A New South Wales Government Initiative

Gerringong to Bomaderry

Princes Highway upgrade

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Executive summary

Introduction

Due to significant changes in land-use and population in the region since 1991 and a review of current planning, traffic and safety conditions, the NSW Government in March 2006 committed to a study investigating an area where it is likely that a preferred option would be located to upgrade the Princes Highway between Mount Pleasant at Gerringong and Cambewarra and Moss Vale roads at Bomaderry. The study includes development of route options and identification of a preferred option followed by concept design and an environment assessment.

Key contributions to the need for the upgrade is the three per cent growth in annual traffic numbers and nine fatalities occurring in eight traffic accidents between October 2002 and September 2007.

The RTA has set out several objectives for the Princes Highway, which generically include:

- Provide a flowing highway alignment that is responsive and integrated with the landscape.
- Protect the natural systems and ecology of the corridor.
- Protect and enhance the heritage and cultural values of the corridor.
- Respect the communities and towns along the road.
- Provide an enjoyable, interesting highway with strong visual connections to the Pacific Ocean, immediate hinterland and the mountains to the west.

More specific objectives for this project have been determined as follows:

- Improving road safety by improving alignment, controlled access and standards in new road design and construction.
- Improve efficiency of the Princes Highway between Gerringong and Bomaderry.
- Support regional and local economic development.
- Provide value for money.
- Enhance potential beneficial environmental effects and manage potential adverse environmental impacts.
- Optimise the benefits and minimise adverse impacts on the local social environment.

The existing highway will be upgraded to include:

- A high standard highway with two lanes in both directions with median separation (auxiliary 'climbing' lanes may also be required).
- Controlled access (rationalising accesses to increase road safety through minimising traffic conflicts).
- A bypass of Berry.

The project is currently in the preferred option development and display phase.

Study area characteristics

The study area identified for the proposed upgrade extends from the Mount Pleasant Lookout in the north to the Cambewarra and Moss Vale roads intersection in the south. The study area varies in width from approximately one to four kilometres and is influenced by natural landform. To the north and west the southern end of the Illawarra Escarpment and the Cambewarra Range and their spurs and ridges provide a 'border'. To the east and south the 'border' is formed by the low-lying coastal and flood plains beyond the railway line.

Significant constraints in the study area that influence the location and design of a preferred option include:

- The existing highway corridor.
- Sub-standard road geometry of the existing highway, particularly in the Foxground area.
- Floodplains and soft soil conditions located generally in the south and east of the study area.
- The South Coast railway.
- Agricultural industry including dairy.
- An approved housing development in Berry.
- The Eastern Gas Pipeline.
- Indigenous and non-Indigenous cultural heritage at various locations across the study area.
- Hilly terrain (generally found to the north-west of the study area with ridges extending south and east).
- Endangered ecological communities and threatened plant species.
- Residences and communities.

Community and stakeholder engagement

Community engagement is a key aspect of this project. The broader community will continue to have the opportunity to make a demonstrable input to the process and to ensure that the requirements and aspirations of the community will be adequately and appropriately addressed.

Objective

The consultation program aims to provide optimum opportunities for community and stakeholder involvement. Program objectives are to:

- Support and maintain the current RTA community involvement process.
- Ensure an open, accountable and transparent community involvement process.
- Ensure all potentially directly affected property owners and interested stakeholders are provided with sufficient information about the project and the likely impacts so that they can provide informed input.
- Ensure appropriate and direct communication with property owners in relation to access to and investigations on landholdings within the study area by study team members.
- Encourage community support and involvement in the project to facilitate better and more generally accepted outcomes through innovative communication methods.
- Provide a range of accessible opportunities for stakeholders, interested groups and the wider public to contribute to the project through issues identification, information provision and options evaluation.
- Build an ongoing relationship between the RTA, the community and stakeholders in order to gain long term support for the project and in particular the preferred option.

Consultation program tools

The following list provides a summary of the communication and consultation tools established for use across the life of the project. The selection and design of these tools was guided by consultation with the community at the commencement of the project in May 2006. Use of these tools has been tailored to meet the specific needs of each stage of the project.

- Permanent shop front information at the project office located at Broughton Court 3/113 Queen Street, Berry.
- Toll free community information contact line (1800 506 976).
- Project website www.rta.nsw.gov.au > Construction and maintenance > Regional maintenance > Southern > Princes Highway upgrade: Gerringong to Bomaderry.
- Dedicated project e-mail address Gerringong_to_Bomaderry@maunsell.com.
- Project database to record all correspondence relevant to the project, including contact details and issues raised during the life of the project.
- Quarterly community update newsletters or correspondence.
- Community information sessions and public workshops.
- Targeted focus group workshops.
- Interest group meetings.
- Face-to-face meetings with individuals / proprietors of potentially directly affected properties and businesses.
- Involvement of community participants in value management workshops.
- Information displays (staffed and unstaffed).
- Advertisements in the local press.
- Mail-outs (addressed and un-addressed).
- Community feedback forms.
- Acceptance of written submissions.

The consultation program is designed to establish two way communications with the community and stakeholders throughout the preferred option selection and approvals process. At each stage of the project the consultation activities proactively inform the community and stakeholders with the aim of increasing public understanding of the project and participation in consultation activities. This ensures the project benefits from the input of local knowledge and priorities and the project team gains greater insight into issues, potential mitigation strategies and opportunities to improve project outcomes.

Value management workshop

A three day value management workshop was held on 14, 15, and 16 May 2008. The purpose of this workshop was to bring together a wide range of stakeholder interests and expertise to review the outcomes of the investigations undertaken to date and, on the balance of issues and consideration of the short-listed options against agreed assessment criteria, to recommend a direction for further investigation to progress the project's development.

The workshop objectives were:

- Clarify the objectives of the project.
- Examine the short-listed options developed to meet the project objectives.
- Recommend a preferred direction to the RTA to progress the project.

Assessment criteria were developed and weighted under three key perspectives:

- Functional.
- Socio-economic.
- Natural and cultural environment.

Following completion of the weighted assessment costs and benefit / cost ratios were also considered.

The value management workshop scope was aligned to the short-listed options which were placed on public exhibition in November 2007. Discussion followed regarding a modification to the Orange route that would avoid / minimise cultural and social impacts. This had been considered by the project team previously as a permutation of the Orange route. It had also been proposed by several respondents during the route options display period. It was decided that there was a risk of a viable option being assessed and lost if the modification was not considered in this value management workshop and the value management workshop group agreed to add the modified Orange route to the assessment process together with the Orange route.

The workshop group reached a consensus on which routes (and therefore options formed by linking routes) should progress and what conditions should apply to their assessments. They also recommended a clear direction and way forward for the project. The following steps were identified to assist in the identification of a preferred route:

- Make recommendation that the Red route in Section A and the Purple route in Section D form part of the preferred option.
- Carry out further actions identified at this value management workshop including:
  - Confirm the feasibility of a modified Orange route.
  - Review the grade on the Pink and Green routes south of Belinda Street[1].
  - Refine the cost data for the Pink and Green routes.

Preferred option selection process

The preferred option has been selected as the option that both best meets the project objectives and which performs well across a combination of the technical input gathered through investigations carried out to date (including a review of studies from previous investigations into the upgrade), community feedback and the findings of the value management process.

The preferred option is summarised below and represented in **Figure ES1.1**.

The preferred option

The preferred option is the combination of the following displayed short-listed routes:

- Red route from Section A.
- Pink or Green route from Section B.
- Modified Orange route from Section C.
- Purple route from Section D.

[1] Post-value management workshop note: The project team has since reviewed this proposal and discounted it from further development based on considerable impact on dwellings and severance of several farms.

Section A (Mount Pleasant to south Gerringong)

In this section the preferred option follows the existing highway alignment. The four-lane carriageway with physical separation of traffic will descend from Mount Pleasant to Omega Flat at a similar grade to the existing highway – in the order of eight per cent. (Consideration will be given to a northbound climbing lane where grades are steep.) The crossing of Omega Flat will be raised on earth embankment to achieve a minimum of 1 in 20 year flood immunity. The vertical alignment will be improved to meet design standards from Omega Flat to Belinda Street

The interchange options for Gerringong will be located in this section. An objective will be to achieve a minimum of 1 in 20 year flood immunity. To improve road and rail safety and efficiency, none of the interchange options will retain the rail level crossing at Fern Street. Access to local roads and properties will be considered as part of the concept design.

Section B (south Gerringong to north Berry)

Two alternatives are preferred in this section – the Pink and Green routes. The Pink and Green routes are common and follow the existing highway alignment from Belinda Street to near Toolijooa Road.

The Pink and Green routes diverge near Toolijooa Road. The Pink route continues to follow the existing ascending highway alignment until the existing alignment becomes significantly sub-standard for the proposed design speed. At this point, approximately one kilometre south of Foxground Road, the Pink route cuts through the peak of the ridge and descends to Broughton Creek in a long sweeping curve. This curve crosses Broughton Creek three times before ascending a ridge to rejoin the existing highway alignment at Austral Park Road. From this point the Pink route is common with the Green route and generally follows the existing highway to approximately 500 m east of Tindalls Lane.

After diverging from the Pink route near Toolijooa Road, the Green route avoids climbing the ridgeline and instead takes a flatter grade into a relatively narrow section of the ridge. At this point the Green route passes into a 350 m long tunnel. The Green route emerges from the tunnel and curves southward to cross Broughton Creek three times in a similar manner to the Pink route. The Green route ascends a ridge to meet the Pink route and is common with the Pink route for the remainder of Section B.

Further studies, field work and cost estimates are required to assist with the determination of preference for either the Pink or Green routes over the length where they diverge.

Section C (Berry township)

A modified Orange route has been identified as preferred in this section. A modification to the Orange route was investigated prior to the value management workshop following considerable concern from the community. The modified Orange route was considered and recommended by the value management workshop participants.

From approximately half a kilometre east of Tindalls Lane the preferred option generally follows the existing highway corridor for three kilometres before leaving the western slope of the ridge over a bridge, in the vicinity of the existing roadside stockpile site. The bridge extends over Broughton Mill Creek, Woodhill Mountain Road and runs along the north side of Bundewallah Creek for approximately 300 m before crossing the creek. The preferred option then turns towards Albany Street where it follows the gazetted road corridor along the northern side of North Street.

Opposite George Street, the preferred option begins to turn south-west crossing Kangaroo Valley Road in cutting before rejoining the existing highway alignment opposite Mark Radium Park. Kangaroo Valley Road crosses the preferred option on an overbridge close to natural ground surface.

South of Kangaroo Valley Road the remainder of the preferred option in Section C follows the existing highway alignment. The vertical alignment will be 'smoothed' to meet design standards – resulting in new embankments and cuttings.

The interchange options for Berry will be located in this section. An objective will be to achieve a minimum of 1 in 20 year flood immunity. Access to local roads and properties will be considered as part of the concept design.

Section D (south Berry to Bomaderry)

In this section the preferred option follows the existing highway alignment.

The existing horizontal alignment will require minor corrections. Some vertical curves are substandard and will be upgraded. This will involve balancing earthworks and making use of existing road pavement and drainage structures where practicable. Widening on one or both sides of the existing highway will be considered to minimise impacts on adjoining properties and to make the best use of the existing road pavement and road reserve. It is expected that work will be carried out adjacent to traffic in this section.

The next steps

Further work is required to determine:

- The best route along a small section of the preferred option, covered by the separate parts of the Green and Pink routes. This will involve further investigation of environmental impacts, geotechnical conditions and road safety and operational issues.
- Access to Gerringong and Berry. This will be addressed through community consultation, technical investigations and a value management process in November.
- The individual projects, or stages, comprising the upgrade.

In addition, commencing in 2009, further community consultation will occur as the environmental assessments for stages of highway upgrades are undertaken.

