RTA

Roads and Traffic Authority
New South Wales

North Kiama Bypass

Environmental Impact Statement

Prepared by

Connell Wagner

NORTH KIAMA BYPASS

ENVIRONMENTAL IMPACT STATEMENT

Prepared for

ROADS AND TRAFFIC AUTHORITY
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JANUARY 1991


DUNMORE
MINNAMURRA
MINNAMURRA RIVER
SWAMP ROAD
PRINCES HIGHWAY
TERRAGONG SWAMP
GAINSBOROUGH
KIAMA DOWNS
BOMBO
KIAMA BYPASS
PROPOSED NORTH KIAMA BYPASS

CONTENTS

LIST OF FIGURES

Note: Figures are included in consecutive order following Section 7.0.

NORTH KIAMA BYPASS
ENVIRONMENTAL IMPACT STATEMENT

Clause 59 Certificate

This is to certify that this Environmental Impact Statement has been prepared in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation 1980.

6.2.91

T J Paterson
Associate
Manager - Environmental Planning

FORM 4

ENVIRONMENTAL PLANNING & ASSESSMENT ACT, 1979
(Section 77(3)(d))

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared on behalf of the *Roads and Traffic Authority of NSW* being the applicant making the development applications referred to below.

The Statement accompanies the development applications made in respect of the development described as follows:

Establishment of a corridor and new high standard dual carriageway road between Dunmore and Kiama which bypasses the northern suburbs of Kiama.

The development applications relate to land affected by State Environmental Planning Policy 14 – Coastal Wetland No 372 and described as follows:

Locality: *Swamp Road, Terragong Swamp*

Comprising: *Municipality of Shellharbour - "Glengowrie" (Lot 2 DP 602557), "Tongarra" (Pt Por 29)*
Municipality of Kiama - "Myree Hill" (Lot 1 DP 632302, "Riversdale" (Por 66)

Situated in: *Parish of Terragong, County of Camden*

The contents of this Statement, as required by Clause 34 of the Environmental Planning & Assessment Regulation, 1980, are set forth in the accompanying pages.

Name, Qualifications and Address of person who prepared Environmental Impact Statement

T J Paterson, B Sc, Dip App Sc, Dip Env Stud
Manager, Environmental Planning
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NEUTRAL BAY NSW 2089

CERTIFICATE

I, T J Paterson of Connell Wagner (NSW) Pty Ltd hereby certify that I have prepared the contents of this Statement in accordance with Clause 34 of the Environmental Planning & Assessment Regulation, 1980.

T Paterson
.....
Signature

6.2.91
.....
Date

SUMMARY

BACKGROUND

In 1986, the former Department of Main Roads (DMR) prepared an Environmental Impact Statement (EIS) for widening a section of the Princes Highway between the Minnamurra River and Bombo. Following additional studies and consideration of public submissions, the Chief Executive of the Roads and Traffic Authority (RTA) decided not to proceed with the project, and in so doing, to initiate a new investigation of main road needs in the area between Dunmore and Kiama.

The proposal to provide a bypass of the northern Kiama suburbs emerged following a comprehensive route selection study conducted by the RTA during 1990. The proposal was identified as the most suitable out of a number of possible solutions to reduce existing traffic problems and to best cater for longer term road transport needs in the area.

In selecting the proposed Bypass as its preferred option, the RTA recognised the road would result in significant impacts. Consequently, this EIS has been prepared to address in detail the potential impacts of construction and use of the Bypass, and to examine appropriate mitigation measures.

THE PROPOSAL

The proposed Bypass would include the following components:

- Widening of the Princes Highway to six lanes between Terralong Street, Kiama and Panama Street, Bombo.
- Construction of a new four lane bypass road from Panama Street through to the intersection of Swamp Road and the existing Highway at Dunmore generally to the south and west of Gainsborough and to the west of the Minnamurra River wetland.
- Widening of the existing Princes Highway to four lanes from Swamp Road to Shellharbour Road.

Major features of the project include a grade separated interchange at Panama Street, a 810 metre bridge crossing of the Minnamurra River flood plain and a large radius roundabout near the existing Swamp Road/Princes Highway intersection. Major earthworks comprising deep cuttings and embankments would be necessary due to prevailing topographic conditions. Substantial property acquisitions would be required as there is no road reservation between Bombo Hill and Swamp Road.

EXISTING TRAFFIC CONDITIONS

Traffic volumes on the Princes Highway have been increasing at an annual rate of 5-6% with annual average daily traffic (AADT) now at about 19,800 vehicles, a level which is well above the design capacity of a two lane road. Origin-destination surveys have indicated that about 80% of this traffic is through traffic.

The most significant problem being experienced along the Highway is the extreme peaking of traffic on Sundays, and long weekend Mondays. This can cause traffic queues and delays often up to 50 minutes. Increasing traffic congestion and delays are also occurring during weekday commuter peaks. At individual intersections through North Kiama, local resident traffic turning from side streets is also experiencing significant delays.

Over 120 accidents including four fatalities have been recorded on the Princes Highway through Minnamurra and Kiama Downs over the three year period ending March 1990. This is largely attributed to the poor horizontal and vertical road alignment (particularly around the Minnamurra Bends), conflict between local and through traffic, and poor stopping sight distances.

FUTURE TRAFFIC CONDITIONS

With the possible future urban expansion of Kiama and centres further south, and the general increase in recreational through traffic, the weekend and weekday problems would be further exacerbated.

Projections indicate an average annual traffic growth of between 3% and 5%, which suggests possible average daily traffic volumes of 30,000 or more by the year 2000.

Other modes of transport are not expected to reduce the burden carried by the road system in the study area. Improvement to the rail system or an increase in bus services may reduce the weekday commuter peak in the medium to long term. However, origin and destination studies have shown that the majority of the critical north bound weekend traffic (i.e. predominantly South Coast recreational movements), has it origin to the south of the rail terminus at Bombadery.

NEED FOR THE PROJECT

Without improvements, the Highway would operate at an unacceptable level of service by as early as 1996, accidents would be more frequent, unsuitable local roads would receive more through traffic and accessibility for local residents (vehicular and pedestrian) would further deteriorate.

A programme of public consultation clearly identified a broad and strong community view that major improvements to the road system through the study area were necessary in the short term.

PROJECT OBJECTIVES

The proposed improvements would need to provide solutions and benefits at both the regional and local scale. The major objectives of the proposal are as follows:

- To provide a satisfactory level of service for road users during commuter and recreational traffic peaks in the short and long term.
- To establish a suitable corridor which will serve as the major road transport route for this section of the South Coast in the long term.
- To reduce conflict between through and local traffic.
- To establish a main road corridor on an alignment which achieves a suitable balance between road safety needs and effect on property, the natural environment and landscape quality.
- To provide community benefits by reducing accidents, improving local accessibility and enhancing North Kiama as a unified residential area.
- To protect the environmental quality of the study area to greatest extent possible consistent with road improvement needs.

BYPASS PERFORMANCE

By the year 2011, the proposed Bypass would still be operating at a satisfactory level of service and safety, even during peak weekend recreational periods. In addition, the corridor and road design would permit additional lane capacity to be constructed, thereby accommodating traffic growth well beyond 2011.

With respect to longer term highway planning (i.e. beyond 2011), the proposed Bypass is on an alignment which would be compatible with connections to the north and south.

ALTERNATIVES

The route selection study undertaken in 1990 to identify the most suitable long term main road corridor involved a comparative assessment of all feasible main road options, exhibition of the study, review of public submissions and selection of a preferred option.

The proposed Bypass was determined to be the most suitable option as it provided a sound long term strategy to meet transport requirements in the area, and it represented the best compromise between various physical and environmental constraints, different land use interests and cost-effectiveness.

Other western bypass alternatives were less favourable than the proposal mainly because of the more significant property and land use implications.

An option to upgrade the existing Princes Highway to four lanes could satisfactorily meet short to medium term road transport needs, although at a lower level of service. However, this alignment offers limited scope to satisfy expected longer term traffic volumes. Indeed, upgrading of the Highway would not eliminate the need, probably within 15 to 20 years, for an alternate route (i.e. a bypass to the west). In addition, this option would also result in significant disruption to the population of North Kiama including increased traffic noise, access constraints and community severance, as well as more construction difficulties.

Examination of the Highway upgrading alternative found that a six lane road option would be less cost-effective than the proposal, and would result in significant impacts on the social and natural environment. This would include major disruption to the lower Minnamurra River wetland which would have to be traversed by a lengthy bridge crossing, and demolition of up to 25 residences in North Kiama to allow for widening. The cost of a six lane road would also be comparable to the proposal.

LAND USE, PROPERTY AND BUSINESS IMPACTS

The proposed route would directly affect 11 properties and several other easements and corridors. Seven of the properties are rural lands that are used mainly for dairy farming or as rural residences. Approximately 21 hectares of good pasture land would be directly affected by the corridor and a further 10 hectares of good pasture land permanently severed. Some 13 hectares of this is within the Dunmore Lakes Park property which is presently the subject of an application for a recreational facility and residential estate. Limited re-design of that development would be required.

Subject to negotiations with the property owners, some of the severed pasture land would be used for natural buffer zones, establishment of new wetlands and erosion control works.

On the basis of the area of pasture which would be lost from individual properties, it is unlikely that the viability of any farm operation would be significantly affected.

On the "Tabbagong" property, three old farm cottages and associated sheds would be demolished. These have no historic or architectural significance.

Negotiation for purchase of affected lands would be based on market value. Access to all properties would be provided and the cost of adjustments to affected properties would be met by the RTA.

The northern sections of the Boral, SRA and RTA blue metal quarries at Bombo would be traversed by the road. This would result in the isolation of material on the Boral property, although in practical terms, the proximity of that area to the Gainsborough residential estate is such that there is uncertainty as to whether the resource would be extracted in the future. A residence on the quarry would be demolished. Activities in the SRA quarry, including operation of a new materials handling and crushing plant, would not be adversely affected by the proposal. The RTA quarry on Bombo Hill has been dis-used for many years and was acquired specifically for road purposes.

A works facility and concrete plant owned by Cleary Bros at Bombo would be significantly affected, including removal of a cottage and several industrial buildings and improvements which are within the existing road widening boundary. Compensation for re-building or relocation would be negotiated between the property owner and the RTA.

At the southern end of the proposed Bypass, a section of Council owned reserve within the existing road widening boundary would be affected. Known as North Kiama Park, this area is vacant and unimproved and there are no short term plans for its development.

Establishment of the Bypass would create a physical barrier to further residential expansion on the western side of Gainsborough as no provision is made for access across the route. Any further development to the west or south would only be possible via Riversdale Road, Panama Street or other new access.

The present proportion of traffic along the existing Kiama Bypass which avoids the town centre, is approximately 75 per cent. As the proposed road would not divert through traffic away from the existing connections to and from the town centre, and the road standard in the area of Spring Creek would be improved with unchanged speed controls, it is not anticipated that this proportion would decline. Loss of passing trade for businesses in the town centre as a consequence of the proposal is therefore unlikely.

The proposed road improvements for local access between Kiama and the North Kiama suburbs including a six lane road along the Bombo Beach section, are expected to have a positive effect on business activity in the town centre as residents would be more attracted to shopping and other services in the town centre.

There are no businesses along the existing Highway section or the proposed Bypass route which are dependent on passing trade.

REGIONALLY SIGNIFICANT RESOURCES

Of the 21 hectares of agricultural land affected by the proposal, approximately 17.5 hectares would be high quality crop and pasture land identified as significant in Illawarra Regional Environmental Plan No 1. Other significant regional resources along the corridor include a sand deposit on the site of the proposed Dunmore Lakes Park, although that development will extract some material and then effectively sterilise what remains by various proposed buildings and works.

The proposed corridor is located along the eastern fringe of the Jamberoo Valley, an important rural and scenic landscape which is addressed by Illawarra Regional Environmental Plan No 2. Approximately 5 hectares of the designated valley would be affected by the alignment. This was necessary to reduce impact on wetlands. Jamberoo Valley Regional Environmental Study recognised the likelihood of a road corridor through the valley and identified numerous matters that warranted close attention when planning such corridor. The proposal provides the best alignment through this area in terms of minimising changes to hydrology, salinity levels and prime agricultural land.

HERITAGE RESOURCES

Three European sites of limited archaeological significance would be affected. The first is the collapsed remains of an old stone wall near "Dunmore House", which although not regarded as a good example, would provide stones that are useful for the restoration of similar walls elsewhere in Kiama.

The second site is that of the original "Riversdale" homestead which was burnt down in 1884. Remaining features include a well, earth terraces and a drain which would be recorded in detail prior to road construction.

Finally, part of a remnant formal garden associated with "Tabbagong" homestead, is within the proposed corridor.

No aboriginal contact sites of significance have been identified within the proposed construction route.

TRAFFIC NOISE

Traffic noise levels associated with the proposed Bypass would be below the day time and night time (external) criteria of 63dB(A) and 55dB(A) respectively. These targets are adopted by the RTA for their road projects in general, and on the basis that they can feasibly be achieved. There are three locations where earth mounds and/or noise barriers are proposed, including an elevated and exposed section on the southern side of McBrien Drive, Gainsborough, a section on the "Riversdale" property which is exposed to the western limits of Gainsborough and a third location near "Dunmore House".

Following construction of the Bypass, traffic noise levels along the Princes Highway through Minnamurra and Kiama Downs would decline by as much as 10dB(A) during both day and night. This would mean significant improvements for many residents in the proximity of the Highway who presently experience noise levels which generally exceed the above criteria.

BIOLOGICAL AND PHYSICAL ENVIRONMENT

The proposed Bypass would traverse two areas which are important for their natural resources, including an area of estuarine wetland on the Terragong Swamp and a wet sclerophyll forest on the elevated "Tabbagong" property. The section of wetland is at the western fringe of the larger Minnamurra River wetland ecosystem, and is partly affected by planning controls including State Environmental Planning Policy 14.

The proposal would impact mainly on an area that is still subject to intensive grazing activities and which is showing little evidence of regeneration by dominant species such as casuarina.

As the proposed route is generally along the interface between the wetland system and adjoining grazing lands, the project could provide a prompt for significant improvement of environmental conditions in the wetland. In particular, the establishment of a natural buffer zone on the edge of the wetland becomes possible by utilising property residues created by the road corridor.

The proposed alignment follows the most disturbed section of the Tabbagong Forest in terms of vegetation density, existing grazing pressures and presence of exotic vegetation. However, as the Bypass would impact on wildlife habitat, the RTA proposes to establish natural corridors alongside the roadway and cross linkages at several locations. This would include establishment of a natural wildlife connection between Tabbagong Forest and the wetlands.

The forest contains a number of plant species not well represented in the region which would be removed. A seed collection programme would be initiated to ensure these species are included in roadside revegetation works. Several rare plant species may also be in the forest, but would not be directly affected due to loss of habitat.

The Minnamurra River flood plain is subject to frequent and significant inundation, thereby strongly influencing the pattern of land use and development in the Jamberoo Valley. A detailed flood study has shown that the proposed 810 metre bridge crossing over the Terragong Swamp, would have negligible impacts on flood height, flood velocity and flood retention times during major events.

Construction of the proposed Bypass would require substantial earthworks, including sections in steep terrain, as well as major structures in sensitive wetland areas. An integrated erosion,

sediment and water quality control plan would be prepared and implemented with advice from the Soil Conservation Service and the State Pollution Control Commission. Comprehensive sediment and pollution measures are proposed.

LIVING ENVIRONMENT

Construction of the Bypass would result in a significant loss of amenity in the living environment for those rural residents generally located along Swamp Road and residents on the western fringe of Gainsborough. The most pronounced change would be the dominant visual presence of the road in close proximity to residences which presently enjoy a scenic rural setting.

By contrast, the residential amenity for a large population in the suburbs of Minnamurra, Kiama Downs and much of Gainsborough would be significantly enhanced as the existing Highway reverts to a local road function. Residents adjacent or near the Highway would especially benefit from improvement in traffic noise, air quality, access, safety and visual quality.

In general terms the living environment of North Kiama would improve considerably as a consequence of removing through traffic on the Highway, and this would be expected to help strengthen local community ties and activities.

VISUAL/LANDSCAPE CHANGES

Based on the nature of development and planned landscape treatments, the proposed corridor would have minimal interaction with the scenic Jamberoo Valley. Approximately 500 metres of the roadway would slightly intrude into the protected Valley environs of its most north-eastern extremity.

The visual character and outlooks from several residential areas, particularly the western part of Gainsborough and the Swamp Road (north) area would be substantially altered. It is proposed that major road side landscaping be implemented in order to integrate the construction into the landscape.

PUBLIC CONSULTATION

In the course of preparation of this Statement, a programme of consultation was conducted. This included information releases in various forms, public meetings, a community working group, briefing sessions and small group meetings. A wide variety of government organisations, community groups, broad interest groups and local individuals were involved.

Many specific issues and concerns were identified during consultations and particularly with respect to property effects, existing traffic and access problems and potential for more substantial flooding of Terragong Swamp.

Different views were expressed regarding the preferred corridor location with North Kiama residents generally supportive of the proposal and rural residents generally in favour of the existing Highway route. General community support for major road and traffic improvements in the study area was resounding.

Potentially affected property owners indicated strong concern over likely impacts and particularly as there had been a long standing plan for road widening of the existing Highway prior to rapid residential development in North Kiama.

DECISION MAKING

This EIS will be placed on public exhibition and advertised. During the exhibition period individuals and organisations may make written submissions.

A determination on the proposed Bypass will be made by the RTA as well as Kiama and Shellharbour Municipal Councils. Although the RTA does not normally seek development consent for main road construction activities, the section of proposed road through protected wetlands is a designated development which can only be approved by the relevant Council with concurrence from the Department of Planning. The decision will be largely based on the EIS and public submissions.

In its role as determining authority, the RTA will prepare an assessment report which includes consideration of public submissions. This report, which will incorporate the Council's decisions regarding the wetlands, will be made available to the public.

1.0 INTRODUCTION

1.1 The Proposal

The Roads and Traffic Authority (RTA) proposes to construct a major new road between Dunmore and Kiama that would bypass the suburbs of North Kiama, which are presently traversed by a poor standard section of the Princes Highway. The proposal forms an important and high priority part of the overall plan to provide a high standard highway route along the New South Wales South Coast. It would facilitate the safe and efficient movement of vehicles through one of the most heavily congested sections of the Princes Highway. The general study area for the purposes of this project assessment is shown on Figure 1.

The preferred scheme, which emerged from a comprehensive Route Selection Study conducted during 1990 (see Section 1.2 below), would involve :

- the widening of the existing Princes Highway to three lanes in the north bound direction from the Terralong Street on ramp to Panama Street, and to three lanes in the south bound direction from the proposed on ramp from the Old Princes Highway to Gipps Street
- the construction of a new four lane bypass road from Panama Street through to the intersection of Swamp Road and existing Highway at Dunmore
- widening of the existing Princes Highway to four lanes from Swamp Road to Shellharbour Road.

The six lane section at Bombo is proposed to provide additional capacity and improved safety for local traffic movements between Kiama and North Kiama, as well as for the growing through traffic volumes.

Major features of the project include a grade-separated interchange at Panama Street to separate local traffic movements and a quarry railway line from the Bypass traffic, and a major bridge crossing over the Minnamurra River flood plain (known locally as the Terragong Swamp).

Substantial property acquisition would be required as there is no existing road reservation to accommodate the new road. A full description of the proposal is provided in Section 4.0.

The project has been initiated by the RTA in response to a long standing need to alleviate significant traffic problems in the study area, due particularly to heavy traffic volumes in peak periods, poor vertical and horizontal alignment of the existing Highway, growth and increasing conflicts between local and through traffic, and a poor accident record.

1.2 Background to the Study

Since the late 1950's, the former Department of Main Roads (DMR) has recognised the future need to widen the existing Princes Highway between Dunmore and Kiama. In the early 1960's the DMR commenced acquiring additional land for widening the Highway along its existing alignment. However, it was not until 1986 that the DMR prepared an Environmental Impact Statement (EIS) for widening the Princes Highway between the Minnamurra River Bridge and Bombo. After public exhibition of the EIS, numerous additional investigations were carried out. Then, following assessment of the proposal in November 1989, the RTA decided not to proceed with the project. In reaching this decision, the Chief Executive Officer of the RTA resolved to commission a new study of all options for addressing the main road needs of the area - "to start afresh and look at both the pressing short term needs and longer term options" (RTA, 1989).

In April 1990 the RTA commissioned a two stage study of future highway needs between Dunmore and Kiama. Stage 1 - Route Selection Study, involved the comparative assessment of all feasible main road options, exhibition of the study, review of public submissions, and selection of a preferred option.

The main outcomes from that stage of the study were as follows :

- A western bypass option was considered to be the most suitable corridor for the Princes Highway as it best satisfied a wide range of key environmental and planning factors.

- An option to upgrade the existing Princes Highway was found to be less satisfactory because of its poorer capacity to satisfy longer term traffic needs, community disruption, increased traffic noise and adverse effects on access for local residents.

- The preferred corridor chosen by the RTA is a modification of the bypass route denoted S4-N3 in the Route Selection Study report (RTA, 1990a). The modification significantly reduced the impacts on a proposed recreation centre (Dunmore Lakes Park) and other rural properties.

This Environmental Impact Statement (EIS) for the proposed Bypass is the main output from the second stage of the study commissioned by the RTA.

1.3 The Study Area

The study area for the purposes of this EIS is located adjacent to the coast approximately 35kms south of Wollongong between Kiama town centre and the intersection of the Princes Highway and Shellharbour Road at Dunmore. The study area and the general alignment of the proposed bypass are shown on Figure 1.

The study area lies within the local government areas of Shellharbour and Kiama Municipal Councils with the boundary generally being the Minnamurra River.

Dominant landscape features in the study area include the Minnamurra River and its associated wetland system, rural properties and homesteads on the eastern fringe of the Jamberoo Valley, the residential community of North Kiama, basalt quarries at Bombo and Kiama township. Section 5.0 of the EIS provides a detailed description of the existing environment of the study area.

1.4 Terms of Reference

The objectives and scope of this EIS were established in the Study Brief issued by the RTA, which is reproduced in full at Appendix B. Key objectives identified were :

- to prepare an EIS of the preferred route in accordance with the requirements of the Environmental Planning and Assessment (EPA) Act 1979
- to meet the requirements issued by the Director of the Department of Planning – these requirements are included at Appendix C
- to maximise consultation during the preparation of the EIS – a summary of the programme of public consultation conducted during both stages of the investigation is included at Section 1.6
- to ensure that Councils and relevant government agencies are consulted.

1.5 Statutory Requirements

Environmental Planning Controls

The statutory controls which establish the requirements for and scope of this EIS, are established in the provisions of the Environmental Planning and Assessment (EPA) Act, and more locally, the relevant environmental planning instruments which cover the alignment of the proposal.

Because the proposed Bypass would traverse a short section of wetland on the Terragong Swamp which is covered by State Environmental Planning Policy (SEPP) No 14, the RTA is required to submit a development application and EIS to the relevant consent authority. In this case, the wetland straddles the Minnamurra River which forms the boundary between the local government areas administered by Shellharbour and Kiama Municipal Councils. As a consequence, both of those Councils receive

applications in respect of the SEPP No 14 wetland area and subsequently assess the proposal in accordance with Part IV of the EPA Act.

For the balance of the proposal between Dunmore and Kiama, the RTA is the responsible determining authority under Part V of the EPA Act. Section 112 of the Act requires that where an activity is likely to have a significant impact on the environment, an EIS is required.

A more detailed account of the relevant statutory controls as they relate to the proposal, including the implications of several Local and Regional Environmental Plans, is addressed in Section 5.7.

Public Involvement Procedures

As the proposal is to be assessed under two parts of the EPA Act, both the RTA and the two Councils (Shellharbour and Kiama) have obligations to advertise the EIS and make it available for public inspection. For practical reasons, this responsibility is to be co-ordinated by the RTA in terms of issue of joint public notices and distribution of documents.

The EIS is to be advertised and placed on public exhibition at various centres in or near the study area, including RTA and Council offices and other readily accessible public locations, as well as in Sydney. Copies of the EIS are also to be available for sale to the public at nominated locations.

During the EIS exhibition period, written submissions can be made to the RTA and/or Shellharbour and Kiama Councils, and they will be examined by those bodies in their respective roles as determining authority and consent authority prior to making a determination on whether or not to approve the proposed Bypass. It is noted that a submission to either Council regarding the wetlands is also a submission on the proposal which will be examined by the RTA.

1.6 Community Consultation

Community consultation has played an important role in the identification and assessment of the potential social and environmental consequences of the proposal. Consultation began at the outset of the Route Selection Study which was commissioned by the RTA in April 1990.

The main consultative mechanisms employed during the study included contact with government departments and other organisations including Shellharbour and Kiama Municipal Councils, press releases, a series of community newsletters, numerous meetings with land owners, interested individuals and community groups including Jamberoo Residents & Ratepayers Association, Jamberoo Valley Environmental Protection Society, RANKS, Minnamurra Progress Association, the Kiama Chamber of Commerce and the Terragong Drainage Union.

Public meetings organised by RANKS/Minnamurra Progress Association and the Jamberoo Residents & Ratepayers Association were attended by project team representatives. Both were widely advertised in newsletters, local newspapers, radio and on television.

In the early stage of the Route Selection Study a community working group was established comprising seven community representatives. The group met regularly over a period of 14 weeks to directly participate in the conduct of the investigation and to progressively review study findings.

A community survey was also conducted (RTA, 1990c) based on a mail questionnaire distributed to 415 individuals in the study area selected at random. A response rate of 81% was achieved.

The Route Selection Study was exhibited for three weeks in September 1990, at the Family History Centre, Kiama and at Warilla Library. A mobile display was also available for inspection at the Jamberoo Community Hall. Public submissions were invited and received up to the end of October 1990.

The RTA subsequently publicised their selection of the preferred option (i.e. the Bypass) in the local media and a series of meetings with affected property owners and community and business groups were held. A briefing session and site inspections were conducted for representatives of relevant State and local government authorities.

2.0 TRAFFIC CONDITIONS AND OBJECTIVES

This section of the report discusses the existing and expected future traffic conditions within the study area and identifies the project objectives for addressing existing and expected problems. An assessment of the traffic implications of the proposal is included in Section 6.1.

2.1 Existing Traffic Conditions

Regional Context

The Princes Highway (SH1) is the major north-south arterial transport route through the study area and provides the main road link for traffic from Sydney and Wollongong to the South Coast. At present, SH1 is constructed to freeway standard from Waterfall through to Yallah.

From Yallah, SH1 reverts to a highway standard with recent provision of four traffic lanes through Albion Park to Oak Flats. From Oak Flats the road narrows to two lanes of often winding alignment and this poorer standard generally continues all the way through the study area until Spring Creek where the four lane Kiama Bypass begins. The Kiama Bypass, which was opened in December 1987, continues as far south as Kiama Heights, where it becomes a four lane undivided carriageway through Kiama Bends and then reverts to a three lane section north of Omega, and two lanes south of Omega.

The study area section of the highway between Dunmore and Kiama has been identified by the RTA as having a high priority for improvement relative to other sections between Yallah and Falls Creek (south of Nowra) (RTA, 1990b). There are also medium term plans by the RTA to reconstruct the Princes Highway to four lanes from Oak Flats through to Shellharbour Road, along a new alignment generally parallel to the South Coast railway line. A study has also recently commenced to consider long and short term options for the Princes Highway between Berry and Gerringong.

Figure 1 shows the general road network around the study area.

Roads in the Study Area

An indicated above, the major road through the study area is the Princes Highway. Whilst providing an arterial road function , the Highway provides a dual purpose, in that it is an important connector road for the local suburbs of Kiama, Kiama Downs, Gainsborough and Minnamurra. It is because of the growing traffic associated with this dual role and the extensive peaking of holiday through traffic (see below), that the Princes Highway has increasingly created conflicts within the urban areas of North Kiama. In particular, the need for the Highway to cater for a greater volume of faster moving through traffic conflicts

with its present standard as a two lane road with generally poor alignment and sight distances. Particular problems are encountered at Bombo Hill due to steep grades, through North Kiama because of conflict with local traffic, and around the Minnamurra Bends due to poor horizontal alignment. Signposted speeds generally range from 100km/hr on the Kiama Bypass through to advisory speeds of 65km/hr around the Minnamurra Bends.

Other roads in the study area perform only a rural or urban access function. The major urban roads include Gipps Street and Terralong Street, which provide access to Kiama town centre; Meehan Drive, North Kiama Drive, Oxley Avenue, Iluka Crescent, Gibraltar Avenue and Federal Street, which provide access to Gainsborough, Kiama Downs and Minnamurra. There are increasing problems of access from these local roads to the Princes Highway. Meehan Drive provides the only access to the Highway for the whole of Gainsborough and thus major delays occur, particularly during recreational peak periods (Sunday afternoons), and increasingly during commuter peak periods (weekday AM and PM peaks).

At Oxley Avenue the poor sight distances provide significant problems for the predominant right turn and thus local traffic is increasingly being forced to take longer circuits using Gibraltar Avenue or North Kiama Drive, which are also experiencing increasing delays in peak periods.

The intersections of Commissioners Lane and Darien Avenue have a significant accident record (refer below) because of the poor horizontal and vertical geometry and the merging of traffic.

Important rural roads include Swamp Road and Jamberoo Road which provide access to farms surrounding the Terragong Swamp and also to the village of Jamberoo, except during peak recreational periods when large traffic volumes divert from the Highway.

Daily Flows

Annual Average Daily Traffic (AADT's) have been recorded for the Princes Highway at counting stations in Dunmore (between Swamp Road and Dunmore Quarry entrance) and Bombo (adjacent to Bombo Railway Station) for the period 1974 to 1989. These are shown in Table 2.1 below. Existing traffic volumes (AADTS) are also shown on Figure 2.

TABLE 2.1 : RECORDED AADT's FOR THE PRINCES HIGHWAY

Location	1974	1982	1986	1988	1989
Dunmore	10,440	16,460	17,968	16,511	19,700
Bombo	11,500	16,830	18,159	N/A	19,800

The table indicates a regular increase in daily traffic flow with an average annual linear increase of between 5 and 6% at these locations. Based on the counting station at Omega, the average weekday flow is about 8% lower or about 18,300 vehicles/day. The average weekend flow is about 14% higher or about 22,600 vehicles/day, whilst the average public holiday flow is about 58% higher than the AADT or about 31,300 vehicles/day.

Weekday Hourly Flows

Weekday hourly counts were undertaken along the Princes Highway in January and February 1990. The surveyed flows are shown in Table 2.2 below.

TABLE 2.2 : PEAK HOUR TRAFFIC VOLUMES ON THE PRINCES HIGHWAY

Location	Weekday AM		Weekday PM	
	Northbound	Southbound	Northbound	Southbound
Princes Highway				
- at Bombo	730	600	680	670
- at Meehan Drive	860	510	580	910
- at Federal Street	990	490	570	1,000

Table 2.2 indicates existing peak flows of up to 1,000 vehicles/hour.

Existing Highway Performance

The existing traffic performance of the Princes Highway can be determined by its 'level of service'. The term level of service is a qualitative measure which is used to describe the operating conditions of a traffic stream. It incorporates factors such as speed, travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety and specifically refers to peak hour conditions.

There are six levels of service ranging from the best-A, to the worst-F which are defined as follows :

- *A - is a condition of free flow in which individual drivers are virtually unaffected by the the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.*

- *B - is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with level of service A.*

- *C - is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.*

- *D - is close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.*

- *E - occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbance within the traffic stream will cause break-down.*

- *F - is the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs, and queuing and delays result.*

The peak hour limits for the existing standard of the Princes Highway for the various key levels of service (LOS) as set out by the National Association of Australian State Road Authorities (NAASRA, 1988), is summarised in Table 2.3 below.

TABLE 2.3 : LOS ONE-WAY HOURLY TRAFFIC FLOWS
(NAASRA, 1988)

LOS	A	B	C	D	E	F
Veh/hr	< 700	700	920	1,180	1,550	> 1,550

This indicates that during peak weekday hours the Highway is presently operating at about a level of service of C/D.

Intersection Performance

At individual intersections through Minnamurra and Kiama Downs, current delays to traffic turning out of the side streets are already a cause for concern, restricting the accessibility of local residents. Average delays to vehicles turning right from the side streets are estimated by means of gap acceptance theory based on traffic counts undertaken in January and February 1990 (RTA, 1990d). The estimated delays are shown in Table 2.4 below.

TABLE 2.4 : EXISTING DELAYS TO LOCAL SIDE STREETS
WEEKDAYS

Location	Delay (secs) Weekday AM	Weekday PM
North Kiama Drive	11	11
Oxley Avenue	12	13
Meehan Drive	17	18
Federal Street	30	15

The delays indicate a general level of traffic congestion that is already significant.

Heavy Vehicles

The data from Dunmore and Bombo counting stations give full details of vehicle types. At Bombo, the proportion of heavy vehicles over a recent survey period (11 to 19 December 1989) was about 8%, whilst at Dunmore the overall heavy vehicle percentage was about 10%. The difference is due to heavy vehicles entering the Bombo quarry area and therefore not being registered at the counting station adjacent Bombo Railway Station.

Recreational Peaks

The most significant problem with traffic conditions along the Princes Highway is the extreme peaking of traffic on Sundays, and particularly on long weekends. Peaking characteristics were assessed by Sinclair Knight & Partners (1989) for the Princes Highway at Omega north of Fern Street, and were assumed to be representative of the area in general. This was verified by subsequent counts undertaken on two Sunday afternoons in October and November 1990 at Bombo (RTA, 1990d). The recorded daily flows on Sundays were found to be some 32% higher than the average weekday flow. The highest flow was on 26 December 1989 (Boxing Day) with traffic volumes recorded as 110% higher than the average weekday flow. It is generally this additional recreational component of the traffic which causes extreme delays along the route within the study area. This can typically be as long as 50 minutes from the end of the Kiama Bypass to Shellharbour Road, a distance of only about 7km.

Analysis of surveys undertaken in October/November 1990 which are representative of an average Sunday, indicate peak hour traffic volumes along the Princes Highway of between 1,450 north of Federal Avenue, to about 1,560 at Bombo (RTA, 1990d). A comparison with Table 2.3 indicates that this would equate to an existing level of service E/F.

Average delays to traffic turning right out of side streets was also assessed for the recreational peak periods from the recent counts. The existing delays (in seconds) are shown in Table 2.5 below.

TABLE 2.5 : EXISTING DELAYS TO LOCAL SIDE STREETS
WEEKENDS

Location	Delays (Secs) Sunday PM
North Kiama Drive	27
Oxley Avenue	24
Meehan Drive	32
Federal Street	36

These figures indicate existing delays of around 30 seconds for average Sundays. These would be even higher during peak summer months such as during December and January.

Traffic Demand for a Bypass (Through Traffic)

One of the fundamental requirements in assessing the suitability of an arterial road corridor is to distinguish between the volume of through and local traffic and hence, determine the traffic demand for a bypass route.

The Traffic Working Paper prepared for the Route Selection Study (RTA, 1990a), assessed the traffic demand for a bypass based on an origin/destination survey undertaken by SKP in 1989. While this survey was considered to provide a sound basis for predicting the future traffic distribution, additional surveys specific to the study area were undertaken. This involved analysis of existing traffic turning movements onto and off the Highway between Bombo and Swamp Road. Survey data for weekday flows and particularly for Sunday afternoon flows, were collated.

The resulting projected traffic demand for the proposed Bypass was not substantially different to that previously estimated for the options containing section "S4". That is, the traffic demand for the proposed bypass would be about 80% of the traffic using the existing Princes Highway through North Kiama.

Recorded Vehicle Accidents

The accident history of the Princes Highway between Swamp Road and Gipps Street, has been reviewed using the accident printouts collated by the Road Safety Bureau for the three year period April 1987 to March 1990. In total there were 123 accidents in which there were four fatalities.

The results, summarised in Figure 2, indicate that the concentration of accidents occur at the locations listed below. Also shown is the number of fatalities (in brackets).

- Swamp Road 6 (1)
- between Swamp Road and Minnamurra Bridge 15 (1)
- Minnamurra Bends 27 (2)
- between Meehan Drive and North Kiama Drive 24 (0)

o	North Kiama Drive	12 (0)
o	Darien Avenue	17 (0)
o	Near Kiama Cemetery	9 (0)
o	Hutchinson Street	6 (0)
o	Gipps Street	7 (0)

It is notable that there were four fatal accidents during this period. The key to the accident type which is provided by the accident records, indicates that a large proportion of accidents at/near Federal Street were single vehicle accidents, where the driver lost control. This is likely as a result of the poor road alignment around the Minnamurra Bends. Other accidents were generally 'rear end' collisions.

Public Transport

Road traffic dominates the transport system within the region and for travel to and from Sydney, Wollongong and Nowra. There is however, some provision of public transport, namely the South Coast Railway and occasional bus services.

The South Coast railway line runs through the study area with stations at Shellharbour, Minnamurra, Bombo and Kiama. At present, rail services are relatively infrequent with about 20 return services between Sydney and Nowra on weekdays. On weekends the trains run about 15 return services per day.

Bus services provide another form of public transport with the principal operator being John J Hills. Services generally consist of school services, a shuttle service and a town centre service. The daily service frequencies are as follows :

Service/School	Frequency
Kiama High	4 return
St Peter & Paul	1 return
Minnamurra Public School	3 return
Shuttle service (Club)	8 return
Town service	5 return.

There are also coach services between Sydney and Nowra that stop at Kiama. These services, operated by Pioneer Express and Pioneer Motor Service, provide at least four return services on every weekday, two return services on Saturdays and one return service on Sundays.

Existing Deficiencies

The discussion above has identified significant deficiencies with the existing Princes Highway. These relate primarily to weekend recreational traffic with north bound traffic causing long delays and traffic queues. Increasingly, the normal weekday commuter peak period is also experiencing substantial delays. Access from local streets has become a particular problem, and coupled with poor vertical and horizontal alignment on the Princes Highway, has led to a significant accident record.

With the possible future urban expansion of West Kiama, and general increase in recreational through traffic, the weekday situation is expected to worsen considerably, and the holiday weekend problem would be further exacerbated. Traffic is likely to seek alternative routes such as Jamberoo Road, Swamp Road and also local roads through Kiama Downs and Minnamurra.

Before assessing the improvements needed to alleviate these problems, future traffic flows also need to be assessed. Additional highway capacity should be planned to cater for the additional demand so that the capacity is in place by the time it is required. The expected future traffic conditions are described below.

2.2 Future Traffic Conditions

A discussion on the expected future traffic conditions in the area is provided below. The impact of this future traffic is discussed in Section 6.1.

Daily Volumes

The report by SKP (1989) sets out the trends in traffic and population growth in the study area, and the 'medium level' has been used as the principal data source for assessing likely traffic growth.

The projected traffic levels based on this assessment are shown on Figure 2 and in Table 2.6 below. The projected volumes indicate an average annual linear growth of 3% from the base year 1989 until 2011. It is noted however, that the historical traffic growth rate indicates an annual average linear increase of about 5%. This growth rate has been used for sensitivity testing of a higher level of traffic and the resultant projected traffic volumes are also shown in Table 2.6 below.

TABLE 2.6 : PREDICTED AVERAGE DAILY TRAFFIC VOLUMES BETWEEN BOMBO AND KIAMA

	1989	1996	2001	2011
AADT (Medium)	19,800	24,750	27,750	33,050
AADT (High)	19,800	26,730	30,690	41,000
Average Weekday	18,300	22,770	25,500	30,360
Average Weekend	22,600	28,200	31,600	37,620
Average Public Holiday	31,300	39,100	43,800	52,140

Note: Average weekday, weekend and public holiday based on medium AADT forecast.

Assessment of the performance of the Highway was undertaken using the projected peak hour traffic volumes. This is discussed below.

Future Weekday Peak Hour Volumes

Future weekday peak hour volumes for the peak direction were estimated by factoring the existing peak hour volumes by the growth rates predicted for daily traffic. This would equate to about 1,140 and 1,520 vehicles on the Princes Highway at Meehan Drive for the year 1996 and 2011 respectively under a medium level forecast. Under a higher level forecast the projected peak hour volumes along the Princes Highway at Meehan Drive would be about 1,200 and 1,850 for the years 1996 and 2011 respectively.

A comparison with Table 2.3 indicates that without improvement the Princes Highway (in peak hour periods) would operate at level of service D by 1996, and at about level of service E/F by 2011 under the medium level of traffic growth. Under the high level of traffic growth, the levels of service would be E in 1996 and F by the Year 2011.

Future Recreational Peak Hour Volumes

The future recreational peak hour traffic flows predicted for the Princes Highway were based on the relationship between the existing weekday and recreational peak flows. The resulting one-way peak flows for 1996 and 2011 were estimated to be 1,960 and 2,610 respectively. It is noted that prediction of the recreational traffic flows is difficult as it is not possible to determine how many motorists delay departure to avoid what is known as a notorious congestion spot. Projected weekend peak hour flows at Bombo are shown on Figure 2.

A comparison with Table 2.3 indicates that without improvement, the Princes Highway would operate at level of service F by 1996 and would be almost double the criteria for level of service F by 2011.

Intersection Performance

The performance of individual intersections along the Princes Highway was assessed based on gap acceptance techniques. Delays to critical movements (right turn out) at four intersections were based on the projected peak hour flows discussed above. The estimated delays to right turns during peak periods in 1996 and 2011 are shown in Table 2.7.

TABLE 2.7 : PROJECTED DELAYS AT INTERSECTIONS ALONG PRINCES HIGHWAY WITHOUT IMPROVEMENT

Highway Intersection	Delay (secs) 1996 Weekday Peak	1996 Weekend	2011 Weekday Peak	2011 Weekend
o North Kiama Drive	19	51	47	157
o Meehan Drive	51	109	*	*
o Oxley Avenue	21	44	51	133
o Federal Street	32	222	*	*

* Theoretically "infinite" delay.

It is evident from Table 2.7 that substantial delays would occur to side streets by 1996 and would be totally unacceptable (i.e. infinite delays) in the longer term.

Field observations (RTA, 1990d) suggest however, that turns on to the Highway can be easier (i.e. shorter delays) when traffic flow on the Highway is saturated.

2.3 Summary of Existing Traffic Problems

Problems with the existing Princes Highway through North Kiama have been discussed in detail above. The major problems identified are summarised below.

- Extreme delays and traffic queues resulting from heavy north bound traffic flows during peak recreation periods.
- Increasing delays to side street traffic such as Meehan Drive, Federal Street and Oxley Avenue during normal commuter peak periods.
- Traffic diverting to rural roads such as Jamberoo Road and Swamp Road, and increasingly onto local roads such as North Kiama Drive, Oxley Avenue and Charles Avenue to avoid delays along the Princes Highway.
- Poor accident record primarily due to the poor road alignment through the Minnamurra Bends and poor sight distances around Bombo Hill.
- Increasing difficulty for pedestrian access across the Princes Highway because of the lack of facilities and the conflicting high traffic volumes.
- Poor horizontal and vertical alignment of the existing road, particularly around Bombo Hill and Minnamurra Bends.

- The Princes Highway is being forced to handle traffic volumes beyond its design capacity and future projections indicate continued growth in the order of 3-5% per annum.

2.4 Objectives for a Solution

Based on the existing and anticipated future traffic conditions, the proposed corridor would need to provide solutions and benefits at both the regional and local scale. The major objectives of the proposal are as follows :

- To provide a satisfactory level of service for road users in the study area during both the commuter and recreational traffic peaks in both the short term (5-10 years) and long term (15-30 years).

- To establish a suitable corridor which will serve as the major road transport route for this section of the South Coast in the long term and which is likely to provide a connection point at its northern limit for any eventual high standard road to the F6 at Yallah.

- To reduce the conflict between through and local traffic in the study area.

- To establish a main road corridor on an alignment which achieves a suitable balance in terms of its effect on property, the natural environment and landscape quality.

- To provide community benefits by reducing accidents and traffic noise, improving local accessibility and enhancing North Kiama (i.e. Minnamurra, Kiama Downs and Gainsborough as a unified residential area.

- To protect and maintain the environmental quality and amenity of the study area to the greatest extent possible by way of environmental controls and safeguards which minimise adverse effects.

- To fulfill broad planning strategies to improve the Princes Highway as the major road link between Sydney and Wollongong and the South Coast for business, tourism and recreational travel.

- To provide net economic benefits by reducing travel times and vehicle operating costs.

It is noted that the primary objective relates to the level of service. This can be more specifically stated as follows :

Short term : for the traffic projected to use the route in 1996 (i.e. the earliest expected completion date of an improved Princes Highway), the level of service for weekday peak period traffic should be B or better. The level of service for weekend peak recreational traffic should be C or better.

Long term : for the traffic projected to use the route in 2011 (i.e. 15 years after opening), the level of service for weekday peak period traffic should be C or better. The level of service for weekend peak recreational traffic should be D or better.

In setting the stated objectives, the cost efficiency of the necessary roadworks to achieve these levels of service, needs to be considered. It is for this reason that level of service A is not considered appropriate as a future objective. The number of times in the year that congestion occurs should also be considered. A higher level of service is desirable for peak hours that regularly occur. Thus, a lower level of service is recommended for weekend peak recreational traffic.

3.0 ASSESSMENT OF MAIN ROAD ALTERNATIVES

This section discusses the method and findings of a comprehensive route selection study which resulted in identification of the preferred main road corridor between Dunmore and Kiama.

3.1 Route Selection Study

In April 1990 the Roads and Traffic Authority commissioned a study to identify and evaluate corridors to satisfy future highway requirements between Dunmore and Kiama (RTA, 1990a).

After detailed mapping of numerous environmental, planning and engineering constraints, 17 possible highway corridors were identified. These included upgrading the existing alignment of the Princes Highway which was the subject of an environmental impact statement in 1986.

Initial assessment showed that four potential corridors might be suitable. These included three western bypass options (denoted as S4–N2, S2–N2 and S4–N3) and an option to upgrade the existing Princes Highway (PH) as shown on Figure 3. A conceptual design of the potential corridors was required to facilitate the subsequent evaluation of options. The designs were consistent with specific road standards, including horizontal and vertical alignment to achieve suitable traffic capacity, design speeds and level of service.

To identify the most suitable road corridor, a detailed evaluation was completed taking into account some nine key environmental and planning assessment factors and an economic evaluation. These factors, which are defined in full in Appendix D, included effects on wetlands and flooding, traffic objectives, land use, access, social and business impacts, heritage, visual changes, noise and engineering practicality or cost.

Of the four potential corridors, the route selection study indicated that corridors N2–S4 and N3–S4 would best satisfy the route selection factors. It was noted that the Princes Highway upgrading (PH) rated below these two corridors because of its lessor ability to satisfy long term traffic needs, adverse effects on local access, increased traffic noise and community disruption.

The route selection study was placed on public exhibition in September/October 1990 with concurrent public displays and meetings. At the end of the exhibition period about 230 submissions were received of which the majority were supportive of a western corridor. Most responses identified a need for works to be implemented as a matter of priority. None of the submissions suggested no road improvements were necessary in the Dunmore to Kiama area.

3.2 Refinement of Options

On the basis of the study and information received during the public review process, the RTA nominated a slightly modified version of the N3-S4 option as the preferred road corridor. This preferred option emerged as there were numerous concerns with the N2 section of the route as it had greater impacts on rural properties including "Glengowrie", "Resthaven" and "Angelsboro" farms. There were also potential flooding problems at the crossing of Rocklow Creek.

The marginally less suitable N3-S4 route was initially thought to have a significant impact on the viability of Dunmore Lakes Park. However, it was found that with some minor alignment modification, these impacts could be significantly reduced. In addition, an Aboriginal site (No 12 in the route selection study) which initially influenced the alignment of the road through the Dunmore Lakes Park site, was later found through discussion with National Parks & Wildlife Service, and inspection by an archaeologist, to be of minimal significance such that it need not constrain the corridor location. The change in alignment would however, cause more significant impacts on the unimproved property located between Dunmore Lakes and Dunmore House (owned by Mandl). In comparison to the original N2-S4 and N3-S4 routes, the preferred corridor would have advantages. This is evident in the rating of options and resultant suitability scores which is discussed below.

3.3 Six Lane Highway Option

Many respondents supporting the option to upgrade the existing Princes Highway (PH) indicated that six lanes instead of four should have been considered in the Route Selection Study in order to provide a level of service equivalent to the western option.

For the section between Oxley Avenue south to Spring Creek, it would be possible to accommodate six lanes within the existing road reserve by eliminating the outer shoulders and reducing the central median. However, in order to provide a comparable road standard and level of service to the proposal, it would be necessary to achieve full access control through Kiama Downs. This would require acquisition of properties on one side of the corridor so as to eliminate private driveways and to provide a service road for the remaining residences on the unaffected side. This could involve the demolition of up to 25 residences generally between Oxley Avenue and Bombo Hill. This study has not identified which side of the road would be preferred for such widening.

North of Oxley Avenue would pose significant problems in widening to six lanes. At least 10 metres of additional width compared to the four lane widening option would be required which could only be obtained either by cutting through the Minnamurra Bends cliff, or entering the Minnamurra River. At Federal Street, the only

option would be to go on the western side along the Minnamurra River due to the horizontal road alignment required at this location. The additional strips taken through these sections would significantly exacerbate the various physical construction problems foreseen with the four lane proposal.

In addition, the cost of the six lane Highway upgrading option would be about $85M to account for the property acquisitions, additional earthworks, bridging structure along and over the Minnamurra River, pavement cost and drainage works. This cost is similar to that for the western bypass options.

Other factors such as local accessibility, property effects, impact on the wetland environment, visual/landscape changes, traffic noise and air quality would be increased significantly.

3.4 Assessment of Options

The method adopted for the assessment was a weighted factor analysis which comprised three main steps as follows :

- weighting of the assessment factors to reflect their relative importance
- rating of the corridor options in terms of their performance relative to those factors
- combination of the weighing and rating values to yield a suitability score for each corridor option.

Table 3.1 presents the importance weightings for the assessment factors and the technique used in the route selection study to derive them. This technique does not endeavour to remove the element of subjectivity which must exist in such cases where personal judgements are involved. However, in seeking to obtain representative community views on the importance of the various factors, the study had regard to feedback through various consultative mechanisms (viz. community survey, written submissions, community working group representatives, public meetings and assorted interest group meetings). Sensitivity testing of different weighting outcomes was also performed and this revealed changes in suitability scores which did not remove the proposal as the highest ranking option.

