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Pacific Highway upgrade Bangalow to Ewingsdale, stage 1 : review of environmental factors

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Roads and Traffic Authority NSW

Maunsell

Pacific Highway Upgrade
Bangalow to Ewingsdale
Stage 1

Review of Environmental Factors
Volume 1
Main Report

Prepared by:
Maunsell Pty Ltd

November 1997

ROADS AND TRAFFIC AUTHORITY NSW

PACIFIC HIGHWAY UPGRADE

BANGALOW TO EWINGSDALE

STAGE 1

REVIEW OF ENVIRONMENTAL FACTORS

Volume 1

Main Report

Prepared by:

MAUNSELL PTY LTD

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GLOSSARY

AADT	Annual Average Daily Traffic volume representing the total traffic in both directions at each location
ADT	Average Daily Traffic based on survey counts and not adjusted for AADT
Acid Sulphate Soils	Naturally acid clays, mud and sediment found in swamps and estuaries that may become extremely acidic when drained and exposed to oxygen causing acid leachate and runoff
Ambient Noise	The background noise at a point caused by sounds from near and far
Background Noise Level	A commonly used indicator of the base or background noise level representing the noise level exceeded for 90% of the sampling time. The background level is commonly referred to as the typical minimum noise levels. Symbol L_{90}
Batter	The side slope of walls, embankments and cuttings or the degree of the slope
Benefit Cost Ratio	The ratio of the present value of benefits to the present costs of the project
Biological Diversity	The variety and abundance of plant and animal life in a defined area
Carriageway	The portion of a road used by vehicles including the shoulder and auxiliary lanes
Culvert	Enclosed channel for conveying a stream below the road formation
Diversion drain	A drain leading water away from a defined area
Dual carriageway	A separated carriageway for traffic travelling in opposite directions
EMP	Environmental Management Plan
Ecologically Sustainable Development (ESD)	A development that maintains and improves the quality of life. Development now and in the future aims to maintain the ecological process on which life depends
EPA	Environment Protection Authority
Fill	Material placed in an embankment
Floodplain	Large flat area of alluvium adjacent to a watercourse, characterised by frequent active erosion and aggregation by channelled and overbank stream flow
Grade Separation	The separation of a road, rail or traffic so that crossing movements, which would otherwise conflict, are at different elevations

ha	Hectare
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways
km	Kilometre
km/h	Kilometres per hour
L_{A19} (18 hour)	Arithmetic average of L10 noise levels for each 18 hour sampling period from 6.00 am to midnight
L_{Aeq} (24 hour)	Equivalent continuous noise levels over any 24 hour period
L_{Aeq} (8 hr)	Equivalent continuous noise level over the eight hour period between 10.00 pm to 6 am
L_{Amax}	Maximum A-weighting noise level during a single event, for example the passing of a truck
m	Metre
mm	Millimetre
Net Present Value (NPV)	The present value of benefits less the present value of costs
Sedimentation Basin	An area where runoff and sediment is ponded to be deposited. The longer the period that the runoff is held, the smaller the particle size of the sediment deposited. Sediment basins need to be cleaned regularly.
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to the land flush with the surface of the pavement
Wetland	Land permanently or temporarily covered by water. The areas are usually characterised by vegetation of moist-soil or aquatic type.

Executive Summary

EXECUTIVE SUMMARY

Introduction

The Roads and Traffic Authority is proposing to construct an interchange and new three and four lane, 100km/hr limited access highway between the existing climbing lane at the base of St Helena Hill and the highway reconstruction north of the Ewingsdale Road intersection, located west of Byron Bay on the NSW north coast.

The proposal is the northern section of a larger proposal to construct dual carriageway between Bangalow and Ewingsdale. Through community consultation and a value management study, it was concluded that the current proposal should proceed while the remainder of the project is being further reviewed.

This Review of Environmental Factors has been prepared to assess the potential environmental impacts of the proposal. The document describes the proposal, provides details of the justification and implications of the work and documents a number of improvements to the earlier proposal. The document also outlines environmental safeguards to help ensure environmental impacts are minimised.

The Proposal

The proposal is to construct a three and four lane dual carriageway extending for 2.0km from the base of St Helena Hill to north of Ewingsdale Road at the commencement of the Tyagarah Duplication Project. The proposal will link into the existing Pacific Highway at both ends and will bypass the existing intersection of Myocum and Ewingsdale Roads with the Pacific Highway.

An interchange is to be constructed 300m west of the existing Ewingsdale Road intersection to service Myocum and Ewingsdale Roads. The proposed new interchange will be a "modified cloverleaf" type with loops in the south-west and north-east quadrants. The new highway will be built across the low point of Myocum Road and an elevated extension of Ewingsdale/ Myocum Roads will pass over a newly aligned highway. The overpass will be 56m long and contain two 3.5m wide lanes in each direction separated by a 1.2m wide median. A pedestrian footpath 1.8m wide will be provided on the northern side of the bridge and it will be separated from the vehicle lanes by a concrete barrier. The footpath will continue along the northern side of Myocum Road.

The bridge will be a concrete slab and pier structure with the central support pier located between the north and southbound highway carriageways. The bridge will have a 5.6m clearance above the highway.

Traffic from Byron Bay heading north will cross above the highway then proceed around the south-west loop under the bridge and gather speed before joining the highway. Traffic from Byron Bay heading south will proceed around the north-east loop under the bridge and gather speed before joining the highway. Vehicles travelling south along the highway and then wishing to proceed to Byron Bay will exit off the highway to use Ewingsdale Road. Vehicles travelling north and wishing to enter Byron Bay will exit off the highway before the interchange and proceed around the south-west loop before crossing over the highway. Access to and from Myocum Road will be from a "T" intersection with the south-west loop. The old Pacific Highway, both north and south of the existing Ewingsdale Road intersection, will be kept open for use by local traffic but will not allow access onto the new section of highway.

Environmental Assessment Process

The proposal is being assessed under Part V of the *Environmental Planning and Assessment Act, 1979.*

This Review of Environmental Factors will be publicly exhibited and comments will be sought from the community. At the conclusion of the exhibition period the Roads and Traffic Authority will examine the Review of Environmental Factors and public comments received and will assess the likelihood of significant impacts. On this basis, the Roads and Traffic Authority will determine if the project should be abandoned, should be subject to an Environmental Impact Statement or should proceed with or without further conditions to protect the environment.

Need

The proposal is Stage 1 of the Bangalow to Ewingsdale Pacific Highway Upgrade, which in turn is part of the overall upgrade program for the Pacific Highway between Hexham and the Queensland border.

Traffic accident records for the Bangalow to Ewingsdale section of the Pacific Highway show that over the six year period between 1990 to 1995, there were 82 accidents for this 6.4km length or 2.1 accidents per year per kilometre. Injuries occurred in nearly half the accidents and there were two fatalities. Of all the accidents, over 70% were at or close to the intersection at Ewingsdale.

Sight distance at the existing Ewingsdale intersection is limited by the location of a vertical crest of radius 5 500m and a 400m radius horizontal curve. Traffic congestion at the intersection is significant. Based on the traffic data for the project area the Pacific Highway/Ewingsdale Road intersection requires upgrading for the following reasons:

- the accident rate for the Pacific Highway/Ewingsdale Road intersection is unusually high and requires immediate corrective action;
- traffic capacity on the Pacific Highway/Ewingsdale Road intersection is currently exceeded;

- sight distances for the Pacific Highway/Ewingsdale Road intersection are limited by a vertical crest and horizontal curve;
- the volume of the Ewingsdale Road traffic turning to or from the north is large;
- the volume of heavy vehicle traffic on the highway is high, and because of the ongoing local service needs, is unlikely to reduce; and
- growth rates are expected to continue in the foreseeable future putting increasing strain on the existing road network.

If the proposed upgrade does not proceed, a situation will arise where there will be a high quality dual carriageway north of Ewingsdale on the Tyagarah section of highway and to the south at Bangalow. A poor section of road at Ewingsdale could consequently create significant problems for traffic flow and safety.

The environmental factors which justify the upgrade stem from the traffic issues and are:

- fewer accidents will reduce human injury, pollution spills and congestion; and
- improved level of intersection performance will reduce consumption of fuel, emission of air pollutants and noise.

Consultation

Consultation activities during the review of the realignment of the Bangalow to Ewingsdale section of the Pacific Highway involved public meetings, focus group meetings and discussions with affected landholders. Discussions were held with the local community, Government agency representatives and other stakeholders.

Although responses varied, most concentrated on the section of the Bangalow to Ewingsdale project south of St Helena Hill, with few concerns expressed about the northern section upgrade. Generally, there was strong support for the northern section to be built quickly and no submission questioned the need to upgrade or replace the existing Pacific Highway/Ewingsdale Road/Myocum Road intersection.

The following issues of concern were, however, expressed by the local community;

Visual Impacts - The natural beauty of the area is highly valued by the local residents and is an important tourist attraction. McLeods Shoot is considered to be one of the best known and most spectacular lookouts in Australia, encompassing the valley, rural lands and coastline. The construction of the interchange at the junction of the Pacific Highway and Ewingsdale Road is considered by the local community to have the potential to result in an adverse visual impact on the view from McLeods Shoot.

Design - The local community expressed concern about a design which would be out of character with the current environment where people come to escape the fast pace of the city.

Heritage - The local fig trees, church and hall south of the existing Ewingsdale/Myocum Road intersection are considered by many to be a significant contribution to the heritage values of the local area.

Real Estate Value - The loss of prime agricultural land is also a concern. The view was expressed that property owners will lose productive land which may seriously lower the value of the remainder of their property.

Noise

Road traffic utilising the proposed upgrade has the potential to adversely impact on the traffic noise amenity at a number of residential locations. The Environment Protection Authority's road traffic noise criteria are predicted to be exceeded at all of the noise sensitive locations in close proximity to the proposed works. The noise levels have the potential to be up to 14dB(A) above EPA criteria and 9dB(A) above existing noise levels, when extrapolate to 2010.

All locations except one are currently subjected to noise levels in excess of the Environment Protection Authority's desirable noise level limit. At one of the other locations it is expected that the noise level would reduce by about 6dB(A) following construction. This is a noticeable reduction in traffic noise, however the route will now be on the opposite side of the residence and it is expected that in 2010 the noise level at the rear facade of the residence will be unchanged from that experienced in 1997.

Noise amelioration measures will be required to reduce the predicted road traffic noise levels at all noise sensitive locations.

There are three options available to ameliorate road traffic noise, namely traffic noise barriers placed in the noise propagation path, low-noise road surfaces and the acoustic treatment of buildings. A fourth alternative is to relocate the building further away from the route on the same allotment. Public consultation will be carried out with the potentially affected residents to determine the preferred method of noise amelioration.

Construction noise is also likely to be consistently above the Environment Protection Authority's construction noise guidelines. It is inherently difficult to limit construction noise due to the nature of the process. Thus for this project the affected community will be consulted during all phases of construction so that a work program that minimises the impacts from the high noise level events may be developed. The contractor will be required to demonstrate that best available work practices are implemented during construction works. It may also be desirable to reschedule activities to increase the level of activity and reduce the exposure time. These matters will be negotiated with the affected community.

The following measures will be stipulated during the construction phase to minimise possible noise nuisance at adjacent noise sensitive locations:

- hours of Construction:
  Monday to Friday - 7 am to 6 pm.
  Saturday - 7 am to 1 pm. However, if construction is audible within residential premises then recommended hours are 8 am to 1 pm.
  Sunday - No construction work to take place on Sundays and Public Holidays;
- road traffic noise attenuation earth mounds and/or barriers to be built in the first stages of construction, if practical to do so, to assist in ameliorating the construction noise to these sensitive locations;
- use of high efficiency mufflers on all construction equipment;
- construction equipment to be well-maintained;
- the construction depot to be located away from residences; and
- haul roads to be well-maintained and repaired immediately if damaged.

Heritage

The heritage assessment for the project was undertaken in two stages. Initially a survey was undertaken of the entire project area between Bangalow and Ewingsdale. The survey addressed indigenous and non-indigenous heritage. During the initial survey the area was deemed to have a low potential for subsurface sites, based on the local topography which is dominated by narrow ridges and extensive wet areas around Myocum Road.

A second phase consisting of further more detailed field study involving test excavation work within the alignment was undertaken. No cultural material of indigenous or non-indigenous origin was found in any of the trenches. The surface around each trench was also inspected. However invariably thick ground cover precluded detailed examination. Nevertheless, no cultural materials were found on the surface within the Preferred Route. The nearby fig trees, church and hall will not be directly affected by the proposal.

Results of the surface survey and subsurface testing indicate that the probability of sites of any kind existing within the proposed corridor area is very low.

The low probability of sites occurring in this area precludes the need for archaeological monitoring of earth-moving activities in the area.

Visual Impact

The upgrade of the Pacific Highway and the construction of an interchange has the potential to alter the visual amenity of the area. Within the study area, agriculture and horticulture are the main land uses and farmhouses are scattered along the route corridor. Adjacent to the Ewingsdale intersection is the McGettigans Lane subdivision which is screened from the highway by existing vegetation.

The original vegetation of the corridor and surrounding areas has been extensively modified. Camphor laurel trees (*Cinamomum camphora*) now dominate the vegetation of the corridor area, with some pockets of native regrowth. There are no remnant areas of intact native forest in the immediate corridor area.

An avenue of large figs (*Ficus microcarpa var hillii*) which tower over the highway adjacent to the Byron Bay turnoff is a local landmark and feature of the "entry" experience to the region.

The proposed realignment of the highway will not affect these historic trees, but will isolate an attractive experience from highway motorists.

From the highway there are excellent panoramic views of the surrounding rural countryside and highway. The view from McLeods Shoot and the adjacent residences will be changed by the introduction of a new straighter section of highway, overpass, associated abutments and onramps, and landscaping and ancillary works.

The McGettigans Lane subdivision is largely screened from the existing highway. Proposed mounding and tree planting, as well as relocation of the highway away from this subdivision, will result in a lower visual impact than at present.

Proposed roadworks will allow for the retention of existing views where possible and noise barriers will be screened by vegetation. Screens will be set back from the carriageway by at least 2m to allow shrubs and trees to be planted along the roadside. This will help soften the visual impact of the barriers. Extensive tree planting will be planned on the other side of the barriers to soften the visual impact on views for surrounding areas.

To mitigate against the visual effect of the proposed works the landscape treatment designs aims to:

- promptly rehabilitate and stabilise disturbed surfaces;
- ameliorate the visual impacts on nearby residents, through roadside planting using endemic and "gateway" species;
- integrate new earthworks and roadways into the surrounding landscape; and
- create an attractive driving experience for motorists.

Air Quality

The upgraded road network is not expected to create air pollution problems. The dispersive effects of the local wind climate, and the moderate traffic volumes (compared with urban highways), mean that all vehicle air pollutant levels are less than a tenth of the thresholds of relevant health guidelines. Ambient air quality levels close to the new highway will be low and well within current guidelines, even adjacent to the road.

The maximum concentrations experienced by nearby vegetation are predicted to be much lower than those known to cause any significant changes in plant physiology or yield. The major air quality impact is likely to be fugitive dust generated during construction activity. Dust suppression will be during construction in order to avoid dust nuisance to traffic on the existing highway and to minimise the spillage and drift of dust onto the existing highway lanes.

The implementation of an effective management program for construction will help ensure that dust concentrations on the existing highway and at nearby residences are maintained below those known to cause nuisance. This will include careful planning of material handling and topsoil removal, a selection of conditions for dust-generating activities and regular cleaning of the adjacent highway lanes close to the construction zone. Exposed soils will be sprayed with water as necessary.

Social Impacts

The existing highway is also used by people in both the local and regional area. The highway is the main route to the NSW north coast and also to the smaller regional centres of Byron Bay and Bangalow. Residents in the corridor rely on the highway and Ewingsdale Road, and to a lesser extent St Helena Road.

Demographic data indicates that the highway is used by morning and evening traffic to access Byron Bay and agricultural businesses along the highway. There is also likely to be a significant movement of school children at certain times of the day.

Social issues of concern in the area include;

Access - The new interchange will provide safer movement of traffic access to and from the highway. There will also be less delays.

Safety - 2.5 metre wide road shoulders on the edge of the highway, on the overpass and access ramps will be provided for cyclists and hitchhikers and will allow motorists to pull out of the traffic. A pedestrian footpath will be provided on the north side of the overpass and will extend from Myocum Road to the old highway.

The roundabout and intersections have been designed to ensure adequate space for the movement of school buses, cyclists, pedestrians and provision will be made at the old highway / Ewingsdale Road intersection for a bus setdown point.

Tourism - Tourism is a significant factor in the region. Improvements at the Ewingsdale/ Pacific Highway intersection may make the tourist road through Lennox Head and Byron Bay more attractive to holiday makers. This could result in increased economic benefit for the towns by increased through traffic.

Settlement Patterns - In the vicinity of the roads connecting the proposed realignment to Byron Bay, there is likely to be an increased demand for urban development. The increased pressure for urban development, although not currently favoured by Byron Council, could occur as access improves and as the highway is identified as forming a distinct western boundary to the development of Byron Bay. The pressure for development may also eventually extend to the western side of the proposal in the vicinity of intersections as a result of greatly improved accessibility at these locations.

Severance - Community severance occurs when the residents of a community become separated or isolated from the services in their community, friends, relations and place of work and recreation. The proposed realignment is reinforcing an existing barrier which will not significantly alter local access patterns.

Five parcels of land are directly affected by the proposed roadworks. Severance of these properties is a problem and there have been discussions with the relevant landholders.

Flora and Fauna

Five vegetation communities were identified within the study area, being exotic regrowth, rainforest "paddock" trees, figs, water plants and grassland. The vegetation is strongly influenced by grazing of livestock. Pasture occurs on the majority of the site with opportunistic regeneration of exotic species occurring along fencelines, gullies or in rocky locations that impedes grazing. Figs and rainforest trees are scattered throughout the site. Only a minimal number of native species of any conservation value remain.

A total of 27 vertebrate species were recorded during the fauna survey including 18 birds, 4 mammals, 2 reptiles and 2 amphibians.

There were no threatened fauna species recorded on the site. The majority of fauna are typical of disturbed grassland and agricultural habitats. Most species recorded or expected are common to abundant across substantial distributions and many are generally tolerant of some level of habitat disturbance.

Hydrology

The proposed corridor runs in a north-south direction, crossing only two significant streams which flow in a general easterly direction towards the coast. Stream 1 only flows during rainfall and passes under the Pacific Highway in a westerly direction to Myocum Road and eventually joins the Brunswick River/Simpsons Creek system.

Stream 2 flows under the Pacific Highway north of Myocum Road and joins Stream 1 to eventually flow into the Brunswick River/Simpsons Creek system. Stream 2 is a small flowpath travelling parallel with, and slightly to the north of Myocum Road. Landuse within the catchment is rural.

During the construction phase of the project there will be an increased potential for sediment mobilisation resulting from ground disturbances and general construction activities. Site investigation has indicated that Acid Sulphate Soils are not present, however to minimise the mobilisation of sediment and ensure that it does not become available to stormwater runoff, a sediment and erosion control plan will be implemented during the construction phase.

After the construction of the proposed highway there will be a potential increase in pollutant loads in stormwater runoff resulting from the increased availability of pollutants and the increased washoff efficiency associated with the impervious area of the road. A stormwater management plan will be implemented prior to the operation phase and will target the reduction of pollutant loads in runoff by treating stormwater before it is discharged to receiving waters.

Introduction and Background

1

1.0 INTRODUCTION AND BACKGROUND

1.1 Purpose and Scope of the REF

Maunsell was commissioned by the Roads and Traffic Authority NSW (RTA) to carry out the route selection, engineering concept design, environmental impact assessment and management of community involvement for the Pacific Highway Upgrade from Bangalow to Ewingsdale on the NSW north coast.

This Review of Environmental Factors (REF) examines the highway route and interchange for the northern section of the Bangalow to Ewingsdale project. This document assesses the development of a 2.0km three and four lane divided highway from the base of St Helena Hill to north of Ewingsdale Road at the commencement of the Tyagarah Duplication Project, west of Byron Bay. The project involves a grade separated interchange on Ewingsdale/Myocum Road.

This REF has the following objectives:

- to define and scope the proposal;
- to present the need for the improved road conditions,
- to present an assessment of the alternatives;
- to identify the location of major engineering and environmental constraints;
- to predict and assess the environmental, social and economic impacts of the proposal; and
- to commit to safeguards and impact mitigation measures proposed to be adopted.

The REF has been prepared to:

- provide information to decision makers on the environmental impacts of the proposal in order to assist them in making decisions concerning the proposed realignment;
- identify the potential environmental, social and economic impacts of the proposed project;
- assist the RTA in making a determination on the significance of the environmental impacts of the proposal and whether the preparation of an Environmental Impact Statement (EIS) is necessary. The requirements of Clause 82 of the *Environmental Planning and Assessment Regulation, 1994*, have been addressed as part of this assessment.

To ensure the evaluation of this REF considers all relevant issues, this REF will be placed on exhibition. If the evaluation of the REF and public comments identifies that the proposal is likely to significantly affect the environment, an EIS will be prepared. If the proposal is not likely to significantly affect the environment, the RTA will decide if the proposal should be abandoned or if it should proceed with or without further conditions to protect the environment.

1.2 Background and Summary of the Project

The Pacific Highway on the north coast of NSW is being upgraded through a joint State and Federal initiative to provide a high quality road connection between Sydney and Brisbane. As part of the Pacific Highway Upgrade Program, the RTA proposes to construct an improved alignment for the Pacific Highway between Bangalow and Ewingsdale, west of Byron Bay.

On 9 August 1997 the Minister for Roads, the Honourable Carl Scully MP, announced that the project would be split into two stages. The planning and construction of the new highway from the base of St Helena Hill to north of Ewingsdale Road, including an interchange at Ewingsdale Road (Stage 1 - the northern section), would proceed as quickly as possible. The balance of the project from the base of St Helena Hill to the Bangalow Bypass (Stage 2 - the central and southern sections), will require more detailed study, including further consultation, before a route alignment is decided.

The section of the Pacific Highway round the Ewingsdale Road intersection is a significant "black spot" for road accidents and traffic delays. There is also increasing traffic growth in Byron Shire and the road alignment in the immediate vicinity of the intersection is sub-standard for the volume and type of traffic.

This REF assesses Stage 1, the Ewingsdale intersection and associated roadworks. The proposed works would not compromise the shortlisted options for Stage 2, St Helena to Bangalow section, but the cumulative impact of both stages is considered in this REF.

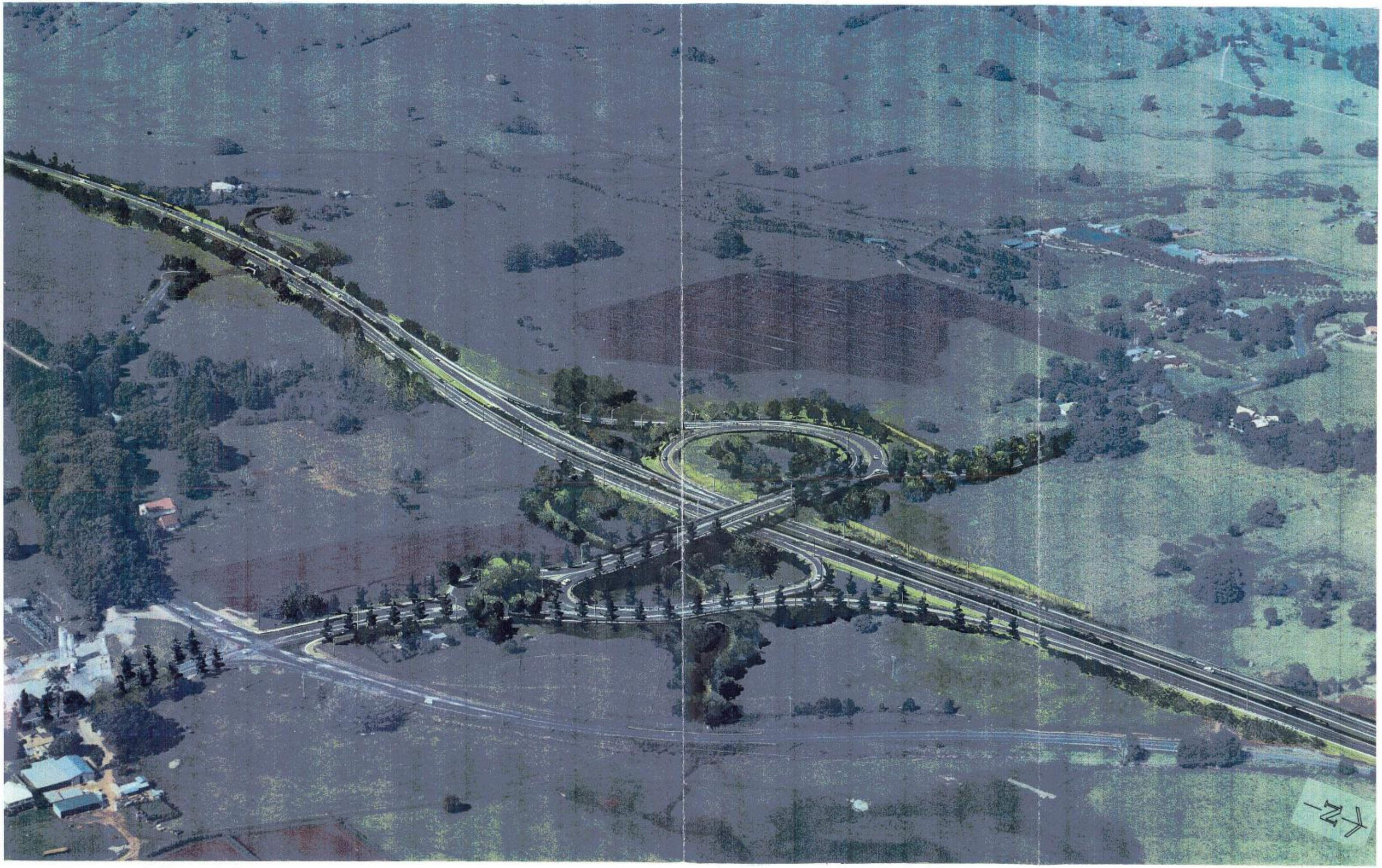
1.3 Location

The study area extends from the base of St Helena Hill to the current construction works for the Tyagarah Duplication Project. The southern extent of the study area is defined by the commencement of the existing climbing lanes on the Pacific Highway at the base of St Helena Hill north of the intersection of St Helena Road and the Pacific Highway south of Ewingsdale Road.

The study area is some 830km north of Sydney and 180km south of Brisbane. The section of Pacific Highway is between Ballina in the south and Brunswick Heads in the north and lies 4km west of Byron Bay, as shown in **Figure 1.1**. The Pacific Highway does not enter Byron Bay.

The proposed interchange would be situated on a new section of Pacific Highway some 300m west of the existing highway.

The section of highway is completely within Byron Local Government Area and it is within the Richmond River catchment.



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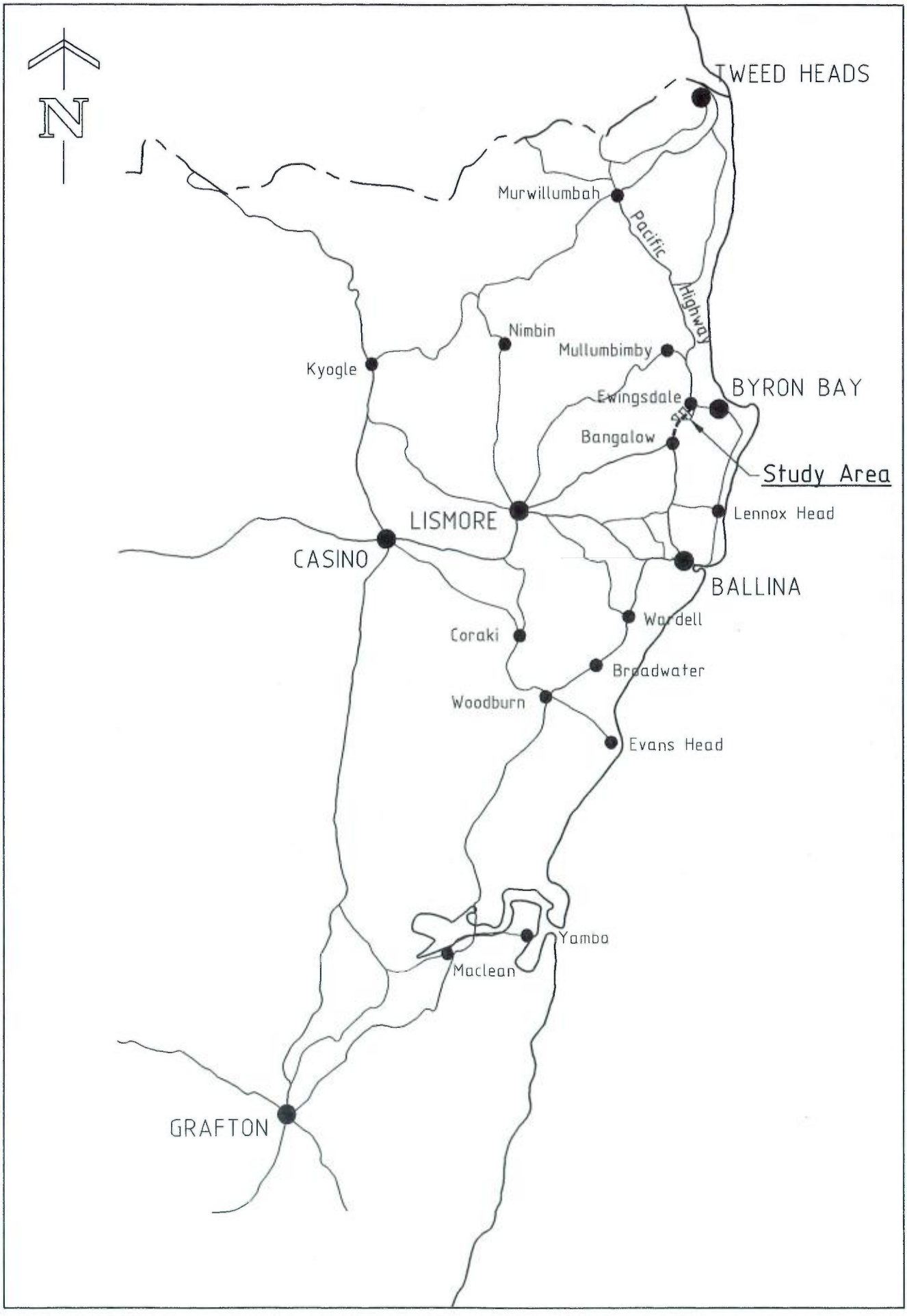
RTA

Upgrading the Pacific Highway

PACIFIC HIGHWAY UPGRADE
BANGALOW TO EWINGSDALE PROJECT
STAGE 1



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Regional Setting

Figure 1.1

1.4 Structure of Report

This REF is structured to provide a description of the existing road and an overview of the existing environment at the site, followed by an assessment of the likely implications for the environment. An expanded structure of the REF follows:

Executive Summary

Section 1 - ***Introduction and Background*** - which introduces the proposal, outlines the background to the proposal and details the structure of the REF.

Section 2 - ***Study Area*** - defines the regional and local setting of the study area.

Section 3 - ***Consultation*** - outlines the community and authority consultations which have been undertaken and the outcomes of public forums.

Section 4 - ***Statutory Requirements and Approvals Process*** - presents an overview of the relevant legislation and approvals for the project and details the role of the RTA.

Section 5 - ***Project Need*** - presents the strategic planning context, traffic conditions and environmental aspects of the proposal and identifies the benefits of proceeding with highway improvements.

Section 6 - ***Route Selection Process*** - provides a description of a range of options and evaluates them on the basis of environmental, social and economic criteria.

Section 7 - ***Project Description*** - outlines the preferred option, its major elements and describes its proposed operation.

Section 8 - ***Biological Environment and Impacts*** - considers geology, flora, fauna and hydrology and presents the potential impacts and proposed impact mitigation measures.

Section 9 - ***Socio-economic Impacts*** - addresses the social aspects and potential impacts and outlines impact mitigation measures which are proposed to be adopted. This section considers social, heritage, noise and vibration, landscape character, air quality, agricultural impacts, waste management and hazards and risks.

Section 10 - ***Ecologically Sustainable Development and Cumulative Impacts*** - discusses the principles of ecologically sustainable development and describes the potential cumulative effects of the proposal.

Section 11 - ***Environmental Management and Summary of Safeguards*** - outlines the environmental management system and impact mitigation measures.

Section 12 - ***Conclusions and Recommendations.***

Study Area

2

2.0 STUDY AREA

2.1 Regional Setting

The study area is located in the north coast region of NSW which is dominated by scattered tourist orientated towns along the coast and rural service towns on rivers further inland. The strip of land between the Great Dividing Range and the coast is relatively narrow (less than 50km) and provides prime agricultural land on fertile slopes and coastal plains.

The Pacific Highway generally runs along the western edge of the coastal plain, avoiding the main tourist towns such as Byron Bay. This arrangement has lead to the coastal towns becoming tourist centres with access roads to the highway, and towns along the highway becoming service centres for surrounding agricultural industries. There is consequently an increasing heavy emphasis on providing good intersection design to allow safe egress and ingress from the highway.

2.2 Local Setting

To the immediate north of Ewingsdale there is a 5km stretch of dual carriageway under construction which is anticipated to be completed by early 1998. Some 5km to the south there is the Bangalow Bypass dual carriageway which has almost been completed. The construction of the Bangalow to Ewingsdale dual carriageway is proposed to complete the 'missing link', providing a dual carriageway of high standard, increased safety for road users and improved access to Byron Bay.

The existing intersection of the Pacific Highway and Ewingsdale Road is the most significant road junction within the area. Ewingsdale Road provides the northern entrance into Byron Bay. At the western end of Ewingsdale is an industrial estate. Three new residential areas are proposed for Ewingsdale opposite the industrial area on existing rural residential blocks. Ewingsdale does not contain hospitals or service centres, however, an Anglican church and community hall are located on the Pacific Highway south of the Ewingsdale Road intersection.

