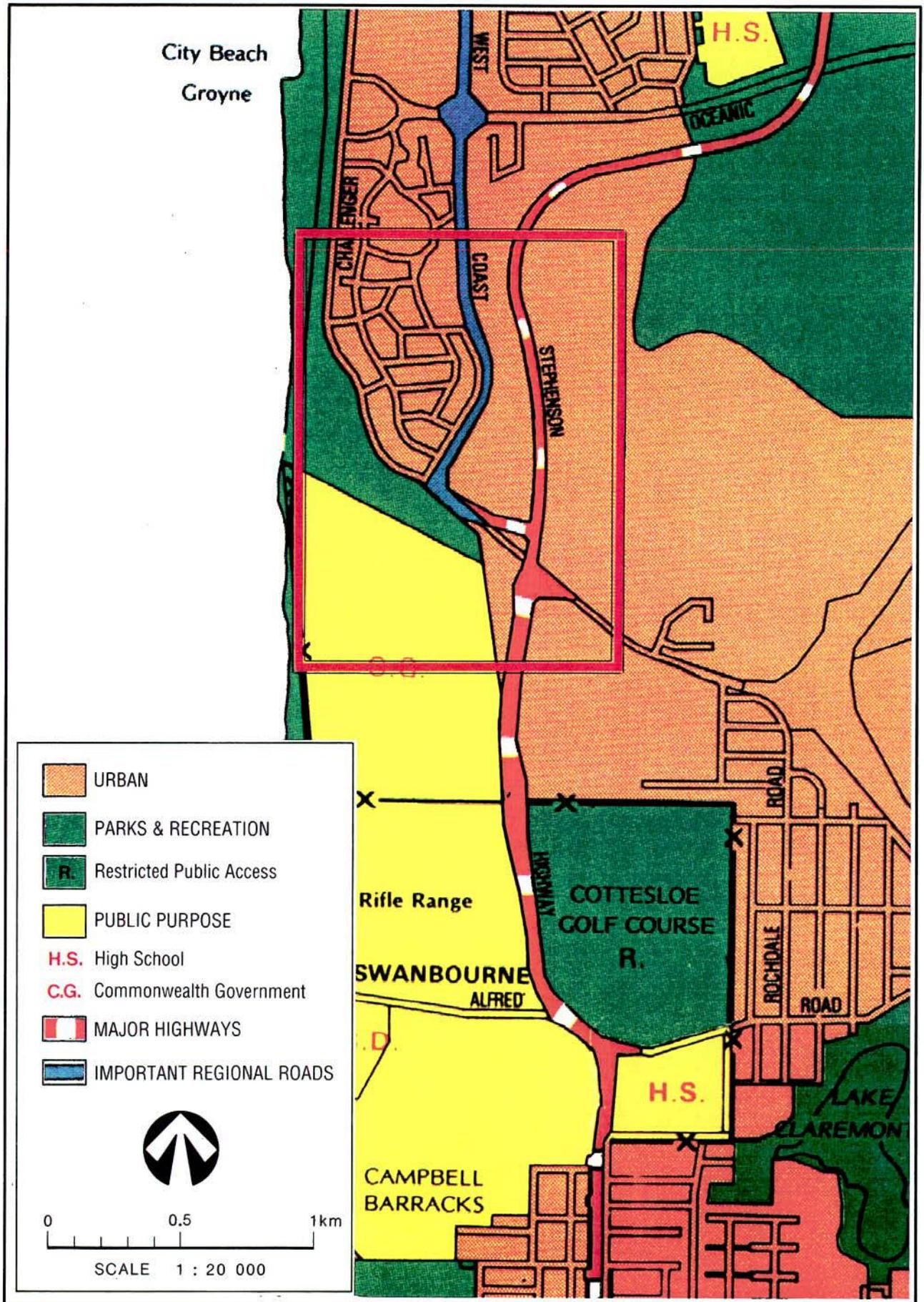


- PHOTOGRAPHIC SITES**
- 1** *BANKSIA* WOODLAND
- 2B** *EUCALYPTUS GOMPHOCEPHALA* (TUART) WOODLAND
- 3A** *ACACIA ROSTELLIFERA* SHRUBLAND
- 4B** DUNE HEATH
- 4C** *DRYANDRA SESSILIS* HEATH
- 6** HEAVILY DISTURBED AREA
- Af** *AGONIS FLEXUOSA* (PEPPERMINT)
- AI** *ALLOCASUARINA LEHMANNIANA*

NOTE: FOR DETAILED DESCRIPTION OF VEGETATION TYPES SEE TABLE 1. SLASHES INDICATE MOSAICS OR MIXTURES OF VEGETATION TYPES.