Figure ES1.1 Preferred option

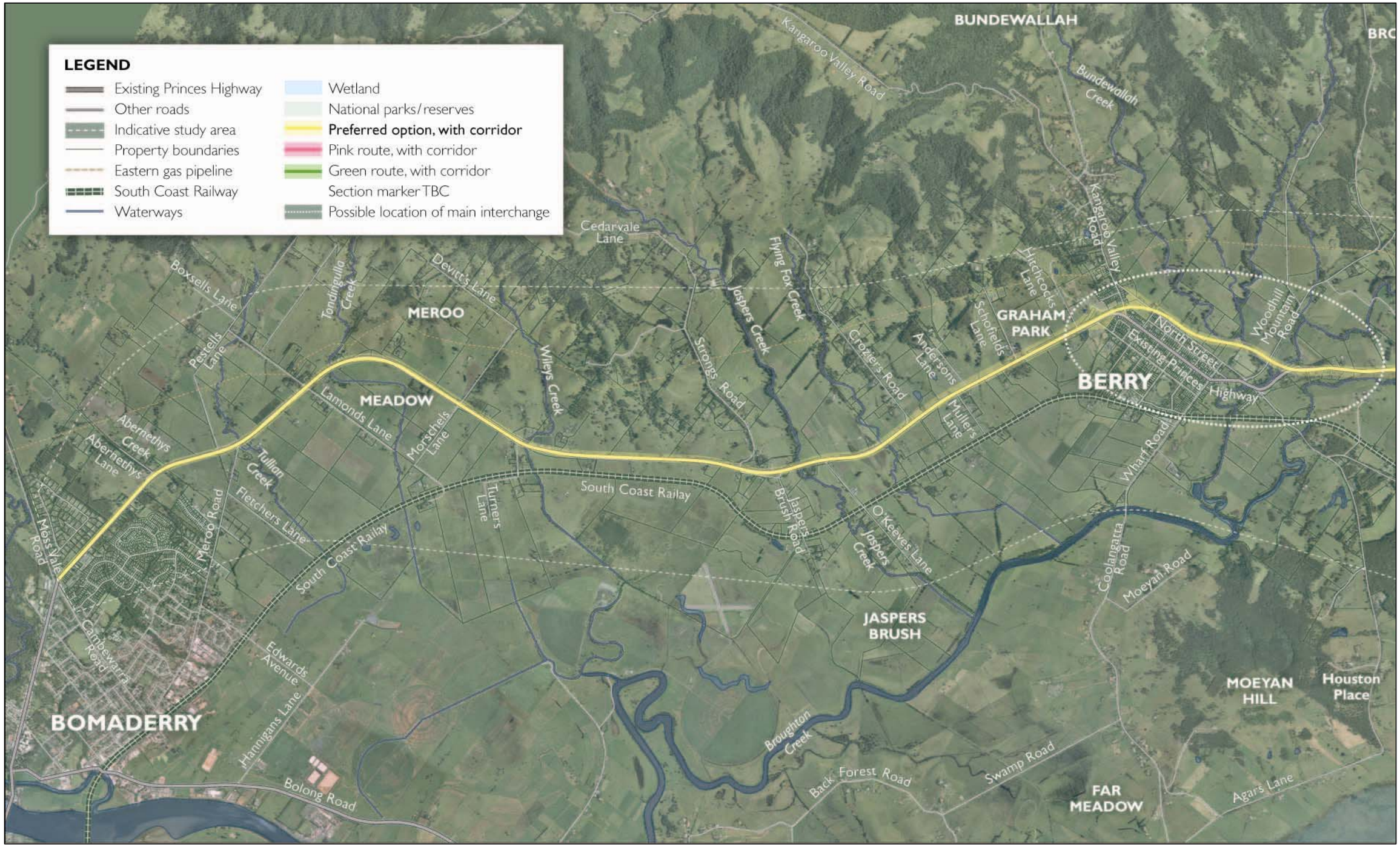


Figure ES1.1 Preferred option cont'd

Not used

1.0 Introduction

1.1 Background and need for the project

Maunsell AECOM was engaged by the Roads and Traffic Authority (RTA) in December 2006 to carry out an Options and Route Selection Study, Concept Development and Environmental Assessment for upgrading the Princes Highway between Gerringong and Bomaderry (approximately 30 km in total).

The northern extremity of the project is in the vicinity of the Mount Pleasant Lookout (north of Gerringong at the termination of the four lane configuration) and the southern extremity of the project is the intersection (roundabout) of the Princes Highway with Cambewarra and Moss Vale roads at Bomaderry. The project will provide a bypass of Berry.

The study includes development of route options and identification of a preferred option. A concept design and environment assessment will be carried out for the preferred option. Results of each of the main stages of the study will be put on public display.

Community engagement is a key aspect of this project. The broader community will have the opportunity to make a demonstrable input to the process and to ensure that the requirements and aspirations of the community will be adequately and appropriately addressed. This is particularly relevant to:

- Any potential impacts on rural and residential areas within the study area.
- Social and economic impacts.
- Accessibility of the road network for local and through traffic.
- Potential impacts on water quality.
- Potential impacts on wetlands.
- Potential impact on flooding.
- Potential impacts on land-use.
- Threatened flora and fauna species.
- Indigenous and non-Indigenous heritage.
- Visual impact.
- Noise.
- Air quality.

Sections of the highway between Gerringong and Bomaderry have a poor accident record and limited safe overtaking opportunities.

Due to the significant changes in land-use and population in the region since 1991 and a review of current planning, traffic and safety conditions, the NSW Government in March 2006 committed to investigating an area where it is likely a preferred route would be located to upgrade the Princes Highway between Mount Pleasant at Gerringong and Cambewarra and Moss Vale roads at Bomaderry. This upgrade would meet current road standards.

Key contributions to the need for the upgrade is the three per cent growth in annual traffic numbers and nine fatalities occurring in eight traffic accidents between October 2002 and September 2007.

The project is currently in the preferred option development and display phase.

This document has been prepared to explain the preferred option development process. It describes the investigative work and analysis that has led to the identification of the preferred option. It describes the preferred option and summarises the next steps.

1.2 The study area

The study area identified for the proposed upgrade extends from the Mount Pleasant Lookout in the north to the Cambewarra and Moss Vale roads intersection in the south (refer to **Figure 1.1**). The study area varies in width from approximately one to four kilometres. Past RTA experience on other similar projects shows that a preferred route can extend beyond the original limits of a study area. Therefore the study area for this project encompasses a larger than usual area and has 'fuzzy edges', reducing the risk that parts of feasible routes extends beyond the study area.

The extent of the study area is influenced by natural landform. To the north and west the southern end of the Illawarra Escarpment and the Cambewarra Range and their spurs and ridges provide a 'border'. To the east and south the 'border' is formed by the low-lying coastal and flood plains beyond the railway line.

From north-east to south-west the study area passes the towns of Gerringong and Berry and terminates at the northern reaches of Bomaderry. The pastureland and rural settlement patterns of the study area are defining features. The rural landscape that exists today is highly reflective of agricultural activities that have been occurring since the first half of the nineteenth century.

The largest agricultural influence has come from dairying activities. These activities have defined the general pattern of vegetation clearance, defined rural boundaries by linear cultural plantings, and the distribution of rural houses and farm buildings.

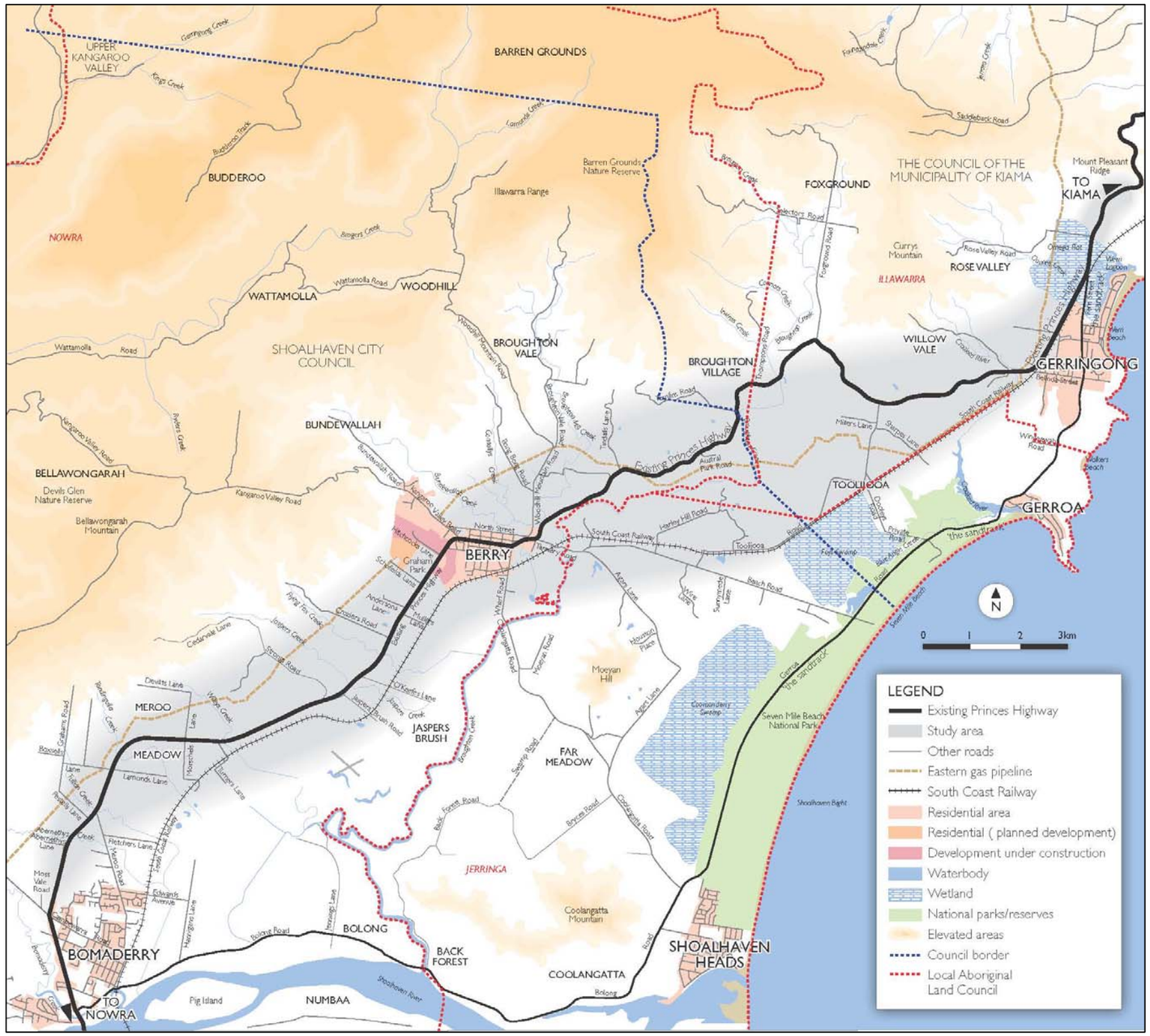
Within the pasture landscape the major source of variation is the topography of the study area. The character of the rural backdrop is markedly different between the undulating higher elevations associated with the foothills of the Illawarra Escarpment and Cambewarra Range, and the coastal plain that occurs generally east of Broughton Creek.

The rural backdrop is slowly changing and the partial decline in the dairying industry has created a more complex landscape pattern. A wider variety of agricultural activities is resulting in more areas under cultivation.

Significant constraints which influence the location and design of the route options include:

- The existing highway corridor.
- Sub-standard road geometry of the existing highway, particularly in the Foxground area.
- Floodplains and soft soil conditions located generally in the south and east of the study area.
- The South Coast railway.
- Agricultural industry including dairy.
- An approved housing development in Berry.
- The Eastern Gas Pipeline.
- Indigenous and non-Indigenous cultural heritage at various locations across the study area.
- Hilly terrain (generally found to the north-west of the study area with ridges extending south and east).
- Colonies of endangered ecological communities and threatened plant species.
- Residences and communities.

Figure 1.1 Study area



1.3 The existing highway

The Princes Highway forms an important north-south corridor linking Sydney with the Illawarra and South Coast regions. The Illawarra and South Coast Regional Strategies identify the Princes Highway as a critical link for both passenger and freight transport between Sydney, Wollongong and communities in the Illawarra and South Coast. It is the primary land transport route servicing the South Coast as the railway does not extend south of Bomaderry. It is also a major route for tourism with peaks at holiday periods, particularly in summer. Traffic volumes along the route are currently growing by approximately three per cent per annum.

Crash statistics collected by the RTA confirm the widely held concern that many areas of highway between Gerringong and Bomaderry perform relatively poorly with regards to road safety (refer to **Chapter 2**). In terms of the existing highway, the study area can be split into two sections.

- Between Gerringong and Berry, the highway is characterised by its rural, hilly and sinuous alignment. Generally it is an unforgiving two lane undivided carriageway with lengths of sub-standard horizontal and vertical alignment. It provides limited opportunity for overtaking and has frequent uncontrolled residential, farm and minor road access and intersections.
- Between Berry and Bomaderry, the alignment is relatively good, although there are a number of sub-standard vertical curves which present overtaking and turning manoeuvre problems. Similar to the northern section many uncontrolled accesses and junctions exist.

1.4 Project objectives

The RTA has set out several objectives for the Princes Highway. Generically these include:

- Provide a flowing highway alignment that is responsive and integrated with the landscape.
- Protect the natural systems and ecology of the corridor.
- Protect and enhance the heritage and cultural values of the corridor.
- Respect the communities and towns along the road.
- Provide an enjoyable, interesting highway with strong visual connections to the Pacific Ocean, immediate hinterland and the mountains to the west.

Objectives for this project have been determined as follows:

- Improving road safety by improving alignment, controlled access and standards in new road design and construction.
- Improve efficiency of the Princes Highway between Gerringong and Bomaderry.
- Support regional and local economic development.
- Provide value for money.
- Enhance potential beneficial environmental effects and manage potential adverse environmental impacts.
- Optimise the benefits and minimise adverse impacts on the local social environment.