The land that will be acquired for this development is presently under rural uses (see **Plate 2.1** and **Plate 2.2**).

2.3 Land Tenure

Almost the entire study area along the eastern and western sides of the Pacific Highway is private land held under freehold title. The only exception is a Crown reserve (R97213 gazetted 6.4.97) for Public Recreation and Community Purposes which does not abut the proposed works but lies between the corridor and the existing highway. The reserve was previously the site of an old school (9 818m^2) located just south of the existing Ewingsdale Road intersection on the western side of the existing highway.

There are no State Forests within close proximity to the study area. Tyagarah Nature Reserve is located 2km north of the study area. Hayters Hill Nature Reserve is 5km east and Andrew Johnson Big Scrub Nature Reserve is located 10km west of the study area.

The Casino to Murwillumbah railway line passes through Bangalow and Byron Bay but does not enter the study area.

Plate 2.1 Looking east - Rural landuse next to Myocum Road church, hall and fig trees along existing highway

Plate 2.2 Myocum Road in vicinity of proposed interchange, looking east towards existing Ewingsdale intersection

Consultation

3

3.0 CONSULTATION

3.1 Approach and Activities

A Community Involvement Plan for the whole Bangalow to Ewingsdale upgrade project was developed. It proposed early notification and media coverage at a local and regional level.

Consultation activities involved public meetings, focus group meetings and discussions with affected landholders. Discussions were held with the local community, government agency representatives and other stakeholders.

The chronology of consultation activities is shown in Table 3.1.

Table 3.1 - Chronology of Consultation Activities

Date	Activity
January 16, 1997	Planning Focus Meeting - A meeting of various relevant State and Local Government Agencies with planning responsibilities was held in Byron Bay to seek input on any issues of concern for the project;
January 16, 1997	Community Reference Group - Meeting No. 1 of various local representatives, including landowners, was held in Byron Bay to seek input on the project;
Ongoing	Landholder Discussions - discussions with affected landholders
January 1997	Community Information Sheet No. 1 was distributed to all potentially affected landowners and any other interested persons and copies made available from the display centres;
5 February 1997	Information Night - An information night for residents was held at the Ewingsdale Hall to explain the project and the study;
April 15, 1997	Community Reference Group - Meeting No. 2 was held at the Ewingsdale Hall;
May 7, 1997	A presentation was made to Byron Council;
May 1997	Public Display - A public display of options for the project was held at several locations in Byron Shire;
May 1997	Community Information Sheet No. 2 was distributed to all persons on the marking list and copies made available from the display centres. Comments on options were invited;
17 May 1997	Open Day - An open day featuring plans of the options and an opportunity for the public to discuss the project with the study team was held at the Ewingsdale Hall;
4 and 5 June 1997 and 1 July 1997	Value Management Study workshops were held and attended by Government Agencies, Shire Councilors, representatives from community groups and affected landowners, and project team members;

3.2 Local and State Government Agencies

Briefing notes were prepared and circulated to the key stakeholders and relevant Government agencies in advance of the Planning Focus Meeting.

The key stakeholders and relevant agencies included:

- Department of Urban Affairs and Planning (DUAP);
- Byron Council;
- Department of Aboriginal Affairs;
- NSW Agriculture;
- NSW Fisheries;
- Department of Mineral Resources;
- National Parks and Wildlife Service (NPWS);
- Environment Protection Authority (EPA);
- Department of Land and Water Conservation (DLWC);
- Department of Transport;
- Tweed Byron Local Aboriginal Land Council;
- Optus Communications;
- North Power;
- Northern River Region Economic Development Organisation (NOREDO);
- Northern River Organisation of Councils (NOROC);
- Telstra; and
- Local emergency management committee.

The issues expressed by government bodies during consultation are included in **Appendix A.**

Table 3.2 - Public Agency Issues

Issues
➢ The impact of the interchange on the Byron Bay gateway effect at Ewingsdale Road
➢ Maintenance of the row of fig trees at the Ewingsdale intersection
➢ Conservation of the church and hall at Ewingsdale
➢ The visual impact of the highway and the interchange as seen by traffic leaving Byron Bay
➢ Landscaping of the new road and its boundary
➢ The need for a detailed assessment of the agricultural lands by a specialised consultant. This data should then be considered during route selection.
➢ Protection of native vegetation within the study area with special reference to species which are threatened or regionally and locally significant flora species or communities
➢ Fauna which may be threatened, or regionally or locally significant

3.3 Landowner Discussions

The proposed Ewingsdale interchange and associated roadworks will impact on five parcels of land. Some 17ha of land needing to be acquired. The areas of land required are shown on **Figure 3.1.** Acquisition of private land will be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act, 1991* and discussions have been held between RTA and the affected landowners. Further details on the acquisition process are provided in Section 7.6.

3.4 Issues Identified during Consultations

The Planning Focus Meeting, discussion with landowners and discussion with community representatives resulted in more than one hundred completed exit surveys and written submissions to the project. A copy of the exit survey is contained in **Appendix B**. Although responses varied, most concentrated on the section of the Bangalow to Ewingsdale project south of St Helena Hill, with few concerns expressed about the northern section upgrade. Generally, there was strong support for the northern section to be built quickly. No submission questioned the need to upgrade or replace the existing Pacific Highway/Ewingsdale Road/Myocum Road Intersection, although two submissions objected to a route corridor west of Ewingsdale because of its property effects.

The following issues of concern were, however, expressed by the local community;

Visual Impacts
The natural beauty of the area is highly valued by the local residents and is an important tourist attraction. McLeods Shoot is considered to be one of the best known and most spectacular lookouts in Australia, encompassing the valley, rural lands and coastline. The construction of the interchange at the junction of the Pacific Highway and Ewingsdale Road is considered by the local community to have the potential to result in a visual impact on the view from McLeods Shoot.

The local community also expressed concern about any potential for the loss of the Ewingsdale/Byron Bay "gateway" created by a row of fig trees which line the Highway south of the Ewingsdale/Myocum Road intersection. The visual impact created from the removal of these trees would be significant.

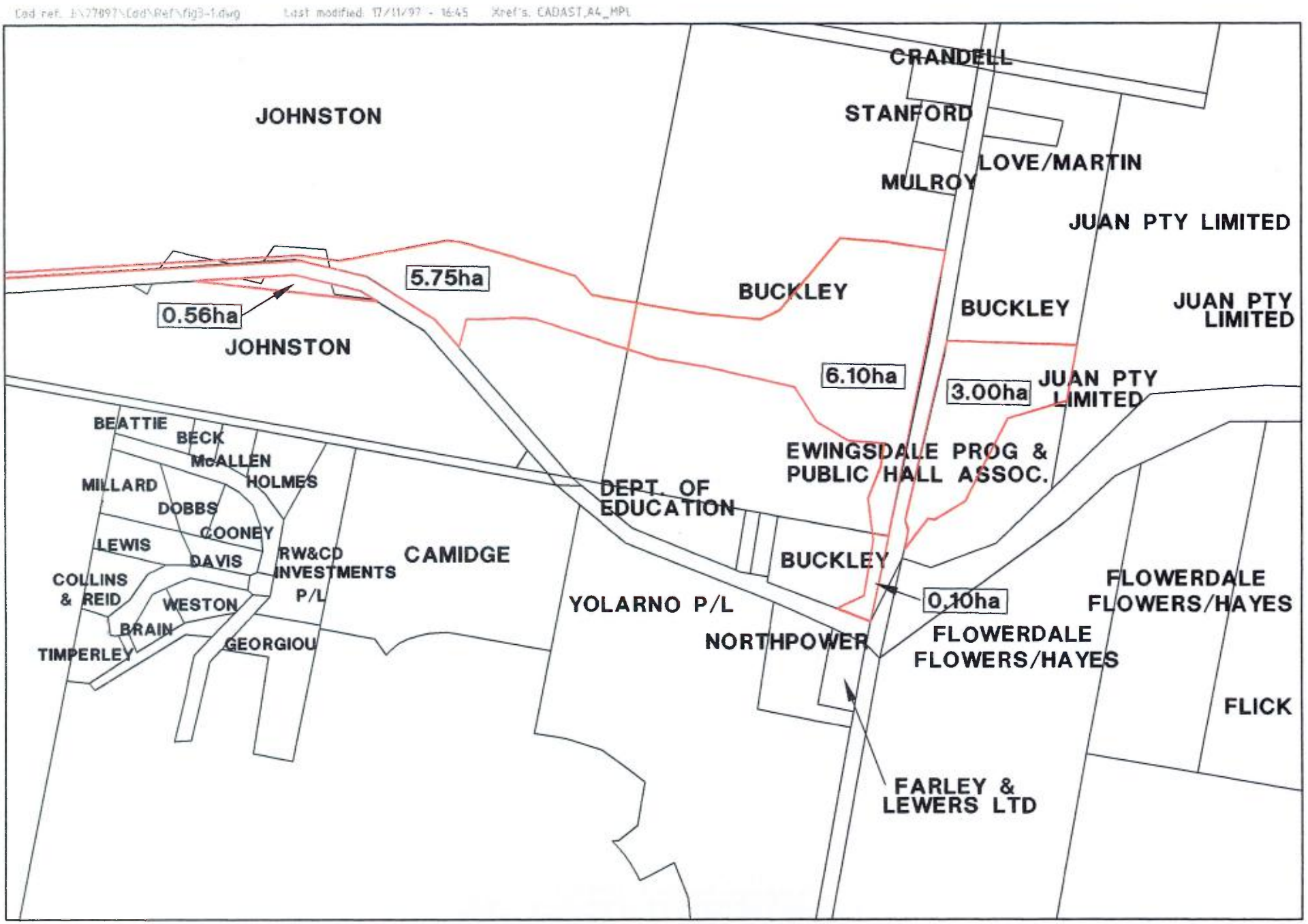
Design
The local community expressed concern about the design of the interchange. Concern was particularly expressed about a design which would be out of character with the current environment where people come to escape the fast pace of the city.

Heritage
The local fig trees, church and hall south of the existing Ewingsdale/Myocum Road intersection are considered by many to be a significant contribution to the heritage values of the local area.

Local residents were also concerned about the preservation of Araluen House and gardens established in the 1920's. Araluen House is at the southern end of the Ewingsdale project. The residents claim that the gardens may be a potential source of species or a seed source for old varieties of flowering plants collected by national seed saving organisations.

Real Estate Value

The loss of prime agricultural land is also a concern. The view was expressed that property owners will lose productive land which may seriously lower the value of the remainder of their property.



Land Acquisition Map

Figure 3.1

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Statutory Requirements and Approvals Process

4

4.0 STATUTORY REQUIREMENTS AND APPROVALS PROCESS

4.1 Local Environmental Plan

The Byron Local Environmental Plan, 1988, gazetted in April 1988, zones the area surrounding the existing highway and the area through which the proposed highway will pass, as 1(b1) Agricultural Protection Zone.

Item 3 of the 1(b1) zone permits, *"only with development consent", "any purpose other than a purpose specified in items 2 or 4"* Item 2 states that agriculture, bushfire hazard reduction, forestry and home occupations are permissible without development consent. Item 4 prohibits many activities, such as commercial premises, recreation areas, service stations, shops and tourist facilities. Item 4, however, does not prohibit road works.

Under the LEP Council consent is required for the proposed works, however as discussed below, State Environmental Planning Policy 4 relieves the RTA from obtaining Council consent.

4.2 Regional Environmental Plan

The North Coast Regional Environmental Plan (REP) gazetted in 1988, has the following objectives for transport within the region;

"To safeguard the role and efficiency of the main road system in the region, particularly by recognising the importance of the primary arterial roads"

The proposed upgrade and construction of the interchange supports this goal. The role of the Pacific Highway is to transport traffic along the NSW north coast. Where the Pacific Highway passes through Ewingsdale the role and efficiency of the network is being affected by increased travelling times, the high number of accidents and low speed limits. The proposed upgrade of the highway will eliminate these issues and contribute to the efficiency of the road system within the region.

Myocum / Ewingsdale Road is the most significant arterial road within the region linking Ewingsdale to Mullumbimby. The construction of the interchange will improve the safety for drivers when making the turn from the Pacific Highway or passing over the highway. Traffic on Myocum Road will not need to cross highway traffic. Myocum Road is proposed to cross over the Pacific Highway.

"to facilitate maintenance and improvement of transport in the region"

The Pacific Highway has a high accident record at the Ewingsdale Road intersection and long waiting times during peak periods. Transport in the region will be improved by the highway upgrade and interchange providing a reduction in travelling time and safer turning movements.

"restrict access on the road except at specially constructed intersections"

Private access to the Pacific Highway will be restricted after the highway upgrade. Two private properties will be able to access their properties via an access road and easement.

Access to the church and hall will be maintained via the interchange and old highway.

"where through traffic is in conflict with local traffic, make provisions for traffic to bypass urban centres"

The Pacific Highway is being moved 300m to the west of its current alignment and will bypass the Ewingsdale church and hall. Local traffic will be able to access these facilities via the old highway and interchange.

4.3 State Environmental Planning Instruments

4.3.1 State Environmental Planning Policy No. 4

Clause 11(c) of State Environmental Planning Policy No. 4 - Development Without Consent (SEPP No.4) enables

"development for the purpose of a classified road ... without development consent, provided the development would otherwise be permissible with consent."

The Pacific Highway is a "classified road" and development consent, from the local council is not required. Accordingly, the proposal is subject to provisions under Part V of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) where the RTA is the proponent and the determining authority for the proposal.

4.3.2 State Environmental Planning Policy No. 14

State Environmental Planning Policy No. 14 - Coastal Wetlands (SEPP No. 14) aims to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the State. No SEPP 14 wetlands are proposed to be effected by the Ewingsdale project although there are SEPP14 wetlands fringing the Brunswick River some 3km downstream. Measures will be taken to ensure that there will be no detrimental impact on the wetlands.

4.3.3 Other State Environmental Planning Policies

SEPP26 - Littoral Rainforests identifies stands of littoral rainforest and defines the types of development in those areas for which Council consent is required. No identified SEPP26 - littoral rainforest is proposed to be affected by the Ewingsdale project.

SEPP44 - Koala Habitat Protection, aims to encourage the conservation and proper management of natural vegetation that provides habitat for Koalas. The area is primarily cleared and does not support habitat for Koalas.

SEPP46 - Protection and Management of Native Vegetation, aims to conserve and manage native vegetation throughout non-metropolitan NSW. The SEPP, however does not apply to clearing up to 2ha per annum per landholding. The necessary tree clearing will be limited to isolated fig trees and exotic regrowth with less than 2 ha of tree clearing required.

4.4 Other Legal Requirements and Approvals

The *National Parks and Wildlife Act, 1974* (NPW Act), provides for the protection of national parks, nature reserves, state recreation areas, designated wilderness and archaeological sites. The NPW Act prohibits the disturbance of an archaeological site, threatened and protected fauna, designated wilderness or NPWS land, without a license, permit or other authority. No NPWS land is proposed to be affected and no known archaeological sites as detailed in Section 9 of this document, will be disturbed. If, however, an archeological site is found during construction, work in the vicinity will cease and approval will be sought from the NPWS and the Local Aboriginal Land Council before there is further disturbance to the site. If a threatened species is found, work will cease and an 8 part test will be undertaken.

The *Threatened Species Conservation Act, 1995,* has an 8 part test to assess the need for a Species Impact Statement (SIS). If the project was likely to significantly affect the environment of threatened species, or was likely to result in the taking, killing, disturbing or injuring of threatened species, then a SIS would have been required. The NPW Act contains schedules listing threatened species and the EP&A Act set criteria for an 8 part test for each determining authority to consider when deciding if a SIS is needed. No threatened species were detected within the corridor. An 8 part test has been undertaken (see Section 8.2.6) and it was concluded that an SIS is not required.

The *Clean Waters Act, 1970*, states that no one may pollute natural or artificial water courses without a licence from the Environment Protection Authority (EPA). An approval would need to be sought under the *Pollution Control Act, 1974*, from the EPA for the construction of temporary sediment ponds and permanent spillage control basins. A licence under the Pollution Control Act will be required for discharge from the temporary and permanent ponds and for the operation of any batch plant.

The *Noise Control Act, 1975*, aims to control unwanted or excessive noise and vibration from transport, industrial, commercial, recreational and domestic sources. The Act sets standards and requires licensing for activities, such as machinery used during construction of the road, which could cause noise problems. All machinery on this project will have the manufacturer's noise control equipment intact and will comply with the Act.

The *Clean Air Act, 1961* allows the EPA to specify what may or may not be discharged to the air by industry, vehicles and individuals. Open fires, other than any EPA approved pit burning of tree stumps would not be permitted during construction and all equipment will be operated according to the standards required by the Clean Air Act.

The *Heritage Act, 1977*, provides protection for items which have an Interim Protection Order or Permanent Protection Order. The Act also provides for consideration of all items which are greater than 50 years old, although such items often only need recording before destruction. If an item of potential heritage value is uncovered during construction, work in the vicinity will cease and advice will be sought from a heritage specialist.

The Commonwealth's *Australian Heritage Commission Act, 1975, Aboriginal and Torres Strait Islander Heritage Protection Act, 1984* and *Native Title Act, 1993* as well as the NSW *Native Title Act, 1994* require, in general, a consideration of Aboriginal interests in the land subject to the development. At the time of writing there were no claims over land in the study area. A representative of the Local Aboriginal Land Council has been on site and has confirmed that there is no reason why the roadworks should not proceed. It is not considered that a non-claimant notice application under Section 29 of the Native Title Act would be appropriate.

The Commonwealth's *Endangered Species Act, 1992* identifies endangered fauna which needs protection, however no such species are likely to occur in the area.

4.5 Commonwealth Assessment

The Commonwealth has contributed financially to the Pacific Highway Upgrade Program and consequently a copy of this REF will be provided to Environment Australia to allow for consideration of the project under the Commonwealth's *Environmental Protection (Impact of Proposals) Act, 1974*. Comments from Environment Australia will be sought during the REF exhibition stage and comments will be considered during the determination by RTA.

4.6 Role of the RTA

The RTA is the proponent and determining authority for the proposal.

Under Part V, Section 111, of the EP&A Act, the determining authority is obliged to:

> *"examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reasons of the activity".*

If it was determined that implementation of the proposal was likely to result in significant environmental impact then an EIS would be required.

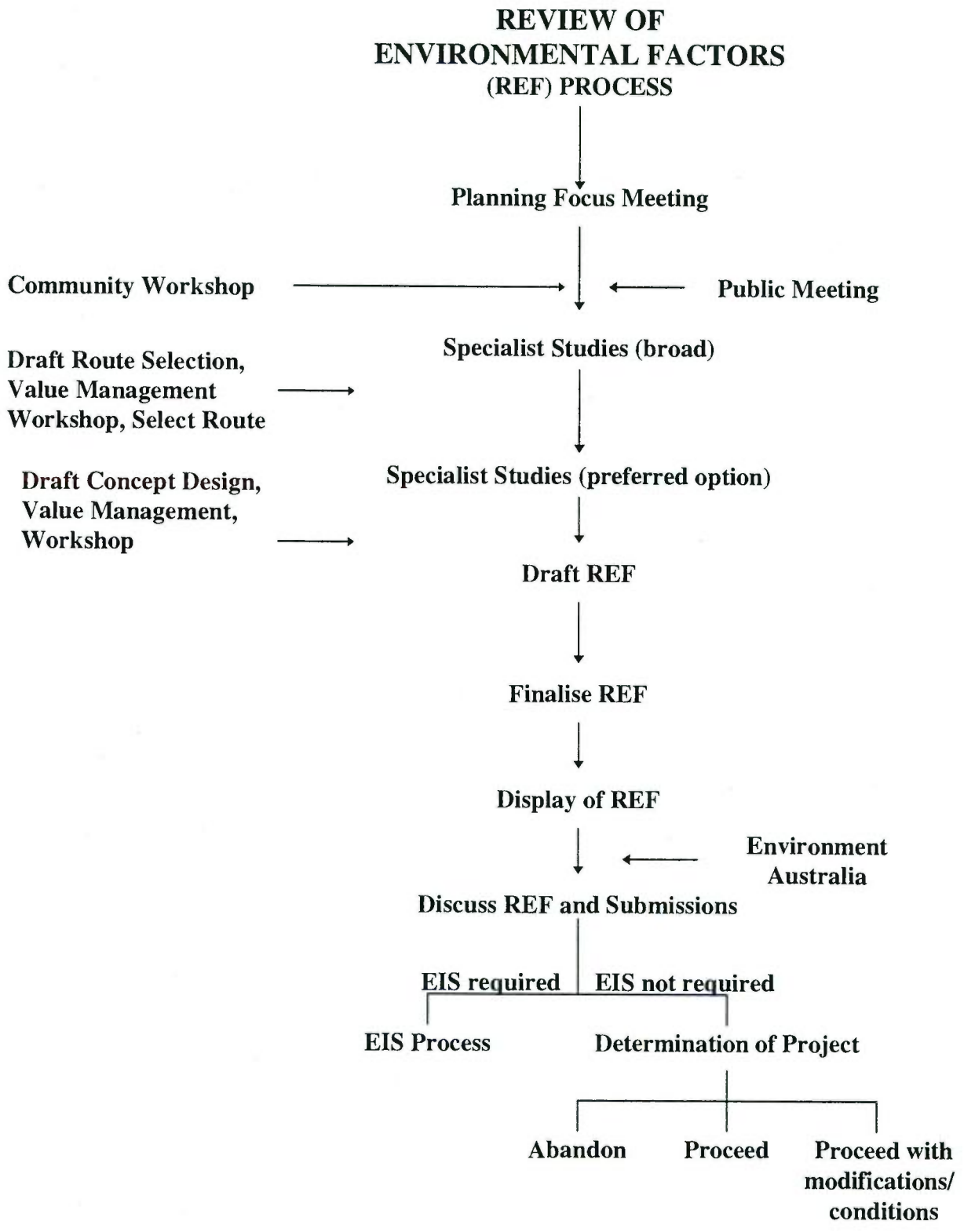
This REF investigates the potential environmental impacts and proposes appropriate safeguards. To ensure the community has an opportunity to comment on the REF, this REF will be placed on exhibition. If the evaluation of the REF and public comments identifies that the proposal is likely to significantly impact the environment, an EIS will be prepared.

The REF only forms one component of the environmental impact assessment process. The other elements of the process include:

- notification of relevant authorities of the proposed development;
- consultation with the local community;
- preparation of the REF;
- public display of the REF;
- assessment of the REF and of submissions from the community and Government Agencies by the RTA;
- decision by the RTA on whether an EIS is likely to be required for the project; and (if no EIS is required)
- determination of the project.

Figure 4.1 outlines the process.

Figure 4.1 Review of Environmental Factors Process



Project Need

5

5.0 PROJECT NEED

5.1 Strategic Setting

The Pacific Highway (State Highway 10) is the principal transport facility serving the north coast and provides the main linkage between Brisbane and Sydney and the north coast region. The north coast region is the fastest growing non-metropolitan region in NSW with a current population of 470 000 which more than doubles in the peak tourist season between December and January. Population growth scenarios have been modeled in the RTA North Coast Road Strategy (RTA February 1993) which estimates the population to grow by between 100 000 and 450 000 people by the year 2016. Most of the population growth is expected to occur in the Richmond Tweed Region but with significant growth in the north coast region. The strategy assumes that State and Local Government controls currently in place to prevent further dispersed growth would be upheld or strengthened. This would ensure continued growth focused on existing centres.

The Ewingsdale section of the Pacific Highway consequently plays an important role in the local, regional and State economy. It carries a mix of local and through traffic comprising freight, tourists, private and business travelers. As population on the north coast of NSW grows a similar increase in traffic volume along the project length is anticipated.

The road network is instrumental in supporting the growth. The North Coast Regional Environmental Plan (REP) gazetted in 1988, supports the North Coast Road Strategy by having the following objectives;

> *"to safeguard the role and efficiency of the main road system of the region, particularly by recognising the importance of the primary arterial roads;"* and
>
> *"to facilitate maintenance and improvement of transport in the region."*

Sections of the current Pacific Highway are inadequate for the purpose of supporting future traffic demands and the proposed Ewingsdale upgrade satisfies the objectives stated in the REP.

The Pacific Highway is funded by the State and Federal Governments and is classified as State Highway 10 (SH10). The RTA, supported by the State and Commonwealth Governments, has a long term aim of securing dual carriageway for the whole Pacific Highway between Hexham and the Queensland border. As stated in the RTA North Coast Road Strategy Report (RTA February 1993), " *SH10 is the backbone of the North Coast and provides its principal links with Brisbane and Sydney".* It has a major role in providing regional, inter-regional, and national freight movements, which will continue for the foreseeable future.

The strategy has the following objectives:

- significantly reduced road accidents and injuries;

- reduced travel times;
- reduced freight transport costs;
- a community satisfied with physical development of the route;
- a route that supports economic development;
- reconstruction of the route managed in accordance with ESD principles; and
- maximum effectiveness of expenditure.

The current proposal has sought to satisfy each of these objectives.

5.2 Existing and Predicted Traffic Conditions

5.2.1 Existing Road Network

A Preliminary Traffic Report was carried out by Maunsell (**Appendix C**) to examine the traffic and general transport issues associated with the proposed highway upgrade between Bangalow and Ewingsdale.

Low Design Speed
The present alignment of the Pacific Highway from the end of the Bangalow Bypass to Ewingsdale is a 6.4km section of two lane highway signed with an 80 to 100km/hr speed limit. The current standard is far below the RTA/ State/ Commonwealth agreed 100km/hr speed limit standard for the highway. The existing alignment contains sharp bends with horizontal curves with a minimum radius of 190m and vertical curves (crests) of 2 100m radius. These correspond to only a design speed of 70km/hr, based on AUSTROADS standards.

The intersection at Ewingsdale Road is an at-grade four way intersection with stop sign (priority) control. There are right turn slots for highway traffic protected by painted median islands. There are left turn lanes for each approach. The intersection and approaches have a signed speed limit of only 80km/hr. Sight distance is limited by the location of a vertical crest of radius 5 500m and a 400m radius horizontal curve.

A low design speed along this section of the Pacific Highway would contrast with the Tyagarah Duplication Project immediately to the north and the Bangalow Bypass section to the south. Continued substandard design would necessitate a reduction in speed limit and/or an increased expectation that accidents will occur.

Poor Condition
Ewingsdale Road is classified by RTA as a Regional Road. It forms the primary access to Byron Bay for traffic from the north, and also links Byron Bay with Mullumbimby, Bangalow and Ewingsdale. All of the remaining roads in the study area between the McLeod Shoot and Ewingsdale are administered by Byron Council and are classified by the Council. The most significant Council road in the study area is Myocum Road which is a Rural Arterial road with links to Mullumbimby from Ewingsdale. An inventory of the roads which connect to the Pacific Highway between McLeods Shoot and Ewingsdale is contained in Table 5.1.

Table 5.1 Road Inventory in Study Area

Road Name	Road Hierarchy Classification	Length (km)	Bitumen Seal Length (km)	Sealed Width (metres)
Pacific Highway	State Highway	2.1	2.1	9m to 14m
Ewingsdale Road	Regional Road			9m
Myocum Road	Rural Arterial	12.5	12.5	1.3km x 4m 11.2km x 7m
St Helena Road	Local Road	4.5	2.0	2.5m

The condition of the local roads is generally only fair. Improvements to the intersection of the Pacific Highway, Ewingsdale Road and Myocum Road will improve the design and, in part, the condition of the roads.

5.2.2 Road Safety and Traffic Accidents

Traffic accident records for the Bangalow to Ewingsdale section of the Pacific Highway have been made available by the RTA. The records have been analysed and the results are presented in Tables 5.2 and 5.3. Over a six year period, 1990 to 1995, there have been 82 accidents for the 6.4km between Bangalow and Ewingsdale or 2.1 accidents per year per kilometre. For the average annual vehicle kilometres (31 000 000), the probability of an accident is thus 4.4 E –7 per year (ie. 4.4 per 10 million per year), or the average accident rate per million vehicle kilometres (Mvk) is about 0.44. This rate is similar to the average for the whole Pacific Highway but is far higher than for dual carriageways. Furthermore, a high proportion of these accidents occurred at or close to the Ewingsdale intersection. .

As shown in Table 5.2, injuries occurred in nearly half the accidents and there were two fatalities. Of all the accidents, 59 were at or close to the intersection at Ewingsdale.

Table 5.2 Pacific Highway - Bangalow to Ewingsdale Accident Data 1990 to 1995

Year	Total Accidents	Fatal Accidents	Injury Accidents	Accidents at or close to Ewingsdale
1990	21	0	8	16
1991	12	1	9	7
1992	11	0	6	7
1993	15	0	6	13
1994	13	1	7	7
1995	10	0	2	9
Totals	82	2	38	59

Based on the RTA's Road User Movement record (accRUM) Table 5.3 now summarises the nature of the Ewingsdale accidents. The largest single category (nearly 40 % of the total) was intersection accidents (RTA codes 10 to 19) where vehicles from adjacent directions have collided. Collisions involving vehicles travelling in the same direction (either rear end or overtaking, RTA codes 30 to 39) represented a further 22%. Nearly half of the Ewingsdale accidents resulted in injury.

Table 5.3 Pacific Highway at Ewingsdale
Ewingsdale Intersection Accident Data 1990 to 1995

Year	Accidents at or close to Ewingsdale	Injury Accidents	Intersection Accidents (RTA codes 10 to 19)	Vehicles in the same direction (RTA codes 30 to 39)	Other accidents
1990	16	7	4	5	7
1991	7	5	5	2	-
1992	7	3	3	1	3
1993	13	6	5	2	6
1994	7	5	2	2	3
1995	9	2	3	1	5
Totals	59	28	22	13	24

The accident rate for the Pacific Highway/Ewingsdale Road/Myocum Road intersection is disproportionately high and indicates a significant safety problem.

5.2.3 Pedestrian, Cyclist and Equestrian Safety

There are difficulties for pedestrians crossing the existing highway and accessing Ewingsdale Hall and church, and the highway is narrow and unsuitable for bicycle traffic.

Related issues are safety of school children crossing the road to or from the school bus and safety of hitchhikers waiting at the Pacific Highway/Ewingsdale Road/Myocum Road intersection.

All of these issues can be improved by a new highway corridor with an interchange at Ewingsdale/Myocum Road.

5.3. Traffic Performance

5.3.1 Traffic Volumes

Traffic volumes on the Pacific Highway near Ewingsdale have grown 6% per annum between 1990 and 1995. In 1995, the annual average daily traffic (AADT) volume of vehicles per day north of Ewingsdale was 14 967 and 11 920 vehicles per day south of Ewingsdale. Ewingsdale Road had an AADT volume of 9 675 vehicles per day.

The Pacific Highway carries the predominant traffic volume in the study area. Traffic volumes on other local roads are considerably less. Average daily traffic (ADT) volumes on these roads have been obtained from Byron Council. Maunsell has undertaken additional traffic counts to supplement these where data was unavailable on local roads. The 1997 average daily traffic volumes on roads within the study area are shown in Table 5.3.

Table 5.3 Average Daily Traffic Volumes in Study Area

Road Name	Road Hierarchy Classification	1997 ADT
Pacific Highway - South of Ewingsdale	State Highway	11 920
Pacific Highway - North of Ewingsdale	State Highway	14 970
Ewingsdale Road	Regional Road	9 420
Myocum Road	Rural Arterial	1 060
St Helena Road	Local Road	210

A classified turning movement traffic count was also carried out by Maunsell at the Pacific Highway/Ewingsdale Road/Myocum Road intersection from 10.00 am to 6.00 pm on Sunday 13 April 1997. Based on permanent counter records this date and time was selected to coincide with the anticipated peak hour in a non-holiday week. The actual survey turning movements were then factored up to match the known AADT volumes on each approach road. The derived 1997 peak hour and daily turning movements are contained in **Figure 5.1**. The predominant turning movement at Ewingsdale Road is turning to or from the north.

The traffic capacity at the Pacific Highway/Ewingsdale Road intersection, according to AUSTROADS standards, is currently exceeded and requires upgrading.

The greatest number of vehicle movements occur between 3 pm and 4 pm on Sundays to Fridays at the intersection of Ewingsdale Road and the Pacific Highway, while the busiest time on Saturday is between 10 am and 11 am. A copy of the daily traffic movement count is included in **Appendix C**.

From a nearby permanent counter at Brunswick Heads (RTA site 270), 11% of highway traffic comprised heavy commercial vehicles in 1995, including 6.4% semi-trailers. A Queensland Main Roads 1990 study found that 70% of Brisbane - Sydney freight travels via the New England Highway. Consequently the majority of trucks on the Pacific Highway currently have a north coast origin and are unlikely to be encouraged to use the New England Highway.

The heavy vehicle volumes on the Pacific Highway, combined with the high traffic volumes on Ewingsdale Road and the predominance of traffic turning across the highway to head north, makes the existing low design speed and capacity of the Ewingsdale Road intersection a critical problem which requires resolution.

5.3.2 Future Traffic Volumes

A number of planning reports have been completed by both the RTA and DUAP which are relevant to forecasting traffic growth in the project area. The North Coast Urban Planning Strategy (Department of Planning 1994) expected the population of the Byron Shire to grow from 23 000 (1991 Census) to 43 000 by 2016. The population of the adjacent Ballina Shire was expected to grow from 30 000 (1991 census) to 58 000 by 2016. The entire north coast region was growing at a rate of 3.2 per cent per annum in 1991 and this growth was expected to continue in the foreseeable future. Anticipated future traffic volumes are shown in Table 5.4. The percentage of heavy vehicles is assumed to remain constant.

