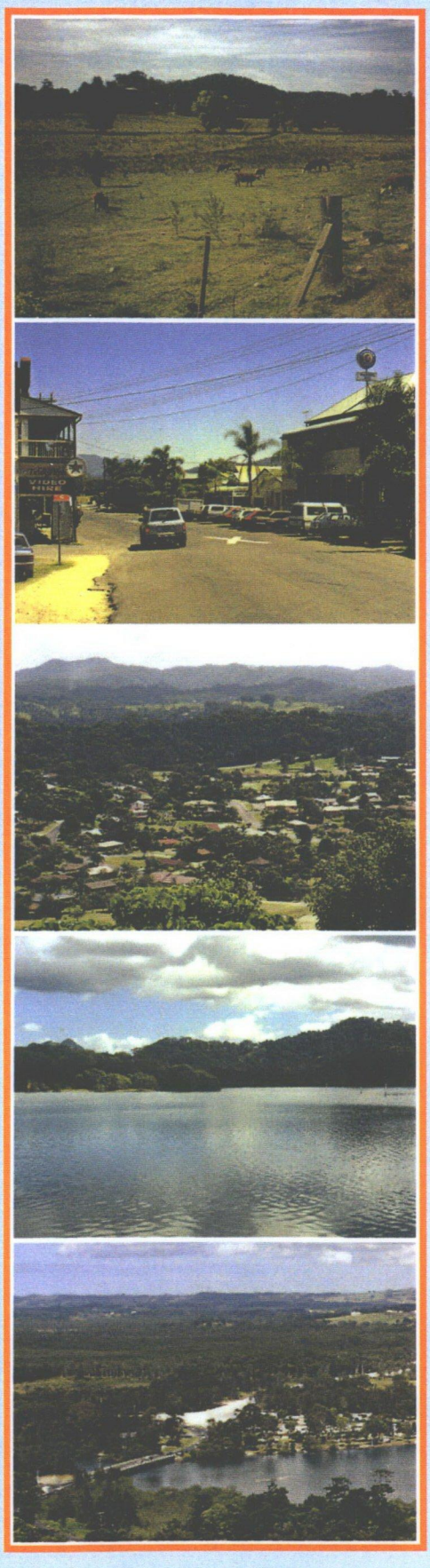


Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

JULY 1998

EIS

Environmental Impact Statement

RTA

TH DEPARTMENT OF
PORT AND
DEVELOPMENT

SINCLAIR KNIGHT MERZ

625.711.3
PA.62

Roads and Traffic Authority

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Environmental Impact Statement

July 1998

Sinclair Knight Merz Pty Ltd
A.C.N. 001 024 095
100 Christie Street
PO Box 164
St Leonards NSW
Australia 2065
Telephone: (02) 9928 2100
Facsimile: (02) 9928 2500



SINCLAIR KNIGHT MERZ

COPYRIGHT: The concepts and information contained in this document are the property of the Roads and Traffic Authority. Use or copying of this document in whole or in part without the written permission of the Roads and Traffic Authority constitutes an infringement of copyright.

Form 14

Submission of environmental impact statement (EIS)

prepared under the Environmental Planning and Assessment Act 1979

Section 122

EIS prepared by

name	Jo Moss
qualifications	BSc, MEnvPlan
address	Sinclair Knight Merz
	100 Christie Street St Leonards 2065
in respect of	Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun

Part 5 activity

proponent name	NSW Roads and Traffic Authority
proponent address	21 Prince Street
	GRAFTON NSW 2460
land on which activity to be carried out: address	All lands required for the construction and operation of the proposed highway, as shown in Figures 6.1 a to 6.1e of the EIS. The proposal includes the construction, operation and maintenance of a pollution control wetland outside the proposed road corridor and identified in Figure 6.1c and Figure 10.2 of the EIS.
proposed development	Construction and operation of a high standard second carriageway for the Brunswick Heads Bypass between the intersection at Saddle Road and the Brunswick River; from the interchange at the Brunswick River the proposal is for the construction and operation of a high standard dual carriageway to Yelgun, generally to the west of the existing Pacific Highway. The proposal includes grade separated interchanges at the Brunswick River and at Yelgun. The existing Pacific Highway would be retained as a local road; service roads are to be provided to maintain access to local properties. The proposal includes the definition of a corridor of sufficient width to accommodate a dual carriageway, and environmental mitigation measures. The proposal includes the construction, operation and maintenance of a pollution control wetland outside the proposed road corridor as indicated above.

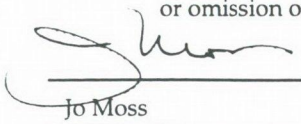
environmental impact statement

an Environmental Impact Statement (EIS) is attached

certificate

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 84 and 85 of the Environmental Planning and Assessment Regulation 1994, and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature	
name	Jo Moss
date	14/7/98

Form 2

Submission of environmental impact statement (EIS)

prepared under the Environmental Planning and Assessment Act 1979

Section 77

EIS prepared by

name	Jo Moss
qualifications	BSc, MEnvPlan
address	Sinclair Knight Merz
	100 Christie Street St Leonards 2065
in respect of	Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun

Development Application

applicant name	NSW Roads and Traffic Authority
applicant address	21 Prince Street
	GRAFTON NSW 2460
land to be developed; address lot no, DPMPS, vol/fol etc. proposed development	The construction and operation of that part of the Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun which traverses SEPP 14 Wetlands Nos 62 & 65, as shown on Figures 6.1c and 14.1 of the EIS.

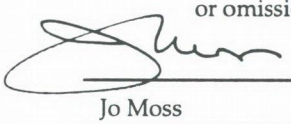
environmental impact statement

an Environmental Impact Statement (EIS) is attached

certificate

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 51 and 52 of the Environmental Planning and Assessment Regulation 1994, and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature	
name	Jo Moss
date	14/7/98

Contents

GLOSSARY
ABBREVIATIONS

Summary i

PART A - PROJECT OVERVIEW AND BACKGROUND

1. Introduction **1-1**
1.1 Introduction 1-1
1.2 The Need for the Proposal 1-1
1.3 The Proposal in Brief 1-2
1.4 Project Objectives 1-4
1.5 Relationship with Adjoining Highway Upgrade Projects 1-4
1.6 Approach to the Study 1-5
1.7 The Principles of Ecologically Sustainable Development 1-6

2. Environmental Determination Process **2-1**
2.1 The Proponent 2-1
2.2 Environmental Impact Assessment Requirements 2-1
2.2.1 EIS Requirements 2-1
2.2.2 Species Impact Statement Requirements 2-2
2.3 Requirements for Changes to Nature Reserve Boundary 2-3
2.4 Purpose of this Environmental Impact Statement 2-3
2.4.1 Objectives of the Environmental Impact Statement 2-3
2.4.2 Scope and Structure of the Environmental Impact Statement 2-4
2.5 Exhibition of the EIS and SIS 2-5
2.6 Guidelines for Making a Written Submission 2-6
2.7 Determination Process 2-7
2.7.1 Part 4 Process 2-7
2.7.2 Part 5 Process 2-7
2.8 Statutory Approvals 2-8
2.8.1 NSW State Government Requirements 2-8
2.8.2 Commonwealth Government Requirements 2-11

3. Consultation **3-1**
3.1 Objectives of the Consultation Program 3-1
3.2 The Consultation Process 3-1
3.2.1 Consultation Prior to Study Commencement 3-1
3.2.2 Consultation at Study Commencement 3-2
3.2.3 Community Involvement in Route Selection 3-3

3.2.4 Community Involvement in Alignment and Interchange Locations and Environmental Mitigation Measures 3-4
3.3 EIS Exhibition 3-5
3.4 Consultation with Authorities 3-5

PART B - PROJECT NEED AND OPTIONS

4. Transport and Environmental Needs 4-1
4.1 Integrating Land Use and Transport Planning 4-1
4.2 Population Considerations 4-1
4.2.1 Existing Population Levels and Forecast Growth 4-1
4.2.2 Population Migration 4-2
4.3 Employment Potential 4-2
4.4 The Transport System 4-3
4.4.1 Road Network and Traffic Characteristics 4-4
4.4.2 Travel Characteristics 4-5
4.4.3 Other Transport User Groups 4-6
4.4.4 Freight Movement 4-6
4.5 Conclusions on Transport and Environmental Needs 4-6
4.6 Consequences of the "Do Nothing" Option 4-7

5. Selection of the Preferred Route and Alignment 5-1
5.1 Previous Investigations 5-1
5.2 The Study Area 5-2
5.3 Identification of Route Options 5-2
5.3.1 Public Display of Route Options 5-3
5.3.2 Value Management Study 5-9
5.4 Refinement of Route A2 5-13

PART C - PROJECT DETAILS

6. Description of Proposed Activity 6-1
6.1 General 6-1
6.2 Design Considerations 6-1
6.2.1 Carriageway Alignment 6-1
6.2.2 Carriageway Design 6-3
6.2.3 Cut and Fill Requirements 6-4
6.3 Drainage and Erosion Control 6-5
6.3.1 Proposed Drainage Design 6-5
6.3.2 Erosion and Sedimentation Control 6-6
6.4 Fencing, Lighting and Signposting 6-8
6.5 Traffic and Access Arrangements 6-8
6.5.1 Proposed Connections with the Local Road Network 6-8

6.5.2 Local Access Arrangements and Road Modifications 6-8
6.5.3 Bridges and Culverts 6-9
6.5.4 Access Arrangements for Private Dwellings 6-9
6.5.5 Provision for Pedal Cyclists and Pedestrians 6-10
6.6 Noise Attenuation Measures 6-10
6.7 Landscaping 6-10
6.8 Property Acquisition 6-11
6.9 Construction 6-11
6.9.1 Management 6-11
6.9.2 Construction Methods 6-11
6.9.3 Construction Traffic 6-12
6.9.4 Temporary Access Arrangements 6-12
6.9.5 Construction Materials 6-13
6.9.6 Construction Schedule and Workforce 6-13
6.9.7 Construction Hours 6-13
6.9.8 Costs 6-13
6.10 Waste Minimisation and Management 6-14
6.10.1 Recycling 6-14
6.11 Energy Statement 6-15
6.11.1 Energy Required for Road Construction 6-16
6.11.2 Energy Consumed During Operation 6-17
6.12 Energy Savings 6-17

PART D - ASSESSMENT OF TRANSPORT AND SAFETY IMPACTS

7. Traffic and Transport Impact Assessment 7-1
7.1 Introduction 7-1
7.2 Existing Conditions 7-1
7.2.1 Road Network and Traffic Characteristics 7-1
7.2.2 Intersection Operation 7-3
7.2.3 Traffic Speed 7-4
7.2.4 Road Safety 7-5
7.2.5 Travel Characteristics 7-6
7.3 Impacts of the Proposal 7-7
7.3.1 Impacts on Traffic Volumes 7-7
7.3.2 Impacts on Road Capacity 7-8
7.3.3 Impacts on Intersection Operations 7-9
7.3.4 Impacts on Local Access 7-10
7.3.5 Impacts on Travel Speeds 7-10
7.3.6 Impacts on Road Safety 7-12
7.3.7 Impacts on Other Road User Groups 7-12
7.3.8 Construction Traffic Impacts 7-13
7.3.9 Potential Economic Benefits 7-14

7.3.10 Summary of Transport Impacts 7-15
7.4 Hazards and Risks in the Transport of Dangerous Goods 7-15
7.4.1 Hazard Identification 7-16
7.4.2 Probability of an Incident 7-16
7.4.3 Consequence Analysis 7-17
7.4.4 Risk Quantification 7-18

PART E - ASSESSMENT OF ENVIRONMENTAL IMPACTS

8. Noise Impact Assessment 8-1
8.1 Approach to Development of the Noise Strategy 8-1
8.1.1 Approach to Assessment 8-1
8.1.2 Existing Noise Environment 8-3
8.1.3 Noise Assessment Criteria 8-4
8.2 Prediction and Assessment of Traffic Noise 8-5
8.2.1 Prediction of Traffic Noise 8-5
8.2.2 Assessment of Traffic Noise Impacts 8-7
8.2.3 Consideration of Impacts and Noise Mitigation Strategies 8-8
8.2.4 Assessment of Traffic Noise Levels with Mitigation 8-9
8.3 Impacts of Construction Noise and Vibration 8-11
8.3.1 Likely Construction Program 8-11
8.3.2 Construction Noise Guidelines 8-12
8.3.3 Predicted Noise Levels at Residences During Construction 8-13
8.3.4 Control of Construction Noise 8-16

9. Air Quality Assessment 9-1
9.1 Air Quality Issues 9-1
9.2 Air Quality Criteria 9-1
9.3 Existing Air Quality 9-4
9.4 Dispersion Meteorology of the Area 9-4
9.5 Assessment of Impacts 9-5
9.5.1 Methods Used for Assessing Impacts 9-5
9.5.2 Prediction of Air Quality Effects 9-5
9.5.3 Enhanced Greenhouse Effect 9-7
9.5.4 Construction Impacts 9-8
9.6 Conclusions 9-9
9.7 Environmental Safeguards 9-10

10. Water Quality and Hydrology 10-1
10.1 Introduction 10-1
10.2 Water Quality 10-1

10.2.1 Existing Water Quality Conditions 10-1
10.2.2 Criteria for Assessment 10-3
10.2.3 Potential Impacts and Environmental Mitigation Measures During Construction 10-4
10.2.4 Potential Impacts and Environmental Mitigation Measures During Operation 10-6
10.3 Hydrology 10-9
10.3.1 Brunswick River 10-10
10.3.2 Marshalls Creek 10-10
10.3.3 Impacts on Flood Levels 10-11
10.3.4 Brunswick River Bridge 10-13
10.3.5 Environmental Safeguards 10-14

11. Indigenous and Non-indigenous Heritage 11-1
11.1 Indigenous Heritage 11-1
11.1.1 Background 11-1
11.1.2 Existing and Potential Archaeological Sites 11-1
11.1.3 Survey Evaluation 11-2
11.2 Assessment of Impacts 11-3
11.2.1 Heritage Management and Mitigation Measures. 11-4
11.3 Non-indigenous Heritage 11-5
11.3.1 Background 11-5
11.3.2 Non-indigenous Heritage Resources 11-6
11.3.3 Survey Evaluation 11-7
11.3.4 Assessment of Impacts 11-8
11.3.5 Environmental Management and Mitigation Measures. 11-8

12. Flora and Fauna 12-1
12.1 Introduction 12-1
12.2 Flora Characteristics of the Proposed Road Corridor 12-2
12.2.1 The Proposed Brunswick Heads Bypass Duplication 12-3
12.2.2 Brunswick River to Yelgun 12-4
12.3 Fauna Characteristics of the Proposed Road Corridor 12-4
12.3.1 The Proposed Brunswick Heads Bypass Duplication 12-4
12.3.2 Brunswick River to Yelgun 12-5
12.3.3 Aquatic Fauna 12-6
12.4 Summary of Potential Impacts on Flora and Fauna 12-6
12.4.1 Impacts on Flora 12-7
12.4.2 Impacts on Fauna 12-8
12.5 Environmental Safeguards 12-11
12.5.1 Brunswick Heads Bypass Duplication 12-12
12.5.2 Brunswick River to Yelgun 12-12
12.6 Compensatory Habitat 12-15

13. Geology and Soils **13-1**
13.1 Introduction 13-1
13.2 Physical Setting 13-1
13.2.1 Regional Geology 13-1
13.2.2 Topography 13-2
13.2.3 Groundwater 13-2
13.3 Geotechnical Characteristics of the Proposal 13-2
13.4 Cuttings 13-3
13.4.1 Soil and Rock Conditions at Cuttings 13-3
13.4.2 Excavation Properties 13-3
13.4.3 Unsupported Cut Batters 13-3
13.4.4 Proposed Excavation Support in Cuttings near Rajah Road 13-4
13.5 Embankment Construction 13-4
13.5.1 Suitability of Excavated Materials for Embankment Construction 13-4
13.5.2 Embankment Batter Stability 13-4
13.5.3 Embankment Construction on Floodplains 13-5
13.5.4 High Embankments on Sloping Ground 13-5
13.5.5 Sources of Select Fill 13-5
13.6 Geotechnical Considerations for Bridges 13-6
13.7 Environmental Management 13-6
13.7.1 Erodibility and Fertility of Soils 13-6
13.7.2 Acid Sulphate Soils 13-7
13.7.3 Potential Contamination 13-7
13.7.4 Construction Staging 13-7
13.7.5 Sterilisation and Depletion of Resources 13-8

14. Present and Future Land Use **14-1**
14.1 Existing Land Use 14-1
14.2 Future Land Use 14-3
14.3 Planning Controls 14-3
14.3.1 Local Planning Controls 14-3
14.3.2 Regional Planning Instruments 14-4
14.3.3 State Environmental Planning Policies 14-4
14.4 Impact Assessment 14-9
14.4.1 Impact on Local, Regional and State Planning 14-9
14.4.2 Impact on River Uses 14-9
14.4.3 Impacts on Future Urban Development Areas 14-10
14.4.4 Property Impacts 14-10
14.5 Land Acquisition 14-13
14.6 Mitigation of Impacts 14-14

15. Visual and Landscape Assessment **15-1**
15.1 Introduction 15-1
15.2 Visual Interaction 15-1
15.3 Existing Visual Environment 15-2
15.4 Visual Character and Effect of the Proposal 15-3
15.5 Visual Interactions and Impacts 15-5
15.6 Landscape Mitigation Measures 15-8
15.6.1 Landscape Principles and Treatment Types 15-8
15.7 Landscape Concept Plan 15-11
15.8 Conclusion 15-15

16. Community Impacts **16-1**
16.1 Social Impact Considerations 16-1
16.1.1 Health and Psychological Effects 16-1
16.1.2 Property effects 16-2
16.1.3 Amenity Effects 16-2
16.1.4 Proposals for the Brunswick River Vicinity 16-4
16.1.5 Impacts on Local Businesses 16-5
16.1.6 Mitigation Measures 16-6
16.2 Road User Economic Considerations 16-7

PART F - CUMULATIVE IMPACTS AND ENVIRONMENTAL MANAGEMENT

17. Cumulative Impacts and Environmental Management **17-1**
17.1 Cumulative Environmental Effects 17-1
17.2 Environmental Mitigation and Management 17-3
17.2.1 Environmental Management Plans 17-5
17.3 Statutory Requirements 17-14

PART G - JUSTIFICATION AND CONCLUSION

18. Justification and Conclusion **18-1**
18.1 Justification 18-1
18.2 Conclusion 18-6

REFERENCES

APPENDICES

Appendix A - Matters to be Addressed in the EIS
Appendix B - Authority Consultation
Appendix C - Study Team
Appendix D - Copies of Information Sheets

WORKING PAPERS (prepared as separate documents to the EIS)

Working Paper No. 1 - Traffic and Transport Assessment
Working Paper No. 2 - Road Concept Design Report
Working Paper No. 3 - Noise Impact Assessment
Working Paper No. 4 - Air Quality Assessment
Working Paper No. 5 - Water Quality and Hydrology Assessment
Working Paper No. 6 - Indigenous and Non-indigenous Heritage
Working Paper No. 7 - Flora and Fauna Assessment
Working Paper No. 8 - Geotechnical Assessment
Working Paper No. 9 - Visual Quality and Landscape Assessment
Working Paper No. 10 - Value Management Study

Species Impact Statement

LIST OF TABLES

There are no Tables in Section 1, 2, or 3

Table 4-1 Byron LGA, Population Projections
Table 4-2 Employment by Sector Type
Table 4-3 Byron Shire Participation Rates
Table 4-4 Critical Highway Operating Characteristics

Table 5-1 Route Comparison
Table 5-2 Options Evaluation Matrix

Table 6-1 Road Design Criteria
Table 6-2 Drainage Design Criteria
Table 6-3 Minor Cross-Drainage Structures Proposed

Table 7-1 Functional Classification of Roads
Table 7-2 Study Area Traffic Volumes
Table 7-3 Road Hierarchy in the Study Area and Volume/Capacity
Table 7-4 Level of Service Criteria for Intersections
Table 7-5 Results of Intersection Analysis
Table 7-6 Traffic Speeds and Travel Times
Table 7-7 Existing and Forecast Traffic Volumes
Table 7-8 Volume/Capacity for Future Traffic and Road Network
Table 7-9 Impacts on Travel Speeds
Table 7-10 Impacts to Intersection Operations Characteristics
Table 7-11 Hazardous Goods Vehicles Accident probabilities
Table 7-12 Risk to People on the Existing Highway
Table 7-13 Risk to People on the Proposal
Table 7-14 Individual Fatality Risk Criteria

Table 8-1 Measured Noise Levels
Table 8-2 Traffic Noise Level Goals for Residences
Table 8-3 Comparison of Measured and Predicted Night time LAeq,9hr Noise Levels
Table 8-4 Predicted LAeq,9hr Noise Levels (no Mitigation)
Table 8-5 Predicted LAeq,9hr Noise Levels with Mitigation
Table 8-6 Construction Noise Level Goals
Table 8-7 Typical Maximum Sound Power Levels from Construction Plant

Table 9-1 NSW Air Quality Goals

Table 9-2 Predicted Increase in 1 Hour Average Ground-Level Concentrations of Vehicle Emissions at Various Distances from the Roadway Edge

Table 10-1 Existing Water Quality in Brunswick River and Marshalls Creek
Table 10-2 Comparison of Water Quality Along the Brunswick Heads Bypass Before and During Construction
Table 10-3 Proposed Location and Sizes of Stormwater Constructed Wetlands and Stormwater Interceptors
Table 10-4 Brunswick River Flood Levels - Comparison of Pre-Bypass, Single Carriageway and Bypass Duplication

There are no Tables in Section 11

Table 12-1 Vegetation Areas included in proposed Road Corridor

There are no Tables in Section 13

Table 14-1 Description of Directly Affected Properties

Table 15-1 Evaluation of Visual Management Units

There are no Tables in Section 16

Table 17-1 Summary of Mitigation Measures
Table 17-2 Outline of Environmental Management Plan

There are no Tables in Section 18

LIST OF FIGURES

Figure 1 Preferred Route

Figure 1.1 Locality Plan
Figure 1.2 Relationship to Other Highway Projects

Figure 2.1 Environmental Determination Process

There are no Figures in Section 3

Figure 4.1 Local Road Network

Figure 5.1 Study Area
Figure 5.2 Route Options Considered
Figure 5.3 Preferred Route Alignment

Figure 6.1a-e Design and Profile
Figure 6.2a Artists Impression of the Proposal South of Brunswick River (View Looking South)
Figure 6.2b Artists Impression of the Proposal North of Brunswick River in the Vicinity of Rajah Road (View Looking North)
Figure 6.2c Artists Impression of the Proposal Near Billinudgel (View Looking South)
Figure 6.2d Artists Impression of the Proposed Yelgun Interchange (View Looking North)
Figure 6.3a Typical Cross Section of the Proposed Duplication of the Brunswick Heads Bypass
Figure 6.3b Typical Cross Section - Different Median Treatments
Figure 6.3c Typical Cross Section - From Rajah Road to Sewage Treatment Plant Access Road
Figure 6.3d Typical Cross Section - Adjacent to Billinudgel Nature Reserve
Figure 6.3e Typical Cross Section - Proposed Bridge Over Brunswick River
Figure 6.3f Typical Cross Section - at Billinudgel
Figure 6.4 Typical Erosion and Sediment Control Structures

There are no Figures in Section 7

Figure 8.1 Location of Noise Monitoring Sites
Figure 8.2 Location of Noise Mitigation Measures
Figure 8.3 Noise Level Contours

There are no Figures in Section 9

Figure 10.1 Water Quality Monitoring Sites
Figure 10.2 Location of Proposed Water Quality Control Structures Sites
Figure 10.3 Hydraulic Modelling Sites for Brunswick River

Figure 11.1 Location of Indigenous and Non-indigenous Heritage Sites

Figure 12.1a Vegetation Communities, Saddle Road to Brunswick River Interchange
Figure 12.1b Vegetation Communities, Brunswick river Interchange to Yelgun
Figure 12.2 Location of Fauna Survey Sites
Figure 12.3 Location of Threatened Fauna and Flora Species of Conservation Significance

Figure 13.1 Geotechnical Investigations
Figure 13.2 Terrain Units

Figure 14.1 Generalised Land Use
Figure 14.2 Land Zoning
Figure 14.3 Effects on Property

Figure 15.1 Visual Management Units
Figure 15.2 Landscape Concept Plan
Figure 15.3 Proposed Landscape Treatment at Ocean Shores
Figure 15.4 Proposed Landscape Treatment at Banana Road Cutting
Figure 15.5 Proposed Landscape Treatment Marshalls Creek Area
Figure 15.6 Proposed Landscape Treatment Yelgun Interchange

There are no Figures in Sections 16, 17 or 18

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Glossary and Abbreviations

Glossary

Access controlled highway/road	A road/highway which has access restricted to a defined group of entry/exit points.
Alignment	A detailed geometric layout, in plan and profile, following a general route.
Asphalt or Asphaltic Concrete	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant.
At-grade intersection	A point where roads cross at ground level, and one is not elevated over the other.
Breakdown lane(s)	Auxiliary lane(s) used for emergency/maintenance stopping only.
Carriageway	The portion of a road or bridge used by vehicles (inclusive of shoulders and auxiliary lanes).
Concept design	Initial functional layout of a concept, such as a road or road system, to provide a level of understanding to later establish detailed design parameters
Cut and fill balance	Difference between earthwork cut and fill volumes.
Cut batters	The side slopes of cuttings.
Depressed median	A strip of road not normally intended for use by traffic, which separates carriageways for traffic in opposite directions, and is graded towards the centre.
dBA	Decibels using the 'A' weighted scale, measured according to the frequency of the human ear
Design speed	A nominal speed used for the design of geometric features of the road, such as curves.
Dual carriageway	A highway or road with separated carriageways for traffic travelling in opposite directions.
EMME/2	EMME is short for "Equilibre Multimodal Multimodal Equilibrium". EMME/2 is an interactive graphic multimodal urban transportation planning system. The "2" indicates the systems development after the original EMME system developed in the late 1970s.

Fill batters	The side slopes of material placed in an embankment; the degree of such slope is expressed as a ratio of X horizontal to 1 vertical.
Gradient	The degree of ascending or descending with a uniform slope.
INTANAL	"INTersection ANAlysis" program is a traffic management and design computer program that analyses the operation of an intersection controlled by: traffic signals, roundabouts or stop/give way signs.
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways or ramps.
K value	Length of vertical curve (in metres) for each 1% change in gradient.
Level of Service	A qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.
Local road	A road or street used primarily for access to abutting properties.
NETANAL	"NETwork ANAlysis" program - road based transport, network analysis computer modelling system.
Pavement	The portion of a carriageway above the subgrade (generally natural material) for the support of, and to form a running surface for, vehicular traffic.
Public transport mode	A mode of transport for carrying large numbers of the public, such as bus or train.
Road corridor/reservation	The strip of land along which a road is to be constructed.
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to, and flush with the surface of the pavement.
Stopping sight distance	The sight distance required by an average driver, travelling at a given speed, to react and stop safely.

Value Management	A structural process through which the various elements and functions are critically analysed to ensure the project, product or service ultimately delivered represents all stakeholders needs.
Verge	That roadside portion of the roadway formation not covered by the carriageway or pathway.
Volume to Capacity Ratio	The ratio of the volume of traffic travelling on a mid block section of road in a specific period to the capacity of that mid block section during that period.
2:1 etc	Refers to the level of gradient (ie. for two horizontal units, the slope moves one vertical unit).
1 in 100 year flood level.	Refers to the flood which occurs, on average, once every 100 years. Also known as the 100 year Average Recurrence Interval of a flood. These events (i.e. floods) are of a random nature; it is possible for there to be two 100 year floods in successive years; similarly the 100 year flood may not occur for 200 years. The 100 year flood may not be the largest flood in the last 100 years.

Abbreviations

AADT	Average Annual Daily Traffic
AEP	Annual Exceedence Probability
AHC	Australian Heritage Commission
ANZECC	Australia New Zealand Environment Conservation Council
ARI	Average Recurrence Interval
ASL	Above Sea Level
AUSTROADS	The National Association of Road Transport and Traffic Authorities in Australasia
CAMBA	China-Australia Migratory Bird Agreement
DLWC	Department of Land and Water Conservation
DUAP	Department of Urban Affairs and Planning
EIS	Environmental Impact Statement
EMP	Environmental Management Planning
EP&A Act	Environmental Planning and Assessment Act
EPA	Environment Protection Authority
ESD	Ecologically sustainable development
ESP Act	Commonwealth Endangered Species Protection Act
JAMBA	Japan-Australia Migratory Bird Agreement
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LOS	Level of Service
NEPC	National Environment Protection Council of Australia
NEPM	National Environment Protection Measures
NHMRC	National Health and Medical Research Council
NPWS	National Parks and Wildlife Service
PASS	Potential Acid Sulphate Soils
POEO Act	Protection of the Environment Operations Act
REP	Regional Environmental Plan
ROTAP	Rare or Threatened Australian Plants
RTA	Roads and Traffic Authority (NSW)
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
STP	Sewage Treatment Plant
TSC Act	NSW Threatened Species Conservation Act
USEPA	United States Environment Protection Agency
VMS	Value Management Study
WHO	World Health Organisation

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Summary

Summary

Introduction and Need for the Proposal

The Roads and Traffic Authority (RTA) is proposing to upgrade the Pacific Highway between the Brunswick River and Yelgun, in northern NSW. The proposal includes the duplication of the Brunswick Heads Bypass and the construction of a new dual carriageway between the Brunswick River and Yelgun. This Environmental Impact Statement (EIS) examines and assesses the potential environmental impacts of the proposal. **Figure 1** shows the proposal schematically.

The upgrade of this section of the highway is part of the Pacific Highway Upgrading Program, which is a joint NSW State/Commonwealth Government initiative. The Program committed some $2.2 billion over 10 years (from July 1996) for upgrading the Highway between Hexham and the Queensland border.

The standard of the existing highway alignment and gradients between Brunswick and Yelgun are below that required to carry the volumes of traffic that use the road now, and which are projected to use it. Accident rates along this section of highway are lower than the State average but almost half the accidents recorded along this section of the highway have resulted in some type of injury.

Traffic forecasts have been used to determine longer term road requirements, with the aim of achieving improved and continuing traffic efficiency and safety objectives. These forecasts show that if the highway is not upgraded in this section, traffic congestion and accident rates could be expected to increase and there would be a resultant decrease in road efficiency. This would have an adverse impact on road users.

There would also be an impact on the local community. The current highway was built many decades ago, when less consideration was given to environmental mitigation measures and there was little development in this area. As traffic volumes have increased, there has been an increasing impact on the community and on the environment. Without the highway upgrade, there will be continuing adverse environmental and community impacts.

The Proposal

The proposal is approximately 8.7 km long. The new highway for through traffic would consist of dual carriageways with two travel lanes in each direction. The carriageways would be separated by barriers or a median of variable width. The proposal would commence just north of Saddle Road and would involve constructing a second carriageway parallel to the new Brunswick Heads Bypass. There would be an interchange approximately 700m south of the Brunswick River to cater for vehicle movements to and from Brunswick Heads.

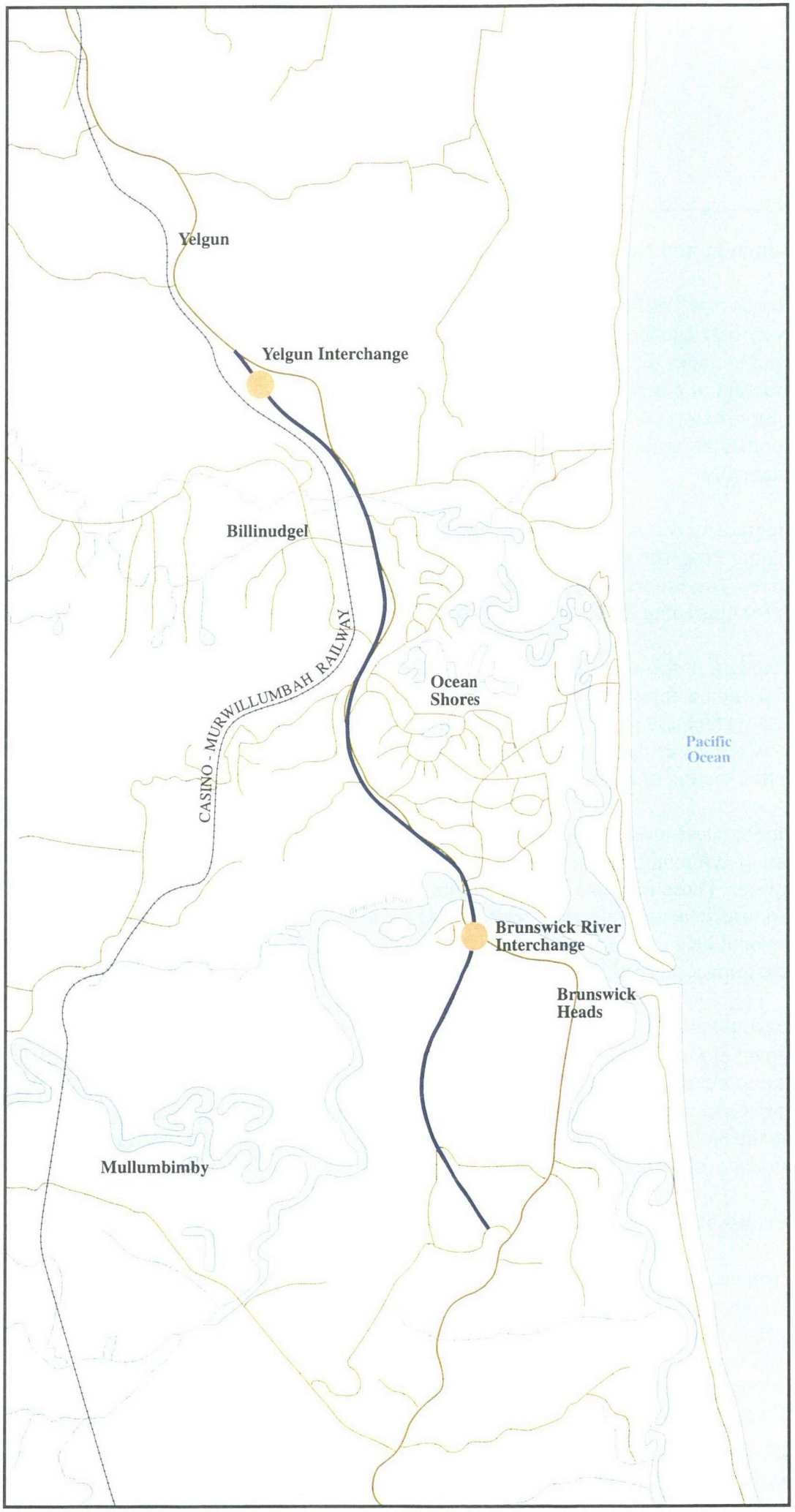


Figure 1
PREFERRED ROUTE

A new bridge over the Brunswick River would be constructed to carry six lanes of traffic - four lanes for the new dual carriageway, and two lanes for local traffic. The design accommodates pedestrians and cyclists across the bridge, as well as under it. The existing bridge would be demolished, which would improve flow patterns in the Brunswick River and allow the river foreshore area to be rehabilitated.

North of the Brunswick River the proposal would travel through the Brunswick Heads Nature Reserve, using the existing (but widened) road corridor. The aim of the design in this vicinity is to minimise impacts on residential properties and on sensitive vegetation in the area immediately north of the river. The design uses as much of the existing road corridor as possible, and separates local and through traffic by locating the local road and the new dual carriageways on two levels. A short section of the existing highway would be realigned to accommodate this arrangement.

Further north, the proposal is located generally parallel to and west of existing highway. The proposal continues to a proposed interchange near Yelgun, passing to the east of Billinudgel.

The existing highway facility would be retained as a local access road between Brunswick Heads and Yelgun and access to Ocean Shores would be maintained. Ocean Shores would have an improved connection with Billinudgel via a new bridge over the proposal.

The southern approaches to the new Brunswick River bridge have been designed to minimise impacts on adjoining wetlands and residents of the Ferry Reserve Caravan Park.

The reserve for the proposal would vary in width between 70-100m depending on the terrain. It would exceed 100 m along deep cuttings and 160m where interchanges are proposed. The corridor has been defined to allow for the road formation, as well as landscaping and other environmental mitigation measures including noise mitigation measures, erosion and sedimentation control, and fauna crossings.

The total project cost including land and property acquisition and provision of environmental mitigation measures is approximately $73 million. The proposal would be funded by the NSW State and Commonwealth Governments. Providing time for determination, acquisition and construction, it is expected that the proposal would be open to traffic by mid 2002.

For the purposes of this EIS, the description and assessment of the proposal is based on a concept design. Detailed design of the proposal would only be undertaken if the Minister for Urban Affairs and Planning approves the proposal and if the Roads and Traffic Authority determined that it was to proceed. The detailed design stage would use the concept design and environmental mitigation measures described in this EIS. It would incorporate the details of the Roads and Traffic Authority's determination and conditions and would be undertaken in conjunction with development of a Project Environmental Management Plan. A more detailed engineering investigation of the proposal would then be undertaken so that construction could commence.

Consultation

An extensive community and authority consultation program was undertaken during the study, and the exhibition of the EIS continues that process. Community and authority input was important in advising the team about local issues and considerations, defining the route options, in selecting the preferred route and in developing the proposed environmental mitigation measures. The consultation process included detailed discussions with Byron Council.

Consultation took a number of forms depending on the phase of the study and the particular circumstances, and included:

- Planning Focus Meeting
- Public Information Meeting
- Advertisements
- Information Sheets
- Public Displays
- On-site meetings with groups, individuals and authorities
- Meetings with directly affected land owners
- Establishment and operation of a freecall project telephone service
- Establishment of a database and community mailing list
- Receipt of submissions
- Value Management Workshop

Route Selection

The choice of a preferred route represents a balance between practical engineering considerations and minimising environmental and community impacts. Overall, the aim is to meet the project objectives (which themselves are a direct outcome of community needs) while ensuring that the environment can be adequately safeguarded. The preferred route needs to demonstrate compatability with the principles of ecologically sustainable development.

A number of feasible route options were identified following consideration of ecological, social, economic constraints and opportunities within the study area, and of the practicability of construction. The study area is within Byron Shire and this area is recognised for its scenic qualities, residential amenity, and for the presence of areas of high conservation value. These were all important factors in the selection of the preferred route.

A comparative evaluation was made of all feasible route options identified by the study team, and of several other options and variations suggested by the community. The process of selecting the preferred route included a two day Value Management Workshop attended by community, government, Roads and Traffic Authority and study team representatives. The route which was considered to offer the best value to the community was the route known as Route A2. Ultimately, the Roads and Traffic Authority and the Minister for Roads decided that the route known as "Route A2" was the preferred route for the purposes of undertaking detailed studies leading to the preparation of an Environmental Impact Statement.

Route A2 is consistent with Byron Council's planning strategies and was the route that would have the least ecological impact, notwithstanding that it would have an impact on the Brunswick Heads Nature Reserve. Other routes including those further to the west would have a greater impact on residential areas and/or sensitive natural areas.

Traffic and Transport Impacts

Traffic volumes will increase in this area and the proposal would provide sufficient capacity for the forecast volumes to at least 2016. The most significant impact of the proposal would be to remove a significant proportion of traffic from the existing highway, particularly from the section north of the Brunswick River. The proposal would also redistribute some traffic from Coolamon Scenic Drive.

Through traffic would use the new road, leaving the existing road primarily to local traffic. Residents would experience an improved traffic situation by not having to share commuting with through traffic. This, in turn, would improve the performance of local intersections. Local access arrangements remain, although they would be altered at some locations.

The proposal would improve travel times, particularly for through traffic. Travel time benefits would also result for traffic using the existing highway, due to the reduction in traffic volumes using this route. The proposal would also provide improved safety compared to the existing alignment due to the separation of traffic

flows in either direction and the reduction in access/conflict points compared with the existing highway.

Public transport using the existing highway would benefit from the removal of through traffic using the existing highway. It also creates the potential for new services to be introduced, using the improved road facility for intra regional travel to destinations such as Tweed Heads.

Pedestrians and cyclist facilities have been included in the proposal. The new facilities would provide for safe paths within the study area. The reduction of traffic in Brunswick Heads would improve the safety and amenity for pedestrians and cyclists in the township and its environs.

Potential Economic Benefits

An economic analysis was undertaken to predict the economic benefits to the community from the proposal. The analysis used conventional cost benefit analysis techniques in accordance with the NSW government guidelines for economic evaluation of assets. This analysis indicated that the proposal would be economically viable. Furthermore, the benefits would begin to flow as soon as the proposal is opened and continue for the design life of the new highway.

In addition, the benefits of the proposal would flow on, in the form of supporting inter and intra regional accessibility for tourist movements and support for industry. This would provide a catalyst for economic development in the area.

Environmental Impacts

Noise

The analysis indicates that the Environmental Protection Authority noise level goals are met at all residences. Some form of noise treatment would be required for the Christian Life Centre at Billinudgel.

At almost all residences noise levels are predicted to reduce at opening by typically 2-8 dBA in the main Ocean Shores area. Although this assessment has indicated that the Environmental Protection Authority guidelines would be achieved at the majority of residences, there are many residences in the Ocean Shores area where noise levels would be similar to current levels or lower as a result of the proposal and would still be subjected to relatively high traffic noise levels.

In addition some residences along Coolamon Scenic Drive and the Tunnel Road would experience barely noticeable increases in noise level, even though the level meets the Environmental Protection Authority guideline for an arterial road.

In the vicinity of Rajah Road, where the proposed new highway and realigned local road are close to each other, it would be necessary for safety reasons to provide a barrier between the proposal and the realigned local road. The RTA would propose to construct this barrier so that it would provide noise reduction benefits. Whether or not an acoustic barrier is constructed would be a matter for negotiation between the Roads and Traffic Authority and potentially affected residents, as the barrier may obstruct views.

The duplication of the Brunswick Heads Bypass would only result in very small changes in noise level. However, no noise mitigation has been provided for the first carriageway of the Brunswick Heads Bypass as it was designed when previous less stringent Environmental Protection Authority and Roads and Traffic Authority guidelines were adopted. Although the duplication would result in only a very small noise increase, the situation has been assessed as if the Bypass were not there and the Roads and Traffic Authority would enter into negotiations with the affected residents to determine the most appropriate form of noise mitigation. Mitigation measures would include treatment of individual houses.

Other than the existing highway, where traffic flows would decrease significantly, there would be no change in traffic flows on local roads. No impact is therefore expected.

Air Quality

The air quality assessment indicated that the emissions generated by traffic using the proposal would not exceed Environmental Protection Authority goals and other relevant air quality criteria.

The main source of potential air emissions during the construction phase of the project is the generation of dust associated particularly with the earthworks phase. Management measures would be implemented to control potential dust impacts from construction work.

Water Quality and Quantity

The proposal would cross two sensitive watercourses, the Brunswick River and Marshalls Creek, as well as affecting or being very close to wetland areas including areas gazetted under State Environmental Planning Policy 14. The proposal includes a new bridge over the Brunswick River, which would be a major structure, and the demolition of the existing bridge.

The construction and operation of the proposal has the potential to introduce contaminants to these sensitive watercourses and wetlands, and also to result in impacts on water flow. A water quality management strategy is an integral part of

the proposal. The aim of the strategy is to maximise the capture of contaminants and consequently mitigate the impact on the water quality of downstream waterways. Importantly, the strategy includes measures to collect runoff and spillages from the new bridge and approaches, thereby providing additional protection to the Brunswick Heads Nature Reserve and the Brunswick River.

Where the road passes over existing creeks, drainage channels and floodways, the crossings are designed to have no significant affect on existing flood levels upstream and downstream of the road.

The potential impact of the new bridge was raised as an issue of community concern. The concern appeared to relate to the fact that the new bridge would have a different pier and abutment structure to the existing bridge, and there could be consequent impacts on the erosional and sedimentation regime of the lower Brunswick River. Particular concerns were expressed about potential adverse impacts on boating conditions at the river entrance.

The sediment movement and depositional processes in the river were investigated and it has been concluded that flow velocities upstream and downstream of the proposed bridge alignments would remain unchanged. The features of the proposed bridge are expected to improve the local hydraulic regime in the vicinity because the new alignment and shape of the piers would give the advantage of streamlining flow through the bridge, and would be an improvement in comparison with the existing bridge with respect to the shape and flow of the river at the new location.

Heritage

There are no significant indigenous or non-indigenous sites in the study area, although there are some areas and items of interest. Detailed investigations, including sub-surface testing, revealed a number of artefacts. A number of non-indigenous items including post and rail fences were identified but considered to be of low significance.

Members of the Tweed-Byron Local Aboriginal Land Council would be present during initial site works to monitor the work for disturbance of artefacts.

Flora and Fauna

The NSW far north coast region is recognised as an area with considerable significance for biological diversity. Consequently, flora and fauna considerations were critical to the selection of the preferred route and to the design of the proposal particularly through the Brunswick Heads Nature Reserve. The proposal would have an effect on approximately 0.6 hectares of the 83 hectare Brunswick Heads Nature Reserve. This is less than 1% of the total Reserve area and located

mostly where these has been previous disturbance. There would also be an impact on several other (generally modified) vegetated areas in the proposed road corridor. To compensate for these potential impacts the proposal incorporates fauna crossings. The Roads and Traffic Authority is liaising with the National Parks and Wildlife Service in regard to the identification of areas suitable for purchase as compensatory habitat. The proposed water quality management strategy would assist in maintaining the health of the Brunswick River, Marshalls Creek and wetland areas.

A Species Impact Statement has been prepared to assess the impact of the proposal on threatened species, populations and ecological communities.

Present and Future Land Use and Community Impacts

The proposal is consistent with Byron Council's planning strategies, and with the future expansion of Billinudgel.

The proposal would potentially have a direct impact on 31 properties. The Roads and Traffic Authority would acquire the land in accordance with the provisions of the Land Acquisition (Just Terms Compensation) Act.

The proposal would also have a direct affect on a number of businesses. The Salad Bowl service station and caravan park would be directly affected. The commercial property on the southern side of the Brunswick River occupied by two restaurants would also be directly affected, although the use of the building for commercial tourism purposes is considered viable in the longer term. There are also two carpentry businesses operated on residential/rural residential properties, and these would be directly affected.

The proposal includes the demolition of the existing Brunswick River bridge and rehabilitation of the foreshore area. There would be liaison with property owners, Byron Council and the local community about the design of this area, and long term management and funding arrangements. The development and rehabilitation of this area represents a significant overall community benefit, which would also benefit the residents of the Ferry Reserve Caravan Park, Riverside Drive and also the businesses operating in this locality.

Visual Quality and Landscape Character

The Byron/Brunswick area is known for its scenic qualities and a major road in this area has the potential for significant visual impacts. These impacts could be minimised by careful landscape treatment. The visual impact of the proposal would be high initially, but would be moderated as the revegetation and planting becomes established and softens the appearance of the road elements such as

major cuts. The EIS includes a set of landscape design principles which would be applied at the detailed design stage.

Environmental Management

The EIS includes a range of measures which would need to be implemented to ensure that the proposal is constructed and operated with minimal environmental impact. These measures are collated in the form of an outline Environmental Management Plan, which would need to be expanded and detailed by the Roads and Traffic Authority or its contractor prior to construction commencing.

A Project Environmental Management Plan would be developed during the detailed design phase of the project.

Conclusion

The Pacific Highway is a major transport link between Sydney and Brisbane and there is a need for this link to be safe and efficient. This section of the highway has been identified as a priority for improvement. Without the upgrade, traffic volumes will continue to increase with consequent impacts on all road users, and on the surrounding community. The most important benefit of the proposal is that it would divert a high proportion of through traffic from the existing highway which would provide a safer and more efficient road in this vicinity, and improved environmental outcomes for the community.

The route for the proposal was selected on the basis of minimising impacts on sensitive ecological areas, rural areas and residential areas. It included consideration of social, biophysical and economic issues, and in accordance with the principles of ecologically sustainable development.

Approvals Process

The majority of the proposal would be assessed under Part 5 of the Environmental Planning and Assessment Act, 1979 as amended. That part of the proposal which affects areas designated under State Environmental Planning Policy No.14 are subject to the provisions of Part 4 of the Act and a Development Application is being lodged with Byron Council concurrently with the exhibition of the EIS.

The EIS is being placed on public exhibition at these locations:

- RTA, Pacific Highway Development Office, 21 Prince Street, Grafton
- Department of Urban Affairs and Planning, 49 Victoria Street, Grafton

- Byron Shire Council, Station Street, Mullumbimby
- RTA Motor Registry, Pacific Highway, Murwillumbah*
- RTA Motor Registry, Carrington Street, Lismore*
- RTA Motor Registry, Keywest Shopping Centre Ballina*
- RTA Office, Centennial Plaza, Ground Floor, Elizabeth Street, Surry Hills*
- Department of Urban Affairs and Planning, 1 Farrer Place, Sydney
- New South Wales Environment Centre (Nature Conservation Council), Level 5, 362 Kent Street, Sydney
- New South Wales Government Information Centre, Goodsell Building, Corner Philip and Hunter Streets, Sydney
- Brunswick Heads Post Office, Fingal Street, Brunswick Heads.

Copies of the Environmental Impact Statement and Working Papers will be available for sale at the locations marked with an asterisk.

The Species Impact Statement will, in addition to the locations described above, be exhibited at the following offices of the National Parks and Wildlife Service:

- Head Office - Information Office, 43 Bridge Street, Hurstville
- Northern Zone Office, GIO House, Moonee Street, Coffs Harbour
- Lismore District Office, Colonial Arcade, Alstonville
- Murwillumbah Sub-District Office, World Heritage Centre, Corner Alma Street and Pacific Highway, South Murwillumbah

During the exhibition period all interested persons are invited to make a submission. These submissions will be considered by the Roads and Traffic Authority and forwarded to the Department of Urban Affairs and Planning, with their consideration of the issues raised. For the proposal to proceed it requires the approval of the Minister for Urban Affairs and Planning and determination by the Chief Executive of the Roads and Traffic Authority. Concurrence of the Director-General of the National Parks and Wildlife Service is also required.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part A

Project Overview and Background

a

1. Introduction

The NSW Roads and Traffic Authority (RTA) is responsible for the management of *a network of major roads and the traffic system in NSW. The RTA's aim is to manage the use, maintenance and enhancement of the State's road and traffic system, with emphasis on road safety and transport efficiency as part of an integrated and balanced transport system.*

The RTA is proposing to duplicate the Brunswick Heads Bypass and upgrade the Pacific Highway between the Brunswick River and Yelgun, in northern NSW, as part of the Pacific Highway Upgrading Program. This Environmental Impact Statement (EIS) examines and assesses the potential environmental impacts of the proposal. This Section introduces the proposal and describes why the upgrade is needed. The Section also describes the structure of the EIS.

1.1 Introduction

The Roads and Traffic Authority (RTA) is proposing to upgrade the Pacific Highway to a new dual carriageway between the Brunswick River and Yelgun, in northern New South Wales (NSW). The proposal also includes the duplication of the Brunswick Heads Bypass, the first stage of which was opened to traffic on 5 June 1998. This EIS examines and assesses the potential environmental impacts of the proposal, which is shown in its regional context in **Figure 1.1**.

The upgrade of this section of the highway is part of the Pacific Highway Upgrading Program, which is a joint NSW State/Commonwealth Government initiative. The Program has committed some $2.2 billion over 10 years (from July 1996) for upgrading the Pacific Highway between Hexham and the Queensland border.

The intended outcomes of the Program are:

- reduced accidents and fatalities;
- reduced travel times;
- reduced freight transport costs;
- increased length of dual carriageways;
- increased safe overtaking opportunities;
- improved alignment and elimination of narrow bridges; and
- maximum environmental benefits.

1.2 The Need for the Proposal

The existing highway alignment in the vicinity of Brunswick Heads to Yelgun portrays similar deficiencies to other segments of the Pacific Highway. Sight distances, particularly on curves and at intersections, are insufficient. Accident

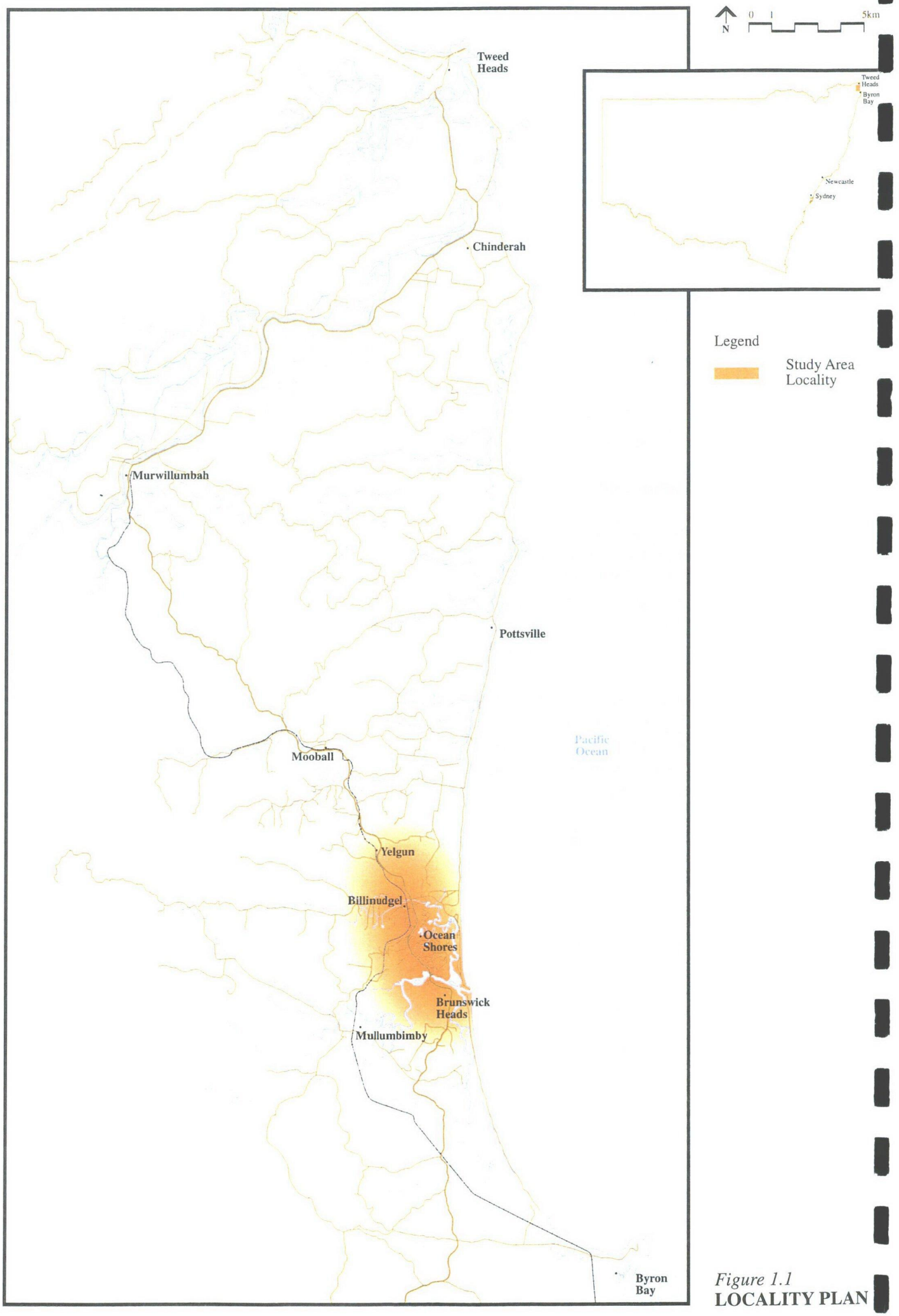


Figure 1.1
LOCALITY PLAN

rates along this section of the highway are lower than the State average but half of the accidents recorded along this section of the highway have resulted in some type of injury.

The Pacific Highway currently carries approximately 14,000 to 15,000 vehicles per day south of Rajah Road (Ocean Shores) and approximately 10,000 to 12,000 vehicles per day in the vicinity of Yelgun. Heavy vehicles contribute up to approximately 14% of the total volume of traffic. Cross roads which link to the highway carry significantly less traffic, with Rajah Road carrying approximately 4,000 vehicles per day and Orana Road, the Pocket Road and Shara Boulevard all carrying volumes in the vicinity of 1,800 to 2,300 vehicles per day. Other local roads carry lower volumes than these.

Approximately 44% of traffic on the highway is through traffic, i.e. traffic travelling through the study area (from the south of Brunswick Heads to the north of Shara Boulevard) to destinations beyond. Routes within the study area that are significant in terms of local travel include travel to/from Ocean Shores to Mullumbimby and travel from outside the study area to destinations within the study area such as Brunswick Heads and Ocean Shores.

Traffic forecasts have been used to determine longer term road requirements, with the aim of achieving improved and continuing traffic efficiency and safety objectives. The expected traffic flows at 2016 fall within a range of 16,000 to 22,000 vehicles per day. If the highway is not upgraded in this area, traffic congestion and accident rates could be expected to increase and there would be a resultant decrease in road efficiency. This would have an adverse impact on road users.

There would also be an effect on the local community. The current highway was built many decades ago, when less consideration was given to environmental mitigation measures and there was little development in this area. Over the ensuing years, as traffic volumes have increased, there has been an increasing effect on the community and on the environment. If the road is not upgraded, these impacts could be expected to continue and increase, with a resultant decrease in amenity for the community, and the potential for on-going environmental impact.

1.3 The Proposal in Brief

This Section provides a brief description of the proposal. A full description of the proposal is provided in Section 6.

The proposal is shown schematically in **Figure 1.2**. It is approximately 8.7 km in total length. It commences just north of the interchange at Saddle Road, which

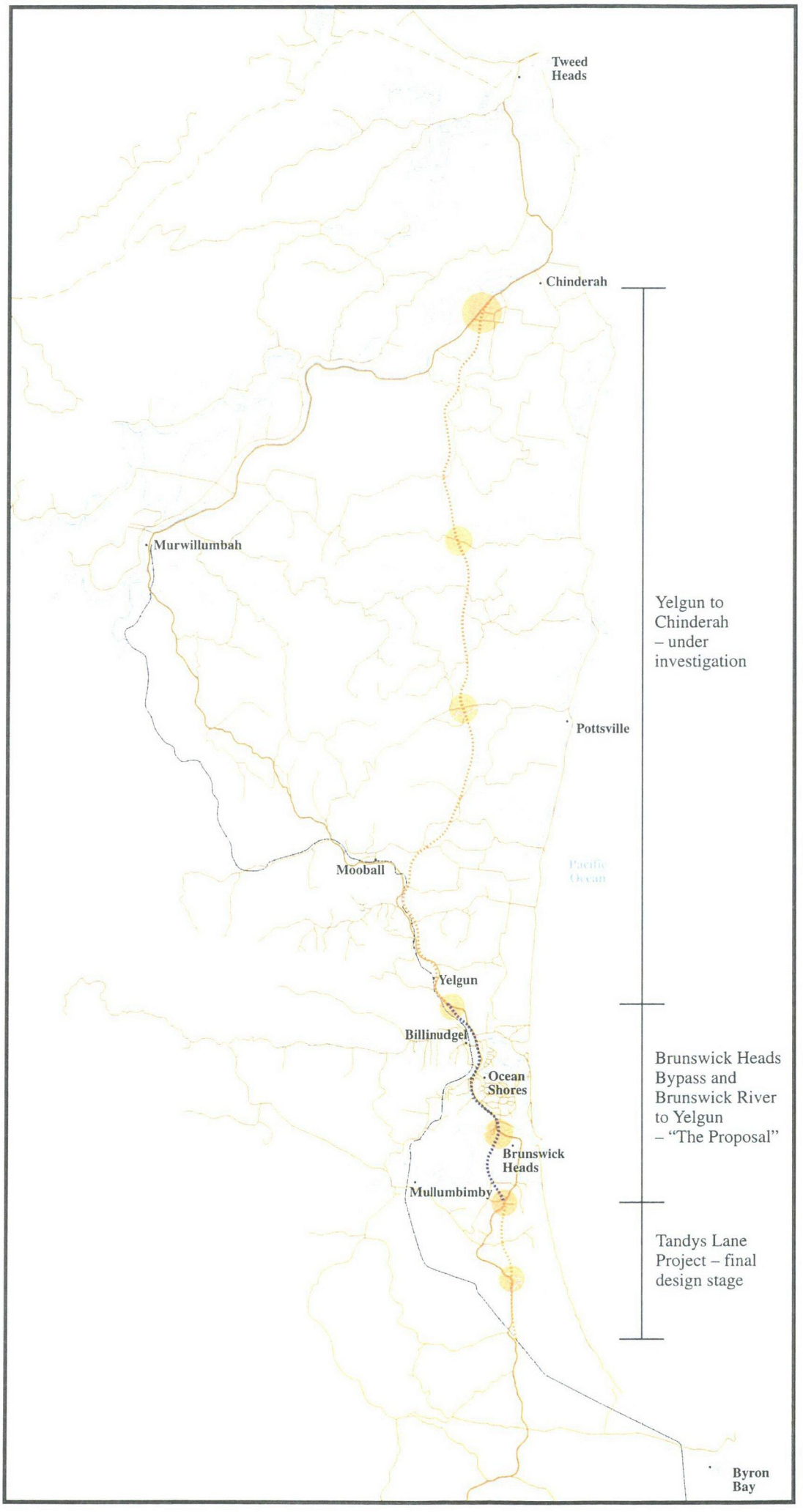


Figure 1.2
**RELATIONSHIP T(
OTHER HIGHWA
PROJECTS**

will be constructed as part of the Tandys Lane project, and would involve constructing a second carriageway parallel to the current Brunswick Heads Bypass. There would be an interchange approximately 700m south of the Brunswick River. This interchange would cater for movements in all directions and provide connections to the local road system.

A new bridge would be constructed approximately 80m to the east of the existing bridge. The new bridge has been designed to carry six lanes of traffic - four lanes for the new dual carriageway, and two lanes for local traffic. The design accommodates pedestrians and cyclists across the bridge, as well as under it. The existing bridge would be demolished, which would allow the river foreshore area to be rehabilitated.

North of the Brunswick River the proposal travels along the edge of the Brunswick Heads Nature Reserve, using the existing (but widened) Pacific Highway road corridor. In the section between the Brunswick River and the access road to Byron Council's Sewage Treatment Plant (STP) there are several residential properties that adjoin the existing highway. There are also substantial areas of vegetation of high conservation value, primarily on the western side. Part of the land on both sides of the existing highway is designated as Coastal Wetland under State Environmental Planning Policy (SEPP) 14 and would be affected by the construction and operation of the proposal. The design of the proposal uses as much of the existing road corridor as possible, and separates local and through traffic by locating the local road (which utilises part of the existing highway) and the new dual carriageway on two levels. Minor realignment of part of the existing highway would be necessary to form the local service road.

Further north the proposal is located generally parallel to, and west of the existing highway. The proposal continues north to a proposed interchange near Yelgun, passing to the east of Billinudgel. This interchange would cater for movements in all directions and provide connection to the local road system.

North of the interchange the proposal would join with the existing highway, and it would also be compatible with the proposed alignment of the Pacific Highway upgrade between Yelgun and Chinderah that is the subject of a separate environmental impact study.

The existing highway facility would be retained as a local access road between Brunswick Heads and Yelgun, with access to Ocean Shores. There would be a bridge over the proposal connecting Ocean Shores with Billinudgel.

The reserve for the proposal would vary between 70-100m depending on the terrain. It would exceed 100m along deep cuttings and 160m where interchanges are proposed. The road reserve would generally include a median between 2.6m

to 9.0m and paved shoulder lanes that can be used by pedal cyclists, and in the case of vehicle breakdowns. The corridor has been defined to allow for the road formations as well as landscaping and other environmental mitigation measures including noise mitigation measures, erosion and sedimentation control structures, and fauna underpasses.

The total project cost is approximately $73 million. The proposal would be funded by the NSW State and Commonwealth Governments. Providing time for determination, property acquisition and construction, it is expected that the proposal would be open to traffic by mid 2002.

For the purposes of this EIS, the description and assessment of the proposal is based on a concept design. Detailed design of the proposal would only be undertaken if the proposal is approved. The detailed design stage would use the concept designs and the information provided in this EIS with regard to environmental safeguards and mitigation measures, as well as any conditions of approval of the Minister for Urban Affairs and Planning. An Environmental Management Plan (EMP) would be prepared which would ensure the implementation of environmental safeguards and mitigation measures. The EMP would be incorporated into the contract for construction of the proposal.

A more detailed engineering investigation of the proposal would then be undertaken so that construction could commence.

1.4 Project Objectives

The objectives of the project are to upgrade the Pacific Highway between Brunswick and Yelgun in a way which:

- minimises negative impacts of the new road on the environment and community;
- improves safety;
- separates through traffic from local traffic;
- improves transport efficiency (reduces time and cost of travel); and
- provides a cost effective solution

1.5 Relationship with Adjoining Highway Upgrade Projects

This proposal is consistent with projects to the north and south, and with the overall program for the Pacific Highway. The proposal and adjoining projects are shown in **Figure 1.2**.

To the south of the Brunswick Heads Bypass, the RTA is proposing a major upgrade of the Pacific Highway. This is the Tandys Lane Project, which extends from the northern end of the Ewingsdale to Tyagarah Upgrade, to the southern end

of the Brunswick Heads Bypass project. A Review of Environmental Factors was prepared for the Tandys Lane Upgrade (Kinhill, 1997) and determined by the RTA in April 1998. The detailed design phase of this project has commenced and it is expected that this project will be open to traffic in mid 2001.

As mentioned earlier, this proposal would connect to the north with the proposed upgrading of the Pacific Highway between Yelgun and Chinderah, which is currently in the concept design and environmental impact assessment stage. The EIS for that section of the highway is expected to be on exhibition during July/August 1998.

1.6 Approach to the Study

Details of the proposal and the proposed environmental mitigation measures were developed within the context of extensive consultation with affected property owners, the wider community, community organisations, and with local and state government agencies. These consultations were beneficial in raising various issues, which led to continuing refinement of the route and interchange arrangements, and other aspects that are addressed in the EIS. The consultation process is described in detail in Section 3.

The study area is within Byron Shire and the Brunswick/Ocean Shores/Billinudgel area in particular is recognised for its residential amenity, and for its scenic attraction. This is the result, at least in part, of the topography and extensive areas of vegetation located primarily to the west of the existing highway. These factors are important considerations in the development of any infrastructure in this area.

A number of feasible route options were identified following consideration of environmental (i.e. ecological, social and economic) constraints and opportunities within the study area, and taking the transport objectives into consideration. Studies were then undertaken to gain an understanding of the potential environmental impacts of these options, and the practicality of construction.

The choice of a preferred route is a critical step in the process, and the one likely to be the most important to the community. The selection of a preferred route takes community concerns and issues into consideration. Ultimately, the choice of a preferred route must represent a balance between practical engineering considerations and minimising environmental and community impacts. Overall, the aim is to meet the project objectives (which themselves are a direct outcome of community needs and which include safeguarding the surrounding environment).

To assist in the process of selection of a preferred route a comparative evaluation was made of all feasible route options. This evaluation was made with the benefit of the best possible technical information available at the time, and broad

community input. This input took the form of phone calls, written submissions and face-to-face discussions as well as direct community participation in the Value Management Workshop.

The extent and location of residential and urban areas, and areas of high conservation value proved to be significant constraints in the selection of the preferred route. When the costs of construction were taken into account, the route that was considered to offer the best value to the community was the route known as "Route A2". This route was recommended to the RTA as a result of the Value Management Workshop which supported this route by consensus, by all participants at the workshop.

Following the workshop, further route options were suggested by the community. These were essentially variations or combinations of options that had been considered earlier. Nevertheless, they were investigated in detail. These investigations concluded that these routes would have resulted in unacceptable impacts on either (or both) sensitive ecological areas and residential properties.

Ultimately, the RTA and the Minister for Roads decided that the route known as Route A2 was the preferred route for the purposes of undertaking detailed studies leading to the preparation of this EIS.

Detailed environmental studies were undertaken on the preferred route. The engineering design was subsequently adjusted in many locations to ensure an optimum alignment for ecological, social, economic and engineering conditions. Information on these studies can be found in the various Working Papers and later Sections of this EIS.

1.7 The Principles of Ecologically Sustainable Development

The State and Commonwealth Governments are committed to the principles of ecologically sustainable development (ESD). The exact nature and definition of those principles has been a matter of debate for some time. The most relevant reference for the purpose of this EIS is contained within the guidelines for the preparation of EISs in the Environmental Planning and Assessment Regulation 1994.

Under this guideline, ESD is based on the following four interrelated principles.

- The precautionary principle - 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 principle has been applied to this project through the reliance of comprehensive scientific data undertaken on the study area for the route selection stage of the project. More detailed scientific data were then collected

for the impact assessment of the preferred route of the proposal and was used in the development of mitigation measures for the project. These mitigation measures are expected to be reflected in the conditions of approval and determination and would be incorporated in the EMP that would be prepared for the construction and operation of the project. As the proposal would be constructed under a "Design and Construct" contract, the implementation of these measures would form a condition of that contract.

Specific examples of the application of this principle can be found in following Sections of the EIS which demonstrate that the approach adopted for selection of the route and design of the alignment was based on the principle of avoiding areas significant from a social, ecological, heritage or resource perspective.

Where environmental impacts would be unavoidable the proposal incorporates comprehensive mitigation measures. Furthermore, these measures would be monitored during construction and operation.

- Social equity - which includes both inter-generational equity and intra-generational equity. Inter-generational equity is concerned that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. Intra-generational equity is concerned that the present generation should ensure that improved well being and welfare are accessible to all sectors of society within Australia and that this does not result in decreased welfare in other nations.

  The construction and operation of the proposal would provide long term benefits to future generations by providing a high standard dual carriageway facility which would improve travel speeds, reduce travel times, increase travel efficiency and above all, improve road safety conditions.

  Importantly, the proposal would provide measures which would improve the amenity of the area, especially for residents of Ocean Shores and Brunswick Heads. The separation of through and local traffic would reduce potential conflict on local roads and increase safety. The proposal also includes measures for improving access between communities, and providing safer access for cyclists and pedestrians.

  Mitigation measures for noise and visual amenity such as the implementation of noise barriers and landscaping treatments would, in some instances, improve the surrounding environment when compared to the existing situation therefore also providing benefits to future generations.

  The approach adopted for route selection aimed to avoid significant social, ecological and heritage areas, assisting in maintaining these resources for future generations.

- The conservation of biological diversity and ecological integrity.

  The preferred route for the proposed upgrade of the Pacific Highway between the Brunswick River and Yelgun was selected primarily based on the impact on sensitive flora environments when compared to other options. The proposal would run along the western edge of the existing highway road corridor and along the edge of the Brunswick Heads Nature Reserve. It is located mostly in areas of vegetation which have been previously affected by the existing highway, by clearing and agricultural practices, and by previous development or disturbance. Other options investigated for the proposal would involve much greater disturbance and clearing of areas of vegetation which are generally in good to excellent condition; and would require the removal of substantially larger areas of native vegetation.

  The location of the proposal in the immediate vicinity of the existing highway avoids creating a second major barrier to fauna movements in an east/west direction through the landscape thereby minimising both habitat fragmentation and barriers to fauna movements and preventing the creation of additional potential 'black spots' for fauna along the highway.

  Mitigation measures for the proposal have also been developed to minimise potential impacts to the vegetation communities in the area and therefore also to reduce the potential impact to fauna. Compensatory habitat would be established by the RTA through consultation with the National Parks and Wildlife Service (NPWS) with respect to the small area of land needed from the Brunswick Heads Nature Reserve for the construction of the proposal. The area of land located on the northern side of the Brunswick River and currently zoned for road purposes could also be made available for incorporation in the Nature Reserve or be managed for conservation purposes by another appropriate authority, and could be rezoned accordingly. This would further enhance the biological diversity and ecological integrity of the region as the community would be assured that this land would not be developed for road purposes (as indicated in the Byron Local Environment Plan (LEP)), rather it would remain in its natural state.

- The use of improved valuation, pricing of environmental resources and incentive mechanisms. Section 5 of this EIS provides an analysis and comparison of the preferred and alternative route options that were considered and include their economic performance. This was considered during the Value Management Workshop in which local and state government representatives and community organisations participated. A road user cost benefit analysis was also undertaken for the proposal.

  The multi-criteria approach used to select the preferred route provided a comprehensive examination of all relevant factors, using both quantitative and qualitative values. This in itself is an important valuation tool, consistent with ESD principles, in that it also considers community values.

The RTA seeks to ensure that major road proposals are consistent with the principles of ESD and that environmental assessments provide sufficient and unambiguous scientific information to satisfactorily assess the performance of the proposal against the adopted principles. The principles of ESD have been applied in the development of this proposal and the preparation of this EIS is a continuation of that process.

2. Environmental Determination Process

This EIS has been prepared in accordance with the requirements of the Environmental Planning and Assessment Act 1979 This Section describes the statutory provisions that would apply to the proposal and the procedures that need to be followed to allow the proposal to go ahead. In addition to requiring consent and determination, the proposal would require a number of other approvals and licences, and these are also described. The public exhibition process and advice on how to make written submissions are also outlined in this Section.

2.1 The Proponent

The RTA is the proponent and nominated determining authority for the proposal for the purposes of the NSW Environmental Planning and Assessment Act (EP&A Act) 1979, as amended.

2.2 Environmental Impact Assessment Requirements

2.2.1 EIS Requirements

Within NSW, development approval and environmental assessment procedures are undertaken in accordance with the provisions of the EP&A Act and the Environmental Planning and Assessment Regulation, 1994 (the Regulation). The EIS has been prepared in accordance with the provisions of the Act, associated Regulation, and in accordance with the requirements of the Director-General of the Department of Urban Affairs and Planning (DUAP) as outlined in **Appendix A.** Clause 82 of the Regulation lists factors for consideration when assessing likely environmental impact. These factors, and the sections in the EIS where they are addressed, are also shown in **Appendix A**.

The proposal is subject to the provisions of both Part 4 and Part 5 of the EP&A Act.

Part 4 Considerations

Part of the proposal is within wetlands gazetted under State Environmental Planning Policy No.14 Coastal Wetlands (SEPP 14), these being Wetlands Nos. 62 and 65. In accordance with the provisions of SEPP 14 the part of the proposal that affects wetland areas is designated development and the RTA must submit an EIS with a Development Application to Byron Council for its review and determination.

The provisions of SEPP 14 (refer Cl4 (2)) do not apply to "land dedicated or reserved under the National Parks and Wildlife Act 1974 as ...nature reserve...", which would apply to SEPP Wetland No.62. However, Council consent would be required for work to be carried out if and when the relevant part of the Nature Reserve is revoked to allow the proposal to proceed.

Any consent from Council would also require the concurrence of the Directors-General of the National Parks and Wildlife Service (NPWS) and the DUAP. Accordingly, this part of the proposal is subject to the provisions of Part 4 of the Act.

The assessment of the potential environmental impacts on the SEPP 14 Coastal Wetland areas are summarised in Section 12 and in more detail in Working Paper No.7 - Flora and Fauna Assessment.

Part 5 Considerations

The remaining land affected by the proposal (that is, that land not classified as SEPP 14 Coastal Wetlands) has various zonings under the provisions of the Byron LEP (1988) and the proposal is located within zones in which the construction of roads is permitted with development consent. The application of the provisions of State Environmental Planning Policy No.4 - Development without Consent, means that development consent for road construction is not required in these areas. Therefore the proposed activity is for the most part subject to the provisions of Part 5 of the Act.

In accordance with the provisions of Part 5 of the Act, the proposal is subject to the approval of the Minister for Urban Affairs and Planning and then determination by the Chief Executive of the RTA.

Under Part 5, Section 111 of the EP&A Act, a 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 that activity". Section 112 of the EP&A Act requires the determining authority to consider whether the proposed activity is "likely to significantly affect the environment". If so, the determining authority is required to prepare and consider an EIS.

The RTA has examined the likely environmental impacts and considers that they would be significant, and therefore has resolved to prepare and consider an EIS for this proposal.

The EIS addresses the requirements of both Parts 4 and 5 of the Act, that is, the effect of SEPP14 Coastal Wetlands (Part 4) and the remaining lands (Part 5).

2.2.2 Species Impact Statement Requirements

Taking into consideration the provisions of the Threatened Species Conservation Act, 1995, the proposal has also been assessed under Section 5A of the EP&A Act, to determine whether a Species Impact Statement (SIS) is required. A precautionary approach has been adopted, as the proposal could have a significant effect on threatened species, populations or ecological communities, and an SIS has been prepared in accordance with the requirements of the Director-General of

the NPWS. The SIS has been prepared as a separate document to the EIS and will be exhibited simultaneously. The Director-General's requirements are contained in an Appendix to the SIS.

2.3 Requirements for Changes to Nature Reserve Boundary

The proposal would have a direct impact on the Brunswick Heads Nature Reserve in that it would require part of the Nature Reserve beyond the corridor already established for road purposes. The Nature Reserve was established in accordance with the provisions of the National Parks and Wildlife Act and any changes to the boundary would require an amendment under the provisions of that Act. It is anticipated that the Environment Minister would initiate such action in the Parliament of NSW if and when the proposal receives consent under the Part 4 provisions and has been determined in accordance with the Part 5 provisions by the RTA.

2.4 Purpose of this Environmental Impact Statement

The EIS provides the community, government and other interested parties with information about the proposal, and its potential environmental impacts. A summary of correspondence received from local and state authorities, outlining matters to be addressed in the EIS, is provided in **Appendix B** and referred to throughout this document.

The EIS also sets out the RTA's environmental management commitments which must be implemented to ensure that potential environmental impacts are mitigated, and the environment is adequately protected during the construction period, and for the long term operation of the road.

2.4.1 Objectives of the Environmental Impact Statement

The objectives of the EIS are to:

- comply with relevant statutory requirements for the planning and development of the proposal on the NSW North Coast;
- identify and assess likely environmental impacts and propose mitigation measures, where possible;
- summarise the strategic and cumulative impacts of the proposal on the land use and transport systems of the local area;
- examine whether the proposal is justified in terms of the principles of ESD; and
- establish the basis for subsequent environmental management of construction and operation if the proposal proceeds; and

- provide an overview of the impacts and benefits of the proposal and propose mitigation measures where possible.

2.4.2 Scope and Structure of the Environmental Impact Statement

The EIS has been prepared for the RTA by Sinclair Knight Merz and a number of specialist sub-consultants. The study team is listed in **Appendix C.**

The EIS has been divided into seven parts:

- Part A (Sections 1, 2 and 3) provides an introduction to the proposal and the EIS including a description of the activities undertaken by the study team as part of the consultation program;
- Part B (Section 4 and 5) discusses the need for carrying out the proposal as well as the route options which were developed and assessed as part of the study;
- Part C (Section 6) describes the proposal in detail;
- Part D (Section 7) assesses the traffic and transport implications of the proposal;
- Part E (Sections 8 to 16) assesses the biophysical, social and economic impacts of the proposal;
- Part F (Section 17) discusses the cumulative environmental effects and provides a summary of the proposed mitigation measures to ensure that the environment will be adequately protected; and
- Part G (Section 18) describes the conclusions of the impact assessment process and discusses the justification for the proposal in terms of the EP&A Act.

Specialist studies which are published as separate Working Papers to this EIS are:

- Working Paper No.1 - Traffic and Transportation Assessment
- Working Paper No.2 - Road Concept Design Report
- Working Paper No.3 - Noise Impact Assessment
- Working Paper No.4 - Air Quality Assessment
- Working Paper No.5 - Water Quality and Hydrology Assessment
- Working Paper No.6 - Indigenous and Non-indigenous Heritage
- Working Paper No.7 - Flora and Fauna Assessment
- Working Paper No.8 - Geotechnical Assessment
- Working Paper No.9 - Visual Quality and Landscape Assessment
- Working Paper No.10 - Value Management Study

2.5 Exhibition of the EIS and SIS

The EIS will be advertised and placed on public exhibition by the RTA for a period of at least 30 days. The EIS accompanying Working Papers and the SIS will be available for viewing and purchase (*) at the following locations:

RTA, Pacific Highway Development Office, 21 Prince Street, Grafton

- Department of Urban Affairs and Planning, 49 Victoria Street, Grafton
- Byron Shire Council, Station Street, Mullumbimby
- RTA, Motor Registry, Pacific Highway, Murwillumbah*
- RTA, Motor Registry, Carrington Street, Lismore*
- RTA, Motor Registry, Keywest Shopping Centre Ballina*
- RTA Office, Centennial Plaza, Ground Floor, Elizabeth Street, Surry Hills*
- Brunswick Heads Post Office, Fingal Street, Brunswick Heads
- Department of Urban Affairs and Planning, 1 Farrer Place, Sydney
- New South Wales Environment Centre (Nature Conservation Council), Level 5, 362 Kent Street, Sydney
- New South Wales Government Information Centre, Goodsell Building, Corner Philip and Hunter Streets, Sydney

In addition to the locations described above, the SIS will be exhibited simultaneously at the following offices of the NPWS:

- Head Office - Information Office, 43 Bridge Street, Hurstville
- Northern Zone Office, GIO House, Moonee Street, Coffs Harbour
- Lismore District Office, Colonial Arcade, Alstonville
- Murwillumbah Sub-District Office, World Heritage Centre, Corner Alma Street and Pacific Highway, South Murwillumbah.

Copies of the EIS will be available for purchase for $20.00 each. The Working Papers can be purchased as a set for $5.00. The EIS can also be purchased by mail from the RTA's Project Manager at 21 Prince Street, Grafton (PO Box 546), NSW, 2460. Copies of the SIS will be provided as part of the set of Working Papers.

During the exhibition period all members of the community, interest groups and government authorities are invited to view the EIS, SIS and Working Papers and make a written submission on any aspect of the proposal.

2.6 Guidelines for Making a Written Submission

If you wish to make a written submission, it would be helpful if you would include (as relevant to you submission):

- the nature of your interest in the proposal;
- your opinions on the proposal
- any suggestions you wish to make about alternatives, or improvements to the proposal;
- any additional measures you consider necessary to adequately protect the environment;
- any errors or omissions in the information presented in the documents;
- any additional factual information you have (and its source); and
- any other aspects that you consider are relevant to this proposal and its determination.

In order to make it easier for the matters raised in your submission to be analysed and properly considered:

- list points wherever possible - this makes the issues clear;
- refer each point to the relevant section (or sub-section) of this document and/or the Working Paper or SIS;
- include your name, address and date if you would like your submission acknowledged; and
- finally, please ensure that your submission is as legible as possible.

All submissions will be treated as public documents unless requested explicitly that they should be regarded otherwise. Please indicate if you wish your submission to remain confidential. Form letters are accepted and considered.

Submissions should be forwarded to:

The Project Development Manager
Pacific Highway Upgrade, Brunswick to Yelgun
RTA of NSW
Pacific Highway Development Office
21 Prince Street (PO Box 546)
GRAFTON NSW 2460

2.7 Determination Process

2.7.1 Part 4 Process

A development application for those sections of the proposal affecting SEPP 14 Coastal Wetlands, together with a copy of the EIS, will be lodged with Byron Council as the consent authority. The RTA will await Council's decision before finalising its Representations Report under Part 5 of the Act and will include in that Report notification of Council's decision, including any conditions that might be applied to a development consent granted by Council.

Any person may, before the end of the exhibition period make a written submission in relation to the Development Application. Submissions relating to the designated development (SEPP 14 wetlands) should be directed to Byron Council in its capacity as consent authority. Submissions should be sent to the General Manager, at the address indicated earlier.

Council will consider public submissions and any concurrence requirements of the Director-General of the NPWS when considering whether or not to grant consent for the Development Application. Council's decision, together with any conditions of approval will be forwarded to the Minister for Urban Affairs and Planning for concurrence. The Minister's decision in relation to concurrence will be advised to Council who will subsequently advise the RTA for consideration in relation to the Chief Executive's determination of the proposal.

2.7.2 Part 5 Process

The RTA will take all submissions received on the EIS into consideration when preparing its Representations Report. The Director-General of the NPWS will also take all submissions received on the SIS into consideration when considering the impacts on threatened species, populations or ecological communities. Copies of all submissions will also be sent to the DUAP for its consideration as well as to Byron Council as outlined in **Figure 2.1**.

The RTA will prepare a Representations Report which incorporates:

- its consideration of the EIS;
- its consideration of all submissions and response to issues raised;
- any new information on the proposal;
- any modifications to the proposal; and
- proposed conditions to approval, should the proposal proceed.

The Representations Report, together with the EIS and any other relevant information, will then be considered by the Chief Executive of the RTA. If the Chief Executive of the RTA decides that the RTA should proceed with the proposal, a copy of the Representations Report would be forwarded to Director-General of the NPWS and the concurrence of the Director-General to the proposal

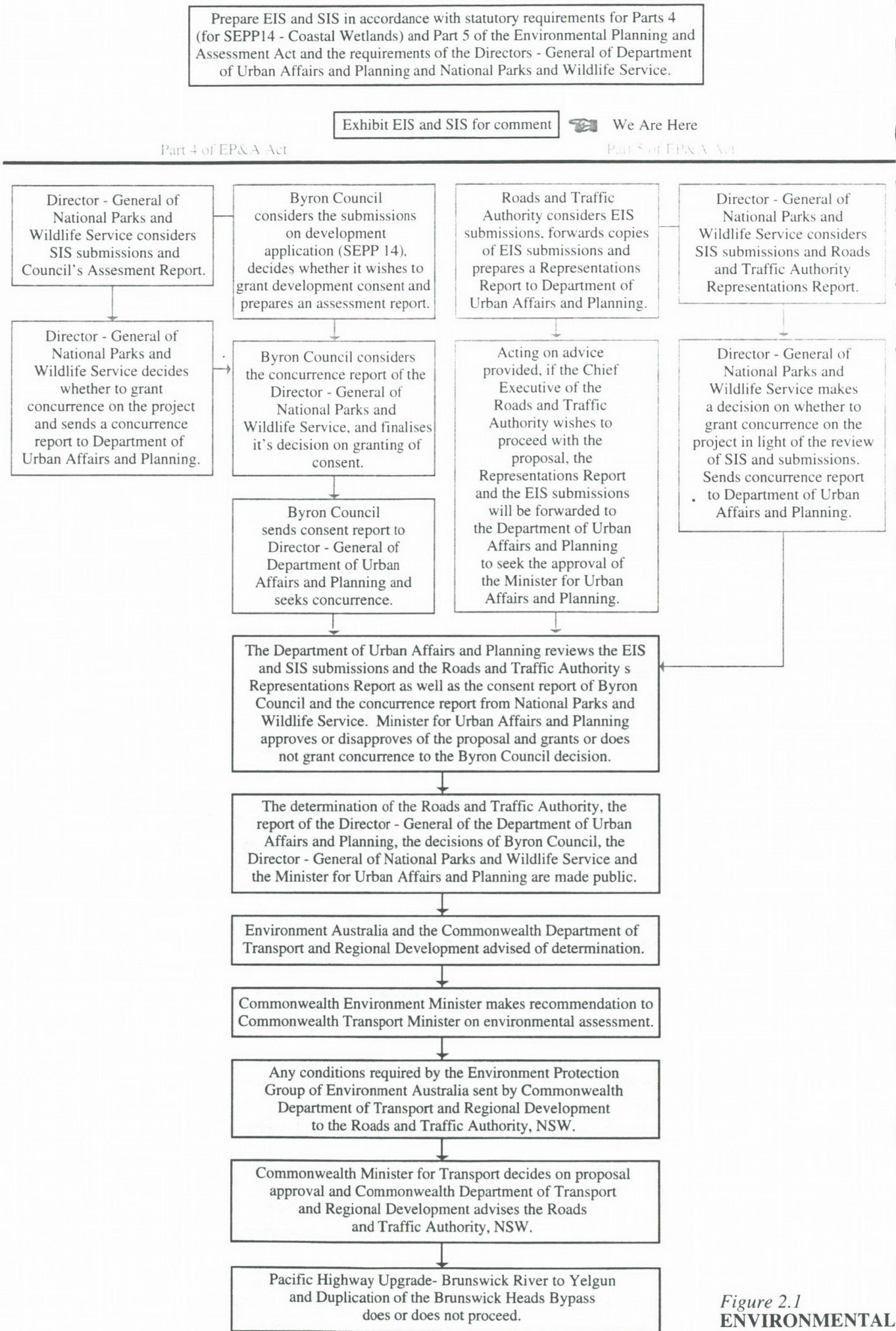


Figure 2.1
ENVIRONMENTAL DETERMINATION PROCESS

would be sought. If the Director-General provides concurrence, the Representations Report, the Director-General's concurrence and any other relevant information would be forwarded to the DUAP seeking the approval of the Minister for Urban Affairs and Planning in accordance with Section 115A of the Environmental Planing and Assessment Act, 1979. The DUAP would examine the proposal and prepare a report to the Minister for Urban Affairs and Planning. Acting on that report and after consultation with the Minister for Roads, the Minister for Urban Affairs and Planning would decide whether to grant approval to the proposal. The Minister for Urban Affairs and Planning may attach conditions to approval. If approval is given, the Chief Executive of the RTA would then determine whether the project will proceed.

2.8 Statutory Approvals

2.8.1 NSW State Government Requirements

If the proposal proceeds, the RTA or its contractor would also need to obtain approvals and licences which are generally aimed at regulating and monitoring the performance of the proposal both during its construction and operation. These approvals and licences include those administered by the NSW Environment Protection Authority (EPA) in relation to potential air, noise and water pollution, the NPWS in relation to potential impacts on Aboriginal archaeological sites, the Department of Land and Water Conservation (DLWC) for stream disturbance, water abstraction and native vegetation clearance, and the Heritage Council in relation to impacts to heritage items.

The need for licences or approvals from the EPA is specified under the Pollution Control Act which complements the Clean Waters Act 1970, Clean Air Act 1961, Noise Control Act 1975 and the Environmentally Hazardous Chemicals Act 1985, to control pollutants from the proposal.

It is also noted that the Protection of the Environment (Operations) Act (POEO Act) is expected to be operational from 1 September 1998. It will repeal the Clean Air Act 1961, the Clean Waters Act 1970, Pollution Control Act 1970, the Noise Control Act 1975 and the Environmental Offences and Penalties Act 1989. The POEO Act consolidates these Acts and also incorporates the major regulatory and enforcement provisions of the Waste Minimisation and Management Act 1995. It is anticipated that the EPA will remake the majority of the Regulations under the pollution control Acts and introduce additional Regulations. In particular, the POEO will replace the existing licensing requirements with a single schedule of activities requiring an environment protection licence which will regulate all forms of pollution (water, air, noise and waste). Also, the existing requirements for a separate pollution control approval and licence will be replaced with an integrated system of licensing.

The approvals currently required by either the RTA or its contractor under the existing pollution control Acts and other legislation are described below. Throughout this document, where there is a reference to an individual pollution control Act, this should be inferred to refer to the POEO Act and its provisions after 1 September 1998.

- Under the Clean Waters Act (section 19(1)(a)) approval is required prior to the construction, installation or modification of any apparatus, equipment or works for the discharge of pollutants into water, or their prior treatment for this purpose. An approval would need to be sought under the Pollution Control Act, 1974 for the construction of temporary sediment ponds and permanent spillage control basins. A licence would be required for discharge from ponds and basins.
- Under the Noise Control Act (section 27(1)(a)) approval must be obtained for installation and use of plant during road construction.
- Under section 16 of the Clean Air Act a licence from the EPA for a temporary on-site batching plant (scheduled premises) is required if such a plant is to be used. If so, a separate environmental assessment would be required. There would be a need to obtain a licence for pit burners if used for vegetation disposal. If the concrete batching plant is to be installed and is capable of manufacturing more than 200 tonnes of concrete per annum, a Pollution Control Licence would be required to be sought from the EPA. Similarly, if an asphalt plant is to be installed, a Pollution Control Licence would also be required.
- The Waste Minimisation and the Management Act, 1995, is administered by the EPA. The objective of the Act is to achieve a 60% reduction in the volume of waste disposed of in NSW by the end of the year 2000 and establish a waste management hierarchy of avoidance, re-use, recycling and reprocessing and disposal. The Act contains requirements in relation to disposal and transport of waste. The Act would prevent the disposal of waste in a public place without consent from the relevant public authority or on public land without consent of the owner or occupier of that land. The RTA would be required to comply with the requirements of the act in relation to waste management during construction of the proposal.
- Approval would be required from the Director-General of the NPWS under section 87(1) of the National Parks and Wildlife Act, 1974 for a permit to excavate archaeological sites and relics. Under section 90(2) of the same Act, approvals from the Director-General would be required for a Consent to Destroy permit for any identified archaeological sites or remains. The non-indigenous heritage survey concluded that, because of their low archaeological significance, no management/mitigation measures would be required for the three identified heritage items.

- The Native Vegetation Conservation Act 1997 is administered by the DLWC. Under the provisions of Part 2 of the Act, the RTA would need to obtain development consent from the Minister for Land and Water Conservation for clearing on State protected land. State protected land is land identified as such by the Minister. It includes any land which includes: trees; understorey plants; groundcover (which means any type of herbaceous vegetation which occurs in an area where not less than 50% of the herbaceous vegetation covering the area comprises indigenous species and not less than 10% of the area must be covered with herbaceous vegetation); and plants occurring in a wetland.

  Section 12 of the Act provides exemption from the provisions of the Act for certain types of clearing. They include any clearing that involves the removal or lopping of any tree or vegetation in accordance with section 88 of the Roads Act 1993.

  Section 88 of the Roads Act states:

  A roads authority may, despite any other act or law to the contrary, remove or lop any tree or other vegetation that is on or overhanging a public road if, in its opinion, it is necessary to do so for the purpose of carrying out road work or removing a traffic hazard.

  Accordingly, the RTA is not required to obtain development consent for any clearing which is undertaken on a dedicated public road for the purposes outlined above.

- The Water Act 1912 is administered by the DLWC. It requires licences to be obtained for extraction of water or realignment of stream beds. For this project, it would apply to any extraction of water for dust control or compaction or stream re-alignment for culvert installation or bridge construction.

- The Fisheries Management Act 1994 is administered by NSW Fisheries. Sections of the Act relevant to the project are those relating to dredging and reclamation and blocking or potentially blocking fish passage. The definition of dredging and reclamation may include most works which affect a creek bed or bank. The Act requires public authorities to give written notice to the Minister for Fisheries prior to commencement of work. Any matters raised by the Minister within 28 days of the advice must be considered by the authority. Notification of the Minister is also required in respect of blocking or potential blocking of fish passage. Construction of temporary crossings which include culverts may be considered as blocking fish passage. Also, the RTA or its contractor would require a permit from the Minister to cut, remove or destroy any marine vegetation (including mangroves or seagrasses).

  The Fisheries Management Amendment Act 1998 came into force on 1 July 1998. It extends the provisions of the Fisheries Management Act of 1994 and would require the RTA to assess the potential impact on threatened species,

populations and ecological communities, of fish or marine vegetation. The Act would require the RTA to seek a permit from the Minister for Fisheries in respect of any activity likely to harm protected areas (public water land, aquaculture lease, marine vegetation). As the requirements for the EIS were sought from the Director-General prior to 1 July 1998, the savings provisions of the Act apply. Nevertheless, the issues raised in the Act have been addressed in the EIS and a preliminary 8-part test is included in Working Paper No.7 - Flora and Fauna Assessment.

2.8.2 Commonwealth Government Requirements

Funding of the proposal would include a contribution from the Commonwealth Government under the terms and conditions of the Pacific Highway Upgrading Program and as a consequence the proposal would be required to address the requirements of appropriate Commonwealth legislation. Commonwealth requirements, together with additional details on specific approvals to be obtained prior to and during construction are included in Section 17 of this EIS.

The following legislation is relevant for consideration on this proposal:

- Endangered Species Protection Act 1992. The objects of the Act are to:
  - promote the recovery of species and ecological communities that are endangered or vulnerable;
  - prevent other species and ecological communities from becoming endangered;
  - reduce conflict in land management through readily understood mechanisms relating to the conservation of species and ecological communities that are endangered or vulnerable;
  - provide for public involvement in, and promote public understanding of, the conservation of such species and ecological communities; and
  - encourage co-operative management for the conservation of such species and ecological communities.

  In order to achieve these objects, the Act provides for listing of native species, ecological communities and threatening processes, provides for certain protective measures to be adopted, imposes obligations on persons (particularly Commonwealth agencies) arising from species, ecological communities or threatening processes being, listed, or protective measures being adopted confers powers for the administration and enforcement of the Act and establishes the Endangered Species Advisory Committee and the Endangered Species Scientific Subcommittee.

  The flora and fauna assessment undertaken for this project has included consideration of species listed under this legislation.

- Australian Heritage Commission Act 1975. The Act set up the Australian Heritage Commission. The function of the Commission is to advise the Commonwealth Government on matters relating to the National Estate. Its primary role is to compile and maintain the Register of the National Estate.

The Register identifies important sites for the natural and cultural/built environment.

Within the study area, no sites of importance for the cultural/built environment are on the Register. The one site listed is the Brunswick Heads Nature Reserve, which is a site of importance to the natural environment. The AHC was consulted during the study and the significance of the rainforest vegetation in the Reserve has been acknowledged and addressed in Section 12 and in Working Paper No.7 - Flora and Fauna Assessment.

- Environment Protection (Impact of Proposals) Act 1974. The object of this Act is to ensure, to the greatest extent that is practicable, that matters affecting the environment to a significant extent are fully examined and taken into account in and in relation to the:
  - formulation of proposals;
  - carrying out of works and other projects;
  - negotiation, operation and enforcement of agreements and arrangements (including agreements and arrangements with, and with authorities of, the States);
  - making of, or the participation in the making of, decisions and recommendations; and
  - incurring of expenditure by, or on behalf of, the Australian Government and authorities of Australia, either alone or in association with any other government, authority, body or person.

- In addition to the above legislation there are other issues of importance to the Commonwealth Government. These include national and international policies and agreements. These are described below. Environment Australia and the Biodiversity Group were consulted during the course of the study in regard to these aspects.

  The National Wetlands Program was established in January 1989 to address issues regarding the loss and degradation of wetland habitats in Australia. The program is a co-operative project between the Commonwealth, State and Territory governments, intended to promote the conservation and better management of Australia's wetlands and to ensure that Australia meets its obligations under the Ramsar Convention (which addresses wetlands of international importance). Other international agreements include the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA).

  One element of the National Wetlands Program has been the preparation of *A Directory of Important Wetlands in Australia* (1996) which lists wetlands of national significance. Within NSW 94 wetlands are included in the Directory. The closest listed wetland to the proposal is Bundjalung National Park which is some 70 km from this locality.

The proposal would not have any impact on any wetlands identified by the Commonwealth Government in terms of the above requirements. This aspect is detailed in Section 12. Eight migratory birds, as listed in CAMBA and JAMBA were recorded during the fauna field investigations. The proposal would not involve a significant impact on any of these species.

Various Commonwealth Government departments were also consulted as part of the authority consultation process of the EIS. Matters raised by those departments in relation to their responsibilities are outlined in **Appendix B** and have been incorporated in this EIS.

3. Consultation

An extensive consultation program was undertaken during the study. The consultation program was initiated at the same time as the study commenced to ensure that the community and other stakeholders were involved throughout all of the stages of the study. This Section describes the consultation activities which were undertaken and describes the way in which community concerns and suggestions were considered in route evaluation and selection, the design of the preferred route and the design of environmental mitigation measures.

3.1 Objectives of the Consultation Program

An extensive community consultation program was implemented for this project. The community was consulted at various stages and in different ways during the study, and their comments have been incorporated into the environmental assessment process.

The community consultation program had the following objectives:

- involve the community in the project for the duration of the study;
- inform the community about the role they have to play, where and how they can make an input, and about the decision making process;
- ensure that all feasible options are identified;
- establish a two-way dialogue between the study team and the community, i.e. listen to community concerns, opinions and local knowledge, and provide feedback;
- provide direct ways for the community to be involved at key stages of the project, i.e. project initiation, route evaluation and selection, the design of the preferred route option and the detailed environmental studies;
- have an open and transparent process;
- ensure that the people who are likely to be directly affected are informed as soon as possible about decisions that affect them;
- provide prompt response to requests for information and for meetings; and
- utilise a variety of mechanisms including information sheets, meetings (with groups and individuals), workshops, public displays, a freecall telephone number and correspondence.

3.2 The Consultation Process

3.2.1 Consultation Prior to Study Commencement

This study arose from the 1996 DUAP/RTA investigations to identify a corridor for upgrading the Pacific Highway between the Brunswick River and Yelgun. Extensive community consultation was undertaken as part of that process,

including public exhibition of options, several public meetings, and discussions with individuals and groups.

As a result, there was a high level of community awareness about the proposal and anticipation about the consultation process for the route selection.

3.2.2 Consultation at Study Commencement

Information Sheet No.1 (November, 1996) was distributed widely via Australia Post through the Ocean Shores/Brunswick/Mullumbimby area. It was also sent directly to groups, individuals and property owners who had been identified from previous and associated studies and discussions with Council. The Information Sheet provided basic details about the project and the study process.

The ***1800 (freecall) telephone number*** was established in November 1996 and operated for the duration of the study. The number was repeated in all Information Sheets and on all display material.

A ***Community Database*** was established and maintained for the duration of the study. Information Sheets 2 to 6 were sent to everyone on the database. Details about how to be included on the database were repeated in all Information Sheets and on all display material.

Advertisements in the local press provided contact details for the study team and details about the Community Information Meeting.

A ***Community Information Meeting*** was held at Ocean Shores on 26 November 1996. The purpose of the meeting was to provide preliminary information about the study and to hear community concerns, issues and suggestions.

A ***Planning Focus Meeting*** was also held on 26 November 1996. The primary purpose of the Planning Focus Meeting was to brief state and local government authorities as a basis for their advice on issues that should be addressed in the EIS. Community representatives were also invited to attend the meeting to ensure that the authorities and the study team were also well informed on community issues.

Government authorities and community organisations invited to attend the Planning Focus Meeting included:

- BEACON (*)
- Billinudgel Chamber of Commerce
- Billinudgel Progress Association
- Brunswick Catchment Management Committee
- Brunswick Heads Police (*)
- Brunswick Progress Association
- Brunswick River Protection Committee

- Brunswick Valley Chamber of Commerce and Industry (*)
- Byron Bay Environment Centre (*)
- Byron Council
- Byron/Brunswick Flora and Fauna Conservation Society (*)
- Caldera Environment Centre (also represented Tweed Byron Greens and the No Freeway Coalition)
- Conservation of North Ocean Shores (CONOS)
- Department of Agriculture (*)
- Department of Land and Water Conservation (DLWC)
- Department of Mineral Resources (*)
- Department of Urban Affairs and Planning
- Environment Protection Authority (EPA) (*)
- Heritage Council of NSW (*)
- Mr Don Page MP, Member for Byron (*)
- Northern Regional Organisation of Councils (*)
- Northpower
- NPWS
- NSW Department of Transport (*)
- NSW Fisheries (*)
- NSW Health (*)
- Ocean Shores Urban Association
- Optus (*)
- Public Works Department (*)
- State Rail Authority (*)
- Telstra
- Tweed Byron Local Aboriginal Land Council
- Tweed-Lismore Rural Lands Protection Board (*)

(*) indicates that representatives were unable to attend.

3.2.3 Community Involvement in Route Selection

Community suggestions were taken into consideration in the identification of route options. In particular, the study area was broadened to include a far western option which was a community suggestion.

Information Sheet No.2 (March, 1997) provided information about the route options that had been identified and invited submissions.

A ***public display*** (March/April 1997) of the route options was held for a period of 3 weeks at four locations. The display at the Ocean Shores Shopping Village was attended by members of the study team on two occasions.

A two day ***Value Management Workshop*** (April 1997) was held to assist the RTA with the selection of the preferred route. In addition to members of the

study team, participants at the workshop represented local and state government authorities and community organisations, including:

- Billinudgel Chamber of Commerce
- Billinudgel residents
- Brunswick Progress Association
- Brunswick River Catchment Management Committee
- Byron Council
- Caldera Environment Centre.
- Department of Agriculture
- Department of Land and Water Conservation (DLWC)
- Department of Urban Affairs and Planning (DUAP)
- Middle Pocket/Yelgun Progress Association and rural residents
- National Parks and Wildlife Service (NPWS)
- Ocean Shores Urban Association.
- Residents of the Ferry Reserve Caravan Park

Following the Value Management Workshop (and later during the course of the study) additional route options were suggested by the community and these were thoroughly investigated. ***Information Sheet No.3*** (May, 1997) described these.

Information Sheet No.4 (September, 1997) advised that a preferred route had been selected and explained the reasons for the decision.

Numerous ***individual and group meetings*** were held during the route selection phase, and after the preferred route had been announced by the Minister for Roads.

3.2.4 Community Involvement in Alignment and Interchange Locations and Environmental Mitigation Measures

Following the announcement of the preferred route the focus of consultation was with potentially directly affected property owners and tenants. Meetings were initiated with these people. In the cases where the property owners were not resident and not in the area, contact was made by phone and/or letter. Meetings were subsequently held with all of the property owners resident in the area. In some cases there were numerous meetings. The purpose of these meetings was to keep property owners fully informed about the proposal and its affect on their properties, especially in regard to land use, access, noise and views.