VEGETATION OF STUDY AREA

FIGURE 7
DAMES & MOORE



MRS ZONING PLAN

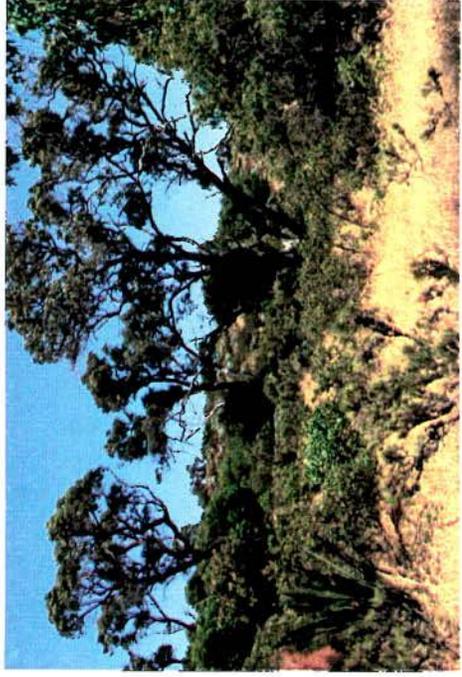
Plate

**CAPTIONS PLATE 1
VEGETATION OF THE PROJECT AREA**

- A Site A *Eucalyptus gomphocephala* (tuart) woodland (Type 2B/Af)
Tuart trees with denser tree understorey of peppermint (*Agonis flexuosa*) to 6m tall and groundlayer comprising *Lepidosperma gladiatum*, *Pelargonium capitatum* and various weedy grasses. Veldt grass (*Ehrharta calycina*) in foreground (ASW 91.P1.1)
- B Site H *Eucalyptus gomphocephala* (tuart) woodland (Type 2B)
Tuart trees with a few peppermint, *Banksia menziesii* and *B. attenuata* trees to 5m tall (Type 1) and *Allocasuarina humilis* and *Hakea prostrata* shrubs to 1m tall; also *Macrozamia riedlei*. On slope on background: dune heath (Type 4B) of numerous species including *Melaleuca acerosa*, *Olearia axillaris* (pale form) and *Santalum acuminatum*. Band of *Calothamnus quadrifidus* heath between tuart woodland and upper slope dune heath (ASW 91.P1.8)
- C Site L *Acacia rostelifera* shrubland (Type 3A)
In valley and slopes with a few tuart and peppermint trees; tuart woodland behind and *Olearia axillaris* dune heath (Type 4B) in foreground (ASW 91.P1.12)
- D Site N *Allocasuarina lehmanniana* shrubland (Type A1)
Slopes south of project area; merges with *Acacia rostelifera* shrubland and may include habitat for *Callitris preissii* trees (ASW 91.P2.00)
- E Site K Dune heath (Type 4B)
50cm tall, species-rich heath on upper slopes of stabilised dune, dominated by *Grevillea crithmifolia*, *Acacia lasiocarpa*, *Melaleuca acerosa* and *Cassytha flava*; less common species include *Olearia axillaris*, *Lechenaultia linearoides*, *Acanthocarpus preissii*, *Helichrysum cordatum*, *Calothamnus quadrifidus*, *Hemiandra pungens* and *Stipa flavescens* (ASW 91.P1.11)
- F Site B *Calothamnus quadrifidus* dune heath (Type 4B)
2m tall heath at base of slope, with *Acacia rostelifera* shrubland (Type 3A) higher on slope, in background (ASW 91.P1.2)
- G Site J *Dryandra sessilis* heath (Type 4C)
With *Hakea trifurcata*, *Hakea prostrata* and *Dryandra sessilis* dominating; also *Calothamnus quadrifidus*, *Allocasuarina humilis*, *Melaleuca acerosa*, *Grevillea ? crithmifolia*, *Jacksonia sericea* and, rarely, *Eucalyptus* "petrensis"; veldt grass. Type 6 (partial) disturbed area in foreground (ASW 91.P1.10)
- H *Eucalyptus* "petrensis" in Type 4C *Dryandra sessilis* shrubland at Site J. Small (ca. 2m) branched, smooth-stemmed tree similar to *E.* "petrensis" (see Powell, 1990). (ASW 91.P1.12A)