Table 5.4 Future Traffic Forecasts

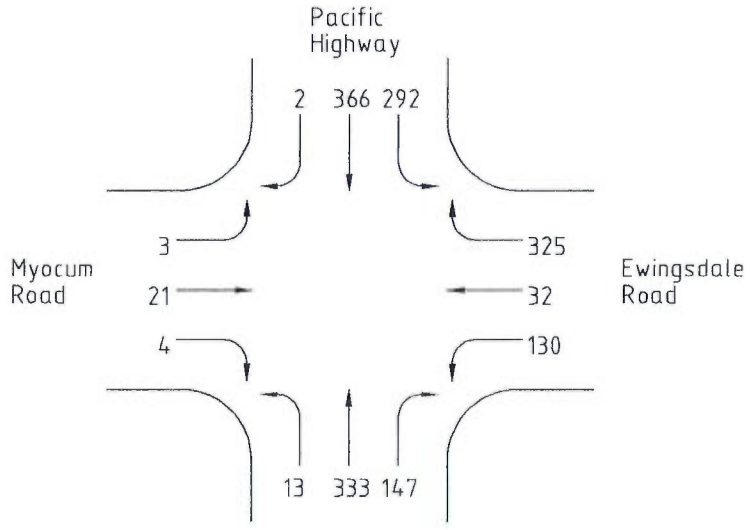
Road Section	1990 AADT	1995 AADT	2016 5% Growth Forecast	2016 3.2% Growth Forecast
Pacific Highway North of Ewingsdale	11 253	14 967	39 000	28 000
Pacific Highway South of Ewingsdale	8 678	11 920	32 000	22 000
Ewingsdale Road	7 021	9 675	26 000	18 000

The existing trends for growth in traffic on both the Pacific Highway and local roads are likely to continue. This growth is likely to exacerbate the existing problems.

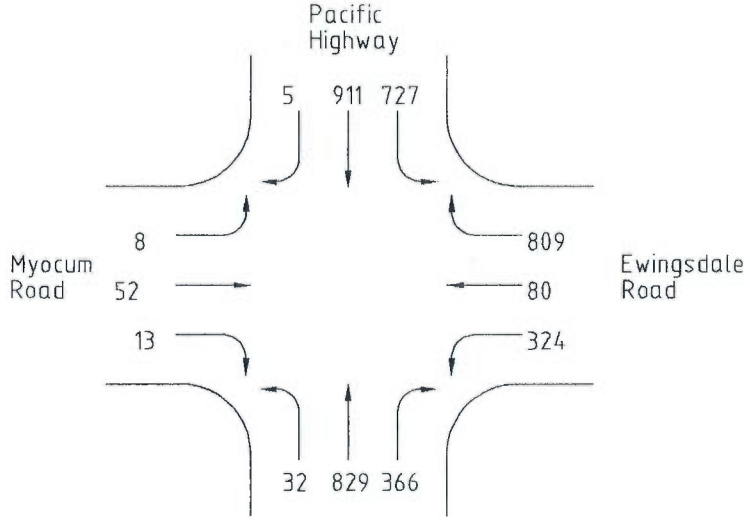
5.4 Overall Traffic Issues

Based on the traffic data for the project area the traffic capacity of the Pacific Highway/Ewingsdale Road intersection requires upgrading for the following reasons:

- this section of the Pacific Highway is below the required design standard;
- the accident rate for the Pacific Highway/Ewingsdale Road intersection is high and requires immediate corrective action;
- traffic capacity on the Pacific Highway/Ewingsdale Road intersection is currently exceeded;
- sight distances for the Pacific Highway/Ewingsdale Road intersection are limited by a vertical crest and horizontal curve;
- the volume of the Ewingsdale traffic turning to or from the north is large;
- the volume of heavy vehicle traffic on the highway is high and because of the ongoing local service needs is unlikely to reduce; and
- growth rates are expected to continue in the foreseeable future putting increasing strain on the existing road network.



1997 Peak Hour (Sunday 11-12AM)



2026 Peak Hour

Pacific Highway/Ewingsdale Road/ Myocum Road Intersection Traffic Volumes

Figure 5.1

5.5 Environmental Aspects

The environmental factors which justify the upgrade stem from the traffic issues raised earlier; viz:

- fewer accidents will reduce human injury, pollution spills and congestion; and
- improved level of intersection performance will reduce consumption of fuel, emission of air pollutants and noise.

The upgrade offers improved environmental controls for the handling of oil spills, road stormwater runoff and noise management. The planning, construction, operation and maintenance phases of the project would be undertaken considering the principles of ecologically sustainable development (ESD). These principles include the precautionary principle, intergenerational equity, conservation of biological diversity and ecological integrity and improved valuation and pricing of environmental resources.

The upgraded highway will result in environmental impacts at a local level, although improved traffic flow and improved stormwater and spill controls will create environmental benefits. In regional terms, through improved traffic flows and accessibility, the environmental benefits are likely to be substantial.

5.6 Consequences of Not Proceeding

If Stage 1, incorporating the new interchange, is not constructed then local traffic will be required to continue using the existing Pacific Highway/ Ewingsdale Road intersection. This will most likely mean that accidents will continue to occur at their existing high rate and severity. If the proposal does not proceed the following will occur/ continue:

- the existing low design standard on the Pacific Highway near Ewingsdale will be exacerbated by the completion of the adjacent high quality Tyagarah Duplication Project;
- the high accident rate at the Ewingsdale Road intersection will continue and, because of the above point and the expected traffic growth, is likely to increase; and
- the low design speed due to the poor vertical and horizontal geometry will continue to result in traffic delays on the Pacific Highway with resultant environmental costs; and
- the limited capacity of the existing intersection will continue to result in traffic delays.

Route Selection Process

6

6.0 ROUTE SELECTION PROCESS

6.1 Selection Criteria

This project is part of the RTA's ten year Pacific Highway Upgrade Program, which has the following key transport objectives:

- to reduce travel times;
- to reduce freight transport costs;
- to reduce accidents/fatalities;
- to increase safe overtaking opportunities; and
- to improve the alignment and elimination of narrow bridges.

The current proposal, Bangalow to Ewingsdale Upgrade Stage 1, has been part of the full Bangalow to Ewingsdale Upgrade Project (Stages 1 and 2). The full project has been subject to route option investigations. The route options have been evaluated through two Value Management workshops. The workshops have also evaluated interchange options.

The route and interchange options have been developed in light of the above selection criteria as well as the constraints within the study area.

The Value Management workshops (VMS 1 and 2) shortlisted two route options (B and F) and resolved that these two route options should be further investigated. Any corridor option at Ewingsdale needs to be considered in the context of the route options for the full Bangalow to Ewingsdale Upgrade. The two shortlisted options have a common corridor in the northern, Stage 1/ Ewingsdale, end of the route.

The second Value Management workshop (VMS 2)reviewed interchange design options and resolved that the "south-west trumpet" interchange design should be further investigated.

These route and interchange options are discussed below. The main criteria which were used to evaluate the options were:

- visual impacts;
- land severance and impact on land productivity;
- impact on residences;
- impact on natural values;
- requirements in land-take;
- impact on Ewingsdale, Ewingsdale Hall, church and corridor of fig trees;
- ability to meet RTA's design criteria (including a 100km/hr design speed and acceptable grades);
- ease of operation and safety; and
- costs.

6.2 Constraints

A number of constraints that exist in the study area dictate alignments for the remainder of the Ewingsdale to Bangalow route. These include the following.

The Ewingsdale Hall and church are located near the south-west corner of the existing Ewingsdale Road intersection. Further south of the intersection there is a row of mature fig trees adjacent to the road. The local Ewingsdale community wants these features protected and this has limited upgrading options near the existing intersection. There is also a concrete batching plant owned by Farley and Lewers Ltd (Readymix) located on the south-east corner of the intersection. The north-east and north-west corners of the intersection are farms owned by the Hayes and Buckley families respectively.

To the east of the Pacific Highway/Ewingsdale Road intersection there is light industry along the road into Byron Bay and to the south-east of the intersection there is a housing subdivision. In addition to the strong local pressure to avoid impacts on the Ewingsdale Hall, church and fig trees, residents and Byron Council feel that the severance impact of the highway through Ewingsdale would be undesirable.

The realigned highway needs to join with the four lane highway currently being built from Ewingsdale to Tyagarah. A temporary connection from the Tyagarah Duplication Project to the existing highway has a horizontal curve radius of 270m which is far less than the 600m desirable minimum. The Tyagarah Duplication Project has been designed to tie into a new road located west of the existing highway.

This combination of constraints has resulted in only a highway upgrading corridor to the west of Ewingsdale being suitable.

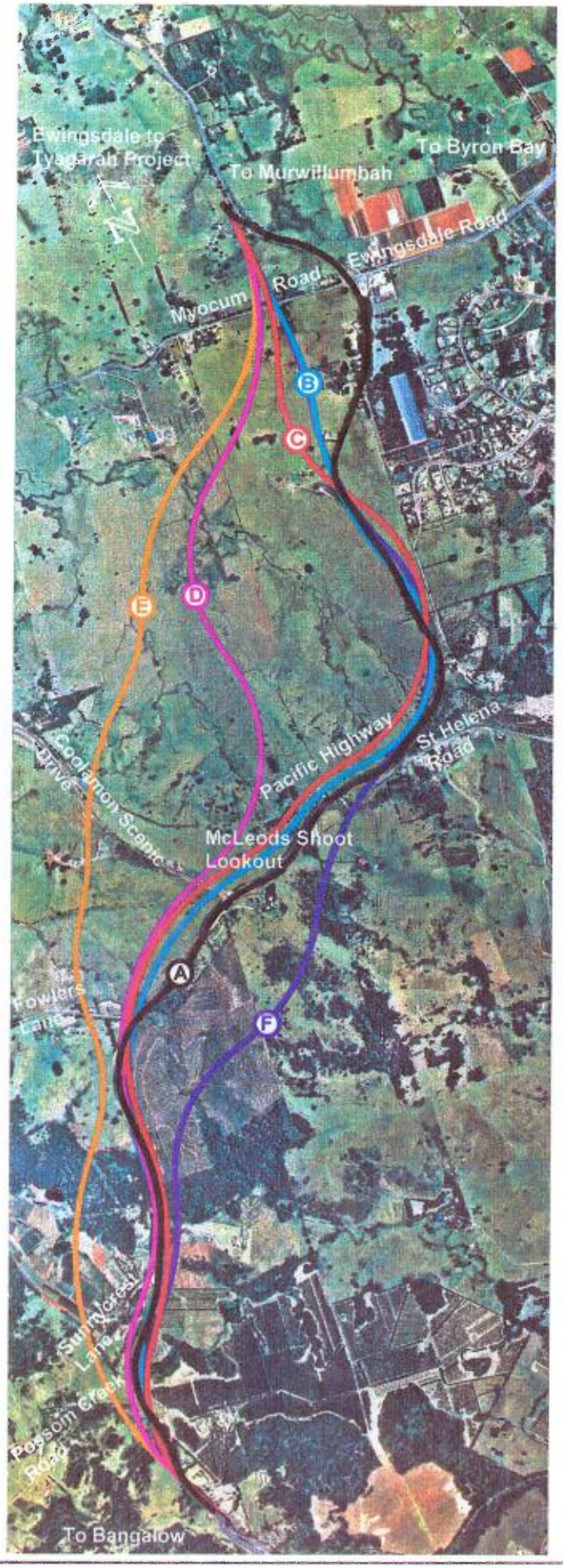
6.3 Initial Option Development

The options developed for the complete upgrading of the existing highway from Bangalow to Ewingsdale are labeled A to F, on **Figure 6.1** and are outlined below (Option A is the existing road for purposes of comparison).

6.3.1 Option B - Minor Upgrade Existing Highway

Option B was the upgrade of the existing highway to the minimum standard which could be tolerated on a 100km/hr highway. Although this option has deliberately been kept as close to the existing road as possible, because of the number of tight horizontal curves and sharp crests needing reconstruction, some sections of the existing highway would still need to be reconstructed.

This option is one of the two options which have been shortlisted and a modified Option B is being refined and evaluated for a design speed of less than 100km/hr.



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Route Options (Options A - F)

Figure 6.1

6.3.2 Option C - Major Upgrade Existing Highway

An investigation was also made of the effects of reconstructing the existing highway upgraded to a desirable 100km/hr design standard. Option C is in most respects similar to Option B, but with larger deviations from the existing highway, in order to achieve a desirable rather than minimum alignment. A cutting required at the crest near McLeods Shoot would be 25m deep and would extend into the existing lookout, requiring its relocation. This cutting would have significant visual impact.

South of Fowlers Lane this route follows the existing highway corridor, however, the road would need to be totally reconstructed to the desired standard with 600m minimum horizontal curve radii.

6.3.3 Option D - Central Route

This route option deviates from the northern section of the existing highway and locates the new highway along a central spur extending north-west of McLeods Shoot. From Fowlers Lane south, it follows the existing highway as in Options B and C. This route achieves a high standard of operational safety through much improved geometry. The two most obvious impacts however are the very large (50m deep) cut on the ridge at Coolamon Scenic Drive west of McLeods Shoot and the large embankment (40m high) needed at the base of the ridge. These impacts are both severe due to the steeper nature of the terrain to the west of McLeods Shoot and the correspondingly greater difficulty in grading a highway over it. Visual impacts would also be very significant.

6.3.4 Option E - Western Route

This option moves the highway to the west and the existing highway becomes a service road for local access. Like Option D, this allows a high standard of operational safety, with similar horizontal curve radii and gradients. At the point where this route crosses Coolamon Scenic Drive west of McLeods Shoot, there is a major change in elevation. This would result in a very large approach embankment (35m high) and deep cut through the ridge (45m deep) with resultant significant visual impact. Because this route deviates the most from the existing highway, it would be difficult to construct in stages.

South of Fowlers Lane the route follows a new corridor west of the houses at Sunnycrest Lane. This reduces impacts on some residences but affects an area of remnant rainforest.

6.3.5 Option F - Eastern Route

This route follows the existing highway slightly to the west from Ewingsdale Road/Myocum Road to St Helena Road but then deviates to the east of the current highway as far as Possum Creek Road. This route achieves the desirable 100km/hr highway standards with horizontal curve radii 600m minimum and crest sight distance curves of radii 6 600m minimum. There is still a substantial cutting (35m) at the top of the ridge immediately south of St Helena Road. However this would be on the eastern side of the existing skyline and so would be less visible from the north. Conversely the cutting would be visible from the valley to the south-east of McLeods Shoot, which is currently shielded from the highway by the ridge. McLeods Shoot lookout would be unaffected. This option has a major impact on an existing banana farm and some impact on an area of remnant rainforest. These impacts may be reduced by the use of viaduct structures.

Option F is one of the two shortlisted options and a modified Option F is being refined and evaluated.

6.4 Value Management Studies (VMS 1 and 2)

In accordance with New South Wales (NSW) Government policy, a Value Management Study (VMS) Workshop was held in Byron Bay on 4 and 5 June 1997 to develop route options and ensure an optimum solution was obtained for the overall Ewingsdale to Bangalow project. The VMS workshop was attended by 21 participants including representatives of local landowners, RTA, other State Agencies, Byron Council and various technical specialists engaged by Maunsell to analyse the project.

A second VMS workshop was held in Byron Bay on 1 July 1997 in order to review amendments to the options carried out after VMS 1.

The first VMS considered the Ewingsdale to Bangalow project by splitting it into three sections, northern, central and southern. The northern section started north of St Helena Road. This effectively corresponds to the section covered by this REF.

The VMS discarded Options D and E, and preferred Option F over Option B for the southern and middle sections. In the northern section, the VMS supported a proposed new highway route and interchange west of Ewingsdale which was common to routes Options F and B. There were a number of modifications, however, which were requested to this route:

- a curvilinear alignment was to be adopted;
- acoustic mitigation was to be provided to meet the EPA guidelines;
- the effect on the two Johnson houses and the Singh's house was to be minimised; and
- the highway should be moved to the west after passing on the eastern side of the Johnson house.

The second VMS reviewed the modifications made to the preferred option following the first VMS. The modified option (Option F modified) had achieved all of the first VMS recommendations except for the curvilinear alignment, which proved incompatible with the other recommendations. The second VMS accepted the modified route option (Option F modified) and chose a preferred Ewingsdale interchange option.

The following preferences were stated for the new Ewingsdale interchange:

- a south-west trumpet was the preferred option; and
- a diamond with a large roundabout on the western side should not be ruled out.

Subsequent to the second VMS a decision was made to investigate further both Options B and F. Option B was shortlisted because the RTA has agreed to consider the implications of reducing the grade and design speed requirements for this section of the Pacific Highway. Both Options B and F have the same broad configuration in the section north of St Helena Hill (Bangalow to Ewingsdale Stage 1).

6.5 Stage 1

Although a final alignment has not been selected for the southern section of the project Options B and F have been shortlisted and are being further refined and evaluated. Both of these options are compatible with the corridor and interchange options developed for the northern section of the project and discussed at the second Value Management workshop.

Option B or Option F have their northern limit 500m north of St Helena Hill. Analysis of the topography to the west of Ewingsdale shows that the shortest and lowest cost option is the most direct route between the highway at the bottom of St Helena Hill and the highway north of Ewingsdale. This route has received consistent support at all consultation meetings and so both options considered for the northern section upgrading have been based on it. The selection of either Option B or F means that the construction of the interchange west of Ewingsdale Road can proceed.

The currently proposed Stage 1 of the project in the vicinity of Ewingsdale will involve the reuse of the existing highway on the southbound carriageway from the current two lane climbing section at the base of St Helena Hill for a distance of 0.7km. Adjacent to this section of the existing highway a new lane will be constructed on the western side to be used as the northbound carriageway. From there a new four lane highway will be constructed for a length of 1.3km to the end of the project north of Ewingsdale. An interchange will be constructed with the local road connection (Myocum Road) bridging over the new highway carriageways.

The interchange would be approximately 300m west of the current Ewingsdale Road/Myocum Road intersection. This has the advantages of minimising impacts on Ewingsdale and straightening the Pacific Highway, which reduces transport distances and costs. The interchange location also has the advantage of being in a natural depression, which reduces the visual intrusion of the interchange, and allows grade separation between the new highway and Myocum Road.

6.6 Horizontal or Vertical Alignment of the Northern Section

For the total Ewingsdale to Bangalow project, it was intended to achieve as close as possible a balanced earthworks cut and fill design. With the possible use of viaduct/ bridge structures instead of large fill embankments on the central and southern sections, there was a potentially large quantity of excess fill material from cuttings through McLeods Shoot. This was counterbalanced by raising the new highway across the northern section. This grading alignment was also designed to complement the Tyagarah Duplication Project currently under construction. The new interchange at Ewingsdale Road/Myocum Road was proposed to be built with the new highway carriageway bridged over the local road connection (Myocum Road). This would have resulted in the flattest grading on the highway, and the largest quantity of fill being used. This alignment option was compatible with any interchange option.

The recent announcement that the northern section is proposed to be built as a separate project prevents the possibility of using fill generated from the remaining southern section of the highway project. It will, however still, be desirable to balance cut and fill volumes as far as possible within the current northern section upgrading. This can be achieved by lowering the highway alignment. The new interchange at Ewingsdale Road/Myocum Road is now proposed to be built so that the local road connection (Myocum Road) bridges over the new highway carriageways. This results in the least quantity of imported fill being required. This alignment option is also compatible with any interchange option.

6.7 Fill Requirements

Under a high alignment option (highway over Myocum Road), the supply of approximately 400 000m^3 of fill material for this stage of the project would have been required. This would represent a major logistical exercise. The existing quarries in Byron Shire are not licensed to supply such a large volume of material in a single year. Only three existing quarries have sufficient reserves to supply the required volume of material, even if relevant approvals were obtained. Of these, only the Leela quarry on Myocum Road has a short haul distance, with the others being located more than 15km from the site.

The existing commercial quarry resources within Byron Shire, excluding sand and other smaller resources are listed in Table 6.1

Table 6.1 Byron Shire: Gravel Resources and Output

Quarry Name	Existing Use (m^3/annum)	Approval Rights (m^3/annum)	Identified Resource (m^3)
Palmwoods	3 825	3 825	
O'Donnells	14 000	14 000	
Keeches	59 000		
Left Bank	1 940	25 000	780 000
Myocum	30 000	15 000	75 000
Donaghys	2 000	2 000	15 000
Leela	67 000	52 000	2 500 000
Mudges	24 900	30 000	600 000
Riches	1 500	4 000	405 000
Archibalds		7,000	180 000
Total	145 165	152 825	4 555 000

Information supplied by Byron Council.

Use of any of the existing quarries would necessitate a SEPP 37 application, which may take up to one year for approval.

In view of the limitations on existing commercial sources, it is considered that use of some other material source would be required for the high alignment option. A source located within a State road reserve would be desirable as this would eliminate the need for a SEPP 37 application, saving time for the project. Two possible material sources have been identified which may provide sufficient quantity of fill. Both are associated with road projects that will require the removal of the material for road construction.

The first possible source is from the Pacific Highway upgrading project near Ocean Shores. This would involve a haul route of approximately 17km along the Pacific Highway. Depending on the timing of the opening of the Brunswick Heads Bypass, the haul route may need to pass through Brunswick Heads. The second possible source is a large cutting required for a proposed deviation of State Road 65 (Bangalow to Lismore) near Nashua. This is approximately 6km from Bangalow, giving a total haul route of 12km. The haul route would need to pass through Bangalow.

The haulage route for the delivery of 400 000m^3 of material needs careful consideration. This volume represents possibly 20 000 truck loads (20m^3 capacity); being up to 150 trucks per day or one truck every 4 minutes for six months. A truck volume of up to 150 vehicles per day (300 two way movements) is a considerable impact compared to the existing Pacific Highway traffic of 12 000 vehicles per day including 1 300 trucks.

The low alignment option (highway under Myocum Road), will require approximately 50 000m^3 of fill material. This could also be from a location within a road reserve or from an existing allowance from an existing commercial quarry. Transportation of the material would represent up to 14 vehicles per day (28 two way movements), which would be more tolerable on the Pacific Highway. The Pacific Highway site near Ocean Shores rather than through Bangalow would result in less noise disturbance and less use of local roads and is the preferable source. All options involve an asphaltic concrete surface with a lean-mix concrete base layer.

There is not a significant difference between the interchange design options in terms of material source requirements other than earthworks fill material.

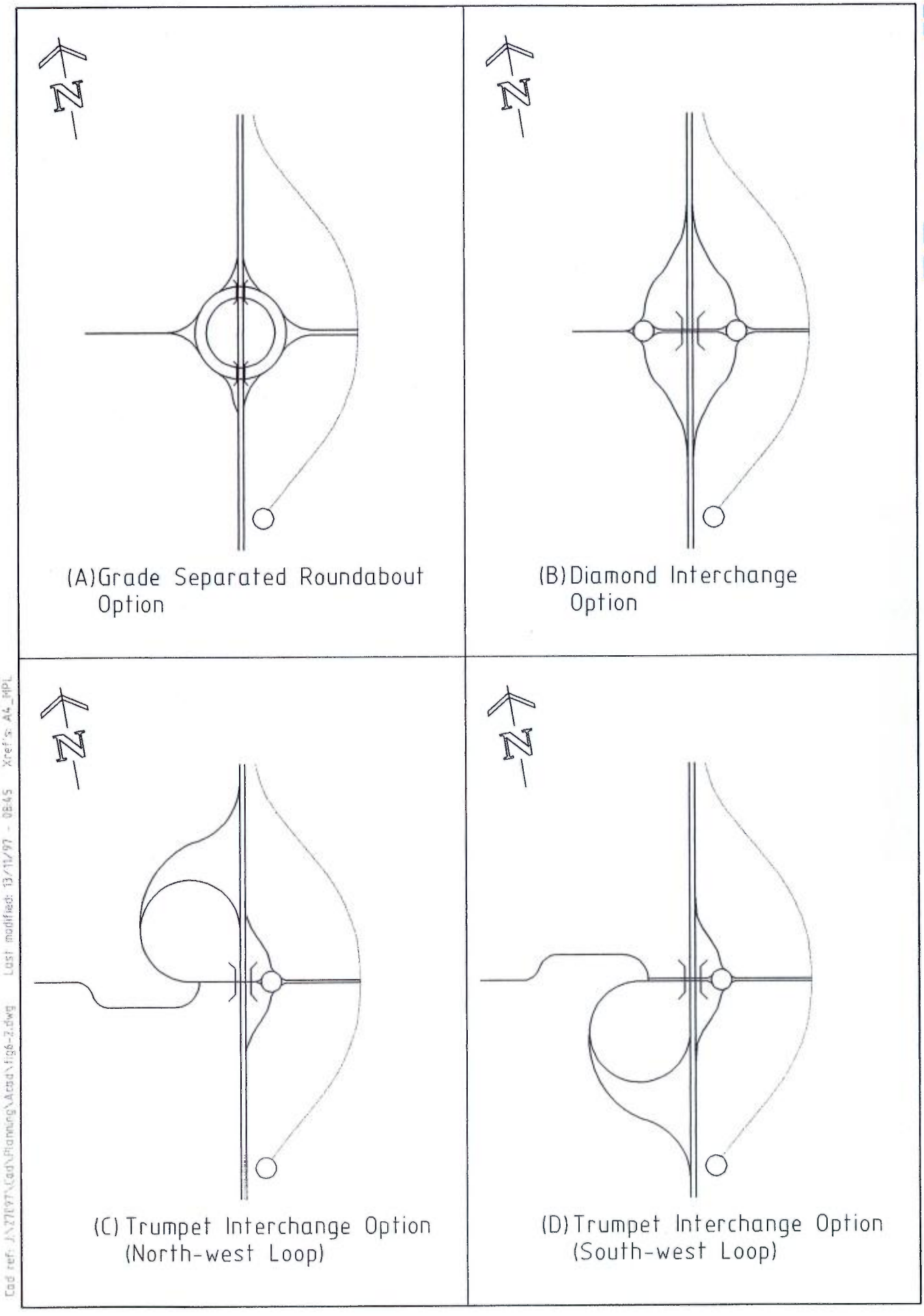
For the above reasons, the low alignment has been chosen and the RTA construction site at Ocean Shores is the preferred source.

6.8. Interchange Options

During the option development phase, a number of different interchange types were considered. Although many interchange types are possible, option selection was limited to the simplest interchange types which provided adequate traffic capacity. More elaborate interchange designs such as full clover-leafs would have required a larger land area and had greater social and environmental impacts. The interchange options which were presented to VMS 2 are discussed below.

6.8.1 Grade Separated Roundabout Option

The simplest form of upgrade would be a large twin circulating lane roundabout, as shown on **Figure 6.2 - Layout A**. Traffic analysis indicated that the roundabout would not have sufficient capacity to meet the required 30 year project design life. Therefore at some stage a grade separated highway flyover of the roundabout would be required. This would require two highway bridges, compared with one bridge for other options. Therefore this option would be more expensive than the other options, and so was not examined further.



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Pacific Highway/Ewingsdale Road/ Myocum Road Interchange Options

Figure 6.2

6.8.2 Diamond Interchange Option

The simplest form of grade separated interchange is a "diamond" type interchange, as shown on **Figure 6.2 - Layout B**. In view of the amount of turning traffic at this interchange, the traffic analysis indicated that the two intersections on the off ramps and the local road connections would need to be twin lane roundabouts. The northbound on-ramp would extend beyond this project over 100m into the currently being constructed Tyagarah Duplication Project.

The interchange would not provide the free flow operation of the other types.

6.8.3 Trumpet Interchange Option (North-West Loop)

The "trumpet" type interchange would be constructed with a loop to cater for the major turning traffic volume. In this case the loop would be constructed in the north-west quadrant, as shown on **Figure 6.2 - Layout C**. Although not essential for traffic capacity purposes, the intersection of the southbound off ramp and the local road connection has been designed as a twin circulating lane roundabout. The connection of Myocum Road to the interchange would be a simple "T" intersection with give-way (priority) control. The traffic travelling eastbound on Myocum Road to Byron Bay would have to turn right across the traffic from Byron Bay traveling to the north. Capacity for turning traffic volumes is greater than for the diamond option, while average delay is less.

The northbound on-ramp would however, extend beyond the project into the currently being constructed Tyagarah Duplication Project.

6.8.4 Trumpet Interchange Option (South-West Loop)

In this case the "trumpet" type interchange has been designed with the loop in the south-west quadrant, as shown on **Figure 6.2 - Layout D**. This would mean that traffic travelling to Myocum Road from Byron Bay would turn right across the movement from south to east, which is a smaller traffic flow than the opposing traffic in the north-west loop option. Thus access from Myocum Road would be improved. The northbound on-ramp would extend into the Tyagarah Duplication Project to a lesser degree than the north-west "trumpet" design.

This option was the preferred option of VMS 2.

6.9 Road User Benefit Cost Analysis

A planning estimate of the cost of the high and low alignment options with the diamond and trumpet interchange options, has been calculated and is shown in Table 6.2. The cost of completing a new link to Myocum Road and a roundabout at the existing Pacific Highway/Ewingsdale Road intersection has also been included. The construction cost includes planning, land acquisition and construction materials.

Based on the findings of the preliminary traffic report, no allowance is expected to be necessary for the upgrading of other local roads as a result of the project. It is assumed that the portion of the existing highway replaced by the new alignment is transferred to Byron Shire as a local road. Therefore no allowance has been made for any increase in road maintenance costs.

The construction costs of the high alignment option together with either the "diamond" interchange option or with either "trumpet" interchange option is $14.3 to $14.4 million. The costs of the low alignment option together with either the "diamond" interchange option or with either "trumpet" interchange option is $12.3 to $12.5 million. The low alignment option has a clearly lower cost for all interchange options. The above costs are however exclusive of additional noise barriers now required and landscaping for a "gateway" theme which is now proposed.

The costs of the three interchange options are similar, with the "trumpet" option being slightly more expensive. The "trumpet" type option has a greater land and bridging cost, which is balanced by the need to build an additional roundabout for the diamond type option.

The most critical assumption in the estimate is the value assumed for imported fill. The value of $\$9/m^3$ used is similar to current commercial supply rates in Byron Shire and assumes that fill will need to be imported over haul distances of 10 to 20km. If a fill source can be obtained closer to the site, then this cost may be able to be reduced. This is particularly significant for the high alignment option cost.

A road user economic analysis of the high and low alignment options and the three interchange options has been carried out in accordance with the RTA's Economic Analysis Manual. This included the use of 1997 updated figures for vehicle operating cost and travel time. Net Present Values (NPVs) and Benefit - Cost Ratios (BCRs) have been calculated, comparing the options with the base case of leaving the current two lane highway and Pacific Highway/Ewingsdale Road/Myocum Road intersection unaltered.

The cost is taken as the total capital cost of the option, including land costs. Benefits are defined as any reductions in community costs such as travel time, vehicle operating cost, and accident cost when comparing the option with the base case.

In this case the travel times and operating costs for the highway are assumed to be reduced by the increase from two to four lanes. Accident costs and intersection delays are reduced to the values indicated in the traffic study for each interchange option. The summary results for depreciation rates of 4%, 7% and 10% and a project life of 30 years are shown in Table 6.2:

Table 6.2 Summary Road User Economic Analysis Results

Option	Parameter	4%	7%	10%
High Alignment/	NPV (millions)	$335	$183	$104
Diamond	BCR	23.3	12.7	7.2
High Alignment/	NPV (millions)	$342	$187	$107
SW Trumpet	BCR	23.7	13.0	7.4
High Alignment/	NPV (millions)	$342	$188	$107
NW Trumpet	BCR	23.8	13.0	7.5
Low Alignment/	NPV (millions)	$337	$185	$106
Diamond	BCR	26.9	14.8	8.5
Low Alignment/	NPV (millions)	$342	$188	$107
SW Trumpet	BCR	27.7	15.2	8.7
Low Alignment/	NPV (millions)	$342	$188	$107
NW Trumpet	BCR	27.8	15.2	8.7

The analysis shows that, due to the high cost of providing fill for the high alignment option, the low alignment option has a superior economic performance under any interchange option. Nevertheless all of the alignment and interchange options and their combinations generate a significant benefit compared with the existing highway.

All interchange options would virtually eliminate the congestion-caused delay and accident costs at the intersection, which are currently excessive. The "trumpet" type interchange has better capacity in the long term and hence a slightly better BCR than the diamond option.

6.10 Preferred Design

Route Options B and F were shortlisted in VMS 2 and subsequent discussions and both have a common corridor in the northern, Stage 1/ Ewingsdale section. The low alignment has been selected for this section because of the reduced need for fill material and the consequential better BCR.

VMS 2 also reviewed the interchange options and agreement was reached that the "trumpet" type interchange is the preferred design and should be constructed with the loop in the south-west quadrant, as shown on **Figure 6.2 - Layout D**. This option has the best traffic configuration, the second best BCR and involves less disruption to the Tyagarah Duplication Project.

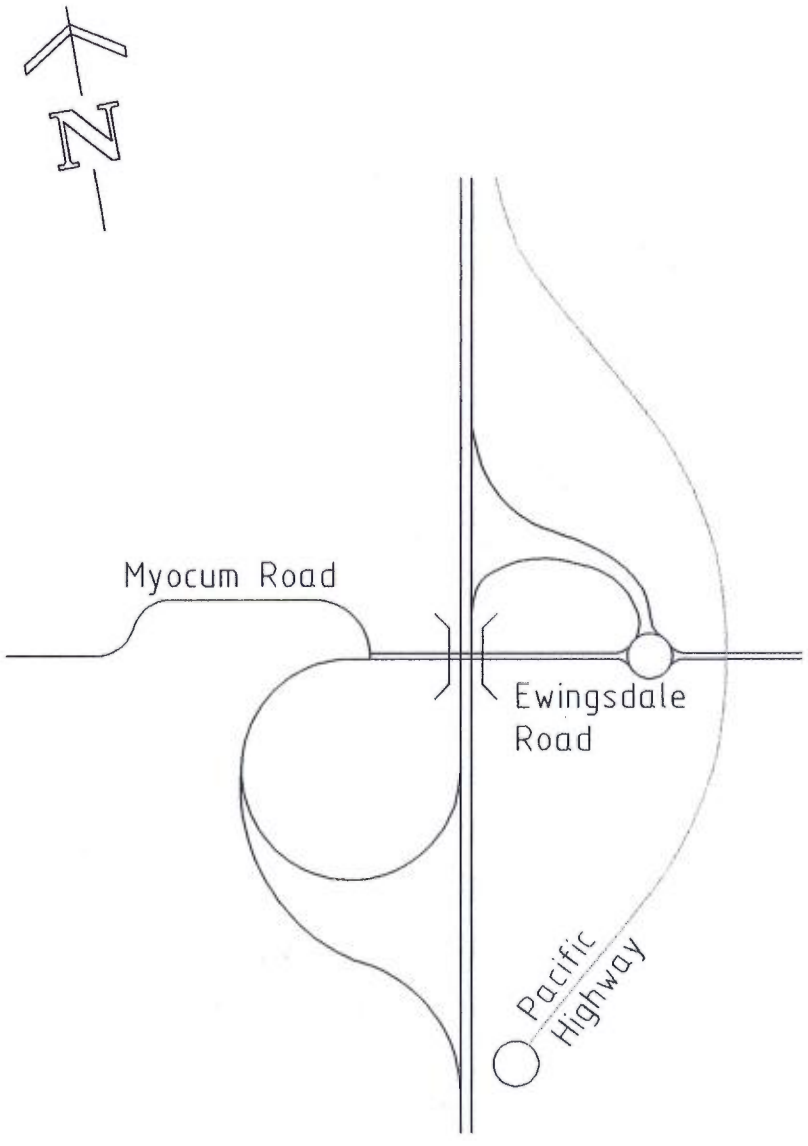
Following VMS 2 further design development has been undertaken particularly to review the land requirements and construction costs. The proposed modifications to the "south-west trumpet" is shown in **Figure 6.3**.