The meetings were a very important part of the process of continuously refining and improving the proposal. The design team was, in most cases, able to make adjustments and modifications to the alignment and associated works to accord with property owner requirements to minimise impacts.

Other members of the community were included in the process at this time, and the study team continued to respond to requests for meetings with individuals and community groups.

All comments and suggestions made during these meetings were noted and taken into consideration in refining the preferred route alignment and in defining the environmental mitigation measures.

Information Sheet No.5 (December, 1997) provided an update on study progress.

Information Sheet No.6 (March, 1998) advised that there would be a ***public display*** showing the proposal, including local access arrangements and interchange locations. The display was held at 3 locations for a period of 3 weeks. Members of the study team were available on one day, over extended hours, to provide advice and answer questions about the proposal.

During the course of the study, and particularly during this phase of the study numerous individual and group meetings were held. Meetings were held with a number of community organisations to brief them on the project and to seek their input to the design of environmental mitigation and management measures.

3.3 EIS Exhibition

The exhibition of the EIS and invitation for written submissions is an important part of the consultation process. Everyone who is included on the project data base was sent a copy of the EIS brochure, which included details about the exhibition period and locations and explained how to make a submission.

3.4 Consultation with Authorities

At commencement of the study, the Planning Focus Meeting was held, as described earlier, and all relevant authorities were contacted by letter. During the course of the study there were numerous meetings with authorities to discuss matters of relevance to their areas of statutory or advisory responsibility.

Numerous meetings and/or discussions were held with Byron Council elected representatives and technical staff to discuss both strategic and specific issues.

Consultation with Local, State and Commonwealth government authorities continued throughout the study period and provided valuable input into the project.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part B

Project Need and Options

b

4. Transport and Environmental Needs

This Section outlines the basic land use and transport characteristics of the study area, and the key traffic implications that lead to the need for improvements to the transport network. These factors are described here to highlight the need for the proposed duplication of the Brunswick Heads Bypass and upgrade of the Pacific Highway, Brunswick River to Yelgun. Further details regarding this study are provided in Working Paper No.1- Traffic and Transport Assessment.

4.1 Integrating Land Use and Transport Planning

Several important factors lead to the demand for traffic infrastructure. These include:

- population and its growth;
- employment potential; and
- commerce and industry development.

The spatial pattern of land use generates demand for travel, which in turn influences the supply of transport infrastructure. Traffic is the consequence of this interaction between land use and the transport system.

The Pacific Highway connects Sydney to Brisbane and the major coastal centres in between. It serves as a significant regional link supporting a variety of development including tourism, agriculture, commercial and residential development, in addition to performing an essential local access function between population centres.

The section of the Pacific Highway between Brunswick Heads and Yelgun is located entirely within Byron Local Government Area (LGA). This area is expected to experience considerable population growth over the next 20 years. Therefore the demands on infrastructure, including transport, will continue to increase. One of the key components of the transport system is the Pacific Highway. Its role will continue as the principal road access to provide for future development, regional and inter-regional travel and improved safety.

4.2 Population Considerations

4.2.1 Existing Population Levels and Forecast Growth

The township of Brunswick Heads is situated on the north coast of NSW approximately 17 km north of Byron Bay. In the 1996 Census, Brunswick Heads urban centre was shown to have a total resident population of approximately 1,866 persons (ABS, 1996: Census). This compares with a population of 1,650 in 1991 and 1,250 in 1986. The Byron LGA comprises some 567 km^2 and includes the townships of Byron Bay, Brunswick Heads, Mullumbimby and other smaller

settlements. The population of the LGA was 27,010 in 1996. The rate of population growth within the area between 1986 and 1991 was 4.62%.

The Australian Bureau of Statistics Richmond-Tweed Statistical Division comprises an area of 7,500 km^2, including Byron LGA, had a total resident population of 201,407 persons in 1996. The rate of population growth within the Division was 3.4 % between 1986 and 1991.

The relatively high levels of population growth in the Shire are expected to continue. Population Projections (DUAP, 1994 Revision) gives the range of low, medium and high level projections for the Byron LGA shown in **Table 4-1**. Based on past trends, it is likely that future growth will approach the high levels, subject to major constraints on infrastructure and land availability.

Table 4-1 - Byron LGA Population Projections

Year	Projected Population		
	Low	Medium	High
1996 (actual)	27,000	27,000	27,000
2001	29,800	30,400	31,000
2006	33,300	34,500	35,600
2011	36,700	38,600	40,500
2016	40,100	42,900	45,700

Source: Department of Urban Affairs and Planning Population Projections, Non-Metropolitan LGAs, 1994 Revision

4.2.2 Population Migration

The mobility of the population in the Byron area is relatively high. At the time of the 1996 Census, more than 12,500 people in the Shire (over 45% of the population) indicated that they had lived at a different address 5 years earlier. This represents one of the highest rates of mobility on the NSW north coast, only exceeded by that of Tweed Shire, and compares with a NSW average of 38%.

This high rate of population migration to the area is a result of a number of influences, including the attractions of climate and lifestyle and its unique coastal setting.

4.3 Employment Potential

Data collected for the 1996 Census indicated that 33% of the Shire's population was employed in a diverse range of employment categories. **Table 4-2** outlines the breakdown of employment by sector type.

Table 4-2 - Employment by Sector Type

Sector	Proportion (%)
Agriculture/Forestry/Fishing /Mining	8.1
Manufacturing	8.6
Construction	7.2
Electricity, Gas & Water Supply	0.7
Wholesale and Retail trade	19.9
Transport and Storage	2.8
Tourism, Cultural & recreational services	12.6
Communications, Finance, Insurance, Property and Business Services	14.5
Government Administration & Defence	3.5
Education, Health & Community Services	18.6
Not Stated/Not Classified	3.5

Indications are that the tourism base within the locality will expand further over time with greater emphasis being placed on eco-tourism and rural tourism following the emerging trends elsewhere, and to make greater use of the natural attributes that exist within the area.

Table 4-3 provides information on the participation rates of the workforce within Byron Shire as at the time of the 1996 census.

Table 4-3 - Byron Shire Participation Rates

Total Labour Force	Males	Labour force %	Females	Labour force %	Total	Labour force %
Employed	4,952	78.5	4,262	83.7	9,214	80.8
Unemployed	1,355	21.5	829	16.3	2,184	19.2
Total Labour Force	6,307	100.0	5,091	100.0	11,398	100.0
Not In Labour Force	3,577		5,293		8,870	

4.4 The Transport System

Transport in the region is primarily road based, with an extensive network of roads of varying classes and standards. The Brisbane to Sydney main rail line follows close to the alignment of the existing highway. Buses provide a range of public transport services mostly in the urban centres. The overwhelming majority of travel in the study area, however, is made by private or commercial road vehicles.

The Pacific Highway carries most of the north-south traffic in the region. Other routes connecting to the highway include: Mullumbimby Road and Coolamon Scenic Drive connecting to Mullumbimby, Rajah Road connecting to Ocean Shores, and Shara Boulevard connecting to Golden Beach and New Brighton.

The rail network in the area consists of two railway lines - the Sydney to Brisbane main line and the Casino-Murwillumbah branch line. The area is served by regional airports at Coolangatta, Lismore, Ballina and Casino.

From traffic surveys undertaken during 1997, it was determined that 44% of traffic on the Pacific Highway is through traffic (no origin or destination within the bounds of the study area). A significant proportion of the traffic on the existing highway in the region is travelling to or from Brunswick Heads and Ocean Shores.

4.4.1 Road Network and Traffic Characteristics

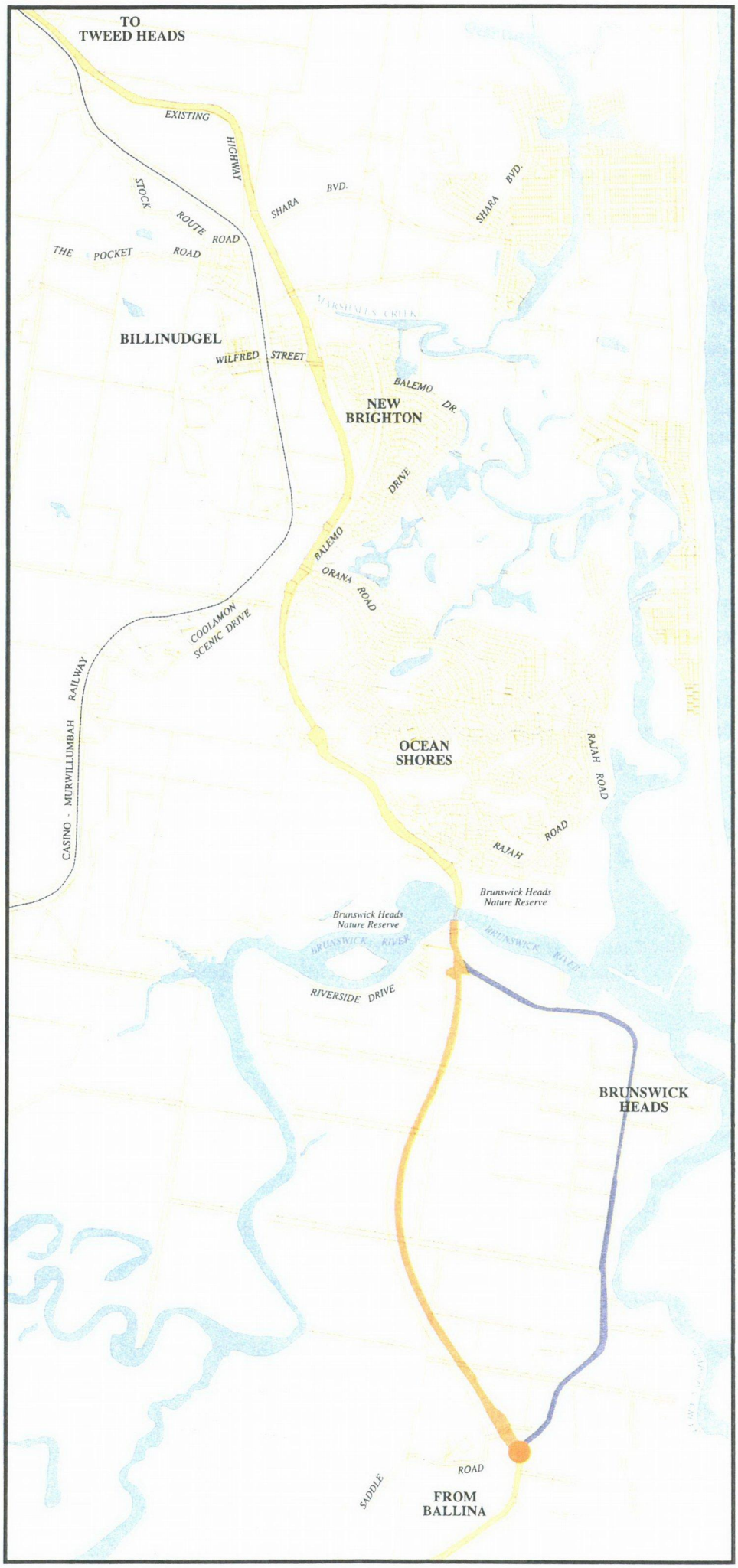
The study area under investigation is shown in **Figure 1.1**. The roads in the Brunswick Heads and environs road network are shown on **Figure 4.1** and include:

- Pacific Highway running north-south west of Brunswick Heads on the Brunswick Heads Bypass and north to Billinudgel;
- The existing highway through Brunswick Heads;
- Mullumbimby Road running east-west between Mullumbimby and the Pacific Highway south of Brunswick Heads;
- Saddle Road which links to the Pacific Highway south of Brunswick Heads but north of Mullumbimby Road;
- Rajah Road which links Ocean Shores (south) to the existing highway;
- Coolamon Scenic Drive which links Mullumbimby to Ocean Shores;
- Orana Road which links Ocean Shores (north) to the existing highway;
- Balemo Drive which also links Ocean Shores (north) to the existing highway;
- Wilfred Street which links Billinudgel to the existing highway;
- The Pocket Road which links areas west of Billinudgel to the existing highway; and
- Shara Boulevard which links areas such as Golden Beach to the existing highway.

Roads are generally classified according to a road hierarchy, in order to determine their functional role within the road network. The RTA has set down guidelines for the functional classification of roads and these are described in more detail in Working Paper No.1 - Traffic and Transport Assessment.

The Pacific Highway represents the only arterial north-south road connection in the study area. Its value is therefore significant in terms of supporting the local and regional economy.

Traffic characteristics of roads are generally described in terms of operating levels of service on sections of road, and also the performance of intersections within the network. The level of traffic flow is determined by land use activity and





Legend

- Existing Highway
- Brunswick Heads Bypass (first carriageway)
- "Old" Pacific Highway through Brunswick Heads
- Proposed Brunswick South Interchange (Tandys Lane Project) (final design stage)

Figure 4.1
LOCAL ROAD NETWORK

distribution, which is in turn determines the operating characteristics of the road system.

Some typical indicators of network performance are:

- road volume to capacity ratio (v/c);
- operating speeds and travel times;
- intersection delays; and
- accident frequency and severity.

Each of these factors, considered together with the road environment, determines the level of service provided by the facility. The Australian Association of State Road Authorities (AUSTROADS) has set guidelines for determining level of service in terms of road and intersection performance. In addition, the RTA monitors accident frequency and severity on a range of road types to assist in comparing conditions across its network.

Table 4-4 below summarises some of the key data relating to the existing operation of the Pacific Highway, its predicted use with no improvements, and the potential benefits of providing an upgrade as proposed.

Table 4-4 - Critical Highway Operating Characteristics

Characteristic	Existing	Future Do Nothing	Future Proposal
1. Road volume/ Capacity Ratio (v/c)	0.81	1.04	0.60
2. Operating Speeds[1]	73 km/h	66 km/h	107 km/h
3. Travel Times [1]	7 min. 15 sec.	8 min. 00 sec.	4 min. 53 sec.
4. Intersection Performance[2]	Satisfactory	At capacity, requires other control mode	Acceptable delays and spare capacity
5. Accidents (per 100 mvkt)[3]	41 [4]	71 [5]	18 [6]

Notes:
1. Operating Speeds and Travel Times quoted for Existing and Future Do Nothing on existing highway including the recently opened Brunswick Heads Bypass.
2. Intersection Performance is based on RTA level of service criteria.
3. Accident rates are based on the Pacific Highway as it existed before the opening of the Brunswick Heads Bypass for the Existing cases, the Pacific Highway with the Brunswick Heads Bypass for the Future Do Nothing.
4. Average accident rate from accident history Brunswick Heads to Yelgun, see Section 7.2.3.
5. Accident rate has been determined using existing accident history and scaling by increase in traffic volumes between existing and future scenarios.
6 From "Rural Crash Rates - Road Stereotypes Summary Report" by Road Safety Bureau, July 1993

4.4.2 Travel Characteristics

Surveys were carried out to determine travel characteristics in and around Brunswick Heads during December 1996. The surveys included intersection

counts at Rajah Road, Coolamon Scenic Drive, Orana Road, Wilfred Street, Balemo Drive and Shara Boulevard. Classified counts at two locations on the existing highway, one south of Rajah Road and the second at Yelgun were also recorded. In addition to these surveys, an origin-destination survey was conducted during December 1996. The results of this survey indicate that approximately 44% of the total traffic volume on the existing highway within the study area is through traffic.

In addition, Mullumbimby acts as a sub-regional centre for the area. It serves as a government centre (i.e. government offices) and employment generator for residents of Brunswick Heads and Ocean Shores. As such, the movement between Ocean Shores and Mullumbimby using Rajah Road, the existing highway and Mullumbimby Road is relatively significant compared to other trip generators/attractors in the area.

4.4.3 Other Transport User Groups

Public Transport

Public transport is mainly in the form of buses servicing local schools. Bus operators within the Brunswick Heads area are: Kirkland's Coaches, Blanchs and Brunswick Valley Coaches. In addition, the Main Northern railway line corridor also runs through Mullumbimby which is approximately 10km to the west.

Pedestrians and Cyclists

There were minimal pedestrian and cyclist activities observed either along or across the Pacific Highway during the survey period and site visits.

4.4.4 Freight Movement

Freight movements between Brunswick and Yelgun are generally undertaken on the Pacific Highway, with some cross road movements to local development. Heavy vehicles using the existing highway account for approximately 12% of the total traffic volume.

It is desirable to remove heavy vehicle traffic from town centres to improve amenity and safety thereby reducing heavy vehicle conflicts with local traffic, pedestrians and cyclists.

4.5 Conclusions on Transport and Environmental Needs

The preceding discussion has highlighted the need for an improvement of the road transport system between Brunswick and Yelgun particularly as the population, and therefore the number of potential users of the road system, is expected to continue to increase. Without improvements, the current mix of local and through traffic needs will result in a continuing deterioration of service levels, amenity and safety.

An upgrade of the Pacific Highway in this area would potentially divert a high proportion of through traffic from the existing highway alignment. This would benefit travel conditions and improve local amenity and safety as lower traffic volumes, consisting of mainly local traffic, would remain on the existing alignment. This would also benefit cyclists and pedestrians as through traffic would be largely removed from the towns therefore increasing the safety of local movements.

The proposal would serve to lower travel times between Brunswick and Yelgun for both tourist and commercial traffic. Currently, through traffic is slowed as it interacts with slow moving and turning local traffic. Through traffic on the proposal would be free flowing thereby reducing vehicle travel times, enhancing vehicle efficiency and road safety conditions. Conflicts between local and through traffic, as is currently the case, would be substantially eliminated. The proposal therefore has the potential to satisfy the objectives of improving transport efficiency and reducing accident costs. More detailed analysis of the traffic and transport assessment is included in Section 7 of this document and Working Paper No.1 - Traffic and Transport Assessment.

4.6 Consequences of the "Do Nothing" Option

The "do nothing" option was considered as part of this EIS, and as discussed above, was discarded as an appropriate long term solution to current traffic and amenity problems. Specifically the consequences of not building the proposal would be:

- the loss of the opportunity to create a high standard dual carriageway between Brunswick Heads and Yelgun which separates through and local traffic. This would result in potential adverse impacts on the viability of the regional road network if another route is not developed;
- the loss of the opportunity to build the second carriageway of the Brunswick Heads Bypass which would enhance the safety and efficiency of the single carriageway currently in operation;
- the loss of the opportunity to resolve existing and predicted traffic conflict, safety and congestion problems particularly in the areas north of the Brunswick River;
- the loss of the opportunity to demolish the existing Brunswick River bridge and replace it with a new high standard bridge which separates through and local traffic;
- the loss of the opportunity to increase social amenity within the area by providing an overpass which links Billinudgel with Ocean Shores; and
- continued use by through traffic of the congested and in places, unsafe, Pacific Highway, particularly through the residential areas of Ocean Shores and Billinudgel.

Specifically, the proposal would:

- improve the social amenity and safety conditions for local traffic and pedestrians between the Brunswick River and Yelgun;
- separate through traffic from local traffic and therefore reduce congestion conditions, reduce travel times, increase travel efficiency and improve road safety generally through the area for all road users; and
- provide a high standard dual carriageway for the local and regional movement of freight and people.

Should the proposal not be built a range of localised impacts created by the construction and operation of the proposal would be avoided. The consequence of these impacts are examined in later sections of this EIS, however the majority of these impacts can be mitigated so that the resultant impact of the proposal is minimised. With the incorporation of appropriate environmental management measures the environment could be adequately protected. The environmental impacts should be considered in the context of the potential environmental impacts of not building the proposal. These include increased congestion and safety problems that would occur on the existing highway due to predicted future traffic volumes and the existing condition and configuration of the highway through the area.

5. Selection of the Preferred Route and Alignment

The selection of the preferred route for the proposal was the most critical step in the study. This Section describes how the preferred route was selected and subsequently refined to be the preferred alignment, which is the subject of this EIS. The approach that was followed included initial investigations of a broad study area and identification of feasible routes. These routes were then investigated in detail and analysed against social, ecological, economic and engineering criteria. Once a preferred route was selected there was a more intensive period of investigation and assessment, which led to refinement of the engineering concept, definition of the preferred alignment and development of the environmental mitigation measures.

5.1 Previous Investigations

The RTA carried out detailed investigations prior to deciding to proceed with the construction of the first carriageway of the Brunswick Heads Bypass (RTA, 1993). These investigations were undertaken initially across a broad area south of the Brunswick River and including a section on the western and northern side of the river. The environmental impact assessment study for the Bypass included a route evaluation phase. Potential ecological impacts were a key consideration for that assessment. These investigations led to the decision to construct the Bypass in its current location.

In 1996 DUAP undertook to work with the RTA to examine the strategic issues associated with the upgrading of the Pacific Highway between the Brunswick River and Tweed Heads. The work was undertaken over a six month period and involved the publication of a Discussion Paper (DUAP and RTA, 1996) and a public consultation program. The aim of the process was to identify the most acceptable land use/transport solution for upgrading the Pacific Highway which meets the needs of the current and future local communities, and for through traffic.

The Final Report of the study (DUAP 1997) concluded that between the Brunswick River and Yelgun there was no clear solution to a new highway route, and also noted that more than half of the public submissions received originated from this area. DUAP recommended that further work would be required to identify routes in this section, as part of a detailed EIS, before a preferred route is selected.

The study recommended locating interchanges at Yelgun and south of the Brunswick River. It also indicated the principles that should guide the route selection to achieve the best possible design and the least possible impact. The recommended investigation area was described as being between the existing highway and the western edge of "Billinudgel 2000". The recommended objectives for investigations were:

- to separate through and local traffic to allow easy access on local roads;
- to minimise the noise impact from the new route to existing and planned residential areas;
- to minimise disturbance to the Brunswick River, wetlands, rainforest and other important natural areas;
- to minimise interference with normal flood water flows;
- to avoid cane land, or potential cane land; and
- to avoid the highway creating a physical barrier between settlements with resulting social dislocation of the existing and future local community.

Other aspects of importance to this project included the overwhelming public support for a new, safer Pacific Highway; Byron Council's preference for a route on the existing highway but support for investigation for a more western route; the numerous constraints to route development; and the view that there should be further work and community consultation before decisions were made about the route between the Brunswick River and Yelgun.

Subsequently, the RTA initiated this study.

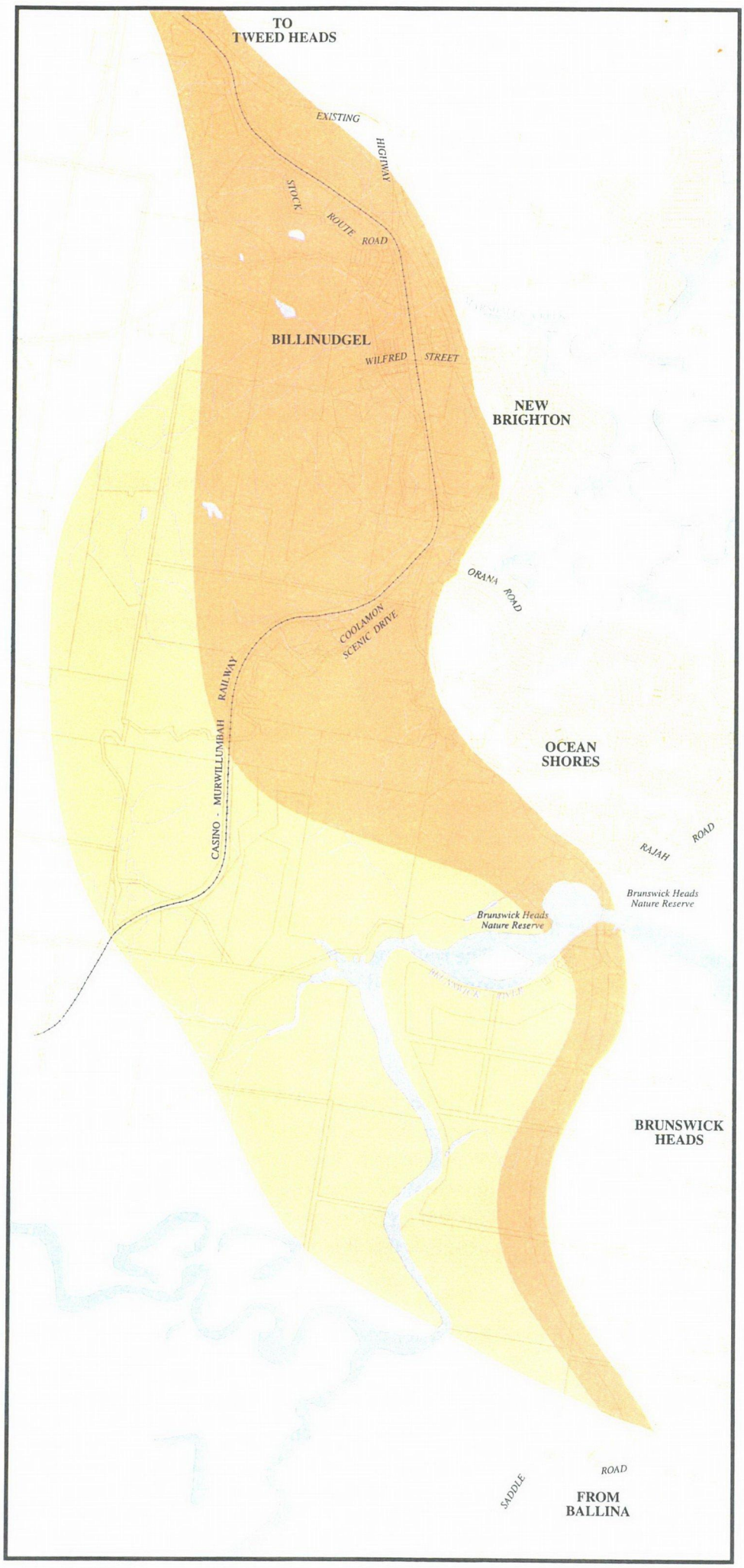
5.2 The Study Area

The study area, which is shown on **Figure 5.1**, was initially defined by the RTA as representing the extent within which feasible routes were likely to be located, taking the project objectives into consideration. The RTA had previously undertaken route selection studies for the first carriageway of the Brunswick Heads Bypass. These studies confirmed the ecological sensitivity of the area, particularly of the Brunswick River and its environs. Notwithstanding this, during the process of route selection the community suggested routes which were located beyond this area, and the study area was subsequently extended. **Figure 5.1** shows the original study area and the extended area which was subsequently investigated.

5.3 Identification of Route Options

Route options for the proposal were developed over the broad study area consistent with the project objectives, engineering considerations, constraints and issues identified by the preliminary technical investigations and consultation with the community and public agencies.

Initially, the key features of the study area were identified. These included:





Legend

Original Study Area

Extended Study Area

Figure 5.1
STUDY AREA

- residential areas, including Brunswick Heads, Ocean Shores, Billinudgel, and the Ferry Reserve Caravan Park and Riverside Drive;
- individual dwellings;
- property boundaries;
- industrial and commercial areas;
- prime agricultural land, areas of rural activity and rural residential development;
- Nature Reserves, including Brunswick Heads Nature Reserve and Billinudgel Nature Reserve;
- areas classified as Coastal Wetlands and gazetted under State Environmental Planning Policy No.14 (SEPP 14);
- areas of littoral rainforest gazetted under State Environmental Planning Policy No.26 (SEPP 26);
- areas of steep topography;
- the occurrence of vegetated east-west running ridges which provide fauna habitat and wildlife corridors; and
- zoning and planning considerations including the existence of a corridor zoned for road purposes (known as the LEP corridor) on the northern side of the Brunswick River and west of the existing highway.

It was acknowledged at the outset that any route would have environmental (i.e. social, ecological or economic) impacts. The routes which were identified recognised the particular features of the study area and sought to minimise the potential and degree of impact.

5.3.1 Public Display of Route Options

Initially five route options were identified. These were called A, B, C, D and E and are shown on **Figure 5.2**. Although they are described separately there are common sections to some of the routes. At this stage of the route selection process it was assumed that there would be a duplication of the Brunswick Heads Bypass (which was then under construction) and an interchange on the southern side of the Brunswick River. It was also assumed that there would be an interchange in the vicinity of Yelgun.

Descriptions of the routes put on public display for community comment follow.

- Route A is 6.4 km in length. It crosses the Brunswick River on a new high level bridge downstream of the existing bridge. The higher level allows for the highway to pass underneath uninterrupted. North of Rajah Road Route A is generally parallel to, and west of, the existing Pacific Highway and passes to

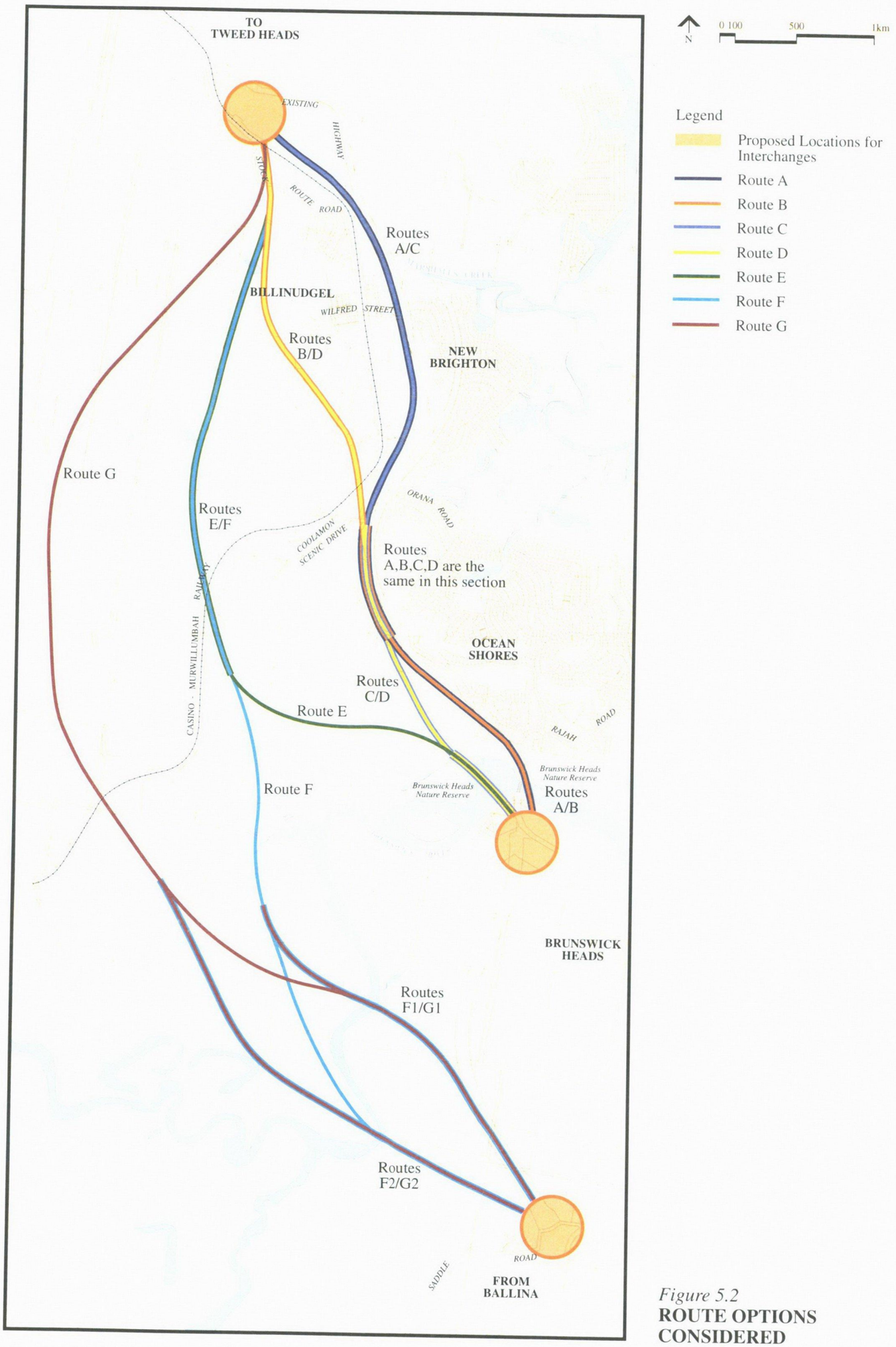


Figure 5.2
ROUTE OPTIONS CONSIDERED

the east of Billinudgel. For this option, the proposal includes retention of the existing highway as a local road between Brunswick Heads and Yelgun with access to Ocean Shores via a grade separated crossing of the new highway in the form of a vehicle overpass at Billinudgel.

- Route B is 6.2 km in length. It is similar to Route A to the crest of the hill south of the Coolamon Scenic Drive and then extends almost due north and crosses the Marshall Creek floodplain west of Billinudgel. It then continues north-east to the proposed Yelgun interchange. This option includes retention of the existing highway and the Brunswick River crossing as a local road.
- Route C is 6.2 km in length. It extends generally north-west through the Ferry Reserve Caravan Park and crosses the Brunswick River with a new crossing upstream of the existing bridge. It utilises the LEP corridor through the Brunswick Heads Nature Reserve and extends northward to the crest of the hill south of Coolamon Scenic Drive. From this point it is similar to Route A.
- Route D is 6.1 km in length. It is the same as Route C to Coolamon Scenic Drive and from Coolamon Scenic Drive north, it is similar to Route B.
- Route E is 7.1 km in length. It extends northward through the Ferry Reserve Caravan Park. North of the Brunswick River it utilises the existing LEP corridor then extends north of the STP, turns west and then northward to cross the Coolamon Scenic Drive and the Casino-Murwillumbah railway. It continues northward to cross the Marshalls Creek floodplain west of Billinudgel and joins the existing Pacific Highway at the proposed interchange near Yelgun. The existing highway is retained as a local road between Brunswick Heads and Yelgun and the existing Brunswick River bridge is also retained.

During the Value Management workshop, described later in this Section, two more options were identified. There was strong adverse community reaction to the proposed high level bridge which was a feature of Routes A and B because of its potential impact on views of residents of Ocean Shores and on the visual environment generally. At the workshop options emerged based on a lower level bridge. These options are described as Route A2 and B2. In terms of their location these routes are the same as A and B except that they include the demolition of the existing bridge over the Brunswick River and the construction of a new lower level bridge to carry local and through traffic.

Later again in the process further suggestions arose from the community. These involved a number of routes which were located either totally, or in part, further to the west of Route E. These routes involved an interchange with the Brunswick Heads Bypass further south than that proposed for Routes A, B, C, D and E. For the purposes of evaluation, the study team interpreted these suggestions as shown on **Figure 5.2**. These routes are described as follows:

- Route F1 commences at the Brunswick Heads Bypass approximately 1.25 km north of the Saddle Road interchange. It extends generally north-west and crosses the Brunswick River about midway between Kings Creek and Midjimbil Creek. It then turns northward and joins the proposed Route E, which it follows to Yelgun. This route includes duplication of 1.25 km of the Brunswick Heads Bypass. The existing highway and the balance of the Brunswick Heads Bypass is retained as a local access road between Brunswick Heads and Yelgun and the existing Brunswick River bridge is also retained.
- Route F2 commences at the Saddle Road interchange. It extends generally north-west and crosses the Brunswick River immediately east of the Kings Creek junction. It then turns north and joins the alignment of Route F1 south of Midjimbil Creek. The existing highway and the Brunswick Heads Bypass is retained as a local access road between Brunswick Heads and Yelgun and the existing Brunswick River bridge is also retained. The Brunswick Heads Bypass is not duplicated under this option.
- Route G1 commences at the Brunswick Heads Bypass approximately 1.25 km north of the Saddle Road interchange and heads generally north-west and crosses the Brunswick River about midway between Kings Creek and Midjimbil Creek along the same alignment as Route F1. It then continues north-west and crosses the Coolamon Scenic Drive and the Casino-Murwillumbah Railway line near the junction with Synotts Road. From this point, it turns north and crosses the main east-west ridge in a saddle west of Hilans Corner and then turns north-east and crosses the Marshalls Creek floodplain west of Billinudgel to join the proposed interchange near Yelgun. This option includes duplication of 1.25 km of the Brunswick Heads Bypass. The existing Pacific Highway and the balance of the Brunswick Heads Bypass is retained as a local road between Brunswick Heads and Yelgun and the existing Brunswick River bridge is also retained.
- Route G2 commences at the Saddle Road interchange. It extends generally north-west and crosses the Brunswick River immediately east of the Kings Creek junction. It then swings in a northerly direction and joins Route G1 south of Midjimbil Creek. The existing Pacific Highway and the Brunswick Heads Bypass is retained as a local access road between Brunswick Heads and Yelgun and the existing Brunswick River bridge is also retained. The Brunswick Heads Bypass is not duplicated as part of this option.

Other route options were also suggested comprising various combinations of parts of route options A to E, including options that used the southern parts of the more western routes and then travelled in a north-east direction to join the existing highway in the vicinity of Smoky Valley. These were all investigated but have not been specifically addressed as separate options in this EIS as they comprise various parts of Options A to E. **Table 5-1** provides a comparison of the routes described above.

Table 5-1 - Route comparison

Route	Features
Route A	☐ crosses the Brunswick River to the east of the existing bridge
	☐ new bridge crosses the existing Pacific Highway south of Rajah Road at a higher level without interference
	☐ the majority of the route closely follows the existing Pacific Highway
	☐ existing highway would become a service road for local traffic
	☐ located between the Billinudgel commercial area and the existing Pacific Highway
	☐ existing access between Ocean Shores and Billinudgel to be preserved by bridging across the new road
	☐ minor edge impacts on the Brunswick Heads Nature Reserve
	☐ avoids all significant environmental areas
	☐ would impact on a number of properties located adjacent to the existing highway especially near Rajah Road and Coolamon Scenic Drive
	☐ minimises impact on agricultural land
	☐ limited effects on saltmarsh at southern interchange (south of Brunswick River) possible
	☐ minor disturbance to significant alluvial rainforest west of the existing Highway (in Brunswick Heads Nature Reserve)
	☐ generally avoids further fragmentation of vegetation communities in the locality
	☐ likely to affect threatened flora species in some localities (especially in the south)
	☐ affects edges of forest remnants in some places, although these are already disturbed
Route B	☐ crosses the Brunswick River east of the existing bridge
	☐ new bridge crosses the existing Pacific Highway south of Rajah Road at a higher level without interference
	☐ closely follows the existing Pacific Highway between the Brunswick River and Coolamon Scenic Drive before veering westward
	☐ passes to the west of the commercial area of Billinudgel
	☐ allows for the existing Pacific Highway to become a service road for local traffic
	☐ bisects the potential development area known as "Billinudgel 2000"
	☐ minimises the impact on significant environmental areas near the railway
	☐ minor edge impacts on the Brunswick heads Nature Reserve
	☐ crosses the Casino-Murwillumbah Railway line at two locations
	☐ would impact on a number of properties, especially near Rajah Road and Coolamon Scenic Drive
	☐ some impact on agricultural land
	☐ limited effects on saltmarsh at interchange (south of Brunswick River)
	☐ avoids significant alluvial rainforest west of the existing Highway (in Brunswick Heads NR)
	☐ limited potential for effects on Brunswick Heads Nature Reserve
	☐ south of Coolamon Scenic Drive route affects edges of forest remnants (which are already disturbed)
	☐ deviation north of Coolamon Scenic Drive through disturbed area, but adjacent to high value rainforest
	☐ likely to affect threatened flora species at some localities
	☐ provides an additional barrier to the central wildlife corridor

Route C

- ☐ section south of Coolamon Scenic Drive follows the existing road reservation established as part of the Local Environmental Plan (LEP)
- ☐ crosses the Brunswick River to the west of the existing bridge
- ☐ passes in close proximity to significant flora species and impacts on other sensitive environmental areas in Smoky Valley
- ☐ would require the closure of the Ferry Reserve Caravan Park and impact on Riverside Drive
- ☐ existing Pacific Highway would become a service road for local traffic
- ☐ located between the Billinudgel commercial area and the existing Pacific Highway
- ☐ would impact on a number of properties especially near Coolamon Scenic Drive
- ☐ existing access between Ocean Shores and Billinudgel to be preserved by bridging across the new road
- ☐ minimises impact on agricultural land
- ☐ avoids saltmarsh at southern interchange
- ☐ utilises existing LEP corridor on northern side of river
- ☐ vegetation in LEP reserve is identical in type, condition and conservation value to that on either side (in the Nature Reserve)
- ☐ increases fragmentation and 'edge-effect' of vegetation between Brunswick River and Coolamon Scenic Drive (including within Brunswick Heads Nature Reserve)
- ☐ bisects moderately-sized areas of native forest south of Coolamon Scenic Drive in Smoky Valley
- ☐ significant increase in 'edge effect' of remnant patches south of Billinudgel
- ☐ deviation north of Coolamon Scenic Drive through disturbed area, but adjacent to high value rainforest
- ☐ likely to affect considerable numbers of threatened flora species
- ☐ affects edges of forest remnants in some places, although these are already disturbed

Route D

- ☐ section south of Coolamon Scenic Drive follows Route C (i.e.the LEP corridor)
- ☐ crosses the Brunswick River to the west of the existing bridge
- ☐ passes in close proximity to significant flora species and impacts on other sensitive environmental areas in Smoky Valley
- ☐ would require the closure of the Ferry Reserve Caravan Park and impact on Riverside Drive
- ☐ passes to the west of the commercial area of Billinudgel
- ☐ allows for the existing Pacific Highway to become a service road for local traffic
- ☐ bisects the potential development area known as "Billinudgel 2000"
- ☐ minimises the impact on significant environmental areas near the railway
- ☐ crosses the Casino-Murwillumbah Railway line in two locations
- ☐ would impact on a number of properties especially near Coolamon Scenic Drive
- ☐ some impact on agricultural land
- ☐ avoids saltmarsh at southern interchange
- ☐ utilises existing road LEP corridor on northern side of river (undisturbed vegetation)
- ☐ vegetation in LEP corridor is identical in type, condition and conservation value to that on either side (in the Nature Reserve)
- ☐ increases fragmentation and 'edge-effect' of vegetation between Brunswick River and Coolamon Scenic Drive (including within Brunswick Heads Nature Reserve)
- ☐ bisects moderate-sized areas of native forest south of Coolamon Scenic Drive in Smoky Valley
- ☐ significant increase in 'edge-effect' of remnant patches
- ☐ likely to affect considerable numbers on threatened flora species

Route E	☐ crosses the Brunswick River to the west of the existing bridge
	☐ traverses large tracts of vegetation identified as being important for a major east-west wildlife movement corridor, particular for the Koala
	☐ crosses the Casino-Murwillumbah Railway line at two locations
	☐ because of the rugged topography, this route would be difficult to construct and would involve deep cuts (up to 45 m) and large fills
	☐ grades would be steeper than other routes
	☐ higher cost due to length and construction difficulties
	☐ would require the closure of the Ferry Reserve Caravan park and impact on Riverside Drive
	☐ would impact on several rural properties located in the vicinity of the Casino-Murwillumbah Railway Line and The Pocket Road
	☐ considerable impact on agricultural land
	☐ avoids saltmarsh at southern interchange
	☐ may utilise existing LEP reserve in Brunswick heads Nature Reserve, or else effects the Nature Reserve directly (including undisturbed vegetation)
	☐ substantial clearing required to the north of the Brunswick River
	☐ increased fragmentation of vegetation on northern side of Brunswick River Heads
	☐ south of the main central ridge this route is predominantly located in cleared or disturbed agricultural land
	☐ provides additional significant barrier across central wildlife corridor
	☐ north of central ridge, route passes through cleared agricultural land
	☐ introduces a major additional barrier to wildlife with regard to east-west movement
Route F	☐ avoids potential effects on Brunswick Heads Nature Reserve
	☐ avoids potential effects on the saltmarsh to the south of Brunswick River
	☐ avoids significant alluvial rainforest in the Brunswick Heads Nature Reserve, west of the existing Highway
	☐ avoids significant plants located close to the existing Highway alignment
	☐ traverses a substantial amount of cleared agricultural land with scattered trees
	☐ is likely to affected threatened flora species, particularly west of the Brunswick River and in the Hilans Corner area
	☐ bisects moderate-sized areas of natural vegetation to the west of Brunswick River (south of Coolamon Scenic Drive which are currently little disturbed
	☐ north of central ridge, route passes through cleared agricultural land
	☐ introduces additional major barrier to fauna with regard to east-west movement along the central ridge, and north-south through vegetation along and near to Brunswick River
Route G	☐ avoids potential effects on Brunswick Heads nature Reserve
	☐ avoids potential effects on the saltmarsh to the south of Brunswick River
	☐ avoids significant alluvial rainforest in the Brunswick Heads Nature Reserve, west of the existing Highway
	☐ avoids significant plants located close to the existing Highway alignment
	☐ traverses a substantial amount of cleared agricultural land with scattered trees
	☐ is likely to affect threatened flora species, particularly west of the Brunswick River and in the Hillans Corner areas
	☐ bisects moderate-sized areas of natural vegetation to the west of Brunswick River (south of Coolamon Scenic Drive) and at Hillans Corner which are currently little disturbed
	☐ introduces additional major barrier to fauna with regard to east-west movement along the central ridge, and north-south through vegetation along and near to Brunswick River

5.3.2 Value Management Study

The process used by the RTA to select a preferred route is based on a "Value Management Study"(VMS). This process has a number of advantages. Firstly, it involves a group of people who have a diverse range of interests and expertise. Secondly, it allows a range of technical and non-technical information to be evaluated and compared. Thirdly, it is an objective process which uses a consensus style of decision making where no one opinion or view outweighs that of the group.

The process accepts that any route will have environmental impacts and that not everyone will agree with the selected route option. The objective of the study is to assist in selecting a route that achieves a balance between meeting the project objectives and minimising impacts, thus providing a route which offers the highest value to the community.

The process of value management is documented fully in Working Paper No.10 - Value Management Study and summarised in this section. It involves identifying a series of selection criteria, deciding on the comparative importance of each criteria and evaluating each option against the weighted criteria. The process also encourages the identification of additional options or improvements to the options already identified.

It is also important to note that the outcome of the VMS is a recommendation for a preferred route. The final selection of the preferred route is made by the Minister for Roads, having considered the outcome of the VMS and other factors, such as community input.

A VMS was held in April 1997 as part of the route selection process. It was held as a two day workshop, attended by 24 people. Within the group there was equal representation of the RTA and study team, local and state government agencies, and community representatives, as indicated below:

- RTA personnel (3) with expertise in project management, safety and planning and environment;
- Sinclair Knight Merz study team (5) with expertise in project management, traffic and transport, engineering, noise, flora and fauna;
- State government agencies (4) - Department of Agriculture, DLWC, NPWS and DUAP;
- Local government (4) representing Byron Council and expertise in planning, engineering, and transportation; and
- Community nominees (8) - representing the Billinudgel Chamber of Commerce, Billinudgel residents, residents of the Ferry Reserve Caravan Park,

Urban Association, Brunswick Progress Association, Brunswick Catchment Management Committee, and Caldera Environment Centre.

By consensus, the workshop agreed on the following evaluation criteria:

- ecological impact,
- social impact,
- visual impact,
- noise impact,
- transport efficiency,
- land use planning, and
- commercial impact.

These were then developed into an evaluation matrix by weighting each of the evaluation criteria. The criteria were ranked in order by the group and this gave a "weighting" (out of 100) by the group as listed below. In terms of ranking, the higher number indicated a higher ranking - i.e. of higher "value" to the group.

ecological impact	29 (highest)
land use planning	24
social impact	15
transport efficiency	14
commercial impact	13
noise impact	4
visual impact	1 (lowest)

Each option was then ranked by the group against the criteria, and the ranking was "weighted" to give a total weighted criteria. The ranking is shown as the first number in each box below with the weighting given second. The option evaluation matrix is shown in **Table 5-2**. Taking the example of Route A with respect to ecological impact, the total ranking was 174. When divided by the weighting given by the group (29) the weighted criteria was 6.0. In each case, a higher number indicates a higher correspondence between the option 1 criteria and the objectives. In considering the outcomes given in **Table 5-2** it is important to note that this technique is a tool used to evaluate qualitative and quantitative information. In other words, the presentation of the information in this way is a shorthand description of what was in fact an extensive discussion and evaluation of options.

Table 5-2 - Options Evaluation Matrix

Evaluation Criteria	Weighting	OPTIONS A	A2	B	B2	C	D	E	F
Ecological Impact	29	174	159.5	145	130.5	116	101.5	87/3.0	101.5
		/6.0	/5.5	/5.0	/4.5	/4.0	/3.5		/3.5
Social Impact	15	67.5	67.5	60	60	52.5	45	52.5	75
		/4.5	/4.5	/4.0	/4.0	/3.5	/3.0	/3.5	/5.0
Visual Impact	1	5/5.0	5.5/5.5	4/4.0	4.5/4.5	3.5/3.5	3/3.0	2/2.0	5/5.0
Noise Impact	4	16	16	18	18	20	22	24	24
		/4.0	/4.0	/4.5	/4.5	/5.0	/5.5	/6.0	/6.0
Transport Efficiency	14	63	63	77	77	70	84	42	56
		/4.5	/4.5	/5.5	/5.5	/5.0	/6.0	/3.0	/4.0
Land Use Planning	24	156	156	72	72	144	48	96	108
		/6.5	/6.5	/3.0	/3.0	/6.0	/2.0	/4.0	/4.5
Commercial Impact	13	58.5	58.5	65	65	39	45.5	45.5	65
		/4.5	/4.5	/5.0	/5.0	/3.0	/3.5	/3.5	/5.0
Total Weighted Criteria	100	540 (1)	526 (2)	441 (4)	427 (6)	445 (3)	349 (7)	349 (7)	434.5 (5)
Estimated Cost ($M)		81.5	61.7	79.1	59.4	63.3	62.6	67.7	67.0
Value Ratio		6.63	8.52	5.58	7.19	7.03	5.58	5.16	6.49
Ranking		**(4)**	**(1)**	**(6)**	**(2)**	**(3)**	**(6)**	**(8)**	**(5)**

The matrix indicates that Route A scored highest on the basis of total weighted criteria with Route A2 scoring second highest. Route C scored third highest. However, when total project costs are taken into account in the calculation of value ratio, Route A2 scored the highest, Route B2 scoring second and Route C remaining third.

On the basis of this analysis Route A2 can be described as the best performing option and the option that delivers the highest level of value for the greatest number of stakeholders, i.e. the best value to the community.

In the evaluation of the options there was very strong support for selecting a route with the least ecological impact and potential to fragment areas of ecological sensitivity, reflecting a recognition of the high ecological value of the area as a whole and of specific locations. To a large extent this resulted in the lower weighting of Routes B, D and E as well as routes further west. At the same time there was a desire to identify a route that would minimise impacts on residential areas (existing and future). This resulted, in part, in the lower weightings for Routes C, D and E. It was considered that while Routes A/A2 were in close proximity to Ocean Shores the new road would be further away than the existing highway and that noise could be adequately managed.

The disadvantages of Route A2 were also identified and time during the VMS was devoted to considering actions and strategies aimed at addressing these. The disadvantages included the potential impacts on commercial activities (both restaurants on the southern side of the Brunswick River and on the Salad Bowl Service Station and Caravan Park) and impacts on wetland areas. It was also acknowledged that Route A2 would have an impact on the Brunswick Heads

Nature Reserve and that any proposal requiring part of the Nature Reserve would also require legislation to change the Nature Reserve boundaries.

Following the VMS additional options (i.e. Routes F and G and their options) were investigated to the same level as Routes A, B, C, D, and E. A comparison of advantages and disadvantages was undertaken to determine if any of these options might offer superior performance to Route A2.

The additional investigations and consideration of the advantages and disadvantages of Routes F1, F2, G1, G2, and other combinations indicated that they are inferior to Route A2. This conclusion was reached on the basis that these latter options would result in greater ecological impact. These options would impact on threatened species, fragment large areas of vegetation and sever wildlife corridors as well as conflict with local planning objectives by creating a new corridor through natural and rural areas; and have significant impact on the floodplain, rural amenity and existing and potential agricultural areas.

Ultimately, Route A2 was selected and announced by the Minister for Roads as being the preferred route for the purposes of further detailed environmental assessment and is the preferred option which is described in this EIS.

In summary, the reasons for selecting Route A2 were:

- it would have the least ecological impact. This route can be developed with minimal impact on the Brunswick Heads Nature Reserve and on the adjoining wetland areas;
- it is a widening of an existing road corridor through the Brunswick Heads Nature Reserve rather than the creation of a new corridor in this location;
- it is consistent with Byron Council's planning strategies, concentrating road infrastructure within a single corridor;
- the selection of the LEP corridor would have resulted in significant impacts on the Ferry Reserve Caravan Park to the extent that the Park would no longer have been viable. The caravan park accommodates both permanent and temporary residents;
- it would have the least impact on prime agricultural land;
- noise can be managed. Route A2 for most of its length would be further away from the residential areas than the current alignment of the existing highway. Much of Route A2 would be in cut thereby minimising noise impacts. In other areas, noise mitigation measures would be part of the design;
- this option meets acceptable engineering design standards and meets the RTA's project objectives;

- it connects with the Brunswick Heads Bypass (which was under construction at the time).

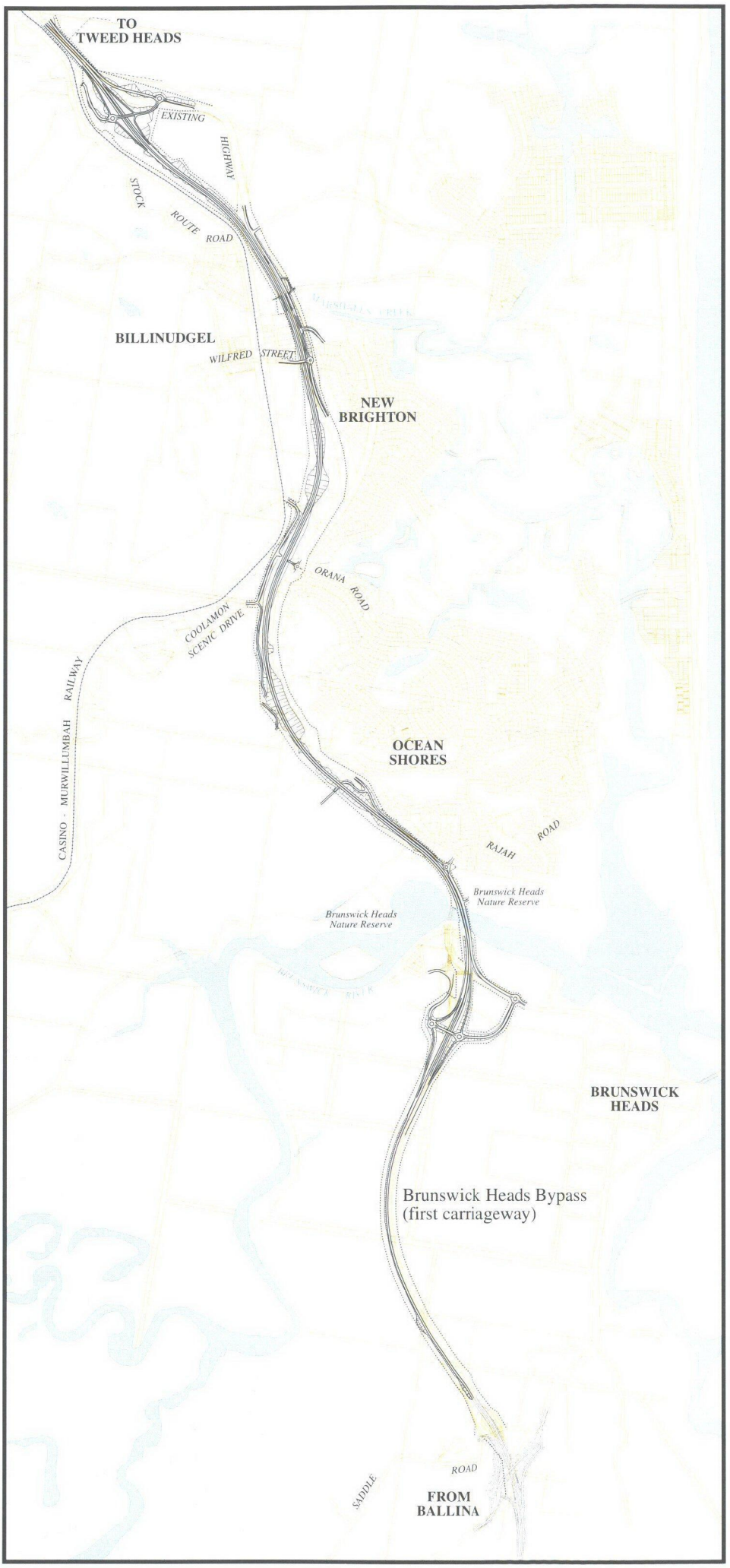
5.4 Refinement of Route A2

Detailed investigations of Route A2 commenced immediately following the Minister's announcement. In parallel with the engineering and environmental investigations there was an intensive period of consultation with property owners who were potentially directly affected by Route A2. The purpose of the consultation at this stage was to establish potential individual property impacts and requirements.

There were numerous modifications and refinements made to Route A2 during this phase of the study to arrive at the alignment described in this EIS. The most significant of these are described below:

- The southern interchange has been located further south and with a modified design to that shown at the route selection phase. This was primarily as a result of the poor ground conditions at that locality, and it also provided benefits in reducing the potential visual and noise impacts on the Ferry Reserve Caravan Park and river foreshore area.
- The bridge and the area immediately north of the Brunswick River have been designed to result in the minimum practicable cross-section. In the vicinity of Rajah Road the local road and the proposal have been located and designed to minimise impact on properties. It was originally considered that there could be an impact on a greater number of houses than is now the case.
- A number of options were considered for the location and design of the interchange at Yelgun, including a split interchange. The design shown in this EIS is the most efficient for traffic and minimises impacts on land use.

Taking into account the above modifications and refinements, the preferred route option for the proposal is shown on **Figure 5.3**. The design of the preferred option is described in detail in Section 6.





Legend

Proposed Road Corridor

Figure 5.3
PREFERRED ROUTE ALIGNMENT

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part C

Project Details

C

6. Description of Proposed Activity

This Section describes in detail the configuration of the proposal including the location and layout of intersections, cut and fill requirements, the types of drainage and erosion control structures that would be implemented and the traffic and access arrangements that would be required during the construction and operational phases of the project. Construction methods and typical equipment that would be used to build the road as well as an indication of the schedule for construction works is also outlined. An energy statement for the proposal taking into account energy consumption during the construction period and energy savings during the operational phase of the project is also provided.

6.1 General

The description of the proposal is based on the concept design which was prepared during the study and documented in Working Paper No.2 - Road Concept Design Report. For the purposes of this EIS, the concept design illustrates the general configuration of the proposal and includes the extent of the proposed road corridor, the location of interchanges, areas requiring cut and fill, local road realignments and a preliminary road profile.

Detailed design of the proposal would only be undertaken if the RTA determined that it was to proceed. The detailed design stage would use the concept designs and the information provided in this EIS with regard to environmental safeguards and mitigation measures, as well as submissions received from both the community and statutory authorities as a result of the exhibition period and any relevant conditions to approval. A more detailed engineering investigation of the proposal would then be undertaken so that construction could commence. During the detailed design stage, existing utilities and services located along the proposal corridor would be precisely identified. These would need to be adjusted or relocated prior to construction commencing, subject to negotiations with the relevant authorities.

6.2 Design Considerations

6.2.1 Carriageway Alignment

The proposed alignment is shown (running south to north) in plan and longitudinal section in **Figures 6.1 a-e**. The proposal commences just north of the Saddle Road (at the southern end of the Brunswick Heads Bypass) and extends to Yelgun. The total construction length of the proposal is 8.7 km.

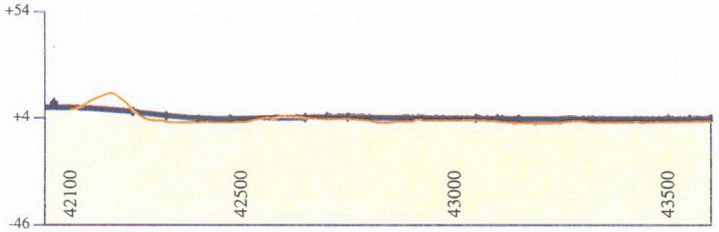
The proposal includes the duplication of the Brunswick Heads Bypass, the first carriageway of which was recently opened. The second carriageway would be constructed on the western side of the existing carriageway to approximately 500m south of its temporary connection to the existing highway at the Ferry

SINCLAIR KNIGHT MERZ

N

0 400m

Figure 6.1a
DESIGN AND PROFILE



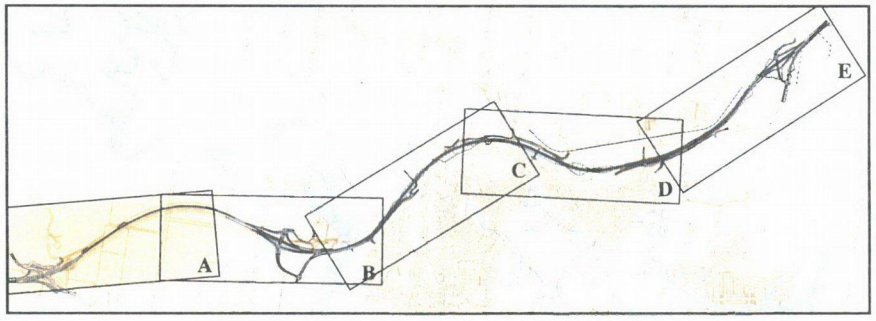
Datum RL -46.0
Scale = 1:4000 Hor - 1:800 Vert

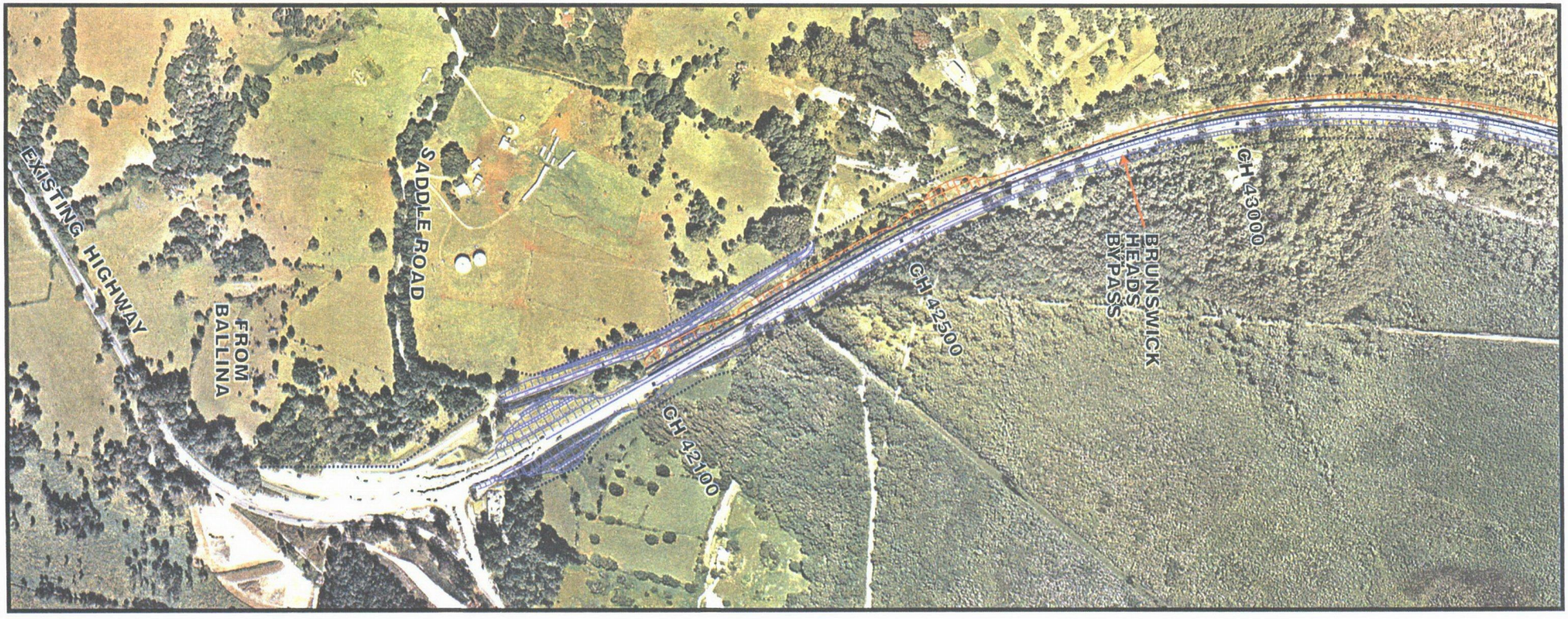
Legend

Cut

Fill

Proposed Road Corridor



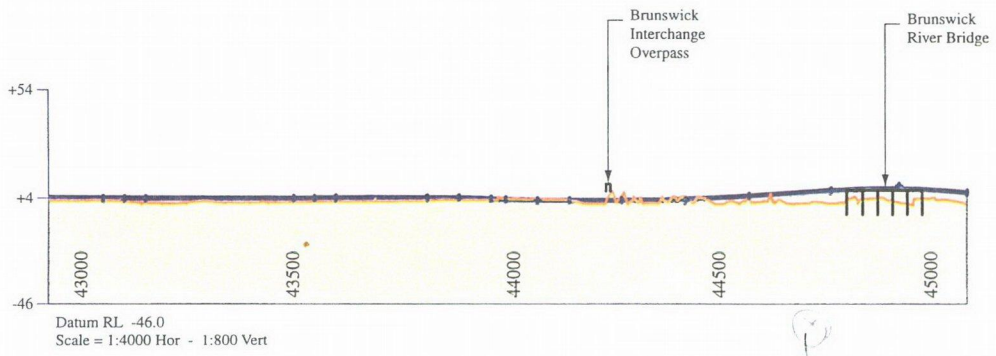


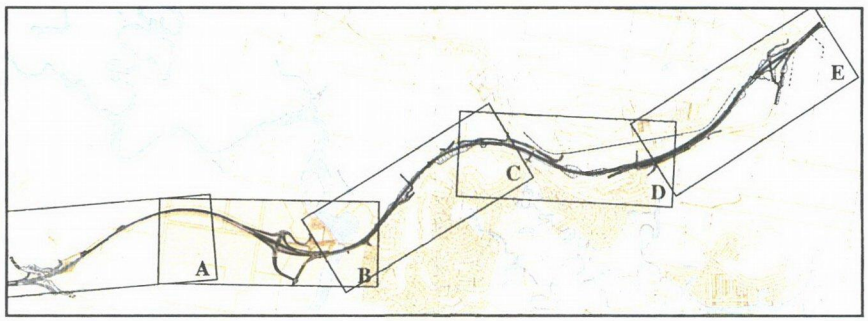
SINCLAIR KNIGHT MERZ

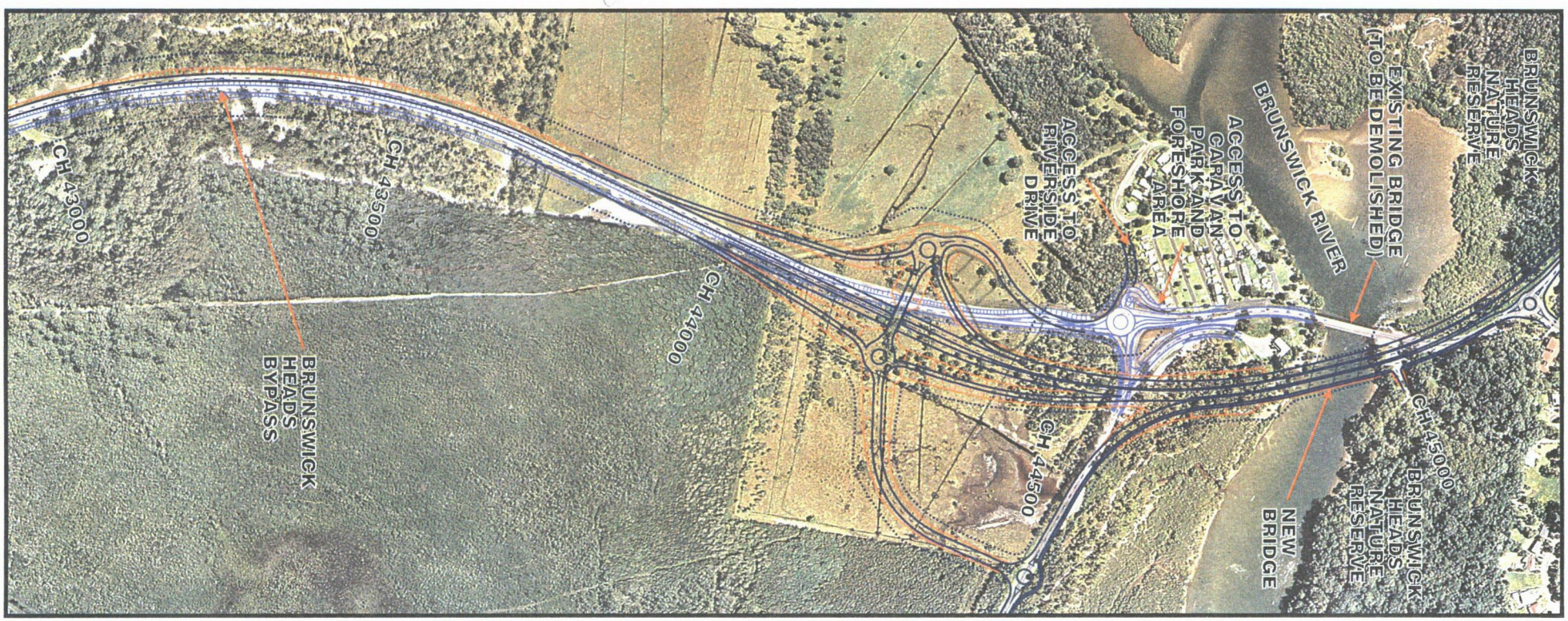
N

0 400m

Figure 6.1b
DESIGN AND PROFILE



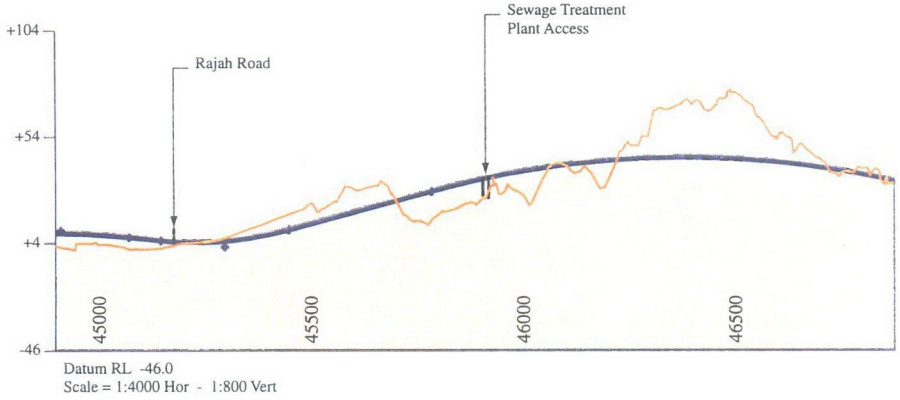


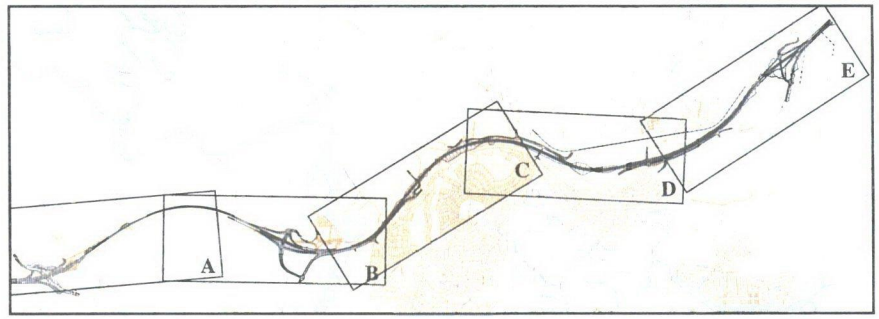


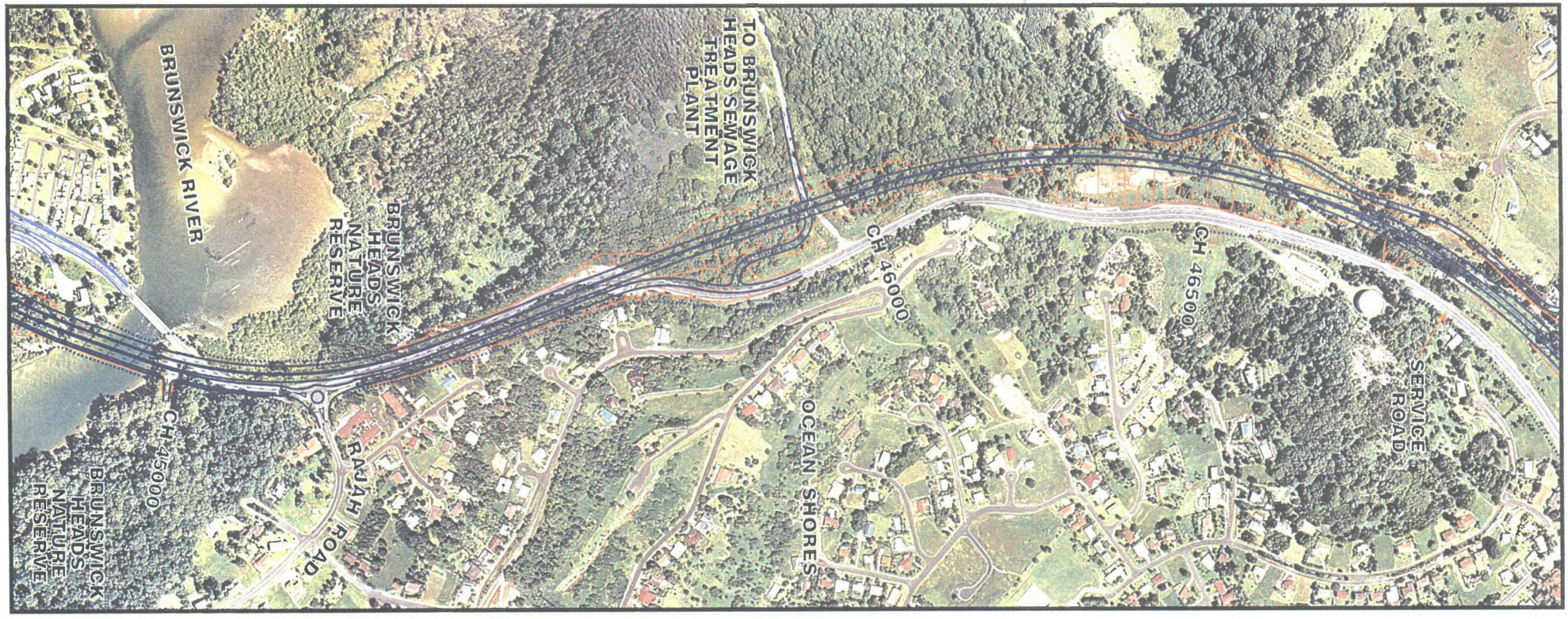
SINCLAIR KNIGHT MERZ

0 400m

Figure 6.1c
DESIGN AND PROFILE





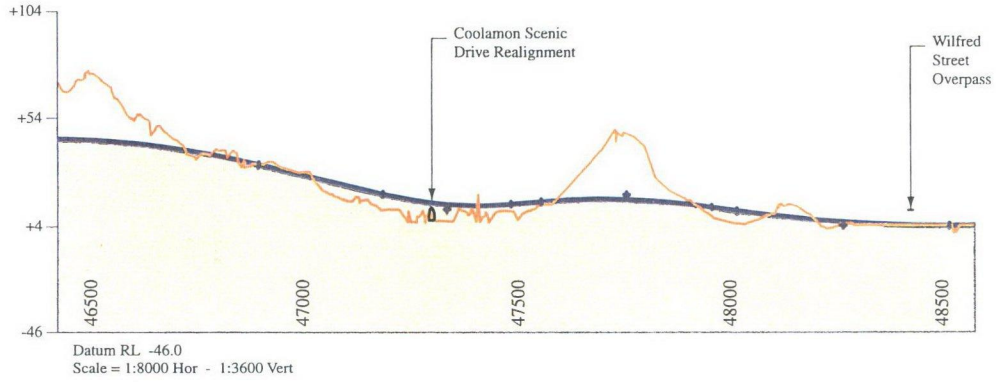


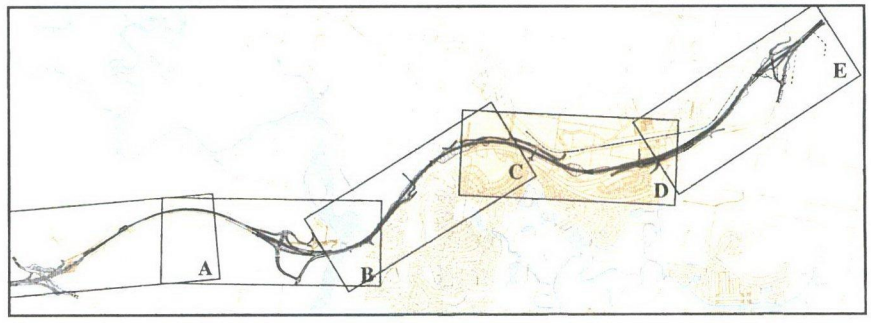
SINCLAIR KNIGHT MERZ

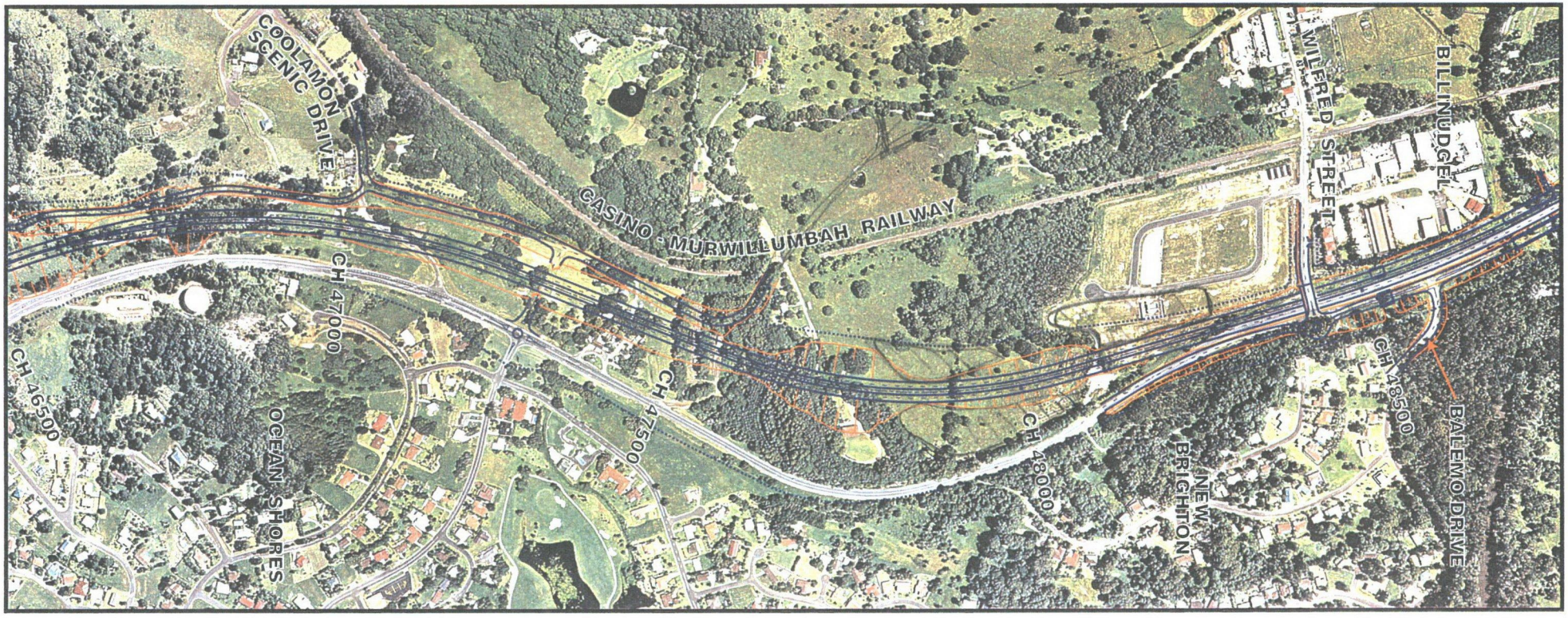
N

0 400m

Figure 6.1d
DESIGN AND PROFILE



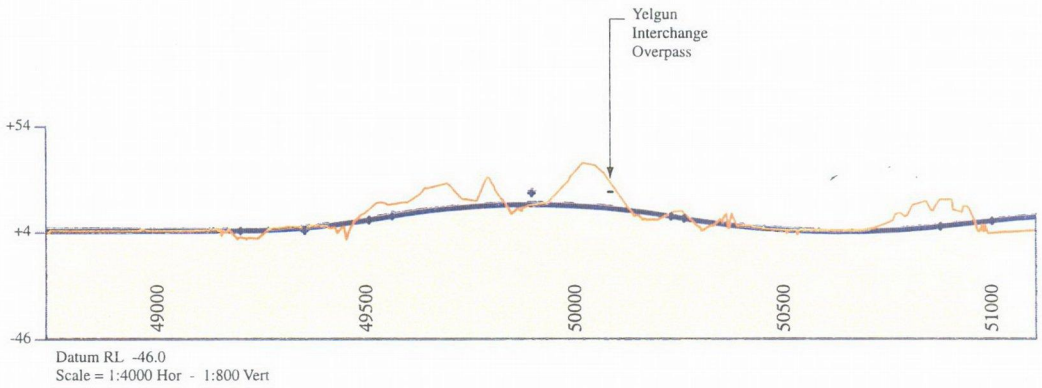


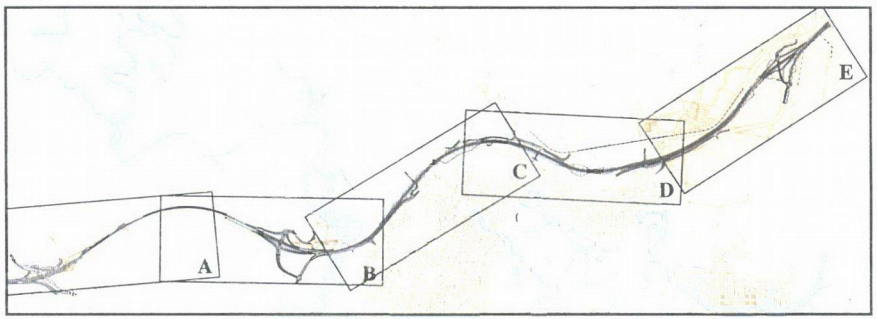


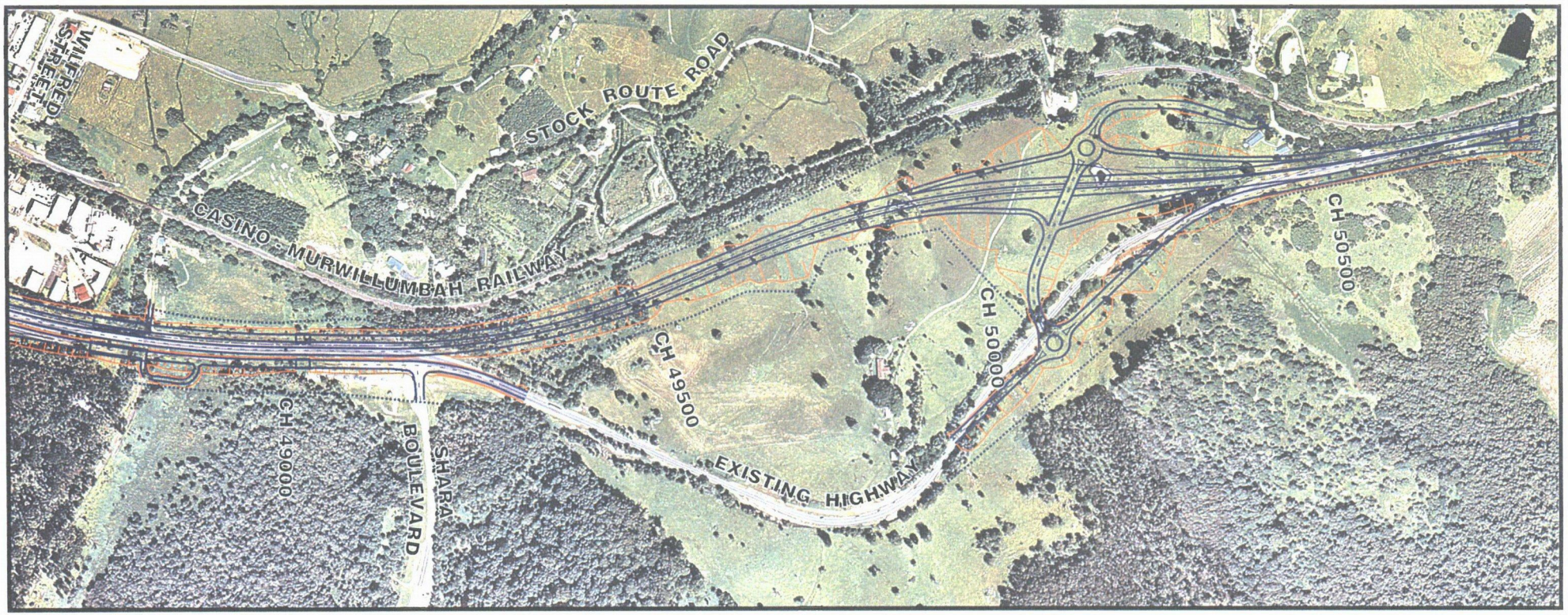
SINCLAIR KNIGHT MERZ

0 400m

Figure 6.1e
DESIGN AND PROFILE







Reserve Caravan Park. The remainder of the proposal, to Yelgun, would be a new dual carriageway facility.

Specifically, the new dual carriageway commences at an interchange at the northern end of the Brunswick Heads Bypass and extends in a north-easterly direction to cross the Brunswick River on a new bridge downstream of the existing bridge. The new bridge has been designed to carry six lanes of traffic - four lanes for the new dual carriageway, and two lanes for local traffic. The bridge design accommodates pedestrians and cyclists across the bridge, as well as under it on the southern side. The existing bridge across the Brunswick River would be demolished as part of the proposal.

North of the Brunswick River the proposal is generally within the existing highway road corridor through the Brunswick Heads Nature Reserve, although the corridor required for the proposal is slightly wider.

The existing highway would be realigned along this section and maintained as a local service road. The area required for the proposal and the service road would be kept to a minimum along the Brunswick Heads Nature Reserve to minimise impacts on the Nature Reserve. This would be achieved by using concrete Type F (New Jersey) barrier separation between the dual carriageways as well as between the proposal and the local road, and using retaining walls to support the road formations.

North of Rajah Road the proposal and the local road would be side by side at different levels, separated by a retaining wall to minimise the impact on sensitive vegetation on the western side, in Smoky Valley. Retaining walls would be provided along some sections of the local road for properties in Ocean Shores adjoining the existing highway, to minimise affects on property.

The proposal then generally runs in close proximity to, and west of, the existing highway, to Billinudgel.

In the vicinity of Billinudgel the proposal uses the existing highway as the southbound carriageway, with a new northbound carriageway to be constructed parallel and to the west. The "old" highway formation (pre 1981) would be reconstructed as a local road, which would be connected to Billinudgel by means of an overpass across the proposal at Wilfred Street.

The proposal then continues in a northerly direction and east of the existing railway line to a proposed interchange near Yelgun. Immediately north of the interchange the proposal is located between the Billinudgel Nature Reserve and the Casino-Murwillumbah Railway Line, and coincides with the existing highway. The cross-sectional configuration would be kept to a minimum along the Nature

Reserve, adopting similar arrangements to those through the Brunswick Heads Nature Reserve.

The proposal connects to the existing highway alignment south of the Dirty Flat Road intersection.

This proposal includes retention of the existing highway facility as a local access road between Brunswick Heads and Yelgun. There would be a need to relocate some short sections of the existing highway, in the vicinity of Rajah Road at Ocean Shores and at Billinudgel. Overall, there would be improved ease and safety of local access. The proposal includes a new roundabout at Rajah Road and at Orana Road, and a bridge over the proposal at Billinudgel to provide better access to Ocean Shores.

The proposal would be accommodated with a road reserve typically 70m wide but exceeding 100m along deep cuttings. Proposed interchanges may require a wider area, up to 160m either side of the centreline of the road reserve, such as would be required for the interchange at the northern end of the Brunswick Heads Bypass and with the existing highway near Yelgun. **Figures 6.2 a-d** provide artists impressions of various views of the proposal.

6.2.2 Carriageway Design

The proposal would be designed to comply with all relevant RTA design requirements. The design parameters selected provide an appropriate level of service while minimising costs and potential environmental impacts. The design criteria are detailed in **Table 6-1**.

Table 6-1 - Road Design Criteria

Criteria	
Design Speed	110 km/hour
Stopping sight distance	210 m
Minimum radius of horizontal curves	600 m (1,200 m desirable)
Maximum gradient	4-6%
Minimum K value stopping distance for crest curves	95
Minimum K value headlight distance for sag curves	34

The design parameters outlined above correspond to the requirements of the RTA's Road Design Guide (1989) and guidelines issued for the Pacific Highway. In general, the proposal would comprise four 3.5m traffic lanes with inner sealed shoulders of 0.5m, a sealed outer shoulder/ breakdown lane of 2.5m, and a 1.0m verge adjacent to the breakdown lane. The cross-section varies in areas where there is a need to reduce the width of the formation because of constraints or where the proposal and the local service road run on common formation. Therefore in some cases the median separation is only 2.6m including a Type F (New Jersey) concrete barrier. There may be wire rope in some sections.

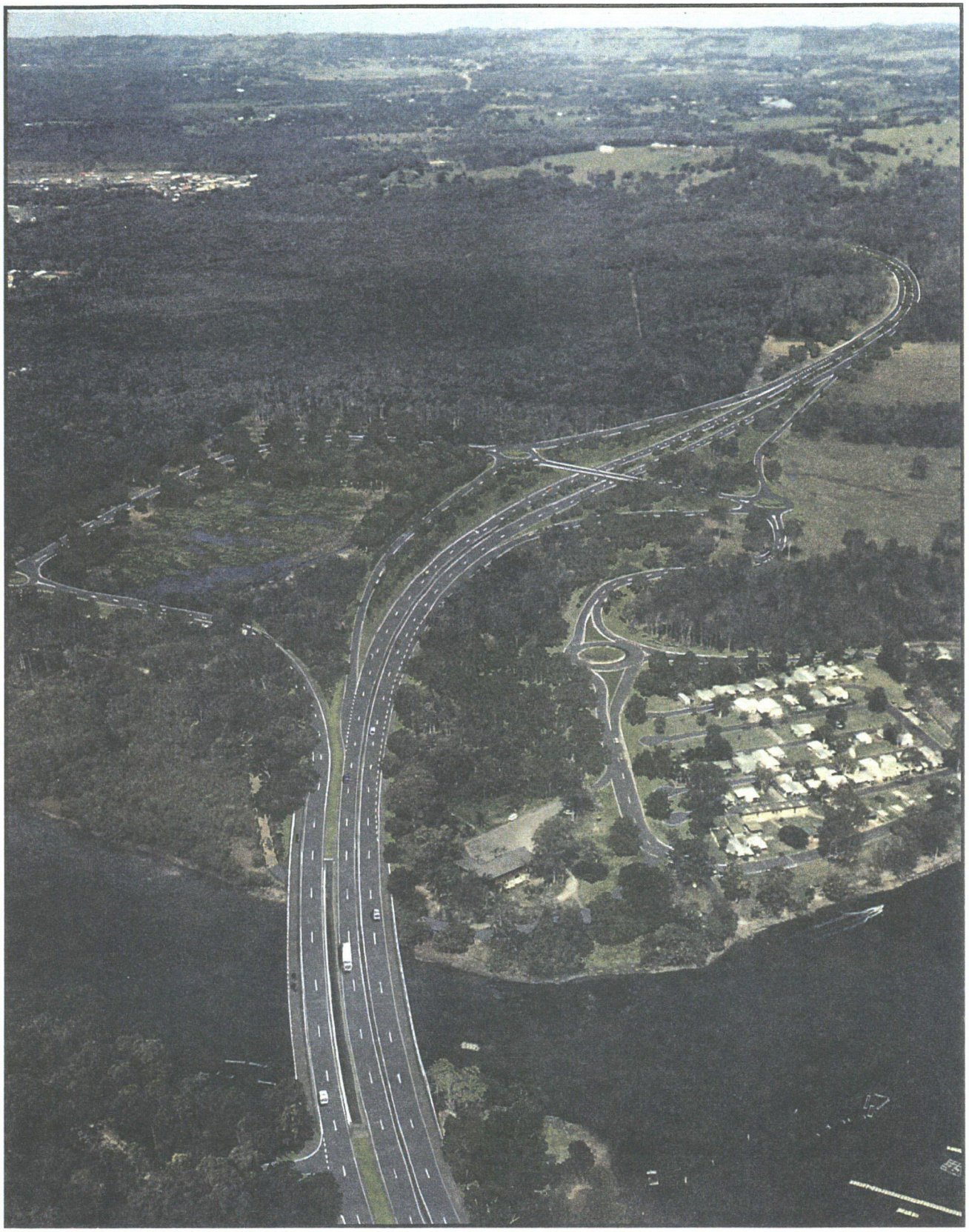


Figure 6.2a
ARTISTS IMPRESSION OF THE PROPOSAL SOUTH OF THE BRUNSWICK RIVER (VIEW LOOKING SOUTH)



Figure 6.2b
ARTISTS IMPRESSION OF THE PROPOSAL NORTH OF BRUNSWICK RIVER IN VICINITY OF RAJAH ROAD (VIEW LOOKING NORTH)



Figure 6.2c
ARTISTS IMPRESSION OF THE PROPOSAL NEAR BILLINUDGEL (VIEW LOOKING SOUTH)



Figure 6.2d
ARTISTS IMPRESSION OF THE PROPOSED YELGUN INTERCHANGE (VIEW LOOKING NORTH)

Being a dual carriageway high standard road proposal, there would be a physical separation of opposing traffic flows by way of a depressed median 9.0m wide, except between the Brunswick River and Coolamon Scenic Drive and along the Billinudgel Nature Reserve where a Type F (New Jersey) concrete barrier would be used.

The carriageway pavement would feature either hessian drag concrete or flexible pavement. These would be surfaced with open graded asphalt where required for noise mitigation. Typical cross-sections along the proposal, including the proposed new bridge over the Brunswick River, are shown on **Figures 6.3 a-f**.

6.2.3 Cut and Fill Requirements

The concept design for the proposal targeted a balance of cut and fill as far as possible, with minimum excess cut when taking into account 60,000 m^3 fill which is required by the RTA for the Ewingsdale interchange project. Earthworks volumes for the total project include interchanges and works associated with the service road and local road adjustments. Calculations indicate that there would be 1.3 million m^3 of cut material and 1.2 million m^3 of fill material. The material excavated from the cuttings would generally be suitable as fill for the embankments.

A significant shortfall of fill material (approximately 0.25 million m^3) occurs south of the Brunswick River, which means that substantial haulage of fill material would be required across the river. The haulage distance is relatively short, with the main source of material being the major cut proposed about 1.3 km north of Rajah Road.

The material would be transported by trucks along the existing highway. The construction program for the haulage would be set so as to minimise disturbance to traffic flows along the highway, while maintaining the efficiency of construction works. The potential impacts of this haulage have been taken into account in the assessment of traffic movements, refer Section 7.

Cut batters would vary between 1:1 and 2:1 (horizontal to vertical) depending on the material encountered in the cuttings. Berms would be provided at 7m height intervals in deep cuttings for catching rock spills. The berms would be landscaped to enhance the visual appearance of the cuttings. Fill batters would be typically 2:1, flattening to 4:1 in areas where the fill is less than 1.5m high and reducing to 1:1 across Smoky Valley to reduce the impact on sensitive vegetation.

The extent of vegetation clearing and soil stripping prior to earthworks would be kept to a practical minimum, allowing for typically 3m to 5m on the bottom side of fill batters and above the top of cuttings (for access and drainage controls).