TABLE 3.1 : RELATIVE IMPORTANCE WEIGHTING

Each factor is progressively paired with another and the perceived importance of one over another is reflected in a score which is established on the following basis:

- o Factor x and y of equal significance score x = y (ie 1 point each)
- o Factor x slightly more important score x = 2 points
- o Factor x substantially more important score x = 3 points

I	Engineering									–
H	Noise/Air								–	H=I
G	Visual							–	G=H	G=2
F	Env/Heritage						–	F=2	F=2	F=2
E	Community					–	E=F	E=2	E=2	E=2
D	Access				–	E=2	F=2	D=G	D=2	D=2
C	Future Use			–	C=D	C=E	F=2	C=G	C=H	C=2
B	Land Use		–	B=2	B=2	B=E	B=F	B=2	B=2	B=2
A	Traffic	–	A=2	A=2	A=2	A=2	A=2	A=2	A=2	A=3
Factor		A	B	C	D	E	F	G	H	I
Weighting		17	12	6	6	11	12	5	3	1

Ranking	Factor	Weighting
1	A – Traffic Objectives	17
2	B – Land Use	12
3	F – Environmental Heritage	12
4	E – Community/Business Effects	11
5	D – Accessibility	6
6	C – Future Land Use	6
7	G – Visual Landscape Changes	5
8	H – Traffic Noise/Air Quality	3
9	I – Engineering Practicality	1

Examples: When Factor A (Traffic Objectives) is compared with Factor B (Land Use) the former is judged to be slightly more important and scores two weighting points (i.e. A=2). When Factor B (Land Use) is compared with Factor F (Environmental Heritage), they are judged to be of equal significance and both score one weighting point (i.e. B=F).

To obtain the total weighting for each factor, the individual paired comparison scores are simply summed. For instance, the Factor F (Environmental Heritage) weighting of 12 comes from a score of zero against Factor A, a score of one against Factors B and E, and a score of two against Factors C, D, G, H and I.

Table 3.2 (overleaf) presents a summary of the comparative assessment of the revised corridor alternatives. This involved rating the options on a scale from zero to five as a measure of how well they conform with the criteria defined for each assessment factor. The rating of options was based on a range of technical investigations which are detailed in the Route Selection Study.

Having established the importance weightings for each assessment factor (refer Table 3.1) and rating of the options (Table 3.2), the total suitability scores for the options were determined by summing the product of the weighting and rating values for each factor as summarised in Table 3.3 below.

TABLE 3.3 : SUITABILITY SCORES OF FULL CORRIDORS

	Factor	Weight	S4–N2	S2–N2	Proposal	PH(4)	PH (6)
A.	Traffic Objectives	17	68	85	68	51	68
B.	Land Use	12	36	24	48	36	12
C.	Future Land Use	6	18	12	18	30	30
D.	Local Accessibility	6	24	24	24	18	18
E.	Community/Business	11	55	44	55	33	22
F.	Environmental/Heritage	12	24	24	24	36	24
G.	Visual/Landscape	5	15	10	20	25	20
H.	Noise/Air Quality	3	12	9	12	3	3
I.	Engineering Practicality	1	3	2	3	3	2
	Total Suitability Score		255	234	272	235	199

Table 3.3 indicates that on the basis of all environmental and planning issues considered, the proposal is the most suitable.

The main advantage of the method used for evaluation is that all identified assessment factors figure in the identification of a most suitable option. This contrasts with most other decision making methods which typically rely on just two or three criteria as the basis for decisions. In addition, the method clearly and systematically presents each step in the evaluation and the judgements which are made, and also has the advantage that sensitivity testing of results can be performed. One such test involved separating Factor F – Environmental/Heritage into two components of natural environmental and heritage resources as suggested by some submissions on the Route Selection Study (RTA, 1990a). Although an additional factor obviously changed the importance weightings, there was no change of any consequence in terms of suitability score with the proposed alignment still being the most suitable option. In this statement, the factors have been presented so as to be consistent with the Route Selection Study.

TABLE 3.2 RATING OF CORRIDOR OPTIONS

A = Traffic Objectives
B = Land Use
C = Future Use
D = Local Accessibility
E = Community/Business
F = Environmental/Heritage
G = Visual/Landscape
H = Noise/Air Quality
I = Engineering Practicality

FACTOR	S4-N2	S2-N2	Proposal	PH (4 Lanes)	PH (6 Lanes)
A	o provides adequate level of service in both short and long term	o provides adequate level of service in both short and long term	o provides adequate level of service in both short and long term	o provides adequate though lower level of service in both short and long term	o provides adequate level of service in both short and long term
	o travel time is 5.4 minutes assuming 80km/hr over Spring Creek to Bombo Hill, then 100km/hr for remainder	o travel time is 4.6 minutes assuming 100km/hr	o travel time is 5.5 minutes assuming 80km/hr over Spring Creek to Bombo Hill, then 100km/hr	o travel time is 6.1 minutes assuming 60km/hr through North Kiama, then 80km/hr	o travel time is 6.1 minutes assuming 60km/hr through North Kiama, then 80km/hr north
	o level of road safety high	o level of road safety high	o level of road safety high	o level of safety good but lower than western options	o level of safety good but lower than western options
	o consistent with long term highway strategy	o consistent with long term highway strategy	o consistent with long term highway strategy	o continued mix of through and local traffic between Bombo and Minnamurra	o continued mix of through and local traffic between Bombo and Minnamurra
	o mix of through and local traffic between Bombo and Kiama		o mix of through and local traffic between Bombo and Kiama	o not consistent with long term highway strategy, no additional capacity available without major acquisitions	o not consistent with long term highway strategy
Rating:	4	5	4	3	4
B	o demolition of one house connected with quarry operations and three other homes at Tabbagong	o demolition of three rural homesteads	o demolition of one home connected with quarry operations, and three other homes at Tabbagong	o demolition of 7 residential properties near Oxley Avenue for new bridge	o demolition of about 25 residential properties between Oxley Avenue and Bombo
	o partial severances to 2 dairy farms, major severances to 1 other, partial severances to 4 other properties	o major severance to 1 dairy farm, partial severance to 1 dairy farm, major severance to 2 other farms, partial severance to 6 other properties	o partial severance to 1 dairy farm, partial severance of 4 other properties	o total loss of access to 5 properties near Iluka Cres for retaining wall, therefore total acquisitions required	
	o no viable quarry/ sand resources affected	o large parcel of high yield agricultural land sterilised	o small parcel of agricultural land sterilised	o affects 1 large rural property (Dunmore House)	o affects 1 large rural property (Dunmore House)
	o large parcel of high yield agricultural land sterilised	o no known extract-ive resources sterilised	o no high quality sand resources affected	o no severance effects	o no severance effects
				o no prime agricul-tural land affected	o no prime agricul-tural land affected
	o maximum use of vacant and degraded site (ie Quarry)	o prime agricultural land affected for most of the corridor		o utilised existing road corridor	o utilised exiting road corridor
				o no significant resources sterilised	o no significant resources sterilised
Rating:	3	2	4	3	1

FACTOR	S4-N2	S2-N2	Proposal	PH (4 Lanes)	PH (6 Lanes)
C	o minor impact to proposed Dunmore Lakes Park	o minor indirect impact on proposed Dunmore Lakes Park, and to Cedar Ridge	o some impact on Dunmore Lakes Park	o does not affect approved or proposed development	o does not affect approved or proposed development
	o some indirect visual/noise impacts on Dunmore Lakes Park and Gainsborough Estate	o some indirect noise/visual affects to proposed Dunmore Lakes Park	o some indirect impacts to Dunmore Lakes Park and some effects to Gainsborough Estate expansion	o no indirect impacts	o no indirect impacts
	o no long term planning strategies affected	o affects possible north expansion of Cedar Ridge and future West Kiama release area	o no long term affects known	o no long term plans affected	o no long term plans affected
Rating:	3	2	3	5	5
D	o minimal affect to local access	o minimal affect to local urban access	o minimal affect to local urban access	o local access generally circuitous because of left in/left out, some at-grade intersections remaining	o local access generally circuitous because of left in/left out, some at-grade intersections remaining
	o no direct access roads affected	o no direct access roads affected	o no direct access road affected	o access to about 40 properties fronting the highway difficult	o access to about 40 properties fronting the highway difficult
	o affects within property access to 3 rural properties, however crossing available	o affects within property access to 7 farms, new connections would be available for all	o affects within property to 2 farms, new connections would be available for all	o no intra-property access affected	o no intra-property access affected
ating:	4	4	4	3	3
E	o considerable improvement in pedestrian safety between Gainsborough and Kiama Downs	o considerable improvement in pedestrian safety between Gainsborough and Kiama Downs	o considerable improvement in pedestrian safety between Gainsborough and Kiama Downs	o continued problems with pedestrian safety	o greater problems with pedestrian safety
	o provides good town centre linkages with reduced speed for visitation encouragement	o provides good town centre linkages with reduced speed for visitation encouragement	o provides good town centre linkages with reduced speed for visitation encouragement	o good direct town centre link, though at-grade available only	o good direct town centre link, though at-grade available only
	o quarry traffic totaly removed from North Kiama	o quarry traffic remains through North Kiama	o quarry traffic totally removed from North Kiama	o quarry traffic remains through North Kiama	o quarry traffic remains through North Kiama
	o possible realignment of bicycle path required	o no community facilities disrupted	o possible realignment of bicycle path required	o no community facilities affected	o no community facilities affected
		o minimal impact on pedestrian/cyclists		o relocation of bicycle path required	o relocation of bicycle path required
		o some isolation effects, with some severance effects to West Kiama release area		o significant isolation/ severance effects	o greater severance/ isolation effects
	o risk potential medium	o risk potential low	o risk potential medium	o risk potential high	o risk potential high
ating:	5	4	5	3	2

FACTOR	S4-N2	S2-N2	Proposal	PH (4 Lanes)	PH (6 Lanes)
F	o crosses south western edge of SEPP 14 wetlands (No 372)	o crosses south western edge of SEPP 14 wetlands (No 372)	o crosses south western edge of SEPP 14 wetlands (No 372)	o disturbance to mangroves in SEPP 14 wetlands near Minnamurra Bends	o major disturbance to mangroves in SEPP 14 wetlands near Minnamurra bends
	o large pocket of Tabbagong Forest affected, though least disturbed section unaffected	o pocket of Tabbagong Forest affected including least disturbed section	o large pocket of Tabbagong Forest affected, though least disturbed section unaffected	o a major disturbance to remnant rainforest in cliff face adjacent to road	o greater disturbance to remnant rainforest in cliff face adjacent to road than PH (4 lanes)
	o small scattered stands of eucalypts and casurinas affected	o small pockets of eucalypts and casurinas affected	o small pocket of casurinas near Minnamurra River and at connection to Princes Highway affected	o large stand of casurinas affected at Dunmore	o more casurinas affected at Dunmore
	o 15-20 fig trees removed	o 15-20 fig trees removed	o No fig trees affected	o 5-10 fig trees affected, one of particular import-ance to local community	o 5-10 fig trees affected, one of particular import-ance to local community
	o some impact on remnant stone walls	o traverses remnant stone walls	o impact on "Tabbagong" gardens	o no stone walls affected	o no stone walls affected
	o no known Aboriginal sites	o affects 1 known Aboriginal site, though highly disturbed	o affects 2 known Aboriginal sites, none of high significance	o affects 3 known Aboriginal sites, though none of high significance	o affects 3 known Aboriginal sites, though none of high significance
	o minor intrusion into Jamberoo Valley	o intrusion into Jamberoo Valley	o minor intrusion into Jamberoo Valley	o disturbance to mangroves with new Minnamurra Bridge	o disturbance to mangroves with new Minnamurra Bridge
				o outside of Jamberoo Valley conservation area	o outside of Jamberoo Valley conservation area
Rating:	2	2	2	3	2
G	o landscape quality medium with minor intrusion into Jamberoo Valley conservation area	o very high existing landscape quality, minor affect on Jamberoo Valley scenic catchment	o medium to low existing landscape quality, minimal affect to Jamberoo Valley scenic catchment	o landscape quality low	o landscape quality low
	o incremental change high	o incremental change very high	o incremental change high	o incremental change low	o incremental change low through urban areas but high
	o landscape sensitivity medium	o medium to very high landscape sensitivity	o low landscape sensitivity	o landscape sensitivity high	o landscape sensitivity high
	o road user views excellent	o road user views high	o medium to high road user views	o road user views good	o road user views good
Rating:	3	2	4	5	4

FACTOR	S4-N2	S2-N2	Proposal	PH (4 Lanes)	PH (6 Lanes)
H	o 40-50 homes within 150m of corridor possibly affected, though high potential for noise control measures. Criteria not exceeded	o 13 homes within 150m of corridor possibly affected. Moderate potential for noise control measures. Criteria likely to be exceeded	o 40-50 homes within 150m of corridor possibly affected, though high potential for noise control measures. Criteria not exceeded	o many homes within 150m of corridor. Noise levels would increase by more than 2dBA above existing levels. Criteria definitely exceeded	o higher noise levels than PH (4 lanes)
				o construction of acoustic barriers difficult and around Minnamurra Bends impossible	o construction of acoustic barriers difficult and aroun Minnamurra Bends impossible
	o no noise sensitive location in proximity to the corridor	o no noise sensitive locations in proximity to the corridor	o no noise sensitive location in proximity to the corridor	o noise sensitive locations including Primary School and Church are in close proximity to the corridor	o noise sensitive locations including Primary School and Church are in close proximity to the corridor
ating:	4	3	4	1	1
I	o high cost	o highest cost	o high cost	o lowest cost	o high cost
	o duration 4 years	o duration 4 years	o duration 4 years	o duration 3 years	o during 3.5 years
	o relocation of 300m water and Telecom mains	o apart from crossing of main 33 kV transmission line, no major utilities affected	o relocation of 300m of water and Telecom mains	o relocation of major water, Telecom, sewerage and electrical services required	o relocation of major water, Telecom, sewerage and electrical services required
	o relatively medium level of earthworks involved	o highest level of earthworks required	o relatively medium level of earthworks required	o relatively low level of earthworks required	o relatively medium level of earthworks required
	o land stability generally satisfactory	o some problems of soil stability foreseen		o land stability generally satisfactory	o land stability generally satisfactory
	o some impacts on traffic during construction, though a minimum of 2 lanes could be provided at all times	o minimal impact on traffic during construction	o some impacts on traffic during construction, though a minimum of 2 lanes could be provided at all times	o temporary, though major impact on traffic during construction, diversion onto local roads may be necessary	o temporary, though major impact on traffic during construction, diversion onto local roads may be necessary
ating:	3	2	3	3	2

4.0 DESCRIPTION OF THE PROPOSAL

This section provides a detailed description of the proposed Bypass in terms of its location, the physical form it would take, relevant operational details and an outline of the construction methods, staging and costs. The proposed landscape treatments are presented in Section 6.10 in the context of visual impact and landscape assessment.

4.1 Road Alignment

General Route Description

The proposed Bypass, which is shown in plan on figures 4A, 4B and 4C and longitudinal section on Figure 5, extends from just north of Shellharbour Road and connects back to the existing Princes Highway near Kiama Cemetery where it would link directly into the Kiama Bypass. From the northern end, the road would extend generally southward to the Minnamurra River and then in a south-easterly direction across the flood plain toward the Bombo quarries. From there, the road would proceed eastwards between the northern edge of the quarries and Gainsborough to reconnect with the existing highway at Bombo Beach. This alignment would therefore provide a complete bypass of the northern Kiama suburbs of Kiama Downs, Gainsborough and Minnamurra.

The total construction length would be about 7.6kms and would be accommodated in a road reserve typically 60 metres wide. However, local areas of deep cut and fill would require a reserve up to 80 metres wide.

4.2 Design Features

Standards

The road has been designed in preliminary form at this stage to generally comply with relevant AUSTROADS (formerly NAASRA) parameters, which are summarised below.

- road design speed generally 110km/hr for a speed zone of generally 100km/hr, except at the northern and southern limits
- horizontal alignment (curves) with a minimum 480 metre radius
- vertical alignment (grades) generally 7 percent maximum
- access - full control of access with service roads if necessary
- pavement design - dense grade and open graded asphalts (replacable as wearing surface) to withstand typical axle loads over next 40 years.

Carriageway and Pavement Design

o New Road Corridor (between Panama Street and Swamp Road)

The dual carriageways would consist of two 3.5 metre wide lanes separated by a 4.5 metre wide median. Three metre wide shoulders would be provided on the outside of each carriageway except where fill embankments exceed 2 metres. In such cases, a guard rail would be installed at the edge of a 1.5 metre wide shoulder. In addition, there would be 1 metre inner shoulders. This would give a total carriageway width of about 26.5 metres. Part of the median and the shoulders could be used for additional lanes (i.e. 6 lanes ultimate) should it be required in the future. These road dimensions would necessarily be confirmed during detail design.

The dimensions and details of the typical carriageway formation are shown on Figure 6.

o Terralong/Gipps Streets to Panama Street

For this section, the existing Princes Highway would be effectively widened to six lanes, consisting of three lanes north bound from the Terralong Street on ramp to Panama Street, and three lanes south bound from the proposed new ramp from the existing Princes Highway to Gipps Street. This is to accommodate local traffic movements between Kiama and North Kiama which would turn onto the Bypass from Terralong Street and off the Bypass at Gipps Street. Additional widening of the bridge over Spring Creek would not be required.

Right turns from Gipps Street would still be permitted in the short term, but would be denied when traffic volumes have substantially increased (about 2001). At that time, traffic from the northern part of Kiama town area would have to travel back to Terralong Street before proceeding northwards.

The dual carriageway would consist of six traffic lanes, and a 1 metre outer shoulders. The north and south bound carriageways would be separated by a 1 metre wide New Jersey kerb.

Access to Bombo Railway Station would be maintained with left in and left out turns only to and from the kerbside lane. Direct access from the inside Bypass lanes would not be possible. A formalised 10 space car park would be provided.

Provision has not been made in the preliminary design for wider carriageways to accommodate cyclists as they would be directed along the existing Highway and the dedicated cycle/pedestrian path at Bombo.

4.3 Major Intersections

Construction of the proposed bypass would involve major intersections at the southern and northern connecting points with the existing Princes Highway. These are detailed below. No

other interchanges would be required between those points as the alignment does not affect any other public roads. Changes to private access are examined in Section 6.0.

Southern Connection with Existing Highway

A plan of the proposed connection with the existing Highway at Bombo is shown on Figure 4C. New access arrangements in this area would be as follows :

- Access from North Kiama (along the existing Highway) to the south would be via a new dedicated one-way ramp which would form the outside lane along the Bombo Beach frontage. Local traffic would either remain in this lane and turn left at Gipps Street for access to Kiama town centre, or merge into the middle lane to continue south. Through traffic using the proposed Bypass would have to merge to the outside lane to access Kiama (i.e the outside lane would turn left only into Gipps Street.

- Access from Kiama to the north would be via the access ramp from Terralong Street (i.e. Gipps Street right turn to be eventually banned). Traffic would then continue along the Bypass and turn left near Panama Street where a new road under the Bypass near the quarry rail line would be provided. This would connect back to the existing Highway alignment on the eastern side of the proposed Bypass.

- Access from the north to the Bombo quarries area or North Kiama would also be possible from the proposed Bypass via an off-ramp located south of Gainsborough which connects to the existing Highway.

- Quarry traffic would be able to gain access to the proposed Bypass for both north and south bound movements, via Panama and Hutchinson Streets, thereby eliminating all quarry trucks through North Kiama. There are currently about 200-300 such movements per day.

There is also the possibility of a direct north bound on-ramp from the Boral quarry. This would be a matter for negotiation between the RTA and Boral during final design.

Northern Connection with Existing Highway

The proposed traffic arrangement for the connection to the existing Highway in the north is shown on Figure 4A. It is proposed to connect the Princes Highway with the Bypass by a T-intersection and seagull arrangement. The intersection would be located south of Swamp Road with priority given to traffic on the Bypass.

Subject to final approval and construction of the Dunmore Lakes Park proposal (refer Section 5.6), Swamp Road would be connected to the Bypass with a large radius roundabout. Traffic speeds in the vicinity of the roundabout would be limited to 80km/hour.

Further to the north, the existing Dunmore quarry railway crossing would remain at grade until such time that there is a commitment for major new road construction northwards from Shellharbour Road (i.e. the longer term Dunmore to Oak Flats proposal).

The Shellharbour Road/North Kiama Bypass intersection would essentially remain in the same form as the present Highway intersection, although the road would be widened to four lanes up to Shellharbour Road, and then taper back to two lanes immediately to the north. The intersection would comprise a dedicated right turn lane from the Bypass (north bound) and a dedicated left turn/acceleration lane from Shellharbour Road (south bound). The RTA plan to eventually construct a new bridge over the South Coast railway line about 1km north of Shellharbour Road. Once this is complete the proposed intersection would be closed and the four lanes would be extended.

4.4 Major Structures

Two major bridges would initially be required as part of the Bypass construction, one across the Minnamurra River flood plain (Terragong Swamp), and the other across Panama Street and the quarry rail line at Bombo. In the medium term a further bridge may be required at the intersection of the Bypass and the existing Highway near Dunmore. The need for such grade separation would to a large extent, depend on whether the proposed Dunmore Lakes Park is completed (refer Section 6.1). If the Park development proceeds in the short term, the proposed intersection arrangements detailed in Section 4.3 would be satisfactory in terms of traffic requirements, at least until the year 2000.

The relevant physical details of the proposed bridges are described in Table 4.1 below.

TABLE 4.1 : BRIDGE DIMENSIONS

Dimension	Terragong Swamp	Panama Street
Total Length (m)	810	100
Width (m)	20	22
Span width (m)	18	20 *
No. Spans	43	5 *

* Subject to final design.

A cross section and elevation of the proposed Terragong Swamp crossing is shown on Figure 7. The preliminary concept design of the bridge has been based on comprehensive flood modelling (RTA, 1990e) and geotechnical investigations (RTA, 1990h). Further discussion on these aspects is provided in Section 6.3.

4.5 Earthworks

As shown on Figure 5, the proposed road would comprise numerous major cuttings and substantial fill embankments. The materials excavated from the cuttings would be generally suitable as fill and sub-grade material. Blasting would be required for deep cuttings in the steep areas around the Bombo quarries and "Tabbagong" in the south and the ridgeline west of "Dunmore House" in the northern section. Blasting has been experienced in these areas for many years due to the proximity of Bombo and Dunmore quarries. Further details on the possible impact of blasting are discussed in Section 6.13.

Cut batters would generally be 1 to 1 in rock (horizontal to vertical), flattening to 2 to 1 where there is indication of instability and where space permits (RTA, 1990h).

The locations for major fill placement include low lying sections generally north of "Tongarra", the southern approach to Terragong Swamp on "Riversdale", a section near the SRA quarry and the southern approach to the proposed bridge at Bombo. In the latter case, the fill would be contained by vertical walls such as 'reinforced earth' owing to the limited available space in that area.

Approximate earthworks quantities have been generated in the preliminary design. Table 4.2 below shows a total cut requirement of 910,000 cubic metres and a total fill requirement of 975,000 cubic metres. This indicates there would be a need for about a further 65,000 cubic metres to be imported to the works and this would most likely be sourced from local quarries.

TABLE 4.2 : INDICATIVE EARTHWORKS VOLUMES

Section	Total Cut (cu m)	Total Fill (cu m)	Balance ** (cu m)
* Southern	570,000	445,000	+ 125,000
Northern	340,000	530,000	- 190,000
Balance	910,000	975,000	- 65,000

* Includes bridge embankment
** Negative sign indicates import of fill material required.

Note: Slight changes in grading and slope angle could adjust the balance without affecting the total volume.

The extent of vegetation clearing and soil stripping prior to earthworks would be kept to a practical minimum allowing for typically 3-4 metres on the bottom side of fill batters (for access) and above the top of cuttings (for access and drainage controls).

4.6 Drainage

A detailed investigation and design of necessary drainage arrangements associated with the proposal would be undertaken following approval. This would entail close attention to both construction stage drainage features and permanent structures, as well as water control objectives (refer Sections 6.2 - 6.4).

Based on preliminary designs to date, the proposed major drainage features would need to include bridge crossings of permanent water bodies, large culverts for smaller water courses and drainage lines and retention basins for runoff control from pavements as shown in Figures 4A, 4B and 4C.

4.7 Construction Methods and Staging

General

Construction activities would generally be confined within the proposed corridor with access to the section north of the Minnamurra River starting from near the intersection of Swamp Road/Princes Highway and in the south from the intersection of Panama Street/Princes Highway. The exception would be access to the construction site of the proposed Terragong Swamp bridge crossing. As the bridge would need to be constructed at an early stage, temporary access would be required along the boundary of the "Glengowrie" and "Tongarra" farms. An access road would be formed along the proposed corridor to connect to the existing Princes Highway however as early as possible to minimise the amount of construction traffic on Swamp Road and access through these rural properties.

It is anticipated that two construction compounds would be required. One would be located near the intersection of Swamp Road/Princes Highway and the other in the disused RTA quarry at the southern end. These would be contained within the proposed corridor reserve. These sites have been selected to avoid identified sensitive areas (e.g. no construction compound at Terragong Swamp bridge crossing), and where there are already proposed heavy machinery movements (i.e. Dunmore Lakes Park sand excavation). Each site would be fenced, established with suitable road base and erosion control measures installed.

Construction activities would be restricted to times based on SPCC (1985) guidelines, with the exception of certain essential night and weekend work (i.e. intersection management).

The project will employ a number of skilled, semi-skilled and unskilled workers. The number of these will depend upon the final contact arrangement, however, it is estimated based on experience with similar size projects, that a workforce in the order of 40 people would be required.

Specific Sections

For construction purposes the proposal can be divided into five sections. Although geographically distinct, they are not necessarily independent in terms of construction staging. Some likely techniques involved in the construction of each of these sections is outlined below.

Section 1 - Princes Highway at Bombo

This section involves the upgrading of the Princes Highway for approximately 1.2kms from Terralong Street to the proposed interchange near Panama Street. Work in this section would be done under traffic however, at least two lanes would be available for traffic at all times. A temporary connection would be required near Panama Street for the Princes Highway until traffic would ultimately travel on the proposed Bypass.

Work would be contained within the existing road widening boundaries in this area. The machinery used on this section would be to the perogative of the construction organisation, however, it is anticipated excavators and larger dozers would do the bulk of the earthworks with loaders and trucks for haulage. Compaction would generally be by vibrating rollers or static drum rollers where vibration was restricted. Other equipment would include cranes, graders, water tanks and service vehicles.

As the work is in close proximity to the quarry for pavement material and concrete plants, the impact of construction traffic on local streets would be minimal. It is anticipated this section of work would take approximately 18 months to complete.

Section 2 - Bombo to Terragong Swamp

This section of work involves a large quantity of earthworks. Initial quantity estimates suggest 570,000m^3 of cut with 465,000m^3 of fill, leaving 105,000m^3 of material.

Work would generally involve the clearing of vegetation and overburden by bulldozers.

Preliminary geotechnical appraisal of this section (RTA, 1990h) indicates hard basalt rock at low depths. Blasting would be required to remove this material. Restrictions are required because of close proximity to the residential estate at Gainsborough. The necessary restrictions are discussed in Section 6.13.

Compaction would be by vibrating compactors and rollers.

Stabilisation of some of the cuttings would be necessary, although the exact treatment would not be determined until detailed design. However, likely methods include flattening of batters, additional berms on the batter wall and retaining structures. Retaining structures may be necessary to limit the impact on property acquisitions.

The bridge at Bombo could be constructed within this section of works as it is detached from the operation of the section of the Princes Highway which is to be upgraded in that area (refer Figure 4C).

Construction for the earthworks would take approximately 18 months to compete with another two months for pavement works. Access would be via the existing Highway at Bombo.

Section 3 - Terragong Swamp Crossing

The configuration of the crossing would comprise a bridge approximately 810m long with 80 metres of embankment at the southern approach. The proposed design would be a multi-span low level bridge. Each span would be approximately 18m. Piling of the foundation would be required to provide adequate structural strength and stability across the soft and poorly consolidated alluvial flats.

Initially, mobile pile driving rigs would need to enter the wetlands area. The piles themselves would be stored away from the wetlands and brought to the desired location as needed by wheeled and if necessary, tracked vehicles. The pile rig would remain on site in order to reduce the number of vehicular crossings of the wetlands, however, would be brought out onto higher ground along the proposed corridor should flooding of the swamp area occur.

Once the piles are driven and the piers constructed, the need to enter the wetlands is minimal. It is envisaged the bridge would incorporate pre-cast concrete planks which can be lowered into position from the abutment outside the wetland area. After the first span has been completed, the planks for the second span can be lowered into place from the first span using a crane, and subsequent materials such as concrete and steel reinforcement can be transported across the existing span. This work sequence would be continued for the remaining spans. This method reduces the impact on the wetlands by keeping construction machinery within the wetlands to a minimum.

As indicated above, access to the bridge site would be required via private property. At this stage access off Swamp Road between "Glengowrie" and "Tongarra" properties would appear to be the most appropriate, considering flood heights, minimal disturbance to farm operations and proximity to the proposed bridge structure. The number of construction vehicle movements cannot be quantified at this stage and is largely dependent on the contractor selected to complete the works. However, in the event of damage to Swamp Road attribuable to construction traffic, the RTA would meet reasonable repair costs.

As soon as the link can be established, construction traffic would access the bridge site within the Bypass corridor from the northern end. The wetlands of Terragong Swamp would be protected by sedimentation devices which would be constructed prior to the earthworks in consultation with the Soil Conservation Service,

and would most likely involve the existing dam in the "Glengowrie" property and a proposed new structure east of the corridor just south of the billabong on the "Riversdale" property. The location of these structures are shown on Figures 4A, 4B and 4C.

A surplus of approximately 105,000m^3 of fill would need to be hauled from south to north of Terragong Swamp. Due to sensitivity of the wetlands and the potential for flooding, the bridge would form the haul road rather than construct a separate haul road across the flats. Bridge construction would therefore start prior to the earthworks north and south of Terragong Swamp so as to contain roadworks activity to the road reserve.

The bridge would take approximately 18 months to construct, and would likely be done in conjunction with Sections 1 and 2.

Section 4 - Terragong Swamp to Princes Highway

The majority of this section is across alluvial flats with a major cut west of "Dunmore House". Indicative earthwork volumes are 375,00m^3 of cut and 530,000m^3 of fill, leaving a shortfall of 155,000m^3 of fill. Approximately 150,000m^3 of this fill would be hauled across the new Terragong Swamp bridge. During detailed design, changes would be made in order to achieve a balance in earthworks.

Geotechnical information recommends special treatment for any embankments across the alluvial flats. The existing topsoil would be removed to a depth of 1.0m, a geotextile fabric placed and backfilling with rockfill to existing levels before placing of general fill.

With the exception of the temporary access from Swamp Road between "Glengowrie" and "Tongarra", construction for this section would be restricted to the road reserve with access available at both ends. No special equipment is likely to be required other than general roadwork machines.

It is anticipated this work would be done in conjunction with the earthworks to the south of Terragong Swamp to overcome the imbalance in earthworks. The earthworks is expected to take 15 months with another two months for pavement works.

Section 5 - Princes Highway Intersection to Shellharbour Road

This work involves the three intersections with the Princes Highway, Swamp Road and Shellharbour Road. The intersections are likely to be constructed under traffic and therefore the rate of work would be reduced.

Standard road construction techniques would be used for this work, which it is expected, would be completed last. However, it can be constructed and used independent of the other roadworks. This work is anticipated to take approximately six months.

4.8 Lighting and Signposting

Lighting would be installed at locations where it is necessary for safety reasons. This would include the two major intersections with the existing Highway. Warning signs would also be provided along low lying areas which are subject to regular heavy fogs, possibly in the Terragong Swamp and Swamp Road area. It is noted that the proposed road design standard for the Bypass is consistent with that for other roads in fog prone locations.

The usual array of signs would be specified during detailed design of the Bypass. Specific warning signs possibly incorporating warning lights or signals would be required to advise of the frequent blasting which occurs in the Boral and SRA quarries at Bombo.

4.9 Project Costs

Table 4.3 below presents a schedule of estimated construction and other relevant project costs for the proposed Bypass. It is evident that earthworks and the crossing of Terragong Swamp represent the highest cost components.

TABLE 4.3 : PROJECT COSTS ($M (1990)

Project	Approximate Costs ($) million
Earthworks	29.3
Pavement	8.0
Drainage	2.0
Structures	2.8
Utilities	0.5
Swamp Bridge Crossing (810m + 80m embankment)	15.7
Miscellaneous (i)	6.0
Noise/Landscape	2.0
Property Adjustment/Acquisitions (ii)	3.5
Sub Total	69.8
Professional/Project Management (10%)	7.0
Sub Total	76.8
Contingencies (10%)	7.7
TOTAL PROJECT COSTS	84.5

Notes:

(i) Miscellaneous category includes numerous items such as vertical walls, gabions, safety barriers, lighting, sign-posting, linemarking, rest areas and other minor equipment and works.

(ii) Property adjustment and acquisition costs could vary markedly (either higher or lower) subject to the outcome of negotiations over the exact land to be purchased and the potential for re-sale.

4.10 Existing Princes Highway

Highway De-classification

When the proposed Bypass has been opened, the existing section of the Princes Highway between the northern and southern intersections would be de-classified as a main road. Subject to negotiations, the road would effectively become a local road primarily for North Kiama residents, with responsibility for maintenance assumed by Kiama Municipal Council with a small section near the proposed Dunmore Lakes Park to be in the care of Shellharbour Municipal Council. This change in status would be subject to negotiations between the RTA and Council with some likely financial commitments from the RTA for remedial maintenance prior to handover.

Immediate Highway Improvements

In view of the significant traffic and road safety problems currently experienced along the Highway through North Kiama, and the estimated construction time for the Bypass, the RTA is investigating and will implement limited traffic management improvements. Various short term options were identified in the Route Selection Study mainly involving intersection improvements and localised shoulder widenings between Bombo Hill and Oxley Avenue (RTA, 1990a). Any such works would be separate from the proposed Bypass and have not been examined in this statement.

5.0 THE EXISTING ENVIRONMENT

This section provides a description of the existing environment of the study area in order to present relevant information for the subsequent assessment of potential impacts from the proposed Bypass.

5.1 Geology, Soils and Topography

Geology

The Kiama area is underlain by rocks belonging to the Shoalhaven Group of Permian age. The sequence comprises an inter-bedded series of sandstones and latites (basalts), of which the Kiama sandstone and Bombo Latite occur within the study area.

The Kiama sandstone, a sub-unit of the Budgong sandstone, includes thin laminated siltstones, and is up to 76m thick. It ranges from red to yellow, grey and green grey in colour and from lithic to lithic telspathic in composition. The sandstones are usually plane bedded, though cross bedded units and pebbly bands often occur at the base of beds.

The Bombo Latite overlies the Kiama sandstone and reaches a maximum thickness of 150m, although it is generally 60m or less. It is considered that it originated as a lava flow. The latite comprises a porphyritic basalt with a fine grained ground mass varying from mid-grey to black in colour. The rock is commonly vesicular with some secondary minerals in the vesicles. Columnar jointing and breccia zones are reportedly common (RTA, 1990h).

The major river valleys have cut through the entire thickness of the Bombo Latite exposing the Kiama sandstone in the lower valley slopes. More recent increases in sea level have resulted in deposition of deep (Quarternary) alluvial sediments in the valley floors. Residual deposits of Quarternary tallus reportedly occur over the crests of the hills immediately west of Bombo (RTA, 1990h).

Generally, hillslopes of less than 15° appear to be relatively stable. The stability and erodability of steeper slopes is however, a function of the depth and nature of the soil cover, as well as surface and groundwater considerations and overall slope patterns and histories. In these steeper slopes there are surface indications of slope creep, characterised by terraces, curvature of trees and other geomorphological features (RTA, 1990h). These details indicate the fact that the geological formations and soil types associated with the area would be very susceptible to the forces of erosion when stripped of vegetation and soil cover.

Soils

The main soil types in the area can be classified as alluvial soils (coarse and medium textured type), swamp soils, krasnozems and other soils.

Medium textured alluvial soils occur in the Minnamurra River flood plain and locally on the Terragong Swamp. These soils are moderate to highly fertile. The coarse textured soils occur in small pockets adjacent to the medium textured soils. Stones are a common feature in these soils, and have a low water holding capacity. Both these soil types are subject to flooding, and erosion is common after heavy rains or floods, especially if vegetation has been removed.

Swamp soils are deep, acidic and rich in organic matter. These soils occur in the permanently inundated Terragong Swamp area, although it is noted that this area is actually covered by a man-made drainage network.

Areas containing swamp soils are a consequence of natural deposition, and in their natural state, have a very low erosion hazard. When drained however, these soils become highly erodible and careful management is required to minimise soil loss. Where vegetative cover has been removed, flooding increases the erodibility of this soil type (RTA, 1990h).

Krasnozems can be specifically associated with the Bombo Latite. These soils are generally red to dark brown and well structured with gradational textured profile. The upper profile tends to a friable loam to clay loam with good crumb structure and a generally high organic content. Erosion hazard is high in slopes above 15°, however, this hazard is moderate in less steep slopes as erodibility of the surface soil is low.

Other isolated pockets of soil located in the area include Lithosols and are associated with the Bombo Latite. These soils are characteristically stony and shallow, and occur on moderately steep sideslopes, and are also susceptible to sheet and gully erosion, especially when vegetation is removed or disturbed.

Topography

The terrain of the study area and along the proposed corridor is predominantly rolling hills, broken by steeper gullies and spur lines. Areas of steep terrain are shown on Figure 8. Other major features include the flood plain and the estuarine wetlands in the lower reaches of the Minnamurra River. A general description of the topography of the proposed corridor is provided below, beginning in the north.

From Rocklow Creek, heading south, the terrain is generally alluvial flats rising gently towards a low ridge (30 metres AHD) trending N-E/S-W, and falls away towards the Minnamurra flood plain. The route traverses the western edge of the flood plain which is generally 2m AHD.

The alluvial flats of the Terragong Swamp extend for approximately one kilometre to the south where the terrain then rises steeply up a spur formation to the ridge top which is about 75 metres AHD. From this high point, the proposed corridor continues in an easterly direction where the terrain falls slowly towards the Bombo quarries south of Gainsborough where there are several vertical cliffs and benches due to former extraction activity. On emerging from the old quarries the land surface slopes down steeply to a narrow coastal strip fronting Bombo Beach.

In the Kiama area there is no flat coastal plain development and the footslopes of the escarpment extend right to the coast. The footslopes of the escarpment are locally formed by extensive outcrops of the Bombo latite, which have been dissected by the major river valleys of Spring Creek, Minnamurra River and Rocklow Creek, where broad alluvial flood plains have formed. The tributary streams of these major rivers have given rise to small valleys and gullies with moderate to steep side slopes.

5.2 Hydrology and Drainage

The major hydrological feature in the study area is the Minnamurra River flood plain. The catchment is roughly triangular in shape and covers and area of 118km^2. The south western boundary of the catchment extends 19km inland along the Saddleback and Illawarra Ranges, with elevations ranging from 300 to 700m AHD. The northern boundary follows a chain of ridges through Stockyard Mountain to just inland of the sea.

The major low lying sub-catchment of Rocklow Creek, with an area of 24km^2, lies at the northern apex of the catchment Rocklow Creek, which flows into the Minnamurra River downstream of the existing Highway and approximately 2km from the river mouth.

A large number of small streams and creeks drain the southern and western slopes of the catchment, each discharging into the Minnamurra River generally upstream of the proposed road crossing near Swamp Road.

Flooding is a common occurrence which can be associated with rainfall events in different parts of the catchment. Whilst there are only very limited official climatic and hydrological data for the area, there are many reported flood events where rainfall occurred only in isolated sections of the catchment. Major flood events on the lower Terragong Swamp are reported by local property owners for the years 1932, 1942, 1952, 1959, 1975 and 1978.

During major flood events in the Minnamurra, the flood plain, which covers an area of approximately 600 hectares, acts as a large retarding basin which significantly attenuates the peak of the flood wave as it moves down the flood plain (RTA, 1990e). Land generally subject to inundation during peak flood events is

shown on Figure 8. Peak flood levels in the Rocklow Creek sub-catchment are caused by backwater from the Minnamurra River rather than by flood flows in the Rocklow Creek sub-catchment.

The main flood plain, which is known as the Terragong Swamp, is actually dry land other than in flood times because of a comprehensive drainage system which was constructed in the early 1900's. These works, which are mostly upstream of the protected wetlands area, included the formation of a new main river channel which diverted flows to the northern side of the flood plain generally west of Swamp Road. A series of drainage ditches is still maintained by the Terragong Drainage Union, and are the mechanism which enable continued productive use of the Terragong Swamp by dairy farmers (refer Section 5.6).

In both the Rocklow Creek sub-catchment and the downstream section of the Minnamurra River, peak flood levels during major events are affected by ocean water levels and by the available flow area at the ocean entrance. After long calm periods with low river flow, the ocean entrance closes partially due to the build-up of coastal sand. This reduction in available area produces an increase in flood levels during the early part of the flood event, after which the entrance is scoured fully open, with a consequent drop in flood levels. This effect extends approximately 2.6km upstream from the mouth (i.e. about adjacent to the Princes Highway).

The main Minnamurra River channel is officially regarded as being tidal to a point approximately 1km upstream of the bridge at Swamp Road, where there is a small weir type structure. However, pronounced tidal effects are not evident beyond the Swamp Road bridge crossing.

The Minnamurra River is classified as a Prescribed Stream under the Soil Conservation Act and this imposes strong limitations on tree removal. Specific approvals under Protected Lands legislation will therefore be required for the proposal.

Specific flood level information was obtained from local farmers with property interests on the Terragong Swamp by way of interview/questionnaires distributed through the Terragong Drainage Union. The survey sought both qualitative and quantitative (if available) information on known flood events, duration of floods and flood depths. The survey results with respect to highest known or recorded flood levels and the year they occurred, are shown in Table 5.1 below. These levels were obtained by field survey of relevant markings (e.g. stains on dairy walls). The locations are also shown on Figure 8.

TABLE 5.1 : LOCALLY RECORDED FLOOD LEVELS

Location (Refer Figure 9)	Maximum Flood Level (metres AHD)	Estimated Year of Event
1	4.7	1975
2	3.6	1975
3	3.7	1975
4	4.2	1975
5	3.2	unknown
6	3.3	1975
7	3.3	1950's
8	4.9	1950's

The table indicates an average maximum flood level of about 4.0 metres AHD, with a maximum of 4.9 metres recorded in the 1950's, just east of Swamp Road north of Minnamurra River.

These levels have been used and are generally consistent with the estimates used for the calibration of the flood model as discussed in Section 6.3. It is noted that there was also a recorded flood level of 8.8 metres AHD at 'Terragong' homestead just south of Jamberoo Road. It is likely this is attributable to localised flooding from Jerrara Creek and that it is not representative of levels on the main flood plain.

A second but much smaller catchment which covers the southern part of the study area is that which drains to Spring Creek, which includes a permanent waterbody near the northern end of the Kiama Bypass. The catchment takes in the land generally south of Gainsborough and east of Riversdale Road. The Bombo quarries form another distinct catchment with drainage direct to Bombo Beach via a culvert under the railway embankment.

5.3 Water Quality

The major water courses in the area traversed by the proposed corridor are the Minnamurra River and Rocklow Creek.

Studies by the State Pollution Control Commission (SPCC) in the early 1980's indicated that water quality in the Minnamurra River was generally good in dry periods. In wet periods, runoff considerably reduces water quality as a consequence of high levels of siltation. Quality of runoff is influenced mainly by land use, landform, soil stability and soil type.

According to Kiama Municipal Council (1989b) surface water in the municipality is of comparatively good quality upstream from urbaned areas and would be suitable for most purposes with little or no treatment.

The SPCC (Pollution Inspector, pers comm) has indicated that water quality in Rocklow Creek is generally inferior to that of Minnamurra River because of the high levels of siltation.

5.4 Climate and Air Quality

Climate

The climatic conditions of the South Coast of New South Wales is characterised by high rainfall and humidity. Maximum rainfall of approximately 150mm per month occurs during late summer, early autumn. Minimum monthly rainfall of 70-80mm is experienced during late winter. Average annual rainfall is approximately 1,300mm.

Temperatures in the area are mild, with a minimum of 5-6°C in winter and an average maximum of 25-26°C in summer.

Prevailing winds in summer are south and north-east, and in winter west and south-west.

Fogs have been frequently reported in and around Kiama with local observation suggesting heavy fogs are a common occurrence in the lower Jamberoo Valley around Terragong Swamp (P McGlinchey pers comm). Official data on the frequency of fog days in the area is not available.

Air Quality

Air quality in the immediate study area is dependent almost totally on motor vehicle emissions and uncontrolled refuse burning. Little industrial pollution except for dust particle emissions from quarry activities, is generated in the area. Much of the area is protected by sea breezes on many days, which dissipates the effects of pollutants in the atmosphere.

5.5 Natural Environment

This section describes the existing natural environment of the study area and includes an appraisal of flora and fauna before European settlement as an important indicator of the former environment.

Flora and Fauna at European Settlement

The Jamberoo Valley has long been known for its brushes and rainforest that formerly covered the land. The described sub-tropical rainforests were characterised by highly structural and floristic diversity. Several canopy layers would have been present, including large emergent trees and vines. There were also stretches of hardwood forest, including timbers such as blackbutt, stringy bark, messmate and some turpentines. Historical records confirm the vegetation pattern was one of an already fragmented rainforest and schlerophyll forest association throughout most of the valley.

Evidence suggests that Terragong Swamp extended over 800 acres before drainage works began in 1867. Outside of the swamp the low lying lands were probably covered with rainforest in the upper part of the valley, and supported casuarina forests and reed/rush beds in the estuarine areas.

With respect to fauna, there is little systematic information however, it was reported to be rich with bird, reptile and insect life.

Mammals that were likely to have occurred but have since become locally extinct, include the eastern native cat, the koala, greater glider, yellow bellied glider, short eared possum, pigmy glider, long nosed rat kangaroo, red necked pademelon, parma wallaby and the grey kangaroo. Extinction is likely to have occurred through loss of habitat and fragmentation of habitat.

Birds were also abundant, however, those species mostly closely associated with rainforest, would have been most vulnerable to extinction. Numerous bird species are now likely to be absent since European settlement, including the emu, lyrebird and brush turkey.

The noted vegetation of the lower Jamberoo Valley has thus experienced significant change since European settlement with the virtual disappearance of large tracts of rainforest/wet sclerophyll and the drainage of a large wetland area, resulting in the disappearance of several species of mammals and birds, and the diminished population of the remaining species. The area has therefore already experienced significant and substantial loss of environmental value as a whole since European settlement (RTA, 1990j).

Existing Flora and Fauna

o Wetlands

Wetlands are an important part of the ecosystems as they provide a habitat for migrating fish, birds and other wildlife species. They also assist in flood control by allowing temporary storage of water.

In recognition of these attributes, the State Government introduced a State Environmental Planning Policy (SEPP 14) in 1985 to protect certain areas. Under this policy, development that may affect wetlands must have the consent of local councils and the concurrence of the Department of Planning.

There is one such classified wetland in the vicinity of the proposed Bypass known as No 372, which is shown on Figure 9. Wetland No 372 was surveyed in detail by Carne (1989). Generally, mangroves flank the river with two species Avicennia marina (grey mangroves) and Aegiceras corniculatum (river mangrove) present. Inland there are tidal marshes, characterised by saltmarshes. The wetland fringes on higher areas are characterised by Casuarina glauca (Swamp Oak) with ground cover dominated by

Suaeda australis. In the upper wetlands the Swamp Oak forests have a saltmarsh understorey and is fringed inland by Melaleuca styphelioides (prickly leaved paper bark).

Generally, wetland communities such as those identified above, are in proximity to the proposed corridor where it passes through the Terragong Swamp. It was observed that there was generally no regeneration of the present dominant vegetation type Casuarina glauca. This is most likely due to intensive grazing activities in the area.

o Tabbagong Forest

Tabbagong Forest is composed of a patchwork of diverse rainforest and wet sclerophyll species. The land directly affected or adjoining the proposed highway is predominantly vegetated by a wet sclerophyll forest characterised by Eucalyptus paniculata (grey ironbark), Syncarpia glomulifera (turpentine) and Eu. saligna/botroides (blue gum/bangalay). Although partially cleared in some places and much disturbed in others by cattle, the understorey of the forest in less disturbed areas is dominated by such rainforest species such as Eu. micrococca (white euodia), Hibiscus heterophyllus (native hibiscus), Doryphora sassafrass (sassafrass), Pittosporum undulatum (Pittosporum), Ficus superba var henneana (deciduous fig) and possibly as many as 35 other species.

In addition, there has been extensive planting of tree species alien to the locality around the Tabbagong homestead and along ridge lines. Particularly evident are Eu. maculata (spotted gums), several conifers, palms and other gums, and exotic trees such as Coral Trees, and Cape Chestnut Tree, and a large stand of bamboo.

Specific details including species lists are provided in Appendix E.

o Fauna

No systematic survey of existing fauna was carried out in the area, but casual observations and information obtained from previous surveys provides a good account of fauna.

Numerous mammals have been identified which are likely to be found in the Jamberoo Valley, including the platypus, spiny anteater, tiger cat, long nosed bandicoot, ring tail possum, sugar glider, brushtail possum, swamp wallaby, bats, rats, rabbits, foxes and feral cats, most of which have been observed by local farmers or during field investigation.

Bird life in the Valley is extensive with almost 100 different species being identified by the Illawarra Bird Observers Club at "Glengowrie" in June 1990. This included a nesting pair of white bellied sea eagles Haliaeetus leucogaster seen in the forest on the Mandl property, ospreys Pandion haliaetus in "Tabbagong" and Brown Falcons Falco berigora north of the "Glengowrie" homestead.

Other fauna such as reptiles and amphibians including snakes, skinks, water dragons, blue tongue lizards and frogs are also abundant in the area.

The Minnamurra River also supports populations of numerous fish species, including Australian bass, estuary perch and grayling Juvenile fish including blackfish, Australian snapper, yellowfin, bream, flathead and silver biddy are also found in the river, all of which are of commercial importance. Within the mangroves the Sydney rock oyster can also be found.

A full species list of fauna is provided in Appendix E.

5.6 Land Use and Property

General

The study area through which the proposed road corridor would pass is diverse in land use as shown on Figure 10.

The land in immediate proximity of the proposed corridor is used primarily for grazing of dairy cattle, except for the southern end which is developed for quarry operations and a concrete plant, and as a buffer zone for the "Gainsborough" residential estate. A detailed description of major land use activity is provided below.

Existing Urban Development

Urban development is almost entirely confined to the east of the proposed corridor, and comprises the suburbs of Minnamurra, Kiama Downs and Gainsborough. Gainsborough currently accommodates approximately 1,800 people with a second stage expansion to the west now under construction which will involve development of an additional 110 homes. This new development area and the southern part of Gainsborough is the only residential area in close proximity to the proposed Bypass, although Kiama Council could proceed with a residential development on a recently acquired property to the west of the cemetery at the southern end of the study area.