A



B



C



D



E



F



G



H

Appendix A

APPENDIX A

**GUIDELINES ISSUED BY THE
ENVIRONMENTAL PROTECTION AUTHORITY**

GUIDELINES FOR PREPARING A PUBLIC ENVIRONMENTAL REVIEW FOR THE PROPOSED REALIGNMENT OF WEST COAST HIGHWAY AT SOUTH CITY BEACH

The guidelines provide a list of topics that should be included within the Public Environmental Review. They are not intended to be exhaustive and the proponent may consider that other topics should also be included in the document. The purpose of the PER should be explained and the contents should be concise and accurate as well as being readily understood. Specialist information and technical description should be included where it assists in the understanding of the proposal. It may be appropriate to include ancillary or lengthy information in technical appendices.

In proposing the realignment of the West Coast Highway, the City of Perth has acknowledged that this proposal is one of several interrelated issues affecting System 6 Recommended Areas M46 and M47 and has agreed to undertake a Second Stage PER study to address those issues. These guidelines, therefore, are intended for the realignment of the West Coast Highway or Stage 1. Separate guidelines will be issued for the Stage 2 PER.

1. Summary

The Public Environmental Review should contain a brief summary of:

- salient features of the proposal
- alternatives considered
- description of receiving environment and analysis of potential impacts and their significance
- environmental monitoring and management programmes, safeguards and commitments
- conclusions

2. Introduction

The Public Environmental Review should include an explanation of the following:

- identification of proponents and responsible authorities
- background and objectives of the proposal
- brief details of, and timing of, the proposal
- relevant statutory requirements and approvals
- the scope, purpose and structure of the PER

3. Need for the Proposal

The Public Environmental Review should examine the justification and fundamental objective for the proposal including supporting data and statistics. Broad costs and benefits of the proposals at local and regional levels should be briefly discussed. Consequences of not implementing the proposal should be outlined.

4. Evaluation of Alternatives

An evaluation of all alternative alignment options identified should be provided. This evaluation should clearly explain the rationale which led to the selection and more detailed analysis of the chosen option(s). Attention should be paid to alternatives that would not necessarily be the ultimate engineering option or the least cost, but would significantly reduce the environmental and social impact of the proposed development. A clear comparison of the environmental impacts of each alternative should be undertaken.

5. Description of Proposed Development

Adequate information and technical data, including maps, diagrams, photographs, etc, should be presented to allow a careful evaluation and review of the chosen option(s).

Important issues which the Authority feels should be incorporated into this section include:

- justification for road standards, staging and timing
- design capacity to meet future traffic demands
- road drainage design, measures
- landscaping and rehabilitation works
- identify pre-construction activities required
- provision for pedestrian access, with particular regard to System 6 areas
- visual appearance
- identify in general terms land use developments or changes in the status quo likely to arise as a result of this proposal proceeding

6. Existing Environment

This section should provide an overall description of the environment and of the physical, ecological and social systems likely to be effected.

It should then concentrate on the significant aspects of the environment likely to be impacted by the development.

This section should include:

6.1 Physical, Biological, Social Environment

- Physical
 - landforms
 - soils
 - climate
 - wetlands
- Biological:
 - emphasis on flora and floral systems (including quantity and quality) affected by the proposed alignment which are important, rare or uncommon (or becoming so)
 - fauna with emphasis on rare or uncommon species

Biological issues to be set in both a local and regional context relative to their conservation status and significance.

- Social environment:
 - landscape value in a local and regional context, from all viewing points
 - relationship with adjacent land uses and severance effects
 - archaeological and ethnographic sites
 - existing social climate, uses and value, including current community expectations and anticipated future needs
 - existing noise climate within the M47 area

6.2 System 6 Report and Recommendation M46 and M47 areas

A brief overview in a regional and local context of the regional park concept for these areas including:

- conservation values
- recreation values

- education values
- landscape values
- social values - with specific emphasis on the isolation afforded by this bushland area

7. Environmental Impacts

This section of the PER should show the overall effect on the total ecosystem and social surroundings of the chosen option(s).

The objective of this section is to synthesize all information and predict potential impacts (both adverse and beneficial) upon the environment in the short and long term, including the impacts of alternatives. This should include an assessment of the resilience of the systems to natural and man-induced pressures associated with the proposal.

Impacts should be quantified where possible. Criteria for making assessments of their significance should be outlined.