The existing highway will be upgraded to include:

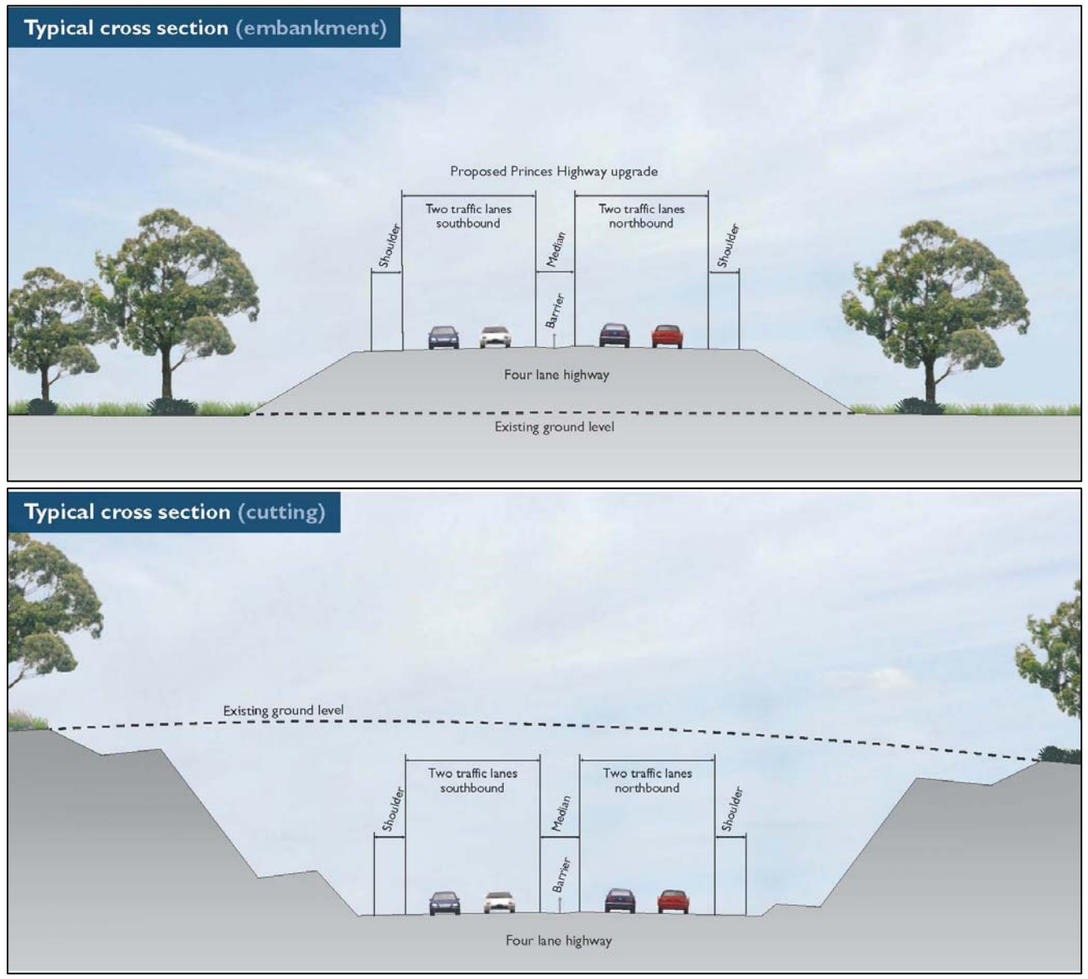
- A high standard highway with two lanes in both directions with median separation (auxiliary 'climbing' lanes may also be required).
- Controlled access (rationalising accesses to increase road safety through minimising traffic conflicts).
- A bypass of Berry.

The preferred option development and selection process is one that seeks to identify the route which best meets these objectives. The process is set out in **Chapter 8**.

1.5 Design requirements

Together with the characteristics discussed in **Chapter 3** the design considerations identified in **Chapter 4** form the guidelines and parameters to which the upgrade must attain. **Figure 1.2** details typical cross-section arrangements of the upgrade (the final arrangement may vary as conditions change eg local topography).

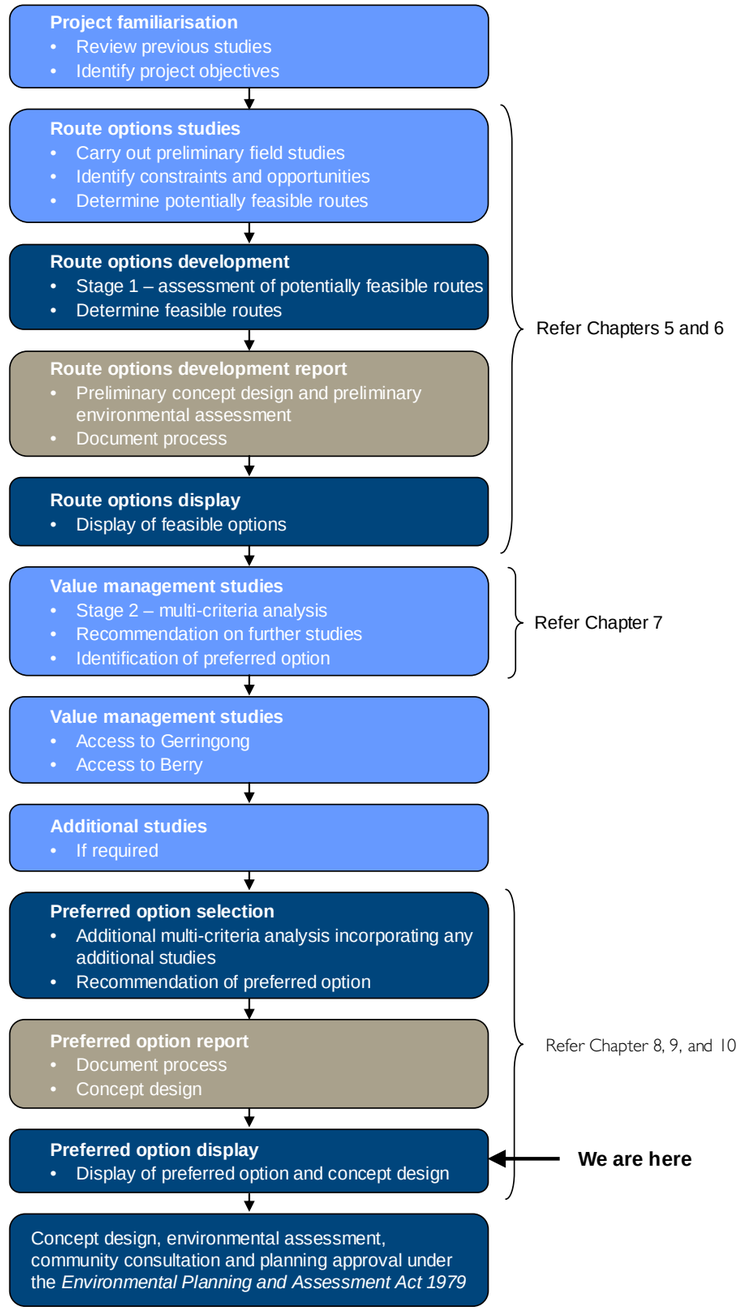
Figure 1.2 Typical cross-section arrangements



1.6 Project development process

A summary of the route option selection process is shown in **Figure 1.3**. **Chapter 8** includes a description of the preferred option development phase.

Figure 1.3 Route option development process



1.7 Previous studies

Several studies have been undertaken since the early 1990s to identify a preferred route to upgrade sections of the Princes Highway between Kiama and Nowra including a bypass around the town of Berry.

These studies include:

- The 1991 Gerringong to Berry Route Study.
- 1998 North Street Berry Bypass Corridor.
- 2004/5 Quantm Study from Kiama to Nowra.

1.8 Specialist studies

A number of key environmental, engineering and economic issues influence the location and design of the preferred option. Preliminary investigations have been carried out and have included reviews of studies from previous investigations into the upgrade.

The current investigations comprise a review of existing background data, fieldwork and analysis to provide a more detailed understanding of the physical, social and economic aspects of the study area. Specialist studies conducted during the route options development phase are presented in the *Route Options Development Report (November 2007)* and include:

- Geotechnical.
- Topography, geology and soils.
- Urban design, landscape and visual amenity.
- Traffic, transport and road safety.
- Public utilities and services.
- Social-economic.
- Flora and fauna (terrestrial and aquatic).
- Water quality.
- Cultural heritage (Indigenous and non-Indigenous).
- Flooding and drainage.
- Land-use and planning.
- Noise and vibration.
- Climate and air quality.

The following additional specialist studies have been undertaken since the initial route options development stage to input into evaluation of route options and the selection of a preferred option:

- Ongoing fog monitoring in two locations to determine the impacts of fog on the route options in terms of a route differentiator and for input into the Environmental Assessment.
- Oral history survey of the study area to gain an appreciation and document the Aboriginal and European heritage in the study area.
- Additional traffic surveys to gather more base data to feed into the traffic models used to determine access movements to and within the towns of Gerringong and Berry including public holidays.
- Additional industry stakeholder interviews to further develop the Preliminary Social-Economic Impacts Report prepared as *Appendix F of the Route Options Development Report (November 2007)*. The study involved both qualitative and quantitative methods, using a combination of discussions with business owners / managers and experience gained from other similar highway upgrade projects.
- Additional cultural knowledge holder interviews held with a panel of agreed cultural knowledge providers as accepted by the Aboriginal Focus Group.
- Site walk with representatives from the Aboriginal Focus Group to obtain cultural knowledge along the preferred route and to evaluate potential route differentiators between the Pink and Green routes in Section B.
- Considerations of ecologically sustainable development and appraisal of the short-listed options to assess the impacts of climate change. Various factors were considered in order to determine whether climate change is an option differentiator. The factors comprised: average annual rainfall and extreme daily rainfall; sea level rise; average maximum temperature and extreme daily temperatures; extreme wind-speed; high bushfire danger days; Peak Oil theory; greenhouse gas emissions; and greenfield land consumption. The appraisal also identified sustainable design and construction opportunities which would address the potential impacts.

1.9 RTA environmental commitment

Through its *Environmental Policy 2007*,[2] the RTA is committed to undertaking activities in an environmentally responsible manner and to effectively manage any risks that may lead to an impact on the environment. To this end, environmental management is considered an essential element of effective road and traffic related infrastructure planning, construction, maintenance and operation.

1.10 Ecologically sustainable development

The principles of ecologically sustainable development as defined in the *NSW Environmental Planning and Assessment Act 1979* and the Environmental Planning and Assessment Regulations 2000 have been considered during the evaluation of the preferred option. The relevant requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* have also been taken into account. The RTA, through its Environmental Policy, has a corporate commitment to the principles of ecologically sustainable development which must be reflected in all stages of the project.

1.10.1 New South Wales ecologically sustainable development requirements

The principles of ecologically sustainable development are listed under Schedule 2 of the Environmental Planning and Assessment Regulation 2000 as:

- *"The "precautionary principles" ie 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. In the application of the precautionary principle, public and private decisions should be guided by:*
  - *Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment.*
  - *An assessment of the risk-weighted consequences of various options.*
- *"Inter-generational equity" ie the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.*
- *"Conservation of biological diversity and ecological integrity" ie biological diversity and ecological integrity should be preserved as much as possible by investigating appropriate route options that minimise the impact of biological resources including threatened species and their habitats and ecologically sensitive communities.*

[2] The RTA Environmental Policy 2007 is available to download from the RTA website www.rta.nsw.gov.au.

- *"Improved valuation, pricing and incentive mechanisms" ie environmental factors should be included in the valuation of assets and services, such as:*
  - *Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement.*
  - *The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.*
  - *Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems."*

1.10.2 Commonwealth ecologically sustainable development requirements

Under Section 3A of *the Environment Protection Biodiversity Conservation Act 1999*, the principles of ecologically sustainable development require:

- Decision-making processes to effectively integrate both long-term and short-term environmental, economic, social and equitable considerations.
- Consideration of the precautionary principle.
- Consideration of inter-generational equity.
- Conservation of biological diversity and ecological integrity.
- Improved valuation, pricing and incentive mechanisms to be considered.

1.10.2.1 Integrating the principles of ecologically sustainable development

Pursuant to the commitment to ensure that major road developments are consistent with the principles of ecologically sustainable development, these principles have been integrated into the identification and evaluation of alternatives for the upgrade.

These ecologically sustainable development principles are recognised as a part of the route selection and evaluation process through the integration of ecological, social and economic considerations into the decision making processes for route selection.

This has included significant input into the route selection process by sustainability and environmental specialists, not just the consideration of engineering and economic requirements. Community submissions on sustainability have also been taken into consideration.

The principle of conservation of biological diversity and ecological integrity has been taken into consideration by developing a range of options which aim to maintain or enhance the range and health of native plants and animals in the study area.

Maps showing areas of high conservation significance were produced for consideration during the route options selection process and these areas were avoided as much as possible in route selection.

The precautionary principle has been taken into account by, wherever possible, avoiding areas of high conservation significance early in the route selection process.

Inter-generational and intra-generational equity have been considered by the route options selection process by including social and community issues in the assessment and avoiding areas of high impact. In addition, the impact of each route on the use of scarce resources has been considered in conjunction with other environmental, engineering and economic criteria.

Further to the incorporation of these principles, an appraisal of the short-listed options has been undertaken and the findings will be considered during the development of the concept design and environmental assessment of the preferred option.

1.11 Report objectives

The objective of this report is to describe the preferred option which has emerged from the route options selection process.

In addition, the report:

- Presents the justification for the project and its strategic context.
- Outlines community engagement to date and key issues arising.
- Confirms the constraints and opportunities which influenced the development of the preferred option including social, environmental and engineering issues.
- Confirms the design parameters applicable to this project.
- Explains the route option development process including the value management process.
- Outlines the next steps.

1.12 Report structure

The report has 11 chapters:

- Chapter 1 provides an introduction to the project.
- Chapter 2 outlines the strategic context of the project.
- Chapter 3 describes the study area characteristics and issues for option development.
- Chapter 4 outlines the design criteria and physical constraints which influence the development of the options.
- Chapter 5 addressed the options development and assessment process.
- Chapter 6 addresses the community and stakeholder involvement in the route options development process.
- Chapter 7 outlines the value management process.
- Chapter 8 addresses the preferred route option development and assessment process.
- Chapter 9 presents the preferred option and its specific impacts on the existing environment.
- Chapter 10 documents the next steps of the project.
- Chapter 11 documents references.