Recreational Activities

The seaside location, scenic character and relatively close proximity to Wollongong and Sydney Metropolitan areas, means Kiama is a popular tourist destination. Major tourist concentrations occur during the Easter and October long weekends and over the Christmas school holiday period. Water and land based recreational activities are important and include the use of the beaches, the Minnamurra River and the inland rural areas of the Jamberoo Valley.

The Minnamurra River estuary offers numerous recreational opportunities including sightseeing, painting, bird-watching, fishing and boating.

At present, relatively little opportunity is provided for motorists to access the Minnamurra River due to the winding nature and narrowness of the Highway. Access is generally limited only to an old boat ramp adjacent to a public oyster lease, via a gravel driveway near the Minnamurra Bridge, and a track off The Village to a boat ramp on the eastern side of the Bridge. There are five other possible stopping areas however, these are generally very narrow, providing room for only a few vehicles and are poorly situated in terms of stopping sight distances and speed of traffic on the Highway.

The Kiama Golf Course is adjacent to the Highway and opposite the Minnamurra River with vehicular access from the Princes Highway via Federal Street and also from Oxley Avenue. The course is very well patronised year round by members and visitors.

Public reserves along the Highway include Iluka Reserve and North Kiama Park. These reserves are generally undeveloped.

The other major recreational feature adjacent to the existing Highway is Bombo Beach. The beach has poor accessibility from the Highway being served by a gravel track opposite Hutchinson Street passing under the South Coast railway line. A gravel car park and toilet block have also been established for beach visitors.

A shared cyclist/pedestrian path is presently under construction by Kiama Council between the railway line and the Princes Highway along Bombo Beach to provide access between North Kiama and Kiama.

Specific attractions in the rural areas are generally located much further to the west and include Jamberoo Village, Minnamurra Falls Reserve, Jamberoo Grass Ski Park and Wild Country Park. Scenic drives throughout the Jamberoo Valley are also a popular activity.

Rural Activities

The Department of Agriculture, which classifies land on a state wide basis, has identified the majority of the land through which the corridor would pass as being Agricultural Suitability Class 3. This is generally suitable for grazing, although with improvements, could be used for occasional cash cropping or farming crops.

As identified in Figure 10, the corridor passes through an area dominated by commercial dairying and grazing. The large farms in the area often have two to three non- adjoining holdings comprising a main farm area, a swamp lot (used during times of drought) and a dry lot (used during times of flood). On average, farm sizes are in the order of 130 hectares, comprising the main farm of 96 hectares, dry run of 30 hectares and a swamp lot of 3 hectares. The farm and swamp are also used for agistment by other farmers.

The value of dairy industry in the Jamberoo Valley was estimated to be about $4.4 million (1985 dollars). This represents about 40% of the total value of agricultural production from the Municipality of Kiama and Shellharbour (DEP, 1985).

Historically, the dairy industry has contracted considerably, generally due to the fall in milk consumption, rising prices of farm inputs, fall in export of manufactured dairy products and the importing of cheeses (DEP, 1985). As a consequence, the industry is now largely oriented to supplying the domestic market.

The outlook for the dairy industry is for further contraction, however, this will depend heavily on the nature of National and State milk marketing arrangements, as well as the international dairy product prices (DEP, 1985). There are however, indications that the outlook for dairy farmers in the Jamberoo Valley should not change significantly should the current state marketing arrangements continue.

There is general scepticism amongst farmers that other forms of agriculture could be practical or economically viable in Jamberoo Valley, suggesting that the pattern of dairy farming in the Valley is likely to only be affected by changes in the State and National milk production.

The DEP (1985) recognises that planning controls to 'save' the local dairy industry by focusing on specific agricultural uses would not be a suitable objective, rather that agriculturally productive land be protected from fragmentation or sterilisation. There is a growing demand for rural residential allotments which has resulted in an increase in the land value of prime agricultural areas, which in turn, places greater operational cost pressure on existing farmers.

This is evident in the proposed Dunmore Lakes Park, the operation of "Twin Figs" hydroponic farm, the small proposed subdivision on the western edge of the "Riversdale" property and the proposed subdivision of part of the "Dunmore House" property.

The rural land use pattern therefore is one of dairying contracting with the residue used for other activities such as rural subdivisions and hobby farms. Despite the decline, the general area is still recognised as having prime crop and pasture land (see below) and primary production is likely to continue as a prominent activity in the area.

Rural Properties

A description of existing land use within each rural property directly affected by, or adjacent to the proposed corridor, is provided below. The property boundaries are identified on Figures 4A, 4B and 4C with the pattern of land use and zoning presented on Figure 10.

o Property 1 - Kiama Municipal Council

This parcel of land contained between the railway line and the existing Princes Highway, is thickly vegetated with casuarinas, but there are large patches of disturbance due to clearing, dumping of refuse and weed infestation. In the past, the area has been logged with the timber used in baker's ovens (D Creagan, pers comm). The parcel is zoned for environmental protection (wetlands), however, is not contained within the SEPP 14 classification.

o Property 2 - Dunmore Lakes Park Pty Ltd

This property was formerly run as a dairy farm 'Allawah'. It is now owned by Dunmore Lakes Park Pty Ltd who propose to develop the site as a rural residential area and tourist park.

Rezoning of the property was completed several years ago and this now allows for rural residential use and to extend the area available for tourist and recreation facilities around the lake. The proposal, which was the subject of a development application before Shellharbour Council at the time of preparing this Statement, comprises the following components:

- 50 rural residential allotments
- cable ski facility
- tavern and restaurant
- conference centre
- 40 unit motel
- recreation centre
- 50 cabins
- BBQ and picnic facilities.

There is a short term proposal to excavate sand from the existing lakes to create two much larger water bodies for cable skiing and providing fill for the development.

o Property 3 - "Dunmore House" (McCormick)

The Dunmore House property comprises a northern elevated precinct which includes an impressive old residence of historic importance, and to the south, a larger expanse of open paddocks and wetland in the lower Minnamurra flood plain. In recent years the property has been improved as a rural retreat and also as a high standard equestrian centre.

An application was recently lodged with Shellharbour Municipal Council for amendment of environmental planning controls to permit subdivision of the south facing hillslope area for rural residential use and for development of visitor accommodation in the equestrian centre bunk house.

o Property 4 - Unnamed Property (Mandl)

This property is unimproved except for perimeter fencing and is used for grazing of goats. Access is off Swamp Road via a right of way through the Dunmore Lakes Park property. Most of the property is subject to periodic inundation. The south facing hillslope at the northern end is the only area with potential for substantive improvement or development for a single dwelling.

A large proportion of the property (over two-thirds) is zoned for environmental protection - wetlands, particularly the southern and eastern sections.

o Property 5 - "Glengowrie" (Dean)

This property is presently used for agistment of dairy cattle. The property has a large water body at the eastern boundary which is the result of illegal extraction of sand resources in the early 1970's. This water body, which has the appearance of a large farm dam, is not generally used except for occasional irrigation during times of drought.

o Property 6 - "Tongarra" (currently being sold)

"Tongarra" is currently used for rural residential purposes, but also for limited agistment of dairy cattle and turf farming. The owner initially acquired the property partly because of a claimed potential for harvesting crabs along the property's frontage to the Minnamurra River. The property has a bore water supply on the western side of Swamp Road adjacent to the driveway to the "Myree Hill" property. This provides the only supply of fresh water to the property. At the time of preparing this Statement, transfer of the property to a new owner was proceeding.

o Property 7 - "Myree Hill" (McGlinchey)

This is a large dairy farm which is basically dumbbell shaped, narrowing considerably near the Minnamurra River and broadening out considerably to the east over the Terragong Swamp, and to the north-west over the elevated main farm area. Access between the two broad sections of the property is available via a track which is accessible off Swamp Road, and which is regularly used for movement of cattle between the larger pasture areas.

o Property 8 - "Riversdale" (Honey/Honey)

This property is another major dairy farm and includes a section known as 'Nobles Island' (an island formed by drainage ditches and oxbows of the Minnamurra River). Generally the western portion of the island is good pasture with the eastern section being less suitable because of the heavier vegetation (i.e. reeds, sedges, casuarinas, etc).

A parcel of the property on the western boundary adjacent to Gainsborough has been zoned for residential use for several

years. A development application for a 25 lot subdivision has been lodged with Kiama Council, but has been deferred by the proponent pending the outcome of this proposal.

o Property 9 - "Tabbagong" (Trustees of Parbury Estate)

This property extends in a wide band from Riversdale Road to Gainsborough across the top of the highest ridge in the North Kiama area. It once held an impressive manor surrounded by native and exotic gardens, part of the latter still being evident. Three lesser standard cottages remain and are occupied by the property manager and other tenants. A large portion of the land is covered by a remnant forest stand, while the cleared portions generally between the forest and Riversdale Road, are used for beef grazing purposes.

An eastern arm of this property generally forms a buffer zone between the quarry operations and Gainsborough residential area. This buffer zone is vacant apart from occasional grazing by horses. The northern edge is generally well maintained and a section fronting properties with line of sight views to the quarries has been landscaped by Boral.

o Property 10 - Bombo Quarry (Boral)

Boral Resources Pty Ltd own a large portion of quarry land at Bombo which contains significant resources of high quality blue metal. Boral is presently operating on the south and east faces of its quarry. Operations to the north are somewhat more restrictive because of the proximity of the residential development and the requirement for buffer zones. Representatives from Boral have indicated that operations are planned to continue in this quarry for at least another 20 years.

o Property 11 - Bombo Quarry (State Rail Authority)

The SRA have extensive quarry operations at Bombo. The SRA are also working on the southern and eastern faces of their quarry, with operations expected to continue for another 25 years. Similar to Boral, further quarrying operations to the north is somewhat restricted because of the proximity of residential development and the need to preserve the buffer zone.

o Property 12 - Old Quarry (RTA)

This small dis-used quarry was purchased by the RTA several years ago specifically for future road widening purposes. Recent advice from Kiama Municipal Council indicates the site had previously been used as a timber mill which included a wood treatment process (Town Planner, pers comm). Specific details on the exact nature of the operation were not available from Council at the time of preparing this Statement.

o Property 13 - Concrete Plant (Cleary Brothers)

This parcel of land at the eastern end of the Bombo quarry area on the corner of Panama and Hutchinson Streets, is operated by Cleary Brothers as a batching plant and compound/workshop facility. There is also a small cottage at the corner of Panama Street.

A road widening reservation covers a large part of the western side of the property. This was established by the then Department of Main Roads initially to accommodate the 1986 proposal to upgrade the Highway.

o Property 14 - North Kiama Park (Kiama Council)

This is a vacant area of land on the ridge area between the Highway and Hutchinson Street, and is not improved for recreational use, despite the name. Council officers have indicated that there are no proposals for development or improvement of the park.

o Property 15 - Kiama Cemetery (Kiama Council)

The cemetery, which is located on the western side of the Highway between North Kiama Park and Spring Creek, has been long established and is still used for burials. Access to the cemetery is directly off the Highway.

Future Land Use

Future land use proposals of particular relevance to the study area are evident in several forms, including statutory and strategic plans, policies and also current re-zoning and development applications. The major proposals include Dunmore Lakes Park, Kiama Council's approved residential subdivision north of Spring Creek and also the proposed West Kiama Release Area. Other planned land use changes include extension of the Boral quarry, a small extension of the Parbury Estate subdivision at Gainsborough on the "Riversdale" property, and a proposed rezoning of the "Dunmore House" property. These sites are shown on Figure 11.

Those areas which are either directly or indirectly affected by the proposed corridor (i.e. Dunmore Lakes Park, Gainsborough Estate) have been discussed in their relevant section above.

5.7 Planning Controls

The study area is covered by numerous environmental planning controls which are of relevance to the proposal. These include various state, regional and local instruments which are identified below.

State Policies

The State Environmental Planning Policy (SEPP) of particular relevance to this proposal is SEPP No 14 - Coastal Wetlands which was gazetted in December 1986 with the aim of preserving and protecting coastal wetlands. The policy applies to any development that has the potential to damage or destroy wetlands. Developments such as road construction are designated within the meaning of the Environmental Planning & Assessment Act and are only permitted provided consideration has been given to other feasible alternatives, the environmental consequences of the proposal and effectiveness of intended safeguards. Additional works to preserve or enhance surrounding wetland must also be taken into consideration, as should the consistency of the proposal with respect to the National Conservation Strategy.

Because the proposal traverses a section of SEPP No 14 Wetland in both Shellharbour and Kiama Municipalities, the consent of both those local Councils and concurrence of the Director of Planning is required.

SEPP No 14 wetlands are defined by a series of maps produced and periodically updated by the Department of Planning. Details on the location and features of SEPP No 14 wetlands in the study area is provided in Section 5.5.

It is noted that SEPP No 19 (Urban Bushland) and No 26 (Littoral Rainforests) do not apply in the study area affected by the road corridor.

Regional Plans

Two regional environmental plans (REP) are relevant to the proposed corridor. They are the Illawarra Regional Environmental Plan No 1 (REP No 1) and the Illawarra Regional Environmental Plan No 2 - Jamberoo Valley (REP No 2)

o Illawarra Regional Environmental Plan No 1

REP No 1 was developed in the early 1980's to provide a broad framework for co-ordinated action between various state government authorities. The aims and objectives of the Plan are to :

- place certain requirements on developments
- provide guidance to local councils in preparing local environmental plans and detailing development applications
- defining the extent of interest of the Department of Planning
- identify the Department of Planning's attitude and position on a wide range of environmental, social and economic issues.

Major elements identified in REP No 1 include :

- land of prime crop and pasture potential
- land supporting rainforest vegetation
- important wildlife corridors
- land containing extractive materials
- land containing coal resources
- land potentially suitable for urban use
- committed industrial land
- land with landscape or environmental attributes, including items of environmental heritage such as Peterborough School, "Dunmore House" and dry stone walls
- a service corridor through the Jamberoo Valley
- escarpment areas.

Three elements were used in the initial selection of the preferred corridor in the Route Selection Study, land of prime crop and pasture potential, land containing extractive resources and land with landscape or environmental attributes (refer Figure 12). No other elements identified in the REP were in close proximity of the proposed corridor.

o Illawarra Regional Environmental Plan No 2 - Jamberoo Valley

With respect to REP No 2, the NSW Government recognises the Jamberoo Valley as rural area of high scenic quality and landscape importance. The REP was prepared because existing plans for the Valley were allowing development to threaten its unique scenery and rural activity. Of particular concern was the need to conserve land of prime crop and pasture potential and to protect it from fragmentation.

The boundary of the Jamberoo Valley as defined in REP No 2 is shown on Figure 10. Roadways or extensions to existing roads are not prohibited by the REP, however must be considered in terms of their impact on the Jamberoo Valley.

Local Plans

The study area falls within the local government areas of Kiama and Shellharbour with the Minnamurra River serving as a common boundary. Present land use and development controls are established primarily by Kiama Local Environmental Plan (LEP) No 5 and Shellharbour LEP No 16 (as amended). Zoning under these instruments, which is shown in Figure 10, is generally consistent with the pattern of land use discussed above. The main exception is the zoning of the wetlands area around Terragong Swamp which is generally more extensive than that protected under SEPP 14. In addition, farming activities intrude significantly into this zone, particularly on the "Myree Hill", "Glengowrie" and "Tongarra" properties. The SEPP No 14 boundary more accurately delineates the actual extent of wetlands in this area.

Table 5.2 below summarises the existing zoning in proximity of the proposed Bypass, as well as the zoning as it affects the individual properties along the corridor.

TABLE 5.2 : EXISTING ZONING

Zoning		Property Affected (Refer Section 5.6)
Shellharbour - Local Environmental Plans Nos 16 & 39		
1(a)	Rural A	2,4
1(b)	Rural B	3
1(c)	Rural C - Small Holdings	2
7(b)	Environmental Protection (Wetlands)	1,4,5,6
7(d)	Environmental Protection (Scenic)	2
Kiama - Local Environmental Plan No 5		
4(c)	Light Industrial	12
4(b)	Extractive Industrial	10,11
5(a)	Special Uses (Cemetery)	15
6(a)	Existing Recreation	14
7(b)	Rural Environmental Protection (Estuarine Wetlands)	7
7(d)	Rural Environmental Protection (Scenic)	8,9

Note: Properties 1, 3, 14 and 15 not directly affected by proposal.

Permissibility

The permissibility of the proposal is established by the inclusion of roads in the land use tables for the above zones as development which may be carried out, or by way of the savings clause in the Environmental Planning & Assessment Model Provisions, 1980. The latter clause is adopted in the relevant environmental planning instruments and it effectively permits the construction of new roads in zones where roads are prohibited. These include 4(b) Extractive Industrial and 7(b) Rural Environmental Protection - Estuarine Wetlands (Kiama) and 7(b) Environmental Protection - Wetlands (Shellharbour). However the Model Provisions do not alter the planning status of the proposal where it traverses SEPP No 14 Wetlands. That is, the proposed Bypass is designated development in such areas with the local Council/s having the role of determining the development application.

At the northern and southern ends of the proposed Bypass, the construction would actually involve road widening rather than new road construction. This work would be contained within existing arterial road reservations.

5.8 Visual and Landscape Quality

The general area affected by the proposed corridor is part of the exceptional landscape of the Jamberoo Valley.

As an indication of its importance to the area's exceptional visual landscape, the National Trust listed the Jamberoo Valley as a rural conservation area. The Valley was subsequently gazetted in 1987 under the Illawarra Regional Environmental Plan No 2. The eastern boundary of the Jamberoo Valley is shown on Figure 10.

The visible form of this landscape is a consequence of formation and erosion over geologic time in conjunction with cultural changes over the past 150 years. The visual catchment for the area affected by the proposal is between Dunmore in the north, the Princes Highway in the east and Saddleback Lookout in the south. The catchment narrows in the west and extends along a narrow strip to the Jamberoo township (RTA, 1990g).

The steep tallus slopes and escarpment benches are the highest topographic unit (over 200 metres) and form a backdrop to the affected landscape. The combination of high relief and precipitous slopes produces a spectacular effect in the landscape.

Three vegetation types have been recognised as affecting the general visual quality of the area (RTA, 1990g). These are:

- cleared rural vegetation
- wetland vegetation
- remnant forest vegetation.

Cleared rural vegetation occupies a significant proportion of the landscape, and hence constitutes an important component in the visual character. It is generally characterised by improved pastures. Remnant cabbage tree palms and fig trees are scattered across this unit. The pockets of remnant vegetation form significant visual elements and contribute to the overall landscape character.

Wetland vegetation occurs along the Minnamurra River and its flood plains west of the Princes Highway at Minnamurra. This vegetation varies from a tall forest in close proximity to the River to an open saltmarsh further from the channel.

Remnant forest vegetation covers the higher areas of the route between Gainsborough and Riversdale Road. This tall closed forest pocket is almost a continuous form with the mixed species producing a canopy of various colours.

When viewed from various vantage points, vegetation is perceived as a mosaic of varying shades of green. Basic differences in structure such as tall vegetation and low lying vegetation, are evident. The most important visual considerations are height, density, colour and texture of vegetation on a broad scale.

Land use is an other important factor which affects the visual and landscape quality of the area, with rural properties of open paddocks and scattered rural homesteads and buildings being dominant. Residential land use occurs in various locations. The township of Jamberoo, located on the western edge of the visual

catchment, is residential. The entire eastern edge (coastline) is developed for residential land use, comprising the suburbs of Kiama, Minnamurra, Kiama Downs and Gainsborough. Most of these suburbs are separated from the rural land by local but prominent ridge lines orientating their main views towards the coast.

The wetland surrounding Minnamurra River and the escarpment in the south-west have been zoned for environmental protection and constitute important components of the landscape. Other land uses include quarries and industrial areas, which have a major effect on the landscape. Quarrying alters the landscape through removal of vegetation and natural relief such is evident at Bombo. Whilst quarries generally have a negative influence in landscape value in the environment of Kiama, they provide an historical perspective and serve to accent the origins of industry in the area.

5.9 Community Profile

Population

The Municipality of Kiama has, over the past 20 years, experienced significant population increase with an average annual growth rate of 6.4% since 1966. This exceeds the average growth rate for the Illawarra region of 2.25% for the same period. Table 5.3 illustrates recent population growth in the area.

TABLE 5.3 : POPULATION CHANGE 1976-1989

	1976	1981		1986		1989	
	Persons	Persons	Change	Persons	Change	Persons	Change
Kiama	8,460	11,368	+ 34%	13,443	+ 18%	15,280	+ 14%
Shellharbour	36,695	41,790	+ 14%	44,203	+ 6%	46,640	+ 6%
NSW ('000)	4,777	5,235	+ 10%	5,402	+ 3%	5,762	+ 7%

Source: Australian Bureau of Statistics

These figures show that the population has continued to grow, but at a lower rate which Kiama Council (1989) suggests can be linked to the decreased availability of land in the Municipality.

Population projections by Kiama Council estimate a population in excess of 21,000 by the year 2011 for the Municipality. These projections are more conservative than those of the Department of Planning which estimate a population in the range of 23,100 and 25,700 by 2011.

Age Structure

There are marked differences in the demographic characteristics of communities within the area. North Kiama is characterised by a high proportion of families with young children, a low

proportion of teenagers and aged residents compared with the Municipality as a whole. Kiama township on the other hand, has a high proportion of people over 64 years (refer Table 5.4).

The Kiama Municipality Local Environmental Study identified the main demographic trends as being an increase in children aged 0-4 years, a decline in youths ages 5-14 years as a proportion of the population, a decline in the number of young adults, increasing numbers of middle aged people (35-49 years) and an increase of people over 64 years.

TABLE 5.4 : AGE PROFILE (%)

Age	North Kiama	Kiama Town	Rural	Kiama LGA	Shellharbour LGA	NSW
< 5 years	11	7	10	9	10	8
5-14 years	18	13	18	16	19	15
15-19 years	6	7	9	7	9	8
20-29 years	11	15	13	13	17	16
30-39 years	20	13	17	17	17	16
40-49 years	10	10	12	11	12	12
50-64 years	12	7	13	14	12	14
> 64 years	10	20	8	14	8	11

Employment

Employment in the area is mainly in the community services sector and wholesale and retail trades. Agriculture accounts for only about 5% of employment in Kiama Municipality. Approximately 19% of the Kiama workforce is employed in professional occupations compared with the State average of 12%.

Employment data compiled by Kiama Municipal Council (1989a) indicates that in the years 1971-1986, there has been an increase in the number of professional people living in the Municipality, and conversely, a significant decrease in the proportion of the population employed in the primary sectors (e.g. farming, fishing).

Within the area, unemployment rates are relatively consistent, although unemployment was a high 10% in the Shellharbour Municipality at the 1986 Census (refer Table 5.5).

TABLE 5.5 : LABOUR FORCE STATUS (%)
(Persons over 15 Years)

Age	North Kiama	Kiama Town	Rural	Kiama LGA	Shellharbour LGA	NSW
Employed	53	46	59	50	51	53
Unemployed	5	6	5	5	10	6
Not in Labour Force	41	48	35	44	37	39

Income

Household incomes within the study area are generally below the regional average, particularly within the township of Kiama where 38% of households had annual incomes of $15,000 or less at the 1986 Census. North Kiama has a high proportion of households in the middle and upper income brackets (see Table 5.6).

TABLE 5.6 : HOUSEHOLD INCOME (%)

Age	North Kiama	Kiama Town	Rural	Kiama LGA	Shellharbour LGA	NSW
Nil	1	0	0	1	1	1
$1-$9,000	7	16	8	7	5	13
$9,001-$15,000	16	22	21	16	13	16
$15,001-$22,000	15	17	14	15	18	15
$22,001-$32,000	20	16	18	18	21	17
$32,001-$50,000	22	16	17	18	18	18
$50,001 and over	9	6	10	8	6	10
Not stated	9	4	10	8	11	9

Home Ownership

The level of home ownership in the region is higher than average. Forty percent of the Kiama population live in dwellings which are owned, 38% in dwellings being purchased and only 17% are renting. In Shellharbour, 30% of the population live in dwellings owned outright, 44% in dwellings being purchased and 24% in rental accommodation, which includes a relatively large proportion (57%) of public housing.

Community Services and Facilities

The provision of community services and facilities in the area are concentrated in the urban areas of Kiama and Shellharbour. Most services are provided by local and State government authorities, although a number of voluntary groups are also active in the area. Local retail and community services in the study area are provided at Kiama town centre, Jamberoo and North Kiama.

The northern suburbs of Kiama are relatively poorly provided with large retail facilities. Almost all community services and facilities in North Kiama are located on the eastern side of the existing Highway. This includes Minnamurra Primary School, the railway station, doctors surgery, chemist, Anglican Church, veterinarian, post office, butcher, petrol station, hairdresser, supermarket, newsagency, take-away food, restaurant and scout hall. The eastern side of the Highway also has access to the beach.

On the western side of the existing Highway in Gainsborough there is a private pre-school, a community based day care centre (which also serves as a Baptist Centre), the Kiama Neighbourhood Centre and sporting fields. There are no local shopping facilities.

Public transport is relatively poor throughout the area, tending to be focussed on commuter travel to Wollongong.

5.10 Cultural Heritage

The cultural heritage of the study area comprises a rich history of both European and Aboriginal occupation and settlement.

European Heritage

The first recording of Kiama was by George Bass in 1797. During the early years of the nineteenth century, the area was rapidly exploited for timber, followed by settlement. The Kiama coast was officially surveyed in 1819 when John Oxley and James Meehan explored the area.

Settlement proceeded throughout the nineteenth century, with land grants being provided for wheat, dairying and pig-farming. Experiments were made with various crops, however, the high rainfall and lack of rapid transport did not aid these ventures. Dairying prospered in the area and continues to be an important rural activity due to the fertile flood plains, soils and rainfall.

An important land grant in the area was one made to J Colles in 1829. James Robb, a Scottish emigrant, later purchased approximately 1,300 acres of this grant and called the property "Riversdale". Following Robb's death in 1880, the property was subdivided into 6-7 farms for Robb's sons. One of these farms was "Tabbagong", the property immediately to the east of the present "Riversdale" property, which is the central portion of the original property and which continues today as a dairy farm.

The production of butter, and the products of its associated industries, was by the late 1850's the area's main export to Sydney. Australia's first co-operative butter factor (the Pioneer Dairy Factory) was set up on the "Riversdale" estate, west of Kiama. This factory was involved in several innovations, the first consignment of butter overseas, the testing of milk for butterfat content, and pasteurisation. However, as the ease of supplying milk to Sydney grew, milk production increased in importance, and by 1896, the Pioneer Dairy Factory had become a milk depot.

Other evidence of the early European settlement in the area includes various early buildings which have been retained, derelict homesteads, remnant dry stone walls and cairns. Table 5.7 lists the significant items of environmental heritage which have been identified along the proposed corridor. The locations are shown on Figure 9.

TABLE 5.7 : ITEMS OF EUROPEAN HERITAGE ALONG PROPOSED CORRIDOR

Map Reference	Name	Location	Details	Significance/ Listing
A	"Dunmore House"	Princes Highway Dunmore	An intact early home constructed around 1868-1872	Classified by the National Trust Register, Shellharbour LEP No 16, Illawarra REP No 1
B	Former Peterborough School and Principal's Residence	Swamp Road Dunmore	Constructed between 1868-1872 with additions in 1909	Recorded by the National Trust Register, Shellharbour LEP No 16, Illawarra REP No 1
C	Kiama Council Cemetery	Princes Highway 1.5km north of the Post Office	Dedicated in 1899, earliest grave is marked 1870	Listed by the National Trust, Kiama Municipality Local Environmental Study: Urban Areas
D	Stone Wall	Near Dunmore House property	Rubble wall, largely disturbed. Some segments of wall still remain	Not listed , but generally identified by Illawarra REP No 1. Identified by Silcox (1990).
E	Original Riversdale Homestead	East of Minnamurra River	Remainder of the original Riversdale Estate, listed in early 1840's	Not listed - identified by Silcox (1990)
F	"Tabbagong"	West of Bombo Quarry	Landscaped surroundings from original estate	Not listed - identified by Silcox (1990)

NOTE: The role of the National Trust is to provide an authoriative expert view on heritage, however, classification is a non-statutory mechanism which recommends for preservation. Listing in REP or LEP provides statutory protection to listed items.

Aboriginal Heritage

Aboriginal groups occupying the Minnamurra region were the Dharawal, the Wadi Wadi, Guarandada, Dharumba and Wandandian (DEP, 1985). Within this territory, seasonal movement between the coast and the hinterland would have occurred, in order to exploit the various animal and plant resources available at different times of the year.

After initial European exploration and the start of European settlement around Kiama in the early 1820's, the extensive timber getting and the subsequent clearing of vegetation for agriculture, pasture and other associated factors such as introduced diseases and a diminishing food supply, would have had a significant impact on population levels and the structure of traditional society. By the mid 1850's the Aboriginal population appears to have greatly declined and most of those remaining existed on the fringes of European society.

Previous Aboriginal occupation of the area is now only evidenced by past remains, the most common of which are middens which are characteristically mounds of shells which have been left around areas which Aboriginal people occupied. They are generally sites used as dumps for the remains of consumed shellfish and food. Middens reveal important anthropological associations of early civilisation with the natural environment, including diet, living conditions and development.

Other evidence of Aboriginal occupation includes surface camp sites, stone arrangements, axe grinding grooves, tools, weapons and burial sites. These are generally not as common as middens.

Aboriginal significance is assigned to a site by the local or regional Aboriginal community, and is generally the result of continuing cultural links with an historical, archaeological or landscape feature.

Scientific significance relates generally to the potential of the site for scientific research or the representative value of a site. A site that contains undisturbed cultural evidence such as in-situ material, has a high potential for research and is therefore of major significance. Due to the amount of development that has taken place along the NSW coast, and other factors such as erosion and animal disturbance, such sites will be relatively rare.

According to Navin (1989), undisturbed midden sites containing in-situ material are not well represented in the Illawarra and this makes them both scientifically significant and of high value to the Aboriginal community. Management strategies and sensitive development planning is required to exclude or minimise any adverse impacts on these sites. On the other hand, disturbed or small surface artefact scatters hold little scientific significance, other than to record their location dimensions and content.

More recent use of the landscape for farming and dairying activities has disturbed and altered many Aboriginal sites of significance. Their pristine or original significance would therefore be somewhat diminished.

The National Parks & Wildlife Service holds a register of Aboriginal sites located in close proximity to the proposal and represents a consolidation of numerous archaeological studies. Table 5.8 lists the recorded sites, together with a description of the content and their condition. The archaeological survey conducted by Silcox (RTA, 1990k), identified three other previously unrecorded sites which are also listed.

TABLE 5.8 : ARCHAEOLOGICAL SITES

Location (Figure 9)	NPWS Listing	Content	Condition
1	(52-5-0251)	midden (shell)	disturbed
2	(52-5-0253)	scattered artefacts	further investigation required
3	(52-5-0072)	midden (shell), stones	generally undisturbed, some in-situ
4	N/L	midden (shell artefacts	disturbed
5	N/L	unknown	possible site further investigations required
6	N/L	unknown	possible site further investigations required

N/L = Not listed but identified by RTA (1990k).

The sites are shown by large notation on Figure 9 so as to prevent accurate identification and possible vandalism.

5.11 Acoustic Environment

An acoustic investigation (RTA, 1990f) was conducted to determine background noise levels in the study area, and to assess road traffic noise associated with the proposed Bypass. Consistent with accepted measurement procedures for road traffic noise, the A weighted scale, described dB(A) was used. Human perception of some common sounds can be readily discriminated within this scale as shown on Figure 13.

To establish the ambient noise levels along the proposed corridor sound pressure levels were recorded during the months of June and July 1990, and then in November 1990 at 16 selected reference locations as shown on Figure 14. The results of the noise surveys for day and night time exposures are summarised in Table 5.9 below.

TABLE 5.9 : EXISTING DAY AND NIGHT TIME TRAFFIC NOISE LEVELS

Location (Refer Figure 14)	L_{A10} (Day time) (18 hours)	L_{Aeq} (Night time) (10pm - 6 am) External
1	54.2	39.0
2	58.5	38.5
3	52.2	37.0
4	51.5	38.0
5	52.5	37.5
6	51.0	38.5
7	52.0	38.4
8	67.5	58.0
9	66.8	56.6
10	63.4	55.5
11	61.5	44.5
12	60.5	43.5

The noise levels presented above relate to both day time (L_{A10} - 18 hours) and night time (L_{Aeq} - 8 hours) recordings. The RTA has adopted 63dB(A) as the assessment criteria for maximum day time noise levels. For night time noise levels the RTA has adopted 45dB(A) for maximum internal noise levels. This is equivalent to a maximum external noise level of 55dB(A).

The table indicates that the existing acoustic environment along the proposed corridor is generally typical for a rural environment, that is, exposure only to noise from traffic and little urban disturbances. The exceptions are the residential areas to the north of the quarries, which are exposed to high noise levels from the quarries during the day (around 60-65dB(A). The areas to the west of Minnamurra River and Riversdale Road have relatively low noise levels with day time levels between 50-58dB(A) and external night time levels below 40dB(A).

The highest noise levels occur along the Princes Highway with day time levels around 68dB(A), and night time external levels above the criteria of 55dB(A).

5.12 Utilities

The area affected by the proposed corridor is serviced by various utilities including electricity, water supply and telecommunication cables.

Electricity

Illawarra Electricity have a major zone substation on the southern side of Spring Creek adjacent to the Princes Highway. This substation has overhead line connections operating at 33 and 11 kV with several lines running north to Bombo Quarry and expanding areas of Kiama Downs and Minnamurra. Other infrastructure includes various 11 kV and 33 kV lines at Dunmore which travel along the Princes Highway and Swamp Road.

Telecommunications

Telecom Australia have indicated that important communication cables occur in the area. This includes a main north-south co-axial trunk cable, which runs generally parallel to the existing Princes Highway and would be crossed by the proposed Bypass near Dunmore House and Hutchinson Street. There are also various subscriber main cables linking to the rural homestead.

Water Supply

The Water Board have indicated that the main utilities in the area include water mains located immediately to the north of Bombo Railway Station. The Board also has a sewer rising main laid from a pumping station located on the eastern side of the Princes Highway and north of Spring Creek to the Board treatment plant at Bombo.

6.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS AND SAFEGUARDS

This section of the EIS provides an identification and assessment of the likely environmental and social effects that would be associated with the proposed Bypass, and where appropriate, specifies safeguards and/or ameliorative measures that would be adopted to minimise such impacts.

6.1 Traffic Impact

General

A discussion on existing and predicted future traffic conditions in the study area was provided in Section 2.0. This section provides an assessment of the suitability of the proposal in terms of the predicted traffic, and the implications for the road system in the study area and beyond. Other areas of relevance to traffic such as local access, bicycle and pedestrian access are discussed in Section 6.11 in the context of social and community impacts.

Daily Traffic Volumes

It is predicted that traffic volumes on the Princes Highway will increase significantly by 2011. Assuming that 80% of this traffic would be through traffic (as discussed in Section 2.0), the projected daily volumes on the Bypass would be as shown in Table 6.1 below and on Figure 2. Again, both a medium and high traffic growth forecast representing a 3% and 5% growth rate respectively, have been used.

TABLE 6.1 : PROJECTED DAILY TRAFFIC VOLUMES (AADTS) ON THE BYPASS

Location	1996		2011	
	Medium	High	Medium	High
Bypass (south of Panama Street) (6 lanes)	24,750	26,750	33,050	41,600
Bypass (Terragong Bridge) (4 lanes)	20,050	21,650	26,800	33,800

In terms of Bypass performance relative to NAASRA criteria, it is generally more relevant to examine peak hour volumes which are a better indicator of 'level of service' than daily volumes. Assessment of peak hour volumes against NAASRA criteria is provided below.

Future Weekday Peak Hour Volumes

The projected peak hour traffic volumes on the proposed North Kiama Bypass and along the Princes Highway are shown in Table 6.2 below. These are based on factoring the existing peak hour flows by the growth rates predicted for the daily traffic as discussed in Section 2.2, and then distributed onto the road network assuming 80% would be through traffic (refer Section 2.1). Two locations on the Bypass are presented as they correspond to different road formations (i.e. 6 lane and 4 lane sections), and would carry different traffic volumes and therefore have different assessment criteria.

TABLE 6.2 : PROJECTED PEAK HOUR TRAFFIC VOLUMES - ONE WAY

Location	1996		2011	
	Medium	High	Medium	High
North Kiama Bypass				
- at Panama Street (3 lanes)	920	970	1,210	1,490
- at Terragong Swamp Bridge (2 lanes 100km/hr)	830	880	1,110	1,410
Princes Highway				
- at Meehan Drive (1 lane)	270	270	370	370

Level of service criteria which define one way peak hour limits for various road formations and signposted speeds as set out by NAASRA (1989), are shown in Table 6.3 below.

TABLE 6.3 : NAASRA LEVELS OF SERVICE (LOS) - ONE WAY FLOWS

Road Formation and Speed (one way)	Level of Service					
	A	B	C	D	E	F
1 lane 80km/hr	< 700	700	920	1,180	1,550	>1,550
2 lanes 80km/hr	< 900	1,400	1,840	2,360	3,100	>3,100
2 lanes 100km/hr	<1,020	1,560	2,000	2,480	3,100	>3,100
3 lanes 80 km/hr	<1,350	2,100	2,760	3,540	4,650	>4,650

A comparison of Table 6.3 with the volumes shown in Table 6.2 indicates that assuming a medium traffic projection, the proposed Bypass would operate at a level of service A at all locations in 1996. In 2011, the level of service would be A along the section between Terralong Street and Panama Street, A along the Princes Highway and A/B at Terragong Swamp Bridge. If a high traffic forecast was assumed the level of service at Panama Street would be A and B for the years 1996 and 2011 respectively. At Terragong Bridge the level of service would be A and B in 1996 and 2011 respectively.

Future Recreational Peak Hour Volumes

The prediction of future recreational peak hour flows was based on actual traffic surveys undertaken in October/November 1990 (RTA, 1991a) and then factored up based on the projected daily traffic increases to the year 2011. The resulting design recreational peak hour flows are shown in Table 6.4 below.

TABLE 6.4 : PROJECTED PEAK HOUR RECREATIONAL TRAFFIC - ONE WAY

Location	1996	2011
North Kiama Bypass		
- at Panama Street (3 lanes)	1,960	2,610
- at Terragong Swamp Bridge (2 lanes 100km/hr)	1,660	2,220
Princes Highway		
- at Meehan Drive (1 lane)	440	570

A comparison with Table 6.3 indicates that at Panama Street the proposal would operate at level of service B in 1996 and level of service C by 2011. At Terragong Bridge the proposal would operate at level of service B/C in 1996 and level of service C/D by 2011. This indicates that the proposed Bypass would satisfy the principle level of service objectives as described in Section 2.0. It is noted that the level of service at Terragong Bridge could be improved to level of service B by the addition of the third north bound lane. It is further noted that the Princes Highway through North Kiama would operate at level of service A in both the short and long term.

Intersection Performance

o Northern Connection

The intersection of the proposed Bypass with the existing Princes Highway near Dunmore was assessed by way of delay analysis of the most critical movement, which would be the right turn from the Princes Highway onto the Bypass. The peak hour delays (in seconds) for this movement during both the weekday and recreational peak periods is shown in Table 6.5 below.

TABLE 6.5 : PEAK HOUR DELAYS FOR RIGHT TURN MOVEMENT FROM OLD PRINCES HIGHWAY ROUTE ONTO THE BYPASS

Period	Peak Hour Delay (secs) Existing	1996	2011
Weekday AM	8	16	1,058
Weekday PM	6	9	19
Sundays PM *	11	21	**

* A long weekend Monday PM
** Indicates movement completely saturated.

Table 6.5 indicates that the intersection would perform satisfactorily until at least the year 2001 for all peak periods. By 2011, delays to the right turn would be unacceptable in the morning commuter peak and in the recreational evening peak. These delays are the result of the proximity of the proposed roundabout required to accommodate the projected traffic to the Dunmore Lakes Park proposal. Without the roundabout, additional capacity to accommodate the right turn would be available by extending the right turn acceleration/merging lane to about 400 metres north of Swamp Road. This cannot be achieved with the proposed roundabout because of the difficulty of accommodating three entering and exiting lanes.

Should the Dunmore Lakes Park proposal proceed, it is likely that a roundabout would be inadequate beyond the year 2001, and would need grade separation. A suitable arrangement would be for the Bypass to bridge over the old Princes Highway which would then connect to Swamp Road through the northern end of Dunmore Lakes Park. This would not affect the tourist component of the Dunmore Lakes Park and could be used as an access to the proposed car parking area. Any grade separation would need to consider the timing of the widening of the Princes Highway north of Shellharbour Road, and to consider the need to eventually provide grade separation of the railway spur line to Dunmore Quarry.

Without the Dunmore Lakes Park proposal, only a simple seagull island treatment would be required at the intersection of Swamp Road and the Bypass with possible banning of the right turn out of Swamp Road. Such an arrangement would not affect the delays to the right turn out of the Princes Highway as with the proposed roundabout.

o Southern Connection

No detailed assessment has been undertaken for the intersection at the southern end of the proposal as all connections would be grade separated and involve simple left turn merging manoeuvres only.

o Along Existing Princes Highway

Section 2.0 indicates that without a Bypass, delays to intersections along the Princes Highway through North Kiama would be generally unacceptable beyond 1996. The intersection of Meehan Drive and Federal Street would have theoretically infinite delays by the year 2011. With the proposal, the reduction in through traffic (i.e. about 80%) would reduce these delays to levels significantly less than they are today, and would be virtually imperceptible. Only 'give way' controls would be required at the side streets with the possibility of priority being given to traffic coming out of Meehan Drive.

Vehicle Accidents

The construction of the proposed Bypass would reduce the potential for accidents because of the much improved road geometry, separation of north and south bound traffic, elimination of conflicting local traffic movements and improved road pavement standard. Accidents along the Princes Highway would also reduce significantly because of the elimination of most through traffic, including Bombo quarry traffic.

The number of accidents that the proposal would 'correct' (i.e. right turns, head-ons, etc) has been identified and broken down into accident severity. The associated costs the number and type of accidents saved in just three years, was estimated by the RTA (1990d) and is shown in Table 6.6 below.

TABLE 6.6 : ACCIDENT SAVINGS OF THE PROPOSAL IN THREE YEARS

Accident Type	Number Prevented	Total Cost ($1990)
Fatal	3	2,118,000
Admitted	4	524,000
Treated	7	101,500
Tow-Away	22	55,000
Total	36	2,798,000

Based on the past accident history, the Table indicates that at least one fatal and 11 non-fatal accidents could be saved each year as a consequence of the proposal (valued at about $1 million).

Longer Term Regional Strategies

o Route Planning

In the context of highway planning, due consideration must be given to the relationship of the proposal with future main road strategies for the region. In this regard, the existing Kiama Bypass is assumed to be a section of the major road transport corridor which will serve the needs of this area of the South

Coast in the long term (i.e. beyond 2011). On this basis, the northern end of the Kiama Bypass is a logical southern connection for the subject proposal.

By contrast, the section north of Dunmore up to the completed F6 Freeway at Yallah is less certain, with several long term route options being possible. In general terms, the RTA recognise that there is a need for a high standard four lane road between Yallah and Kiama. This could be achieved by upgrading of the existing Highway or establishing a new corridor generally bypassing the Albion Park urban area. In the former case, the RTA has an approved concept plan which allows for a four lane carriageway from the recently completed road widening at Oak Flats through to Shellharbour Road along a new alignment which parallels the South Coast Railway. With respect to the potential high standard four lane road southward from Yallah to bypass Albion Park, there is no currently approved corridor. Indeed, constraints in that area such as urban expansion, steep terrain and flooding would have to be investigated before such a corridor could be reserved for possible longer term needs.

Whatever the outcome, the northern end of the proposed North Kiama Bypass generally in the vicinity of Shellharbour Railway Station and the Dunmore Quarry, represents a probable connection point for the long term corridor to the north. In this respect, the steep and rugged topography to the west of Dunmore, as well as the large Dunmore Quarry operation, are significant limitations to any potential corridor to the west of the proposed alignment. Similarly, the wetlands and waterway of the Minnamurra River/ Rocklow Creek are real constraints to the east.

In the past, various planning scheme reservations and expressway/ freeway gazettals have traversed an area much further to the west of North Kiama. This includes the services corridor identified in Illawarra Regional Environmental Plan No 1. These would have included crossing through the middle of the Jamberoo Valley and very steep terrain to the north and south of the valley. These corridors figure only in the RTA's very long term road planning options for the region.

o Traffic Growth

The traffic growth rates adopted for up to the year 2011, equated to the medium level projected growth rates for the population of Kiama and Shellharbour. These indicate a tapering off in growth towards the end of the projection period. While the overall growth rate between 1989 and 2011 averaged 3% per annum, the rate between 2001 and 2011 was lower. The Department of Planning has only regional population projections beyond 2011. For the Illawarra Region, the high estimate from 2011 to 2016 is only 4.1% total, over the five year period. This would suggest that the objective of not exceeding level of service D for recreational traffic would still be met for a considerable number of years beyond 2011, considering the corridor capacity to provide an ultimate of six lanes.

After the construction of the proposed Bypass, the significant improvement in travel time may in fact, attract more traffic to the South Coast (i.e. latent demand) and hence, bring traffic growth rates back up to their historical levels of 5-6%.

6.2 Erosion and Sedimentation Control

The proposed road construction has the potential for significant on-site and off-site erosion and sedimentation. The extent of such effects would depend on the volume and velocity of runoff, the area and slope of exposed land, and the resistance of the soil to particle detachment and transportation.

To minimise erosion and sedimentation, the amount of runoff generated from the proposed project would be controlled with appropriate devices which comply with the requirements of the Soil Conservation Service. From the outset of the project, a co-ordinated programme of erosion and sedimentation control would be adopted and include :

- Preparation of an erosion control plan prior to construction, including the provision of retention basins which incorporate sediment and pollution control measures and perimeter banks.

- All control measures would be regularly inspected and maintained, during and after construction stages.

- A programme to progressively revegetate exposed areas would be implemented in areas of completed works to stabilise the soil.

Specific sedimentation, pollution and erosion control devices would be planned during the detailed design and specification stage with full implementation of the appropriate measures before, during and after the construction stage. The proposed control measures would comprise both permanent and temporary structures to include :

- Adequate buffer zones between the area of disturbance and the natural drainage lines.

- Establishment of a stable drainage system throughout the zone of disturbance including temporary control structures such as diversion banks, sedimentation ponds, drop inlets with embedded bales, interceptor ditches and open channels with embedded bales, sediment traps and sediment fences.

- Catch drains would be formed above intended cut batter slopes before excavation, to prevent runoff from reaching the exposed surfaces. These drains would be formed as near the top edge of the cutting as possible to maximise collection of runoff water.

- Toe drains would be formed as close as possible at the base of fill embankments or construction areas with runoff directed to retention ponds.

- Where practical, the extent of cut and fill would be kept to a minimum. Detailed design would ensure that the minimum batter grade would be 2H:1V, as the area features dispersible and erodible soils. In certain locations suitable rock facing would also be placed to permanently stabilise fill batters, to allow batter grades of 1.5H:1V to be achieved with environmental safety and considerably reduce the impacts on flora and fauna and properties.

- All diversion drains would be lined and erosion control structures (temporary and permanent) would be topsoiled and revegetated.

- Earth diversion banks and channels would be placed across access roads and other areas to control overland flow, and prevent scouring which would otherwise cause sheet and rill erosion of disturbed surfaces.

- No surface drains would discharge directly into the wetlands or drainage channels, but into suitable sediment control structures such as retention ponds.

The location of major retention and sedimentation ponds along the route would include the dam currently on the "Glengowrie" property, one on the "Riversdale" property east of the corridor just above the flood plain and another on the dis-used quarry at Bombo (refer Figures 4A, 4B and 4C). Numerous other small sedimentation and retention structures would be constructed at strategic locations along the route, particularly during construction.

Permanent ponds would have the capacity to contain the first flush from a 1 in 10 year duration storm. In addition, all sections of the completed Bypass would drain to ponds fitted with outflow baffles to prevent the discharge of oil and grease products which settle on the road pavement.

To ensure that the objectives of the erosion and sedimentation control plan are achieved before, during and after construction, the RTA would engage the Soil Conservation Service as a specialist consultant to supervise relevant planning, design and construction activities.

6.3 Flooding and Drainage

Because of the complexity of flood behaviour in the catchment and the paucity of detailed relevant information, an hydrological investigation was undertaken to determine the potential impacts of road construction over the flood plain (RTA, 1990e).

The primary purpose of the investigation was to produce flood water levels and discharges at points along the Terragong Swamp and to determine the necessary design of the proposed bridge crossing, as well as the effects of the structure, including upstream flood level rises, flow velocity at the crossing and flood water retention. Computer hydrological and hydraulic models RORB and RUBICON were used.

A 1 in 100 year storm event and probable maximum precipitation (PMP) were tested through the calibrated model, and verified with information determined through landowner interviews.

Three bridge structures were tested, representing 80 metre, 200 metre and 300 metre restrictions in the flood plain (i.e. 810m, 690m and 590m bridge crossings).

The modelling study (RTA, 1990e) indicated that with a 300 metre restriction (590 metre bridge), there would be a peak flood level rise (afflux) of approximately 10mm with an increase in flow velocity of about 0.5m/s.

The flood level rises (afflux) and velocities were less for the 80 metre and 200 metre restriction (i.e. 810m and 690m bridge crossings).

The modelling also indicated that weir flow (i.e. water over-topping the bridge) would not occur with the proposed bottom of the bridge set at RL 4.5m AHD (i.e. bridge deck level of 5.5m and bridge deck thickness of 1.0 metres).

An independent check of the bridge afflux was also undertaken using a different procedure developed in the United States specifically for bridge hydraulics. This resulted in a similar afflux as predicted by the RUBICON model (RTA, 1990e). The proposed restriction of 80 metre (i.e. 810m bridge) therefore presents the best case of the options tested.

The proposed bridge structure would have no direct effect on the channel of the Minnamurra River or the drainage system maintained by the Terragong Drainage Union. The potential for any additional scour of banks, drains or pasture areas would also be negligible with the predicted flood velocities, and risks to stock and human life would remain essentially as at present. As flood retention times would increase only very slightly (RTA, 1990e), the impact on routine land use activities on the flood plain following flood events would be similar to conditions now experienced.

It is proposed as an additional safeguard, that a pluviograph and stream gauge station be set up within the catchment to improve available calibration data as soon as possible. Results of these measurements would need to be reviewed before the design of the bridge length and deck level are finalised.

6.4 Water Quality

The presence of more impervious surfaces such as road pavements following the Bypass construction has the potential to increase the amount of runoff into the Minnamurra River and Rocklow Creek. Without appropriate runoff and retention structures, this would affect local drainage patterns by increasing discharge volumes and stream flow velocities. Uncontrolled runoff would also increase the level of soil erosion, and consequently, the potential for sedimentation in the natural drainage system.