It will be necessary to determine impacts on individual components of the environment before a final overall synthesis of potential impacts is made.

This section should include, but not be limited by, consideration of the following:

7.1 Impact on System 6 and the recommendation M47 and M46 areas

Impacts on those environmental values identified in Section 6 should be discussed, including:

- how do the proposed alignments meet the intent and objectives of the System 6 recommendations?
- implications of each alignment on the future planning, values and integrity of M46 and M47 areas
- roadside effects, eg weed invasion, fire, drainage
- access to and from the System 6 areas (pedestrian and vehicles)
- impact upon the land alienated by the alternative alignments, eg conservation value, recreational value, susceptibility to weed invasion, etc
- noise; post construction; future traffic noise effects on identified values
- landscape values - area generally and from within the System 6 M46 and M47 areas specifically

7.2 Impact on environmental and social values identified within the project area

7.3 Impact on adjacent lands and communities

8. Environmental Management

Environmental management should be described on the basis of (and cross-referenced to) each of the potential environmental and social impacts described in Section 7.

The purpose of the overall management programme is to demonstrate the manner in which the potential environmental and social impacts can be avoided or ameliorated.

Major issues requiring attention would include:

- management of unavoidable impacts during construction and operation
- amelioration of lesser impacts
- staging and construction

- landscaping and rehabilitation
- monitoring and reporting
- ongoing management activity and responsibility including integration with management of M46 and M47 areas

9. Selection of Preferred Option

Based on a synthesis of all relevant issues and with specific regard to environmental impact and management, the preferred option should be identified.

10. Conclusion

Conclusions on the overall impacts of the preferred realignment option and the associated management requirements need to be presented. On this basis, an assessment of the environmental acceptability of the preferred option needs to be made.

11. Guidelines

A copy of the guidelines should be included in the PER document.

12. References

All references should be listed.

13. Appendices

Where detailed technical or supporting documentation is required, this should be placed in appendices.

14. Commitments

A numbered list of all environmental management commitments should be given. A commitment should include:

- who makes the commitment
- the nature of the commitment
- when the commitment will be carried out and to whose satisfaction

The following commitments in this Stage 1 PER are inherent in the acceptability of the staged approach to this development.

- Council will identify other proposals within the M46 and M47 areas which will form part of an integrated long term plan for these areas. This is necessary to ensure the road issues are not addressed in isolation from other critical elements affecting the long term values of these System 6 areas.
- The relationship of the highway realignment with potential development proposals, land use zonings, etc, will be identified.
- A Stage 2 PER covering these longer term issues in accordance with the Environmental Protection Authority's guidelines will be produced within 12 months of the release of this Stage 1 report.

15. Public Participation and Consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the PER. This section should describe the activities undertaken, the dates, the groups and individuals involved and the objectives of the activities. A summary of the concerns raised should be documented. This section should be cross referenced with the 'Environmental Management' section which should clearly indicate how these concerns have been addressed.

Appendix B

APPENDIX B

PUBLIC CONSULTATION PROGRAMME

APPENDIX B
PUBLIC CONSULTATION PROGRAMME

Organisations identified and contacted as users of the project area

- o Riding for the Disabled - Capricorn Group¹
- o West Australian Marathon Club¹
- o Naturalists Club of Western Australia
- o Athletics Association of Western Australia¹
- o Western Australian Museum
- o Royal Australian Ornithologists Union
- o Ministry for Sport and Recreation
- o City of Perth - Recreation
- o Bushwalkers of Western Australia
- o Western Australian Wildflower Society (Inc.)
- o The National Trust of Australia (WA)
- o Perth Wildlife Watch

Organisations contacted as part of the public participation programme

- o Friends of Bold Park
- o City Beach Ratepayers' Association
- o City Beach Highway Safety Action Group

Announcement inserted in the following newspapers

- o Subiaco Chronicle
- o Fremantle Gazette
- o Stirling Times
- o Subiaco Post
- o Claremont/Nedlands Post
- o Mosman Park/Cottesloe Reporter

A total of 27 members of the public responded to the programme.

¹ Riding for the Disabled - Capricorn Group, the Athletics Association of Western Australia and the West Australian Marathon Club responded to say that they did not use the project area for their activities.

9 January 1991

Dear Resident,

WEST COAST HIGHWAY REALIGNMENT PROPOSAL - CITY BEACH

Dames & Moore, Environmental Consultants, have been retained by the City of Perth to prepare a Public Environmental Review for the proposed realignment of West Coast Highway in the vicinity of Challenger Parade, City Beach.