The modified design has the following additional advantages:

- less land required;

- less agricultural land required;
- reduced quantity of fill required;
- reduced construction cost;
- greater traffic capacity;
- less drainage cost; and
- the more symmetrical interchange type which will reduce driver confusion.

An opportunity for landscaping or some form of "gateway" design feature can be provided in the centres of either or both the loops.



Modified Trumpet

Preferred Interchange Design

Figure 6.3

Project Description

7

7.0 PROJECT DESCRIPTION

7.1 Design Criteria

The project involves the construction of an interchange and new three and four lane, 100km/hr limited access highway between the existing climbing lane at the base of St Helena Hill and the Tyagarah Duplication Project north of the Ewingsdale Road intersection. The route is generally shown on **Figure 7.1**.

The project involves construction between 31.3km and 33.3km north of Ballina.

The following considerations have been incorporated into the design:

- 100km/hr travel speed on the highway;
- provision for cyclists on the carriageway;
- installation of road surface drainage;
- elimination of at grade intersections on the highway;
- highway traffic capacity of level of service D or better at the end of 30 years; and
- intersection capacity at the Ewingsdale Road/ Myocum Road intersection 80% capacity or less at the end of 30 years.

The concept design has also been developed with references to the following documents:

- RTA Road Design Guide;
- AUSTROADS Rural Road Design;
- AUSTROADS Intersections at Grade; and
- "Pacific Highway Schedule of Design Policies and Specifications for the Construction of New Sections of Dual Carriageway" (RTA 1996).

7.2 Carriageway Concept Design

The proposed road has two carriageways separated from one another by either a narrow 3m median (see **Figure 7.2**) in the vicinity of the existing highway below St Helena Hill or by an 8m wide grassed depressed median (see **Figure 7.2**) away from the existing highway. Each of the carriageways would have two lanes 3.5m wide with a sealed shoulder 0.5m to 1.0m wide before the median and a 2.5m shoulder on the left or nearside of the carriageway.

The 2.5m wide nearside shoulder will cater for cyclists and vehicle breakdowns. The road and shoulder areas are proposed to be constructed of high strength pavement to cater for the design loads. Adjacent to the nearside shoulder in areas of steep gradient or deep cutting there would be a concrete drain (see **Figure 7.2**) 1.2m wide.

The maximum grade for the new carriageways has been set at 6% with vertical curves having rates of grade change of at least 33m per one percent (representing the headlight sight distance for sag curves) up to the desirable 66m per one per cent for crest curves. Where possible, a maximum superelevation of 3% has been adopted in the design with a desirable horizontal curve radius of 1200m.

7.3 Major Structures

7.3.1 Interchange

The proposed new interchange will be a "modified trumpet" type with loops in the south-west and north-east quadrants. The new highway will be built across the low point of Myocum Road and an elevated extension of Ewingsdale/ Myocum Roads will pass over the new highway. The overpass will be 56m long and contain two 3.5m wide lanes in each direction separated by a 1.2m median. A 1.2m wide shoulder will be constructed on the southern side and a 1m shoulder on the northern side. A pedestrian footpath 1.8m wide will be provided on the northern side of the bridge and it will be separated from the vehicle lanes by a concrete barrier. A footpath will be constructed along the northern side of Myocum Road.

Figure 7.3 shows the interchange bridge design.

The bridge will be a concrete slab and pier structure with the central support pier located between the north and southbound highway carriageways. The bridge will have a 5.6m clearance above the highway. The bridge will be constructed using "Super T" beams 1200mm deep.

Batters from the bridge to the highway and around the "interchange loop" will be 1.5:1 in cutting and 2:1 in fills.

Traffic from Byron Bay heading north will cross above the highway then proceed around the south-west loop under the bridge and gather speed before joining the highway. Traffic from Byron Bay heading south will proceed around the north-east loop under the bridge and gather speed before joining the highway. Vehicles travelling south along the highway and then wishing to proceed to Byron Bay will exit off the highway and use the Myocum Road and Ewingsdale Road. Vehicles travelling north and wishing to enter Byron Bay will exit off the highway before the interchange and proceed around the south-west loop before crossing over the highway. Access to and from Myocum Road will be from the "T" intersection within the south-west loop. The old Pacific Highway both north and south of the existing Ewingsdale Road intersection will be kept open for use by local traffic but will not allow access on to the new section of highway.

There will be extensive landscaping of the earth batters at the interchange. Landscaping will be with species local to the area and some ameliorative noise treatments (refer to Section 9.2) will be included.

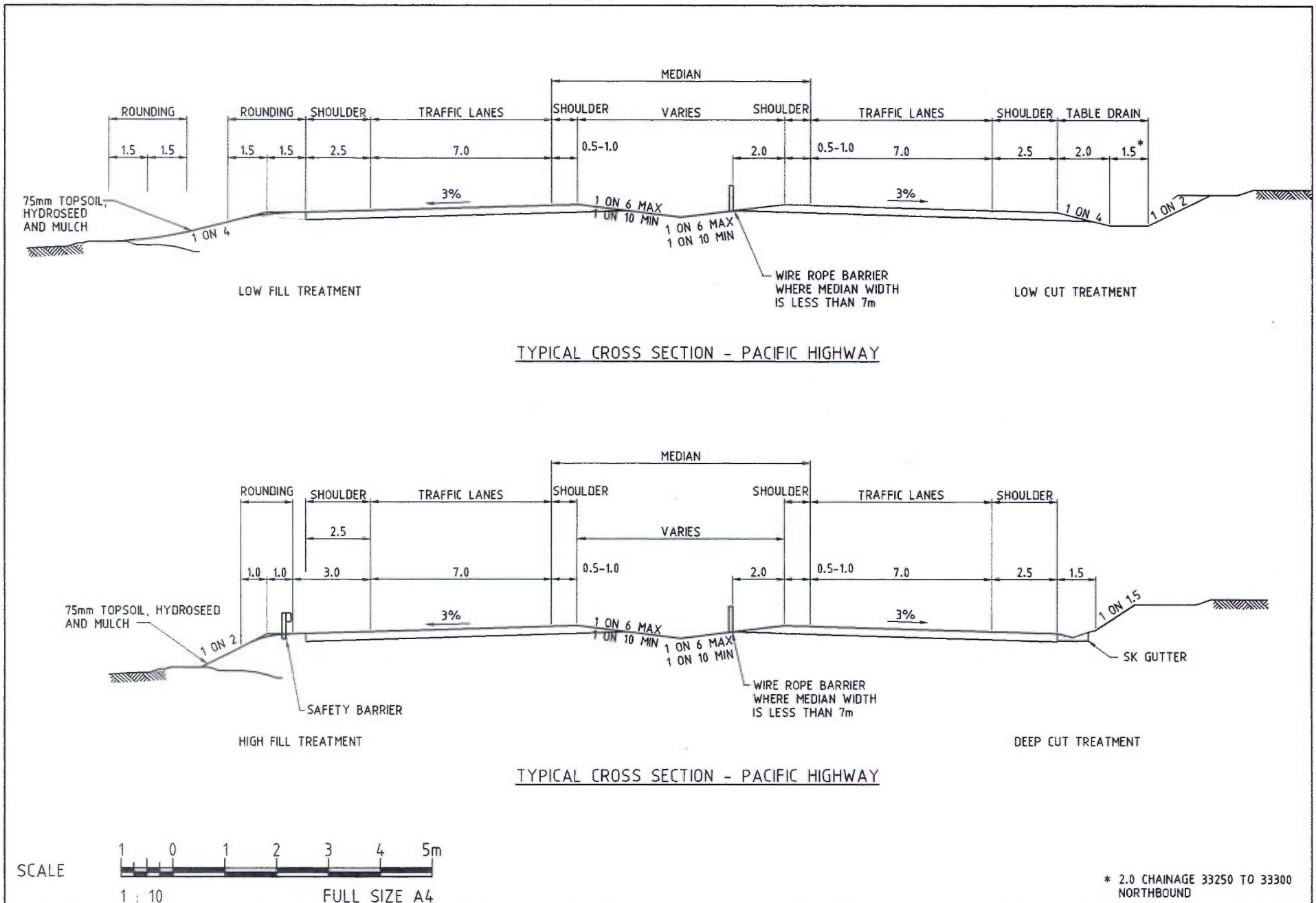
Maunsell

SCALE 100 0 100 200 300 400 500m

1 : 10000 FULL SIZE A4

Road Design and Interchange

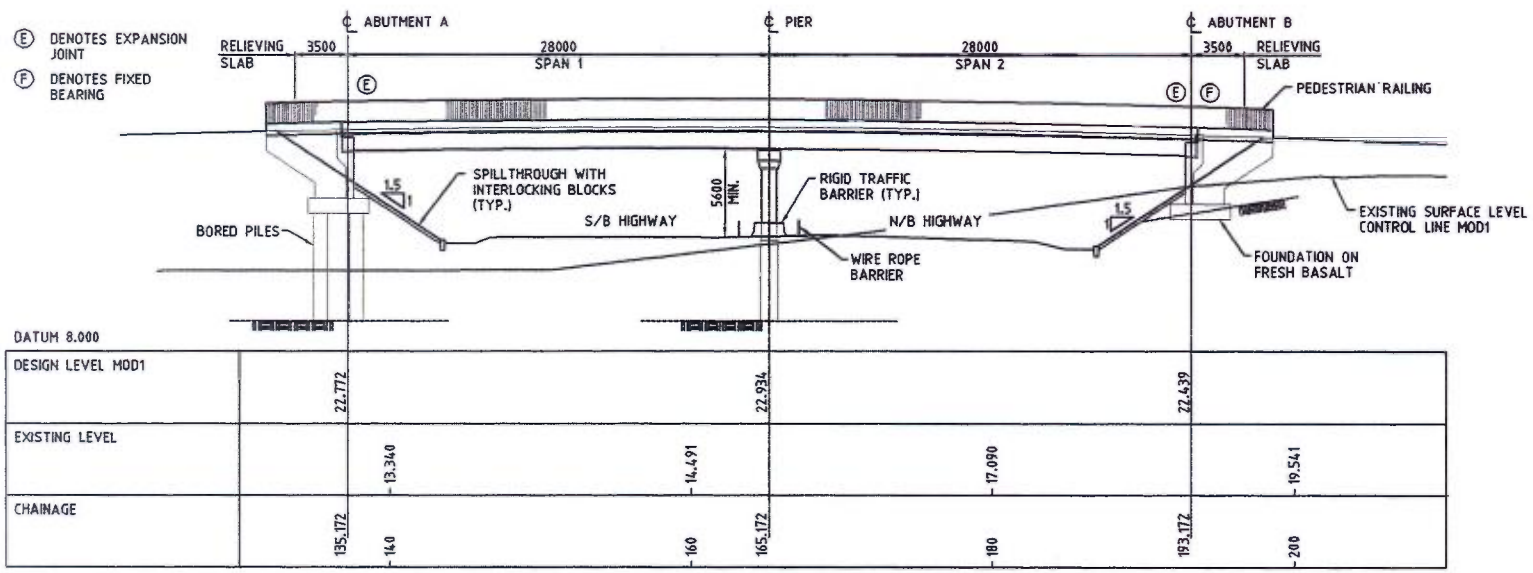
Figure 7.1



Median Width and Shoulder

Figure 7.2

Maunsell



ELEVATION
CONTROL MOD1
SCALE 1:200

Interchange Bridge Design

Figure 7.3

Maunsell

7.3.2 Underpass

Where the new highway joins the old Pacific Highway south of the interchange, the old highway will terminate at a cul-de-sac. From the head of this cul-de-sac a vehicle driveway will be constructed to the "Johnston" property on the western side of the new highway via an underpass.

The underpass will be a concrete box 4.5m wide and 4.5m high.

7.3.3 Drainage

The gradient on this section is sufficient to ensure adequate drainage. Stormwater will be directed via catch drains running longitudinally parallel to the fill embankments to water pollution control ponds. Away from the interchange, the depressed median will have enough slope longitudinally to allow rain falling on the median to be collected in catchpits.

All runoff collected in the drains, trenches, channels, catchpits and at the toe of embankments will pass through water pollution control ponds before dispersal. The pollution control ponds and drains will be grassed to assist in the collection of sediments and pollutants. The pollution control ponds will be located at the lowest points along the section of highway, near the interchange and within the proposed road reserve. Access will be provided to allow the ponds to be pumped/ cleaned out. Their location is shown on **Figure 7.4.** The ponds near the interchange, close to the creek line will be capable of containing a spillage of 20 000 litres of fuel or other liquid escaping from a vehicle on the highway together with a large volume of washdown water.

7.4 Allied Structures

7.4.1 Access Arrangements

No private access points will be provided onto the new highway. Access to the Ewingsdale church and hall will be from the old Pacific Highway. The old highway will be terminated at a cul-de-sac.

Access to the Johnston property on the western side of the new highway will be via the underpass as described in Section 7.3.2.

Access to the property owned by Juan Pty Ltd on the western side of the highway at the northern end of the project will be onto Myocum Road.

Final details are being discussed with the relevant landholders.

7.4.2 Cyclists, Pedestrian and Breakdown Lane

The 2.5m minimum width shoulder on both the north and south bound carriageways, is to be provided as a cycleway and as an emergency breakdown and pedestrian access corridor. No pedestrian access is proposed to be provided between the carriageways. The overhead bridge at Ewingsdale will provide a 1.8m wide pedestrian path and the access ramps will have wide shoulders suitable for cyclists. Provision will also be made for the stopping of school and local buses on the old Pacific Highway/Ewingsdale Road intersection east of the new interchange.

7.4.3 Fencing/Lighting/Sign Posting

The Ewingsdale interchange will be lit at night with lighting which will have shields to ensure there is no light spillage beyond the road surfaces. These lights will be pole mounted and will be located around the interchange ramps and on the bridge over the highway.

The entire corridor will be fenced with stock-proof fencing.

There will be road warning signs and markings along the length of both carriageways to clearly indicate changed traffic conditions. Appropriate signs will be located on the approaches to the interchange.

In the vicinity of the interchange, where there will be a central bridge support pier, and at the southern end of the project where the median is narrowed, a wire rope barrier will be erected to provide a physical barrier. A wire rope barrier will also be installed where the carriageway has fill batters exceeding 3m in height and 4:1 slopes, as well as at culverts if warranted.

Safety barrier fencing will also be installed around the ramps at the interchange.

It is not intended to install metal grids/screens on the overpass.

7.4.4 Tie-ins

The northern tie-in for this project is being built as part of the current Tyagarah construction project. This early work will enable the work on the Ewingsdale section to proceed without disruption to the highway traffic.

The southern tie-in will taper back to the existing highway at the base of St Helena Hill.

7.5 Utilities

Telstra has its main fibre optic cable from Sydney to Brisbane on the eastern side of the existing highway. Telstra also has a lot of plant at the Ewingsdale intersection and an exchange is on the western side of the intersection. The cable and plant along the existing highway will not be affected by the project.

Maunsell

100 0 100 200 300 400 500m

1 : 10000 A4 FULL SCALE

Drainage Basin Plan

Figure 7.4

Telstra has several cables along Myocum Road which will require modification to place them into new conduits underground. Cabling will be required along the western side of the new highway from Myocum Road to the northern end of the project to link up with the existing network.

Northpower have a 66kV powerline along Myocum Road and although they do not want interruption of this supply during construction there will be a need for relocation of this overhead powerline to suit the new construction.

None of the service authorities require provision to be made for future services through the new bridge over the highway.

Relocation of utilities in the area will be undertaken during the construction period.

7.6 Property Acquisition

Some 17ha of land is required for the highway corridor and interchange. The interchange requires 11ha and the highway and batters require 6ha. Major severance will occur to two properties. **Figure 3.1** shows the areas and properties effected as well as the proposed new road reserve boundaries.

Discussions have been held with the landholders and these discussions are documented in Section 3 of this REF. The expected impacts on property viability are also discussed in Section 9.5.

The RTA's Land Acquisition Policy will be implemented to achieve a purchase of the land by negotiation between the Authority and the land owner. Land acquisition for the proposed works would only proceed if the project is approved.

Land acquisition for the proposed road would follow the provisions of the *Land Acquisition (Just Terms Compensation) Act, 1991*. Compensation is assessed by having regard to the market value of the property as if it were unaffected by the road proposal, as per Division 4 Section 55 of the Act. In addition to the market value, regard is also taken of special value, severance, disturbance and any increase or decrease in the value of any other land adjoining or severed by the carriageway due to the proposal. The purchase price would be negotiated with the land owner to establish an agreement satisfactory to both parties. There is no appeal against acquisition, but provisions exist for appeal to the Land and Environment Court regarding the amount of compensation to be paid.

Where partial acquisition of a property is necessary, the RTA purchases the affected portion of the property. In these cases, the RTA is responsible for the relocation and replacement of fences, driveways, landscaping and any other affected improvements to a standard similar to existing, and for the relocation of electricity and water as appropriate.

The RTA seeks only to acquire the land that is needed for the road corridor reserve. However, if owners of directly affected property can demonstrate that property and/or businesses are rendered unviable as a result of part acquisition, then the RTA may consider acquiring the whole property if requested by the owner.

If agreement cannot be reached, the RTA has available a statutory process for compulsory acquisition of land under the Land Acquisition (Just Terms Compensation) Act. This legislation sets up a process to enable landowners to have access to an independent valuation and assessment of compensation by the Valuer General, if agreement cannot otherwise be negotiated with the Authority. This process is also able to resolve title problems if they arise.

In circumstances where an affected property owner is suffering hardship as a result of the proposal and desires immediate purchase of land, the RTA would consider acquisition under the hardship provisions of the Land Acquisition (Just Terms Compensation) Act. This would usually occur once the project has been approved and the need to acquire the property has been established. In each case a genuine hardship has to be demonstrated (as defined in the Act) and agreed by the Authority, following which the owner negotiates the sale of the land with the RTA or requires acquisition under the compulsory acquisition process.

In each case where the proposed road requires property acquisition, the RTA considers a range of acquisition options including:

- partial acquisition of the property affected, usually where there are no major improvements being affected;
- where the road reserve requires strip acquisition which severs and isolates a portion or portions of a property the RTA, upon request, negotiates to purchase the isolated portions. The RTA is responsible for relocation of services, fence reconstruction and access adjustments should they be required in either of the above cases; and
- where the road proposal affects the majority of a property, including major improvements or structures such as houses and business, or otherwise affects the viability of the property, the RTA considers acquisition of the entire property.

Following acquisition of any land in the course of the property adjustment process, the RTA as owner retains the option to transfer or sell any surplus land.

7.7 Construction Methods

The construction work is proposed to be undertaken by contract resources and commence by the start of 1999 with completion programmed for mid 2000. Construction would commence with installation of sediment control devices, site clearing, stripping of topsoil, laying of culverts and relocating of utility services. Table 7.1 provides an indication of the type of machinery that will be used on site and the duration of the activities.

Bulldozers, scrapers, front-end loaders and excavators will undertake excavation of cut sections. Excavated material will be carted along construction roads within the road reservation to places where fill is required. Compaction of this material will be undertaken using rollers and vibrating compactors then trimmed by graders.

Table 7.1 Construction Equipment to be used Onsite - Indicative Durations

Activities	Plant and Equipment	Approximate Duration (Days)
Install erosion control	Backhoe, trucks	30
Clearing	Chainsaws, bulldozer, excavator, trucks	10
Strip and stockpile topsoil	Scrapers, graders, loader, excavator, trucks	25
Install drainage structures including excavation	Excavator, concrete trucks	80
Excavate cuttings and construct fills	Scrapers, compactors, grader, rollers, loader, excavator, trucks	150
Pavement construction	Trucks, concrete paving machine, pugmill, grader, loader, rollers, truck mounted crane	60
Bridge construction	Trucks, pile boring equipment, truck mounted crane	50
Roadside furniture	Trucks, boring equipment, post driver, linemarker	20
Landscaping and revegetation	Grader, hydromulcher, tractor	20

Material unsuitable for road fill will be used in interchange mounds and for flattening fill batters. Clean topsoil won from the site will be stockpiled near Myocum Road for later spreading on fill batters, sound mounds and median areas. Weed contaminated topsoil will be disposed at an EPA approved disposal point. Drainage and siltation controls will be installed to prevent erosion of the stockpile and siltation of creek flowlines. Stockpiles will be bunded and seeded within 7 days with sterile exotics.

Some 130 000m^3 of material will be excavated and 50 000m^3 of material is expected to be imported for this project. The imported material required as fill will be stockpiled in defined areas adjacent to the interchange.

To meet the precautionary principle, extensive erosion control works will be installed. Erosion control measures will be installed around the perimeter of each stockpile. An earth catch drain and where necessary, a temporary sediment pond will be built to capture any runoff from the site.

Sediment basins will be constructed at strategic locations along the project length as shown in **Figure 7.4.** These temporary basins will be constructed in accordance with:

- the RTA Road Design Guide;
- the RTA Pacific Highway Schedule of Design Policies and Specifications for the Construction of New Sections of Dual Carriageway; and
- the RTA Water Policy.

The basins will be earthlined and will collect sediment from the site during construction. The basin will be de-silted as required as part of an environmental management program. A ramp will be included to assist in the de-silting operations. The basins will act as:

- siltation controls;
- stormwater retention ponds to reduce erosive water flows; and
- emergency holding ponds in cases of accidental spills.

After construction the basins will be retained as spillage control basins, designed to store at least 20 000 litres of oil or other spillage material pending safe removal.

Additional siltation controls to reduce the risk of siltation of the waterways will include:

- on dirt access tracks, cross drains to small sediment traps;
- silt fencing, or similar silt barriers, on the down slope of workings and temporary spoil sites;
- drainage of any ponded water to an adequately sized siltation pond; and
- prompt restoration of the ground surface and completion of stabilisation works.

Maintaining access for residents during construction will be an important consideration. Construction activities, including heavy plant operation and truck movement in proximity to residential properties and passing vehicles, have the potential to adversely impact on road users and landholders. To minimise this impact, a traffic management plan will be prepared and there will be appropriate training provided to traffic controllers working on the construction site.

7.8 Maintenance and Operation

Regular road inspections and maintenance of the works will occur. Maintenance will help to ensure that the condition of the road surface is maintained and that it provides safe and comfortable travel. Maintenance will also be regularly undertaken on road signs, kerbing, drainage structures, barriers and landscaping.

The sediment basins constructed during the construction phase are proposed to be modified to act as spillage control basins to contain sediment and accidental spills. The basins will be cleaned when necessary as part of the environmental control plan for the structure. After a spillage, the basins will be pumped out so that the collected material can be removed to a suitable EPA approved disposal point.

7.9 Costing and Staging of Works

The construction of the Ewingsdale interchange and associated roadworks described in this section is estimated to cost about $12M (inclusive of extensive noise barriers and landscaping). Staging of this section is not proposed.

Biophysical Environment and Impacts

8

8.0 BIOPHYSICAL ENVIRONMENT AND IMPACTS

8.1 Geology, Soils and Landforms

Published geological mapping indicates that the whole of the study area is underlain by volcanic rocks of the Lismore Basalt Formation of the Lamington Volcanics. The age of the formation has been ascribed to late Oligocene to Early Miocene (about 24 - 20 million years old). The Lismore Basalt is described as consisting of mainly basalt with some agglomerate and boles (fossil soils).

Field geological observations in the study area and immediate surrounds involved investigation of excavated faces along the Pacific Highway and adjoining roads. Natural outcrops are rare in the area.

The study area is entirely underlain by residual, colluvial or alluvial soils derived from Tertiary age basaltic rocks. The mantle comprises decomposed to weathered basaltic rocks and soil from an unknown number of relatively thin individual lava flows. The time lapse between flows has been variable, but usually sufficient for considerable weathering and sometimes soil formation. Variations in permeability between flows commonly results in seepage lines and springs forming at the interface between individual lava flows.

Soils formed on the basalt are red brown earths or ferrosol and are of medium to high plasticity. Such soils (and decomposed and weathered basalt parent material) are usually found to have workability problems when used as fill in embankment construction, particularly in terms of moisture control. The soils often contain residual weathering kernels of strong or very strong basalt, which may range in size from cobble to very large boulder size. The presence of such cobbles and boulders causes problems in excavation and workability of soils.

The low undulating hills, below St Helena Hill, comprise slopewash, colluvium and residual soils formed on Tertiary age basaltic rocks. Colluvium is formed during erosion and scarp retreat and is expected to cover most slopes in the study area. Slope angles are generally less than 5 degrees and relief less than RL40m. Some small sections of instability, mainly slumping, are present near gullies, and may represent failure of colluvial fans. Drainage and slope protection measures will be installed and if significant layers of soil strength material or unfavourably orientated defects are found during further geotechnical work or construction, overall slopes will be relatively flat.

The low lying area in the immediate vicinity of the proposed interchange primarily comprises alluvium. This is generally shallow, mainly clayey and of medium to high plasticity.

The possibility of acid sulphate soils being present is assessed as being very low.

8.2 Flora & Fauna

8.2.1 Overview

A systematic flora and fauna survey was undertaken between 22 – 30 October, 1997.

Five vegetation communities were identified within the study area including exotic regrowth, rainforest "paddock" trees, figs, water plants and pasture. The vegetation is strongly influenced by grazing of livestock. Pasture occurs on the majority of the site with opportunistic regeneration of exotic species occurring along fencelines, gullies or in rocky locations that impeded grazing. Figs and rainforest trees are scattered throughout the site. Very few native species of any conservation value remain in the area.

A total of 27 vertebrate species were recorded during the fauna survey including 18 birds, 4 mammals, 2 reptiles and 2 amphibians.

There were no threatened fauna species recorded on the site. The majority of fauna are typical of disturbed grassland and agricultural habitats. Most species recorded or expected are common to abundant across substantial distributions and many are generally tolerant of some level of habitat disturbance.

Variable weather conditions were experienced during the field survey. Heavy downpours and showers preceded the frog survey undertaken on 22 October. Showers continued into the evening of 22 October providing ideal conditions for sampling this vertebrate group. Fine weather with northerly winds reaching approximately 10 knots was recorded during the three small mammal and spotlight surveys (27 – 30 October 1997). The minimum overnight temperature recorded, using a digital maximum/minimum thermometer, on 28 October was 19°C.

8.2.2 Flora

Methodology

The road corridor was traversed on foot and all trees or associations recorded and mapped. Vegetation was mapped over a coloured aerial photograph. Vegetation boundaries or polygons were drawn around each clump of vegetation or individual tree.

Various inconspicuous plant species, exotic species or species that were only identifiable during their flowering period (eg orchids) may have been overlooked in this study, however, the survey methodology addressed all trees and shrubs within the road corridor.

Results

The site supports a depauperate vegetation community characteristic of cleared and pastured areas in northern NSW. The floristics recorded at the site are strongly influenced by grazing pressure, the invasion of exotic species (eg. camphor laurel, broad-leaved privet and narrow-leaved privet).

A total of five vegetation associations were recorded and mapped at the site. These associations comprised;

- exotic regrowth;
- rainforest "paddock" trees;
- figs;
- waterplants (sedgeland / rushland); and
- pasture.

The floristics recorded at the site were strongly influenced by the grazing of livestock. Pasture occurred on the majority of the site with opportunistic regeneration of exotic species occurring along fencelines, gullies or in rocky locations that impeded grazing. Figs and rainforest trees were scattered throughout the site, as shown in **Figure 8.1**.

Exotic regrowth
Regrowth is dominated by exotic species including *Cinnamomum camphora and Ligustrum sinense* in the forest upperstorey. The understorey is dominated by *Lantana camara,* (lantana), narrow leaved privet, wild tobacco, mist weed and annual exotics. Isolated clumps of exotic regrowth are patchily distributed throughout the site.

Dead stags provide testimony to the success of a systematic poisoning program undertaken over the last few years.

Exotic regrowth has little conservation value, although magpies, fig birds, currawongs and fruit-doves will forage on camphor laurel fruit.

Exotic plants in the garden of the Johnston property may have some local interest.

Rainforest "paddock" trees
Isolated or small clumps of rainforest trees including *Cupaniopsis anarcardioides* (tuckeroo) and/or *Pittosporum undulatum* (sweet pittosporum) and/or *Toona ciliata* (red cedar) and/or *Mallotus discolor* (white kamala) and/or *Guioa semiglauca* (guioa) occurred along the proposed route. These trees comprise the rainforest upperstorey and generally grow to a height of 15m. The understorey is comprised of pasture grasses.

A tuckeroo, located on the western margin of the proposed corridor, was the most significant rainforest tree encountered, as shown in **Figure 8.1**. This individual was estimated to be over 50 years old and extended to approximately 18m in height. This tree will be protected during construction and is not expected to be affected by the proposal.

Figs
A significant stand of *Ficus obliqua* (small-leaved figs) is located to the east of the existing highway. Other isolated or clumps of small-leaved, *Ficus macrophylla* (Moreton Bay fig) and/or *Ficus macrophylla* (strangler fig) were located adjacent to the highway corridor. The fig species comprise the upperstorey while camphor laurel, narrow leaved privet and lantana dominate the mid-storey. Pasture grasses, mist weed and narrow leaved privet comprise the understorey.

Several figs were within the proposed road corridor and will require removal. However, these are small in stature (<10m) and do not have the extensive girth that characterises local representatives of this species. The relocation of the smaller specimens and their use in the landscaping of the new corridor will be investigated

Waterplants (sedgeland/rushland)
Waterplants including *Periscaria strigosa* (slender knotweed), *Myriophyllum aquaticum* (parrots feather), *Juncus usitatus* (tussock rush) occurred in a drainage line that passed under Myocum Road and extended northwards to the Pacific Highway.

Pasture
Axonopus compressus (broad-leaved carpet grass) dominated the majority of the site. This species is extremely common on the poorer quality north coast grazing lands. It has little conservation value. The upper storey of the pasture is dominated by carpet grass, paspalum, kikuya, sedges and exotic annuals (e.g., fireweed, thistle, Paddy's lucerne).

8.2.3 Threatened Flora
No threatened plant species were located at the site and it is unlikely that threatened species would be present due to the site's highly modified vegetation.

8.2.4 Koala Food Trees

An assessment of potential koala habitat was undertaken pursuant to the requirements of SEPP 44 Koala Habitat Protection. No koala food trees occur at the site.

8.2.5 Fauna

Methodology

Reptiles and amphibians
Reptiles were searched for in suitable habitats (e.g., under logs, rocks and among leaf litter). Litter was searched and raked at one 5m x 5m plot for 0.5 hours.

Frog habitats were investigated during the day and at night both prior to and during rainy periods. Sampling locations included farm dams, small ponds or depressions, a small stream passing through the site, road fringes and forested areas.

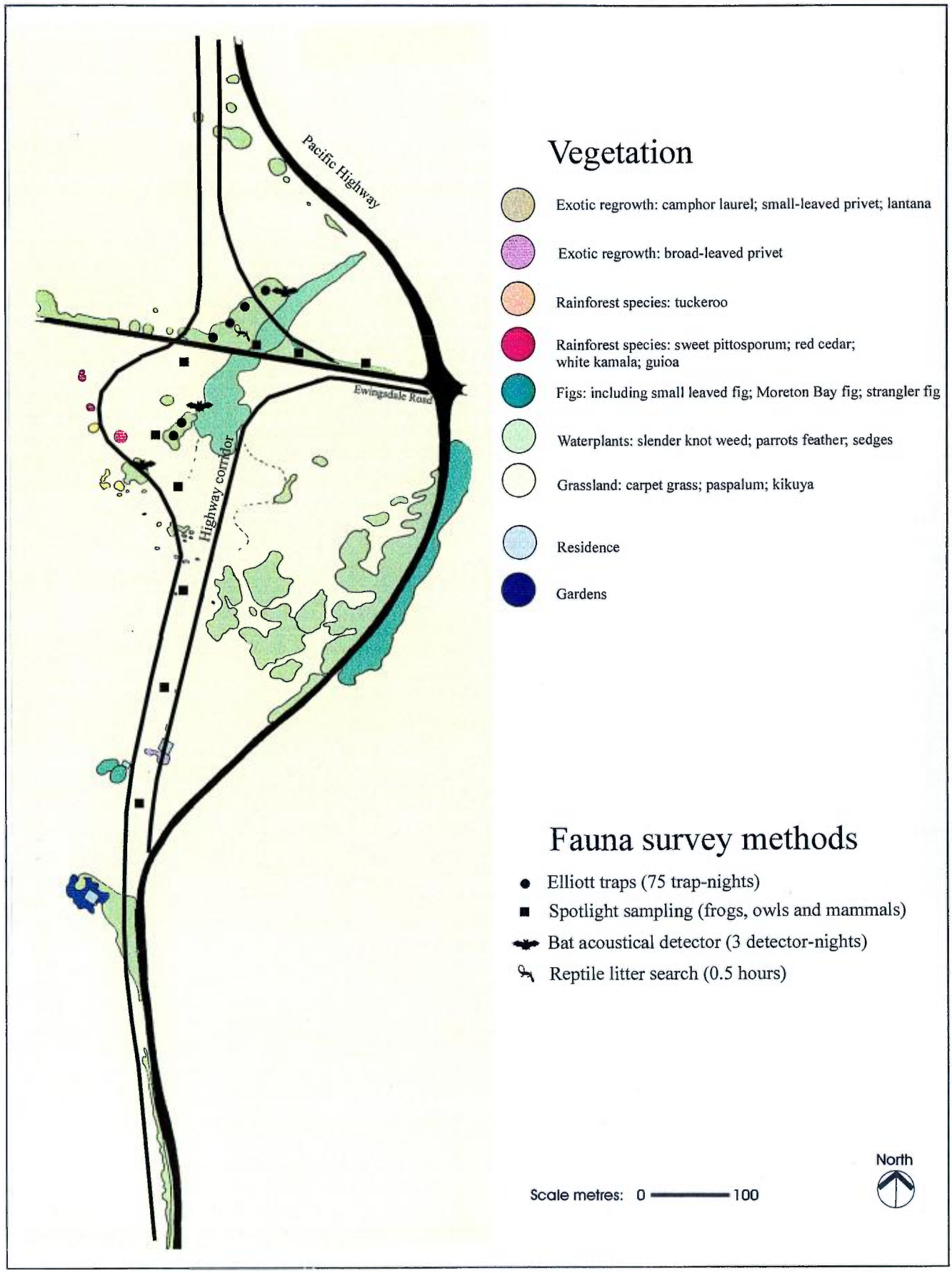


Figure 8.1 **Vegetation and Fauna Sampling Sites**

Birds

Birds were identified visually and aurally during post-dawn and evening transects. The transects adopted various routes on each occasion to optimise the opportunity to gather data. Transects of approximately 45 minutes duration were undertaken over three consecutive mornings. Birds were also recorded on an opportunistic basis during the vegetation transects and while laying and retrieving mammal traps.