Sediments which contain high concentrations of phosphorous and nitrogen mainly from agricultural sources, would affect the physical form of streams (e.g. encourage excessive growth of algae and other water plants), which could consequently cause the deterioration of the aquatic habitat, reduce stream hydraulic capacity, increase riverbank erosion, and possibly increase the occurrence of flooding.

Other potential impacts associated with the proposal include road and vehicle pollutants which are many and varied, including a range of trace metals (lead, zinc, cadminim, copper, chromium and nickel), hydrocarbons and their combustion derivatives, and accidental spillages. These pollutants would dissipate from the road in stormwater runoff, and unless contained by retention structures with pollution control devices, they could affect water quality.

To mitigate the potential adverse impacts of erosion, pollution and sedimentation on water quality in the Minnamurra River and Rocklow Creek, the erosion and sedimentation control measures (both temporary and permanent), detailed in section 6.2, would be fully implemented. Other specific measures to ensure water quality is not degraded include :

- A systematic water quality monitoring programme including pre-construction sampling and analysis.

- Use of grassed verges and stormwater gutters where soil structure would allow.

- Provision of a combination of retention basins/artificial wetlands at appropriate locations to help remove sediments, nutrients and pollutants from stormwater off the Bypass. Design of such wetlands to ensure they are not breached by flood events as they would accumulate substantial pollution loads over time, which should not be released into the surrounding environment. Removal and disposal of accumulated sediment at appropriate intervals to ensure adequate capacity.

6.5 Air Quality

Improvements to air quality in the area through which the existing Highway passes are expected to occur as a result of generally reduced congestion and smoother traffic flows. This is because more vehicle emissions tend to occur at low speeds and during acceleration/deceleration cycles than from steady speed smooth flowing traffic. In particular, the proposal would have major positive impacts for the residents of Minnamurra and Kiama Downs in close proximity of the Highway.

In the future, volumes of motor vehicles traversing regional roads would rise regardless of the construction of the proposed Bypass. The effect on air quality of the proposal in isolation would therefore be negligible. As traffic density and speed are related, the proposed Bypass would facilitate an unimpeded flow and a generally more stable vehicle speed, which would assist in reducing the amount of vehicle emissions into the atmosphere.

For the whole of its length the proposed Bypass would traverse rural and industrial land with a small population. No existing dwellings would be within 50 metres of the roadway.

The coastal setting of the corridor is a positive aspect for the dispersal of atmospheric pollutants. The prevailing winds (south and north-east in summer, and west and south-west in winter) and topography (refer Section 5.1) of the area generally ensure that pollutants do not concentrate to levels which are of consequence.

Some minor vehicle pollution may be experienced in the lower Minnamurra flood plain near the route and particularly on still winter mornings with the presence of inversion layers which would act as a barrier to pollutant dispersal. In such events, the pollution would usually disperse by the mid to late morning. Afternoon see breezes would help to create the mixing of fresh air with the pollutants, and evening katabatic winds drifting from the escarpment travelling out to sea, would clear the atmosphere. Pollutant concentrations are not likely to pose health risks or discomfort to residents near the route under these conditions.

During construction, air quality within the immediate vicinity of the proposed Bypass could deteriorate due to the generation of dust from earthworks. On the southern edge of Gainsborough this impact would be similar to the dust generation associated with the local quarry activities.

Effective watering down of vehicle and machinery operating areas during the construction period would be specified in the contract documents as a means of minimising this effect. Overall, no major adverse air quality effects are foreseen.

6.6 Natural Environment

As indicated in Section 5.5, the proposed road corridor passes through an area which has generally been highly disturbed since European settlement, yet nevertheless, still holds significant ecological importance, particularly the estuarine wetlands and the Tabbagong Forest. The implications of the proposal for the natural environment are addressed in this section with further more specific attention to wetland issues presented in Section 6.7

Potential Impacts of the Proposal

This section identifies the potential impacts of the proposed corridor during both the construction and operation stages. These impacts need to be described before appropriate mitigation measures/safeguards can be defined. Such measures can not only minimise the impacts, but also set in place a framework through which the quality of the valley's natural resources could be substantially improved over time.

o Erosion and Sedimentation

The RTA (1990j) indicated that the potential effects of erosion and sedimentation (refer Section 6.2) would be specific to three major groups of organism in the Minnamurra River. These are :

- Oysters - increased silt loads result in the gradual decline in oyster condition
- Fish - numerous effects including gill clagging and disruption to migration behaviour
- Seagrasses - smoothing of seagrass reduces photosynthetic efficiency by settling on leaves.

o Ground and Surface Water Flows

At least three potential adverse impacts can be envisaged relating to water flow (RTA, 1990j). They are :

- construction of the deep cutting through Tabbagong Forest could affect the pattern of groundwater movement above and below the roadway
- release of highway related runoff into the Minnamurra River could exacerbate the adverse effect of flood flows
- conversely, the impedance of flood flows by construction of embankments could alter the species composition of affected plant communities.

o Pollution

This relates to the potential adverse effects of vehicle and highway derived pollutants including trace metals and hydrocarbons. In addition, accidental spillage of hazardous materials is a risk.

Other pollutants include biocides that may be used during the construction, and also construction dust that may settle on leaves limiting photosynthesis and in turn, growth.

o Habitat Loss

Some habitat loss would occur at the following locations :

- a stand of casuarinas at the northern junction of the proposed Bypass with the existing Highway
- a sedge/rushland community in the Mandl property
- a wetland community in the "Tongarra" property
- the swamp oak communities adjacent to the Minnamurra River
- the wet sclerophyll forest community which partly constitutes Tabbagong Forest which is already limited in extent.

o Fragmentation of Habitat

New road corridors have the potential to not only directly affect wildlife populations, but also fragment communities. Fragmentation could be the most severe impact of the proposal, particularly between the forested lands to the west of the corridor and estuarine wetlands near the "Dunmore House" and Mandl properties, and those of Tabbagong Forest on the other side of the corridor. Isolation of these reservoirs from one another and from their 'hinterlands' could adversely affect faunal diversity over a considerable part of the lower Jamberoo Valley.

The proposed Bypass would not directly affect any of the important wildlife corridors identified in Illawarra REP No 1.

o Wildlife Mortality

The extent of clearance of natural vegetation in the lower Jamberoo Valley has already led to several localised extinctions (refer section 5.5). Populations of surviving wildlife species in the lower valley (e.g. swamp wallaby) are small and fragmented, and hence susceptible to local extinction. It is therefore conceivable that wildlife kills on the highway could further lessen the likelihood of survival for such species.

o Wildlife Disturbance

The impact of noise, vibration and visual stimulii may cause animals to avoid the vicinity of the road for nesting and/or feeding purposes. Whilst this is generally poorly researched or understood, and essentially undocumented for Australian fauna, it is quite possible that such changes could have adverse impacts on some wildlife species.

Strategies to Conserve Ecological Values
(Mitigation and Safeguards)

The key elements of the strategies proposed to conserve ecological values are discussed below. These mitigation measures would be incorporated into the design and contract documents, and they would be monitored during and after construction so that there is feedback regarding the effectiveness and practicality of the work.

In view of the environmental resources which could be affected by construction and operation of the proposed roadway, it is proposed that an independent environmental specialist be appointed to oversee the construction and early operation of the roadway in accordance with an environmental management plan to be prepared before construction.

o Erosion and Sedimentation Control

Strategies for erosion and sedimentation control are discussed in detail in Section 6.2. Generally, it is proposed that no surface drains will discharge directly into either the wetlands or drainage channels during construction, but into suitable sediment control structures. As much vegetation as possible between the roadway and wetlands or drainage channels would be retained, as this vegetation will help filter out sediment. Fording of waterways with construction equipment would be prevented by fencing off the wetlands from the construction site, and by building the intended crossing at an early stage for use thereafter by all construction vehicles.

o Control of Pollution

With respect to chemical pollutants such as hydrocarbons washed from the road surface or accidental chemical tanker spills, the current indicators are that the best treatment would comprise artificial wetlands and retention basins. These basins typically have long retention times to allow for settlement of fine particles, and the containment also permits specialist treatment where possible.

Artificial wetlands generally comprise macrophyte planting to facilitate biological improvement in water quality. The wetlands would be located so that they would not be breached by flood events, as they generally accumulate substantial pollution loads over time. The designs would consider the need for dual pond systems and litter traps. Ponds could also be located in parallel so that very large flows, which usually contain few non-sediment pollutants, would bypass the artificial wetlands and help maintain its integrity. Regular maintenance of the ponds would include dredging and disposal of accumulated material to ensure ample capacity at all times.

The potential for major tanker spills on the proposed 810 metre Terragong Swamp bridge represents a risk to the wetland ecology. The type of bridge design envisaged would not specifically allow for total drainage of such spills to the basins on either side of

the flood plain. Rather, the bridge would provide for discharge of stormwater or liquids at regular intervals along the structure. Therefore, in the event of a spill, adverse impacts on the wetland environment could be potentially significant depending on the type of substance and quantity spilled.

As with potential community risks associated with hazardous road transport events (refer Section 6.15), the probability of major spills occurring on a high standard road such as proposed, would be very small. In this regard, drainage from the bridge would be typical of virtually all crossings over wetlands, waterways and flood plains.

It is noted that a different bridge crossing alignment (e.g. Minnamurra Bends) may pose similar or higher risks to ecological damage from potential spills.

o Loss of Important Natural Resources

Plant species which are generally regarded as absent or limited distribution on the coast of Central Illawarra, and which would be directly affected or within close proximity to the proposed corridor are Sassafrass (Doryphora sassafrass), Turpentine (Syncarpia glomulifera), Native Hibiscus and Spotted Gum (Eucalyptus maculata). These are found in the Tabbagong Forest.

With respect to species at or close to their southern most limits of distribution two species would be affected by the corridor, Native Hibiscus (Hibiscus heterophyllus) found in the Tabbagong Forest and Grey mangroves Avicennia marina) found in the wetland areas (refer Section 6.7.

There are also five plant species which are considered to be rare or threatened which could occur in the Tabbagong Forest. None of these however, would be directly affected by the corridor.

A full listing of plant species known to occur in the study area which are of limited distribution, at their southern-most distribution or are rare and threatened is provided at Appendix E.

To compensate for the potential loss of individuals of the important species identified above, the RTA would initiate a seed collection programme prior to construction commencement. These species would then be established as part of the progressive re-vegetation programme.

No important animal species are likely to be directly affected by the proposed corridor in terms of habitat destruction, however, indirect effects such as impact on wildlife corridor or water quality, could result in adverse effects. This aspect is discussed below.

One animal species of particular interest in the river area is the Australian Grayling (Prototoctes manaena). The DEP (1985) identified that the Minnamurra River supports populations of this fish which is reported to be at its northern-most extent and

declining in population. It is generally regarded as being rare and is classified as potentially threatened by the Australian Society for Fish Biology (RTA, 1990j). Safeguards to control water quality and to protect and improve the wetland environment near the proposed road would not affect the conservation of this species.

o Creation of Wildlife Habitat and Corridors

The conservation value of a road corridor as a flora and fauna habitat is recognised as it can provide a long continuous area of shrubs and trees, and therefore has potential as a reservoir for populations of plants, invertebrates and small vertebrates.

Revegetation of the road verge with native trees and shrubs would create natural habitat and discourage invasion by non-indigenous fauna. It would also obviate the use of herbicides and fertilisers, and would eliminate the need for mowing which reduces flora and hence faunal diversity.

The proposal would also create new habitats such as nesting for birds and bats under the proposed bridge, and also roosting sites for various other fauna. The proposed continuous planting along the edge of the corridor would provide a faunal corridor for the length of the roadway and would compensate for the existing fragmentation of habitat on the lower Jamberoo Valley.

To reduce road kills, it is also proposed where necessary, to fence off the roadway as near as practical to the road shoulder.

As indicated above, the proposed corridor has the potential to separate the Minnamurra wetlands and natural lands of Tabbagong Forest with respect to potential wildlife movement. On the other hand, it can re-establish a natural bridge or link between the two areas.

It is proposed that a wildlife connection be provided under the roadway at several locations including the major bridge crossing over Terragong Swamp and in conjunction with culvert construction. Preliminary design indicates two culvert crossings on the Dunmore Lakes Park site, one on "Glengowrie" and at Rocklow Creek, and two in the Bombo quarry area. In addition, a connection would be available under the southern end of the Tabbagong Swamp crossing on "Riversdale".

In addition to establishing these vegetated links under the road, the RTA would intend to establish a wildlife corridor on both sides of the Bypass between Tabbagong Forest and the Minnamurra wetlands. As such a strip of wildlife corridor additional to the proposed road corridor would affect the "Riversdale" property, the width available would be subject to negotiations with the owner.

It is noted that such a wildlife corridor was identified by the DEP (1985) and would enhance and extend existing wildlife habitats.

o Wetland Buffer Zone

As indicated in Section 5.5, the casuarina forests within the Minnamurra River and its adjoining wetlands are showing little regeneration due to cattle trampling and feeding. Much of the forest has now reached maturity and tree deaths are occurring.

The RTA would negotiate with the owners of relevant properties (viz. "Glengowrie", "Tongarra", "Myree Hill" and "Riversdale"), to establish a riparian buffer zone on the land residues severed by the proposal. This could entail either purchase of the areas or supply of materials (e.g. fencing, plant stock, etc).

The riparian buffer zone would be preferably 40 metres on either side of the Minnamurra River and its tributaries and around the SEPP 14 wetlands.

A detailed discussion on the effect of the SEPP 14 wetlands is provided below.

6.7 SEPP 14 Wetlands

Location

The proposal would directly effect part of a wetland No 372 protected by State Planning Policy No 14 Coastal Wetlands. The boundary of this wetland in relation to the proposed corridor is shown on Figure 15.

Construction Phase

o Effects

The corridor generally passes through the western extremity of the designated wetland boundary with specific contact at two locations. The first is just south of the "Tongarra" property. Although this section would be completely bridged, establishment of piers would require the removal of most of the vegetation in a corridor of about 35 metres wide. The total area of vegetation removal would be about 1.1 hectares with the predominant vegetation type being Swamp Oak (Casuarina glauca). There are also scattered grey mangroves (Avincennia marina) and an understorey of Common Reed (Phragmite australis) and Sea Rush (Juncus Kraussii).

As indicated in Section 4.7, construction machinery within the wetland would be limited to pile driving rigs only. The bridge deck would be constructed in sections and lowered by crane from the span already in place. Subsequent materials required such as concrete and steel reinforcement, would be transported across the existing spans. This method would keep construction machinery in the wetland to a minimum.

The second area affected is a small mixed stand of Swamp Oak (Casuarina glauca) and grey mangrove (Avincennia marina) with an understorey of Common Reed (Phragmite australis) and Lantana (L. camara) contained in the "Glengowrie" property. It is notable that there is no present regeneration of Casuarina due to stock trampling and consumption of juveniles. The area of vegetation removed would be about 0.8 hectares.

o Safeguards

A number of safeguards would be implemented to reduce the impact on the vegetation loss and protect the adjacent wetland areas. They include :

- o Regular consultation with officers from the Soil Conservation Service and other relevant government authorities at commencement of major construction phases.
- o Construction methods to limit movement of machinery in the wetland area.
- o Progressive placement and removal of a geotextile silt fence placed on the downstream side of the active construction site to prevent alteration of water quality.
- o Progressive surface stabilisation and re-vegetation alongside and beneath the bridge structure once the bridge piers are in place. Numerous cases of successful mangrove re- establishment through transplanting have been reported by the State Pollution Control Commission and they indicate that such action would be particularly suitable for both screening and habitat restoration (SPCC, 1983).
- o Progressive establishment of indigenous vegetation on the road embankments and provision of a culvert on the wetland area in the "Glengowrie" property.
- o Regular water monitoring during construction with testing of parameters such as turbidity, oil and grease, pH, conductivity, salinity and chlorinated hydrocarbons.
- o Other measures such as construction of wet retention basins, sedimentation ponds and erosion control measures as outlined in Section 6.2 and 6.4 would also be adopted.

Operation Phase

o Effects

As indicated above, the proposal would require the removal of about 2 hectares of wetlands protected by SEPP 14. A large proportion of the area affected by the proposed bridge would be reinstated with casuarinas and mangroves planted right up to and alongside the bridge. Beneath the bridge only smaller species

such as the rushes and reeds, would be re-established. The net permanent removal of vegetation is thus estimated to be about 1.2 hectares.

The proposal would also have the potential to effect water quality by increased input of litter, and possible impact of hydrocarbons and metals such as lead from highway runoff.

The effect of these impacts would be minimised by the relevant safeguards outlined in Sections 6.2 and 6.4. In addition it is be noted that the removal of 80% of traffic from the existing Princes Highway around the Minnamurra Bends would provide a significant beneficial effect on water quality for the Minnamurra River in that area.

Indirect effects to the main wetland area would be negligible as there would be no alteration to hydrological conditions, substrata or water quality outside the construction zone. In view of the small proportion of the wetland to be removed, no detrimental impacts on habitat quality of the wetland is expected provided that re-vegetation and the controls outlined below are undertaken.

o Safeguards

Proposed safeguards during the operation phase include :

o Installation and monitoring of the proposed sedimentation, erosion and water quality controls outlined in Sections 6.2 and 6.4.

o Regular monitoring of water quality to assess effectiveness of drainage and re-vegetation.

o On-going native re-vegetation.

o Regular removal of accumulated litter.

o Regular inspection of culverts, and sedimentation structures for silt blockage, erosion damage.

Compensation

Numerous measures have been identified in order for the RTA to compensate for loss of SEPP 14 wetlands. These include :

o Negotiations with the property owners of "Glengowrie", "Tongarra" and "Riversdale" for the purchase of areas to be established as new wetland areas/riparian buffer zones. These areas, which are shown on Figure 15, represent about 10 hectares of land which could be established for such purposes and which would compensate for the 1.2 hectares of wetland permanently affected by the road corridor.

o Representation would be made by the RTA to have the designated boundaries of the SEPP 14 wetlands adjusted to include these new wetland areas.

- Preparation of a management plan for the conservation of the whole wetland area. This would be done in consultation with Shellharbour and Kiama Councils and relevant government authorities and would most likely consider the following issues :

  - appropriate authority for management
  - exotic flora eradication
  - access control of domestic stock
  - possible access for recreation/education including use of board walks.

Alternatives

An alternative to the current proposal which would avoid SEPP 14 wetlands is also shown on Figure 15. The alternative however, has significant disadvantages and thus, cannot be justified. These relate to the following :

- Intrudes further into the Jamberoo Valley Rural Conservation Area and has particularly visual exposure to the Jamberoo Valley on the the western face of the hill at "Tongarra" farm.

- Effects Swamp Road which would have to be reconstructed, including a new bridge crossing and re-alignment works in a difficult swamp area.

- Likely to involve the demolition of the "Tongarra" farm and would prevent or entail a costly access structure for access to the main part of the property.

- Passes diagonally through the middle of the "Glengowrie" farm rendering existing use for grazing unviable.

- Would cause a major disturbance to the "Riversdale" dairy farm passing much closer to the homestead and the dairy sheds, and would also effect the best pasture land contained in the Swamp blocks.

- Potential contamination would be the same regardless of the alignment (i.e. proposed bridge structure is just upstream of wetland).

- Effects an additional property owner's swamp blocks.

- Involves a longer bridge crossing (approximately 950 metres), and hence would increase construction costs.

Other road corridor alternatives such as a completely different western alignment or options to upgrade the existing Highway, have been addressed in Section 3.0.

Thus, the proposal, whilst affecting the western extremity of the classified wetland Area No 372 would minimise impact on property, land use, farm access and visual. It also provides a shorter bridge crossing and is less costly. In addition, the proposed

mitigation and safeguard strategies discussed above would enhance the existing wetlands by establishment of a new and larger wetland buffer zone (with potential for SEPP 14 status).

National Conservation Strategy

On the basis of the criteria adopted for route selection, the condition of the subject wetlands, and the range of proposed environmental safeguards and compensatory measures for loss of wetland, it is concluded that the proposal is not inconsistent with the objectives and goals of the National Conservation Strategy of Australia. The strategy broadly aims at encouraging better integration of living resource conservation and development (Department of Home Affairs & Environment, 1984).

6.8 Regionally Significant Resources

Illawarra Regional Environmental Plan No 1

The proposed Bypass would affect three resources identified in Illawarra Regional Environmental Plan No 1, namely prime crop and pasture land, land with landscape or environmental attributes and extractive resources. No other regionally significant resources would be affected.

o Land with Prime Crop and Pasture Potential

The proposed corridor fringes the eastern edge of the classified prime crop and pasture land (refer Figure 12) and would result in the direct loss of about 16 hectares and severance of a further 16 hectares from the main farm areas. Of the severed land, about 6 hectares are contained on the Dunmore Lakes Park property, and it has already been re-zoned to allow rural residential tourist park development. In this regard, the potential for this land to remain as prime crop and pasture land has already been significantly diminished.

The balance of severed prime crop and pasture land (10 hectares) is contained wholly on the "Riversdale" property. About 4.5 hectares is located on the east side of the proposed corridor south of the billabong. The road would be bridged in this section and thus would provide suitable clearance to permit movement of stock and low clearance farm equipment.

The balance of 5.5 hectares is located on the east side of the corridor north of the large billabong on what is known as 'Nobles Island'. Access beneath the corridor would not be available and thus, all this area would be effectively lost for grazing. The property owner has advised that about 4 hectares of this area is not suitable for grazing any way because of the incursion of the wetland vegetation (Honey, pers comm). It is proposed that this area be re-established as a protected wetland as part of the proposal. The remaining 1.5 hectares east of the corridor is suitable as pasture land, and therefore would represent a nett loss.

The resultant loss of classified prime crop and pasture land a taking into consideration those matters identified above, is therefore about 17.5 hectares. Importantly, the proposed corridor would result in significantly less classified prime agricultural land being affected than would be the case with other western bypass options.

o Extractive Resources

The corridor would potentially affect one area identified as having significant extractive resources at Dunmore Lakes Park (refer Figure 12). The proposal to extract sand resources from the land before development of the Tourist Park would not be affected by the corridor given the likely timing of that project in advance of road construction. Once the sand removal has been completed, the Dunmore Lakes Park development would be the major constraint on further extraction.

o Land with Significant Landscape or Environmental Attributes

Classified landscape and environmental attributes would be affected across Tabbagong and through the back of the quarries at Bombo. The implications at Tabbagong have been addressed in Section 6.6. It is not apparent why the quarry areas were identified apart from being included in a blanket cover of the area. The visual and ecological assessments provided in Sections 6.6 and 6.10 further support this view. More relevant issues such as impact on extractive resources, proximity and indirect impacts on Gainsborough are discussed below.

Illawarra Regional Environmental Plan No 2

o Visual Effects

Jamberoo Valley is recognised as an area of special character, including high scenic quality and landscape importance (DEP, 1985) and hence, consideration of the effects on the visual environment is required. In the Illawarra REP 2, the boundary of the Jamberoo Valley is defined. This line aimed to incorporate all lands that were considered to be of significance to the Jamberoo Valley and its important character.

Only a small section of the corridor (approximately 500 metres) is located marginally within the Jamberoo Valley Rural Conservation Area. This section of the route is in the north eastern corner of the Valley, within cleared rural land and adjacent to the Minnamurra River. The route is primarily on grade and the surrounding topography and vegetation would screen the proposed road from views from the township of Jamberoo. In those areas the proposal is not of a scale of nature that will significantly compromise the conservation values of the broader Valley.

Views from the Valley to the proposed road sections outside the gazetted REP boundary would be minimal. Glimpses may be gained of the proposed bridge over Minnamurra River. However, the

nature of the development in conjunction with landscape treatment for screening purposes, would reduce the visual effect on the landscape and visual impact on the viewers of the Jamberoo Valley such that the proposal would have minimal interaction with the Jamberoo Valley.

o Other Considerations

The Regional Environmental Study prepared as background to Illawarra REP No 2 acknowledges the possibility of a road corridor through part of the Jamberoo Valley. This is envisaged as part of a possible future extension of the F6 Freeway south of Yallah. The study indicates that such a route could cause significant environmental problems in the wetland areas and thus, recommends that any possible swamp crossing should ensure:

- no alteration to the hydrological characteristics of the swamp
- no alteration to salinity levels of the swamp and; that
- alteration to prime crop and pasture be minimised.

Furthermore, the study indicates that any crossing of the Terragong Swamp should seek the shortest crossing, be a bridge, have minimal width and be high enough for farm equipment to pass underneath. The study also indicates that any possible route should avoid the flying fox colony at "Riversdale", the dense woodlands on the "Riversdale" property, alienation/fragmentation of farmland and minimise the impact on the scenic landscape. It is noted that investigations for this proposal did not identify a flying fox colony at "Riversdale".

The proposed corridor would generally satisfy these recommendations in that alteration to the hydrological characteristics of the swamp and the salinity levels would be negligible (refer Section 6.4). The corridor would affect approximately 5 hectares of land contained within the Rural Conservation Area. Out of a total area of prime crop and pasture land contained within the Jamberoo Valley of 6,200 hectares (DEP, 1985), this loss would not be significant.

The proposed bridge across the swamp would be at the shortest crossing, would be designed to the minimum width necessary to accommodate the projected traffic, and be high enough to allow farm equipment to pass underneath. The route would not directly affect the dense woodlands located in the "Riversdale" property (i.e. generally the undisturbed area south west of the proposed corridor). There would be no alienation of farms and fragmentation would be kept to a minimum with the proposed alignment.

The regional study also recognised that an alternative of widening the Minnamurra Bends would have a significant environmental impacts including filling of river, loss of wetlands and the loss of an attractive entrance to the town.

6.9 Land Use and Property

Property Impacts

The nominal 60 metre corridor width for the Bypass would mean at least 32 hectares of essential acquisitions of land presently committed to various conservation, rural, agricultural, quarrying and industrial activities. The proposal would also result in severances and separation of numerous properties. These are detailed below on an individual property basis.

o Property 1 - Kiama Municipal Council

Preliminary design of the proposal indicates construction in this area would be contained within the existing Highway reservation, thereby leaving this property unaffected.

o Property 2 - Dunmore Lakes Park

The proposed Bypass would traverse the low lying northern section of the property, part of the north facing hillslope and another low lying area in the south. These areas are presently used for grazing, which is regarded by the owner as an interim use prior to construction of the proposed tourist park and residential estate.

The proposal would affect a total of 13 hectares, including an area planned for drainage controls, car parking and internal access in the north, and sections of four planned rural residential allotments in the south. Some redesign of these and other components of the proposed Dunmore Lakes Park would therefore be necessary in order for the development to be functional. This would necessarily include attention, by the owner and RTA, to measures which offset the loss of amenity associated with visual and noise changes, possibly including layout changes, design details and landscape treatments.

The Bypass would sever an area of approximately 6 hectares (included in the 13 hectares) to the east of the corridor adjacent to the "Dunmore House". Although being effectively isolated from the property, about 50 per cent of this land is required as detention ponds for the proposed tourist development.

o Property 3 - "Dunmore House" (McCormick)

This property would not be directly affected by the proposal. However, the close proximity of the road to the western boundary would result in changes to the environmental amenity of the property. Visual alterations and traffic noise effects in the area are detailed in relevant sections.

o Property 4 - Unnamed (Mandl)

The proposed corridor generally hugs the western boundary of the property and a large cutting through the ridge would effectively reduce the area with development potential (presently for one dwelling) by about 40% from 2.8 hectares to about 1.7 hectares. Whilst there would still be ample space for a dwelling, any future development for residential use would have much diminished amenity due to indirect effects including visual and traffic noise impacts.

The proposal would also sever the existing legal access to the property. An alternative arrangement would have to be negotiated with the most practical solution likely to involve shared use of the road proposed to service the subdivision of the Dunmore House property. Alternatively, the RTA would seek to acquire an access strip from the Highway to the property from the Dunmore House and/or Dunmore Lakes Park properties.

Part of this land could, subject to negotiation, be exchanged for the land severed by the road corridor through the Dunmore Lakes Park property. The balance of the Mandl property (about 90% of the total area) would remain unaffected.

o Property 5 - "Glengowrie" (Dean)

The proposed road corridor would require the direct acquisition of 3.5 hectares of pasture land and would sever a further 3.5 hectares on the eastern side of the corridor. On the severed side, there is a large dam and extensive wetland vegetation which occupies about 2 hectares, with the balance of 1.5 hectares being pasture land.

The RTA proposes to use the dam as a retention basin for sedimentation and erosion control, and would therefore seek to acquire the severed part.

The net effect could therefore be the loss of about 7 hectares of land of which 5 hectares would be regarded as good pasture. As the existing farm does not have a holding size sufficient to support a viable dairy farm, the direct effect of this loss would be the loss of pasture land available for agistment.

o Property 6 - "Tongarra" (Richardson)

The proposed corridor would require the direct acquisition of about 3 hectares of pasture land. In addition, a further 3 hectares would be isolated on the eastern side of the corridor although access could be available beneath the proposed Terragong Swamp bridge. This would allow continued access from the main farm area to the Minnamurra River, and also 1 hectare of prime pasture land. The farm does not have the size to support a sustainable dairy farm however, would still lose 3 hectares of prime pasture land with potential for agistment or other rural use.

o Property 7 - "Myree Hill" (McGlinchey)

The proposed corridor affects only a narrow parcel of this property (0.2 hectares) however, would be significant as it provides the only access between larger pasture areas to the east and west. At this location the roadway would be on an elevated bridge which would allow the continued movement of stock across the corridor and also most farm equipment. However, high equipment (e.g. trucks) would not have sufficient clearance under the bridge.

o Property 8 - "Riversdale" (Honey/Honey)

The proposed corridor would have a major impact on this property, effecting about 15 hectares in total. The corridor and a proposed water retention/sedimentation basin would directly affect about 5 hectares which are presently used for grazing of dairy cattle, whilst about 10 hectares would be severed from the main farm area on the eastern side of the corridor. About 5.5 hectares of the severed land is on "Nobles Island" of which about 4.0 hectares is not generally usable for grazing because of the wetland vegetation. The other 4.5 hectares, located south of the large billabong, is prime pasture land that would still be accessible beneath the proposed bridge. The bridge would have sufficient clearance to allow stock movement and the passage of most farm equipment.

About 3 hectares of this severed land has potential for residential development, given the proximity to Gainsborough and the already rezoned area of land proposed for subdivision further south on "Riversdale". In the event that the owner obtains approval and proceeds with a residential development on the latter area, it is probable that some reduction in land value below present expectations would result due to amenity affects from the proposal.

The loss of agricultural land is unlikely to significantly affect the viability of the property as a dairy farm in view of the total size of "Riversdale", and given its arrangement with adjoining main farm and swamp blocks.

As indicated in Section 6.6, it is proposed that a section of the intended residential submission on the eastern side of "Riversdale" would be established as a natural corridor between the Tabbagong Forest and Minnamurra wetlands. This natural corridor, which preferably be 30-40 metres wide, would also serve as a buffer between the road and any future residential development. However, the extent of such conversion would be subject to negotiations with the owner.

Other impacts would include changes in the noise and visual environment. These are discussed in relevant section below.

o Property 9 - "Tabbagong" (Trustees of Parbury Estate)

The major impact on land use would be the demolition of three houses and associated buildings and sheds, thereby displacing two resident families.

In addition, the corridor would involve the direct acquisition of about 3 hectares of land, of which only 1 hectare is of moderate suitability for grazing. The topography of the area would prevent access being provided across the corridor, therefore effectively severing a further 12.5 hectares from the main part of the property to the south.

Access from Panama Street could no longer be provided to the severed area on the north which would have to be accessed via Gainsborough a new 'right of way' or similar.

The northern parcel has limited agricultural value, and the potential for additional residential development from Gainsborough is constrained. The RTA would therefore consider acquisition of this severed portion for retention as an important landscape feature and buffer area between the road corridor and Gainsborough Estate. The area could be dedicated as a public reserve, possibly incorporating a motorist stop providing excellent views over North Kiama and the Minnamurra River.

The land use on the southern side of the corridor would generally remain unchanged as a consequence of the proposal.

o Property 10 - Bombo Quarry (Boral)

The RTA would need to acquire about 2.2 hectares of land directly for the corridor, plus about 0.8 hectares severed in the north-western corner. This area is underlain by high quality basalt which Boral considers it has approval to extract under long standing development consents, although this remains somewhat uncertain. Unless extracted before, or as part of road construction, this resource would be sterilised by the proposal.

The other major impacts would be the demolition of one home and the isolation of another on the northern side of the road. With respect to the latter, the RTA would negotiate for either full acquisition, or to compensate by providing new vehicle access, which could only be provided by an 'right of way' through the Parbury property connecting to McBrien Drive.

Boral Resources has expressed concern at the resulting visibility of quarry operations to motorists on the Bypass (Quarry Manager, pers comm). The RTA would propose to screen such views by way of landscaping and/or fencing treatments. The potential for fly-rock from quarry operations reaching the Bypass would be negligible. As such, no specific safeguards are proposed although a visual screen adjacent the road would form a physical barrier.

Boral Resources have also indicated interest in a possible north bound on ramp from their quarry to the Bypass. Preliminary design of the Bypass does not preclude such an opportunity, however, the merits of such a proposal have not been addressed in this Statement.

o Property 11 - Bombo Quarry (SRA)

The proposed corridor traverses the northern boundary of the SRA quarry. As indicated in Section 5.6, this section of the quarry is dis-used and the SRA are presently constructing a major crushing plant and handling facility on the old quarry floor further to the south. Advice from the SRA has indicated that the proposal is unlikely to adversely impact on planned quarry operations if the roadway is contained on the proposed alignment (P Rhodes, Quarry Manager, pers comm).

o Property 12 - Disused Quarry (RTA)

The proposed corridor is contained within the existing road widening reservation which includes an old quarry site owned by the RTA. The land has no extractive resources potential nor any agricultural worth, and in this regard, no significant land use impacts are envisaged.

As the former timber mill activity on this site involved wood treatment process, the RTA would propose to obtain an analysis of soil samples to ascertain whether specific precautions need to be taken when carrying out earthworks in this area, or in disposing or re-using such materials. Advice would be sought from the SPCC for such monitoring, and if required, in subsequent material handling.

o Property 13 - Concrete Plant (Cleary Brothers)

The proposed corridor and interchange requirement would be contained within the existing road reservation which covers a large part of this property. As such, the existing property, and numerous improvements would be significantly affected.

The proposal would require the demolition of the cottage, a large storage shed, as well as the probable relocation of the batching plant. The buildings affected by the proposal are shown on Figure 4C.

Negotiations between the owner and the RTA would determine whether the effected facilities are re-established on the property further to the west, or whether relocation at an alternate site is more appropriate.

o Property 14 - North Kiama Park (Kiama Council)

The proposed route would be contained with the gazetted road reserve boundary and thus, would have no direct affect to this property. The proposal would not have any significant

impact on potential future use of this area as a public park as the road would be in a cutting. Access to the park would still be provided from Hutchinson Street.

o Property 15 - Kiama Cemetery

The cemetery is outside the existing road reservation in this area and would not be directly affected by road construction. However, access changes would result with left in, left out turns only permitted. In the longer term and subject to traffic safety conditions in the immediate area, it is likely that the Highway connection would need to be eliminated. This would require that cemetery access then be via Terralong and Dido Streets, which would accommodate the related traffic volumes with minimal local disruption.

Property Acquisition

All properties required for the proposed Bypass would be the subject of an acquisition and compensation process which would follow approval of the proposal and accurate definition of road reservation boundaries. As previously noted, there is no existing road reservation for the proposal except at the northern and southern sections, where works would be on the existing Highway alignment. The land acquisition procedure would include:

- Written notice to property owners advising of the effects of the proposal and requesting an asking price and conditions of sale.

- Reimbursement of reasonable professional fees incurred by the owner in obtaining a compensation price would be met by the RTA.

- RTA assessment of the owner's asking price based on the 'before and after' valuation method which considers land value, as well as severance and betterment effects. A letter containing the consideration and conditions of purchases is then forwarded to the property owner.

- Negotiation between the owner and RTA where the assessment and/or conditions are unacceptable (usually based on negotiations between the respective valuers).

In the event of no resolution through the above process, the RTA would invoke its land resumption powers. This typically involves the Valuer General to assess the claim. The opportunity exists for property owners to appeal to the Land & Environment Court where dis-satisfied with the final assessment of valuation.

Future Residential Development

As previously indicated, the proposed Bypass would form a strong physical barrier to further residential development on the western fringe of Gainsborough. However, other pre-existing constraints in close proximity such as the Illawarra REP No 2 boundary, would also limit urban expansion. In this regard, the

Bypass would complement the aim of the REP to protect the rural environment just west of north Kiama. No provision has been made in the preliminary design for a future crossing of the Bypass in that area.

For the area south of Gainsborough mainly including "Tabbagong", the proposal would again represent a definite constraint to any future expansion of residential development. If rezoning of that area for residential purposes could be achieved, access via Panama Street, Riversdale Road or some alternate new route would be necessary. It is noted that this area is presently zoned Rural Environmental Protection (Scenic).

Other proposed or planned rural and urban residential developments (refer Section 5.6 and Figure 11) with the exception of the Dunmore Lakes Park proposal (see above), would not be directly affected, although certain changes in residential amenity would result for sites in close proximity of the proposed Bypass.

Recreational Activities

As indicated in Section 5.6, major recreational activities focus around the Minnamurra River, the beaches and the inland rural areas of the Jamberoo Valley.

The proposed Bypass would provide substantial benefits particularly for recreational activities along the Minnamurra River. The substantially reduced traffic volumes would allow much safer access to and from the riverside parking areas, as well as improving the aesthetical values by reduction of traffic.

Formalised and landscaped rest/parking areas could be established including provision of picnic facilities. Localised traffic management could provide substantial improvement for access to the boat ramps near Minnamurra Bridge.

Access to Kiama Golf course would be improved substantially with the significant reduction of through traffic, as would be the amenity of the course as a recreation area.

Access to Bombo Beach would be maintained with a connection to the proposed south bound on ramp which would be two-way north of the Bombo Beach access road.

6.10 Visual and Landscape Changes

Changes to the visual character of the area were examined by overviewing the full length of the proposed route, and by assessment of the proposed route broken into nine visual units.

The location of these units is shown on Figure 16 and discussed below. Figures 17, 18, 19 and 20 are photomontages of the existing and future landscape at selected locations along the route. The future photomontages are representative of the landscape at about 20 years after construction.

Unit 1 : Dunmore Lakes

A small pocket within Dunmore Lakes has a very high visual quality. The proposed Bypass would have a significant impact on this section, however, as the roadway would be on grade, visual exposure and overall visual impacts would be reduced.

To mitigate the visual impact of the road, it is proposed that sections in this unit with 1 in 2 batter slopes be landscaped with species including Swamp Oak, Blackwattle, Bangalay, Cheese Tree and Turpentine to reflect the composition of the existing ecosystems. It is also intended that the median strip in this unit be landscaped with coastal banksia, tick bush and paperbarks.

The street lighting proposed at the intersection of Swamp Road and the Bypass would be apparent at night by those residents in close proximity and in elevated positions. This would include "Anglesboro", "Dunmore House", "Sea View", the caretakers cottage on Dunmore Lakes Property, homestead (unnamed) south of Rocklow Road and the "Petersborough" heritage site. Beyond this immediate area (e.g. Gainsborough, Jamberoo Valley, North Kiama), the lighting would not be noticeable because of screening by the topography and/or vegetation.

Unit 2 : Dunmore House

To the west of "Dunmore House", filling would be required to accommodate the proposed road, as well as cutting through an elevated area, thereby affecting the units visual character.

The proposed Bypass would be in the foreground views of "Dunmore House". As such, the eastern side would require screening through landscape treatments to reduce its prominence and associated impacts such as glare reflecting from passing traffic. This unit has been identified as a critical visual effect zone, and landscape treatments are proposed to assist in reinstating the visual quality of the existing environment, and to screen the visual impacts of the proposed Bypass from surrounding viewers. Proposed landscape treatments are shown on Figure 21.

To minimise the impact of the proposed road on Dunmore House, it is proposed that the planting density on the eastern side of the Bypass be greater than the western side. It is proposed that sections of the Bypass with a 1 in 2 grade be landscaped with species such as turpentine and blackwattle. In sections where cut would be required, species such as Banksias would be used. The median strip would be landscaped with wattles, paper barks and various native grasses.

Unit 3 : Glengowrie

This unit comprises an area of high visual quality which by nature of its surrounding vegetation, would be affected by the proposed Bypass. The western section of the road, which would

pass through this unit, would be seen by approximately four residences in their foreground views, and approximately 12 residences in their middle-ground views.

As this unit is considered a critical zone, appropriate landscape treatments would be required to minimise the visual impacts. The western side of the proposed Bypass is important, and the density of landscaping would have to be increased to screen views. Proposed species in this unit would include figs and casuarinas in areas affected by a 1 in 2 batters Landscape treatments in the median would include species such as banksias and melaleucas. Similar landscape treatments to those proposed for Unit 2 would be undertaken.

Unit 4 : Minnamurra Wetland

Almost all this unit is characterised by a very high visual quality which would be significantly affected by the proposed Bypass. The road would however, be on grade in this unit, thus reducing the required changes to the topography, visual exposure and overall visual impacts.

The high visual quality of the unit would require appropriate screening and landscaping. Planting would be required on the western side of the proposed Bypass to visually screen it from residences in the west. As wetland vegetation would be very close to the eastern edge of the proposed road, it provides an effective screen.

On the western side of the proposed Bypass it is proposed that Swamp Oak be planted. Sections with a 1 in 2 batter slope, and species such as wattle and banksia would be planted in the median. Proposed landscape treatments are shown on Figure 22.

Unit 5 : Minnamurra Crossing

A bridge and embankments would be required for the proposed Bypass to cross the Minnamurra River flood plain. It is anticipated the crossing would include an 810 metre bridge, 20 metres wide, and about 2.5 metres (bottom of deck) above the wetland.

The landscape affected by the proposed Bypass is characterised by open casuarina woodland. The surrounding casuarina forest and other tall wetland associations would be cleared in some sections, but the majority, and particularly the outer edges of the vegetation, would be maintained as a visual screen.

Visual quality in this unit is high, and as the proposed bridge and embankment would involve some clearing, the unit would be subject to visual change. As the majority of the proposed structures would be accommodated in the open casuarina woodland, its visual impact would be reduced in the landscape by surrounding vegetation. The visual quality of the immediate wetland would however, be changed.

Approximately 10 rural residences would be located in close proximity of the foreground zone of the proposed Bypass. The tall wetland forest of the flood plain would effectively screen areas of the Bypass, however, clearing to accommodate the road would be required in some locations, and would break the canopy of the vegetation and could open views. In areas where the natural wetland vegetation is low, for example reedlands, views would be open. The bridge would therefore be open and would occupy foreground views.

About 280 residences located in Gainsborough are considered to be visually sensitive towards the proposed Bypass. As many would be screened by adjacent residences or local topographic features, this number represents the maximum number affected.

Some residences at the western fringe of Gainsborough Chase, including yet to be built dwellings, would be denied distant western views to the Jamberoo Valley because of the high embankment which would be established on "Riversdale" at the southern bridge approach.

To screen structures in this unit, appropriate landscape treatments would be required. Only fill areas and batters at either end of the bridge over the River can be landscaped. Re-generation of the natural ecosystems is recommended. Planting may, however, be required to assist with re-generation, and only species indigenous to the wetland would be utilised to avoid invasion of the ecosystems. Particular landscape treatments on the eastern side of the Highway is proposed to reduce the percentage of foreground views. Landscape treatments would be similar to those proposed for Unit 4.

Unit 6 : Tabbagong

A large proportion of this unit is characterised by very high visual quality and the proposed Bypass would have the greatest visual impact. However, as the proposed road would be below grade, visual exposure and overall visual impacts would be minimised.

Similar to Unit 5, about 280 residents will have potential views towards the Highway, particularly as it rises up from the Minnamurra River to Tabbagong Hill. There is however, good potential for effective screening of the Highway with density of landscaping to be particularly high on the eastern side. Density on the western side should reflect the existing landscape, to allow road users to gain views of the landscape which is recognised to be of very high visual quality.

Proposed landscape treatments for the section leading up to "Tabbagong" from the Minnamurra River and then through the main cutting in Tabbagong Forest, is shown on Figures 23 and 24 respectively.

Unit 7 : Bombo Quarry

The ground level of this unit has been altered by quarrying activities and large quantities of fill would be required to accommodate the proposed Bypass, but would also be required in the unquarried sections of the quarry.

The unit has a low visual quality and it is considered that landscaping associated with the proposed Bypass would provide a positive impact on the landscape. It is proposed that landscaping densities on both sides of the road be similar, with various species including figs, turpentine and sassafrass on 1 in 2 batter slopes, banksias in cuttings and wattle, banksia and myrtle in the median. Proposed landscape treatments are shown on Figure 25.

Visual screening of the quarries is also proposed for the benefits of road users and would include landscape and barrier treatments.

Unit 8 : Bombo

The proposed interchange and widening of the Highway near Bombo beach would be visible from Bombo and Kiama headlands. Although the changes are not in the main direction of views from these locations, a high number of viewers at these locations would regard landscape treatments as being necessary.

Due to the engineering constraints from the proposed structures required in the Bombo interchange, little opportunity would be available for intensive landscape treatments. However, it is proposed that aesthetic planting of species such as wattle, banksia, turpentine and sassafrass be included to break the scale of the structure and increase road user experiences. Similar landscape treatments to those identified in Figure 25 are proposed.

The proposed roadway lighting around Panama Street bridge would be an additional feature for those residents located on Hutchison Street, and also for residents in elevated positions in Kiama and North Kiama, near Darien Avenue and Commissioners Lane. These locations generally already experience views of street lighting, particularly from the town centre of Kiama.

Unit 9 : Kiama

As the widening would be incorporated into the existing road easement, the visual impact on the neighbouring land uses would be minimised. One area of cut would however, be required in the local ridgeline abutting the existing Highway between Bombo and Kiama.

Approximately 20-30 residences in Kiama would view the widening to the Highway in this unit as part of their foreground views. The changes would not considerably alter the existing landscape

however, as numerous people view the Highway, proposed landscape treatments would enhance views for both residents and road users. Proposed landscape treatments are shown on Figure 26.

As North Kiama is the entrance into Kiama, reinforcement of the existing cultural landscape, particularly through use of Norfolk Island Pines, is considered to be important. This would partially screen the railway line from the road users, whilst still enabling views of the beach and ocean. It would also allow a continuity of the existing images in the commercial centre to be established.

An assessment of the visual implications of the proposed route on the broader Jamberoo Valley scenic environment was included at Section 6.8.

6.11 Social Impact Assessment

Social impact assessment aims to anticipate the likely social and economic effects of a project, thus providing a basis for enhancing benefits and ameliorating undesirable effects. It was assumed that involvement of the community potentially affected by the proposed corridor would enable or facilitate this assessment.

Community consultation has therefore played an important role in the assessment of the social and environmental consequences of the proposed corridor. Consultation has played an integral role in the study and began at the inception of the Route Selection Study.

A social assessment (RTA, 1990i) determined that the proposed corridor would lead to a range of positive and negative consequences for different sectors of the local community. The main potential impacts associated with the proposal are discussed separately below in terms of:

- access
- residential amenity (including noise and visual effects)
- safety
- economic issues
- community disruptions.

Access

The proposed corridor would have implications for access to homes, community facilities, rural properties, Kiama town centre and other retail and commercial services in the area. Positive impacts on access would flow from the proposed corridor for residents of North Kiama. The existing alignment of the Princes Highway through North Kiama creates a barrier effect and divides the community. Residents of the area must cross the Highway to access schools, public transport, recreation facilities, retail development and community services.

In a Pedestrian Study of the Princes Highway, between Minnamurra River and Bombo, undertaken by the RTA (n.d.), it was concluded that any upgrading of the existing highway would lead to a greater dissection of the community. It also concluded that problems would also be created for pedestrians trying to cross from both sides of the Highway.

By reducing traffic flows on the current Highway, a bypass would facilitate movement between residential areas east and west of the existing alignment. For the residents of Gainsborough in particular, this would significantly improve access to local retail outlets, school, recreation facilities and community services located in the east. Further positive consequences would accrue to motorists resident in North Kiama, especially Gainsborough, who currently experience problems gaining access to the Highway during peak periods.

Modified traffic arrangements that would result from the proposed Bypass would facilitate access to Kiama town centre for Gainsborough residents who currently experience problems turning from Meehan Drive on to the existing Highway. It has been reported that these difficulties encourage travel to Shellharbour Square shopping centre rather than Kiama, for major shopping trips. The proposed Bypass should therefore have positive impacts for movements to Kiama town centre as the Bypass joins the existing Highway alignment at Bombo before the existing town centre turn off.

The proposed corridor would have negative impacts on some rural residents. The proposal would result in the severance of six rural properties, two of which (Mandl, "Tabbagong") would have existing access arrangements affected. It is proposed to provide new access arrangements as part of the development to ameliorate these impacts should this be desired by the property owner. The disruption to property holders during construction of the road and changes to existing connections would also be a source of inconvenience.

Residential Amenity

The proposed corridor has the potential to detract from the residential amenity of people living in adjacent areas. Both rural properties and residential subdivisions in Gainsborough would be affected. During the construction stage of the proposed project, residential amenity is likely to be affected by noise, dust and visual intrusion of construction activities.

In a recent community survey (RTA, 1990c) it was concluded that features of the natural and physical environment are factors which make an important contribution to the perceived quality of the living environment. Major changes in these important attributes would therefore significantly affect amenity of the residential setting where it is close to the proposed Bypass. The number of residential properties likely to be significantly affected by the proposal is a small proportion of the local population. By contrast, improvements in the residential amenity

of properties which adjoin the existing Highway alignment, would represent a substantial benefit to a much larger proportion of the study area population.

It is recognised that many residents who would benefit from the proposal had acquired property fronting or near the existing Highway with the full expectation that the main road function would be a long term component of their residential amenity. This feature would also have been reflected in the values or prices achieved for properties along the Highway. On the other hand, property owners adversely affected by the proposal have lived with little or no expectation that a new main road would intrude on their residential amenity.

Safety

The proposed Bypass would improve safety for road users and pedestrians. Benefits to road users have been addressed in the traffic assessment (refer Section 6.1). The benefits accruing to pedestrians have been addressed above.

The possible temporary removal of the recently established cycle track between Kiama and North Kiama would have a negative short term impact on the safety of cyclists. This portion of the cycle track would however, be replaced as soon as possible after construction is completed. The overall effect of the Bypass would be to significantly improve the level of safety for both road users and local residents.