While the draft Public Environmental Review will be released for public comment later in the year it is recognised that you may have information and/or opinions that would be of considerable value in the actual preparation of this document.

I therefore invite you as an interested party to contact me in writing to offer information or opinions that you feel will assist us.

A map of the area of interest is attached.

Thanking you in anticipation.

Yours faithfully
DAMES & MOORE



Sandra Gray
Project Environmental Scientist

West Coast Highway Study Underway

Dames & Moore, Environmental Consultants, have been appointed by the City of Perth to undertake environmental and public opinion studies for realignment of the West Coast Highway near Challenger Parade City Beach.

A draft Public Environmental Review is to be released for public comment later in the year. In the meantime members of the public who want to offer suggestions are invited to write to the Project Manager, Sandra Gray at 26 Lyall Street, South Perth, 6151.

Appendix C

APPENDIX C

REPORTED ACCIDENT STATISTICS

WEST COAST HIGHWAY (ROCHDALE ROAD/HELSTON AVENUE), CITY BEACH

01 JANUARY 1985 TO 15 NOVEMBER 1990

APPENDIX C
REPORTED ACCIDENT STATISTICS
WEST COAST HIGHWAY (ROCHDALE ROAD/HELSTON AVENUE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

SOURCE: MAIN ROADS DEPARTMENT

TABLE C1
ACCIDENT SEVERITY
WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No. of Accidents</i>	<i>%</i>
Fatal	2	4
Injuries	23	40
Major Property Damage	25	44
Minor Property Damage	7	12
TOTAL	57	100

TABLE C2
PAVEMENT CONDITION AT THE TIME OF ACCIDENT
WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No. of Accidents</i>	<i>%</i>
Wet	26	46
Dry	30	53
Unknown	1	2
TOTAL	57	100

TABLE C3
ROAD ALIGNMENT AT SITE OF ACCIDENT
WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No. of Accidents</i>	<i>%</i>
Curve	50	88
Straight	7	12
TOTAL	57	100

TABLE C4
ROAD GRADE AT POINT OF ACCIDENT
WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No.</i>	<i>%</i>
Level	19	33
Crest of Hill	2	4
Slope	36	63
TOTAL	57	100

TABLE C5
LIGHT CONDITIONS AT TIME OF ACCIDENT
WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No.</i>	<i>%</i>
Daylight	28	49
Dusk	1	2
Dark/Street Lights On	25	44
Dark/Street Lights Off	1	2
Unknown	2	4
TOTAL	57	100

TABLE C6
 ACCIDENTS INVOLVING COLLISION WITH FIXED OBJECT
 WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
 01 JANUARY 1985 TO 15 NOVEMBER 1990

	<i>No.</i>	<i>%</i>
SEC/PMG Poles	18	36
Traffic Sign Posts	2	4
Trees	10	20
TOTAL	30	60

TABLE C7
 REPORTED ACCIDENT STATISTICS AT SIX MONTHLY INTERVALS
 WEST COAST HIGHWAY (ROCHDALE RD/HELSTON AVE), CITY BEACH
 01 JANUARY 1985 TO 15 NOVEMBER 1990

<i>Time Period</i>	<i>No of Accidents</i>
January 1985 - June 1985	2
July 1985 - December 1985	2
January 1986 - June 1986	1
July 1986 - December 1986	3
January 1987 - June 1987	2
July 1987 - December 1987	6
January 1988 - June 1988	3
July 1988 - December 1988	5
January 1989 - June 1989	10
July 1989 - December 1989	9
January 1990 - June 1990	7
July 1990 - November 1990	6

- o Servetus Street extension to West Coast Highway opened on 3 July 1986
- o Minor modificaions to Challenger Parade junction were carried out in the latter part of 1989

Appendix D

APPENDIX D

COMPARISON OF OPTIONS

APPENDIX D

COMPARISON OF OPTIONS

To facilitate the comparison process within the three broad categories, the detailed criteria have been given a score of 0 (no influence) to 5 (very high degree of adverse impact) in terms of their perceived impact on the public and the environment in relation to the realignment of the West Coast Highway. This ensures consistent ranking throughout the study. The criteria were scored by Dames & Moore ecologists, botanists, social scientists, meteorologists, hydrogeologists, planners, etc., after discussion and debate.