Mammals

Mammal sampling was conducted using the following methods :

- Elliott traps were baited with a mixture of peanut butter and oats containing vanilla essence. Twenty Elliott traps were set for three nights (27 - 29 October 1997; 25 x 3 = 75 trap-nights);
- nocturnal sampling along tracks and roads within and around the corridor using a hand-held 55 watt halogen spotlight was used for this purpose;
- day-time searching for scratches and scats at the base of suitable food trees;
- sampling for megachiropteran and microchiropteran bats using ultrasonic detection devices (Anabat II) and a spotlight;
- recording calls of microchiropteran bats on a 45 minute tape using a detector, timing device and tape recorder at three sites on the evening of 28 October 1997; and
- spotlighting potential flying fox food trees by the identification of their characteristic social calls. Spotlighting for bats especially among the fig trees throughout the study area.

Results

Reptiles and frogs

The most common reptile recorded was *Lampropholis delicata* (eastern grass skink). The *Pogona barbata* (bearded dragon) was the only other reptile species recorded. Numerous other species recorded in nearby locations during other studies are likely to occur at the site. These include *Eulamprus tenuis* (lace monitor), *Cacophis krefftii* (dwarf-crown snake), *Dendrelaphis punctulata* (common tree snake), *Boiga irregularis* (brown tree snake), *Demansia psammophis* (yellow-faced whip snake) and *Pseudechis porphyriacus* (red-bellied black snake). A list of reptiles expected to occur at the site is included in **Appendix D.**

Two frog species *Litoria fallax* (eastern dwarf frog) and *Limnodynastes peronii* (brown striped frog) were recorded near permanent and semi-permanent waterbodies and grassland areas.

Birds
A variety of open country birds and waterbirds were recorded or were expected to utilise the habitats at the site **(Appendix D).** The most conspicuous bird species recorded was the *Corvus orru* (torresian crow). Other "open country" species included the *Ardea ibis* (cattle egret), *Ardea novaehollandiae* (white-faced heron) and *(Vanellus miles)* masked lapwing.

Some bird species had specific habitat preferences. Flocks of *Sturnus vulgaris* (common starling), had colonised hollow camphor laurel stags and were recorded migrating between these perches and nesting sites and nearby powerlines.

Some bird species were more confined in their habitat preferences. *Anas superciliosa* (Pacific black duck), was confined to a farm dam located just south of Myocum Road and small colonies of *Sericornis frontalis* (white-browed scrubwrens), were restricted to dense thickets of small-leaved privet or lantana.

No raptors were recorded foraging over the site, however, records from nearby locations included the *Elanus notatus* (black-shouldered kite), and *Aquila auda* (wedge-tailed eagle).

No nocturnal bird species were recorded although *Podargus strigoides* (tawny frogmouth owl) has been previously recorded at Ewingsdale.

Mammals
The only small mammals expected to occur at the site are introduced species. *Canis familiaris* (dog) were observed chasing cattle through the site. The *Vulpes vulpes* (fox) was not observed during the survey, although it is known from the Ewingsdale area. *Rattus rattus* (black rat) and *Mus musculus* (house mouse) were not recorded but are expected to occur at the site.

Bats
No bat species were detected at the site. This results conform with similar surveys undertaken in the area (Parker 1996) and suggests that the lack of species diversity in these exotic forests limits their exploitation by bats. A number of bat species, however, may pass through or over the site during suitable seasonal conditions.

8.2.6 8 Part Test

An eight part test is a requirement of the *Threatened Species Conservation Act, 1995* (TSC Act). It is an assessment used to determine whether a proposed development is likely to significantly effect threatened species, populations or ecological communities or their habitats. Section 5A requires the following factors to be taken into account:

a). In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction,

No threatened species was recorded or is considered likely to occur at the site. Thus, it is unlikely that *the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction;*

b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;

Currently, there are no endangered populations in the region listed under the TSC Act. Thus, this clause does not apply;

c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed;

The habitats recorded at the site were dominated by pasture, exotic regrowth (e.g. camphor laurel, broad-leaved privet and narrow-leaved privet) and "paddock" rainforest trees. These habitats are not considered significant for threatened species. Thus, *a significant area of known habitat* will not *be modified or removed;*

d) whether an area of habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for threatened species, population or ecological community;

The upgrading of the highway will not require the clearing of any habitat of significance to threatened species. Moreover, it is anticipated that extensive parts of the site will be landscaped with local native tree stock. This will enhance the value of the site by linking it with nearby rainforest remnants, including the Hayters Hill Nature Reserve. Thus, there is little likelihood that the proposed development will result in the habitats becoming *isolated from currently interconnecting or proximate areas of habitat for threatened species.*

e) whether critical habitat will be affected;

There are currently no areas of critical habitat listed under the TSC Act in the north coast region. Thus, this clause does not apply;

f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region;

No threatened species or their habitats were recorded at the site. Thus, in this case the representation of threatened species *in conservation reserves (or other similar protected areas) in the region* has no relevance to the subject site;

g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;

A threatening process is defined under the TSC Act as a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. There are currently no threatening processes listed under the Act. Thus, this clause does not apply;

h) whether any threatened species, population or ecological community is at the limit of its known distribution;

The site is unlikely to be of significance to threatened species due to the site's habitat largely dominated by ubiquitous exotic vegetation. Thus, no threatened species is likely to be at the extreme of its known range.

8.2.7 Impact Mitigation Measures

Although less than 2ha of tree clearing will be required, the areas to be cleared will be defined by para-webbing or other fencing to ensure that the amount of clearing is restricted to the smallest area possible. The site office, equipment storage, carparking areas and stockpiles will be located away from vegetation which is to be retained. Individual trees will be inspected for animals before clearing and the NPWS and WIRES contact details will be kept on site.

Endemic plant species from regional seed stock will be used in landscaping and culverts and drainage channels under the highway will be maintained to allow fauna movement. These impact mitigation measures will exist in meeting the Biological Diversity principle of ESD.

Opportunity for the collection of seed stock for the Johnston garden will be considered if a request is made.

8.3 Hydrology

This section outlines the site characteristics that are relevant in assessing water quality and hydrology within the various watercourses that cross the corridor. The information provided was sourced from:

- relevant topographical maps and contour information; and
- site inspections undertaken by consultant hydrologists, WBM Oceanics Australia.

8.3.1 Catchments

The proposed corridor crosses only two streams. **Figure 8.2** shows all watercourses with reference to the existing highway.

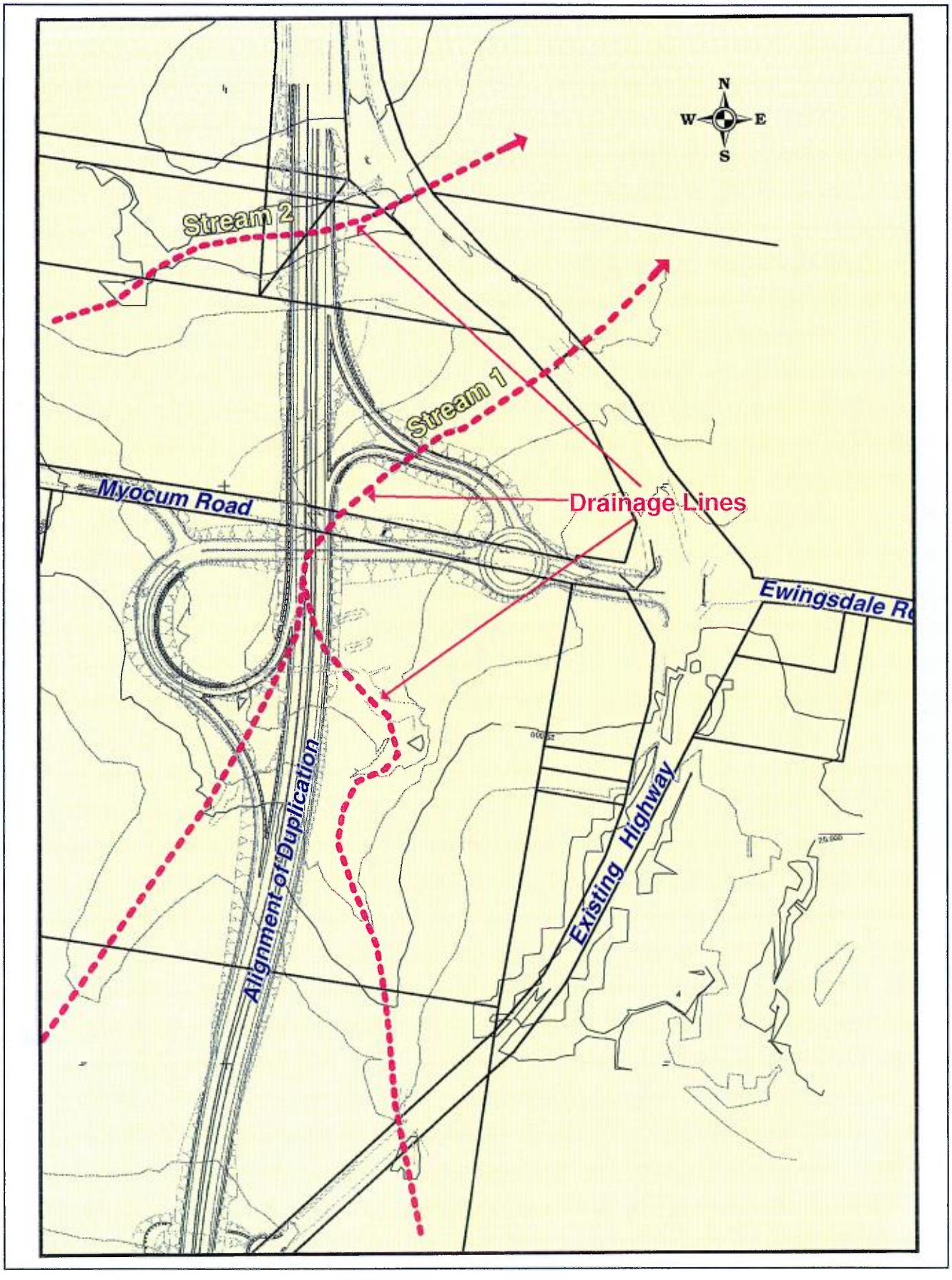


Figure 8.2 **Watercourse Locations**

Stream 1

At the southern end of the works, on the existing highway alignment, a stream draining about 9.9ha of land currently flows in a western direction via a 600mm round culvert under the Pacific Highway. It is a small drainage path that flows only during rainfall. Landuse within the catchment is mainly rural.

Once the stream passes under the highway it flows into a catchment with a total area of 58.1ha. Myocum Road marks the downstream boundary of this catchment. After collecting a number of other small tributaries, the stream flows under Myocum Road via two 950mm round culverts. It then flows in a north-easterly direction, collecting further runoff from a small catchment (5.7ha) between Myocum Road and the existing Pacific Highway. The stream passes under the existing Pacific Highway via two 900mm round culverts to eventually join the Brunswick River/Simpsons Creek system.

Stream 2

Stream 2 flows under the Pacific Highway north of Myocum Road via two 900mm round culverts and joins Stream 1 to eventually flow into the Brunswick River/Simpsons Creek system. Landuse within the catchment is rural. Stream 2 is a small flowpath travelling parallel with, and slightly to the north of Myocum Road. The catchment area is approximately 23.2ha.
The flowpaths described above have relatively small catchments and are only expected to flow immediately following rainfall events. They do, however, still provide an important source of water for environmental flows, small farm dams and recharge of underground aquifers and springs.

8.3.2 Conservation Issues

There are two important downstream ecosystems that are of conservation value:

- *the water quality and associated ecosystem within the Brunswick River* - the river is the downstream receiving environment for the whole of the study area. The river is relatively shallow and subject to tidal fluctuation. It has important recreational and conservation values, with the lower reaches being particularly popular with anglers and swimmers. Also a number of oyster farms exist in the downstream areas,
- *SEPP14 Wetland* - extensive wetland areas fringe Brunswick River along its tidal extent. These wetlands have been declared as Designated Wetlands under SEPP 14.

8.3.3 Water Quality Issues

Water quality data is not available for creeks in the study area. There has been minimal or no flow in any of the drainage paths across the study site. Therefore no in situ measurements or water samples have been taken to assess the current water quality of the area.

No areas of significant erosion occurs in the area and there are no obvious signs of pollution such as oils and grease stains. There is no obvious water usage occurring in the study area.

8.3.4 Potential Impacts

During the construction phase of the project there will be an increased potential for sediment mobilisation resulting from ground disturbances and general construction activities. To minimise the mobilisation of sediment and ensure that it does not become available to stormwater runoff, a sediment and erosion control plan will be implemented during the construction phase.

After the construction of the proposed highway there will be a potential increase in pollutant loads in stormwater runoff resulting from the increased availability of pollutants and the increased washoff efficiency associated with the impervious area of the road. Pollutant buildup on roads is generally associated with atmospheric deposition as well as direct deposition from motor vehicle emissions, including oils and rubber.

8.3.5 Mitigative Measures

Although there are no significant water courses in the vicinity, it is proposed to adopt the precautionary principle and implement extensive environmental safeguards.

This section describes the mitigative measures that will be incorporated to minimise the impact of the highway construction and operation on downstream water quality.

Construction Phase - Sediment and Erosion Control
Activities associated with earthworks and construction result in the mobilisation of sediment and the production of high sediment loads in stormwater runoff. To guard against this high sediment export during construction, an effective sediment and erosion control system will be developed. The sediment and erosion control plan will form a critical component of the environmental management.

Sediment and erosion control measures adopted for this development have been integrated with the long term management strategy for runoff from the site. This enables more cost effective and efficient management of runoff quality and quantity during both the construction and operational phase, as well as minimising the amount of unnecessary disturbance to the site.

The earthworks will be limited to the immediate area of the construction site. Generally no maneuvering of vehicles or stockpiling of materials will occur in areas outside the fenced construction corridor. Stockpile will be protected from overland flow by earth banks, silt fences or diversion channel. Stockpiles which are to be retained for over one month will be hydroseeded. Where necessary, areas adjacent and outside of the immediate construction site will be cordoned off to ensure no unnecessary disturbance by earthmoving equipment. As soon as possible after the completion of construction works, landscaping and revegetation of road edges will commence to minimise the extent of bare earth and the time of exposure.

The first step in site construction will be the development of the sedimentation ponds. The material extracted from sedimentation pond construction will provide some of the bulk fill required for the development.

In line with the RTA's Schedule of Design Policies and Specifications for the Construction for New Sections of Dual Carriageways, a series of small and large sedimentation ponds will be constructed at specially designate positions. The ponds are designed to reduce sediment loads in road runoff during the operational phase.

Diversion banks will be installed around the lowest sides of all land disturbed and all construction area runoff will be directed into graded drains. The gradients of the drains will be maintained to direct flows toward the sedimentation ponds which will be positioned at the bottom of small subcatchments. The gradient of the drains will be sufficient to permit flow without achieving high runoff velocities. At approximately 20m intervals, hay bales and silt fences will be placed across the drains to reduce the velocity of the runoff and trap sediment. The small drains will be planted with suitable vegetation and irrigated until the vegetation is established. This will reduce erosion and improve stability of the drains.

Sediment and sludge trapped in the sedimentation basins will be removed on an as needs basis and reused on-site. Access areas will be available adjacent to the structures to enable sediment removal. This process will require water level control, utilising the outlet devices installed at the commencement of construction. During the construction phase, all sediment control structures will be inspected and maintained daily by the site manager.

Operational Phase
The following mitigative measures have been developed to minimise these impacts associated with the operational phase:

- the vegetated drains constructed during earthworks will provide initial water quality polishing of all stormwater running from the operating highway. The swales will direct stormwater to sedimentation basins and wetland systems;

- in line with the RTA's Schedule of Design Policies and Specifications for the Construction of New Sections of Dual Carriageways, the small sedimentation ponds constructed during earthworks will be maintained at specially designate positions to collect any accidental spills and provide stormwater treatment through sedimentation; and

- the larger sedimentation basins constructed during earthworks will be desilted and downslope areas will be planted with aquatic plants forming constructed wetlands which will accommodate long term stormwater management.

8.3.6 Water Quality Monitoring Program

A water quality monitoring program will be developed in an Environmental Management Plan and commence 6 months before the commencement of construction to define baseline water quality. Monitoring will also be carried out at key locations during and after construction downstream and upstream of construction activities to ascertain the effects of construction activities on water quality.

Socio-Economic Impacts

9

9.0 SOCIO-ECONOMIC IMPACTS

9.1 Indigenous and Non-Indigenous Heritage

9.1.1 Introduction

As part of the broad route investigations undertaken for the Bangalow to Ewingsdale project an initial survey for indigenous and non-indigenous heritage was undertaken. This phase involved pre-route selection survey activities which included liaison with the Tweed - Byron Local Aboriginal Land Council (LALC), background research and reconnaissance field survey. The field investigations were undertaken in March 1997 by Bonhomme and Craib, heritage consultants (a copy of the report is contained in **Appendix E**).

A second phase consisting of further more detailed field study involving test excavation work within the alignment of the current Ewingsdale project was undertaken in October 1997.

The objectives for the study of indigenous and non-indigenous heritage were:
Indigenous heritage - To undertake a study of matters of significance in relation to indigenous heritage.

This objective involved the following tasks -

- a review of all available archaeological literature applicable to the area, including a search of the NPWS Aboriginal Sites Register and obtain any specific requirements for an investigation of the area from the Director-General of NPWS;
- consultation with the LALC and other relevant indigenous groups and individuals on the presence and significance of any sites relating to the proposal; and
- field study accompanied by representative members of the local Aboriginal community to assess the impacts of options on any known Aboriginal sites or relics, to identify potential site (surface and subsurface) which may be of archaeological and Aboriginal significance, and, to assess the areas for conditions conducive to the presence of Aboriginal sites.

Non-Indigenous Heritage - to undertake a study of matters of significance in relation to the non-indigenous heritage.

This objective involved the following tasks:

- review of the heritage literature and liaison with the Australian Heritage Commission, NSW Heritage Council, the National Trust, local council and historical societies;
- assess the effect of the route options on heritage sites;
- identification of any major heritage issues;
- issue a statement of the cultural significance of the area/sites identified; and
- determine mitigation measures as applicable.

9.1.2 Initial Investigation and Results

From background research and contact with the Tweed - Byron LALC there is considerable evidence of past Aboriginal settlement in the region. The coastal strip, including the hinterland of northern NSW is known to have been a major focus of Aboriginal occupation at the time of European settlement, as evidenced by the number of recorded sites in this region in the NPWS Site Register. Archaeological sites in the region include burials, middens, open camp sites, shelters with midden, open camp with burial and bora/ceremonial grounds. The general area has been used primarily for grazing and homesteads and rural industry sites are likely to be the most common class of non-indigenous heritage found in the region.

Notwithstanding this, no such evidence has been found to date in the study area and no archaeological sites nor cultural materials were found during the survey. General surface visibility, however, was greatly restricted due to the low, thick pasture grass throughout most of the project area.

The main findings from this survey are as follows:

- no known indigenous nor non-indigenous sites have previously been recorded within the project area;
- no sites were found during the survey;
- identification of loci [priority was for searches] within the project area was refined to the following:
  - the alluvium area near creek beds had a moderate probability of sites; and
  - the remainder of the area had a low probability of containing sites.

In terms of sites of heritage value, there are some heritage listed houses further south near Possum Creek, however these will not be affected by the construction in the northern section.

All known relevant heritage registers were investigated and no sites of heritage value have been listed for the corridor area. The Johnston property, "Araluen" is over 50 years old and was reported, during consultation to have some local heritage interest. The building will not be directly impacted.

9.1.3 Second Stage Investigations

On 21-22 October 1997 a series of eighteen (18) backhoe trenches were excavated along the Ewingsdale project corridor. Although the specific purpose of the trenching was for geotechnical investigations, examination of these trenches for cultural heritage purposes was also performed by Bonhomme, Craib & Associates.

The trenches were located within all the major topographic divisions - creek margin, wet areas, low ridges and high ridges. Distances between trenches varied from about 50m to 150m. The trenching regime is regarded as providing a representative sampling of the area.

Most of the trenches were roughly uniform in size, about 2.5m long by 0.7m wide, covering approximately 1.75m^2. Slightly larger trenches were opened only when subsurface boulders were present which required removal. The depth of the trenches varied according to the depth of bedrock; the shallowest trench was 1.0m; the deepest trench was 3.6m.

All sediment was inspected as it was being dumped onto a pile adjacent to the trench and was subsequently inspected for the presence of cultural materials. The soil profile in each exposed trench was examined for the presence of subsurface cultural materials, deposits and features.

The eighteen trenches exposed a total surface area of about 36m^2 and approximately 78m^3 of sediment and bedrock were excavated.

No cultural material of indigenous or non-indigenous origin was found in any of the trenches. The surface around each trench was also inspected, however invariably thick ground cover precluded detailed examination. Nevertheless, no cultural materials were found on the surface within the proposed corridor.

9.1.4 Discussion

The geotechnical sampling program obtained a stratified sample from all major topographic features. Spacing between the trenches was large, averaging about 100m. Nevertheless, this was sufficient to ascertain the presence of any extensive scatters of cultural materials (e.g. flaked stone artifacts, shellfish remains).

No cultural materials, deposits or features were found on the surface nor in the trenches. Results of the surface survey and subsurface testing indicate that the probability of sites of any kind existing within the proposed corridor area is very low.

9.2 Noise and Vibration Assessment

9.2.1 Methodology

The proposed highway and interchange will be 300m west of the existing highway and the currently exposed properties will generally still experience some noise impact. In order to fully assess the future impacts of road traffic, Kampst & Simpson was commissioned to carry out a noise and vibration assessment. Their specialist report is contained in **Appendix F**.

Ten (10) noise and vibration sensitive receptors along the route (shown on **Figure 9.1**) were considered in this study. These receptors are all residences and were selected for their proximity to the route.

Noise monitoring was carried out at three of the locations over a period of 7 days with modelling being undertaken to extrapolate to the other sites. Two of the noise monitoring locations were adjacent to the existing and proposed routes. The third noise monitoring location was selected because it is considerably closer to the new intersection at Ewingsdale Road.

The monitoring locations were:

- M1: Mulroy Residence, Myocum Road (L2);
- M2: Araluen Residence, Pacific Highway (L4); and
- M3: Beattie Residence, 38 Plantation Drive (L8).

The monitoring locations used in the noise monitoring program are shown on **Figure 9.1.** The noise surveys were carried out using Acoustic Research Laboratories Environmental Noise Loggers. The loggers were programmed to record statistical parameters over hourly periods. Noise monitoring commenced on Friday 10 October 1997 and finished on Sunday 19 October 1997.

A Davies Weather Monitor II weather station was also set up at monitoring site M1 (L2) for the duration of the detailed noise survey. No rainfall was recorded in the monitoring period and wind was light and prevailed from the south to south-east. These conditions were suitable for the noise monitoring.

9.2.2 Existing Noise Level Measurements

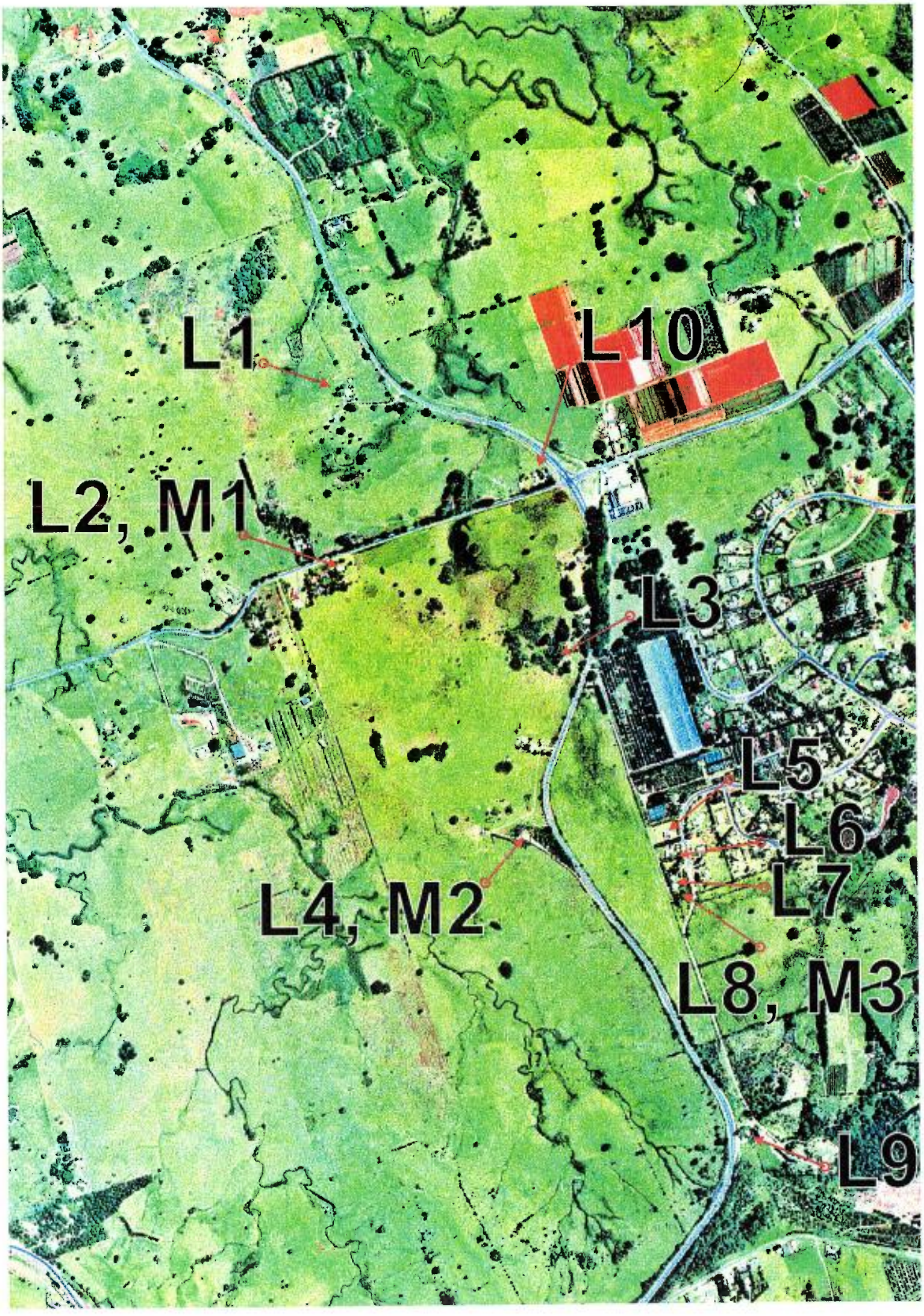
In accordance with the EPA requirements, the predicted noise levels have been assessed in terms of the $L_{Aeq,15\ hour}$ and $L_{Aeq,9\ hour}$ assessment goals. The $L_{Aeq,15\ hour}$ is equivalent to the sound level for the 15 hour period between 7:00am and 10:00pm, and the $L_{Aeq,9\ hour}$ level is the equivalent sound level for the period from 10:00pm to 7:00am.

The summarised noise data from each of the monitoring locations is included in Table 9.1.

Table 9.1 Monitored Noise Levels At Noise Sensitive Locations

Site	Site Description	L_{90} (07:00 - 18:00) dB(A)	L_{eq} (15 hour) (07:00 - 22:00) dB(A)	L_{eq} (9 hour) (22:00 - 07:00) dB(A)
M1	Mulroy (L2)	44	51 - 58	46 - 52
M2	Araluen (L4)	49	63 - 66	58 - 62
M3	Beattie (L8)	43	54 - 64	47 - 54

Note: L_{90}(0700-1800) is the lowest repeatable hourly L_{90}, (the noise level exceeded 90% of the time,) noise levels measured between 7 am and 6 pm; L_{eq}(15 hour) is the equivalent continuous noise level between 7 am and 10 pm; L_{eq}(9 hour) is the equivalent continuous noise level between 10 pm and 7 am.



M1..M3 Noise monitoring Sites
L1..L10 Noise Sensitive Receptors

RTA - Pacific Highway
Bangalow to Ewingsdale
Noise Monitoring Sites and
Noise Sensitive receptors

Figure 9.1

9.2.3 Noise Prediction Model

Noise levels due to the existing Pacific Highway were modelled and measurements at M2 and M3, which are close to the existing highway, were used to validate the model. In both instances the predicted road traffic noise level was with ±2dB(A) of the measured value. The model is therefore considered to provide an acceptable representation of the noise levels at the remaining residences. The predicted noise levels, validated by the noise level measurements, were used to establish existing noise levels based on current AADT estimates.

The road traffic based noise levels at the 10 sites calculated using the model are shown in Table 9.2.

Table 9.2 Road Traffic Based Noise Levels for Existing Noise Levels

Location	Noise Level Limit in dB(A) L_{eq} (15 Hour)	L_{eq} (9 Hour)
L1	59	55
L2	N/A [#1]	N/A [#1]
L3	64	60
L4	66	61
L5	57	53
L6	57	53
L7	56	52
L8	56	52
L9	68	64
L10	64	60

Note #1: The site is not adjacent to the existing Pacific Highway.

9.2.4 Traffic Noise Criteria

The NSW EPA, in conjunction with the RTA, has developed road traffic noise guidelines which are to be used for assessing road traffic noise in residential areas. The assessment point is outside a building 1m from the ground floor window or door on the facade which is most exposed to road traffic noise.

The EPA's criteria for new highways and new road corridors are $L_{eq,15\ hour}$ 55dB(A) and $L_{Aeq,9hour}$ 50dB(A) for traffic growth predictions. For the redevelopment of existing road corridors, the EPA have recommended that the appropriate design goals are $L_{Aeq,15hour}$ 60dB(A) and $L_{Aeq,9hour}$ 55dB(A). Where the existing traffic noise levels already exceed their goals for the redevelopment of an existing road, the assessment goal is 2dB above the existing noise level. In such situations the EPA recommend that consideration be given to reducing the traffic noise levels to satisfy the recommended assessment goals, where cost effective and practical.

Table 9.3 presents a summary of the relevant criteria.

Table 9.3 Road Traffic Noise Criteria for Noise Sensitive Locations

Type of Development	Criteria in dB(A) L_{eq} (15 Hour)[#1]	L_{eq} (9 Hour)[#2]	Where Criteria are already exceeded
New freeway or arterial road corridor[#3]	55	50	Where feasible, noise levels from existing roads should be reduced to meet the noise criteria, and the new road should not increase existing noise levels by more than 0.5 dB(A)
Upgraded existing freeway/arterial[#4]	60	55	It is highly desirable that no increase to existing noise levels occurs. Hence, noise criteria applies as the target

Note #1: L_{eq} (15 hour) is the equivalent continuous noise level between 7 am and 10 pm
Note #2: L_{eq} (9 hour) is the equivalent continuous noise level between 10 pm and 7 am
Note #3: New freeway/arterial refers to a freeway or arterial road which is proposed on a 'corridor' which has not previously been a freeway or arterial road, or an existing freeway or arterial road which is being substantially realigned.
Note #4: Upgraded freeway/arterial refers to proposals where changes are not designed to increase traffic carrying capacity and are generally changes related to safety or amenity objectives.
Note #5: Where existing traffic noise exceeds the goal, the goal is 2dB(A) above the existing noise level.

The EPA has classified the Ewingsdale project as primarily a new arterial road although the extreme northern and southern ends, near the Tyagarah Upgrade and along the highway up to the point where the works depot from the existing road corridor, are classed as an "upgrade".

The residences along and close to the existing Pacific Highway are subject to existing road traffic noise levels. The guidelines recognise that it may not always be feasible to meet the criterion and an upper limit applies which is 0.5dB(A) above the existing road traffic noise levels. Since the relocated Pacific Highway will still remain the dominant road traffic noise source the 0.5dB(A) increase is considered to be the noise goal. The noise limits for each site, based on the EPA criteria and for the 0.5dB(A) above the existing levels, are shown in Table 9.4.