Economic Issues

The proposed Bypass would have a negative impact on production on classified high quality agricultural land, although a relatively small area (approximately 15 hectares) of such lands would be lost. Of this area, five hectares is within the Jamberoo Valley which has a total of about 6,200 hectares classified as prime crop and pasture land.

In terms of the dairy industry in the Jamberoo Valley, the proposed Bypass would impose additional pressures on the industry by way of a reduction in their stock of prime pasture lands which are available. However, in view of the nature of anticipated property affects (refer Section 6.9), the proposal would not be expected to significantly impact on the viability of any single dairy operation. Some loss of income would be likely for those owners who lease land for non-residential dairy farmers, although these properties are now essentially rural residential or special purpose sites.

Insofar as the proposed Bypass would form an effective barrier to further westward urban expansion at Gainsborough, there may be some longer term relief in pressures for land use conversion away from dairying, with consequent relief from increasing land values.

The dairy property most affected by the proposal would be "Riversdale", with about 15 hectares of land affected. The proposed corridor and a proposed retention pond would directly affect about 5 hectares currently used for the grazing of dairy cattle. In addition, about 10 hectares would be separated from the main farm on the eastern side of the corridor. About 5.5 hectares of this latter area is useful pasture, of which 4.5 hectares would still be accessible beneath the proposed bridge. It is possible that the owner could seek rezoning of this area for residential subdivision, consistent with recent land use conversion in Gainsborough Chase.

Residential properties affected by the proposal may suffer some loss in the value. This would include both developed homes and vacant blocks in both urban and rural settings. The extent of any reduction in property values is however, difficult to quantify and would be affected by broader fluctuations in the market. Impacts are likely to be more severe in the short term, diminishing over time as the market adjusts to the presence of the road.

Properties in close proximity of the existing Princes Highway would be likely to benefit from some improvements in the value of their real estate, with the proposed Bypass resulting in the down grading of the Highway to a local road, and the consequent improvement in residential amenity with reduced traffic.

Resource sterilisation or indirect disruption to resource based industries in the Bombo area arising from the proposed Bypass may have an impact on their future operating capacity.

The proposed corridor would affect about 3 hectares of land within the Bombo Quarry Reserve, owned by Boral. At this stage, it is difficult to predict what, if any, impact the proposal would have on quarry employment.

Community Disruption

Proposals to upgrade the Princes Highway between Dunmore and Kiama have had a long and controversial history. A recurring theme throughout the extensive community consultation process undertaken as part of the social impact assessment, has been the need to resolve the issue.

While implementation of the proposed development would resolve the source of community conflict and uncertainty, it would at the same time lead to major disruptions for property owners and occupiers along the proposed Bypass. For 11 private landowners whose properties would be directly affected by the proposal, the combined effect of the social and economic impacts of the Bypass would be acute in the short term, but may also be long lasting.

The proposal would require the demolition of three houses and associated buildings and sheds on the "Tabbagong" property. Two families would be displaced from their current residences as a result of this demolition. A house on the Bombo Quarry Reserve

land would also be demolished, displacing a family currently renting the property, and a second residence on this land would be severed by the proposal.

The RTA would provide compensation for the demolished properties. For the severed property, the RTA would negotiate for either full acquisition or provision of vehicle access by an acquired right of way which would connect to McBrien Drive. This would significantly improve the amenity of the house as its present access is through the quarry and along a rough dirt track. It would also link the house with Gainsborough and its associated community facilities.

6.12 Heritage

An Aboriginal and European heritage survey was conducted (RTA, 1990k) to identify items of Aboriginal and European significance which would be affected by the proposed corridor.

Aboriginal Heritage

The proposed corridor would affect two known Aboriginal sites. The first site (denoted No 1 on Figure 9) is located on the western edge of the route on the crest of the ridge just west of Dunmore House. The site consists of a small open scatter of artefacts in association with shell fragments. The site area has been highly disturbed by various European activities associated with agriculture (i.e. cattle trucks, fences, stone walls and shed construction).

The second site is located just west of the large dam in the 'Glengowrie' property (denoted No 4 on Figure 9) and consists of a small sparse scattering of shell and artefacts in a greatly disturbed condition.

Due to the disturbed nature of both of these sites, the low density of artefacts and shells present and the low possibility of the occurrence of any insitu archaeological deposits, these sites are not considered to be of any significance. The site type is also much better represented elsewhere in the area. It is therefore recommended that the RTA apply to the National Parks & Wildlife Service for Consent to Destroy the section of these sites through which the road will pass.

The survey by the RTA (1990k) also identified two locations along the corridor which have potential for Aboriginal sites and require further test excavation. These sites (denoted Nos 5 and 6 on Figure 9) are located on low ridge lines which has been shown by previous records (e.g. Sullivan (1982) and Navin (1989) to be typical of Aboriginal camp sites. It is therefore recommended that limited excavation be undertaken at these sites in order to determine the existence and extent of possible archaeological deposits.

European Historic Sites

The survey by the RTA (1990k) indicated three sites of historical importance would be affected by the proposed route. These are denoted on sites D, E and F on Figure 9 and are discussed below.

o Site D

This site is the collapsed remains of a section of a dry stone wall and now forms a long low mound of basalt rocks, 50m long, 1-3m wide and 30cm to 1m high. The present structure is not a good example of its type due to its present deteriorated condition and therefore does not have high significance. However, the stone may be of use for the restoration of similar walls elsewhere in the Kiama area (e.g. Blowhole Point). It is recommended therefore that the RTA consult with the Illawarra Heritage Committee and Kiama Municipal Council as to whether the stone can be re-used and whether recording of the structure prior to its removal is warranted.

o Site E

This is the location of the original "Riversdale" homestead which was constructed in the early 1840's, but was destroyed by fire in 1884. The Riversdale Estate appears to have played a major role in the economic development of Kiama through its participation in various agricultural development and experiments, and its participation in the establish of the dairy industry.

The remaining feature consists of a well, terraces and a drain which can be classed as historic relics. It is therefore recommended that an historical archaeologist be commissioned to examine these structures to more fully assess their historic significance and to provide appropriate procedures for their recordings, prior to the start of road construction.

o Site F

This is the site of the "Tabbagong" homestead. As construction of the building and surroundings is reported to have occurred in the late 1920's, the site is considered as an historic relic within the means of the Heritage Act. The existing building likely to be destroyed by the road construction, consist of two fibro and timber clad cottages, one red brick two-storey house, five timber and corrugated iron clad sheds (two derelict), a red brick pergola (deteriorated), a small cement cistern and two water tanks.

In addition the road would destroy five or six low terraces faced with loose sandstone blocks (now densely overgrown by lantana and in process of being demolished by cattle), and several specimens of various exotic plant species, including an extensive and vigorous grove of bamboo (refer Figure 9). The research carried out indicated that none of the buildings have high historic or architecture significance.

The landscape around the homestead building however, is the remains of what is reported to be a spectacular example of a formal garden of a type relatively rare in the Kiama region. The gardens are likely to of been established before 1940 and can therefore also be regarded as an historic relic. The garden should therefore be subject to assessment by an historical consultant with landscape expertise to determine whether detailed recording or some form of salvage should be undertaken before construction commences.

6.13 Noise and Blasting

Assessment Criteria

The assessment of road traffic noise at residential facades has been conducted in terms of the RTA's policy which is:

"the L_{A10} (18 hour) noise at 1 metre from the facade of a residential dwelling is 63dB(A) or a lower level where cost effective"

"the sleep disturbance criteria of internal levels of 45dB(A) L_{eq} between the 8 hour period 2200-0600 hours".

It is noted that the sleep disturbance criteria refers to internal levels. This criteria is equivalent to external (facade) noise level of 55dBL_{Aeq}.

Prediction of Future Road Traffic Noise Levels

Prediction of future day and night time traffic noise levels which would be contributed by the proposed Bypass were based on forecast traffic growth, increase in average traffic speed, road gradient, percentage of heavy vehicles, acoustic shielding by road cutting and open ground propagation. Predicted noise levels at 16 reference locations (refer Figure 14) are presented in Table 6.7 (overleaf).

o Day Time Noise Levels (6.00 am to 10.00 pm)

A comparison of Table 6.7 with existing daytime noise levels shown in Table 5.9 indicates that by the Year 2011, daytime noise levels at locations around the Bombo Quarry (1, 2, 3, 11, 12, 13, 14 and 15) contributed by the proposed Bypass would not be greater than existing background levels.

At rural locations generally east of the Swamp Road (4, 5 and 6), noise levels would be higher by about 3 to 4dB(A) however, would still be below the criteria of 63dB(A).

Generally west of Swamp Road (7), noise levels contributed by the proposed Bypass would not be higher than existing levels and certainly not above the criteria of 63dB(A).

TABLE 6.7 : PREDICTED NOISE LEVELS CONTRIBUTED BY PROPOSED BYPASS AT FACADES

Location	Year 1996		Year 2011	
	L_{A10} (Day)	L_{Aeq} (Night) External	L_{A10} (Day)	L_{Aeq} (Night) External
1	45.0	33.5	46.5	35.0
2	57.0	45.5	58.5	47.0
3	50.0	38.5	51.5	40.0
4	54.0	42.5	55.5	44.0
5	54.0	42.5	55.5	44.0
6	51.0	39.5	52.5	41.0
7	44.0	32.5	45.5	34.0
8	61.5	50.0	62.0	51.0
9	59.0	47.5	60.0	48.5
10	56.5	45.0	57.5	46.0
11	47.0	35.5	48.5	37.0
12	51.0	39.5	52.5	41.0
13	- house to be demolished -			
14	50.0	38.5	51.5	40.0
15	- house to be demolished -			
16	57.0	45.5	58.5	47.0

All locations along the existing Princes Highway (8, 9 and 10) noise levels would be reduced significantly by between 8 and 14dB(A), and would fall below the criteria of 63dB(A).

At Dunmore House (16), noise levels would generally remain unchanged and would still be below the criteria of 63dB(A).

o Night Time Noise Levels

A comparison of Table 6.7 with existing night time noise levels shown in Table 5.9 indicates that by the Year 2011, external night time noise levels generally north of Bombo Quarry would be below the criteria of 55dB(A). This is because the road would be shielded by being in a cutting. However, there would be two sections where the road would be exposed. The first is a 250 metre section just east of the SRA quarry (Location 12) and the other a 200 metre section abutting the western edge of Gainsborough (Location 2). It is proposed that earth mounds or a screen wall be constructed along the road at these locations.

At rural locations generally east of Swamp Road, night time noise levels would be higher than existing levels, however, would still be below the 55dB(A) external criteria.

West of Swamp Road night time noise levels contributed by the Bypass would not be significantly higher than existing levels, and would certainly be below the 55dB(A) external criteria.

At Dunmore House (Location 16), night time noise levels would still be high, although below the criteria of 55dB(A). In this regard, consideration would be given during final design to the construction of noise barriers along the roadside if it is practical and cost effective.

With respect to residential properties along the existing section of the Princes Highway that would be bypassed, night time noise levels would be significantly reduced by more than 10dB(A) and would fall below the criteria of 55dB(A) external.

Construction Noise Criteria

The main construction activities would involve major earthworks, preparing a new road surface and pouring concrete to form the road. Likely operating machinery would include dozers, breakers, loaders, scrapers and rollers. Controlled blasting will also be required.

General construction activity would be restricted to the following times based on SPCC Noise Control Guidelines (1989) for construction site noise, with the exception of certain essential night and weekend work:

Monday to Friday	7.00 am to 6.00 pm
Saturday	7.00 am to 1.00 pm
Sunday and Public Holidays	Generally no work.

o Assessment Criteria

The criteria used for the assessment of construction noise levels as recommended by the SPCC (1989) is set out below. This relates to a construction period greater than four weeks and not exceeding 26 weeks.

"The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level of more than 10dB(A)".

The SPCC (1985) also establish limits for both ground vibration and blast over-pressure. These levels are based on comfort rather than damage effects.

Predicted Construction Noise Levels

Based on the existing average background noise levels and SPCC recommendations, the most appropriate criteria adopted by the RTA for this proposal for the assessment of construction noise is a maximum L_{Aeq} of 48dB(A) (RTA, 1990f). Table 6.8 below shows the calculated L_{Aeq} noise levels for various stages of construction.

The table indicates that noise emissions from construction activities would at times exceed the recommended criterion, particularly during the excavation stages. However, there would also be extended periods when the construction activities would be inaudible.

TABLE 6.8 : CALCULATED LAeq NOISE LEVELS - CONSTRUCTION

Location	Stage I (Excavation)	Stage II (Sub-base Prep)	Stage III (Concrete)
1	54	44	39
2	68	58	53
3	61	51	46
4	65	55	50
5	64	54	49
6	59	49	44
7	49	39	34
11	58	48	43
12	58-70	48	43
14	63-78	53	48
15	71-86	61	56
16	68	58	53

To minimise the potential for noise impact, construction would be restricted to day time hours only. Activities which are transient and short term can be amelioriated through careful programming of the roadworks. For the section of elevated roadway south of McBrien Drive, Gainsborough, which would have direct line of sound exposure for residents (near reference Location 12 on Figure 14), it is proposed that mounds be established with material extracted elsewhere before major earthworks commence.

Ground Vibration and Overpressure from Blasting

It is proposed to use blasting techniques for the removal of rock. At this stage, there is insufficient data to accurately predict the effects of blasting in the existing residents. However, it is clear from preliminary investigations RTA (1990f) that blast MIC's will need to be controlled and monitored if the normal 'comfort' criteria is to be satisfied. It is the opinion of the noise consultant (RTA, 1990f) that the affects of a blast pressure can be controlled to satisfy the normal assessment criteria.

As a safeguard it is therefore proposed that a detailed study be undertaken to assess the potential of blasting on the residents and their dwellings, particularly the Gainsborough Estate area. It will also be essential to establish and maintain close liaisons with the residents throughout the blasting programme.

6.14 Utility Installations

The following section describes the main utility installations which would be affected by the proposed corridor, and appropriate safeguards to be taken.

Electricity

Illawarra Electricity have indicated that the main electricity cables and associated infrastructure which would be affected by the proposal, would be various 11 kV lines located at Dunmore, and along the Princes Highway and Swamp Road. Other affected infrastructure would include a 33 kV and 11 kV lines situated in and around the Bombo area.

Sections of the 11 kV line at Dunmore would have to be relocated, and would be done in consultation with officers of Illawarra Electricity. Once a detailed road design has been prepared, some sections of both the 33 kV and 11 kV lines at Bombo would also have to be relocated.

An existing substation at Kiama (corner of Princes Highway and Gipps Street), would not be affected by the proposal, as the widening of this section would be contained within the existing road reserve.

There are long term plans for a new 33 kV line, proposed to be constructed between the existing substations at Jerrara and Kiama. This line would probably cross the proposed Bypass near Spring Creek.

Water

The only major water main traversed by the proposed corridor would be a 500mm main located in the northern section of the corridor, adjacent to Swamp Road and the Princes Highway at Dunmore. Other smaller mains are situated in the Bombo area, adjacent to the Princes Highway and the South Coast Railway Line.

These mains would need to be relocated in consultation with the Water Board. Detailed relocation plans would be prepared during the final design stage of the project, and would be implemented during the construction stage.

Telecommunications

The proposed corridor would affect a major co-axial communication cable at its northern and southern connection to the existing Princes Highway (i.e. at Dunmore and Bombo). It is possible that they would have to be relocated. Although subject to detailed investigation, it may be possible to construct the proposed road above them. This would involve the provision of a concrete slab to cover the cable, and the construction of additional conduits in the event that the existing cables are damaged during construction. At Bombo, it may be possible to construct the proposed Bypass over the cables, as is the situation with the existing Princes Highway.

Caution would need to be taken when working near the co-axial cables due to their sensitivity to vibration and disturbance. It would therefore be important to ensure that static equipment is used during construction, and that no vibration from machinery is allowed within 30 metres of these cables.

Other affected mains include various subscriber mains located throughout the area, however, no specific problems are envisaged.

6.15 Hazard and Risk Potential

The risks to the community associated with transport of hazardous materials along the existing Highway are assumed to be largely a function of the following conditions :

- o poor road alignment (e.g. the Minnamurra Bends) coupled with high travel speeds and high traffic volumes
- o conflict between local and through traffic movements
- o numerous at grade and uncontrolled intersections with the existing Highway
- o quarry truck traffic through residential areas of North Kiama
- o large residential populations in immediate proximity of the road.

The proposed Bypass would significantly reduce these existing hazards by removing up to 80% of the traffic from the existing Highway alignment. In addition, all quarry trucks would be removed from the Highway through North Kiama.

The proposed Bypass would introduce a new potential hazard to the rural areas. However, based on the high standard of road alignment, and the provision of numerous safety features (e.g. guard rails, embankments, lighting, etc), the hazard level would be lower. In addition, the number of residents in proximity to the proposed corridor and at risk to hazardous events is lower than at present on the Highway.

Other hazards such as potential ecological impact of accidental chemical spills, would be contained to a large extent by the proposed pollution control measures discussed in Section 6.2 and 6.4. There are no existing pollution control measures along the Minnamurra Bends.

Accordingly, it is concluded that with the proposed Bypass in place, the probability of hazardous events which pose risks to human safety, would be lower than is the case with the existing road.

7.0 JUSTIFICATION FOR THE PROPOSAL

7.1 Need for a Solution

The need for the proposal is established essentially in terms of existing deficiencies (namely traffic congestion and traffic accidents), projected future traffic conditions and the implication of doing nothing to address these conditions.

The nature and extent of existing and potential traffic conditions and problems which substantiate the need to plan and provide additional road capacity, have been detailed in Section 2.0. The 'Do Nothing' scenario is examined in Section 7.4.

Broad based consultation with the community during the course of both this environmental impact study and the preceding route selection study, confirmed the need for major road improvements in terms of community support. Whilst there are different views as to the preferred alignment of any new or improved roads, there has been a strong and almost unanimous call for improvements to be effected in the short term. Issues such as travel time delays, road safety and local resident accessibility are clearly of concern to much of the local population, regardless of whether or not they are resident along or near the existing Highway.

The very small number of individuals or groups who expressed opposition or reservations about the need for main road improvements, were not residents in the study area. It could be inferred that these parties did not have a full appreciation of local road and traffic conditions.

7.2 Regional Road Strategy

Following the determination not to proceed with the widening of the Princes Highway between the Minnamurra River and Bombo (RTA, 1989), it was evident that there would be considerable benefit in a regional traffic study to address broad traffic movements in general, and particularly the Sunday peak congestion period.

The "Yallah to Falls Creek Strategy Study" was subsequently commissioned by the RTA in May 1990. To date the study has involved a comprehensive origin and destination number plate survey recording a 20% sample of all vehicle movements on a busy Sunday in the area. Analysis of this survey data and of daily and weekly traffic counts at permanent stations in the region has yielded detailed information on travel speed, route chosen and traffic volumes which has been utilised in this statement. The report discusses the future traffic scenario in light of both population increase and growth in tourist development in the region.

Based on the study to date, the RTA (1990b) has indicated that a bypass of the area to the north of Kiama is highly desirable, given the present congestion experienced and the high levels of

through traffic. Furthermore, motorist travel patterns indicate a significant preference for town bypasses along the Coast, evidenced by fewer than 25% of motorists passing through the town centre of Kiama since the opening of the current Kiama Bypass.

The compatibility of the proposed alignment and standard of the proposed North Kiama Bypass with the future main road strategy for the region, is also an important element in evaluation of the project. In this regard, the existing Kiama Bypass was opened in 1987 as a high standard section of the major road transport corridor to serve this area of the South Coast in the long term. On this basis, the northern end of the Kiama Bypass forms the logical southern limit for any proposed major corridor through or around North Kiama.

Between Dunmore and the completed F6 Freeway at Yallah, the long term Highway strategy is less certain. In general terms, there is an emerging need for a high standard four lane road between Yallah and Kiama. This could be achieved by either upgrading of the existing Highway or establishing a new corridor such as an alignment generally bypassing the Albion Park urban area. In the former case, the RTA has an approved concept plan which allows for a four lane carriageway from the recently completed road widening at Oak Flats through to Shellharbour Road along a new alignment which parallels the South Coast Railway. This corridor is the subject of a soon to be gazetted Local Environmental Plan prepared by Shellharbour Municipal Council. Actual construction of this road is not on the RTA's present works programme. With respect to the potential high standard four lane road southward from Yallah to bypass Albion Park, there is no currently approved corridor. Constraints in that area such as urban expansion, steep terrain and flooding, would have to be further investigated before such a corridor could be proved suitable as a possible longer term route.

Whichever alignment is adopted, the Dunmore area generally in the vicinity of Shellharbour Railway Station and Dunmore quarry, represents an obvious southern limit for the corridor between Dunmore and Yallah.

In the past, various route investigations, planning scheme reservations and freeway gazettals have traversed an area much further to the west of North Kiama. This includes the REP No 1 service corridor. These would have involved crossing the middle of the Jamberoo Valley, including very steep terrain and a broad flood plain. Such corridors would only figure in the RTA's very long term road planning for the region.

The proposed Bypass of North Kiama is therefore consistent with the future long term main road strategies to the north and south.

In terms of road design (refer Section 4.0), the proposal would be a high standard, access controlled route similar to the existing Kiama Bypass and as previously noted, with capacity in the corridor for amplification in the longer term if required.

7.3 Assessment of Alternatives

Road Options

The evaluation of a number of feasible main road options and alternatives has been presented in detail in Section 3.0. Central to this was a route selection study which identified that a western bypass would best fulfil the short term and the longer term road transport requirements because of the higher capacity that could be provided with a better horizontal and vertical alignment. This would be consistent with the standards required of any possible future extension of the F6 Freeway from Yallah.

In addition to meeting such traffic objectives, a western bypass was also determined to be the most effective and suitable in satisfying a broad range of environmental and planning criteria (refer Section 3.4). This is reflected below in a summary of the advantages the proposal would have over other western bypass options.

- Has the least impact on existing rural properties in terms of number of properties, area of land, loss of improvements and resultant property management implications.
- Crosses the Terragong Swamp at the narrowest point requiring the shortest bridge structure.
- Has the least impact on prime crop and pasture land.
- Involves the least intrusion into the Jamberoo Valley Rural Conservation Area.
- Is the only corridor which effectively removes truck traffic associated with quarry activities from the Princes Highway through North Kiama.
- Is the least costly of any bypass route.
- Takes maximum advantage of the major government expenditure made in the existing Kiama Bypass, including full use of the complex bridge structure over Spring Creek.
- Is the only western corridor which maintains a direct link into the Kiama Town Centre for passing traffic.

Comparison of the proposal with the alternative to upgrade the Highway has been discussed in numerous sections of this EIS in the context of traffic conditions, social and environmental consequences and engineering practicality. Its major advantages over the Highway option can be summarised as follows:

- Satisfies long term traffic objectives to achieve certain levels of service which are appropriate for new main road projects.

- It would be more suitable in terms of providing additional future lanes, whereas an upgraded Highway would be much less satisfactory because of longer term capacity limitations due to environmental and social constraints.

- Permanently eliminates the conflict between local and through traffic through Minnamurra, Kiama Downs and Gainsborough.

- Improves local accessibility and enhances North Kiama as a unified residential area and living environment for a growing population.

- Substantially improves recreational amenity and opportunities along the Minnamurra River.

- Improves safety conditions, particularly for pedestrians and cyclists between Kiama and North Kiama, as well as reducing the potential for traffic accidents.

- Confines direct impact on the Minnamurra wetland system to a degraded section at the upstream fringe with negligible flood effects, whereas the Highway option could result in pronounced changes to the main channel, and consequently, to the hydraulic regime of the whole wetland.

- Reduces existing excessive traffic noise levels through residential areas without creating similar noise problems in other areas.

- Significantly improves access (vehicular, pedestrian, cycle) between Kiama town centre and the northern Kiama suburbs for shopping, community and business activities.

- Increased traffic capacity can be added to the proposal by virtue of provisions in the corridor width and road design for extra lane/s, whereas the provision of six lanes along the Highway alignment to achieve a comparable level of service, is considered socially and environmentally unacceptable for reasons including:

  - extensive loss of wetlands along the eastern side of the Minnamurra River flood plain and probable alteration of the estuarine hydraulics

  - probable demolition of up to 25 properties fronting the Princes Highway to obtain full access control

  - construction costs at least comparable to a western bypass option (i.e. about $85 million)

  - adverse community impacts associated with the physical dominance of a six lane expressway through a residential area.

The proposal however, would still have numerous disadvantages and adverse impacts. These have been identified and discussed in detail through Section 6.0, together with necessary safeguards and controls. The above issues though, serve to highlight the clear benefits and advantages of the proposed Bypass relative to the alternatives.

Other Modes of Transport

Road traffic dominates the transport system within the study area and inter-regional travel along the coast to Victoria. In terms of regular weekday travel in the area, there is an increasing volume of commuter traffic in peak periods between Nowra/Kiama and Wollongong/Sydney. Certainly, there is some scope to encourage more rail and bus patronage through improvements like more car parking and bus interchanges at Kiama and Minnamurra Stations (refer Section 2.1 for details of existing services).

There is however, little to suggest that significant shifts away from private car commuting would result after such improvements. Indeed, mode of transport choice for most sub-regional centres with a superior level of public transport services to the South Coast (e.g. Gosford, Hornsby, Dee Why, Gordon), is in favour of the private car by as much as 80 per cent of movements (State Transport Study Group, 1985).

On the assumption that trips between Kiama and Wollongong account for a large proportion of weekday peak period flows, and that these are typically 30 minutes or less in duration, the flexibility of the car is expected to remain attractive and cost effective in the future. Consequently, expenditure on public transport in lieu of the proposal would not likely prompt substantial change in weekday traffic volumes.

The major traffic problems encountered in the study area are associated with the weekend recreational traffic between the South Coast and Wollongong/Sydney. This form of travel has traditionally, and will most likely continue, to demand the flexibility offered by the private car, with little dependence on public transport. In this regard, it is unlikely that promotion of public transport travel through the area, or expenditure on facilities, would result in any substantial shift in mode of transport away from the private car.

Importantly, it is also noted that the South Coast Railway presently terminates at Bombaderry, with all transport further to the south, except for limited air services, reliant on the road system. According to the State Rail Authority, the potential for and feasibility of southward rail extension in the medium term is very low.

The Very Fast Train project has examined a coastal route, however it trends inland near the NSW/Victorian border, and would not offer any scope for a full South Coast rail link.

As a consequence of attitudes towards mode of transport for South Coast travel, and the limited rail infrastructure in place, there is unlikely to be any diminution of the transport burden to be borne by the road system. As such, expenditure on improvements in other modes of transport would not provide a satisfactory alternative to the proposal.

7.4 Consequences of No Action or "Do Nothing"

The entire 7.6km section of the Princes Highway between Shellharbour Road and the Kiama Bypass has major deficiencies that require attention.

Of particular concern is the poor horizontal alignment around the Minnamurra Bends combined with relatively high traffic volumes during both the commuter peak and weekend recreational peaks. In addition, the narrowing of the road from four lanes to two lanes at Kiama Cemetery places major capacity constraints, creating significant delays typically up to 50 minutes in recreational peaks for north bound traffic to get from Kiama to Dunmore. The normal travel time without congestion would be about six minutes.

The high traffic volume also places significant restrictions on the movement of local traffic, particularly from North Kiama to Kiama. This is because the constant stream of through traffic and indeed, solid queuing, leaves little or no gaps for local traffic to join the mainstream of traffic. In addition, delays along the Highway are also unacceptable. Local residents will often not drive their vehicles between certain hours (particularly on Sunday afternoons) because of the traffic congestion.

Increasingly through traffic is infiltrating into local streets such as North Kiama Drive, Gibraltar Avenue, Oxley Avenue and Federal Street, as well as through Jamberoo and along Swamp Road as drivers search for alternatives to the main Highway through North Kiama. Because of frustrations with the Highway, such through traffic on local/rural roads tends to be at a high speed which can present a significant safety problem for both pedestrians and local traffic.

The expansion of residential development along the south coast and the growth of Wollongong as a major regional centre, will continue to attract more traffic on the Princes Highway in the future. Average daily traffic volumes are expected to grow from 20,000 per day to over 30,000 per day by the year 2011. Weekday peak hour volumes are expected to increase from 900 vehicles to over 1,500 vehicles.

On average weekends, the traffic would be even worse. Daily traffic volumes are expected to increase from about 23,000 to about 38,000 by 2011. Peak hour weekend volumes are predicted to increase from about 1,600 vehicles to over 2,600 vehicles by 2011. It is expected that a greater proportion of traffic would find the additional delays unacceptable and would likely use

alternative routes such as Swamp Road or Jamberoo Road. These roads are not designed to accommodate any more than local traffic, having narrow carriageways and extremely poor horizontal and vertical alignment. Traffic accidents and interruptions to normal rural activities would become a normal occurence on almost every Sunday afternoon.

Discussions with quarry operators indicate that operations at the Bombo quarries are planned to continue for at least another 25 years. The existing Princes Highway through North Kiama provides the only route for this traffic, and large quarry trucks would therefore continue to proceed through the middle of the residential area of North Kiama.

7.5 Economic Evaluation

An economic evaluation was undertaken involving a benefit cost analysis with respect to a Base Case ('Do Nothing') and an Improved Case (the Proposal). In addition, two alternatives were compared with the proposal, one which involved the upgrading of the existing Princes Highway to four lanes, and the other, an alternative western corridor denoted S2–N2 in the Route Selection Study.

The benefit/cost analysis was undertaken using the RTA's 'SIMCBA' computer model which has been developed as a procedure specifically for economic evaluation of road projects.

Benefit/Cost analysis refers to the process whereby the benefits (including vehicle operating cost savings, user travel time savings and accident cost savings), are compared with the costs (i.e. construction, maintenance) to determine the nett benefit or returns flowing through the life of the investment (generally 30 years). The benefits and costs used in the analysis are strictly economic, and do not account for social and environmental issues which are addressed in other sections of the EIS.

Manual adjustment of the SIMCBA model was undertaken to account for accident rates.

The base case travel speed estimated by SIMCBA (the most sensitive of all parameters) corresponding to the earliest possible opening time of the project, was generally in accordance with travel time surveys undertaken in October/November 1990, allowing for some reduction with future increases in traffic volumes.

The key economic indicators derived from the discounted cash flow analysis at a 7% real discount rate, assuming a 30 year project life and accommodating the changes discussed above are shown in Table 7.1 below.

The analysis indicates that the proposal is economic with road user benefits outweighing costs.

TABLE 7.1 : SUMMARY OF KEY ECONOMIC INDICATORS

Indicator	Benefit/Cost Ratio		
	Proposal	Upgraded Highway (4 lane)	Western Alternative (S2-N2)
Benefit/Cost Ratio	2.2	2.2	2.0
Nett Present Value ($M)	85.3	57.2	78.5
1st Year Rate of Return (%)	16.6	16.7	16.0

Sensitivity testing was also undertaken by varying key parameters of the model including the base case travel speed, project costs, discount rates and traffic growth rates. This sensitivity testing indicated that the proposal would still be economic with a benefit cost ratio of between 1.6 (worst case combination of key parameters) and 3.4 (best case combination of key parameters).

7.6 Energy Statement

The construction of the proposed Bypass would require extensive use of heavy vehicles and machinery including graders, bulldozers, scapers, front end loaders, compactors, vibrating rollers, dump trucks, water trucks, compressors, backhoes, paving machines and cranes.

The machinery would use large quantities of fuel. Usage has been based on RTA advice and experience with other road projects is estimated to be about 5.5 to 6.0 million litres which would represent approximately $4 million.

The fuel used would be offset by fuel savings to the motorist once the project is complete. These savings result from more efficient vehicle operations, particularly from more consistent traffic speeds, improved grades and better pavement conditions and reduced traffic congestion. Additional fuel savings will accrue to local motorists in North Kiama as traffic queues and congestion would be practically eliminated. The fuel savings are incorporated in the economic evaluation presented above.

Energy consumed during road maintenance following construction would be minimal in comparison to regular maintenance of the existing Princes Highway through North Kiama. In addition, native landscaping on the road verges would reduce, if not eliminate, the need for regular maintenance such as regular grass cutting.

There are no known energy resources in the study area that would be sterilised by the proposal.

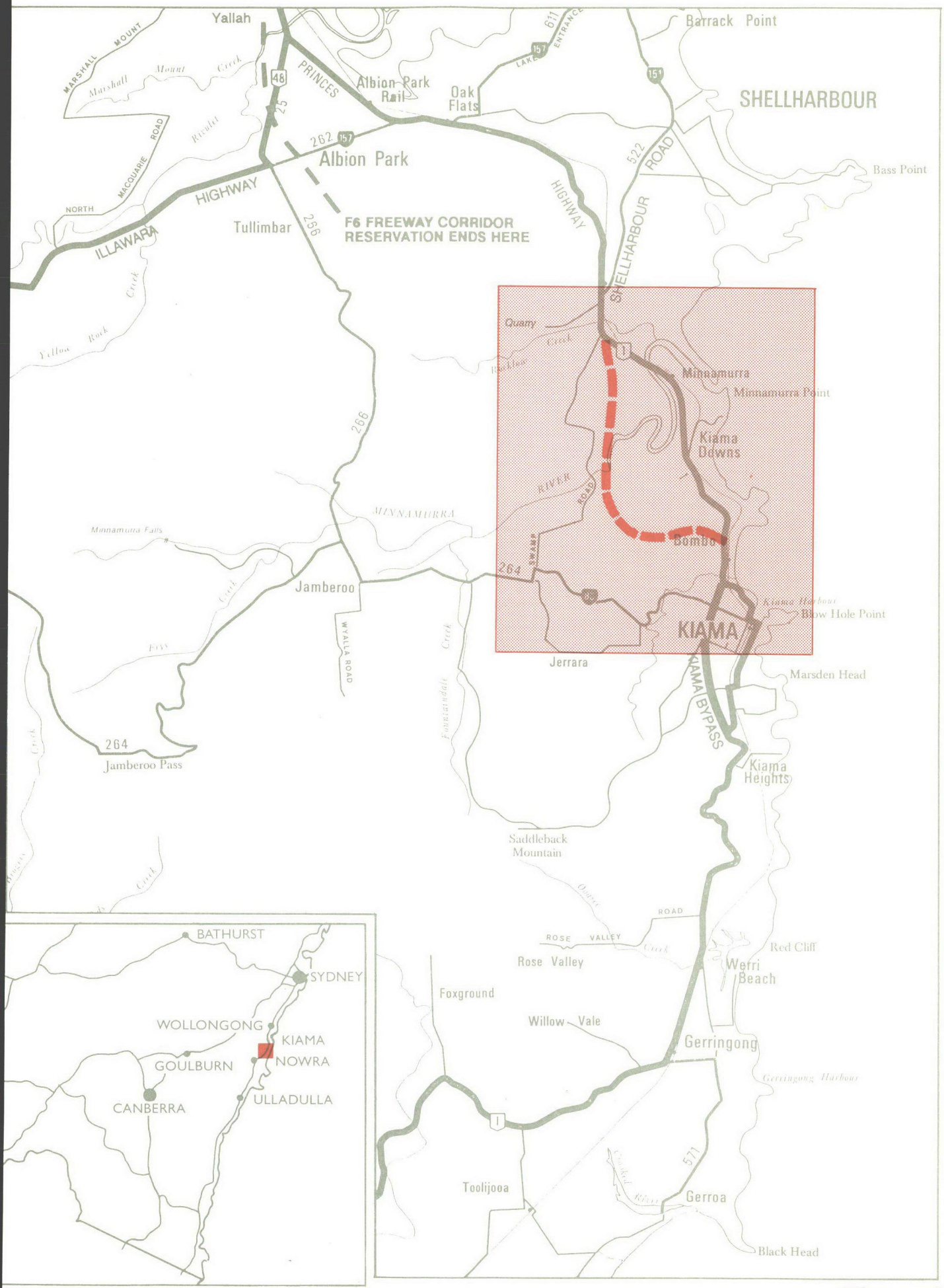

Figure 1

Locality Map and Study Area

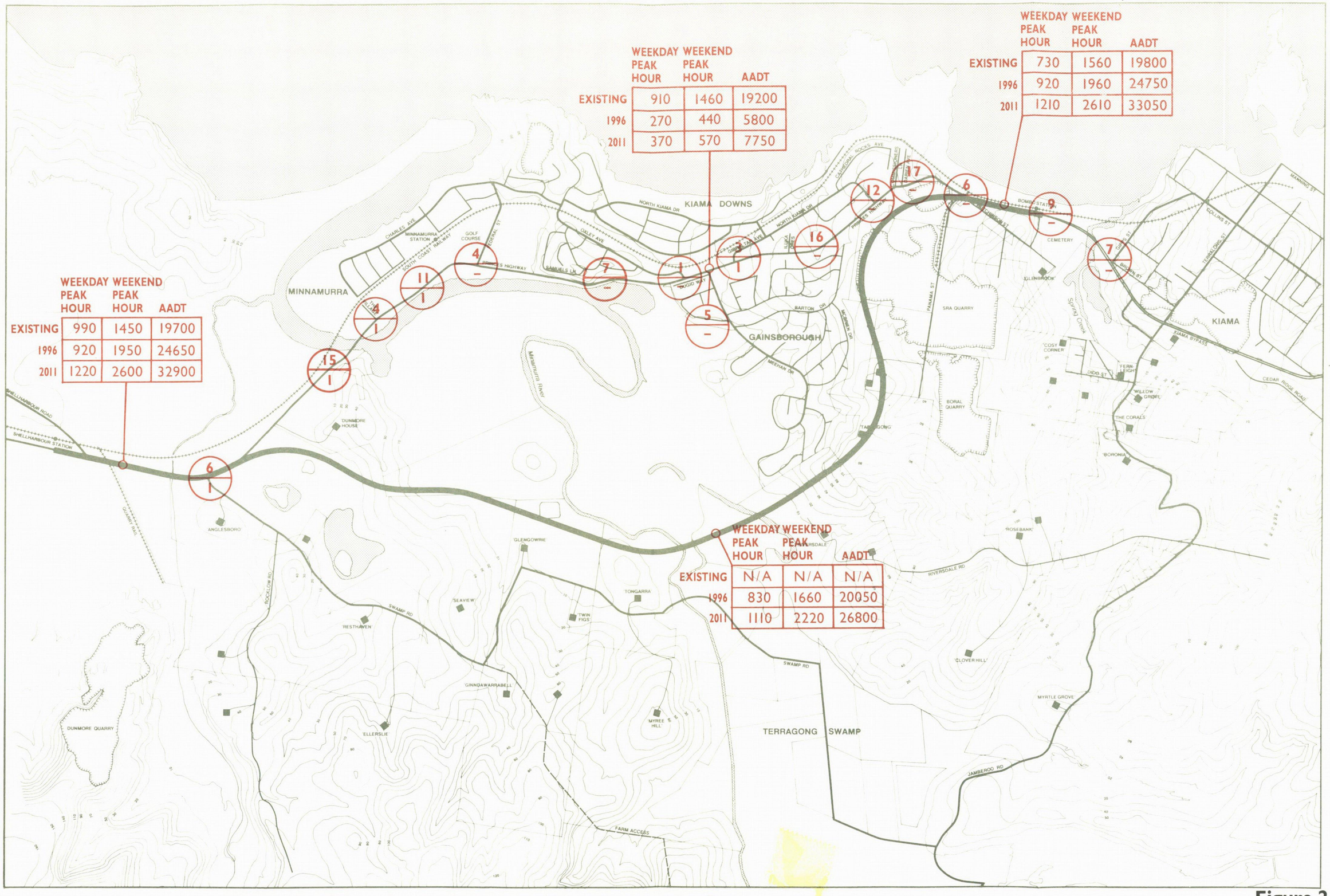

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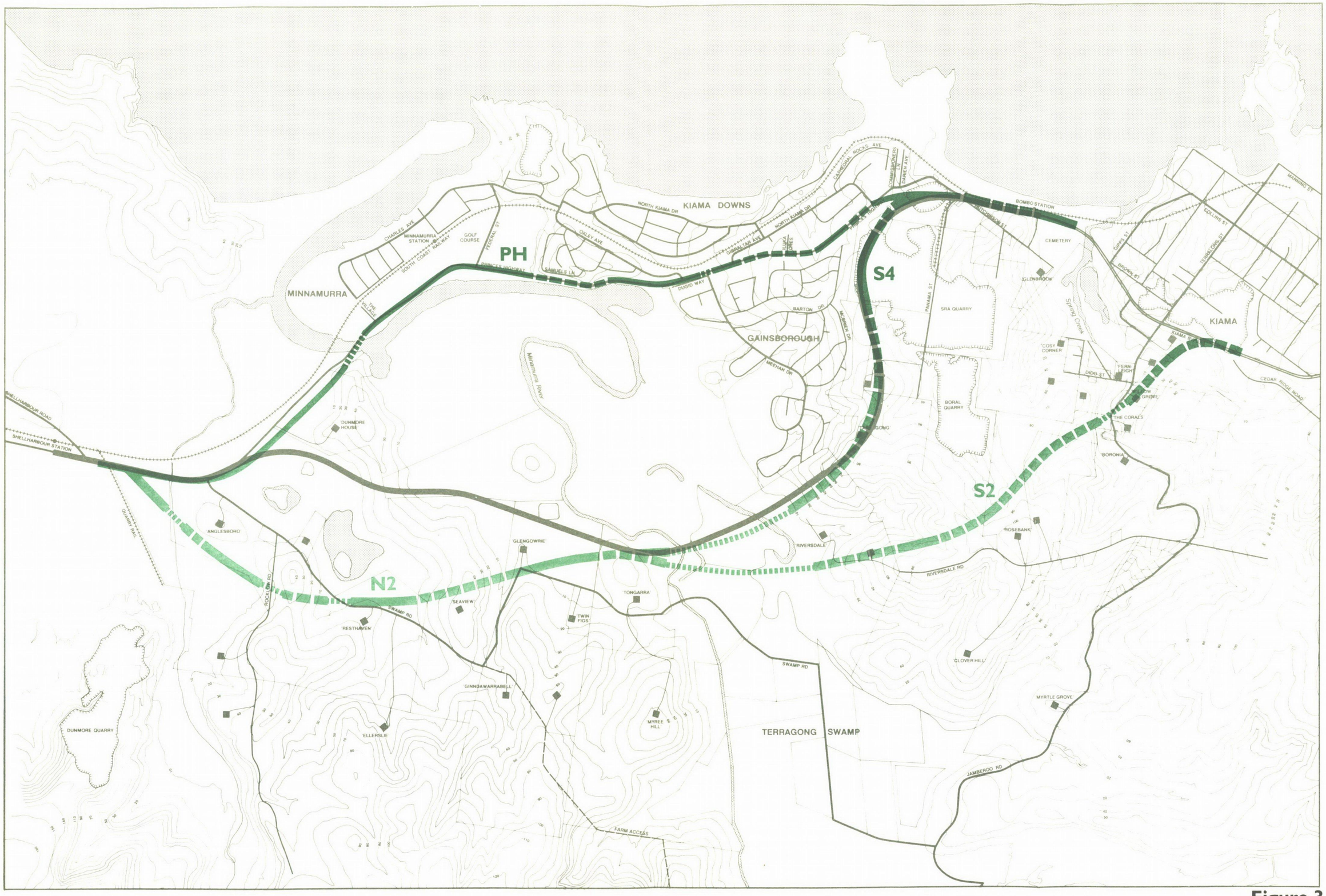
Figure 2
Existing and Predicted Peak Hour Traffic Flows, AADT's and Recorded Traffic Accidents