Not used

2.0 Strategic context

2.1 Introduction

The Princes Highway is the main north-south corridor between Sydney and the Illawarra and South Coast regions. It is a critical link for both passenger and freight transport and is a major route for tourism with significant peaks in holiday periods. The section of the highway from Gerringong to Bomaderry experiences a high rate of accidents with nine fatalities occurring between October 2002 and September 2007. The two lane undivided road has limited overtaking opportunities, many junctions with rural roads and private uncontrolled accesses.

On completion of the Oaks Flats to Dunmore project, planned for late-2009, this section of the Princes Highway will be the only section of two lane highway between Sydney and Nowra.

The NSW Government is committed to the investigation of this section of the Princes Highway to determine a preferred option. This commitment was further demonstrated recently by the NSW Treasurer in the 2008/09 budget, when he announced a further budget allocation of $4.0 million towards planning of this upgrade.

Figure 2.1 shows this section of the Princes Highway in the regional context.

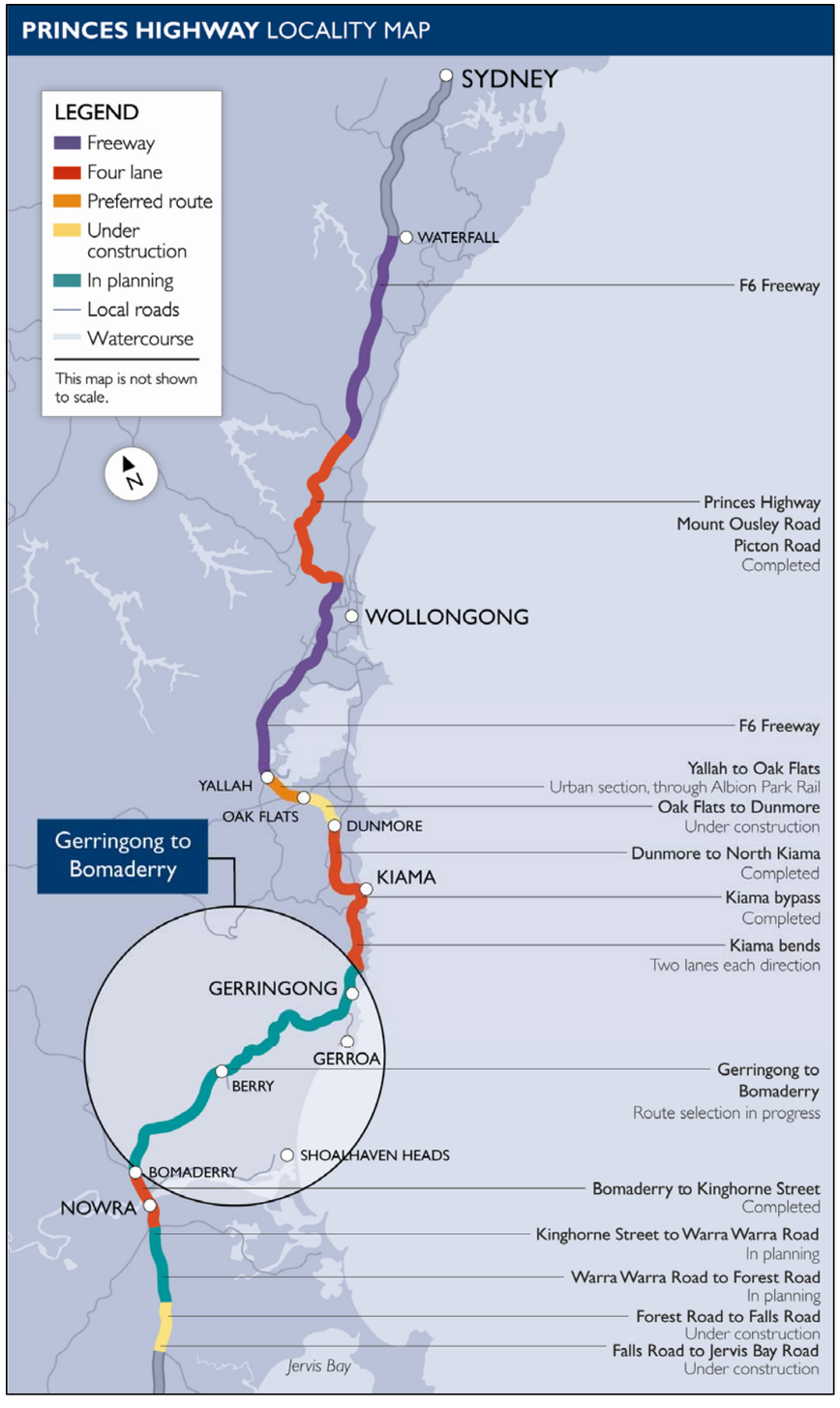
2.2 Planning context

The South Coast is experiencing a significant expansion in terms of population and tourism. This is due to an attractive climate, a unique blend of landscape setting and cultural heritage, and its growing popularity as a 'lifestyle change' destination. As the traditional agricultural characteristics of the area are changing they affect the landscape and the economic make-up of the local environs.

The Princes Highway provides the principle road linking Sydney and Wollongong to the South Coast and south-eastern Victoria. It is an important link as it provides a:

- Commuter route between Sydney, Wollongong and Nowra.
- Local route for residents of surrounding smaller towns and rural residences.
- Major tourist route for key destinations including Berry, Nowra and the South Coast with peak traffic on weekends and holiday periods.
- Important freight and bus route, particularly for the South Coast and far South Coast where there are no rail services.

Figure 2.1 Regional context



2.3 Traffic and transport

2.3.1 Traffic volumes

Traffic counts conducted in February 2007 recorded traffic flows at locations within the study area. These are summarised in **Table 2.1**.

Table 2.1 Traffic volumes on the Princes Highway in February 2007

Location	Highest weekday peak hour flow (vehicle/hour)			Estimated 2007 AADT* (veh/day)
	Northbound	Southbound	Total	
Princes Highway, north of Fern Street, Gerringong	800	800	1,600	20,700
Princes Highway, north of Tannery Road, Berry	400	350	750	11,500
Princes Highway, north of Cambewarra Road, Bomaderry	450	500	950	13,400

Source: Australasian Traffic Surveys, 2007
*** AADT = average annual daily traffic**

The highest traffic volumes were observed on the existing highway just north of Fern Street at Gerringong.

Analysis of the weekday traffic profiles on the highway at Gerringong (north of Fern Street) and Bomaderry (north of Cambewarra Road) shows that the AM peak period occurs between 8am and 9am and the PM peak period occurs between 4pm and 5pm. These peaks can be primarily attributed to commuter traffic. A distinct AM peak is not evident on the Princes Highway in Berry. An early afternoon peak in Berry may indicate school and commercial activity.

The highest flow on the Princes Highway north of Gerringong occurs during the school holidays at Christmas, Easter and in October. At the same location, traffic flows during the Christmas / New Year week accounted for 2.5 per cent of the yearly flows, or more than 25 per cent higher than the average weekly traffic flow.

Traffic flows extracted from RTA Southern Region's strategic traffic models for 2001 and 2026 indicate that the highway is experiencing a growth rate of approximately three per cent per annum based on the change in land-use within the region. Should the highway not be upgraded between Gerringong and Bomaderry, higher traffic volumes would continue to grow on the present highway and the 'Sandtrack' with increases in travel time and the potential for accidents on both roads.

Heavy vehicles currently make up between nine and 15 per cent of traffic on the Princes Highway in the study area on weekdays. The proportion of heavy vehicles is much lower on weekends (three to five per cent).

The study area is served by two modes of public transport – bus / coach services and train. Public transport accounts for less then 10 per cent of the mode share in Kiama and Shoalhaven Local Government Areas.

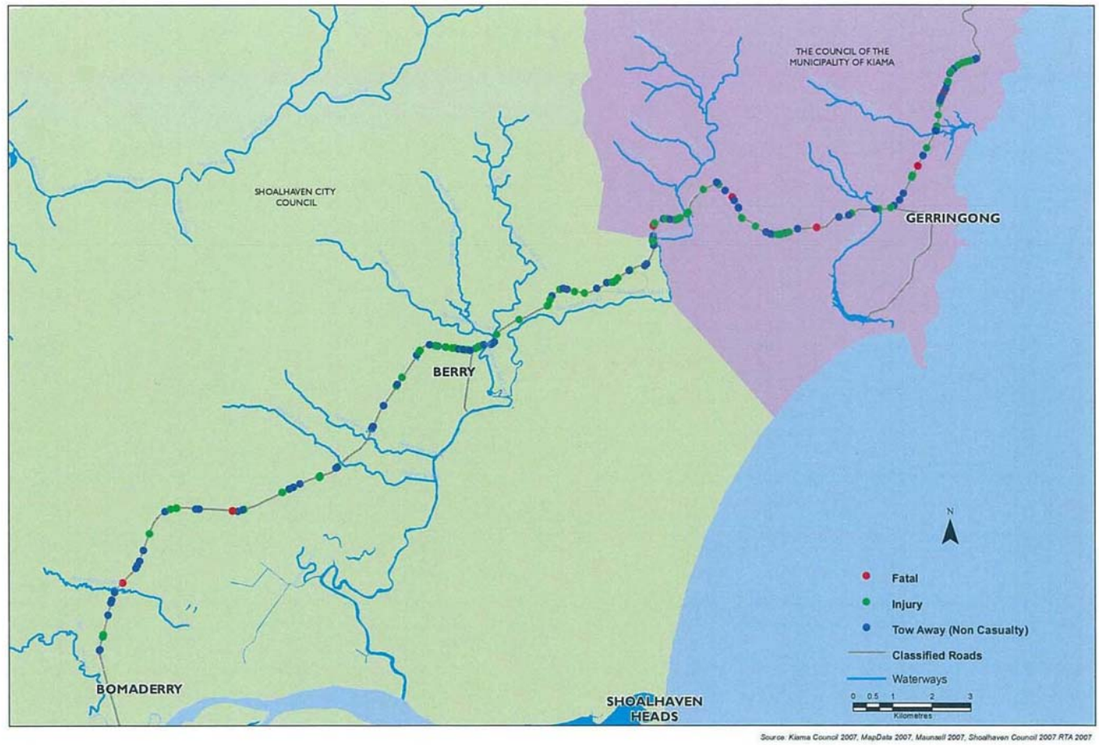
2.3.2 Crash analysis

Crash data shows that 242 recorded crashes have occurred on the Princes Highway between the Mount Pleasant Lookout and Cambewarra Road in Bomaderry in the five years between October 2002 and September 2007. Eight were fatal, resulting in nine fatalities. There were 119 recorded injury crashes resulting in 171 injuries and 115 non-injury crashes.

Figure 2.2 shows the location of each type of accident along the Princes Highway within the study area.

Pedestrians were involved in three crashes resulting in injuries only. All of the crashes involving pedestrians occurred in Berry at Victoria, Prince Alfred and Alexandra streets.

Figure 2.2 Location of accidents on the Princes Highway (October 2002 and September 2007)



2.3.3 Travel patterns and times

An Origin-Destination survey was undertaken during AM and PM peaks of a typical weekday in February 2007[3] as part of this study.

The survey shows that in the northbound direction, over 17 per cent of the vehicles crossing the Shoalhaven River are 'through trips' during the AM and PM peaks. For southbound trips, over 46 per cent of vehicles at Mount Pleasant are 'through trips' in the morning peak, and over 38 per cent are 'through trips' in the afternoon peak.

Of the traffic travelling between Gerringong and Bomaderry, approximately 60 per cent use the Princes Highway and 40 per cent use the 'Sandtrack' in both directions.

The survey suggested that it takes approximately 30 minutes to travel from the Mount Pleasant Lookout to the Shoalhaven Bridge along the Princes Highway. The travel time using the 'Sandtrack' is within one minute of this.

[3] A further Origin-Destination survey was carried out over the October 2007 holidays and results are being used in interchange planning.

Should the highway not be upgraded, travel times on the Princes Highway would increase as the level of congestion increases. Delays may be caused by local traffic conflicting with major through traffic movements at major destinations such as Berry.

Increases in travel times on the highway could reduce the attractiveness of the local area to commercial business and the region may suffer economically. For example, new businesses may choose to locate outside the area to gain adequate freight access.

The potential for accidents is likely to increase with increased traffic volumes especially at major intersections along the route, such as Fern Street and Belinda Street in Gerringong.

The potential for more crashes is also likely as delays on the Princes Highway continue to increase. Access to and from local roads and properties is expected to become more difficult with increased volumes of through traffic. Some drivers may take greater risks to make turns as gaps in the flow of traffic on the Princes Highway become less frequent, while others would experience a greater risk of rear-end crashes waiting for right turn opportunities.

There are currently high pedestrian movements across Queen Street in Berry. Removal of through traffic to a bypass of Berry would dramatically reduce the increased likelihood of accidents involving pedestrians.

2.3.4 Minimal intervention

Fundamental requirements of this study include the provision of a bypass of Berry and a highway alignment meeting a posted speed of 100 km/h. Scenarios involving only minor improvements would not meet these requirements or the study objectives. Implementation of minor improvements would also not provide a satisfactory solution from a strategic, regional, local planning or transport context.

Not used

3.0 Study area characteristics

3.1 Overview of study area

The study area extends from the Mount Pleasant Lookout north of Gerringong to the Cambewarra and Moss Vales roads intersection at Bomaderry in the south as shown in **Figure 1.1**. It varies in width from approximately one to four kilometres.

The extent of the study area is influenced by natural landform. To the north and west the southern end of the Illawarra Escarpment and the Cambewarra Range and their spurs and ridges provide a 'border'. To the east and south the 'border' is formed by the low-lying coastal and flood plains beyond the railway line.