Table 9.4 Noise Limits

Noise Sensitive Location	Location Description	EPA Criteria		EPA Criteria Where Noise Levels are Already Exceeded	
		Leq, 15 hour dB(A)	Leq, 9 hour dB(A)	Leq,15 hour dB(A)	Leq,9 hour dB(A)
L1		55	50	59	55
L2	Mulroy (M1)	55	50	55	50
L3		55	50	64	60
L4	Araluen (M2)	60	55	68	63
L5		60	55	59	55
L6		60	55	59	55
L7		60	55	58	54
L8	Beattie (M3)	60	55	58	54
L9		60	55	70	64
L10		55	50	64	60

9.2.5 Noise Prediction and Discussion

On the basis of the RTA's Interim Noise Policy (1992), the predicted road traffic noise levels have been calculated for the year 2010, which is ten years after the proposed completion of the Ewingsdale project.

To obtain the predicted traffic flows, linear growth has been assumed, based on the difference between traffic flows for the years 1997 and 2010. The calculations have also been based on the design criteria given in Section 7 and the use of dense grade asphaltic concrete road surface or acoustic equivalent.

The traffic is assumed to be free-flowing at a speed of 100km/hr on the Pacific Highway and 60km/hr on Ewingsdale Road, ramps and roundabout. Analysis of actual traffic data yielded an existing heavy vehicle proportion of 11% of the total vehicles. A summary of the relevant traffic data details for the year 1997 and 2010 are presented in Table 9.5.

Table 9.5 Summary of AADT Traffic Flow For the Years 1997 and 2010

Road Segment	1997	2010
Pacific Highway North of Ewingsdale Road	14 967	24 000
Pacific Highway South of Ewingsdale Road	11 920	19 120
Ewingsdale Road	9 675	15 520

The traffic flow during the 18 hour period between 6:00 am and midnight was assumed to be 94% of the AADT for traffic noise modeling purposes.

The road traffic noise predictions for 2010, along with the EPA road traffic noise criteria are shown in Table 9.6. The predicted road traffic noise levels for the year 2010 are compared with the EPA L_{eq} (15 hour) and L_{eq} (9 hour) noise level criteria.

Table 9.6 Noise Goal and Predicted Road Traffic Noise Levels at Noise Sensitive Locations - Year 2010

Site	Noise Goal		Predicted Noise Levels				Comment
	L_{eq} (15 hour) dB(A)	L_{eq} (9 hour) dB(A)	L_{eq} (15 hour) dB(A)	L_{eq} (9 hour) dB(A)	Qualifies for noise control	Required noise reduction	
L1	55 (59)	50 (55)	68	63	Yes	13 (9)	Near northern end of route, the route will be significantly closer and changed in orientation.
L2	55	50	58	54	Yes	4	Other houses behind this residence, but further away from the road, would also be subjected to similar noise levels
L3	55 (64)	50 (60)	58	54	Yes	4 (0)	Predicted future noise level is less than existing noise level. Route now to the rear of residence while previously it was to the front of the residence
L4	60 (68)	55 (63)	69	65	Yes	10 (2)	Route remains on same side as previously except slightly closer and having a different orientation.
L5	60 (59)	55 (55)	59	54	No	0	Route remains on same side of residences as is currently the case and approximately the same distance.
L6	60 (59)	55 (55)	59	54	No	0	
L7	60 (58)	55 (54)	58	54	No	0	
L8	60 (58)	55 (54)	58	53	No	0	
L9	60 (70)	55 (64)	67	63	Optional	8 (0)	Predicted future noise level is less than existing noise level. At end of route the residence will have a virtually unchanged road
L10	55 (64)	50 (60)	67	63	yes	13 (3)	

Note 1: The numbers in brackets ( ) represents the required noise reductions based on the existing road traffic noise level.

It can be seen from Table 9.6 that road traffic utilising the proposed upgrade would adversely impact on the traffic noise amenity at a number of residential locations. The road traffic noise criteria previously detailed are predicted to be exceeded at all of the noise sensitive locations. These noise sensitive locations would require treatment to mitigate noise impacts in order to satisfy the EPA noise criteria.

All locations except L2 are currently subjected to noise levels in excess of the desirable noise level limit. In these instances the noise goal is specified in the lower limit as the desirable noise goal with the upper limit being the noise level not to be exceeded.

At location L3 it is expected that the noise level would reduce by about 6dB(A) following construction. This is a noticeable reduction in traffic noise, however the route will now be on the opposite side of the residence and it is expected that in 2010 the noise level at the rear facade of the residence will be unchanged following the upgrade.

Location L9 is immediately adjacent to the southern end of the route. Additional roadworks/ upgrading is likely immediately to the south of his location. Since any roadside noise control measures would need to account for any upgrade in this section it is recommended that noise control options for this site be deferred and considered in the subsequent Stage 2 of the project.

9.2.6 Operation Noise Management

The EPA's noise criteria for the upgrade of an existing highway or arterial road, applying to noise generated after 10 years of operation, is 60dB(A) $L_{eq(15\ hour)}$ and 55dB(A) $L_{eq(9\ hour)}$ and for new freeways, highways and arterial roads 55dB(A) and 50dB(A), respectively. For the above calculations it was assumed that both the northern and southern ends of the Stage 1 works, where the new carriageways are within the existing road reserve, that the former criteria applies. In the middle section, including the interchange, the latter criteria has been assumed to apply.

Noise sensitive locations are identified in **Figure 9.1.**

Noise amelioration measures would be required to reduce the predicted road traffic noise levels at all noise sensitive locations to an acceptable level.

There are a number of options available to ameliorate road traffic noise, including traffic noise barriers placed in the noise propagation path, low-noise road surfaces and the acoustic treatment of buildings. A fourth alternative is to relocate the building further away from the route on the same allotment, however, this should be considered on a case by case basis.

9.2.7 Noise Mitigation Options

Low Noise Road Surface

Open-graded asphalt is a low-noise road surface and typically generates noise levels about 2.5dB(A) less than those generated by dense graded asphalt. If a low noise road surface was used as the road surface throughout the road upgrade the predicted road traffic noise levels would be 2.5dB(A) lower. This surface in itself would not provide sufficient noise attenuation at any location.

Building Treatments

Acoustical noise control treatments could be applied to the buildings in lieu of, or in conjunction with, alternative noise control measures (low noise road surfaces or roadside noise barriers). In these instances building control treatments are provided following extensive consultation with the residents and agreement from all affected parties.

Building treatments may include:

- improving glazing in the facades exposed to the highway,
- provision of mechanical ventilation or airconditioning;
- upgrading the facades if the existing building materials are inadequate, and
- upgrading the roof structure if the existing is inadequate.

The external road traffic noise criteria would not be met at these premises, however the internal noise levels due to road traffic noise would be reduced to meet acceptable internal noise level limits (eg: Australian Standard AS2107 "Recommended Internal Noise Levels and Reverberation Times for Building Interiors").

Barriers

In the event that barriers are to be used, the recommended barrier locations and heights are described in Table 9.7.

Noise barriers have been located wherever possible to allow screen planting infront and behind the barriers,. These measures will ensure that the RTA Road Environment Safety Guidelines are met.

A digitised format of the local ground contours of the study area was entered into the model together with representations of the ground cover. A dense grade asphalt road surface has been assumed.

The barriers B2, B3 and B5 will achieve compliance with the EPA criteria for all residences identified in Table 9.7. Barrier B1 and B4 would achieve compliance with the less stringent noise level goal, ie based on existing noise levels.

Noise barriers higher than 5m have not been considered in this analysis.

Table 9.7 Noise Barrier Requirements based on Dense Graded Asphalt Road Surface

Noise Barrier Code	Barrier Length (m)	Barrier Height (m)	Barrier Type & Comment	Residences Protected
B1	125	5	Located near top of cutting.	L1
B2A	190	3.5 to 5.0	Earth mound located near the top of cut associated with drainage channel.	L2 and L3 others
B2B	130	2.0 to 5.0	Earth mound and fence close to top of cutting.	
B3A	75	2.0	On edge of road, requires crash barrier.	L3
B3B	350	4.0 to 5.0	Earth mound and fence on top of cutting.	
B3C	75	2.0	On edge of road, requires crash barrier.	
B4	150	4	Earth mound approximately 10m from edge of road.	L4
B5	75	2	Timber fence on top of cutting and close to property boundary.	L10

Altered EPA Noise Criteria

The proposed works are Stage 1 of the larger Ewingsdale to Bangalow upgrade. The EPA has classified this project as primarily a new arterial road, although the works near the northern and southern ends, near the Tyagarah Duplication Project and along the highway up to the point where the works depart from the existing road corridor, are classified as an upgrade.

Site L1 - The proposed barrier meets the limits based on the existing noise levels (rather than the strict criteria) and there is consequently no option to reduce the barrier height unless one of the other options discussed below (eg: building treatments) is adopted.

Site L2 - If the noise criteria is relaxed to meet the criteria for an existing highway (ie:60/55 dB(A)) then no barriers are required in the positions of B2A and B2B.

Site L3 - If the noise criteria for the existing highway is adopted (ie: 60/55dB(A)) then no barriers are required in the positions of B3A, B3B and B3C.

Site L4 - The proposed barrier meets the limits based on the existing noise levels (rather than the strict criteria) and there is consequently no option to reduce the barrier height unless one of the other options discussed below (eg: building treatments) is adopted.

Consultation will be carried out with the potentially affected residents to determine the preferred methods of road traffic noise amelioration.

Planning Controls

The local Council has a role in ensuring that road traffic noise is considered when determining development and building approvals under the provisions of the EP&A Act and the Local Government Act, 1993. Consultation with the local Council will be necessary to identify how Council could modify its planning strategy to require noise attenuation to be considered for future residential developments.

9.2.8 Traffic Vibration

The RTA advise that the operational phase vibration criterion is 2mm/s at sensitive locations adjacent to the Ewingsdale project. Ground vibrations are not considered to be a problem on the Ewingsdale project or to be of any consequence from modern highways.

9.2.9 Construction Noise Guidelines

RTA has undertaken to comply with the EPA's Environmental Noise Control Manual (ENCM), which details construction noise guidelines in Chapter 171.

According to the ENCM, the recommended construction noise guidelines are, for a construction period exceeding 26 weeks, that the L_{10} noise level measured over a period of not less than 15 minutes when the construction site is in operation, must not exceed the background level by more than 5dB(A) during the day.

9.2.10 Construction Noise Impacts

Based on the average measured L_{90} noise levels shown in Table 9.1, the relevant construction noise criteria at each of the noise sensitive locations adjacent to the route have been estimated and are shown in Table 9.8. For residential locations where noise monitoring was not carried out, the L_{90} noise level was estimated based on the monitored data collected at residences in similar locations.

Table 9.8 Construction Noise Guidelines

Noise Sensitive Location	Location Description	Measured / Estimated L_{90} (07:00 -18:00) dB(A)	Construction Noise Guidelines L_{10} dB(A) over 26 week construction period
L1		49[#1]	54
L2	Mulroy (M1)	44	49
L3		49[#1]	54
L4	Araluen (M2)	49	54
L5		49[#1]	54
L6		43[#2]	48
L7		43[#2]	48
L8	Beattie (M3)	43	48
L9		49[#1]	54
L10		49[#1]	54

Note: #1 Background noise levels based on noise monitoring carried out at M2 the Araluen residence along existing Pacific Highway.

#2 Background noise level based on noise monitoring carried out at M3 the Beattie residence in Plantation Drive.

Table 9.9 shows a typical inventory of the type of plant likely to be employed during a particular construction activity and the typical noise levels associated with this equipment. The noise levels generated by the various construction activities would vary in intensity and character depending upon the combination of plant in operation at any one time, and the location and duration of the individual activities.

The typical noise levels for the construction equipment in Table 9.9 have been extracted from the Australian Standard 2436-1981 entitled "Guide to Noise Control on Construction, Maintenance and Demolition Sites."

Table 9.9 Typical Sound Power Levels From Construction Equipment

Equipment Type (Plant)	Sound Power Level Range dB(A)
excavators/backhoes/loaders	114 to 118
dump trucks	102 to 114
bulldozer	115 to 118
rollers/compactors	110 to 119
graders/scrapers	114 to 118
crane, truck mounted	118 to 120
pile driver (2 t drop hammer)	114 to 128
rotary bored piles	112 to 124
concrete/ dump trucks	103 to 108
saw cutting equipment/chain saws	105 to 118
slip form paver	99 to 112

The site clearance, development of side tracks and drainage, and general earthworks activities are likely to generate significant and prolonged potential noise impacts during the construction of the highway realignment.

9.2.11 Construction Noise Predictions

Distances were estimated from the road corridor to the noise sensitive locations. It is likely that there would be some further reduction in the estimated construction noise levels due to ground effects and topographical shielding, particularly when the cuttings have been formed and the construction equipment is operating in the cuttings. The estimation of noise levels are provided in Table 9.10 on the assumption that all of the considered noise sources are operating concurrently.

The predicted maximum construction noise should not be considered to be the continuous noise throughout the construction phase. Over any period the noise will fluctuate with the highest noise levels likely to occur when the relevant noise sources are positioned at the closest approach of the route to the site and on the natural ground level.

Table 9.10 Estimated Maximum Construction Noise Levels at Sensitive Locations

Site	Distance to Route, Bridge (m)	Construction Noise Guidelines[#1] L10 dB(A)	Estimated Maximum Noise in dB(A) due to			
			Site Clearance	Pavement Construction	Haul Roads	Bridge Construction
L1	35, 400	54	78	74	71	52
L2	140, 250	49	64	60	57	59
L3	200, 400	54	60	55	53	52
L4	40, 700	54	77	73	70	41
L5	200, 840	54	60	55	53	37
L6	200, 890	48	60	55	53	35
L7	180, 930	48	61	57	54	34
L8	150, 1000	48	63	59	56	32
L9	30, 1500	54	80	75	73	18
L10	250, 250	54	58	53	51	59

Note #1: The construction noise guidelines contained in this table are based on a more than 26 week construction period adjacent to the site in question.

A construction work plan is not yet available. Only when activity schedules and duration times are identified will potential construction noise impacts be able to be adequately assessed. This will occur upon application to the EPA for Pollution Control Approval. Table 9.10 contains a list of noise levels for construction activities in terms of maximum (instantaneous) noise levels while the construction guideline is the desired long term noise level. However it would be reasonable to expect that the L_{10} could be between 5dB(A) and 15dB(A) below the maximum noise levels quoted in Table 9.9.

From a comparison of the construction guideline with the predictions of construction noise, it is considered likely that the construction noise guideline may be exceeded at noise sensitive locations along the route. It is highly unlikely that the noise level in the Table will be continuous throughout the construction phase. With this in mind the Table should be considered to identify locations where construction noise may be intrusive.

9.2.12 Construction Noise Management

Construction noise is likely to be consistently above the construction noise guidelines. It is inherently difficult to limit construction noise due to the nature of the process. Thus for this project it will be important that the affected community is consulted during all phases of construction so that a work program that minimises the impacts from the high noise level events is developed. The contractor will be required to demonstrate that best available work practices have been implemented during construction works. It may also be desirable to reschedule activities to increase the level of activity and reduce the exposure time. These matters will be negotiated with the affected community.

The following additional measures will be stipulated during the construction phase to minimise possible noise nuisance at adjacent noise sensitive locations:

- hours of construction:
  Monday to Friday - 7 am to 6 pm;
  Saturday - 7 am to 1 pm. However, if construction is audible within residential premises then recommended hours are 8 am to 1 pm;
  Sunday - no construction work to take place on Sundays and Public Holidays;
- road traffic noise attenuation earth mounds and/or barriers to be built in the first stages of construction, if practical to do so, to assist in ameliorating the construction noise to these sensitive locations;
- use of high efficiency mufflers on all construction equipment;
- construction equipment is to be well-maintained;
- the construction depot is to be located away from residences; and
- haul roads to be well-maintained and repaired immediately if damaged.

9.2.13 Construction Vibration

It is unlikely that blasting would be carried out during the construction phase of this project. The use of heavy plant and equipment in the construction of the highway may generate discernible vibrations at those sensitive locations closest to the work activities. The level of vibrations generated as a result of these activities would vary in intensity and character depending upon the combination of plant in operation at any one time, and the location and duration of the individual activities. Of the various activities conducted as part of the construction works those likely to be associated with vibrations are the vibrating rollers and the rock hammers.

Vibration from construction equipment can adversely affect people in sensitive locations such as hospitals and schools, or damage old structures and buildings including structures of heritage significance if not managed correctly. The Ewingsdale church and hall and the Johnston property, Araluen, are the only potentially sensitive structures in the study area and there are at sufficient distance to be unlikely to experience any effects from vibration.

9.2.14 Conclusion

Construction Phase
Construction noise may have an impact on the noise sensitive locations adjacent to the proposed route. Construction is predicted to take place over an 18 month period and certain operations are expected to adversely affect some residences. Construction contractors will be required to have in place an active environmental noise control program to minimise the nuisance during this period as described in this report.

Blasting is unlikely to be carried out during the construction phase of this project. The construction and operation of the proposed highway upgrade will generate minimal ground borne vibrations in the vicinity of the alignment. Therefore, the vibration impacts generated by the construction phase of the works are likely to be minimal, localised and transitory.

Road Traffic Noise
Modelling was carried out using a digital terrain model utilising ground terrain. The noise levels during the operation of the proposed upgrade are predicted to exceed limits at ten noise sensitive locations. Options have been discussed and barriers have been designed for each location.

The barriers proposed will achieve compliance with the stringent noise level goal at all residences except three. At these locations the barriers have been designed to achieve compliance with the less stringent noise level goal, based on existing noise levels. Consultation with the affected landholders is continuing to develop the best noise control strategies.

9.3 Landscape and Landscape Treatments

9.3.1 Existing Landscape

The existing Pacific Highway passes through an attractive rural landscape. This section of highway crosses relatively flat landform and the surrounding farmland includes many springs and seepages which form the headwaters of local creeks. These features are shown on **Figure 8.4** and discussed in **Appendix G.**

The character of the corridor is predominantly rural and open and typical of the northern NSW coastal plains and foothills. It has an attractive pattern of grazing and agricultural uses on rolling countryside framed by hills.

The existing highway curves through the area and, while it is a strong visual element, the bends and grades are sympathetic to the landform. It provides a scenic driving experience with views framed by vegetation and topography. The contrast of treed farmland, orchards, homesteads contained and sweeping views offers a rewarding and scenic journey to travellers using the route.

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100 0 100 200 300 400 500m

1 : 10000 A4 FULL SCALE

Landscape Features of the Study Area

Figure 8.4

Maunsell

Landuse
Agriculture and horticulture are the main land uses in the area. Adjacent to the southern section is a suburban subdivision (an extension of the Byron Bay township) referred to locally as "McGettigans Lane subdivision." This is effectively screened from the highway by existing vegetation.

The free draining basaltic soils and reasonably high rainfall of the district formerly supported a dense closed forest ("the scrub"). Today the original vegetation of the corridor and areas surrounding have been extensively removed or modified. There are no remnant areas of intact native forest visible in the immediate corridor area, however an avenue of large figs (*Ficus microcarpa var hillii*) which tower over the highway adjacent to the Byron Bay turnoff, is a local landmark.

9.3.2 Viewsheds

The proposed new section of highway is entirely within a distinct visual catchment formed by the ridgeline from St Helena Hill. This locally-prominent ridge offers views over the surrounding farmland and the coast from Cape Byron, through to the north (**see plate 9.1**).

Views from existing farmhouses and residential areas in the corridor are noted in **Figure 9.5**. The most attractive of these are from the Myocum Road area looking south-east towards the rural hillslopes of St Helena Hill. The view of the proposed interchange from Ewingsdale Road will also be important.

9.3.3 Landscape Constraints and Opportunities

Residences
A number of residences are located immediately adjacent to the road corridor. Many of these houses are rural in character and contribute to the landscape identity of the area.

Houses in the subdivision of McGettigans Lane are close to the Pacific Highway and are more suburban in character, but are effectively screened at present from both the existing highway and the proposed re-alignment.

Noise considerations will require the erection of noise barriers or landscaped mounds adjacent to some of the residents in the Myocum Road area. These will be visible as a new element in the landscape, and will impact on views to and from the road corridor.

Fig Avenue
An avenue of large fig trees along the existing highway is a feature of the entry experience to Byron Bay. The proposed re-alignment of the highway will not affect these historic trees, but will remove an attractive experience for highway motorists.

Views
The highway has excellent panoramic views of the surrounding rural countryside. Proposed roadworks will allow for the retention of existing views where possible. Where solid noise barriers are the only acceptable option for noise control, vegetation will be used to soften their visual impact on both sides of the walls.

Rainforest Remnants
No rainforest remnants are located adjacent to the preferred realigned highway and much of the original vegetation has been reduced to scattered fragments. Replanting rainforest species, from local genetic stock, is proposed as part of the landscaping and opportunities to link several existing pockets to create canopy continuity alongside of the realigned highway will be investigated.

Soil Stability
The soils of the area are prone to both slip and erosion, and existing road cuttings show evidence of these problems, particularly in the steeper sections.

Tree planting on the red soils of this area appears to significantly reduce erosion and slip. Vigorous rates of plant growth on these fertile soils, and the generally high rainfall of the district will also ensure that any batter slopes are readily revegetated.

9.3.4 Impact of Views

The proposed work will be visible from a number of view points. These are :

- the McLeods Shoot Lookout and adjacent residences particularly those with views, north-east from Coolamon Scenic Drive and north from the highway between St Helena Road and Coolamon Scenic Drive;
- residences on Myocum Road, with views east towards the highway; and
- residences in McGettigans Lane subdivision with views west to the highway.

From McLeods Shoot Lookout and the adjacent residences, the existing views of rural countryside and the curving highway will be changed by the introduction of a new straighter section of wider highway, an overpass bridge / noise barriers and associated abutments and on-ramps. Much of the road will be heavily landscaped to minimise the impact of the highway corridor.

The off-ramps and overpass bridge will be visible from the lookout. Proposed planting will enhance, but minimise the detrimental impact of these structures. From Myocum Road, the highway will be largely screened by tree planting adjacent to the off-ramps and overpass.

The McGettigans Lane subdivision is largely screened from the existing highway. Proposed screening and tree planting, as well as relocation of the highway away from this subdivision, should result in a lower visual impact than at present.

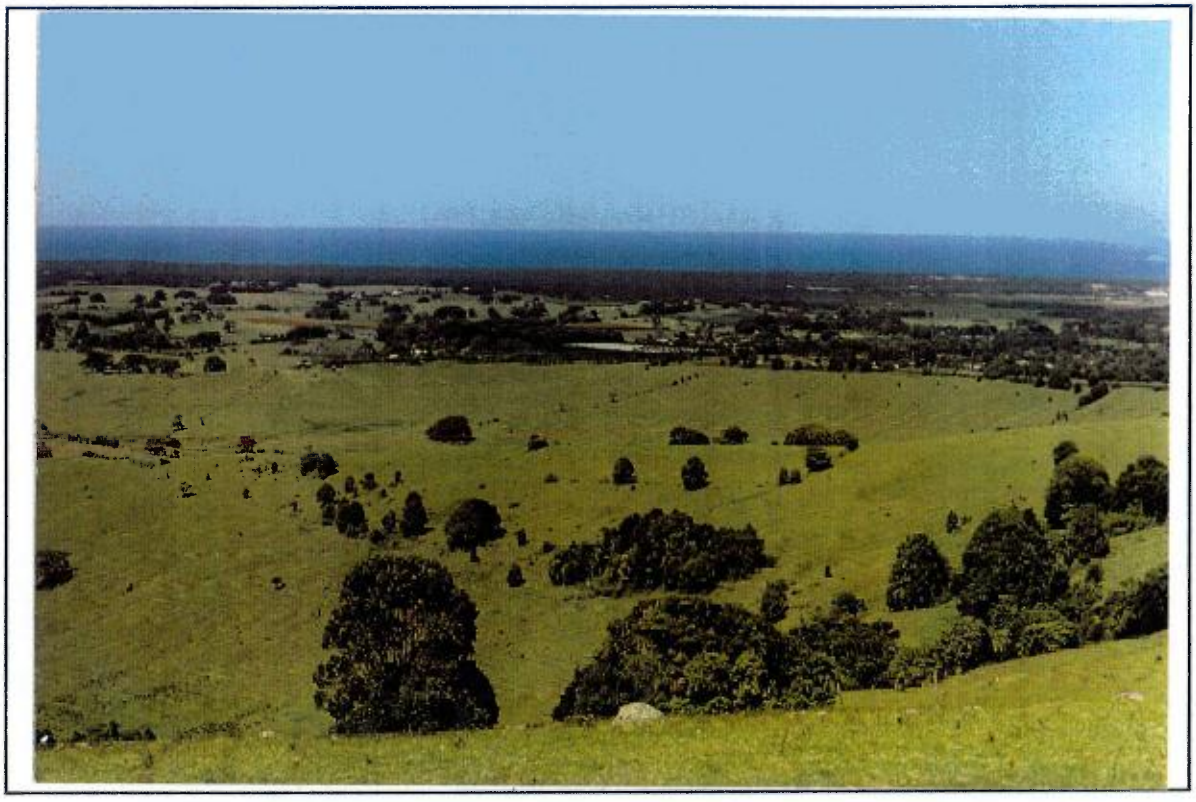

Plate 9.1 Views over study area from McLeods Shoot - St Helena Hill, ridge and existing highway in middle distance

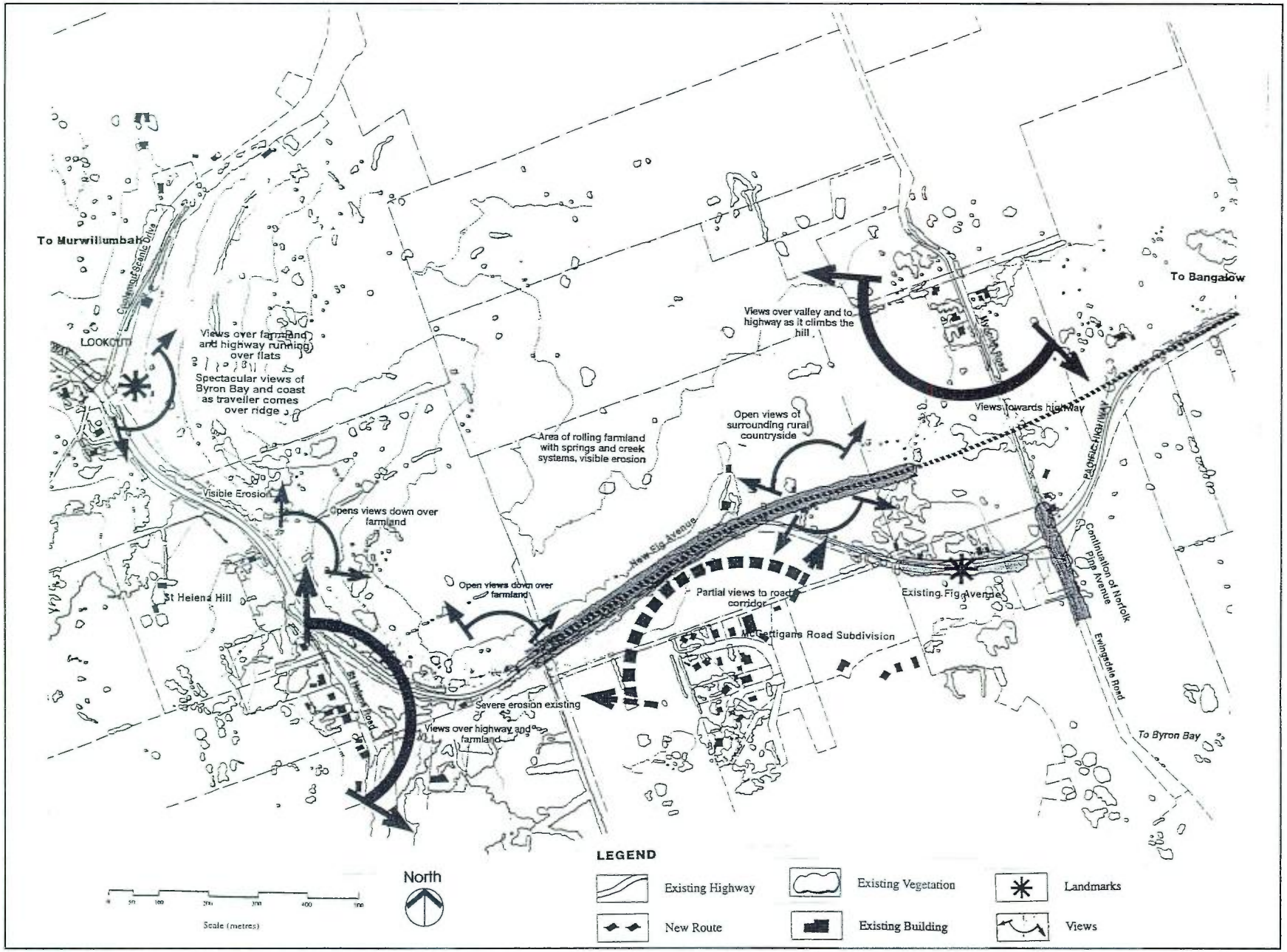

Figure 9.5 Views from residential areas

Maunsell

Noise barriers will be required along part of the new highway and adjacent to the overpass. Noise barriers by their nature are intrusive and not an attractive element in the landscape. The barriers will restrict views to and from the highway and will be in contrast to the rural landscape surrounding the project. In particular the barriers will be visible from the Ewingsdale church and hall.

To minimise the impact of the barrier screens, they will be placed at least 2m back from the road surface. This will allow the wire rope barrier to be placed next to the road surface, as well as at least a 2m wide strip which will be planted with trees or vines. Trees will also be placed behind the screens. Once planting is established, views to the highway from residences, the church/ hall and adjacent roads and viewpoints will be of a dense corridor of vegetation rather than of noise barriers. Views from elevated points such as McLeods Shoot will identify the highway as a corridor of trees forming a gateway to Byron Bay. While this will be in contrast to the open countryside it will be an attractive pattern on the landscape.

9.3.5 General Proposed Landscape Treatment

VMS 2 revealed a number of concerns of residents and other stakeholders. Particular concerns were expressed about the visual impacts of the upgrading project on nearby houses in McGettigans Lane and from the eastern side of the existing highway. Some of these concerns have been addressed by the preferred alignment, and others will be addressed by proposed landscape planting and screening measures.

The landscape treatment for the Ewingsdale section of the highway aims to:

- rehabilitate and stabilise disturbed surfaces;
- ameliorate the visual impacts on nearby residents;
- compensate for loss of vegetation and habitat;
- reduce the barrier effects on local fauna;
- integrate new earthworks and roadways into the surrounding landscape; and
- create an attractive driving experience for motorists.

These aims will be achieved by developing a landscape plan/strategy which will direct attention to:

Pattern

The proposed planting treatment aims to reflect the existing pattern of the landscape. This includes groves and scattered individuals of large shade trees, with dense forested gullies, interspersed with areas of open rural character.

Drainage Lines
Two drainage lines cross the highway. One is a fairly defined corridor to the north of the project and the other is located adjacent to the proposed offramps. It is proposed that these drainage corridors are retained and incorporated as natural gullies and seasonal detention ponds. These areas will be densely planted with indigenous forest species to provide habitat for wildlife.

Feature Avenue Plantings
The proposed landscape plan will include two feature avenues. An avenue of Hill's Fig (*Ficus microphylla var hilli*) is proposed to the south of the turnoff to Byron Bay, in order to reinstate the driving experience provided by the original avenue which will be bypassed by the project. This fig avenue was nominated by the community as being a feature of the highway during the value management workshops.

The other avenue is of Norfolk Island pines (*Aravcaria heterophylla*) to be planted along Myocum/Ewingsdale Road as an extension of the existing avenue located adjacent to the township.

The landscaping has been designed with the intention that further development of sculpture or landscape features can be incorporated at a later date.

Screen Planting
Where noise barrier fences or visual screening are required, planting of screening vegetation is proposed. This will be multi layered to provide a dense screen.

9.3.6 Detailed Landscape Treatments

The following detailed landscape treatments will be applied. The treatments have been designed to improve the visual setting as well as improve biological diversity (in terms of ESD).

Earthworks - Grading
Rounding-off of construction batters into the existing gradients and using a variety of batter profiles, will minimise the impact of cut and fill and create a more natural appearance.

Earthworks - Soils
The soils over much of the corridor are highly erodable and require careful treatment. Construction will include stripping the upper layer of topsoil and stockpiling it for later use. All disturbed soils and temporary stockpiles will be stabilised by vegetation as quickly as possible.

Species Selection
Generally revegetation will aim to stabilise batter slopes by grassing, consistent with the open rural character of the area. Distinct avenues, clumps and groves of feature trees and shrubs will also be planted. In some areas, grassing may be inappropriate: eg. steeper batters will require dense shrub planting rather than grassed treatment, to minimise future maintenance requirements. A combination of native seeding and plant stock endemic to the local area will provide species diversity.

Tree Planting
Tree planting is required at interchanges and in areas where roadworks will remove and fragment existing habitat. In these areas avenues or groves of trees will be planted wherever safety considerations permit.

Avenues and groves of trees along the highway, provided they are consistent with safety considerations, provide an attractive driving experience, effective landscape integration and habitat restoration. Part of the highway will have guardrails, which allow tree planting on batters without comprising road safety standards. Other opportunities for tree planting occur at interchanges and on land disturbed by earthworks, construction activities and / or work depots.

Native Plants
Sections of the highway through rural areas will be replanted with shrubs and trees native to the area, including local rainforest species and trees which have a similar form and colour to the characteristic Camphor Laurels of the district. Where possible, species will be sourced or propagated from locally collected seed. The interchange area however will be planted with a wider range of species, including avenues of other 'feature trees'.

Planting Strategy
A long lasting, low maintenance and attractive vegetation cover is required for all cut and fill batters. This will be provided by a combination of direct native seeding and use of established plant stock. The majority of planting will comprise suitably hardened semi-advanced and tube-stock sized plants. At more sensitive locations such as interchanges and proposed avenues, super advanced or semi-mature stock will also be utilised. Within the time available, it is not possible to raise super advanced or semi mature plants from seed collected from local seeds hence interchanges and avenues will use plants from other sources.

It is also considered important to maximise the diversity of plant material used to revegetate disturbed areas, and to use a range of plant sizes and establishment techniques. This approach will not only ensure maximum diversity of floristics, community structure and habitat, but will also increase the likelihood of successful revegetation. Dependence on hydromulching as the sole means of plant establishment would be cheaper, but would limit plant diversity, create an even-aged community and run the risk of patchy establishment. A more diverse representation of the native vegetation types will require hand-planting of other species raised in nurseries.