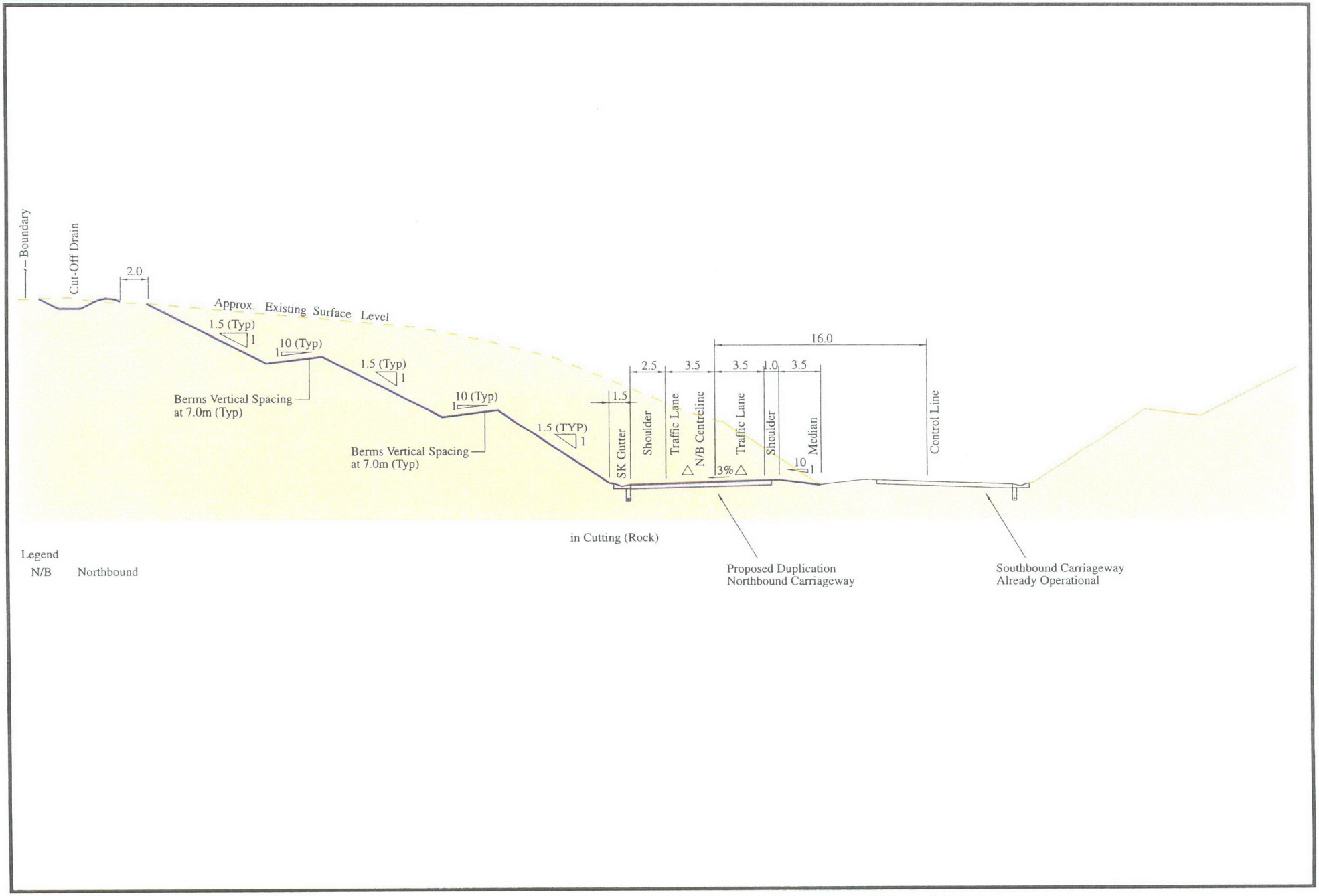


Figure 6.3a
TYPICAL CROSS SECTION OF PROPOSED DUPLICATION OF BRUNSWICK HEADS BYPASS

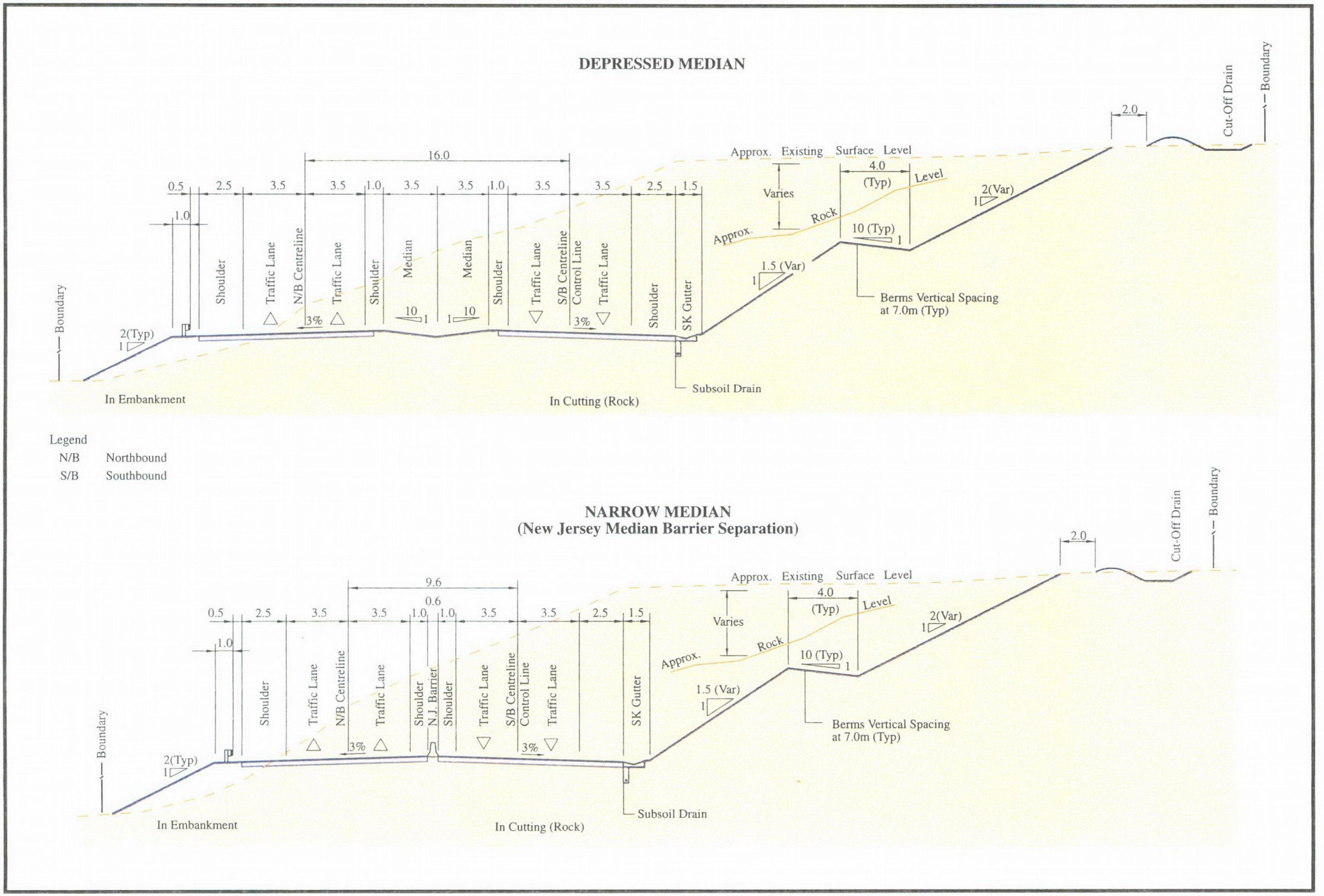


Figure 6.3b
TYPICAL CROSS SECTION — DIFERENT MEDIAN TREATMENTS

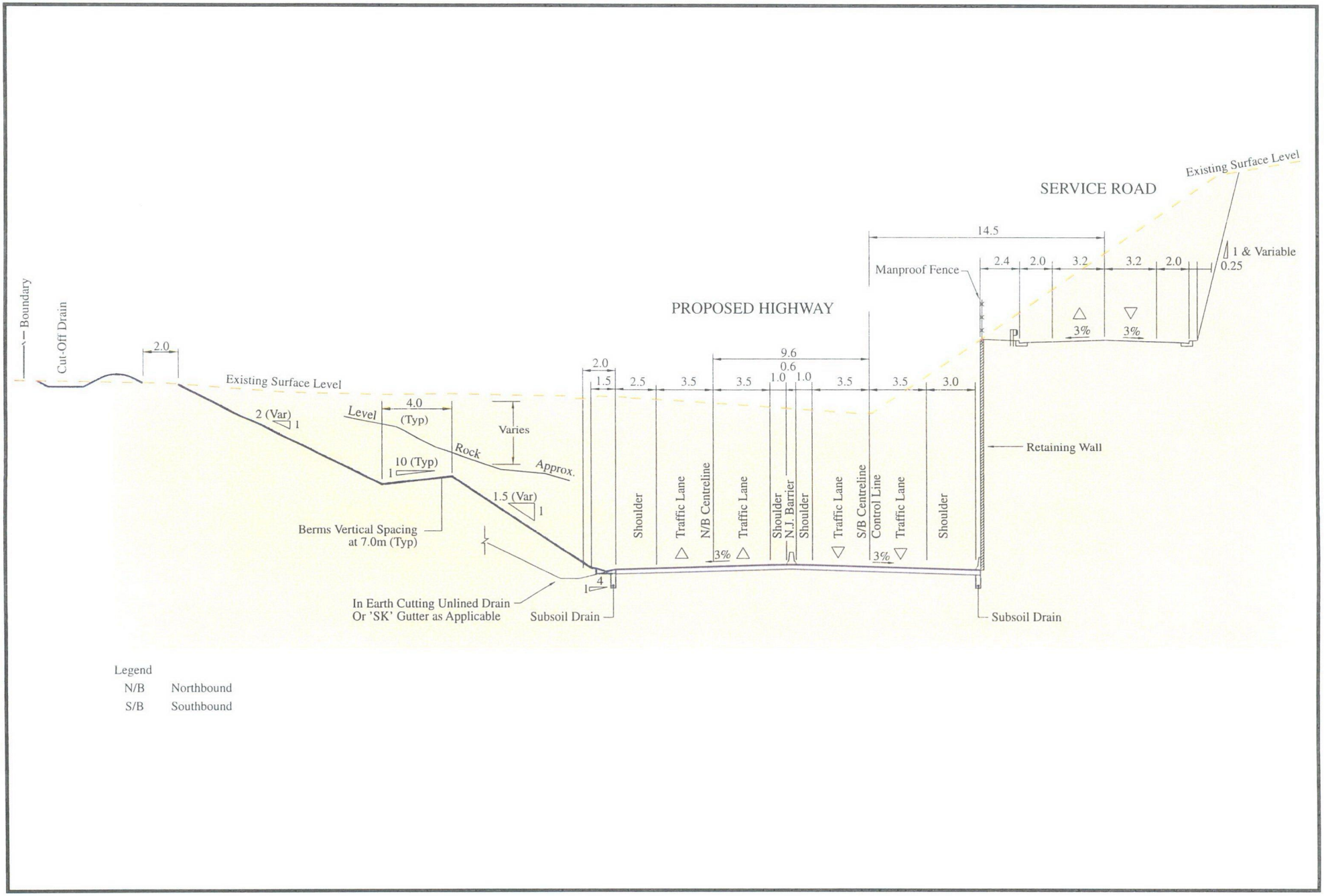
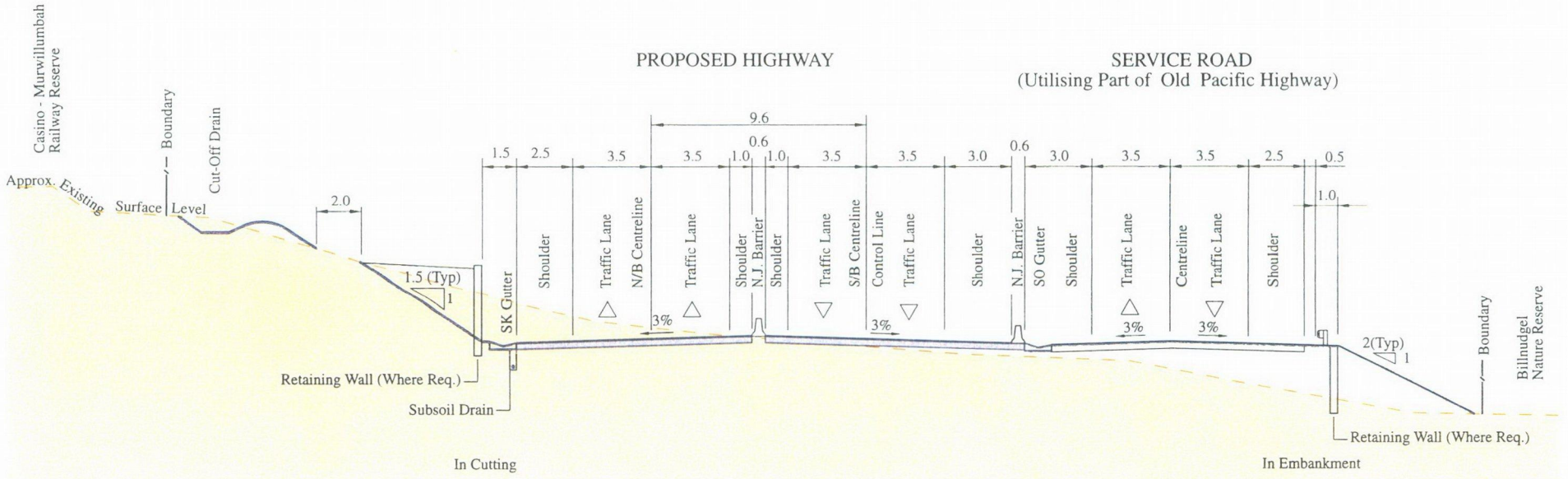


Figure 6.3c
TYPICAL CROSS SECTION — FROM RAJAH ROAD TO SEWAGE TREATMENT PLANT ACCESS ROAD



Legend

N.J. Barrier	New Jersey Barrier
N/B	Northbound
S/B	Southbound

Figure 6.3d
TYPICAL CROSS SECTION — ADJACENT TO BILLINUDGEL NATURE RESERVE

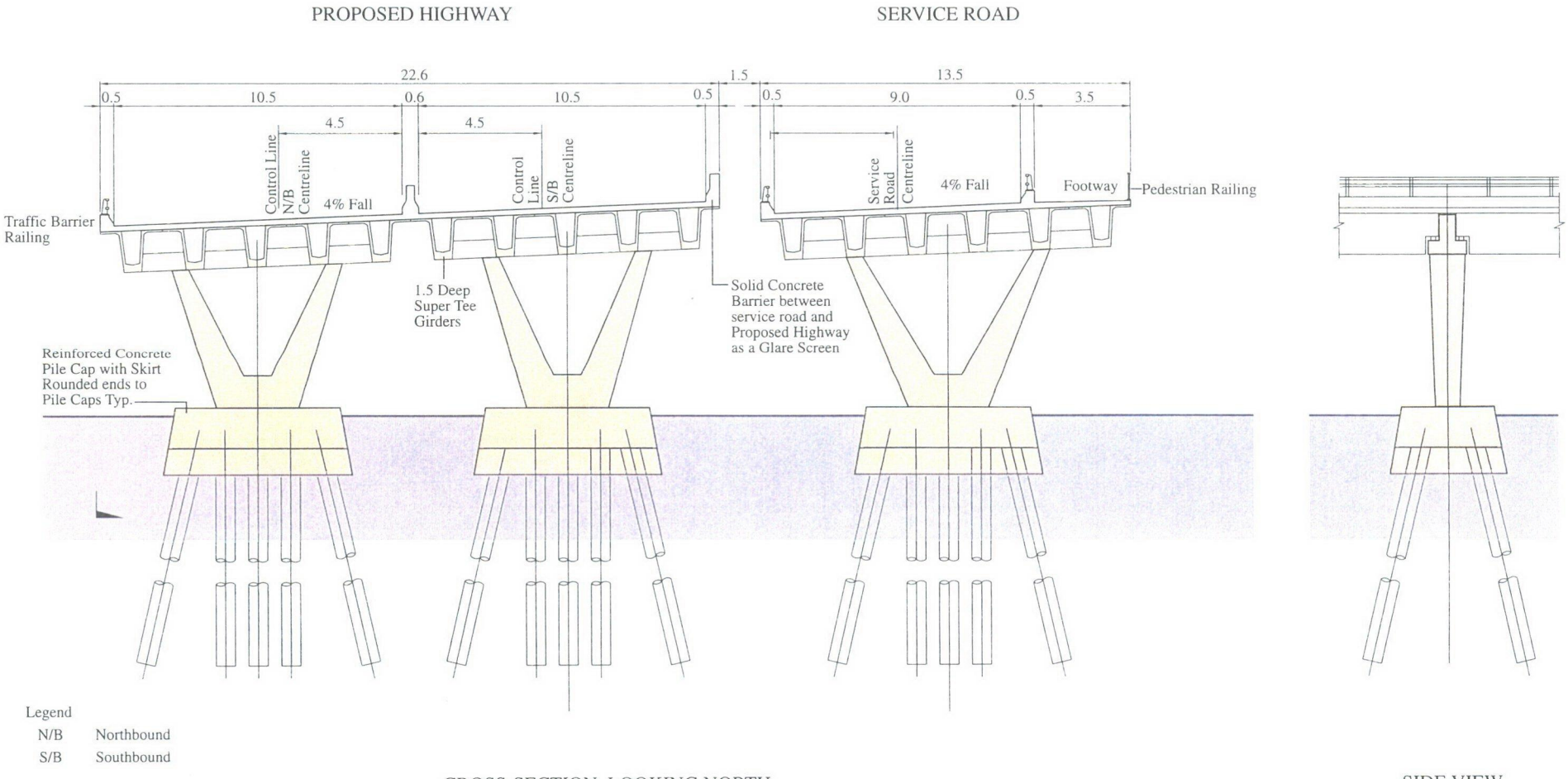


Figure 6.3e
TYPICAL CROSS SECTION-PROPOSED BRIDGE OVER BRUNSWICK RIVER

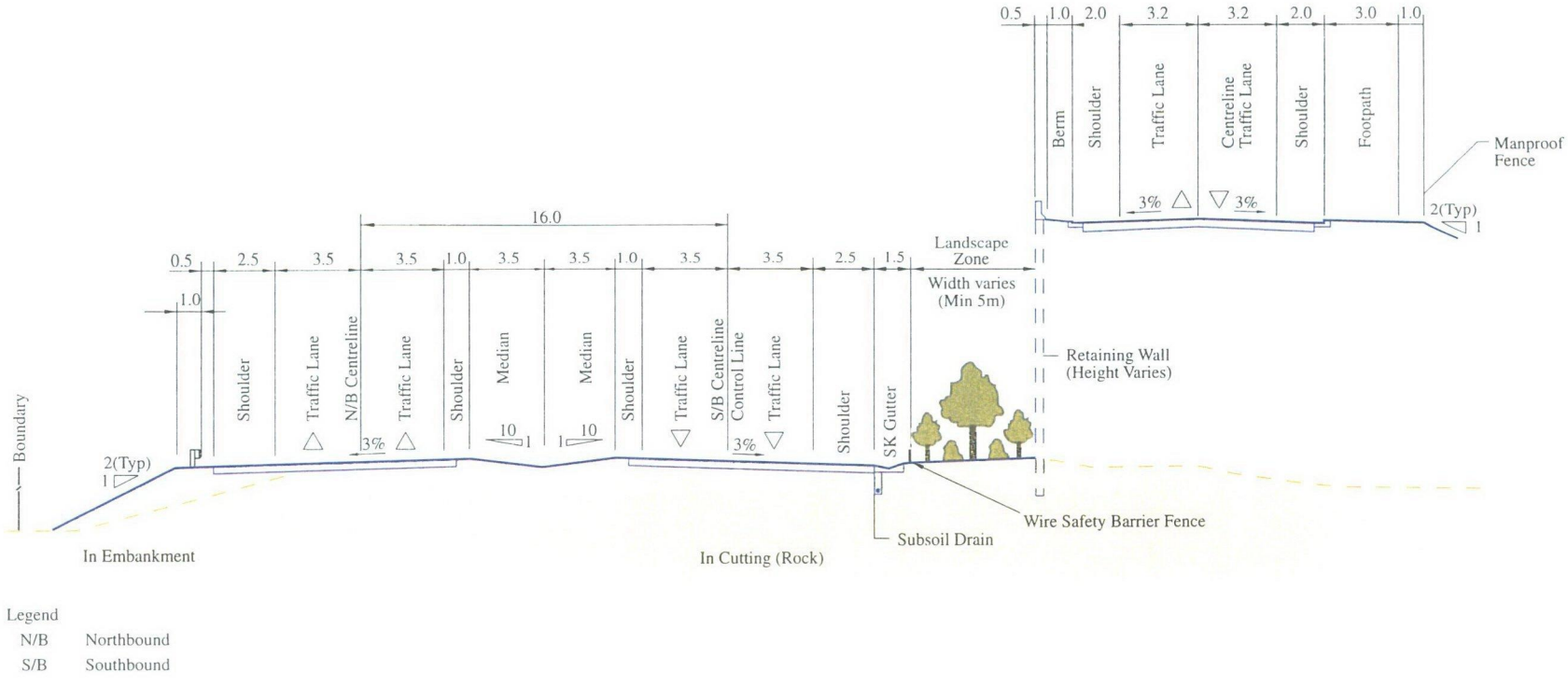


Figure 6.3f
TYPICAL CROSS SECTION — AT BILLINUDGEL

The height of fill across floodplain areas or watercourses would be such that the edge of the formation would be equal to or above the 1 in 100 Year average recurrence interval (ARI) flood levels. This is the flood level with a probability of occurrence of once in 100 years.

6.3 Drainage and Erosion Control

6.3.1 Proposed Drainage Design

Drainage design of the proposal would conform to the requirements of Australian Rainfall and Runoff (1987). The proposed design criteria are summarised in **Table 6-2**.

Table 6-2 - Drainage Design Criteria:

Criteria	
Cross Drainage	1 in 100 year ARI (50% allowance for blockage if pipe less than 600 mm diameter)
Road Drainage	1 in 5 year ARI
Freeboard at Edge of Road Formation	300 mm (above 1 in 100 year flood levels)
Pipe System Design	Pressure Flow
Pit Losses	Missouri Charts and Hare Charts
Water Quality	Sedimentation basins to be provided where necessary
Incident Management	Additional storage to be incorporated in sedimentation basins

Note: ARI = Average Recurrence Interval

Preliminary sizing of cross drainage structures has been carried out as part of the concept design undertaken for the EIS.

An investigation and design of the necessary drainage arrangements associated with the proposal was undertaken as part of the EIS and is detailed in Section 11. Further investigations would be undertaken during the detailed design stage of the proposal. The investigation and design of major structures associated with the Brunswick River and Marshalls Creek floodplains forms part of a separate report (Working Paper No.5 - Water Quality and Hydrology Assessment).

In general, where the road is in cut, the runoff generated by the road would be concentrated in a drainage system, and directed to the constructed stormwater wetlands for water quality treatment prior to discharge into local creeks and downstream waters (refer Section 10). Wherever possible, grassed swales/channels would be used for the conveyance of road runoff to filter stormwater. Stormwater would be directed to a number of stormwater interceptor structures and also to constructed wetlands (refer Section 10).

Cross drainage structures are also proposed to channel stormwater and flood runoff under the proposal. Culverts of suitable size to cater for flows experienced in a runoff event with a 1 in 100 Year ARI would be constructed under the road

embankment. These would ensure that flood waters do not increase the flood liability of existing lands in the area. Road drainage would be designed for 1 in 5 Year ARI storm flows as per the design criteria outlined in **Table 6-2**. Minor cross drainage structures (other than bridges) are listed in **Table 6-3**. Along the duplication of the Brunswick Heads Bypass cross-drainage structures would match the existing culverts.

Table 6-3 - Minor Cross-Drainage Structures Proposed

Road Chainage	Size	Type
Under Brunswick Heads Bypass Duplication	Structures to match existing size	
45100	1500	RCP
45780	900	RCP
STP access	750	RCP
Service Road	750	RCP
46190	600	RCP
46740	900	RCP
46860	600	RCP
47240	three culverts 2700 mm wide by 1200 mm high	RCBC
47350	two culverts 1800 mm wide by 1200 mm high	RCBC
Under Coolamon Scenic Drive connection	three culverts 3000 mm wide by 1200 mm high	RCBC
Augment existing highway	three culverts 2700 mm wide by 1500 mm high	RCBC
48015	600 mm	RCP
48220	one culvert 1500 mm wide by 900 mm high	RCBC
Under existing highway	one culvert 1500 mm wide by 900 mm high	RCBC
49400	two 1500 mm	RCP
49775	450 mm	RCP
49900	750 mm	RCP
50340	two culverts 2400 mm wide by 1200 mm high	RCBC
50730	two culverts 2400 mm wide by 1200 mm high	RCBC
Under highway deviation	750 mm	RCP

Note: RCP = Reinforced Concrete Pipe
RCBC = Reinforced Concrete Box Culvert

6.3.2 Erosion and Sedimentation Control

To mitigate the potential impacts of erosion, sedimentation and water pollution in the waterways of the study area an Erosion and Sediment Control Plan would be prepared during the detailed design and specification stages of the proposal and would form part of the construction contract. The detailed plan would include measures aimed at minimising the erosion of exposed soil surfaces, including preserving as much as possible of the existing vegetation, and reducing the time during which disturbed surfaces are exposed. Adequate buffer zones between areas of disturbance and natural drainage lines would be provided.

Erosion control structures such as diversion channels, level spreaders and contour drains to convert concentrated flow from diversion channels to non-erosive sheet flows, and outlet protection structures would be included. These structures serve to reduce runoff velocities and flow quantities, thereby minimising soil erosion.

Typical sediment control measures such as sediment traps, sediment filters and sediment basins likely to be required are discussed in Section 10 and shown on **Figure 6.4**. These structures trap and retain any eroded sediments, thus preventing them from leaving the site. A number of constructed wetlands would be included in the design and these would incorporate trash racks and stormwater interceptors which would capture floatables, large debris, coarser sediments and oil and grease. These wetlands would comprise shallow ponds with emergent reeds which filter suspended sediments and associated contaminants from water. The pollutants in water are taken up by the various physio/channel and biological processes which take place in the water and the wetland soils. The wetlands would be maintained and harvested on a regular basis to maintain their effectiveness.

A site rehabilitation program would be prepared during development of the detailed design in order that all exposed areas would be re-established in the shortest possible time. This program would be included as part of the construction contract. This would include progressive revegetation of the disturbed areas during construction.

All control structures implemented would be regularly inspected and maintained to ensure that they are fully functional.

Any erosion and sedimentation control works to be undertaken as part of the proposal would be required to comply with both Section 17 (licences in respect of certain drains) and 19 (certain apparatus not to be installed except in accordance with a pollution control approval) of the Clean Waters Act, 1970.

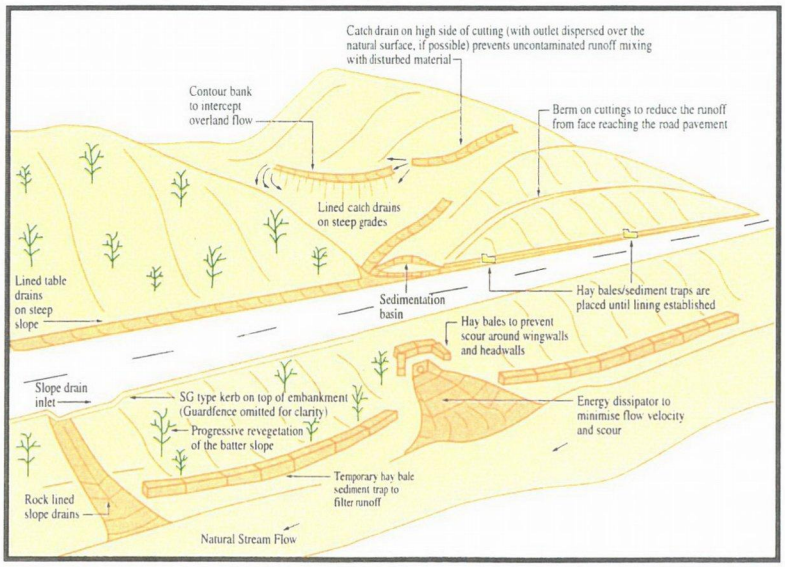


Figure 6.4
TYPICAL EROSION AND SEDIMENT CONTROL STRUCTURES

6.4 Fencing, Lighting and Signposting

The reserve for the proposal would be fenced in a manner consistent with adjoining land uses to prevent pedestrian and unauthorised access, and for safety reasons. In rural areas this would be post and wire type fencing; in urban areas it would be 1.8m chain wire or possibly a fence with acoustic properties. At some locations there would be fauna exclusion fencing. Access to the proposal would be limited to maintenance vehicles only. The proposal would not be lit except at interchanges in accordance with the AUSTROADS Roadway Lighting Guide (AUSTROADS, 1988).

Road signage would be determined during the detailed design stage and would conform to standard RTA practice. Discussions with Byron Council would be undertaken during this stage of the project regarding any specific signage requirements at each end of the proposal.

6.5 Traffic and Access Arrangements

6.5.1 Proposed Connections with the Local Road Network

Local access would be maintained by providing connections from the service road (i.e. the existing highway) to the existing road system and where necessary for properties across the proposed alignment. Existing connections to the highway from the east would also be maintained.

6.5.2 Local Access Arrangements and Road Modifications

Once the proposal is open the existing highway would become a service road, used primarily by local traffic. The arrangements for the long term ownership and responsibility for maintenance of this road would be the subject of negotiations between the RTA and Council, which would commence following the determination of the EIS. In this regard, the standard of local roads which would require realignment would be subject to the concurrence of Council.

The abandoned section of the existing highway, south of the existing bridge, would be used as access to the Ferry Reserve Caravan Park and would also provide for a separate access into the adjacent residential area. The road would be narrowed and modified to provide the maximum possible area of foreshore for rehabilitation. A new roundabout would be constructed for the intersection of Rajah Road and the local road, improving the traffic conditions at this location.

The road which provides access to the Brunswick Heads STP would be realigned with an underpass across the proposal. The connection to the local road would be south of the existing one, however the intersection treatment is unchanged.

Coolamon Scenic Drive would be realigned, via an underpass across the proposal, to connect to the local road with a new roundabout at Orana Road. The new

connection would be a substantial improvement compared to the existing intersection and would also link the realigned southern connection of Stock Route Road to the service road.

Banana Road would be realigned parallel to the new road formation over two sections, with a new connection to Coolamon Scenic Drive.

Wilfred Street would be connected to the local road with an overpass across the proposal, while Balemo Drive would be regraded to match the local road. The Balemo Drive intersection could be maintained as a T- junction, or a roundabout could be provided at this location.

Some modifications would be required at the intersection of Shara Boulevard and the service road to accommodate changes to the service road alignment.

The northern connection of Stock Route Road to the service road would be provided by linking this road into the Yelgun interchange.

6.5.3 Bridges and Culverts

A new bridge would be constructed across the Brunswick River and the existing bridge demolished as part of the proposal.

A bridge would be constructed across the realigned access to the STP and a concrete arch would be provided for the realigned Coolamon Scenic Drive under the proposal.

An overpass would be constructed over the proposal, providing a link between Billinudgel and Ocean Shores and new bridges matching the size of those existing would be provided under the northbound carriageway and the service road across the Marshalls Creek floodplain.

In addition to these a bridge would be required across the proposal at each interchange.

The design and construction methods of the structures would vary and would be dependent on local topographical and geotechnical conditions. At this stage, it is expected that all these structures would be of concrete construction. **Figure 6.3 e** shows a typical cross section of the proposed bridge over the Brunswick River.

Culverts would be constructed for the minor waterway crossings along the proposed alignment as detailed in **Table 6-3**.

6.5.4 Access Arrangements for Private Dwellings

In some areas the proposal would sever existing private access roads and therefore these would be reinstated as part of the proposed works. A number of access

roads would be constructed to enable individual property owners to obtain access to properties. These access roads would also cater for specific requirements for present and future agricultural pursuits. As necessary, this would include the provision of service roads that can accommodate heavy vehicles such as cattle trucks, semi-trailers and cultivation equipment. The location and type of new service roads that would be constructed as part of the proposal are detailed in Section 14.

6.5.5 Provision for Pedal Cyclists and Pedestrians

Specific provisions have been included in the design for local pedestrian and cyclist traffic along the service road at locations where demand for such links have been identified.

From Rajah Road a shared footpath/cycleway runs south along the eastern side of the service road connecting to existing pedestrian/cyclist facilities on the southern side of the Brunswick River. A new link, which is an extension of the existing pathway is also provided along the foreshore under the southern end span of the proposed bridge.

A shared footpath/cycleway would go from Balemo Drive along the eastern side of the service road to Wilfred Street connecting to Billinudgel along the proposed overpass. The footpath/cycleway would be carried across the main bridge over Marshalls Creek to link up with an existing facility.

Provisions for long distance cyclists along the proposal have been made through the inclusion of sealed shoulders and maintaining the continuity of these on the new Brunswick River Bridge.

6.6 Noise Attenuation Measures

The effect of construction and operational noise from the proposal is described in Section 8 of this EIS. In order to meet the required criteria for road traffic noise, it would be necessary to construct noise attenuation measures along certain sections of the proposal to protect the existing acoustic environment of adjacent residential areas. Therefore, as part of the construction of the proposal, roadside noise barriers or noise mounding would be installed to reduce the effects of road traffic noise. A variety of landscape treatments would be undertaken to screen the barriers from view or to provide a landscaped mound. The type and location of noise attenuation measures are further discussed in Section 8.

6.7 Landscaping

Landscaping works would be implemented as part of the proposal and as each stage of construction is completed in order to screen the proposal from sensitive

locations such as residential areas and to assist in soil conservation and erosion control. Landscaping treatments are discussed in detail in Section 15 of this EIS.

Topsoil management practices would be implemented during the construction period. Specifically, the following measures would be undertaken prior to any landscaping works:

- identify and mark out weed contaminated areas of topsoil prior to clearance;
- segregating weed contaminated topsoil from reusable topsoil during excavation;
- protecting and storing reusable topsoil; disposing of contaminated topsoil in an environmentally acceptable manner; and
- tracing imported topsoil to ensure that it is weed free.

6.8 Property Acquisition

The potential impacts on properties and indications of proposed property acquisition is detailed in Section 14. The land would be acquired in accordance with the provisions of the Land Acquisition (Just Terms Compensation) Act, 1991, which is also described further in Section 14.

6.9 Construction

6.9.1 Management

Construction of the proposal would probably take the form of a design and construct tender. It would be the responsibility of the successful contractor to determine the actual means of construction, including detailed design, scheduling of works and overall timing, to the satisfaction of the RTA and in accordance with any conditions of development approval, and subject to obtaining the necessary licences etc.

The description of construction methods provided here is typical for a proposal of this size and is adequate for the purposes of environmental impact assessment. The successful tenderer would be required to comply with the concepts provided in this EIS and with all adopted environmental safeguards.

6.9.2 Construction Methods

The construction would follow the regular pattern for roadworks and drainage. The main tasks would include:

- site establishment,
- clearing and demolition,
- temporary erosion and sediment control,
- topsoil stripping and management,

- bulk earthworks,
- drainage construction including water quality measures,
- installation of road side noise barriers or mounding,
- bridge construction,
- pavement construction,
- topsoiling and revegetation of batters and berms,
- landscaping,
- line marking and signposting,
- interchange lighting, and
- finishing works.

All the contractor's operations, equipment compounds and materials storage areas would be located within the road reserve or in adjacent areas. All sites used for these purposes would be securely fenced. All equipment, facilities and temporary services would be removed on completion of the proposal and the sites rehabilitated as part of the landscaping strategy (refer Section 15).

6.9.3 Construction Traffic

Construction traffic would include traffic from the construction workforce as well as heavy vehicles delivering material and equipment to the work sites. Consultation would be held with Byron Council to determine which local roads could be used by heavy construction traffic based on traffic safety, noise, and road condition considerations. It is expected that the existing highway would be the main access for transport of machinery and materials to work sites.

The most significant construction traffic movements would be trucks delivering and/or removing earthworks and paving material to and from work sites. Semi trailers would also be used to transport pipes, culverts and other precast materials. It is expected that there would be a need to move fill material from the vicinity of Banana Road south across the Brunswick River to the site of the proposed interchange and also to move fill material south to Ewingsdale for use in the construction of another Pacific Highway Upgrade project.

General access along the highway would be maintained at all times although there may be minor disruptions. The potential impacts to local and regional traffic during the construction period are detailed in Section 7.3.8.

6.9.4 Temporary Access Arrangements

Access to public roads and properties would be maintained throughout the full duration of the construction works. The construction of bridge structures and interchanges would be scheduled to expedite the completion of permanent works and structures and provide improved access. Any activities requiring access to private property would be the contractor's responsibility, who would make the necessary arrangements.

During the construction of the Wilfred Street overpass it would be necessary to divert traffic and it is proposed that this would occur via the El Dorado Industrial Estate by means of a temporary access connection.

6.9.5 Construction Materials

Total pavement areas for the proposal would comprise approximately 250, 000 m^2 of road pavement including the service road and local road adjustments. Concrete would be required for bridge works, drains and headwalls for culverts and other drainage structures as well as for overpasses such as that linking Billinudgel with Ocean Shores.

It is anticipated that construction materials would be sourced from the established ready mixed concrete, gravel/aggregate and asphalt suppliers in the region. Existing quarries in the area supply road pavement materials meeting RTA specifications and would be the source of construction materials for the proposal.

6.9.6 Construction Schedule and Workforce

It is expected that construction of the proposal would take 2.5 years. For a proposal of this size, it is anticipated that the peak workforce on site is likely to be approximately 180-200 persons. The average size of the workforce over the construction period is expected to be about 80-100 persons.

6.9.7 Construction Hours

In accordance with the EPA's Noise Control Manual, construction activities would be restricted to between 7.00 am and 6.00 pm Mondays to Fridays and 7.00 am to 1.00 pm on Saturdays. If construction noise is audible at the closest residential locations, then construction would not be undertaken until 8.00 am on Saturdays. No construction work would be undertaken on Sundays or public holidays.

Construction work may be permitted outside the hours specified above, e.g. for routine works, concrete sawing at night etc, or to allow work to continue and shorten the construction time. However, this would be the subject to approval from the EPA following consultation with affected residents.

6.9.8 Costs

Preliminary construction cost estimates for the proposal were prepared based on:

- quantities derived from the concept design;
- current average construction contract rates;
- traffic management costs assessed from notional staging arrangements;
- 350 mm allowance for total pavement thickness (known as boxing);
- average 150 mm allowance for topsoil stripping

- allowance for site establishment and quality assurance (3% and 1% of the construction costs respectively);
- allowance for design/investigations and construction management costs (3% 40and 7% of the construction costs respectively);
- no allowance for RTA overheads and management costs.

Based on the above, the estimated project costs is approximately $73 million.

6.10 Waste Minimisation and Management

The EMP which would be prepared prior to construction commencing would detail aspects for waste management and this would be a condition of the construction contract. In general, all waste material produced during construction activities would be handled in a responsible manner. A construction compound would be developed adjacent to the proposal. Any waste generated by the site would be contained within the boundary and removed at regular intervals to a licenced waste disposal depot or recycled. The EMP would specifically outline waste management measures that would be followed for the construction period as a condition of contract.

6.10.1 Recycling

Recycling has become an important aspect in environmental management in recent times. It may be addressed on both a State-wide and project specific basis. On a state-wide basis, the RTA has undertaken research projects which are aimed at recycling resources.

The RTA spends in excess of $40 million a year on road materials such as aggregate for road base, asphalt and cement. To help reduce this cost and to minimise environmental impacts, trials aimed at incorporating industrial waste into traditional road-making materials are being carried out. These involved working with the steel industry in Newcastle and working in conjunction with Pacific Power.

For the proposal, measures that involve recycling include:

- chipping and mulching of vegetation which is cleared for road construction purposes, and reusing the chipped and mulched material as part of the landscaping strategy on soil surfaces as an organic base for revegetation;
- the use of carefully placed and managed windrows of cleared vegetation as sediment fences;
- as part of the environmental management plan prepared for the proposal, the contractor would be required to provide for the recycling of rubbish on site including waste paper, metals and glass;

- in the demolition of any affected buildings, specifically in the vicinity of Ocean Shores and the existing highway, as much material as practicable would be recycled. This would include bricks, timber, tiles and other items. These items would be collected and taken to a recycling depot in the region;
- topsoil free of weeds that is stripped prior to the earthworks phase of the construction period would be stockpiled and stored. Following the completion of the earthworks stage, the topsoil would be spread on the road batters as part of the landscaping strategy. Any stored stockpiles would be protected from water and wind erosion by spreading with hydroseed until they are required or by covering them with a geotextile fabric;
- require the EMP to refer to the EPA's Industrial Waste Recycling Directory in order to ensure ready access to information about professional recycling businesses operating in the surrounding area;
- require the collection and delivery to crushing and recycling plants of concrete kerbs, medians and similar material;
- any earth which is unsuitable for use in road embankments would be used in noise mounding for noise mitigation where practicable;
- investigate the availability of treated waste water from the Brunswick Heads STP for use in spraying roadworks to reduce dust generation and for watering the progressive landscaping works;
- it would be a condition of contract that no rainforest timbers are used in bridge formwork;
- where a concrete and/or asphalt batching plant is to be established adjacent to the proposal, it would incorporate a closed water recycling system; and
- it would be a condition of contract that the contractor uses a proportion of recycled materials in concrete, roadbase, asphalt and other construction materials.

6.11 Energy Statement

An energy statement for the proposal (including the proposed duplication of the Brunswick Heads Bypass) takes into account the energy consumed during construction of the road and the amount of energy (fuel) that is saved by vehicles that would use the development over the existing highway. It should be noted that only an estimation of the energy consumed and saved by the proposal can be made as there are many factors that influence energy consumption including the type and age of the vehicle, vehicle speed, and road conditions (gradient, road surface, and traffic conditions).

6.11.1 Energy Required for Road Construction

The construction equipment used on this proposal would be largely dependent on the construction fleet proposed by the successful contractor. For the purposes of understanding the potential environmental impacts, and the energy required for road construction it is reasonable to assume that construction would use a wide range of equipment, including:

- light transport vehicles,
- cranes,
- padfoot rollers,
- steel drum vibrating rollers,
- rubber tyred rollers,
- excavators,
- bulldozers,
- graders and scrapers,
- front-end loaders,
- compactors and compressors,
- excavation trucks,
- water trucks,
- backhoes, paving machines and other heavy weight vehicles,
- barge mounted pile driving rig,
- land based pile driving rig,
- barge mounted crane for erecting formwork,
- land based crane for abutment work,
- large mobile crane to install girders, an
- concrete pumps and air compressors.

The main components in the completion of the proposal before opening to traffic would be site preparation, fencing, construction of culverts and sedimentation ponds, bridge construction, earthworks, pavement laying, landscape works, pavement markings and signposting.

It is expected that vehicles and equipment involved during the construction phase would consume a large amount of fuel. The degree of fuel consumption during the construction phase would be affected by the age of the construction fleet, the type of equipment used, the speed of operation and the ground conditions encountered. Due to the amount of cut and fill required in certain sections of the proposal, it is expected that site preparation and earthworks as well as the new bridge over the Brunswick River would be the major consumer of energy during the construction period.

According to recent road projects, fuel consumption (distillate) could be expected to be in the order of 8 million litres. This would include energy consumed in manufacturing concrete/asphalt within the batching plant(s) and in the fabrication of pre-cast structures such as bridgework components and culverts.

6.11.2 Energy Consumed During Operation

Following construction of the proposal, energy requirements would be limited to that required for periodic maintenance and occasional pavement repair. Landscape plantings would be used as appropriate to minimise the need for grass cutting.

Street lamps and lighted signs would be connected to the existing electricity network.

6.12 Energy Savings

The carriageway of the proposal would be more efficient and of superior grade and pavement quality than the existing highway, with savings in time, travel distance, vehicle fuel and other operating costs anticipated. Improved levels of safety on the proposal would result in substantial savings to both the local and regional community in accident costs. The proposal would be more energy efficient due to improved grades and curvature, better pavement condition, improved traffic speeds and free flow traffic conditions.

Energy savings, in terms of vehicle fuel savings as a result of using the proposal in preference to the existing highway are considered to be substantial. Fuel consumption, however, would vary depending on vehicle type, speed and road conditions. In assessing fuel consumption rates, average travel speeds of 107 km/hr (dependent on the imposed legal limit) may be assumed for the travelling conditions along the proposal, based on Year 2001 traffic forecasts, while 72 km/hr may be taken as the average travel speed on the existing highway for the same period.

Based on the average sized car consuming 0.133 litres of fuel/km, approximately 1.16 litres of fuel would be consumed travelling along the proposal (north of Saddle Road to Yelgun, a distance of 8.7 km) compared with 1.24 litres which would be consumed along the existing highway between the same two points (a distance of 8.8 km), resulting in a fuel saving of 0.08 litres. This is considered to be a significant fuel saving for one car and is considered to be substantial when multiplied by the traffic volumes which have been predicted to travel along the proposal being 21,602 vehicles per day along the Brunswick Heads Bypass and 17,843 vehicles per day along the proposal (Year 2016 - refer Section 7). This calculation has been based on free flow traffic conditions for both roads. Traffic travelling along the proposal would be free flowing although traffic travelling along the existing highway would still be disrupted by local traffic characteristics, for example, cars entering from local access roads, pedestrian movements, thereby resulting in stop-start vehicle operating conditions which also result in greater fuel consumption rates for these vehicles.

Vehicle operating costs have been calculated for the project and are 17.5 cents per vehicle kilometre travelled for the proposal and 18.8 cents per vehicle kilometre travelled along the existing highway. These costs include fuel, oil, tyre, maintenance and depreciation costs based on Appendix C of the Economic Analysis Manual (RTA, 1997). Therefore, it would cost an average car $1.52 to travel along the proposal and $1.74 to travel along the existing highway (the service road) giving a saving of 0.22 cents per trip by utilising the proposal. Over time, this would lead to substantial savings taking into account the predicted daily traffic volumes that would use this route (refer to Section 7 and Working Paper No.1 - Traffic and Transport Assessment).

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part D

Assessment of Transport and Safety Impacts

d

7. Traffic and Transport Impact Assessment

This Section presents the traffic and transport impacts of the proposal. A description of the existing traffic conditions within the study area is provided and covers existing peak period traffic flows, daily traffic distribution, traffic composition and speed, and intersection performance levels. The impacts of the proposal are assessed against the base case or "do nothing" option in terms of forecast traffic flows on the road, intersection performance levels and network efficiency. Public transport options and the opportunities for the proposal to cater for pedal cyclists are also summarised. Finally, the section includes an assessment of the potential impacts arising from the transport of hazardous goods. The traffic study is documented in Working Paper No.1 - Traffic and Transport Assessment.

7.1 Introduction

Traffic and transport impacts were determined by describing the existing situation and then comparing the potential effects of the proposal against it. This was undertaken using quantifiable measures such as two way traffic flows, intersection operation and travel speeds. Other measures such as accessibility were also assessed to assist in providing a detailed understanding of the potential effects of the proposal.

The method adopted for transport and traffic impact assessment included:

- developing an EMME/2 traffic model to determine traffic alterations due to implementation of the proposal;
- checking the EMME/2 forecasts against up to date traffic volumes and land use information; and
- describing the existing situation or "do nothing" option as a basis for comparison.

The impacts of the proposal were analysed and compared to the base case in terms of:

- forecast traffic flows,
- intersection performance, and
- local access.

7.2 Existing Conditions

7.2.1 Road Network and Traffic Characteristics

The Pacific Highway is a principal transport corridor connecting Sydney to Brisbane along the NSW coastline. It also connects inter- and intra-regional centres such as Port Macquarie, Coffs Harbour, Grafton and Tweed Heads. The

section under investigation traverses the far North Coast of New South Wales between Brunswick Heads and Yelgun. The local road system is shown in **Figure 4.1**. The existing highway between Brunswick Heads and Yelgun is a two lane highway with at-grade intersections which connect to east-west aligned roads as described in Section 4.

Roads are generally classified according to a road hierarchy, in order to determine their functional role within the road network. The RTA has set down the following guidelines for the functional classification of roads. These are shown in **Table 7-1**.

Table 7-1 - Functional Classification of Roads

Road type	Traffic volume (AADT)[1]	Through traffic	Inter-connections	Speed limit (km/h)	Heavy vehicle restrictions
Arterial	No limit	Yes	Sub-arterial	70 - 110	No
Sub-arterial	<20,000	Some	Arterial/ Collector	60 - 80	No
Collector	<5,000	Little	Sub-arterial/ Local	40 - 60	Yes, if residential
Local	<2,000	No	Collector	40	Yes, if residential

Source: "Updated Guidelines for Functional Classification of Roads in Urban Areas". RTA, 1993
Note 1: AADT - Average Annual Daily Traffic = number of vehicles passing a point during a 24 hour period averaged over a period of one year.

The roads within the study area can be classified using the parameters shown in **Table 7-1**. This was done using traffic volumes on roads within the study area collected during December 1996, as shown in **Table 7-2**.

Table 7-2 - Study Area Traffic Volumes

Road	AADT (Two Way)	Light Vehicles (%)	Heavy Vehicles (%)
Pacific Hwy (south of Rajah Rd)[1]	14,553	88	12
Pacific Hwy (Yelgun)[1]	10,097	88	12
Saddle Road	107[2]	-	-
Rajah Road	3,993[2]	-	-
Coolamon Scenic Drive	1,089[2]	-	-
Orana Road	2,208[2]	-	-
Pocket Road	2,322[2]	-	-
Shara Boulevard	1,851[2]	-	-

Note 1: SKM surveys undertaken December 1996.
Note 2: 1994 volumes supplied by Byron Council for roads other than the Pacific Highway did not include a breakdown of light and heavy vehicles.

To assess the performance of major roads, traffic flows are compared with mid-block capacities. Typical mid-block capacities for urban roads with interrupted flows are shown in **Table 7-3,** as adopted from **Table 7-1**. Road capacity is

affected by many factors such as property access, bus stops and pedestrian crossings. Using this information, the volume/capacity ratio (v/c) for each road has been determined and is shown in **Table 7-3**. Note that the peak hour volumes and capacities are assumed at 10% of the AADT.

Table 7-3 - Road Hierarchy in the Study Area and Volume/Capacity

Road	Functional Classification*	Mid-block Capacity (Peak Hour)	V/C Ratio
Pacific Highway (south of Rajah Road)	Arterial	1,800	0.81
Pacific Highway (Yelgun)	Arterial	1,800	0.56
Saddle Road	Local Access	200	0.05
Rajah Road	Major Collector	500	0.79
Coolamon Scenic Drive	Major Collector	500	0.22
Orana Road	Major Collector	500	0.44
Pocket Road	Major Collector	500	0.46
Shara Boulevard	Major Collector	500	0.37

* Source: Byron Council.

The mid-block capacities are regarded as the limiting factors for the road. The v/c compares the adopted capacity on a road with the actual traffic volume on the road. If the v/c is greater than one, it is interpreted that the road is operating beyond its ideal capacity. Conversely, if the v/c is less than one, the road is operating at less than capacity, indicating available capacity for future growth. **Table 7-3** shows that the roads examined in the study area are operating within their functional capacity.

7.2.2 Intersection Operation

Six intersections which link to the Pacific Highway in the vicinity of Brunswick Heads and Billinudgel were surveyed for both the AM and PM peak periods to determine the peak turning volumes during December 1996. These were:

- existing highway /Rajah Road,
- existing highway /Coolamon Scenic Drive,
- existing highway /Orana Road,
- existing highway /Wilfred Street,
- existing highway /Balemo Drive, and
- existing highway/Shara Boulevard.

The turning movement counts at these intersections were analysed using the INTANAL computer analysis program. The program analyses the operating conditions which can be compared to various performance criteria set out in **Table 7-4.**

Table 7-4 - Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
D	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity, requires other control mode
E		Roundabouts require other control mode	

Source: Guide to Traffic Generating Developments, RTA 1993.

These performance criteria have been used to assess the existing intersections. The results are shown in **Table 7-5**.

The results of the intersection analysis indicate that all intersections analysed within the vicinity of Brunswick Heads and Billinudgel are operating well within their theoretical capacity.

Table 7-5 - Results of Intersection Analysis

Intersection	Degree of saturation [1]	Average delay (seconds)	Level of service
AM Peak			
Pacific Hwy/Rajah Rd	0.18	2.5	B
Pacific Hwy/Coolamon Scenic Dve	0.05	1.3	B
Pacific Hwy/Orana Rd	0.09	2.1	B
Pacific Hwy/Wilfred St	0.19	3.0	B
Pacific Hwy/Balemo Dve	0.03	1.2	B
Pacific Hwy/Shara Blvd	0.08	2.7	B
PM Peak			
Pacific Hwy/Rajah Rd	0.19	3.1	B
Pacific Hwy/Coolamon Scenic Dve	0.06	1.3	B
Pacific Hwy/Orana Rd	0.10	2.5	B
Pacific Hwy/Wilfred St	0.15	3.6	B
Pacific Hwy/Balemo Dve	0.03	1.0	B
Pacific Hwy/Shara Blvd	0.07	2.2	B

Note 1: The degree of saturation is the ratio of demand to capacity for the most disadvantaged movement at the intersection.

7.2.3 Traffic Speed

Average traffic speeds along the existing highway (before the opening of the Brunswick Heads Bypass) were determined by observing the existing posted speed and the traffic volumes. These were assessed against the speeds documented in AUSTROADS "Guide to Traffic Engineering Practice, Part 2: Roadway Capacity" (Tables 3.1 and 7.2).

With the opening of the Brunswick Heads Bypass, travel times would be expected to reduce between the northern and southern ends of the study area. The route length from 240 m north of Saddle Road to 140 m south of Dirty Flat Road on the existing highway including the Brunswick Heads Bypass is 8.8 km. The signposted speed for the Brunswick Heads Bypass is 100 km/h and 60 km/h at the roundabout south of the Brunswick River. The speed along the Brunswick Heads Bypass is predicted to be approximately 80 km/h and 55 km/h respectively at the southern and northern ends. Based on these speeds the travel time on the Brunswick Heads Bypass is predicted to be 2 minutes 05 seconds. The total travel time on the Pacific Highway route with the Brunswick Heads Bypass would be 7 minutes 15 seconds. This is shown in **Table 7-6**.

Table 7-6: Traffic Speeds and Travel Times

Pacific Highway Road Segment	Length (km)	Posted Speed (km/h)	Link Speed (km/h)	Travel Time
Start of Project - Brunswick River	2.4	100/60	80/55	2 min 05 secs
Brunswick River - End of Project	6.4	100/60	71	5 mins 10 secs
Total				7 mins 15 secs

7.2.4 Road Safety

A road safety audit was undertaken of the Pacific Highway for the study area. The length of the Pacific Highway audited extended from Saddle Road in the south to Jones Road in the north. The audit included additional lengths of the Pacific Highway to include the connection points for all route options. The audit was undertaken in accordance with the RTA Road Safety Audit Manual 1995 and AUSTROADS Road Safety Audit Guidelines 1994.

The major findings from the field inspection undertaken in December 1996 are described below.

- The quality of the pavement along the route is generally in good condition.
- The route does not have sufficient shoulder width in some sections for vehicles to safely move off the carriageway.
- The posted speed along the highway within Brunswick Heads is 60 km/h and 80 km/h on the approaches.
- Visibility on curves is not sufficient and sight distance at intersections needs improvement.
- A large number of trees are located within 0.5m to 1.0m from the back of kerb along the southern section of the route.

In addition to the field inspection, an accident analysis was undertaken to compare the road with the State average for other similar roads. These are recorded as accident rates. An accident rate is defined as the number of police reported

accidents on a defined road section per million vehicle kilometres of travel, i.e. an accident rate is calculated directly against the length of route, a specified time period (each year in this case) and the amount of traffic carried by the route in the study time period.

- existing highway from Orana Road to Banana Road;
- existing highway at the northern approach to the bridge over the Brunswick River near Rajah Road;
- existing highway immediately north of Brunswick Heads where the posted speed changes from 60 to 80 km/h; and
- existing highway in the vicinity of Fingal Street, Brunswick Heads.

7.2.5 Travel Characteristics

Surveys were carried out to determine travel characteristics in and around Brunswick Heads during December 1996. In addition to these surveys, an origin-

Accident data for the period 1990 to 1995 have been reviewed. The following summary provides an indication of the problem locations along the existing route and the potential types of accidents that could be expected with the construction of the proposed route.

The data available are:

- 5 years of accident data;
- length of segment for Saddle Road to Jones Road;
- total of 109 accidents over the 5 year period;
- accident degree
  - 2 fatalities;
  - 14 admitted injury;
  - 26 treated injury;
  - 10 non-treated injury; and
  - 57 tow away.
- accident rate
  - 1991 - 46 accidents per 100 million vehicle kilometres travelled (100mvkt);
  - 1992 - 32 per 100mvkt;
  - 1993 - 38 per 100mvkt;
  - 1994 - 32 per 100mvkt; and
  - 1995 - 41 per 100mvkt.

These accident rates are lower than the State average (46.7 accidents per 100mvkt) for similar types of highway in NSW as determined in the RTA Road Safety Bureau "Rural Crash Rates - Road Stereotypes", July 1993. However, there has been a significant number of injury accidents.

The most common accident types in the study area were rear end, head on and off carriageway accidents. The locations along the route with a concentration of accident numbers are:destination survey was conducted during December 1996. The results of this survey indicate that approximately 44% of the total traffic volume on the Pacific Highway within the study area is through traffic.

In addition, Mullumbimby acts as a sub-regional centre for the area. It serves as a government centre (i.e. government offices) and employment generator for residents of Brunswick Heads and Ocean Shores. As such, the movement between Ocean Shores and Mullumbimby using Rajah Road, the Pacific Highway and Mullumbimby Road is relatively significant compared to other trip generators/attractors in the area.

7.3 Impacts of the Proposal

7.3.1 Impacts on Traffic Volumes

The impacts on the study area road network in terms of altered traffic patterns and two way flows as a result of the proposal are shown in **Table 7-7**.

The projected traffic volumes shown in indicate that if the proposal is not constructed, the existing highway would be required to accommodate a much higher traffic volume at 2016. The operation of the proposal would alter traffic flows within the study area. The most significant change would be the removal of some traffic from the existing highway alignment, particularly from the section north of the Brunswick River. The implementation of the proposal would also redistribute some traffic from Coolamon Scenic Drive.

Table 7-7 - Existing and Forecast Traffic Volumes

Road	Existing 1996	Base Case 2001	Build Case 2001	Base Case 2016	Build Case 2016
Pacific Hwy (south of Brunswick Heads)	15517	5536	4326	10104	8062
Pacific Hwy (north of Brunswick Heads)	14288	3992	2782	6742	4706
Pacific Hwy (south of Rajah Rd)	14288	15572	5274	23508	8826
Pacific Hwy (north of Rajah Rd)	11246	10822	356	15206	526
Pacific Hwy (north of Orana Rd)	11505	13230	818	18824	1784
Pacific Hwy (north of Shara Blvd)	11184	11850	630	18546	1512
Brunswick Heads Bypass	N/A	11578	14642	16764	21602
Brunswick River to Yelgun Bypass	N/A	N/A	12494	N/A	17843
Rajah Road	3042	3448	3620	6500	6500
Coolamon Scenic Drive	1090	2406	634	3540	862
Orana Road	2080	2132	1960	2984	3300
Wilfred Road / The Pocket Road	1226	1442	1442	1858	1858
Shara Boulevard	894	2058	874	2398	888

Source: EMME/2 Model traffic volume projections. 1996 volumes have been calibrated to match existing 1996 traffic volumes survey counts.

7.3.2 Impacts on Road Capacity

To assess the performance of roads both with and without implementation of the bypass and upgrade, traffic flows were compared with mid-block capacities. Note again that the peak hour volumes and capacities are assumed at 10% of the AADT. The volume/capacity ratios are shown in **Table 7-8**.

The proposal would provide sufficient capacity for the forecast volumes. The existing highway would benefit from the proposal as it would remove a significant volume of through traffic from the existing highway onto the proposal. This is projected at 12,500 for 2001. This would improve capacity and travel efficiency for local traffic. However, Rajah Road would continue to attract increasing traffic volumes with or without implementation of the proposal due to its role as the principal access point to Ocean Shores. Increased road capacity would need to be investigated in future if local demand continues, and exceeds the available capacity at this location. This would be a matter for Byron Council to investigate.

Table 7-8 - Volume/Capacity for Future Traffic and Road Network

Road	Mid-block Capacity (Peak Hour)	Base Case Traffic Volumes	V/C Ratio	Build Case Traffic Volumes	V/C Ratio
1996					
Pacific Hwy (south of Brunswick Heads)	1,800	15,517	0.86	N/A	-
Pacific Hwy (north of Orana Rd)	1,800	10,822	0.60	N/A	-
Brunswick Heads Bypass	3,600	N/A	-	N/A	-
Brunswick River to Yelgun Bypass	3,600	N/A	-	N/A	-
Rajah Road	500	3,042	0.66	N/A	-
Coolamon Scenic Drive	500	1,125	0.23	N/A	-
Orana Road	500	2,132	0.42	N/A	-
Wilfred Road / The Pocket Road	500	1,226	0.24	N/A	-
Shara Boulevard	500	854	0.17	N/A	-
2001					
Pacific Hwy (south of Brunswick Heads)	1,800	5,536	0.31	4,326	0.24
Pacific Hwy (north of Orana Rd)	1,800	13,230	0.74	818	0.05
Brunswick Heads Bypass	3,600	11,578	0.32	14,642	0.41
Brunswick River to Yelgun Bypass	3,600	N/A	-	12,494	0.35
Rajah Road	500	3,448	0.69	3,620	0.72
Coolamon Scenic Drive	500	2,406	0.48	634	0.13
Orana Road	500	2,132	0.43	1,960	0.39
Wilfred Road / The Pocket Road	500	1,442	0.29	1,442	0.29
Shara Boulevard	500	2,058	0.41	874	0.17
2016					
Pacific Hwy (south of Brunswick Heads)	1,800	10,104	0.56	8,062	0.45
Pacific Hwy (north of Orana Rd)	1,800	18,824	1.04	1,784	0.10
Brunswick Heads Bypass	3,600	16,764	0.47	21,602	0.60
Brunswick River to Yelgun Bypass	3,600	N/A	-	17,843	0.50
Rajah Road	500	6,500	1.30	6,500	1.30
Coolamon Scenic Drive	500	3,540	0.71	862	0.17
Orana Road	500	2,984	0.60	3,300	0.66
Wilfred Road / The Pocket Road	500	1,858	0.37	1,858	0.37
Shara Boulevard	500	2,398	0.48	888	0.18

7.3.3 Impacts on Intersection Operations

The impacts on intersection operations are shown in overleaf. The method of determining future flows has been to adopt EMME/2 traffic volume projections for the existing highway and use these through flows to re-run the INTANAL simulations for intersections along the existing highway.

The results of the intersection analysis shown in **Table 7-10** indicate that the proposal would improve the intersection operation due to the removal of a significant proportion of the traffic. Due to this removal of through traffic, which experiences a lower level of delay, the average delay per vehicle actually increases in many of the Build Case intersections analysed. However, the total delay at these intersections is reduced because there are more gaps for turning vehicles due to the reduced through traffic.

7.3.4 Impacts on Local Access

The local access arrangements remain, although they would be altered at some locations. This is discussed in Section 6.5.2.

7.3.5 Impacts on Travel Speeds

Impacts on travel speeds along the proposal and the existing highway have been taken from the future traffic volume projections and speeds from the EMME/2 model. The model provides a speed - traffic flow relationship for various road types, as shown in **Table 7-9**. The speed on the existing highway with the Brunswick Heads Bypass has been taken from Section 7.2 that estimates a travel time of 7 minutes, 15 seconds to cover a distance of 8.8 km, giving an average travel speed of 73 km/h.

Table 7-9: Impacts on Travel Speeds

Road Segment	Existing Speed (km/hr)	2001 Base Case	2001 Build Case	2016 Base Case	2016 Build Case
Pacific Hwy (Saddle Road to River)	64	62	64	62	63
Pacific Hwy (River to south of Dirty Flat Road)	71	68	76	63	73
Brunswick Heads Bypass	73*	70	107	68	107
Brunswick River to Yelgun Upgrade	N/A	N/A	107	N/A	107

Source: AUSTROADS "Guide to Traffic Engineering Practice, Part 2: Roadway Capacity" (Tables 3.1 & 7.2)
Note: Speeds on the Brunswick Heads Bypass for the Existing situation have been estimated from signposted speeds and AUSTROADS "Guide to Traffic Engineering Practice"

Table 7-9 indicates that if the proposal is not built the existing highway would continue to deteriorate in terms of travel speeds, due to increases in traffic using the route. The proposal would improve travel times, particularly for through traffic. Travel time benefits would also result for traffic using the existing highway, due to the reduction in traffic volumes using this route.

Table 7-10 - Impacts to Intersection Operational Characteristics

Scenario	Base Case	Build Case	Base Case	Build Case	Base Case	Build Case
1996						
AM Peak	D/S	D/S	Av. Delay	Av. Delay	LoS	LoS
Pacific Hwy/Rajah Rd	0.18	N/A	2.5	N/A	B	N/A
Pacific Hwy/Coolamon Scenic Dve	0.05	N/A	1.3	N/A	B	N/A
Pacific Hwy/Orana Rd	0.09	N/A	2.1	N/A	B	N/A
Pacific Hwy/Wilfred St	0.09	N/A	3.0	N/A	B	N/A
Pacific Hwy/Balemo Dve	0.03	N/A	1.2	N/A	B	N/A
Pacific Hwy/Shara Blvd	0.08	N/A	2.7	N/A	B	N/A
PM Peak						
Pacific Hwy/Rajah Rd	0.19	N/A	3.1	N/A	B	N/A
Pacific Hwy/Coolamon Scenic Dve	0.06	N/A	1.3	N/A	B	N/A
Pacific Hwy/Orana Rd	0.10	N/A	2.5	N/A	B	N/A
Pacific Hwy/Wilfred St	0.15	N/A	3.6	N/A	B	N/A
Pacific Hwy/Balemo Dve	0.03	N/A	1.0	N/A	B	N/A
Pacific Hwy/Shara Blvd	0.07	N/A	2.2	N/A	B	N/A
2001						
AM Peak	D/S	D/S	Av. Delay	Av. Delay	LoS	LoS
Pacific Hwy/Rajah Rd	0.20	0.15	2.6	3.7	B	A
Pacific Hwy/Coolamon Scenic Dve	0.11	0.02	2.2	4.6	B	A
Pacific Hwy/Orana Rd	0.11	0.07	2.2	6.8	B	A
Pacific Hwy/Wilfred St	0.12	0.06	3.2	7.6	B	A
Pacific Hwy/Balemo Dve	0.04	0.02	1.2	5.6	B	A
Pacific Hwy/Shara Blvd	0.08	0.02	2.8	6.4	B	A
PM Peak						
Pacific Hwy/Rajah Rd	0.21	0.14	3.2	4.3	B	A
Pacific Hwy/Coolamon Scenic Dve	0.15	0.02	2.5	4.7	B	A
Pacific Hwy/Orana Rd	0.12	0.07	2.6	7.3	B	A
Pacific Hwy/Wilfred St	0.19	0.08	3.9	7.8	B	A
Pacific Hwy/Balemo Dve	0.04	0.02	1.0	5.3	B	A
Pacific Hwy/Shara Blvd	0.07	0.02	2.2	5.6	B	A
2016						
AM Peak	D/S	D/S	Av. Delay	Av. Delay	LoS	LoS
Pacific Hwy/Rajah Rd	0.50	0.28	4.6	4.7	C	A
Pacific Hwy/Coolamon Scenic Dve	0.20	0.03	2.7	3.6	B	A
Pacific Hwy/Orana Rd	0.21	0.10	2.8	6.4	B	A
Pacific Hwy/Wilfred St	0.25	0.09	4.0	7.3	B	A
Pacific Hwy/Balemo Dve	0.09	0.03	1.6	4.9	B	A
Pacific Hwy/Shara Blvd	0.16	0.03	3.4	5.4	B	A
PM Peak						
Pacific Hwy/Rajah Rd	0.51	0.31	5.7	5.5	D	B
Pacific Hwy/Coolamon Scenic Dve	0.30	0.03	3.5	4.0	C	A
Pacific Hwy/Orana Rd	0.23	0.11	3.3	7.0	B	A
Pacific Hwy/Wilfred St	0.44	0.12	5.4	7.7	C	A
Pacific Hwy/Balemo Dve	0.08	0.03	1.3	4.6	C	A
Pacific Hwy/Shara Blvd	0.15	0.03	2.9	4.6	C	A

Notes: D/S - Degree of Saturation; Ave. Delay - Average Delay (seconds); LoS - Level of Service
The degree of saturation is the ratio of demand to capacity for the most disadvantaged movement at the intersection.

7.3.6 Impacts on Road Safety

A Stage 2 Draft Design road safety audit was undertaken on the proposal in accordance with RTA Road Safety Audit Manual and the AUSTROADS Guide to Road Safety Audits. The results of the audit indicate that the proposal would provide improved safety compared to the existing alignment. This is due to the improved cross section of the proposal, the separation of traffic flows in either direction and the reduction in access/conflict points compared with the existing highway. Limiting the number of highway access points allows safer, higher travel speeds, because drivers do not have to constantly worry about traffic entering their travel path. It provides a safer road environment by minimising traffic conflicts and replacing potential conflicts with merge zones.

Access to the existing highway alignment would be maintained. Access to the proposal would be provided at two interchanges where the existing road environment would be improved. Through traffic would be removed from the local road network resulting in a reduction in traffic volume and consequently an expected reduction in accidents.

7.3.7 Impacts on Other Road User Groups

Public Transport

Public transport using the existing highway would benefit from the removal of through traffic using the existing highway. This would also assist in improving turning movements at intersections. It also creates the potential for new services to be introduced, using the improved road facility for intra regional travel to destinations such as Tweed Heads.

Pedestrians and Cyclists

Pedestrians and cyclist facilities have been provided within the proposal. Included in the design is a shared bicycle/pedestrian path from Rajah Road, along the local road, across the bridge over the Brunswick River, and back onto the local road towards Brunswick Heads township. Also included is a bicycle and pedestrian path under the bridge to link to the Ferry Reserve Caravan Park. This would allow for travel between Ocean Shores and Brunswick Heads, and allow recreational access to the caravan park.

A bicycle and pedestrian path is also included on the overpass of the proposal at Wilfred Street into Billinudgel. This path would then continue north along the Pacific Highway to North Ocean Shores just north of Marshalls Creek, where it would connect to New Brighton Road (which is closed at the Pacific Highway to motor vehicles). This would allow for bicycle movements between Billinudgel and the school in North Ocean Shores. Both these measures are consistent with Byron Council's Bicycle Plan. Cyclists would also be permitted to travel along the outer shoulders of the proposal.

These facilities would provide for safe paths within the study area for pedestrians and cyclists. The reduction of traffic in Brunswick Heads would improve the safety and amenity for pedestrians and cyclists in the township and its environs.

7.3.8 Construction Traffic Impacts

The existing highway would be the main access for transport of machinery and materials to work sites. Disruption of local public roads may occur during construction. Site access for construction traffic would be controlled by the RTA in accordance with work site policy and practices. Construction traffic routes to and from work sites would be specified by the RTA and Byron Council.

The most significant construction traffic movements would be trucks delivering and/or removing earthworks and paving material to and from work sites. Semi trailers would also be used to transport pipes, culverts and other precast materials. It is expected that heavy machinery would generally be transported to the work site and then remain within the new road reserve as construction continued along the route.

There are likely to be three main traffic issues during construction:

- general access along and to the construction site, which will be on or right next to much of the existing highway;
- movement of fill material from the vicinity of Banana Road south across the Brunswick River for the Brunswick Heads Bypass duplication and construction of the proposed interchange; and
- movement of fill material south to Ewingsdale for use in highway construction.

General access along the highway would be maintained at all times. This would include all local access. Changes to the local access arrangements would begin with the construction and re-direction of Coolamon Scenic Drive / Stock Route Road and the STP access road. This would coincide with the construction of the proposed roundabout at Orana Road.

A temporary access would be provided into Billinudgel to allow the construction of the Wilfred Street overpass. Once constructed, traffic from the existing highway would be diverted onto the northbound carriageway through Billinudgel and also at the north of the Yelgun interchange.

Construction of the service road (i.e. the "old" Pacific Highway) north of the Brunswick River would proceed with the traffic using the existing highway. Once this service road and the new bridge over the Brunswick River were completed, Pacific Highway traffic would be diverted onto the new bridge and the service road.

With the existing highway traffic diverted onto the northbound carriageway and the Wilfred Street overpass completed, the existing highway would be temporarily closed. Access to Billinudgel would be facilitated using the new overbridge and Balemo Drive.

The realignment of the existing highway in the proximity of the Yelgun interchange could be commissioned before the opening of the proposal. This would provide the additional benefit of safe access to Stock Route Road.

Construction traffic management plans would be prepared during the detailed design stage to control the movement of heavy machinery and other construction related vehicles. The plans would limit the on-road movements to non peak periods, and where possible utilise the actual construction corridor.

The transportation of fill across the Brunswick River for the Ewingsdale project and the interchange south of the Brunswick River would occur at separate times. It is anticipated that, on a typical day the traffic volume/capacity ratio across the Brunswick River Bridge would change, but still remain within the road capacity.

The intersection of Rajah Road experiences delays in the order of 2-3 seconds (average per vehicle). Over the estimated four month period of material haulage delays are not expected to increase significantly.

The delays indicated here are within the range of normal daily fluctuations of traffic movements. Being temporary, they are considered reasonable in the context of the longer term benefit of the proposal.

7.3.9 Potential Economic Benefits

A road user economic analysis was completed to predict the road user economic benefits to the community from the proposal. The analysis used conventional cost benefit analysis techniques in accordance with the New South Wales government guidelines for economic evaluation of assets and the results indicate that the proposal is economically viable.

Costs were estimated for the construction of the proposal, ongoing maintenance and the cost of acquiring land. Intangible costs and benefits such as effects to air quality, ecological effects or noise affects were not included in the economic evaluation process. The estimated capital cost of the proposal is $68.9 million, including a property acquisition cost of $3.7 million. The economic analysis has been completed using cost projections over a forty year period after the opening of the proposal using a discount rate of seven per cent per annum.

The road user benefit cost ratio for the proposal was calculated as 2.0. This indicates that the proposal would be economically viable.

7.3.10 Summary of Transport Impacts

The proposal would provide significant benefits to the existing transport and traffic systems by:

- providing decreased travel times for through traffic using the proposed alignment;
- providing a route alignment, cross section and access points which improve safety compared to the existing alignment;
- providing benefits in the form of cost-savings for the expenditure of public funds;
- assisting in removing through traffic from the existing highway alignment;
- reducing the volume of traffic on the existing alignment and therefore improving safety at intersections connecting to the existing alignment;
- maintaining access for local travel and providing access to the proposed alignment at various locations; and
- providing for pedestrians and cyclists along the proposed alignment in the form of shared pedestrian and bicycle paths: from Rajah Road, across the bridge at the Brunswick River and onto the local road towards Brunswick Heads; under the new bridge on the southern bank of the Brunswick River; and on the Wilfred Street overpass into Billinudgel.

These benefits would begin to flow as soon as the proposal is opened and continue for the design life of the new highway. The proposal was assumed to have an approximate 20 year time horizon and could be expected to maintain a good level of service up to that time.

In addition, the benefits of the proposal would flow on, in the form of supporting inter and intra regional accessibility for tourist movements and support for industry. This would provide a catalyst for economic development in the area. While such benefits are beyond the scope of this assessment, they would be supported by the improved accessibility provided by the proposal.

7.4 Hazards and Risks in the Transport of Dangerous Goods

A variety of materials would be transported along the new road, including dangerous goods. The risks associated with the road transport of hazardous goods along the proposal were examined, and compared with the risks associated with the transport of these goods along the existing highway. The probabilities for the loss of life, injury and damage to property are quantified based on several worse-case scenarios. These

scenarios involve a hazardous goods vehicle involved in an accident releasing its contents causing an explosion, the leakage of toxic gases or other such hazard.

The method used to assess the risk of a hazardous goods accident was adopted from the New South Wales Department of Urban Affairs and Planning *Risk Assessment - Hazardous Industry Planning Advisory Paper No.3 Environmental Risk Impact Assessment Guidelines* (1994). The method outlines a four stage process for a risk analysis as follows:

- Hazard Identification
- Probability of an Incident
- Consequence Analysis
- Risk Quantification

7.4.1 Hazard Identification

The following hazardous goods loads were identified and adopted as worse-case incident scenarios:

- Ammonium Nitrate;
- Liquid Propane Gas (LPG);
- Chlorine; and
- Petroleum.

7.4.2 Probability of an Incident

The probability of a hazardous goods vehicle being involved in an accident on the proposal was based on the frequency of hazardous goods vehicle accidents on all NSW State highways and specific data relating to the existing highway between Brunswick Heads and Yelgun. As there are no substantial accident data for the recently opened Brunswick Heads Bypass, the Pacific Highway route as it existed before the opening of the Brunswick Heads Bypass has used as a comparison to the proposal. The number of heavy goods likely to be involved in an accident on the proposal was determined using existing data for State highways and specific data relating to the existing highway in the study area.

The total accident rates for the existing highway in the study area were based on the accident history. The accident rate for the proposal was assumed to be equal to the State average for a dual carriageway road. The probabilities are shown in **Table 7-11**. All values are for one complete year.

Table 7-11 - Hazardous Goods Vehicles Accident Probabilities

Road Segment	Total Vehicle Kilometres Travelled	Total No. Accidents	Total No. of Hazardous Accidents	Accident Probability (per vkt)
State Highway Network	14,941,195,795*	9,591	18***	1.205×10^{-9}
(Existing Highway)	26,362,600#	19 (1)	0.0352	1.335×10^{-9}
Proposal	18,913,300#	3.5 (2)	0.0066	0.347×10^{-9}

Sources:
* - RTA Technology
** RTA Annual Report, 1996
*** Road Safety & Traffic Management- Figures for '92-'96 with '97 being calculated using Weighted Average
# EMME/2 Traffic Network Modelling Software figure (2001 & 2016given) projected '97 figure using forecasting principles.
(1) - Based on Accident History from Saddle Road to south of Dirty Flat Road before the opening of the Brunswick Heads By-pass.
(2) - Estimated from Rural Road Crash Rates - Road Stereotypes Summary Report, RTA Road Safety Bureau, 1993 for similar start and end points..

It was assumed that the proposal would carry similar hazardous goods vehicle types as those using the existing highway.

The existing highway travels through the residential and commercial areas of Brunswick Heads, to the west of the residential areas of Ocean Shores and to the east of the industrial/commercial and residential areas of Billinudgel. The proposal would follow a fairly similar alignment. The closest affected residences of Ocean Shores would be protected from potential incidents by the split level nature of the proposal in the vicinity of Rajah Road. The dual carriageway roads are at a lower level than the residences, and are separated by a retaining wall and the local road. There are several other land uses in the area including a church, a caravan park and commercial premises. These factors have to be taken into account in the risk analysis.

7.4.3 Consequence Analysis

The majority of accidents resulting in the release of dangerous goods involve rupture to a vessel which in turn results in a liquid spill. All four types of hazardous good incidents were analysed for ignition and non ignition.

The scenario for ammonium nitrate not igniting is considered similar to that for chlorine, however, as chlorine is much more toxic, its assessment is considered to provide a worst-case scenario. Ignition of ammonium nitrate fertiliser will only occur if it is accidentally mixed with a fuel such as diesel or petrol. The risk of death to people is below 1% some 50 m from the accident. The damage to buildings extends further out with window breakage occurring over 1 km away.

The Worksafe Australia exposure standard for propane is designed to ensure that a minimum oxygen concentration of 18 % is maintained. To maintain this oxygen content in air, the propane vapour cloud can have a maximum concentration of 10 % (100,000 ppm) in air. Following an incident involving propane with no ignition, the 10% propane vapour cloud would disperse downwind to a maximum distance of 55 m approximately 4 minutes after the rupture.

Assuming the ignition of propane from an accident, the 1% fatality level is at approximately 250 m and assumes that anyone with light clothing will be affected. The damage to buildings caused during a catastrophic release will occur to around 460 m although window breakage may occur to 1.5 km.

The potentially serious outcomes following a chlorine truck accident only involve exposure hazards. Ignition of the vapour cloud is not likely to occur and as such, only the exposure hazards to the toxic vapour cloud have been assessed. The analysis indicates that people within a radius of approximately 250 m of the accident are at risk of exposure to deadly concentrations (1,000 ppm) of chlorine gas for up to 19 minutes after rupture of the tank.

The exposure hazard for a toxic vapour cloud from a petrol spill has not been investigated as the spilled liquid will not vaporise to form a toxic gas cloud in open conditions. The consequences of an explosion of a petrol tanker are not as serious as other scenarios, although people in its direct path may be overcome by fumes and receive radiation burns.

7.4.4 Risk Quantification

The risk associated with a transportation facility, in this case a road upgrade, is expressed as the probable number of fatalities per year. The proposal can be compared to the existing highway (before the opening of the Brunswick Heads Bypass) to indicate if the proposal would achieve a reduction in the potential for loss of life from an incident. The risk quantification for the existing highway and the proposal is determined by the product of the number of people exposed and the likelihood of an incident. The results are shown overleaf in **Table 7-12** and **Table 7-13**.

Table 7-12 - Risk to People on the Existing Highway

Scenario	Maximum Consequence Distance or Radius (m)	Maximum Populated Area that Could be Affected (Ha)	Possible Number of People Affected	Number of Accidents Per Year	Risk - Probable Fatalities Per Year
Ammonium Nitrate (Ignition)	50	0.44	165	1.335 x 10-9	2.202 x 10-7
Propane (No Ignition)	50	0.44	165	1.335 x 10-9	2.202 x 10-7
Propane (Ignition)	250	17.89	501	1.335 x 10-9	6.687 x 10-7
Chlorine (No Ignition)	250	17.89	501	1.335 x 10-9	6.687 x 10-7

Table 7-13: Risk to People on the Proposal

Scenario	Maximum Consequence Distance or Radius (m)	Maximum Populated Area that Could be Affected (Ha)	Possible Number of People Affected	Number of Accidents per Year	Risk - Probable Fatalities per Year
Ammonium Nitrate (Ignition)	50	0.20	201	0.347 x 10-9	6.975 x 10-8
Propane (No Ignition)	50	0.20	201	0.347 x 10-9	6.975 x 10-8
Propane (Ignition)	250	8.82	397	0.347 x 10-9	1.378 x 10-7
Chlorine (No Ignition)	250	8.82	397	0.347 x 10-9	1.378 x 10-7

The individual fatality risk for the proposal was then calculated using the criteria developed by DUAP (1992). The results for the existing highway and the proposal are shown in **Table 7-14**.

Table 7-14: Individual Fatality Risk Criteria and Levels

Land Use	Risk Assessment Criteria	Fatality Risk Levels for the Existing Highway	Fatality Risk Levels for the Proposal
Hospitals, schools, child care facilities and old age housing developments	Not exposed to individual fatality risk levels of more than 0.5 in one million per year	Propane and Chlorine potential hazards exceed the required limit. 0.67 in one million per year	Not exposed to individual fatality risk levels of more than 0.5 in one million per year
Residential development and places of continuous occupancy such as hotel and tourist resorts	Not exposed to individual fatality risk levels of more than 1 in one million per year	Propane and Chlorine potential hazards exceed the required limit. 0.67 in one million per year	Not exposed to individual fatality risk levels of more than 1 in one million per year
Commercial developments including offices, retail centres, warehouses, restaurants and entertainment centres	Not exposed to individual fatality risk levels of more than 5 in one million per year	Not exposed to individual fatality risk levels of more than 5 in one million per year	Not exposed to individual fatality risk levels of more than 5 in one million per year
Sporting complexes and active open space	Not exposed to individual fatality risk levels of more than 10 in one million per year	Not exposed to individual fatality risk levels of more than 10 in one million per year	Not exposed to individual fatality risk levels of more than 10 in one million per year
Industrial development	Not exposed to individual fatality risk levels of more than 50 in one million per year	Not exposed to individual fatality risk levels of more than 50 in one million per year	Not exposed to individual fatality risk levels of more than 50 in one million per year

The proposal meets the assessment criteria for individual fatality risk. The assessment of risk for the proposal has indicated that based on the scenarios tested the proposal would have a lower probability of fatalities than the existing highway. The risk of operational hazard cannot be entirely eliminated, however, it would be significantly reduced from the current situation.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part E

Assessment of Environmental Impacts

e

8. Noise Impact Assessment

A noise and vibration assessment was undertaken for the proposal. Full details of the methodology and analysis are contained in Working Paper No.3 - Noise Impact Assessment. This Section outlines the noise and vibration assessment and describes the environmental mitigation measures that would be implemented. Potential noise impacts arising as a result of construction activities are also addressed.

8.1 Approach to Development of the Noise Strategy

8.1.1 Approach to Assessment

The issue of noise generation from any road development is of major concern, particularly where the road development is near residential areas. Clearly, it is not possible to design roads that have no noise impacts whatsoever, neither is it acceptable to permit the uncontrolled development of roads such that the impacts on local residents interfere with their usual daily activities. The noise guidelines that are applied to road projects recognise this and seek to achieve a balance between facilitating road development while ensuring that any such development does not have undue adverse impacts. Over the past few years there have been many changes to noise policies and guidelines, as techniques for predicting and mitigating noise improve and as the community expectations change. These policies and guidelines have become more stringent over time.

In this regard, the EPA has recently proposed new draft traffic noise guidelines which are significantly more stringent than the previous Noise Control Guidelines detailed in the Environmental Noise Control Manual. Although these guidelines have not been formally released they have been adopted by the RTA. These new draft guidelines have been used as the basis for assessment of traffic noise, along with an assessment of short term intrusive noise levels in terms of sleep arousal goals. This is to address the often cited concerns regarding heavy vehicle noise particularly at night time. Construction noise and vibration has been assessed according to the guidelines contained in the 1994 EPA Environmental Noise Control Manual (ENCM).

Those residents who currently experience little or no road traffic noise are likely to be more affected by noise from traffic on a new road alignment than those residents who currently experience some road traffic noise where noise from traffic on a realigned or upgraded road may make little or no change. The way in which the new draft EPA guidelines have been interpreted and applied to this proposal has required various sections to be categorised differently. That is, the EPA classifications and noise guidelines have been adopted and applied to the particular circumstances, rather than using a single classification for the whole proposal.

This approach has meant that at those residences where noise levels increase significantly to above the guidelines, the RTA is committed to providing noise mitigation subject to technical practicability and cost effectiveness. However at those residences where noise levels remain similar, or decrease, the RTA has options for noise mitigation subject to the detailed design.

The guidelines generally refer to future road capacity, however, no quantitative definition of capacity is provided. Since the proposal is for a dual carriageway facility the capacity is not expected to be reached for over 20 years. Predictions have been based on the Year 2012, which represents a scenario 10 years after opening where reliable traffic data are available and allows for reasonable traffic growth.

For freeways the EPA has three assessment categories.

New Road - The guidelines relating to new roads are as follows:

- $L_{Aeq,15hr}$ (7.00 am - 10.00 pm) = 55 dBA
- $L_{Aeq,9hr}$ (10.00 pm - 7.00 am) = 50 dBA.

The guidelines also states "*The new road should be designed so as not to increase existing noise levels by more than 0.5 dBA*."

Road Upgrade - This refers to minor realignment of an existing road which does not involve any change in traffic capacity, i.e. straightening out curves or the inclusion of traffic control measures. The guidelines relating to road upgrades is as follows:

- $L_{Aeq,15hr}$ (7.00 am - 10.00 pm) = 60 dBA
- $L_{Aeq,9hr}$ (10.00 pm - 7.00 am) = 55 dBA.

If these goals are already exceeded then the guidelines states "*it is highly desirable that no increase in noise levels occur*". In this regard it is practical and reasonable to assume that an increase of 0.5 dBA or less is allowable as this would not be noticeable. This increase should apply at opening.

Road Redevelopment - This includes the upgrade of an existing alignment which will include an increase in capacity. The guidelines relating to road redevelopment are:

- $L_{Aeq,15hr}$ (7.00 am - 10.00 pm) = 60 dBA
- $L_{Aeq,9hr}$ (10.00 pm - 7.00 am) = 55 dBA.

If these goals are already exceeded, the guidelines states "*in all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dBA*". This increase should apply 10 years after opening.

The major part of the proposal would be considered as a "redevelopment of an existing road", that is, design changes which include a change in traffic carrying capacity. This includes the Brunswick Heads Bypass. A small section of the northern part of the proposal would be considered as a "new road", that is, a new road or a substantial realignment of an existing road. This classification would apply to the residences on Billinudgel Road to the north of Shara Boulevard where the proposal deviates significantly from the existing highway to the point where it rejoins the existing highway at the Yelgun Interchange.

For residences adjacent to the Brunswick Heads Bypass the assessment is based on a comparison between the existing situation with just the Bypass open and the future situation (10 years after opening) with the duplication.

8.1.2 Existing Noise Environment

Measurements of the existing ambient noise level were made for up to 7 days at 17 residences along the proposal and in the Billinudgel industrial/commercial area, as shown on **Figure 8.1**. The ambient noise level is taken to be the total noise that would normally occur at a location excluding extraneous noises. For this reason, monitoring was carried out during the school term when normal levels of traffic are present. The locations were representative of groups of residences likely to be affected by traffic noise from the proposal.

The results of the monitoring, excluding extraneous noise are summarised in **Table 8-1**.

Table 8-1 - Measured Noise Levels

Ref	Location	Measured Noise Levels (dBA)	
		$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
N1	Ferry Reserve Caravan Park	64.5	61.0
N2	1 Rajah Road(1)	62.5	59.5
N3	5 Arika Avenue	64.0	60.0
N4	5 Weeronga Way(1)	50-55	45-50
N5	1 Oola Place	62.5	58.5
N6	5 Tongarra Drive	70.5	66.0
N7	24 Binya Close	47-52	42-47
N8	Lot 4 Mountain View Road	56.5	50.0
N9	48 Yamble Drive	60.0	56.5
N10	Salad Bowl Caravan Park	67.0	63.0
N11	1 Kulgun Court(2) free field/facade	57.0/59.5	54.0/56.5
N12	Villa Ruidosa Cottage (3)	53.0	49.0
N13	123 Balemo Drive(1)	62.5	60.0
N14	Humble Pie, Billinudgel Industrial Area	63.5	61.0
N15	175 Billinudgel Road(1)	63.5	57.5
N16	Holm Farm, Billinudgel Road	50-55	45-50
N17	Jagwen, Billinudgel Road	55.5	52.5
N18	Lot 2, Billinudgel Road	63.0	60.0

Notes: (1) Balcony location
(2) Free field location levels are rounded to the nearest 0.5 dBA
(3) The main residence would be demolished, however an associated cottage would remain.

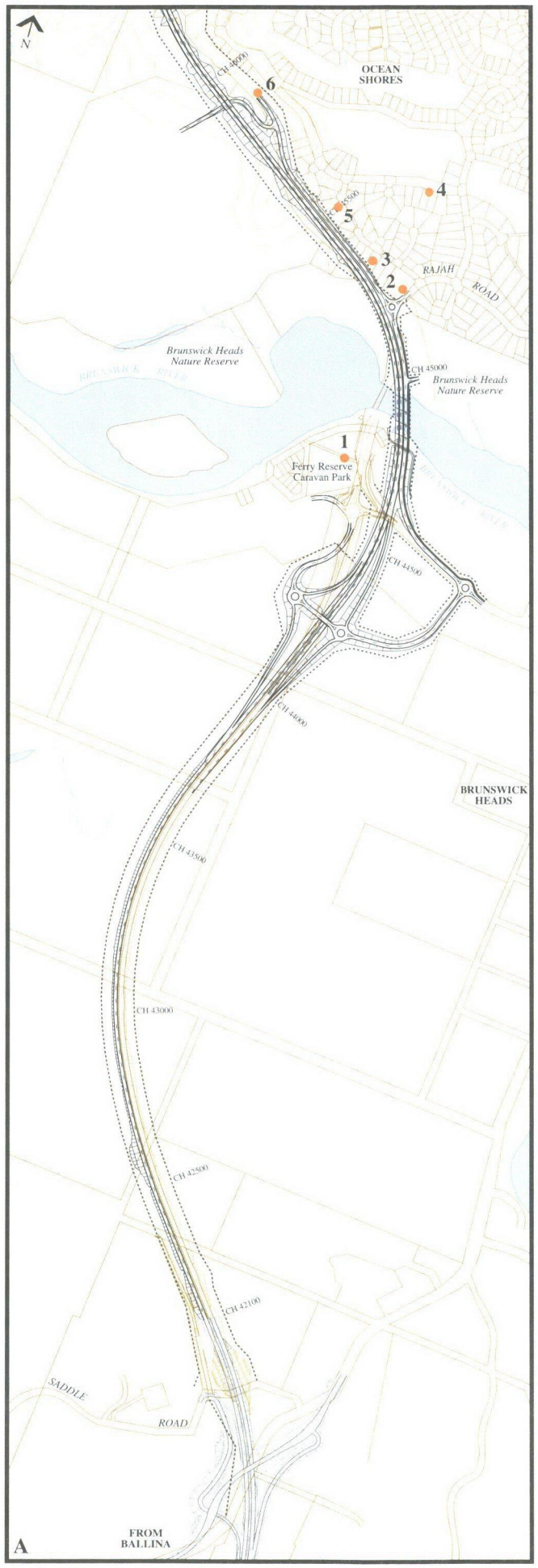
8.1.3 Noise Assessment Criteria

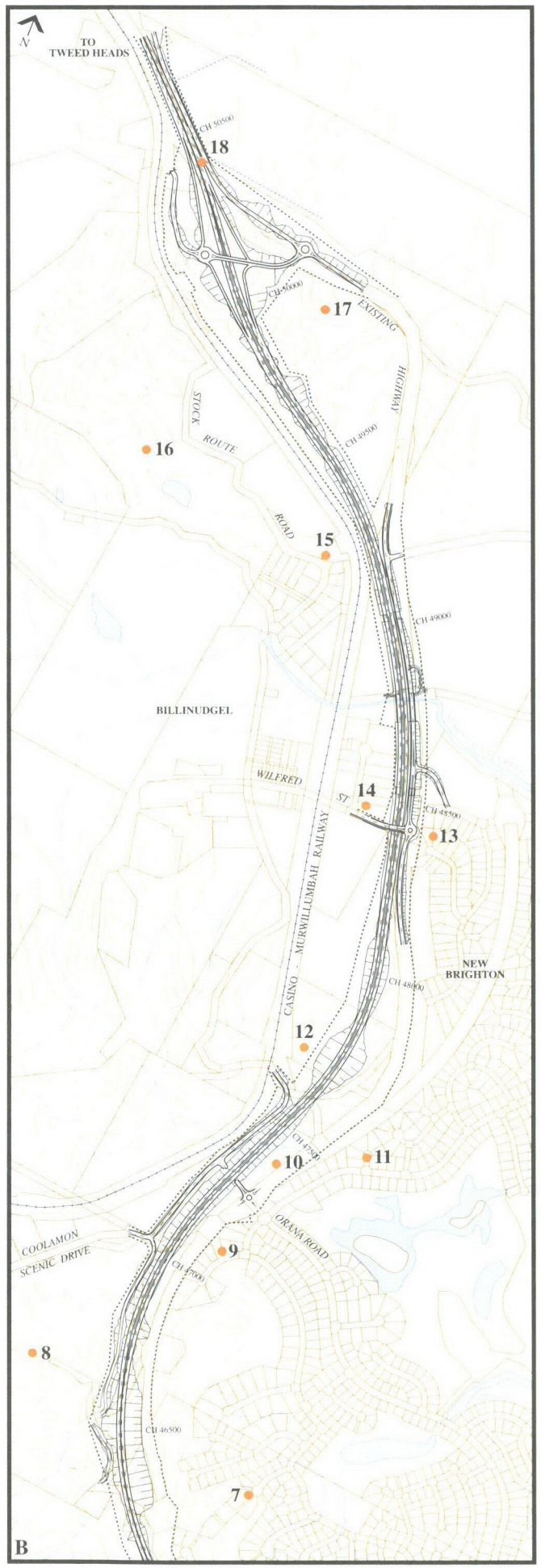
Residential Properties

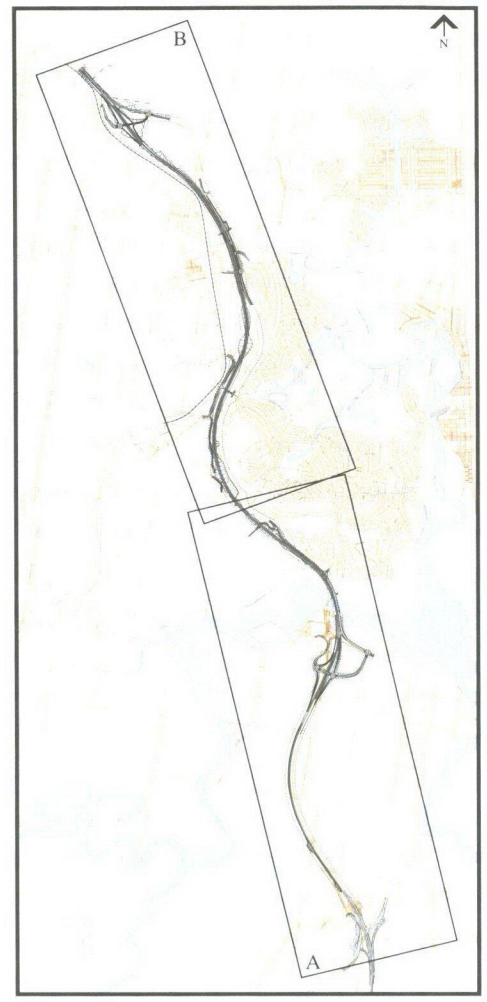
Since the monitoring was carried out at representative residences, the goals derived from results would apply to regions in the vicinity of the monitoring location. Based on traffic flows including the percentage of heavy vehicles and the existing ambient noise levels, the most stringent goal is an $L_{Aeq,9hr}$. If this goal is achieved then the EPA daytime goals would automatically be satisfied. The noise level goals are shown in **Table 8-2**.

Places of worship

For places of worship, the draft EPA guidelines recommend internal noise levels of $L_{Aeq,1hr}$ of 40 dBA. It is considered appropriate to apply this goal in the main area of the Church where services are held, rather than ancillary spaces such as Church halls or offices. This goal would apply to a 1 hr daytime (7am-7pm) period for the Year 2012. For building facades which contain openable windows an equivalent external goal would be 50 dBA. For fixed windows or facades with no windows the appropriate external level would depend on building and window construction but would be at least 65 dBA and possibly 70 dBA. Although not stated in the EPA guidelines if existing traffic noise results in internal levels above the EPA guidelines then it would be appropriate in some cases where existing noise levels are not too high to apply the "redevelopment" guidelines applicable to the residential receivers and limit increases in noise level to 2 dBA.







Legend

- Noise Monitoring Site
- Proposed Road Corridor

0 100 500m

Figure 8.1
LOCATION OF NOISE MONITORING SITES

Table 8-2 - Traffic Noise Level Goals for Residences

Ref.	Location Description	Goal
-	Bashforths, Bashforth Lane	55 dBA or Ambient + 2.0 dBA
N1	Ferry Reserve Caravan Park	55 dBA or Ambient + 2.0 dBA
N2	1 Rajah Road	55 dBA or Ambient + 2.0 dBA
N3	5 Arika Avenue	55 dBA or Ambient + 2.0 dBA
N4	5 Weeronga Way	55 dBA or Ambient + 2.0 dBA
N5	1 Oola Place	55 dBA or Ambient + 2.0 dBA
N6	5 Tongarra Drive	55 dBA or Ambient + 2.0 dBA
N7	24 Binya Close	55 dBA or Ambient + 2.0 dBA
N8	Lot 4 Mountain View Road	55 dBA or Ambient + 2.0 dBA
N9	48 Yamble Drive	55 dBA or Ambient + 2.0 dBA
N10	Salad Bowl Caravan Park	55 dBA or Ambient + 2.0 dBA
N11	1 Kulgun Court	55 dBA or Ambient + 2.0 dBA
N12	Villa Ruidosa Cottage, The Tunnel Road	55 dBA or Ambient + 2.0 dBA
N13	123 Balemo Drive	55 dBA or Ambient + 2.0 dBA
N14	Humble Pie, Billinudgel Ind. Est.	no goal as it is a commercial premise
N15	175 Billinudgel Road	55 dBA or Ambient + 2.0 dBA
N16	Holm Farm, Billinudgel Road	50 dBA or Ambient + 0.5 dBA
N17	Jagwen, Billinudgel Road	50 dBA or Ambient + 0.5 dBA
N18	Lot 2, Billinudgel Road	55 dBA or Ambient + 2.0 dBA

Heavy Vehicle Noise Events

Although it is not a quantitative part of the EPA guidelines the potential for sleep disturbance from short term maximum noise levels generated by heavy vehicles at night time has been assessed. Previous surveys have identified some noise impact may occur from short term noise events at night. Impacts generally relate to heavy vehicle movements on steep grades or near intersections, where engine braking or numerous gear changes occur. Since the at grade intersections are being replaced with full grade separated interchanges almost all the heavy vehicle movements would be likely to be through traffic, and the grades associated with the proposal are significantly reduced and it is unlikely that engine braking would be required.

8.2 Prediction and Assessment of Traffic Noise

8.2.1 Prediction of Traffic Noise

Since almost all the residences where monitoring was undertaken are currently affected by traffic noise it was considered appropriate to check the accuracy of the prediction model by comparing the measured noise levels to the predicted noise levels for the existing situation. The results are shown below in **Table 8-3**.

These results show excellent correlation between the predicted and measured results with differences being typically between +/- 1 dBA. The only locations where differences of greater than 2 dBA have arisen are likely to be due to either the measurement location not being a true facade (i.e. on an enclosed balcony) or localised shielding being provided by garden fences or topography.

Table 8-3 - Comparison of Measured and Predicted Existing Night time $L_{aeq,9hr}$ Noise Levels

Reference	Location Description	Measured Existing (dBA)	Predicted Existing (dBA)	Difference	EPA Goal (dBA)
N0-A	Lot 264 Bayside Way [1]	-	47.5	-	55.0
N0	Bashforths - Bashforth Lane [1]	-	50.0	-	55.0
N1	Ferry Reserve Caravan Park	61.0	62.0	+1.0	64.0
N2-A	2 Rajah Road	-	57.5	-	59.5
N2	1 Rajah Road	59.5	58.5	+1.0	60.5
N3-A	1 Arika Ave	-	60.0	-	62.0
N3	5 Arika Ave	60.0	61.0	+1.0	63.0
N5	1 Oola Place	58.5	59.5	+1.0	61.5
N5-B	Oba Close	-	61.5	-	63.5
N4	5 Weeronga Way (east) [3]	45-50	43.0	-5.0	55.0
N4-A	5 Weeronga Way (west)	-	61.5	-	63.5
N6	Tongarra Drive	66.0	64.0	-2.0	66.0
N7	Binya Close [2]	42-47	52.5	+6.0	55.0
N8	Mountain View Road	50.0	52.0	+2.0	55.0
N9-A	Yamble Drive	-	67.5	-	69.5
N8-A	Coolamon Scenic Drive	-	53.0	-	55.0
N9	48 Yamble Drive	56.5	57.5	+1.0	59.5
N11-A	Balemo Drive	-	58.5	-	60.5
N12-A	Lot 6, The Tunnel Road	-	47.5	-	55.0
N11	1 Kulgun Ct [2]	56.5	58.0	+1.5	60.0
N11-B	Ulpira/Nargoon	-	58.0	-	60.0
N12	Villa Ruidosa Cottage	49.0	39.0	-10.0	55.0
N13-A	Matong Ave	-	61.5	-	63.5
N13-B	Gilba Ave	-	59.5	-	61.5
N14	Humble Pie Company	61.0	60.5	-0.5	-
N14-B	Christian Life Centre [4] [5]	-	65.0	-	50.0
N14-C	Funeral Parlour	-	61.5	-	63.5
N13	123 Balemo Drive	60.0	57.5	-2.5	59.5
N14-D	Lot 1 Pacific Highway	-	56.0	-	58.0
N15	175 Billinudgel Road	58.0	55.5	-2.5	57.5
N16-A	Holm residence, Billinudgel Road	-	48.0	-	50.0
N16	Holm farm, Billinudgel Road [3]	45-50	38.5	-6.5	50.0
N17	"Jagwen", Billinudgel Road	52.5	50.0	-2.5	52.0

Notes 1) Existing noise levels take into account that the first carriageway of the Brunswick Heads Bypass is open
2) Localised shielding not included in predictions
3) Noise levels controlled by non traffic sources
4) Noise levels are average $L_{Aeq,1hr}$ for the daytime period
5) External goal based on internal goal of 40 dBA with operable windows.

The assessment of noise impact considers the potential impact of the proposal without noise mitigation, a comparison with the noise goals, whether some form of mitigation is required, the range of mitigation measures that are available, and the predicted benefit and cost effectiveness of these measures. The assessment is then made on the outcome assuming that noise mitigation is incorporated in the proposal.

The noise management strategy which is presented includes those measures which the RTA would implement to meet the new draft EPA guidelines and other measures which would be implemented to achieve beneficial noise reduction.

$L_{Aeq,9hr}$ noise levels were predicted at the residences without any noise mitigation measures incorporated into the road design. The results are summarised in **Table 8-4** below.

Table 8-4 - Predicted $L_{Aeq,9hr}$ Noise Levels (no mitigation)

Ref.	Location Description	EPA Goal (dBA)	LAeq,9hr (dBA)		Change in traffic noise level at opening[1]	Meet EPA
			Opening	2011		
N0	Lot 264 Bayside Way	55.0	50.0	51.5	0	✔
N0-A	Bashforth Lane	55.0	47.5	49.0	0	✔
N1	Ferry Reserve CP	64.0	55.0	56.0	-7.0	✔
N2-A	2 Rajah Rd	59.5	58.0	59.0	+0.5	✔
N2	1 Rajah Rd	60.5	58.5	59.5	0	✔
N3A	1 Arika Ave	62.0	60.0	61.0	0	✔
N3	5 Arika Ave	63.0	56.0	57.0	-5.0	✔
N5	1 Oola Place	61.5	55.5	56.5	-4.0	✔
N5-B	Oba Close	63.5	57.0	58.0	-4.5	✔
N4	Weeronga Way (east)	55.0	44.5	45.5	+1.5	✔
N4-A	Weeronga Way (west)	63.5	53.5	54.5	-8.0	✔
N6	Tongarra Dr.	66.0	57.0	58.0	-7.0	✔
N7	Binya Cl.	55.0	40.5	41.5	-12.0	✔
N8	Mtn. View Rd	55.0	53.5	54.5	+1.5	✔
N9-A	Yamble Dr.	69.5	58.0	59.0	-9.5	✔
N8-A	Coolamon Scenic Dr	55.0	52.5	53.5	-0.5	✔
N9	48 Yamble Dr	59.5	53.5	54.5	-4.0	✔
N11-A	Balemo Dr	60.5	53.0	54.0	-5.5	✔
N12-A	Lot 6, The Tunnel Rd	55.0	48.0	49.0	+0.5	✔
N11	1 Kulgun Ct	60.0	49.5	50.5	-8.5	✔
N11-B	Ulpira/Nargoon	60.0	48.0	49.0	-10.0	✔
N12	Villa Ruidosa Cottage	55.0	51.0	52.0	+12.0	✔
N13-A	Matong Ave	63.5	54.5	55.5	-7.0	✔
N13-B	Gilba Ave.	61.5	57.5	58.5	-2.0	✔
N14	Humble Pie Company	-	59.5	60.5	-1.0	-
N14-B	Christian Life Centre [2]	50.0	62.0	63.0	+0.5	x
N14-C	Funeral Parlour residence	63.5	62.0	63.0	+0.5	✔
N13	123 Balemo Drive	59.5	51.0	52.0	-6.5	✔
N14-D	Lot 1 Pacific Highway	58.0	55.0	56.0	-1.0	✔
N15	175 Billinudgel Road	57.5	56.0	57.0	+0.5	✔
N16-A	Holm Res, Billinudgel Rd	50.0	49.0	50.0	+1.0	✔
N16	Holm Farm, Billinudgel Rd	50.0	43.0	44.0	+4.5	✔
N17	"Jagwen", Billinudgel Rd	52.0	46.0	47.0	-4.0	✔

Notes: (1) difference between predicted noise levels with and without the proposal
(2) external goal based on internal goal of 40 dBA with openable windows.

8.2.2 Assessment of Traffic Noise Impacts

The EPA noise level guideline of 55 dBA or ambient + 2 dBA is predicted to be met at all the residences along the proposal. Although the future noise levels are predicted to be above 55 dBA for the Year 2012 at the closer residential locations in Ocean Shores the proposal results in a reduction in noise levels at almost all residences in the order of 2-8 dBA compared with existing levels and only small increases of less than 2 dBA at a few residences.

At those isolated residences to the west of the proposal off Coolamon Scenic Drive and The Tunnel Road, noise levels are predicted to increase by typically up to 2 dBA, however, they would remain below 55 dBA and therefore meet the EPA noise level goals. This increase would be barely noticeable and marginal impact

would be expected. Even in these areas where the proposal would be closer to residences the improved gradient and quieter road surface would result in similar or slightly lower noise levels at opening.

At those residences which currently experience relatively low traffic noise levels towards the north of the project along Billinudgel Road in the "new road" section, future noise levels are predicted to meet the EPA goal of 50 dBA even though increases in noise levels to the west of typically 2-5 dBA are predicted. These changes are considered to be barely noticeable (2 dBA) to clearly noticeable (5 dBA).

At the few residences which are potentially adversely affected by the duplication of the Brunswick Heads Bypass, the future noise levels meet the EPA goal of 55 dBA. At these residences, changes in noise levels were predicted as 1.5 dBA. This change is considered to be barely noticeable and marginal impact would be expected.

8.2.3 Consideration of Impacts and Noise Mitigation Strategies

Various methods of noise mitigation were considered including roadside noise barriers, roadside earth mounds, road pavement surface treatment and treatment to individual residences. The cost effectiveness and practicalities were considered for these options including the additional maintenance required for the quieter open graded asphaltic concrete road pavement and the limited mitigation that treatment to residences provides for outdoor areas.

The analysis indicates that the EPA noise level goals would be met at all residences, however, noise levels remain above the base guidelines of $L_{Aeq,9hr}$ 55 dBA at night time. The use of an open graded asphaltic concrete surface on its own would not be sufficient to reduce noise levels to below this guideline and is not considered cost effective given the high associated maintenance costs.

The internal goal within the Christian Life Centre would not be met with the windows open, (but would be met with the windows closed) and noise mitigation would be required. These measures would also be considered in conjunction with the noise mitigation measures for the adjoining residence.

At almost all residences noise levels are predicted to reduce at opening by typically 2-8 dBA in the main Ocean Shores area. Although this assessment has indicated that the EPA guidelines would be achieved at the majority of residences, there are many residences in the Ocean Shores area where noise levels would be similar or lower as a result of the proposal although these residents would still be subjected to relatively high traffic noise levels.

In the vicinity of Rajah Road, where the proposal and realigned local road are close to each other, it would be necessary for safety reasons to provide a barrier between the proposal and the realigned local road. Also a boundary fence would be required to adjoining residences. These barriers could both be constructed to provide some noise mitigation.

The construction of a barrier approximately 2m high located above the higher of the two road levels for a distance of approximately 650m would reduce noise between 1-4 dBA for approximately 40 residences. This barrier (shown on **Figure 8.2**) would be constructed as part of the proposal, subject to negotiation between the RTA and adjacent property owners.

In addition, some residences along Coolamon Scenic Drive and The Tunnel Road would experience barely noticeable increases in noise level, even though the level meets the EPA guideline for a freeway redevelopment.

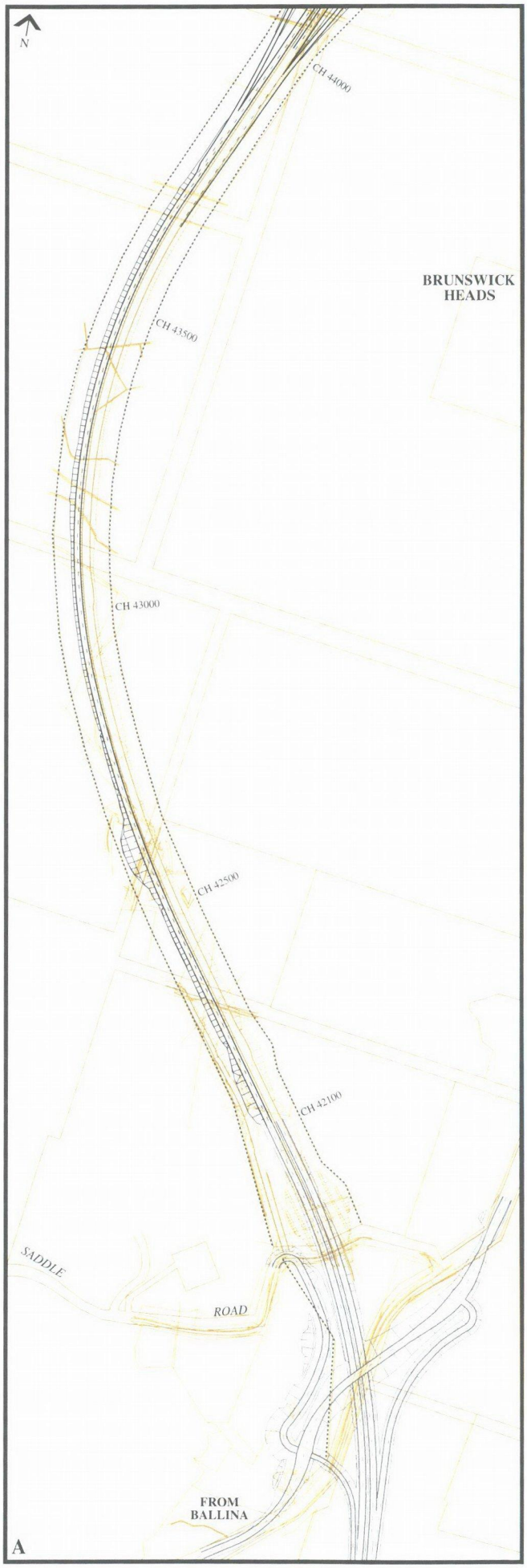
The design of the proposal would therefore consider additional noise mitigation measures which are considered optional and would be subject to the detailed design process. For example, the provision of additional earth mounds would be subject to the final earthworks balance.