PH Upgrade / Widen Princes Highway

N2–S2 Alternate bypass option

N2–S4 Alternate bypass option

Road in fill

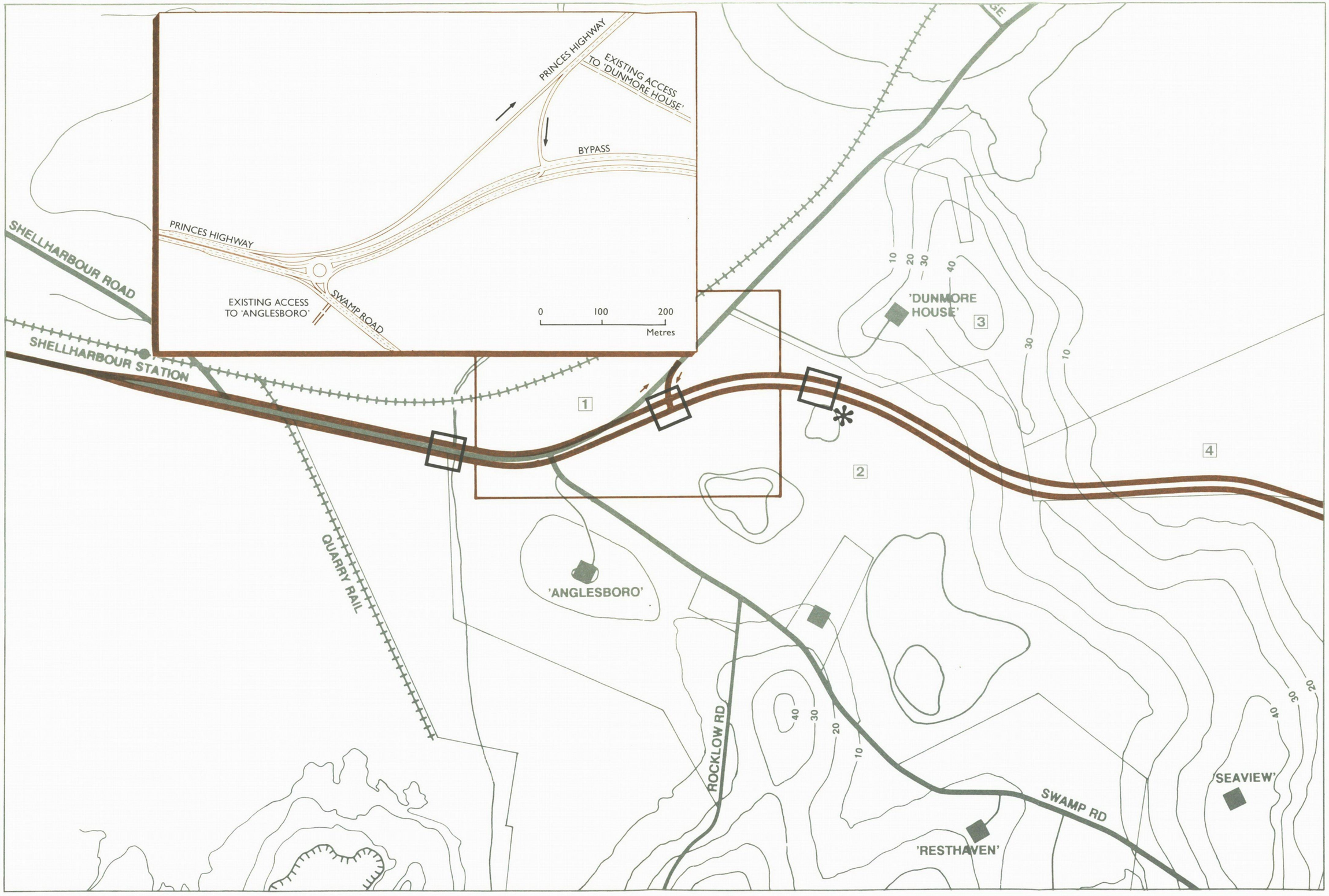
Road in cut

Bridge

Figure 3
Corridor Alternatives

N

0 0.5 1.0 Km



* Site where major sedimentation/retention structure is required

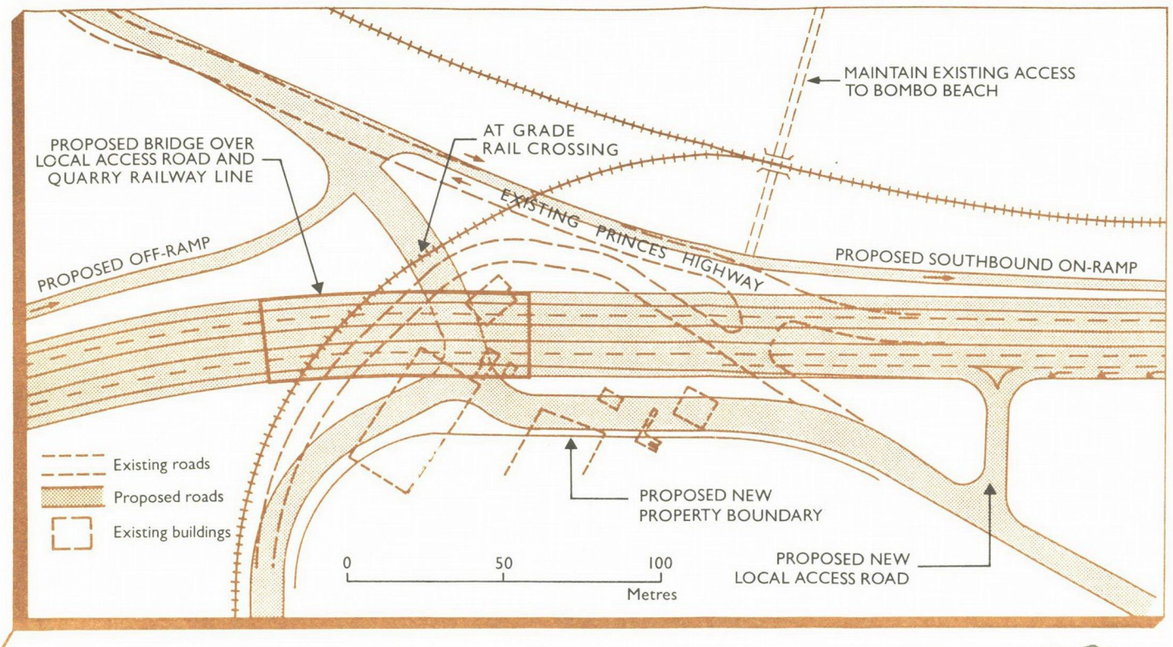
□ Major drainage culvert

[1] Property number

Figure 4a
Plan of Proposed Bypass

N 0 200 400 Metres

Figure 4b
Plan of Proposed Bypass



✱ Site where major sedimentation / retention structure is required

10 Property number

Figure 4c
Plan of Proposed Bypass

1:8000

N

0 200 400 Metres

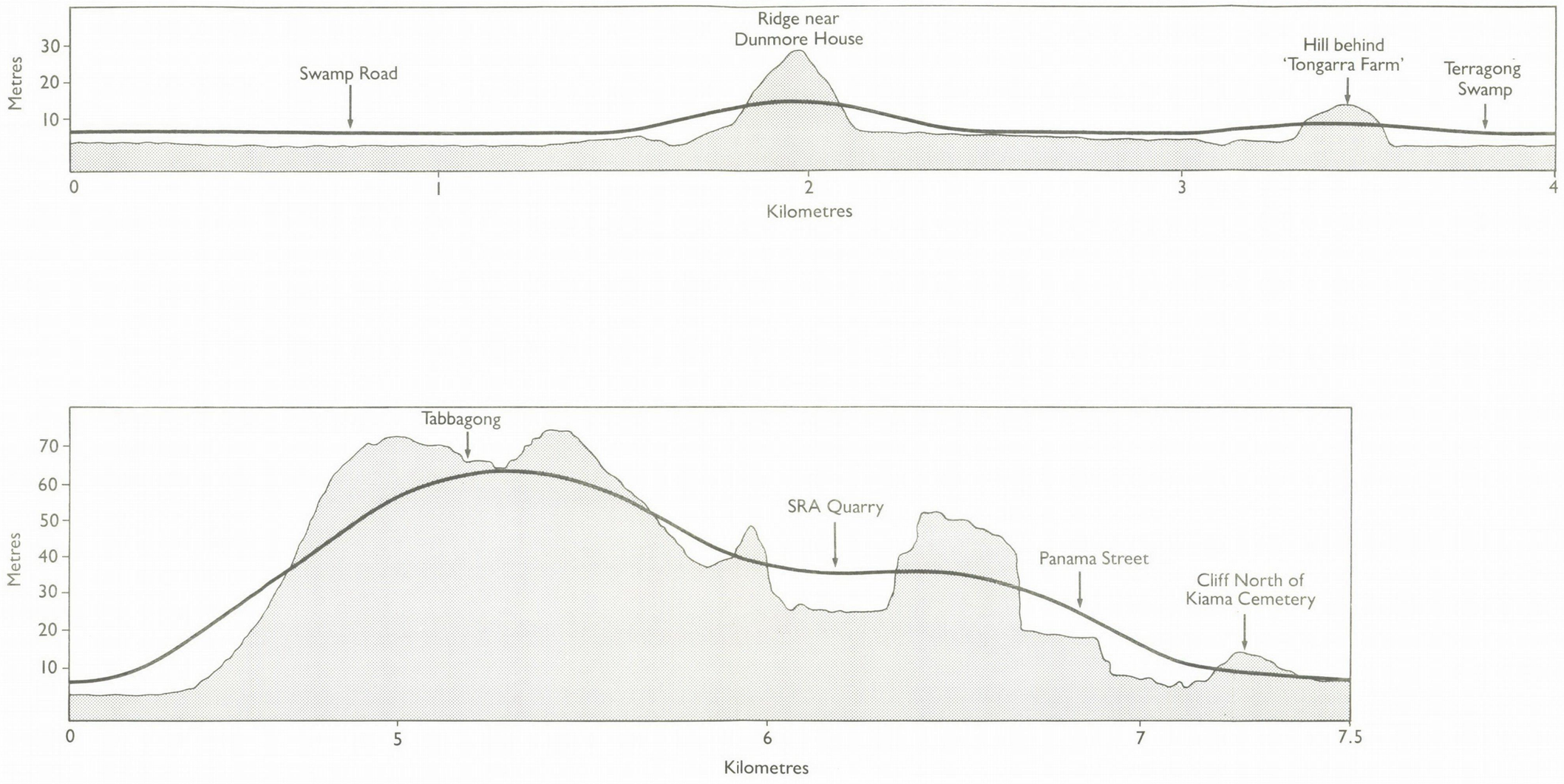
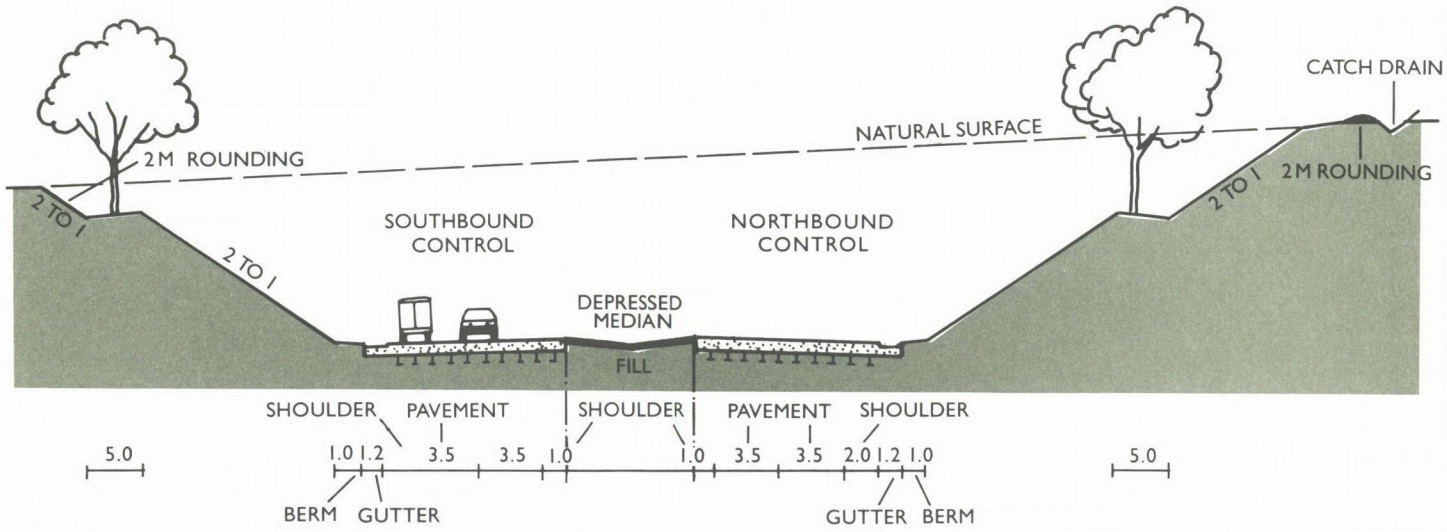
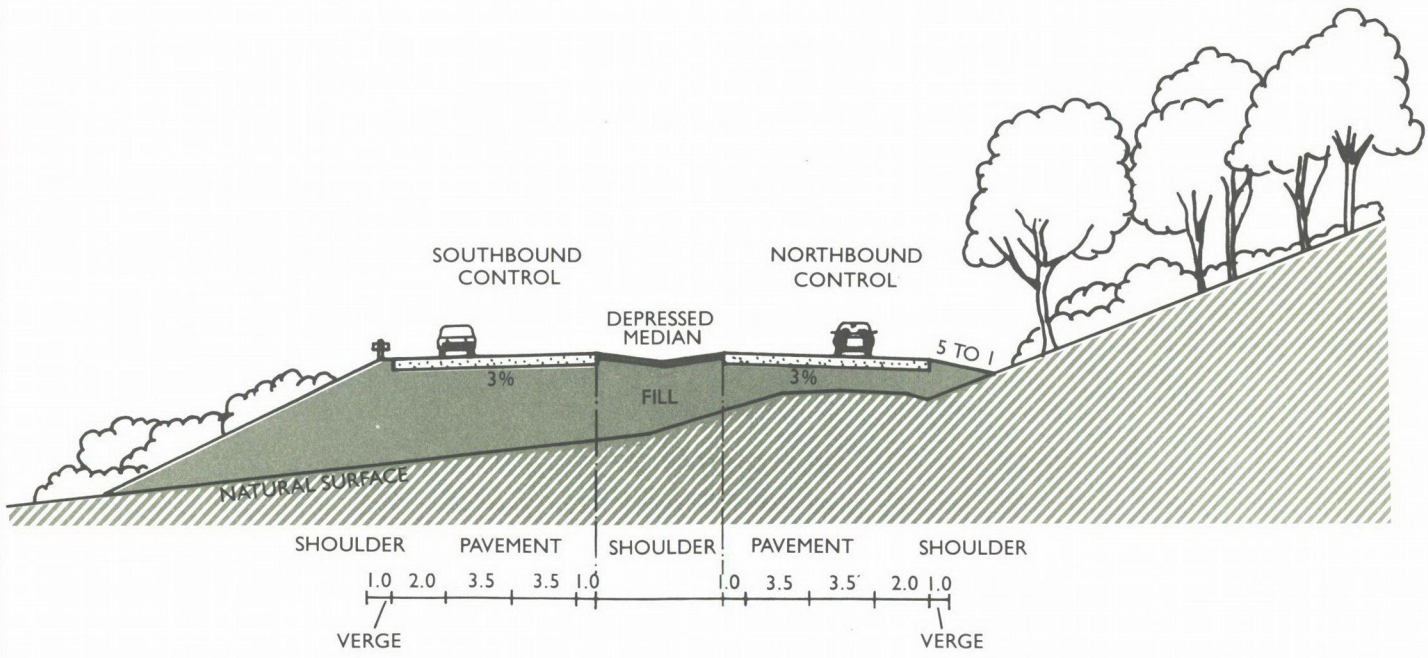


Figure 5

Long Section of Proposed Bypass



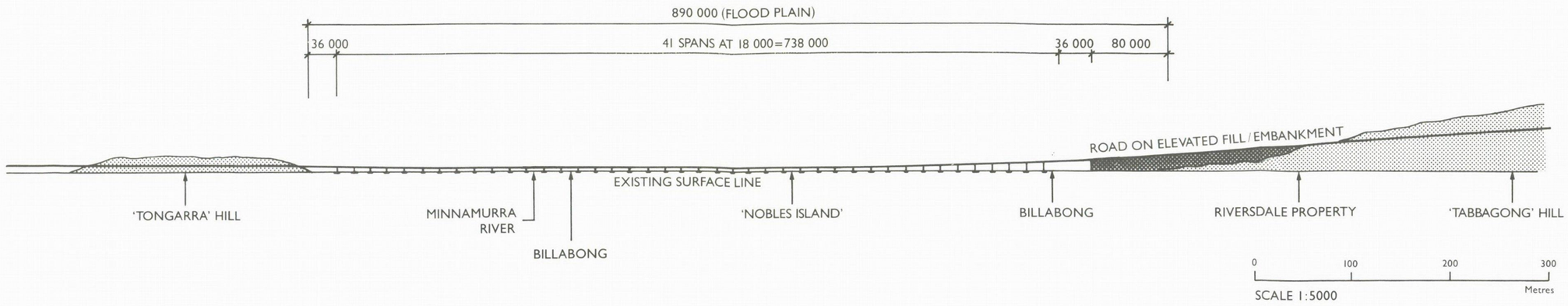
TYPICAL CROSS-SECTION IN CUT



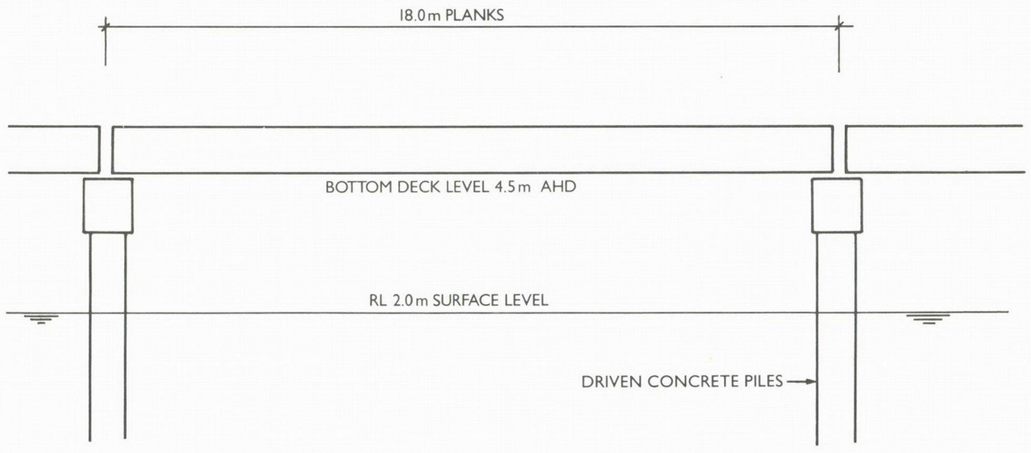
TYPICAL CROSS-SECTION IN FILL

Drawings not to scale

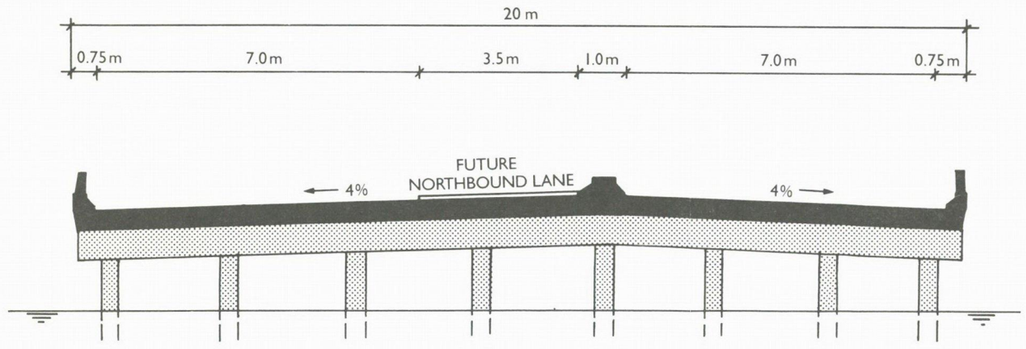
Figure 6
Typical Road Cross Sections



ELEVATION



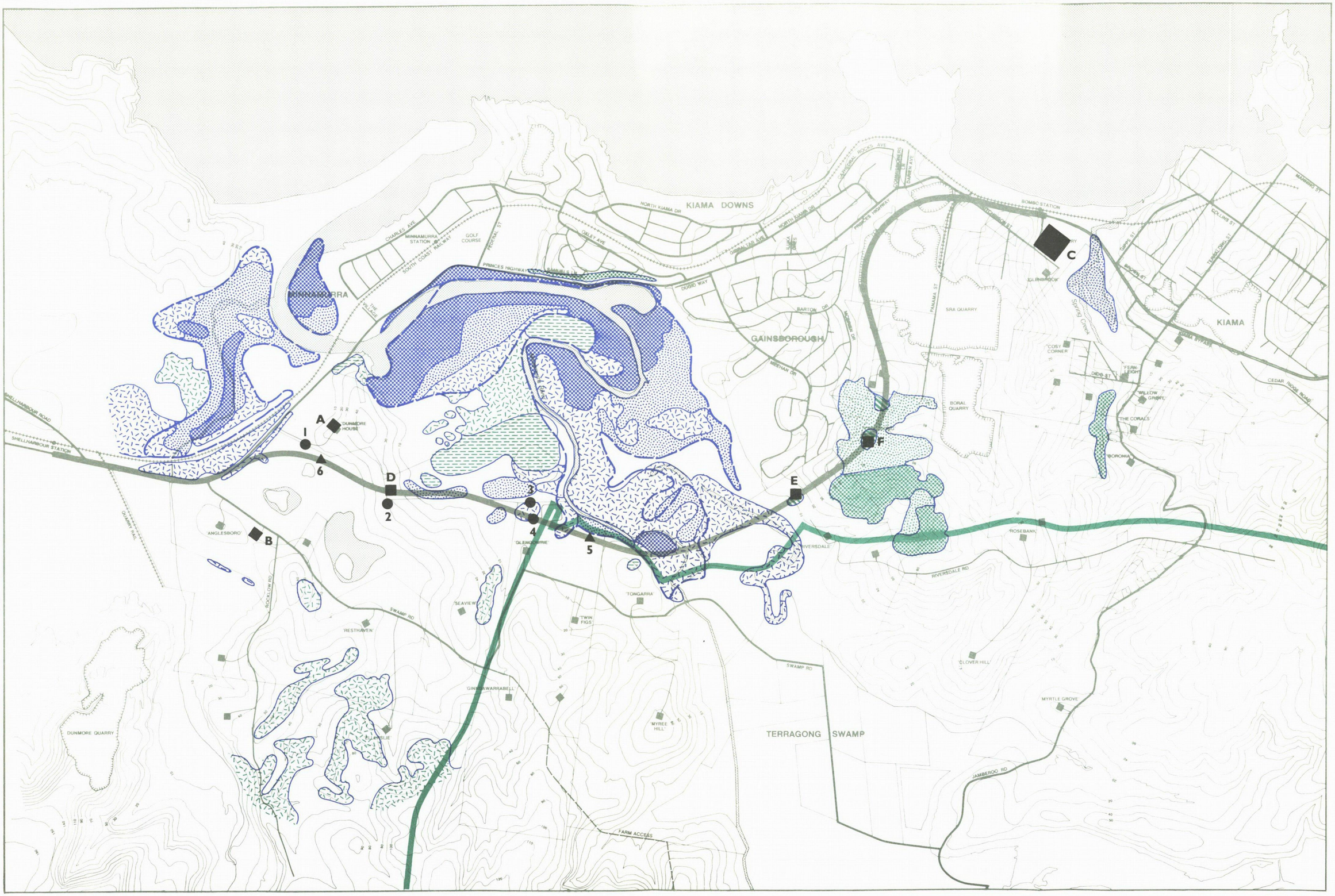
SECTION VIEW



CROSS SECTION

Figure 7
Proposed Terragong Swamp Bridge Crossing

Figure 8
Terrain and Hydrology



Remnant Subtropical Rainforest (Relatively undisturbed)

Remnant Subtropical Rainforest (Partly cleared)

Open Eucalypt Forest (Uncleared)

Eucalypt Woodland (Partly cleared)

Mangroves (Avicennia and Aegiceras)

Sarcocornia and Rushlands

Casuarina

SEPP 14 Wetland

Exotics (ie Bamboo, Chestnut, Coral Tree)

Jamberoo Valley (REP No. 2)

Items of Aboriginal heritage

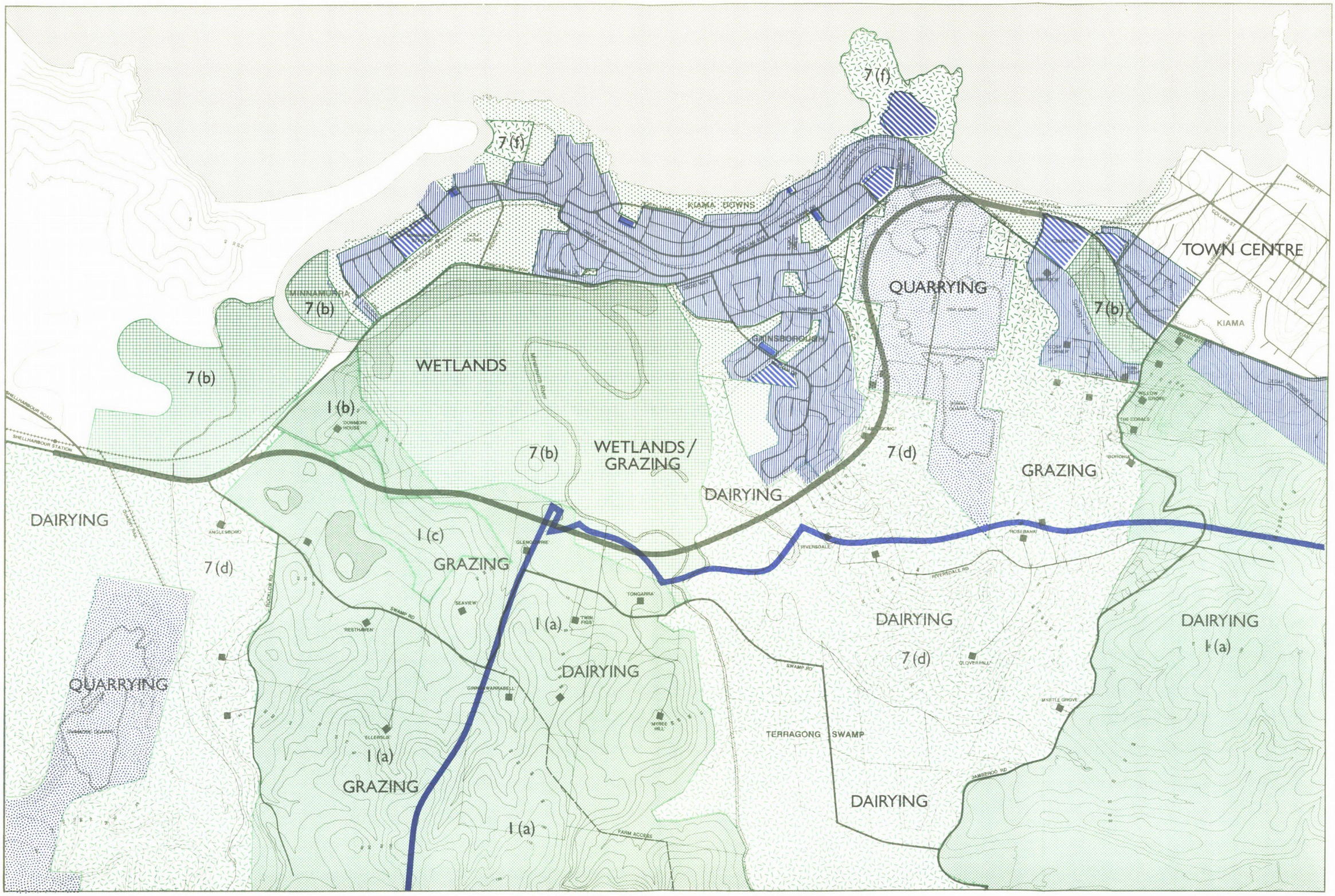
Potential Aboriginal Site

Items of European heritage

N

0 0.5 1.0 Km

Figure 9
Natural and Cultural Resources



- 2 (a-e) Residential
- 3 (a) Business
- 4 (b/c) Industrial
- 5 (a) Special Uses
- 6 (a/b) Open Space
- 7 (b) Environmental protection (Estuarine Wetlands)
- 7 (d) Environmental protection (Scenic)
- 7 (f) Environmental protection (Foreshore)
- 1(a) Rural
- 1(b) Rural
- 1(c) Rural
- Jamberoo Valley (REP No. 2)

Figure 10
Existing Land Use and Zoning

N

0 0.5 1.0 Km

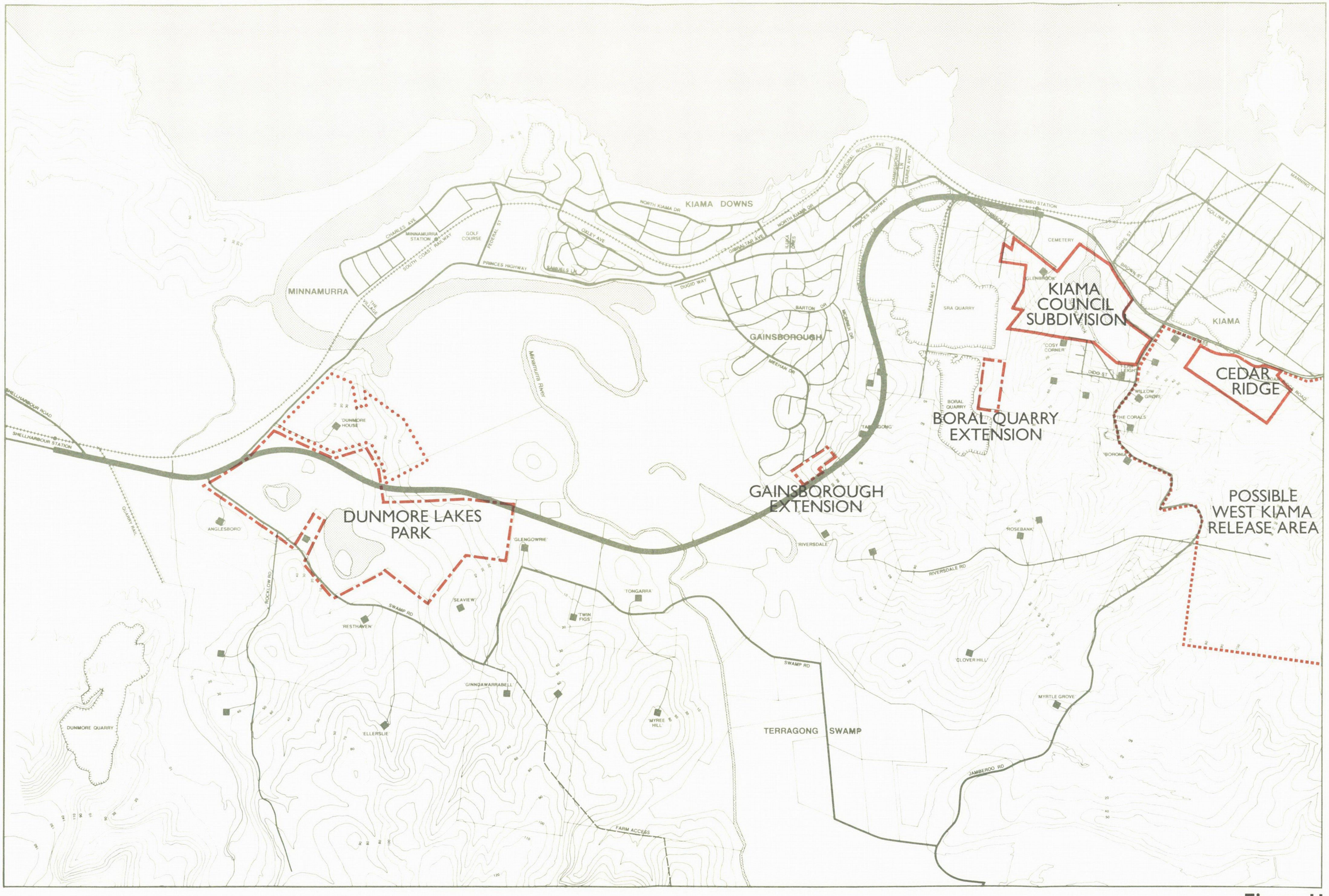
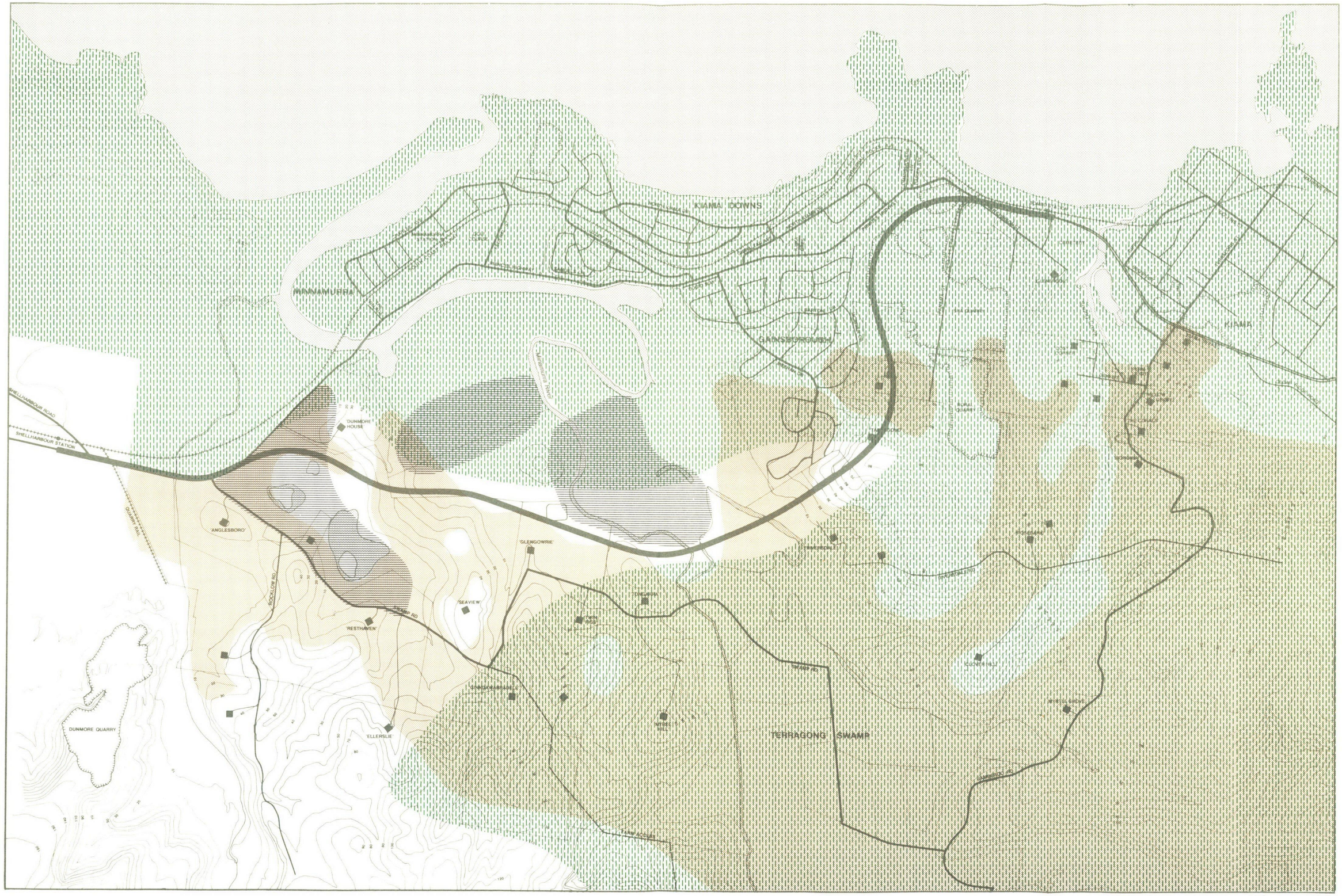


Figure 11
Future Land Use

- Land zoned and approved for development
- Development application lodged but not yet approved
- Development potential identified by planning studies
- Rezoning application

N

0 0.5 1.0 Km



Land with landscape and/or environmental attributes

Land with prime crop and pasture potential

Land containing extractive resources

Figure 12
Illawarra REP
No 1 (Policy Map)

N

0 0.5 1.0
Km

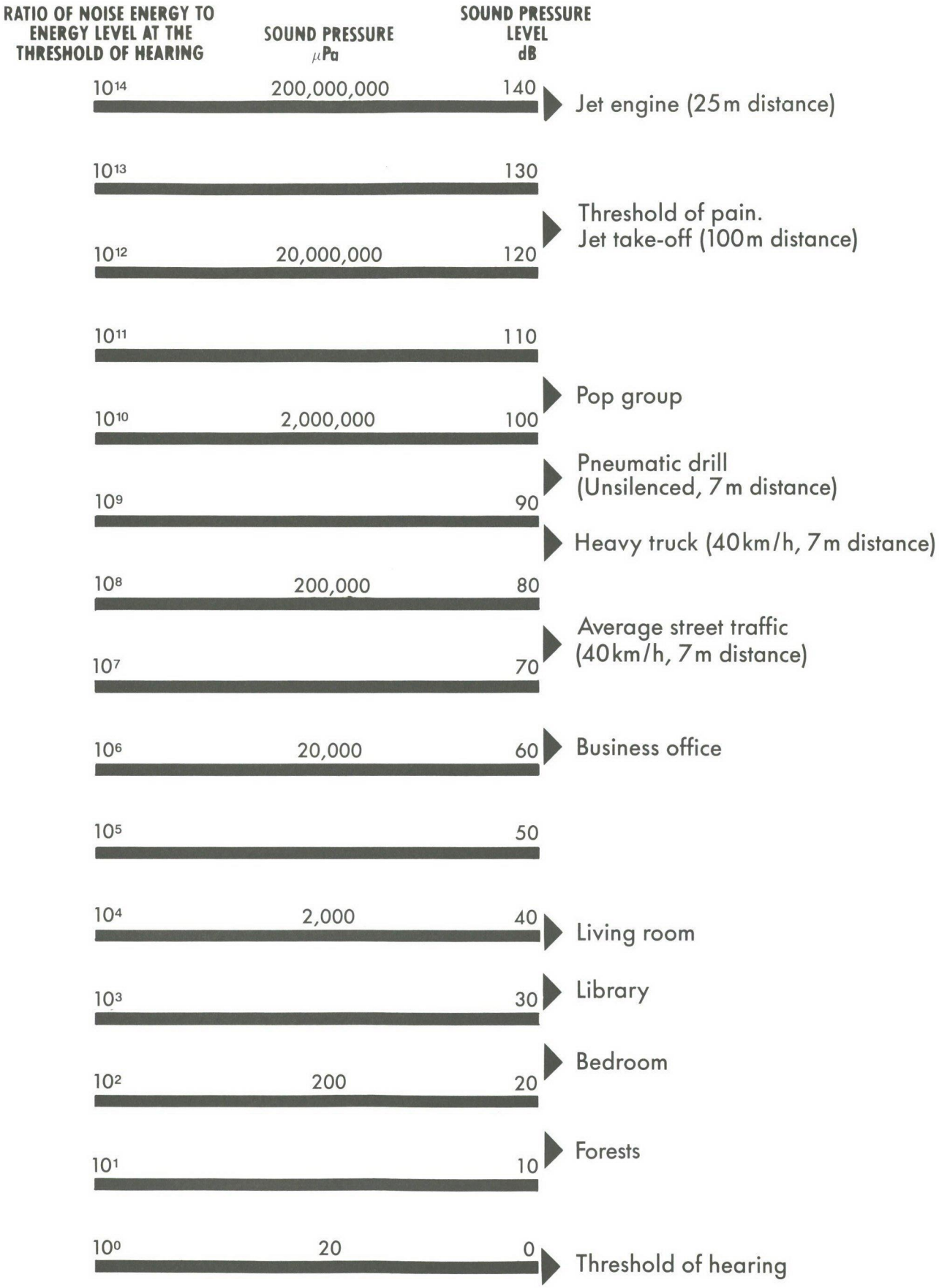
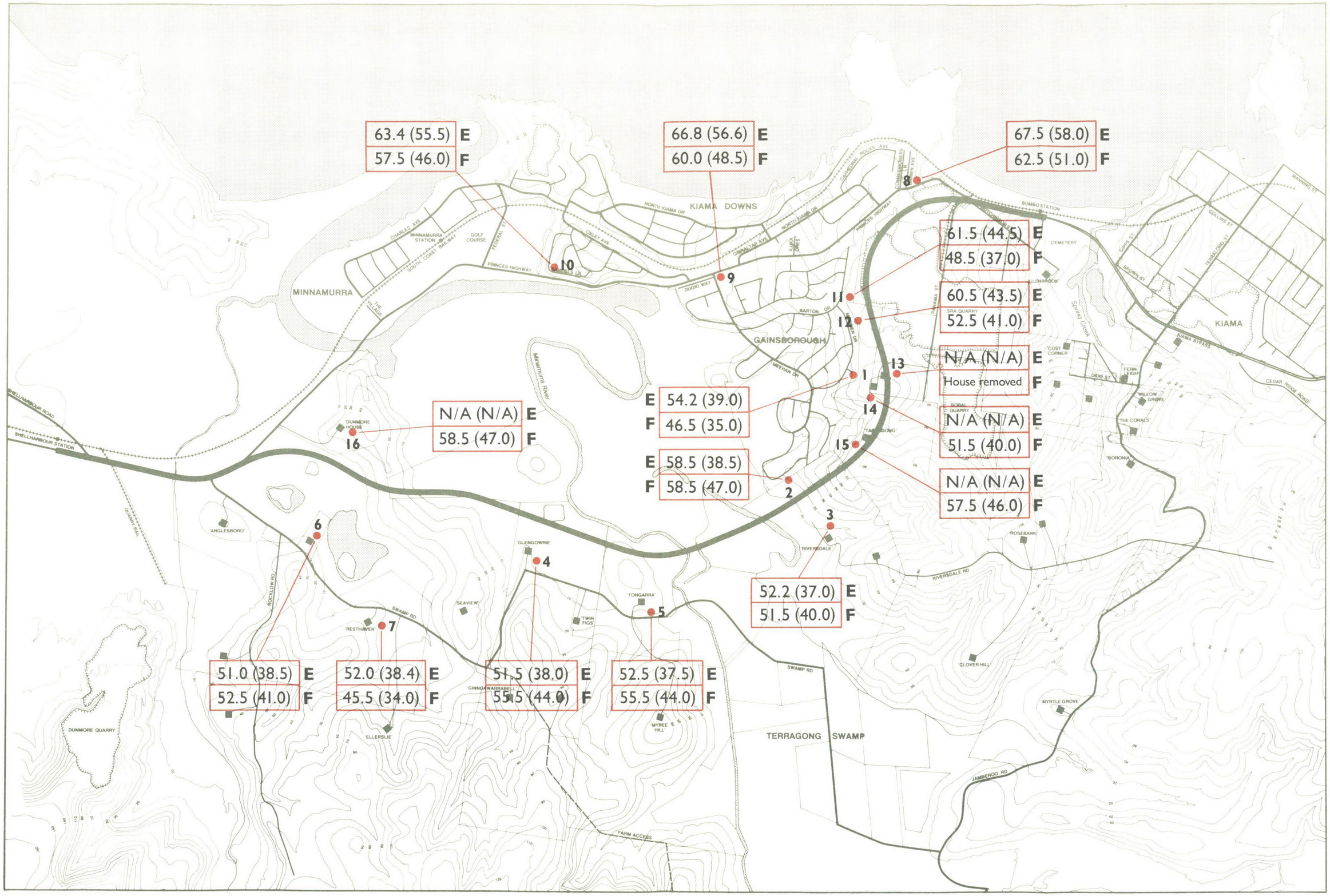


Figure 13
Common Sounds



Note: Predicted refers to contribution by the road (ie existing background noise levels may be higher than noise contributed by the road)

3 Noise Monitoring Location

60.8 L_{A10} Daytime (6am to 10pm)

(35.5) L_{Aeq} Nightime (10pm to 6am)

E Existing

F Future Predicted (2011)

Figure 14
Existing and Predicted Noise Levels

N

0 0.5 1.0 Km

Alternative to avoid SEPP 14

SEPP 14 Wetland Boundary

Vegetation Units Within SEPP 14 Near Corridor

- Scattered Grey Mangroves
- Scattered Casuarinas / Reed Understorey
- Rushlands / Reeds
- Proposed establishment of new Wetlands / Buffer zone

N

1:8000

0 200 400

Metres

Figure 15
SEPP 14 Wetland

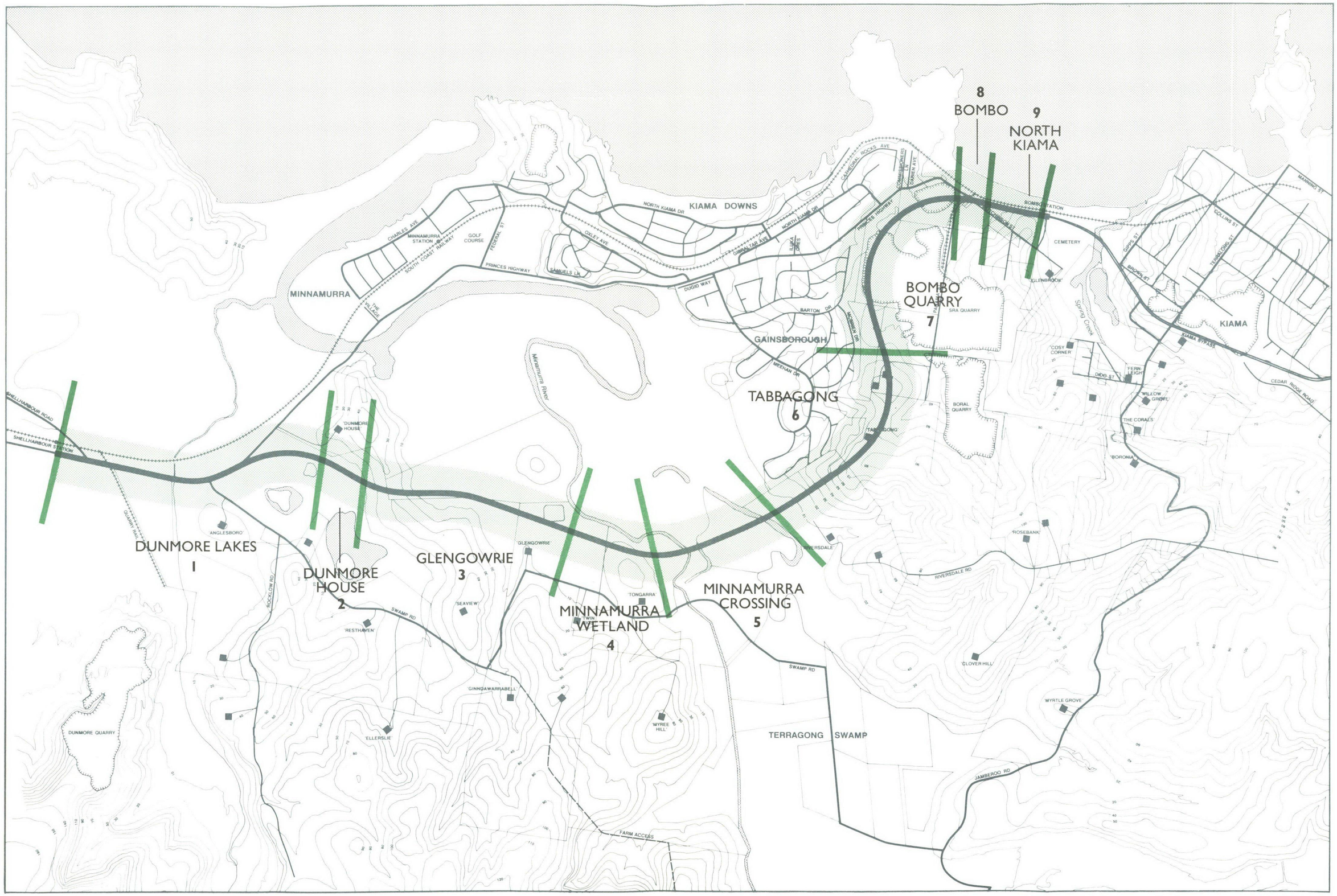


Figure 16
Visual Effects Units

N 0 0.5 1.0 Km

Figure 17
Before and After View
– North to 'Dunmore House'

Figure 18
Before and After View
– South to Terragong Swamp
from 'Tongarra'

Figure 19
Before and After View
– North to Terragong Swamp from 'Riversdale'

Figure 20
Before and After View
– South East to Bombo Quarry,
Near South Gainsborough