The strategy of immediate section by section seeding of native shrubs, followed by later single-stage overplanting using container grown stock, will provide some insurance against losses from faunal grazing. Planting modules will be designed to allow considerable flexibility in placement of plants, so that successfully established seedlings can be avoided and gaps filled.

Planting Modules

Planting plans will be based on a modular arrangement to simplify landscape construction, documentation and contract administration, with different mixtures of shrub heights (+/- trees) appropriate to different vegetation types. These modules will cover almost all batters and exposed or disturbed surfaces.

In general, modules with smaller species will be used closer to the pavement edge, especially on the inside of gradual curves, and those with taller species will be used towards the base of fill batters and the outside of curves. The modules will be large and each will include a variety of plant species and sizes in order to ensure considerable visual and ecological diversity.

The proposed rehabilitation of batters by hydromulching, followed by a final operation of hand planting and individual mulching of plants and bed mulching of supplementary modules, means that planting will take place over areas previously hydromulched. The spacing of plants in each module will allow interplanting and avoidance of any seedlings which at that stage have become established. The contractor will be required to avoid removing or disturbing these seedlings during module planting.

Soil and Mulch

Depth of clean topsoil material for planting will be at least 100mm. This topsoil will be placed over a ripped sub-base. Planting areas will to be mulched with a hardwood chip to a depth of about 75mm, but mulch cannot be used in areas to be hydromulched with native seeds as it will prevent germination.

9.4 Air Quality

9.4.1. Climate / Meteorology and Weather Conditions

A Meteorological Summary for Bangalow to Ewingsdale has been prepared by Katestone Scientific (May 1997). There are no significant issues identified for the Ewingsdale section of the highway. The average rainfall of the area (1734mm per year) is high, and this has been considered in pavement drainage design. There is a moderate wind climate caused by sea breezes. There may be morning fog in low lying areas on average 20 times per year.

The most comprehensive historical meteorological measurements in the region have been taken by the Bureau of Meteorology for sites at Cape Byron, Ballina, Lismore, Casino and Murwillumbah. Data from these sites (Cape Byron 1957-97 [0900 and 1500 hours data], Ballina 1992-97 [0200, 0500, 0800 and 1400 hours], Lismore 1957-97 [0900 and 1500 hours], Casino 1996-97 [0200, 0500, 0800, 1100, 1400, 1700, 2000 and 2300 hours] and Murwillumbah 1972-97 [0900 and 1500 hours]) have been reviewed.

The closest observations are from the Byron Bay lighthouse which is a very exposed site. The observations from Ballina are taken from the Ballina airport on very flat terrain only a few kilometres from the coast. The proposed works are located some 4km inland from the coast and it passes through flat terrain at an elevation of between 25m to 75m above sea-level. The Ballina observations would be most typical of conditions for the Ewingsdale area.

Wind: Wind directions are commonly experienced from all quadrants, due to the various combinations of the synoptic wind directions (generally south-easterly during summer and south-easterly to south-westerly during winter), the daytime onshore seabreezes and the offshore night time drainage flows. Strong winds in excess of 15m/s (54 km/hr) which may cause significant dust problems during construction and impact on the stability of traffic (especially caravans) are noted to occur on up to 2.2% of the daytime readings (i.e. 95 hours of daytime per year) at Byron Bay. The frequency of strong winds at night is much reduced. Gale force winds in excess of 20m/s (72 kph) occur on up to 0.3% of daytime observations (26 hours of daytime per year). The frequency of occurrence of strong winds at the more sheltered inland sites (similar to the section of road) is expected to be very much lower than such winds at Byron Bay.

Rain: The rainfall experienced during the construction and operation of the road would be most similar to that monitored at Byron Bay and Murwillumbah.

The rainfall records demonstrate:

- there is a strong seasonal variation in the rainfall;
- the highest rainfalls occur during the period of January - March (average monthly rainfall of between 162 and 263mm occurring on an average of 14 to 18 days per month);
- the lowest rainfalls occur during the period of July - September (average monthly rainfall of between 34 and 103mm occurring on an average of 7 to 10 days per month);
- rainfalls occur at Byron Bay and Murwillumbah with annual average falls of respectively 1 734mm (over 149 raindays) and 1 687mm (over 156 raindays);
- the average rainfall during the wetter period of the year is generally 12mm to 14mm per rainday. This rainfall is largely due to convective (cumulus and thunderstorm type) cloud activity. That rainfall is relatively heavy and commonly occurs for only a short period (e.g. an hour);
- the average rainfall during the drier period of the year is generally between 5mm and 11mm per rainday. This rainfall is commonly due to more stratiform (low-level stratocumulus and middle-level altostratus) cloud and is relatively light and occurs for longer time periods (e.g. 12 hours);
- a maximum rainfall of approximately 120mm over 24 hours can be expected to fall over the region once per year; and

- thunderstorms which may significantly interrupt construction and traffic activities (due to heavy rainfall rates, possible strong winds and danger from hail and lightning) have been reported in the hour preceding the observations at 9 a.m. and 3 p.m. on approximately 10 occasions per year. Thunderstorms are much more prevalent in the later afternoon and evening with a frequency of occurrence of 5 to 8 times higher than at the times of the available observations. Thunderstorms are most prevalent in the November to March period.

Fog: Fortunately fog is not common in most of Australia. Climatological records and advice from local residents suggest that fogs would occur in the area on up to about 20 times per year. These would be most significant between the hours 3 a.m. to 8 a.m., unless associated with or following heavy rain.

Frosts: Frost on roadways can reduce friction and thereby cause dangers to the motorist. The movement of cooling night time air down sloping terrain tends to favor the formation of cooler air and frosts in lower lying areas. Morning frosts will occur when the air temperature falls to 2 °C or less and the ground temperature cools to -1 °C. Frosts occur in the area generally during June, July and August and about 6 times per year on average.

The frequencies of meteorological conditions that may affect the construction and operation of the roadway are summarised in Table 9.11 below.

Table 9.11 Frequency of adverse climate conditions for the construction and operation of the roadway at Ewingsdale.

Parameter	Occurrence
Strong and gale force winds	Affecting mostly the southern section of road on approximately 95 hours per year during the daylight hours.
Rainfall	Highest rainfall between January and March with rain occurring on average 14 to 18 days per month.
Thunderstorms	On average about 10 per year between 9 a.m. and 3 p.m. with between 5 and 8 times that number in the late afternoon and evening hours.
Fogs	Generally in the low lying northern section of the route, occurring up to 20 times throughout the year and most significant between 3 a.m and 8 a.m.
Frosts	About 6 morning frosts per year will occur on the low-lying northern section of the route during June, July and August.

9.4.2 Air Quality

For the considered section of the Pacific Highway there is only one major connecting service road. Ewingsdale Road accommodates during peak traffic hours a traffic volume which is approximately 64% of the Pacific Highway traffic volume north of the intersection and 86% of the Pacific Highway traffic volume south of the intersection. At peak traffic hours, traffic from Byron Bay entering the Pacific Highway experiences extended periods of idling. Under adverse meteorological conditions, these factors have the potential to combine to produce elevated pollutant concentrations in the vicinity of the intersection.

The average travel speed for the current configuration and traffic volume has been estimated to be 75km/hr. This estimate arises from:-

- maximum travel speeds for cars between 90-100km/hr during off-peak traffic hours and 70km/hr during peak hours, and
- maximum travel speeds for heavy vehicles between 60-70 km/hr during off-peak hours and 50-60km/hr during peak hours.

The projected increase of the number of lanes from 1 to 2 in each direction will result in an increase of travel speed assuming an unchanged traffic volume. The average travel speed has been assumed to increase to 90km/h for the current traffic volume, however, this estimate of travel speed may be too optimistic for future traffic.

The basic emission factors (eg in grams per km per vehicle) cater for vehicle type, age, fleet composition and ambient conditions and have been estimated for the standard ADR27 drive cycle. For this project, the emission factor for the arterial free-flow (average speed of 31 km/hr and idle time of 15%) have been adjusted to the anticipated highway speed of 75 km/hr and 90km/hr, respectively, using relationships of pollutant emissions with vehicle speed derived from Australia, North America, and European studies.

Emission rates of carbon monoxide and volatile organic compounds decrease with increased vehicle speed whilst there is likely to be an increase in nitrogen oxide emission rates by a factor of 50% for an increase of vehicle speed from 30km/hr to 90km/hr. There is considerable uncertainty in the speed dependence of emission rates for heavy goods vehicles (over 2.5 tonnes) and for diesel vehicles in general. Conservative assumptions have been used for this report. Emission rates for steep terrain are also uncertain with recent work (Kelly and Groblicki, 1993) reporting increases by several orders of magnitude for emissions of carbon monoxide and volatile organic compounds during the brief enrichment events that occur during hard acceleration or hill climbing. This report has used the power-based model (Williams *et. al.* 1994) with a component to include the power necessary to climb a slope; this methodology also produces significant emission increases on even moderate slopes.

9.4.3 Comparison

In the following analysis, the CALINE-4 has been used to evaluate the distribution of carbon monoxide under worst case meteorological and traffic conditions for the current route and the upgrade. The input data required for this modelling includes traffic volumes (ADT), traffic

mix, road gradient and an emission factor. For this study a small set of measurements of background air quality was conducted in the residential area of Ewingsdale using a portable carbon monoxide monitor. The region is essentially rural and populated areas are well separated from a small commercial area adjacent to Ewingsdale Road. Low level residential traffic is the major emissions source in Ewingsdale. The closest distance of the current highway to the residential area is 300m. There are unlikely to be any major anthropogenic emissions from the region, apart from the intermittent emissions due to farming, forestry and bushfire activity. The measured carbon monoxide concentrations (1-hour average) well below 1ppm.

Based on experience in monitoring at similar sites, background concentrations (Table 9.12) have been used in this modelling assessment and are considered conservative for this relatively remote site.

Table 9.12 Background concentrations used in the dispersion modelling

Pollutant	Concentration
Carbon Monoxide (CO)	1.0 ppm
Nitrogen dioxide (NO_2)	10ppb
Particulate matter (PM_{10})	30μg/m^3
Total suspended particulates (TSP)	50μg/m^3

The changes of slopes along the highway and terrain adjacent has been taken into account. The section of the Pacific Highway around Ewingsdale Road has been modelled as relatively flat with slopes significantly less than 8%. The ADT south and north of Ewingsdale Road was between 11 920 and 14 967 vehicles per day in normal conditions. Traffic counts in 1995 indicate that the proportion of heavy vehicles is 11%.

The results for the current configuration and years 1995 and 2010 traffic volume area shown in **Figures 9.6(a)-(c)**. The results for the route option in years 1995 and 2010 traffic volumes are shown in **Figures 9.7(a)-(b).**

Existing Highway

Year 1995

The contour plot **(Figure 9.6(a))** displays highest hourly concentrations for carbon monoxide of approximately 2.5ppm at the intersection of Pacific Highway and Ewingsdale Road. Elevated concentrations of this magnitude are also predicted at the Pacific Highway 1km and 2km to the south. Carbon monoxide concentrations decay rapidly with distance from kerbside and survey return to the assumed background concentration of 1ppm. The conservative estimates for local traffic in Ewingsdale are estimated to give rise to less than 0.5ppm increase for carbon monoxide above background level. However, highway emissions would not impact significantly in Ewingsdale, which is located more than 300m away from the highway. **Figure 9.6(b)** displays the estimated concentrations profiles along an east-west cross-section which encompasses the intersection at Ewingsdale Road/Myocum Road. It may be seen that maximum concentrations of 2ppm are reached at the intersection but decay to 1.5ppm within 50m from the kerbside.

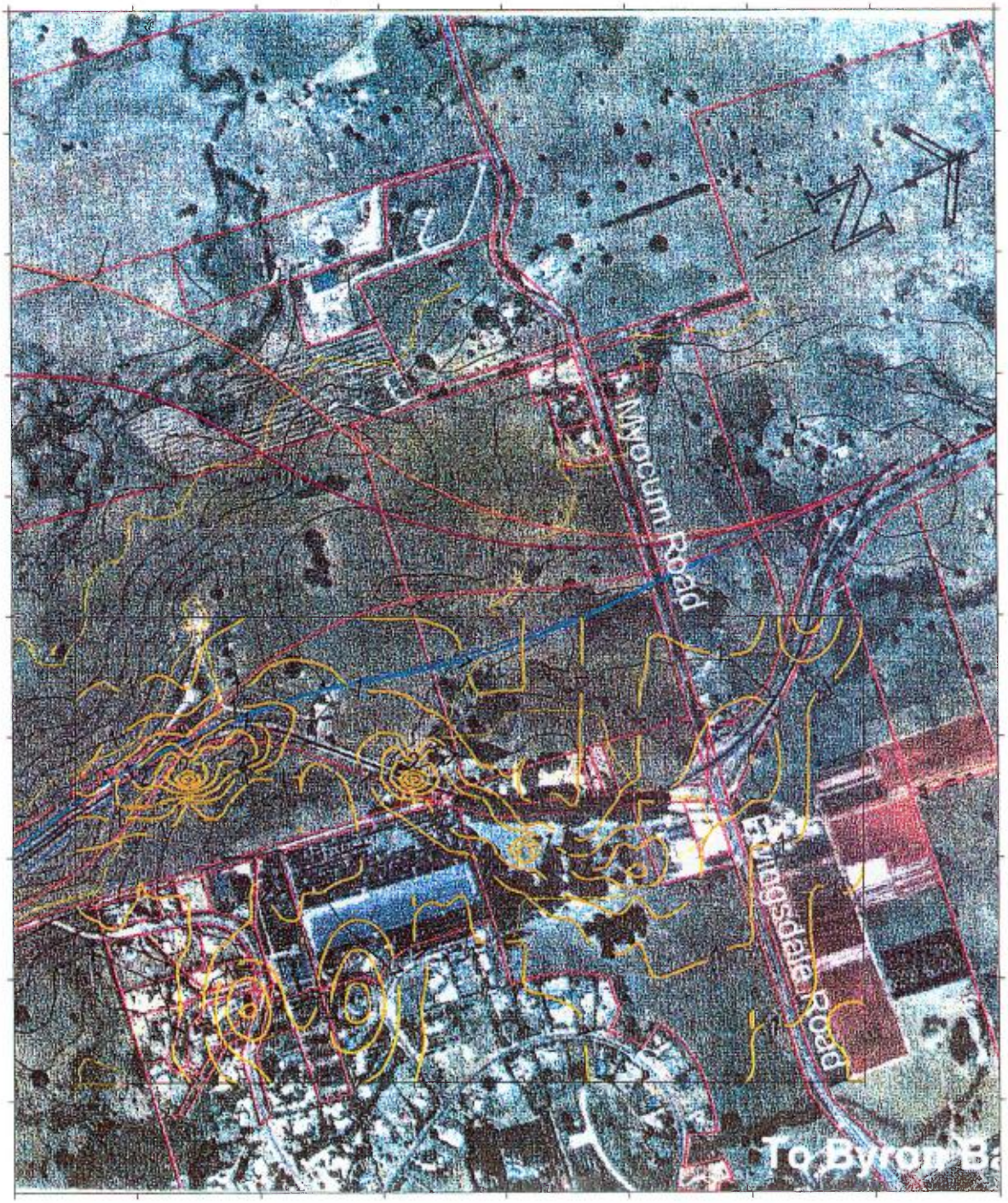

Figure 9.6 (a) Contour plot of estimated carbon monoxide concentrations (ppm) along the current route for a traffic volume of year 1994. The concentrations were estimated using the CALINE-4 traffic pollution model.

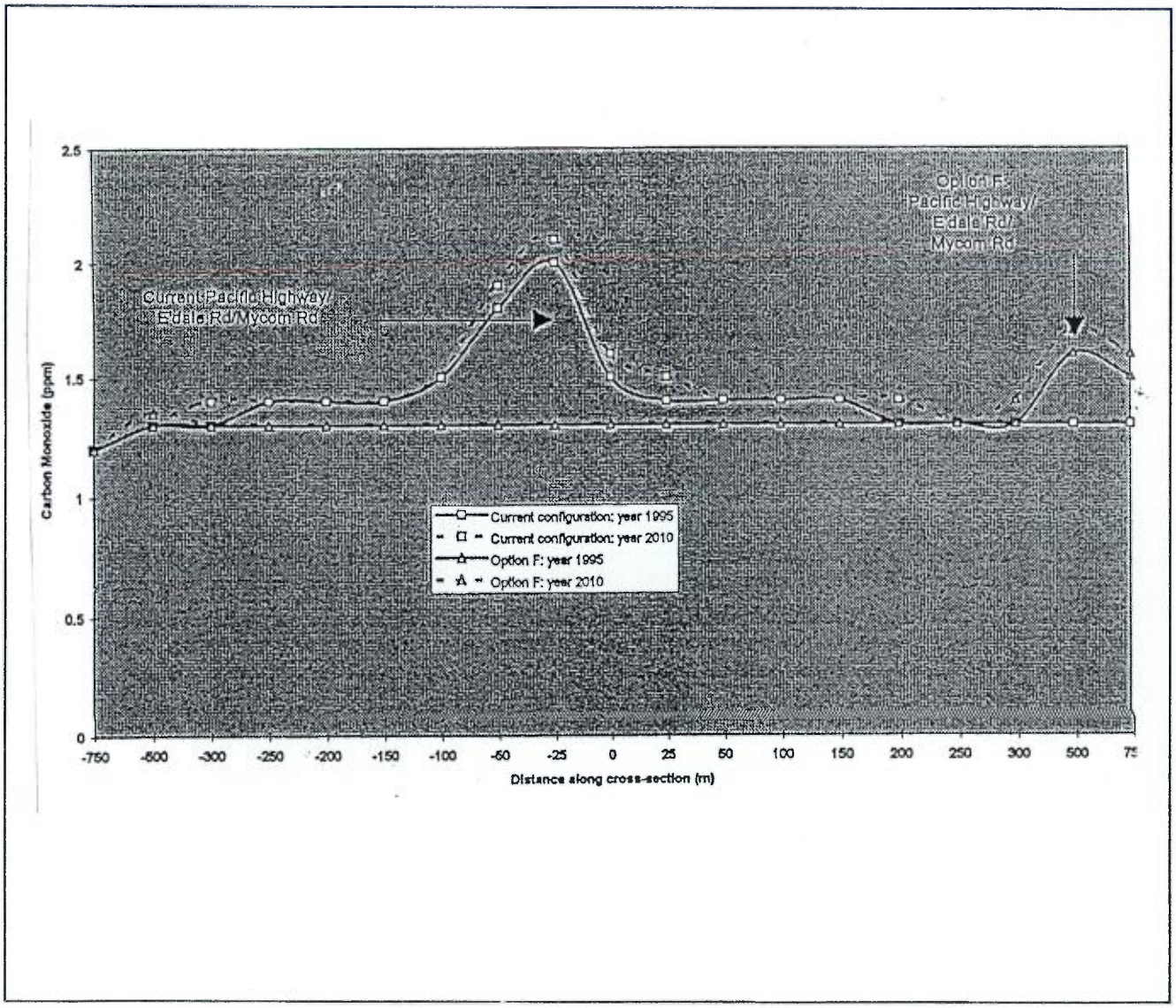

Figure 9.6 (b) **Estimated concentration (ppm) profile of carbon monoxide along a cross-section of the study area. The cross-section extends from the east to the west and encompasses the intersection of Pacific Highway with Ewingsdale road/Mycom Road. The concentrations were estimated using the CALINE-4 traffic pollution model.**

Figure 9.6 (c) **Contour plot of estimated carbon monoxide concentrations (ppm) along the current route for a traffic volume of year 2010. The concentrations were estimated using the CALINE-4 traffic pollution model.**

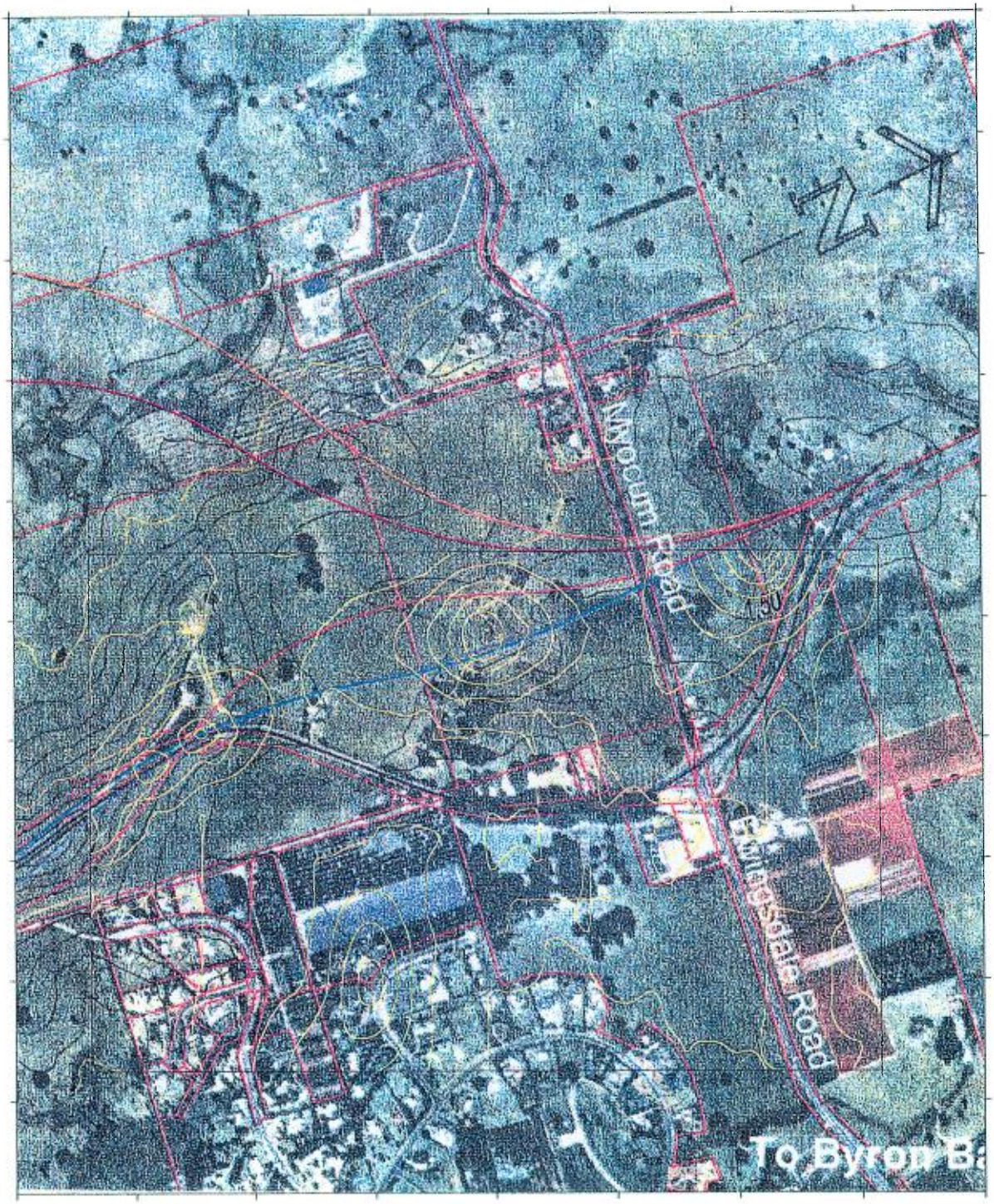

Figure 9.7 (a) Contour plot of estimated carbon monoxide concentrations (ppm) along the proposed route for a traffic volume of year 1994. The concentrations wer eestimated unsing CALINE-4 traffic pollution model.

Figure 9.7 (b) Contour plot of estimated carbon monoxide concentrations (ppm) along the proposed route for a projected traffic volume of year 2010. The concentrations wer eestimated unsing CALINE-4 traffic pollution model.

Year 2010

The estimated vehicle emission rates of carbon monoxide until the year 2010 is 17% due to technological advances. However, in the Ewingsdale area traffic volumes are predicted to increase by 51% to 2010 and the next increase of fleet emission rates has been calculated at 11%. Under the do nothing option, carbon monoxide emissions are expected to increase by about 10% by the year 2010.

That is, the contour plot of hourly carbon monoxide concentrations for the year 2010 (**Figure 9.6(c)**) shows that peak concentrations at the highway are predicted to be increased by approximately 10%, or 0.2ppm.

Highway Realignment

Year 1995

Figure 9.7(a) displays contours of estimated ground-level hourly carbon monoxide concentrations along the corridor for the traffic volume of year 1995. With the proposed realignment, the vehicle carbon monoxide emission rates are estimated to decrease due to topographical aspects and increased travel speed. Considering the technological advances, but also the increased traffic volumes, the net reduction in carbon monoxide emissions has been calculated to be about 25%. That is, the model predicts a decrease for locations near to and at the highway by 25% or 0.2-0.5ppm. This is a direct result of the widening of the highway from 12.5m to 25m and a decrease of the vehicle fleet emissions rates. This option also contains (compared to the current configuration) a longer part of the highway with less rapidly changing slope. **Figure 9.6(b)** also displays the concentrations profile along the same east-west cross-section discussed above, with the intersection of the Pacific Highway with Ewingsdale Road/Myocum Road located approximately 500m to the west of the current location.

Year 2010

Figure 9.7(b) displays the estimated contours of hourly carbon monoxide concentration for traffic volumes expected in 2010. Similar to the current configuration, a small increase of concentrations near the highway (above the reduced levels obtained by the realignment) are estimated of approximately 10 %, or 0.1-0.2ppm.

9.4.4 Summary of Impacts from Traffic Emissions

The modelling results for carbon monoxide, nitrogen dioxide and particulates are generally low at the kerbside of the Pacific Highway. Table 9.13 lists the modelling results for carbon monoxide, nitrogen dioxide and particulates for the current route and the proposed route. The year 1995 estimate for carbon monoxide of 2.5ppm at the current route are supported by initial kerbside measurements conducted within this study by Katestone Scientific. The results of the field measurements are listed in Table 9.14. The estimated maximum concentrations for all pollutants considered are only slightly above the background concentrations and well below the guideline concentrations (see Table 9.13).

Table 9.13: Estimated maximum hourly road-side pollutant concentrations at 1 m distance from kerbside for the year 1995 and 2010, including:-

Pollutant	Existing Highway		Proposed Highway		Guidelines	Source
	Year 1995	Year 2010	Year 1995	Year 2010		
Carbon monoxide (ppm)	2.5	2.6	2.0	2.3	27	Stretton/ WHO
Nitrogen dioxide (ppb)	18	20	14	16	160	NH&MRC
Particulates ($\mu g/m^3$)	80	93	65	83	1000	NH&MRC

Table 9.14 Kerbside measurements [1] of CO levels at selected sites along the proposed highway.

Existing Highway	Mean 1-hour average [ppm]
Ewingsdale Rd/Myocum Road	2-4
St Helena Road	1-2
Coolamon Scenic Drive	1-2
Possum Creek Road	1-2
Ewingsdale [2]	< 1

Note: [1] Estimated from a series of instantaneous measurements over 15 minute intervals.
[2] Distance 300m from Pacific Highway.

The estimated pollutant concentrations for the new alignment are generally between 12% and 27% lower than for the current configuration. These low levels are a consequence of free-flowing traffic and low traffic flow rates during adverse meteorological conditions.

The results indicate that the ambient air quality close to the corridor will be well below ambient air quality guidelines.

Neither the existing road, nor the upgraded option appear to create air pollution concentrations which are problematic. The dispersive effects of the local wind climate, and the moderate traffic volumes (compared with urban highways), mean that all vehicle air pollutant levels are less than a tenth of thresholds in relevant health guidelines.

Ambient air quality levels close to the new highway will be low and well within current guidelines, even adjacent to the road. The maximum concentrations experienced by nearby vegetation are predicted to be much lower than those known to cause any significant changes in plant physiology or yield. Due to reduced congestion, pollutant levels are expected to be lower for the upgraded option than for the existing highway.

9.4.5 Construction Activity

Dust suppression is critical during construction in order to avoid dust nuisance to traffic on the existing highway and to minimise the spillage and drift of dust onto the existing highway lanes. The implementation of an effective management program for construction will help ensure that dust concentrations on the existing highway and at nearby residences are maintained below those known to cause nuisance. This will require careful planning of material handling and topsoil removal, a selection of conditions for dust-generating activities and regular cleaning of the adjacent highway lanes close to the construction zone. Exposed soils will be sprayed with water as necessary and all vehicles moving spoil or fill material on public roads will be required to have their loads covered. Disturbed areas will be promptly stablised by revegetation as soon as possible.

9.5 Agricultural Impacts

An individual farm assessment of the impact of the project on properties has been carried out as per the methodology specified by the NSW Agriculture Department. This is contained in the report Assessment of Agricultural Lands; Pacific Highway - Bangalow to Ewingsdale Duplication, by Wilkie Fleming & Associates Pty. Ltd (June 1997) **(Appendix H).** A summarised extract of the findings of the report is presented here.

Five parcels of land are directly affected by the proposed roadworks. Two of these properties are owned by Mr P Buckley, two by Mr R.J Johnston and the other by Juan Pty Ltd. The Buckley property is the most severely affected severing Class 1 and Class 2 agricultural land. Access to water and drainage would also be restricted affecting the overall viability of the property.

The proposal also severs an area of Class 2 land on the Johnston property. A small holding would be left on the opposite side of the highway to the remainder of the property.

The individual farm assessment rates various impacts on a scale of 0 to 3, with 3 being the most severe impact. The ratings are combined to give a cumulative impact index across the various measures. A value of 9 or greater generally indicates that a farm may no longer be viable as an enterprise. The cumulative indexes for the affected farm properties are shown in Table 9.15.

Table 9.15 Individual Farm Impact Assessment

Owner's Name	DP	Lot	Area (ha)*		Impact Index
Juan Pty Ltd	358256	22	37.0	North	0
Mr P Buckley	623351	17	22.8	South	12
Mr P Buckley	623351	17	10.2	North	6
Mr R J Johnston	755692	12	46.4	West	2
Mr R J Johnston	755692	12	11.6	East	1

* The areas shown are south and north of Myocum Road and west and east of the new highway alignment respectively.

The assessment suggests that the Buckley farm will no longer be viable as a result of the project. The Johnston farm is affected, but not critically as long as a new access is provided.

Consultation is taking place with the responsible land holders and the acquisition policy discussed in Section 7 will be implemented.

9.6 Waste Management

The waste products generated by the proposal during construction may include cleared vegetation, oils, greases, lubricants, water from wash down areas and general litter. The *Environmental Offenses and Penalties Act, 1989,* makes it an offense to allow any wastes, chemical and fuel to leak, spill or escape from the site where it might harm the environment.

Storage of wastes, chemicals and fuel on site for use in construction will be managed in such a way as to reduce their potential to pollute. The materials will be located at least 5m clear of concentrated water flow, poorly drained areas and through traffic areas. Storage areas will also be located on slopes of less than 10% and separated from any standing vegetation that is more than 100mm high. All stockpiles will be protected from overland flow with earth banks, silt fences or minor diversion channels around the perimeter and all refuelling and machinery maintenance areas will be temporarily sealed and protected with earth perimeter banks. These earth banks will be stabilized by a covering of matting or a geotextile firmly secured so as to remain in uniform contact with the bank.

Vehicle maintenance will only be permitted in bunded areas except for emergency repairs

All storage will comply with the following Australian Standards for storage of wastes, chemicals and fuels:

- AS 1940 - The storage and handling of flammable and combustible liquids;
- AS 3780 - The storage and handling of corrosive substances;
- AS 4332 - The storage and handling of gases in cylinders;
- AS 4084 - Steel storage racking;
- AS 3773 - Bulk solid containers - safety requirements; and
- AS 2430 - Classification of hazardous areas.

All wastes, chemicals and fuel will be handled to minimise the risk of accidental spillage and will be in accordance with the above Australian Standards as well as AS 1678 - Emergency procedure guide - transport.

The proposal will also comply with the requirements of the *Waste Minimisation and Management Act, 1995* and the *Waste Minimisation and Management Regulation, 1996.*

Adoption of the following will also help ensure safe disposal practices:

- receptacles of waste materials will be cleared when they are 75% full. Construction litter will be stored in bulk bins and removed from site for disposal by conventional means to an approved waste disposal facility;
- waste will only be removed in an approved manner (as defined by the appropriate regulatory authority) and by means of suitable transport to licensed landfill sites;
- construction wastes such as oils and timber will be recycled where appropriate;
- waste vegetation will be disposed on site by chipping for use in restoration;
- provision will be made for composting toilets or the collection and removal of all effluent from the site and disposal at an approved EPA disposal point;
- staff facilities will be located so that any accidental spillage of effluent, including wash down-water can be totally contained and treated within the area; and
- staff will be informed of their obligation to use the facilities provided.

On commissioning of the work, operational wastes such as tyre sediment, oils, grease and litter that are washed off the road by rainfall will be collected by the drainage system. A maintenance program involving RTA maintenance crews regularly removing silt and pollutants from the sediment basins will be established. Sediment will be mechanically removed and disposed off site at an EPA approved disposal site. After the removal of the sediment which has been captured in the installed sediment pits, road runoff will be allowed to discharge to nearby creeks.

9.7 Operational Hazards and Risks

The proposed works will significantly decrease the level of risk and hazard for traffic travelling on the stretch of at Ewingsdale. The road alignment will be straightened and the substandard intersection with Ewingsdale and Myocum Roads will be improved.

Sources of hazard and risk associated with the proposed project include:

- hazard and risk during the construction period; and
- dangerous goods being transported along the roads.