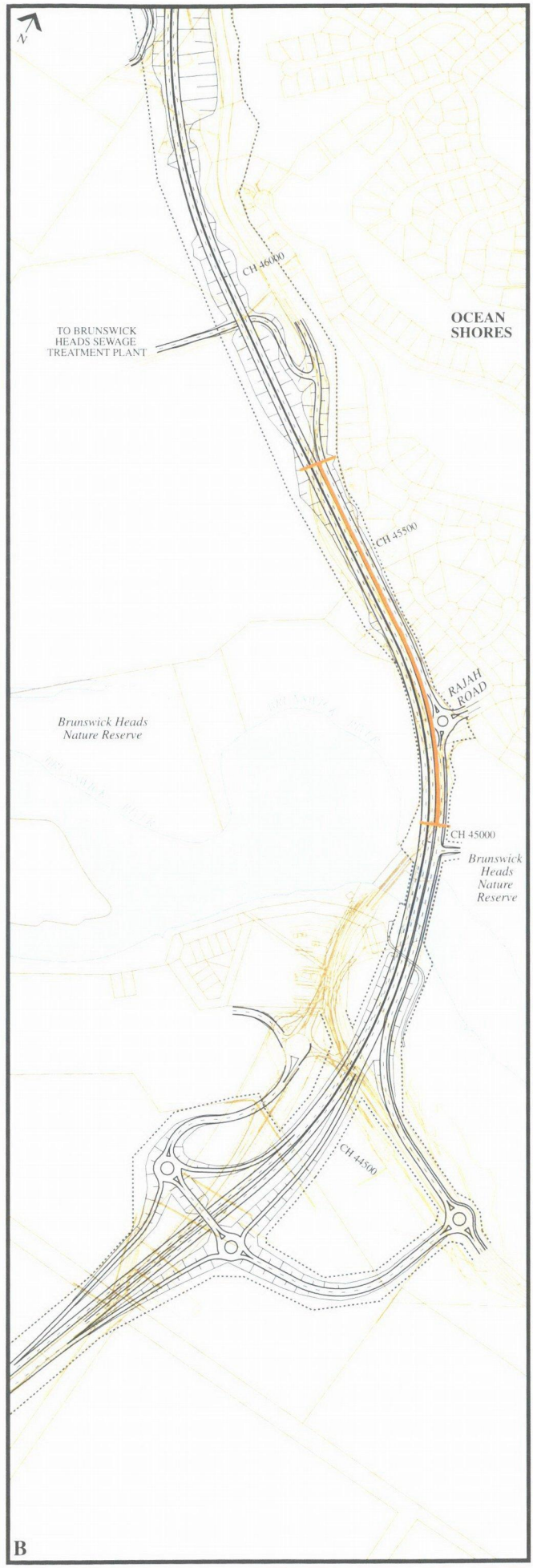
8.2.4 Assessment of Traffic Noise Levels with Mitigation

Table 8-5 gives the results of the predicted $L_{Aeq,9hr}$ noise levels at relevant locations in relation to the draft EPA guidelines. These have only reduced the noise levels slightly in the Rajah Road area. Noise level contours have also been generated and are shown in **Figure 8.3**.

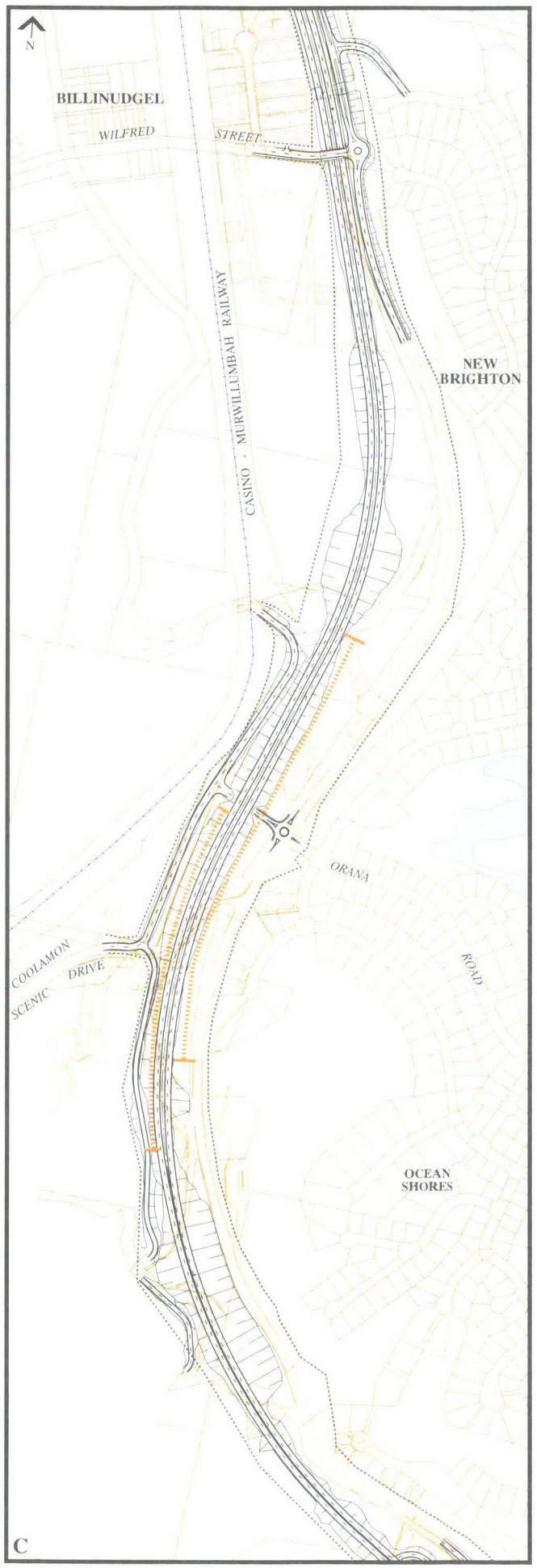
The duplication of the Brunswick Heads Bypass would only result in very small changes in noise level (less than 1 dBA at opening and 1-2 dBA by the Year 2012), however no noise mitigation has been provided for the Brunswick Heads Bypass since it was designed when previous less stringent EPA and RTA guidelines were adopted. This is an unusual circumstance and some form of noise mitigation requires consideration for the few residences to the west of the Brunswick Heads Bypass. Noise mitigation in the form of barriers would not be cost effective and the RTA would enter into negotiations with the affected residents to determine the most appropriate form of noise mitigation.

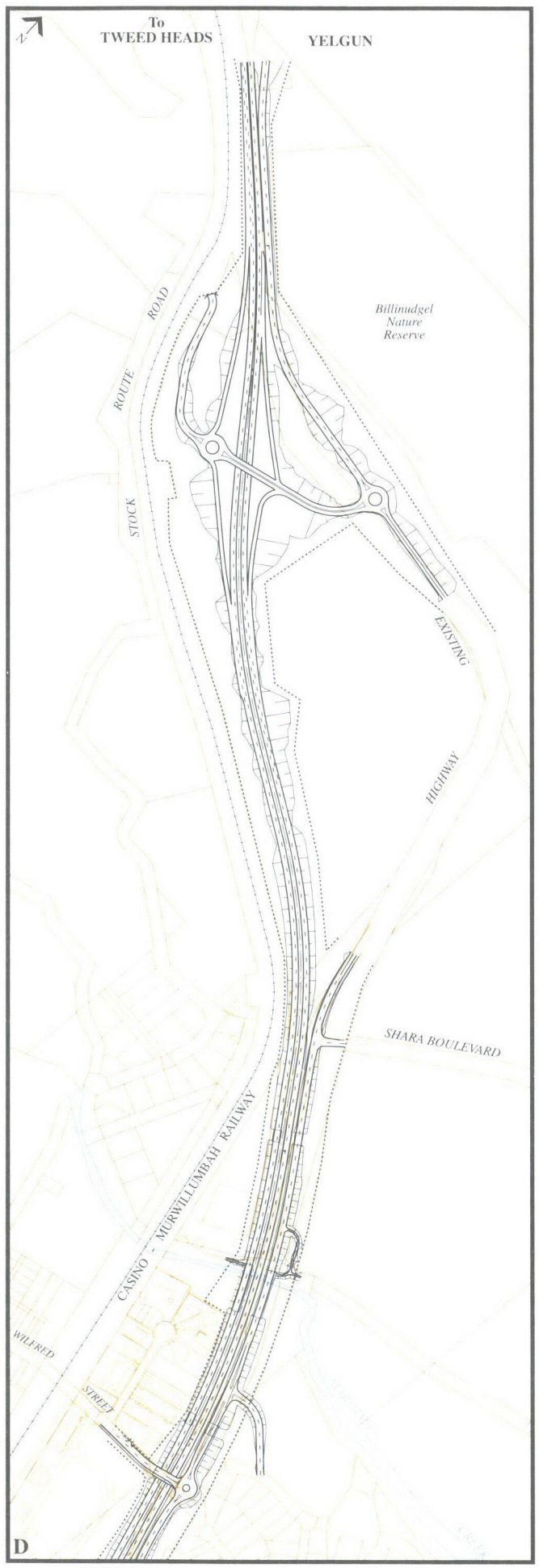
In the vicinity of Orana Road there are residences in both Yamble Drive, Balemo Drive and Kulgun Court where noise levels are predicted to reduce significantly as a result of the proposal. In many cases the noise levels are predicted to be below the guideline level of 55 dBA $L_{Aeq,9hr}$. However, the construction of an acoustic barrier 2m above road level between the new and existing highway would provide a further noise reduction of up to 5 dBA.

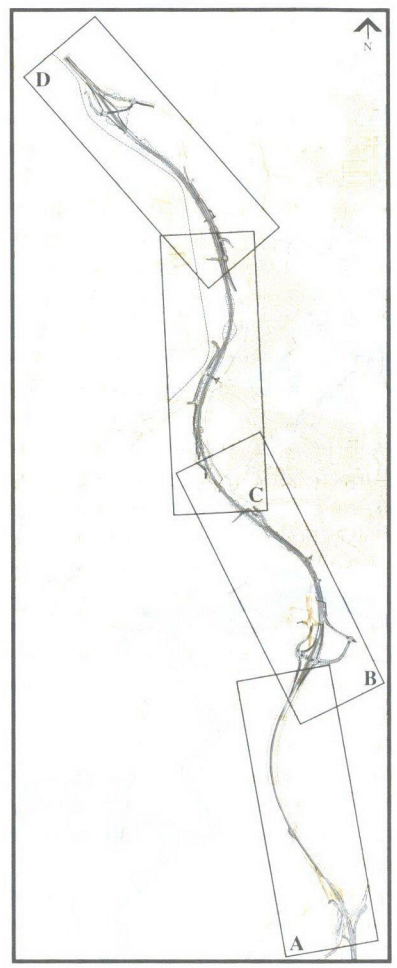

N
CH 44000
CH 43500
CH 43000
CH 42500
CH 42100
BRUNSWICK HEADS
SADDLE
ROAD
FROM BALLINA
A


N
CH 46000
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
OCEAN SHORES
CH 45500
RAJAH ROAD
Brunswick Heads Nature Reserve
CH 45000
Brunswick Heads Nature Reserve
CH 44500
B

0 100 500m





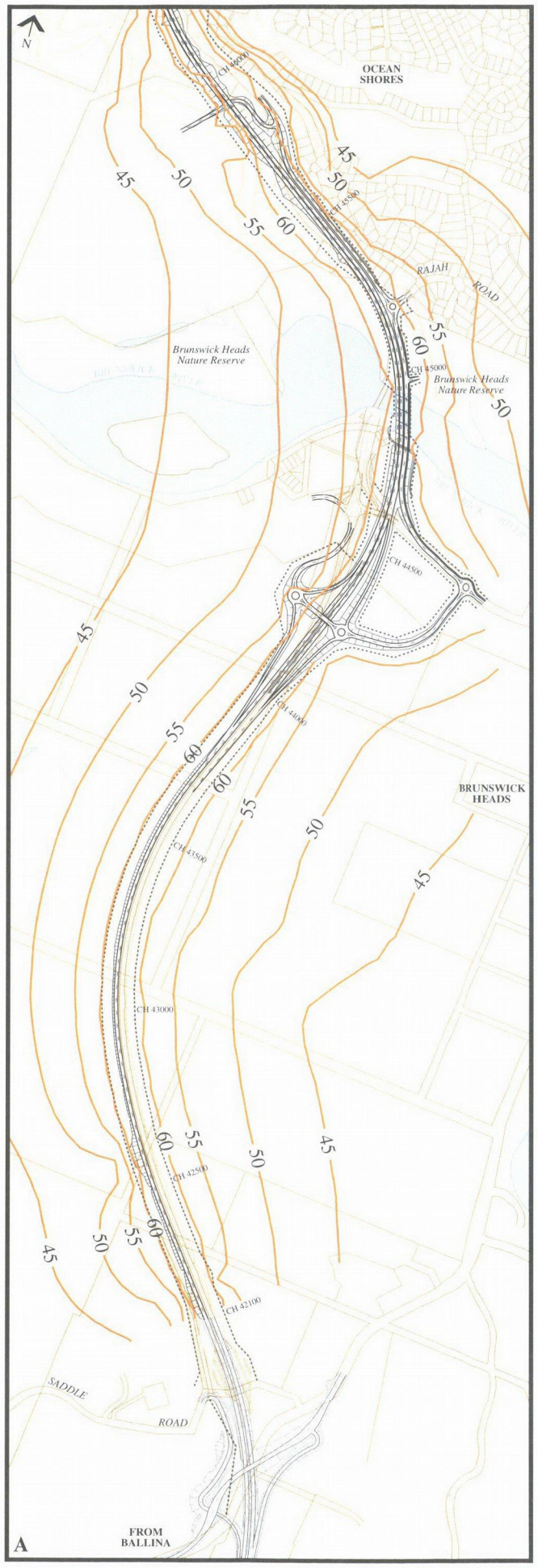


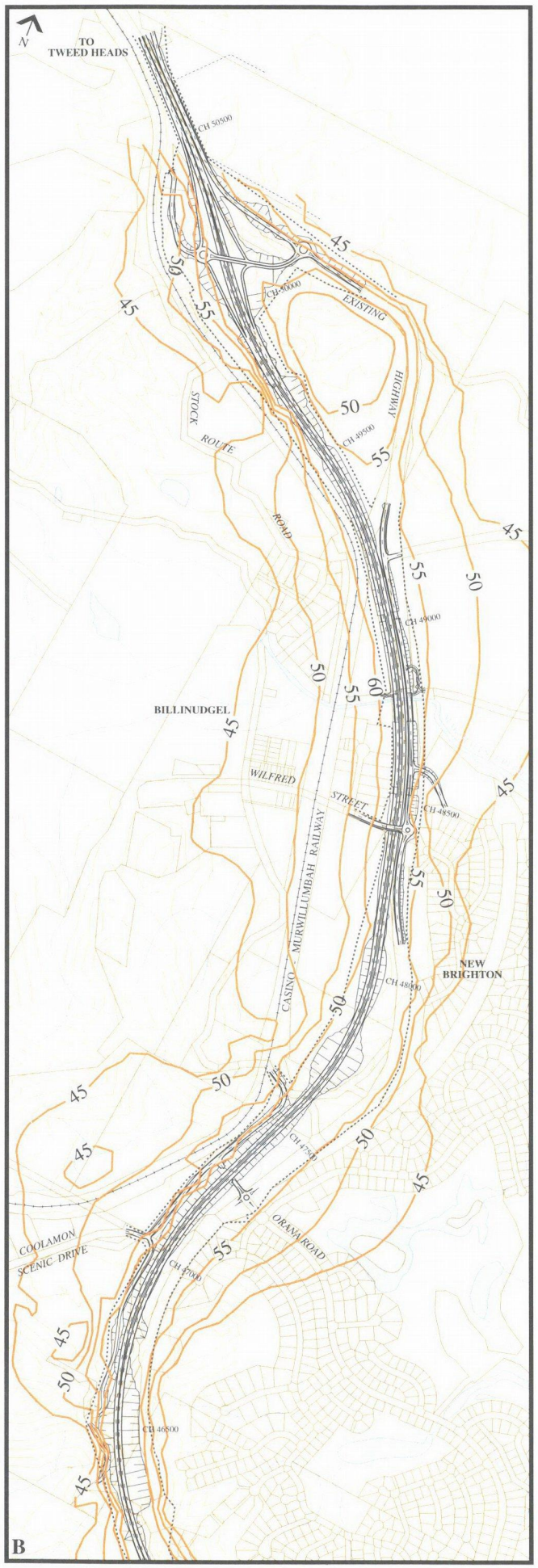
Legend

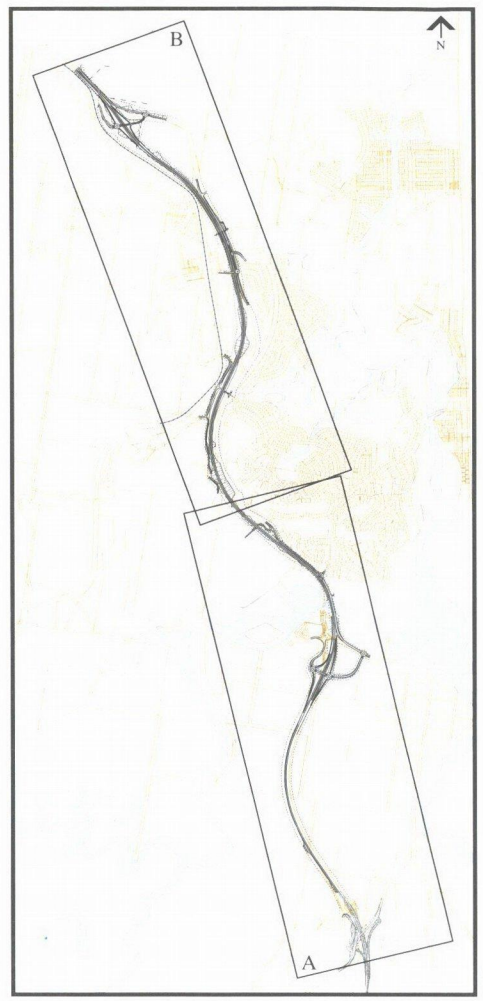
- Proposed Noise Barrier
- Optional Noise Barrier
- Proposed Road Corridor

0 100 500m

Figure 8.2
LOCATION OF NOISE MITIGATION MEASURES







Legend

50 Noise Contour - 50 dBA

Proposed Road Corridor

0 100 500m

Figure 8.3
NOISE LEVEL CONTOURS

One implication of constructing this barrier is the reflection of noise back towards residences in Coolamon Scenic Drive. This reflection component would increase noise levels in this direction to a level where the EPA guidelines would be exceeded. This would require a barrier 2m above road level on the west side of the proposal which would not only ensure that the EPA guidelines are met but would also provide a reduction of approximately 5 dBA which would be a significant benefit to those residences. The location of proposed noise control barriers is shown on **Figure 8.3**.

Table 8-5 - Predicted $L_{Aeq,9hr}$ Noise Levels with Mitigation

Ref.	Location Description	EPA Goal	L_{Aeq},9hr (dBA)		Change in traffic noise	Meet
		(dBA)	Opening	2011	level at opening	EPA
N0	Lot 264 Bayside Way	55.0	50.0	51.5	0	✔
N0-A	Bashforths-Bashforth Lane	55.0	47.5	49.0	0	✔
N1	Ferry Reserve CP	64.0	55.0	56.0	-7.0	✔
N2-A	2 Rajah Rd	59.5	56.5	57.5	-1.0	✔
N2	1 Rajah Rd	60.5	58.0	59.0	-0.5	✔
N3A	1 Arika Ave	62.0	59.0	60.0	-1.0	✔
N3	5 Arika Ave	63.0	55.0	56.0	-6.0	✔
N5	1 Oola Place	61.5	52.5	53.5	-7.0	✔
N5-B	Oba Close	63.5	53.5	54.5	-8.0	✔
N4	Weeronga Way (east)	55.0	44.5	45.5	+1.5	✔
N4-A	Weeronga Way (west)	63.5	52.0	53.0	-9.5	✔
N6	Tongarra Dr.	66.0	57.0	58.0	-7.0	✔
N7	Binya Cl.	55.0	40.5	41.5	-12.0	✔
N8	Mtn. View Rd	55.0	53.5	54.5	+1.5	✔
N9-A	Yamble Dr.	69.5	58.0	59.0	-9.5	✔
N8-A	Coolamon Scenic Dr	55.0	52.5	53.5	-0.5	✔
N9	48 Yamble Dr	59.5	53.5	54.5	-4.0	✔
N11-A	Balemo Dr	60.5	53.0	54.0	-5.5	✔
N12-A	Lot 6, The Tunnel Rd	55.0	48.0	49.0	+0.5	✔
N11	1 Kulgun Ct	60.0	49.5	50.5	-8.5	✔
N11-B	Ulpira/Nargoon	60.0	48.0	49.0	-10.0	✔
N12	Villa Ruidosa Cottage	55.0	51.0	52.0	+12.0	✔
N13-A	Matong Ave.	63.5	54.5	55.5	-7.0	✔
N13-B	Gilba Ave.	61.5	57.5	58.5	-2.0	✔
N14	Humble Pie	-	59.5	60.5	-1.0	✔
N14-B	Christian Life Centre	50.0	62.0	63.0	+0.5	x
N14-C	Funeral Parlour residence	63.5	61.5	62.5	+0.5	✔
N13	123 Balemo Drive	51.0	52.0	52.0	-6.5	✔
N14-D	Lot 1 Pacific Highway	58.0	55.0	56.0	-1.0	✔
N15	175 Billinudgel Road	57.5	56.0	57.0	+0.5	✔
N16-A	Holm Res, Billinudgel Rd	50.0	49.0	50.0	+1.0	✔
N16	Holm Farm, Billinudgel Rd	50.0	43.0	44.0	+4.5	✔
N17	"Jagwen", Billinudgel Rd	52.0	46.0	47.0	-4.0	✔

The RTA would implement a post construction noise monitoring program to confirm these predictions and ensure that the noise mitigation measures are achieving the design goals.

In terms of heavy vehicles, at most residences close to the proposal only minor changes in maximum noise level are expected as a result of the proposal since it is no closer than the existing highway. Negligible noise impact would therefore be expected. At many residences in the Ocean Shores area which are close to the

existing highway maximum noise levels from the proposal would reduce significantly. However, as the existing highway would remain open it is possible that an occasional heavy vehicle would generate maximum noise levels which are only slightly lower than currently experienced as a result of the reduction in speed.

Noise levels would only be marginally higher at those residences to the west of the proposal off Coolamon Scenic Drive, The Tunnel Road and Billinudgel Road. The most affected residences are in areas where the road gradient would be significantly improved or intersections would no longer exist and the use of engine brakes would diminish greatly and is unlikely. These factors would reduce the number of events likely to result in sleep disturbance however some sleep disturbance is possible where the proposal would be closer.

Other than the existing highway, where traffic flows would decrease significantly, there would be no change in traffic flows on local roads. No noise impact is therefore expected.

8.3 Impacts of Construction Noise and Vibration

8.3.1 Likely Construction Program

The guidelines for assessment of traffic noise are those established by the EPA. Because the proposal would be built by a contractor who would be commissioned by the RTA after the proposal has been determined, detailed information regarding the construction program is unavailable. Therefore, this assessment is based on the general type of construction activity likely to occur. A detailed construction noise assessment would be required to be undertaken by the contractor and a licence would be required under the Noise Control Act.

It is anticipated that, after 1 September 1998, the provisions of the Protection of the Environment Operations Act, 1997 would apply. The project would be classified as a freeway in the schedule of activities (premises based). Licensing requirements under this Act are currently being negotiated between the RTA and the EPA.

The assumptions that have been made are:

- earthworks and drainage (24 months);
- bridgeworks at Brunswick River (16 months);
- bridgeworks at the STP access road, Coolamon Scenic Drive, Wilfred Street (4 months); and
- noise barriers, pavement, pavement furniture and landscaping (6 months).

These activities would overlap within the 28 month period. Priority would be given to early installation of noise barriers which may be included as part of the earthworks phase to minimise construction noise.

The preliminary geotechnical investigation indicated that the rock in most sections of cut could be removed with mechanical ripping and minor hydraulic hammering. In each of the three largest cuts, to the north of the STP access road and south of Coolamon Scenic Drive, in the vicinity of the Villa Ruidosa residence and near the northern interchange some blasting will be required.

The earthworks and drainage phase is expected to have the longest duration and to generate the highest construction noise levels. A variety of earth moving equipment would be used to remove material from cut sections of the alignment and place material into fill sections. This includes the movement by truck of significant quantities of material from the cut north of the STP access road to the southern interchange, just south of the Brunswick River.

Surface preparation would involve compaction with vibratory rollers and road surface finishing would involve numerous concrete pours. This process would be shorter in duration and generally produce lower noise levels than the earthworks phase. Road surface finishing, noise barriers and road furniture installation are likely to be progressive activities with machinery being immediately adjacent to any nearby residence for a period of only one to two weeks.

The construction of bridges and grade separations would be expected to involve the use of plant such as concrete trucks, concrete pumps, generators, compressors, pneumatic hammers, hydraulic hammers, mobile cranes and bored or driven type piling machines. Unlike earthworks and surface preparation, the noise from bridge works would be largely stationary.

8.3.2 Construction Noise Guidelines

The guidelines for mitigation of construction noise as specified in the EPA's Environmental Noise Control Manual are as follows:

- for periods of 4 weeks or less, the L_{A10} level should not exceed the background (L_{A90}) level by more than 20 dBA.
- for periods greater than 4 weeks and less than 26 weeks, the L_{A10} level should not exceed the background (L_{A90}) level by more than 10 dBA.
- although not clearly stated by the Environment Protection Authority it is considered that for periods greater than 26 weeks, the Environment Protection Authority would expect that the L_{A10} level should not exceed the background (L_{A90}) level by more than 5 dBA.

However, in general, road construction activities are continually moving and not in any one area for more than 26 weeks.

- Monday to Friday: 7.00 am to 6.00 pm;
- Saturday: 7.00 am to 1.00 pm if construction noise is inaudible on residential premises otherwise 8.00 am to 1.00 pm; and
- No construction work is to take place on Sundays or Public Holidays.

The EPA also recommends that all possible steps should be taken to reduce noise levels of construction site equipment so as to minimise the impact of construction noise.

The noise generated by construction equipment would rise and fall as construction progresses along the route. The equipment may therefore be assumed to have a moving acoustic centre, which for most of the construction period would not be immediately adjacent to a single residence. Although the total contract duration would be in excess of 26 weeks the normal duration of the particular road building operations adjacent to a given receiver makes it appropriate to assess construction noise levels against the short term and medium term guidelines indicated above. The construction noise level goals for each of the monitoring locations are outlined in **Table 8-6**.

The only areas where this may not apply would be in the vicinity of bridgeworks at the Brunswick River. This activity alone is expected to last up to 16 months.

Table 8-6 -Construction Noise Level Goals

Ref (Fig 1)	Location Description	Measured Background L_{A90} Level	LA10 (dBA) (<4 Wks)	LA10 (dBA) (4-26 Wks)	LA10 (dBA) (>26 Wks)
N1	Ferry Reserve Caravan Park	58	78	68	63
N2	1 Rajah Road	53	73	63	58
N3	5 Arika Avenue	48	68	58	
N4	5 Weeronga Way	45	65	55	
N5	1 Oola Place	53	73	63	
N6	5 Tongarra Drive	50	70	60	55
N7	24 Binya Close	37	57	47	
N8	Lot 4 Mountain View Road	48	68	58	
N9	48 Yamble Drive	46	66	56	51
N10	Salad Bowl Caravan Park	52	72	62	
N11	1 Kulgun Court	46	66	56	
N12	Villa Ruidosa Cottage	47	67	57	
N13	123 Balemo Drive	49	69	59	54
N14	Humble Pie, Billinudgel Ind. Area	53	73	63	58
N15	175 Billinudgel Road	44	64	54	
N16	Holm Farm, Billinudgel Road	37	57	47	
N17	Jagwen, Billinudgel Road	44	64	54	49
N18	Lot 2, Billinudgel Road	45	65	55	

8.3.3 Predicted Noise Levels at Residences During Construction

Table 8-7 shows the maximum Sound Power Levels (L_{WA}) of plant likely to be used for the various phases of construction. Noise levels have been predicted by grouping typical types of noise sources for a particular section and construction

phase and by taking into account relevant acoustic factors such as distance attenuation, shielding effects and ground effects.

Table 8-7: Typical Maximum Sound Power Levels from Construction Plant

Drainage	LWA (dBA)	Paving and Asphalting	LWA (dBA)
Backhoe	110	Generator	111
Excavator	112	Backhoe	110
Dump Truck	110	Asphalt Paver	114
Earthworks	**LWA (dBA)**	Pneumatic Tyred Roller	111
Compactor	112	Concrete Truck	110
Bulldozer (D10)	116	Concrete Vibrator	105
Scraper (Cat 627)	117	Concrete Batch Plant	111
Scraper (Cat 631)	113	Concrete Saw	114
Excavator	112	**Bridgeworks**	**LWA (dBA)**
Vibrating Roller	113	Crane (Mobile)	110
Water cart	107	Bored Piling Rig	114
Grader	111	Concrete Pump	107
Haul Truck	112	Concrete Truck	110
Front End Loader	114	Compressor	105
		Generator	111
		Pneumatic hammer	113

Noise levels have been predicted at a number of indicative distances between the centre of earthworks operations and the typical residential receiver locations. The closest residences would be located approximately 30m from the noise sources but more typical distances would be between 60 and 120m from the centre of operations.

Residences near sections which would require extensive fill or cut operations may be exposed to construction noise levels for extended periods. Adjacent to cut sections, some shielding would be provided as roadworks progress, with a maximum expected noise reduction of 10 dBA. Near fill operations, however, this would not be the case. In such locations, the period that construction equipment would be adjacent to the nearest residences may exceed four weeks.

The predicted construction noise levels exceed the EPA guidelines at the closest residences along the whole alignment and indicate the need to construct noise barriers as soon as possible in the construction program. Some impact would therefore be expected along the entire proposal however significant impact would be expected in areas where fairly extensive cut and fill would be required for longer durations or where noise levels are predicted to be above 70 dBA. This would apply particularly in the section between Rajah Road and Oola Place, Coolamon Scenic Drive, the area south of Billinudgel village, Gilba Avenue, the northern end of Balemo Drive, within the Billinudgel Industrial Area and along Billinudgel Road.

The paving operations would on the whole be significantly quieter than the earthworks and would in general affect each particular residence for a period of

1-2 weeks only. It has been assumed that where noise mitigation barriers would be required these would be constructed prior to the paving.

The predicted noise levels exceed the EPA goals and construction noise levels would be clearly audible. However, given this operation would only occur in any one area for a short period the impact is likely to be limited. The use of a hessian dragged concrete pavement requires the use of concrete cutters at the required time during the curing process. This may require this activity to occur during the evening or night-time. This has the potential to cause significant annoyance.

The construction of overpasses and bridges at various locations along the proposal would involve the use of equipment and plant such as concrete trucks, concrete pumps, generators, compressors, pneumatic hammers, mobile cranes and piling machines. All of these would vary in number and position for the different bridges.

In general terms, it would be reasonable to assume that the noise generated by the construction of bridges would last for longer periods of time than the earthworks and paving construction and the noise levels are likely to be marginally quieter than those predicted for the bulk earthworks. With the exception of the Brunswick River bridge the remaining bridges are expected to take approximately 4 months to construct. At the closest residences to these bridges the EPA guideline for up to 6 months construction would be met. At the Brunswick River Bridge which is expected to take 16 months to construct the longer term EPA guideline would be met.

The proposal also requires the demolition of the existing Brunswick River bridge which is approximately 125m from the Ferry Reserve Caravan Park. The noise levels are predicted as up to 65 dBA. This would meet the EPA guideline based on existing background noise levels.

Blasting

In each of the three large cuts, to the north of the STP access road and south of Coolamon Scenic Drive, in the vicinity of the Villa Ruidosa main residence and near the northern interchange some blasting would be required in the deepest parts. The nearest residences to each of these potential blast sections are 200m, 125m and 275m respectively. In all cases shielding would be provided by the cut.

Blasting operations would in most cases be confined to the periods Mondays to Saturdays, 9.00 am - 3.00 pm. For this time period, the following EPA guidelines for human comfort apply:

- Blast overpressure (dB Linear) - 115 dBL
- Ground vibration peak particle velocity - 5 mm/s.

Conventional blasting techniques would be appropriate for blasts in excess of 150m from residences. A decked loading blast design may be required for blasts where they occur closer to residences. All blasts would incorporate sufficient delays to minimise the maximum instantaneous charge. Chapter 154 of the EPA ENCM provides many recommendations for the control of blast vibration and airblast overpressure. These would be adopted by the blasting contractor commissioned for the project as part of the construction contract.

8.3.4 Control of Construction Noise

Since the assessment indicates a potential noise impact from some construction activities, consideration may need to be given to noise control measures where these are practicable. The project EMP would incorporate a Noise Management Strategy and associated Community Consultation Program.

This Noise Management Strategy would consider the methodology proposed by the contractor and the relative phasing of different construction activities in various areas. It would also outline the means of keeping the community informed about noise generating activities, and for inspection of properties prior to blasting and vibration generating activities.

These documents would be submitted to the RTA and then to the EPA prior to the contractor gaining EPA approval. The licence issued by the EPA would be likely to contain limits for construction hours and possibly noise levels.

9. Air Quality Assessment

This Section assesses the air quality impacts associated with the construction and operation of the proposal. It provides background information on the key air quality issues, a summary of relevant air quality goals, an estimate of expected emissions from traffic using the proposal and predictions of concentrations of these emissions. Full details of the study are contained in Working Paper No.4 - Air Quality Assessment.

9.1 Air Quality Issues

The main air quality impacts of the proposal would be due to exhaust emissions from motor vehicles using the road. Whether this constitutes a significant impact would depend on whether the resultant concentration of pollutants exceed respective air quality goals, taking into account existing background concentrations. The impacts at both local and regional level need to be considered.

Impacts may also occur during the construction phase but would be relatively short-term and would comprise mainly nuisance dust due to earthmoving activities. Nevertheless these impacts would need to be controlled through an Air Quality Management Plan which is discussed in Section 9.7. The Air Quality Management Plan would form part of the EMP for the project and would contain measures which would be conditions of contract for the successful construction contractor.

The following sections discuss the major emissions from motor vehicles, their health impacts and the basis for setting the air ambient quality goals currently referred to in New South Wales.

9.2 Air Quality Criteria

The NSW EPA has historically noted air quality goals for nitrogen dioxide, carbon monoxide and particulate matter determined by the World Health Organisation (WHO), the United States Environmental Protection Agency (US EPA) and the National Health and Medical Research Council of Australia (NHMRC).

The National Environment Protection Council of Australia (NEPC) is currently determining a new set of air quality standards for adoption at a national level, which are part of the National Environment Protection Measures (NEPM).

Table 9-1 lists the EPA's air quality goals for NSW including historical goals and new interim goals. Not all of the pollutants listed are major emissions from motor vehicles.

Table 9-1 - NSW Air Quality Goals

Pollutant	Standard*	Agency
Carbon monoxide	87 ppm or 108 mg/m^3 (15-minute maximum)	WHO
	25 ppm or 31 mg/m^3 (1-hour maximum)	WHO
	9 ppm or 10 mg/m^3 (8-hour maximum)	NHMRC, draft NEPM
Nitrogen dioxide	0.16 ppm or 320 µg/m^3 (1-hour maximum)	NHMRC
	0.05 ppm or 103 µg/m^3 (annual mean)	US EPA, draft NEPM,
	0.125ppm or 256 µg/m^3 (1-hour maximum)	NSW EPA interim
	0.11ppm or 200 µg/m^3 (1-hour maximum)	WHO, NSW EPA long-term reporting goal
	0.03 ppm or 60 µg/m^3 (annual mean)	draft NEPM, NSW EPA interim
Total suspended particulate matter (TSP)	90 µg/m^3 (annual mean)	NHMRC
Particulate matter < 10 µm (PM10)	50 µg/m^3 (annual mean)	US EPA
	30 µg/m^3 (annual mean)	NSW EPA Interim
	150 µg/m^3 (24-hour maximum)	US EPA
	50 µg/m^3 (24-hour maximum)	draft NEPM, NSW EPA interim
Lead	1.5 µg/m^3 (90-day average)	NHMRC
	0.5 µg/m^3 (annual average)	draft NEPM
Ozone	0.10 ppm or 200 µg/m^3 (1-hour maximum)	NHMRC, draft
	0.08 ppm or 150 µg/m^3 (4-hour maximum)	NEPM, NSW EPA
	0.08 ppm or 150 µg/m^3 (1-hour maximum)	NSW EPA long term reporting goal**
	0.06 ppm or 120 µg/m^3 (4-hour average)	
Sulphur dioxide	0.25 ppm or 700 µg/m^3 (10-minute maximum)	NHMRC and
	0.20 ppm or 570 µg/m^3 (1-hour maximum)	draft NEPM
	0.08 ppm or 225 µg/m^3 (24-hour maximum)	draft NEPM
	0.02 ppm or 60 µg/m^3 (annual mean)	NHMRC and draft NEPM

* *all concentration units have been converted at 0°C*
** *based on WHO goals*

Carbon Monoxide

Carbon monoxide can be harmful to humans because it can reduce the capacity of the blood to carry oxygen. The process is reversible. Symptoms of carbon monoxide intoxication are lassitude and headaches, however these are generally not reported until the concentrations of carboxyhaemoglobin in the blood are in excess of 10% of saturation. However, there is evidence that there is a risk for individuals at lower levels and the WHO recommends that ambient concentrations be kept to values which would protect individuals from exceeding the 4% level.

Oxides of Nitrogen

Nitrogen oxides (NO_X) emitted by motor vehicles are comprised mainly of nitric oxide (NO, approximately 95% at the point of emission) and nitrogen dioxide (NO_2, approximately 5% at the point of emission). Nitric oxide is much less harmful to humans than nitrogen dioxide and is not generally considered a

pollutant with health impacts at the concentrations normally found in urban environments. Concern with nitric oxide relates to its transformation to nitrogen dioxide and its role in the formation of photochemical smog. Nitrogen dioxide has been reported to have an effect on respiratory function although the evidence concerning effects has been mixed and conflicting.

Hydrocarbons

Reactive hydrocarbons play a significant role in photochemical smog formation. Some hydrocarbons such as benzene are known to have an adverse effect on human health but the effects are thought to occur at concentrations higher than the levels of exposure found at roadsides from traffic emissions. The NSW EPA no longer notes a general goal for hydrocarbons largely because it is now recognised as not being useful either for assessing heath impacts or identifying the need for air quality management strategies.

Particulate Matter

The presence of particulate matter (PM) in the atmosphere can have an adverse effect on health and amenity, largely related to the extent to which particles can penetrate the respiratory tract.

Much of the recent concern over the health effects of fine particulate matter is based on investigations carried out in the US, with the view to quantifying the health risks associated with both long-term and short-term exposure to airborne particulate matter. The original work by Dockery and others (1993), determined a relationship between fine particulate matter (defined as particles smaller than 2.5 μm in diameter) in the air and mortality in six US cities. The basic findings of the Six Cities Study is that there is an increase in mortality with increasing concentrations of fine particulate matter. The conclusions appear to be robust and have been supported by subsequent studies however the mechanism is still unknown.

Lead

Lead is a cumulative poison which exerts its effects on the kidneys, blood and central nervous system. It is now generally agreed, that while the effects are not readily discernible on an individual basis, on a population basis, lead exposure in young children can lead to an IQ deficit of between 2 to 3 points for each 10 μg/dL increment in blood lead (EPA, 1993).

Sulphur Dioxide

Sulphur dioxide (SO_2) is an acid gas which can have harmful effects on the respiratory system as well as on vegetation and building materials. It is however a minor component of motor vehicle emissions, due to the low sulphur content of Australian petrol and, as such, has not been assessed quantitatively in this study.

Vehicle emissions and photochemical smog

Motor vehicle emissions have the potential to contribute significantly to photochemical smog in an urban environment. Photochemical smog is formed by the reaction between nitrogen oxides and reactive hydrocarbons in the presence of sunlight. At sufficient concentrations the smog can affect the eyes and respiratory system and can adversely affect plants and materials.

Photochemical smog is often a concern on the fringes of large cities as parcels of smog-laden air can travel to areas remote from the source. In the study area there are unlikely to be any regional air quality problems associated with vehicle emissions. The most important air quality issue associated with the proposal would be the local impacts at kerbside and nearby residences from specific emissions from vehicles.

9.3 Existing Air Quality

Site-specific air quality monitoring was not carried out for this study. Local air quality with respect to carbon monoxide was, however, monitored at 10 sites on five occasions within the Billinudgel to Chinderah area for a previous study (Sinclair Knight, 1994).

Measurements were made along the Pacific Highway and were designed to determine the carbon monoxide levels under "worst-case" meteorological conditions during typical peak traffic flow. The results indicate that in general, hourly concentrations of carbon monoxide in this type of environment are quite low, averaging between 2 - 5 ppm (2.3 - 5.8 mg/m^3). These are below all NSW air quality goals (see **Table 9-1**). On occasions, quite high readings were obtained in these studies, (up to 17.7 ppm, or 19.6 mg/m^3) but these did not appear to be associated with roadway emissions. Other local factors such as cane-burning or bushfires may contribute more significantly to air pollution in rural areas than motor vehicle emissions.

9.4 Dispersion Meteorology of the Area

The closest meteorological monitoring station with data which can be considered as representative of the meteorological conditions along the route is at the Cape Byron Lighthouse. Historical data have been collected at 9 am and 3 pm by the Bureau of Meteorology since 1957. On an annual basis at 9 am winds are predominantly from the southwest. This is also the case for autumn and winter, while in spring and summer there are winds from a number of directions including the north, northwest and southeast.

In the afternoon, the winds tend to blow from the southeast in all seasons, indicating the direction of the seabreeze. In summer and spring winds from the

northeast are also common. There are very few calm conditions which is typical of an exposed coastal location.

Indicative wind data were derived from the historical information and included in the computer based dispersion model discussed below.

9.5 Assessment of Impacts

9.5.1 Methods Used for Assessing Impacts

A computer-based dispersion model was used to estimate the concentration of oxides of nitrogen, carbon monoxide, hydrocarbons and particulate matter, that are likely to be produced in the vicinity of the highway. Details of the dispersion model and methods of estimating emissions are provided in Working Paper No.4 - Air Quality Assessment.

9.5.2 Prediction of Air Quality Effects

The air quality impacts of the proposal were assessed by comparing the predicted ground-level concentrations of roadway emissions with air quality goals or other air quality criteria where specified goals are not available. Predictions have been made for peak hour flows.

Table 9-2 presents the maximum predicted 1-hour average increase in ground-level concentrations of carbon monoxide, hydrocarbons, nitrogen oxides, nitrogen dioxide, particulate matter and lead, at 0m, 10m, 20m, 30m and 50m from the roadway edge. Predictions at 30m and 50m have been made to assess impacts at any nearby residences.

Carbon Monoxide

It can be seen that the highest predicted 1-hour carbon monoxide concentration 10m from the proposal is 2.3 mg/m^3 in both 2002 and 2012. This is well below the EPA's 1-hour goal of 31 mg/m^3 and levels at 30m and 50m are even lower. Levels at the kerbside are also below the 1-hour EPA goal. Levels of this order added to existing background levels which are likely to be of the order of 2 - 5 mg/m^3 are less than the EPA's 1-hour goal.

Nitrogen Dioxide

The highest predicted 1-hour nitrogen dioxide concentration 10 m from the road in 2002 is 98 $\mu g/m^3$, and 113 $\mu g/m^3$ in 2012, both of which are below the 1-hour interim goal of 256 $\mu g/m^3$ and long-term reporting goal of 200 $\mu g/m^3$. These predictions do not take into account background concentrations which are likely to be in the range of 30 - 50 $\mu g/m^3$.

Table 9-2 - Predicted Increase in 1 Hour Average Ground-Level Concentrations of Vehicle Emissions at Various Distances from the Roadway Edge

	Distance from kerb (m)	Carbon Monoxide (mg/m^3)	Nitrogen Oxides ($\mu g/m^3$)	Nitrogen Dioxide* ($\mu g/m^3$)	Hydrocarbons (mg/m^3)	Particulate Matter ($\mu g/m^3$)	Lead ($\mu g/m^3$)
2002							
Brunswick	0	4.3	1169	117	0.38	43.7	1.15
Heads	10	2.3	652	98	0.21	24.2	0.58
Bypass	20	1.8	504	101	0.16	19.6	0.46
	30	1.5	431	86	0.14	16.1	0.46
	50	1.2	332	66	0.10	12.7	0.35
Brunswick	0	3.9	1156	116	0.36	47.2	1.04
River to	10	2.1	640	96	0.20	26.5	0.58
Yelgun	20	1.7	492	98	0.15	20.7	0.46
Interchange	30	1.4	418	84	0.13	17.3	0.35
	50	1.1	320	64	0.10	12.7	0.23
2012							
Brunswick	0	4.2	1353	135	0.37	54.1	
Heads	10	2.3	750	113	0.21	29.9	
Bypass	20	1.8	578	116	0.16	24.2	
	30	1.5	492	98	0.14	20.7	
	50	1.2	381	76	0.10	16.1	
Brunswick	0	3.7	1316	132	0.35	57.5	
River to	10	2.1	726	109	0.20	31.1	
Yelgun	20	1.6	566	113	0.15	24.2	
Interchange	30	1.3	480	96	0.13	20.7	
	50	1.1	369	74	0.09	16.1	

** Assumed to be 10% by weight of total nitrogen oxides at the kerbside, 15% at 10 m and 20% at 20m, 30m and 50m from the roadway edge, (**RTA, 1997**).*

Hydrocarbons

The predicted maximum 1-hour increase in total hydrocarbons is of the order of 0.21 mg/m^3 in both 2002 and 2012 at 10m from the roadway. Assuming a 5% benzene composition in the exhaust the benzene concentration at 10m from the roadway edge would be approximately 0.01 mg/m^3 or 10 $\mu g/m^3$ (1-hour average), under unfavourable dispersion and with peak traffic flows. This is below the proposed UK goal of 16 $\mu g/m^3$ (the UK goal however is an annual average). Concentrations of total hydrocarbons are of course substantially lower at the locations of residences 50m from the road, 0.10 mg/m^3 (5 $\mu g/m^3$ benzene) being the maximum predicted in both 2002 and 2012. It is nevertheless recognised that there may be no safe limit for benzene, but the risks to a particular individual over a lifetime are small, and on a population and individual basis could be offset by lower risks through safer roads, although to an undetermined extent.

Particulate Matter and Lead

The predicted levels of PM_{10} are for 1-hour averaging periods, while the air quality goal refers to a 24-hour period. Comparing these is therefore a conservative approach (that is an over-prediction) as the maximum predicted 1-hour average will always be higher than the predicted 24-hour average. An empirical averaging time correction factor of 0.24 has been suggested by Katestone Scientific (1995) to convert 1-hour predictions to 24-hour averages. However, the actual relationship is dependent on hourly variations in traffic flow and meteorological conditions. Predictions of 24-hour average PM_{10} concentrations are therefore limited at Brunswick as there are no on-site meteorological data.

Kerbside levels are not predicted to exceed the historical 24-hour PM_{10} goal of 150 $\mu g/m^3$. In 2002 the highest 1-hour concentration at kerbside is predicted to be 47.2 $\mu g/m^3$, increasing to 57.5 $\mu g/m^3$ in 2012. Using the correction factor of 0.24, the 24-hour concentrations are likely to be of the order of 11 $\mu g/m^3$ (2002) and 14 $\mu g/m^3$ (2012). These levels are below both the historical and interim 24-hour NSW EPA goals. Background PM_{10} concentrations would have to be of the order of 30 $\mu g/m^3$ or more to cause exceedances of the 50 $\mu g/m^3$ level (the EPA interim goal), which is unlikely in the area between Brunswick River and Yelgun. The highest predicted increase in PM_{10} at 10m from the proposed road is in the order of 6 $\mu g/m^3$ in 2002 and 7 $\mu g/m^3$ in 2012 (using the 0.24 conversion factor) which are both less than the historical and interim NSW EPA 24-hour goals. All predicted increases in PM_{10} more than 10m away from the road are less than 50 $\mu g/m^3$.

Lead impacts have been assessed for 2002, assuming that about 15% of vehicles will still be using leaded petrol. It should be noted that the lead goal applies to a 90-day average, and the predicted level is for a "worst-case" 1-hour period. However, none of the predicted values here are above the 90-day average of 1.5 $\mu g/m^3$. These are short term predictions and are therefore likely to remain even further below the long term goals since "worst-case" conditions are unlikely to prevail for any significant period of time.

9.5.3 Enhanced Greenhouse Effect

The temperature of the earth's atmosphere and most of the surface is determined by the balance between incoming solar radiation and the loss of heat energy by radiation from the earth and atmosphere to outer space. One of the important factors in determining the amount of radiant energy absorbed in the atmosphere is the concentration of carbon dioxide. Changes in this concentration are likely to cause changes in the temperature of the earth's atmosphere near the earth's surface. Increases in carbon dioxide concentration are expected to cause increases in temperature.

Australia is signatory to the "International Frame-work Convention on Climate Change" (Rio Convention), which commits Australia to programs of monitoring and reporting on greenhouse gas emissions. A target of the Rio Convention is that signatory countries should attempt to reduce greenhouse gas emissions to the levels that applied in 1990. At the recent Kyoto meeting (1997) the convention agreed that Australia would be allowed to reduce its emissions to 5% above the 1990 level by 2010.

The RTA is committed to ensuring that its environmental goals and policies are consistent with those outlined in the 1992 Intergovernmental Agreement on the Environment which includes consideration of the enhanced greenhouse effect.

Approximately 21% of NSW's total carbon dioxide emissions are estimated to come from the transport sector (EPA, 1995). At a broad level, the RTA has been involved in and implemented several strategic initiatives to address the issue of road transport related greenhouse gas emissions. Emissions of carbon dioxide from motor vehicles are directly proportional to fuel consumption. They cannot be reduced by emission control technologies except where they result in an improvement in fuel consumption. RTA programs which encourage better vehicle maintenance and hence better fuel economy will be beneficial.

The RTA also continues to engage in other strategies to encourage the tightening of vehicle emissions standards. These include:

- working with the EPA to implement the State's Motor Vehicle Maintenance Program for lowering emissions, and on the introduction of vehicle emissions testing;
- enhancing the State's vehicle emissions enforcement resources; and,
- continuing its role on ACVEN (Advisory Committee on Vehicle Emissions and Noise) to encourage the early implementation of more stringent Australian Design Rules, including the revision of ADR-37/0X to tighten current light vehicle emission standards. A revision of ADR-70, is also in progress. This will also contribute to controlling emissions from diesel vehicles, which will be particularly important for NO_x and particulate matter emissions (RTA, 1995).

In terms of the proposal, the new route is likely to result in better traffic flow and hence better fuel economy and therefore reduced greenhouse emissions.

9.5.4 Construction Impacts

Dust would be generated from earthworks associated with the construction of the proposal. The total amount of dust generated would depend on wind conditions, the fine clay and silt content of the soil, moisture content of the soil and the area of exposed soil as well as the types of operations being carried out, such as extent of water spraying and the speed of machinery.

Estimates of dust emissions from construction operations can be made using emission factors developed by the State Pollution Control Commission (1983) and the US EPA (1981). The most likely equipment to be used in the project includes back hoes, rollers, excavators, pavers, concrete trucks, jackhammers and haul trucks. The major sources of dust would be from the dozers, excavators, scrapers, haul trucks and wind erosion during construction. An estimate of the amount of dust generated by each operation per day is summarised below. It should be noted that the emission estimates relate to an area which would impact individual residences, not emissions from the entire length of the proposal.

The total dust generated in a ten-hour working day from construction of a 200m strip of the road could be as high as approximately 50-60 kg. On a hot, dry, windy day (worst case emission conditions with respect to dust) the amount of dust from wind erosion could be much higher, and should be controlled using water sprays. It is possible that under some extreme wind conditions, construction activities would be stopped.

It is anticipated that the established ready mixed concrete and asphalt suppliers in the region would not be able to provide fully the quantity of material required for the construction of the roadway. Such plants would therefore need to be constructed on site, however at this stage the exact location and specifications are not known. If the RTA or its contractor decides to establish one (or more) batch plant, such a development would require separate environmental assessment, and a Pollution Control Licence (or other licence consistent with the requirements of the PEOE Act, from 1 September 1998).

The appropriate historical air quality goal for determining impacts from construction work is the EPA 24-hour goal for PM_{10} of 150 $\mu g/m^3$. This is approximately equivalent to the former EPA 24-hour goal of 260 $\mu g/m^3$ for total suspended particulate matter (TSP). It is still useful to refer to this goal as many historical measurements are for TSP.

Previous dispersion modelling studies (Stephenson, 1991) indicate that high levels of dust generation associated with road construction work, can result in short-term dust impacts. These include exceedances of the 24-hour air quality goal for TSP out to 600m or more under "worst-case" dispersion conditions and out to 300m for typical conditions. As construction is likely to continue for at least one year, it is important that exposed areas be stabilised as quickly as possible and that appropriate dust suppression methods be used to keep dust impacts to a minimum.

9.6 Conclusions

The conclusions of this study are:

- due to the present emission controls on motor vehicles and the projected traffic conditions for 2002 and 2012, the EPA 's carbon monoxide 1-hour goals would not be expected to be exceeded during the operation of the proposal.
- the PM_{10} annual and 24-hour maximum air quality goals, would not be likely to be exceeded at any nearby residences. This is also the case for the 90-day lead goal which is not even exceeded in the short-term.
- the predicted increases in concentration of nitrogen dioxide indicate that the EPA's interim goal would not be exceeded at any distance from the proposal.
- predicted concentrations of benzene (and other pollutants) are not at levels which should pose health effects. However it is recognised that there may be no safe level for exposure to benzene.

The introduction of catalytic converters has resulted in a substantial reduction in carbon monoxide and hydrocarbon emissions from motor vehicles. This is also true for nitrogen oxides, as all new fuel-injected passenger vehicles are fitted with three-way catalytic converters which reduce nitrogen oxide emissions. The EPA has also targeted heavy duty diesel vehicles for emission control in its Air Quality Management Plan, outlined in its publication "Action on Air" as these are major emitters of oxides of nitrogen and fine particulate matter. The increased speed on upgraded roads results in increased nitrogen oxide emissions and this has offset to some extent the gains from the improved technology. Nevertheless the proposal is predicted to result in nitrogen dioxide levels which are substantially below the air quality goal.

9.7 Environmental Safeguards

The only significant air quality impact of the project is the potential for nuisance dust impacts during the construction phase. It would be necessary to ensure that all exposed areas are stabilised or controlled through the application of water. Also, compound areas, stockpile sites would need be carefully located and take local wind and soil conditions into account so that any potential dust nuisance impacts are minimised on residents in the vicinity. There may also be a need for other control measures such as speed control in the works area. These aspects would be addressed in the Construction EMP.

Dust monitoring would be carried out during this stage of the project and this would be detailed in the EMP for the project and be a condition of contract for the successful construction contractor. Under extreme wind conditions, construction activities should be halted.

10. Water Quality and Hydrology

This Section describes the water quality and flow behaviour of waterways in the study area. It examines the potential environmental impacts of the construction and operation of the proposal on drainage, water quality and flooding, and outlines measures to mitigate any adverse impacts. The proposed environmental mitigation measures recognise the sensitive nature of the Brunswick River and Marshalls Creek. The detailed water quality and hydrology studies are found in Working Paper No.5 - Water Quality and Hydrology Assessment.

10.1 Introduction

The proposal crosses two sensitive watercourses, the Brunswick River and Marshalls Creek, as well as affecting or being very close to wetland areas including areas gazetted under SEPP 14. The proposal includes a new bridge over the Brunswick River, which would be a major structure, and the demolition of the existing bridge.

The construction and operation of the proposal has the potential to introduce contaminants to these sensitive watercourses and wetlands, and also to result in impacts on water flow. The objective of the proposed water quality management strategy is to maximise the capture of these contaminants and consequently mitigate the impact on the water quality of downstream waterways. Where the road passes over existing creeks, drainage channels and floodways, the crossings are designed to have no significant affect on existing flood levels upstream and downstream of the road and, where possible, to alleviate existing flooding problems.

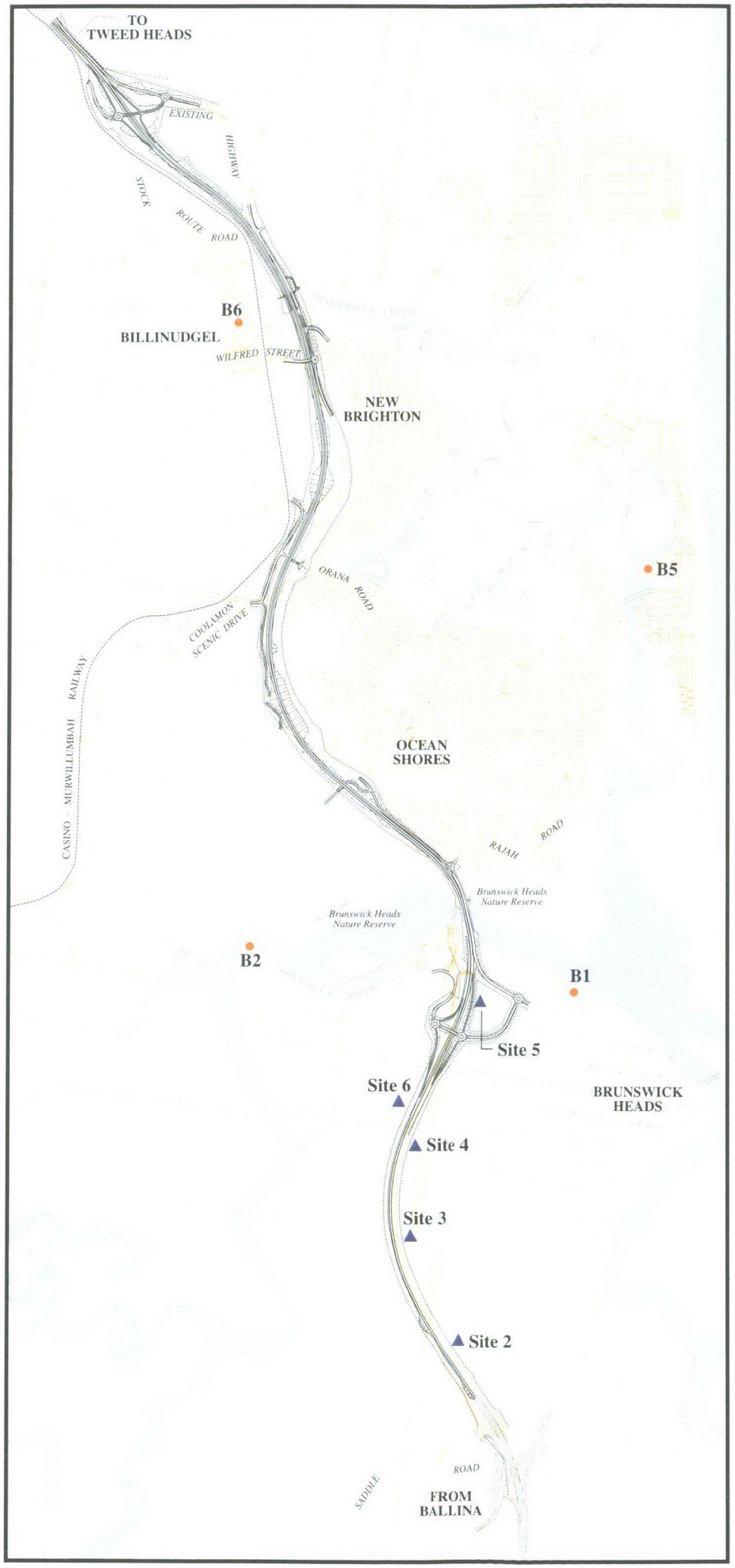
10.2 Water Quality

As mentioned above, the Brunswick River and Marshalls Creek are the waterways potentially affected by the proposal. Extensive wetland areas are associated with the Brunswick River which also supports marine flora and fauna, including several oyster leases. The on-going health of the Brunswick River is an aspect of concern. Similarly the condition of Marshalls Creek is of concern as it connects to the Billinudgel and Brunswick Heads Nature Reserve and also flows through the residential area of Ocean Shores.

10.2.1 Existing Water Quality Conditions

Brunswick River and Marshalls Creek

Water quality data for the Brunswick River and Marshalls Creek were supplied by the EPA, for monitoring carried out in 1994 and 1995. Sites were monitored in the Brunswick River approximately 1 km downstream of the proposed bridge (Site B1) and at Smoky Valley approximately 1 km upstream of the proposed bridge (Site B2). Marshalls Creek was monitored at Porana Bridge, Ocean Shores (Site





Legend

- Water Quality Monitoring Stations for Marshalls Creek and Brunswick River
- Water Quality Monitoring Stations for Brunswick Heads Bypass
- Proposed Road Corridor

Figure 10.1
WATER QUALITY MONITORING SITES

B5) and at Billinudgel (Site B6). These sites are shown in **Figure 10.1**.

This monitoring indicates a reasonable level of water quality in both waterways when compared to ANZECC guidelines. Nutrient levels are approaching the upper limit of desirable values and exceeding them slightly for some of the samples. (ANZECC, Australian Water Quality Guidelines, 1992). Dissolved oxygen, pH, and water clarity (turbidity and non filterable residue (NFR) are generally acceptable with the exception of the site sampled on Marshalls Creek near Billinudgel, which has elevated values of turbidity and NFR for some of the samples. Faecal coliform densities are reasonable for swimming in the Brunswick River, but of poorer quality in Marshalls Creek. **Table 10-1** below summarises existing median water quality conditions at these sites.

Table 10-1 - Existing Water Quality in Brunswick River and Marshalls Creek (Median Levels)

	Brunswick River		Marshalls Creek	
Parameter	**Site B1**	**Site B2**	**Site B5**	**Site B6**
Temperature (^{0}C)	19.1	23.5	22.1	21.2
pH	8.0	7.9	7.5	6.5
Turbidity (NTU)	2	4	4	16
Conductivity (mS/cm)	46.6	51	38.4	0.17
Dissolved Oxygen (mg/L)	6.4	5.9	6.9	6.8
Total Nitrogen (mg/L)	0.2	0.24	0.3	0..27
Total Phosphorous (mg/L)	0.024	0.029	0.027	0.04
Non Filterable Residue (mg/L)	3.3	4.1	4.4	11.6
Chlorophyll-a (µg/L)	0.7	1.8	2.1	7.5
Faecal Coliforms (CFU/100mL)	545	30	140	600

Brunswick Heads Bypass

Intensive monitoring has been carried out along the Brunswick Heads Bypass duplication. Monitoring was initiated to define baseline water quality prior to the construction of the first carriageway of the Bypass. Samples were collected at six sites (shown in **Figure 10.1**) in drainage lines crossing the Brunswick Heads Bypass.

Site 2 had elevated total nitrogen and total phosphorus, was low in dissolved oxygen, and high in suspended solids concentrations. These eutrophic conditions reflect the stagnant nature of the water bodies at this location. Some very high total nitrogen concentrations were recorded at this site following storm events, which may be attributed to the piggery upstream in the catchment discharging nutrients into the waterway (B. Eyre 1996). All other sample sites had total nitrogen and total phosphorus concentrations within or only slightly above ANZECC guidelines and showed no signs of eutrophication. Median total oils and greases were below EPA guidelines for discharge into protected waters.

Aluminium concentrations were high at all sites but this is considered typical of waters draining swampy areas of the northern NSW.

Water quality monitoring was continued at these sites during construction. Several parameters increased for most sites. Most notable was the decrease in dissolved oxygen which could be caused by decomposing organic matter from topsoil entering the drainage lines. **Table 10-2** compares the results of monitoring at these sites before and during construction of the Brunswick Heads Bypass.

Table 10-2 - Comparison of Water Quality Along the Brunswick Heads Bypass Before and During Construction

		pH	Dissolved Oxygen (% saturation)	Turbidity (NTU)	Total Nitrogen (mg/L)	Total Phosphorous (mg/L)	Total Aluminium (µg/L)
Site 2	before	6.66	62	117	2.66	0.09	266
	during	6.01	20	54	1.10	0.13	582
Site 3	before	5.9	69	52	0.93	0.01	630
	during	5.61	11	143	1.65	0.1	1436
Site 4	before	5.37	52	25	0.95	<0.01	490
	during	4.21	45	95	1.37	0.03	3300
Site 5	before	6.32	75	65	0.79	0.01	280
	during	6.79	64	33	1.05	0.04	1089
Site 6	before	6.25	72	32	0.55	<0.01	420
	during	6.1	57	20	0.75	0.03	765

10.2.2 Criteria for Assessment

The primary issues affecting the management of water quality for the proposal include:

- the proximity of the Brunswick Heads Nature Reserve and, to a lesser extent, the Billinudgel Nature Reserve;
- environmental values of the Brunswick River and Marshalls Creek;
- proximity of wetlands gazetted under SEPP 14 Coastal Wetlands;
- requirements of public authorities particularly NPWS, EPA, DLWC, NSW Fisheries, Environment Australia and Byron Council;
- expressed community concerns with potential location of constructed wetlands in proximity to dwellings;
- soils (including potential acid sulphate soils) and climate of the study area; and
- requirement for compliance during both construction and operational phases of the project with the RTA's Water Policy and the NSW Clean Waters Act 1970 (POEO Act from 1 September 1998).

10.2.3 Potential Impacts and Environmental Mitigation Measures During Construction

The construction phase of the proposal presents a potential risk to local water quality. The major risk occurs during earthworks when vegetation is removed and soils are exposed and sediment and associated pollutants can be washed into watercourses. This could cause a deterioration in water quality, damage to the aquatic ecosystems and siltation of waterways. To prevent this, road construction works are subject to controls which are documented prior to the commencement of any works in an Erosion and Sediment Control Plan. This plan documents the controls which need to be implemented in order to limit the movement of sediment, and the controls which are needed to remove sediment from runoff prior to it discharging from the site.

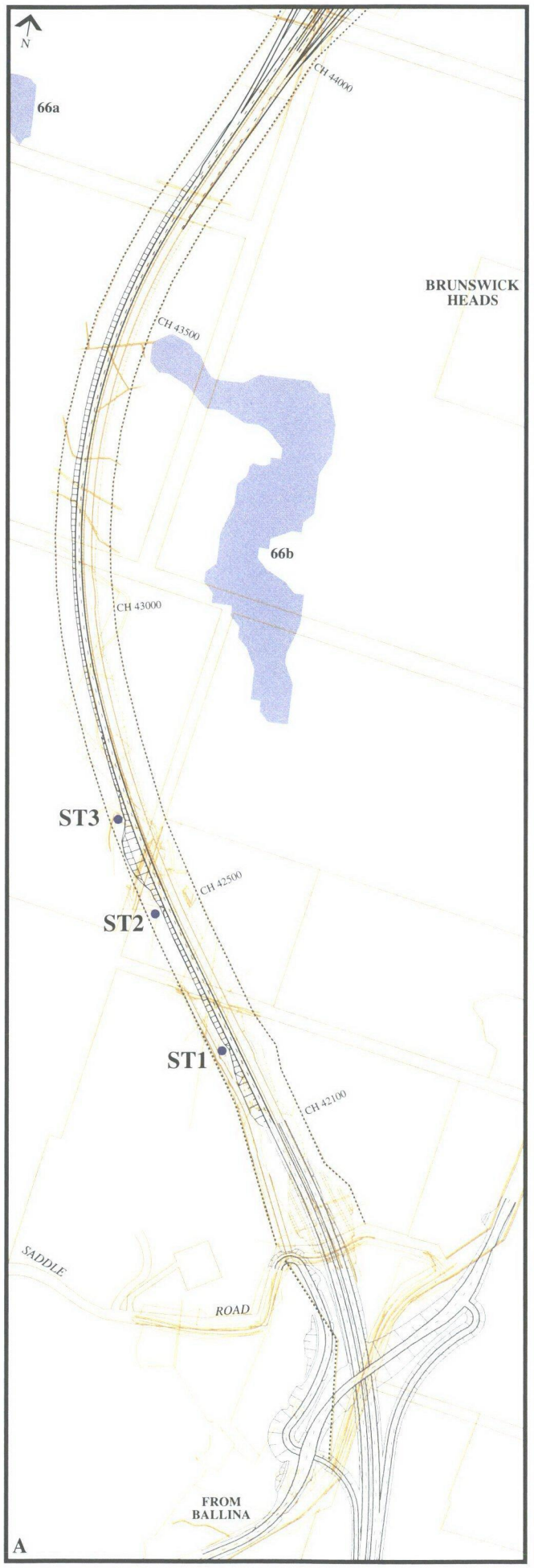
The Erosion and Sediment Control Plan would be prepared by the RTA or its contractor (to the RTA's requirements) prior to the commencement of construction. Soil erosion and sedimentation controls would need to be in place prior to commencement of construction and maintained during the construction period until all ground surfaces are stabilised and revegetated. This would be a condition of the construction contract.

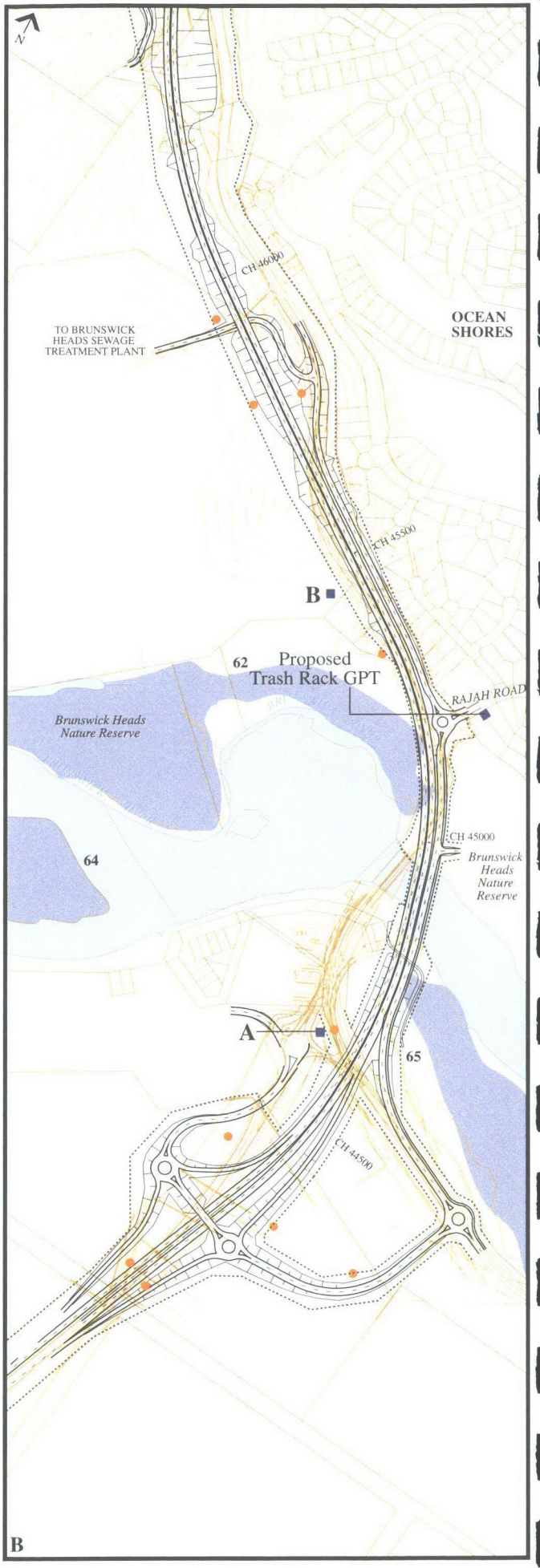
A key component of the Erosion and Sediment Control Plan would be the collection of runoff from disturbed areas into sedimentation basins or other treatment structures. A sediment basin is a barrier or dam designed to intercept and retain sediment laden runoff, usually from areas larger than 1 ha. It is usually located on a drainage line below a construction site, or at some other stormwater collection point. It may be fitted with a dewatering system, which allows the basin to remain empty between rainfall events with water treatment where required. Alternatively it may provide a source of construction water for uses such as dust control. By collecting sediment they prevent stormwater pipes and floodways from becoming clogged, and reduce environmental damage which can be caused by sediment.

The location of the proposed sediment control structures are shown in **Figure 10.2**. These structures would be installed prior to commencement of construction and would remain in place until construction has been completed and the disturbed areas stabilised. Some of these basins would be could be converted to wetlands as part of the detailed design. Any sedimentation basins used would be sized using the Road Design Guide (RTA, 1989) based on the soil type in the region plus areas disturbed and catchment size.

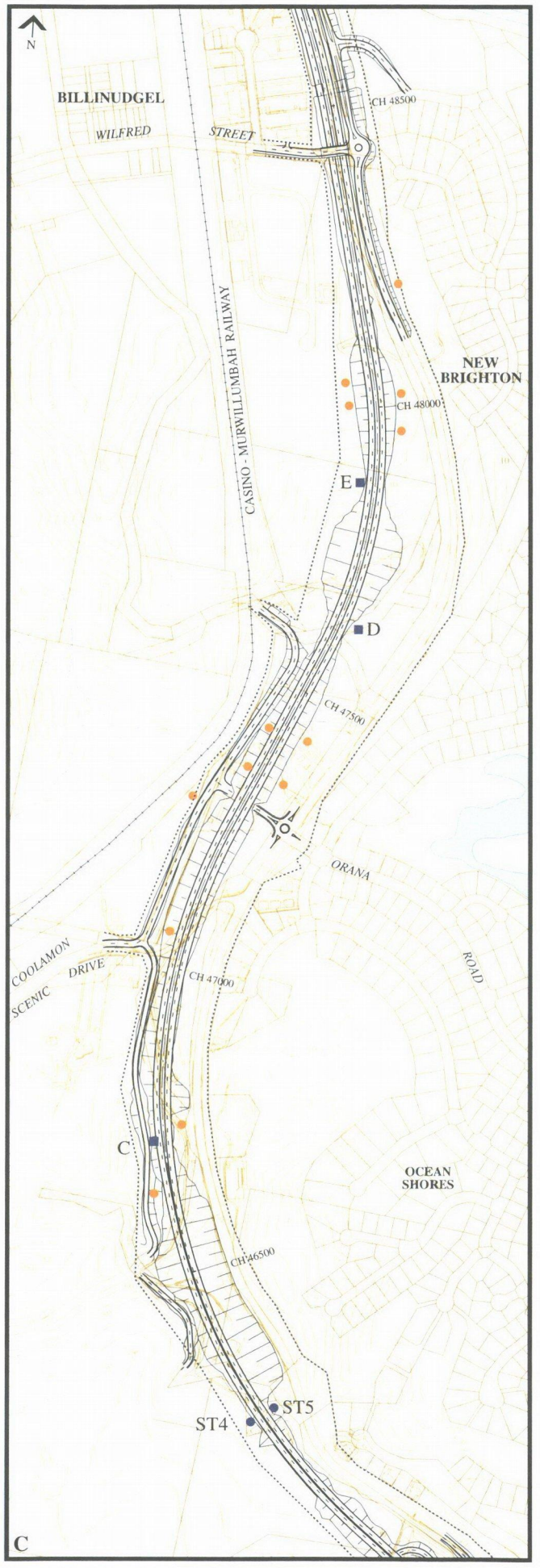
Other erosion control measures or practices that would be implemented prior to and/or during the construction period include the following:

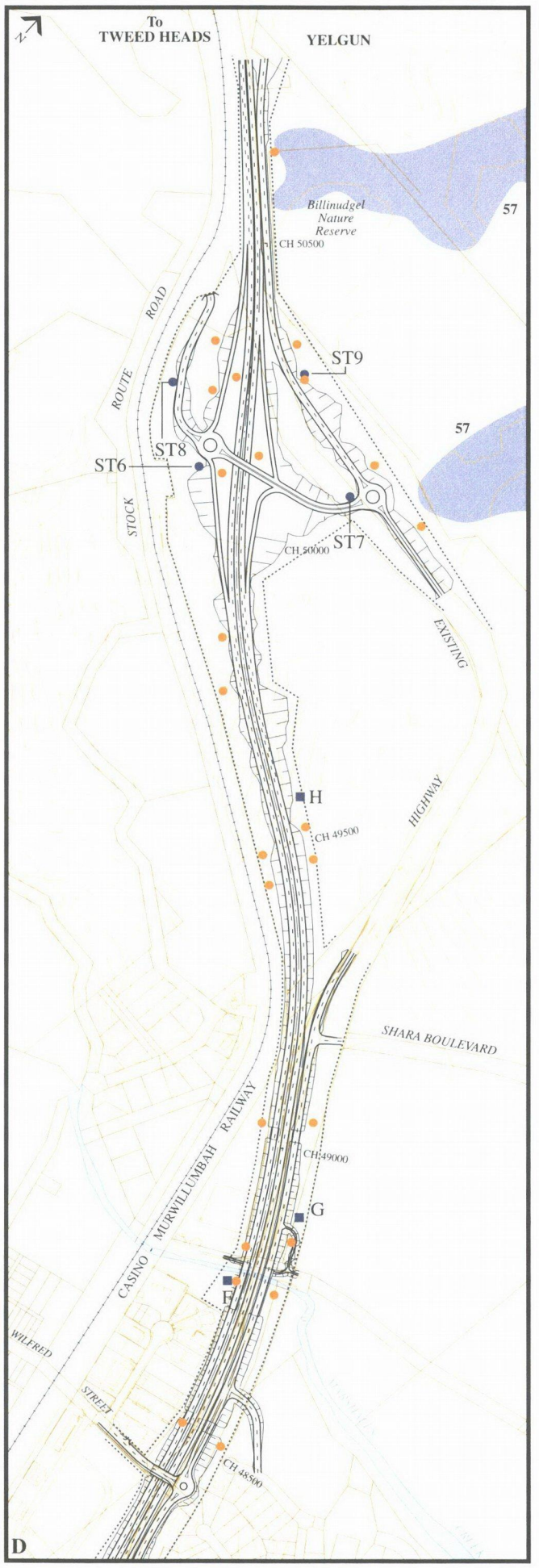
- all access to the site would be limited to well defined haul roads;

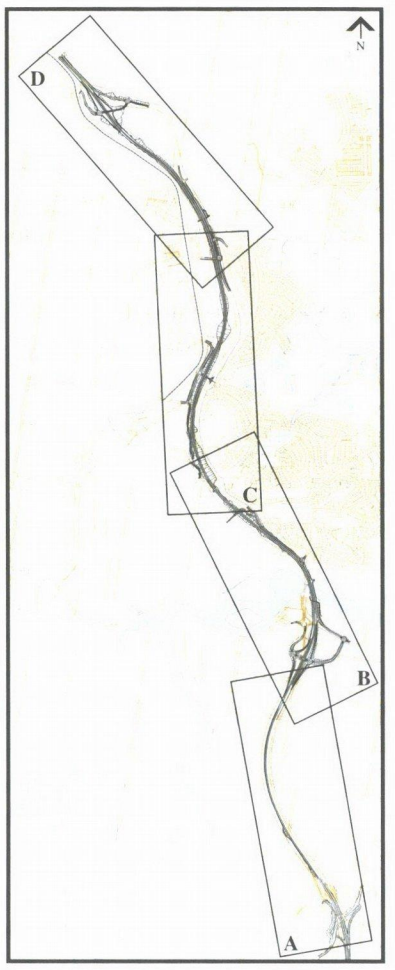

N
66a
CH 44000
BRUNSWICK HEADS
CH 43500
66b
CH 43000
ST3
CH 42500
ST2
ST1
CH 42100
SADDLE
ROAD
FROM BALLINA
A


N
CH 46000
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
OCEAN SHORES
CH 45500
B
62
Proposed
Trash Rack GPT
RAJAH ROAD
Brunswick Heads Nature Reserve
CH 45000
64
Brunswick Heads Nature Reserve
A
65
CH 44500
B

0 100 500m







Legend

- Sediment Control Structures (incl. sediment control basins, sediment traps and/or sediment filters)
- SEPP 14 Wetlands
- Stormwater Interceptor
- Proposed stormwater wetlands for Water Pollution (incl. Stormwater Interceptor)
- Proposed Road Corridor

Note: 1 For capacity of Stormwater Wetlands A to H and Stormwater Inceptors ST1 to ST9 refer to Table 4.1 in Working Paper No. 5.

0 100

Figure 10.2
LOCATION OF PROPOSED WATER QUALITY CONTROL STRUCTURES

Figure 10.2
LOCATION OF PROPOSED WATER QUALITY CONTROL STRUCTURES

- a temporary construction exit would be established to minimise movement of sediment out of the construction site via vehicles;
- all existing vegetation to be retained would be protected;
- all erosion control measures would be installed as soon as practical;
- all site topsoil free of weed would be stockpiled and protected;
- land shaping would aim to minimise slope lengths and gradients;
- disturbed areas would be left in a roughened surface condition;
- temporary sediment trapping and filtering structures would be used throughout the proposal;
- soil stockpiles would be protected and stored outside hazard areas;
- construction procedures which minimise water flow velocities would be specified;
- work sequences would be realistic and practical, so that progressive construction and stabilisation are feasible;
- appropriate methods would be employed to prevent wind blown dust creating an unacceptable hazard or nuisance on the site or down-wind;
- prompt revegetation of disturbed areas including hydroseeding with sterile varieties of fast growing exotics such as Japanese Millet or Rye Corn for initial site stabilisation;
- site supervision would be flexible to accommodate changes in the construction sequence;
- diversion channels and bunds to direct runoff from undisturbed areas around the site: and
- regular site surveillance would ensure on-going maintenance of temporary structures and measures.

The proposal also crosses areas identified as having potential acid sulphate soils including the Brunswick River and Marshalls Creek floodplains. The presence of these soils, and existing drainage practices contribute to the entry of varying levels of acidic drainage waters into creeks and rivers during wet periods.

Techniques to manage acid sulphate soils during construction are described in Working Paper No.8 - Geotechnical Assessment, and these follow the RTA's acid sulphate soil policy and procedures guidelines. With the proper implementation of these techniques there should be minimal potential for adverse impacts on water quality.

Construction of the proposal would also generate a requirement for water usage. Possible water sources, in order of preference, would be from:

- water detained in sediment ponds;
- industrial waste water e.g. treated sewage from the Brunswick Heads STP (to be used in non-sensitive areas);
- local non-potable supplies e.g. Brunswick River or Marshalls Creek upstream of the tidal limit; and
- potable supplies.

A detailed water balance would be carried out at the detailed design phase of the project and, if necessary, appropriate licences for water extraction would be sought.

10.2.4 Potential Impacts and Environmental Mitigation Measures During Operation

Motor vehicles contribute a broad range of pavement surface contaminants including: fuel, lubricants, hydraulic fluids and coolants; fine particles worn from tyres, clutches and brake linings; particulate exhaust emissions; dirt, rust and decomposing coatings which drop off undercarriages; vehicle components broken by vibration or impact and also litter discarded by vehicle occupants. These deposits build up on road surfaces in dry weather and usually disperse and are carried downstream during rainfall periods. Unless such pollutants are retained by pollution control structures and devices they can adversely affect downstream water quality. Heavy vehicles are also a potential source of spills of chemicals and other hazardous materials.

These pollutants potentially impact on the environment in the following ways:

- suspended sediments reduce clarity of water and silt up downstream waterways;
- heavy metals are toxic to aquatic biota;
- oils and grease are unsightly and cause water quality problems in streams;
- litter is unsightly and pollute streams; and
- accidental spills of chemicals or petrol in accidents can cause severe damage to the ecology of waterways.

With community expectations of environmental performance increasing, and the RTA's commitment to best environmental practice, the level of environmental protection provided for the proposal would be an improvement on that provided on the existing highway. To protect sensitive and other environments the design includes stormwater treatment to minimise the impact of road runoff.

Stormwater treatment facilities to be included as part of the drainage system include:

- grass swales,
- stormwater interceptors, and
- constructed stormwater wetlands.

Grass Swales

Grass swales and filter strips have been identified by the EPA(Treatment Techniques, Managing Urban Stormwater, 1997) as effective water quality improvement devices for road runoff.

Grass swales be can constructed to minimise the impact of pollution contained in road runoff. They reduce runoff volumes (through infiltration). They are most effective in removing particulate matter and associated pollutants, but less effective in removing hydrocarbons (through soil micro-organisms).

There are no comprehensive guidelines on the design of grass swales and filter strips available, and a number of 'rules of thumb' have been developed. The performance of grass filter strips and grass swales are reduced if located on grades exceeding 5%. In general, if a contact time of approximately 9 minutes (minimum 5 minutes) is achieved between the runoff and the grass, then the expected improvement in water quality is significant for suspended solids, oil & grease, iron, lead, and less so for total phosphorus and for total nitrogen.

Stormwater Interceptors

A stormwater interceptor is a pollution control device that removes oil and sediments from stormwater. Unlike the traditional gross pollutant traps (GPT), the stormwater interceptor prevents the resuspension and scour of captured material during subsequent storm events and is therefore a more efficient long term device when properly maintained. A stormwater interceptor is very effective in removing free oil and suspended solid sediments. Seventeen stormwater interceptors are provided in the design, with eight located above each constructed wetland. **Figure 10.2** and **Table 10-3** show the location and capacity of these proposed treatment structures.

Table 10-3 - Proposed Location and Sizes of Stormwater Constructed Wetlands and Stormwater Interceptors

Approximate Road Chainage (km)	Wetland ID No.	Wetland Storage Capacity (m3)	Wetland Surface Area (m2)	Stormwater Interceptor ID No.	Stormwater Interceptor Capacity (m3)	First Flush Tank (Y/N)
3.15	A	645	322	SIA	2.7	Y
3.75	B	806	403	SIB	2.7	Y
5.20	C	450	196	SIC	2.3	N
6.02	D	368	176	SID	2.3	N
6.40	E	468	210	SIE	2.3	N
7.28	F	560	257	SIF	2.7	Y
7.34	G	486	241	SIG	2.7	Y
8.03	H	560	256	SIH	2.7	N
0.73, 0.99, 1.2				SI1, 2, 3	2.7	
4.74	-	-	-	SI4	2.7	
4.75	-	-	-	SI5	2.7	
Yelgun Interchange				SI6, 7, 8, 9	2.7	

Constructed Stormwater Wetlands

Eight wetlands would be constructed as shown in **Figure 10.2**. Typically, a wetland would incorporate a small trash rack upstream of a stormwater interceptor. Trash racks intended to capture floating and large debris and coarser sediments, and prevent them from entering the wetland area. In this manner these pollutants would be removed and disposed of more easily and effectively. The wetlands would incorporate macrophyte beds to accelerate the water purification process and some of the wetlands would incorporate "first flush" tanks to capture accidental spills.

The proposed constructed wetland sizes are given in **Table 10-3**. Their sizes have been calculated to take account of local average annual rainfall conditions, local catchment areas, estimated pollutant loads, and the recommended EPA pollutant retention criteria. There is also an allowance for the capture and storage of fine sediments.

A trash rack/GPT is proposed at the open channel located near the Rajah Road roundabout (see **Figure 10.2**) to treat runoff from the catchment upstream of Rajah Road. This water treatment would be limited to the capture of floatable material and large debris.

All of the wetlands would be located within the proposed road corridor, with the exception of wetland B. This wetland would be located outside the road corridor. A pipe to this site would be laid, avoiding areas of sensitive bushland. Access for maintenance of this wetland would be by a track leading from the STP access road. Wetland B would discharge treated stormwater into the Brunswick River

through the natural flow paths in the Brunswick Heads Nature Reserve. The majority of this runoff would percolate into the ground.

The deeper section of the constructed wetlands would be sized to capture the volume of suspended solids such that maintenance, including pond emptying and cleaning would be necessary approximately every 5 years. Aquatic plant management would also be required. The density of emergent stands would be checked and, if necessary, weeds removed periodically to ensure and promote growth of the macrophytes. Yearly inspections of macrophyte beds would be undertaken to ensure continuing adequate performance.

Accidental Spill Management

As the proposal would carry freight and heavy vehicles, some hazardous materials would be transported over the route with some risk of accidental spillage. Hazardous materials such as heavy metals are toxic to aquatic biota and accidental spills of chemicals or petrol can cause severe damage to the ecology of waterways. Measures have been incorporated in the drainage system to prevent any accidental spillage from reaching downstream ecosystems and waterways.

These measures include:

- during the detailed design phase stormwater channels would be sized to include the ability to temporarily bund and contain runoff;
- first flush tanks would be incorporated into wetlands A &B and F & G which are located immediately upstream of the environmentally sensitive areas of Brunswick River and Marshalls Creek respectively (refer to **Table 10-3** for the location of first flush tanks).

In the event of a chemical spill on the Brunswick River bridge, runoff would be directed into Wetland A or Wetland B treatment systems depending just where on the bridge the spill was to occur. Spills on the southern fall would be directed into wetland A and on the northern fall into Wetland B. No runoff would be discharged into the Brunswick River without first passing through the treatment systems. This represents a significant improvement on the existing situation where untreated runoff can find its way directly into the Brunswick River.

10.3 Hydrology

The Brunswick River and Marshalls Creek have extensive flood plains. The design of the proposal needs to take account of this and ensure that the existing flood levels upstream and downstream of the Brunswick River and Marshalls Creek crossings are maintained.

10.3.1 Brunswick River

Floods in the Brunswick River have only been accurately recorded since the 1970s. The May 1987 event is the largest event in recent times on the Brunswick River and approximates a 3% annual exceedance probability (AEP) event at Mullumbimby. A 3% AEP means that the flood had 3 chances in 100 of occurring, or being exceeded, in a calendar year. Considerable damage was caused to the community of Mullumbimby by this flood.

The majority of the floodplain is used for cattle grazing with little arable farming. There are also extensive stands of high quality heathland vegetation. Further upstream near Mullumbimby, there is some sugar cane farming. A survey of the buildings located within the floodplain showed some areas are flood liable in a 1% flood:

- the Ferry Reserve Caravan Park situated on the west side of the southern approach to the highway bridge, including the Manager's Residence and Kiosk;
- Riverside Crescent adjoining the Ferry Reserve Caravan Park. All twelve residences are flood liable;
- the township of Mullumbimby, which includes approximately 70 flood liable buildings to the east of the railway line and approximately 50 buildings to the west of the Casino-Murwillumbah railway line;
- a Sawmill, Football Club, isolated houses and a commercial development located along Football Club Road extending northwards from the main road (MR524);
- eight or more houses in Fingal and Cudgen Streets, Brunswick Heads; and
- isolated farm buildings and yards.

10.3.2 Marshalls Creek

Marshalls Creek has a reasonably good flood record (based on residents' recollections) dating back to the 1920s. Since 1971 flood heights have been accurately recorded by the DLWC stream recorder gauge at Billinudgel.

May 1987 is most likely the largest flood recorded in Billinudgel in the last 100 years. It approximates a 1% event. The May 1987 event inundated Billinudgel, New Brighton and South Golden Beach. Several properties on the lower parts of Ocean Shores were also inundated and there was considerable damage and disruption.

Billinudgel is within the floodplain between the existing highway and The Pocket Road. Prior to 1980, the village was entirely located upstream of the railway line and consisted of approximately 12 flood liable buildings (hotel, houses, shops and industrial premises). Since 1980, a considerable amount of additional

development has occurred on the floodplain near Billinudgel including commercial and industrial development in the area around Wilfred Street.

10.3.3 Impacts on Flood Levels

Construction of a road across a floodplain has the potential to impact on flood levels upstream and downstream of the crossing. For example, if there are insufficient openings under the crossing flooding will increase upstream, increasing flood damage. Conversely if too many openings under a existing crossing are enlarged, downstream flooding will increase.

The factors which affect the amount of flood damage are:

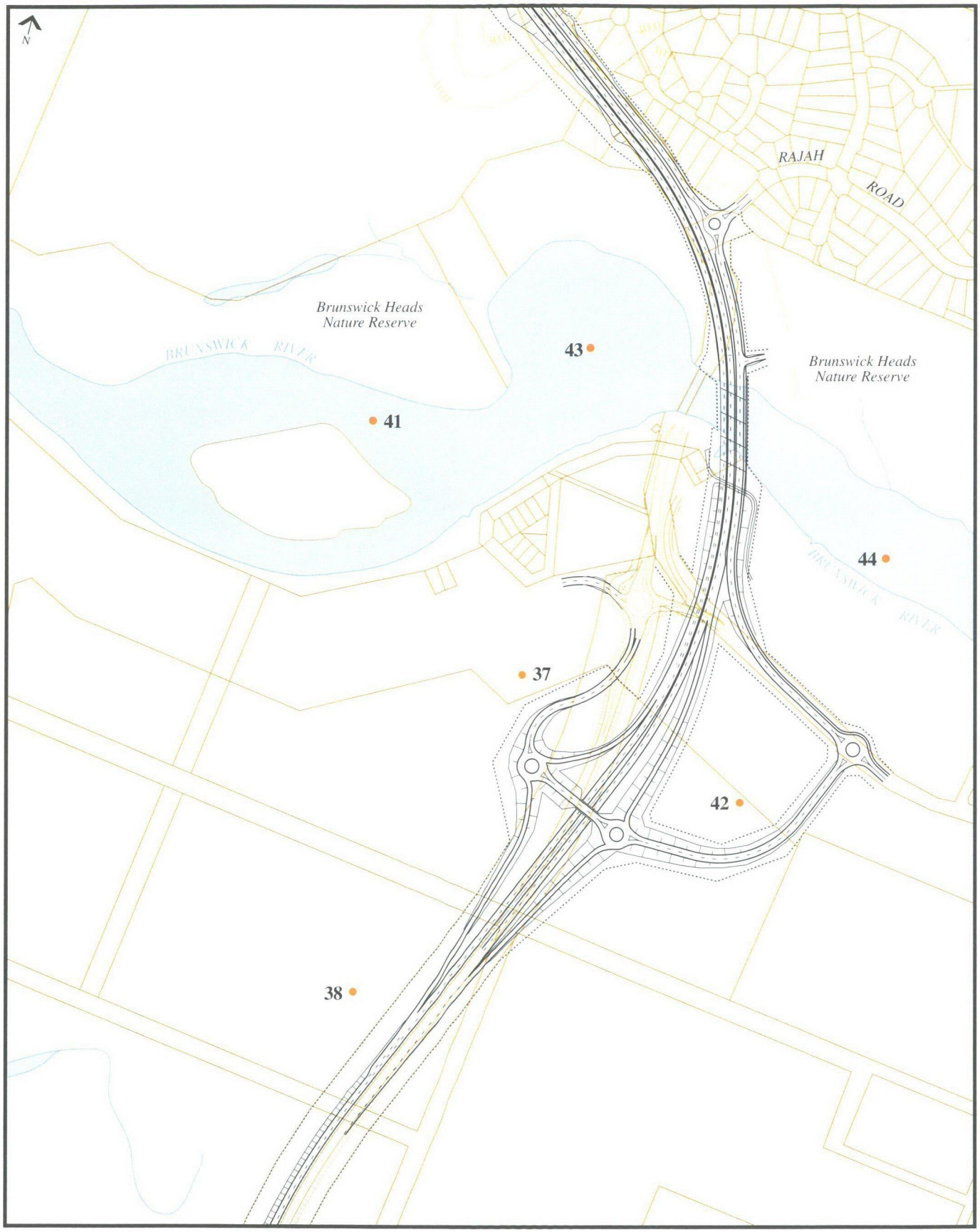
- depth of inundation,
- duration of inundation,
- frequency of inundation,
- extent of inundation, and
- velocity of flow.

Brunswick River

Model simulations were undertaken to assess any impacts from the construction of the proposal across the Brunswick River and floodplain. In this process several factors were taken into consideration, including the removal of the existing bridge and construction of the new bridge, duplication of the Brunswick Head Bypass and associated hydraulic structures across the floodplain and the works near the southern abutment of the new bridge. To maintain the flood levels from the existing Brunswick Head Bypass, openings (bridges and culverts) along this section would be replicated for the Brunswick Head Bypass duplication.

The first step in assessing the potential impact of the proposed duplication of the Brunswick Head Bypass was to establish baseline conditions. **Table 10-4** shows the pre-Bypass flood levels and changes to those levels caused by the single carriageway construction and the proposed Brunswick Head Bypass duplication. **Figure 10.3** indicates the location of the sites referred to in the hydraulic modelling results.

The modelling indicates that the construction of the proposed Brunswick Head Bypass duplication would result in negligible changes to flood levels, with a change of less than 0.15m. The Brunswick Head Bypass duplication would also be constructed so that the low point of the road is at 2.7m AHD, which is the approximate 1% AEP flood level. Changes to flood velocities flow paths and inundation times were also found to be negligible. For minor floods (less than a 5% AEP event) there may be a minor reduction in flood level above the Brunswick River bridge as a result of the proposal, due to the slightly improved hydraulic profile of the new bridge piers compared to the existing ones. The impacts of the new bridge are discussed in detail in Section 10.3.4.



Legend

- Hydraulic Modelling Site
- Proposed Road Corridor

0 100 300m

Figure 10.3
HYDRAULIC MODELLING SITES FOR BRUNSWICK RIVER

Table 10-4 - Brunswick River Flood Levels - Comparison of Pre-Bypass, Single Carriageway and Bypass Duplication

		Cell 37	Cell 38	Cell 41	Cell 42	Cell 43	Cell 44
Pre-bypass flood levels(mAHD)	1% flood	2.67	2.77	2.63	2.67	2.52	2.39
	2% flood	2.44	2.52	2.36	2.44	2.21	2.21
	5% flood	2.21	2.30	2.11	2.21	2.12	2.15
Relative Change in flood level due to	1% flood	+0.05	+0.05	+0.04	-0.15	*	+0.02
single- carriageway only (m)	2% flood	-0.03	*	*	-0.05	*	*
	5% flood	-0.04	*	+0.02	+0.06	+0.02	*
Relative Change in flood level due to	1% flood	+0.05	+0.06	+0.04	-0.12	*	+0.02
Bypass duplication compared to pre-	2% flood	-0.03	*	*	-0.04	*	+0.02
Bypass flood levels (m)	5% flood	-0.04	*	+0.02	+0.05	+0.02	*

* represents a change in flood level of less than ± 0.015m. A change of this order can not be accurately determined by the computer model and can be considered negligible.

Marshalls Creek

The existing highway and railway form a major barrier across the floodplain of Marshalls Creek. A number of waterway openings exist under the existing highway alignment and railway line.

Model simulations were performed to assess the potential impacts of flooding as a result of the proposal. The criterion adopted was to achieve a less than a 0.01m change in flood level upstream or downstream of the existing highway as a result of the proposal. This took into account:

- filling of the floodplain to account for the loss of temporary floodplain storage;
- construction of new bridges of similar dimensions under the new carriageway, at the main Marshalls Creek crossing and further north near Shara Boulevard; and
- construction of a new bridge under both the existing highway and the new carriageway to replace the bridge near Wilfred Street and the culvert approximately 600m north of the Marshalls Creek Bridge.

The exact location of this new bridge would be determined during the detailed design phase with the main requirement being an adequate flow path upstream and downstream of the structure.

The model indicated that a bridge with a 50m total span would be needed to replace the Wilfred Street Bridge, with the addition of culverts to cater for local runoff. If these works are undertaken there would be no significant increase in flood damages, flood velocity or period of inundation. There would be a change in the location of flow paths between the railway line and the existing highway, as a result of replacing the Wilfred Street Bridge. Preliminary investigation indicate that the change in the location of the flow paths would be unlikely to have a

significant adverse impact on existing land use activities, although some fences and vegetation would have to be removed to ensure that there is an adequate flow path. This would be determined at the detailed design phase and require liaison and negotiation with the relevant property owners.

10.3.4 Brunswick River Bridge

The potential impact of the new bridge was raised as an issue of community concern. The concern appeared to relate to the fact that the new bridge would have a different pier and abutment structure to the existing bridge, and there could be consequent impacts on the erosional and sedimentation regime of the lower Brunswick River. Particular concerns were expressed about potential adverse impacts on boating conditions at the river entrance.

The sediment movement and depositional processes in the river were examined by using the following procedures:

- review of historical aerial photography;
- sediment analysis to identify the marine and fluvial sediment unit distribution;
- review of tide gauging data and gauging reports; and
- hydraulic modelling of tidal and flood conditions.

Generally, the review of aerial photographs for the lower Brunswick River indicates that the marine tide delta, or zone of active sediment movement, is defined by the area from the ocean entrance upstream to around the boat harbour. Sediment movement in the area upstream of the marine tide delta, and away from the major entrance works, is relatively stable.

The results of sediment analysis confirm this, with the area upstream of the boat harbour defining the limit of Holocene beach and near shore sand unit and the Pleistocene reworked coastal sand unit. This demonstrates that there is a decline in tidal flow regime and reduced tidal flow velocities upstream of the boat harbour.

Tidal modelling of the Brunswick River was undertaken to compare the relative change in flow velocity in the vicinity of the existing and proposed bridge structures. Three scenarios were modelled over different tide conditions. The three scenarios were:

- the river channel with the existing highway bridge;
- the river channel with the existing highway bridge removed; and
- the river channel with the existing bridge removed and the new bridge in place.

The modelling indicates that flow velocities upstream and downstream of the proposed bridge alignments remain unchanged for all scenarios.

The features of the proposed bridge are expected to improve the local hydraulic regime in the vicinity. The new alignment and shape of the piers give the advantage of streamlining flow through the bridge. The existing bridge has blade piers with square-nosed ends, which are approximately 0.7m wide extending across the full road width and skew to the flow. The pier columns on the new bridge are proposed to have tapered ends which would further minimise stream drag. The arrangement is intended to maximise flow area through the bridge and prevents debris build-up around the piers

The proposed alignment for the new bridge also provides some advantages over the existing bridge location. The existing bridge is situated just at a bend in the Brunswick River whereas the new bridge would be located downstream of the bend within a straight section of the river. The full cross-section would therefore be effectively available to convey the flow compared to the uneven distribution created at the river bend.

The construction of the proposed bridge some 2 km upstream of the entrance area would have no significant impact on the river mouth or within the local area. The area around the bridge is predominantly subject to riverine influences and the hydraulic model results indicate that the proposed bridge would also have no significant impact on the local regime.

10.3.5 Environmental Safeguards

To ensure the flow capacity of flood waters is not significantly impeded by the proposal, culverts and bridges as determined by the modelling would be installed. The installation of these structures would ensure that impacts on peak flood levels would not be significant.

11. Indigenous and Non-indigenous Heritage

Aboriginal people have been present in the north coast region for at least 22,000 years. The first non-indigenous people came to this area in the early 1800s and initial activity focussed on the cedar trade. A heritage study was undertaken to establish whether there are any remaining sites of either indigenous or non-indigenous significance which would be affected by the proposal. This study identified no sites of significance but there are some areas of potential interest. This Section describes the proposed management measures for these areas. The heritage study is contained in Working Paper No.6 - Indigenous and Non-indigenous Heritage.

11.1 Indigenous Heritage

11.1.1 Background

Archaeological evidence shows that Aboriginal people have been present in the north coast region for at least 22,000 years (Neal and Stock 1986). Most sites, however, postdate Pleistocene sea level stabilisation which occurred about 6,000 years ago. Although the cause is subject to debate, evidence suggests that an increase in population occurred in the region after 4,000 years ago. This growth is represented in the archaeological record by a dramatic increase in the number of sites, increases in the intensity of use of sites and more extensive resource exploitation characterised by use of new habitats, resource types, extractive technologies and management strategies (Collins, 1993).

By approximately 2,500 years ago, the north coast region was populated by numerous language groups, linked through extensive systems of marital exchange and ceremonial obligation. People who inhabited the study area were part of the Bundjalung linguistic group which occupied the area between the Clarence and Logan Rivers. The Bundjalung language speakers were divided into at least twenty separate territories, each with its own dialect. Early historical accounts describe the North Coast region as supporting one of the most concentrated prehistoric Aboriginal populations in Australia (Collins, 1993). Flick, a resident of Lismore in the 1870s, recounts a fight between over 500 warriors from Lismore and the Tweed (Steele, 1988). Pierce (1978) suggests that there were at least three coastal groups and three inland groups in the Tweed-Byron area.

11.1.2 Existing and Potential Archaeological Sites

A search of the NPWS register identified 28 sites recorded within a 4 km radius of the proposed route. These sites include Ceremonial Bora Grounds, midden sites, scarred trees and open camp sites. The Register of the National Estate lists four items of Aboriginal heritage significance in the Byron Council area. These include the Bangalow Stone Arrangements, North Ocean Shores Aboriginal Place (Bora Ground) at Billinudgel, Two Sister Rocks (Cocked Hat Rocks) at Broken

Head and Palm Valley at Byron Bay. None of these sites is within the proposed road corridor.