As a further level of assessment, the criteria have also been weighted to reflect their relative significance. This ranking has been undertaken using a scale of 1-3. Those criteria considered to be of major importance in the identification of options suitable for the realignment of West Coast Highway have been assigned a weighting of 3. Those criteria considered to be of moderate importance were assigned a weighting of 2 while those of minor importance were assigned a weighting of 1. The final evaluation is in terms of an overall weighted score for each alternative.

The raw scores indicate the impact of an option in terms of a set of specific criteria. The weighted score (i.e. the raw score multiplied by the weighting) attempts to quantify the relative importance of each criterion with respect to the others. As a consequence of these procedures, an option which finishes with a low score has the least adverse impact and an option with a high score has the greater adverse impact.

This method of scoring, while widely used in research of this type, tends to aggregate the criteria and hence totals may be simplified in some cases. For example, it is considered that the safety criterion do not necessarily distinguish the small differences in safety levels between options. This aggregation is also partially due to the fact that whole scores, not fractions, are used and therefore one rating of 2 may not be totally equivalent to another rating of 2.

Nonetheless, we have endeavoured to ensure that the calculation of final scores has given equal weighting to environmental, social and safety factors through a process of normalisation. The normalisation process is undertaken to ensure that those broad categories which have more criteria than others are not given an unfair weight. For example, the assessment of environmental constraints involved twelve criteria, and the possible total weighted score was 165 points. In contrast, the assessment of safety involved only one criterion, and the total possible weighted score was only 15 points. The normalised score is obtained by dividing the weighted score assigned for each category by the total possible weighted score for the assessment category, thus giving each category equal weighting in the overall assessment.

As the weighting is a measurement of the level of adverse impact with the lowest level of adverse impact scoring 0, the most favourable option will be that one with the lowest overall score and that satisfies all three categories.

The overall assessment is made by comparing the options in terms of three major categories. These categories and the criteria within each category are briefly discussed below.

ENVIRONMENTAL ASSESSMENT CATEGORY

The following concerns have been identified as criteria for the environmental assessment and the results are presented in Table D1.

Hydrological Issues

The potential for surface stormwater runoff to adversely impact on existing drainage systems and vegetation has been considered. The likelihood of decreasing groundwater quality/quantity has been examined.

Ecological Sensitivity

A number of criteria are considered, including the number of habitats and plant associations, the presence of significant flora and fauna and the implications of each option for the System 6 recommendations (Conservation Through Reserves Committee, 1981). The approximate area of each vegetation type which would be cleared for each option is shown in Table D2.

SOCIAL ASSESSMENT CATEGORY

The following criteria were considered for an assessment of the social issues and results are presented in Table D1.

Air quality

This criterion includes consideration of the impact of poor air quality (i.e. exhaust fumes, brake-lining dust, dust caused by vehicle movement) on residents, users of the project area and the potential for air emissions to adversely affect plants.

Planning Issues

This criterion considered land uses and the relationship of each option to local, state and policy planning.

Heritage

The potential for sites of Aboriginal or European heritage significance was considered.

Noise

This criterion evaluates the effect on noise levels experienced by local residents and users of the project area as a result of moving the alignment of West Coast Highway. It is noted that current noise levels caused by traffic are probably high. No data are available. It should be noted that background noise levels are also probably high in this area due to the proximity of the ocean.

Other Social Issues

Several miscellaneous social issues were considered in this category. Amongst these were the influence of each option on landscape amenity (e.g. visual impact), the impact of each option on recreational use of the project area, and ease of access for both residents and users of the project area.

Economic Costs

The capital and maintenance costs of each option were considered and ranked accordingly.

Community Attitudes

Community attitudes to various issues such as safety, environmental concerns and noise and air pollution were determined through a programme of public consultation. Section 6.0 outlines the methods used to survey public opinion.

SAFETY CATEGORY

Considering the road history, safety was considered to be sufficiently important to warrant its own category. As a result, safety issues have been given equal weighting to environmental and social concerns. Results are presented in Table D1.