From north-east to south-west the study area passes the towns of Gerringong and Berry and terminates at the northern reaches of Bomaderry. The pastureland and rural settlement patterns of the study area are defining features. The largest agricultural influence is from dairy activities.

Within the pasture landscape the major source of variation is the topography of the study area. The character of the rural backdrop is markedly different between the undulating higher elevations associated with the foothills of the Illawarra Escarpment and Cambewarra Range, and the coastal plain that occurs generally east of Broughton Creek.

The rural backdrop is slowly changing and the partial decline in the dairying industry has created a more complex landscape pattern. A wider variety of agricultural activities is resulting in more areas under cultivation.

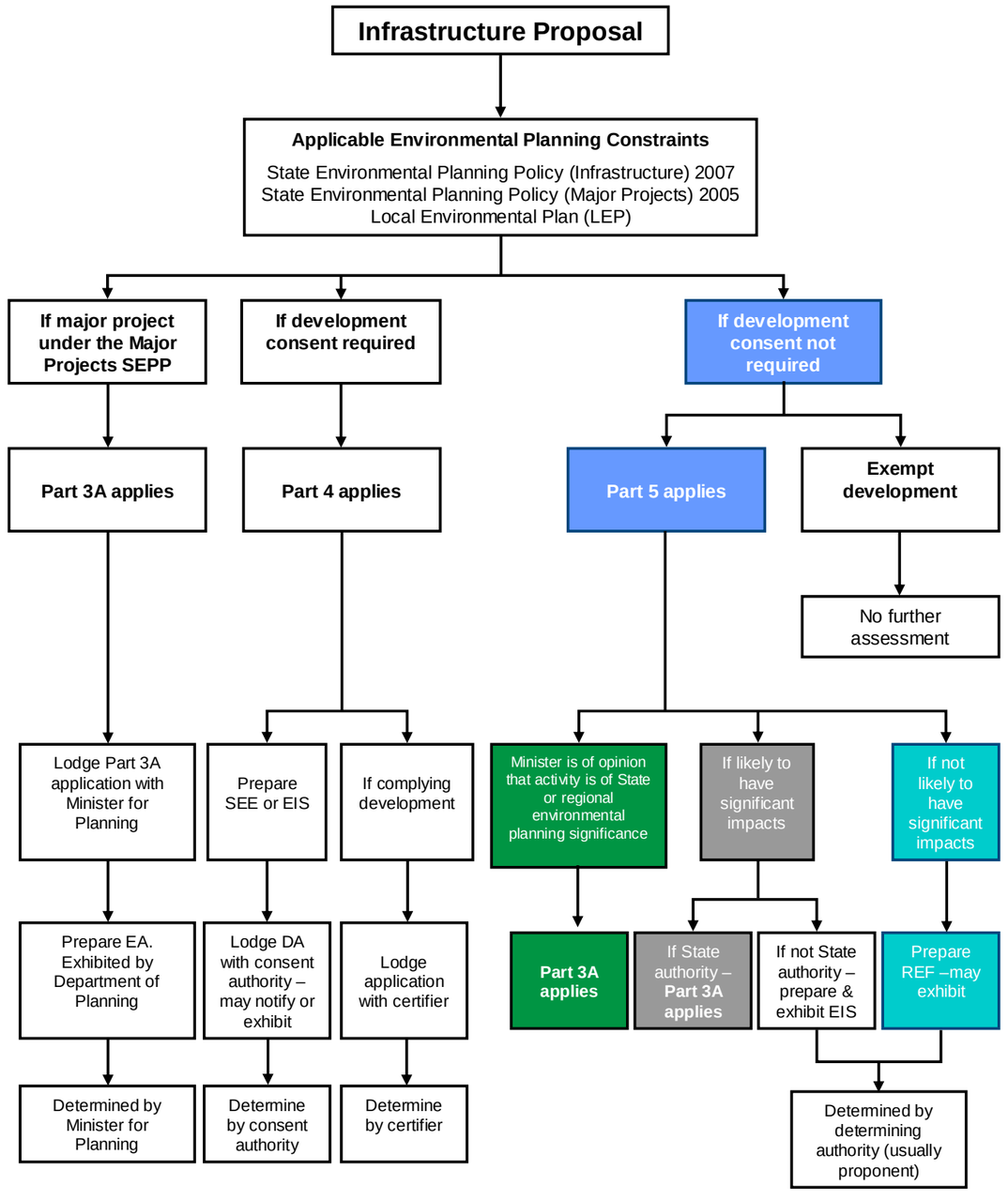
3.2 Planning approval process

This section provides an overview of the current NSW planning provisions applicable to the development of this project. The *Preliminary Planning and Zoning Issues Report* prepared as *Appendix L* of the *Route Options Development Report (November 2007)* provides additional detail on statutory and strategic planning relevant to the study area.

This summary identifies the statutory planning requirements that are relevant to the upgrade. A planning approvals strategy will be prepared in conjunction with an implementation strategy for the preferred option that will re-examine the applicability of each part of the *Environmental Planning and Assessment Act 1979* and will identify which approvals process will be applied and the expected timing of those approvals. This will include consideration of new and updated legislation that is relevant to the project.

The planning approvals path for the project is outlined in **Figure 3.1**.

Figure 3.1 Infrastructure approval process flowchart



Source: Adapted from Department of Planning, 2008

3.2.1 Local Environmental Plans

Local land use zoning provisions in the study area are considered to be one of the key planning influences over the feasibility of the preferred option. The key Local Environmental Plans (LEP) have been considered in order to describe the relevant planning and zoning issues and land use zoning provisions.

The study area spans parts of two Local Government Areas:

- Kiama Municipal Council – land subject to Kiama Local Environmental Plan 1996.
- Shoalhaven City Council – land subject to Shoalhaven Local Environment Plan 1985.

Local planning and zoning provisions as they currently relate to the study area are detailed in **Figure 3.2**.

3.2.1.1 Kiama Local Environmental Plan 1996

Under the Kiama Local Environmental Plan (as amended) roads are permissible either with or without development consent in each of the zones that the study area is subject to excluding Zone 7(b). Roads are prohibited in Zone 7(b) Rural Environmental Protection (estuarine wetlands).

3.2.1.2 Shoalhaven Local Environmental Plan 1985

Under the Shoalhaven Local Environmental Plan (as amended, dated 13 April 2007) roads are permissible with development consent in each of the zones that the study area is subject to. Parts of the study area are also subject to provisions relating to land that is:

- Subject to urban flooding.
- Subject to a Scenic Protection Area.
- Identified as being Land of Ecological Sensitivity.

Depending on the location of the works, these land characteristics would need to be considered as part of environmental assessment and concept design.

For clarification, some road works are permissible without consent, under Clause 52 of Shoalhaven Local Environmental Plan, which states that nothing in the Local Environmental Plan restricts or prohibits a public authority from carrying out development "*in connection with the construction, reconstruction, improvement, maintenance or repair of a road within an existing road reserve*". However, this does not apply to the proposed Princes Highway upgrade works as Clause 52 does not apply to "*any widening, realignment or relocation of an existing physically constructed road which involves works which may have a significant environmental impact*". Accordingly, the proposed works are permissible with consent under the Shoalhaven Local Environmental Plan.

3.2.2 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (SEPP Infrastructure) commenced on 1 January 2008, which aims to facilitate development of a range of infrastructure works in NSW. To facilitate infrastructure, SEPP Infrastructure establishes a consistent planning regime for infrastructure projects.

Where there is inconsistency with LEPs, under Clause 8(1) of SEPP Infrastructure, the SEPP prevails to the extent of the inconsistency.

With respect to permissibility of the proposal, Clause 94(1), Division 17 of SEPP Infrastructure is relevant to establishing the approval process for 'roads' and 'road infrastructure facilities', which states:

> *"(94) Development permitted without consent – general.*
>
> *"(1) Development for the purpose of a road or road infrastructure facilities may be **carried out by or on behalf of a public authority without consent on any land**. However, such development may be carried out without consent on land reserved under the National Parks and Wildlife Act 1974 only if the development:*
>
> *(a) is authorised by or under the National Parks and Wildlife Act 1974, or*
>
> *(b) is, or is the subject of, an existing interest within the meaning of section 39 of that Act, or*
>
> *(c) is on land to which that Act applies over which an easement has been granted and is not contrary to the terms or nature of the easement".*

The proposed works are not within an area of land reserved under the *National Parks and Wildlife Act 1974*. Accordingly, the proposed upgrade is permitted without consent on any land under SEPP Infrastructure. As this is inconsistent with the provisions of the LEPs (**Section 3.2.1** refers), the SEPP prevails over the LEP provisions and development consent is not required for the proposed Princes Highway upgrade.

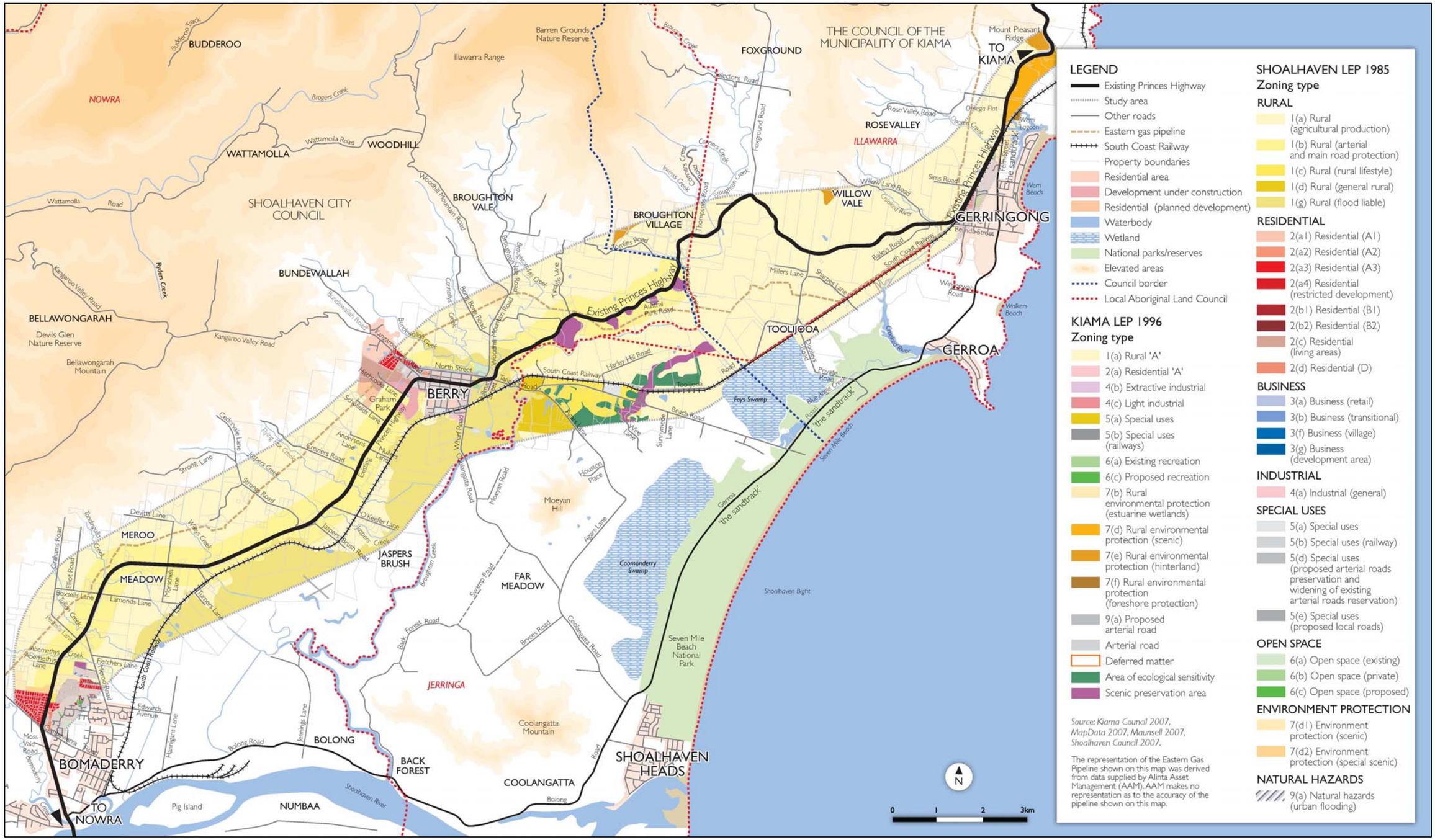
3.2.3 State Environmental Planning Policy (Major Projects) 2005

The aim of the *State Environmental Planning Policy (Major Projects) 2005 (SEPP Major Projects)* is to identify development to which the assessment and approval regime under Part 3A of *the Environmental Planning and Assessment Act 1979 (EP&A Act)* applies. Clause 6(1) of SEPP Major Projects identifies projects to which Part 3A of the EP&A Act applies:

> *"(1) Development that, in the opinion of the Minister, is development of a kind:*
>
> *(a) that is described in Schedule 1 or 2, or*
>
> *(b) that is described in Schedule 3 as a project to which Part 3A of the Act applies, or*
>
> *(c) to the extent that it is not otherwise described in Schedules 1-3, that is described in Schedule 5,*
>
> *is declared to be a project to which Part 3A of the Act applies".*

The upgrade does not fall within the meaning of a Major Project as described by Schedule 1, 2, 3 or 5 of SEPP Major Projects (See **Section 3.2.4** for discussion regarding the approval process for the works under the *Environmental Planning and Assessment Act 1979*).