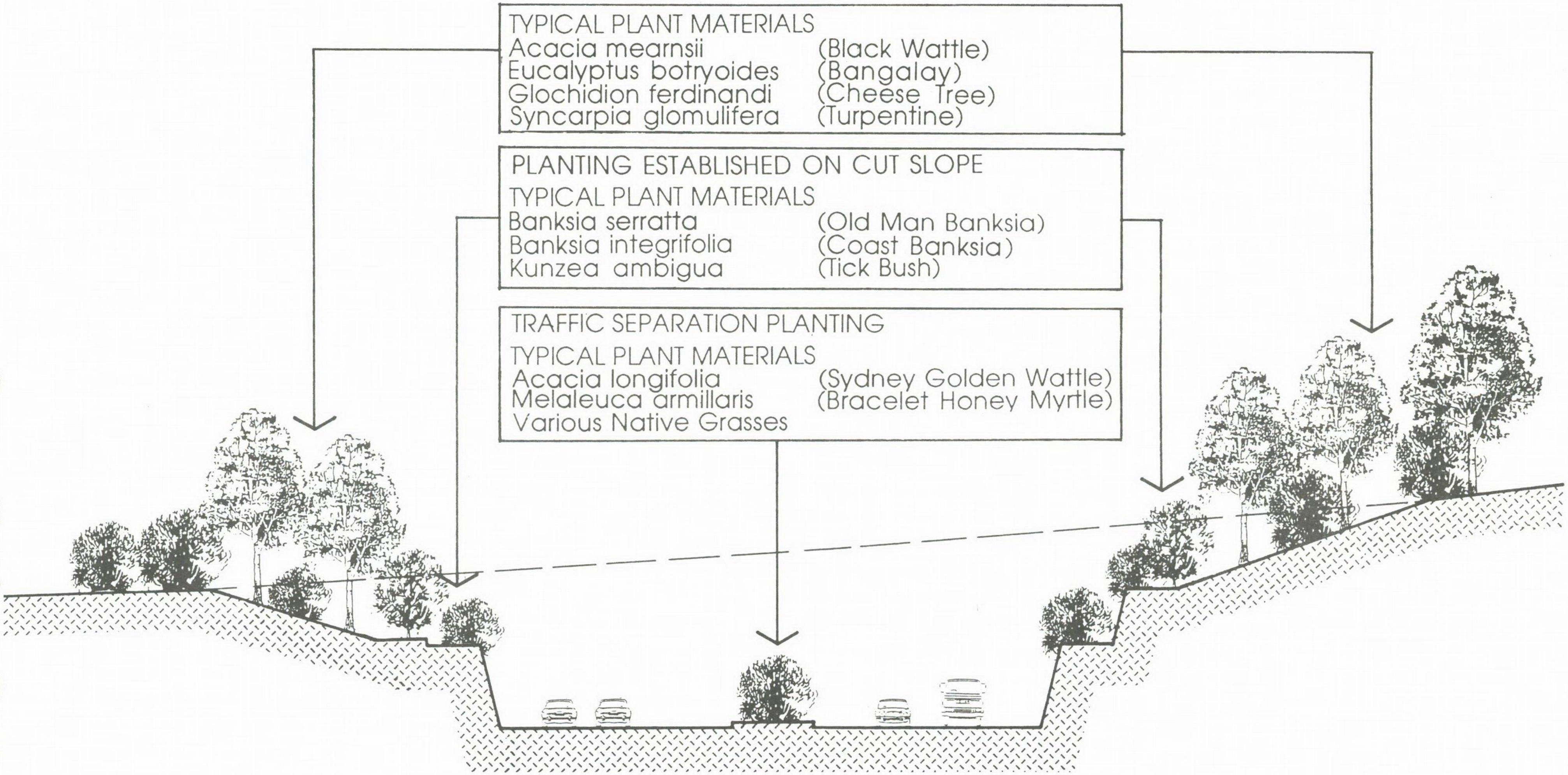


Figure 21
Proposed Landscape Treatments – Unit 2

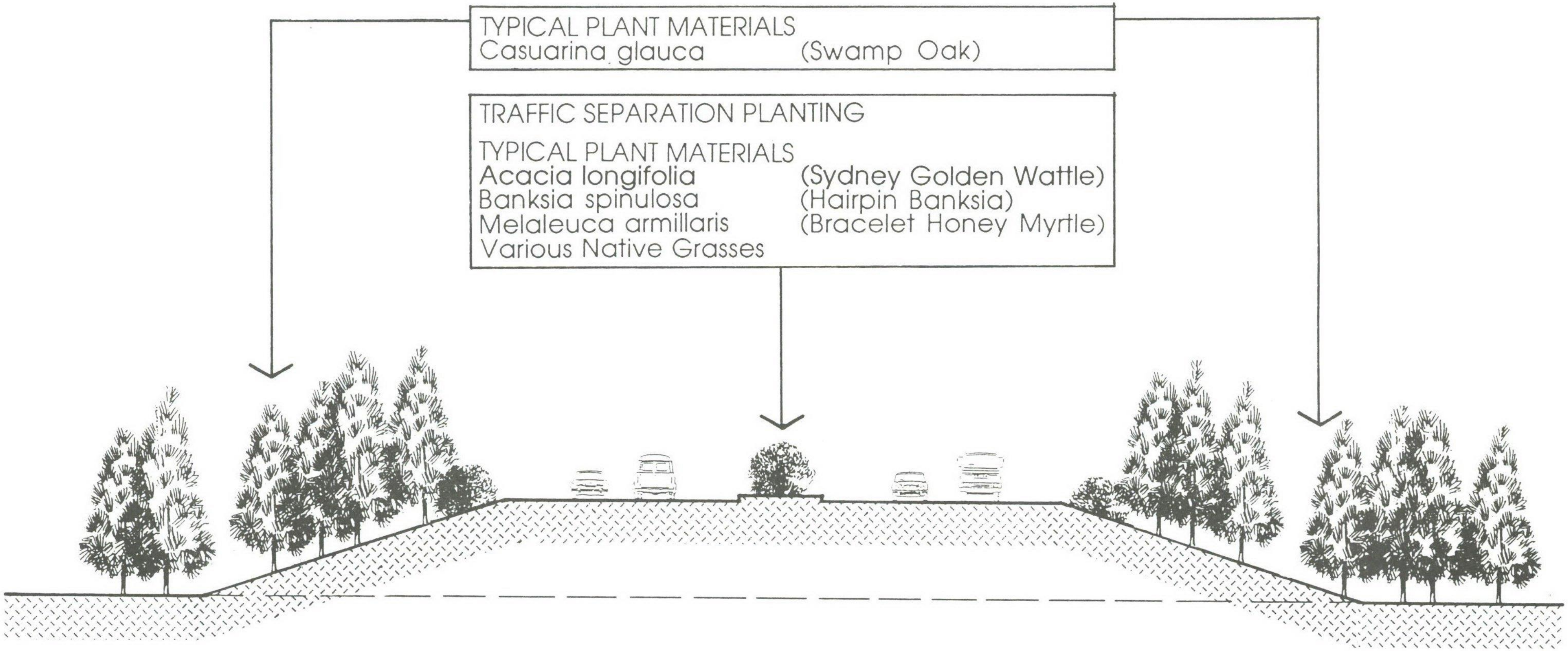


Figure 22
Proposed Landscape Treatments – Unit 4

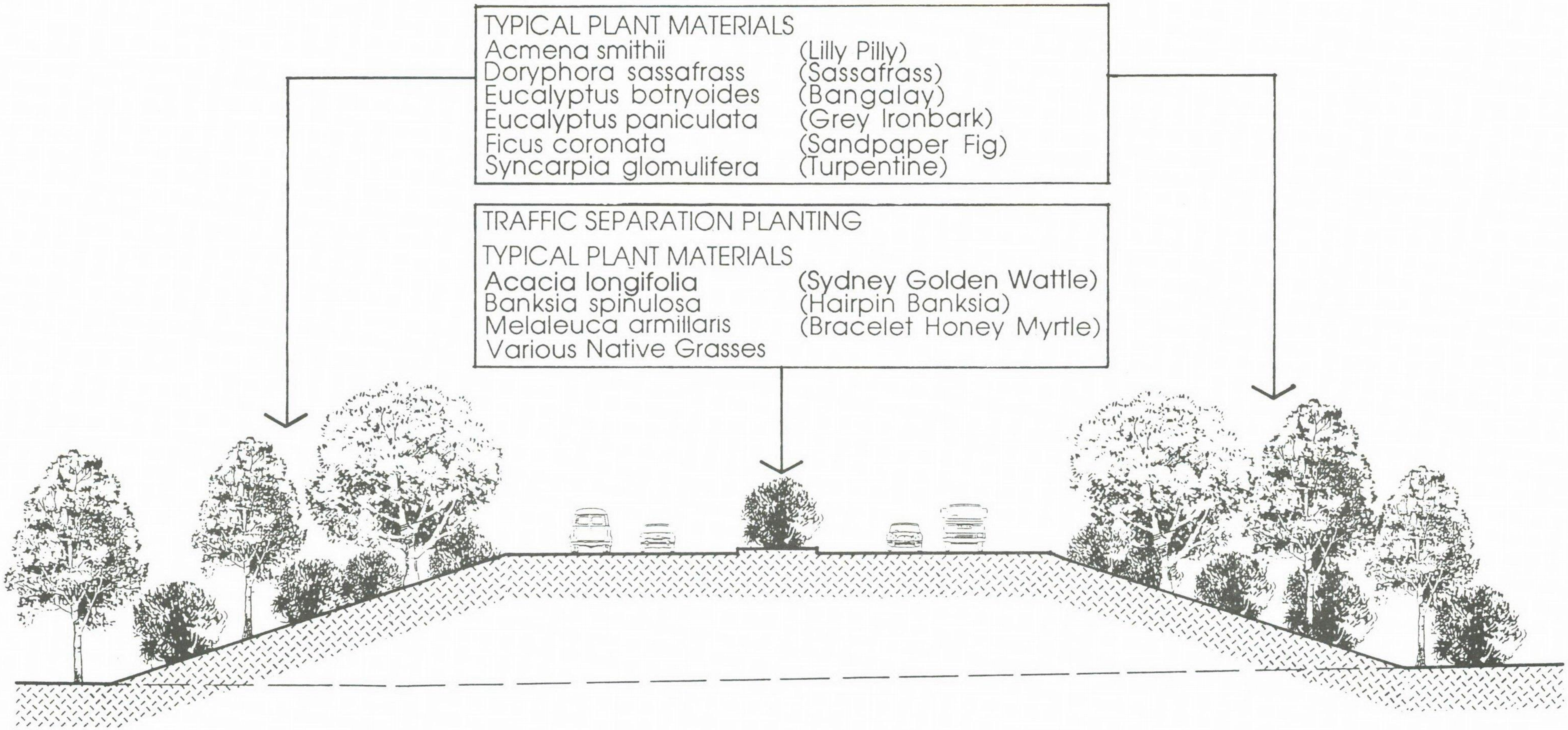


Figure 23
Proposed Landscape Treatments – Unit 6A

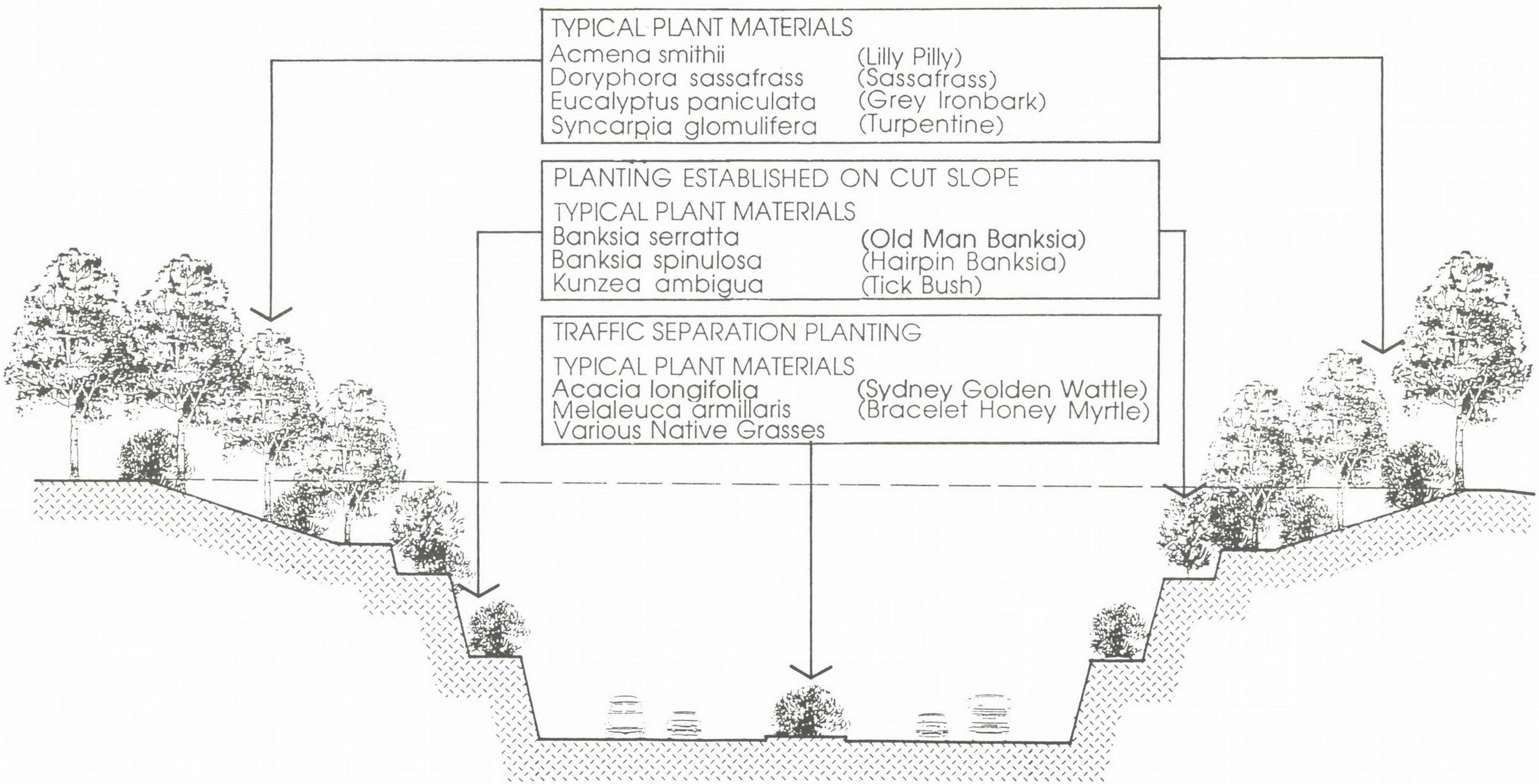


Figure 24
Proposed Landscape Treatments – Unit 6B

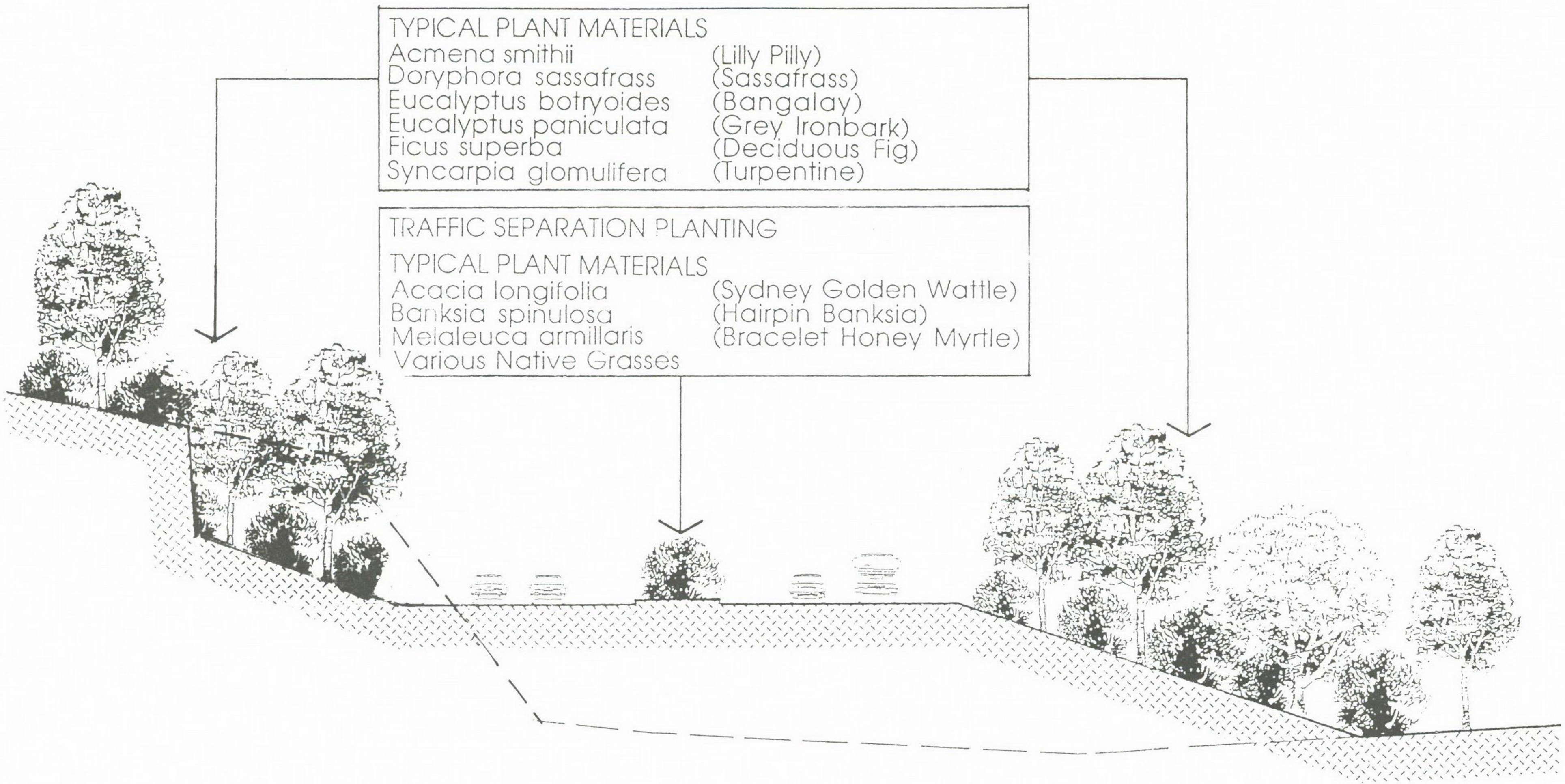


Figure 25
Proposed Landscape Treatments – Unit 7

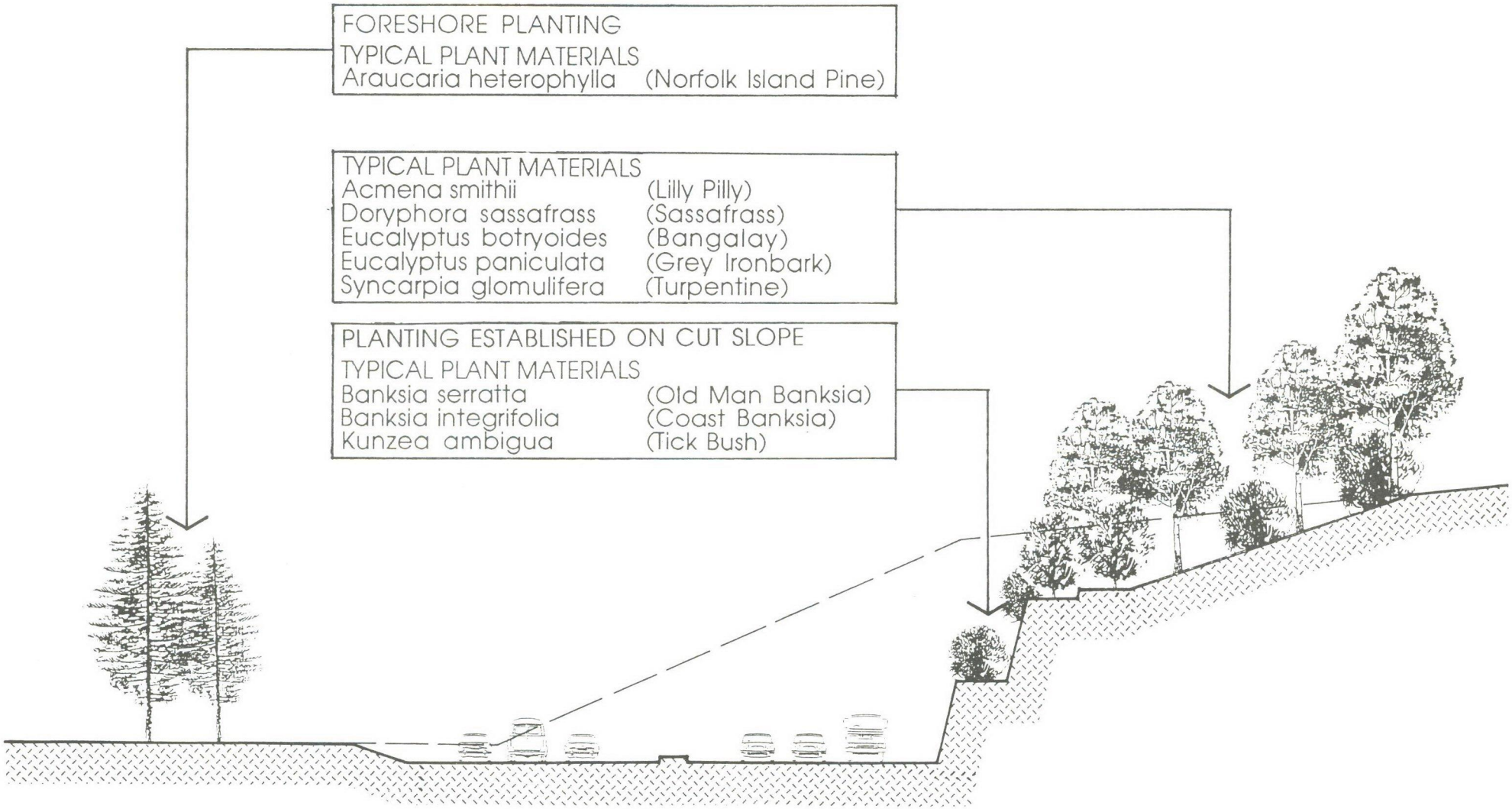


Figure 26
Proposed Landscape Treatments – Unit 9

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BRIEF FOR ROUTE SELECTION STUDY AND ENVIRONMENTAL IMPACT STATEMENT STATE HIGHWAY 1 - PRINCES HIGHWAY, DUNMORE TO NORTHERN END OF THE KIAMA BY-PASS

1. BACKGROUND TO THE PROJECT

In 1986 the former Department of Mains Roads (DMR) placed on public exhibition an Environmental Impact Statement (EIS) for the proposed widening and partial realignment of the Princes Highway between the Minnamurra River Bridge and the Kiama By-Pass. A preferred route and six alternative options were examined in the EIS including the "no build" option, two other Princes Highway corridor options and three western corridor options.

Following examination of the EIS, consideration of public submissions and the carrying out of a number of additional investigations, the Chief Executive of the Roads and Traffic Authority (RTA) decided not to proceed with the EIS proposal - Scheme E. However, in making this determination, the Chief Executive resolved to carry out a more comprehensive review of the short and long term main roads needs of the area and to prepare a fresh EIS on the outcome of the new investigations.

The new study is to involve a thorough evaluation of all possible alternative solutions and the preparation of an EIS for a preferred route, in accordance with the requirements of the Environmental Planning and Assessment Act, 1979. A two phase study is envisaged to allow for:

(i) The selection of a preferred route and a short list of feasible alternatives;

(ii) Preparation of the EIS.

Importantly, the study is to be undertaken with the participation of the Kiama and Shellharbour Municipal Councils and the input of local communities, community organisations and relevant government agencies. Specialists in public participation will therefore be essential members of the study team.

The area of investigation extends from the Shellharbour Road/Princes Highway intersection at Dunmore, in the north, to the Kiama By-Pass, in the south.

The study area and the schemes examined to date are shown in Figure 1.

2. OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

Phase 1: Route Selection Study

(i) To clearly identify short and long term transportation needs of the study area, having particular regard to how arterial roads can assist in meeting those needs;

(ii) To identify the constraints to both existing and possible route corridors in the study area;

(iii) To generate alternative route corridors and route options that would help meet the transport needs;

(iv) To evaluate these route options having regard to social, environmental and economic considerations;

(v) To identify a preferred route and a short list of feasible alternatives in consultation with the RTA, the local Councils and relevant government agencies; and

(vi) To maximise public participation in the route selection process.

Phase 2: Environmental Impact Statement

(i) To prepare an EIS of the preferred route in accordance with the requirements of the Environmental Planning and Assessment (EPA) Act 1979;

(ii) To meet the requirements of the Director of Planning;

(iii) To maximise community consultation during the preparation of the EIS; and

(iv) To ensure that local Councils and relevant government agencies are consulted.

3. SUGGESTED SCOPE OF THE STUDIES

The scope of the work is to be identified by the consultant based on discussions with officers of the RTA, the requirements of the EPA Act and the specifications of the Director of Planning. As a guide, it is suggested that the studies include the following:

3.1 Phase 1: Route Selection Study

(i) A review of the studies already undertaken and the preliminary design work completed by the RTA for routes previously identified and considered.

(ii) A clear identification of what the problem to be addressed is, having regard to the local and regional short and long term transport needs.

(iii) Identification of likely natural and cultural constraints to development of existing and potential route corridors in the study area.

(iv) Identification and evaluation of alternative routes corridors and options having regard to appropriate evaluation criteria.

(v) Design and implementation of an effective public participation programme for assisting the process.

(vi) Incorporation of input from local Councils and relevant government agencies.

3.2 Phase 2: Environmental Impact Statement

(i) Formulation of appropriate transportation, environmental, social and economic objectives for the proposed activity.

(ii) Investigation of the likely environmental impacts including (but not limited to):

* social impacts including community severance and effects on local access;
* economic impacts including changes to travel times and implications for energy conservation;
* impacts on wetland and terrestrial ecology;
* visual impacts including effects on Jamberoo Valley;
* potential for disturbance to Aboriginal archaeology or items of environmental heritage value;
* impacts on land and water use including the effect on agricultural land and farm viability;
* noise, air pollution and other local effects associated with both construction and operation of the works;
* impacts on local and regional traffic flows and travel times;
* water quality impacts including measures to control soil erosion during construction; and
* implications of any relevant local, regional or State environmental planning instruments.

(iii) Outline the route selection process including details of feasible alternatives, the reasons for selection of the preferred route and an assessment of the "do nothing" option.

(iv) Justification of the preferred route option in terms of environmental, economic and social considerations.

(v) Energy implications and requirements of the proposal and measures to be taken to conserve energy.

(vi) Consequences of not undertaking the proposed works.

(vii) Details of measures to be taken in conjunction with the works to protect the environment and an assessment of the likely effectiveness of those measures.

(viii) Consideration of comments received from various affected government instrumentalities and possible determining authorities.

(ix) Incorporation of a programme of community consultation.

4. INPUT TO BE PROVIDED BY THE RTA

(i) Information and reports listed in Appendix A.

(ii) Results of origin and destination survey to be carried out during March 1990 (results available in May 1990).

(iii) Preliminary design plans for previous schemes.

(iv) Aerial photography.

(v) Files for previous work will be made available for perusal and photocopying.

(vi) Specifications of the Director of Planning (to be requested at completion of route selection study).

5. OUTPUTS REQUIRED

At the completion of the Phase 1 Route Selection Study, a report is required to be submitted which documents the route selection process, including the criteria used to evaluate alternative routes and the justification for selection of the preferred route. This report should be accompanied by appropriate tables and maps and provide sufficient information for review by the RTA and the consultant review team.

Following review and adoption of the recommendations of the Phase 1 Study, a draft EIS should be prepared and submitted for review, together with technical appendices and any sub-consultant reports used in compiling the EIS. A final review will be undertaken prior to printing.

Short monthly progress reports to the Project Manager will be required throughout both phases of the study which should include a review of the study tasks and the study timetable.

6. STUDY TIMING

A study programme should be prepared for both phases of the study that allows for the public exhibition of the EIS no later than October 1990.

A period of two weeks should be allowed for review of the Route Selection Study and a further two weeks for draft EIS review.

7. CLIENT-CONSULTANT LIAISON

The Project Manager for the study will be Mr Brian Lefoe who will be responsible for the RTA input to the study and will be the point of contact for all matters relating to the study.

The consultant is required to nominate a Study Director and a Study Manager and to indicate expected work-hour commitments of these key persons to the study.

Monthly progress reports are to be submitted to the Project Manager.

8. RESPONSE TO THE BRIEF

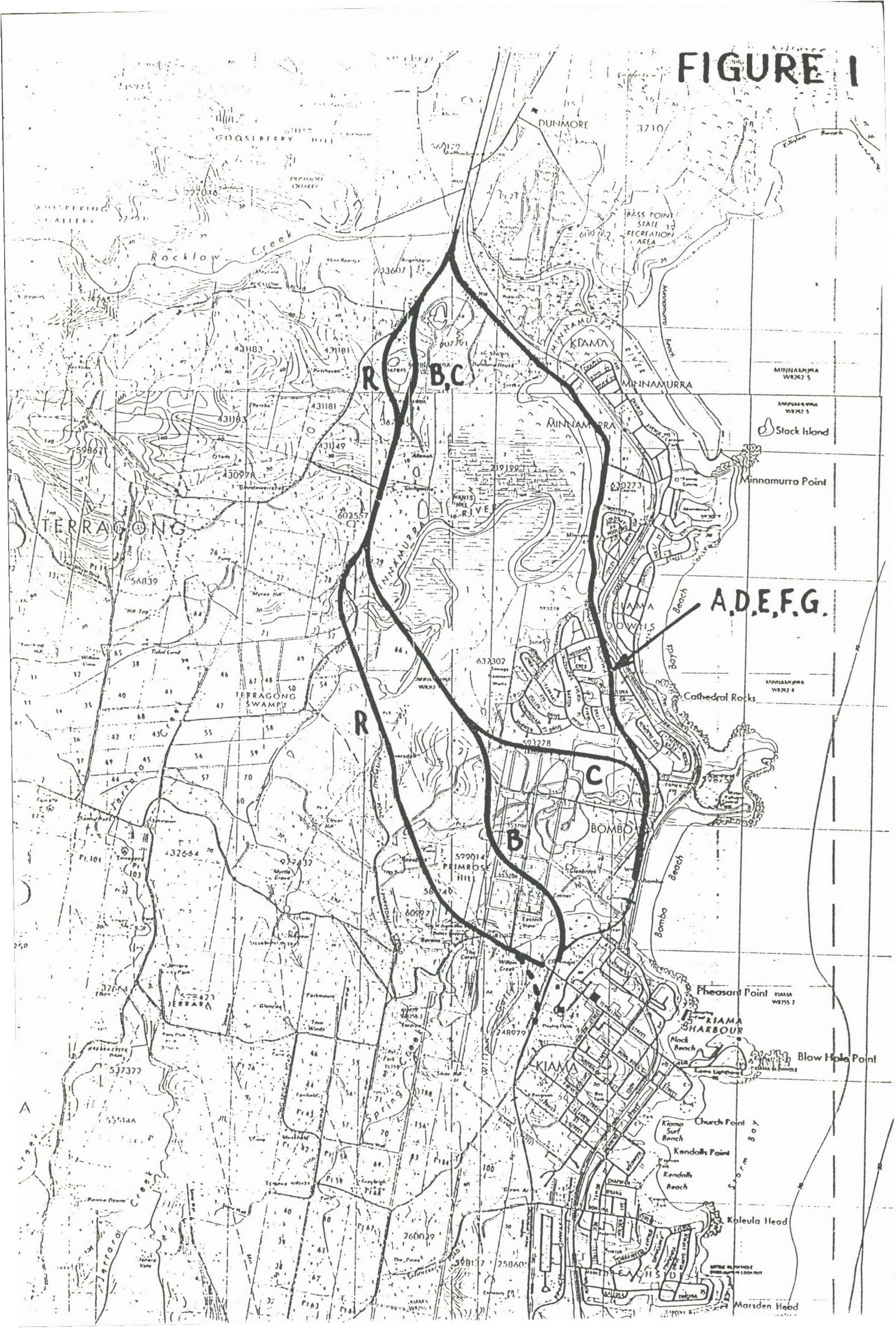
A response to this brief must include the following:

* a short appreciation of the problem and the key issues to be addressed (limit of two pages);
* an outline of the proposed study methodology and scope of work for both the route selection study and the EIS;
* proposed design of public participation and community consultation programme and the specialist consultants to be used for this aspect of the studies;
* a timetable for carrying out the work including all study tasks, progress reporting, study outputs and RTA review;
* a fee estimate on a time (hours) plus expenses basis, which specifies an upper limit for the work proposed. The estimate should include printing of the Route Selection Study report (10 copies), the completed draft EIS (10 copies) and the final draft EIS (5 copies);
* the proposed standard of production of the final EIS (eg. method of binding, printing, colour or black/white production) and an estimate of the cost per copy of printing should be separately itemised. This estimate will not be used as a basis for comparison of quotes;
* proposed staffing, including intended work-hour commitment of each nominated staff member and hourly rates. All sub-consultants should also be included;
* a concise description of the relevant experience of the firm and any sub-consultants to be used (limit of five pages); and
* hort (one page or less) CVs for each staff member and any sub-consultants.

No company brochures are required to accompany the response to the brief.

Three (3) copies of the response to the brief are required to be submitted to the Project Manager by 5 pm, Thursday 1st March 1990, in a sealed envelope marked "Route Selection Study and EIS - Princes Highway, Dunmore to Kiama".

FIGURE 1


DUNMORE
Rocklow Creek
BASS POINT STATE RECREATION AREA
MINNAMURRA
MINNAMURRA RIVER
Stock Island
Minnamurra Point
TERRAGONG
TERRAGONG SWAMP
WANTS HILL
R
B,C
A.D.E.F.G.
Boyds Beach
Cathedral Rocks
C
B
BOMBO
Bombo Beach
PRIMROSE HILL
Pheasant Point
KIAMA HARBOUR
Black Beach
Blow Hole Point
KIAMA
Church Point
Kiama Surf Beach
Kendalls Point
Kendalls Beach
Koleula Head
Marsden Head
Spring
Storm Boy

Princes Highway: Minnamurra River to Bombo, Kiama, EIS, DMR, July 1986

Princes Highway: Minnamurra River to Bombo, Kiama, EIS Working Papers, DMR, July 1986

Princes Highway: Minnamurra River to Bombo, Kiama, Supplementary Documents, DMR, July 1986

State Highway No 1 Section: Minnamurra River to Bombo: Municipality of Kiama, Environmental Impact Assessment Report, RTA, November 1989

A Reappraisal of the Archaeological Impact of the Proposed Princes Highway Reconstruction - Minnamurra River to Bombo, Kiama, A report to Dames & Moore, Heritage Resource Services, April 1987

Assessment of Archaeological Sites Along the Alternative Route for the Princes Highway Proposed Reconstruction: Minnamurra River to Bombo, Kiama, A report to the DMR of NSW, M Koettig, September 1988

Assessment of Blasting Impacts and Alternative Excavation Methods, Road Realignment and Widening Minnamurra Bends, Kiama, A report prepared for RTA of NSW, Richard Heggie Associates Pty Limited, May 1989

Highway Reconstruction at Minnamurra River: Assessment of Alternative Designs, A report for RTA of NSW, Coffey & Partners Pty Limited, June 1989

Princes Highway: Minnamurra River to Bombo, Kiama, Pedestrian Study, RTA NSW

Princes Highway Widening: A Report on the Impact of the Possible Widening of the Princes Highway in Northern Kiama, Kiama Municipal Council (M Vallejos - Social Planner), December 1988

Report on Alternative Route Proposed by R.A.N.K.S., DMR, NSW, Dames & Moore, March 1987

Report of the Effects of Road Upgrading on the Mangrove Vegetation of the Minnamurra Wetland, Dames & Moore

RTA Intersection and Lane Counts, 1989

State Highway No 1 Princes Highway Economic Analysis of Proposed Road Improvements from Swamp Road Dunmore to the Kiama By-Pass, T Keating

State Highway No 1 Princes Highway, Levels of Services of Proposed Road Improvements from Swamp Road, Dunmore to Kiama By-Pass, S Lappin & T Keating

State Highway No 1 Princes Highway Municipality of Kiama: Traffic Predictions, A report for RTA of NSW, Sinclair Knight & Partners, August 1989

Subsurface Geotechnical Investigation, DMR, NSW Materials and Research Laboratory Princes Highway, North Kiama, Coffey & Partners Pty Limited, November 1988

APPENDIX C

REQUIREMENTS OF THE DIRECTOR
OF PLANNING

New South Wales Government

Department of Planning

Remington Centre
175 Liverpool Street, Sydney 2000
Box 3927 G.P.O. Sydney 2001
DX . 15 Sydney

Telephone : 02) 391 2000
Fax No : (02) 391 2111
Contact : Barbara Callcott
Ext. 2030

Our reference 87/10559(4)

Your reference 5209/03

Mr T J Paterson
Connell Wagner (NSW) Pty Ltd
PO Box 538
NEUTRAL BAY 2089

Dear Sir,

PRINCES HIGHWAY - DUNMORE TO KIAMA
ENVIRONMENTAL IMPACT STATEMENT

Thank you for your letter of 28 September 1990 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. An EIS is required to be prepared where the proposal is an activity referred to in Section 112(1) of the Environmental Planning and Assessment Act, 1979.

3. As development consent is required for parts of the proposal and certain parts are development pursuant to State Environmental Planning Policy No. 14 - Coastal Wetlands, an EIS must accompany the development application to Kiama Municipal Council.

4. The EIS should be prepared in accordance with clauses 34 and 57 of the Environmental Planning and Assessment Regulation, as amended and shall bear certificates required by clauses 26(1)(b) and 59 of the Regulation (see Attachments 1a and 1b).

5. In addition, pursuant to clauses 35 and 58 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

- detailed description of the proposal, including diagrams, photo montages based on aerial photographs and photo montages of the proposal from the perspectives of road users, pedestrians and adjoining residents;

- diagrammatic identification of proposed property resumptions, if any, and a description of the resumption process. Identification of ownership of affected lands;

- traffic justifications for the proposal, indicating its relationship to local and regional traffic management strategies;

- justification for the design and route of the proposal, indicating alternative design and route options that have been considered, particularly options that would minimise intrusion into private properties and wetlands, and reasons for selecting the preferred option. If the preferred option necessitates resumptions of property outside the existing road reservation then these proposed resumptions should be specifically justified and options investigated to minimise impacts;

- description of the statutory provisions and approval process for the road in relation to the provisions (including permissibility) of relevant environmental planning instruments for the preferred and alternative road options. The need for rezoning should be considered;

- the impact on the natural environment including:

  - regionally significant resources as identified in the Illawarra Regional Environmental Plan (IREP) No. 1;

  - scenic, conservation and heritage values of the Jamberoo Valley;

  - the Minamurra River; and

  - wetlands identified in SEPP No. 14 (in this regard the matters listed in Attachment 3 should be addressed).

- the impact on agricultural land resources, particularly land, identified in IREP No.'s 1 and 2;

- the impact on existing/future urban and rural residential development areas and residential amenity;

- the impact on existing/future economic resources of the area including any extractive industry or tourist industry (including the Dunmore Lakes proposal);

- the impact on the hydrology of the Minamurra flood plain and wetlands and proposed design features to mitigate any identified impacts.

. an assessment of the impact of the proposal on Aboriginal cultural resources and their protection.

6. Attachment No. 2 is a guide to the type of information most likely to be relevant to the development you propose; not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal; equally, the guide is not exhaustive.

7. In preparing your EIS you should have regard to any comments of the Roads and Traffic Authority, Kiama and Shellharbour Municipal Councils and the Fisheries Division of the Department of Agriculture and Fisheries and take into account any comments they consider may apply to the determination of the proposal. Consultation should also be made with the Department of Water Resources, the Soil Conservation Service, the National Parks and Wildlife Service, and incorporate their views of the proposal in relevant considerations in the EIS.

8. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully,

Charles Hill 19/11/90
Acting Manager
Assessments Branch
As Delegate for the Director

DEPARTMENT OF PLANNING
ATTACHMENT NO. 1A

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS

In accordance with Part IV of the Environmental Planning and Assessment Act, 1979, an environmental impact statement (EIS) must meet the following requirements.

Pursuant to clause 34 of the Environmental Planning and Assessment Regulation, 1980, as amended, the contents of an EIS shall include the following matters:

(a) full description of the designated development proposed by the development application;
(b) a statement of the objectives of the proposed designated development;
(c) a full description of the existing environment likely to be affected by the proposed designated development, if carried out;
(d) identification and analysis of the likely environmental interactions between the proposed designated development and the environment;
(e) analysis of the likely environmental impacts or consequences of carrying out the proposed designated development (including implications for use and conservation of energy);
(f) justification of the proposed designated development in terms of environmental, economic and social considerations;
(g) measures to be taken in conjunction with the proposed designated development to protect the environment and an assessment of the likely effectiveness of those measures;
(g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;
(h) any feasible alternatives to the carrying out of the proposed designated development and reasons for choosing the latter; and
(i) consequences of not carrying out the proposed development.

The EIS must also take into account any matters required by the Director of Planning pursuant to clause 35 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 26(1)(b) of the Regulation.

DEPARTMENT OF PLANNING
ATTACHMENT NO. 1β

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS.

In accordance with Part V of the Environmental Planning and Assessment Act, 1979, an environmental impact statement (EIS) must meet the following requirements.

Pursuant to clause 57 of the Environmental Planning and Assessment Regulation, 1980, as amended:

(1) An environmental impact statement referred to in section 112 (1) of the Act shall be prepared in written form and shall be signed by the person who has prepared it.

(2) The contents on an environmental impact statement referred to in subclause (1) shall include the following matters:-

(a) a full description of the proposed activity;

(b) statement of the objectives of the proposed activity;

(c) a full description of the existing environment likely to be affected by the proposed activity, if carried out;

(d) identification and analysis of the likely environmental interactions between the proposed activity and the environment;

(e) analysis of the likely environmental impacts or consequences of carrying out the proposed activity (including implications for use and conservation of energy);

(f) justification of the proposed activity in terms of environmental, economic and social considerations;

(g) measures to be taken in conjunction with the proposed activity to protect the environment and an assessment of the likely effectiveness of those measures;

(g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;

(h) any feasible alternatives to the carrying out of the proposed activity and the reasons for choosing the latter;

(i) consequences of not carrying out the proposed activity.

The EIS must also take into account any matters required by the Director of Planning pursuant to clause 58 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 59 of the Regulation.

DEPARTMENT OF PLANNING
ATTACHMENT NO 2

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR A MAJOR ROAD DEVELOPMENT IN A RURAL/ SUBURBAN ENVIRONMENT

Pursuant to S112 of the Environmental Planning and Assessment Act, 1979, where a proposal is a prescribed activity or where a proposal is likely to significantly affect the environment, a determining authority must, before deciding whether to proceed with the proposal, consider an EIS prepared in respect of the proposal.

It is the responsibility of the determining authority to decide whether an EIS is required (unless the proposal is a prescribed activity). While the site characteristics largely determine the need for an EIS to be prepared, in general major road developments in rural/suburban environments have the potential to create problems for local residents and landholders due to land resumption, loss of access, severence effects on agricultural activities, sterilisation of minerals, noise generation, erosion and siltation; and impacts on flora and fauna, visual amenity, local and regional traffic flows, and local commercial interests.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for such major road developments. It is intended to assist the preparation of the EIS. It is the applicant's responsibility to identify and address, as fully as possible, the matters relevant to the specific development proposal in complying with the statutory requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of such a major road development. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the determining authority and the Department of Planning to properly understand the environmental consequences of the proposed development.

1. Description of the proposal.

The description of the proposal should provide general background information on the location of the proposed road works, particularly in relation to, and compatibility with, the arterial and local road network and any traffic management schemes in force or proposed and including the criteria used for route selection. It should provide an indication of adjacent developments, and land use activities, as well as details of the site, land tenure, zonings and relevant forward planning proposals, and any other land use constraints including natural environmental features sensitive to the impact of the proposal.

It may also be appropriate for the EIS to describe statutory procedures for implementing the proposal.

This section should provide specific information on the nature, intent and form of the development. Particular details that may generally be relevant include:

- The form and physical dimensions of the proposed roadworks, including locations and dimensions of bridge structures and associated facilities.
- Earthworks involved including details of cut and fill and balancing of volumes proposed.
- Presence of median strips, barriers to pedestrians, and grade separation proposals at intersecting roads.
- Provision of facilities for faunal corridors.
- Flood prevention measures.
- Alterations to access to adjoining properties.
- Resumptions required of existing development to accommodate the proposed road.
- Construction problems envisaged including staging of works, source and transport and assembly of plant and materials, employment details, construction camps, access arrangements, alternative routes and traffic management proposals for local and through traffic, and hours of operation for demolition/construction works etc.
- rehabilitation proposals on completion.

2. Description of the Environment.

This section should provide details of the environment in the vicinity of the development area and also of aspects of the environment likely to be affected by any facet of the proposal. In this regard, physical, natural, social and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development. In particular:

- Geography, topography, geology and geotechnical data, meteorology, hydrology etc.
- Noise and air quality where appropriate for impact consideration.

. Aesthetics.
. Flora and fauna with particular regard for sensitive environments such as wetlands.
. Agricultural and mining activities that may be affected by the proposed works.
. Utilities and communications.
. Buildings or items having architectural/heritage significance.
. Existing traffic levels and traffic flow patterns.
. Socio economic aspects including local commercial activities.

3. Assessment of Alternative Routes.

The EIS should include a proper assessment of the alternative routes considered in the feasibility study for the proposal including the key physical and engineering constraints as well as the environmental and economic factors pertinent to same including clear reasons for rejecting such alternatives in favour of the recommended proposal.

4. Analysis of Environmental impacts.

Environmental impacts usually associated with a major road development in a rural/suburban environment and related activities are listed below. Where relevant to the specific proposal, these should be addressed in the EIS, taking into account the adequacy of safeguards proposed to minimise them both during construction and when in use after completion:

. Likely noise disturbance caused by the construction of the road, and by traffic operating on the completed roadway, on any nearby residential and commercial buildings. A map depicting anticipated noise contour levels in relation to residences and inhabitants involved may be necessary. Consideration should be given to both existing and proposed residential developments for such an analysis.
. Emission of air pollutants from vehicular traffic affected by the proposal, and their impact on the local and regional environment.
. Stormwater runoff and erosion and siltation potential.
. Impact on natural vegetation and faunal movement, flood plains, drainage patterns, (particularly sedimentation from construction activity).
. Mineral sterilization and subsidence potential.
. Visual impact, particularly on residential developments by both day and night taking into account the following effects of the proposed road:

  - Scale in relation to the natural landscape and adjacent residential and commercial development.
  - Appearance from nearby and afar.
  - Lighting effects on existing and proposed residential/ commercial buildings.

- Changes in traffic patterns.
- Impacts of traffic at entry/exist points.
- Impact on historic buildings, heritage items and matters of archaeological interest.
- Effect on commercial and agricultural operations and changes in community characteristics caused by severence.

In addition, any potential for hazard or risks to public safety and any proposal to monitor and reduce environmental impacts should be included.

5. Contact with relevant Government Authorities.

In preparing the EIS, it is suggested that authorities, such as those listed below, should be consulted and their comments taken into account in the EIS.

- The State Pollution Control Commission in regard to air, water and noise impacts and relevant pollution control legislation requirements.
- The Traffic Authority with regard to traffic and road development aspects.
- Any servicing authorities which may be required to supply water, power, etc.
- The Soil Conservation Service with regard to erosion control.
- The Department of Agriculture and Fisheries with regard to impact on agricultural activities.
- The Department of Minerals and Energy with regard to mineral sterilisation and subsidence.
- The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State.
- The National Parks and Wildlife Service with regard to impact on known archaeological sites.
- Local Councils through whose areas the road passes.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

5. Supporting information.

The EIS should refer by suitable appendices to all relevant studies/investigations that have been carried out in support of the proposals. This supporting documentation should be made available during the period of public display of the EIS.

ATTACHMENT 3

DIRECTOR'S REQUIREMENTS FOR SEPP 14 WETLANDS

(a) Identification of the wetland's habitats and ecological values and of its water characteristics including:

(1) a vegetation survey and map (preferably at a scale of 1:4 000) to particularly indicate the occurrence of any rare or endangered plant species, their values and the extent of any weed infestation;

(2) a faunal survey describing the birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) of the area and the occurrence of any rare or endangered and protected species; and

(3) an analysis of the surface and groundwater quality and hydrological regime.

(b) Alternatives to the site and to the proposal including the reasons and justification for choosing the proposed development at this location.

(c) A discussion of the environmental implications of the proposal including but not limited to the following:

(1) an assessment of the changes in the distribution and abundance of plant and animal species;

(2) a description of the design features incorporated in the proposed development to guard against actual and potential disturbances to the vegetation, fauna, water quality and hydrological regime;

(3) a description of measures proposed to be taken to guard against actual and potential disturbances to the vegetation, fauna, water quality and hydrological regime during the construction and operation of the proposal.

This discussion should not be limited to direct effects within the site proposed to be developed; it should include consideration of possible effects on proclaimed wetlands not included in the development proposal.

(d) A description of any proposed measure intended to offset losses in wetland values or other environmental impacts which may occur if the development is allowed to proceed such as:

(1) the preparation and adoption of a management plan which provides for the enhancement of wetlands not affected by the proposal;

(2) the establishment either on site or nearby of a wetland habitat which functions to replace some values lost through the development or contributes other wetland values.

APPENDIX D

ROAD CORRIDOR ASSESSMENT FACTORS

ROAD CORRIDOR ASSESSMENT FACTORS

This section provides a definition of the environmental and planning factors that have been identified for consideration in assessment of road corridor alternatives. The factors have been defined so that they provide the basis for a comparative rating of the options in terms of how well they satisfy that factor.

FACTOR A : TRAFFIC/TRANSPORTATION OBJECTIVES

The ability of a new road to meet its designed objectives is one of obvious fundamental importance. This issue therefore considers the level to which each corridor would be able to meet them. The main components in assessing the performance of a corridor on this issue are as follows.

Level of Safety

For road users, level of safety is largely a function of the design of the road. Roads which are flat and straight give less potential for road accidents than roads which have sharp curves or steep climbs or drops. A road which complies more with the former will therefore perform better as opposed to the latter. In addition, grade separated access for local traffic to heavily trafficked arterial roads provides significant improvements to safety in comparison to at-grade intersections.

Level of Service

The most important objectives is that the road provides an acceptable level of service in both the immediate and long term. Level of service is a qualitative measure which is used to describe the general level of comfort and convenience for the driver. This relates to freedom to manoeuvre and the level of traffic congestion.

Level of service can be determined generally from the relationship between the number of traffic lanes and the traffic volumes.

Level of service B and C have been determined as the objective for the road in the short term for weekday and weekend peak traffic respectively. Levels of service C and D are considered appropriate for the long term objective for weekday and weekend peak traffic respectively. The level of service will be better for a road corridor on which traffic volumes are less in both the short and long term, but have equivalent capacity (i.e. if a four lane road carries less traffic than another four lane road, it will rate higher on this issue).

Long Term Highway Strategy

Consistency with road planning strategies in this case is mainly concerned with the long term ability of the corridor to provide a link with the F6 Freeway. The greater the length of the corridor which can be used as part of the eventual long term highway strategy, the better it will perform on this issue. In this regard, a future highway alignment has not yet been finalised, however, it is assumed that a likely situation is for the corridor to bypass the Albion Park urban area and enter Rocklow Creek Valley via the Wentworth Hills/Goosebery Hill range. Also, the more likely the corridor is able to accommodate a road that can be upgraded to perform as well as the existing F6 the higher it should rate.

Travel Time and Speed

These parameters relate indirectly to the items discussed above. Whilst two roads could theoretically have the same level of service, one may be better because it can allow higher speeds and therefore reduce travel time. One corridor will perform better than another if the typical average travel time between two common points is lower.

FACTOR B : LAND USE IMPACTS

As far as possible, the adverse effects on existing land use and development have been minimised in the course of identifying potential corridors (i.e. constraints mapping). However, with the information of and easement notionally 60 metres wide, impacts on some properties will be inevitable, and the extent of this will be important. The elements to consider in assessment of this factor are discussed below.

Effect on Residential Property

The number of actual residential or rural buildings (including curtilage) is a major component in assessing the performance of the corridor options in this issue. Obviously, the more homes and other fixed property and/or improvements that fall in the corridor, the lower its rating.

Rural Property Severance

Whilst actual demolition of homes and improvements is of major significance, a corridor which affects adjacent land, causing property severance, can have similar impacts. The residual land may no longer be able to support a viable business (e.g. as a dairy farm), and thereafter the existing use of the land is effectively destroyed by the corridor.

A potential route will therefore rate more highly where it generally follows property boundary lines as opposed to bi-sections which create pockets of non-viable residual land. The greater the value and extent (i.e. milk quotas, value of site improvements) of the rural property affected, the lower the corridor will rate on this issue.

Resource Sterilisation

The assessment will also need to consider the potential resources that the corridor may sterilise. This could include valued mineral resources (i.e. quarry basalt), and valuable agricultural land (i.e. pasture land in Terragong Swamp). The suitability of the route will therefore depend upon the size and value of the land resources affected, and the extent to which future utilisation will be constrained.

FACTOR C : FUTURE LAND USE IMPLICATIONS

Future land use objectives and strategies of relevance to the Study are evident in several forms, including statutory plans, policies and also in current rezoning and development applications. A preferred route will preferably cause the least interference or conflict with such plans and proposals.

Planned/Proposed Development

The most important factor in assessing corridor suitability in terms of this issue is whether the corridor will affect land that is already zoned or approved for development. The corridor should be rated according to the area of the land directly affected, as well as the scale time-frame and value of the development proposed. For example, a road corridor through a planned residential area will perform lower than a corridor through a proposed rural residential area. Similarly, a corridor through land which has development approval and soon to occur, will perform lower than a corridor which affects land which is rezoned, but where actual development proposals are not yet as imminent.

Indirect Impacts

Aside from the direct effects that a corridor would have if it traversed a planned or proposed development site, there is also a need to assess the impacts of a corridor which skirts the site. In this regard, various proximity effects such as access problems, traffic noise, emissions and visual impact, may diminish the quality or value of the proposal to some extent. On the other hand, corridor proximity could have decided benefits. for instance, exposure of a proposed tourist site could have significant commercial benefits.

Longer Term Planning

Another assessment issue is the effect corridors on the longer term planning strategies of both local and state government authorities. This includes relationships to land identified as suitable for long term urban expansion, as well as land to be preserved for agricultural/resource purposes. whilst the potential of the land may not be reflected in current local environmental plans, identification in studies and long term planning strategy policies should be considered. The greater the

potential adverse impact or restriction that a corridor might have on such plans, the lower it should rate. This item of future land use should not affect the rating of the option to the same extent as the above items.

FACTOR D : LOCAL ACCESSIBILITY

The extent to which local vehicular access would be affected by a potential route will strongly influence its suitability. This relates to both local and regional access, as well as access to and within individual properties. These elements are discussed below.

Access to Residential Areas

Ease of access to existing residential areas is a major consideration in the planning of a highway corridor. This can be assessed by quality of proposed crossings or connections between local roads and the highway. Grade separated interchanges provide a high level of access, whilst at-grade intersections, permitting uncontrolled right turns to and from a main highway, provide a low and often dangerous form of local access. Similarly, a new highway to the west would eliminate most of the through traffic on the existing Princes Highway, and thus permit much safer access along local roads to residences, shops and facilities.

Access to Rural Properties

In the case of western bypass options, a highway corridor can have significant effects on individual rural property access. The easement required for a new road will often sever property access roads from local service roads (e.g. driveways connecting to Swamp Road). Accordingly, these properties may be provided with either tunnels or bridges, or alternatively, an entirely new access road. If this is not possible, then it may be prudent to acquire the whole property. The performance of this issue is determined by the number of rural property access roads that will be severed.

Access within Rural Properties

Whilst access to and from rural properties has been considered above, access within an individual property must also be examined. For large rural holdings (e.g. "Riversdale", "Myree Hill" and "Clover Hill"), within property access is important for their commercial viability. Thus corridors that sever such access have the potential to significantly affect the viability of farming. The corridor should be rated according to the number and severity of holdings affected.

FACTOR E : COMMUNITY AND BUSINESS IMPACTS

This factor is concerned mainly with a comparison of the road options in terms of how they would impact on the residential community of Kiama in the study area (i.e. primarily northern Kiama suburbs and rural residential areas such as Jamberoo), and also the business and commercial activities of Kiama. Rating the options on the basis of business and social changes they would cause should be based on the following items :

Pedestrian Safety

The impacts of major road construction on non-vehicular access in the local area is an important community consideration. The assessment of this issue should take account of several matters, including loss of flexibility in routes available for pedestrains and bike riders, the number of people affected and any change in safety features. The rating of corridors will largely depend on the provision of and quality of design of appropriate facilities.

Disruption of Community Facilities

Any corridor which would directly or indirectly affect the utility of a community facility or site, should be rated lower according to the nature of the change or disruption, the number of people and events affected, and the likely duration of the impact. The facilities which should be assessed would include schools, recreation and sporting areas, community centres, clubs, etc.

Town Centre Links

The availability and ease of access to Kiama town centre for both local residents and non-local traffic (e.g. travellers and tourists) is vitally important to the economic well-being of most business operations. An option which provides various opportunities for safe, direct and efficient access to and from the town centre rates higher than an option which provides only limited or restricted access.

Isolation/Severance Effects

Aside from the more tangible changes to accessibility, major new roads including town bypasses and dedicated road corridors through urban centres, can also result in psychological impacts which might be described in terms of a personal sense of community severance caused by the road as a barrier, or of the community as a whole becoming isolated from the 'outside world' due to a road bypass. In this regard, the basis or criteria for making judgements on different corridors is difficult.

Dangerous and Hazardous Goods

General community safety in relation to the transport of such goods, should also figure in the evaluation. The number of people in close proximity of the corridor and potentially at risk, is an important consideration, as is the probability for

accidents. Assuming comparable road safety standards would be achieved in each corridor, it would be difficult to assess accident probability.

FACTOR F : ENVIRONMENTAL HERITAGE

This assessment factor is defined to encompass a diverse range of issues, but generally include sites, locations, buildings and items which have some importance in terms of both natural and cultural heritage value. The rating of corridor options should therefore focus on the biological and physical attributes of the land traversed by the corridor, as well as any Aboriginal and European heritage resources which have been identified.

Assessment of the corridors in terms of this factor is largely concerned with determining the degree to which road construction would adversely affect or reduce the significance of these natural and cultural values.

Nature Conservation Values

The present natural conservation values or intrinsic natural qualities of an area would be a function of criteria such as :

- how well the vegetation communities or natural ecosystems are represented or protected in areas nearby or elsewhere
- presence of rare or endangered flora or fauna
- presence of significant ecological associations (e.g. unusual animal-habitat relationships)
- the size and shape of the area and its function as a natural corridor or land matrix component
- degree of disturbance or condition
- importance of the area for educational and scientific purposes
- outstanding physical form such as geological features, water bodies or vegetation structure.

A combination of these items, with the first three probably of most importance, should provide the basis of a judgement as to whether the natural environment along the corridor is of significance, and if so, whether the features are important locally, or significant from a regional of broader perspective. The rating of the corridor should then be established by assessing both the extent of the impact or change that road construction would have, as well as the significance of the areas affected.