TABLE D1
MATRIX OF OPTION SCORES
WEST COAST HIGHWAY REALIGNMENT

Category / Criteria	Criteria Weight	Raw Score							Weighted Score							Normalised Score						
		A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
ENVIRONMENTAL ASSESSMENT CATEGORY																						
HYDROLOGICAL ISSUES																						
Runoff Effects	2	1	1	1	1	1	2	2	2	2	2	2	2	4	4							
Potential Impact on Groundwater	2	1	1	1	1	1	2	2	2	2	2	2	2	4	4							
	4	2	2	2	2	4	4	4	4	4	4	4	4	8	8	0.02	0.02	0.02	0.02	0.02	0.05	0.05
ECOLOGICAL SENSITIVITY																						
Area Cleared	3	0	1	2	2	3	5	4	0	3	6	6	9	15	12							
Area Alienated	3	0	1	1	3	5	4	4	0	3	3	9	15	12	12							
Habitat Types Affected	3	0	1	2	2	3	2	2	0	3	6	6	9	6	6							
Plant Associations Affected	2	0	1	3	4	3	4	3	0	2	6	8	6	8	6							
Presence of Significant Flora	3	0	1	3	4	5	5	5	0	3	9	12	15	15	15							
Probability of Significant Mammals	3	0	1	1	1	1	1	1	0	3	3	3	3	3	3							
Probability of Significant Birds	3	0	1	1	2	3	3	3	0	3	3	6	9	9	9							
Probability of Significant Herpetofauna	3	0	1	2	3	4	4	4	0	3	6	9	12	12	12							
Probability of Significant Invertebrates	3	0	1	1	2	3	3	3	0	3	3	6	9	9	9							
Implications for System 6	3	0	1	2	2	4	4	4	0	3	6	6	12	12	12							
	29	0	10	18	25	34	35	33	0	29	51	71	99	101	96	0.00	0.18	0.31	0.43	0.60	0.61	0.58
GROUP SCORE - ENVIRONMENTAL ASSESSMENT CATEGORY																						
																0.02	0.20	0.33	0.45	0.62	0.66	0.63

TABLE D1
(Continued)

Category / Criteria	Criteria Weight	Raw Score							Weighted Score							Normalised Score						
		A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
SOCIAL ASSESSMENT CATEGORY																						
PLANNING ISSUES																						
Alienation of Existing/Future Land Uses	2	2	2	2	3	4	4	4	4	4	4	6	8	8	8							
Conflicts with City of Perth Planning Scheme	2	0	1	2	3	4	3	3	0	2	4	6	8	6	6							
Conflicts with System 6 and Other Policies	3	0	1	2	3	5	5	5	0	3	6	9	15	15	15							
	7	2	4	6	9	13	12	12	4	9	14	21	31	29	29	0.02	0.05	0.08	0.12	0.18	0.17	0.17
HERITAGE																						
Aboriginal Heritage	2	0	1	1	1	1	1	1	0	2	2	2	2	2	2							
European Heritage	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
	3	0	1	1	1	1	1	1	0	2	2	2	2	2	2	0.00	0.01	0.01	0.01	0.01	0.01	0.01
AIR QUALITY (EXHAUST EMISSIONS AND DUST)																						
Impact on Residents	2	4	4	3	2	1	1	2	8	8	6	4	2	2	4							
Impact on Recreationists	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1							
Potential for Adverse Impact on Plants	1	0	1	1	2	2	2	2	0	1	1	2	2	2	2							
	4	5	6	5	5	5	4	5	9	10	8	7	6	5	7	0.05	0.06	0.05	0.04	0.03	0.03	0.04
EXCESSIVE NOISE																						
Impact on Residents	2	4	2	3	2	1	2	2	8	4	6	4	2	4	4							
Impact on Recreationists	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2							
	3	6	4	5	4	3	4	4	10	6	8	6	4	6	6	0.06	0.03	0.05	0.03	0.02	0.03	0.03

TABLE D1
(Continued)