Figure 3.2 Planning and zoning constraints



3.2.4 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979 (EP&A Act)* and the *Environmental Planning & Assessment Regulation 2000 (EP&A Regulation)* provide the statutory planning framework for environmental assessment of the proposed upgrade and ultimately its approval.

Under the EP&A Act, development not requiring approval under Part 4 of the Act (development consent) or Part 3A of the Act (project approval), must be assessed under Part 5 of the Act. In this case, the upgrade is permitted without consent and does not meet the criteria for a Major Project specified under SEPP Major Projects. However, the EP&A Act provides that certain projects that are otherwise subject to Part 5 of the Act may be declared to be projects to which Part 3A applies under the following two scenarios (refer to **Figure 3.1**).

Environmental planning significance

Under Section 75B(2)(a) of the EP&A Act, the Minister may declare major infrastructure (or other development) that, in the opinion of the Minister, is of "*State or regional environmental planning significance*" to be a project to which Part 3A of the Act applies.

Due to the prominence of the proposed upgrade to the regional and State for transportation of goods and people, the works may be a project that the Minister for Planning considers to be of regional or State environmental planning significance.

Significance of impact

Section 75B(2)(b) of the EP&A Act provides that:

> "major infrastructure or other development that is an activity for which the proponent is also the determining authority (within the meaning of Part 5) and that, in the opinion of the proponent, would (but for this part) require an environmental impact statement to be obtained under that part".

In the case of this project, the RTA is the proponent and the determining authority and therefore the project is subject to approval under Part 5 of the EP&A Act.

Under Section 75B(2)(b) if there is likely to be significant impacts, meaning an Environmental Impact Statement would otherwise be required under Part 5, the Minister for Planning may declare the proposal to be a project to which Part 3A of the EP&A Act applies. If the impacts are deemed not likely to be significant, the works would be subject to approval under Part 5 (refer to Figure 3.1).

3.2.5 Approval process summary

Under SEPP Infrastructure, the upgrade is permitted without consent on any land if the works are carried out by or on behalf of a public authority.

The planning approval scenarios that may apply are:

- **Part 5 of the Act** – if the proposal is not likely to generate significant environmental impacts and the Minister does not consider the upgrade to be of State or regional environmental planning significance, approval under Part 5 of the EP&A Act would be required. This would involve the preparation of a Review of Environmental Factors. Factors for consideration are described in Section 228 of the EP&A Regulation.

- **Part 3A of the Act** – if the Minister considers the upgrade to be of State or regional environmental planning significance, approval under Part 3A of the EP&A Act would be required. This would involve the preparation of an Environmental Assessment.

- **Part 3A of the Act** – if the Minister does not consider the upgrade to be of State or regional environmental planning significance, but the upgrade works are likely to generate significant environmental impacts (factors for consideration are described in Section 228 of the EP&A Regulation), approval under Part 3A of the EP&A Act would be required. This would involve the preparation of an Environmental Assessment.

3.2.6 Other State environmental planning policies

The following State Environmental Planning Policies are applicable to the upgrade and have been considered for this report.

State Environmental Planning Policy No. 14 – Coastal Wetlands

SEPP 14 provides protection for wetlands identified as significant coastal wetlands and gazetted for protection. Werri Lagoon is a coastal wetland north-east of the study area north of Gerringong. Near to the study area there is a large area of coastal wetlands at Coomonderry Swamp to the west of Seven Mile Beach. This area is unlikely to be directly impacted by the selected preferred option, although indirect impacts such as the potential for sedimentation runoff during construction have been considered as part of the development of a preferred option and subsequent preliminary environmental assessment.

State Environmental Planning Policy No. 26 – Littoral Rainforests

SEPP 26 provides protection for areas of littoral rainforest. No littoral rainforest has been recorded in the study area. One area of littoral rainforest is located at the northern end of Seven Mile Beach National Park south of Crooked River near to the study area. There are also three areas of littoral rainforest located to the north-east of Gerroa. These areas are unlikely to be directly impacted by the selected preferred option, although indirect impacts such as the clearance of surrounding vegetation and adjacent wildlife movement corridors have been considered as part of the development of the preferred option and subsequent preliminary environmental assessment.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 provides protection for areas identified as koala habitat and requires the implementation of management measures in the event of disturbance of such habitat. The study area is affected by State Environmental Planning Policy No. 44 – Koala Habitat Protection and the assessment processes would need to be followed as part of the environmental assessment of the preferred route. State Environmental Planning Policy No. 44 – Koala Habitat Protection is discussed in the *Preliminary Biological Report - Terrestrial Flora and Fauna*, prepared as *Appendix G* of the *Route Options Development Report (November 2007)*.

State Environmental Planning Policy No. 71 – Coastal Protection

SEPP 71 applies to land defined as the coastal zone by maps held by the local council and identifies a number of issues to be considered by a consent authority before issuing development consent. There is State Environmental Planning Policy 71 land by the coast which extends into the study area in two locations in the north-east of the study area:

- In the area surrounding Crooked River through to the existing Princes Highway.
- In the area surrounding Werri Lagoon through to the other side of the study area.

These areas are unlikely to be directly impacted by the selected preferred option, although indirect impacts such as the potential for sedimentation runoff during construction will continue to be considered as part of the development of the preferred option and subsequent preliminary environmental assessment.

3.2.7 Other applicable legislation

Commonwealth

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, populations and communities and heritage items.

The approval of the Commonwealth Minister for the Environment, Water, Heritage and the Arts is required for actions that may have a significant impact on the environment of Commonwealth land or on matters of national environmental significance. Matters of national environmental significance are defined as Ramsar[4] wetlands, listed threatened species and communities, World Heritage properties, listed migratory species, nationally significant heritage items, the Commonwealth marine environment and nuclear actions.

New South Wales

Table 3.1 identifies the state legislation considered and the authorities responsible for their implementation.

Table 3.1 Approving authorities and licence considerations for proposed activity

Authority	Approval requirements	Criteria
Department of Planning	*Environmental Planning and Assessment Act 1979*	Assessment of potential environmental impacts of a proposed activity: • Part 3A of the Act for declared Major Projects or activities where the proponent is also the determining authority (within the meaning of Part 5) and that would require an environmental impact statement to be obtained. • Part 5 of the Act for activities that do not require development consent. • Part 4 of the Act for activities requiring development consent.
Department of Water and Energy	*Water Management Act 2000*	Works within 40 m of a lake, river or estuary require a controlled activity approval under this Act. Consideration of potential impact of boreholes on aquifers. Licence required for extraction of groundwater.
Department of Environment and Climate Change	*Native Vegetation Act 2003*	This act will provide a framework for: a) Management of native vegetation. b) Protection of native vegetation of high conservation value. c) Revegetation and rehabilitation. d) Prevention of broad-scale land clearing.
	Soil Conservation Act 1938	The removal of vegetation within 20 m of the high bank requires Department of Environment and Climate Change approval.
	National Parks and Wildlife Act 1974	Consent to destroy permit under Section 90 of the Act is required for work that will disturb, destroy, damage or otherwise harm an Aboriginal relic. A preliminary research permit is required under Section 87 for the disturbance or removal or taking possession of archaeological objects.
	Threatened Species Conservation Act 1995	Protection of threatened flora and fauna species, ecological communities and local populations. A licence under Section 91 is required if it is determined that a threatened species, populations or ecological communities are likely to be harmed.
	Protection of the Environment Operations Act 1997 and *Protection of the Environmental Operations Amendment Act 2005*	Offence to pollute the environment under the Act. An environmental protection licence required for scheduled activities.

[4] The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 155 Contracting Parties to the Convention, with 1675 wetland sites, totalling 150 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance. Under the EPBC Act 1999, a Ramsar wetland is either an Australian wetland on the List of Wetlands of International Importance kept under the Ramsar Convention; or a wetland declared to be a Ramsar wetland by the Commonwealth Environment Minister.

Table 3.1 Approving authorities and licence considerations for proposed activity cont'd

Authority	Approval requirements	Criteria
Department of Primary Industries (Fisheries)	*Fisheries Management Act 1994* and *Fisheries Management Amendment Act 1997*	This Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. Section 199 permit required for any dredging or reclamation works. Section 205 permit required for any harm to marine vegetation. Section 219 permit required for any obstruction to fish passage.
Heritage Office	*Heritage Act 1977*	An excavation permit under Section 139 is required for the disturbance or excavation of land likely to result in any non-Indigenous historic artefacts and/or sites (older than 50 years) being discovered, exposed, damaged or destroyed.
Roads and Traffic Authority / Local Council	*Roads Act 1993*	Consideration of works within public road reserves. Any works carried out on classified roads require a road occupancy licence from the RTA. Works on local road require approval from the relevant local council (Kiama or Shoalhaven).

3.3 Planned and future land-uses

Kiama Council stated that there is no urban growth planned along the Princes Highway corridor (the only urban expansion area being to the south of Gerringong, outside the study area).

Shoalhaven City Council has stated that minor development is envisaged around Berry, but none to the north of North Street. In this regard, it is assumed that pockets of land on the periphery of Berry will be developed and such areas have been considered as part of any route selection.

Grand Pacific Drive is a tourist drive that extends from Sydney to Wollongong and beyond. Beyond Wollongong tourists have the opportunity to extend their trip to the Shoalhaven via Fern Street, Gerroa Road and Bolong Road (the 'Sandtrack'). Development of the concept design of the preferred option will consider future development of the Grand Pacific Drive.

The Department of Planning has indicated within the recently released regional strategies and through liaison during early stages of the project, that there are no new towns proposed within the study area. Further, no new residential development will be supported by the Department of Planning unless part of a structure plan. To date, there are no publicly available structure plans for lands within the study area apart from the Nowra-Bomaderry Structure Plan.

3.4 Existing major infrastructure and utilities

A network of major utility and service infrastructure traverses the study area. This infrastructure is described below and shown in **Figure 3.3**.

3.4.1 South Coast railway

The South Coast railway extends from Waterfall in southern Sydney to Bomaderry. From Waterfall to Kiama the line is electrified. From Kiama to the terminus at Bomaderry the line is non-electrified. The railway services the towns of Gerringong, Berry, and Bomaderry with regular passenger services. The railway also provides freight services for Manildra Group operations at Bomaderry.

Generally the railway is located on the south-eastern boundary of the study area and is remote from the existing Princes Highway alignment. Adjacent to Gerringong, the railway parallels the Princes Highway for a length of approximately two kilometres. A level crossing of the railway is provided at Fern Street which serves as a northern road access for Gerringong. A rail overpass at Belinda Street provides a southern road access to Gerringong. At Berry the railway skirts the southern extent of the town and underpasses are provided for local roads. For much of its length the railway is constructed on embankment in order to provide flood immunity.

3.4.2 Eastern Gas Pipeline

The most significant gas asset in the study area is the Eastern Gas Pipeline owned and operated by Alinta. The Eastern Gas Pipeline was constructed in 2000 and runs from northern Victoria to Western Sydney. It is a 450 mm diameter 15 MPa main buried at a depth between 900 and 1200 mm. The main traverses almost the entire study area and crosses the existing highway twice. The Eastern Gas Pipeline follows a similar alignment to the 132 kV transmission line from Bomaderry to north of Berry. Between Berry and Gerringong, the Eastern Gas Pipeline alignment deviates towards the railway line, tracks along the railway line for a short section, then diverges northward from the railway line and the highway in the vicinity of Belinda Street.

Agility also own and operate a reticulation network in the Bomaderry industrial area. This network is fed by a main from the Bomaderry offtake of the Eastern Gas Pipeline and crosses the existing highway at Pestells Lane.

3.4.3 Electrical transmission lines

Integral Energy own and operate an overhead 132 kV transmission line that tracks inside the study area on the western side of Bomaderry and Berry. This is a twin line supported on timber poles.