Typical nature conservation areas and attributes in the study area will include estuarine wetlands (most of which are protected by State Environmental Planning Policy 14), remnant forest

communities, water bodies and individual trees. It is important to note that when evaluating effects on ecological systems, it is not only the immediate direct impacts of construction which are of consequence. New roads can cause environmental change both well beyond the construction site (e.g. drainage and water effects. downstream wildlife corridor severance), and well into the future.

Cultural Heritage

In terms of cultural resource values, the assessment of corridors relies on judgement of significance usually made by relevant authorities such as archaeologists, NPWS, Heritage Council and the National Trust. The rating is otherwise the same in that the greater the effect of road construction on identified heritage resources, the less suitable the corridor will be. The types of items, places and features which are likely to figure most in this assessment, would include sites of significance to Aboriginal culture (e.g. possible burial sites, artefacts), historic buildings from early settlement in the area and places of importance historic events.

Natural values should not figure any more prominently in the rating than culturally important features, but it is evident that there will be less of the latter in terms of both number of sites and area covered.

FACTOR G : VISUAL/LANDSCAPE CHANGES

Construction of a major highway in any of the corridors would result in changes to the landscape. The significant scenic qualities of the Kiama area are considered to be most important attraction for tourists to the area and through travellers, and indeed one of the reasons why Kiama continues to be a popular place to live. The importance of the Jamberoo Valley as one of the most attractive locations in NSW is evident in the regional plan which seeks to protect that character. To assess the corridor options on the basis of visual and landscape changes, the following issues should be examined.

Landscape Quality

The existing scenic characteristics of the area that the corridor traverses must first be assessed. For most corridors, the diversity or richness or visual elements will change along its length. This can be defined by landscape zones or units which delineate areas of similar scenic quality.

Sensitivity

While a corridor may traverse highly scenic lands, the diminution of that landscape by the road would be of less consequence if only a relatively small number of people regularly enjoyed or had access to the view. By contrast, if a relatively larger number of people were regularly in the visual catchment of

the corridor (e.g. major thoroughfare, a busy public location, a residential area), then the level of sensitivity to landscape alteration would be expected to be much higher.

Incremental Change

This refers to the introduction of a new feature in the landscape. Widening the Princes Highway is within an existing corridor, whilst any western corridor is a new feature on the landscape.

Road User Views

Also of relevance to comparison of options, but of less importance than the above issues, is the variety and quality of views that road users would enjoy. Many tourists travel to Kiama on sight seeing tours of the countryside, and as such, the importance of views from the various corridors should not be dismissed. In simple terms, the corridor which offers the widest variety of outlooks and landscape features will generally receive the highest rating.

FACTOR H : TRAFFIC NOISE/AIR QUALITY

The level of traffic noise generated from a newly operating roadway development is an important factor influencing the identification of a preferred corridor. It is noted however, that the assessment should assume that the RTA would erect typical noise control devices (e.g. barriers and earth mounds) in locations expected to receive high noise levels. In terms of air quality impacts associated with vehicle emissions, it is unlikely that any of the corridor options would have significant advantages. As such, this factor would have minimal influence in assessing the options. The main items in this factor are as follows.

Number of Residences Affected

One of the first indications of how well a potential corridor will perform on the issue of noise and air pollution is the number of people potentially affected. Whilst there is not yet widespread agreement on the most appropriate index to measure noise, the 63dBA L10 (18 hour) has been adopted for residences incorporating a 45dBA (L_{eq}) internal measure between 10.00 pm and 6.00 am. For assessing the western proposals, houses within 150 metres of the corridor were quantified as a basis for comparative assessment.

The more people who are likely to have exposure to above the criteria, the worse the corridor will perform. A measure of the performance of a corridor with respect to air pollution is also the number of people likely to be affected. However, this is a somewhat more subjective assessment.

Potential for Noise Attenuation

Whilst many people may be potentially exposed to high noise levels, the scope for noise attenuation measures could effectively eliminate traffic noise problems. This will depend upon topography and whether the road is located above or below surface level (i.e. fill or cut). Below surface level noise attenuation is much easier and more effective.

Sensitive Locations

As well as the number of people affected, the type of land use affected will also be an important determinant in choosing a corridor. Schools for example, require more stringent noise controls (i.e. 55dBA L10), and therefore will need to be considered in the assessment. The road corridor will perform better where the fewest noise sensitive locations (e.g. schools, hospitals, convalescent homes, churches) are affected.

FACTOR I : ENGINEERING PRACTICALITY

This factor relates to the difficulties and problems of building a road within the corridor, or conversely, the relative ease of construction. Key items which warrant consideration when rating the corridor options are listed below. Assessment of engineering practicality assumes that road design standards such as horizontal and vertical alignment are generally satisfied, and that the road will not result in significant change to flooding patterns upstream or downstream.

Construction Cost

Whilst this factor will be incorporated in the Benefit/Cost analysis (as a separate financial assessment), it is also an important planning consideration. Obviously the less costly the construction, the easier it is to obtain the necessary funding. Incorporated in cost are earthworks, pavement, drainage, structures, utilities, the swamp crossing, erosion controls, land stabilisation, noise attenuation measures, landscaping, property adjustments and acquisitions.

Duration

The longer the duration of construction, the higher the impacts to traffic flows and interruptions. Obviously, the shorter the construction time, the grater the economic return of the project to the community.

Traffic Management

Road construction activities can be significantly hampered by traffic flows on or near the corridor. The staging of works to cater for traffic can become very complex, depending on features such as traffic volumes, duration of peak flows, availability of space for detours, interim diversions of traffic and the type and difficulty of construction involved.

APPENDIX E

INVENTORY OF FLORA AND FAUNA

4.0 Contemporary flora and fauna

4.1 Introduction

4.2 Flora

4.2.1 Previous Studies

4.2.1.1 Wetlands

Carne(1989) studied in detail most of the vegetation contained in SEPP 14 Wetland No 372, located in the lower reaches of Minnamurra River. The wetland vegetation demonstrates a complex pattern of distribution which can be related largely to the geomorphic evolution of the area. This complexity would in itself create numerous ecological habitats and, through these, high faunal diversity.

Where mangroves flank the river the two species Avicennia marina(Grey Mangrove) and Aegiceras corniculatum(River Mangrove) are both present. Inland of these are tidal plains characterised by saltmarsh. Towards the river entrance the saltmarsh is dominated by Sporobolus virginicus with Sarcocornia quinqueflora, Triglochin striata and Samolus repens also present. Further upstream the rush Juncus kraussii characterises the saltmarsh, with Phragmites australis, Sporobolus virginicus, Suaeda australis, Samolus repens, Sarcocornia quinqueflora and Triglochin striata all present.

The wetland fringes, or higher areas within the wetlands are characterised by Swamp-oak Casuarina glauca forest. In the lower wetland this contains Myoporum acuminatum and Glochidion ferdinandi in the understorey, with a ground cover dominated by Suaeda australis. In the upper wetlands the Swamp-oak forest has a saltmarsh understorey and is fringed inland by the bottlebrush Melaleuca styphelioides.

4.2.1.2 Tabbagong Forest

Tabbagong Forest is of particular botanical interest. It is located on an area of sandstone talus and, presumably because of the lower fertility of this land, was left largely untouched by the early settlers; this is in stark contrast to the forests on the adjoining geology, which were mostly cleared for agriculture

The Department of Main Roads(1986) provided the following list of species 'prominent in forest at Tabbagong':

Trees, small trees, tall shrubs:
Acacia floribunda
A. implexa
Brachychiton acerifolium(planted?)
Eucalyptus consideniana(?)
E. maculata
E. sieberi
E. tereticornis
Exocarpos cupressiformis
Syncarpia glomulifera
Tristania conferta

Other species:
Acacia binervata
Breynia oblongifolia
Goodenia ovata
Hardenbergia violacea
Helichrysum bracteatum
H. diosmifolium
*Juncus effusus
*Lantana camara
Lepidosperma laterale
*Passiflora edulis
*Pyracantha angustifolia

* Introduced species

4.2.2 Current Study

The present study centred on those stands of natural/near natural vegetation located within or close to the proposed road easement. For convenience, the results for Tabbagong Forest are presented separately from those for elsewhere.

4.2.2.1 Tabbagong Forest

Tabbagong Forest is composed of a patchwork of rainforest and wet sclerophyll forest. Those lands directly affected or adjoining the proposed highway appear to have been predominantly vegetated by a wet sclerophyll forest characterised by Grey Ironbark Eucalyptus paniculata, Turpentine Syncarpia glomulifera and Blue Gum/Bangalay Eu. saligna/botryoides hybrids. Although partially cleared in some places and much disturbed by cattle in others, the understorey of this forest in less-disturbed areas is characterised by such rainforest species as White Euodia Euodia micrococca, Native Hibiscus Hibiscus heterophyllus, Sassafrass Doryphora sassafrass, Pittosporum Pittosporum undulatum, Common Wilkiea Wilkiea huegeliana, Coffee Bush Breynia oblongifolia, Cheese Tree Glochidion ferdinandi, Brown Kurrajong Commersonia fraseri, Native Cherry Exocarpos cupressiformis, Red Ash Alphitonia excelsa, Lilly Pilly Acmena smithii, Deciduous Fig Ficus superba var henneana and Orange Thorn Citriobatus pauciflorus.

Tabbagong Forest is, however, much more diverse floristically than the above list might suggest; from the distribution maps of Fuller & Mills(1985), for instance, perhaps another thirty-five rainforest trees alone might reasonably occur in this locality.

In addition, there have been extensive plantings of tree species alien to the locality around the homestead and along ridgelines. Particularly evident are the Spotted Gums Eucalyptus maculata, but several conifers, palms, other gums(e.g. Eu. sieberi, Eu. tereticornis, Eu. consideniana), Brush Box Lophostemon conferta, Flame Tree Brachychiton populneus and truly exotic trees(e.g. Coral Tree Erythrina sp, Cape Chestnut Tree Calodendron capense) are also present.

The proposed road easement west of 'Tabbagong' will require clearance of a large bamboo stand(Site 17, Figure 4.1)and some Grey Ironbark Eu. paniculata forest with associated tree species including Black Wattle Acacia mearnsii, Brush Kurrajong Commersonia fraseri, Red Ash Alphitonia excelsa, Deciduous Fig Ficus superba var henneana, Lilly Pilly Acmena smithii and Cheese Tree Glochidion ferdinandi(Site 16).

Several planted trees will be affected by the proposed roadway immediately around and to the east of the homestead, including eucalypts, conifers, Coral Tree Erythrina sp and Cape Chestnut Tree Calodendron capense(Site 18).

4.2.2.2 Other natural vegetation

Apart from Tabbagong Forest, several other stands of more-or-less natural vegetation occur within or close to the proposed road easement. These stands are shown in Figure 4.1 and their associated vegetation is described in Table 4.1 below.

Figure 4.1 : Stands of natural vegetation within or close to the proposed road easement

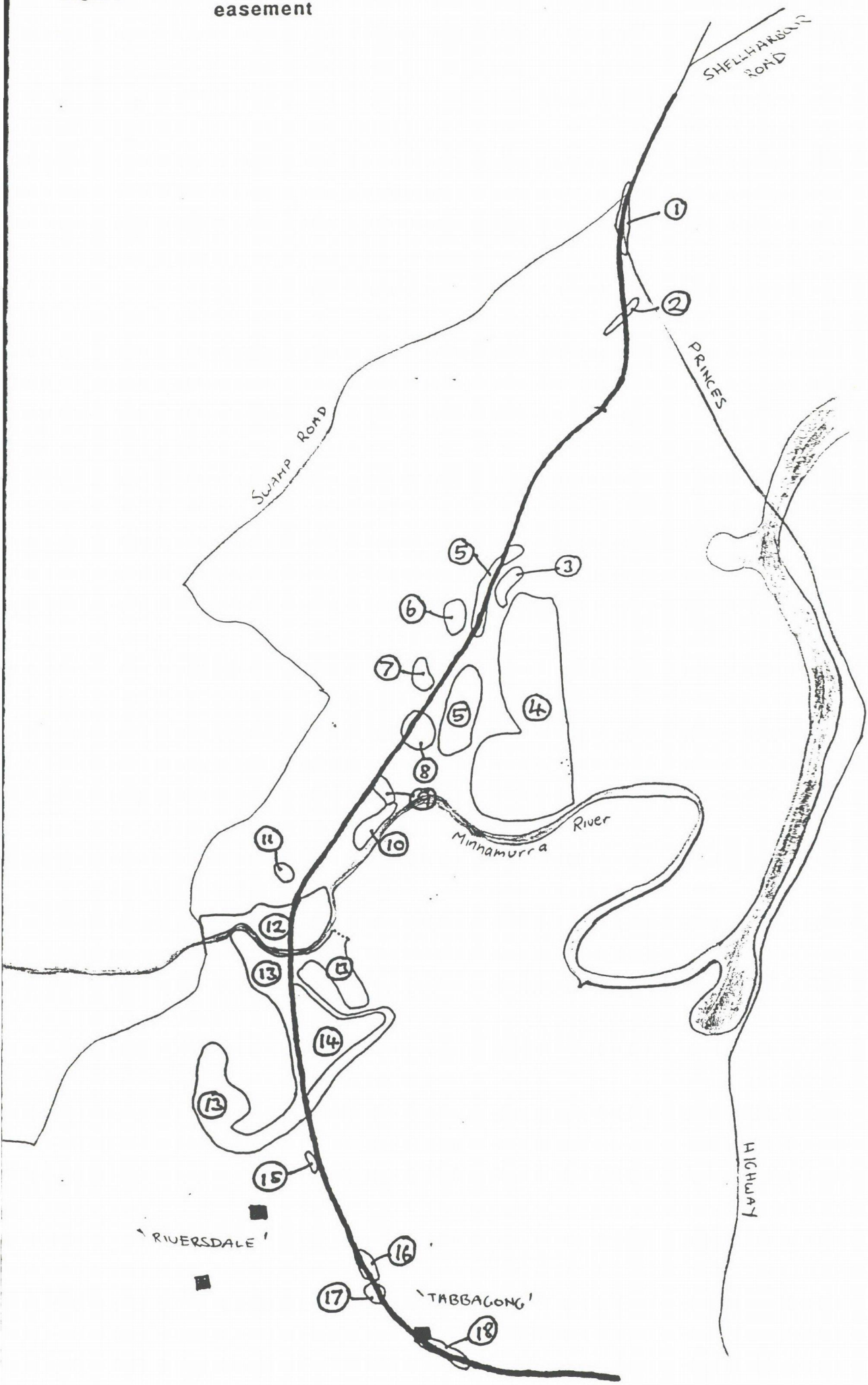


Table 4.1: Stands of natural vegetation within or close to the proposed road easement

Site	Vegetation
1	Swamp Oak C. glauca forest much disturbed and invaded by exotic species e.g. Lantana Lantana camara, Blackberry Rubus vulgaris
2	A row of trees along fenceline, mostly Casuarina glauca with two conifers(Pinus sp)
3	A small stand of Bangalay Eucalyptus botryoides with an understorey containing Corkwood Duboisia myoporoides, Lantana Lantana camara, Bracken Pteridium esculentum and Cockspur Maclura cochinchinensis
4	This very important relict of natural vegetation supports a diverse array of tree and shrub species. The Bangalay Eu. botryoides characterises the overstorey while mid- and understorey species include Maidens Wattle Acacia maidenii, Black Wattle A. mearnsii, Black She-Oak Allocasuarina littoralis, Coast Banksia Banksia integrifolia, Old Man Banksia Banksia serrata, Red Ash Alphitonia excelsa, Corkwood Duboisia myoporoides, Cheese Tree Glochidion ferdinandi, Lantana Lantana camara, Bracken Pteridium esculentum, Dogwood Cassinia aculeata, Climbing Guinea Flower Hibbertia scandens, Common Silkpod Parsonsia straminea
5	Sedge/rushland characterised by Juncus sp, Cyperaceae, River Buttercup Ranunculus inundatus and Water Primrose Ludwigia peploides ssp montevidensis
6	Site of former homestead/dairy with native species such as Moreton Bay Fig Ficus macrophylla, Deciduous Fig Ficus superba var henneana, Orange Thorn Citriobatus pauciflorus and Common Milk Vine Marsdenia rostrata and introduced species like Peppercorn Tree Schinus molle, Camphor Laurel Cinnamomum camphora, Coral Tree Erythrina sp.
7	Wetland with fringing emergent vegetation and associated rushland . Characterised by Juncus sp,Water Ribbons Triglochin procera
8	Farm dam with small stand of Swamp Oak Casuarina glauca, Black Wattle Acacia mearnsii and Cabbage Gum Eucalyptus amplifolia on embankment. Emergent aquatic vegetation includes Bulrush Typha australis, Eleocharis sp, Polygonaceae, Water Primrose Ludwigia peploides ssp montevidensis, Water Plantain Alisma plantago-aquatica
9	Mixed stand of Swamp Oak C. glauca and Grey Mangrove Avicennia marina with some Purple Twining-pea Hardenbergia violacea present. Wetland understorey of Creeping Cotula Cotula reptans, Sea Rush Juncus kraussii, Creeping Brookweed Samolus repens; Common Reed Phragmites australis, Lantana L. camara also present. No regeneration of Casuarina
10	Small stand of Swamp Oak C. glauca with a much modified understorey and no tree regeneration. Wetland towards river with Waterbuttons Cotula coronopifolia, Creeping Cotula C. reptans, Sea Rush Juncus kraussii, Seablite Suaeda australis, Common Reed Phragmites australis and Creeping Brookweed Samolus repens
11	Small patch of highly degraded sub-tropical rainforest, mostly Giant Stinging Tree Dendrocnide excelsa, Coral Tree Erythrina sp. Understorey of Lantana L. camara, thistles, Cockspur Maclura cochinchinensis and Orange Thorn Citriobatus pauciflorus

Site	Vegetation
12	Wetland with Grey Mangrove Avicennia marina reaching its upper limit on Minnamurra River, scattered Swamp Oaks C. glauca and an understorey dominated by the Common Reed Phragmites australis and Sea Rush Juncus kraussii
13	Casuarina forest dominated by the Swamp Oak Casuarina glauca with Prickly-leaved Paperbark Melaleuca styphelioides, Boobialla Myoporum acuminatum, Willow Bottlebrush Callistemon salignus and Cabbage Gum Eucalyptus amplifolia. The climbers Purple Twining-pea Hardenbergia violacea and Common Silkpod Parsonsia straminea widespread. Understorey includes Sea Celery Apium prostratum and Scurvy Weed Commelina cyanea. Major waterways lined with Common Reed Phragmites australis and Swamp Lily Crinum pedunculatum. Small wetland areas with Waterbuttons Cotula coronopifolia, Creeping Cotula C. reptans, Seablite Suaeda australis, Sea Rush Juncus kraussii and Samphire Sarcocornia quinqueflora. Lantana L. camara and Cockspur Maclura cochinchinensis also present. Understorey often very disturbed by cattle, with introduced species widespread and Casuarina regeneration virtually absent
14	Open Casuarina woodland with swampy depressions characterised by e.g. Common Reed Phragmites australis. Creeping Cotula Cotula reptans widespread
15	Four individual Coral trees Erythrina sp.

The paucity of regeneration in the Swamp Oak forests is of particular concern. The Department of Environment and Planning observed in 1985 that: 'The fisheries division of the Department of Agriculture is concerned for the maintenance of bank stability and riparian vegetation along the river. The impact of cattle grazing is apparent within a stand of riparian Casuarina sp between the Minnamurra Reserve road crossing and a point downstream 2km beyong the butter factory. The stand is aging without regeneration resulting in reduced bank stability'. This concern can be extended to all Swamp Oak stands examined during the present study and, five years later, the need for urgent remedial work is even more pressing. Casuarinas are now dying of old age and falling into the river; without appropriate remedial action much of the Swamp forests lining Minnamurra River seem destined to disappear within the next few decades.

4.3 Fauna

4.3.1 Mammals

It was not possible to carry out any systematic survey of mammals in the time available. However, Table 4.2 contains those species most likely to occur within the study area. This listing was established by reference to Robinson(1988).

Table 4.2: Mammals likely to occur in the lower Jamberoo Valley
(based on Robinson(1988), with remarks from that source)

Species	Comments
Platypus(Ornithorhynchus anatinus)	'Common in all streams between Macquarie Rivulet and the Shoalhaven'; observed near Jamberoo (R.Young, pers.comm.)
*Spiny Anteater (Tachyglossus aculeatus)	
Tiger Cat (Dasyurus maculeatus)	'Found throughout most of the farming and natural areas of the district on both the tablelands and the coastal plains'
Brown Antechinus(Antechinus stuartii)	In natural vegetation
*Long-nosed Bandicoot(Perameles nasuta)	'This species was abundant throughout the whole coastal plain'
Ring-tail Possum (Pseudocheirus peregrinus)	'One of the most numerous of all the possums ...found throughout the district...along the coast it lives wherever there is sufficient cover'
Sugar Glider (Petaurus breviceps)	'Frequents a variety of habitats throughout the natural and partly forested rural areas of the district where it can be classified as generally very common'
*Brushtail Possum (Trichosurus vulpecula)	'The species is found throughout the whole area'
*Swamp Wallaby(Wallabia bicolor)	'By far the most numerous large, native species recorded in the survey area'
*Grey-headed Fruit Bat Pteropus poliocephalus	'This species is found throughout the area'
Gould's Long-eared Bat(Nyctophilus gouldi)	
Lesser Long-eared Bat(N. geoffroyi)	
Common Bent-wing Bat(Miniopterus schreibersii)	
Gould's Wattled Bat (Chalinolobus gouldii)	
Eastern Water Rat (Hydromys chrysogaster)	'Found in all the large streams of the area'
Bush Rat (Rattus fuscipes)	'Overall this species is the most numerous wild mammal in the survey area'
*Black Rat(R. rattus)	'This species was trapped along water courses through urban areas and rural areas along the coastal plains where it is common in suitable habitat'
*House Mouse(Mus musculus)	'Recorded throughout the surveyed area around dwellings and rural properties'
*Hare (Lepus capensis)	'Recorded along the whole of the coastal plains'
*Rabbit(Oryctolagus cuniculus)	'Found throughout the whole surveyed area in cleared countryside and woodland'
*Fox (Vulpes vulpes)	'Distributed throughout the survey area'
*Feral Cat(Felis catus)	

* Species seen during fieldwork or reported by local residents

Particular mention should be made of the distribution of wallabies in the study area. J. Mandl (pers.comm.) believes that wallabies occur on his property although he has never seen them. Some 15-20 wallabies were routinely recorded in Tabbagong Forest until some 18 months ago when it is believed they were shot. M. Honey(pers.comm.) has since observed a pair of wallabies in the Forest, so that the population may well return to its previous level. These observations suggest very low populations of this species in the residual natural lands of the lower Jamberoo Valley, with the consequent risk of its extinction.

Another mammal species of some local interest is the Grey-headed Fruit Bat Pteropus poliocephalus. Although associated with Tabbagong Forest, it appears that this species roosts in a gully on the 'Myree Hill' property north of Minnamurra River.

4.3.2 Birds

Although no systematic survey of birdlife in the study area was possible in the time available, sixty-seven species were observed during field work. This total was increased by the results of a field outing by the Illawarra Bird Observers Club to "Glenowrie" on 14th June 1986(Results courtesy of R. Young). A small number of additional species were reported by local residents or in the published literature. These species are all listed in Table 4.3, with the source of information for each species.

Table 4.3: Birds of the study area

Common name	Scientific name
Hoary-headed Grebe	Poliocephalus poliocephalus(2)
Australasian Grebe	Tachybaptus novaehollandiae(1,2)
Australian Pelican	Pelecanus conspicillatus(1,2)
Darter	Anhinga melanogaster(2)
Great Cormorant	Phalacrocorax carbo(2)
Pied Cormorant	P. varius(2)
Little Black Cormorant	P. sulcirostris(1,2)
Little Pied Cormorant	P. melanoleucos(1,2)
Pacific Heron	Ardea pacifica(1)
White-faced Heron	A. novaehollandiae(1,2)
Cattle Egret	Ardeola ibis(2)
Great Egret	Egretta alba(1)
Australasian Bittern	Botaurus poiciloptilus(3)
Black-necked Stork	Xenorhynchus asiaticus(4)
Sacred Ibis	Threskiornis aethiopica(1,2)
Black Swan	Cygnus atratus(2)
Pacific Black Duck	Anas superciliosa(1,2)
Grey Teal	A. gibberifrons(2)
Chestnut Teal	A. castanea(1,2)
Hardhead	Aythya australis(4)
Maned Duck	Chenonetta jubata(1,2)
Osprey	Pandion haliaetus(4)
Black-shouldered Kite	Elanus notatus(1)
Whistling Kite	Haliastur sphenurus(2)
White-bellied Sea-Eagle	Haliaeetus leucogaster(2)
Little Eagle	Hieraaetus morphnoides(2)
Spotted Harrier	Circus assimilis(2)

Common name	Scientific name
Australian Hobby	Falco longipennis(2)
Brown Falcon	F. berigora(1)
Brown Quail	Coturnix australis(1)
Dusky Moorhen	Gallinula tenebrosa(1)
Purple Swamphen	Porphyrio porphyrio(1,2)
Eurasina Coot	Fulica atra(4)
Brolga	Grus rubicundus(4)
Masked Lapwing	Vanellus miles(1,2)
Black-fronted Plover	Charadrius melanops(1)
Latham's Snipe	Gallinago hardwickii(1)
Silver Gull	Larus novaehollandiae(1,2)
Spotted Turtledove	Streptopelia chinensis(1)
Crested Pigeon	Ocyphaps lophotes(1)
Galah	Cacatua roseicapilla(1)
Little Lorikeet	Glossopsitta pusilla(2)
Australian King parrot	Alisterus scapularis(5)
Eastern Rosella	Platycercus eximius(1)
Pallid Cuckoo	Cuculus pallidus(1)
Brush Cuckoo	C. variolosus(1)
Azure Kingfisher	Ceyx azurea(1)
Laughing Kookaburra	Dacelo novaeguineae(1,2)
Sacred Kingfisher	Halcyon sancta(1)
Dollarbird	Eurystomus orientalis(1)
Welcome Swallow	Hirundo neoxena(1,2)
Tree Martin	Cecropis neoxena(1)
Fairy Martin	C. ariel(1)
Richard's Pipit	Anthus novaeseelandiae(1,2)
Black-faced Cuckoo-shrike	Coracina novaehollandiae(1,2)
Red-whiskered Bulbul	Pycnonotus jocosus(1,2)
Rose Robin	Petroica rosea(2)
Flame Robin	P. phoenicea(2)
Scarlet Robin	P. multicolor(2)
Eastern Yellow Robin	Eopsaltria australis(1,2)
Golden Whistler	Pachycephala olivacea(1,2)
Rufous Whistler	P. rufiventris(1)
Blach-faced Monarch	Monarcha melanopsis(1)
Grey Shrike-thrush	Colluricincla harmonica(1,2)
Grey Fantail	Rhipidura fuliginosa(1,2)
Willy Wagtail	R. leucophrys(1,2)
Eastern Whipbird	Psophodes olivaceus(1)
Clamorous Reed-Warbler	Acrocephalus stentoreus(1)
Golden-headed Cisticola	Cisticola exilis(1,2)
Superb Fairy-wren	Malurus cyaneus(1,2)
Variegated Fairy-wren	M. lamberti(1,2)
Southern Emu-wren	Stipiturus malachurus(2)
White-browed Scrubwren	Sericornis frontalis(1,2)
Brown Gerygone	Gerygone mouki(1,2)
Brown Thornbill	Acanthiza pusilla(1,2)
Yellow-rumped Thornbill	A. chrysorrhoa(2)
Yellow Thornbill	A. nana(1,2)

Common name	Scientific name
Striated Thornbill	A. lineata(2)
White-throated Treecreeper	Climacteris leucophaea(1,2)
Lewin's Honeyeater	Meliphaga lewinii(1,2)
New Holland Honeyeater	Phylidonyris novaehollandiae(1,2)
Eastern Spinebill	Acanthorhynchus tenuirostris(1,2)
Mistletoe Bird	Dicaeum hirundinaceum(1,2)
Spotted Pardalote	Pardalotus punctatus(2)
Striated Pardalote	P. striatus(2)
Silvereye	Zosterops lateralis(1,2)
European Goldfinch	Carduelis carduelis(1,2)
House Sparrow	Passer domesticus(1)
Red-browed Firetail	Emblema temporalis(1,2)
Common Starling	Sturnus vulgaris(1,2)
Common Mynah	Acridotheres tristis(1)
Olive-backed Oriole	Oriolus sagittatus(1)
Satin Bowerbird	Ptilonorhynchus violaceus(1,2)
Australian Magpie-lark	Grallina cyanoleuca(1,2)
Grey Butcherbird	Cracticus torquatus(1,2)
Australian Magpie	Gymnorhina tibicen(1,2)
Australian Raven	Corvus coronoides(1,2)

1. Present study
2. Species recorded at 'Glenowrie' on 14th June 1986 by the Illawarra Bird Observers Club
3. Mark Honey, personal communication
4. Department of Environment & Planning(1985)
5. Robert Young, personal communication

Particular note should be made of the nesting of the following birds of prey:

* White-bellied Sea-Eagles Haliaeetus leucogaster in the Mandl property(J.Mandl, pers. comm.),
* Ospreys Pandion haliaetus in Tabbagong Forest
* Brown Falcons Falco berigora in a large fig at Site 6.

Mention should also be made of the paucity of pigeons, lorikeets and other parrots, and honeyeaters seen during fieldwork. This may be attributable to the limited observations made but, more likely, it is due to the very limited extent of the residual natural vegetation in the lower Jamberoo Valley.

4.3.3 Reptiles and amphibia

No systematic survey of reptiles and amphibians was possible in the available time. M.Honey(pers. comm.) reported Red-bellied Black Snakes Pseudechis porphyriacus and Diamond Pythons Morelia spilotes on his property, while an Eastern Water Skink Sphenomorphus quoyii and Eastern Water Dragon Physignathus lesueurii were seen near Minnamurra River. A Blue-tongue Lizard Tiliqua scincoides was found dead on the road between Jamberoo and Kiama. Frogs heard calling in Casuarina forest were thought to be the Bleating Tree Frog Litoria dentata.

4.3.4 Fishes

Although it was not possible in the time available to systematically study the fishes of Minnamurra River, the following extract from the Department of Environment and Planning's 1985 Regional Environmental Study of Jamberoo Valley gives some idea of the species present:

'The Minnamurra River supports populations of Australian bass, estuary perch and Australian grayling (the northernmost extent of this fish which seems to be declining in population).

'Also likely in the Minnamurra and its permanent tributaries are a variety of gudgeon, common galaxies or jollytail, the Australian smelt, the southern blue-eya and the long-finned eel'.

Further, the study by the Department of Main Roads NSW(1986) of Minnamurra River estuary noted that 'juvenile fishes were very abundant: the most common being Blackfish Girella tricuspidata, Australian Snapper Chrysophrys auratus, Yellowfin Bream Acanthopagrus australis, a species of mullet (possibly Mugil cephalus), Dusky Flathead Platycephalus fuscus and Silver Biddy Gerres ovatus. All species, except the mullet, are of commercial importance.'

4.4 Species of particular interest

Jamberoo Valley is of considerable interest with respect to species of plants and animals which are either rare and endangered or approaching the limits of their distribution. This section of the report details available information on such species

4.4.1 Plant species

Fuller & Mills(1985) identified several species from Tabbagong Forest which otherwise are absent from or of limited distribution on the coastal zone of central Illawarra, notably:

* Doryphora sassafrass Sassafrass: a common tree of the escarpment rainforests, otherwise only found at Tabbagong and Gerroa on the central Illawarra coastal plain
* Elaeocarpus kirtonii Pigeonberry Ash: limited to the escarpment forests with coastal locations at Tabbagong and just south of Gerroa
* Eucalyptus maculata Spotted Gum: found only at Tabbagong in the central Illawarra; 'This occurrence is possibly due to planting than natural regeneration. It is surrounding a farm homesite. Limited in extent and lines of trees are evident'
* Ficus coronata Sandpaper Fig: largely restricted to the escarpment rainforests in the central Illawarra, but occurring coastally around Gerroa and at Tabbagong
* Symplocos thwaitesii Buff Hazelwood: found in the escarpment rainforests with Tabbagong and Gerroa the only known coastal locations in the central Illawarra
* Syncarpia glomulifera Turpentine: largely restricted to the lower escarpment and upper valleys of the central Illawarra, with isolated stands at Tabbagong and Seven Mile Beach

The Bird Lime Tree Pisonia umbellifera occurs uncommonly in the central Illawarra where it is found unevenly distributed through rainforest at the base of the escarpment and at Minnamurra Estuary and Gerroa(Fuller & Mills,1985). Its preference for subtropical rainforest(Mills,1987) suggests that this species may also occur in the Tabbagong Forest.

Regarding species at or close to their southernmost limits of distribution, Mills(1987) listed the following three species as being associated with subtropical rainforest in the district; they may therefore well occur in Tabbagong Forest:

* Native Hibiscus Hibiscus heterophyllus, which was recorded from Tabbagong Forest in the present study and reaches its southern limit of distribution at Kiama

* Scrub Ironwood Austromyrtus acmenioides, which reaches its southern limit of distribution at Jamberoo
* Native Holly Coelebogyne ilicifolia, which occurs in drier rainforest patches or along eucalypt forest-rainforest margins(Fairley & Moore,1989) reaches its southern limit of distribution at Bombo, near Kiama

Another rainforest species, Native Celtis Celtis paniculata reaches the southern limit of distribution in littoral rainforest on the Minnamurra sand spit.

The Grey Mangroves Avicennia marina, which extend up Minnamurra River to just upstream of the proposed road crossing of the river, have a very restricted distribution in the central Illawarra, occurring only at Lake Illawarra entrance and Minnamurra River(Fuller & Mills,1985).

Although not directly affected by the current roadway proposal, the vegetation of site 4 contains the following two species of local interest(Fuller & Mills,1988):

* Black She-oak Allocasuarina littoralis: essentially a plateau species within the central Illawarra, with only a few coastal locations one of which is the Minnamurra Estuary
* Old Man Banksia Banksia serrata: confined to sandy soils along the coast and on the plateau, with only four significant stands in the central Illawarra coastal zone - at Illawarra Lake entrance, Bass Point, Minnamurra Estuary, and south of Gerroa

Finally, there are several rare or threatened plant species which could occur in Tabbagong Forest. These are listed below with their known conservation status, as determined by Briggs & Leigh(1988); the codes used are as follows:

2 :Species with a very restricted distribution in Australia and with a maximum geographic range of less than 100km
3 :Species with a range over 100km in Australia but occurring only in small populations which are mainly restricted to highly specific habitats
E :Endangered species in serious risk of disappearing from the wild state within one or two decades if present land use and other causal factors continue to operate
V :Vulnerable species not presently endangered but at risk over a longer period through depletion, or which largely occur on sites likely to experience changes in land use which would threaten survival of the species in the wild
R :Species which are rare in Australia but which are not currently considered endangered or vulnerable
C :Species known to be represented within a national park or other proclaimed reserve

The species in question are:

* Irenepharsus trypherus: occurs in gullies of the coastal region of New South Wales between Wollongong and Nowra; present in Budderoo National Park(Bureau of Flora and Fauna, 1982). The ecology of this species is poorly understood. Status: 2RC
* Sphaerocionium lyallii: Grows of rocks and trees in rainforests in the altitudinal range 400-1200m. Present in Budderoo National Park. Possibly unlikely to be present, as it prefers cool, moist locations; however, as several escarpment plants occur in Tabbagong Forest(Fuller & Mills,1985), the occurrence of this species at a lower altitude should not be entirely discounted. Status: 3RC
* Syzygium paniculatum: distributed from Jervis Bay to Bulahdelah with records from St Georges Basin, Beecroft Peninsula, Towra Point and Botany Bay. Occurs mainly in littoral rainforest on sand or in subtropical rainforest on sandy soil derived from sandstone (Floyd,1989). K.Mills(pers.comm.) considers this species unlikely to be present in Tabbagong

forest, but its presence should not be entirely discounted.Status: 3EC

* Typhonium eliosurum: recorded by Leigh, Boden & Briggs(1984) as occurring in or near coastal rainforest, or on banks of streams, generally on sandy or loamy soils. Recorded from the southern parts of the north coast, the central coast and south coast as far as the Jervis Bay district, with the only comparatively recent collections from the Nowra area. Present in Royal and MortonNational Parks. Occurrence in Tabbagong Forest considered quite possible (K. Mills,pers.comm.)Status: 3EC
* Zieria granulata: Recorded by Fairley & Moore(1989) as a species of the south coast of New South Wales, with a very restricted distribution in the Sydney district. Recorded west of Kiama at Saddleback Mountain, in the Jamberoo Valley, Budderoo and Killalea National Parks. Known also from Tabbagong Forest(K.Mills, pers.comm.) Status: 2VC

4.4.2 Animal species

Of particular interest among the fauna associated with Jamberoo Valley is the Australian Grayling Prototoctes maraena(Connell Wagner, 1990). This species is known only from south-east Australia including Tasmania. It formerly occurred on mainland Australia north to the Grose River near Sydney and south-west to the Otway Ranges in Victoria(McDowall,1976; Bell,Berra, Jackson, Last & Sloane,1980). The northernmost known contemporary locality for the species is Macquarie Rivulet, south of Wollongong. The northern limit of the Grayling's range has thus been reduced by some 160 kilometres. It now extends over some 250 kilometres of southern New South Wales, in rivers east of the Great Divide. McDowall(1976) recorded the species from nine localities within its NSW range, while Bell et al(1980) added a further five localities.

The Grayling was once commonly taken by freshwater anglers, but experienced a severe decline in numbers throughout most of its range in the latter half of the nineteenth century. Prior to the studies of McDowall(1976) and Bell et al(1980), the Australian Grayling was considered the Australian freshwater fish species most seriously threatened with extinction(Lake,1971). The species is now generally regarded as being rare, and is classified as 'potentially threatened' by the Australian Society for Fish Biology.

4.5 Conservation values

The Jamberoo Valley as a whole has long been highly-regarded for both its high scenic and natural values. Almost 15 years ago the National Trust of Australia(NSW)(1976) proposed the creation of the Jamberoo-Cambewarra Scenic Protection Area . This proposal subsequently found expression through the Illawarra Regional Environmental Plan No 2: Jamberoo Valley(Department of Environment and Planning 1985,1987).

In addition, it is now recognised that several relicts of natural vegetation within or adjoining the proposed road easement also have important conservation values; these are considered more fully below.

4.5.1 Minnamurra River wetlands

The high conservation values of the Minnamurra wetlands are well-recognised. The Department of Environment and Planning(1983) stressed that: 'The Minnamurra River estuary is an outstanding feature of the valley in particular and the northern half of the Region more generally. It has both local and regional significance'. The study continued that the extensive stands of mangroves and saltmarsh areas demonstrate 'the importance of the Minnamurra River as a nursery and feeding area for estuarine organisms ranging from tube worms and crabs to prawns and oysters. The wetlands also provide habitat for many wading birds'.

The study concluded: 'It cannot be stressed strongly enough that the values of the Minnamurra River estuary are many and that the estuary is indeed worthy of conservation. The value of wetlands to the community is much higher than the purely monetary values reflected, for example, in prawn catch figures and sales. These wetlands provide natural recreation areas, areas for scientific study and educational use. These non-monetary values are especially significant in this case in view of the proximity of the estuary to major residential centres'.

The Department's recommendations were, inter alia, that:

'* The Minnamurra river estuary should be conserved and protected from development pressures
* Conservation protection should include all wetland areas defined on the map(see Figure 4.2)
* To protect the wetland area a buffer zone between the wetland and any future development should be created
* There should be no drainage, filling, waste disposal or clearing in the wetland area'

These values and conservation measures were later re-endorsed by the Department(1985).

According to Dovers(1983): 'Minnamurra River is the largest river in the region, and the mangrove lined banks and naturally vegetated areas behind them are one of the most valuable areas remaining'. This view is confirmed by the NSW estuarine inventory prepared by the Division of Fisheries, NSW Department of Agriculture(West et al, 1985). This study established that Minnamurra River estuary contains 48.4ha of mangroves, 23.2ha of sea grass beds and 19.7ha of saltmarsh. The estuary thus supports the largest area of mangroves between the Georges River in Sydney and the Shoalhaven River near Nowra.

In 1985 State Environmental Planning Policy No 14: Coastal Wetlands was gazetted, 'with the aim of ensuring that coastal wetlands are preserved and protected in the environmental and economic interests of the State'(Department of Planning,1989). The estuarine wetlands of the Minnamurra River(Nos. 372, 373, 374A & B) have all been designated under this policy(see Figure 4.3).

Mitchell McCotter(1987) observed that 'The lower reaches of the Minnamurra estuary, to a large extent, still remain in their natural state and represent the last remaining undeveloped estuary between the Shoalhaven River and Wollongong'.

The ecological and economic values of estuarine wetlands are not only now widely recognised by are also the subject of a very large literature(e.g. Department of Main Roads,1986; National Trust,1985; Angel & Hayes,1983).

4.5.2 Tabbagong Forest

Tabbagong Forest is certainly of local and probably of regional conservational significance. As detailed in Section 4.4 above six tree species present in Tabbagong Forest are of limited occurrence elsewhere in the coastal zone of central Illawarra. Further, at least one and possibly three rainforest species at or near to the southern limits of their distribution occur in Tabbagong Forest. Finally, as many as seven rare or threatened plant species may well occur in this forest relict.

Figure 4.2 : Boundary of Minnamurra wetlands
(as defined by the Department of Environment and Planning, 1983)

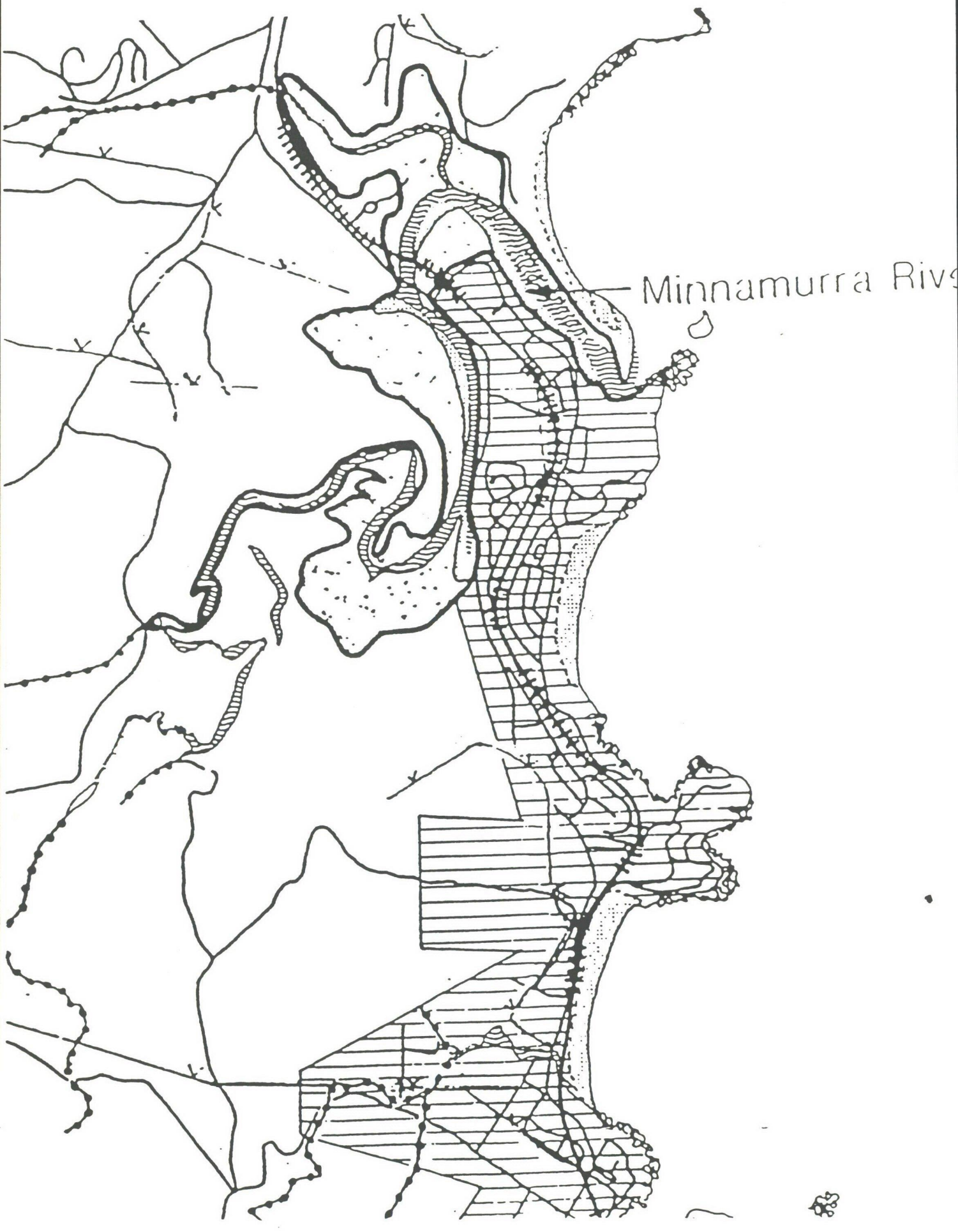
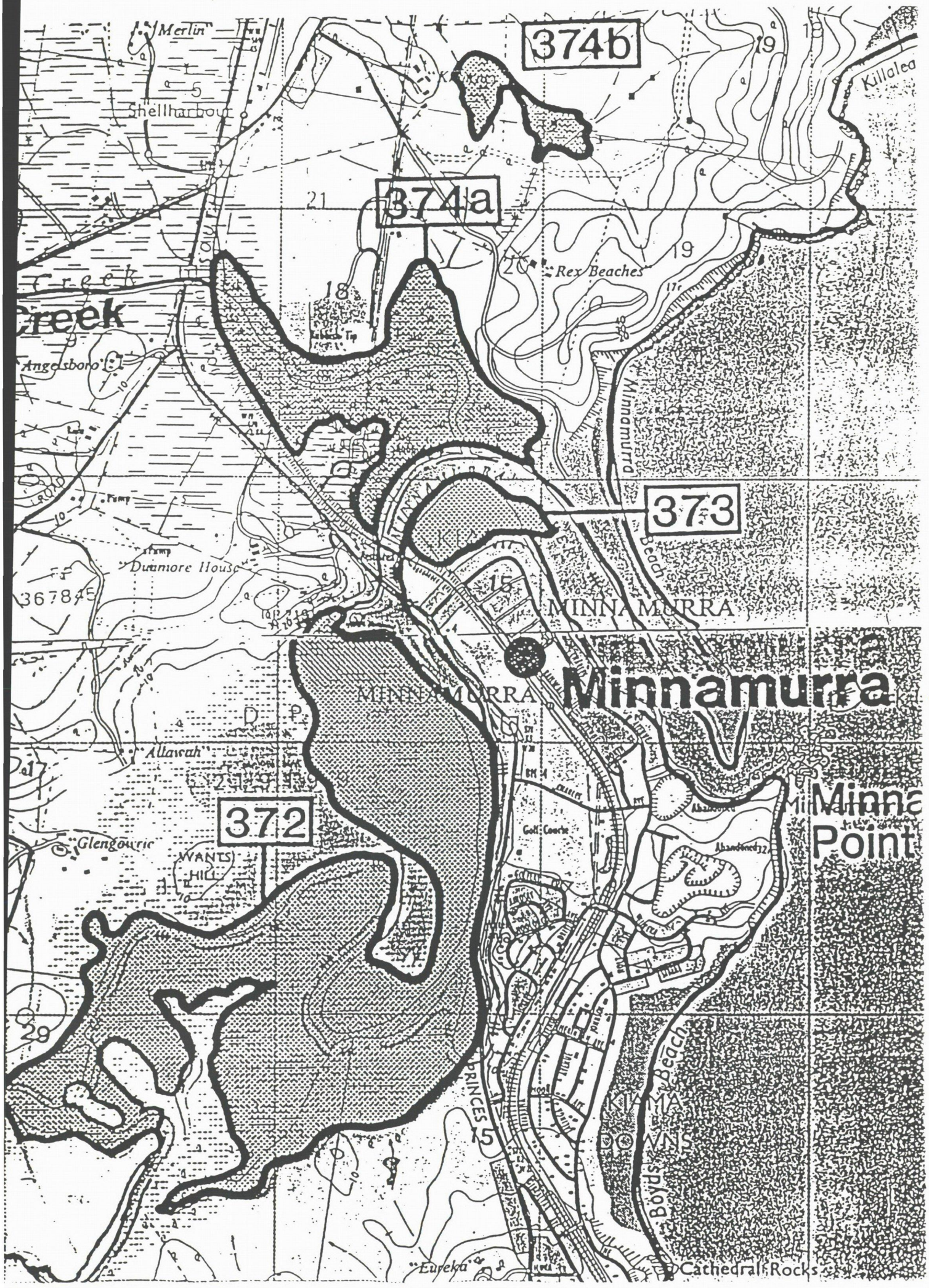


Figure 4.3 : Wetlands in the Minnamurra estuary designated under State Environmental Planning Policy No 14: Coastal Wetlands



4.5.3 Other natural vegetation

Several relicts of natural vegetation within or adjoining the proposed road easement also have important conservation values, viz:

Site 4:	A very important relict of eucalypt forest with a partial rainforest understorey; supports a diverse fauna, and acts as a faunal reservoir in the lower Jamberoo Valley
Site 5:	This freshwater wetland is an important feeding resource for waterbirds and waders, particularly in times of drought
Site 7:	This seasonal fresh swamp has high value as waterfowl habitat: the extent of this wetland type on the south coast has been much reduced by agriculture(Goodrick, 1970). Although small and much degraded by cattle, this wetland has a very high conservation value
Sites 10/12:	Estuarine wetlands important to a variety of waterbirds(herons, ibis, egrets) and waders(e.g. Latham's Snipe), particularly during droughts
Sites 13/14:	Although much degraded by cattle, these Casuarina forests have a very high conservation value and should be protected from further degradation

4.6 Conclusions

The natural lands adjoining or directly affected by the proposed roadway have very high ecological value: in particular, the Minnamurra River wetlands are considered to be of regional significance. Tabbagong Forest may well also be of regional siginificance, especially if further studies demonstrate the presence of rare or threatened plant species. It is recommended that the Roads and Traffic Authority support a study to establish more conclusively the ecological value of Tabbagong Forest. The forest is also important as a relatively large relict of the vegetation which clothed the coastal plains of the central Illawarra prior to European settlement. Other relict stands of natural vegetation may have some local significance.

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