Category / Criteria	Criteria Weight	Raw Score							Weighted Score							Normalised Score						
		A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
OTHER SOCIAL ISSUES																						
Landscape Amenity	2	1	2	2	3	3	4	5	2	4	4	6	6	8	10							
Recreation	3	1	1	2	3	4	3	3	3	3	6	9	12	9	9							
Access to Residential Area	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
Access for Bold Park Users	2	1	1	1	1	1	1	1	2	2	2	2	2	2	2							
	8	4	5	6	8	9	9	10	8	10	13	18	21	20	22	0.05	0.06	0.07	0.10	0.12	0.11	0.13
ECONOMIC COSTS OF OPTIONS																						
	2	1	2	2	3	4	4	4	2	4	4	6	8	8	8							
	2	1	2	2	3	4	4	4	2	4	4	6	8	8	8	0.01	0.02	0.02	0.03	0.05	0.05	0.05
COMMUNITY ATTITUDES																						
Safety	3	5	4	4	2	1	2	2	15	12	12	6	3	6	6							
Pollution (air and noise)	2	4	3	3	2	2	2	2	8	6	6	4	4	4	4							
Conservation	3	0	2	2	3	5	4	4	0	6	6	9	15	12	12							
	8	9	9	9	7	8	8	8	23	24	24	19	22	22	22	0.13	0.14	0.14	0.11	0.13	0.13	0.13
GROUP SCORE - SOCIAL ASSESSMENT CATEGORY																						
																0.32	0.37	0.42	0.44	0.54	0.53	0.56
SAFETY CATEGORY	3	5	4	3	2	2	2	2	15	12	9	6	6	6	6	1.00	0.80	0.60	0.40	0.40	0.40	0.40
OVERALL SCORE - ALL CATEGORIES																						
																1.34	1.37	1.35	1.29	1.56	1.59	1.59

The following ranking system for adverse impact has been used:

- 0 - no influence
- 1 - very low impact
- 2 - low impact
- 3 - moderate impact
- 4 - high impact
- 5 - very high impact

TABLE D2
APPROXIMATE AREA OF VEGETATION TYPE
CLEARED FOR EACH REALIGNMENT OPTION

<i>Vegetation Type</i>	<i>Option / Approximate Area (ha)</i>						
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>
1/2B	0	0	0	0	0.125	0	0
2B	0	0	0.25	0.25	0.8	0.45	0
2B/Af	0	0	0	0.625	1.3	0	0
2B/4B	0	0	0.75	0.25	0	1.25	0.5
3A	0	0	0	0	0	0	0
3A/Af	0	0.75	0.75	0.25	0	1.2	1.125
3A/Af/4C	0	0	0	0	0	0.875	0.625
3A/4C	0	0	0	0	0	1.5	2.125
4B	0	0	0.5	1.125	1.8	1.15	1.0
4B/3A	0	0	0	0	0	0	0
4B/4C	0	0	0	0	0	0	0
4C	0	0.5	0.5	0.875	1.0	1.0	1.0
TOTAL	0	1.25	2.75	3.38	5.03	7.43	6.38

- Notes:**
1. Area calculated assuming a 50m easement.
 2. Due to the mixtures of vegetation it is impossible to give precise figures for individual species that could be destroyed.
 3. In order to estimate these areas the vegetation types used are those shown on Figure 7.

Appendix E

APPENDIX E

LETTER FROM MAIN ROADS DEPARTMENT

MAIN ROADS DEPARTMENT

WATERLOO CRESCENT, EAST PERTH, WESTERN AUSTRALIA.
PO Box 6202 EAST PERTH WA 6004 Phone (09) 323 4111 Fax (09) 323 4430 Telex AA 92894



Enquiries

Mr Missikos on 323 4478

Our Ref

72-394-54

Your Ref

The Manager
Dames & Moore
South Shore Centre
85 The Esplanade
SOUTH PERTH WA 6151

ATTENTION: MS GRAY

Dear Madam

PROPOSED RE-ALIGNMENT OF WEST COAST HIGHWAY, CITY BEACH PUBLIC ENVIRONMENTAL REVIEW

I refer to the above proposal and the request for Main Roads to provide comment.

In previous consultations and review Main Roads has recommended a minimum design radius of 400 m.

This minimum radius of 400 m which has been applied to West Coast Highway and in particular the recent connection through the coastal dunes to Marmion Avenue north, provides for an appropriate design at an acceptable level of safety for the Community. It should be noted though that the radius of the preferred design (OPTION E) which provides the shortest and best road alignment is 1 400 m.

Austrroads (previously NAASRA) of which Main Roads is a member as the State Road Authority in WA, does not produce standards it provides guidelines to which Engineers develop design standards for particular roads. Minimum radii are only used where necessary and are gradually introduced into the alignment so as to transition the drivers safely into the changed road environment. This is not the situation at present as highlighted by the high level of accidents including injury and deaths at the S bend.

Taking into account all the factors related with this proposal and in particular the safety standards required by the Community, Main Roads recommends a design standard based on a 400 m minimum radius.

Yours faithfully

D Kilvington
ACTING DIRECTOR TRAFFIC MANAGEMENT

LIBRARY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WESTRALIA SQUARE
141 ST. GEORGE'S TERRACE, PERTH

January 22 1992

TM-16011