Several archaeological surveys have been carried out in the vicinity of the proposal. Bartz (1982) and Navin (1990) surveyed the Ocean Shores area, to the east of the proposed corridor. Bartz recorded 14 midden sites on Crabbes Beach and Navin found 22 sites which included 15 midden sites, 5 open camp sites, one scarred tree and one Bora ground with associated midden. The 5 open camp sites were located on ridgelines and the scarred tree in an area of wet sclerophyll forest. Navin identified ridge line and hill slope areas with low gradient topographies, elevated, well drained land adjacent to creek lines, and wetlands, as areas of potentially high archaeological sensitivity. This approach was considered in the development of the predictive model for assessment of likely areas of potential archaeological deposit (PADs).

A survey by Lomax (1994) of the first stage of the Brunswick Heads Bypass identified two open camp sites at the southern end of the route near Saddle Ridge. Both were open camp sites which were excavated as a condition of NPWS issuing a Consent to Destroy permit for the sites.

11.1.3 Survey Evaluation

The purpose of the heritage assessment was to identify all heritage items which may be affected by the proposal and to also, in consultation with the Tweed-Byron Local Aboriginal Land Council (LALC), develop a management program for these sites which would enable the RTA to implement appropriate management and mitigation measures to ensure that the items are protected within the guidelines of the National Parks and Wildlife Act and the EP&A Act.

The heritage investigation included searches of the registers of the NPWS; the Native Title Tribune and the Australian Heritage Commission (AHC). Consultation took place with the RTA's Aboriginal Liaison Officer, representatives of the Tweed-Byron LALC, representatives of the Bundgelung Council of Elders and the regional archaeologist with the NPWS at Coffs Harbour.

A predictive model for site type and distribution was developed from a review of current archaeological literature, analysis of locations of known sites from the NPWS data base and an evaluation of the topography of the study area.

Two field surveys were conducted and involved representatives of the Tweed-Byron LALC and the Bundgelung Council of Elders. The first survey involved a full "on foot" inspection of the route of the proposed duplication of the Brunswick Heads Bypass and a combined vehicle and on foot survey of a broad corridor based on the preferred route, north of the Brunswick River. The purpose

of this vehicle survey was to confirm the status of areas which had been identified as areas of potential archaeological sensitivity from the "desk top" assessment. No sites or PAD areas were identified in Brunswick Heads Bypass duplication area and no further archaeological investigation in this area was recommended. Eight PAD areas were identified in the section of the route north of the river.

After the preferred route was identified, a second survey was undertaken and again involved representatives of the Tweed-Byron LALC and the Bundgelung Council of Elders. This was an "on foot" inspection of the entire route.

This survey identified two isolated artefacts (B-IS-1 and B-IF-2) and seven PAD areas. The artefacts were left "in situ" to be collected by the LALC once a care and control permit has been obtained. Both isolated finds were located to the south of Billinudgel on an elevated spur which had been heavily disturbed by quarrying and the removal of topsoil. PAD areas 1, 2 and 3 are located between the existing highway and the railway easement to the north of Coolamon Scenic Drive and south-west of the Ferry Reserve Caravan Park. All PAD areas are adjacent to two unnamed creeklines which pass through the area from west to east. PADs 4, 5, 6 and 7 are located in the section of the route between The Pocket Road and the junction with the existing highway. In this location the route passes across a ridge line which is cut by deep ephemeral creeklines. These creeklines flow west into the headwaters of Marshalls Creek and its associated swamplands. The dissection of the ridgeline has created a series of elevated spurs, all of which are associated either directly with Marshalls swamp or elevated wetland areas. The locations of the artefacts and PAD areas are shown on **Figure 11.1**.

The scientific and Aboriginal significance of both isolated artefacts has been assessed as low and this was confirmed by representatives of the Tweed-Byron LALC. The significance of the PAD areas would be the subject of further sub-surface testing prior to construction. The probability of these PAD sites containing high artefact densities is low, as no artefacts were located in the vicinity of the PAD areas and sub-surface investigations of sites in similar topographic areas by Lomax (1995) and Navin (1990) recorded sites with low artefact densities.

11.2 Assessment of Impacts

The section of the proposal which duplicates the Brunswick Heads Bypass has been previously disturbed by agricultural activities and subsequently by activities associated with the construction of the first carriageway.

Past impacts on the section of the proposal north of the Brunswick River include extensive clearance of mature forest, intensive farming practices, road construction and both industrial and residential development. The proposal has

the potential to impact on any sites which are located within the road corridor and/or any areas outside the corridor where heavy machinery, gravel pads, car parks or administration areas are located.

11.2.1 Heritage Management and Mitigation Measures.

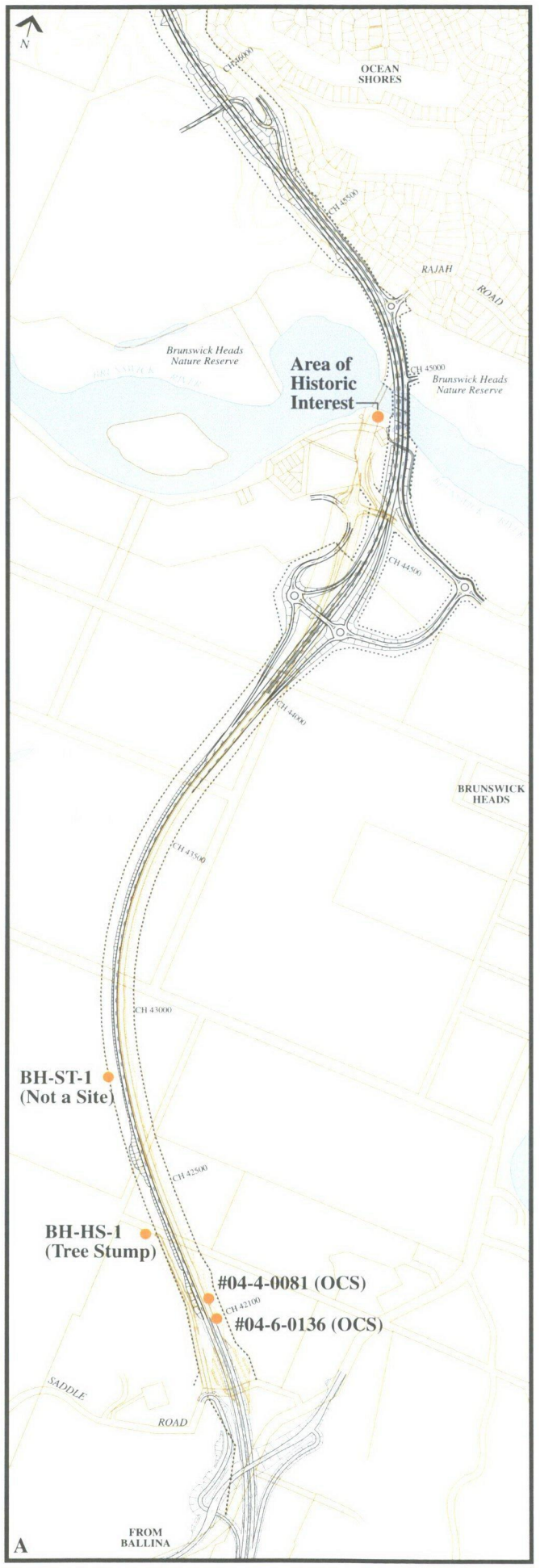
The area in which the isolated artefacts were located would be affected by the proposal. This area has been heavily disturbed and the artefacts have low archaeological and Aboriginal significance. The RTA would apply to the NPWS for a Consent to Destroy Permit. The Tweed-Byron LALC has indicated it wishes to collect these artefacts and it is suggested that this should be a condition of the Consent to Destroy Permit. The Tweed-Byron LALC would also apply to NPWS for a Care and Control Permit so that these items can be kept in an appropriate place.

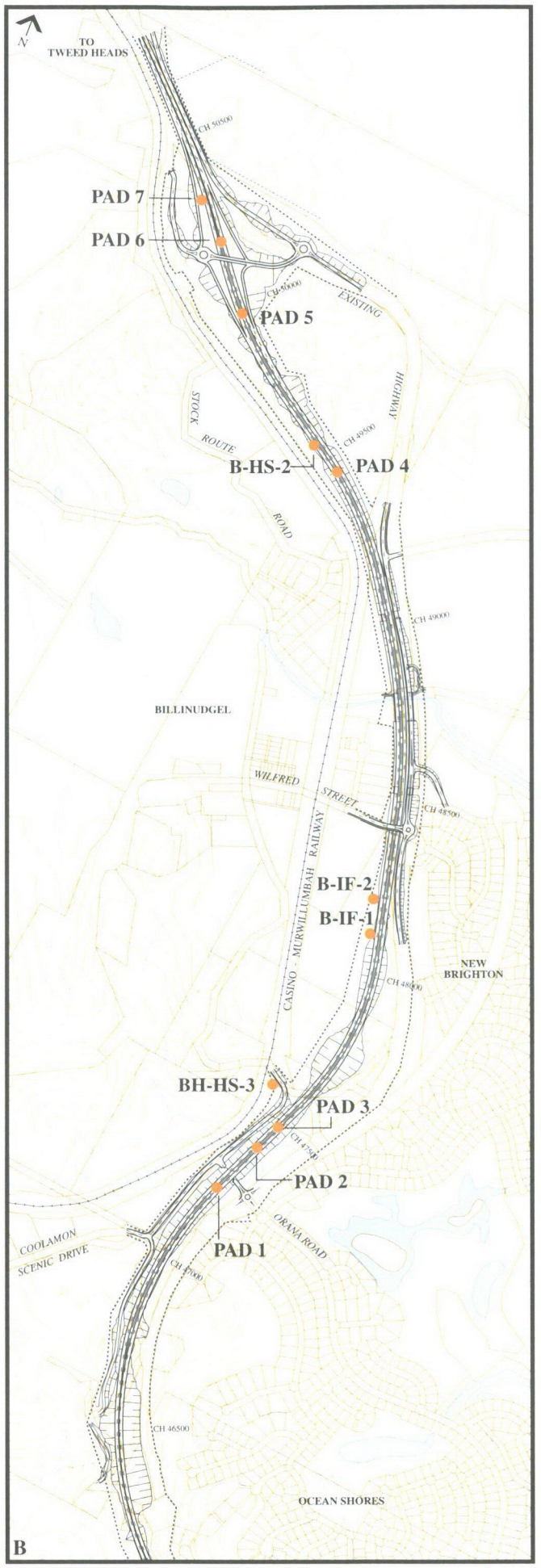
As PAD areas would be affected by the proposal, a sub-surface testing program was carried out from 1-9 June, 1998 under NPWS Research Permit No. N27. Tweed-Byron LALC endorsed the research methodology and participated in the testing program. The testing program revealed one isolated artefact in PAD 2 and a low density of artefacts at PADs 4,5,6, and 7. The research report is currently in preparation and a formal statement from the Tweed-Byron LALC will be included in that report.

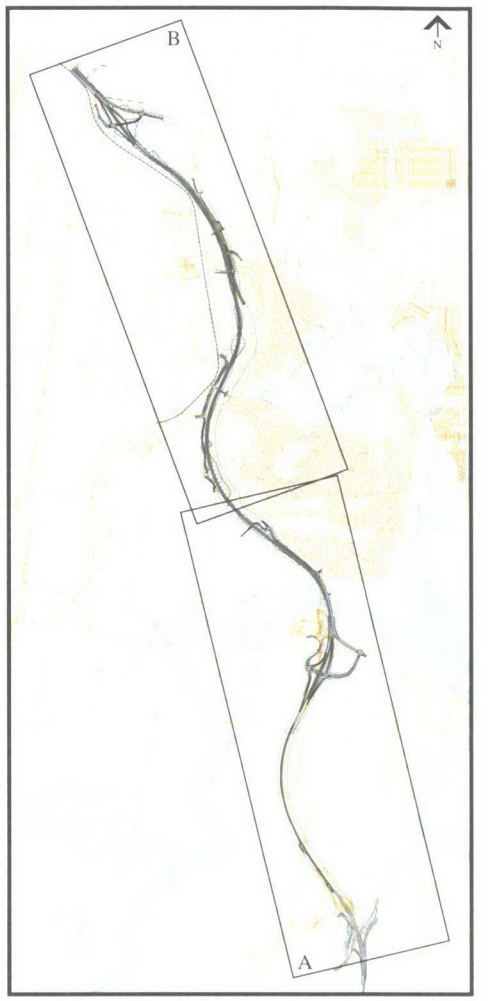
A preliminary assessment of the results indicates that the significance of these PAD areas is such that they would not present any impediment to the proposal going ahead on the route described in the EIS. This would be subject to confirmation by the Tweed-Byron LALC and NPWS following their consideration of the research report. The consideration of the research report is in progress and it is anticipated that NPWS advice would be available during the determination period.

If areas additional to those assessed in the survey are to be affected (e.g. borrow areas, levelled gravel pads, access roads, water storage dams, drilling pads, additional side tracks etc) the RTA or its contractor would seek the advice of a qualified archaeologist in regard to the need for further archaeological assessment.

To assist in the early identification of any potential sites during construction, the RTA or its contractor would ensure that a representative of the Tweed-Byron LALC is present during initial site clearing and disturbance. In the unlikely event that unrecorded archaeological deposits are uncovered during construction, work would cease immediately at the location and the Zone Archaeologist of Northern Region NPWS and the Tweed-Byron LALC would be contacted.







Legend

PAD	Potential Archaeological Deposit
OCS	Open Camp Site
IF	Isolated Find
.....	Proposed Road Corridor

0 100 500m

Figure 11.1
LOCATION OF INDIGENOUS AND NON-INDIGENOUS HERITAGE SITES

Figure 11.1
LOCATION OF INDIGENOUS AND NON-INDIGENOUS HERITAGE SITES

11.3 Non-indigenous Heritage

11.3.1 Background

The Brunswick River was named by Captain Rous in honour of Queen Caroline of Brunswick, wife of King George IV of England. In October 1828, Rous describes the Brunswick as "another river.. with a narrow, deep channel and rocky bar at the entrance and shallow north and south arms" (Brokenshire 1988)

The first Europeans came to the Brunswick area in the 1840s in pursuit of cedar. They were faced with the almost impenetrable forest, locally referred to as the "Big Scrub", which stretched from the Richmond River to the Tweed. There has been little documentation of these early Brunswick pioneers but it is certain that their objective was the wealth to be gained from the great red cedar trees of the Big Scrub. By the 1860s, there were in excess of 60 men cutting timber in the Brunswick area. The first well defined track inland from the coast followed the route that was to become known as Saddle Road and McAulays Lane.

By 1870, with most of the cedar cut from areas further south, Brunswick became the centre of the trade. The Clarence-Richmond Examiner reported that cedar logs were scattered along the river banks awaiting "surfing" to southern markets. "Surfing" was a method which was necessary because of the difficulties associated with crossing the bar. The ships would anchor as close as possible to the beach and then bullocks would draw the logs which had been rafted together into the surf. Once afloat, the logs would be winched to the vessel (Brokenshire 1988). Between 1866 and 1898, 15 ships were lost attempting to enter the river mouth.

By 1880, there are records of the opening of the first, commercial premises in Brunswick. These included Bob Marshall's shop at Brunswick, Henry French's "Halfway House" at Tyagarah and the Ocean View Hotel, fronting onto the south arm of the river, later known as Simpsons Creek.

During the 1890s, the number of travellers on the "Beach Highway" increased dramatically and the first ferry across the Brunswick was built in 1890. This ferry gave access between the town and the northern beach area. Difficulties for shipping associated with crossing the bar led to agitation for the construction of a breakwater. This debate was cut short when work began on the construction of a jetty at Byron Bay in 1885. Once complete, this jetty became the main port facility for the whole of the Brunswick Valley. Brunswick remained an important centre for settlers along the river and two small sailing ships continued to trade over the bar. The dairying industry began in Brunswick in the early 1800s. Settlers moved north from the South Coast and diary herds appeared along the three arms of the Brunswick and Mullumbimby Creeks.

Through the 1880s it was thought that the railway from Lismore to Murwillumbah would pass through Brunswick. The choice of a rail route, however, was through Mullumbimby rather than Brunswick. When the railway line opened in 1894, it heralded a period of decline for Brunswick. The Government school closed in 1896. The Court House and several other public buildings were moved to Mullumbimby and the School of Arts to Billinudgel. The decline was short lived as the ocean and river beaches made the town attractive as a tourist destination. In 1903, the school was reopened and many new business outlets opened. A punt was installed to facilitate easier crossing of the river. The first oyster leases were granted in 1902, a business which continues to this day. In 1917, the Department of Lands surveyor visited Brunswick to peg out 17 ocean front blocks at South Beach. The promised bridge, however, did not materialise for another 20 years.

In June 1918, the land on the southern approach to the present Brunswick River bridge was gazetted as "reserved from lease and sale for a ferry landing point." Although little information about this event could be located in the State archives, it would appear that the ferry crossing was upgraded at this time to carry additional vehicles across the river.

The 1920s saw the increased attraction of Brunswick Heads as a holiday destination. In 1934, the first road bridge was constructed across the middle arm of the Brunswick River. This was followed in 1937, by the construction of a footbridge across the South Arm of the river which made the approach to the ocean beach more attractive and convenient. The construction of the breakwaters in the 1950s brought the first major industry to Brunswick Heads. They made it possible for prawn trawling in the river and, by the 1960s, Brunswick Heads supplied a safe anchorage for more than 30 trawlers although crossing the bar remained a tricky manoeuvre.

11.3.2 Non-indigenous Heritage Resources

A search of heritage data bases was conducted to identify known heritage items and places in the Brunswick/Yelgun area. There were 34 items listed in the Australian Heritage Commission data base for the Byron Bay area. None, however, is within the proposed road corridor. There are no items listed in either the NSW Heritage Council data base or the National Trust Register. Byron Shire Council Heritage Schedules have 21 items and places listed, none of which is within the study area.

Consultation with the Brunswick Historical Society indicated that the only items of heritage significance known to the Society within the study area were the Billinudgel School buildings and the Billinudgel Church, both of which were over 100 years old. It was also suggested by a local resident that areas of importance to the local community include Cyprus trees over 100 years old in the Billinudgel School grounds and 2-3 ha of original rainforest, located west of the railway line

near the Salad Bowl. He recalled that this was the only piece of original rainforest which had not been cleared by settlers. He considered it to be a "very special piece of rainforest". He also noted 3-4 fig trees which were planted over 100 years ago, located west of Billinudgel School. No other relics or places of heritage significance were identified.

The most historically interesting location in the Brunswick/Yelgun area is associated with the middle arm ferry crossing and the original bridge crossing. Information obtained from the RTA archives, the Mitchell Library and discussions with local residents indicated that the only remaining evidence of the ferry crossing and the "puntman's" house is a section of landing ramp on the northern side of the river, upstream from the existing bridge. This area would not be affected by the proposal. Because of the lack of physical evidence and previous impact to the area, the heritage significance of the ferry landing site has been assessed as low. The current bridge has undergone many changes since its construction in 1934 and the only original sections of the structure appear to be the pylons and support bearers. Accordingly, its heritage significance has been assessed as low.

11.3.3 Survey Evaluation

The survey for non-indigenous sites was designed to identify areas of possible heritage significance within the study area and make a brief assessment of the heritage significance of sites. The areas of direct impact were surveyed on foot by five field surveyors, each responsible for a transect approximately 30m in width (i.e. 15m each side of the transect line). All items of potential heritage significance were recorded and photographed.

Three heritage items and one area of historical interest were identified during the survey, and are shown on **Figure 11.1**. These included two old growth cedar stumps with logging cut-outs (BH-HS-1 and BH-HS-2), a 60m section of slip rail fencing (BH-HS-3) and the Ferry Reserve area which contains the site of the ferry slip ways and the first bridge crossing of the Brunswick River.

BH-HS-1 and BH-HS-2 are both sawn stumps of original large red cedar trees of the "Big Scrub" area. The stumps exhibits cut-outs in which boards would have been placed to give the loggers access to the tree trunk so that it could be more easily felled.

BH-HS-3 is approximately 60m of wooden slip rail fencing. The item is located adjacent to the northern side of Stock Route Road and extends from approximately 50m east of the rail overpass to 150m west of the existing highway. There are currently 7 fence posts standing at intervals of approximately 8-10m. No fence rails remain. At the eastern end of the site, a large pine tree may have

delineated an entrance to the property but there is no physical evidence of a house in the vicinity.

11.3.4 Assessment of Impacts

Sites BH-HS-2 and BH-HS-3 and the existing bridge across the middle arm of the Brunswick River would be directly affected by the proposal. These items were assessed as having low heritage significance. No house within the proposed road corridor has heritage significance. There would be no direct impact to site BH-HS-1 or the Ferry Reserve area.

11.3.5 Environmental Management and Mitigation Measures.

Because of the low archaeological significance status assigned to the cedar tree stump sites (BH-HS-1 and BH-HS-2) and the slip rail fence post (site BH-HS-3), no management/mitigation measures have been adopted for these sites.

Despite the lack of physical evidence, the Ferry Reserve area has played an important role in the development of the township of Brunswick and, as such, it seems appropriate to record this history in a prominent place within the Reserve. This could be achieved by a visual display which records the history of the crossing of the Brunswick River. The exact nature and location of the signage could be a joint initiative of Council, the RTA and local residents. It could be part of the overall foreshore improvements envisaged for this area which would be possible after the existing bridge is demolished. This would need to be negotiated between the RTA, Council and property owners.

12. Flora and Fauna

The study area supports a high diversity of flora and fauna species and this feature was a key consideration in the selection of the preferred route. A detailed flora and fauna assessment was undertaken and is reported in a separate Working Paper No.7 - Flora and Fauna Assessment. Because of the potential impact on threatened species a Species Impact Statement has been prepared, also as a separate Working Paper. This Section describes the flora and fauna potentially affected by the proposal and outlines the environmental mitigation and management measures which have been incorporated in the design to minimise these impacts.

12.1 Introduction

The North Coast region supports a high diversity of fauna and flora species as a result of high rainfall and rich soils, and of being located in the overlap zone of tropical and temperate climatic conditions. The NPWS (1992) describes the north coast of NSW as having the second highest level of biodiversity in Australia (exceeded only by the wet tropics). The information obtained on biota in the study area includes descriptions of the major vegetation types and their conservation significance, an assessment of the condition of the vegetation in the area, known and potential occurrences of significant plant and animal species, the location of habitat or resources of special value to certain threatened fauna, and the extent of land dedicated for conservation purposes (SEPP 14 Coastal Wetlands and Brunswick Heads and Billinudgel Nature Reserves).

Assessment of the proposal requires consideration of its potential impacts on the natural environment. In this regard, the effects of the proposal on the fauna and flora of the area and particularly on threatened species, populations or ecological communities of high conservation value were considered. Investigation of the biota and fauna and flora habitats include previous studies by Milledge and McKinley (1992), Kinhill (1996), detailed field investigations conducted for the route selection process and the more intensive investigations undertaken to assess the potential impact of the proposal.

The biological environment of the study area provided a number of environmental constraints to any potential alignment for the proposal. These constraints relate to vegetation communities (their condition and significance), fauna and flora species (particularly threatened species, as listed on the NSW TSC Act and the Commonwealth ESP Act, known or likely to occur in the area), and fauna movement corridors (particularly for species such as the Koala). In addition, the presence of two Nature Reserves and several SEPP 14 wetlands in the study area indicates its biological value.

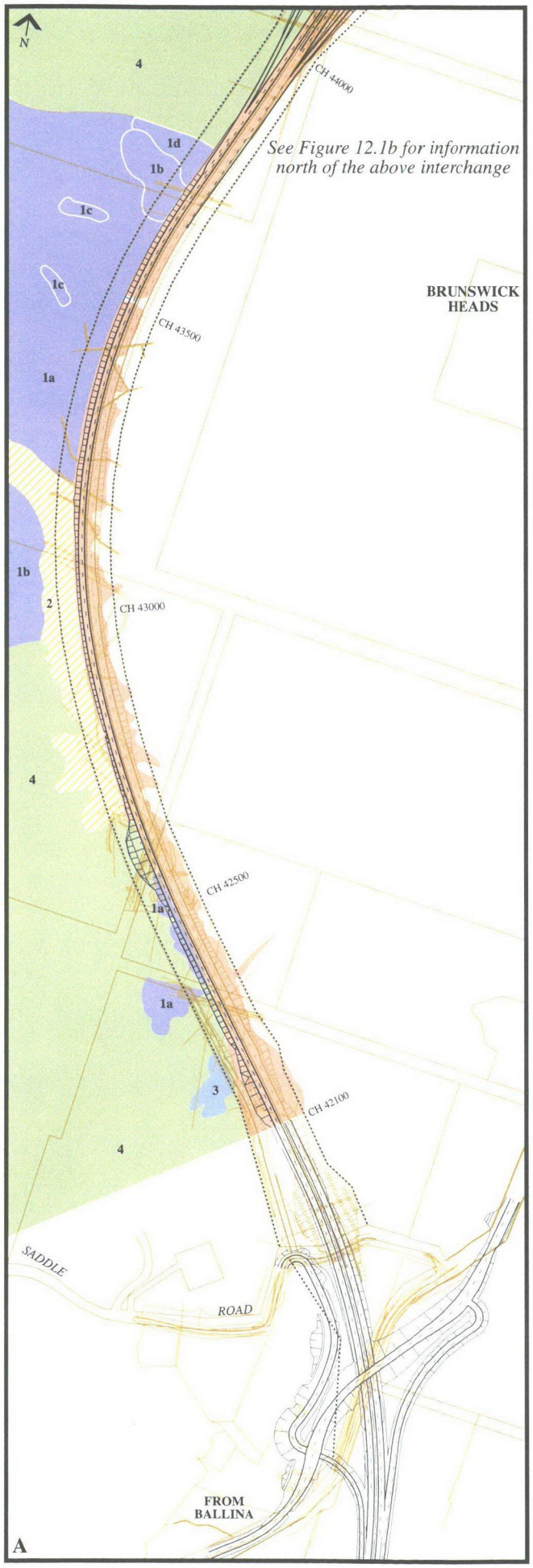
It was recognised at the outset that it would not be possible to select a route that would have no impact on the biological environment. Any alignment for a new

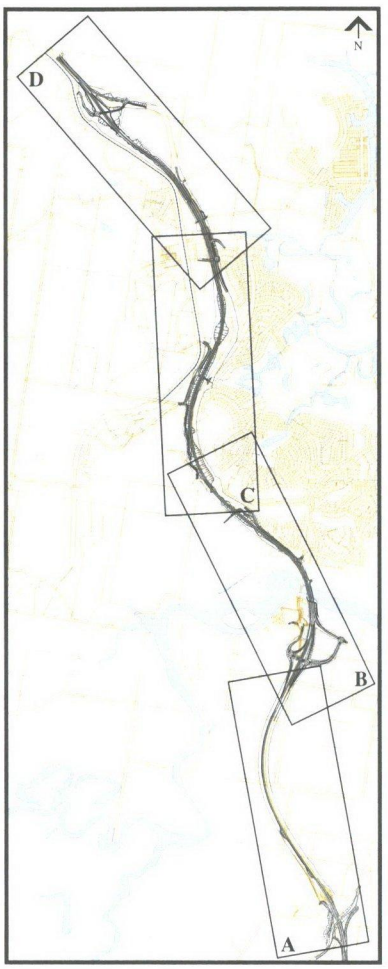
highway through this part of northern coastal NSW would inevitably involve some disturbance to habitats and resources of relevance to threatened fauna species, and to involve the imposition of effects on threatened plant species. Consequently, the approach was to avoid areas of biological significance and to concentrate on minimising effects on the natural landscape and on threatened biota. The biological considerations in the selection of Route A2 included:

- the avoidance of habitat fragmentation and a second major barrier to fauna movements to prevent the creation of additional potential 'black spots' for fauna along the highway, by selection of Route A2. The selection of route options to the west would require the severance of existing fauna movement corridors, and impose a significantly greater effect on native fauna than Route A2;
- the upgrade along the Route A2 alignment is located at the boundary between development (to the east) and areas of agricultural activities and native vegetation (to the west). Thus, Route A2 would not significantly extend the area of disturbed lands beyond those currently affected;
- disturbance to existing relatively intact native vegetation would be largely avoided. Other options would involve the imposition of disturbance and clearing into areas which are currently in good to excellent condition and would require the removal of substantially larger areas of native vegetation;
- the fragmentation of habitats and vegetation communities would be minimised by locating the upgrade as close as possible to the existing highway and areas of current disturbance. Other options for the alignment would involve the fragmentation of existing large tracts of vegetation (particularly to the west and north of the Brunswick River), and the creation of less viable habitats and fauna and flora communities;
- the location of the new alignment in the immediate vicinity of the existing highway avoids the imposition of a second major barrier to fauna movements in an east/west direction through the landscape. The selection of route options to the west would require the severance of existing fauna movement corridors, and impose a significantly greater effect upon native fauna than Route A2;
- most of the areas that would be affected are already disturbed to some extent or highly modified from their original condition. Route A2 is largely located in areas which have been affected by previous development.

12.2 Flora Characteristics of the Proposed Road Corridor

Detailed field investigations were undertaken along the route of the proposed Brunswick Heads Bypass duplication and the proposal north of the Brunswick River to identify vegetation communities and plant species, and to assess the





Legend

Swamp Sclerophyll Forest and Woodland

- 1a Paperbark (*Melaleuca quinquenervia*)
- 1b Swamp Mahogany (*Eucalyptus robusta*)
- 1c Swamp She Oak (*Casuarina glauca*)
- 1d Swamp Terpentine (*Lophostemon suaveolens*)

Dry Sclerophyll Forest

- 2 Blackbutt (*Eucalyptus pilularis*)

Remnant Subtropical Rainforest Regrowth

- 3 Red Kamala (*Mallotus philippensis*)

Pasture/Cleared

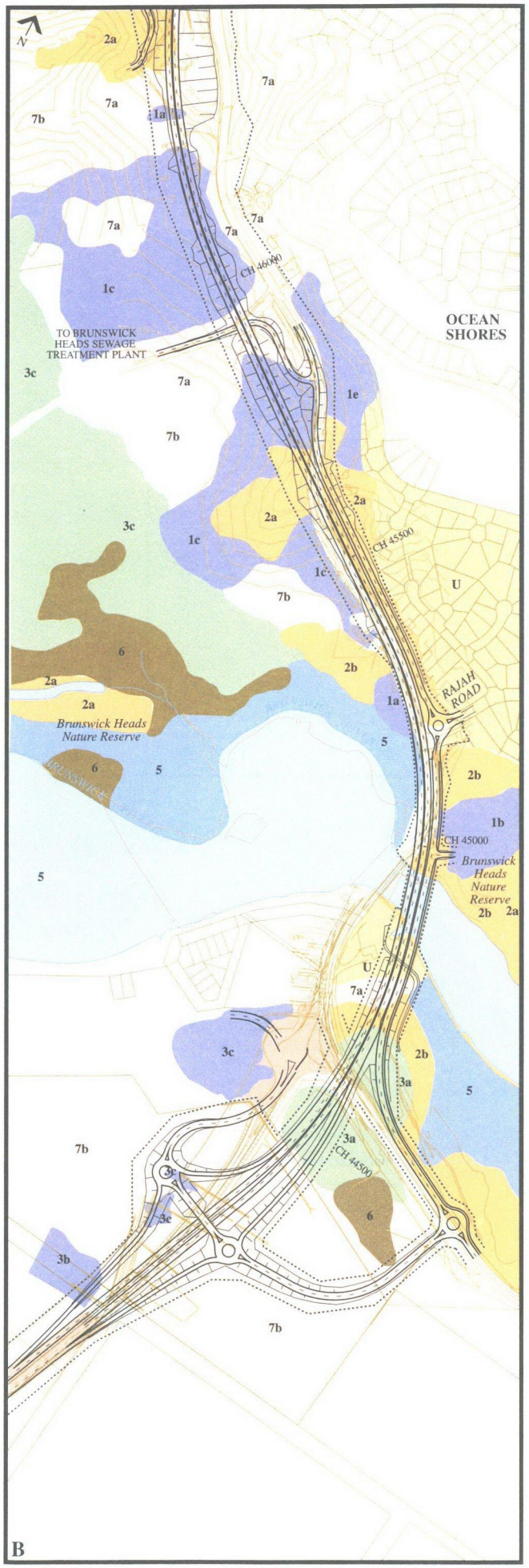
- 4

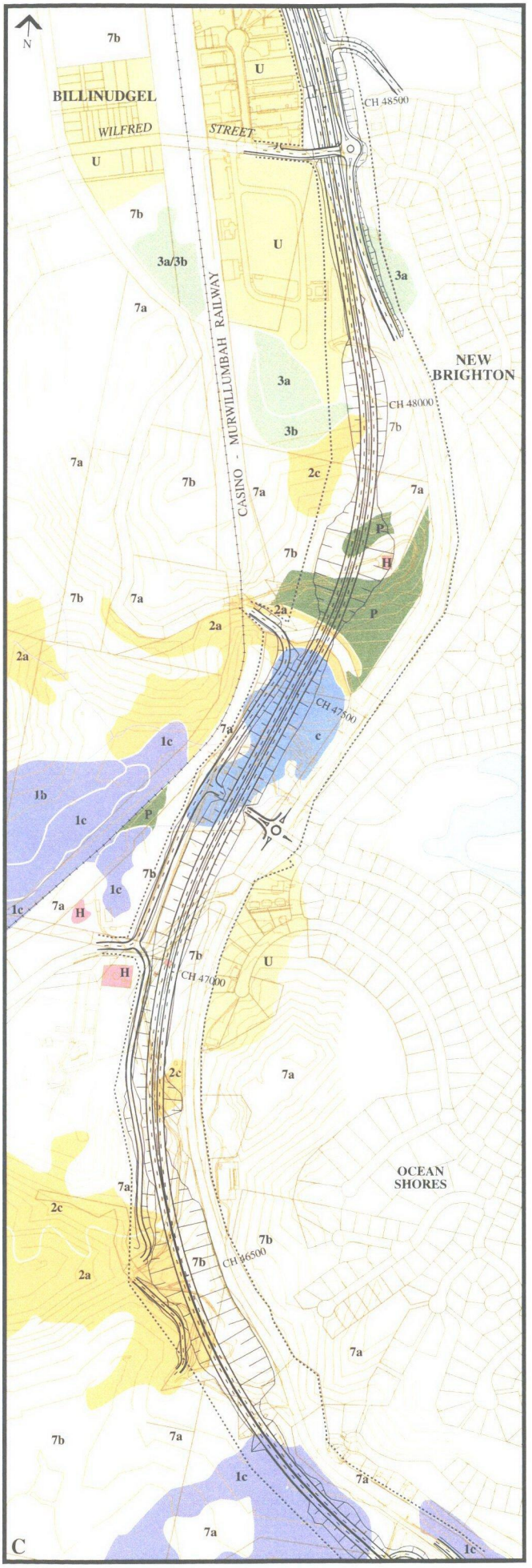
Brunswick Heads Bypass open to traffic

Proposed Road Corridor

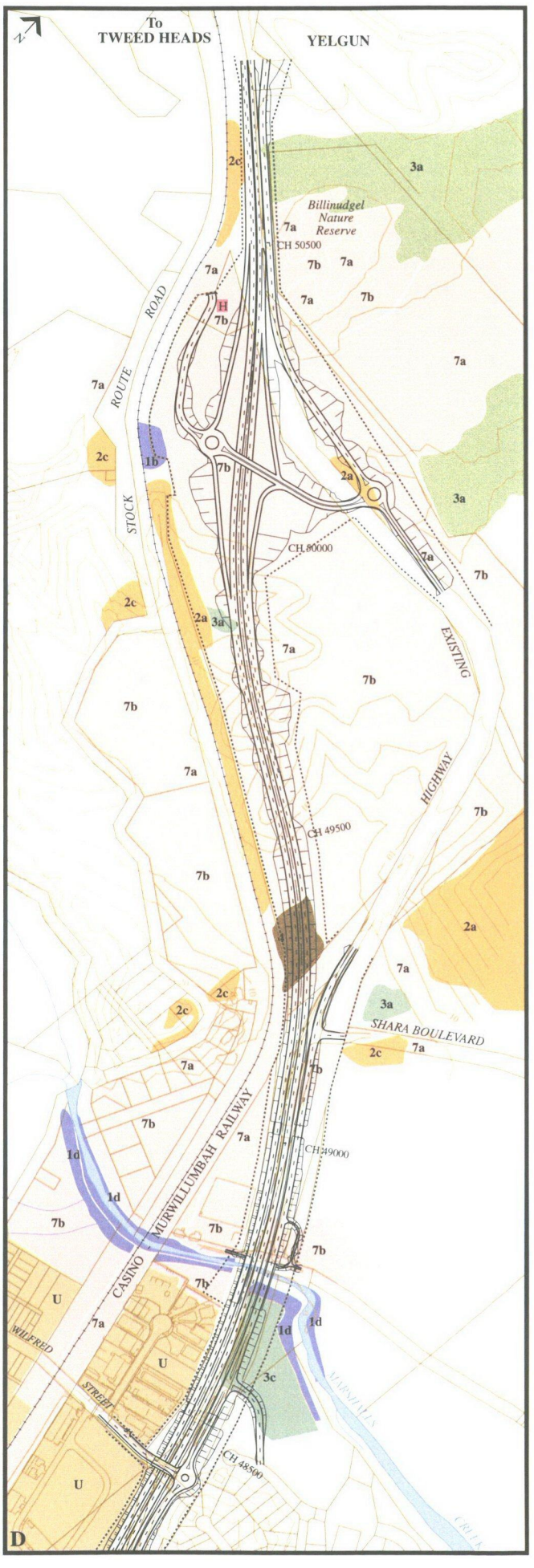
0 100 500m

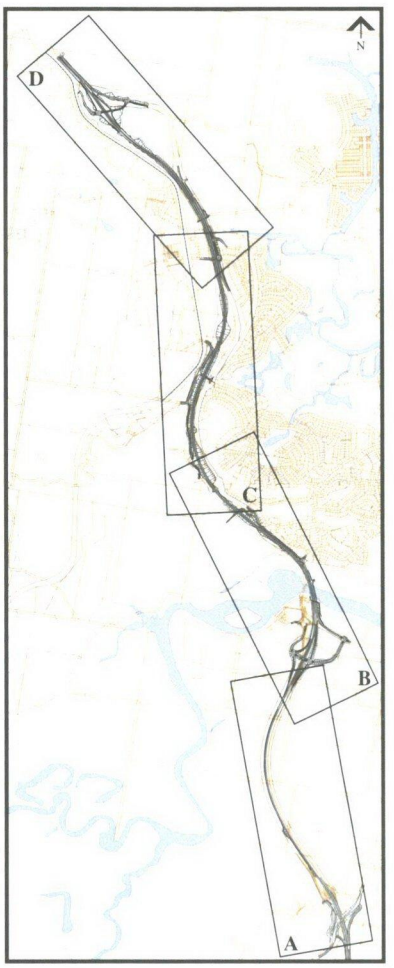
Figure 12.1a
VEGETATION COMMUNITIES, SADDLE ROAD TO BRUNSWICK RIVER INTERCHANGE


N
OCEAN SHORES
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
CH 46000
CH 45500
CH 45000
CH 44500
RAJAH ROAD
Brunswick Heads Nature Reserve
Brunswick Heads Nature Reserve
BRUNSWICK
B


N
BILLINUDGEL
WILFRED STREET
CASINO - MURWILLUMBAH RAILWAY
NEW BRIGHTON
OCEAN SHORES
CH 48500
CH 48000
CH 47500
CH 47000
CH 46500
C

0 100 500m





Legend

- P Pasture
- H House
- U Urban/Commercial
- C Cleared

Rainforest

- 1a Subtropical rainforest on alluvium
- 1b Subtropical rainforest on metasediment
- 1c Regrowth subtropical rainforest on metasediment
- 1d Gallery dry rainforest
- 1e Regrowth dry rainforest on basalt

Wet Sclerophyll Forest

- 2a Brush Box (*Lophostemon confertus*)
- 2b Forest Red Gum (*Eucalyptus tereticornis*)
- 2c Blackbutt (*Eucalyptus pilularis*)
- 2d Broad-leaved Ironbark (*Eucalyptus siderophloia*) Tallow-wood (*Eucalyptus microcorys*) - Pink Bloodwood (*Corymbia intermedia*)

Swamp Sclerophyll Forest

- 3a Broad-leaved Paperback (*Melaleuca quinquenervia*)
- 3b Swamp Mahogany (*Eucalyptus robusta*)
- 3c Swamp Oak (*Casuarina glauca*)

Sedgeland

- 4 Saw Sedge (*Cyperus lucidus*) - Articulated Rush (*Baumea articulata*)

Mangroves

- 5 Grey Mangrove (*Avicennia marina var australasica* —) River Mangrove (*Aegiceras corniculata*)

Saltmarsh

- 6 Saltwater Couch (*Sporobolus virginicus var minor*)

Pioneer Forest Regrowth/Cleared

- 7a Sally Wattle (*Acacia melanoxylon*) — Camphor Laurel (*Cinnamomum camphora*)
- 7b Cleared Grassland or Lantana (*Lantana camara*) shrubland with scattered trees

..... Proposed Road Corridor

0 100 500m

Figure 12.1b
VEGETATION COMMUNITIES, BRUNSWICK RIVER INTERCHANGE TO YELGUN

potential impacts of the proposal on them. The conservation significance of plants recorded in the study area was assessed with reference to:

- Schedules 1 (Endangered) and 2 (Vulnerable) of the NSW TSC Act for plants of state conservation significance;
- Schedule 1 (Part 1 - Endangered and Part 2 - Vulnerable) of the Commonwealth ESP Act for plant species of national conservation significance;
- Briggs & Leigh (1996) for nationally significant plants also known as the ROTAP (Rare Or Threatened Australian Plants) register; and
- DeVries (1997) and Sheringham & Westaway (1995) for regionally significant plants.

A vegetation map of the study area was generated by air photo interpretation, ground-truthing and a systematic vegetation survey. Vegetation communities were classified firstly as broad ecological vegetation types, and then as plant associations. Vegetation floristics and structure were recorded at representative sites within each plant community. **Figures 12.1 a** and **12.1 b** show the vegetation communities of the area.

The condition of plant communities throughout the study area was assessed using a qualitative scale which considers the following criteria for each association:

- spatial extent,
- structural maturity,
- plant species diversity,
- weed infestation, and
- impact of previous disturbance.

The conservation status of plant communities was assessed according to Hager and Benson (1994), RACAC (1996) and Griffith (1993). In addition, the conservation status of rainforest vegetation types were assessed according to the suballiances in Floyd (1990) and Griffith (1993).

12.2.1 The Proposed Brunswick Heads Bypass Duplication

A total of 152 plant species were recorded within the Brunswick Heads Bypass duplication area (south of the Brunswick River), of which 20 were introduced species. No plant species listed as Endangered or Threatened under the TSC Act or the Commonwealth ESP Act, or Rare or Threatened (ROTAP) in Briggs & Leigh (1996) were recorded in the study area, although four plant species considered to have regional conservation significance (DeVries, 1997) were

recorded within the proposed road corridor (i.e. would be affected by the proposal).

12.2.2 Brunswick River to Yelgun

A total of 271 plant species were recorded within the section of the proposal north of the Brunswick River to Yelgun, of which 21 were introduced species. Thirteen plant species of conservation significance were recorded, of which five are listed as Endangered (Schedule 1) and four as Vulnerable (Schedule 2) in the TSC Act, and an additional four are listed as Rare Or Threatened by Briggs & Leigh (1996). Species listed under the Commonwealth ESP Act are the same as those listed under the TSC Act. Eleven plant species that are considered to have regional conservation significance (DeVries, 1997) were also recorded in the study area, of which 4 would be affected by the proposal.

12.3 Fauna Characteristics of the Proposed Road Corridor

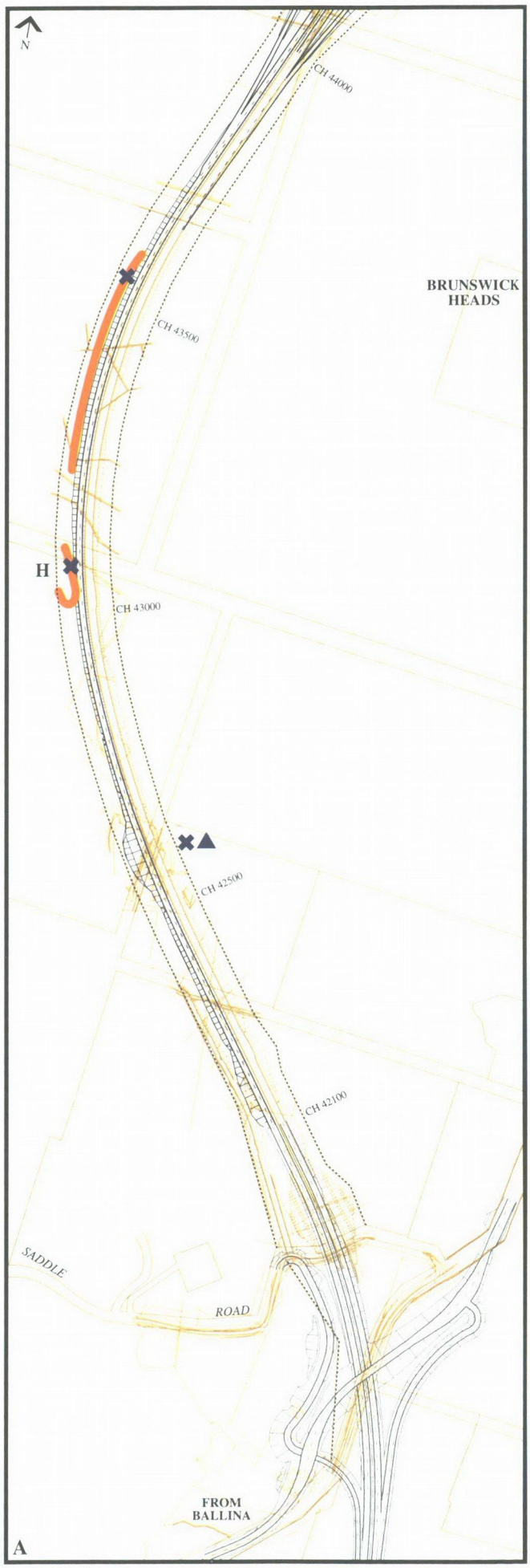
Detailed field surveys (see **Figure 12.2**) were conducted along the proposed alignment to identify fauna present or passing through the area. Survey methods for fauna included:

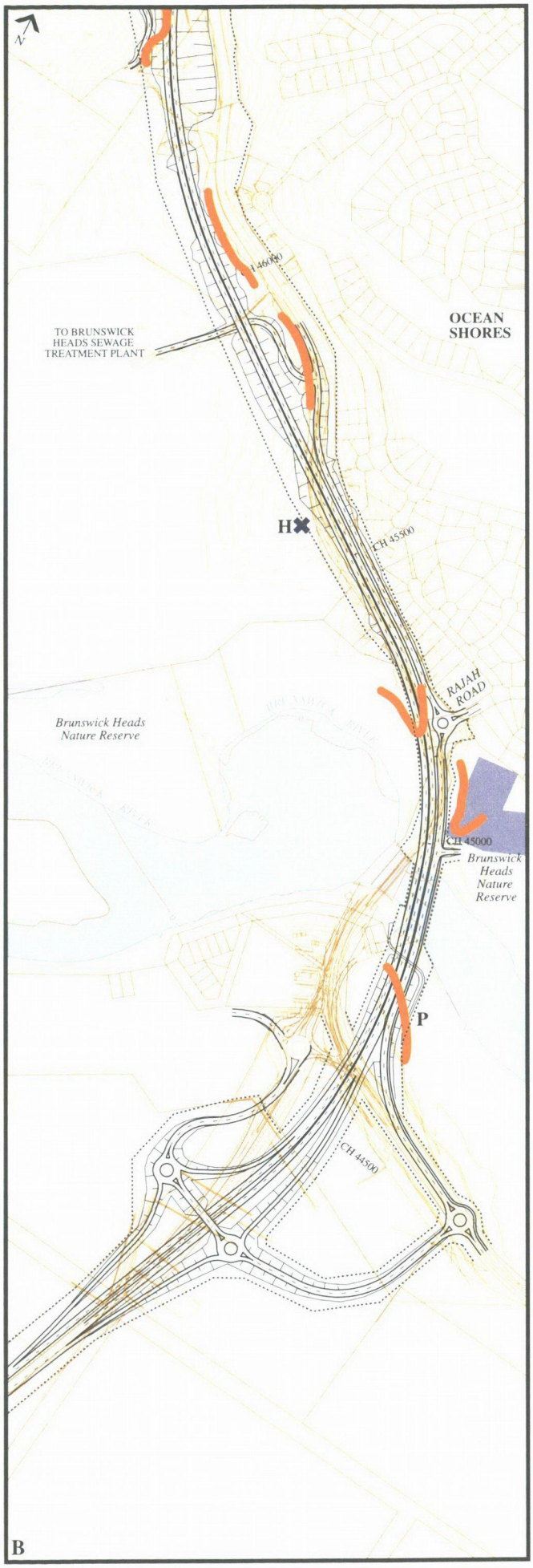
- the placement of traps,
- the placement of hair-tubes,
- the setting of Anabat II detectors,
- spotlighting,
- diurnal bird, reptile and amphibian surveys,
- the placement of harp traps,
- an assessment of the type and condition of the habitats present,
- supplementary surveys to target the Eastern Grass Owl and the Green and Golden Bell Frog, and
- call playback.

12.3.1 The Proposed Brunswick Heads Bypass Duplication

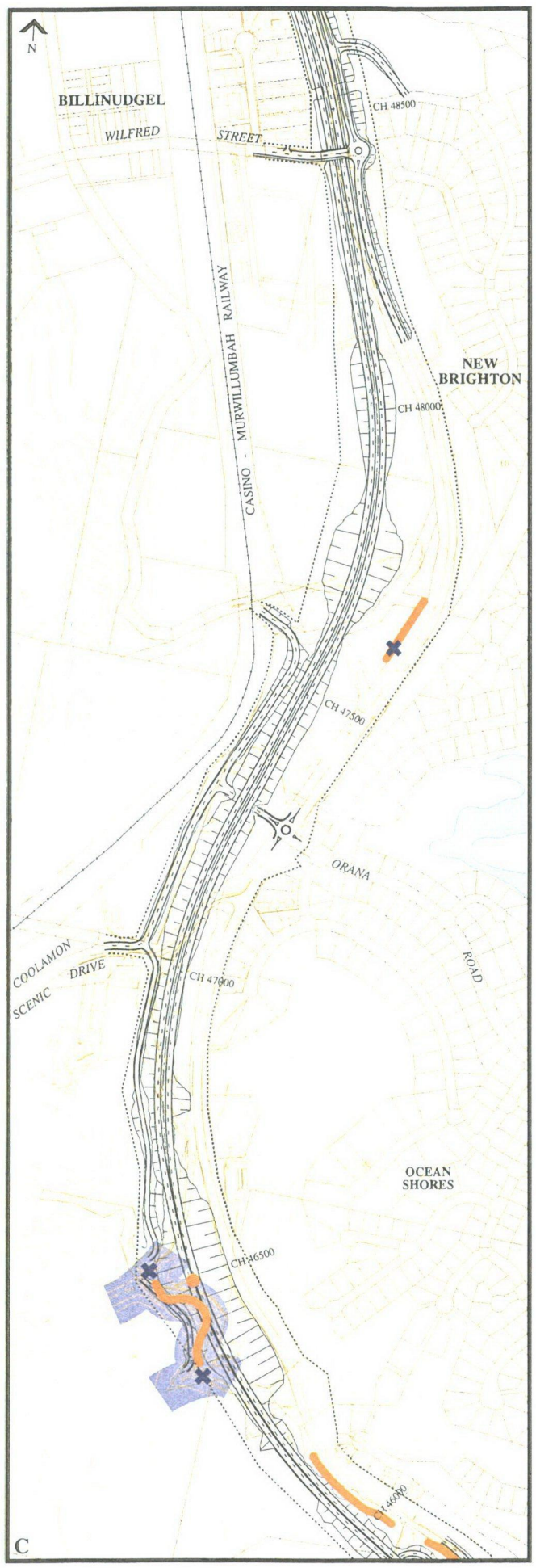
Fauna habitats along the Brunswick Heads Bypass are already highly disturbed and modified as a result of previous clearing and agricultural practices, and as a consequence of the construction of the first carriageway of the Bypass. The Brunswick Heads Bypass is generally located in disturbed woodland and open forest communities and in areas used for agriculture.

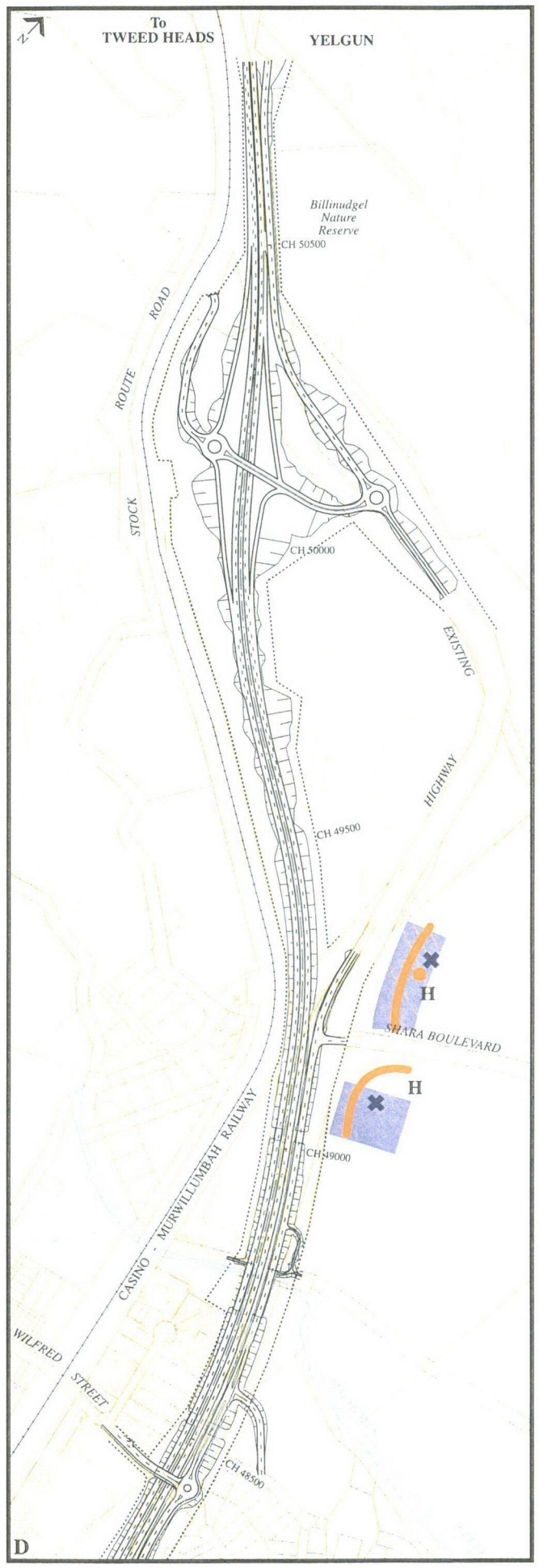
The main habitats for native fauna include areas of modified woodland and open forest (generally with a relatively sparse understorey), pasture and grassland, and several small creeklines. Previous and existing disturbance along the route of the Brunswick Heads Bypass has affected the woodland and forest habitats in this locality, and they are do not support resources or habitat features (such as hollow-bearing trees, hollow logs or dense understorey vegetation) of particular significance for native fauna.

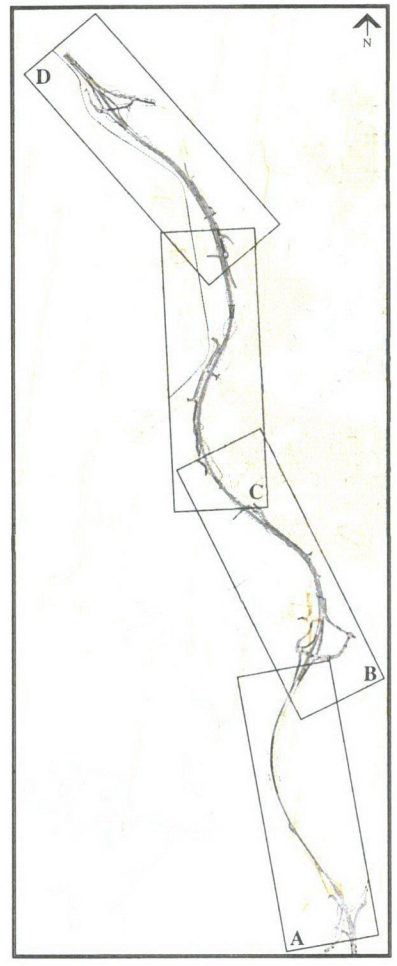

N
CH 44000
BRUNSWICK HEADS
CH 43500
H
CH 43000
CH 42500
CH 42100
SADDLE
ROAD
FROM BALLINA
A


N
CH 46000
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
OCEAN SHORES
H
CH 45500
RAJAH ROAD
Brunswick Heads Nature Reserve
CH 45000
Brunswick Heads Nature Reserve
P
CH 44500
B

0 100 500m







Legend

H	Harp Trap
	Trapline
P	Pitfall Line
	Dedicated Koala Scat Search
	Anabat Site
	Owl Survey Site
	Targeted surveys for Green and Golden Bell Frog
	Proposed Road Corridor

0 100 500m

Figure 12.2
LOCATION OF FAUNA SURVEY SITES

Figure 12.2
LOCATION OF FAUNA SURVEY SITES

A total of 65 native vertebrate fauna species were recorded during the fauna surveys conducted within the area of the proposed Brunswick Heads Bypass duplication, including 40 birds, 10 mammals (including two megachiropteran and two microchiropteran bats), three reptiles and 12 amphibians. While a number of additional fauna species which have been recorded in the general area during previous investigations, and could also potentially occur in the vicinity of the proposed duplication, many species (e.g. coastal waterbirds) would not be expected, as their preferred habitats are not present.

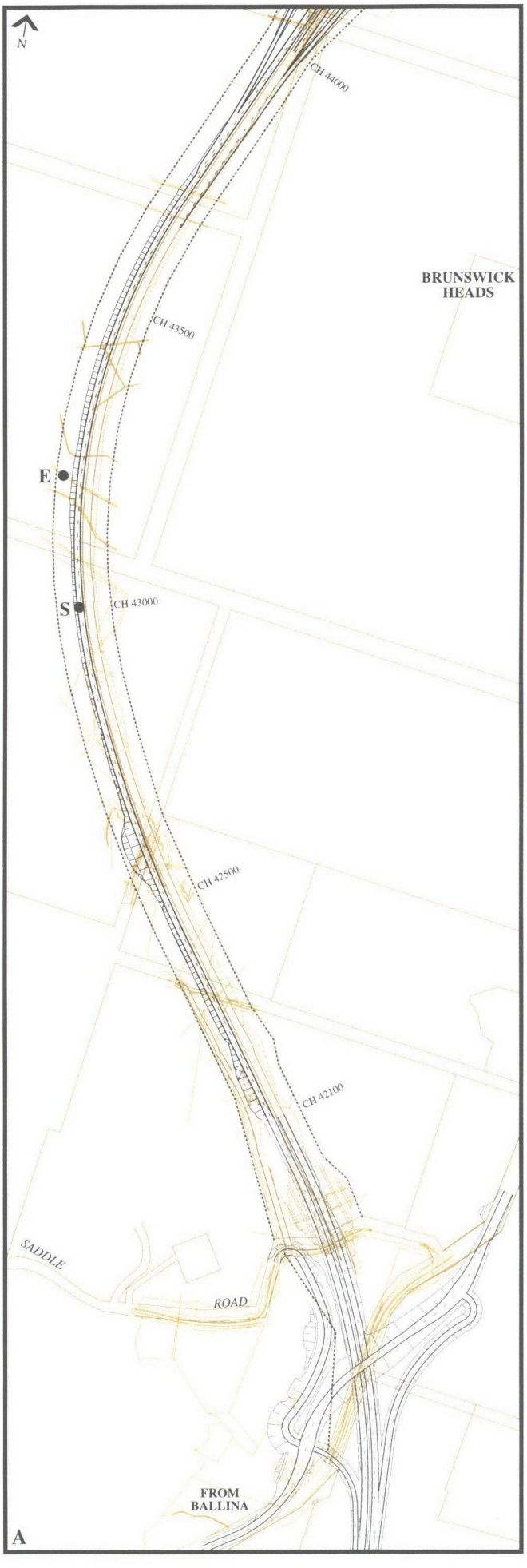
Four threatened fauna species (TSC Act) were recorded during the fauna investigations as shown in **Figure 12.3**, including one tentative identification (Squirrel Glider, Queensland Blossom Bat, Eastern Long-eared Bat and possibly the Greater Broad-nosed Bat). A range of additional species of conservation concern recorded previously in the general area could potentially occur in the vicinity of the study area, at least on occasion. No threatened (ESP Act) fauna species were recorded.

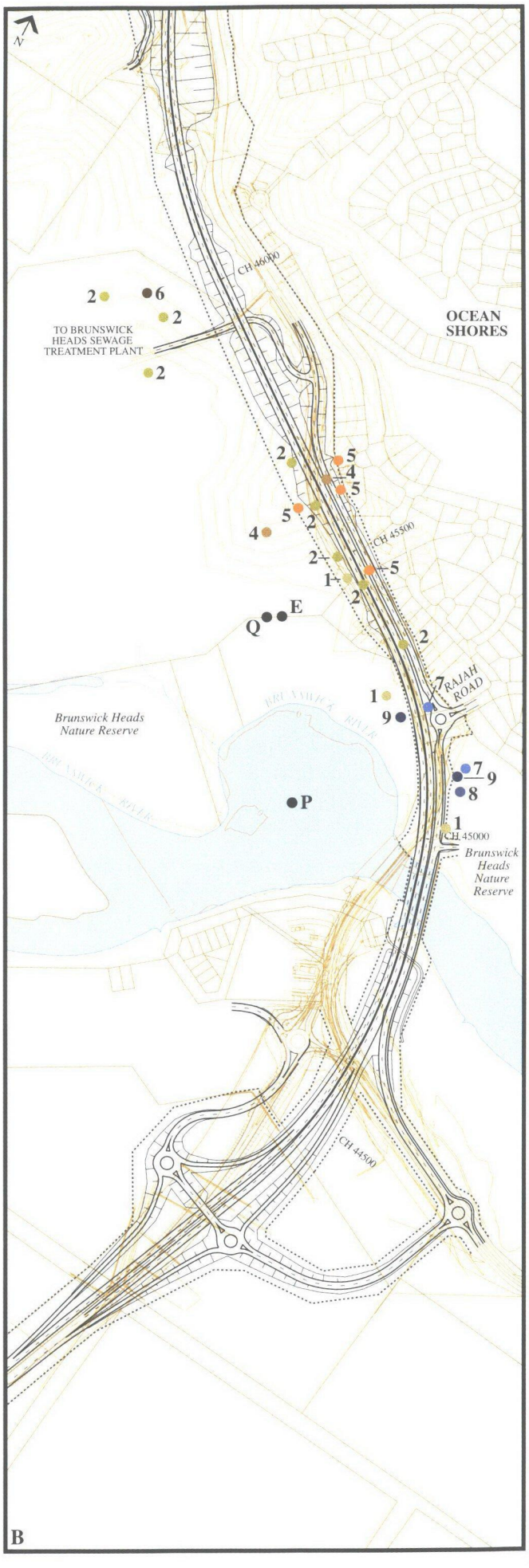
12.3.2 Brunswick River to Yelgun

In contrast to the Brunswick Heads Bypass duplication, the Brunswick River to Yelgun section of the proposal supports an array of habitats and resources of relevance for native fauna. Features present along the proposed corridor include wetlands, mangroves, swamp forest, wet and dry forest communities, rainforest, creeks and rivers, as well as disturbed habitats such as pasture and grassland. Some parts of the corridor are highly modified or are disturbed and degraded as a result of previous activities (agricultural activities, clearing, general access, weed-infestation etc), but other areas retain high quality habitat and resources for native fauna species.

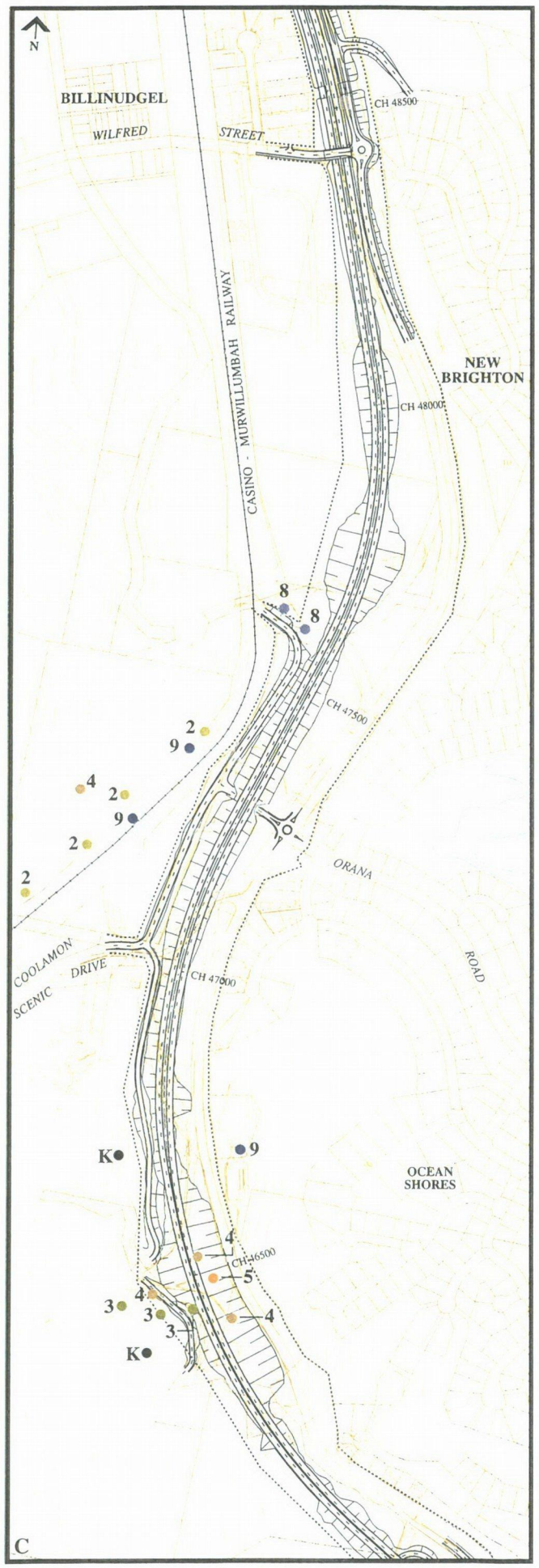
A total of 119 native vertebrate fauna species were recorded during the fauna surveys, including 83 birds, 18 mammals (including two megachiropteran and 4 microchiropteran bats), 13 reptiles and five amphibians. A large number of additional fauna species which have been recorded in the general area during previous investigations could also potentially occur in the general vicinity, given the wide variety of habitat types present.

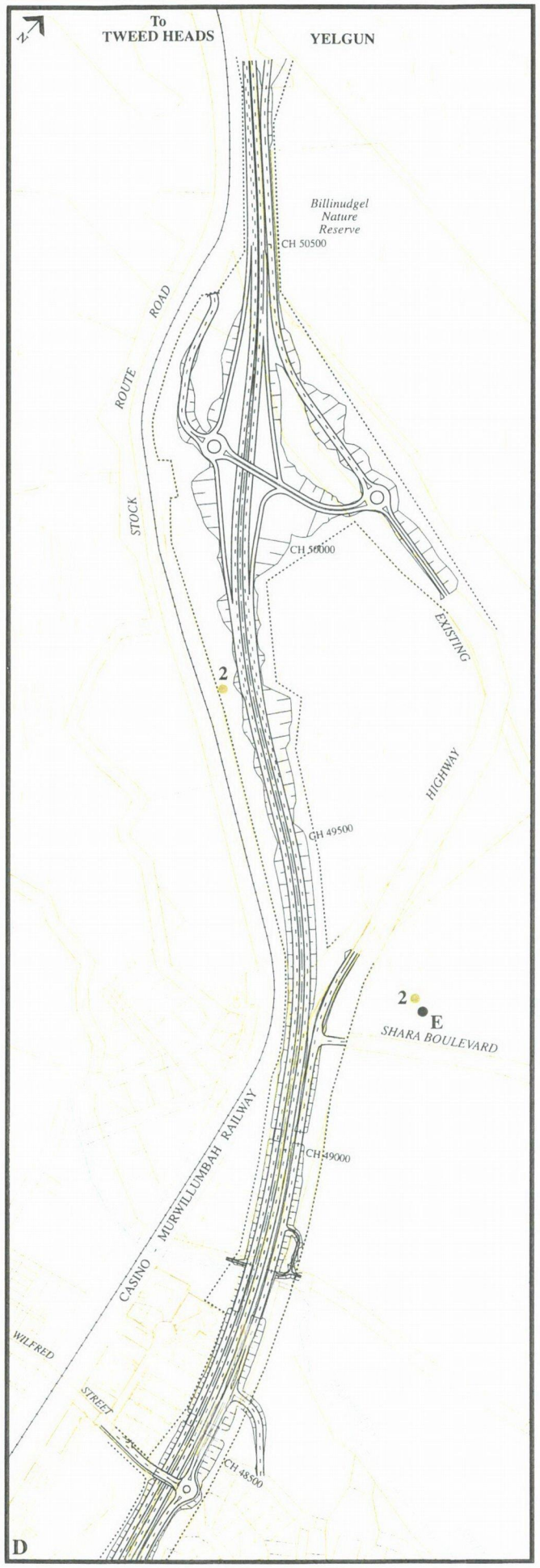
Six threatened fauna species (TSC Act) were recorded during the fauna investigations in the study area and immediate vicinity (the Koala, Queensland Blossom Bat, Little Bent-wing Bat, Eastern Long-eared Bat, Osprey and Pied Oystercatcher). A range of additional species of conservation concern recorded previously in the general area could potentially occur in the vicinity of the study area, at least on occasion.

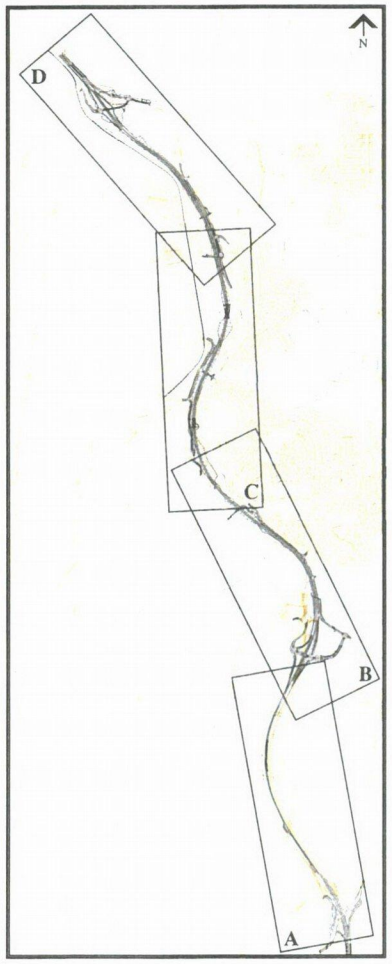

N
CH 44000
BRUNSWICK HEADS
CH 43500
E
S
CH 43000
CH 42500
CH 42100
SADDLE
ROAD
FROM BALLINA
A


N
CH 46000
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
OCEAN SHORES
CH 45500
Q
E
P
RAJAH ROAD
Brunswick Heads Nature Reserve
CH 45000
Brunswick Heads Nature Reserve
CH 44500
B

0 100 500m







Legend

E	Eastern Long-eared Bat *Nyctophilus bifax*
Q	Queensland Blossum Bat *Syconycteris australis*
P	Pied Oystercatcher
S	Squirrel Glider
K	Koala
1	*Cryptocarya foetida* (Schedule 2)
2	*Davidsonia poriens ssp jerseyana* (Schedule 1)
3	*Elaeocarpus williamsianus* (Schedule 1)
4	*Endiandra floydii* (Schedule 1)
5	*Endiandra muelleri ssp braeteata* (Schedule 1)
6	*Macadamia tetraphylla* (Schedule 2)
7	*Randia moorei* (Schedule 1)
8	*Syzygium hodgkinsoniae* (Schedule 2)
9	*Syzygium moorei* (Schedule 2)
.....	Proposed Road Corridor

Figure 12.3
LOCATION OF THREATENED FAUNA AND FLORA SPECIES OF CONSERVATION SIGNIFICANCE

Figure 12.3
LOCATION OF THREATENED FAUNA AND FLORA SPECIES OF CONSERVATION SIGNIFICANCE

12.3.3 Aquatic Fauna

The Brunswick River provides habitat for a variety of aquatic invertebrate species and fish. Most of the species recorded in the Brunswick River estuary are widespread in the estuaries of southeastern Australia (Jones *et al* 1986; Jones 1987; Wert and Gordon 1994; Scribnor and Kathuria, 1996).

The freshwater fish fauna of NSW comprise 83 species in 33 families, 58 of which potentially occur in drainages on the NSW far north coast. Few fish surveys have been undertaken in this area. Marshalls Creek was sampled in 1992 and at that time there was opposition to a proposal for dredging, based on the perennial value of the creek as a nursery area for a large range of species. There are no published data on the Brunswick River although the estuary supports a recreational fishery and there is an extensive offshore fishery based partly on prawns, which are dependent on the estuary.

Of the fish species identified as threatened in NSW, only the Oxleyan Pygmy Perch could be affected. It is noted that no populations have been located in the Brunswick River or Marshalls Creek, but these areas are included in the potential range of this species.

12.4 Summary of Potential Impacts on Flora and Fauna

The potential impacts on native fauna and flora and their habitats include:

- habitat removal, involving the clearing of native vegetation, and the removal of habitat features and resources (such as hollow-bearing trees, swamps, logs etc);
- the formation of barriers to animal movements, particularly for terrestrial mammals, reptiles and amphibians;
- habitat fragmentation, which may split populations or communities into smaller, and less viable, units;
- wildlife mortality as a result of collision with motor vehicles, which is of particular relevance to species such as wombats, Koalas, macropods and larger reptiles;
- the disturbance and degradation of adjacent habitat as a result of clearing and construction activities, and the discharge of water, sediment and contaminants both during and after construction. Other possible indirect effects include altered hydrologic regimes, weed infestation and encroachment, general access and littering, and 'edge' effects;
- the impact on approximately 0.6 ha of the Brunswick Heads Nature Reserve. This is a small component (less then 1%) of the 83 ha Reserve and most of this area has been disturbed by previous activities;

- the impact on approximately 0.4 ha of areas gazetted as SEPP 14 wetlands in both the Nature Reserve (included in the figure given in the previous point) and on the southern side of the Brunswick River.

12.4.1 Impacts on Flora

Proposed Brunswick Heads Bypass duplication

Given the existing levels of disturbance in this locality, arising in part from the current and previous construction activities for the Brunswick Heads Bypass and from previous clearing and grazing activities in the locality, the likelihood for adverse impacts to be imposed on native vegetation and plants in general is regarded as relatively low.

No threatened plant species, as listed in Schedules 1 or 2 of the TSC Act, were recorded, and consequently there is no requirement for a section 5A Assessment of Significance to be undertaken (refer to Working Paper No.7 - Flora and Fauna Assessment). No nationally threatened (ESP Act) or ROTAP species were recorded. Four plant species considered of regional conservation significance were recorded of which one, the Burny Bean (*Mucuna gigantea)* appears likely to be affected by the proposal. It appears likely that part of this population would be removed as a result of clearing for the Bypass duplication.

The plant species and vegetation communities present which would be affected are generally common and relatively widespread, with the vegetation communities being moderately to highly disturbed and degraded. The loss of individual plants or of stands of vegetation as a consequence of the proposed duplication is not considered a significant impact in conservation terms.

Brunswick River to Yelgun

This section of the proposal would involve clearing native vegetation and habitats and disturbance to habitats of relevance for threatened and protected fauna and flora. It is important to recognise, however, that much of the proposed road corridor has been already modified or degraded. The selection of Route A2 as the preferred route, the careful location of the proposed alignment and associated design features (such as using minimum cross-sections and retaining walls rather than embankments in sensitive areas) has limited the significance and extent of potential impacts. Nevertheless, there would be impacts on the natural environment.

Of the 9 threatened plant species recorded in this section, (eight of which are also listed on the ESP Act), 6 species are likely to be affected by the proposal. Specimens of Stinking Cryptocarya, Davidson's Plum, Crystal Creek Walnut, Green-leaved Rose Walnut, Spiny Gardenia and Red Lilly Pilly would require removal, although other individuals of these species are known to occur in the general vicinity.

While it is not known exactly what constitutes a "viable population" for the purposes of establishing the potential significance of impacts on threatened species, a precautionary approach has been adopted. On this basis, application of section 5A of the EP&A Act to some of the threatened plants which occur along the proposed alignment indicates that the activity may involve the imposition of "a significant effect" on these species, (refer to Working Paper No.7 - Flora and Fauna Assessment) and consequently a Species Impact Statement (SIS) has been prepared.

Several ROTAP species have been identified along the proposed road corridor, and other ROTAP species, not identified within the corridor, are known to exist in the locality. However, the number of individuals which would require removal would not be significant with respect to the conservation of those plant species.

The proposal would affect a few individuals of up to eleven plants regarded as of regional conservation significance. There are substantial populations of these plant species away from the corridor and the potential impact is not considered significant in terms of their local or regional conservation.

The Marshalls Creek is known to support areas of seagrass, and these are likely in the Brunswick River associated with the mangrove areas or downstream of the bridge. The proposal does not include dredging and it is anticipated that there would be no significant impact on seagrasses.

12.4.2 Impacts on Fauna

Proposed Brunswick Heads Bypass duplication

Given the high levels of disturbance and environmental modification of this area, and provided there is similar implementation of impact amelioration measures as have been applied to the construction of the first carriageway of the Brunswick Heads Bypass, there is not likely to be an adverse impact of any significance on native fauna or their habitats.

No threatened fauna, habitats or resources of significance or of restricted disturbance for any species (listed under the TSC Act or the ESP Act) were present in the immediate vicinity of the proposed Brunswick Heads Bypass duplication during this study. However, it is likely that some individuals of several threatened species would occur in habitat on or near the proposed duplication alignment, at least on occasions. At the same time it cannot be considered likely that these species would be dependent on those areas of land which would be affected by the proposed duplication. Furthermore, threatened fauna species which are known from the general vicinity are moderately or highly mobile.

It is noted that the RTA obtained a Section 120 licence from NPWS for the first carriageway of the Brunswick Heads Bypass because of the potential impacts on endangered fauna assessed for that project and in accordance with the legislation that applied at that time.

It is considered unlikely that this element of the proposal would impose "a significant effect" on any threatened species, as determined by the application of section 5A of the EP&A Act (refer to Working Paper No.7 - Flora and Fauna Assessment). There is no known "endangered population" or "endangered ecological community", as identified in the TSC Act, located in the vicinity of the proposed duplication.

Brunswick River to Yelgun

The proposal would require removal of some areas of native vegetation, as shown in **Table 12-1**. Most of the areas to be affected are moderately to highly modified with extensive weed-infestation, existing development and other disturbances. Notwithstanding their disturbed and modified condition, some habitats and vegetation communities which would be affected by the proposal are of conservation value and provide resources and habitat features for protected and threatened native fauna.

Table 12-1 - Vegetation Areas included in Proposed Road Corridor

Brunswick Heads Bypass Duplication	**Area affected**	**Extent in Locality - i.e within 10 km of the proposal**
Swamp Sclerophyll Forest	2.2 ha	moderate (>100ha)
Dry Sclerophyll Forest	1.6 ha	moderate (>100ha)
Rainforest	0.2 ha	limited (a few hectares)
Cleared / Disturbed Land	0.2 ha	considerable (>> 100 ha)
Brunswick River to Yelgun		
Rainforest	4.2 ha	moderate (>100ha)
Wet Sclerophyll Forest	6.5 ha	considerable (>> 100 ha)
Swamp Sclerophyll Forest	3.9 ha	moderate (>100 ha)
Sedgelands	0.7 ha	limited (a few hectares)
Mangroves	0.1 ha	moderate (>100ha)
Saltmarsh	-	limited (a few hectares)
Cleared / Disturbed Land	33.9 ha	considerable (>> 100ha)

Several threatened fauna species have been recorded in this section, although no records were obtained from the immediate vicinity of the proposal. Many of the threatened fauna species recorded are moderately to highly mobile, and all of the species recorded in this locality could potentially occur along the corridor, at least on occasions. It does not appear likely that the proposal would involve the removal or modification of habitat critical to the survival of any threatened fauna species. None of the species which have been recorded in the immediate vicinity is likely to be restricted to those areas which are to be affected by the proposal.

The species that are regarded as most likely to be affected by the proposal include the Koala, the fruit-doves and a few of the microchiropteran bats (refer to Working Paper No.7 - Flora and Fauna Assessment). However, given the existing levels of disturbance along the proposed corridor, the proposed environmental mitigation measures and the rehabilitation and compensatory habitat proposals, it is not considered likely that the proposal in this section would significantly impact upon threatened fauna species or their habitats (refer to Working Paper No.7 - Flora and Fauna Assessment).

For species such as the Koala and Long-nosed Potoroo, the proposal includes the construction of fauna-exclusion fences, and fauna underpasses at the Brunswick River, Marshalls Creek and Billinudgel Nature Reserve, allowing free movement and avoiding conflict between these species and motor vehicles. For the other moderately to highly mobile species, the proposal would involve an array of measures, to ensure that local populations of these species remain in the locality.

It is considered unlikely that the proposal would impose "a significant effect" on any threatened fauna species "or their habitats", as assessed under section 5A of the EP&A Act (refer to Working Paper No.7 - Flora and Fauna Assessment). Consequently, there is no requirement for a SIS with respect to threatened fauna as a result of the proposal.

No additional threatened species (listed under the ESP Act or the TSC Act) are regarded as likely to be affected by the proposal.

A preliminary 8-part test in accordance with the requirements of the Fisheries Management Amendment Act was undertaken for the Oxleyan Pygmy Perch, and this is included in Working Paper No.7 - Flora and Fauna Assessment.

The application of the test suggests that habitat destruction and pollution are major threats to the species. The proposal would not affect the habitat of this species and has the potential to result in overall improvements to water quality by containing and treating runoff and accidental spills.

In the construction phase, there would need to be strict protocols included in the Construction EMP to ensure that any disturbance to the River and Marshalls Creek is minimised.

JAMBA and CAMBA

The migratory bird species listed in the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) have been considered both in the location of the preferred route for the proposal and in its design. Eight migratory birds, as listed in JAMBA and CAMBA, were recorded during field investigations for the proposal, of which

there are few or no relevant habitats or resources for four (the Ruddy Turnstone, Common Tern, White-throated Needletail and Rainbow Bee-eater). The proposal would affect only a very small area of potential or theoretical habitat for four other species (the Bar-tailed Godwit, Whimbrel, Easter Curlew and Common Sandpiper), but would not involve a significant effect on any of these species.

12.5 Environmental Safeguards

A number of environmental management measures are incorporated in the proposal to avoid or minimise potential adverse impacts on native fauna and flora. These general measures include:

- the area of land on the northern side of the Brunswick River and adjacent to the Brunswick Heads Nature Reserve which is currently zoned in the Byron LEP for road purposes would be relinquished and could then be made available for incorporation into the Nature Reserve or be managed for conservation purposes by another authority, and rezoned accordingly;
- minimising vegetation clearing to the area of the road footprint;
- management of erosion and sediment discharge during the construction phase, to ensure that there is no significant discharge of sediment into watercourses or vegetation communities downslope and downstream of the roadworks, as specified in Section 10;
- the construction and use of water quality control ponds and constructed wetlands, incorporating macrophyte vegetation, to ensure that the water quality of adjacent watercourses and water bodies does not deteriorate as a consequence of discharges from the construction and operational phases of the proposed road;
- the careful siting of water discharge points and the use of water flow control structures to avoid the potential for excessive flows adversely affecting nearby watercourses and vegetation;
- the implementation of an intensive and extensive rehabilitation and replanting program along the road and in the affected wetlands, involving the use of removed vegetation in landscaping and local native species, including the propagation and replanting of plant species of conservation significance;
- the location of all works sites, stockpile areas, storage facilities and vehicle parking and maintenance areas on already disturbed land, avoiding any necessity for the clearing of vegetation for these activities;
- the avoidance of any stockpiling of materials or parking of vehicles, or other unnecessary disturbance, beneath vegetation and trees which are to be retained along the alignment;
- the avoidance and/or management of disturbance to actual or potential acid sulphate soils;

- the management of general construction activities along the alignment to ensure the appropriate disposal of rubbish and general waste materials, to prevent the loss or discharge of waste into remnant vegetation, the collection and removal of excess contaminants, the bunding of potential liquid contaminants, and the provision of appropriate ablution and work-shed facilities to prevent the discharge of contaminants into native vegetation; and
- the provision of compensatory habitat as discussed in Section 12.6.

12.5.1 Brunswick Heads Bypass Duplication

To a large extent, the environmental management measures of particular relevance for native fauna and flora along this section involve an extension and continuation of those measures applied to the current portion of the Bypass, as recommended by Milledge & McKinley (1992) and included in the (EMP) for that portion of the project (Kinhill 1996), and included in the section120 licence to take or kill endangered fauna.

One specific additional impact amelioration measure is proposed, relating to the Burny Bean (*Mucuna gigantea*) which is located near the southern end of the proposed duplication. At this location, it appears likely that a proportion of that population would be removed for the duplication, and a series of protocols is proposed, including:

- the collection of seed from the population, including from those plants which are to be removed, and the collection of cuttings or root stock (if appropriate);
- propagation of plant material and seedlings, and the introduction of the species into appropriate habitats in the vicinity (e.g. in land to be conserved to the east of the Bypass); and
- the collection of ecological and morphological information from the population and from those individuals to be removed, to provide an increased information base regarding this species.

12.5.2 Brunswick River to Yelgun

In addition to the general measures already described, a number of specific environmental management measures are proposed. Particular measures would be applied to the SEPP 14 wetlands, the saltmarsh vegetation, the Brunswick Heads and Billinudgel Nature Reserves and native plants and fauna.

SEPP 14 Wetlands

These measures would also apply to other wetlands and watercourses along the alignment (i.e. those not protected under SEPP 14) and include:

- a construction protocol which requires all earthworks, machinery and personnel to be restricted to the road footprint;

- stringent application of erosion and sediment discharge control measures;
- implementation of a weed removal, control and management program;
- the removal of litter and rubbish from areas adjacent to the roadworks; and
- the implementation of a rehabilitation and replanting program.

Detailed documentation of the measures to be applied at these locations would be included in the EMP prepared as part of the detailed design and engineering documentation for the proposal. The contractor would be required to address these matters as a condition of the construction contract.

Saltmarsh

Environmental management of the proposed construction in the area on the southern side of the Brunswick River would essentially involve avoiding direct or indirect damage to the saltmarsh, and appropriate management of water discharges from the construction and operation of the proposed upgrade. Particular measures with regard to the saltmarsh would include:

- strict and stringent application of erosion and sediment control measures and water quality management measures during the construction phase of the project;
- implementation of an appropriate rehabilitation and replanting program;
- implementation of a weed removal, control and management program; and
- the design and implementation of an appropriate water quality control and stormwater management program.

A management plan for this area would be formulated during the detailed design stage of the project. This plan would include detail such as establishing an appropriate hydrological regime and vegetation management strategy.

Brunswick Heads and Billinudgel Nature Reserves

Similar protocols and environmental management measures are to be implemented where the proposed upgrade abuts the Brunswick Heads Nature Reserve and the Billinudgel Nature Reserve as would apply at the SEPP 14 wetland sites. In this regard, stringent application of the erosion and sediment control measures, water quality and stormwater discharge measures, and minimisation of vegetation clearing protocols in specified areas would apply. Additional measures would include the implementation of weed removal, plant propagation and long-term habitat enhancement and rehabilitation programs.

Flora

As noted above, several specific environment management measures would be implemented for native vegetation, including (in all locations) limiting removal of

vegetation required for the project. Specific measures to be applied along the project with respect to plants of conservation significance would include:

- identification and avoidance of individual significant plants during the construction phase wherever possible;
- marking and fencing individual plants which are to be retained near the roadworks;
- appropriate design of wetlands and stormwater discharge points;
- appropriate treatment and management of water derived from the construction and operation of the road; and
- relocation and/or propagation of plants of conservation significance to appropriate locations.

Fauna

In addition to the measures proposed generally for environmental management along the proposal, which contribute to best practice environmental management for native fauna and fauna conservation, a number of specific measures and protocols would be implemented, including:

- conducting pre-clearing surveys of native vegetation, wherever required;
- specific searches for fauna of particular concern immediately prior to clearing activities;
- the identification and retention of habitat trees as appropriate;
- the retention of habitat features and resources for native fauna (such as hollow-bearing trees, hollow logs etc) wherever possible;
- re-use of elements of potential value for native fauna (such as hollow-bearing trees, hollow logs, rocks etc) in suitable areas (possibly including the Brunswick Heads and Billinudgel Nature Reserves), if appropriate;
- installation of fauna-exclusion fencing (particularly designed for terrestrial fauna and Koalas) to limit the opportunities for animals to gain access to the new road. Fauna-exclusion fencing would be installed at sites where fauna underpasses or bridges designed for fauna movements are located, including:
  - the Brunswick River
  - Marshalls Creek, and
  - Billinudgel Nature Reserve.
- the use of extended bridge structures at the Brunswick River and Marshalls Creek, and appropriate contouring of the river and creek banks, to provide fauna movement underpasses at these localities; and
- the maintenance of communication between the RTA or its contractor and local NPWS officers, WIRES and/or other relevant local wildlife carer groups.

12.6 Compensatory Habitat

The proposal would have a direct impact on the Brunswick Heads Nature Reserve, although the area to be affected is a very small portion of the total Reserve (approximately 0.6 ha from a total Reserve area of 83 ha) and it is mostly in a degraded condition. It is nevertheless part of the national parks estate and is valued by the community. Recognising this, the RTA would, during the determination period, liaise with the NPWS and other stakeholders in relation to identifying suitable areas for the retention and protection of habitat. These discussions would resolve the mechanism for transfer of these lands and management arrangements.

Also, as indicated above, the area of land located on the northern side of the Brunswick River and currently zoned for road purposes could be made available for incorporation in the Brunswick Heads Nature Reserve or be managed for conservation purposes by another appropriate authority, and could be rezoned accordingly.

In summary, the construction and operation of the proposal would have an impact on flora and fauna, and on the Brunswick Heads Nature Reserve, although the area of sensitive vegetation and habitat affected is small in extent. The proposal includes measures to mitigate the potential impacts and, as indicated above, the RTA would consider the provision of compensatory habitat. The provisions of these measures is consistent with the ESD principle of conservation of biological diversity and ecological integrity.

13. Geology and Soils

This Section describes the geotechnical conditions of the study area, and provides specific detail on the area along the proposal. The geotechnical conditions of the study area were important factors in developing the concept design, and particularly in developing the proposed treatments in the vicinity of Rajah Road, the depths and shape of cuts and fills, and the location of the interchanges. Understanding the geotechnical considerations was also important to the development of the proposed erosion control and sedimentation measures. Full details of the geotechnical study are contained in Working Paper No.8 - Geotechnical Assessment.

13.1 Introduction

The geotechnical investigations (refer **Figure 13.1**) included:

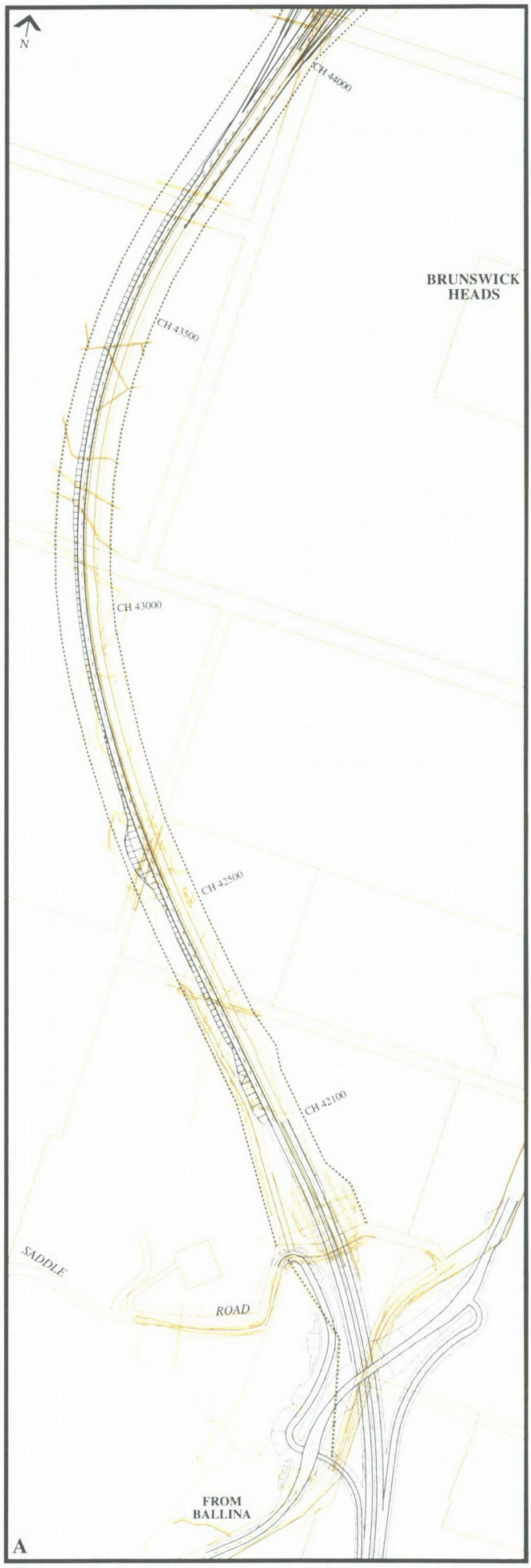
- previous investigations for the first carriageway of the Brunswick Heads Bypass;
- air photo interpretation;
- field geological mapping;
- sub-surface investigation by boreholes, test pits, cone penetrometer tests;
- seismic refraction survey;
- field testing for soil and rock strength, and acid sulphate soil potential;
- mechanical and chemical laboratory testing of soils for various properties,
- chemical laboratory testing for acid sulphate potential;
- X-ray diffraction of soil samples to characterise clay minerology;
- petrographic analyses of rock to characterise rock minerology.

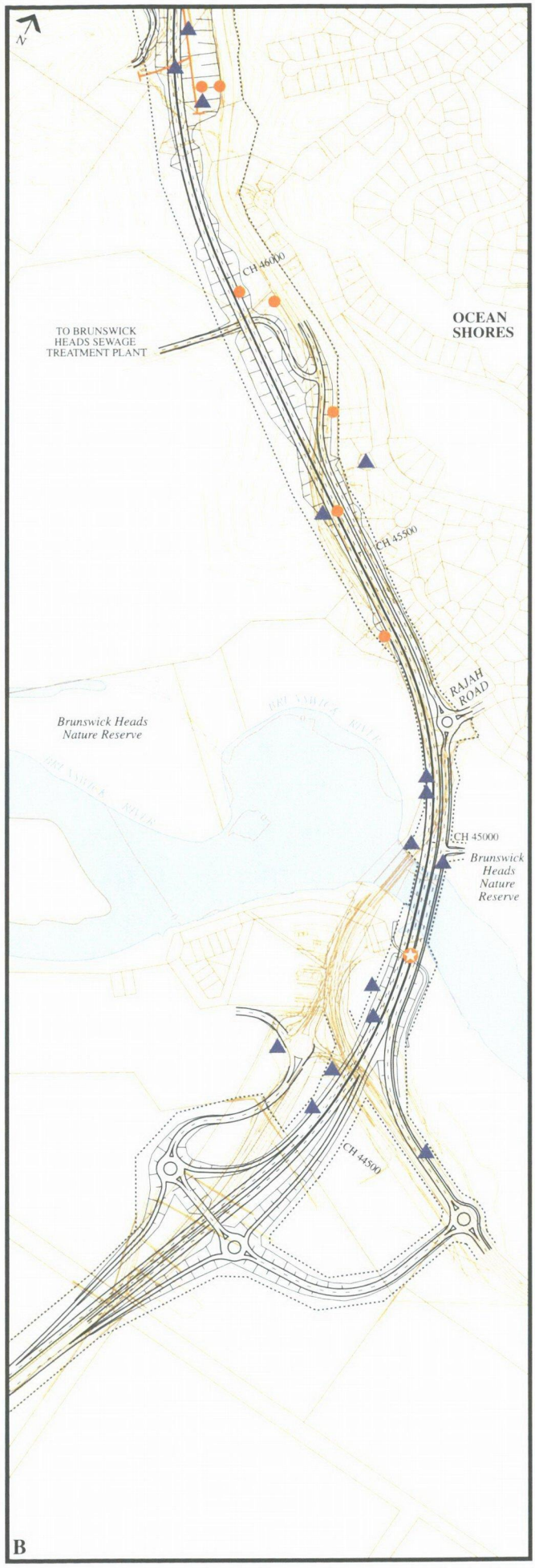
Field investigations were restricted to areas that could be readily accessed without the need to carry out excessive clearing or earthworks. Investigations in sensitive environmental areas were undertaken under the supervision of a botanist, and all works in the Brunswick Heads Nature Reserve were undertaken with the permission of NPWS and in accordance with agreed protocols. Further investigation and assessment would be required prior to final detail design.

13.2 Physical Setting

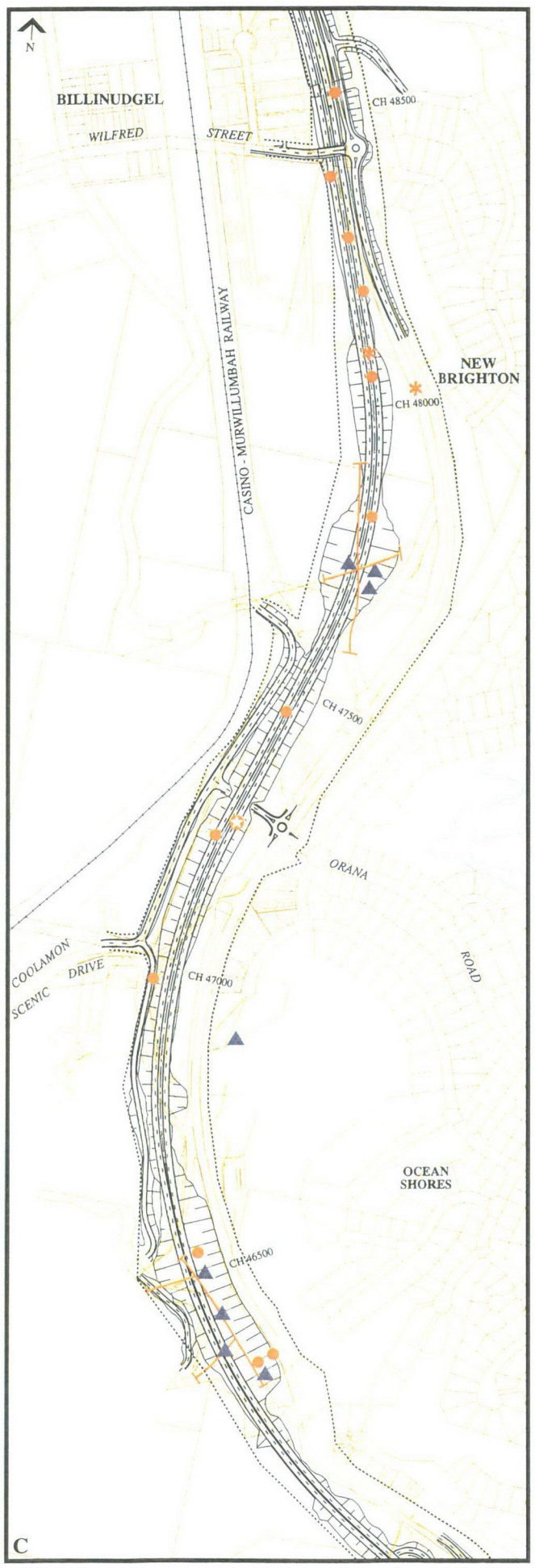
13.2.1 Regional Geology

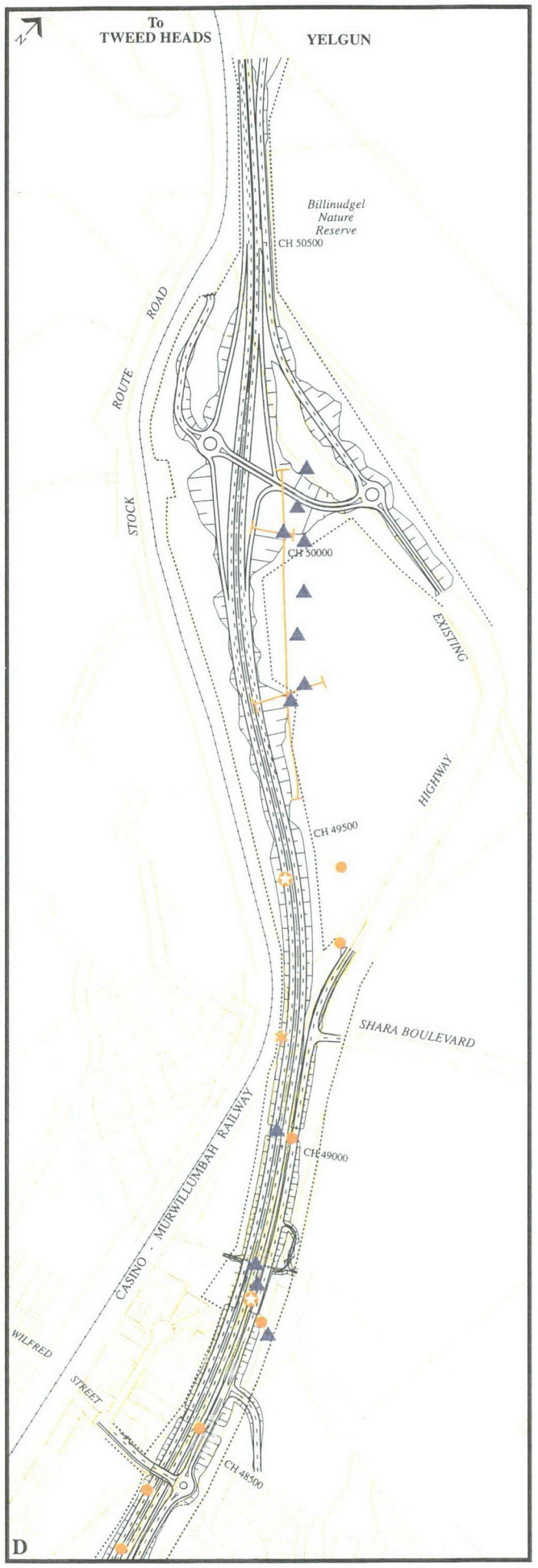
The area south of the Brunswick River is principally underlain by coastal, river and estuarine alluvium, and this material is also found at lower elevations around Marshalls Creek.

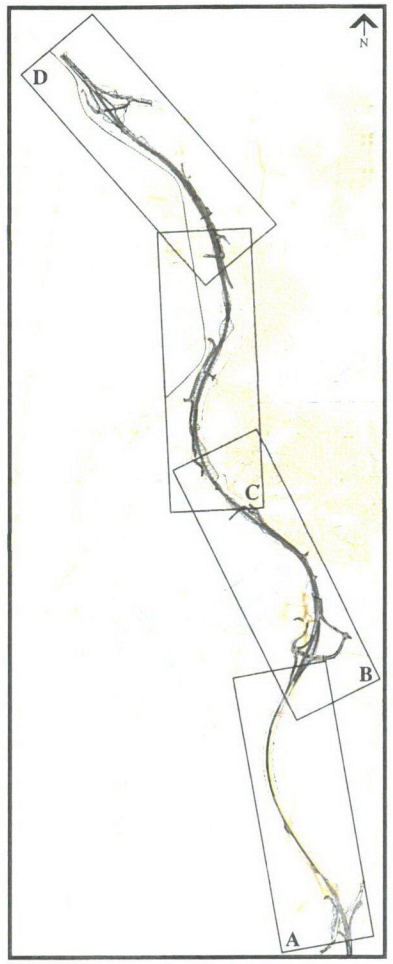

N
CH 44000
BRUNSWICK HEADS
CH 43500
CH 43000
CH 42500
CH 42100
SADDLE
ROAD
FROM BALLINA
A


N
CH 46400
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
OCEAN SHORES
CH 45500
RAJAH ROAD
Brunswick Heads Nature Reserve
CH 45000
Brunswick Heads Nature Reserve
CH 44500
B

0 100 500m







Legend

- Approximate Test Pit Location
- Approximate Borehole Location
- Approximate Combined Borehole and Cone Penetrometer Test Location
- Cone Penetrometer Test Location
- Seismic Refraction Traverse
- Proposed Road Corridor

0 100 500m

Figure 13.1
GEOTECHNICAL INVESTIGATIONS

Sedimentary rocks (locally capped with basalt) principally underlie the hillslopes north of the Brunswick River. Typically the rocks comprise inter-layered argillite (a bedded rock formed from clay and silt) and greywacke (a sandstone with lithic fragments and clay). In this area these rocks are generally deeply weathered and are typically extremely low to very low strength. However there are local areas of medium to very high strength argillite and greywacke, and high/very high strength chert/quartzite and basalt (volcanic rock).