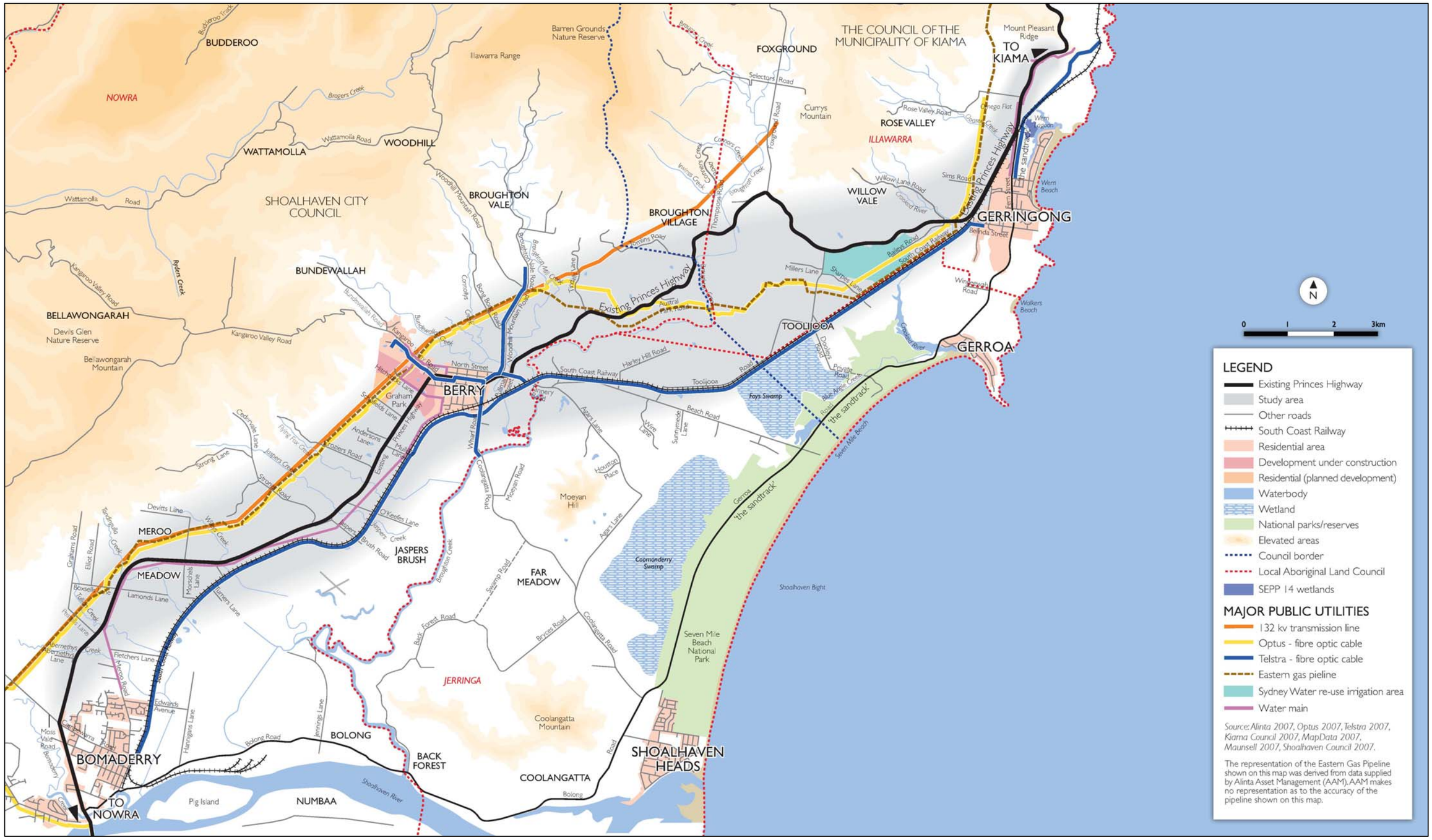
A 33 kV transmission line generally tracks adjacent to the railway line from Gerringong to Berry. North of Gerringong, the line splits in two with one branch following the existing highway and another tracking true north. Lines cross the highway and terminate at the Gerringong substation on Rowlins Road opposite the playing fields. South of Berry the line diverges from the railway line, crosses the existing highway at Croziers Lane, and tracks between the western side of the existing highway and the edge of the study area to Bomaderry.

Integral Energy also own and operate an overhead 11 kV network and local low voltage distribution network which corresponds to the local road network over the entire study area.

3.4.4 Sewer and water

The study area is bisected by the boundary between Kiama and Shoalhaven Local Government Areas. This boundary also defines the jurisdictions for Sydney Water and Shoalhaven Water. Sydney Water jurisdiction includes Kiama Shire Council. Shoalhaven Water is a business unit of Shoalhaven Council.

Figure 3.3 Major public utilities



3.4.4.1 Sydney Water

Sydney Water operates a sewer and water network in Gerringong and Gerroa on the eastern side of the railway line. Water is provided to Gerringong from the Gerringong reservoir located at the northern extremity of the study area. A Sydney Water 375 mm diameter main follows the eastern side of the existing highway from Mount Pleasant to Fern Street and follows Fern Street into Gerringong and on to Gerroa. There are no other water mains in the study area within the Kiama Local Government Area.

The sewerage network in Gerringong culminates at the Gerringong Gerroa Wastewater Treatment Plant south of Crooked River outside the study area. The Gerringong Gerroa Wastewater Treatment Plant does not discharge to the ocean. Advanced tertiary treated effluent is pumped to Sydney Water owned grazing land between the railway line and the existing Princes Highway where it is used to irrigate pasture. The effluent re-use irrigation scheme covers a substantial area east of Sharpes Lane in the Toolijooa area. The scheme is operated by Veolia Water. The treated effluent pipeline is the only significant sewer line in the study area within the Kiama Local Government Area.

3.4.4.2 Shoalhaven Water

Shoalhaven Water operates a sewer and water network in the Shoalhaven Local Government Area. This includes the towns of Berry and Bomaderry. Water is provided to Berry from reservoirs located on Kangaroo Valley Road, approximately 400 m west of the intersection with Bundewallah Road. Two asbestos cement mains leave the reservoir and track Kangaroo Valley Road to the intersection with North Street. They then track North Street to the intersection with George Street. Water is supplied to Bomaderry from a reservoir located outside the study area and the supply line is not affected by the upgrade.

A Nowra to Berry trunk main is located between the railway and the eastern side of the Princes Highway. The main is located within the road boundary between Jaspers Brush Road and Meroo Road. There are various PVC (polyvinyl chloride) mains crossing the highway to service properties on the western side.

The sewer network in Berry extends as far east as Pulman Street, as far north as North Street, and up Kangaroo Valley Road. The network culminates at the Berry Wastewater Treatment Plant off Wharf Road, south of Berry. The Wastewater Treatment Plant discharges to Broughton Creek. The sewer network in Bomaderry discharges to the Bomaderry Wastewater Treatment Plant located on Bolong Road, south-east of the study area. Properties outside of the urban centres are not serviced by the sewer network.

3.4.5 Telecommunications

3.4.5.1 Optus

A Sydney-Melbourne fibre optic cable traverses the study area on a similar alignment to the Eastern Gas Pipeline and 132 kV transmission line south of Berry. North of Berry, the cable alignment is similar to the Eastern Gas Pipeline alignment.

3.4.5.2 Telstra

The major Telstra asset located in the study area is a Sydney-Melbourne optic fibre cable which is generally aligned with the railway entering Gerringong. The cable tracks through Gerringong and re-joins the eastern side of the railway in the vicinity of Belinda Street. It then follows the southern side of the railway line to Bomaderry.

Telstra also own and operate inter-exchange network cables between telephone exchanges which carry high volumes of data between Berry and Kangaroo Valley and Berry and Nowra. These are also optic fibre cables. The Telstra optic fibre cables are shown in **Figure 3.3**.

3.5 Biophysical environment

The description of the biophysical environment includes terrestrial and aquatic ecology, topography, geology and soils, flooding and drainage, water quality, climate and air quality.

3.5.1 Topography, geology and soils

3.5.1.1 Topography

The study area, extending from the Mount Pleasant lookout north of Gerringong to the intersection of Cambewarra and Moss Vale roads with the Princes Highway at Bomaderry, involves two main regional topographic settings:

- The undulating hills, and their associated foothills, to the north-west of the South Coast railway.
- The Shoalhaven lowland plain that extends south-east beyond Coolangatta towards the Shoalhaven Bight.

The elevated north-western portion of the study area has been influenced by the Cambewarra Mountain Range. Compared with the Illawarra Range (north of Mount Pleasant at Kiama), the Cambewarra Range is a narrow low range that runs roughly parallel with the coastline. The lower slopes of this range extend into the study area as the ridge lines approach Berry.

Harley Hill and Toolijooa Hill lie disjointed from the Cambewarra Range towards the eastern part of the study area. The prominent high points within the study area include Mount Pleasant (reduced level 200 m), Toolijooa Hill (reduced level 130 m), Harley Hill (reduced level 140 m) Foxground (reduced level 120 m) and Tomlins Hill (reduced level 136 m).

A ridge of moderate elevation, from Foxground to Toolijooa Hill and a flatter ridge to the south-west of Toolijooa Hill, separates the Broughton Creek floodplain from the Crooked River floodplain.

Many secondary streams and creeks migrate from higher elevations within the Cambewarra Range. These secondary creeks and streams generally flow to the south-east where they merge with either Crooked River in the north or Broughton Creek in the south. The Shoalhaven lowland plain with a surface elevation generally less than reduced level five metres, includes the Crooked River floodplain and Broughton Creek floodplain.

Broughton Creek floodplain

The Broughton Creek floodplain and tributary valley floor areas, occupy a large portion of the study area to the south and south-east of Berry and tributary valleys to the north and north-east of Berry. Broughton Creek is the dominant watercourse in this area extending back to the escarpment slopes to the north and north-east in the areas of Broughton, Broughton Vale and Bundewallah, and Jaspers Brush and Meroo Meadow areas to the south and south-east of Berry. Broughton Creek flows across a broad floodplain in a southerly direction, flowing into the Shoalhaven River about five kilometres west of Shoalhaven Heads.

Crooked River floodplain

The Crooked River floodplain, where it occurs within the study area, includes the low lying areas to the south-west of Gerringong, generally between Toolijooa Road or the Princes Highway and the railway line. Crooked River originates in the Broughton Vale highlands and flows south-east across the Crooked River floodplain and into Crooked River coastal lagoon.

Omega Flat

Omega Flat is situated between Gerringong and Mount Pleasant Ridge in the northern part of the study area. It is a lowland marsh / floodplain that is regularly inundated during periods of high rainfall. Fluvial sediments originating from Ooaree Creek and general runoff from Gerringong, the Princes Highway and surrounding pavement areas, contributes to the area's accelerated rate of infilling.

3.5.1.2 Geology

A summary of the ground conditions in the study area that potentially affect feasible route options is provided in **Figure 3.4**.

Local geology

The geology present within the study area corresponds to the Permian Shoalhaven Group, which may be sub-divided into two subgroups, the Gerringong Volcanics and the Berry Formation (Rose, 1966).

The younger Gerringong Volcanics Subgroup comprises Broughton Tuff and Kiama Tuff, which are found in the north-eastern section of the study area, at Mount Pleasant Ridge, and further south following ridgelines through Toolijooa Hill and high points to Harley Hill. The Berry formation comprises Budgong sandstone and siltstone, sandstone and interbedded shale, and occurs south-east of the Crooked River.

Fluvial, estuarine and marine sediments of the Shoalhaven lowland plain overlay the sedimentary rocks of the Shoalhaven Group. Generally the sediments comprise thin, recent floodplain sediments (mud, silt, sands and local gravels) overlying estuarine muds, sands and clays. These are generally found underlain by alluvium and associated transported soils.

The estuarine soil deposits occur in the north of the study area in the vicinity of Omega Flat. It is also highly probable that this same soil occurs on the floodplain in the eastern fringe of the study area, near Crooked River, Flying Fox Creek and Jaspers Creek. The surface appearance of this unit within the study area comprises mainly low lying swales and semi-permanent swamps. Acid sulphate soils are commonly found in this unit.

3.5.1.3 Acid sulphate soils and soft soils

Figure 3.4 shows the locations in the study area that are likely to contain acid sulphate soils. This figure incorporates data obtained from acid sulphate soil risk mapping undertaken by the Department of Water and Energy (previously the Department of Natural Resources) and testing undertaken by Coffey Geosciences. Areas mapped as 'high risk areas' for encountering acid sulphate soils are generally indicative of areas underlain by soft, compressible soils. The main areas of high risk include:

- The Ooaree Creek floodplain, north-west of Gerringong.
- The Crooked River floodplain, east of Toolijooa Road, south of the current Princes Highway and south-west of Gerringong.
- The Broughton Creek floodplain east of Berry.
- The Shoalhaven River / Broughton Creek floodplain, between Berry and Bomaderry and generally lying to the south or east of the current South Coast railway line.

3.5.2 Flooding and drainage

3.5.2.1 General

Figure 3.5 illustrates watercourses and floodplains in the study area.

The study area incorporates part of the expansive floodplain of the Lower Shoalhaven River and Broughton Creek, Crooked River, Ooaree Creek (Omega Flat) as well as other minor watercourses.

3.5.2.2 Surface drainage

There are several main drainage watercourses and floodplain areas within the study area which include:

- Omega Flat.
- Crooked River.
- Broughton Creek (upper catchment).
- Berry floodplain area.
- Shoalhaven River (upper catchment).

The surface drainage associated with these areas is further described below:

Omega Flat

Omega Flat is located north of Gerringong near Werri Beach. Ooaree Creek crosses Omega Flat and the Princes Highway before discharging into the ocean via Werri Lagoon. The Princes Highway flood immunity is influenced by Ooaree Creek as well as the levels of the tidal Werri Lagoon.

Crooked River

The route options cross Crooked River and several minor tributaries of the Crooked River. The river enters the ocean at the northern end of Seven Mile Beach adjacent to Black Head and Gerroa. In the lower reaches south of the railway line, floodwaters spread out across the low lying area between Beach Road, Gerroa Road and the railway line.

Broughton Creek (upper catchment)

Broughton Creek (upper catchment) upstream of Berry transverses the study area in a southerly then westerly direction. The catchment consists predominately of rural pastures below steeper forested hillsides. The dominating land-use is agriculture. The creek's catchment area upstream of Berry is approximately 30 km^2 which is predicted to produce a 1 in 100 year annual recurrence interval discharge of approximately 760 m^3/s.

Berry floodplain area

Berry is located on floodplain land adjacent to the confluence of two major creek systems; Broughton Mill Creek and Bundewallah Creek. The catchment consists predominately of rural pastures below steeper forested hillsides. The dominating land-use is agriculture.

Bundewallah Creek located to the north of Berry flows eastwards under a bridge at Woodhill Mountain Road to join Broughton Mill Creek. From the confluence with Bundewallah Creek, Broughton Mill Creek flows southwards under an existing bridge at the Princes Highway, then under a second bridge at the railway line before running to the south of Berry. Downstream and to the east of Berry, Broughton Mill Creek flows into Broughton Creek, which in turn flows southward into the Shoalhaven River.