The possible hazards and risks during the construction period and measures to avoid such incidents are outlined in Table 9.16

Table 9.16 Hazards and Risks During Construction

Hazard/Risk	Measures
The operation of machinery and general activities associated with construction road works causes potential hazard and risk to the safety of construction workers, local residents and to members of the public.	Compliance with the Australian Standards - Occupational Health and Safety criteria for constructing roads Compliance with Workcover Authority criteria for Occupational Health and Safety The construction area will be fenced off, deterring members of the public from entering the construction area Compliance with the Australian Standard 1742 for traffic control devices
Confusion for traffic on the existing highway whilst new carriageways are being constructed.	Traffic would remain on the existing road route until the new carriageway is completed and then signs would be erected to minimise driver confusion and accidents. Compliance with Australian Standard 1742 series on traffic control devices foe 'Works on Roads'. Conforming with these standards will minimise chances of driver confusion resulting in collisions or other traffic accidents
The pollution of the surrounding creeks due to water runoff from the construction area, resulting in turbidity, siltation and damage to aquatic life	Erosion mitigation and soil stabilisation techniques such as those described in an Environmental Management Plan will mitigate impacts on water quality

Detailed construction design will help ensure occupational health and safety, and the traffic control standards are met.

For traffic on the new route the risk of a major accident occurring is dependent on:

- the percentage and frequency of vehicles transporting dangerous goods;
- the accident rate on the subject section of road (currently high);
- the proximity of nearby residents;
- the extent of authority awareness and preparedness for handling incidents;
- weather conditions;
- geographical locations; and
- road design.

The transportation of dangerous goods on the Pacific Highway has the potential to result in hazardous incidents, particularly at night or in adverse weather conditions. Risks associated with hazardous incidents include the release or spillage of dangerous goods, possibly resulting in explosions, fire or the release of toxic gas, all of which have potential consequences for the public, nearby property and the surrounding environment. Spills could enter any of the creeks or seep into the ground water, impacting in a negative manner upon water quality.

Major incidents involving dangerous goods are relatively rare and the majority do not result in the release of hazardous materials or injury. Table 9.17 provides a breakdown of dangerous goods transported in New South Wales.

Table 9.17 Dangerous Goods Vehicle Type as a Percentage of all Heavy Vehicles in NSW

Vehicle Type	% of Total Heavy Vehicles
Petrol	0.75
LPG	0.1
Chlorine	0.1
Poisons	0.1
Other Dangerous Goods	0.1

(Source: Workcover Authority in RTA 1993)

The exposure of the nearby residents to hazards depends on their distance from the hazard and level of protection afforded by building structures or landforms at the time of a hazardous incident. The range of possible hazardous effects to the public are listed in Table 9.18.

Table 9.18 Adjacent Hazard Zones

Zone	Range of Effect	Events Major Affecting Zone
High Hazard Zone	Up to 200 m approximately	➢ Fire ➢ A boiling liquid expanding vapour explosion (BLEVE) ➢ Vapour Cloud Explosion and maximum toxic effects
Low Hazard Zone	From approximately 200 to 1 000m	Toxic effects from fires and toxic gas release

(Source: North West Transport Link Western Section Hazard and Risk Study of Dangerous Goods Transportation, 1991).

In NSW the transport of dangerous goods is regulated under the *Dangerous Goods Act, 1975* and the *Dangerous Goods Regulation, 1978,* which call for the control of all hazards and risks, including restrictions on quantities carried, and the use of codes and standards to ensure the safe transport of dangerous goods. Drivers of vehicles containing dangerous goods are required to have good driving records and special training. The EPA licenses dangerous goods vehicles and their drivers, with the exception of drivers of explosives carriers which are licensed by the Workcover Authority of NSW.

The responsibility for handling emergency incidents rests with the Fire Brigade, Police, State Emergency Service or the Ambulance as combat organisations under the NSW Disaster Plan. Under the plan, the Chemical Incident Co-ordinator is primarily responsible for rendering safe and cleaning up sites after incidents involving flammable or hazardous substances, vapours, gases or liquid spillages. The RTA is a participating organisation under the plan with a role to assist the combat organisations. The RTA Northern Region "Interim Environmental Guidelines for Incident Management" provides the RTA's Responsibilities and Liabilities should such incidents occur. Further, the RTA's Environment and Community Impact Branch has developed procedures for the "Treatment of Chemical Spills on Roads". The guidelines and procedures will be incorporated in the Environmental Management Plan for the project.

Higher levels of traffic are not anticipated on the Pacific Highway as a result of the proposed road works. Consequently hazard and risks from passing traffic would not increase as a direct result of the works, and the above noted spill containment ponds and safeguards along with the current RTA procedures, should ensure that the impact of hazards will be less than that experienced along the current route.

9.8 Other Social Effects

9.8.1 Demographics

Local Demography
The Ewingsdale census district encompasses the area bounded by Possum Creek Road, McLeods Shoot, St Helena and Ewingsdale and can be considered representative of the study area. The 1991 census statistics describe the population at Ewingsdale as being predominantly young families where males are employed as managers in low income industries, such as agriculture, wholesale and the retail industry, and females are typically employed in sales and administration. Children tend to be attending government schools.

Population and Household
The population of Ewingsdale has a relatively young age profile with peaks in the distribution graph at the ages 30 - 39 and 5 -14. That is, the population is characterised by two distinct age groups. The data seems to represent a predominance of families comprising adults with young children.

Consistent with the age profile, 59% of households are two parent families with offspring. The parents are predominantly aged between 24 - 44 and the children between 5 - 14. Sole parent families with offspring comprise 12 % of the population. There are 3% of people that are members of a group household and 5% of people who occupy a house alone.

Population Migration and Housing
Approximately 40% of people have been living in the area for the past 5 years and 20% of people were located in the same census area but at a different address. Approximately 32% of people have come from other areas in Australia to live in Ewingsdale. These figures indicate that there is a high percentage of people who have specifically come to the area, possibly for lifestyle reasons.

The greatest percentage of people own their own home. Typically the home is occupied by one family, usually comprising four persons, two parents and two children. These figures seem to confirm that the area is characterised by young families.

Employment and Income
Unemployment levels in 1991 were 9%. The unemployment rate was most significant in the 25 - 34 age group with a higher proportion of females seeking employment in this age group than their male counterparts.

Marginally more people were employed in wholesale and retail industry (18%), than in community service industry (17%). Males were generally employed in the wholesale and retail industry, possibly orchards, food production and sales, while the community service industry employed the greatest number of females. The highest proportion of the workforce are aged between 35 - 54.

Ewingsdale residents have a lower income level than the State average. In 1991, 61% of individual annual incomes in Ewingsdale were lower than the bench mark of $16 000, compared to 48% on a statewide basis. Although males were employed as managers their income is lower than is commonly associated with this position. This possibly indicates that employment occurs in home businesses or agriculture.

Education
A significant proportion of the population (30%) are attending school, TAFE colleges or university. Fourteen percent of people are attending infants/primary schools at government (7.8%) and non government (5.8%) institutions. The number of people attending secondary schools is 7.4%, with a much greater proportion of people attending government (6.8%) compared to non government (0.6%) schools.

Transport
Usually two cars are available in each household in the Ewingsdale census district. Most people travel to work in a private vehicle as the driver, while a significant proportion of people work from home. Very few people travel by bus to work and there is only one private bus company operating within the local area. There is no train service available in the local area.

Demography of Byron Bay
The demographic data on the adjacent census district of Byron Bay in comparison. The 1991 census data describes the population in Byron Bay including the town centre and its urban fringes as a less family orientated, more itinerant population which has lower home ownership rates.

Population Profile and Households
The population of Byron Bay has a relatively young age profile with the greatest percentage of people aged between 30 - 34 and 35 - 39. There are relatively few people aged either 45 and over or very young.

Population Migration and Housing
Like Ewingsdale, approximately 40% of people have been living in Byron Bay for the past five years and in addition 20% of people were located in the same area but at a different address. Approximately 33% of people have come from other areas within Australia, principally NSW to live in Byron Bay.

In Byron Bay there is a minimal difference between the number of private dwellings which are rented and those which are owned. In total, slightly more private dwellings are owned rather than rented by families, however a large proportion of lone and group households rent property. Therefore, the total of houses rented is slightly higher that that which are owned due to the contribution of lone and group households. Generally houses are either occupied by families, usually with four people, or are group houses, generally occupied with two people.

Employment and Income
The level of unemployment at Byron Bay was 10% in 1991 with the greatest proportion of people aged between 25 - 34. There were significantly higher numbers of unemployed males than unemployed females.

An equivalent number of people were employed in the recreational, personnel and other service industry (18.7%) and the wholesale and retail trade industry (18.6%). Males were principally employed in wholesale and retail industry while the community service industry employed the greatest number of females. In both industries, where the highest proportion of the workforce is employed, people are aged typically between 35 - 54.

The primary occupation of both males and females is as sales and personnel service workers (16.4%) and tradespeople (15.9%). Men were generally employed as tradespeople while most women work mainly in sales and personnel. The age profile, for the highest level of employment in the most popular occupation, for both genders, is between 35 - 54.

Byron Bay residents have a lower income level than the State average. In 1991, 60% of individual annual incomes were lower than the benchmark of $16 000 compared to 48% on a statewide basis. This figure is virtually the same as for Ewingsdale.

Education
Nine percent of people attend infant/primary schools and of these 6% are government schools and 3% are non government schools. Only 6% of people attend secondary schools with almost all at government schools. A significant proportion of the population (74%) are not attending any type of educational institution.

Transport
There was usually one car available per household in Byron Bay. Most people travelled to work by car, as the driver. A significantly lower proportion walked to work or were a passenger in a private vehicle and a number of people worked at home. Very few people travel by bus. The train service is not commonly used as a mode of travel to work as there is only a regional service available from Sydney to the north coast.

Conclusion
The main conclusions which can be drawn from the demographic data are, that, both Ewingsdale and Byron Bay have people with a lower than average income and that many are employed in agricultural or home-based businesses. The Byron Bay community tends to have fewer families than the Ewingsdale community and they tend to rely less on cars. The Ewingsdale community, meanwhile appears to have two cars per family and have more school aged children.

The data tends to confirm that there is likely to be morning and evening movements of local traffic to Byron Bay and to the agricultural businesses along the highway, and that there is also likely to be a significant movement of school children at certain times of the day.

The existing highway is used by people in both the local and regional area. The highway is the main route to the north coast and also to the smaller regional centres of Byron Bay and Bangalow. Residents in the corridor rely on the highway and Ewingsdale Road, and to a lesser extent St Helena Road, to access daily services and schools.

9.8.2 Safety and Access

From the demographic data, it is apparent that, because of the need to attend schools, people who live west of the current highway will still be travelling east to Byron Bay, therefore the normal route access paths will need to be maintained via Ewingsdale Road and St Helena Road. There is also likely to be local traffic movements to Bangalow. The new interchange will provide safer movement of traffic from west of the highway to the east. There will also be fewer delays.

Provision, through the adoption of 2.5m wide road shoulders, will be made for cyclists along the edge of the highway and on the overpass and access ramps. The road shoulder will also provide access for hitchhikers and allow motorists to pull out of the traffic for pick-ups. A pedestrian footpath will be provided on the north side of the overpass and will extend from Myocum Road to the old highway.

The roundabout and intersections have been designed to ensure adequate space for the movement of school buses, and provision will be made at the old highway / Ewingsdale Road intersection for a bus setdown point.

Prior to the commencement of construction, a traffic management plan will be prepared and temporary barriers will be erected to deter members of the public from entering the construction area. Access to properties will be maintained during construction, with any temporary closures being subject to consultation with the landholders. The construction work will comply with the Australian Standard for Occupation Health and Safety criteria for constructing roads, Workcover Authority criteria and AS 1942 Work on Roads, to reduce the risk of driver confusion.

9.8.3 Tourism

Tourism is a significant factor in the region. Improvements at the Ewingsdale - Pacific Highway intersection may make the tourist road through Lennox Head and Byron Bay more attractive to holiday makers. This could result in increased economic benefit for Byron Bay and the people involved in the service industry. Conversely, this may be partially off-set by greater highway speeds and a reduction of holiday stop-overs on the journey to a chief holiday destination out of the region.

The construction of the new works will be separated from the existing highway and there will only be minimal impact from truck movements accessing the construction corridor. The tie-ins at the northern and southern ends of the works will be short in duration and result in only minimal disruption to traffic.

9.8.4 Settlement Patterns

The proposed intersection with Ewingsdale Road is likely to influence the longer term pattern of urban development by providing high accessibility. Similarly, alongside and in the vicinity of the roads connecting the proposed works to Byron Bay, there is likely to be an increased demand for urban development. The increased pressure for urban development will occur as access improves and as the highway is identified as forming a distinct western boundary to the development of Byron Bay. The pressure for development may also eventually extend to the western side of the realigned highway in the vicinity of intersections as a result of greatly improved accessibility at these locations.

Although Council's strategic planning can control development, the proposed road has the potential to form a new boundary for Byron Bay. The land is developed for rural purposes and infilling between the existing centre and the realigned highway may potentially occur in the future.

Increased accessibility will also facilitate increased tourism, but it is also recognised that tourism in the region depends on the existing environmental quality of the region, some of which may be undermined by activities and effects associated with the proposed highway upgrade, particularly any urban development effects.

9.8.5 Community Severance

Community severance which occurs when the residents of a community become separated or isolated from the services in their community, friends, relations and place of work and recreation is not perceived to be a significant problem if adequate accessways (overpasses) are provided. The proposed realignment is reinforcing an existing barrier and will provide improved access, so it should not significantly alter local access patterns.

Access to the Ewingsdale Hall and church will be maintained via the old highway and the buildings and immediate curtilage will not be impacted.

Ecologically Sustainable Development and Cumulative Impacts

10

10.0 ECOLOGICALLY SUSTAINABLE DEVELOPMENT AND CUMULATIVE IMPACTS

10.1 Ecologically Sustainable Development

In the document *'Ecologically Sustainable Development: A Commonwealth Discussion Paper"*, the Federal Government defined ecologically sustainable development as:

> *"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future can be increased."*

Recent amendments to *Schedule 2 of the Environmental Planning and Assessment Regulations 1994*, require reasons be given justifying the carrying out of any development or activity, having regard to "the principles of ecologically sustainable development". These principles have been applied to the project through this REF.

The ESD principles are detailed under four headings:

Precautionary Principle *- that is, if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

This project has adopted the precautionary principle by acknowledging that although the full environmental impacts of implementing the proposal are unknown, the known environmental impacts have been identified in the REF. Examples of adopting the precautionary principle have been the avoidance of the row of fig trees along the existing highway and the proposed installation of spill containment ponds. Impacts will also be addressed in the Environmental Management Plan in an endeavor to minimise the negative impacts of the proposal during construction and operation phases.

Intergenerational Equity *- that is the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;*

The road realignment will be constructed and operated according to high environmental standards to avoid or minimise adverse environmental impacts. The duplication of the road will provide a safer transport environment which will benefit future generations. Fewer vehicle accidents would reduce injury to travellers, reduce wastage from vehicle repairs and other accident related costs. Regional accessibility and equity will also improve.

Air quality will improve considerably under the proposal. There will be about a 25% reduction in the level of carbon monoxide emissions due to the smoother alignment and reduced congestion.

Long term water quality will also be improved by the creation of a safer alignment and the installation of an effective pollution control drainage systems.

Although noise will be an issue of concern for the local residents along the stretch of the Pacific Highway while the construction activity proceeds, noise levels will return to the existing levels or less, once construction works are completed (refer to Section 9.2 for operation and noise details). The road will be smoother and the long term noise levels, given the implementation of noise barriers, will be less than experienced at present. Consequently, the quality of life should only deteriorate marginally over a maximum of 18 months during intermittent periods. These impacts will be significantly out-weighed by the longer term safety benefits to society and future generations.

Conservation of Biological Diversity *- that is, measures that halt the loss of species and promote genetic diversity should be pursued;*

The existing biological diversity of the corridor has been investigated and is not considered to be significant. Replanting with local species and water quality protection measures will entrance the habitat values of the area and assist in promoting biological diversity.

Valuation and Pricing and Environmental Issues *- that is, while prices for natural resources should be set to recover the full social and environmental costs for their use and extraction, many environmental values can not be priced in monetary terms.*

The road is feasible to improve because its cost is less than half its worth as a transport route. The improved road will have positive benefits for the movement of tourists and the supply of goods. There will be considerable economic flow-on benefits to the local and regional community. In addition, traffic accidents cost an average of $38,000 per accident incident (using 1994 figures) and improvements to the highway will reduce the number of traffic accidents. The project will thus save money and resources and allow finances to be allocated to other projects of societal value.

10.2 Cumulative Impacts

The proposal is Stage 1 of the Bangalow to Ewingsdale Pacific Highway Upgrade, which in turn is part of the overall upgrade program for the Pacific Highway between Hexham and the Queensland border. Improvement of the Pacific Highway will eventually result in more Brisbane - Sydney through traffic using the Pacific Highway rather than the New England Highway.

The upgrade of the Ewingsdale Road intersection will reduce delays and improve safety, as a consequence, more through traffic may pass through Byron Bay and Lennox Head with consequential pressures being placed on the Byron Bay town centre and road network.

If the proposed upgrade does not proceed, a situation will arise where there will be high quality dual carriageway north of Ewingsdale on the Tyagarah section of road and to the south at Bangalow. A poor section of road at Ewingsdale could consequently create significant problems for traffic flow and safety.

The new alignment of the highway is proposed to be west of the existing alignment. The highway forms a physical and psychological boundary to urban/commercial development at Ewingsdale. If the alignment is further west, there is the potential for increased pressure to allow urban/commercial development to migrate westward. Such development, if not prohibited by Council, must create another suite of impacts.

Table 10.1 summarises these and other local cumulative effects. These effects relate specifically to the potential consequences of the proposed road realignment at Ewingsdale. Addition of environmental impacts associated with other developments in the region would, for some issues, result in more impact.

Table 10.1 Cumulative Impacts and Overview

Strategic	
Issue	**Impact Assessment**
Demand	The improved highway design will not immediately increase the amount of traffic along this section. Existing vehicle movement constraints to the immediate south will remain. Cumulatively, the upgrading of the whole Pacific Highway is likely to increase the traffic volumes, particularly the Sydney - Brisbane long distance traffic.
Safety	Improved road safety due to new highway design. Improvement works will meet all Australian Standards and conform to RTA Pacific Highway design standards. The design will be compatible with the road design immediately to the north.
Geology / Soils	Erosion and water quality is not a problem in adjoining lands. Sediment controls will be designed to prevent erodible soils leaving the corridor which would otherwise cause increased turbidity in adjoining waterways and downstream wetlands.
Water Quality	Due to the topography, flooding is not considered to be a likely issue. Water quality will be protected using sediment basins and appropriate emergency procedures in cases of a spillages.
Other ecological issues	No significant impacts on the regional biological diversity or direct negative consequences for ecologically sustainable development.
Social	
Statutory Planning	Consistent with the objectives of the EP&A Act and Byron Shire LEP, North Coast REP and SEPPs.
Departmental Authorities	Key authorities have been informed and their comments have been reviewed. There are no known developments or other initiatives proposed which will be jeopardised by the proposal.

Table 10.1 Cumulative Impacts and Overview (cont)

Strategic	
Issue	**Impact Assessment**
Land use	Loss of prime agriculture land will occur and this will add to the cumulative loss on the north coast.
Visual Considerations	The interchange will be visible from McLeods Shoot and will combine with the visual impact of the upgraded Tyagarah section of the highway.
Noise	Construction noise will be localised along the route.
Traffic	Short-term lane closures will be required along the highway and will be needed when work is being tied-into the existing highway. Property access is to be maintained throughout construction. Vehicle movements and highway congestion will increase in the region during construction. Other road work to the south is unlikely to start until after this proposal is completed.
Social	There will be a minimal amount of community severance. Access will be provided at all times to residents and temporary measures will be implemented. Long term issues concerning pedestrian safety have been addressed.
Conclusion	
Activity as a whole	Short term and/ or low potential for detrimental regional impacts with long term benefits to the community arising from the cumulative impacts of an upgraded highway.

10.3 Energy Statement

This section discusses the energy aspects of the proposed development by outlining the equipment required to complete the construction works, energy consumed during construction and energy savings which would result if development proceeds.

Energy Required for Road Construction
Items of construction equipment commonly used for roads of this type would be required for the proposed duplication. This would include:

- excavators;
- dump trucks;
- bulldozers/tractors;
- truck mounted crane;
- graders;
- front-end loaders;
- compactors and compressors;
- steel drum vibrator rollers;
- dump trucks;
- concrete trucks;
- water trucks;
- backhoes;
- slip from concrete paving machines and other heavy pavement vehicles;
- scrapers; and
- hydomulcher.

Most machinery would be operated on diesel fuel with refuelling performed on site. Fuel required during construction is largely dependent on the volumes of earthworks and, based on past projects, each cubic metre of earthworks consumes about 1.15l of fuel. Earthworks would involve approximately 156 000m^3. Expected energy use over an 18 month construction period could be equivalent to 179 400l of fuel.

Energy Consumed During Maintenance
After construction, the energy requirements would be limited to that required for periodic maintenance and occasional pavement repair.

Energy Savings during Operations
The new highway will be slightly shorter in overall length when compared to the existing highway with consequential savings in travel time, travel distance, vehicle fuel and other operating costs.

In assessing fuel consumption rates during operation, average travel speeds of 90 km/hr may be assumed for the travelling conditions on the new route, while 75 km/hr may be taken as being the average travel speed on the existing section of the highway. The high standard road conditions provided by the new route would eliminate the need for frequent acceleration and deceleration cycles and stop-start conditions encountered on the existing route, especially during holiday periods.

It is assumed that heavy vehicles (comprising 11% of traffic) have a fuel consumption of about 34l/100km, local traffic (comprising upto 65% of traffic) uses about 16l/100km and through traffic (comprising some 24% of traffic) uses about 9l/100km, with the average vehicle consumption along the section of highway about 16l/100km. Assuming an average fuel consumption of 16l/100km for vehicles using the highway and a reduction in travel distance of 0.3km, for the 1997 traffic figure of upto 14 967 vehicles per day, a fuel saving of 262 222l per year can be anticipated at the time of opening. The fuel savings would increase as traffic volumes increase, although, because of increased traffic volumes, the increased savings may not be linear.

Apart from the shorter length, undesirable road conditions, such as at the existing Ewingsdale Road junction, would be eliminated resulting in substantial savings to both the local and regional community in accident costs. The new carriageways would be more energy efficient due to the improved grades and curvature, better pavement surface, improved traffic speeds and free flow traffic conditions.

10.4 Clause 82 Assessment

Table 10.2 summarises the issues under the headings stipulated by Clause 82 of the *Environmental Planning and Assessment Regulations*.

Table 10.2 Clause 82 Assessment

	Factor	Relevant Section or Comments
a)	any environmental impact on a community	The highway and interchange would be visible to all residents living alongside the highway and the noise generated from the road will be heard by some residents
b)	any transformation of a locality	The new highway will be constructed to the west of the existing highway with an interchange at the intersection of the Pacific Highway and Ewingsdale Road. There will be noise barriers along the highway and landscaping around the intersection and road side. The use of the locality will be transformed with a superior highway and interchange and there will be increased safety for road users.
c)	any environmental impact on the ecosystems of the locality	There is unlikely to be any significant adverse effects on threatened flora, fauna and their habitats
d)	any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	No reduction in the recreation or scientific value of the locality is anticipated. There will be some change to the aesthetics of the locality with the construction of the new highway to the west of the existing highway and construction of the interchange.

Table 10.2 Clause 82 Assessment (cont)

	Factor	Relevant Section or Comments
e)	any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations	There is not anticipated to be any impact on anthropological, archaeological, cultural, historic or scientific significance. The construction of the new highway and interchange to the west of the highway is unlikely to significantly change the aesthetics, architectural or social setting of the locality as it will reinforce existing landuse.
f)	any impact on the habitat of any protected fauna (within the meaning of the National Parks and Wildlife Act 1974)	No impact on the habitat of protected or endangered fauna is anticipated.
g)	any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	No impact on endangered species of animal or plant or any other life form is anticipated.
h)	any long-term effects on the environment	The visual impact of the carriageway on residents and motorists will be long term but in keeping with the current landuse. Figs and pine trees will be planted along the highway to create a "gateway" effect. There is potential for impacts on water quality and air quality in the long term.
i)	any degradation of the quality of the environment	There is not expected to be degradation of the existing environment.
j)	any risk to the safety of the environment	The safety of the users and motorists will be enhanced.
k)	any reduction in the range of beneficial uses of the environment	Residential properties will be avoided where possible however 17ha of private land will be acquired. Farm viability is likely to be altered. Acquisition and farm amalgamation arrangements will be negotiated according to the Land Acquisition (Just Terms Compensation) Act.
l)	any pollution of the environment	Only short term (construction period) noise, dust and sediment pollution of the environment is anticipated.
m)	any environmental problems associated with the disposal of waste	The waste generated by the construction will be minor and will be removed by the constructing authority.
n)	any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	No demands are to be placed on resources that are or are likely to become in short supply. Fill material will be imported from excavations required at other nearby RTA projects.

Table 10.2 Clause 82 Assessment (cont)

	Factor	Relevant Section or Comments
o)	any cumulative environmental effect with other existing or likely future activities	The cumulative impact will be primarily generated when the remaining sections of the Pacific Highway have been completed. The net impact will include improved safety, fuel efficiency and time savings, but may also include increased traffic volumes as a direct result of the improved conditions.

Environmental Management and Summary of Safeguards

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11.0 ENVIRONMENTAL MANAGEMENT AND SUMMARY OF SAFEGUARDS

11.1 Environmental Management

11.1.1 Principles

If the proposal is approved, an Environmental Management Plan (EMP) will be prepared to overcome environmental issues and impacts that are predicted to occur during implementation of the project, and to ensure that the management of the project during construction and future operation is undertaken in an environmentally sensitive manner.

To do this, the EMP will:

- identify statutory environmental requirements;
- identify environmental management responsibilities during the project's implementation;
- provide an environmental monitoring, auditing and training framework;
- provide for ongoing communications with stakeholders, individuals and interest groups;
- outline the scope of environmental management commitments; and
- describe specific environmental safeguards.

The EMP will aim to guide the construction and operation of the roadwork to ensure that there is minimal affect on the physical, biological, social, economic and cultural aspects of the environment.

Environmental management guidelines will arise from the assessments contained in this REF.

The key environmental objective for the EMP would be to avoid environmental impacts and ensure that where impacts do occur, they are minimised. RTA would seek, among other things, to also meet the following objectives:

- minimise the environmental impacts of the duplication on watercourses and other sensitive locations identified along the alignment;
- control runoff and prevent and minimise soil erosion;
- enhance existing vegetation and habitat values;
- minimise disturbance to landholders and the public; and
- monitor works and restore site conditions at the completion of construction.

11.1.2 Environmental Management System

An Environmental Management System (EMS) is being established by the RTA to provide a framework for the implementation of environmental management procedures. The aims of the EMS are to enhance environmental management performance through:

- implementation of the RTA's Environment Policy;
- education and training throughout the RTA;
- establishment of performance indicators and measurement;
- dissemination of information on environmental issues;
- self-assessment at RTA sites;
- standardising procedures;
- producing policies;
- maintenance of records and an inventory of RTA sites; and
- implementation of audits and assessment of activities and environmental management.

Practical application of the EMS for projects is by way of EMPs and Environmental Control Plans (ECPs) which are integrated into normal activities for various projects, work programs and administrative operations.

Within the overall EMS, the EMP will aim to:

- establish the framework under which environmental measures are implemented;
- provide the basis for environmental problems to be identified and managed at the site;
- establish a program of activities to address major issues to ensure the achievement of acceptable environmental performance;
- identify cumulative environmental issues of lower liability risk;
- devise management strategies aimed at integrating ameliorative measures into Authority operational routes; and
- develop longer term monitoring programs to ensure that environmental controls and mitigation techniques are effective.

The end products of the EMS include:

- working within the principles of the ESD;
- compliance with environmental legislation and regulations; and
- recognition of environmental management procedures by the community.

11.1.3 Environmental Requirements

The RTA and RTA Project Manager will have all the responsibilities in co-ordinating appropriate environmental management procedures for the project under the following legislation:

- *Clear Air Act, 1961;*
- *Clean Water Act, 1970;*
- *Noise Control Act, 1975;*
- *Pollution Control Act, 1989;and*
- *Waste Minimisation Management Act,1995;*

Relevant licences, permits and consultation stemming from the legislative framework will be required for the project.

All aspects of design and construction will be carried out in accordance with Australian Standards.

11.2 Summary of Impact Mitigation Measures

Table 11.1 summarises the environmental impact mitigation measures arising from this environmental assessment.

Table 11.1 Summary of Impact Mitigation Measures

Issue	Mitigation Measure
Approvals	➢ Preparation of this REF to comply with EP&A Act ➢ Pollution Control Approval/Licence under the Clean Waters Act is to be sought for sediment basins and discharges ➢ The Waste Minimisation and Management Act is to be complied with
Noise	➢ All machinery to have manufacturers noise control equipment intact ➢ Consultation to continue with effected land holders
Dust and Air Quality	➢ Water sprays to be used on all cleared, unsealed areas and stockpiles ➢ All vehicles moving spoil or fill material on public roads to have their loads covered ➢ The speed limit on the construction site will be 20km/h ➢ Disturbed areas to be promptly stabilised by revegetation
Landscaping	➢ A landscape plan/ strategy will be developed and implemented ➢ Species occurring in the local area to be used ➢ Screen planting to reduce visual impact of noise barriers ➢ RTA Road Environment Safety Guidelines to be met

Table 11.1 Summary of Impact Mitigation Measures (cont)

Hydrology and Water Quality	➢ Diversion bunds to be installed around lowest sides of all land disturbance and all sediment laden water to be directed to a sediment basins ➢ Temporary bunds and silt-stop fencing will be used slopes to reduce the velocity of runoff and capture silt ➢ Sediment basins to be constructed in accordance with RTA design guide and policies. ➢ Basins to be regularly de-silted ➢ Adoption of RTA's Northern Region Interim Environmental Guidelines for Incident Management and RTA's guide for Treatment of Chemical Spills on Roads ➢ Wastes, chemicals and fuel to be stored at least 5m clear of concentrated water flow, poorly drained areas, flood prone areas, streambanks or through traffic areas, and on slopes less than 10% in an appropriate blended area ➢ Refuelling areas to be temporarily sealed and bunded ➢ Vehicle maintenance, other than for emergencies, to be in bunded area ➢ Chemical and fuel storages and handling to comply with Australian Standards ➢ Stockpiles to be protected from overland flow by earth bunds, silt fences or diversion channels ➢ Stockpiles which will be retained for over 1 month will be hydroseeded ➢ Monitoring of water quality discharged from sediment basins to be undertaken to meet EPA requirements
Private Property Access	➢ Accesses to be maintained during construction with temporary closures to be subject to consultation
School Bus Safety	➢ Area to be provided to allow buses to pull off near old highway
Construction Safety	➢ Traffic management plan to be prepared ➢ Compliance with the Australian Standard for Occupational Health and Safety criteria for constructing roads ➢ Compliance with Workcover Authority criteria ➢ Temporary barriers to deter members of the public from entering construction area ➢ Compliance with AS1742 Works on Roads to reduce risk of driver confusion
Flora and Fauna	➢ Areas to be cleared will be defined by para-webbing ➢ Site office, equipment storage, carpark and stockpiles to be away from vegetation which is to retained ➢ Drainage channels under highway to be maintained to allow fauna movement ➢ Species occurring in the local area to be used in landscaping ➢ Individual trees to be inspected for animals before clearing ➢ NPWS and WIRES contact details to be kept on site

Table 11.1 Summary of Impact Mitigation Measures (cont)

Waste Management	➢ Receptacles to be cleared when 75% full ➢ Construction litter to be stored in bulk bins ➢ Waste disposal to be by conventional means to approved waste disposal facility ➢ Construction wastes, such as oils and timber to be recycled where appropriate ➢ Composting toilets to be used during construction or effluent removed to EPA approved disposal point ➢ Construction staff facilities to contain wash down water for approved disposal ➢ Construction staff to be informed of waste and effluent control requirements ➢ Maintenance crews to regularly remove silt and pollutants from sediment basins and dispose at EPA approved disposal site
Archaeology/ Heritage	➢ Work likely to impact on any discovered archaeological relic is to cease until agreement is reached with NPWS and the LALC

Conclusions and Recommendations

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12.0 CONCLUSIONS AND RECOMMENDATIONS

Stage 1 works have been proposed to overcome significant traffic and safety problems associated with the existing Ewingsdale Road / Pacific Highway intersection.

The works were originally planned as part of a major project involving the construction of a four lane dual carriageway between Ewingsdale and Bangalow, linking the existing Bangalow Bypass with the Tyagarah Duplication Project. The larger project is being subjected to further option analysis and community consultation. Value management studies comprising government and community representatives, however, have agreed that the current proposal to upgrade the section of Pacific Highway between Ewingsdale and the base of St Helena Hill should proceed immediately.

The proposed works have been designed to meet social, engineering and environmental needs and this REF has assessed the project under these categories. The works satisfy a range of objectives for the upgrade of the Pacific Highway and will not compromise the resolved option for the remainder of the route between Ewingsdale and Bangalow. The proposal is also compatible with strategic land use, economic and transport planning directions that have been set for the NSW north coast.

The proposal will result in severance of five parcels of land of which some have high quality agricultural value and which will result in reduced viability of the on-farm operations. The proposal will also alter the visual setting in the vicinity of Myocum Road and the proposed works will be visible from McLeods Shoot Lookout. The major visual impacts will arise from the large noise barriers, the overpass and the lighting. These impacts will be mitigated by major tree planting on the embankments.

The environmental and social impacts will be mitigated by the measures proposed to be adopted. The measures are appropriate and achievable and the net impacts are considered to be acceptable when the overall community benefits are considered.

An EMP incorporating all agreed safeguards will be prepared for the project following exhibition of this REF, further community consultation and determination by the RTA.

References

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13.0 REFERENCES

Australian Bureau of Statistics (1991) Census of Population and Housing

Department of Planning (1994) *North Coast Urban Planning Strategy*

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Roads and Traffic Authority (1996) *Pacific Highway Schedule of Design Policies and Specifications for the Construction of the New Sections of Dual Carriageway*

Roads and Traffic Authority (1993) *RTA North Coast Strategy Report*

Roads and Traffic Authority (1992) *Interim Noise Policy*