13.2.2 Topography

The proposal crosses four main terrain units, as shown on **Figure 13.2** and described below:

Brunswick River Floodplain

South of the Brunswick River the proposal crosses flat to gently sloping, low-lying coastal plain, which is underlain by deep deposits of inter-layered coastal, estuarine and river alluvium. Soils vary from soft to stiff clay and very loose to dense sand.

Neranleigh-Fernvale Hillslopes

North of the Brunswick River the proposal passes through hillslopes formed by weathering of the sedimentary rocks. The ground comprises mostly clay soils over weathered argillite and greywacke rocks. Isolated basalt occurs at ridge crests.

Hainsville Alluvium

This is a narrow, gently sloping valley floor within the Neranleigh-Fernvale hillslopes. Soils comprise mainly stiff alluvial clays.

Marshalls Creek Floodplain

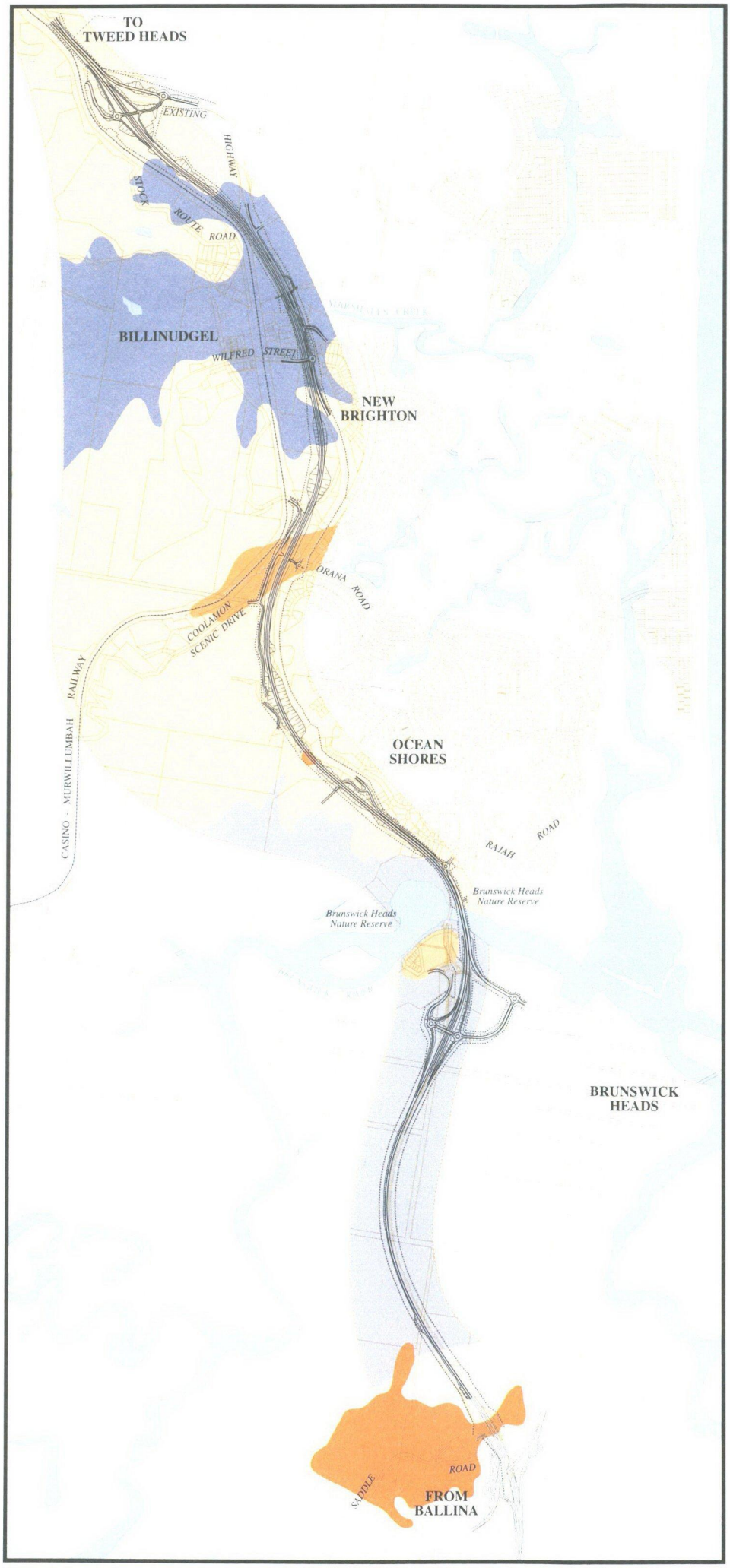
The northern part of the proposal crosses this flat to gently sloping, low-lying coastal plain underlain by deep deposits of inter-layered coastal, estuarine and river alluvium. Soils comprise soft clay over interbedded sand and clay.

13.2.3 Groundwater

Groundwater levels within the floodplain topography are often less than 1m below present ground surface. Groundwater within the Neranleigh-Fernvale Hillslopes was generally not identified in boreholes nor observed in cuttings or hillslopes (springs), however, the investigation was conducted during relatively dry weather. Groundwater seepage may occur in wetter weather.

13.3 Geotechnical Characteristics of the Proposal

The proposed Brunswick Heads Bypass duplication construction would mainly involve embankments ranging from 1m to 3m high over potentially compressible soils of the Brunswick River Floodplain. The depth of soft/compressible soils is generally less than about 3m. There would be two relatively short sections where the duplication cuts into the hillslopes, resulting in cuts to about 10m deep.





Legend

Basalt Cappings:
Generally moderately sloping red brown residual and colluvial soils developed on Tertiary basalt - boulders common - some areas of outcrop.

Hainsville Alluvium:
Narrow, gently sloping valley floor between hillslope formed from weathering of the Neranleigh-Fernva Beds. The elevation is above RL5m

Fill

Neranleigh-Fernvale Beds:
Hillslopes formed by weathering of Neranleigh-Fernvale Beds, comprisi slopewash, colluvium and residual soils derived from the underlying argillite and greywacke. At the ridge crests (RL130m) some basalt caps remain these are generally isolated.

Marshall Creek Floodplain:
Flat to gently sloping coastal plain at about RL2m, underlain by deep Quaternary alluvial deposits of inter-layered coastal, estuarine and river alluvium comprising soft to stiff clay and very loose to dense sands.

Brunswick River Floodplain
Flat to gently sloping coastal plain a about RL2m, underlain by deep Quaternary alluvial deposits of inter-layered coastal estuarine and river alluvium comprising soft to stiff clay and very loose to dense sand.

Proposed Road Corridor

Figure 13.2
TERRAIN UNITS

The Brunswick River interchange would comprise high embankments and a bridge located on soft, potentially acid sulphate soils. Between the Brunswick River interchange and the southern abutment of the proposed new bridge over the Brunswick River the typical soil profile comprises very loose sand, clayey sand, and soft clay, to a depth of 8 to 10m, over less compressible inter-layered sand and clay extending, to a depth of more than 20m depth.

From the Brunswick River to Yelgun, there are a number of sections where the geotechnical conditions are significant. These include four sections of deep cuttings (about 25m to 30m) through the hillslopes; embankments to about 15m high on moderate/steep hillslopes; embankments to about 10m high on Hainsville Alluvium and embankments usually less than 3m high on the Marshalls Creek floodplain, but up to 10m high where the floodplain meets the hillslopes.

At the Marshalls Creek floodplain, the general soil profile is very soft and soft clay, typically about 6m deep, underlain by generally denser sand and stiffer clay inter-bedded to about 20m depth.

13.4 Cuttings

13.4.1 Soil and Rock Conditions at Cuttings

The proposed cuttings would mainly intersect variable depths of clay soil, over extremely and very low strength argillite and some greywacke. Some cuttings would also reveal zones of low, medium and high strength argillite, high strength basalt at higher elevations, alluvial gravels and very high strength quartzite.

13.4.2 Excavation Properties

Most of the argillite and greywacke encountered in cuttings is expected to vary from extremely low strength (virtually soil) to medium strength. These rocks should be able to be excavated with crawler tractors and dozers, but localised blasting may be required.

Blasting is likely to be needed to assist excavation of:

- a significant lens of very high strength quartzite/chert in the ridge north of Coolamon Scenic Drive;
- localised capping of high strength basalt below the ridge south of Coolamon Scenic Drive
- localised zones of high strength argillite near the proposed Yelgun interchange.

13.4.3 Unsupported Cut Batters

Most of the rock cuttings are expected to comprise either extremely/very low strength rock, or higher strength rock that is fractured. As a result, batter slopes of cuttings must be relatively flat to reduce the risk of instability. Analytical

modelling indicates that the excavation profiles must comprise a series of benches and berms with an overall average slope of about 1V:2H.

Most of the rocks are affected by steeply dipping bedding planes and joints and sometimes shearing induced fractures. If these rock defects are unfavourably oriented in respect to the cutting face, rock bolting, shotcrete and drainage may be required to provide additional local support. Similar treatment may be required where groundwater seepage occurs.

13.4.4 Proposed Excavation Support in Cuttings near Rajah Road

The road corridor through this section has been designed to be as narrow as possible to minimise impacts on properties and on sensitive vegetation. The proposal is to locate the service road in a cutting 10m into the hillslope. The uphill batter slope would be 4V:1H. There would also be a vertical cutting approximately 15m deep to the proposal, below the service road. It would be necessary to construct the vertical cutting using a large diameter anchored contiguous concrete pile wall and reinforcing the slope uphill of the service road by soil nailing, protected with reinforced shotcrete. There would also be a need for a surface treatment to minimise the visual impact of this treatment.

13.5 Embankment Construction

13.5.1 Suitability of Excavated Materials for Embankment Construction

Most materials derived from cuts should be suitable for use as general embankment fill. The clay and weathered argillite would probably pose problems for handling in wet conditions. There may be localised problems associated with highly reactive, dispersive or "halloysitic" clays but these are not expected to be extensive throughout the route and there are management techniques that have proven to be successful. Laboratory testing suggests that the excavated soils will have a low strength when recompacted and saturated, and thick pavements (possibly incorporating the use of geosynthetics) would be required.

13.5.2 Embankment Batter Stability

The maximum embankment batter slopes that can be achieved are a function of several factors including the nature of the material, the height of the embankment and local topography. Embankments on hillslopes must be constructed by benching into the residual soils and weathered rock. For well constructed embankments up to about 10m high, batter slopes of 1V:2H are typically suitable. Flatter batter slopes may be required in locations where the embankments are higher, the foundation soils are soft or where the slope is steeper than 15 degrees. Reinforcement may be needed if the batter slope cannot be flatter.

13.5.3 Embankment Construction on Floodplains

Embankments constructed on the Brunswick River and Marshalls Creek floodplains would experience significant settlement. The preferred option to mitigate the effects of settlement would be to pre-load the embankment foundations. Pre-loading involves construction of the embankment up to full design height and allowing the embankment to consolidate the foundation soils before road construction. Installing vertical wick drains to improve soil drainage can be used to increase the rate of consolidation. This method was used successfully during the construction of the first stage of the Brunswick Heads Bypass.

At many locations the foundation/embankment interface will require reinforcement with a geogrid and/or temporary berms outside the embankment footprint to reduce the risk of failure and instability.

For the higher embankments north of the Brunswick River interchange and at the fringes of the Marshalls Creek floodplain, embankment construction would have to be staged to avoid foundation failure. With staged construction and a pre-load period of 6 months, preliminary estimates of post-construction settlements for the higher embankments are estimated to be in the order of 0.2m to 0.3m. Differential settlements could also occur, particularly at Marshalls Creek floodplain.

Immediately north of the Brunswick River, the proposed northbound carriageway would cross the Nature Reserve located at the northern fringe of the Brunswick River floodplain. To limit the encroachment into the Nature Reserve and reduce differential settlements relative to the southbound carriageway (which would be generally founded on residual soil), a piled embankment is proposed. The embankment would most likely be constructed of reinforced soil, supported on a grid of piles founded below the soft surface alluvium.

13.5.4 High Embankments on Sloping Ground

Near the STP access road embankments would be up to 15m high. The stability of the embankments would be assisted by techniques such as establishing benches into the natural slopes and by providing adequate surface and subsurface drainage. Further investigation of these areas would be necessary during the detail design stage to define the extent of site preparation, drainage and stabilisation works that may be necessary.

To reduce the embankment width in this zone, batter slopes steeper than 1V:2H are proposed. These would need to be reinforced to avoid batter slope instability.

13.5.5 Sources of Select Fill

The higher strength rock from proposed cuttings would provide a source of select fill. Additional material, if required, can be obtained from approved local

quarries. Aggregate for pavements would be sourced from approved local hard rock quarries in the region. Concrete and asphalt could be sourced from suppliers in the district. Concrete could be provided from an established batch plant in the local area. The potential for an on-site batch plant has been addressed in the environmental assessment (see Section 9).

13.6 Geotechnical Considerations for Bridges

Investigations for the concept design did not specifically address bridge or culvert sites. Smaller bridges at interchanges within the Neranleigh-Fernvale hillslopes would not be expected to present significant design, construction or environmental difficulties.

At the northern bridge abutment of the Brunswick River bridge shallow footings are considered feasible. Deep piled footings would be required at the southern abutment. The Construction EMP would need to contain specific protocols to ensure that the river environment is adequately safeguarded during the construction period.

At the Brunswick River interchange it should be possible to found the bridge on the indurated sand using shallow footings.

At the proposed Wilfred Street Overpass bridge deep friction into the stiffer/denser soils below 6m depth are likely to be feasible.

Construction staging would likely to be required between bridges and their approach embankments. The settlements that occur beneath the approach embankments during pre-loading would cause lateral soil displacements. This could result in large lateral forces being applied to piled footings unless footing construction is delayed until pre-loading is substantially completed.

At all floodplain bridge sites, the proposed construction techniques would need to adopt techniques and protocols to manage areas of Potential Acid Sulphate Soils (PASS), particularly in selecting footing types and construction methods.

13.7 Environmental Management

13.7.1 Erodibility and Fertility of Soils

Cuts and embankments exposing soils and weathered argillite must be protected from erosion by vegetation cover appropriate for the high intensity rainfall conditions which prevail in this area. Concrete lined catch drains would be installed above the top of batter slopes to reduce water flow over the exposed faces.

Soil fertility is a function of soil origin, current land use and topographic position. In the floodplain areas, organic rich topsoils of variable thickness (often as little as 0.2m) are fertile, but are underlain by potential acid sulphate soils. In the soils derived from Neranleigh-Fernvale beds, soil fertility appears variable, apparently related to topography. Vegetation on the upper slopes and crests is sparser than on the more thickly vegetated lower and middle slopes.

13.7.2 Acid Sulphate Soils

Potential acid sulphate soils (PASS) have been identified in the study area. These soils have a content of sulphate that is usually stable under naturally occurring conditions. But, if the soils are exposed, which may occur if they are excavated or if the water table is lowered, the consequent oxidation produces acid sulphate soils (ASS). Leachates from these soils increase the acidity of waterways, mobilising metals, depleting dissolved oxygen and reducing photosynthesis, all of which harm aquatic flora and fauna.

Acid sulphate soils would be managed in accordance with the Acid Sulphate Soil Management Strategy which is consistent with the principles outlined in the Acid Sulphate Soil Guidelines (RTA, 1996) and with reference to Assessing and Managing Acid Sulphate Soils (EPA 1995). Further details of the Management Plan are contained in the Working Paper No.8 - Geotechnical Assessment. The principles include avoiding disturbance, preventing oxidation and neutralising acid if produced, and the adoption of construction techniques which minimise disturbance or transfer of acid sulphate soils. These measures would be detailed in the Construction EMP for the project and in the dedicated Acid Sulphate Soil Management Plan.

13.7.3 Potential Contamination

Possible sources of soil contamination include residual pesticides used on agricultural land, and chemicals from old cattle dips. The field investigations have not revealed any evidence of significant contamination along the proposal route, and only isolated dip sites. Further investigation and assessment of these areas would be required during the detail design stage.

13.7.4 Construction Staging

Construction methods would be developed by the contractor in response to RTA specifications which would incorporate the design features and environmental mitigation measures described in this document.

The embankments would have to be constructed in stages. Fill for embankments would have to be imported from the cut areas and other sources. The requirements for embankment construction over soft soils, with associated drainage, pre-loading and subsequent relocation of some earthen materials would require careful planning and would be addressed in the detail design stage.

13.7.5 Sterilisation and Depletion of Resources

Geological records do not indicate the presence of any mineral or fuel resource that would be sterilised by the proposal. The Department of Mineral Resources records reveal that there are no current exploration licences in place in the vicinity of the proposal.

The area has several quarries supplying "hard rock" for roadworks and associated construction. The Proposal will require about 55,000m^3 of select fill for working platforms for construction of the floodplain embankments and beneath concrete pavements. This material will be provided from the harder rock encountered in proposed cuttings, supplemented by material from approved local quarries, if necessary. It is unlikely that this will seriously deplete local resources.

Some of the local quarries advise that they produce material that complies with RTA specifications for sub-base and base material. Extensive supplies of this material are not expected to be required for concrete pavement construction, so local supplies are unlikely to be depleted.

14. Present and Future Land Use

The existing and future land use patterns, planning controls and zoning that relate to the area potentially affected by the proposal are summarised in this Section. Local and regional planning controls are described as are specific regional environmental plans and state environmental planning policies that relate to the study area. Land use impacts resulting from the construction, and operation of the proposal are then discussed and a description of each affected property provided. This Section also contains an explanation of the provisions for land acquisition.

14.1 Existing Land Use

The study area and its environs are characterised by both rural and urban development. Major infrastructure occurs within the study area and comprises the existing highway and the Casino-Murwillumbah Railway line. The pattern of existing development and occupation relates to both historic and recent urban settlement, to agricultural land use and to rural residential lifestyles. A description of the existing land use for each of the localities along the proposal is provided below and shown schematically on **Figure 14.1**.

Brunswick Heads
The township of Brunswick Heads is the traditional service centre for the locality. Historically, it has provided for the needs of the rural hinterland, of coastal fishing, trawling and tourist activities and of travellers on the Pacific Highway. Much of the commercial development is highway-oriented and dependent on passing trade. The existing highway frontage is dominated by uses such as service stations, fast food and convenience retail outlets and visitor accommodation in the form of motels and caravan parks.

Brunswick River Crossing
The locality immediately to the south of the Brunswick River, where the Brunswick Heads Bypass meets the existing highway, accommodates the Ferry Reserve Caravan Park and a small residential subdivision at Riverside Drive. On the eastern side of the existing highway is a commercial building currently occupied by two restaurants. The Brunswick Heads Nature Reserve occupies the land on the northern side of the Brunswick River on either side of the existing highway.

Ocean Shores
The recent and still developing suburban area of Ocean Shores extends between the existing highway and the coast and from Rajah Road in the south to Shara Boulevard in the north. In contrast to Brunswick Heads, Ocean Shores is not highway-oriented, but is focussed internally with shops and commercial and personal services aimed at providing for the needs of local residents. Ocean

Shores is a relatively self-contained development with its own shopping centre, schools and recreation facilities.

Billinudgel

Billinudgel is the site of a village originally established along the north coast railway. Much of the original village has disappeared, with few houses remaining and the school closed. There are, however, some remnants of the old village including the hotel and a church. More recently, that part of the village east of the railway has been developing as an industrial service centre for the locality, providing for the needs of Ocean Shores and the rural hinterland. There are a number of existing establishments and a recently created industrial subdivision, "El Dorado". Located in Mogo Place is a manufacturing/retail food business, a church and a home/business and several industrial operations. Developments in both the El Dorado and Mogo Place subdivisions have access via Wilfred Street and none has direct access to the existing highway.

The Billinudgel Nature Reserve is located on the eastern side of the existing highway.

Yelgun

The settlement of Yelgun, to the north of the study area, has extended as a local rural service centre but this function has been largely superceded by larger centres and little remains of its commercial function or village atmosphere.

Rural Pursuits

The most intensive agricultural area is the flats to the north and west of Billinudgel known as The Pocket. The combination of volcanic soils and reliable water make The Pocket a productive area for pastures, forage and crops. The size of holdings is relatively small so the study area includes a number of productive rural operations.

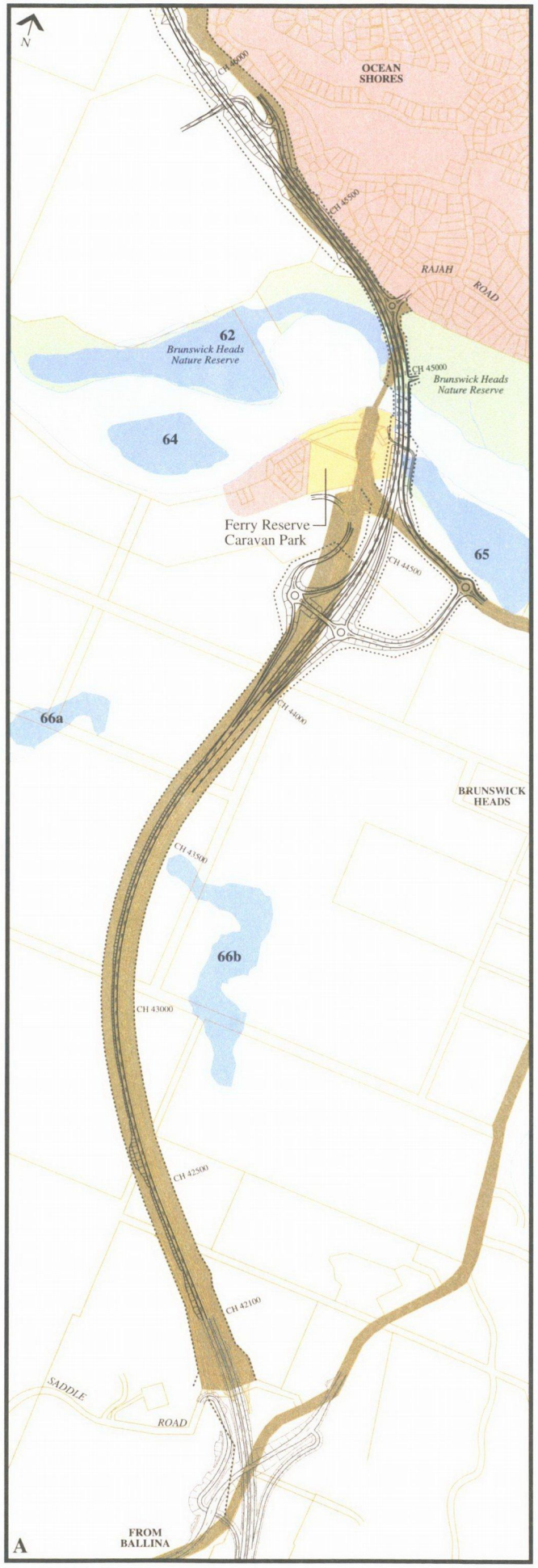
Rural-Residential Development

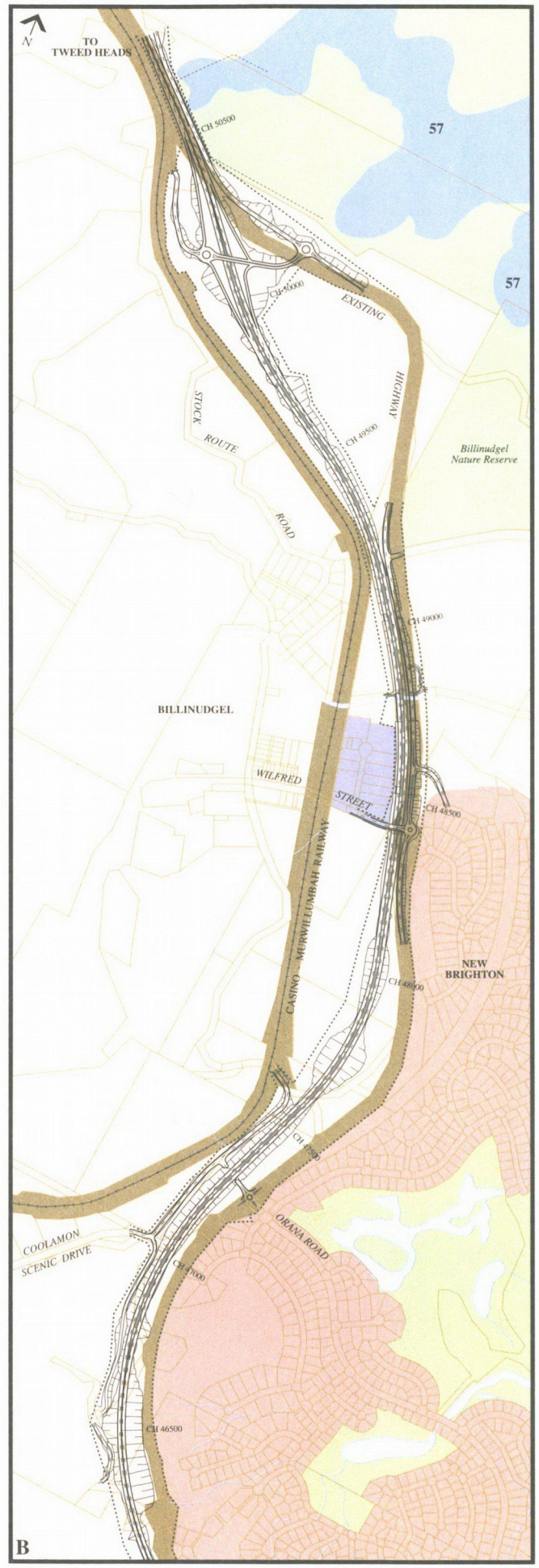
The area south of Billinudgel and along Coolamon Scenic Drive is characterised by rolling topography and provides an attractive setting enjoyed by residents of acreage development. Some of this rural residential development is very recent and characterised by substantial homes.

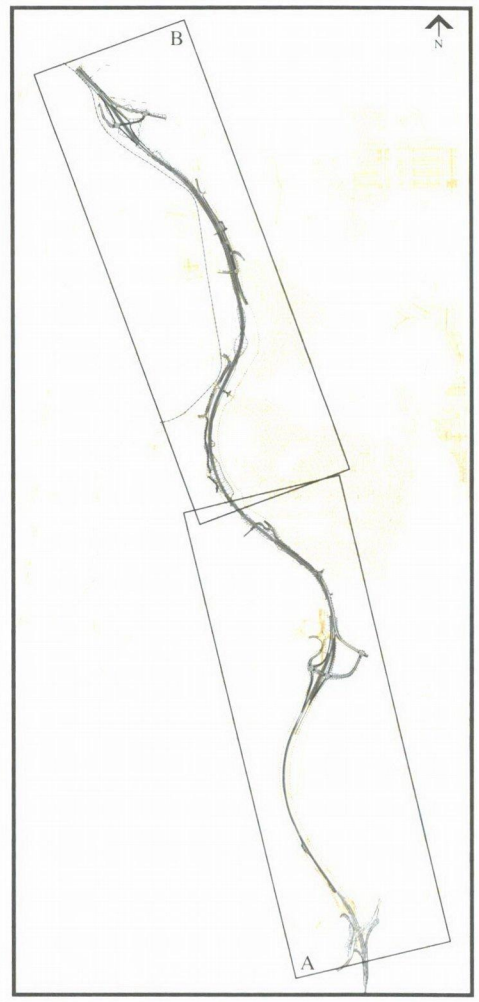
Brunswick River

The river is the basis of the local fishing industry although there is no commercial fishing in the river. There are a number of oyster leases located both upstream and downstream of the existing bridge. The oystergrowers currently gain access to the river via the ramp on the northern bank of the river, on the north-western side of the existing highway. The small bay immediately to the west of this area also provides a safe shelter for oystergrowers' dinghies.

The river is also used for a range of water-based recreational activities.







Legend

- Industrial/Commercial
- Residential
- Open Space
- Tourism and Associated Uses
- Rural Land (incorporating rural residential development)
- Existing Major Infrastructure (Pacific Highway and Casino-Murwillumbah Railway)
- Nature Reserve
- 65 SEPP 14 Coastal Wetlands
- Proposed Road Corridor

0 100 500m

Figure 14.1
GENERALISED LAND USE

14.2 Future Land Use

One of the most significant future land uses within the study area would be the proposed upgrade of the Pacific Highway, which is the subject of this EIS.

The most significant development potential relates to the ongoing expansion and infill of Ocean Shores as a planned community and the opportunity for new urban development as a westward extension of Billinudgel.

Ocean Shores is a pre-planned and staged development which has been in progress for a number of years and has achieved a critical mass sufficient to support its own commercial centre, schools and other community facilities. The staged development is continuing but the greatest proportion of the area able to be developed in the southern part is already subdivided and serviced by roads, water supply, sewerage and electricity. Much of the developed area is already occupied by dwellings, although there are still a number of vacant allotments and potential infill sites available.

The more northerly part of the Ocean Shores locality is more heavily constrained by biophysical characteristics and cultural heritage values. Its development potential has not yet been fully determined and it has remained in the category of "deferred" or "investigation" for many years.

In addition to land available for further development in Ocean Shore, a consortium of landholders to the west and southwest of Billinudgel have identified an opportunity for urban development of largely previously-cleared farm and grazing lands. This concept, known as "Billinudgel 2000", has been the subject of preliminary investigations and of approaches to Byron Council and DUAP. These preliminary investigations have demonstrated the suitability of the land for urban development but infrastructure issues, particularly the need for augmentation of sewerage capacity, are yet to be resolved. While Billinudgel 2000 is under consideration, it has not yet been incorporated into the Byron LEP.

14.3 Planning Controls

14.3.1 Local Planning Controls

Land use and development within the study area is governed by the provisions of the Byron LEP 1988. Zoning in the vicinity of the proposal is shown on **Figure 14.2**. The area to be affected by the proposal is zoned variously rural, small holdings, tourism, residential, special uses and Nature Reserve. Within these zones, road development is permitted with Council consent.

A substantial length of the proposal is within land zoned as Proposed Road, and within the existing road corridor. A road reservation exists within the study area and is zoned in the LEP as 9(a) - Roads (Main Roads Proposed) Zone. This

covers a 60m wide easement which runs north-south through the study area north of the Brunswick River and identifies the original corridor anticipated for the upgrade of the highway.

14.3.2 Regional Planning Instruments

The North Coast Regional Environmental Plan (REP) was gazetted in 1988 and covers the north coast region, being that area along the coast between the Tweed Shire in the north to the Hastings Shire in the south and including the Shires of Kyogle, Copmanhurst and Nymboida to the west. The REP outlines a number of planning criteria and policies against which local planning and development control decisions could be set. Part 5 of the REP outlines the objectives of the plan in relation to regional infrastructure. The objectives of Division 1 (Transport) are to:

- safeguard the role and efficiency of the main road system of the region, particularly by recognising the importance of primary arterial roads; and
- facilitate maintenance and improvement of transport within the region.

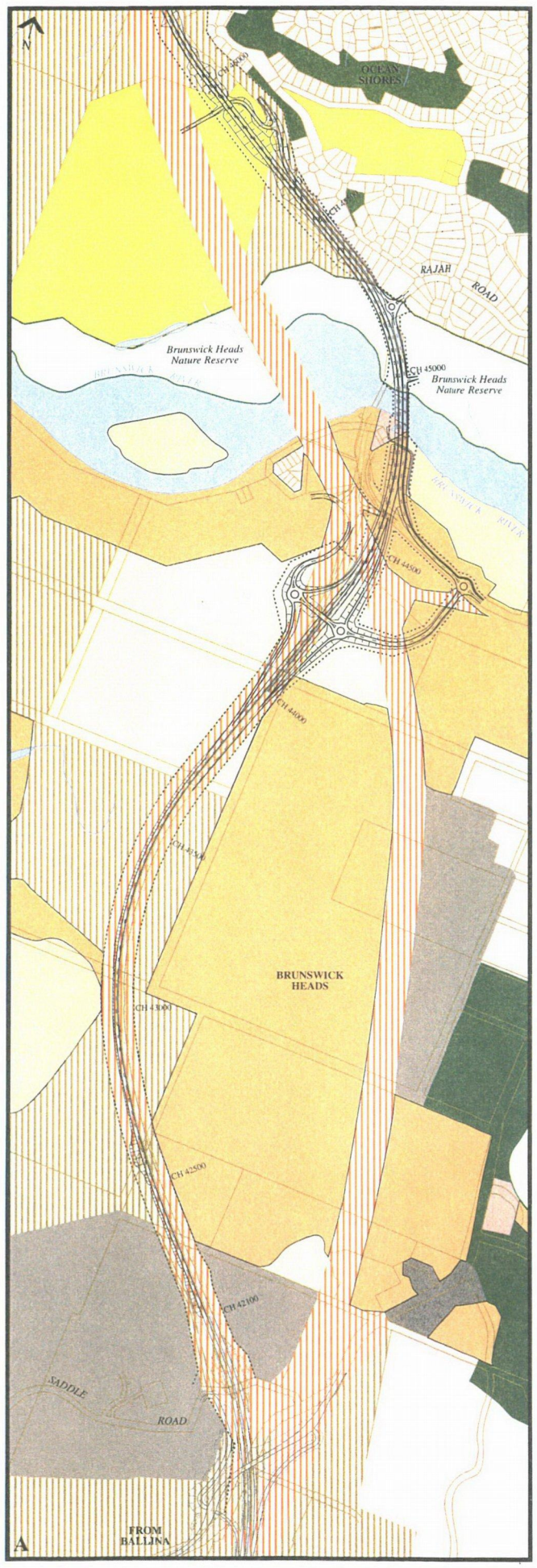
The REP aims to achieve strong town centres within the region as well as the promotion of tourist facilities. A safe and efficient Pacific Highway which separates local and through traffic is paramount to achieving these aims and objectives.

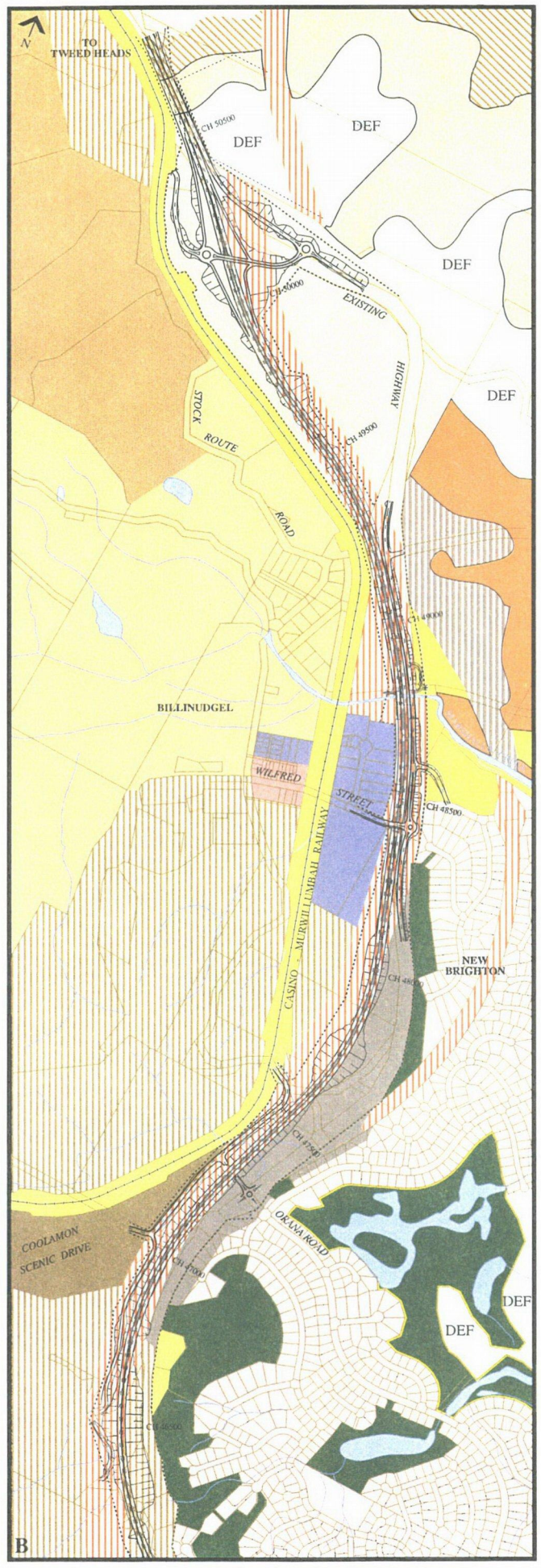
14.3.3 State Environmental Planning Policies

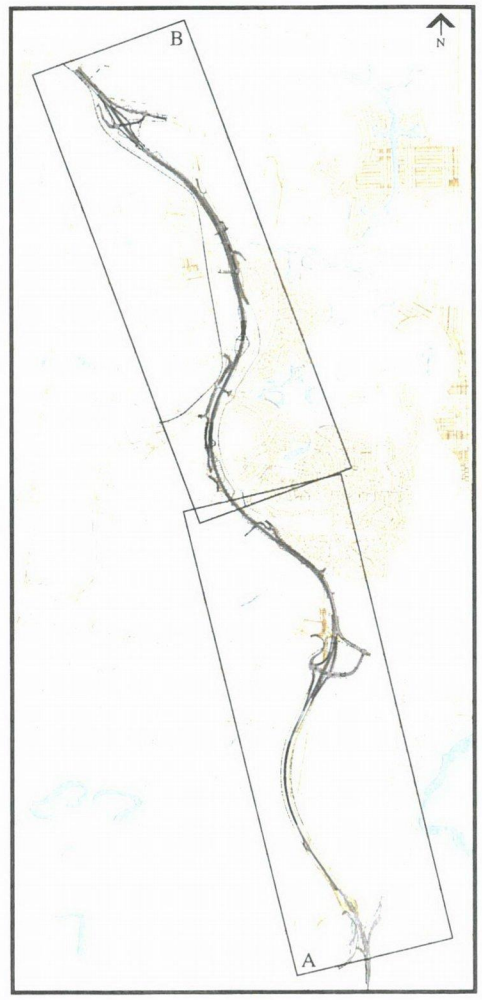
State Environmental Planning Policy No. 4

The provisions of State Environmental Planning Policy (SEPP) No. 4 - Development Without Consent apply to this project. This instrument allows for, *inter alia*, certain types of development by public authorities without the need for a Development Application, as long as that development is not prohibited under the local environmental planning instrument. The types of development that are covered are described in the policy. Clause 11C(2) - Classified Roads and Tollways, however, provides that development for the purposes of a classified road or tollwork can be undertaken without development consent from the local Council. The policy does not apply to land:

- where road development is permissible without consent in the local planning instrument;
- to which SEPP No. 14 - Coastal Wetlands applies (by agreement between the RTA and the DUAP);
- to which SEPP No. 26 - Littoral Rainforest applies;
- which is reserved under an environmental planning instrument for the acquisition for a public purpose such as open space.







Legend

1(a)	General Rural Zone
1(b1)	Agricultural Protection (b1) Zone
1(b2)	Agricultural Protection (b2) Zone
1(C2)	Small Holdings (c2) Zone
1(d)	Investigation Zone
1(d)	Investigation Zone (with Site Constraints)
2(a)	Residential Zone
2(t)	Tourism Area Zone
2(v)	Village Zone
4(a)	Industrial Zone
5(a)	Special Uses Zone
5(b)	High Hazard Flood Liable
6(a)	Open Space Zone
6(b)	Private Open Space Zone
7(a)	Wetland Zone
7(b)	Coastal Habitat Zone
7(k)	Habitat Zone
8(a)	National Park or Nature Reserve
9(a)	Proposed Road
	Hatching denotes land zoned 1(a) (General Rural) which has limited capability for development
	Buffer Area
DEF	Deferred
	Proposed Road Corridor

0 100 500m

Figure 14.2
LAND ZONING

State Environmental Planning Policy No.14

State Environmental Planning Policy No 14 - Coastal Wetlands (SEPP 14) aims "*to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the state*". Any activity which involves the clearing, construction of a levy, draining or filling of coastal wetlands may only proceed with the consent of Council and the concurrence of the Director-General of DUAP.

The provisions of SEPP 14, by virtue of Clause 4 (2) do not apply to land dedicated as a Nature Reserve under the provisions of the National Parks and Wildlife (NPW) Act. However, if the relevant part of the Nature Reserve is revoked to allow the proposal to proceed, the dedication under the National Parks and Wildlife Act would not apply and Council consent would be required to allow the works to be carried out.

There are three wetland areas gazetted under SEPP 14 in the immediate vicinity of the proposal, being Coastal Wetlands No.65, 62 and 57.

SEPP 14 Coastal Wetland No.62 is located on the northern shores of the Brunswick River, west of the existing highway and extends over the existing road reserve and into the Nature Reserve. A very small portion (just under 0.2 ha) of the eastern extremity of this wetland (where it abuts the existing highway and partly into the Nature Reserve) would require clearing and filling for construction of the proposal.

Coastal Wetland No. 65 is located on the southern shore of the Brunswick River, to the east of the existing highway. An estimated area of approximately 0.2 ha of Coastal Wetland No 65 would be directly affected (by clearing or filling) as a result of the proposal. Due to the scale of mapping of SEPP wetlands (1:25,000), it is difficult to define precisely the boundaries of the SEPP wetlands. A conservative approach has been adopted in the estimation of the affected area and the assessment of impacts.

The existing highway, north of Billinudgel, abuts Coastal Wetland No.57. In this vicinity, the proposal has been designed to avoid direct effects on the Billinudgel Nature Reserve which coincides at that location with the boundary of Coastal Wetland No.57. On this basis, the proposal would avoid Coastal Wetland No 57.

Development of the proposal in Coastal Wetland No.62 and Coastal Wetland No.65 would require consent under the EP&A Act by Byron Council, and the concurrence of the Director-General of DUAP. A Development Application is being lodged with Byron Council in respect of the proposal as it affects Coastal Wetland No.62 and Coastal Wetland No.65. The proposal is designated

development and an EIS must accompany the Development Application to Council. The relevant matters to be considered in respect of Clause 7 of SEPP 14 are summarised below and addressed at length in various sections of this EIS. Further details about the potential impact of the proposal on the wetland areas are contained in Working Paper No.7 - Flora and Fauna Assessment.

The matters to be taken into consideration are as follows:

- *the environmental effects of the proposed development, including the effect on the growth of native plant communities; the survival of native wildlife populations; the provision and quality of habitats for both indigenous and migratory species; the surface and groundwater characteristics of the site on which the development is proposed to be carried out and of the surrounding area, including salinity and water quality.*

  The potential environmental effects of the proposal are described in detail in Section 12. The vegetation communities to be affected in both Wetland No 62 and No 65 are predominantly mangrove forest (comprising Grey Mangrove *Avicennia marina* and River Mangrove *Aegiceras corniculatum*), with small patches of saltmarsh (comprising Saltwater Couch *Sporobolus virginicus* var *minor* and Saltwater Rush *Juncus kraussii* subsp. *australiensis*) and fringing areas of Swamp Oak (*Casuarina glauca*). These vegetation communities provide resources for a number of native fauna species, although only a limited number of species are capable of using mangrove forest communities. Development of the proposal in these wetlands would not threaten any native wildlife populations or degrade the quality of habitat.

  Both wetlands are entirely or largely tidal, and are thus characterised by high salinity, except during flooding of the Brunswick River and (for Coastal Wetland No 62, at least) during high rainfall events and subsequent freshwater discharge from the existing highway.

  Due to the difficulties in accurately defining the boundaries of SEPP wetlands, a very conservative estimate has been made for the area of wetland communities that would be removed for the proposed roadworks. These areas would be confined to the eastern extremity of Coastal Wetland No 62 and the western extremity of Coastal Wetland No 65.

  The areas of Coastal Wetlands No 62 and 65 which would or may be cleared for the proposal are of extremely limited extent and are already disturbed by the existing highway and/or by recreational activities, including human access, discharges from the existing road, previous and partial clearance, and some littering and weed encroachment.

  The loss of habitat for native fauna is not significant, given the very small extent of coastal wetland communities and resources which are to be removed, and the extent of these habitats and resources occurring in the locality.

- *whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment.*

  Sections 12 and 17 detail a number of environmental mitigation and management measures as integral to the proposal to ensure that the environment is adequately safeguarded. Furthermore, the proposal includes the commitment to rehabilitation of the foreshore area once the existing bridge over the Brunswick River is demolished, and to rehabilitating the saltmarsh area within the interchange on the southern side of the river.

  Construction protocols would require all construction activities to be confined to the road alignment itself, and that construction activities, personnel and vehicles must remain within the roadway alignment and not operate from beyond it. This approach would be adopted to ensure that any requirements for vegetation clearing are confined to the absolute minimum necessary.

- *whether the carrying out of this development would be consistent with the aims of this policy*

  The proposal has been located so as to have the minimal effect on the wetlands and additional compensatory habitat initiatives would be considered.

- *the objectives and major goals of the "National Conservation Strategy for Australia" insofar as they relate to wetlands*

  The proposal is limited to a very small area of the total SEPP 14 area and largely to areas that have previously been disturbed. There would not be an affect on the viability of the wetlands nor on species covered by any national or international treaties. Furthermore, the proposed saltmarsh rehabilitation together with the proposed future conservation of the much larger wetland (part of Coastal Wetland No. 62) area currently zoned for road purposes (in the LEP corridor) would more than offset any potential loss and secure a continuous wetland area on the northern side of the Brunswick River and on the western side of the Pacific Highway.

- *whether consideration has been given to establish whether any feasible alternatives exist to the carrying out of the proposed development*

  An extensive and rigorous process of route selection was undertaken for the proposal, as described in Section 5. While this option involves some minimal clearing of Coastal Wetland No 62 and Coastal Wetland No 65, it does so in an area where these wetlands are already affected by human activities. The LEP corridor proposal would have required a substantially greater area of clearing of Coastal Wetland No 62, approximately 1 hectare, compared with the 0.28 hectares of Coastal Wetland that is required by the current proposal. Other route options to the west, although in most instances avoiding designated coastal wetlands, would also have required substantially greater clearing of mangrove forest or other wetland communities than would be required for this proposal.

- *representations made by the Director-General of the National Parks and Wildlife Service in relation to the development application*

  The RTA has initiated a process of liaison with the NPWS in regard to the potential impact of the proposal on the Brunswick Heads Nature Reserve (which includes Wetland No 62) and in regard to a range of environmental measures which would be satisfactory to NPWP to ensure that the environment would be adequately safeguarded. The NPWS was represented at the VM workshop to assist in the selection of the preferred route and supported the recommendation for Route A2.

  As indicated elsewhere in the EIS, the proposal could only proceed on Route A2 with an amendment in the boundary of the Brunswick Heads Nature Reserve which could only occur following a legislative change initiated in the NSW Parliament by the Minister for Environment.

- *any wetlands surrounding the land to which the development application relates, and the appropriateness of imposing conditions to preserve or enhance the condition of those wetlands*

  The potential impact on adjoining areas has been minimised through the use of extremely tight design criteria in the vicinity of the Brunswick River, involving narrowing the roadway as much as possible and the use of vertical retaining walls rather than battered slopes.

  As indicated above, both wetlands are affected only on their margins and the majority of each wetland would remain unaffected. The implementation of the proposed environmental mitigation measures would assist in maintaining the integrity and function of these wetlands. Furthermore, the proposed water quality management measures have the potential to result in improved quality of water flowing into the wetlands, with subsequent enhancement.

  The area of wetland on the northern side of the Brunswick River (part of Coastal Wetland No. 62), currently reserved in the Byron LEP for road purposes, is approximately 1ha and of similar composition and condition to adjoining wetland areas in the Brunswick Heads Nature Reserve and SEPP 14 No. 62. As part of the proposal this area would be relinquished and could then be made available for inclusion in the Nature Reserve or for management for conservation purposes by another appropriate authority and could be rezoned accordingly.

  Given the above considerations, the proposal is considered to be the most appropriate option with regard to its potential impacts on coastal wetlands. The approach which has been adopted for this project involves restricting the clearing of coastal wetland communities to the minimum possible, affecting already partially disturbed wetland communities, implementation of design criteria and construction protocols intended to minimise the potential for any

adverse impacts, and has appropriately considered the options available. The proposed activity addresses the aim of SEPP 14, both in intent and in detail.

State Environmental Planning Policy No.26 - Littoral Rainforest
The vegetation affected by the proposal is not Littoral Rainforest, and the proposal is located further than 100m from the nearest mapped rainforest. SEPP 26 does not apply to the proposal.

State Environmental Planning Policy No.44 - Koala Habitat Protection
SEPP 44 has, as its aims and objectives, the encouragement of "*the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline...*". The Policy requires an assessment of whether land to which the SEPP applies is "*potential koala habitat*" or "*core koala habitat*". However, Clause 6 of SEPP 44 states that Part 2 - Development Control of Koala Habitats of the SEPP applies only to land "*in relation to which a development application has been made*", and under certain circumstances. The proposal requires a Development Application only in respect of those wetland areas covered by SEPP 14. Therefore, SEPP 44 does not apply to the proposal.

Even so, the presence of Koalas in the vicinity is described in the flora and fauna assessment. Measures to ensure the conservation of this species in the vicinity, have been incorporated in the construction and operation of the proposal.

14.4 Impact Assessment

14.4.1 Impact on Local, Regional and State Planning
The selection of Route A2 as the preferred route is consistent with Byron Council's long term planning strategies. The proposal uses part of the existing designated road corridor and, in most cases, it is in close proximity to the existing highway alignment. The remaining land is predominantly zoned for rural/agricultural purposes, and the RTA would seek to rezone the area required for the proposal as a road corridor under the provisions of the Byron LEP.

The proposal is consistent with the planning controls as they apply in the study area at the local, regional and state level. The exception is that part of the proposal that is within the Brunswick Heads Nature Reserve. This has been addressed in this document and the proposal, apart from approximately 0.6 ha required, would not result in any long-term impacts on the Reserve.

14.4.2 Impact on River Uses
The proposal would cut access used by oystergrowers to the boat ramp on the northern side of the river. Various options were investigated to provide limited

vehicle access the new bridge but it was concluded that providing for a vehicle access track would have required more clearing in the Brunswick Heads Nature Reserve area and this was considered unacceptable. This has been discussed with the affected oystergrowers, who are considering other options. It remains a matter for negotiation and resolution between the oystergrowers and the RTA.

14.4.3 Impacts on Future Urban Development Areas

The location of the proposal is consistent with planned future development within the study area. The proposal for the Billinudgel 2000 development is still under investigation by Byron Council.

The proposal has also been located at the eastern end of the Billinudgel industrial area so that any future development to the north, south or west can take place with no impact from the proposal. Although not linked directly to the proposal, any future development of this area would benefit from the proposal as it would divert heavy vehicle traffic from the existing highway to the proposal.

14.4.4 Property Impacts

As the proposal has been located predominantly on land in private ownership and not within the existing highway corridor, it is expected that there would be impacts to zoning and land use within the study area. These impacts, however, have been minimised by locating the proposal as close as possible to the existing highway, thereby reducing fragmentation impacts. The proposal has also been designed so that the existing highway facility would remain as a local road, predominantly for local traffic.

Prior to the commencement of this study the RTA owned land within the proposed road corridor, most of it in the area of the Brunswick Heads Bypass duplication. During the course of this study, the RTA purchased additional properties, at the request of the owners. The land affected by the proposal, in addition to land owned by the RTA, is shown on **Figure 14.3**.

The proposal would potentially directly affect 31 freehold properties, as shown in **Figure 14.3**. Each property would be differently affected, with the area of land required varying from significant, in the case of total property acquisition, to moderate where a smaller area of land would be required. There would also be changes to access, fences, and utilities.

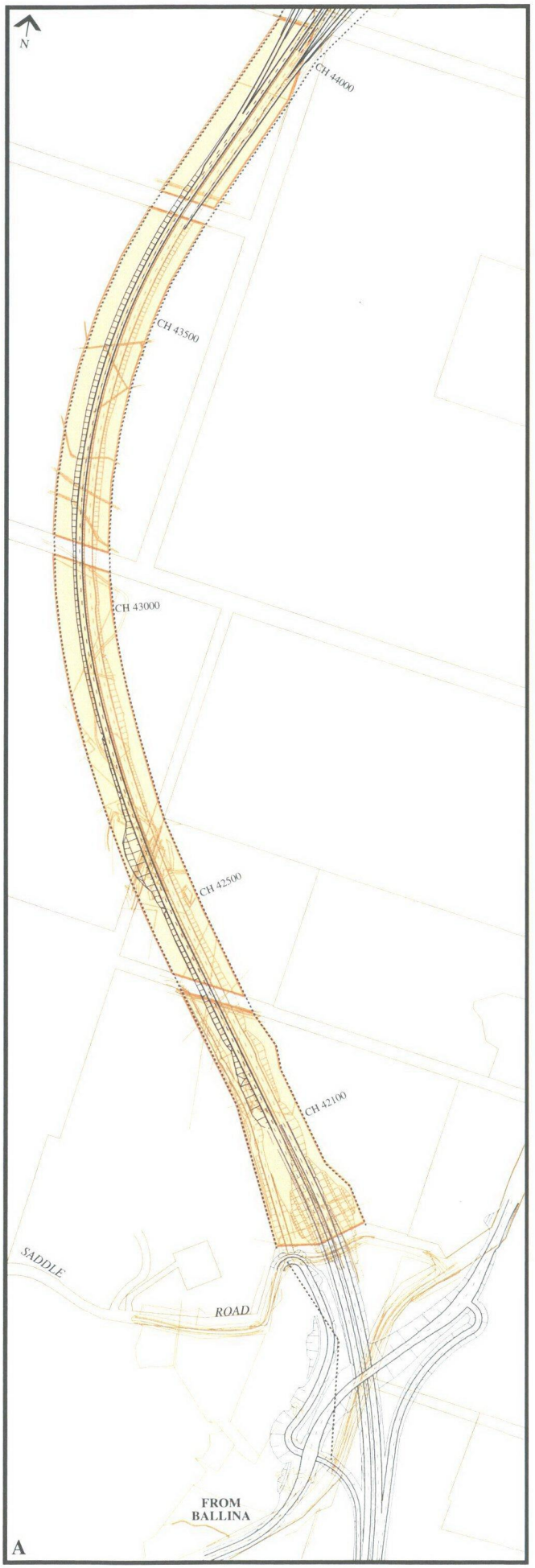
Where the proposal and the local service road are located in close proximity to each other in the section north of Rajah Road, it is proposed to construct a retaining wall. Depending on the type of retaining wall used in the section north of Rajah Road, there may be a need for an easement of support. This would be determined as part of the detailed design and would be subject to negotiation between the RTA and the property owners.

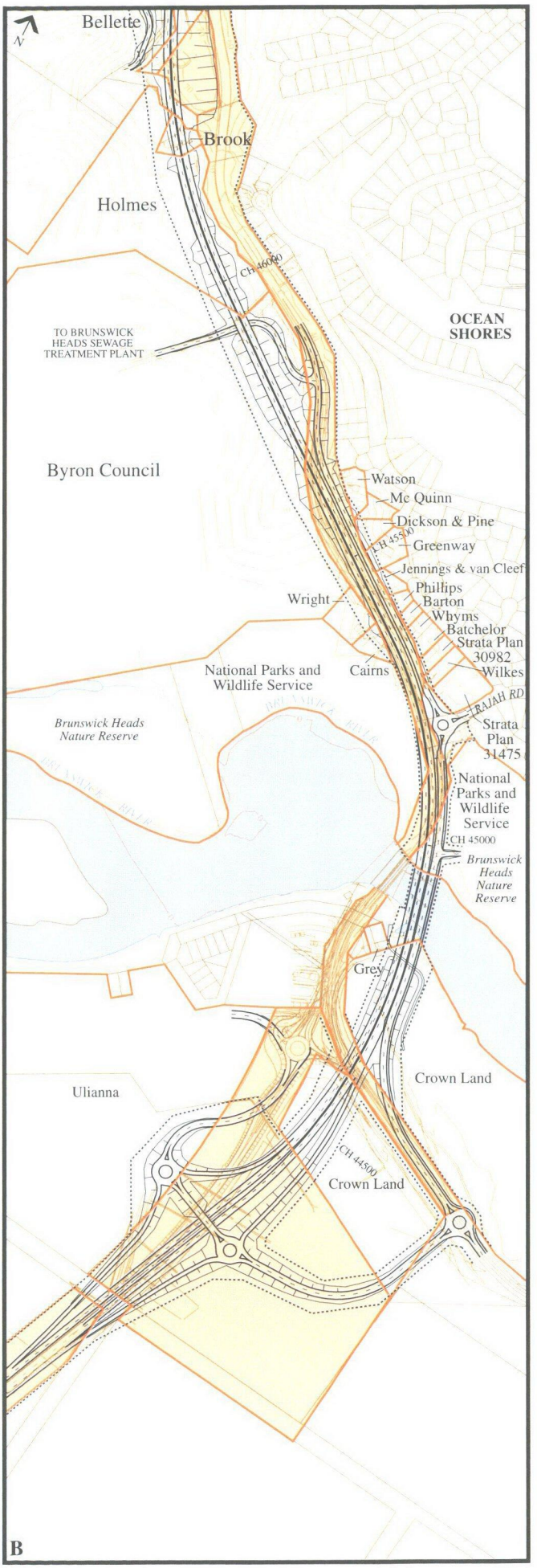
Properties that would be affected directly by the proposal based on the design indicated in **Figures 6.1a-d** are provided in **Table 14-1**, with properties listed as they are located north to south. This table is provided for the purposes of indicating the potential impact as it is currently understood, based on the concept design and discussions with property owners; precise impacts on properties would be confirmed by survey.

The RTA seeks only to acquire the land that is needed for the construction, operation and maintenance of the proposal. It is acknowledged that as a result of partial acquisition, the owner may consider that the property is no longer viable or that their amenity has been significantly and irreversibly affected. For all properties that are directly affected, the actual extent and terms of property acquisition would be negotiated between the property owner and the RTA and the information provided in this EIS would not preempt those negotiations.

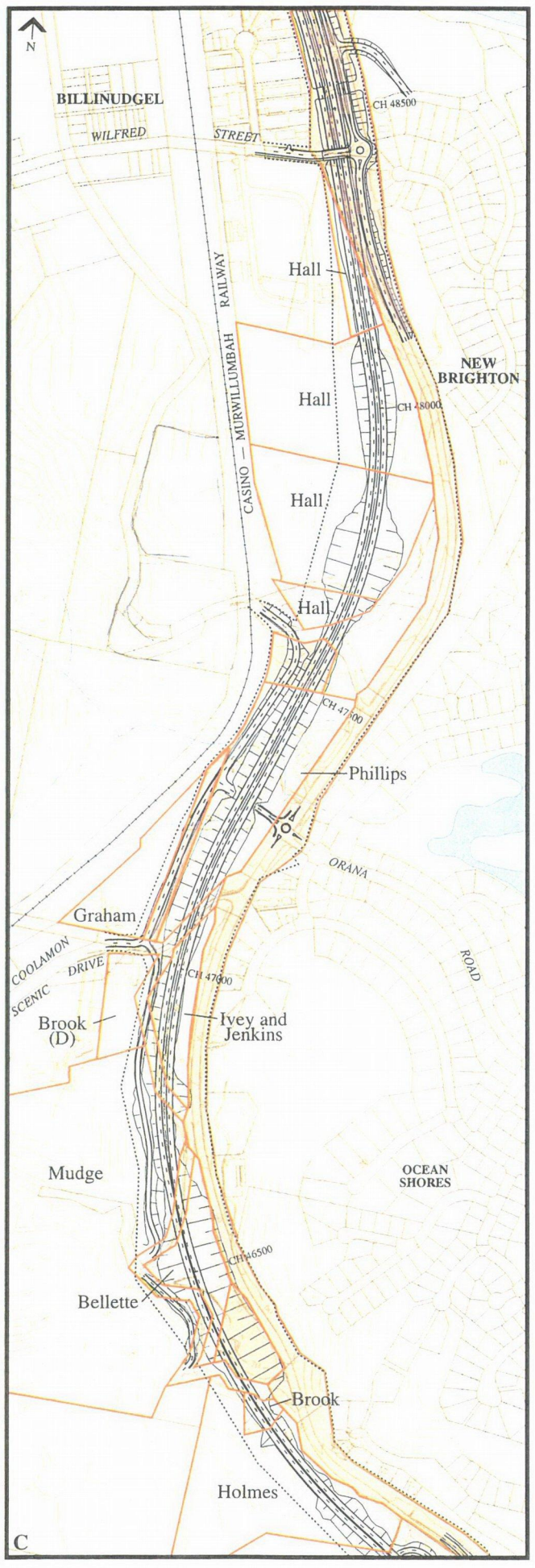
Table 14-1 - Description of Directly Affected Properties

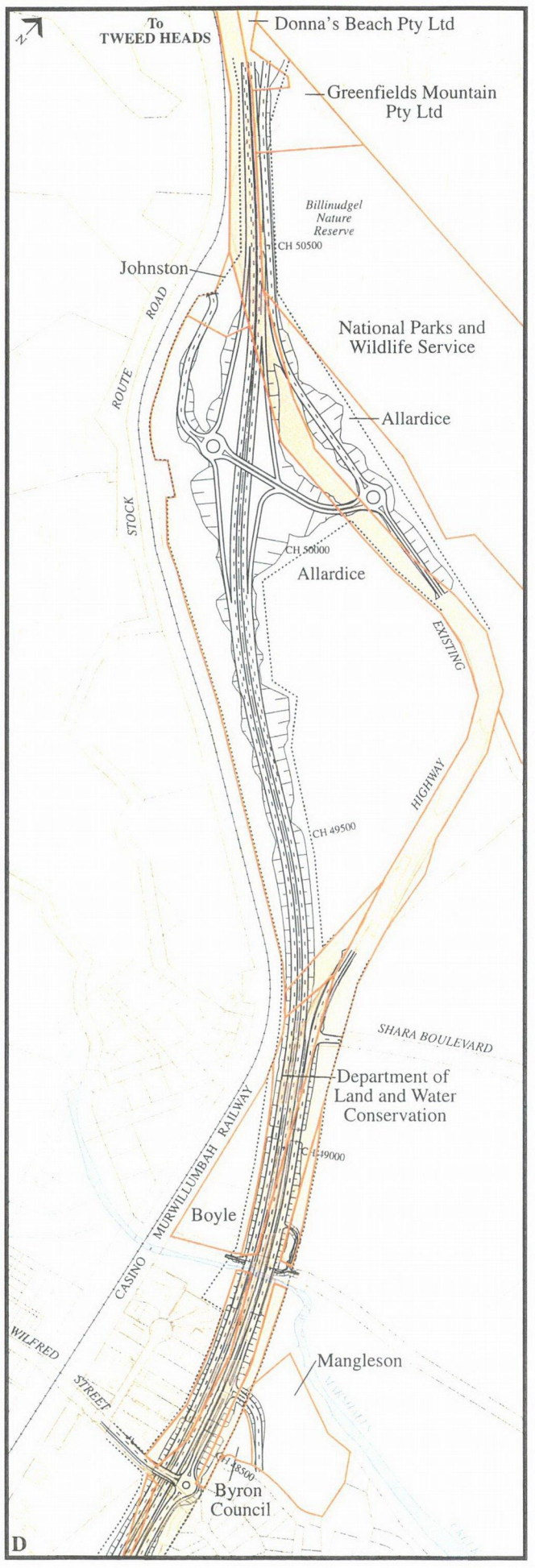
Owner	Summary of Potential Impacts on Property and Proposed Acquisition
Greenfields Mtn P/L/ Donna's Beach P/L	This rural property would be partially affected by the proposal; partial acquisition is proposed.
Johnston	This is a rural residential property with a dwelling and a workshop for a carpentry business; the effect on this property would be considerable and therefore total acquisition is proposed.
Allardice	This rural property is in a number of portions; the dwelling would not be directly affected; there would be considerable effect on the portion of land where the proposal would be located, but it is large property and the remainder may be viable; partial acquisition of the affected portion(s) is proposed; there would also be a need to provide a new access to the service road.
Boyle	Property adjustments would be required; access to the existing highway would be removed; access to be provided under the Marshalls Creek bridge, subject to negotiation with DLWC; access across the railway in wet weather and for high loads, subject to negotiation with SRA.
Mangleson	The proposed reconstruction of the "old" highway may result in changes to the connection with the local road and may require some property readjustment; this would be clarified during the detailed design stage.
Hall	This rural property is in a number of portions; the property including a dwelling would be considerably impacted on by the proposal; total acquisition of the affected portion(s) is proposed.
Phillips	This property is developed as a service station, shop and a caravan park; the proposal has a considerable impact on the property and therefore total acquisition is proposed.
Graham	A small part of this residential property would be affected by the proposed modifications to Coolamon Scenic Drive; partial acquisition proposed; property adjustments for access would be negotiated.
Brook	This is a property developed as a plant nursery business; it would be affected to a minor extent by the realignment of the local road; partial acquisition is proposed
Ivey	This property including two dwellings would be considerably affected; total acquisition proposed.
Mudge	A small part of this rural residential property would be affected; partial acquisition of affected portion(s) proposed.
Brook	This property including a dwelling and kennels would be considerably affected; total acquisition is proposed.

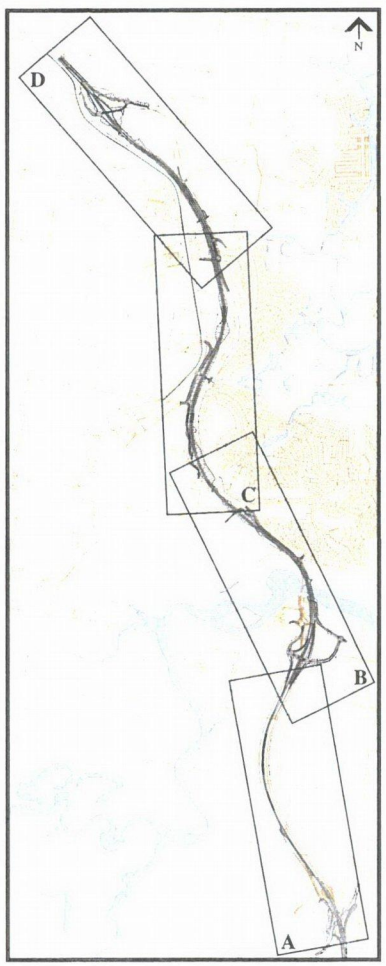

N
CH 44000
CH 43500
CH 43000
CH 42500
CH 42100
SADDLE
ROAD
FROM
BALLINA
A


N
Bellette
Brook
Holmes
CH 46000
TO BRUNSWICK
HEADS SEWAGE
TREATMENT PLANT
OCEAN
SHORES
Byron Council
Watson
Mc Quinn
Dickson & Pine
CH 45500
Greenway
Jennings & van Cleef
Phillips
Barton
Whyms
Batchelor
Strata Plan
30982
Wilkes
Wright
Cairns
National Parks and
Wildlife Service
RAJAH RD
Brunswick Heads
Nature Reserve
Strata
Plan
31475
National
Parks and
Wildlife
Service
CH 45000
Brunswick
Heads
Nature
Reserve
Grey
Crown Land
Ulianna
CH 44500
Crown Land
B

0 100 500m







Property owned by the RTA

Proposed Road Corridor

0 100 500m

Figure 14.3
EFFECTS ON PROPERTY

Owner	Summary of Potential Impacts on Property and Proposed Acquisition
Bellette	This rural property would be considerably affected by the proposal; total acquisition is proposed.
Holmes	A small area of this rural property would be affected; partial acquisition of the affected portion is proposed; in addition, the proposal would sever the potential southern access to one of the portions which has a separate title; future access arrangements would be negotiated between the RTA and the owner.
Byron Council	The proposed water management strategy would require the construction of a wetland on land owned by Byron Council to the north-east of the proposal, as well as access off the STP access road to enable maintenance; partial acquisition of the affected portion(s) is proposed; there would also be adjustments to Byron Council owned land arising from the construction of the roundabouts for Orana and Rajah Road.
Wright	This property, including the dwelling and carpentry workshop would be considerably affected; total acquisition is proposed.
Cairns	This is a residential property; the property including the dwelling would be considerably affected; total acquisition is proposed.
Watson	This is a residential property; the dwelling would not be directly affected; a small area of this property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
McQuinn	This is a residential property; a small area of this property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
Dickson & Pine	This is a residential property; the dwelling would not be directly affected; a small area of this property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
Greenway	This residential property would be affected by the proposed relocation of the existing highway; the dwelling would not be directly affected; partial acquisition is proposed.
Jennings & van Cleef	This is a residential property which would be considerably affected by the proposed relocation of the existing highway; total acquisition is proposed.
Phillips	A small area of this vacant property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
Barton	This is a residential property; the dwelling is not directly affected; a small area of land adjacent to the existing highway would be affected by the proposed relocation of the highway; partial acquisition is proposed.
Whyms	A small area of this vacant property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
Batchelor	This is a residential property with three units; the proposal would affect a small area of that part of the property adjacent to the existing highway, but not the dwellings; partial acquisition is proposed.
Strata Plan 30982 (numerous owners)	This is a residential property with a block of home units; a small area of the property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed; The RTA would negotiate with the owners of the strata plan regarding the use of part of the rear of the property during construction - after construction the RTA or its contractor would restore the land not required as part of the road corridor, potentially resulting in an improved situation for this property.
Wilkes	A small area of this vacant property would be affected by the proposed relocation of the existing highway; partial acquisition is proposed.
Strata Plan 31475 (numerous owners)	This is a residential property with a block of home units; a small area of this property would be required as a result of the construction of the roundabout at Rajah Rd; partial acquisition is proposed.
Grey	This property would be affected by construction of the new bridge embankments and by the land required for the road corridor; because of the considerable impacts on the commercial nature of this property total acquisition is proposed.
Ulianna	A small part of this rural property would be affected by the western part off the interchange south of the Brunswick River; partial acquisition is proposed.

It is understood that a section of Coolamon Scenic Drive/Banana Road may be a private road. This would be established during detailed boundary survey.

There would also be a direct effect on lands owned and managed by NPWS and DLWC. It is anticipated that the terms of the transfer of the areas affected of these lands to the RTA would be a matter for negotiation between those agencies and the RTA.

14.5 Land Acquisition

Land would be acquired for the proposal in accordance with the procedures outlined under the Land Acquisition (Just Terms Compensation) Act 1991. The RTA's Land Acquisition Policy reflects these procedures. The policy sets out the procedures for partial acquisition and the special conditions which apply to acquisition, compulsory acquisition and hardship acquisition. The RTA would seek to purchase the land required for the proposal in much the same way as private land sales are undertaken, whereby compensation is assessed by having regard to the market value of the property as if it were unaffected by the proposal. The purchase price would be negotiated with the property owner to establish an agreement satisfactory to both parties, and the RTA would allow for compensation as a result of the impact of the road on the property. There is no appeal against acquisition, but provisions exist for appeal to the Land and Environment Court regarding compensation.

Where partial acquisition of a property is necessary, the RTA would purchase the affected portion of the property. In these cases, the RTA would be responsible for the reconstruction of fences, driveways and landscaping to a standard similar to existing, and for the relocation of utilities, if necessary.

If and when the proposal is approved the acquisition process would be initiated, based on a detailed land survey undertaken along the road corridor. Where a property is affected, the owner would be informed as to when the land would be required for roadworks. In addition, a valuer representing the RTA would make arrangements to commence negotiations. If the owner engages a registered valuer and solicitor, the RTA would reimburse reasonable fees.

The compulsory acquisition process is an option available to property owners and the RTA for resolving problems associated with land acquisition. It enables a property owner to have to access an independent assessment of compensation by the Valuer General if an agreement cannot be reached with the RTA.

It is anticipated that the proposal may be approved by the end of 1998. If this occurs, the RTA would commence negotiations for property acquisitions early in 1999. The RTA has planned for 12-15 months for this process.

14.6 Mitigation of Impacts

When properties have been acquired, but only part of the property is affected by the proposal, the remaining part would be resold as it is, or consolidated with other portions and sold. Any rezonings which may be required to facilitate this consolidation and resale would be instigated by the RTA.

It would be necessary, as part of the detailed design phase, to confirm suitable access arrangements with individual property owners. Preliminary discussions have already been held with current property owners in this regard, and their requirements, as they are currently understood, are reflected in the design of the proposal.

15. Visual and Landscape Assessment

The visual qualities of the landscape are the basis of our scenic amenity. Scenery is important, as part of the community's residential, recreational and general amenity. The north coast region is renowned for its beautiful and dramatic landscape. Although the preferred route has been located in a landscape which has been already disturbed and fragmented by road and urban development, the proposal still has the potential to result in a significant effect on the local landscape. A visual and landscape assessment was undertaken to identify the visual impacts of the proposal and to develop visual and landscape strategies which would be implemented to minimise impacts so that, ultimately, the proposal is integrated into the local landscape. The strategies are presented in the form of a landscape concept plan. Full details of the visual assessment are contained in Working Paper No.9 - Visual Quality and Landscape Assessment.

15.1 Introduction

As described in Section 4, the route evaluation process considered the potential impacts of the various options on the landscape. While visual impact was not a deciding factor in route selection, it was considered that routes located further west than the preferred route would have greater impacts on vegetated areas, and would result in significantly deeper cuts, both of which would have consequently increased impacts on the landscape. However, this is not to imply that visual considerations are not important with respect to the preferred route and they have been thoroughly evaluated for the proposal.

The purpose of the visual assessment study was to define the status of the scenic amenity and determine the visual effect and the impact of the proposal on this environmental value. The visual impact of the proposal is determined by combining the visual effect of the development and the visual sensitivity of users on the surrounding areas.

15.2 Visual Interaction

Visual effect is the expression of the visual interaction between the proposal and the existing visual environment. This can also be expressed as a level of visual contrast between the proposal and its visual setting. To establish the level of visual effect, both the proposal and the existing visual environment have to be evaluated.

Visual sensitivity is a measure of how critically a change to the landscape would be viewed from various areas. Many factors influence this, including viewer activity, angle of view, distance from viewer, extent of view time and viewer perception.

Visual impact is determined by considering both the visual effect and the visual sensitivity. Various combinations of visual effects and visual sensitivities would produce high, moderate or low impact levels.

Visual treatments are developed to mitigate the visual impacts of the proposal and include treatment of cut and fill batters, visual effects of structures as well as treatments to decrease the linear effect of the road on existing landscape patterns. Landscape treatments are also intended to lessen the visibility of the proposal from critical view areas.

15.3 Existing Visual Environment

The landscapes adjacent to the proposal create a mosaic of visual settings. South of the Brunswick River the proposal crosses a low plain. This plain supports many remnant estuarine vegetation communities. The Brunswick River is a major visual and landscape element along the route. It creates a visual and recreational focus in the area.

After crossing the Brunswick River the proposal rises to a saddle on the ridge which separates Brunswick River and Marshalls Creek catchments. It then drops to the Marshalls Creek Valley floor before gently rising to the Yelgun Ridge.

Marshalls Creek has a less dramatic landscape, with fewer open water areas surrounding the proposal than the Brunswick River. The vegetation along the flood plain creates a strong edge on the eastern side of the existing highway, while it has been cleared to the west. In the vicinity of the proposal, agricultural uses occur on the flood plain, creating an interesting landscape pattern.

Topography is gently undulating and varies in elevation from less than 5 m above sea level (ASL) to 70 m ASL. The steep ridge areas of Brunswick Heads Nature Reserve, on the northern banks of the river provide strong enclosure, and visual contrast to the river and the adjoining river flats. Further west, the topography becomes steeper and the degree of vegetation cover increases, which forms a dramatic backdrop. Seen together, the topography, the vegetation and various water views create attractive and diverse landscape settings adjacent to the proposal corridor.

Topography would have a significant influence on the visual effect of the proposal through its ability to screen sections of the road, particularly for many elevated locations in Ocean Shores where there are views over the existing highway, to the river and beyond. Land use and land cover are also important considerations in terms of the opportunity to integrate the proposal with the surrounding environment.

Brunswick Heads urban area is totally screened from the proposed duplication of the Brunswick Heads Bypass. The Ferry Reserve Caravan Park is located on the southern bank of the Brunswick River (on the western side of the existing highway). A commercial building currently occupied by two restaurants is located on the eastern side of the highway.

The urban areas of Ocean Shores and New Brighton are located on the eastern side of the existing highway extending from Rajah Road in the south to the village of Billinudgel to the north. There is a small industrial estate at Billinudgel which is located close to the existing highway and would be close to the proposal. This area supports a range of light industrial buildings and commercial facilities.

There are a number of rural residences within the areas adjacent to the proposal. These residences are often in elevated positions and therefore have views of the surrounding landscape. The main area of rural residential development is adjacent to Coolamon Scenic Drive, with smaller areas occurring around Billinudgel and Yelgun.

Open rural lands are located around Billinudgel. These areas are gently undulating and support scattered trees within open grassland.

Forests and woodlands are a significant land cover type throughout the study area. These areas are mostly located along both sides of the Brunswick River leading north along the western side of the Pacific Highway to the Casino-Murwillumbah Railway line and include the Brunswick Heads Nature Reserve and the Billinudgel Nature Reserve. Other scattered areas of dense vegetation occur on major ridgelines and within rural lands adjacent to the proposed alignment.

The major road through the area is the existing highway. Other roads can be divided into two categories, those that give access to beach side residential areas and those that give access to the hinterland. Coastal access roads include Rajah Road, Orana Road and New Brighton Roads. Rural roads include Banana Road, Saddle Road, Coolamon Scenic Drive and The Pocket Road.

15.4 Visual Character and Effect of the Proposal

The corridor essentially follows the alignment of the existing highway, slightly to the west. The visual effect of the different sections of the proposal were determined on the basis of the interaction of the proposal with the landscape and the degree of contrast that would be created.

The visual effect of the proposal would generally be low to moderate where it is located in close proximity to the existing highway and it is not in major cut or fill or supporting a major structure such as an overpass. However, there are some

major features of the proposal that would have greater visual effects due to the large-scale road structures that are proposed which would contrast strongly with the existing surrounding environment.

These structures include the following:

- new bridge over the Brunswick River,
- section of the proposal to the west of Ocean Shores in the vicinity of Rajah Road;
- underpass for the road leading to the Brunswick Heads STP;
- proposed overpass linking Billinudgel with New Brighton and Ocean Shores;
- proposed interchange facilities south of the Brunswick River and adjacent to the Ferry Reserve Caravan Park, and at Yelgun; and
- major cut and fill areas.

The visual effects of these structures are described below:

Brunswick River Interchange
The visual effect of this interchange would be high because the line, shape and overall scale of the development would contrast strongly with the existing open landscape and the existing road pattern.

Brunswick River Bridge
The new six lane bridge would be a major structure in the landscape. The visual effect of this structure would be high, as it would create a strong contrast to the scale, shape and form of the present bridge and the small river setting in the locality of the bridge crossing. It should be noted, however, that the existing bridge is proposed to be demolished as part of the proposal resulting in only one crossing point of the Brunswick River which would minimise the visual effect to some extent.

Local Road Configuration in the Vicinity of Rajah Road
The scale of the proposal, including the existing highway (which would be transformed to a local road as part of the proposal), vegetation clearing, cuttings and retaining walls would have a high visual effect on the local setting, compared with the present setting that only supports the existing, two lane highway.

Local Road Underpasses
The visual effect of proposed underpasses for the access road to the Brunswick Heads STP and for Coolamon Scenic Drive would be moderate. This effect is based on the modification of landform caused by the moderate fill embankments that would be required and the ability of the adjoining landscape to visually integrate this development.

Overpass at Billinudgel
The visual effect of this overpass would be moderate given its proximity and elevation with respect to the proposal and the existing highway and the industrial area.

Yelgun Interchange
This interchange occurs in open hilly terrain and would create a major change by introducing numerous new lines and shapes into the existing open rural landscape setting. The visual effect of the interchange would be high, due to the extensive modification of the hilltop area that would be required.

Areas Requiring Major Cutting
There are two major cut areas, one located to the north of the access road to the STP and the other to the south of Billinudgel. These cuts are generally between 10-25m deep with some points up to 30m deep. These cuts would introduce a major change to the form of the hills on which they occur by introducing new shapes and colour into the landscape. The visual effect of these two cuts would be high in terms of the effect on landform, and the introduction of new shape and colour.

15.5 Visual Interactions and Impacts

A number of visual management units have been defined along the length of the proposal as shown on **Figure 15.1**. Each unit contains certain landscape and land use characteristics that would result in a general range of visual interactions with the proposal that are typical throughout the unit. The visual management units are described and evaluated in **Table 15-1**.

Table 15-1 - Evaluation of Visual Management Units

Visual Management Unit	Description	Visual Effect	Visual Use	Visual Sensitivity	Visual Impact/Treatment
Brunswick River Floodplain	The highway bypass duplication, from the Tandys Lane interchange into Brunswick Heads to the river.	Low for most of this section.	Viewed by few residences. Views from Ocean Shores are in the middle distance.	Generally low. The few residences that can see the area would have a high sensitivity. Views from Ocean Shores have moderate visual sensitivity.	Generally low to moderate.
Brunswick River	The Brunswick River area and bridge.	High	Uses include residential, commercial and recreation. Restaurant would have direct views to the bridge. Area visible from Ocean Shores.	The existing highway and bridge mostly are more visible than proposed road and bridge. Moderate sensitivity, but high in relation to views from restaurant and a few residences.	Initial impact would be high. Treatments reinforce entry into Brunswick Heads and consider form of bridge in context of the river and longer views onto it.
Ocean Shores	VMU has Ocean Shores residential development on the east and vegetated areas on the west. Includes the proposal and the realigned local road, parallel to it. For much of this section the proposal would be at a lower level than the local road and is separated from it by a retaining wall up to 10m high	The major view area is the housing within the Ocean Shores south of Tongarra Drive; also include some rural residential. Would also be viewed from the caravan park and adjoining waterfront reserve areas on the south side of the River.	Visibility of the road in this section from residences in Ocean Shores would be limited as most residences would look over the proposal to the river and to views beyond.	The visual sensitivity of the residential areas, both urban and rural is high. However the visibility of the proposal would be limited to a small number of houses.	The visual impact of the section would be mostly moderate. Where the large cuts and or retaining walls are seen from the residential areas, the impact would be high. Treatments, including revegetation of cut batters, aim at screening the view of the highway while retaining longer distant views. This should also soften the visual effect of the retaining walls and cuttings.
Brunswick River / Marshalls Creek Ridge	The ridgeline dividing the Brunswick River and Marshalls Creek catchments.	High. The cutting would be visible from areas to the south and from the Lookout. A few houses along Tongarra Drive could view the cutting but they are generally orientated to the ocean views to the northeast.	Rural residents and road users on Scenic Drive to the north may also have views of the area, but views would be restricted to viewers to the east and west of the road as the cutting would be below sight lines across the ridge.	The visual sensitivity relates to river area and water based recreation, having a moderate sensitivity. Views from the lookout would be have a high sensitivity, as views are the primary function of visits to the site.	High visual impact on foreshore areas. Visual treatment, including revegetation, should aim at reducing the effect of the cutting on landform and colour/texture values of the cutting's earth and rock compared to adjoining vegetation.

Visual Management Unit	Description	Visual Effect	Visual Use	Visual Sensitivity	Visual Impact/Treatment
Coolamon Scenic Drive Valley	Approximately 1km of the proposal, generally on embankment of less than 5m. The proposal would create minor visual foreshortening of the valley.	The valley is predominantly used for small acre farming and rural residences.	Effects would be localised. There are some houses overlooking the new alignment in elevated areas in the southeastern part of the valley.	The visual sensitivity of this area is high, due to the dominance of rural residential lands in the lower part of the adjoining valley and the potential over-viewing from residences that have elevated positions in the valley.	High. Treatments would aim at reducing the unnatural enclosure created by the embankment and reduce the impact of the cutting by removing colour contrast and also using vegetation to help improve residual form effects.
Billinudgel	The proposal is on minor fill. Includes an overpass linking Billinudgel and Ocean Shores. Proposal close to industrial and commercial area.	Low, as there are only minor earthworks and the road is in close proximity to the existing highway, rail line and industrial area.	The visual use of the area is limited from sensitive areas. Ocean Shores is screened by vegetation.	Generally low. Minor exceptions are the few rural residences overlooking the road corridor.	Low. Treatments aim at general integration of the road into the landscape and establishing an entry into Billinudgel.
Yelgun	The northern end of the proposal and the location of a major interchange.	The visual use of the area is generally low, however it would be seen from a limited number of localities. Views of the interchange would potentially be visible from more distant locations such as Billinudgel.	Effects would be localised. There are some houses overlooking the new alignment in elevated areas in the southeastern part of the valley.	Generally low, however views from a few residences would be moderate to high.	Moderate overall, but high when is viewed from adjoining rural residences. Treatments aim at integrating the roadway structures in dense forest planting that would assist in reconstituting the hill.

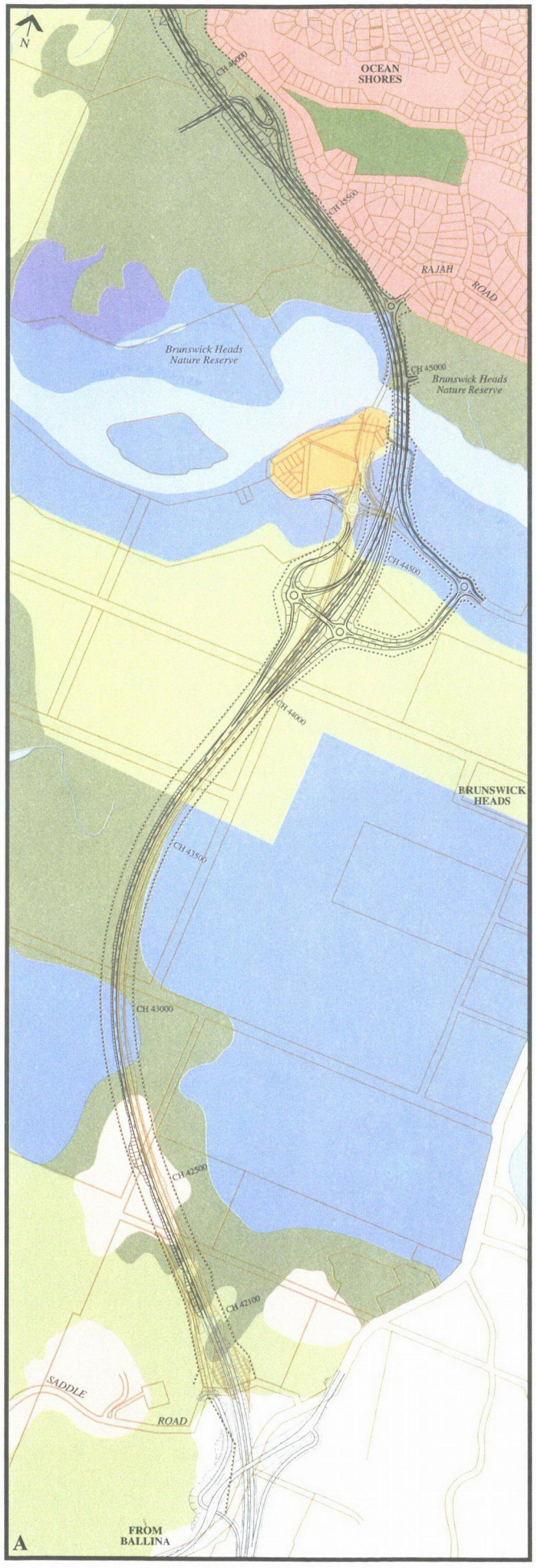
15.6 Landscape Mitigation Measures

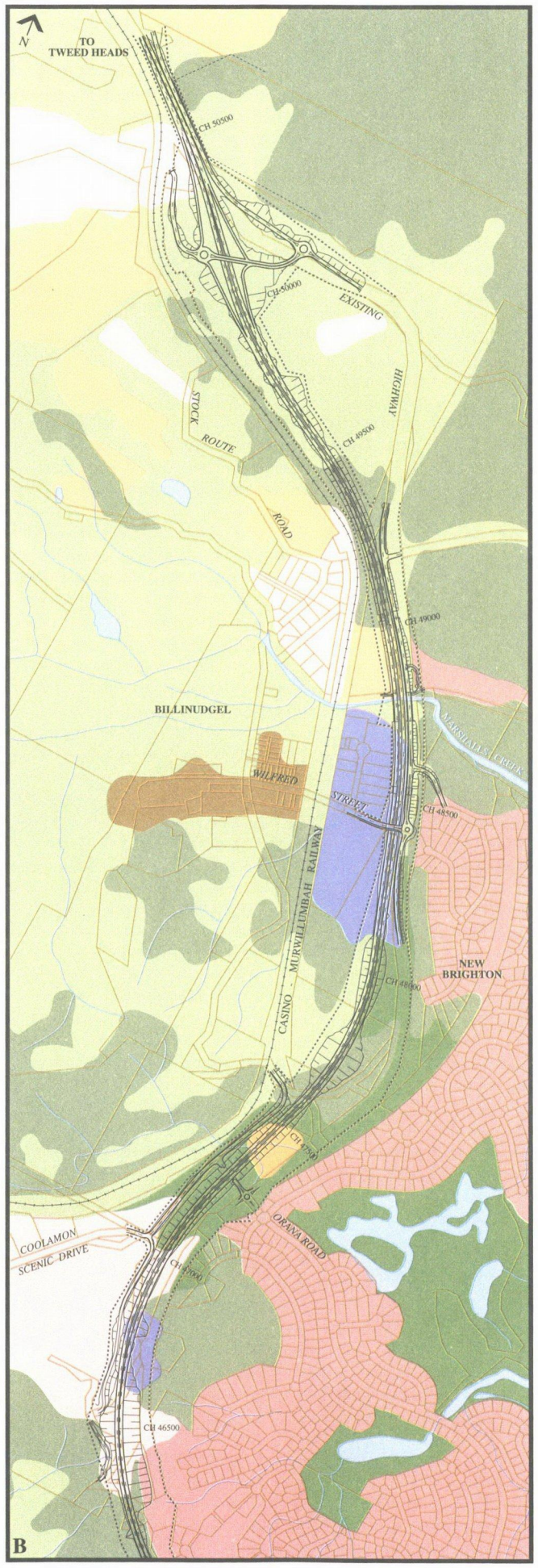
15.6.1 Landscape Principles and Treatment Types

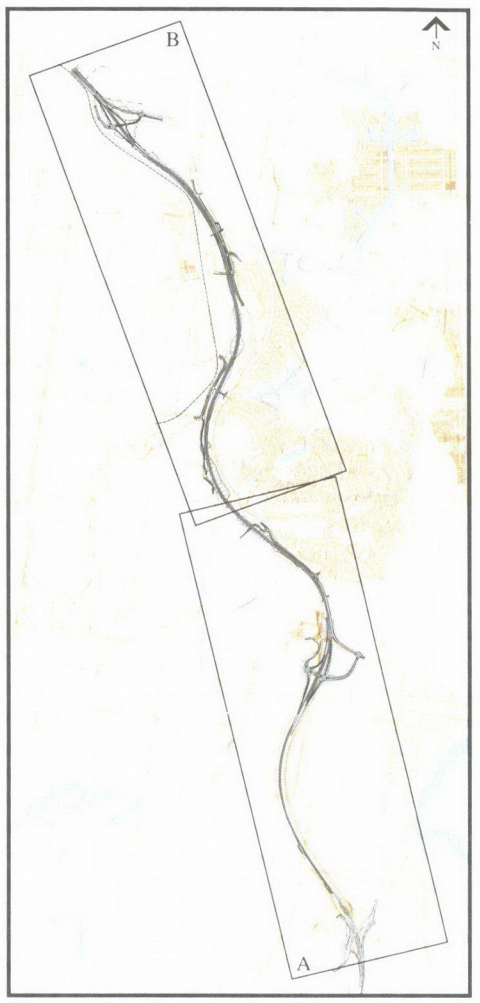
Landscape principles provide the basis for minimising the visual impact of the proposal, as well as increasing its integration into the local landscape setting. Landscape treatments and design considerations recognise the proposal as a part of the cultural landscape and seek to achieve a visual fit of this new element into the existing landscape. Features such as the bridges and interchanges are therefore considered in terms of the opportunities they create as gateways to the destinations of Brunswick Heads and Billinudgel.

The proposal would be constructed by a contractor commissioned by the RTA. The contract applying to the design and construct phase would include detailed specifications which define the "performance criteria". These would include, *inter alia*, specifications relating to landscape treatments and architectural finishes. This study has developed the basic principles, treatment types and a landscape concept plan which would form the basis for the detailed landscape and design plan. The landscape concept plan is based on the following principles:

- generally indigenous and native planting materials are to be used. However in certain cultural settings, e.g. town entry points such as for Brunswick Heads, exotic, non-invasive plant species may be used where landscape designs have been developed with the community;
- revegetation would achieve one or more of the following functions:
  - screen views of the proposal from various sensitive locations;
  - where screening is not possible or effective within the road reserve, complement roadside treatments with planting at the sensitive viewing location, e.g. around a rural residence;
  - reduce negative visual effects and visual contrast of various road elements, e.g. colour and form contrasts of cut and fill embankments;
  - visually integrate the proposal into the landscape; and
  - complement bridge approaches and overpass elements to create a strong visual setting that would enable visual balance between natural elements and the built elements of the proposal;
- apply treatments to extensive areas of concrete retaining walls to improve the visual quality of these elements;
- ensure that elements such as guard rails are well sited, designed and finished to achieve the best visual solution for these elements, provided these are also consistent with safety requirements; and
- where elements such as a retaining wall and guard rail are used together ensure that they are designed as an integrated element, not just as a collection of separate elements. provided these are also consistent with safety requirements.







Legend

- Residential Areas
- Dense Vegetation and Woodland
- Open Grassland and Grazing Land
- Open Space/Recreation Areas
- Crops
- Rural Residential Areas
- Industry and Infrastructure
- Commercial Areas
- Wetlands
- Rural Village
- Proposed Road Corridor

Note: approximate boundaries of units have been shown - see Working Paper No. 9 for more detailed information.

0 100 500m

Figure 15.1
VISUAL MANAGEMENT UNITS

Within the context of these principles, a range of landscape treatments have been designed to achieve the visual integration of the proposal into the existing landscape and its visual impact on adjoining land uses. These treatments respond to the range of visual effects created by the proposal as well as to the need to screen it from visually sensitive areas and integrate it into the landscape as a major infrastructure element.

Treatment 1: Urban Area Screening

Some houses in Ocean Shores, in the vicinity of Rajah Road, would be screened from the proposal. Low planting would be established to retain long distant views to the west, while also having the effect of blocking views to the proposal.

Treatment 2: Rural Residential Screening

In some areas isolated rural residences are visually exposed to long lengths of the proposal. In addition to integration planting along the proposal corridor, consideration would be given to supplementary revegetation within residence gardens to screen or break up views of the proposal, but not other desirable elements of the view. Any such revegetation would only be undertaken with the agreement of the property owner and would be subject to negotiation between the property owner and the RTA.

Treatment 3: Fill Embankment Stabilisation

Fill embankments create visual form and colour contrasts with the existing landscape settings and treatments would lessen and soften this contrast, as well as achieving batter stabilisation. Planting of shrubs, hydromulching and straw mulching and hydroseeding of suitable small trees and ground covers would provide a stabilising cover to prevent erosion.

Treatment 4: Cut Embankments

Cut embankments also create form and colour contrast with adjoining landscapes. The scale of some of the cuttings, up to 30m deep and up to 400m long, is a major consideration. The cuts would have benches 4m wide, spaced at 10m intervals. The benches have a dual purpose of providing access for road maintenance, but they would also be planted with ground cover and shrubs to soften the appearance of the cut. Hydroseeding, hydromulching and straw mulching of the cut embankments would be undertaken as early as possible during the construction period to stabilise the banks, and also to ensure that some of the landscaping is established on opening.

Treatment 5: Open Rural Landscape Planting

The rural landscape is attractive and enhances the view from the proposal. Where there are no sensitive areas viewing the proposal, the landscape would be based on an open treatment. This would comprise a suitable low growing exotic grass mix or low level native shrubs to provide a ground cover, although a maintenance free

grass cover is more in keeping with the rural setting. Tree clumps would be planted at irregular intervals or at various existing landscape points (drainage lines, spurs, fence intersection points, etc.).

Treatment 6: Creek and Wetland Planting

Impacts on creeks and wetlands should be minimised by defining the extent of earthworks and fencing off these sensitive areas from construction traffic movement and general construction impacts.

Revegetation on embankments would be reinforced with species endemic to the area. Revegetation may, if necessary extend beyond the proposed road reserve. The permission of adjoining property owners would be sought to replace trees that are removed during road construction and which cannot be replaced within the road corridor.

Treatment 7: Gateways

Entry points into Brunswick Heads and Ocean Shores/Billinudgel would be punctuated with landscape treatments that contrast with other landscape treatments and that of the existing landscape. Such an effect could be achieved by planting large specimen trees in large formal groupings and planting patterns.

This planting could provide an attractive gateway signage to the town. One idea for a gateway treatment for Brunswick Heads is presented as part of the landscape concept plan (Section 15.6). However, the final decision about the location and form of such "gateway" treatments is one which requires community input and would be subject to discussion and liaison between the RTA, Byron Council, property owners and the community.

Treatment 8: Major Structures

Revegetation adjacent to large structures such as overhead bridges and roundabouts would include mass planting of suitable sized vegetation to ensure that visual integration is achieved. Revegetation would not necessarily aim to screen the structure, but rather provide a large-scale natural element to balance and even dominate the hard edge, mass and shape of the road structure.

The new bridge could be a positive element in the landscape of the Brunswick River through various landscape treatments. The final design of the bridge would be undertaken as part of the detailed design stage of the proposal. As mentioned earlier, the RTA would prescribe the design goals that have to be met by the contractor and these would relate to elements such as the bridge decks and piers, parapets and railings.

Treatments for local road underpasses would create a lead into the viaduct and assist in softening views to fill embankments. Avenue planting would be

established. Treatments for local road overpasses would establish a local road gateway treatment, with formal well-detailed landscape treatments.

Treatments for interchanges need to be developed in accordance with safety requirements while also providing good visual views to the driver. Treatments for interchanges include large plantings of trees to give the surrounding landscape visual strength.

Treatment 9: Noise Abatement Structures
Where noise abatement measures are required and there is sufficient space, the preference is to use earth mounding. Where there is limited space, noise barriers/walls would be constructed and screened with vegetation. In the vicinity of Ocean Shores, the opportunities for screening are limited and any noise abatement barriers in this area could also incorporate artwork to add visual interest and minimise adverse visual impacts.

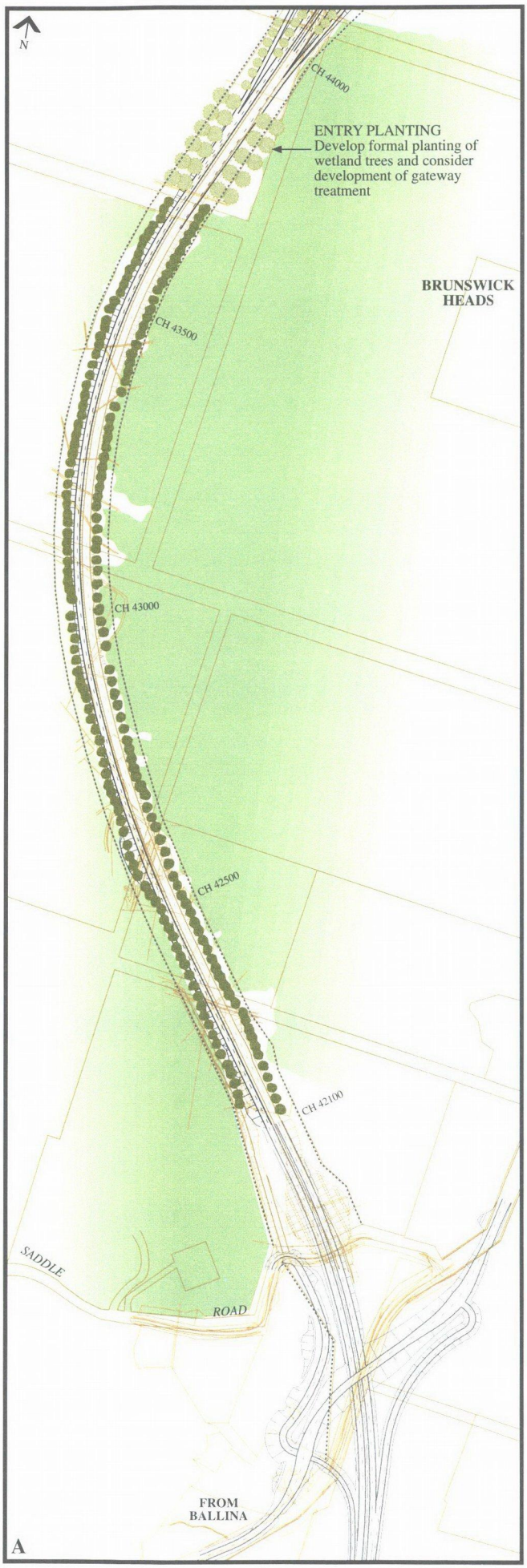
In all cases landscape treatments would reduce potential visual impacts from high and moderate, to low, especially as landscape treatments are established and planting becomes increasingly effective. The exception would be the large cutting south of Billinudgel where the visual impact would be lessened to moderate as the initial impact is softened by planting. This large cutting would continue to be seen from the Highway itself and some adjoining areas. Planting adjacent to the cuttings would screen all residential areas and views to the cutting from the Lions Lookout.

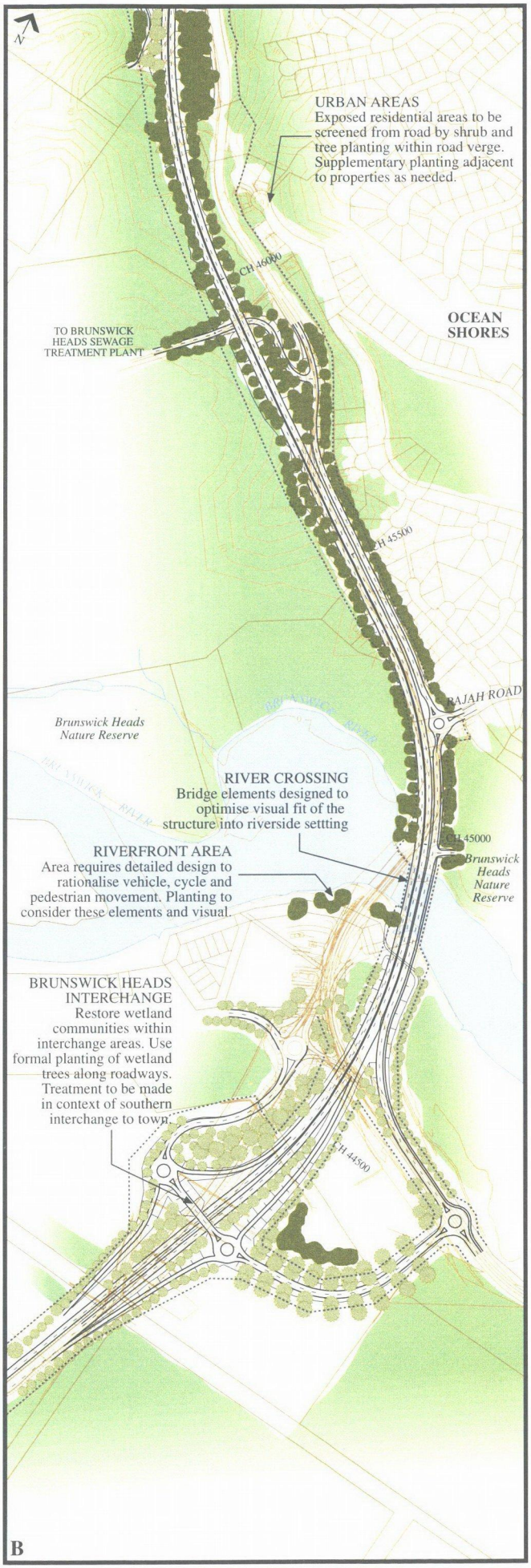
15.7 Landscape Concept Plan

The landscape concept plan, shown on **Figure 15.2**, implements the principles and treatments discussed in Section 15.6 and customises them for the various locations along the proposal corridor. The landscape concept plan would form the basis for a detailed landscape plan which would be prepared as part of the detailed design phase of the project.

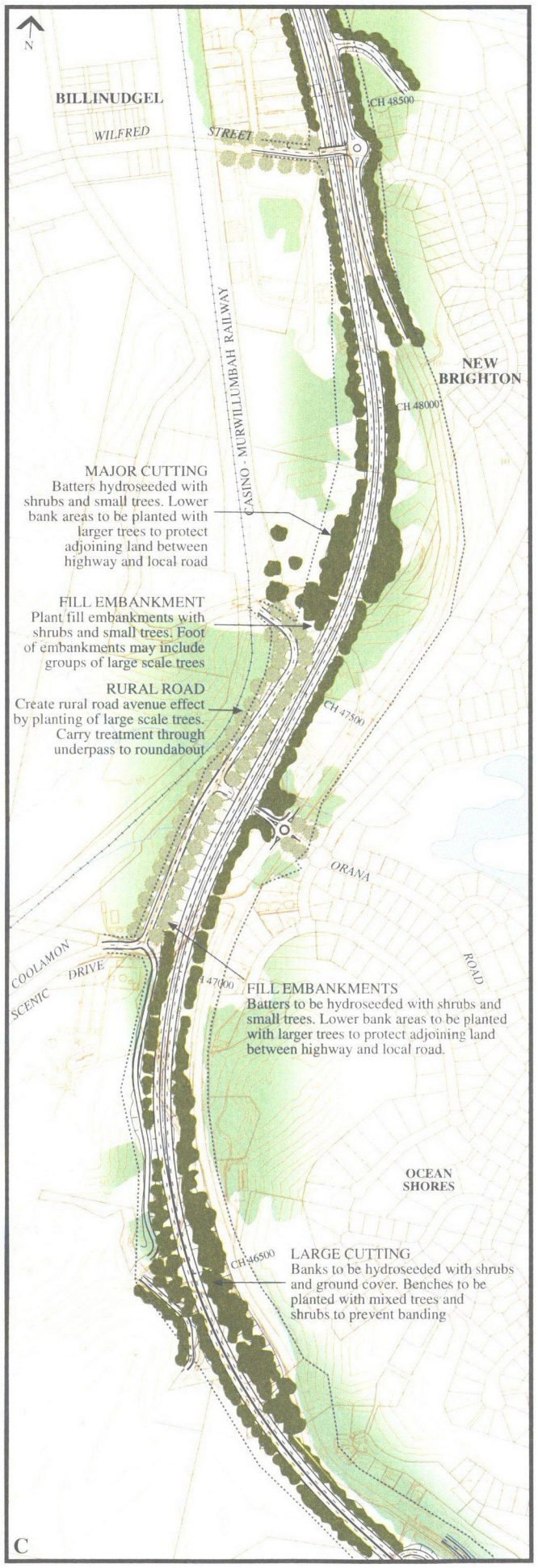
Specific treatments that form part of the landscape concept plan have been briefly described below for the major elements along the proposal.

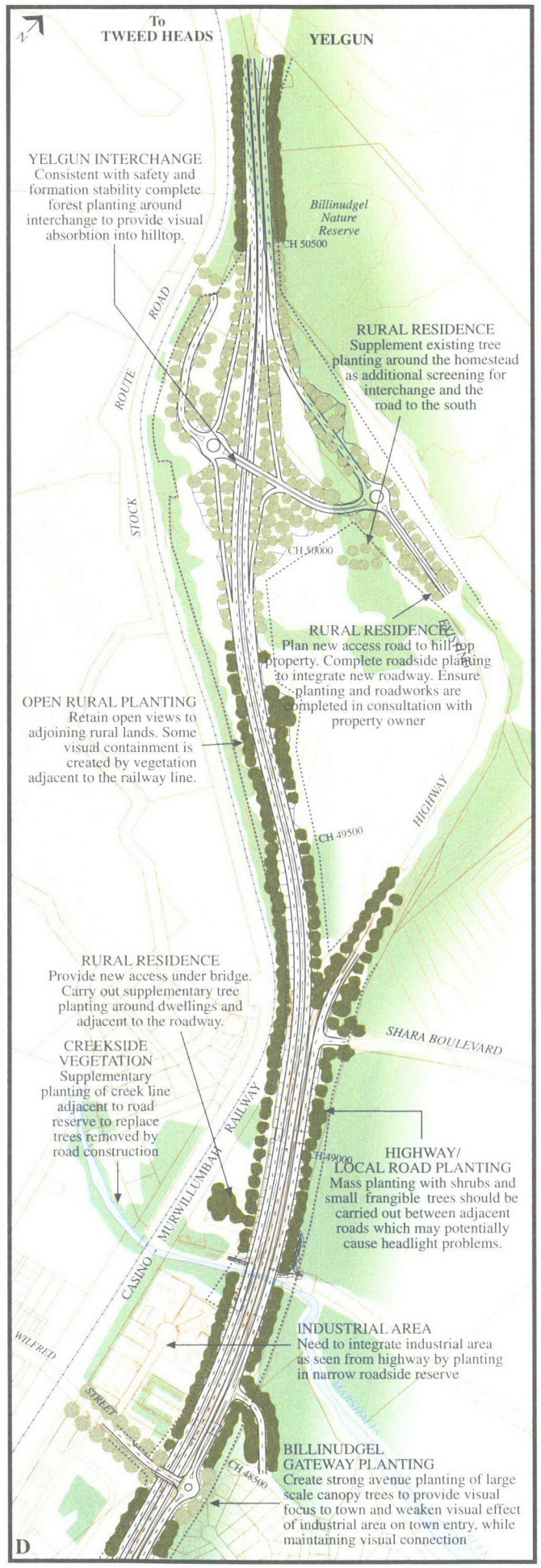
Brunswick Heads Bypass Duplication
- The road is on minor fill along this section. Treatment would retain the forest areas not needed for the road formation and facilities.
- Fill batters would be hydroseeded with sterile grasses and indigenous seed mix including *Leptospermum whitea*, *Leptospermum polygalifolium*, *Hakea stenophylla* and *Callistemon seibana*.

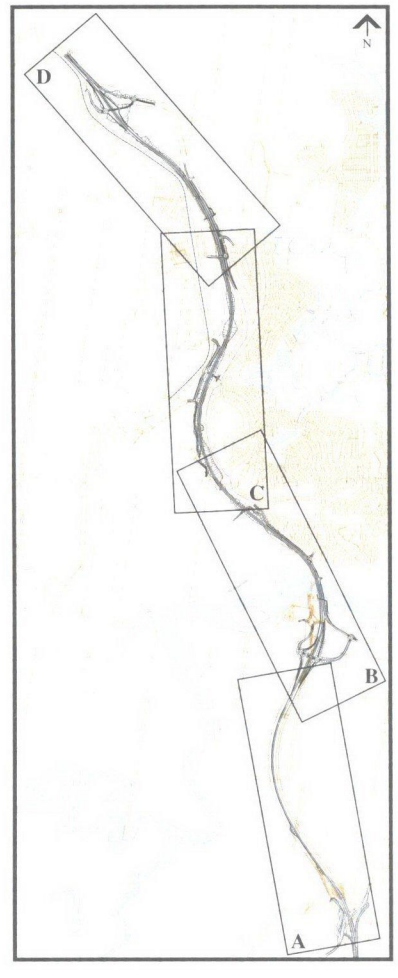

N
CH 44000
ENTRY PLANTING
Develop formal planting of wetland trees and consider development of gateway treatment
BRUNSWICK HEADS
CH 43500
CH 43000
CH 42500
CH 42100
SADDLE
ROAD
FROM BALLINA
A


N
URBAN AREAS
Exposed residential areas to be screened from road by shrub and tree planting within road verge. Supplementary planting adjacent to properties as needed.
CH 46000
OCEAN SHORES
TO BRUNSWICK HEADS SEWAGE TREATMENT PLANT
CH 45500
BRAJAH ROAD
Brunswick Heads Nature Reserve
RIVER CROSSING
Bridge elements designed to optimise visual fit of the structure into riverside settting
CH 45000
Brunswick Heads Nature Reserve
RIVERFRONT AREA
Area requires detailed design to rationalise vehicle, cycle and pedestrian movement. Planting to consider these elements and visual.
BRUNSWICK HEADS INTERCHANGE
Restore wetland communities within interchange areas. Use formal planting of wetland trees along roadways. Treatment to be made in context of southern interchange to town.
CH 44500
B

0 100 500m







Legend

..... Proposed Road Corridor

0 100

Figure 15.2
LANDSCAPE CONCEPT PLAN

Brunswick River Interchange

- The location of the proposed interchange maximises the visual environment of in relation to the salt marsh while minimising the ecological impact. The salt marsh and the woodland provide the context and theme for a gateway treatment for Brunswick Heads. Planting themes would use indigenous planting, but use them in a formal planting pattern.
- The estuarine woodland and salt marsh are to be rehabilitated in the vicinity of the interchange. A detailed plan would be developed during the detailed design phase to achieve this. Revegetation would include a full mix of tree, shrub and ground cover species. The planting structure would represent the open and closed treed character of the wetland woodland. As required, ground shaping to achieve appropriate hydrological conditions would be carried out.
- Planting within the roundabouts of the interchange must meet safety and visibility requirements. It would include a formal layered planting. The central tree-planting theme could be of *Casuarina,* contrasting with the white trunk *Melaleuca* that is used elsewhere in the entry treatment.
- The remaining on and off ramps would be planted with avenue planting of the paperbark tree, *Melaleuca quinquinervia* in a phalanx of 2 –3 rows either side of the road shoulder.

The concept plan provides one idea for a gateway treatment, but the final design would be decided following consultation with Byron Council and the community. Any such gateway treatment should be integrated with the master planning for the foreshore area.

Brunswick River Bridge

- On the southern side of the river, the proposed route for the proposal east of the existing highway and the demolition of the existing bridge creates an important opportunity for significant improvement of the foreshore area. After opening of the new highway and bridge the existing road pavement could be significantly reduced as the only road access requirements would be for the caravan park, the commercial building and the foreshore area. A new access road is proposed for access to the residential area of Riverside Drive. The existing bridge would be demolished and this area would be rehabilitated. The concept design incorporates pedestrian and cycle access under the bridge on the southern side.
- The redevelopment of this area for recreation and tourism purposes would be undertaken in accordance with a masterplan to be prepared jointly between the RTA, Byron Council, property owners and the general community. During the detailed design phase the RTA would initiate discussions with the relevant stakeholders and identify the process by which the masterplan would be developed.

- The masterplan needs to consider the following elements, so they can be incorporated in the detailed landscape plan:
  - existing and future property ownership
  - responsibilities and arrangements for development, maintenance and on-going management
  - existing and future uses
  - the overall theme for the area
  - pedestrian and cyclist access and linkages to Brunswick Heads and across the bridge to Ocean Shores
  - foreshore recreation opportunities
  - the relationship and orientation of activities in the commercial building
  - access for the Ferry Reserve Caravan Park and the commercial building
  - boating access
  - restoration of wetland areas, including areas on both sides of the river and the salt marsh between the existing highway and the southbound off load ramp on the eastern side of the interchange.
- The concept plan includes specific consideration of the bridge structure. Bridge abutments should be natural slopes adjacent to the road approaches and walled under the carriageways. Walls should avoid smooth expansive concrete surfaces that would also become a potential graffiti surface. Rock abutments may be considered as one alternative.

Cutting at Ocean Shores, north of the STP Access Road

- North of the STP access road the proposal is in major cut that includes the realigned existing highway (see **Figure 15.3**). The cut would be benched to enable planting. The surface of the retaining wall between the new highway and the local road would have relief concrete detailing to avoid a stark finish and reduce reflectivity.
- Planting adjacent to the cut on the eastern side of the proposal would be carefully planned to remove sightlines to the proposal but retain long distant views.

Banana Road Cutting

- This major cutting requires detailed landscape design consideration.
- Batter slopes would where possible be rough-cut to enable natural seeding to occur as shown in **Figure 15.4**. Benches would be included to enable intermittent planting to screen adjoining slope areas.
- Revegetation of areas immediately adjacent to the cuttings would be with large indigenous trees to decrease the visibility of the cuts from adjoining areas as well as long distant views.

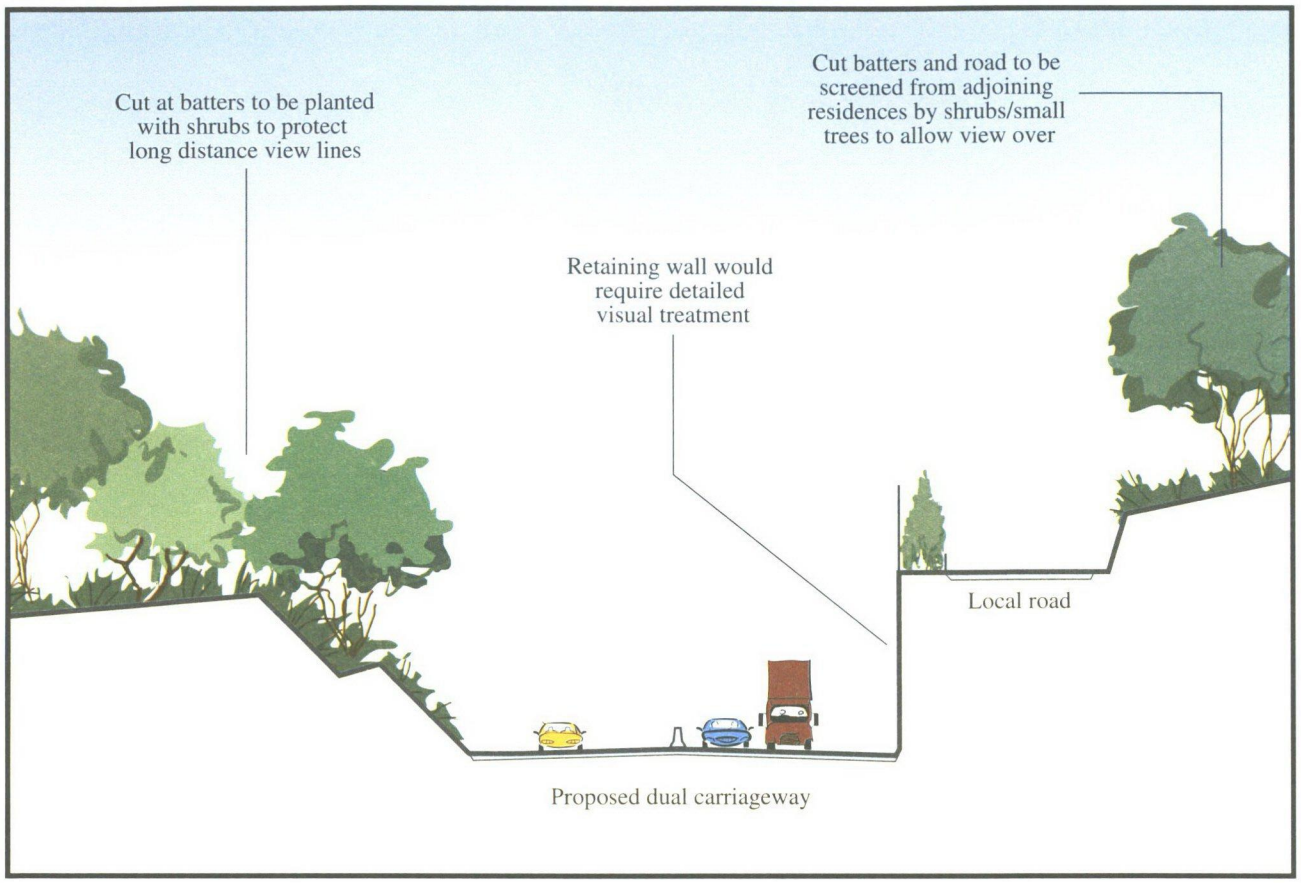


Figure 15.3
PROPOSED LANDSCAPE TREATMENT CUTTING AT OCEAN SHORES

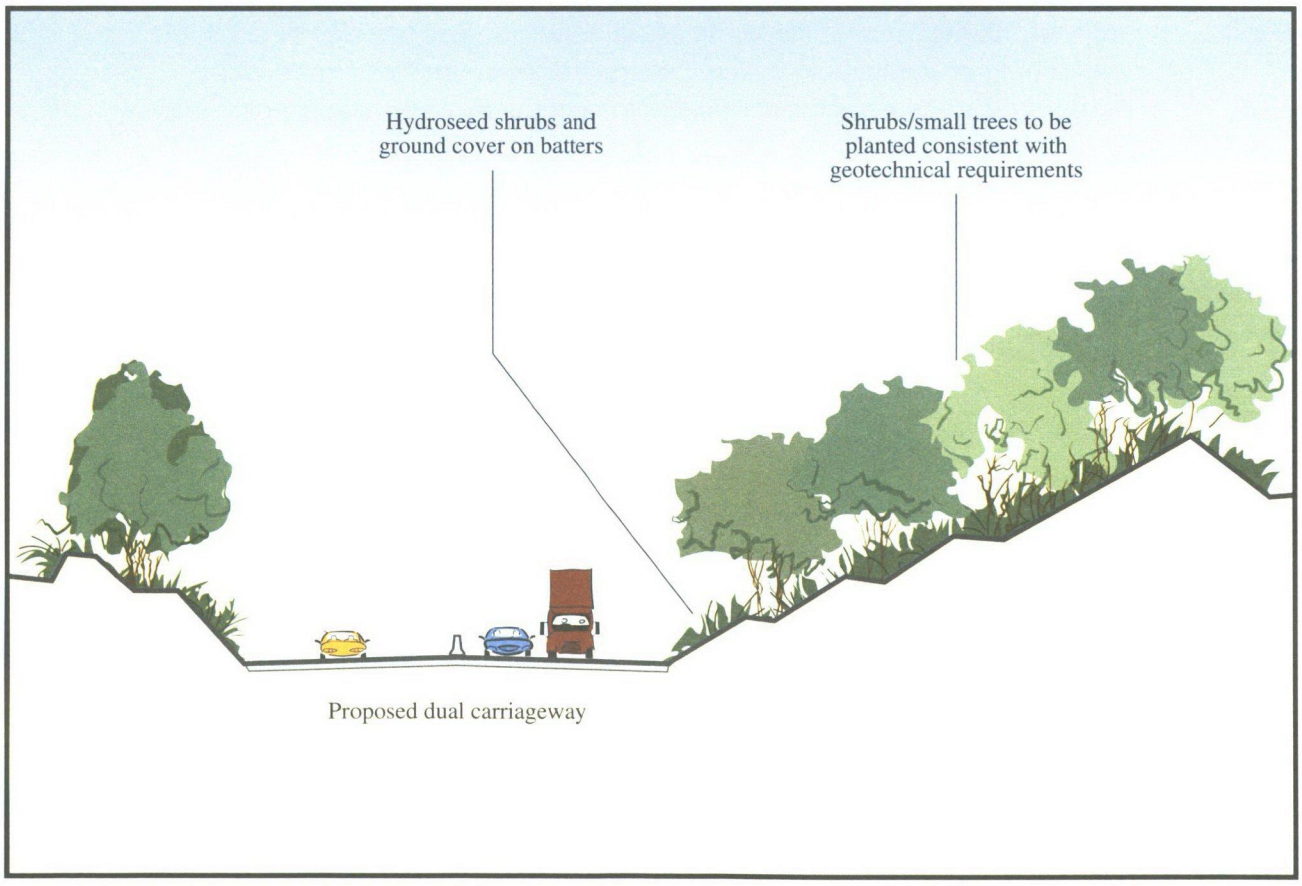


Figure 15.4
PROPOSED LANDSCAPE TREATMENT BANANA ROAD CUTTING

Coolamon Scenic Drive Underpass

- The embankment associated with the underpass would be weakened by the forest planting along the toe of the fills. Avenue planting would be carried out along the roadways adjacent to the fill areas and leading to and from the viaduct under the highway. This planting would also remove the road from the view of more elevated properties in the lower parts of the adjacent valley that would overview the road and fill embankments.

Spur Cutting

- Treatment of this cutting would be similar to that proposed for Banana Road. Existing forest vegetation adjacent to the southern end of the cutting would be protected conserved during construction. This would assist in screening long distant views onto the cutting. The cuttings would be hydromulched with a mix of indigenous shrubs and ground covers. The northern edges of the cutting should be heavily planted with forest planting to screen the cutting from long distant views.

Marshalls Creek and Adjacent Flats

- The corridor of land between the proposal and the realigned local road is very narrow and would only allow for small scale planting in the median and area.
- The preferred landscape treatment in this area aims at screen planting to soften views from the highway to the industrial estate as shown in **Figure 15.5**, but this should be compatible with the commercial developments for which visibility is critical. The landscape treatment in this area would be designed in liaison with local property owners and commercial operators.
- Open rural areas should be kept open to provide for open rural views to adjoining rural lands.

Billinudgel Overpass

- The new overpass would provide an opportunity to create a more appropriate approach to the village of Billinudgel. It would also significantly improve pedestrian and cycle access between Ocean Shores and the village.
- Fill embankments should be heavily planted to provide a visual filter to industrial areas. The top of the embankment is to support large canopy trees to create an avenue effect into the town. This planting should be used on the local road in the vicinity of the roundabout.

Yelgun Interchange

- The Yelgun interchange would be a major structure in an open and locally elevated position. It occurs in part on a minor hill that defines the northern viewshed of Billinudgel. The southern part of the interchange is in cut,

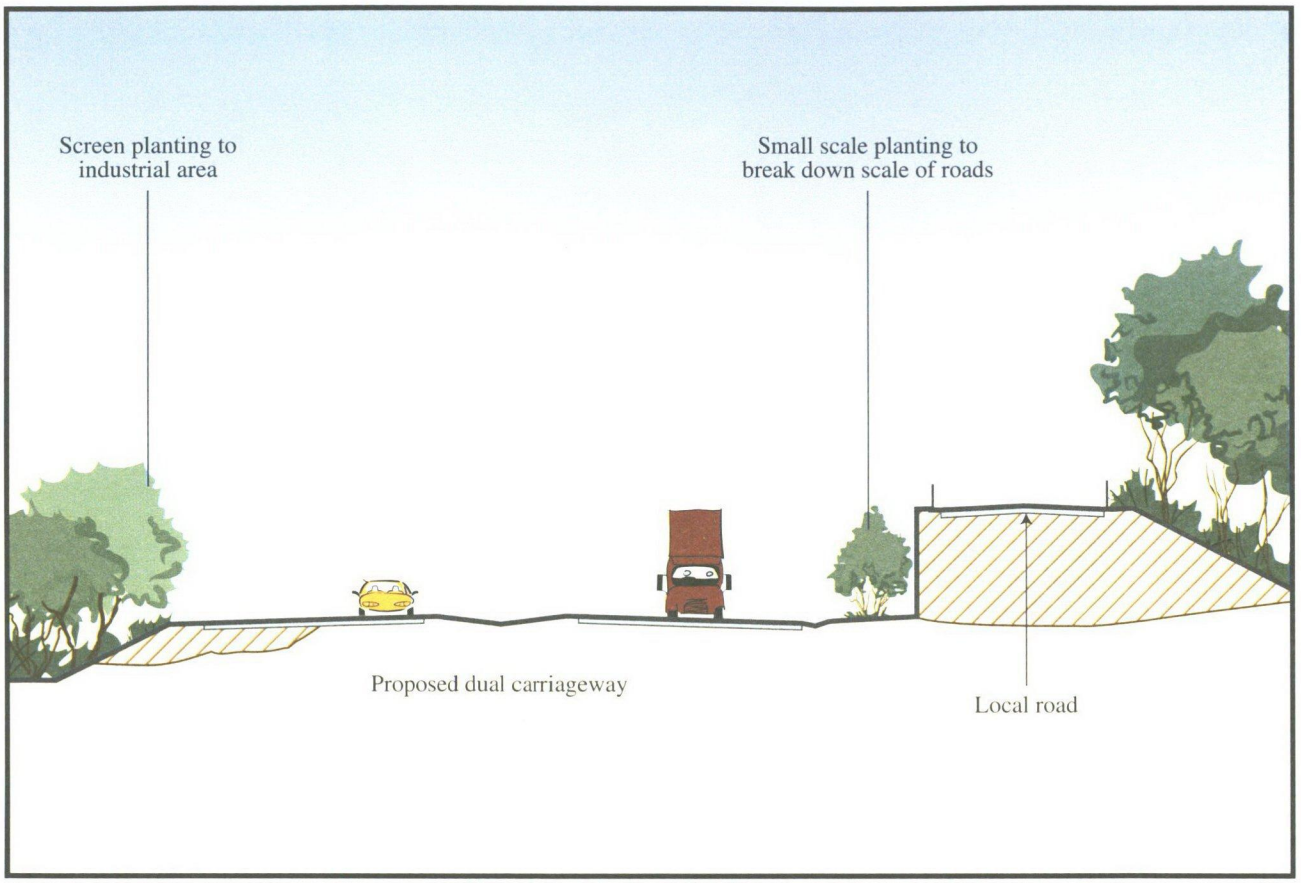


Figure 15.5
PROPOSED LANDSCAPE TREATMENT MARSHALLS CREEK AREA

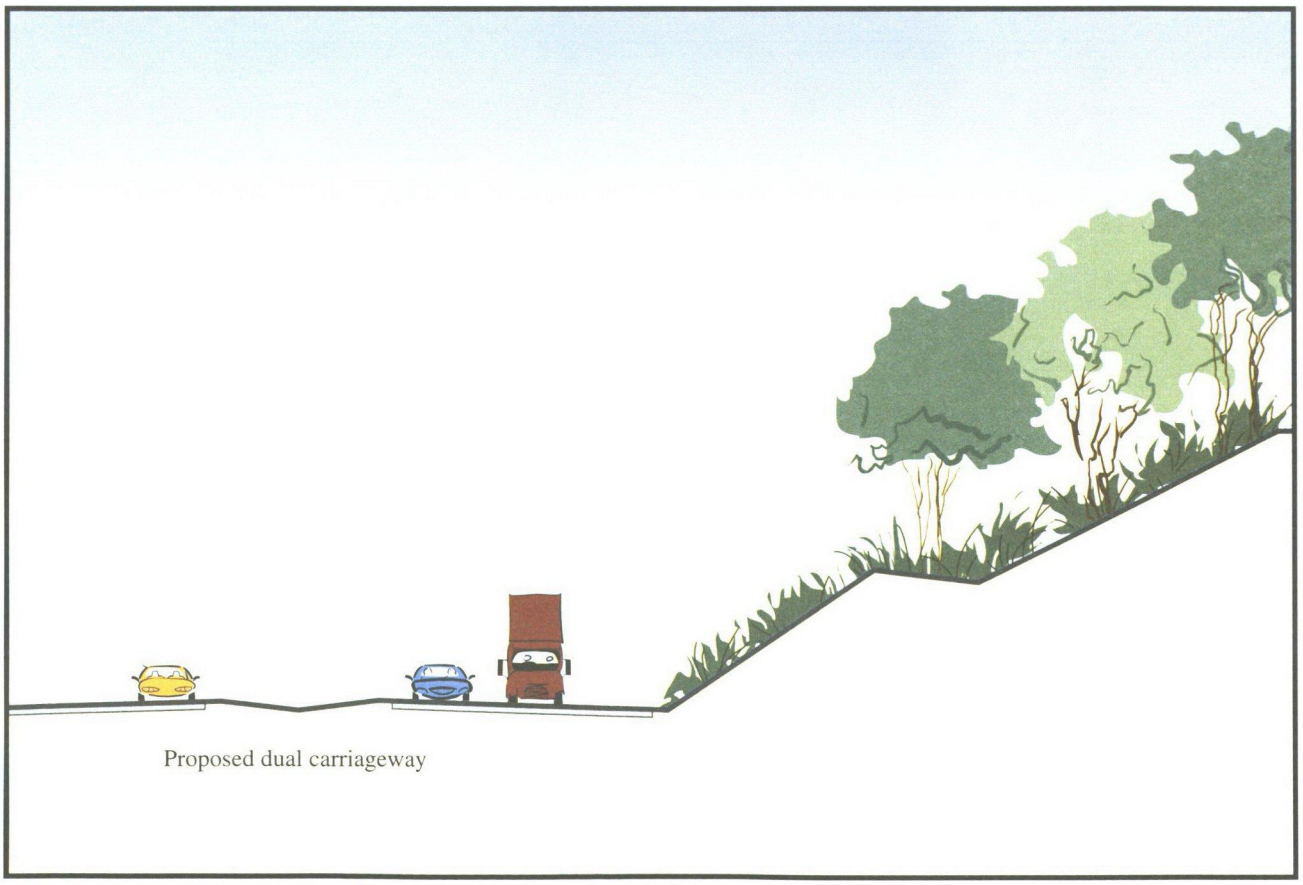


Figure 15.6
PROPOSED LANDSCAPE TREATMENT YELGUN INTERCHANGE

removing the top of the hill over an area of some 150m. The northern part of the interchange is in cut and fill.

- The earthworks cover an area of approximately 400m with cuts and fills being in the order of 5 -10m with one cut being in the order of 20m. The landscape treatment for this area is based on the need to visually integrate the roadway into the landscape and recreate a common rural pattern of cleared valleys, lightly wooded slopes and forested ridges as shown on **Figure 15.6**. Consistent with safety requirements, the ridge top interchange would be within a forest planting. This would counteract the modification of hill form, providing it with the visual absorption capacity for the interchange as well as creating a positive landscape element.
- Because of the distance to Ocean Shores and the village character of Billinudgel a "gateway" treatment is not proposed for this interchange.

Minor Cut and Fill Locations

- Minor cuts and fills would be revegetated, to stabilise the embankments.
- Cuts would also be planted to reduce the impact of the cut slope on adjoining areas as well as to improve the experience for road users.
- Fill embankments would be treated to reduce the regular form of the embankment by replacing them visually with tree belts and planting areas that reflect existing vegetation patterns in the locality of the embankments.

15.8 Conclusion

Landscape treatments aim to go beyond mitigating visual impact and are intended to visually integrate the highway development into the landscape, as an essential part of society's transport infrastructure system. The aim of the landscape strategy is to visually integrate the proposal into these landscape settings, minimising major visual modification and effects on sensitive areas. Landscape treatments in all cases would reduce the visual effects of road works to low in most cases, and moderate in others.

The implementation of the landscape concept plan including the proposed combination of landscape treatments and visual design of particular elements, as well as the screening of views to the proposal, would achieve reduced impact levels and allow the road to be integrated into the landscape.

The detailed landscape plan would be developed as part of the detailed design stage. It is anticipated that the RTA or its contractor would liaise with Byron Council and the community in regard to preferred landscape treatments, particularly for the "gateways" and for the area along the Brunswick River which is to be rehabilitated following demolition of the existing bridge.

16. Community Impacts

This Section describes the potential social and economic impacts of the proposal on the community. Property effects which include land acquisition are detailed as are amenity effects which include changes to the existing noise environment, changes to the surrounding air quality and also changes to the visual environment. Health and psychological effects are also discussed.
The Section concludes with an explanation of the potential economic impacts of the proposal.

16.1 Social Impact Considerations

Community impacts comprise the accumulation of the range of impacts which would result from the proposal. Community impacts may be both beneficial, and adverse - depending on the perception of individuals or groups. Beneficial impacts for road users have been described earlier in this document. The focus of this section is on the potential impacts, singularly and cumulatively, for the community in the vicinity of the proposal. This assessment takes into account the likely and potential impact of the proposal on property, activities, levels of public and private amenity and, to the extent possible, the potential health and psychological effects of the proposal.

16.1.1 Health and Psychological Effects

There is an established relationship between noise and public health. Public health effects cover a wide spectrum, ranging from annoyance or nuisance, to sleep disturbance, the most common reason for distress caused by noise. Measures to mitigate the adverse effects of noise are therefore generally desirable from a health and psychological point of view. To the extent that there would be noise effects resulting from the proposal, they would be mitigated with appropriate noise control measures.

The more general psychological issue of stress may involve concerns about matters other than noise. To the extent that stress may be an issue in the proposal, it may relate to people's uncertainty about when the proposal may proceed, how and when they may be compensated for property effects, whether the proposal and related activities may affect their amenity and other related matters. Given other factors which cause stress in people's lives, it is not possible to separate out those factors relating to the proposal which may cause stress and those relating to other events, or to separate out the effects of various concerns relating to the proposal. Nevertheless, these are acknowledged to be real issues for the community.

During construction there would be disruption to people's travelling patterns when traffic is temporarily diverted, and there may be periods of intense noise. These impacts are unavoidable during construction of a major project and could result in increased stress to the community. The most appropriate way to address this is to

ensure that the community is kept fully informed about upcoming road construction activities, through advertisements in the local media and by prominently placed advisory notices. The contractor would also establish a project phone number which the community could use for more information, or to advise of difficulties or complaints.

As indicated above, uncertainty is a major stress factor. The RTA and its contractor would also maintain an open process of communication with the community to facilitate a two-way flow of information.

16.1.2 Property effects

Most of the area for the proposed Brunswick Heads Bypass duplication and a substantial area of the river foreshore area is owned by government agencies including the RTA, DLWC and NPWS. During the course of the study the RTA has also acquired property in the area (at the request of those property owners) on hardship grounds. A large area to the north of the river where one of the pollution control wetlands would be located is owned by Byron Council. Nevertheless, the majority of land to be acquired is in private ownership and would need to be acquired by the RTA to construct the proposal.

Numerous meetings were held between the RTA and affected property owners during the course of the study. Through these discussions affected property owners had the opportunity to express the ways they perceived the proposal would affect them and their amenity. While it would be fair to say that the general preference was for the route to be in another location, there was a degree of acceptance of the proposal by most affected owners and they were co-operative in working with the RTA in identifying refinements to minimise individual impacts.

Properties directly affected by the proposal which would be acquired by the RTA are described in Section 14. The RTA would continue to negotiate with individual property owners regarding access requirements and property adjustments. These negotiations are expected to be finalised during the detail design stage of the project should the project be approved.

16.1.3 Amenity Effects

The majority of residents of Ocean Shores would be better off in regard to noise: the proposal would be located further away from them, i.e. the major source of noise would be further away; for most of this area the proposal would be lower than the existing highway thereby providing noise shielding; and the proposal would have a better grade and surface reducing the need for continual vehicle breaking and gear changing, reducing these noise impacts.

Between the Brunswick Heads Nature Reserve and the road to the STP, where adjustments would be required to the existing highway and to properties in this

locality, the RTA would fence the property boundaries. There would be a fence or barrier between the local road and the dual carriageway. Although it would not be required under the EPA's guidelines, the RTA would investigate the practicability of installing fences that also have some acoustic properties, providing further noise reduction benefits to these properties. Heights of the roads, and of the dwellings vary considerably through this section, as do the views from the dwellings. One of the problems arising from the erection of solid fences could be the loss of views. The RTA would liaise with property owners during the property acquisition stage to seek to identify a solution that maximises environmental benefits while ensuring that individual needs are recognised and views are not compromised.

There would be potentially significant noise level effects, as a result of the proposal, in the vicinity of Rajah Road, Coolamon Scenic Drive and Billinudgel village where residential dwellings and a church (at Billinudgel) are located close to the proposed road corridor. Noise mitigation measures are proposed as part of the proposal to minimise these impacts. These have been designed to achieve compliance with the EPA's noise objectives. There are some isolated dwellings where it would not be economically viable to construct noise barriers along the proposal. In these cases the RTA would liaise with property owners and investigate the implementation of alternative measures, which could include treatment of the dwelling or surrounding area.

In respect of air quality, there are not expected to be any adverse impacts contributing to the change in amenity in the area. Minor impacts would occur during the construction phase of the project from the generation of dust and mitigation measures have been proposed which would reduce potential impacts to a minimum. Care would be taken to locate works areas/compounds away from residences where possible.

The proposal would benefit those dwellings that currently front the existing highway. The proposal would attract much of the through traffic away from the existing highway, leaving the existing highway as a local road. There would be less traffic on the local road, with reduced vehicle emissions.

The initial visual impact of the proposal is likely to be high. The landscaping strategy includes measures for early stabilisation of cuts and the use of mature trees to lessen the initial adverse impacts. Even so, it would take some time for the landscaping to be established and to mature. Over time, it is anticipated that the visual impact would be moderate. The potential for the most significant impact is in the vicinity of the new bridge. This has been considered as part of this study. It would be particularly important for the RTA to include specific design performance criteria for the bridge design as part of its documentation for

the construction tender. It would be appropriate for the RTA to continue liaison with Byron Council and the community in this regard.

The proposal would reduce traffic volumes on the local road network, relative to the "do nothing" option and there would be consequent benefits to residents in the vicinity of the proposal. These benefits include: reduced traffic volumes on the existing highway particularly during peak traffic periods; reduced conflict between pedestrians, light and heavy vehicles; increased traffic safety levels from the separation of through and local traffic; improved and safe access for pedestrians and cyclists; and improved access between Ocean Shores and Billinudgel via the proposed bridge at Wilfred Street.

Currently runoff from the existing road and Brunswick River Bridge is not collected or treated and there is the potential for hazardous material to flow directly into the Brunswick River, or Marshalls Creek. The proposal includes measures for treatment of road runoff which would provide a significant improvement over the existing situation. This is considered to represent a community benefit as it would in the longer term assist in maintaining the health of these waterways and the enhancement of the natural environment. The health of these waterways is also important to continued fisheries production.

16.1.4 Proposals for the Brunswick River Vicinity

The opportunity for a significant improvement of the Brunswick River foreshore area is a major feature of the proposal, arising from the demolition of the existing bridge and the design of the new bridge.

The new bridge has been designed to allow for pedestrian and cycle access both across and under it. This can be readily integrated into existing access to Ocean Shores and between the Ferry Reserve Caravan Park/Riverside Drive area and Ocean Shores.

The demolition of the existing bridge and construction of the new bridge would provide the opportunity for rehabilitation of the foreshore area on both sides of the river but particularly on the southern side. Much of the existing road pavement would become redundant as access requirements would be limited to traffic using the caravan park, river foreshore and commercial area. The ultimate design, ownership and management of this would need to be resolved by the RTA in liaison with the land owners, Byron Council and the community. Other stakeholders which may be relevant include NPWS, the Waterways Authority, DLWC and NSW State Fisheries. To a large extent the design needs to be developed in association with these stakeholders and consequently has not been developed as part of this study. Nevertheless, this study has concluded that there is the opportunity for the proposal to result in an area which provides significant benefit to the local community, and to visitors to the area. If and when the

proposal is approved, the RTA would facilitate a meeting of the stakeholders to discuss a program for the development of a master plan for this area, identify the ways the community are to be involved, and identify the key parameters to be addressed in the plan. This process would be integrated with the development of the landscaping proposals, particularly for the interchange in this area.

The necessary actions to relinquish the LEP corridor north of the river in the vicinity of the Brunswick Heads Nature Reserve and identify the future management and ownership of that area, together with initiatives for compensatory habitat could form part of the master planning process.

16.1.5 Impacts on Local Businesses

The proposal would effect local businesses. Whether the impact would, in the short and long term, be beneficial or adverse would depend on a range of factors, including future business management and market factors that are beyond the scope of this assessment. This section is confined to making an assessment about the potential direct impacts. It is acknowledged that the business operators' views may differ with those expressed here.

The potential impacts of the proposed duplication were addressed in the EIS prepared for the first carriageway of the Brunswick Heads Bypass project (RTA 1993) and are not addressed again here.

In the vicinity of the Brunswick River there are two areas for consideration. The Ferry Reserve Caravan Park would likely be beneficially affected. Overall, traffic would be further away than at present; the interchange has been located to the south, away from the caravan park; separate access would be provided to Riverside Drive to minimise vehicle and pedestrian conflict; and the proposed landscaping of the interchange and the proposed rehabilitation of the foreshore area would improve the amenity for residents and visitors. In the context of the rehabilitation and development of the foreshore area there could be the possibility of extending the caravan park or developing compatible uses but this could only occur with the consent of Council and the agreement of property owners.

On the eastern side of the existing highway there is a commercial building which is currently occupied by two restaurants. These businesses are sources of employment, in an area where there is high unemployment. For both businesses there would be significant impacts during construction arising from noise, construction activities and access alterations.

One of the restaurants is primarily orientated indoors and towards the existing highway. Once the new road is operational it is anticipated that there would not be an adverse impact on this location as traffic would be further away than it is at present and noise impacts would be decreased. The other restaurant includes an extensive outdoor eating area which is oriented to the north-east. The proposal would have a significant impact on this business

as it would be significantly closer and the new bridge would traverse the field of view of diners in the outdoor area of the restaurant.

The interim and future operation of these businesses would be a matter for the operators to decide, and for negotiation with the RTA. In the long term it is anticipated that the improvements arising from the rehabilitation of the foreshore area, removal of unnecessary pavement and the landscaping proposed as part of the road design would contribute to this being a very attractive area for commercial development.

At Ocean Shores there is a property which has been developed as a service station and caravan park. The location of the proposal in this vicinity, while it would directly affect this business, has been accepted and agreed to by the owners.

There are a number of industrial and commercial developments in Billinudgel. There would be improved access between Billinudgel and Ocean Shores which may facilitate businesses in Billinudgel. There is one retail business located at Billinudgel and currently fronting the highway which has a manufacturing component and is reported to receive a significant amount of trade from passing traffic. While there is no direct access to Billinudgel from the proposal, there is an interchange at Yelgun which is approximately 1km away and this would provide reasonable access to these businesses. The proposal would have a direct benefit on transport of materials, produce and freight to and from Billinudgel by decreasing travel times and increasing travel efficiency.

The proposal also has a significant effect on two carpentry businesses which are carried out in workshops associated with dwellings. The RTA would acquire both properties. The owners have indicated a preference to remain in the local area but that would be a matter for their personal decision.

16.1.6 Mitigation Measures

Various mitigation measures are described in this EIS to address potential air and noise emissions, visual impacts and other impacts on the biophysical environment (refer Sections 8 to 14). These measures incorporate best practice environmental management and offer opportunities for environmental enhancement. With these measures in place, it can be concluded that the proposal would have overall beneficial social impacts. It would increase traffic efficiency and therefore reduce fuel consumption, increase traffic and pedestrian safety, and through vegetative screenings and landscape treatment, provide an improved visual environment.

After opening, the RTA would monitor the performance of the environmental mitigation measures to ensure that they are functioning correctly, to determine whether they accord with predictions and to determine whether any further action is required.

16.2 Road User Economic Considerations

There would be economic benefits to the region from the construction of the proposal. These would include reduced vehicle costs, reduced accident costs, increased vehicle efficiency and increased safety for the Brunswick Heads, Ocean Shores and Billinudgel communities, which includes pedestrians, pedal cyclists and vehicle users.

The road user economic evaluation of the preferred option has been undertaken by comparing the 'do nothing' situation against the construction and operation of the proposal and is presented in Section 7. The proposal would be economically viable. The benefits are mainly accrued due to the expected improvements in travel times along the proposal compared to the existing highway, associated lower vehicle operating costs and improvements in road safety.

Note that the evaluation is a road user cost benefit analysis only. Intangible costs and benefits such as air quality effects, ecological effects or social effects were not quantified or included in the economic evaluation process. Notwithstanding this, environmental and community values formed part of the route selection and alignment definition process and these considerations are an integral part of the proposal. Therefore they are, in this context, a valid economic tool.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part F

Cumulative Impacts and Environmental Management

17. Cumulative Impacts and Environmental Management

This Section outlines the cumulative environmental effects of the proposal. The various monitoring, environmental management and mitigation measures that would be implemented to ensure that the environment is adequately protected and that adverse impacts are ameliorated, are also summarised. The mitigation measures outlined in this section of the EIS are a compilation of the mitigation measures described throughout the document. These measures would be incorporated into the construction contract for the proposal. An outline of the contents of an Environmental Management Plan is also provided.

17.1 Cumulative Environmental Effects

In accordance with clause 82 of the EP&A Regulation, 1994, any cumulative environmental effects of the proposal with other existing and likely future activities must be taken into account in determining the potential impacts of the proposal on the environment.

This study has addressed the individual and cumulative impacts of the proposal including the construction of the new road, interchanges and the new bridge; the proposed transport of fill to Ewingsdale; and the realignment and modifications to the local road network. The impacts of the construction of these facilities and the transport of fill have been analysed in respect of their potential impact on traffic, noise, air and water quality, flooding, flora and fauna, as well as on the social and economic environment. The potential impacts of the operation of the proposal including interchanges, the new bridge over the Brunswick River and modifications to local roads have also been addressed.

In terms of the Pacific Highway Upgrading Program, the RTA is currently undertaking a study of the Cumulative Impact Assessment Study. This study will address the potential for cumulative impacts at the broad regional and network level.

This project is consistent with road upgrade proposals to the north and south. The combined effect of these projects would be to provide an overall improvement in this region with respect to road safety, traffic efficiency, decreased traffic congestion, reduced travel times and improved level of service.

In the context of the Pacific Highway Upgrading Program, the proposed duplication of the Brunswick Heads Bypass and upgrade of the Pacific Highway between the Brunswick River and Yelgun would result in cumulative effects on the environment by:

- decreasing travel times and increasing travel efficiency for through traffic thereby reducing vehicle operating costs;
- increasing the safety of the Pacific Highway by providing a route alignment with an improved cross section and access points;

- improving the level of service and safety on the existing highway/local roads by reducing the number of through vehicles and allowing redistribution of travel patterns;
- having the potential for improvements to the amenity of the area by removing through traffic from local roads and by locating the major source of traffic noise and air emissions generally further from the existing residential areas;
- creating impacts on the local community during construction, in the form of disruption, noise impacts, dust and visual impacts. These need to be considered in terms of the longer term benefits that the community would derive. These would be managed to minimise undue adverse effects;
- having a direct impact on 31 properties. It is likely that, after construction of the proposal has been completed, there would be some property adjustments to minimise areas that are sterilised and to improve the viability of adjoining properties. This would be a matter for negotiation between the property owners and the RTA. It is also likely that some of the residual property could be incorporated into the landscaping, and/or be planted and managed as compensatory habitat;
- creating an impact on flora and fauna, including threatened species; and on the Brunswick Heads Nature Reserve. The proposal includes mitigation measures and the RTA would liaise with the NPWS in regard to the provision of compensatory habitat. Measures such as the proposed rehabilitation of the foreshore area following demolition of the existing bridge and the saltmarsh within the Brunswick River interchange area would assist in offsetting impact to estuarine communities;
- directly impacting on 6 threatened plant species, listed under Schedule 2 of the Threatened Species Conservation Act, 1995. On the basis of the application of Section 5A of the EP&A Act to determine "whether there is likely to be a significant effect on threatened biota", an SIS was prepared. The SIS provides details of the threatened plants to be affected, notes that individuals and populations of the six affected species will be retained, and details impact amelioration measures to be applied. Although a number of individual threatened plants would require removal for the construction of the proposal, it is proposed to propagate individuals of these threatened species and use them as part of the landscaping plan in strategic locations, such as adjacent remnant areas. Disturbed portions of the Brunswick Heads Nature Reserve could also be rehabilitated with threatened species, and the longer term cumulative impact of propagating threatened species in the study area would be beneficial;
- Some threatened fauna species were identified in the study area however the proposal would not remove critical fauna habitat or resources and therefore the impacts on potential threatened fauna are not considered to be significant. The propagation of threatened plant species, together with the planting of other native flora species as part of the landscape strategy, would create new habitat

areas and enable animal movement between existing habitat areas. Safe fauna underpasses would also be provided. Where possible degraded areas within the corridor would also be rehabilitated. This would contribute to the amelioration of overall impact on fauna and potential fauna habitat areas;

- having a direct impact on the local businesses which have been discussed in Section 14. While there is the potential for some of these businesses to remain or temporarily relocate during the construction period, or relocate in the local area, this remains the decision of the business operators and direct and long term impacts cannot be discounted. There could also be an indirect impact on local businesses with access to the existing highway. The proposal includes interchanges to facilitate connections with the local road network. These impacts need to be considered in terms of the overall economic benefits that would be derived from the project in the form of improved access to the area, improved amenity and consequent potential benefits to business;
- not having any discernible cumulative impacts on flooding and drainage in the area. The proposed water management strategy would provide an improvement over the existing situation in respect of the containment and treatment of runoff from the proposal;
- contributing to the cumulative reduction in greenhouse gas emissions in the long term as a result of reduced traffic congestion on other roads within the study area; the reduction in travel times between destinations and increased fuel efficiency; and
- complying with existing environmental goals and standards with respect to noise, air quality and water quality through the adoption of "best practice" mitigation measures.

The impacts of the proposal in combination with the projected population growth within the study area were considered in the traffic modelling and traffic impact assessment. The proposal is consistent with State and Regional planning strategies and with Council's planning strategies. Overall the proposal is expected to result in positive cumulative environmental effects in the study area.

17.2 Environmental Mitigation and Management

The mitigation measures identified throughout the EIS are summarised in **Table 17-1**.

Table 17-1 - Summary of Mitigation Measures

Impact	Mitigation Measures
General construction and operation impacts	☐ preparation of EMPs for construction and operation, incorporating obligations of EIS and approval conditions (refer to Table 17-2 below)
Water quality and hydrology	☐ erosion and sedimentation control plans ☐ comprehensive surface water and spill management plans ☐ acid sulphate soils management plans ☐ design for flows - bridges and culverts
Noise and vibration	☐ provision of noise barriers or earth mounds at sensitive locations and/or architectural treatment to affected dwellings ☐ controls on construction activities and equipment ☐ undertake noise monitoring post construction
Flora and fauna	☐ improvements to fauna movements by provision of a fauna underpass under the new bridge on the northern side of the Brunswick River and in the vicinity of Marshalls Creek. ☐ provision of fauna exclusion fencing in the vicinity of the Billinudgel Nature Reserve and the Brunswick Heads Bypass ☐ revegetation of some areas as part of landscaping strategy ☐ negotiation with NPWS regarding compensatory habitat options ☐ short and long term monitoring programs
Visual environment	☐ preparation and implementation of landscape plan consistent with flora and fauna requirements, including extensive planting in visually sensitive areas ☐ design of gateway treatments in liaison with Council, the community and property owners
Effects on land use	☐ maintenance or provision of new access for properties affected by the proposal ☐ acquisition of significantly affected properties
Social effects	☐ community consultation program throughout design and construction of project ☐ maintain local road network ☐ improvements to the intersections of Rajah Road and Orana Road through the construction of roundabouts at each location ☐ provision of an overpass to connect Billinudgel and Ocean Shores ☐ provision of cycleways and pedestrian ways along the proposal and a new pedestrian/cycleway to be constructed over the Brunswick River ☐ in liaison with Council and property owners, rehabilitation and revegetation of foreshore areas following the demolishing of the existing bridge
Air quality	☐ Controls on equipment and construction activities
Heritage and archaeology	☐ presence of LALC during initial site disturbance ☐ provision of protective measures or recovery plans should sites be found

Provided these environmental mitigation measures are adhered to and the appropriate standards incorporated into the detailed design phase of the project and construction and operation work practices, the environment would be adequately protected.

17.2.1 Environmental Management Plans

Construction and post construction operation of the proposal would be a major undertaking. Environmental mitigation measures outlined in this document would be incorporated into the detailed design phase of the proposal and as part of its construction and operation, thereby reducing any significant impact to the surrounding environment. All of the mitigation measures described throughout this EIS, subsequent environmental safeguards developed during the detailed design of the road and any conditions of approval issued by the Minister for Urban Affairs and Planning would be incorporated into a Project EMP for the proposal.

Such an EMP would be an integral part of the detailed design phase of the proposal and would form part of any contractual requirements. The EMP would be a stand alone document which addresses the mitigation measures outlined in the EIS, subsequent environmental safeguards developed during the detailed design phase of the project, requirements for compliance with relevant legislation, requirements for ensuring implementation of the environmental safeguards and development of self-assessment and auditing schedules. Therefore, the EMP would be a compilation of all environmental undertakings should the RTA decide, following a favourable decision by the Minister for Urban Affairs and Planning, to determine that the proposal proceed.

The EMP would outline a checklist of actions to ensure that the environment is adequately protected during the construction and operational phases and that adverse impacts are minimised. An outline of an EMP is detailed **Table 17-2**. It should be noted that approvals/licences listed under various control Acts would be addressed in accordance with the requirements of the POEO Act from September 1998.

Table 17.2 Outline of Environmental Management Plan

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
PRIOR TO CONSTRUCTION					
Environmental Management	Develop project environmental management guidelines for the proposal	☐ Develop EMP ☐ Develop Contract EMP	☐ Environmental Planning and Assessment Act 1979	☐ RTA	RTA Project Manager Site Manager/Contractor
		☐ All staff are to receive training in environmental awareness and management.			RTA Project Manager Site Manager/Contractor
		☐ A copy of the Contractor EMP is to be available at the site office in a visible and accessible location.			Site Manager
		☐ Provision to be made for regular updates of the EMPs to reflect any proposal changes.			Site Manager/Contractor
		☐ Field assessment reporting sheets to be prepared in accordance with the EMP.			Site Manager
	Obtain all licences required for construction works prior to the commencement of construction activities	☐ Obtain Pollution Control Approval from Environment Protection Authority in accordance with Section 19 of the Clean Waters Act to permit installation of erosion and sedimentation control measures.	☐ Clean Waters Act 1970	☐ Environment Protection Authority	RTA Project Manager
		☐ Conditions of approval specified in pollution approvals/licences shall be incorporated as safeguards in the Project and Contractor EMPs.			Site Manager RTA Project Manager
	Community to be advised of progress on proposal	☐ Distribution of an Information Sheet or advertisement providing a brief outline of construction programme, contact name and number for inquiries.			RTA Project Manager Site Manager/Contractor
		☐ Distribution of an Information Sheet advising the community of alterations to the construction of the proposal eg, change to working hours resulting in noise impacts.			
Visual and Landscape Quality	Develop landscape plans to minimise disturbance to the natural environment and protect and enhance the visual and potential habitat qualities of the area	☐ Develop landscape plans in accordance with the following scenic management requirements: - reduce visual impact of cut and fill - ensure landscape treatments are sympathetic with landscape character of adjoining areas- - collect seed from threatened plants in the region and propagate seedlings for landscaping - minimise ongoing landscape requirements by selecting plant material that is adapted to the prevailing growing conditions - select indigenous plant species of known habitat value - vegetation clearing to be kept to a minimum - landscape themes shall be based on existing vegetation character to achieve integration - bridges, culverts and road structures are to be designed and constructed to match the existing residential and natural conditions		☐ Byron Council ☐ NPWS ☐ DLWC	RTA Project Manager Site Manager/Contractor

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
Erosion and Sediment Control	Develop sediment control and surface water management plans to ensure sediment laden runoff does not enter local watercourses	☐ Obtain Pollution Control Licence from Environment Protection Authority to permit installation of pollution control works. ☐ Licence conditions of Environment Protection Authority's Pollution Controls shall be incorporated as environmental safeguards in the Contractor EMP. ☐ Erosion and sedimentation control plans acceptable to the RTA shall be prepared outlining erosion protection controls. ☐ Prior to construction commencing, graded contour drains or diversion channels shall be formed around the disturbed area. ☐ Clear water shall be diverted away from disturbed areas. ☐ Drainage systems shall be designed and constructed to limit flow velocities in order to minimise scouring and encourage precipitation of particulates in the runoff. ☐ Drainage structures for waterways, catch drains and sediment traps and basins shall be installed prior to the commencement of bulk earthworks in order to allow existing waterflows to pass through the construction zone without mixing with unfiltered runoff. ☐ Erosion and sediment control measures shall be designed by the RTA in consultation with the DLWC.	☐ Pollution Control Act 1970 ☐ Clean Waters Act 1970	☐ Department of Land and Water Conservation ☐ Environment Protection Authority	RTA Project Manager Site Manager/Contractor
Noise	Develop noise safeguards - for construction noise to meet the requirements of the EPA Environmental Noise Control Manual and, for traffic noise to meet the objectives of the EPA's guidelines.	☐ Undertake a detailed noise impact assessment during the detailed design stage for the construction phase of the proposal. ☐ Where possible install roadside noise barriers or earth mounding where space permits prior to construction commencing so as to protect those residents who would otherwise receive adverse construction noise. ☐ Consult with those residents which would be adversely affected by noise even with the implementation of roadside noise barriers or earth mounds to determine appropriate architectural treatments to individual dwellings to reduce noise.	☐ Pollution Control Act 1970	☐ Environment Protection Authority	RTA Project Manager Site Manager/Contractor
Flora and Fauna	Plan construction works to minimise impacts on flora and fauna	☐ Construction works to be designed to minimise impacts on native vegetation. ☐ Revegetation works to be undertaken in accordance with the landscape plan. ☐ Establish a detailed flora and fauna management plan, including detailed activities regarding protection of trees and other vegetation, habitat management, landscaping and habitat creation. ☐ Collect seed from threatened plant species that would require removal for construction activities and propagate these as seedlings to be incorporated in adjacent areas and overall as part of the landscape strategy for the project.	☐ Threatened Species Conservation Act 1995 ☐ Noxious Weed Act 1993 ☐ National Parks and Wildlife Act	☐ National Parks and Wildlife Service	RTA Project Manager and Contractor

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
Water Quality and Hydrology	Develop safeguards to restrict potential water pollution associated with chemical storages	☐ Should quantities of fuels and oils in excess of exemption quantities be required to be stored on-site a licence should be obtained from Workcover	☐ Clean Waters Act 1970 ☐ Dangerous Goods Act 1975 ☐ Pollution Control Act 1970	☐ Department of Land and Water Conservation ☐ Environment Protection Authority	RTA Project Manager and Contractor
	Provide adequate water safeguards in the event of environmental emergencies	☐ The RTA and Contractor shall provide details of emergency procedures that would be implemented to minimise the environmental effects of spillages of fuels and chemicals that may occur on-site.		☐ Environment Protection Authority	RTA Project Manager and Contractor
	Design appropriate waterway openings so that flooding is minimised.	☐ Duplicate hydraulic structures during the construction of the Brunswick Heads Bypass duplication. ☐ Determine the exact location of bridges and culverts during the detailed design stage for the Marshalls Creek Floodplain area.		☐ Environment Protection Authority ☐ Department of Land and Water Conservation	RTA Project Manager
Land Use, Zoning, Property Acquisition	Manage land acquisition process to minimise disruption to affected residents.	☐ All affected property owners would be contacted and negotiations held, as appropriate. ☐ Where partial property acquisition is required, vegetation screening is to be implemented to ameliorate visual impacts from the roadway. ☐ All property acquisitions would be undertaken in accordance with the RTA's Property Acquisitions Policy which follows the procedures under the Land Acquisition (Just Terms Compensation) Act 1991.	☐ Land Acquisition (Just Terms Compensation) Act 1991	☐ RTA	RTA Project Manager
Indigenous and Non-indigenous Heritage	Monitor areas regarded as containing potential archaeological deposit prior to the commencement of construction.	☐ Seven PAD areas were identified and a subsurface testing program should be carried out at each of these. ☐ Representative of the Tweed-Byron LALC to be present during initial site disturbance. ☐ Should unrecorded archaeological deposits be uncovered during construction all work would cease and a representative of the National Parks and Wildlife Service and Tweed-Byron LALC should be contacted so that appropriate action can be taken.	☐ National Parks and Wildlife Act	☐ National Parks and Wildlife Service ☐ Tweed Byron LALC	RTA Project Manager Site Manager/Contractor and RTA Aboriginal Liaison Officer
DURING CONSTRUCTION					
Community Consultation	Community to be advised of progress on proposal	☐ Contractor to prepare Information Sheet or advertisement to outline progress and provide contact details of person for inquiries relating to the works. ☐ Where property access arrangements are disturbed notification of the nature, timing of temporary access arrangements and a contact telephone number are to be provided by Contractor. ☐ Contractor to address complaints in regard to environmental, social and traffic considerations and keep register of complaints.			Site Manager to notify public 7 days prior to disturbance. RTA Project Manager/Contractor

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
Air Quality	Implement air quality safeguards in order to meet the requirements of the Clean Air Act (1961)	☐ Construction activities to be undertaken in accordance with the Clean Air Act (1961) and any specific licence conditions specified in relation to air pollution. ☐ An air quality monitoring programme would be established and include the provision of dust monitoring equipment at the most potentially affected residences and incorporated into the EMP for the project. ☐ EMP would include measures to minimise impacts on air quality from the emissions of concrete/asphalt batching plants in order to protect the ambient air quality. ☐ Regularly used access tracks to be stabilised using water seal, bitumen seal or other means acceptable to the Environment Protection Authority to minimise dust generation. ☐ Trucks to be available for the watering of exposed surfaces to control dust emissions and watering shall be carried out whenever required or as directed by the RTA Site Manager. Investigate using treated effluent for this purpose. ☐ Stockpiles and exposed areas to be stabilised through the establishment of quick growing surface cover crops, emulsion spraying or regular watering. ☐ Construction equipment shall be maintained in an efficient condition and operated in an efficient manner.	☐ Clean Air Act 1961 ☐ Pollution Control Act 1970	☐ Environment Protection Authority ☐ Byron Council	RTA Project Manager Site Manager/Contractor
Visual and Landscape Quality	Implement landscape treatments to provide visual screening, habitat generation and land stabilisation	☐ Implementation of landscape plan is to be periodically reviewed and any necessary amendments to the plan shall be incorporated into the EMP. Landscaping along the proposal boundary is to be undertaken progressively as construction is completed. ☐ Vegetation clearing and riverbank disturbances to be minimised as this dense riparian vegetation provides an effective visual screen. ☐ Respreading of topsoil to be undertaken to assist revegetation. ☐ Seeding and tubestock planting of exposed batters. ☐ Seeding and planting scattered groups of trees around affected houses. ☐ Landscape treatments to be implemented in accordance with the Landscape Plan. ☐ Where properties require partial acquisition, vegetation screening is to be implemented to ameliorate visual impacts. ☐ All access tracks not required following completion of construction are to be rehabilitated and seeded with species similar to adjacent lands.			RTA Project Manager Site Manager/Contractor

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
Erosion and Sediment Control	Implement sediment protection safeguards in order to meet the requirements of the Clean Waters Act (1970)	☐ Construction activities to be undertaken in accordance with the Clean Waters Act (1970) and any specific licence conditions specified in relation to water pollution. ☐ Temporary drainage and erosion controls to be provided to ensure that sediment laden runoff does not enter local waterways. ☐ Sediment traps to consist of hay bales, silt fences and filter trenches at downstream end of disturbed areas. ☐ Water quality of receiving water to be monitored for evidence of polluting emissions. ☐ Quality of runoff from stormwater outlets to be monitored to ensure compliance with Environment Protection Authority requirements and the sediment control plan. ☐ Temporary controls which are earth formed shall be stabilised. ☐ Disturbed areas should be kept to a minimum at any one time. ☐ Protection of soil stockpiles to include erosion and temporary vegetative cover of the surface.	☐ Pollution Control Act 1970 ☐ Clean Waters Act 1970	☐ Environment Protection Authority ☐ Department of Land and Water Conservation	RTA Site Manager/Contractor Environment Manager
Noise	Implement noise control safeguards in order to meet the requirements of the EPA Environmental Noise Control Manual	☐ Construction activities to be undertaken in accordance with the EPA Environmental Noise Control Manual and any specific licence condition specified in relation to noise pollution. ☐ Construction activities to be restricted to the hours approved by the Environment Protection Authority. ☐ Assess noise levels during construction activities at adjacent properties. Where levels are exceeded noise reduction measures shall be implemented i.e. restriction of working hours and the use of silencing equipment on particularly noisy equipment.	☐ Noise Control Act 1975 ☐ Pollution Control Act 1970	☐ Environment Protection Authority	RTA Project Manager Site Manager/Contractor
Flora and Fauna	Implement management safeguards to ensure that construction works minimise impacts on flora and potential fauna habitat areas and on aquatic flora and fauna	☐ Management of waste materials to prevent discharge to remnant vegetation. ☐ To minimise the impact area of native vegetation the boundary of the construction works are to be clearly defined by temporary fencing. ☐ Removal of vegetation to be minimised and restricted to areas within the proposed road alignment. ☐ All construction activities to be undertaken in accordance with guidelines that restrict the spread of weeds. ☐ No disturbance is to be undertaken to areas outside the construction zone without the prior approval of the RTA Project Manager.	☐ Noxious Weeds Act 1993 ☐ Threatened Species Conservation Act 1995 ☐ Fisheries Management Act ☐ Fisheries Management Amendment Act	☐ National Parks and Wildlife Service ☐ NSW Fisheries	RTA Site Manager/ Contractor
Water Quality	Implement water pollution control safeguards in order to meet the requirements of the Clean Water Act (1970)	☐ Any fuels and chemicals stored at the site are to be placed within an impervious paved and bunded area capable of holding at least 110% capacity of the volume of stored fluids at a level above the 1:10 year flood.	☐ Clean Waters Act 1970 ☐ Pollution Control Act	☐ Environment Protection Authority ☐ Department of Land and Water Conservation	Site Manager/ Contractor

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
		☐ Wastewater from amenities on-site are to be pumped or trucked to Byron STP or composting toilets utilised			Site Manager/ Contractor
Waste Management	Minimise waste generated during construction and reuse materials where possible	☐ Any waste generated by the work shall be properly disposed of at an licenced waste disposal depot or landfill under the control of Byron Council, The EPA or the Waste Management Authority. Recycling of waste is to be undertaken wherever possible.	☐ Waste Disposal Act 1970 ☐ Waste Minimisation and Management Act 1995 ☐ Environmental Offences and Penalties Act 1989	☐ Environment Protection Authority ☐ Waste Recycling and Processing Service of NSW	Site Manager/Contractor
		☐ The Contractor shall comply with the Environmental Offences and Penalties Act and the Waste Minimisation and Management Act, 1995.			Contractor
Traffic and Access	Prevent disruption to local residents and the local road network	☐ Access to the construction site would be confined to defined access roads.		☐ Byron Council ☐ STP	Site Manager/Contractor
		☐ The access roads would be maintained to a suitable standard to cater for construction traffic.	☐ Traffic Authority Act 1976		Site Manager/Contractor
Archaeology	Prevent damage to archaeological deposits	☐ It is illegal to damage, deface or destroy an Aboriginal relic without the permission of the Director-General of the NPWS. If any relics are encountered during the course of the construction period, officers of the National Parks and Wildlife Service should be informed.	☐ National Parks and Wildlife Act 1974	☐ National Parks and Wildlife Service ☐ Tweed Byron LALC	Site Manager/Contractor
POST CONSTRUCTION					
Environmental Management	Conduct follow up activities to ensure effectiveness of environmental safeguards following proposal hand over	☐ Undertake monitoring and management activities in accordance with the EMP.			RTA Project Manager
		☐ Maintain road in a safe manner. RTA to develop a regular maintenance program.			RTA Project Manager
Community Consultation	Community to be advised of progress on proposal	☐ Advise community of proposed opening date.			RTA Project Manager
Visual and Landscape Quality	Ensure landscape treatments are maintained and effective	☐ Following construction and before proposal operation, undertake maintenance of landscape treatments to ensure effectiveness.			RTA Project Manager Site Manager/Contractor
Erosion and Sedimentation	maintain surface water control measures and monitoring of water discharge until such time as landscape works are effective	☐ Stormwater drainage outlets to be monitored for evidence of stream sedimentation.	☐ Clean Waters Act 1970 ☐ Pollution Control Act 1970	☐ Environment Protect Authority ☐ Department of Land and Water Conservation	RTA Project Manager and Site Manager
		☐ Water quality of receiving waters to be monitored for evidence of pollution.			RTA Project Manager

Issue	Objectives	Actions	Relevant Legislation	Government Authority Contact	Responsibility
		☐ Quality of runoff from stormwater drainage outlets to be monitored to ensure compliance with Environment Protection Authority requirements as provided in the licence and in accordance with the sediment control plan.			RTA Project Manager/Contractor
		☐ Sediment traps to be retained after construction ceases until restoration works such as landscape treatments have become effective.			RTA Project Manager
Noise	Monitor traffic noise associated with the proposal to check the accuracy of the predictions made in the EIS up to 1 year following the opening of the proposal	☐ Conduct post construction monitoring and necessary action in accordance with the EPA traffic noise objectives.	☐ Noise Control Act 1975 ☐ EPA Noise Criteria	☐ Environment Protection Authority	RTA Project Manager

17.3 Statutory Requirements

All activities carried out in the study area as part of the construction and operation of the proposal must comply with the relevant provisions of all relevant environmental legislation and regulations. These include but are not necessarily restricted to:

- Clean Air Act (1961)
- Clean Waters Act (1970)
- Dangerous Goods Act (1975)
- Environment Protection (Impact of Proposals) Act 1974
- Environmental Offences and Penalties Act (1989)
- Environmental Planning and Assessment Act (1979)
- Environmentally Hazardous Chemicals Act (1985)
- Fisheries Management Act 1994
- Fisheries Management Amendment Act 1997, from 1 July 1998
- Land and Environment Court Act (1979)
- Local Government Act (1993)
- National Parks and Wildlife Act (1974)
- Native Vegetation Conservation Act (1997)
- Noise Control Act (1975)
- Noxious Weeds Act (1993)
- Ozone Protection Act (1989)
- Pollution Control Act (1970)
- Protection of the Environment Administration Act (1991)
- Protection of the Environment Operations Act from 1 September 1998
- Threatened Species Conservation Act (1995)
- Waste Disposal Act (1970)
- Waste Minimisation and Management Act (1995)
- Water Act (1912)

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Part G

Justification and Conclusion

g

18. Justification and Conclusion

Early Sections of the EIS described the need for the project. This section summarises and draws conclusions about the likely impact of the proposal on the social, biophysical and economic environment and discusses the justification for the project.

18.1 Justification

The proposal forms part of the Pacific Highway Upgrading Program which is a joint NSW State and Commonwealth Government initiative. The Program has been committed to meet the demands for improved capacity and safety of roads in the northern part of NSW, to respond to population increases in the area and facilitate economic growth through access to tourism and employment. The commitment to the Program is a direct response to the pressing need to address safety and efficiency problems associated with the existing alignment of the Pacific Highway.

Within the context of the Program, the Pacific Highway between Brunswick and Yelgun has been identified as a priority. This section is located entirely within Byron LGA. This area is expected to experience considerable population growth over the next 20 years. Therefore the demands on infrastructure, including transport, will continue to increase. The Pacific Highway will continue to play a key role as the principal road access to provide for future development, regional and inter-regional travel and improved safety.

The proposal's justification stems from economic and social considerations. Benefits are realised in the form of:

- road user benefits - benefits to the road user comprise savings in vehicle operating costs, travel time and avoided accidents; and
- regional economic development benefits - additional economic activity and employment induced by the construction expenditures and by the consequent reduction in road transport costs and improvement in accessibility.

The traffic and transport studies undertaken during this assessment indicate the need for an improvement of the road transport system between Brunswick and Yelgun particularly as the population, and therefore the number of potential users of the road system, is expected to continue to increase. Without improvements, the current mix of local and through traffic needs will result in a continuing deterioration of service levels, amenity and safety. The existing highway would not be able to accommodate the expected growth in traffic demand, for either local or through traffic.

An upgrade of the Pacific Highway in this area would potentially divert a high proportion of traffic, being through traffic, from the existing highway alignment. This would benefit travel conditions on the new highway as well as local roads.

Lower traffic volumes, consisting mostly of local traffic, would remain on the local roads (as the existing highway would become) and improve local amenity and safety. This would also benefit cyclists and pedestrians as through traffic would be largely removed from the towns therefore increasing the safety of local movements.

The proposal would serve to lower travel times between Brunswick and Yelgun for both tourist and commercial traffic. Currently, through traffic is slowed as it interacts with slow moving and turning local traffic. Through traffic on the proposal would be free flowing thereby reducing vehicle travel times, enhancing vehicle efficiency and road safety conditions. Conflicts between local and through traffic, as is currently the case, would be substantially eliminated.

The justification of upgrading can therefore be expressed in terms of three key parameters:

- accident savings,
- transport efficiency savings, and
- vehicle operating costs.

The detailed economic assessment of the proposal is discussed in Section 7 and is based on a forty year evaluation period. Put simply, if the proposal and growth projections are realised, then the net present value of potential accident savings to the community would be in the order of $7 million.

Similarly, the net present value of potential travel time savings of the proposal would be in the order of $96 million over the same 40 year period. The savings are a result of the slightly shorter route of the proposal, 8.7 km compared to the equivalent 8.8 km section of the existing highway, and also the higher design standard, allowing a design speed of 100 kph compared to the general operating speed of 80 kph or less on the existing highway. The higher design standard also reduces the probability of accidents occurring.

If the existing highway were to be retained and growth to continue, then the above savings figures represent the potential cost to the community of not proceeding with the proposal. This cost is also reflected in a continually lower level of service leading to increased frustration among users.

This serves to demonstrate that the project is justified in broad social terms in that it would effectively meet the traffic and transport objectives by providing a safer and more efficient highway, and also provide for safer and more efficient transport and access for local traffic due to the changed use of the existing highway.

When the construction and maintenance costs of the proposal are considered against the potential benefits, the resulting economic indicators of Benefit to Cost

Ratio (BCR) and Net Present Value (NPV) are 2.0 and $56 million respectively. This serves to justify the project in terms of economic considerations.

As part of this discussion it is important to note that this proposal includes the duplication of the Brunswick Heads Bypass, the first carriageway of which was recently opened. At the time of selecting the preferred route the Bypass was under construction. The proposed Bypass had been addressed through a separate environmental impact assessment process, undertaken well before the establishment of the Pacific Highway Upgrading Program.

Initially, a number of feasible routes were identified, all based on the premise that part of the proposal would include the duplication of the Bypass. As the route selection process proceeded, as a result of the community consultation process, additional routes using only part of the Bypass were also investigated.

In all, eight options (and variations and combinations of these) were investigated in detail. These are described in Section 5.

Ultimately, Route A2 was selected as the preferred route. The reasons for its selection are detailed in Section 5, but in summary it was concluded that this route represented the option with least potential impact on sensitive ecological areas; avoided existing residential areas such as the Ferry Reserve Caravan Park, potential residential areas at Billinudgel and rural residential areas at the Pocket; was consistent with Council's planning strategies; and was able to meet the traffic and transport efficiency objectives.

The route for the proposal is consistent with the continued operation and growth of Brunswick Heads, Ocean Shores and Billinudgel. Again, this supports the broad social justification as the proposal does not inhibit the development of these areas and, by providing improved access, improves the amenity and potentially the economic performance of the area.

It was recognised that the proposal would have environmental impacts and this included social impacts, but it was considered that these potential impacts could be managed to ensure that the environment could be adequately protected.

Furthermore, while it was not an over-riding consideration in route selection, the route is located adjacent to the existing Brunswick Heads Bypass and does take advantage of the investment made in this infrastructure; the route is then located for most of its length to the west of, but still close to, the existing highway alignment. Where the design and environmental considerations allowed, the proposal uses part of the existing road corridor, e.g. through the Brunswick Heads Nature Reserve, and at Billinudgel and much of the proposed corridor is located within land zoned for future road purposes.

Once the route had been selected there was a further phase of detailed investigation which aimed to maximise the concept design in terms of its horizontal and vertical alignment and other engineering requirements, and also, very importantly, to minimise property and environmental impacts. The design includes measures, such as retaining walls in the vicinity of the Nature Reserve, to minimise the road footprint.

Significant environmental benefits are incorporated in the proposal to minimise potential adverse impacts. These include a comprehensive water management strategy to manage road runoff and protect the health of sensitive waterways; extensive landscaping to shield the road and also to provide an attractive experience for road users; careful design and location of the proposal so that the vast majority of residents would be better off in regard to noise than they are now and implementing noise mitigation strategies where this is not the case; careful design and location of the new bridge so there are no adverse impacts on the river and the possibility of improvements for the river and its users.

Accordingly, it is considered that the proposal is justified in terms of the objective of minimising environmental impacts.

The proposal incorporates means of maintaining local access and access to properties. No properties are isolated as a result of the proposal, although the impact of the proposal on some properties is significant and these would be purchased by the RTA.

As stated earlier, the proposal would improve the amenity of the area and the Brunswick River environment. These improvements have the potential to result in economic benefits to Brunswick Heads, Ocean Shores and Billinudgel.

The economic assessment of the proposal has demonstrated its justification primarily in terms of the road user benefits mentioned above. It would have present net benefits in excess of its discounted costs. While environmental costs were not quantified as part of the economic analysis they were considered in the route selection process through a structured multi-criteria approach which places "values" on environmental attributes. In this sense, they are a valid economic input. This provides further justification of the proposal in the sense that the economic evaluation has concluded that the proposal, along its current route, provides benefits and minimises impacts on community resources.

The principles of ESD were an integral part of the route selection process, the development of the concept design and the development of environmental mitigation and improvement measures. Each of the four key principles are discussed below.

The ***precautionary principle*** has been applied through the whole process in that route identification and selection, and environmental assessment has relied on the best available technical information through the whole process and in the development of mitigation measures to address identified impacts. Local anecdotal information has also been acknowledged to ensure that local conditions are understood.

The selection of Route A2 is an example of the application of this principle, in that it could not be adequately demonstrated that other options could be developed with the potential for less environmental impact than the preferred route. Other examples include the proposed rehabilitation of the Brunswick River foreshore area and the potential for the provision of compensatory habitat.

In terms of ***inter-generational equity*** the proposal would benefit the community by providing improvements in safety, access and amenity for existing and future generations. The proposal is consistent with Council's long term planning strategies and does not inhibit potential future development options.

The proposal is consistent with the ***conservation of biological diversity and ecological integrity***. The preferred route was selected primarily because other options would have had greater and potentially unmanageable impacts on biological resources and ecological diversity. Although the proposal would have an impact on the Brunswick Heads Nature Reserve, the area of Reserve affected has mostly been previously disturbed.

The proposal includes the opportunity to relinquish the existing proposed road zoning on a corridor of wetlands located to the west of the Brunswick River bridge and secure this area for conservation purposes in the long term. By locating the proposal in the vicinity of the existing corridor through the Nature Reserve the potential to create another discontinuity in the wetlands along the Brunswick River has been avoided, thus maintaining the ecological integrity of that area.

The proposed water management strategy provides an improvement over the existing situation with long term benefits for the health and biological integrity and diversity of the Brunswick River and Marshalls Creek.

Finally, as indicated above, the process of route and alignment selection, and environmental assessment has taken into account the principle of ***improved valuation and pricing of environmental resources***. All of the options were evaluated using a range of technical and community "values" against a set of criteria developed in response to technical and community requirements. The study team, government agencies and the community were involved in this process. The selection of the preferred route reflected their values and was not

based solely on technical considerations. One of the most important criteria for route selection was to minimise impacts on the natural environment, and this was a clear and definite community requirement. This serves to demonstrate that while many of the values were not quantified, their environmental "value" is incorporated in the decision making process through the priority that the community and others place on them.

Accordingly, it is considered that the proposal is justified on the basis of social, biophysical and economic considerations, and in accordance with the principles of ecologically sustainable development.

18.2 Conclusion

The proposed duplication of the Brunswick Heads Bypass and the upgrade of the Pacific Highway from the Brunswick River to Yelgun is needed to provide a safer and more efficient route for the Pacific Highway in this area. The proposal would separate through traffic from the local road system at Ocean Shores and the vicinity of Billinudgel, as well as duplicate the Brunswick Heads Bypass. As well as providing significant benefits for users of the Pacific Highway, these works would result in improvements for local road users, including cyclists and pedestrians, and provide for increased amenity for Brunswick Heads, Ocean Shores and Billinudgel.

The route described and assessed in the EIS provides the best balance between social, biophysical and social factors, and would provide an acceptable economic benefit. The identified adverse impacts of the proposal can be managed to ensure that the environment can be adequately protected and achieve a net positive environmental impact and benefit to the community.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

References

References

Australia and New Zealand Environment and Conservation Council, (1992), *National Water Quality Management Strategy, Australian Water Quality Guidelines for Fresh and Marine waters.*

Australian Bureau of Statistics, (1996), *Census Data.*

AUSTROADS, (1988), *Guide to Traffic Engineering Practice, Part 2: Roadway Capacity.*

AUSTROADS, (1988), *Roadway Lighting Guide.*

AUSTROADS, (1994), *Road Safety Audit Guidelines.*

Bartz, R., (1988), *An archaeological survey of a proposed heavy mineral extraction site at Newrybar Swamp north of Ballina, NSW.* Report to Corkery and Co. Pty. Ltd.

Briggs, J. and Leigh, J., (1996), *Rare or Threatened Australian Plants.* CSIRO, Canberra.

Brokenshire, J., (1988), *The Brunswick: another river and its people.*

Byron Council, (1988), *Local Environmental Plan 1988.*

Collins, J., (1993), *Lismore flood levee system: and archaeological assessment.* (Report to WBM Oceanics, Australia).

Department of Urban Affairs and Planning, (1994), *Population Projections Non-Metropolitan LGAs.*

Department of Urban Affairs and Planning, (1997), *Land Use and Pacific Highway Upgrading Strategy - Brunswick River to Tweed Heads.*

Department of Urban Affairs and Planning and Roads and Traffic Authority, (1996), *Discussion Paper Land Use and Pacific Highway Upgrading Strategy - Brunswick River to Tweed Heads.*

Department of Urban Affairs and Planning, (1992), *Risk Assessment - Hazardous Industry Planning Advisory Paper No.4 Risk Criteria for Land Use Safety Planning.*

Department of Urban Affairs and Planning Risk, (1994), *Risk Assessment - Hazardous Industry Planning Advisory Paper No.3 Environmental Risk Impact Assessment Guidelines*

DeVries, R., (1997), *Vascular Plant Taxa of Priority Conservation Concern within North-eastern New South Wales.* Flora Report No. 4 of the Forest Biota Response to Disturbance Project in North-Eastern NSW. Unpublished Draft Report prepared by the NSW NPWS Northern Zone as part of the Comprehensive Regional Assessment of NSW Forests.

Dockery, D.W., Pope, C.A., Xiping Xu, Spengler, J.D., Ware, J.H., Fay, M.E., Ferris, B.G. and Speizer, F.E., (1993), An Association Between Air Pollution and Mortality in Six US Cities. *The New England Journal of Medicine*, Volume 329, Number 24, pg 1753-1759.

Environment Protection Authority, (1993), *NSW Government Lead Issues Paper.*

Environment Protection Authority, (1994), *Environmental Noise Control Manual.*

Environment Protection Authority, (1995), *Acid Sulfate Soils Assessment and Management - Guidelines for Land Developments in Coastal Areas, Draft XI.*

Environment Protection Authority, (1995), *NSW Greenhouse Gas Inventory Report - Estimate for 1990 and 2000.*

Environmental Protection Authority, (1997), *Treatment Techniques, Managing Urban Stormwater.*

Eyre, B., (1996), *Water Quality Monitoring, Brunswick Heads Bypass, pre-construction phase.*

Floyd, A., (1990), *Australian Rainforests in NSW.* Volume 2. Surrey Beatty and NPWS, Chipping Norton.

Griffith, S., (1993), *Conservation Status of Coastal Plant Communities in Northern New South Wales.* National Parks and Wildlife Service.

Hager, T. and Benson, J., (1994), *Conservation Status of Forest Communities in North East NSW.* Report to the Australian Heritage Commission. NSW National Parks and Wildlife Service, Hurstville.

Jones, A., Watson Russell, C. and Murray A., (1986), Spatial Patterns in the Macrobenthic Communities of the Hawkesbury Estuary, NSW. *Australian Journal of Marine and Freshwater Research* 38, 521-43.

Jones, A., (1987), Temporal Patterns in the Macrobenthic Communities of the Hawkesbury Estuary, NSW. *Australian Journal of Marine and Freshwater Research* 38, 607-24.

Kinhill, (1996), *Pacific Highway - Brunswick River to Billinudgel Route: Constraints Study and Preliminary Investigations.*

Kinhill, (1997), *Proposed Upgrade of the Pacific Highway at Tandys Lane - Review of Environmental Factors.*

Lomax, K., (1994), *Survey for archaeological sites - Brunswick Heads Bypass, Far North Coast.* Report to RTA.

Lomax, K., (1995), *RTA Ridge 1* (NPWS Site #4-4-0081) and Saddle salvage excavations, Brunswick Heads Bypass, Far North Coast, NSW. Report to the RTA.

Millidge, D. and McKinley, A., (1992), *A Flora and Fauna Survey for the Route Selection Study. Proposed Pacific Highway Bypass, Brunswick Heads/Pacific Highway - State Highway No. 10 Brunswick Heads Bypass EIS, Volume 2 - Fauna Impact Statement.* Roads and Traffic Authority.

National Parks and Wildlife Service, (1992), *North East Bio News. Newsletter of the North East NSW Biodiversity Survey.*

Navin, K., (1990), *An archaeological survey of North Ocean Shores Development Area, NSW.* Report to BondCorp.

Neal, R. and Stock, E., (1986), Pleistocene occupation in the south-east coastal region. *Nature*, 323: p618-721.

Pierce, R., (1978), The evidence of J. Ainsworth on the diet and economy of the Ballina Horde. In McBryde (ed) *Records of times past.* Australian Institute of Aboriginal Studies, Canberra.

RACAC, (1996), *Draft Interim Forest Assessment Report.* Resource and Conservation Assessment Council, Sydney.

Roads and Traffic Authority, (1989), *Roads Design Guide.*

Roads and Traffic Authority, (1993), *Guide to Traffic Generating Developments.*

Roads and Traffic Authority, (1993), *Pacific Highway - State Highway No.10 Brunswick Heads Bypass. Environmental Impact Statement.*

Roads and Traffic Authority, (1993), *Rural Crash Rates - Road Stereotypes*, Road Safety Bureau.

Roads and Traffic Authority, (1993), *Updated Guidelines for Functional Classification of Roads in Urban Areas.*

Roads and Traffic Authority, (1995), *Road Safety Audit Manual.*

Roads and Traffic Authority, (1995), *Plan for Reducing Vehicle Emissions.* RTA Environment and Community Impact Branch.

Roads and Traffic Authority, (1996), *Acid Sulfate Guidelines.* RTA Environment and Community Impact Branch.

Roads and Traffic Authority, (1997), *Economic Analysis Manual.*

Roads and Traffic Authority, (1997), *RTA Air Quality Monitoring Program,* prepared for the RTA by Holmes Air Science.

Sinclair Knight, (1994), *Proposed Motorway - Billinudgel to Chinderah, Environmental Statement.*

State Pollution Control Commission, (1983), *Pollution Control in NSW: A Progress Report.* Supplement of 1982, 1983 Annual Report.

Steele, J.G., (1988), *Aboriginal Pathways in South-east Queensland and the Richmond River.* University of Queensland Press, St Lucia.

Stevenson and Associates, (1991), *Air Quality Study, North West Transport Links, Environmental Impact Statement.*

The Institution of Engineers, Australia, (1987), *Australian Rainfall and Runoff - A Guide to Flood Estimation, Volume 1.*

US Environmental Protection Agency, (1981), *Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources.* US EPA, Office of Research and Development, Cincinnati, Ohio.

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Appendix A

Matters to be Addressed in the EIS

Appendix

Appendix A - Matters to be Addressed in the EIS

Requirements of the Environmental Planning and Assessment Regulation, 1994

Matters to be Addressed in EIS	Where in EIS?
Clause 84 Summary of the EIS.	Summary, Section 2 describes the components of the EIS
Statement of objectives of the proposal.	Section 1
Analysis of feasible alternatives to carrying out the proposal.	Sections 4, 5
Consequences of not carrying out the proposal.	Sections 1, 4, 7, 18
Reasons justifying the carrying out of the proposal.	Sections 1 and 4
Full description of the proposal.	Section 6
Description of the environment likely to be affected by the proposal.	Sections 7-17
Detailed description of those aspects of the environment that are likely to be significantly affected by the proposal.	Sections 7-17
Likely impact on the environment of the proposal having regard to the:	
☐ likelihood of soil contamination	Section 13, WP No.9
☐ impact on flora and fauna	Section 12, WP No.8, SIS
☐ impact on the health of people in the neighbourhood	Sections 7, 16
☐ hazards	Section 7, WP No.1
☐ impact on traffic in the neighbourhood	Section 4, 7, WP No.1
☐ effect on local climate	WP No.4
☐ social and economic impact	Section 7, 16
☐ visual impact and impact on scenic quality of land in the neighbourhood	Section 15, WP No.9 Section 15, WP No.10
☐ effect on soil erosion and silting of rivers or lakes	Section 10, WP No.5
☐ effect on the cultural and heritage significance of the land.	Section 11, WP No.7
Full description of measures proposed to mitigate any adverse impacts of the proposal.	Sections 7-17
Reasons justifying the carrying out of the proposal in the manner proposed having regard to:	
☐ biophysical considerations	Section 5, 8-16
☐ economic considerations	Section 4,5, 7, 16, 18
☐ social considerations	Section 1, 4, 5, 14, 16, 18
☐ the principles of ecologically sustainable development	Described in Section 1, addressed throughout the EIS, and concluded in Section 18
A compilation (in a single section of the EIS) of the mitigation measures to be undertaken to reduce impacts of the proposal.	Section 17.
A list of any approvals that must be obtained under any other Act or law before the proposal may lawfully be carried out.	Section 2, 17

WP - Working Paper

Director-General's Requirements (DUAP)

Matters to be Addressed	Where in EIS
Relationship of the proposal to:	
☐ North Coast Regional Environmental Plan	Sections 4 and 14
☐ Roads and Traffic Authority's State Road Network Strategy	Sections 4 and 14
☐ Pacific Highway Reconstruction Program	Sections 4 and 14
☐ Brunswick River to Tweed Heads Land Use and Pacific Highway Upgrade	Sections 4 and 14
Any deviation from the existing Pacific Highway corridor should be fully justified.	Section 5, Section 18
State Environmental Planning Policy No. 14 - Coastal Wetlands:	
☐ consultation with Byron Shire Council	Section 3, 5
☐ identification of the wetland's habitats and its relationship to the surrounding environment, including a vegetation survey map to indicate any rare or threatened species, their values and the extent of weed infestation	Section 12 WP No.8
☐ a faunal survey describing the birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) of the area and the occurrence of any rare or threatened protected species	Section 12 WP No.8
☐ an analysis of the surface and groundwater quality and hydrological regime	Section 13 and WP No.9
☐ discussion of the environmental implications of the proposal, including, but not limited to:	
- assessment of the changes to plant and animal species	Section 12 WP No.7
- description of the design features incorporated to guard against actual and potential disturbances to the vegetation, fauna water quality and hydrological regime	Sections 10 and 12 WP No. 5, 7 and 8
- description of any proposed mitigation measures during construction and operation of the proposal	Sections 7-16, 17
- soil analysis consistent with Environmental Protection Authority guidelines to assess potential acid sulphate soils and mitigation of impacts	Section 13, WP No.8
☐ description of any proposed measures that will offset losses in wetland values or other environmental impacts which may occur, such as the preparation of a management plan which maintains or enhances wetlands not affected by the proposal or establishment of a wetland habitat which replaces some values lost through the development or contributes to other wetland values	Section 12, 14, WP No.7
Detailed description of the proposal including diagrams, photomontages based on aerial photographs and key perspectives from nearby residents and landowners.	Section 6, WP No.2
Description of all ancillary works including interchanges, traffic management measures and property access.	Section 6 WP No.2
Identification of proposed property adjustments and acquisitions and a description of the acquisition process.	Section 14
Impact on Nature Reserve on Brunswick River and other significant vegetation, in particular, the rare and endangered rainforest tree *Fontainea oraria.*	Section 12 WP No. 8
Potential impact on fauna, in particular koala populations and habitat.	Section 12 WP No.8

Matters to be Addressed	Where in EIS
Potential impacts on the rural population, land use (including potential for change), agriculture and oyster leases within the study area. Impacts on local businesses, including service stations, hotels and other facilities relying on passing trade, any safeguards and proposed mitigation measures.	Section 5, 8, 14, 10, 17
Water quality impacts, aquatic ecology impacts and particularly mitigation measures against pollution/degradation of the Brunswick River, particularly during construction.	Section 10 WP No.5
Flood mitigation measures and assessment of likely impact on flood regime.	Section 10 WP No.5
Analysis of soils in any floodplain area to determine the presence and severity of acid sulphate soils. Requirements for sampling and testing to be discussed with the Environment Protection Authority. Provide options to avoid disturbance to potential acid sulphate soils, treatment and/ disposal of contaminated soils, methods to minimise impacts and proposed safeguards.	Section 13, WP No.8
Consideration of any additional issues arising from the Planning Focus Meeting held on 26 November 1996.	Section 3 and throughout EIS

New South Wales Government
Department of Urban Affairs and Planning

Ms Jo Moss
Sinclair Knight Merz
PO Box 164
ST LEONARDS 2065

Meredith McIntyre

G96/00354

EN00484

Dear Ms Moss,

Proposed Bypass Duplication of the Brunswick Heads Bypass and the Realignment of the Pacific Highway from the Brunswick River to Billinudgel

Thank you for your letter of 14 November 1996 seeking consultation with the Director-General for the preparation of an environmental impact statement (EIS) for the above proposal. The proposal could be subject to both Part 4 and Part 5 of the Environmental Planning and Assessment (EP&A) Act 1979.

Part 4 of the EP&A Act may apply where the proposal affects State Environmental Planning Policy No. 14 - Coastal Wetlands (SEPP 14). If the Policy applies, development consent will be required from Byron Shire Council with concurrence from the Director-General of this Department. The proposal will also be a designated development under clause 7(3) of SEPP 14 and an EIS must be prepared to accompany the development application to the Council. You should consult Byron Shire Council to clarify the statutory requirements where SEPP 14 wetlands are affected. The exhibition of the EIS will need to be co-ordinated with the Council.

Under clause 52 and 85 of the Environmental Planning and Assessment Regulation 1994 (the Regulation), the Director-General requires that the key issues outlined below are specifically addressed in the EIS.

Key issues

1. Relationship of the proposal to relevant State and regional planning strategies and objectives, including the North Coast Regional Environmental Plan, the Roads and Traffic Authority's State Road Network Strategy, the Pacific Highway Reconstruction Program, the Brunswick River to Tweed Heads Land Use and Pacific Highway upgrade strategy.
2. Any deviation from the existing Highway corridor should be fully justified.
3. State Environmental Planning Policy No. 14 - Coastal Wetlands:
   - Identification of the wetland's habitats and its relationship to the surrounding environment, including a vegetation survey map (preferably at a scale of 1:4000)

Governor Macquarie Tower
1 Farrer Place, Sydney 2000
Box 3927 GPO, Sydney 2001

Telephone: (02) 9391 2000
Facsimile: (02) 9391 2111

to indicate any rare or threatened plant species, their values and the extent of any weed infestation; a faunal survey describing the birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) of the area and the occurrence of any rare or threatened and protected species; and an analysis of the surface and groundwater quality and hydrological regime.

- A discussion of the environmental implications of the proposal, including, but not limited to, assessment of the changes to plant and animal species; a description of the design features incorporated to guard against actual and potential disturbances to the vegetation, fauna, water quality and hydrological regime; a description of any proposed mitigation measures during the construction and operation of the proposal; and soil analysis consistent with Environment Protection Authority Guidelines to assess potential acid sulphate soils and mitigation of potential impacts.
- A description of any proposed measures that will offset losses in wetland values or other environmental impacts which may occur, such as the preparation of a management plan which maintains or enhances wetlands not affected by the proposal or the establishment of a wetland habitat which replaces some values lost through the development or contributes to other wetland values.

4. detailed description of the proposal including diagrams, photomontages based on aerial photographs and key perspectives from nearby residents and landowners. Description of all ancillary works including interchanges, traffic management measures and property access. Identification of proposed property adjustments and acquisitions and description of acquisition process.
5. Impact on Nature Reserve on Brunswick River and other significant vegetation, in particular, the rare and endangered rainforest tree "Fontainea Oraria".
6. Potential impact on fauna, in particular koala populations and habitat.
7. Potential impacts on the rural population, land use (including potential for change), agriculture and oyster leases in the Study Area.
8. Impacts on local businesses, including service stations, hotels and other facilities relying on passing trade; any safeguards and proposed mitigation measures.
9. Water quality impacts, aquatic ecology impacts and particularly mitigation measures against pollution/degradation of the Brunswick River, particularly during construction.
10. Flood mitigation measures and assessment of likely impact on flood regime.

11. Analysis of soils in any floodplain area to determine presence and severity of acid sulphate soils. Requirements for sampling and testing to be discussed with the Environment Protection Authority. Provide options to avoid disturbance to potential acid sulphate soils, treatment and/or disposal of contaminated soils, methods to minimise impacts and proposed safeguards.

12. Consideration of any additional issues arising from the Planning Focus Meeting held on 26 November 1996.

Attachment No. 1 is the Department's EIS Guidelines for Roads and Related Facilities and contains a guide on the type of information most likely to be relevant to the proposed development. Not all the matters it contains may be appropriate for consideration in the EIS for your proposal; equally, the guideline is not exhaustive.

The EIS shall be prepared in accordance with clauses 50, 51, 83 and 84 of the Regulation. Statutory requirements for the form and content of the EIS (assuming that both Parts 4 and 5 apply) are outlined in Attachment No. 2.

The issues emerging from consultation with relevant local, State and Commonwealth government authorities, service providers and community groups are to be addressed in the EIS. The applicant should also identify and consult with any other parties who may have an interest in the proposal.

If there is any significant variation of the final alignment from the Study Area, you should consult again with the Director-General for any additional requirements.

Should you require any further information regarding the Director-General's requirements for the EIS, please contact Ms Meredith McIntyre on (02) 9391 2384.

Yours sincerely,

Neville Osborne

David Mutton 16/12/96
A/Manager
Major Assessments and Hazards Branch
As Delegate for the Director-General

DEPARTMENT OF URBAN AFFAIRS AND PLANNING

Attachment No. 2

STATUTORY REQUIREMENTS FOR THE PREPARATION AND EXHIBITION OF AN ENVIRONMENTAL IMPACT STATEMENT UNDER PARTS 4 AND 5 OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clauses 51 and 84 of the *Environmental Planning and Assessment Regulation 1994* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. An analysis of any feasible alternatives to the carrying out of the development or activity, having regard to its objectives, including:
   (a) the consequences of not carrying out the development or activity; and
   (b) the reasons justifying the carrying out of the development or activity.
4. An analysis of the development or activity, including:
   (a) a full description of the development or activity; and
   (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
   (c) the likely impact on the environment of the development or activity, having regard to:
      (i) the nature and extent of the development or activity; and
      (ii) the nature and extent of any building or work associated with the development or activity; and
      (iii) the way in which any such building or work is to be designed, constructed and operated; and
      (iv) any rehabilitation measures to be undertaken in connection with the development or activity; and
   (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment.
5. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.
6. Compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
7. A list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out.
8. For the purposes of Schedule 2, the principles of **ecologically sustainable development** are as follows:
   (a) The precautionary principle - namely, that 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.
   (b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
   (c) Conservation of biological diversity and ecological integrity.
   (d) Improved valuation and pricing of environmental resources.

Note

The matters to be included in item (4)(c) might include such of the following as are relevant to the development or activity:

(a) the likelihood of soil contamination arising from the development or activity;

(b) the impact of the development or activity on flora and fauna;
(c) the likelihood of air, noise or water pollution arising from the development or activity;
(d) the impact of the development or activity on the health of people in the neighbourhood of the development or activity;
(e) any hazards arising from the development or activity;
(f) the impact of the development or activity on traffic in the neighbourhood of the development or activity;
(g) the effect of the development or activity on local climate;
(h) the social and economic impact of the development or activity;
(i) the visual impact of the development or activity on the scenic quality of land in the neighbourhood of the development or activity;
(j) the effect of the development or activity on soil erosion and the silting up of rivers or lakes;
(k) the effect of the development or activity on the cultural and heritage significance of the land.

An environmental impact statement referred to in Sections 77(3)(d) and 112(1) of the Act shall be prepared in written form and shall be accompanied by a copy of Form 2 or Form 8 (as appropriate) signed by the person who has prepared it.

The EIS must also take into account any matters required by the Director-General of Urban Affairs and Planning pursuant to clauses 52 and 85 of the Regulation, which may be included in the attached letter. A copy of the Director-General's Requirements should be included as an appendix to the EIS.

Attention is also drawn to clause 115 of the Regulation regarding false or misleading statements in EISs.

Nominated Determining Authority

Where there are a number of determining authorities (as defined under Part 5 of the Act), Section 110A of the Act provides for the Minister to make one of them the nominated determining authority. This avoids duplication of procedures and simplifies the exhibition of the EIS.

It is recommended that you discuss with the other determining authorities which one should become the nominated determining authority and advise the department accordingly. Normally it is the proponent agency that becomes the nominated determining authority. The written agreements of all other determining authorities must be forwarded with the request to be made the nominated determining authority.

It should be noted that the onus is on the proponent agency to identify all other potential determining authorities.

Public Exhibition

When the EIS has been completed, four (4) copies should be forwarded to the Secretary (Attention: Manager, Major Assessments and Hazards Branch) pursuant to Sections 77(5) and 112(2) of the Act, together with details of the exhibition period and public display locations.

This should occur prior to public exhibition of the EIS in order that simultaneous exhibition of the EIS occurs in the offices of the Department, council and determining authority as required by Sections 86 and 113 of the Act and clauses 55 and 88 of the Regulation.

It is requested that a copy of the text of the EIS also be supplied on a 1.44 MB floppy disk. This should be in a format readable by MS Word for Windows® Version 6 or as plain text (ASCII). Inclusion of files of supporting maps and diagrams is optional.

Procedures for public exhibition of the EIS are set down in clauses 55 to 57 and 87 to 88 (under Parts 4 and 5 respectively) of the Regulation.

Note

Should the EIS not be exhibited within 2 years from the date of issue of the Director-General's requirements, under clauses 52(5) and 85(5) of the Regulation the proponent is required to reconsult with the Director-General.

Submissions and Representations

Any submissions (Part 4) and representations (Part 5) made in response to public exhibition of the EIS should, as soon as practicable and not less than 21 days before determining the activity, be forwarded to the Secretary in accordance with Sections 87 and 113(3) of the Act.

Seeking the Minister's Approval

If Division 4 of Part 5 of the Act applies to the proposal, the proponent, pursuant to Section 115B, should seek the Minister's approval once it has obtained and exhibited an EIS, examined and considered any representations, and forwarded copies of all representations to the Department.

If a Species Impact Statement (SIS) has been prepared, the Proponent must have complied with Sections 112B and/or 112C of the Act (i.e. concurrence and/or consultation requirements) before seeking the Minister's approval.

The Department's *Best Practice Guidelines* encourage proponents when seeking approval to provide:

- a comprehensive report which addresses in detail its consideration of issues raised in representations;
- any proposed changes to the activity, and any further measures to mitigate impacts; and,
- all relevant technical information relating to the proposed activity.

– ✧ –

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Appendix B

Authority Consultation

Appendix

Appendix B - Authority Consultation

Summary of Authority Consultation

Authority Consulted	Response Received	Where Addressed in EIS	Comments
Australian Heritage Commission	14/2/97	Section 5, 6, 10, 11, 12, WP No. 5, 6,7	☐ The Brunswick Heads Nature Reserve is listed in the Register of National Estate and should remain intact. Options to achieve this should be investigated. ☐ vegetation communities and endangered flora and fauna should be investigated and measures to minimise the impact on these communities ☐ hydrology and water quality issues should be discussed ☐ erosion and silting of creeks, rivers and wetlands should be addressed ☐ impacts resulting from bridge construction should be addressed ☐ may need weed control program ☐ minimise disruption to movements of terrestrial fauna, provide underpasses ☐ minimise fire risk ☐ rehabilitate disturbed areas using local native plant seed where possible ☐ assess potential impacts to Aboriginal sites
Brunswick River Protection Committee	7/2/97	Section 6, 10,	☐ re-use of effluent on nature strips should be investigated
Byron Council			☐ consultation with Byron Council has been ongoing and extensive over the duration of this project. Byron Council has been represented at the Value Management Workshop, where route selection decisions were made, as well as the Value Engineering and Risk Management Workshops, where the route alignment was refined and risks associated with the project recorded and ranked. Byron Council have also been consulted regarding particular issues such as consent requirements for SEPP 14 wetlands, provision of new and altered access to properties impacted by the proposal and treatment of runoff along the proposal. Byron Council have also been a key source of information for the project , providing material such as property and landuse plans.

Authority Consulted	Response Received	Where Addressed in EIS	Comments
Department of Land and Water Conservation	5/12/96	Section 2, Section 10, Section 13, WP 5, 8	☐ need to consider Crown public roads in area ☐ concern about potential impact on Crown land caravan park and need for relocation of tenants ☐ need to minimise constriction of flood flows within the catchments of Billinudgel and Marshalls Creeks ☐ develop erosion and sedimentation control plan prior to construction, including rehabilitation plan ☐ seek permit for clearing protected lands under section 21(c) of the Soil Conservation Act, 1936; and trees and shrubs within 20m of River under 21-D permit ☐ investigate area to north of River for instability of steeper lands ☐ test for potential acid sulphate soils and prepare plan of management ☐ minimise impacts on riparian zone of local creeks and the Brunswick River
Heritage Council of NSW	21/11/96	Section 5, 11, WP 6	☐ concern about impacts on any item of environmental heritage that may exist in the study area ☐ refer to LALC, National Trust, AHC and local historical societies re heritage significance ☐ heritage assessment to include natural areas and places of Aboriginal, historical or archaeological significance, buildings and works, any other archaeological deposit
Mineral Resources	6/12/96	Section 5, 13, WP 8	☐ preference is for more easterly corridor to avoid heavy mineral sand development in Smoky Valley ☐ consider demand for construction material and impacts on local quarries ☐ no objection to proposed duplication of highway at Brunswick Heads
National Parks and Wildlife Service	11/3/98	Section 2, 5, 12, 14 WP 7	☐ NPWS provided detailed requirements for the SIS ☐ maintain access to Brunswick Heads Nature Reserve, east of the proposed bridge over Brunswick River, for NPWS visitor facilities in the Nature Reserve to be reached. PWD also require this access to maintain a rock wall in the Brunswick River.
North Power	5/2/98	Section 6, WP 2	☐ preference is to locate proposed road on the eastern side of the highway, north of Brunswick Heads to avoid switching station. ☐ consider access to assets during planning ☐ need to consider environmental impacts and timing for creation of new access
NSW Agriculture	26/11/96	Section 5, 14	☐ concern for prime agricultural land and potential sugar cane land, particularly west of Billinudgel. ☐ detailed agricultural study recommended

Authority Consulted	Response Received	Where Addressed in EIS	Comments
NSW Department of Transport	7/1/97	Section 4, 6,7 WP 1, 2	☐ endorses the separation of local and through traffic ☐ encourages use of public transport by providing safe pickups, including off the shoulder lay-bys; safe turning, entry and exit for buses, minimising disruption to existing bus services and infrastructure; providing sufficient opportunities to pull off ☐ encourage bicycle use by providing bicycle paths
NSW Environment Protection Authority	30/12/96	Section 2, 5, 6, 8, 9, 10,13, WP 2, 3, 4, 5, 7, 8,	The EPA provided a detail response. Issues to be considered included: ☐ impacts on local air quality during construction ☐ ambient noise levels at nearby residential premises, school, hospital and commercial premises ☐ noise, blasting and vibration control criteria ☐ measures to control and mitigate noise impacts during road construction and operation stages; approval of road construction and operation noise control measures ☐ criteria for control of noise, vibration and blasting impacts caused by construction works and associated traffic ☐ noise mitigation measures ☐ monitoring of performance of noise mitigation measures; policies on vehicle design to reduce noise emissions ☐ water quality of affected waters ☐ soil erosion, sediment control and water quality management plan ☐ identification and management of contaminated sites and acid sulfate soils ☐ prepare water management plan ☐ prepare vegetation management plan ☐ prepare habitat preservation management plan (to satisfy the requirements of the NSW Threatened Species Conservation Act 1995) ☐ waste management ☐ Consultation, Monitoring, Reporting and Training - prepare EMP

Authority Consulted	Response Received	Where Addressed in EIS	Comments
NSW Fisheries	18/3/98		☐ the types of aquatic vegetation and fish habitat likely to be affected by the route ☐ the value on a local and regional scale of such vegetation ☐ means for mitigating impacts to vegetation and habitats ☐ vegetation rehabilitation or compensation ☐ impacts to commercial and recreational fisheries ☐ impacts to water quality and management options ☐ interruptions to access to fishing grounds ☐ for any watercourse crossed by the route impacts to water flow, turbidity and sedimentation rates
Optus	20/12/96	Section 6, WP 2	☐ written approval required prior to any works occurring in the vicinity of Optus assets
Telstra	14/1/98	Section 6, WP2	☐ need to identify Telstra assets
Tweed-Byron Local Aboriginal Land Council	contained in WP 6	Section 10, WP 6	☐ the Tweed-Byron Local Aboriginal Land Council have been involved in extensive discussions and ongoing consultation as part of the indigenous and non-indigenous heritage assessment. Working Paper No.7. contains copies of correspondance with the Tweed-Byron Land Council.
Waterways Authority	15/5/98	Section 6, 10, WP 2, 5	☐ clearance of the new bridge above mean high water ☐ visibility of construction, barges and work boats ☐ lighting of existing bridge during construction period ☐ demolition of existing bridge to be complete ☐ navigation lighting requirements for new bridge

In addition to the responses received and summarised above, a number of other authorities and organisations were consulted. In many cases, consultation involved on site and informal meetings, or phone contact; in some cases these organisations made submissions in respect of particular aspects of the proposal. Some Many of these organisations also participated in the Planning Focus Meeting and/or Value Management workshop. These organisations included:

- BEACON
- Billinudgel Chamber of Commerce
- Billinudgel Progress Association
- Brunswick Catchment Management Committee
- Brunswick Heads Police Department
- Brunswick Heads Progress Association
- Brunswick Valley Chamber of Commerce and Industry
- Byron Bay Environment Centre
- Byron/Brunswick Flora and Fauna Conservation Society
- Caldera Environment Centre
- Conservation of North Ocean Shores
- Member for Ballina
- National Trust of Australia
- Northern Rivers Regional Organisation of Councils
- NSW Health Department
- Ocean Shores Urban Association
- State Rail Authority
- Tweed-Lismore Rural Lands Protection Board

AUSTRALIAN HERITAGE
COMMISSION

File No: 1/1/111/4

Contact Officer: Ms Lenore Fraser, (06) 217 2187

6 February 1997

Ms Jo Moss
Project Manager
Sinclair Knight Merz
PO Box 164
ST LEONARDS NSW 2065

Dear Ms Moss

Proposed Second Carriageway for the Brunswick Bypass and the Upgrade of the Pacific Highway Between the Brunswick River and Yelgun

Thank you for your letter of 17 December 1996, requesting the Australian Heritage Commission to identify any issues of concern that should be addressed in the Environmental Impact Statement for the above proposal.

The Commission's major concern is to conserve the national estate values of the Brunswick Heads Nature Reserve which is in the Register of the National Estate (RNE). I have enclosed a printout about the place from the RNE database and map of the place for your information. I have also included a printout of all proposed RNE places in the study area.

The Commission stresses that in selecting the specific route of the highway upgrade immediately north of the Brunswick River, the Brunswick Heads Nature Reserve should remain intact.

One option would be to begin the second carriageway north of the Nature Reserve, rather than beginning 400m to the south of the river. This would avoid fragmentation of the Reserve and also the need to construct additional bridges. Another option would be to route the road across the river so that it passes between the two parts of the Nature Reserve, west of the existing bridge. The "do nothing" option should also be discussed in the EIS.

In assessing the impact of the proposed works on the national estate values of the Brunswick Heads Nature Reserve, the Commission considers that the EIS should also describe impacts in relation to the following issues, and measures proposed to minimise these impacts:

- the vegetation communities present in the Reserve. The EIS should detail the amount of clearing which would be required and a description of the actual plant communities to be disturbed. Measures to minimise impacts on these communities should be discussed;

MTA HOUSE 39 BRISBANE AVENUE BARTON ACT 2600 PHONE (06) 217 2111 MTA FAX (06) 217 2095 IBM FAX (06) 217 2000
GPO BOX 1567 CANBERRA ACT 2601 AUSTRALIA

- any endangered fauna or flora present in the reserve that may be affected;
- the hydrology of the area, particularly the flow regimes of the Brunswick River and its tributaries;
- erosion and subsequent silting of rivers, creeks and wetlands (particularly impacts on the mangrove and wetland forest communities present in the Reserve);
- any impacts resulting from bridge construction;
- water quality (including minimising fuel and chemical pollution and excess nutrient flows in the river);
- exotic species and avoiding their distribution in the Reserve (cleaning of machinery and vehicles before transport to the site and the development of a weed control program may be required);
- minimising disruption to the movements of terrestrial fauna, eg through providing underpasses, etc;
- minimising the risk of fire in the area as a resulting of constructing, maintaining or using the second carriageway; and
- the rehabilitation of disturbed areas, preferably using plantings derived from native plant seed collected locally.

The Commission also suggests that as part of the EIS the local Aboriginal Land Council and the New South Wales National Parks and Wildlife Service be contacted regarding the impact of the proposed works on Aboriginal sites in the area. It is an offence under the *National Parks and Wildlife Act 1974,* to destroy Aboriginal relics in New South Wales. The Service administers the Act and can advise on how its requirements can be satisfied.

No historic places in the Register of the National Estate appear to be effected by the proposal. However, the Register of the National Estate is not a comprehensive list of historic places and the Commission recommends that the proponent should consult with local government authorities to determine if any proposed routes affect historic places in the area, including significant trees. Proposed routes should also be surveyed for historic places.

If you require any further information about this matter please contact Ms Lenore Fraser on the above telephone number.

Yours sincerely

Christine Lawrence
Acting Deputy Executive Director

Identification

Name of Place: Brunswick Heads Nature Reserve

Other Names:

Database No: 000213

File No: 1/01/111/0004

Principal Group: Vegetation communities

Status

Legal Status: 21/10/1980 — Registered

Admin Status: 21/10/1980 — Registered

Location

Nearest Town: Brunswick Heads

Distance (km): 1.00

Direction from town: N

Area (ha): 74.00

Address: North Head Rd, Brunswick Heads NSW 2483

Local authorities: Byron Shire (Current LGA)
Byron Shire (Now 1/1/2)

Property Information

Location/Boundaries
74ha, located 1km north of Brunswick Heads.

AHC Official Statement of Significance
The rainforest stands at Brunswick Heads are unique. There is no longer any comparable portion of rainforest in NSW. Several rainforest species reach their southern limit of distribution at this point. Thus the species composition of this area is substantially different from similar habitats further south.
(The Commission is in the process of developing and/or upgrading official statements for places listed prior to 1991. The above data was mainly provided by the nominator and has not yet been revised by the Commission.)

Description
Brunswick heads Nature Reserve is an extensive area of sub-tropical rainforest which has developed on alluvial sand. Floristically the area is rich in species and several rainforest species reach the southern limit of distribution at this point. It is located on the foreshores of the Brunswick River Estuary and North Arm Brunswick River thus Mangroves are adjacent to the rainforest providing habitat for water birds.

Condition
Natural condition

Brunswick River Protection Committee

the Secretary
B R P C
~~PO Box~~ 925
Mullumbimby 2482

February, 1997

EIS Project Manager
Sinclair Knight Merz
PO Box 164
ST. LEONARDS 2065

attention: Jo Moss

PROPOSED SECOND CARRIAGEWAY FOR BRUNSWICK HEADS

Thank you for the opportunity to have some input into the investigations for the above project. This Committee is dedicated to the cleaning of our beautiful but polluted Brunswick River. As such we do not condone the duplication: it will ease the current choke on traffic in our region and thus produce more vehicles and people here, with consequent degradation of the environment including our waterways.

We do however wish to highlight the possibility of one positive outcome for the River. In Byron Shire treated and untreated sewage from our urban centres is currently directed to our waterways. If the highway is to be dual carriageway, the lack of human access to the nature strip between offers the an opportunity for re-using treated effluent to irrigate it.

Council is currently seeking sites for the effluent. Please investigate this avenue of environmental retribution within your project.

Yours faithfully

Duncan Dey
for the Committee

LAND & WATER CONSERVATION

Ms Jo Moss
Sinclair Knight Merz
P.O. Box 164
St Leonards NSW 2065

Our Reference:
6037216
Your Reference:
EN00484.15
[U:\RTAYELGU.DOC]

Dear Madam,,

Re: Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway from Brunswick River to Yelgun

In reference to your letter of the 20th November and the planning focus meeting held on the 26th November, 1996, concerning the above matter, the Department of Land and Water Conservation considers that the following matters will need to be addressed:

Crown Land

A number of Crown public roads dissect the Brunswick bypass. A Crown public road may be impacted north of the Brunswick River to Yelgun depending on the route selection.

The expanded corridor for the Brunswick Bypass may impact on the Crown land caravan park situated on the southern bank of the Brunswick River. In the event that the corridor through the caravan park is widened then the relocation of tenants will be required and the impact on the viability of the caravan park considered.

The RTA will need to arrange for the purchase of any Crown land prior to commencement of works.

Flooding

Highway design should endeavour to minimise any constriction of flood flows within the catchments of Billynudgel and Marshalls Creeks.

The impacts of flood flows on the highway and the highway on flood flows should be examined.

Erosion and Sediment

An erosion and sediment control plan with a maintenance plan should be developed prior to construction. It is important that any sediment control structures be constructed prior to commencement of road works where practical to minimise possible sediment loss.

The plan should also include a rehabilitation plan detailing species to be used and techniques.

50 Victoria Street PO Box 371 Grafton NSW 2460
Telephone: (066) 42 7799 Facsimile: (066) 43 1161

Protected Lands

A significant area of protected lands occurs within the proposed zone as shown on the copy of the 1:25000 scale protected lands map. A permit will be required for clearing protected lands, from the Department under 21(c) of the Soil Conservation Act (1936).

Mass Movement

Investigation of the area to the north of the Brunswick should be carried out to assess and soil and geological instability on the steeper lands

Acid Sulfate Soils

The Billynudgel and Marshalls Creek floodplains have a low risk of potential acid sulfate soil occurring within 1m of the surface while the Brunswick Bypass has a high risk.

Potential acid sulfate soils will need to be tested and if present a plan of management compiled to eliminate any potential impacts.

Riparian Zones

Care should be taken to minimise any impact on the riparian zones of the Billynudgel and Marshals Creek and Brunswick River to minimise erosion, sediment and nutrient movement into the water systems. and to protect flora and fauna.

Any clearing of trees and shrubs within 20m of the Brunswick River, which is a prescribed river, will require a 21-D permit under the Soil Conservation Act (1936) from the Department.

Resource Materials

The Department currently has available detailed soil landscape maps and multi-attribute maps (1:25000) for the area. The multi-attribute maps include information on slope, terrain, land use, general vegetation classes, land use, erosion, rock cover and mass movement. These are available at cost price from our GIS unit at Grafton (Contact-Jeremy Black or Sue Rae: Phone - ~~(066) 420518~~ (066) 432822).

For more information, please contact David Thompson, telephone (066) 427799 facsimile (066) 431 161, e-mail dthompso@dlwc.nsw.gov.au.

Yours faithfully,

D.F. Thompson
Regional Environmental Co-ordinator
Grafton NSW 2460
5 December, 1996

New South Wales Government

HERITAGE COUNCIL OF NEW SOUTH WALES

Level 17, Governor Macquarie Tower, 1 Farrer Place, Sydney
Postal Address: Governor Macquarie Tower, 1 Farrer Place, Sydney, NSW, 2000
Telephone (02) 9391-2255 Fax (02) 9391-2336

SINCLAIR KNIGHT MERZ
P.MGR
SIGHDATE

Mr Jo Moss
Prject Manager
Sinclair Knight Mertz
100 Christie Street
ST LEONARDS NSW 2065

Contact: Ms J Kerr
Telephone: (02) 9391-2047
File:
Your Ref: EN00484:BH
PDPPFM.DO

Dear Ms Moss

PROPOSED EIA-DUPLICATION OF BRUNSWICK HEADS BYPASS AND REALIGNMENT OF PACIFIC HIGHWAY FROM BRUNSWICK HEADS TO BILLINUDGEL

I refer to your letter of 19 November 1996 advising the Heritage Council on the proposed EIS for the above project. Members of the Heritage Office will be unable to attend the Planning Focus Meeting to be held on the 26 November, 1996. However, the following comments are provided in relation to the proposed EIS.

It is advised that consideration should be given to the impact that the proposed works resulting from the EIS may have on any item of environmental heritage that may exist in the area.

The Heritage Office maintains a public register of items protected under the Heritage Act, 1977. You are welcome to inspect the register to determine if there are any items of environmental heritage which are covered by an environmental planning instrument. In addition, you should consult the Roads and Traffic Authority's (RTA) Section 170 Register for further details relating to the protection of items owned by the RTA.

You are also reminded to contact the local Aboriginal Land Council, the National Trust of NSW, the Australian Heritage Commission and local historical societies if you have not already done so. These organisations can comment on any other items of heritage significance in the area affected by the EIS.

In addition to contacting the above organisations and registers, you should assess the heritage significance of the land that will be affected by any proposed activities, and the impact of the proposal on that significance. The assessment should include natural areas and places of aboriginal, historical or archaeological significance, as well as buildings and works, and any other archaeological deposits.

Further, under section 146 of the Heritage Act, 1977, any relics discovered through proposed works should be reported to the Heritage Council. A relic is defined as any deposit, object or material evidence which is more than 50 years old and relates to the settlement of the area (not being Aboriginal settlement).

You are also advised that under section 40 of the Heritage Act, should disturbance to archaeological relics or a site known or suspected to contain relics be proposed, an excavation permit must be obtained from the Heritage Council.

Should you have any further questions, please contact Jane Kerr at the Heritage Office on (02) 9391 2047

Yours sincerely

31/10/96

For Secretary

MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES
Level 2, ABS House 97-101 Faulkner Street
(P.O. Box 63), Armidale, NSW 2350, Australia
Phone (067) 70 2100 · Fax (067) 70 2121

P.MGR
SIGN/DATE

The Manager,
Sinclair Knight Metz
P.O Box 164,
St. Leonards NSW 2065

Attn: Jo Moss

OUR REF: L91/0505
OUR REF: EN00484:BHPDPPFM.DOC

6th December, 1996

Dear Sir/Madam,

Duplication of Pacific Highway, Brunswick, and
Realignment of Pacific Highway, Brunswick River to Billinudgel

Thank you for your letter of 19th November, 1996.

The realignment options mainly traverse ridges of Paleozoic metasedimentary rocks of the Neranleigh-Fernvale beds and Tertiary age volcanics, as well as low lying areas of alluvium along creeks and sands and muds of the coastal plain.

The westernmost extent of the study area traverses an area of minor heavy mineral sands development in Smoky Valley, immediately north of the Brunswick River. The Department would prefer that a more easterly corridor were chosen so as to avoid that area, but considers it to be insufficiently important to warrant an objection.

Numerous pits and quarries are developed within the study corridor, especially close to Coolomon Scenic Drive. These include at least one operational pit which are understood to be supplying the RTA. Therefore, the Department recommends that the EIS include consideration of:

1. The demand for construction materials for use in the proposed highway development in the context of future supply in the district.

2. The potential for adverse impact on existing quarry operations within the study area, including whether those quarries could be worked out and (if appropriate) rehabilitated as part of the proposed highway development.

3. The possibility that the proposed highway development could open up opportunities for short or long term quarry development adjacent to the highway, and whether highway design could incorporate provisions for access to ongoing and possible new quarries.

The Department has no objection to the proposed duplication of the Pacific Highway at Brunswick Heads.

Should you have any further enquiries on this subject, please do not hesitate to contact Mr Jeff Brownlow in the Department's Armidale Office (Tel 067 702 113).

Yours faithfully,

per **S.R. LISHMUND**
for Director-General

11 March 1998

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Project Manager
Roads and Traffic Authority
PO Box 576
GRAFTON
NSW 460

Our reference:
Your reference: DB:db3047-4

ATTENTION: Ken Oldfield

Dear Ken

RE: ACCESS TO BRUNSWICK HEADS NATURE RESERVE EAST OF THE PROPOSED NEW BRIDGE OVER THE BRUNSWICK RIVER

I wish to clarify the requirements of National Parks and Wildlife Service (NPWS) in relation to the access that will be needed into Brunswick Heads Nature Reserve adjacent to the proposed new bridge over the Brunswick River as part of the upgrade of the Pacific Highway between Brunswick Heads and Yelgun.

The current access from the Pacific Highway into the Nature Reserve needs to be retained in order to reach NPWS visitor facilities at this location, and for use by the Public Works Department to maintain a rock wall in the Brunswick River.

The access provided should be low-key, and minimise disturbance within and adjacent to the Nature Reserve.

Please contact Dianne Brown on (02) 6659 8273 if you require any further information.

Yours faithfully

JANELLE BROOKS
Manager, Environmental Planning Unit
Northern Zone

for DIRECTOR-GENERAL

Northern Zone
GIO House
24 Moonee Street
Coffs Harbour NSW
Australia
PO Box 914
Coffs Harbour 2450
Tel: (02) 6651 5946
Fax: (02) 6651 6187

Head Office
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Tel: (02) 9585 6444
Fax: (02) 9585 6555

Australian-made 100% recycled paper

ergy for you" NorthPower

Cnr Carrington Street & County Lane, Lismore
PO Box 110
Lismore NSW 2480
Phone: 13 2066
Facsimile: 02 6623 0851

5 February 1998

Messrs Sinclair Knight Merz
PO Box 164
ST LEONARDS NSW 2065

Attention: Jenny Bradford

Dear Jenny

RE: BRUNSWICK HEADS TO YELGUN - PACIFIC HIGHWAY UPGRADE

NorthPower would like to make the following comments regarding the proposed highway upgrade:

- NorthPower has a switching station eastern side of the existing highway north of Brunswick Heads. It is recommended that the new highway be located so as to avoid this switching station.
- NorthPower has distribution lines in the vicinity which may need to be relocated or placed underground, at your expense.
- NorthPower requests that access to our existing and proposed assets is considered in your planning phase. Should access not be available from the roadway then we would require access via adjoining properties.
- Any works NorthPower carries out must be preceded by an Environmental Impact Assessment. This may be a lengthy process depending on the level of work required.
- Any new NorthPower assets placed on private property must be covered by an easement in favour of NorthPower. As such, it is normally an easier and cheaper option to locate power lines within the road easement.

Should you require any further information please contact me on telephone (02) 6623 0623.

Yours faithfully

STEVE GOLDIE
Investigations Co-ordinator

RDA Unit

NSW Agriculture

Wollongbar
Agricultural Institute
Bruxner Highway
Wollongbar NSW 2477
Australia

Telephone: (066) 261 200
Facsimile: (066) 281 744

Your Ref:
Our Ref: MRB:et

26 November 1996

Sinclair Knight Merz
PO Box 164
ST LEONARDS 2065

Dear Sir

PROPOSED DUPLICATION OF THE BRUNSWICK HEADS BYPASS AND THE UPGRADE OF THE PACIFIC HIGHWAY FROM THE BRUNSWICK RIVER TO YELGUM

Thank you for your letter of the 19th November regarding the proposed duplication of the Brunswick Heads Bypass and the Upgrade of the Pacific Highway from the Brunswick River to Yelgun.

It is noted that the study area includes a significant area of agricultural land west of the village of Billinudgel.

These lands are considered to be prime agricultural lands and have a high potential for sugar cane production. Sugar cane is produced in Middle Pocket and at The Pocket.

It will be necessary as part of the data set to arrange for a detailed agricultural study of the area so that the impact of the various routes can be considered and their likely affects on potential cane lands and rural holdings in the area.

I have previously submitted to the RTA a list of agricultural consultants who could carry out this study.

Should you require further information please do not hesitate to contact me.

Yours faithfully

M R BELLERT
Agricultural Environment Officer

C:\WPDATA\BELLERT\YELGUN.LET

NEW SOUTH WALES **DEPARTMENT OF TRANSPORT**

227 ELIZABETH STREET
SYDNEY NSW AUSTRALIA
GPO BOX 1620
SYDNEY 2001 AUSTRALIA
FACSIMILE (02) 268 2900
TELEPHONE (02) 268 2800

Ms Jo Moss
Project Manager
Sinclair Knight Mertz
1 Chandos Street
ST LEONARDS 2065

2 January 1997

Dear Ms Moss

re: Proposed duplication of the Brunswick Heads By-pass

I refer to your letter dated 20 Nov 1996 on the above matter. The Department of Transport thanks you for the opportunity to identify issues of relevance resulting from this proposal.

It is suggested that the following local public transport issues be addressed in the Environmental Impact Statement:

Bus services

The DoT contracts the provision of local public transport in this region to local operators. This includes town-feeder and school bus services. On any of the identified carriageways, these bus services may mix, now or in the future, with the high volume of traffic.

The DoT would like Sinclair Knight Mertz to endorse the principle of separation of through and local traffic, encouraging the use of public transport and bicycles and consider the following measures would assist in the safe operation of services by any operators involved:

* providing safe pick-ups, including off the shoulder lay-bys wherever possible;

* providing for safe turning, entry and exit by buses;

* minimising disruption to existing bus services and attendant infrastructure, such as signage, waiting sheds etc; and

* providing sufficient opportunities to pull off the pavement in emergencies.

Incorporation of such measures at the design stage would enhance the utility and safety of this section of the highway.

.../2..

Bicycle paths

Provision of bicycle paths along these sections would further enhance utility and encourage use of this environmentally friendly mode.

Should you require further information on these matters, please contact me on (02) 268 2817.

Yours sincerely

Noel Lonergan
Senior Transport Planning Adviser

EPA

Environment
Protection
Authority
New South Wales

NSW Government Offices
49 Victoria Street
PO Box 498
Grafton
N S W 2460

Telephone .066. 42 0535
Facsimile .066. 42 7743

The Project Manager
Sinclair Knight Merz
PO Box 164
ST LEONARDS NSW 2065

Our Reference: GR1613

Your Reference: EN00484.15:PFMACK2.DOC

Contact: STEVE SMALL

ATTENTION: MS JO MOSS

Dear Ms Moss,

BRUNSWICK TO YELGUN PROJECT

Thank you for your letter dated 10 December 1996 to the Environment Protection Authority (EPA) enclosing notes from a Planning Focus meeting held at the Ocean Shores Country Club to discuss the above project.

We were unable to attend the workshop but offer the following comments for your consideration in the investigation of the proposed upgrading and preparation of an Environmental Impact Statement.

Environmental Issues

The EPA recommends that consideration to the following issues be given in planning for major road construction activities. These issues include:

- Local Air Quality

- measures to control and mitigate air impurities emissions during road construction and operation stages
- maintenance of the proposed control measures

Road construction activities

- clearing and burning of vegetation
- dust and particulate emissions generated by demolition, wood chipping, excavation, earth moving, loading,

grading, drilling, blasting, quarrying, rock crushing, tunnel boring, landscaping and vehicle / mobile equipment movements

- windblown dust from exposed construction surfaces, stockpiles, excavated materials or trucks transporting loose materials
- exhaust emissions from vehicles and other equipment operating on the site
- odours and hydrocarbon emissions from pavement spray sealing work and painting
- emissions from onsite concrete batching works

- prediction of dust fallout downwind from construction site
- identification of sensitive receptors likely to be impacted by dust and other air emissions from the site/s
- proposed measures to mitigate and control dust generation

- weather conditions monitoring

Road operation

- design features of the road which may cause increased emissions (eg steep gradients)
- prediction of changes in traffic volume and traffic types on the proposed road and the adjacent road network
- location of toll plazas (where applicable)
- existing air quality along the proposed route
- influence of meteorological or topographical conditions on dispersion of air impurities emissions
- modelling of dispersion of air impurities emissions along the proposed route

♦ **Noise and vibration**

- ambient noise levels at nearby residential premises, school, hospital and commercial premises
- noise, blasting and vibration control criteria
- measures to control and mitigate noise impacts during road construction and operation stages
- approval of road construction and operation noise control measures

Road construction activities

- representative samples of the pre-construction ambient noise levels: time history of the L_{A90}, L_{Aeq}, L_{A10}, L_{Amax} ambient noise descriptors measured continuously at the areas likely to be affected by the construction works for 15 minute intervals over proposed construction site operation hours
- criteria for control of noise, vibration and blasting impacts caused by construction works and associated traffic
- hours of operation of construction site
- equipment noise levels
- location of depots and other facilities emitting high noise levels such as batching plants, wood chippers,

crushers, etc
- access routes and times for construction and heavy delivery vehicle traffic
- assessment of noise, vibration and blasting impacts including assessment of frequency and duration of intermittent high level noise impacts on the areas affected by the road construction activities
- construction work program and associated noise, vibration and blasting impacts
- noise mitigating measures including construction work management program, noise barriers and noise attenuating treatment of equipment (eg, piling hammers, concrete saws, tunnel ventilation systems)
- blasting and vibration mitigating measures
- time frame for and sequencing of construction of noise barriers
- monitoring of equipment noise emission and construction noise emission at the affected areas

Road operation

- road traffic noise control criteria
- traffic noise mitigation measures:
  - traffic management: traffic direction, vehicle speed
  - road surface cover
  - road levels / alignment
  - noise barriers
  - building acoustical treatment
- monitoring of performance of noise mitigation measures
- policies on vehicle design to reduce noise emissions (engine, exhaust, brakes etc)

- traffic noise monitoring (noise emission of road vehicles and noise emission level at affected areas)

♦ **Soil and water management**

Road construction activities

- waters affected by construction activities (classification, use, ANZECC guidelines, interim water quality objectives)
- water quality of affected waters (baseline water quality data)
- soil erosion, sediment control and water quality management plan:
  - site vegetation clearing / disturbed area management (clearing minimisation / retention of existing trees and vegetation)
  - creek management (diversion, road crossing management, bridge / culvert construction, stabilisation of creek batters / banks)
  - clean stormwater management (diversion around, under, over disturbed areas including diversion under storm conditions)
  - management of stormwater runoff from disturbed area
  - design criteria and design of soil erosion and

sediment controls including sedimentation basins, catch/ diversion drains, etc
    - location of soil erosion and sediment controls
    - sequencing of clearing works and installation of associated soil erosion and sediment controls
    - sequencing of earthworks and installation of associated soil erosion and sediment controls
    - control of access road effects on waters (eg, creek crossings)
    - maintenance of soil erosion and pollution controls
    - revegetation and replanting
    - wastewater control management (eg, from cement type works, equipment washing, equipment depots)
    - spillage control
    - maintenance of pollution control measures
    - monitoring of performance of control measures
    - monitoring of water quality (construction site discharges and affected waters)
- identification and management of contaminated sites
- identification and management of acid sulfate soils

Road operation

- water pollution control management plan:
    - water quality objectives (current ANZECC guidelines for water quality)
    - potential impacts of preferred option on water quality and aquatic environment
    - changes to local drainage patterns
    - soil and water management plan
    - stormwater management (eg, diversion of clean stormwater from disturbed areas)
    - the use of bridges / viaducts as culverts
    - wet detention basins
    - wetlands
    - road spillage collection systems
    - water quality monitoring (discharges and affected waters)
- flood detention and control
- litter control

♦ Vegetation management

Road construction activities and road operation

- vegetation management plan:
    - potential impacts of preferred option on existing vegetation generally and particularly on protected vegetated areas (eg, National Park) or threatened species (according to the requirements of the NSW Threatened Species Conservation Act, 1995)
    - minimisation of vegetation disturbance / retention of existing trees and vegetation
    - weed infestation control
    - revegetation and replanting
    - landscaping

◆ **Habitat preservation**

Road construction activities and road operation

- habitat preservation management plan (to satisfy requirements of the NSW Threatened Species conservation Act, 1995):
  - existing habitat
  - surveys
  - severance of ecological communities
  - routes, alignments, widths, bridges, viaducts
  - bridge and viaduct construction methods
  - vegetation strips, boulders, rocks
  - wildlife corridors
  - rehabilitation measures

◆ **Waste Management**

- waste disposal
- hazardous waste / chemicals
- use of materials earned from building demolition
- use of recycled materials in construction
- design to balance need for excavation and filling of land
- reuse of surplus excavated material on present or other sites
- recycle / processing of green waste
- identification of hazardous materials

◆ **Consultation, monitoring, reporting and training**

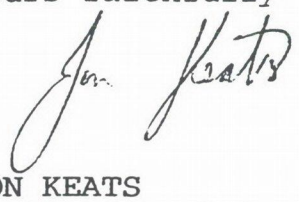
Construction site and road operation Environmental Management Plan (EMP):

- pollution control measures (design criteria and design)
- implementation and maintenance of the control measures
- monitoring requirements (performance, quality assurance)
- reporting requirements
- environmental audit
- ongoing community consultation and provision of information and contact point for complaint handling

Note: The EPA does not assess proposed EMP's but encourages the RTA / road developer to adopt such a system to manage its environmental responsibilities and commitments.

We hope these comments are of assistance. If the EPA can offer further advice on this issue please contact Steve Small of the EPA on 066 726134.

Yours faithfully



JON KEATS
Head Regional Operations Unit
North Coast
for Director-General

NSW FISHERIES

SF:gh
REF:jomoss2

3/13/98

Ms Jo Moss
Project Manager
Sinclair Knight Merz
PO Box 164
ST LEONARDS NSW 2065

Dear Ms Moss

RE: PROPOSED UPGRADE OF THE PACIFIC HIGHWAY - BRUNSWICK TO YELGUN

Further to our meeting on 6 March, 1998, below is a list of issues that NSW Fisheries would like to see addressed in the Environmental Impact Statement for the above project:

1. Aquatic Vegetation & Other Fish Habitat Types

- types of aquatic vegetation and fish habitat likely to be affected by the route (eg during and after construction such as mangrove removal, seagrass shading from bridge structure)
- the value or significance of such vegetation or habitats on a local and regional scale
- how impacts on the above vegetation or habitats will be minimised during and after construction
- any plans for vegetation or habitat rehabilitation or compensation (eg transplanting or seeding of mangroves after construction, compensatory wetlands)

2. Commercial and Recreational Fisheries

- how the proposed route will affect the viability of commercial or recreational fishing (eg oysters, trawler access to the boat harbour)
- impacts on water quality during and after construction (eg. acid sulphate soils, runoff, sedimentation, turbidity)
- how these impacts will be managed
- whether access to fishing grounds by commercial and recreational fishers will be affected during and after construction (eg access to boat ramps, roads)
- impacts of the proposed route on water flows, turbidity and sedimentation rates within any crossed watercourses

I have discussed the matter of suitable sites for mangrove rehabilitation in the Brunswick River estuary with members of the Estuary Management Committee. No suitable locations could be identified, however, they have asked that the EIS address

the possibility of transplanting or seeding mangroves, in those foreshore areas used for temporary work/storage areas for construction of the bridge crossing at the Brunswick River.

As outlined in previous correspondence from Craig Copeland, dated 25 August 1997, permits from NSW Fisheries will be required for any damage to marine vegetation or any works involving dredging or reclamation. I have enclosed copies of the permits for your information.

If you have any further inquiries, please contact me on (02) 6686 2018.

Yours sincerely

SARAH FAIRFULL
CONSERVATION MANAGER
NSW FISHERIES

NSW Fisheries, PO Box 154, Ballina NSW, 2478, Australia
Tel: (02) 8886 2018; Fax: (02) 6686 8907;

OPTUS
communications

20 December 1996

Sinclair Knight Merz
PO Box 164
St Leonards NSW 2065

Dear Sir,

SUBJECT: ***OPTUS Networks Asset Relocation***
Pacific Hwy upgrade
Brunswick River to Yelgun
NSW

Ref. DRI #0245

I take this opportunity to advise you that OPTUS Networks do have existing assets within vicinity of the above proposal.

It would be appreciated that as your project progresses copies of all information and correspondence is forwarded to myself.

I also take this opportunity to inform you that it is necessary for written OPTUS Networks approval to be obtained prior to any works occurring within the vicinity of our assets so as to ensure that the ongoing security and integrity of those assets is maintained.

If you require further information please contact me on Ph. 03 9233 5025, 0412 289944 or Fax 03 9233 5026.

Yours faithfully,

Russell Furlonger
Senior Network Engineer
Damages, Relocation's and Investigations

Optus Communications
Pty Limited
ACN 052 833 208

3 Leader Street
Campbellfield VIC 3061
Australia

Telephone: (03) 233 5000
International: +61 3 233 5000
Facsimile: (03) 233 5026

Waterways
We're with you on the water

15 May 1998

REF: EN00484;WATAUTH

J Moss
Project Manager
Sinclair Knight Merz
PO Box 164
St Leonards 2065 NSW

Dear Ms Moss

BRUNSWICK RIVER BRIDGE WORKS

I am writing in response to your letter of 8 May, in which you sought Waterways Authority input for the EIS for duplication of the Brunswick Heads Bypass, specifically, the bridgeworks.

Our comments are as follows:

Clearance above MHWM is critical for long term marine activity in the estuary, particularly tourism, and we believe that the proposed height of 4.9-5.4m is the minimum required, given an expected 80-100 year life of the bridges. Any possible reduction in height would be resisted.

The over-water construction area should be flood lit, with sufficient intensity to ensure that all pylons, cables, barges and obstacles are visible to vessel operators in any conditions. Daytime warning signage should be prominent for vessel operators, as should the normal `channel blocked` and navigation buoys installed prior to work commencing. All barges and work boats should have at least a single 360 degree white light on at night.

The old bridge should be lit during the construction process, either with flashing yellow warning lights or fixed port/starboard red/green lights at the preferred channel. All pylons are to be individually lit during the demolition process by yellow flashing lights. Nothing of the old structure is to remain in the waterway after demolition, apart from a short span adjacent to shore, which Council may choose to adapt as a wharf structure (similar to the old Barneys Point bridge in the Tweed River).

The new bridges are to be both lit by navigation lighting on the upstream and downstream sides (subject to more detailed discussion at the

WATERWAYS AUTHORITY NORTH SERVICE CENTRE
JORDANS ESPLANADE PO BOX J23 COFFS HARBOUR NSW 2450
TELEPHONE (066) 513 400 FACSIMILE (066) 511 352

construction stage). The lights may be powered by either solar or 240v street lighting.

The new bridges are to be clearly signed for vessel clearance above MHWS, in the standard Waterways national signage format.

Please contact this office (Tel 0266519067) if you have any further questions on our requirements or if we are able to help in any way. Mr Carl Cormack from our Tweed Heads office (Tel 0755361001) will be the point of contact during the construction/demolition phase.

Yours sincerely

Peter Chappelow
Regional Manager
North Coast

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Appendix C

Study Team

Appendix C

Appendix C - Study Team

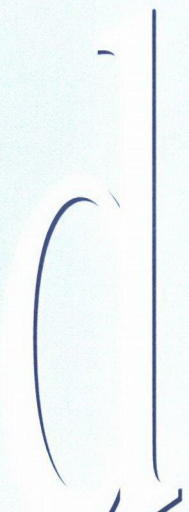
This Environmental Impact Statement was prepared for the RTA by Sinclair Knight Merz and a team of specialist subconsultants. The following personnel contributed to the study:

NSW Roads and Traffic Authority(Pacific Highway Development Office	
Ken Oldfield	Project Development Manager
Robert Kook	Senior Project Designer
Sinclair Knight Merz	
Ken Robinson	Project Director
Jo Moss	Project Manager
Jennifer Bradford	Environmental Scientist
Matthew Davies	Environmental Scientist
Laszlo Muranyi	Road Design Engineer
Steve Kostakis	Design Draftsman (MOSS)
Daniel Vanechop	Design Draftsman (CADD)
Mark Waugh	Traffic and Transport Engineer
Tom van Drempt	Traffic Engineer
Niel Nielsen	Economist
John Constandopoulos	Environmental Engineer
Rosalynd Dare	Graphics
Pamela McKenzie	Word Processing/Secretary
Wilkinson Murray Pty Ltd	Noise Impact Assessment
Nigel Holmes and Associates	Air Quality Assessment
Webb McKeown and Associates	Hydrology and Hydraulics
Robynne Mills Archaeology and Heritage Services	Archaeology and Heritage Assessment
Gunninah Environmental Consultants	Flora and Fauna Assessment
Golders Pty Ltd	Geotechnical Assessment
EDAW (Australia) Pty Ltd	Visual Impact Assessment
Value Management International Pty Ltd	Value Management, Value Engineering and Risk Management

Proposed Duplication of the Brunswick Heads Bypass and Upgrade of the Pacific Highway Brunswick River to Yelgun

Appendix D

Copies of Information Sheets



AUSTRALIA POST
TO THE HOUSEHOLDER
POSTAGE PAID

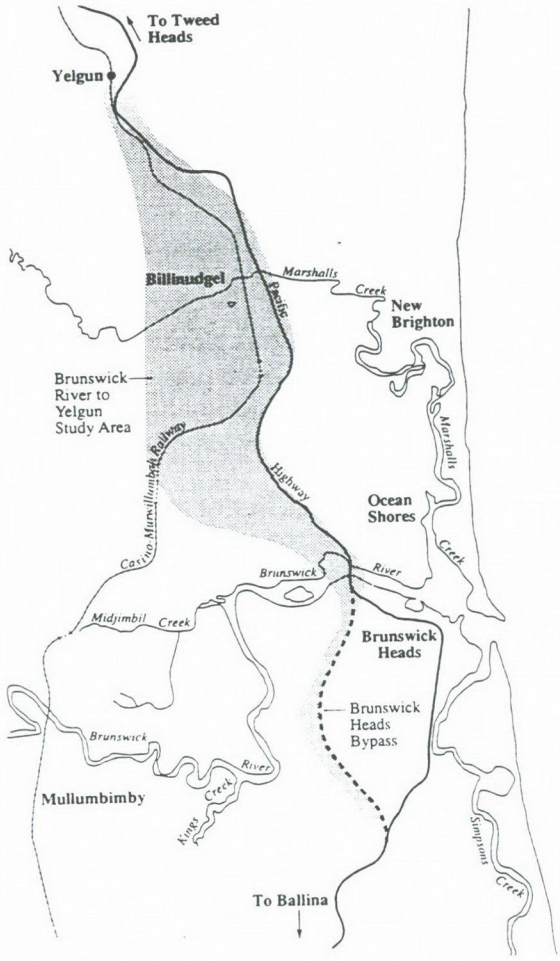
Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun

Information Sheet No.1 . . . November 1996

The Roads and Traffic Authority (RTA) is very keen to ensure that the community is able to make an input to all aspects of this study as part of the community consultation plan. This information sheet tells you about the project and how to be involved.

What is this information sheet about?

The RTA is proposing to duplicate the Brunswick Heads Bypass and realign the Pacific Highway between the Brunswick River and Yelgun, as shown on **Figure 1**.



This Information Sheet describes the proposed studies and how you can participate in the process. At the end of the Information Sheet you will find the freecall number you can call to register for our project mailing list, and for more information, as it becomes available.

Background

The proposed work is part of the Pacific Highway Reconstruction Program. The aim of this Program is to provide a high standard dual carriageway facility for the Highway between Hexham and Tweed Heads. The Program is being funded jointly by the Commonwealth and NSW State Governments, which will guarantee funding for projects identified under this Program. It is being implemented as an urgent government priority to eliminate existing blackspots and to progressively improve the Highway to divided, dual carriageway standard.

In conjunction with the Highway Reconstruction Program, the Department of Urban Affairs and Planning, the Department of Transport and the RTA are finalising the recommendations on the Land Use and Pacific Highway Strategy, Brunswick Heads to Tweed Heads. The strategy was developed to cater for the large changes which have taken place in the area between the towns of Brunswick Heads and Tweed Heads as a result of new land releases and economic pressures.

The work so far has indicated that this area needs further detailed investigation before a route is selected. The first phase of this study will be focussed on identifying a preferred route for the Highway between Brunswick and Yelgun.

This Strategy has been the subject of extensive community consultation over the past few months and is relevant to this project because any decisions about a preferred route for the Highway upgrade north of the Brunswick River will need to be consistent with the Land Use Strategy.

Environmental Impact Assessment

The proposed second carriageway for the Brunswick Heads Bypass will be located parallel to the present route currently under construction. The previous EIS only assessed the project as a single carriageway. Detailed and engineering investigations are now required to determine the potential impact of the duplication.

Detailed studies will also be required for the proposed realignment and improvement of the Highway between

RTA
NSW Roads and Traffic Authority

Brunswick River and Yelgun. These studies will also involve identification and assessment of feasible route options, and selection of a preferred route for the realignment.

Who is carrying out the studies?

The RTA has commissioned environmental and engineering consultants Sinclair Knight Merz, to undertake the route selection, concept design and environmental assessment. The Sinclair Knight Merz team includes specialists in environmental assessment, traffic studies, engineering, noise and air assessment, flora and fauna assessment, planning and socio-economic assessment.

Study program

The current program for the study is provided below:

Project Commences
November 1996

↓

Preliminary Environmental and Engineering Studies
December 1996 - January 1997

↓

Develop and Assess Route Options
January 1997 - February 1997

↓

Select Preferred Route
March 1997

↓

Environmental and Engineering Studies of Preferred Route
April 1997 - July 1997

↓

Draft EIS and Working Papers
September 1997

↓

EIS Exhibition
October 1997 - November 1997

What will happen immediately?

We will be commencing our field investigations immediately. We expect these investigations will, at an early stage, identify areas which act as absolute constraints to the project and which will be excluded from further investigation. During these investigations landowners are likely to be contacted.

We also stress that the first stage of the study focuses on the environmental features of the entire study area and our investigations will be undertaken with that in mind. Consequently, investigations undertaken in the first stage, in any location should not be taken to imply that any decision has been made about route options.

How to be involved or get more information

The RTA is very keen to ensure that the community is involved, and able to provide input to all aspects of this study.

As a first step, we would be pleased to hear of any issues or aspects of the project that may be of concern to the community, and those which may be of interest to the study team. Please call us on the freecall number (given below) or write to us.

We also invite you to attend a **Community Information Meeting** to be held as follows:

Date:	Tuesday, 26th November, 1996
Time:	7:30 pm - 9:00 pm
Location:	Ocean Shores Public School Shara Boulevard, North Ocean Shores.

This Information Sheet is the first of several which will be issued during the course of the study. If you would like to be on our mailing list please write to:

Jo Moss
EIS Project Manager
Sinclair Knight Merz
PO Box 164
St Leonards NSW 2065

or, phone our **freecall** number : **1 800 500 410**

This number connects to an answering machine. Our aim is to return calls within 24 hours.

The RTA's Project Manager, Ken Oldfield may also be contacted on: 066 401 300.

We welcome and encourage the participation of local and state government, community groups and interested individuals.

Proposed Second Carriageway For Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick River to Yelgun

Information Sheet No. 2 March 1997

This project was initiated in November 1996. Since then, we have been looking closely at land use, environmental issues and engineering requirements in the study area. Investigations are highly complex, and have led to the identification of a number of possible routes for the Pacific Highway between the Brunswick River and Yelgun. These possible routes reflect our understanding of potential impacts.

Understandably, there has been considerable community pressure to know what route options are under consideration, and for a decision to be made on a preferred route.

This Information Sheet describes the possible routes which have been identified for the Brunswick River to Yelgun section of the project. It provides information on how the decision about a preferred route will be made. Importantly, it tells you how you can have your say.

Route Identification

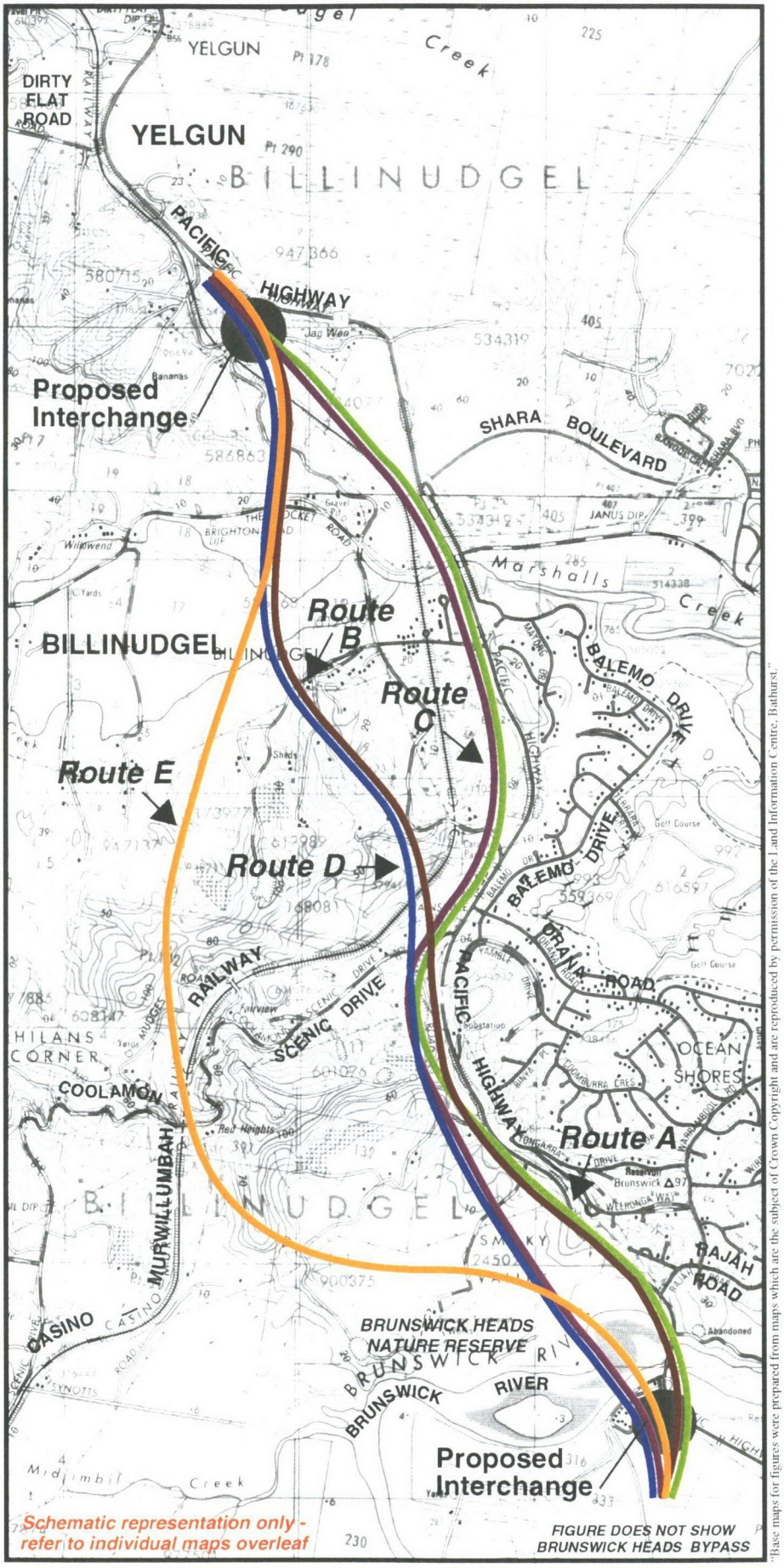
There is no route which will have no impact on people, or on the environment. The presence of the communities of Ocean Shores and Billinudgel, and the rural residential areas, present major constraints to route development.

An important issue for route identification is that the study area is rich in flora and fauna, many species of which are categorised as rare, endangered or threatened.

Studies of the heritage and archaeological features of the area, together with other aspects such as water quality and flooding, have indicated that while there needs to be careful management of these issues, none acts as absolute constraints to any route.

The geotechnical and engineering studies have been important in identifying areas which are either not suitable or less desirable from an engineering and construction point of view.

The route which is ultimately selected will represent compromises between minimising potential impacts on people's lifestyles, their homes and properties; on flora and fauna, water quality and soils; while still meeting acceptable engineering design standards and providing "value for money" to the community.



"Base maps for figures were prepared from maps which are the subject of Crown Copyright and are reproduced by permission of the Land Information Centre, Bathurst."

Route Options

The RTA has identified a number of objectives for this project. These are (in no particular order of priority) to:

- minimise negative impacts of the new road on the environment and community
- improve safety
- separate through traffic from local traffic
- improve transport efficiency (reduce time and cost of travel)
- provide a cost effective solution.

Five possible routes have been identified and these are labelled as A, B, C, D and E on the map on the previous page. The routes have been presented as separate options although there are some common sections.

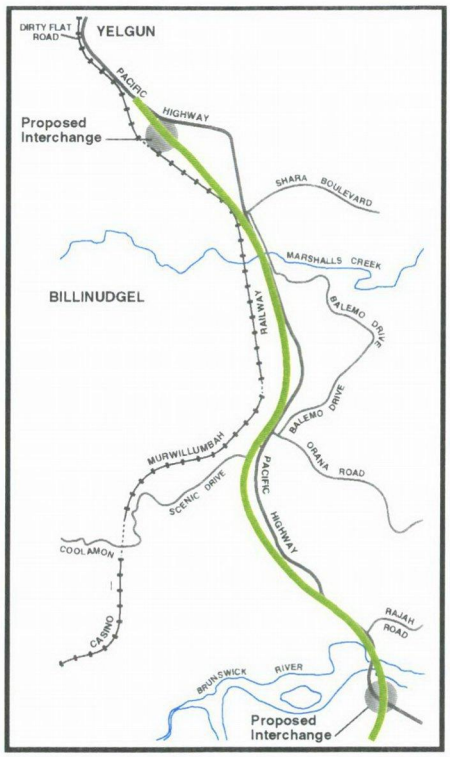
At this stage, the options are shown as broad lines, each approximately 80 metres wide. We have used a uniform width at this stage as a basis for comparison between the route options, although the final road corridor may vary in width along its length. For example, the road corridor may be narrower in some areas such as on flat ground, but wider where interchanges (that is, a grade separation of two or more roads with one or more interconnecting carriageways or ramps) or deep cuts are required. The lengths shown are between common points for all routes.

The space needed for environmental mitigation measures, such as roadside noise barriers and stormwater detention basins will also influence the width of the road corridor. These aspects, and the final corridor shape and area, will be considered in more detail once the preferred route has been selected.

Indicative locations of interchanges are shown, as the final design will depend on the alignment of the preferred route and on the results of more detailed traffic studies.

This section of the highway is not being developed in isolation from the rest of the highway. To the south, the proposed upgrade will include duplication of the Brunswick Heads Bypass. The proposed interchanges for this section are being investigated in conjunction with the Tandys Lane Project being undertaken by Kinhill Cameron McNamara for the RTA and are discussed in a separate Information Sheet. If you would like more information about the Tandys Lane Project, please call 1 800 627 971 (freecall).

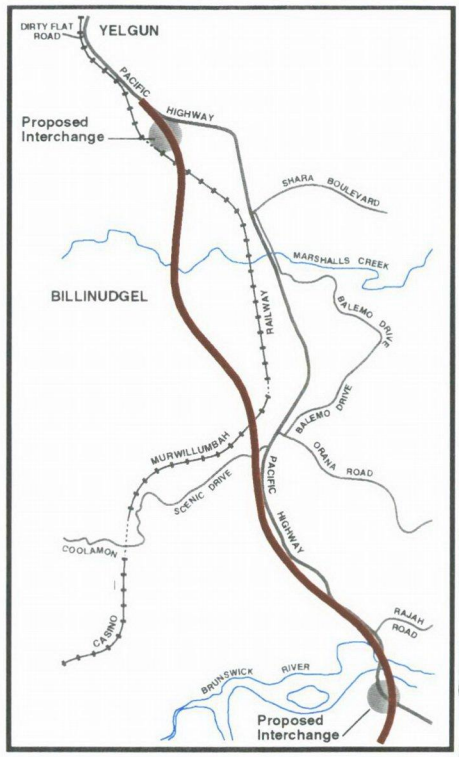
ROUTE A



Features

- 6.4 km in length
- crosses the Brunswick River to the east of the existing bridge
- new bridge crosses the existing Pacific Highway south of Rajah Road at a higher level without interference
- the majority of the route closely follows the existing Pacific Highway
- existing Pacific Highway would become a service road for local traffic
- located between the Billinudgel commercial area and the existing Pacific Highway
- existing access between Ocean Shores and Billinudgel to be preserved by bridging across the new road
- minor edge impacts on the Brunswick Heads Nature Reserve
- avoids all significant environmental areas
- would impact on a number of properties located adjacent to the existing highway especially near Rajah Road and Coolamon Scenic Drive
- minimises impact on agricultural land

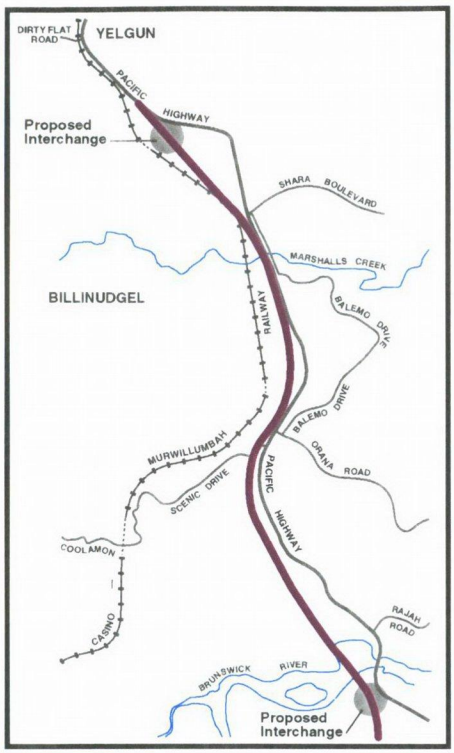
ROUTE B



Features

- 6.2 km in length
- crosses the Brunswick River east of the existing bridge
- new bridge crosses the existing Pacific Highway south of Rajah Road at a higher level without interference
- closely follows the existing Pacific Highway between the Brunswick River and Coolamon Scenic Drive before veering westward
- passes to the west of the commercial area of Billinudgel
- allows for the existing Pacific Highway to become a service road for local traffic
- bisects the potential development area known as "Billinudgel 2000"
- minimises the impact on significant environmental areas near the railway
- minor edge impacts on the Brunswick Heads Nature Reserve
- crosses the Casino-Murwillumbah Railway line at two locations
- would impact on a number of properties, especially near Rajah Road and Coolamon Scenic Drive
- some impact on agricultural land

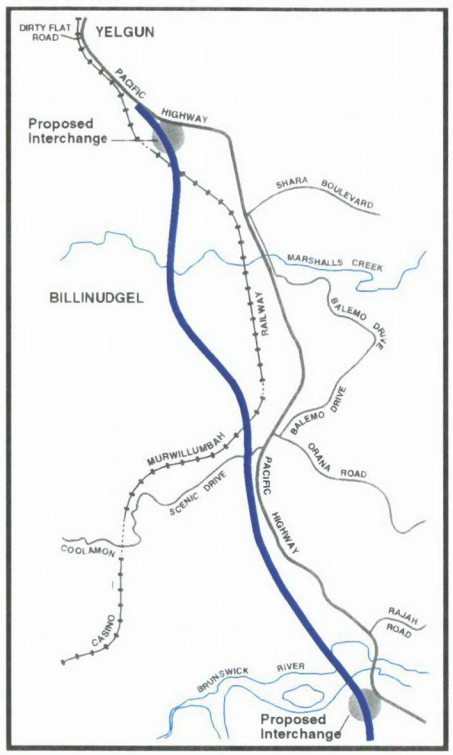
ROUTE C



Features

- 6.2 km in length
- section south of Coolamon Scenic Drive follows the existing road reservation established as part of the Local Environmental Plan (LEP)
- crosses the Brunswick River to the west of the existing bridge
- bisects the Brunswick Heads Nature Reserve
- passes in close proximity to significant flora species and impacts on other sensitive environmental areas in Smoky Valley
- would require the closure of the Ferry Reserve Caravan Park and impact on Riverside Drive
- existing Pacific Highway would become a service road for local traffic
- located between the Billinudgel commercial area and the existing Pacific Highway
- would impact on a number of properties especially near Coolamon Scenic Drive
- existing access between Ocean Shores and Billinudgel to be preserved by bridging across the new road
- minimises impact on agricultural land

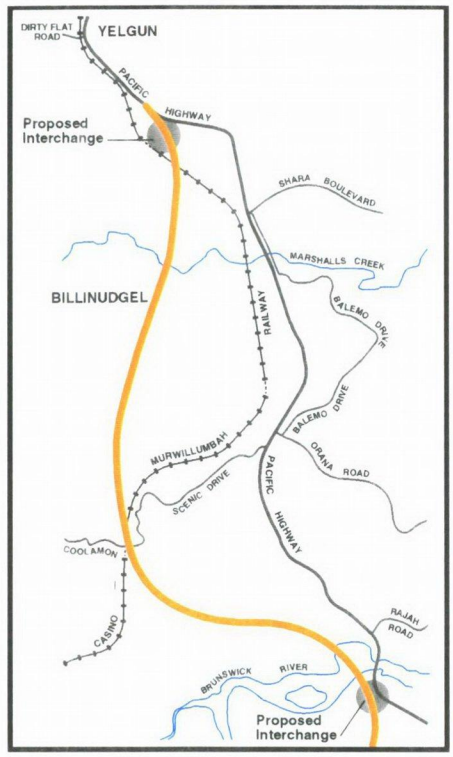
ROUTE D



Features

- 6.1 km in length
- section south of Coolamon Scenic Drive follows Route C (i.e. the LEP corridor)
- crosses the Brunswick River to the west of the existing bridge
- bisects the Brunswick Heads Nature Reserve
- passes in close proximity to significant flora species and impacts on other sensitive environmental areas in Smoky Valley
- would require the closure of the Ferry Reserve Caravan Park and impact on Riverside Drive
- passes to the west of the commercial area of Billinudgel
- allows for the existing Pacific Highway to become a service road for local traffic
- bisects the potential development area known as "Billinudgel 2000"
- minimises the impact on significant environmental areas near the railway
- crosses the Casino-Murwillumbah Railway line at two locations
- would impact on a number of properties especially near Coolamon Scenic Drive
- some impact on agricultural land

ROUTE E



Features

- 7.1 km in length
- crosses the Brunswick River to the west of the existing bridge
- traverses large tracts of vegetation identified as being important for a major east-west wildlife movement corridor, particular for the Koala
- crosses the Casino-Murwillumbah Railway line at two locations
- because of the rugged topography, this route would be difficult to construct and would involve deep cuts (up to 45 m) and large fills.
- grades would be steeper than other routes.
- higher cost due to length and construction difficulties
- would require the closure of the Ferry Reserve Caravan Park and impact on Riverside Drive
- would impact on several rural properties located in the vicinity of the Casino-Murwillumbah Railway Line and The Pocket Road
- considerable impact on agricultural land

The eastern route options (A and B) are practical to build from an engineering point of view, and to varying extents minimise the impact on areas identified as environmentally sensitive. While there would be an impact on vegetation along these routes, there are also real opportunities for significant revegetation as part of the project. It would be our aim to ensure that such opportunities are realised - so that in the longer term there would be a net environmental benefit.

Options C and D vary from A and B to the south of the ridge behind Ocean Shores. The southern section of these routes is based on the LEP corridor which was established in 1988. These routes are feasible but would have a significant impact on vegetation (bisecting the Brunswick Heads Nature Reserve and other environmentally sensitive areas).

Option E would have major environmental impacts (such as bisecting the Brunswick Heads Nature Reserve and bisecting long lengths of vegetation, some of which has been identified as an important wildlife corridor); it would present severe engineering difficulties and would require significant cuts in the landscape (up to 45 m). It would be much longer and steeper than the other routes (with consequent impacts on travel efficiency) and would result in substantially higher costs due to the added length and difficult construction conditions.

All options would have negative impacts on property. Options A and B would affect houses at Ocean Shores near Rajah Road. Options C, D and E would require the closure of the Ferry Reserve Caravan Park and affect houses on Riverside Drive. Impact on residences in the rural areas varies with Routes B and D having the greatest effect and Route E the least.

The RTA does not at this stage favour any option. However, Routes C, D and E appear to have significant disadvantages when compared to Routes A and B on the basis of the information available so far. All route options are being put forward for public comment and will be assessed as part of the route selection process.

Advice to Property Owners

We have not been able to individually contact all property owners in the study area. If you are affected by these routes and would like to speak to the Project Manager, please call us on the freecall number given at the end of this Information Sheet, or come along to the display.

Route Evaluation and Selection of a Preferred Route

In order to establish which route best meets the needs of road users and the community there will be a detailed analysis of all environmental, social, economic and engineering criteria. This is done through a process known as "Value Management", where the importance of each factor is compared with all others.

The evaluation is carried out in a two day workshop comprising participants from technical and non-technical backgrounds, representing the range of government and community interests in the project. These typically include:

- RTA Team members with technical expertise
- Council
- Representatives from State government agencies
- Community and business representatives.

The recommendation arising from the Value Management Workshop will be considered by the RTA and the Minister for Roads, who will make the announcement on the preferred route.

Everyone on our mailing list will be advised about the decision, through an Information Sheet such as this one.

How to Make an Input into Route Selection

Please come along to our special display of the route options, which will provide more detail than we can show in this Information Sheet. The display will be on for a period of three weeks from 18th March to 7th April 1997 at:

- Byron Council Offices, Mullumbimby
- Ocean Village Shopping Centre
- Billinudgel Post Office
- Murwillumbah Motor Registry Office

The display at the Ocean Village Shopping Centre will be attended by members of the study team on: Wednesday 26th March 1997, and Wednesday 2nd April 1997 between 9:30am and 7:30pm.

At these times members of the study team will be available to answer your questions and to discuss the routes with you.

If you wish to do so, you are also invited to make a submission on the route options. Please send your submission to the address given below.

In order to make it easier for the study team to analyse the matters raised in your submission:

- list points wherever possible - this makes it clearer and easier to understand
- please ensure that your submission is as legible as possible.
- If you have a preference for any route, please say so, and your reasons for preferring it.

Your views are important to us. If you have any suggestions, modifications to, or criticisms of the routes, please let us know.

Please send your submission by 9th April 1997.

For Further Information and Where to Send Your Submission

If you would like to be on our mailing list, or need further information, please call: **1 800 500 410** (freecall).

Please send your submission to:
Sinclair Knight Merz (Attention: Jo Moss)
PO Box 164
St Leonards NSW 2065
or fax to (02) 9928 2502.

The RTA's Project Manager is:
Mr Ken Oldfield
RTA Grafton
PO Box 576
Grafton NSW 2460

RTA

AUST. POST
TO THE HOUSEHOLDER
POSTAGE PAID

Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway. Brunswick to Yelgun

Information Sheet No. 3 ... May 1997

What is this Information Sheet about?

This Information Sheet provides an update on the study process, information about routes being investigated, and describes where we are up to in selecting a preferred route.

There have been many requests for more specific information about Routes A2, F and G, and we have endeavoured to provide it in this Information Sheet.

What are the project objectives?

The objectives of the project are to upgrade the Pacific Highway between Brunswick and Yelgun in a way which:

- minimises negative impacts on the environment and the community
- improves safety
- separates through traffic from local traffic
- reduces the time and cost of travel
- is a cost effective solution.

How has the Community Been Involved?

The study was initiated in November 1996 when we held a public information meeting and distributed Information Sheet No.1, which described the study process and timing. At the same time, a Planning Focus Meeting was held to brief government agencies, Council, and community groups on the project.

Investigations were carried out between November 1996 and February 1997 to gain a thorough understanding of the characteristics of the study area. During this time we were contacted by numerous landowners and residents of the area, and were provided with a lot of useful information.

Information Sheet No.2 was issued in March 1997. It described the five routes that the study team had identified, and the factors that influenced route identification. These routes were put on public display for three weeks in March/April and submissions were invited. The display was staffed by key members of the study team on two separate occasions and hundreds of people came to the displays on those days. In addition, we received 175 written submissions, including several petitions, as well as many phone calls. The key issues raised were:

- potential for increase in road noise
- community severance impacts
- visual impact of road and bridge structures
- impacts during construction
- negative impacts on property values
- disturbance to lifestyle and amenity in rural areas
- impact on agricultural land uses.

The issues raised by the community were considered by the study team and resulted in modifications to the routes. Feedback from the community (primarily residents of Ocean Shores) indicated that the proposed viaduct option (Routes A and B) was perceived to have unacceptable visual impacts. We undertook further work after the display period to determine if there were other feasible options for crossing the river in the vicinity of the existing Highway, and Routes A2 and B2, incorporating a low level bridge across the river, were developed as a result.

Another community suggestion was for a route located to the west and joining the southern end of the Brunswick Heads Bypass (currently under construction). This is known as Route F.

The Value Management Study

In Information Sheet No.2 we indicated that we would hold a Value Management Workshop to indicate which route appears to best meet the needs of the project objectives. The workshop was held in April. Participants at the workshop included representatives from:

- the RTA (3)
- Sinclair Knight Merz (5, including specialists in flora & fauna, noise, engineering and traffic/transport)
- NSW government agencies (Agriculture, National Parks, Land & Water Conservation, Urban Affairs & Planning)
- Byron Council (2 Councillors & 2 staff)
- Billinudgel Chamber of Commerce (1)
- Billinudgel rural residents (1)
- Brunswick Catchment Management Committee (1)
- Brunswick Heads Progress Association (1)
- Caldera Environment Centre (1)
- Residents of the Ferry Reserve Caravan Park (1)
- Middle Pocket/Yelgun Progress Association (1)
- Ocean Shores Urban Association (1)

The workshop was held over two days, and during this time all of the route options, including Route F and modified Routes A and B (called Routes A2 and B2) were thoroughly analysed and considered.

The criteria chosen by the workshop participants to analyse the options were:

- ecological impact
- visual impact
- transport efficiency
- commercial impact.
- social impact
- noise impact
- land use planning.

RTA
NSW Roads and Traffic Authority

On the basis of the information available, the workshop participants concluded, by consensus, that Route A2 best meets the project objectives. At the same time, it was acknowledged that there was a need for further investigations in the vicinity of the river, particularly on the potential impacts on the Nature Reserve.

Selection of the Preferred Route

The RTA is considering the workshop report. Route investigations are continuing so the RTA can recommend a preferred route to the Minister. All options are still under evaluation, including those put forward by the community, to ensure that the preferred route is optimal in terms of meeting the project objectives.

No decision has yet been made on a preferred route.

Announcement of the Preferred Route

The preferred route will be announced by the Minister for Roads. At that time, another Information Sheet will be distributed. The route which is announced as the preferred route will be the one that is presented as the "proposed activity" in the Environmental Impact Statement.

Your questions

Details about Routes A to E were contained in Information Sheet No.2. Over the past weeks we have been asked a number of questions about further routes, specifically Route A2, Route F and Route G.

ROUTE A2

Why wasn't Route A2 displayed? Route A2 (and also Route F) resulted directly from community feedback during the public display of the other options. Both did not form part of the display because they had not been developed at that stage.

Where does Route A2 go? Route A2 is the same as route A except that the viaduct (high level bridge) which was proposed to commence just north of Rajah Road would be replaced with a low level bridge over the Brunswick River. The sketch on the back page shows how this could be done, and we are still investigating other design options.

How many lanes of traffic would there be across the new bridge? The new bridge would carry traffic from both the new road (4 lanes) and a relocated Pacific Highway (2 lanes). The existing bridge would be used by traffic heading north to get on to the new road. The new bridge would therefore need to be designed for six lanes of traffic.

We are aware of community concerns over the impact of this route on the river, and options which would allow removal of the existing bridge are also being investigated.

How high would the new bridge be? It would be of a similar height to the existing bridge. It could be 1 to 2 metres higher, but it would not be lower.

How many bridges would there be? The new structure would appear to be a single bridge, designed to be as narrow as possible. Whether the new bridge would be built as one or more structures is a question of engineering design and would not be obvious to anyone viewing the bridge from the river banks. For example, the existing bridge is actually built as two structures, but it is perceived as being one bridge.

What would be the impact of Route A2 through the Nature Reserve? Routes A and A2 were concluded by the participants of the Value Management Workshop to have the least ecological impact - both overall and on the Nature Reserve in the vicinity of the river. Other routes were considered to have the potential for greater impacts on the Nature Reserve (Routes C, D and E), on areas with threatened species (Routes B, D, E and F) or would fragment large areas of vegetation and/or wildlife corridors (Routes B, C, D, E and F). If Route A2 were selected, the new road could be located alongside the existing Highway (with some adjustment to the alignment) with very little intrusion on the Nature Reserve and no significant impact on the important rainforest areas in the Nature Reserve on either side of the Highway. Investigations are on-going to gain a better understanding of the potential impacts.

Would Route A2 sever the communities of Brunswick Heads, Ocean Shores and Billinudgel? The existing Highway route would be maintained under all options for the use of local traffic. There would be no adverse changes to the current level of accessibility between these areas.

If the preferred route is one based on the existing Highway (such as Route A2), the design would incorporate a bridge over the new road which would connect the existing Highway with the village area of Billinudgel. This would provide safer access for local traffic than is currently available, and the bridge design would include provision for cyclists and pedestrians. There would also be the opportunity of connecting the road for local traffic with pedestrian paths and cycleways into Ocean Shores.

Would the Highway upgrade increase noise for residents of Ocean Shores? All route options generally locate the new road further away from houses in Ocean Shores than the existing Highway. The road for local traffic could be closer to some houses in the vicinity of Rajah Road under options A/A2 and B/B2. The gradient and alignment of the new road would be significantly better than for the existing road; long lengths of the new road would be in cutting; noise mitigation measures would be established. Consequently, for all options, the majority of residents of Ocean Shores would benefit from the new road alignment.

OTHER ROUTES UNDER INVESTIGATION

As part of the community consultation process we invited suggestions on modifications to the routes, or suggestions for other routes. The routes currently being investigated are shown on the diagram on the back page.

What is Route F? Route F is a community suggestion made during the route options display. This route has been investigated to a comparable level of detail as Routes A to E and was analysed to the same degree as these routes during the Value Management Workshop.

Route F is similar to Route E in the northern section but continues south to cross the Brunswick River to join to the south of the Brunswick Heads Bypass.

What about the impacts of Route F? Our investigations to date indicate that Route F would have a significant ecological impact. It would fragment a heavily vegetated ridge west of Ocean Shores, which is known to contain several threatened plant species and Koala habitat, and to be an important wildlife movement corridor. Both areas where Route F could cross the Brunswick River are characterised by a mosaic of vegetation some of which is relatively undisturbed, is in good to excellent condition, contains some threatened plant species and provides Koala habitat.

What is Route G? Route G was a suggestion from the community after the Value Management Workshop had considered the other routes. It is located further west than Route F, for most of its length, with the possibility of crossing the river at the same points as for Route F.

How does Route G compare with the other routes? Route G is considerably longer than Route F. Being longer, travel costs would increase and this route would provide considerably reduced transport efficiency than the other routes.

Wouldn't it be easier to cross where the river is narrower? The river crossing for Routes F and G may appear narrower than one near the existing bridge. However, Route G has a wider floodplain which would require a longer bridge structure. Constructing a high level highway across a long length of the floodplain has the potential to cause an increase in flood levels upstream. The increase could be reduced by providing a large number of openings under the road. The potential impact on flooding has not been quantified at this stage. The need for additional structures would also increase the cost of construction.

Routes F2 and G2 cross a wide meandering section of the Brunswick River floodplain, where the river appears to have changed its course in recent times. Extensive areas of soft ground are likely to be encountered, increasing the difficulty (and cost) of construction. We are still investigating this aspect.

What about the ecological impacts of Route G? Our investigations indicate that, as for Route F (and to some extent Routes B and D), Route G crosses a significant east-west ridge which is heavily vegetated. In the area of Hilans Corner, there are known to be threatened plant species and Koala habitat, and the ridge provides for fauna movement. In addition to the potential impacts on these species, any route through the ridge would result in habitat fragmentation and severance of a corridor. The large cut which would be required would have an impact which could not readily be mitigated. Route G would also have the same ecological impacts in the vicinity of the river as Route F. Our investigations to date indicate that, overall, Route G has the potential for similar ecological impacts as Route F, and greater ecological impacts than Route A2.

OTHER ISSUES

What about the construction costs used for the route analysis? The costs used at the Value Management Workshop were estimates based on current engineering concepts. Our estimates have been independently reviewed by the Snowy Mountains Engineering Corporation (SMEC), a firm which has considerable experience and expertise in road construction. SMEC concluded that "... the original cost estimates are of the right order of magnitude for use in the cost comparison of the route alternatives ...".

What about the construction time? - It is expected that the new road would take approximately three years to build. This would not be three years continuously at any one location.

What about impacts on businesses in Billinudgel during construction? - Local road access would be maintained during the construction period. There would be no significant interruption to local businesses during this period.

Will an Environmental Impact Statement be prepared? It has always been the intention of the RTA to prepare an Environmental Impact Statement (EIS) for this project, and this was stated in Information Sheet 1. The selection of the preferred route is part of an environmental impact assessment process leading to preparation of an EIS, which will be publicly exhibited and on which formal submissions will be invited.

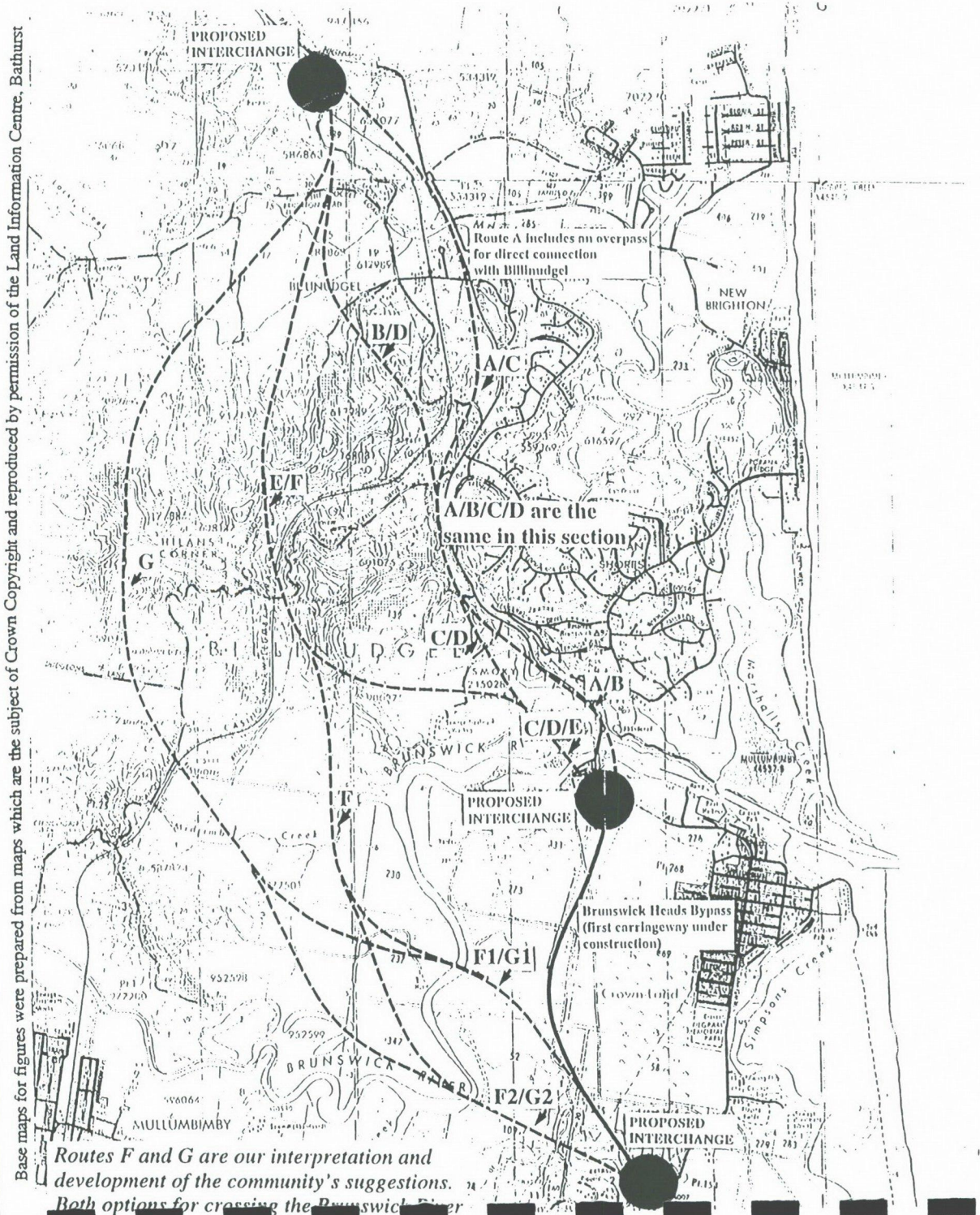
If you would like to be on our mailing list, or would like further information, please call **1 800 500 410** (Freecall). Written comments and suggestions may be sent to:

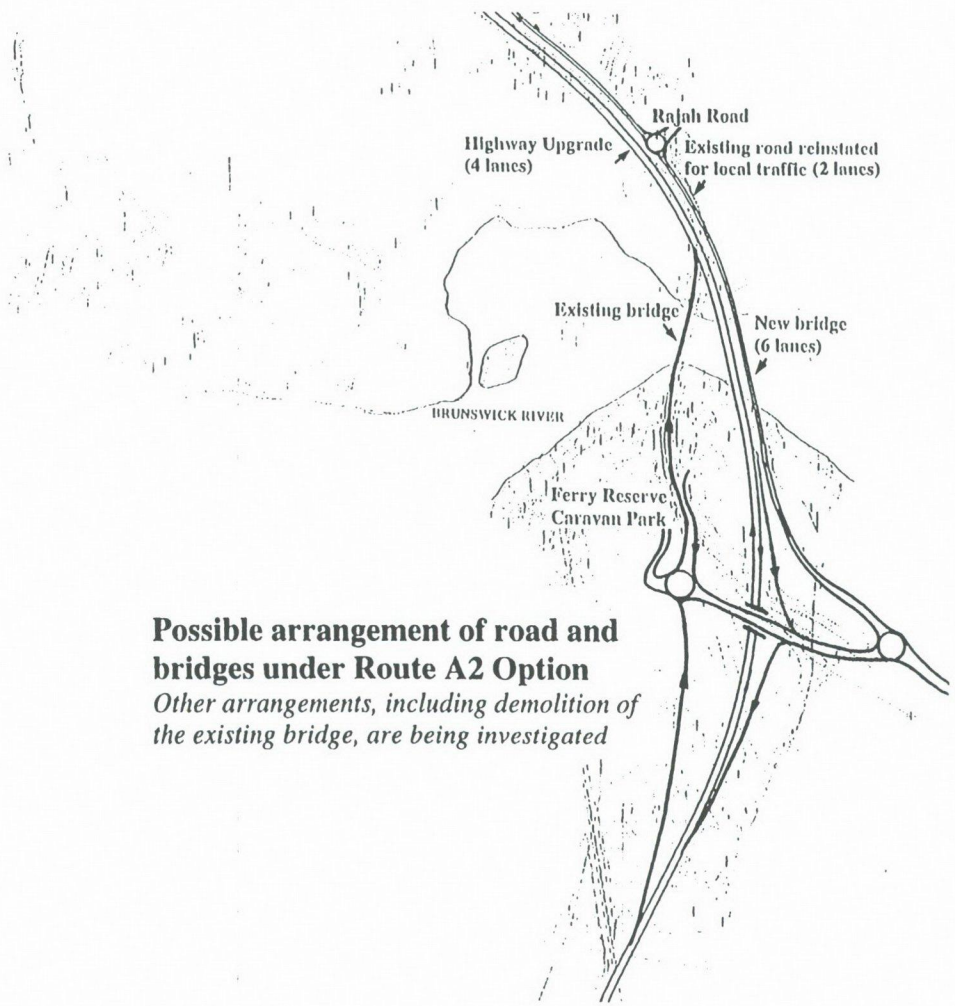
Sinclair Knight Merz (Attention: Jo Moss)
PO Box 164, St Leonards NSW 2065
or fax to : (02) 9928 2502

The RTA's Project Manager is:

Mr Ken Oldfield, RTA Grafton
PO Box 576, Grafton NSW 2460

Base maps for figures were prepared from maps which are the subject of Crown Copyright and reproduced by permission of the Land Information Centre, Bathurst





Possible arrangement of road and bridges under Route A2 Option

Other arrangements, including demolition of the existing bridge, are being investigated

THESE FIGURES ARE SCHEMATIC ONLY

NSW Roads and Traffic Authority

Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun

Information Sheet No. 4 ... September 1997

The Preferred Route

e Minister for Roads has announced that the preferred ıte for the proposed Pacific Highway Upgrade between Brunswick River and Yelgun is Route A2.

e preferred route will connect at its southern end with the unswick Heads Bypass, via an interchange located south the Brunswick River. A new bridge will cross the unswick River, and the existing bridge will be molished. North of the river, the route will have an gnment which is relatively close to, and generally west of, existing Pacific Highway. There will be a northern erchange at Yelgun. The existing highway route will be intained for local access.

e precise location of the highway upgrade, and the erchanges, will be determined through the detailed design ocess which will be undertaken during the coming months.

e preferred route is shown inside this Information Sheet.

How the Route was Selected

ute Identification

evious Information Sheets explained the study process, l that the RTA would consider all feasible routes for the hway upgrade. The study team identified five route ions, and has seriously investigated all additional options ich have been put forward by the community. In all, the m investigated eight routes, and many variations to these.

of these routes have been investigated and analysed to a nparable level.

e most important considerations for route identification l selection are:

the urban settlements of Brunswick Heads, Ocean Shores and Billinudgel and the Ferry Reserve Caravan/Riverside Cresent;

the western part of the study area is characterised by rural activity, and by rural residential development;

vegetated east-west running ridges contain varying numbers of threatened plant species, and provide habitat for fauna, and for fauna movement;

the Brunswick Heads Nature Reserve and associated wetland areas;

the steep ridges to the west;

any crossing of the Brunswick River has the potential for impacts on river hydrology, flooding, estuarine vegetation and acid sulphate soils, as well as on oyster leases and river access;

the road reservation identified in the Byron LEP.

Community Input

There has been extensive community consultation to identify areas and issues of community concern. To date, over 800 people have been included on our mailing list, and hundreds of people have spoken to us - at the public meeting, at the route displays and using our freecall number. We have also responded to all requests for meetings with individuals or small groups of people.

We have been very appreciative of the information and local detail which the community has brought to our notice through their letters, calls and discussions.

Value Management Workshop

The community participated directly in selection of the preferred route through participation in the Value Management Workshop, which was described in Information Sheet 3. The workshop participants represented community organisations, Byron Council, government agencies with a statutory or regulatory responsibility for this project, and key members of the study team.

The workshop participants concluded by consensus that, on the basis of the information available, Route A2 best meets the project objectives, and was superior to Routes B,C,D and E and F.

We also indicated in the Information Sheet that investigations were continuing on this route, particularly in the vicinity of the Nature Reserve and the Brunswick River, as well as on other routes and variations suggested by the community. All routes which were suggested to the study team by the community have been analysed and evaluated.

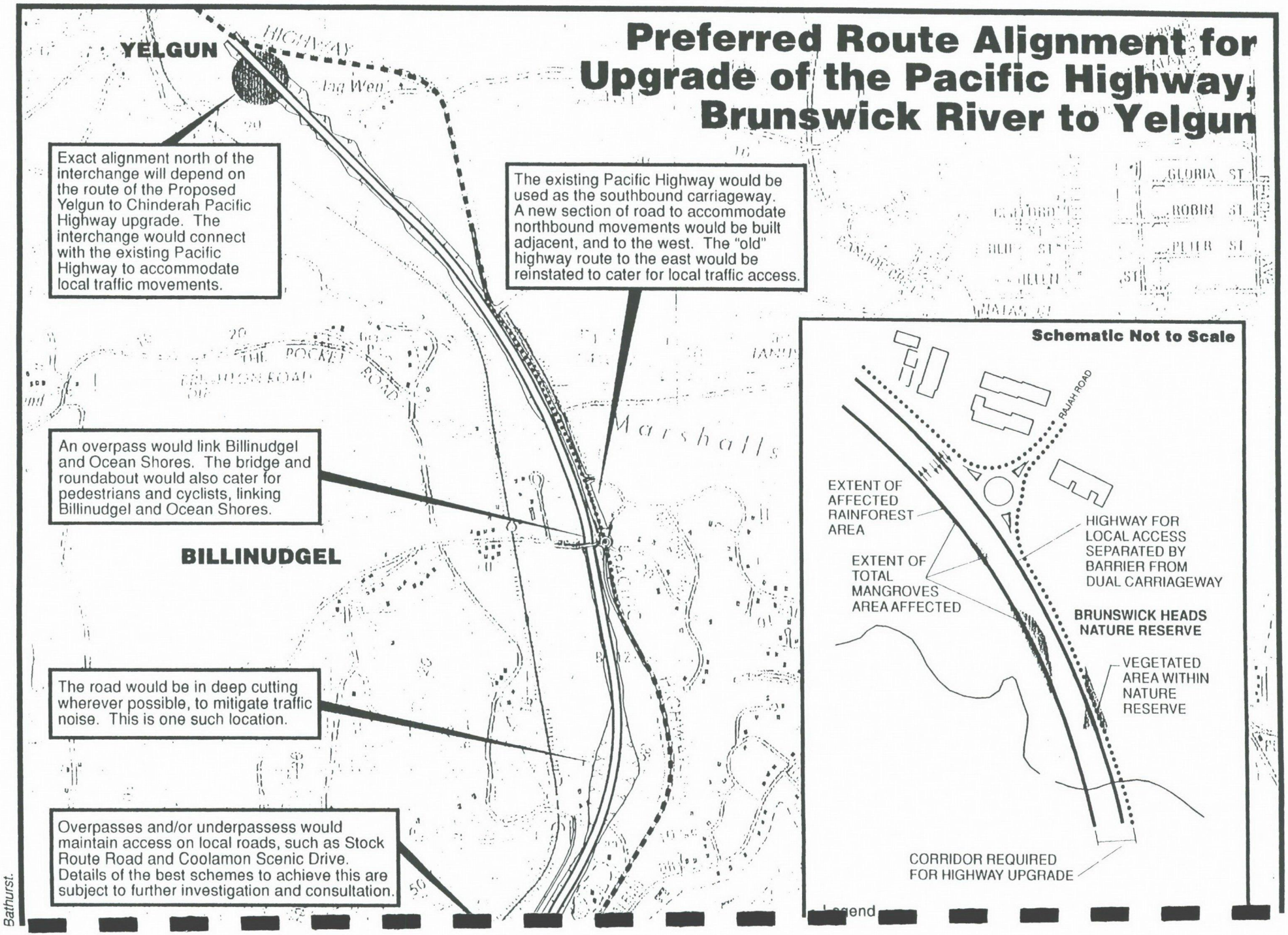
Consideration of Community Suggestions

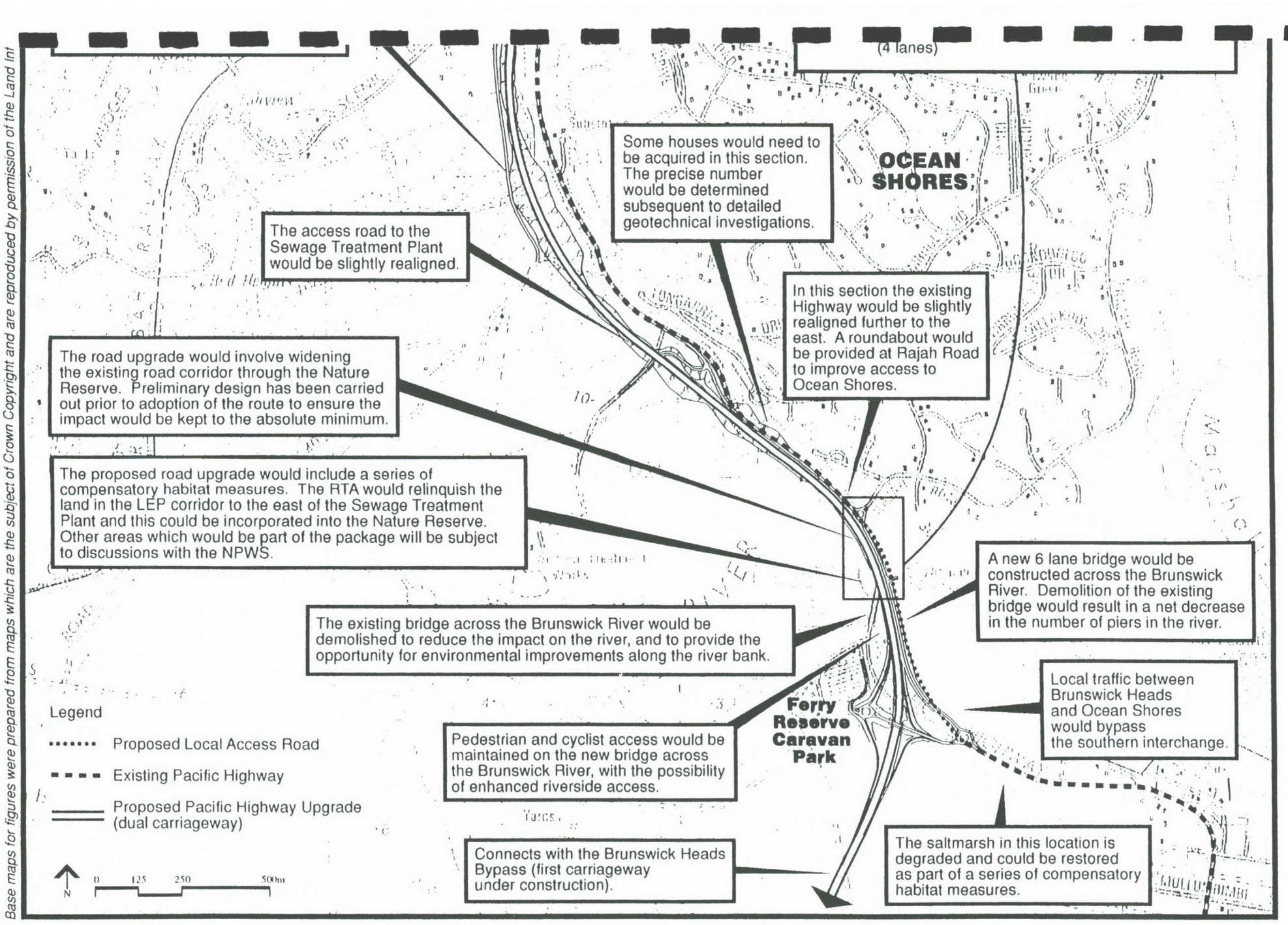
Our investigations have concluded that Routes F and G and variations to these, and other routes which cross to the west of the existing bridge, have the potential for more significant environmental impact than Route A2. These other routes would result in greater direct impacts on threatened species, fragment large areas of vegetation, and sever wildlife movement corridors.

These other routes would conflict with local planning objectives by creating a new corridor through natural and rural areas. This, in turn, could have significant impacts on the floodplain, rural amenity and on prime agricultural areas.

Route G in particular, because of its increased length, would be considerably more expensive to build, and would result in significantly less transport efficiency.

Preferred Route Alignment for Upgrade of the Pacific Highway, Brunswick River to Yelgun





Base maps for figures were prepared from maps which are the subject of Crown Copyright and are reproduced by permission of the Land Int

Decision on the Preferred Route

The RTA and the Minister for Roads have taken into consideration all of information provided by the technical investigations, community suggestions, the workshop and the additional investigations. The Minister has decided that Route A2 is the preferred route for the purposes of further investigations and preparation of an EIS.

Why Route A2 has been Selected as the Preferred Route

Route A2 has been selected as the preferred route because:

- It would have the least ecological impact. This route can be developed with minimal impact on the Nature Reserve and on the wetlands. Other routes would have resulted in greater fragmentation or severance of areas of vegetation and/or impact on greater number of threatened species.
- It is a widening of an existing corridor through the Nature Reserve rather than creation of a new corridor in this location.
- It is consistent with Council's planning strategies, concentrating road infrastructure within a single corridor. Selection of other routes would have resulted in impacts on existing and future residential and development areas or created new corridors.
- The selection of the LEP corridor would have resulted in significant impacts on the Ferry Reserve Caravan Park, and both permanent and temporary residents, and the Park would no longer have been viable.
- It will have least impact on prime agricultural land.
- Noise can be managed. The highway upgrade route, for most of its length, will be further away from residential areas than the existing highway is now. Much of the new road will be in cut. Noise mitigation measures will be part of the design.
- This option meets acceptable engineering design standards and meets the RTA's project objectives.
- This route connects to the Brunswick Heads Bypass (under construction).

Refinement of Route A2

Any route through this area would have some environmental impact, although, as described above, the potential impacts of Route A2 are less than for the other routes. Nevertheless, as part of the development of Route A2, there are several aspects that will require further attention and the incorporation of mitigation measures in the design.

As a result of the recommendation of the Value Management workshop, further investigations through the Nature Reserve have been undertaken by our ecologists and road designers. These have included on-site meetings and discussions with the National Parks and Wildlife Service, to identify the most sensitive areas and to ensure that the road corridor through the Nature Reserve is as narrow as it can be. We are now confident that the highway upgrade can be built along this alignment with little significant impact on the Reserve.

Nevertheless, the project will include measures to ensure that there is compensation for any area of the Nature Reserve, wetland areas and other areas of vegetation that are needed for road construction. This can be achieved through restoration of degraded areas, and the transfer of suitable lands to the NPWS and other land management agencies. Over the coming months we will be working with the relevant agencies to identify these areas.

Route A2 now includes the demolition of the existing bridge, with many consequent benefits. The new bridge would be built with fewer piers than the existing bridge. The river bank can be restored and rehabilitated, and on the southern side there is the possibly of developing a riverside park. These improvements to this area would provide long term benefits to the residents of the Ferry Reserve Caravan Park and Riverside Cresent, as well as the wider community. The improvements resulting from the demolition of the existing bridge and the creation of a significantly improved environment on the southern side of the river would also facilitate the continued use of this area for commercial and tourism purposes.

The RTA recognises that the impacts of any realignment of the existing highway and the construction of the new road are of concern to local residents, if these result in greater noise impacts. The RTA and the EPA have established stringent guidelines which road projects must comply with. Detailed noise monitoring and modelling will be undertaken along the preferred route to ensure that the road design, including noise mitigation, results in a highway upgrade that will meet these requirements.

The Next Steps

The next stage of the study involves detailed engineering assessment to identify the alignment of the highway upgrade and to define the road corridor boundaries. Detailed environmental studies will be undertaken to identify and quantify potential impacts and to design appropriate mitigation measures including any further modifications to the route which are required to minimise impacts.

From the outset, we have recognised the need for the earliest possible selection and announcement of the preferred route, to remove future uncertainty about impacts on property. Over the coming months we will be continuing to talk with the community to address specific issues of concern and interest. All landowners directly affected by this proposal will be contacted individually and offered the opportunity of an individual meeting. In this regard, our first priority will be to advance the study as quickly as possible, so that we can more clearly define individual property impacts.

Throughout the duration of the study we will continue to issue Information Sheets. These will advise on the progress of the detailed studies, the final route alignment, and on the exhibition of the Environmental Impact Statement.

If you would like to be on our mailing list, or need further information, please call **1 800 500 410** (freecall). Or you may write to:

Sinclair Knight Merz - (Attention: Jo Moss)
PO Box 164 St Leonards, NSW 2065
(Fax: 02 9928 2502)

The RTA's Project Manager is:
Mr Ken Oldfield, RTA Grafton
PO Box 546, Grafton NSW 2460

Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick to Yelgun

Information Sheet No 5 ... December 1997

Purpose of this Information Sheet

In September of this year, the Minister for Roads announced that the preferred route for the proposed Pacific Highway Upgrade between the Brunswick River and Yelgun is Route A2.

The purpose of this information sheet is to :

- tell you what we have been doing since September;
- advise how you can continue to make an input to the project; and
- give you more information about the program for the completion of the Environmental Impact Statement.

Progress to Date

Following the Minister's announcement, further investigations commenced. These investigations will assist with locating the preferred alignment and determining the boundaries of the proposed road corridor.

At the same time we were able to meet with the majority of property owners. We are most grateful for their co-operation and the input they have made to the study. Liaison with property owners and other key stakeholders will continue for the duration of the project.

Definition of the alignment requires detailed survey and a very good understanding of the geotechnical conditions. The survey and geotechnical investigations commenced in September and are now nearly complete.

The analysis and interpretation of the survey and geotechnical information will lead to a more precise understanding of the potential impacts of the road on individual properties.

The flora and fauna investigations are well advanced. Although these studies were initially concentrated on the section through the Nature Reserve and on the southern side of the Brunswick River, they have subsequently been extended along the whole route.

The purpose of the flora and fauna investigations is to more accurately define the location and types of plants and animals which will be affected by the road. This information is fed into the engineering design to ensure that impacts are minimised.

The next step is to define the measures which need to be incorporated in the design to further reduce environmental impacts on the natural environment. These measures are expected to include some provision for continued fauna movement (e.g. by fauna underpasses), restrictions on fauna/vehicle conflicts (e.g. by exclusion fencing) and revegetation of suitable areas, possibly as part of the road landscaping plan.

Proposals for minimising potential environmental impacts will be discussed with local environmental groups and other stakeholders, such as Byron Council and the National Parks and Wildlife Service, so that we can achieve a satisfactory package of measures to maintain the biological diversity and value of the area.

Other investigations are also proceeding, including indigenous and non-indigenous heritage, hydrology and water quality, and air quality.

One of the most important considerations, especially for the residents of the area, is the potential noise impact of the road. Background measurements have been taken and are being analysed so that the existing noise environment and the characteristics of noise propagation in this area are understood.

A high level of design detail is required for the prediction of noise arising from the project. So, we are not yet in a position to answer questions of detail about noise impacts and the options for noise mitigation measures.

Equally important, given the scenic and natural amenity of the area, will be the visual impact of the highway upgrade. Once the preferred alignment has been defined we will undertake a visual assessment.

A landscape concept plan will be prepared as part of the project. The landscaping will screen the road, and also enhance the appearance of the area, as has been achieved with the Bangalow Bypass.

We will be discussing the treatment of key areas, such as the end points (gateways) for the project and the river foreshore area, with Byron Council and other stakeholders. It is important that the resultant landscape is consistent with other initiatives in the local area, and benefits the community.

Information about the Brunswick Heads Bypass

The first carriageway of the Brunswick Heads Bypass is currently under construction. It is anticipated that the Bypass will be open to traffic around mid 1998.

The second carriageway for the Bypass would be built as part of this project and will be addressed by the Environmental Impact Statement.

The Next Steps

In summary, although we are able to prepare part of the engineering design in parallel with the field investigations, the refinement and completion of the design requires considerable detail. Once the design is complete we will be able to finalise the noise and visual assessments. Further modifications of the alignment can still be made at that stage to accommodate required mitigation measures.

As part of the detailed investigations and impact assessment, our team is identifying measures which need to be incorporated in the design to mitigate impacts. Some of these have been mentioned previously and include aspects such as minimising impacts on flora and fauna, appropriate landscaping, measures to treat road runoff and noise attenuation measures. We welcome the community's suggestions on these aspects.

There are also property impacts to consider, such as access, impacts on houses and buildings, and possible changes to the use of the property. In some cases local access roads will need to be realigned, and over or underpasses built to accommodate these. These are all being addressed at present.

Public Display

In early 1998 we will be holding another public display which will provide more details about the outcomes of our investigations. We will tell you more about this in our next Information Sheet.

Environmental Impact Statement

All of the investigations and design will be documented in a comprehensive Environmental Impact Statement. The Environmental Impact Statement will be accompanied by a series of Working Papers which contain more technical details about methodology, results and methods of analysis. All of these documents will be publicly available.

We anticipate that the Environmental Impact Statement will be on exhibition in April 1998.

Prior to the public exhibition we will send out another Information Sheet. It will contain information about:

- dates of the exhibition of the Environmental Impact Statement;
- locations for the exhibition;
- times when you can attend the exhibition;
- how to purchase a copy of the Environmental Impact Statement and Working Papers;
- information about how to make a submission; and
- the decision making process and probable timing.

Would You Like More Information?

If you would like to be on our mailing list, or need further information please call **1 800 500 410** (freecall).

Or you may write to:

Sinclair Knight Merz - (Attention: Jo Moss)
PO Box 164
St Leonards, NSW 2065
(Fax: 02 9928 2502)

The RTA's Project Manager is Mr Ken Oldfield
RTA Pacific Highway Development Office
PO Box 546, Grafton NSW 2460

******

THE RTA AND THE STUDY TEAM WOULD LIKE TO WISH EVERYONE THE COMPLIMENTS OF THE SEASON, AND A HAPPY AND SAFE NEW YEAR.

RTA
Roads and Traffic Authority

Proposed Second Carriageway for Brunswick Heads Bypass and Upgrade of the Pacific Highway, Brunswick River to Yelgun

COMMONWEALTH DEPARTMENT OF TRANSPORT AND REGIONAL DEVELOPMENT

Information Sheet No 6 ... March 1998

Purpose of this Information Sheet

Since the NSW Minister for Roads and Minister for Transport, Carl Scully, announced Option A2 as the preferred route for the Brunswick River to Yelgun upgrade in September last year, further detailed investigations have been underway.

The Brunswick River to Yelgun upgrade is jointly funded by the NSW State and Federal Governments, as part of the 10 year $2.2 billion Pacific Highway Reconstruction Program.

The previous Information Sheet advised that a public display would be held to provide more details of the outcomes of the study team's investigations. The purpose of this Information Sheet is to let you know:

how the study is progressing, and
where and when the public displays will be available.

Study Progress

Over the past few months, detailed investigations have been underway on the preferred route. These will enable us to define exactly where the new road will go and to determine the boundaries of the proposed road corridor. Although investigations are still continuing, we believe we are now able to provide some advice to the community on issues which are causing concern.

In particular, our investigations have increased our understanding of the potential environmental impacts of the preferred route and the measures which must be implemented to ensure the environment is adequately safeguarded. Proposals for minimising potential environmental impacts are being discussed with various stakeholders, including Byron Council, National Parks and Wildlife Service, Department of Land and Water Conservation and industry groups.

We are continuing to meet with property owners, and our ongoing investigations will allow us to continue providing more comprehensive advice about potential property impacts.

Public Display

The public display will give the broader community an opportunity to better understand the project and offer valuable input.

- The display will include plans showing the proposed route, and plans for the existing highway and local roads, as well as some preliminary sketches of the new bridge over the Brunswick River.
- Potential impact on the Brunswick Heads Nature Reserve, and on the Rajah Road area - issues of considerable community concern - will be displayed more clearly.
- Preliminary indications of noise impacts will be included in the display to address community concerns, and we would like to hear the community's views about noise mitigation measures.
- Study team members will be available to answer your questions at the Ocean Village Shopping Centre (Ocean Shores) on Wednesday 25 March 1998.

You can view the display at a number of locations. Details of the display are given overleaf.

You are also welcome to contact the study team at any time on the project freecall hotline (details below).

Want to be on our mailing list, or need further information? Call 1 800 500 410 (freecall) or write to:

Sinclair Knight Merz - (Attention: Jo Moss)
PO Box 164, St Leonards NSW 2065
Fax: 02 9928 2502

The RTA's Project Manager is Mr Ken Oldfield
RTA Pacific Highway Development Office
PO Box 546, Grafton NSW 2460

Upgrading the Pacific Highway

You are invited to attend a public display for the

Brunswick River to Yelgun Pacific Highway Upgrade

from Wednesday 18 March 1998
to Friday 3 April 1998

at the following locations:

- Billinudgel Post Office
- Byron Council Offices, Mullumbimby
- Ocean Village Shopping Centre, Ocean Shores

Please come along and meet the members of the Study Team
at the Ocean Village Shopping Centre (Ocean Shores)
Wednesday 25th March, 1988
10:00am - 7:30pm.
Learn more about the project and have your questions answered.