Figure 3.4 Summary of ground conditions

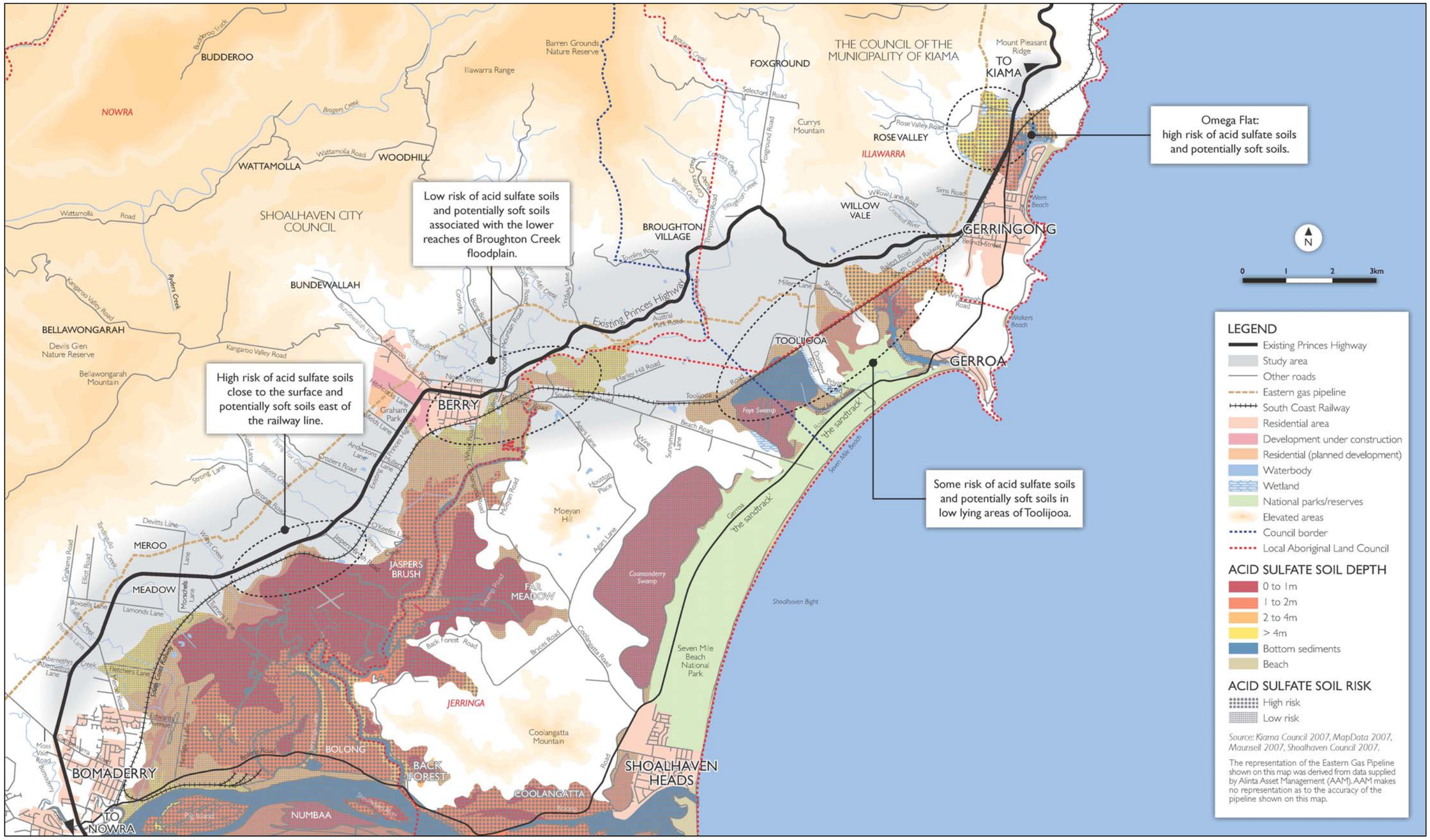
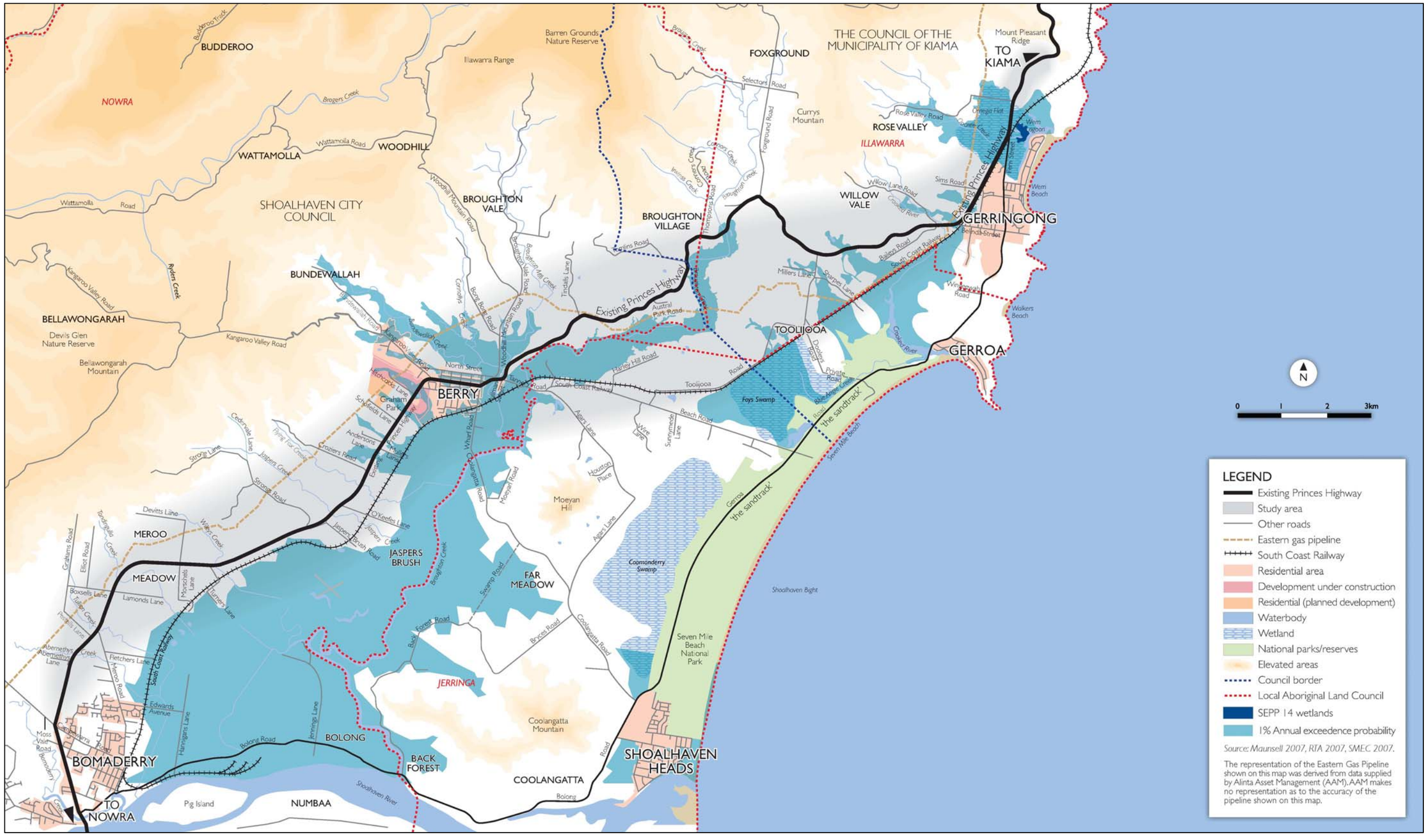


Figure 3.5 Watercourses and floodplains



Connollys Creek enters Bundewallah Creek upstream of the confluence with Broughton Mill Creek. Bundewallah Creek and Connollys Creek have catchments of approximately 1500 ha and 630 ha respectively. Broughton Mill Creek has a catchment of approximately 2000 ha immediately upstream of the confluence with Bundewallah Creek. At the railway bridge, approximately 500 m downstream of the Princes Highway, the total catchment is 4400 ha. The predicted 1 in 100 year annual recurrence interval discharge at the Broughton Mill Creek and Bundewallah Creek confluence is approximately 1100 m^3/s. Broughton Creek at the railway bridge has a predicted 1 in 100 year annual recurrence interval discharge of approximately 1880 m^3/s.

Two unnamed creeks flow through Berry before joining Broughton Mill Creek. Princess Creek is the name associated with the watercourse which meanders eastwards through the Berry town centre, adjacent to Princess Street, before joining Broughton Mill Creek. At the north of Berry, Princess Creek has a catchment of approximately 68 ha which increases to 116 ha at the confluence with Broughton Mill Creek. Albert Creek is the name associated with the creek which flows adjacent to Albert Street.

Shoalhaven River

The existing Princes Highway alignment is outside of the floodplain of the Shoalhaven River in this region. Existing flooding characteristics in the southern part of the study area are defined in the *Lower Shoalhaven River Flood Study (April 1990)*. Shoalhaven City Council utilises this document for the determination of flood planning levels for development in the Lower Shoalhaven River floodplain. This study covers the lower section of the Shoalhaven River from approximately 10 km upstream of Nowra to the Pacific Ocean outlets, and includes the section of Broughton Creek downstream of Coolangatta Road.

Groundwater characteristics of the study area

From the limited piezometric data and variable geographical formations found in the study area, it is not possible to accurately determine groundwater divides and aquifer geometry. However, based on the available borehole data and geological mapping, it can be assumed that the study area is characterised by relatively shallow unconfined groundwater which would be expected to closely mimic the natural topography. Due to undulating terrain, a number of sub-basins would be expected, superimposed on the regional system. This unconfined water table may include some areas of perched water table. Several boreholes indicate possibly confining layers below the unconfined aquifers comprising clays or hard sandstones.

Below this are several different confined or semi-confined water bearing layers, mainly within fractured shales and sandstones within areas of the Berry formation, and within fractured tuff and basalt in areas characterised by Gerringong volcanics. These deeper aquifers are accessed by the majority of licensed bores within the study area generally at depths ranging between 15 m and up to 50 m below ground level.

3.5.3 Water quality

Physico-chemical water quality properties have been recorded in situ from the major watercourses in each of the three drainage systems. Collected samples were analysed for nutrients, oil and grease, organochlorine pesticides, heavy metals, suspended solids, chloride and sulphate.

Previous studies indicated that land-uses including agriculture and grazing have had deleterious impacts on water quality, with many parameters exceeding guidelines for the protection of aquatic ecosystems. The analysis of water samples collected by this study revealed similar patterns.

There was not a significant difference among watercourses with respect to water quality. Nearly all creeks lie adjacent to cleared land used for agricultural purposes and most recorded values of total phosphorus and dissolved oxygen that exceeded Australia, New Zealand Environment Conservation Council threshold values for the protection of aquatic ecosystems.

All sites had levels of organochlorine pesticides and trace elements that were below Australia, New Zealand Environment Conservation Council thresholds with the exception of copper at Crooked River. Values for suspended solids, oil and grease were also much greater at Crooked River than any other site. The in situ water testing revealed most waterways had pH and salinity levels within acceptable limits, but dissolved oxygen values were almost universally less than the Australia, New Zealand Environment Conservation Council lower threshold for the protection of ecosystems.

3.5.4 Terrestrial ecology

A desktop examination, field surveys and constraints mapping of flora and fauna in the study area has been undertaken. A summary of the findings is included in **Figure 3.6**.

Plant communities

Existing vegetation mapping provided background information and was updated and amended based on ground-truthing. 15 plant communities were identified within the study area (**Table 3.2**).

Eight plant communities are part of an endangered ecological community listed on the *NSW Threatened Species Conservation Act 1995*: Estuarine fringe forest, Floodplain swamp forest, Illawarra lowland woodland, South Coast grassy woodland, Subtropical complex rainforest, Subtropical dry rainforest, Riverfront forest and Coastal sand swamp forest.

There are no plant communities present that form part of an endangered ecological community listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

3.5.4.1 Plant species

A total of 370 species were recorded in the study area, comprising 306 (83 per cent) native species and 64 (17 per cent) exotic species including nine species of noxious weeds.

31 threatened flora species have been recorded within 10 km of the study area. Three threatened flora species have been recorded in the study area: Daphnandra sp. 'Illawarra', *Eucalyptus langleyi* and *Zieria granulata*. In addition, potential habitat for another 10 threatened plant species was found within the study area: *Acacia terminalis ssp. terminalis, Cryptostylis hunteriana, Cynanchum elegans, Galium australe, Irenepharsus trypherus, Pomaderris parrisiae, Pterostylis gibbosa, Solanum celatum, Syzygium paniculatum* and *Thesium australe*.

Zieria granulata

Large numbers of this species were recorded during the current survey and by Muston & Associates (1991) during surveys for the *Gerringong to Berry Route Selection Study*. Data from the *Zieria granulata* Recovery Plan [Department of Environment and Climate Change, 2005 #2981] estimates a total population of at least 2410 plants in the study area.

The population represents the southern-most occurrence of the species and occupies the rocky outcrops of Toolijooa ridge and the lower escarpment slopes. For these reasons, the population of *Zieria granulata* within the study area is considered to be highly significant and of extremely high conservation value. Additional sites within two kilometres of the study area appear to support relatively few plants, with the maximum containing count information being 27 plants.

Figure 3.6 Summary of terrestrial ecology

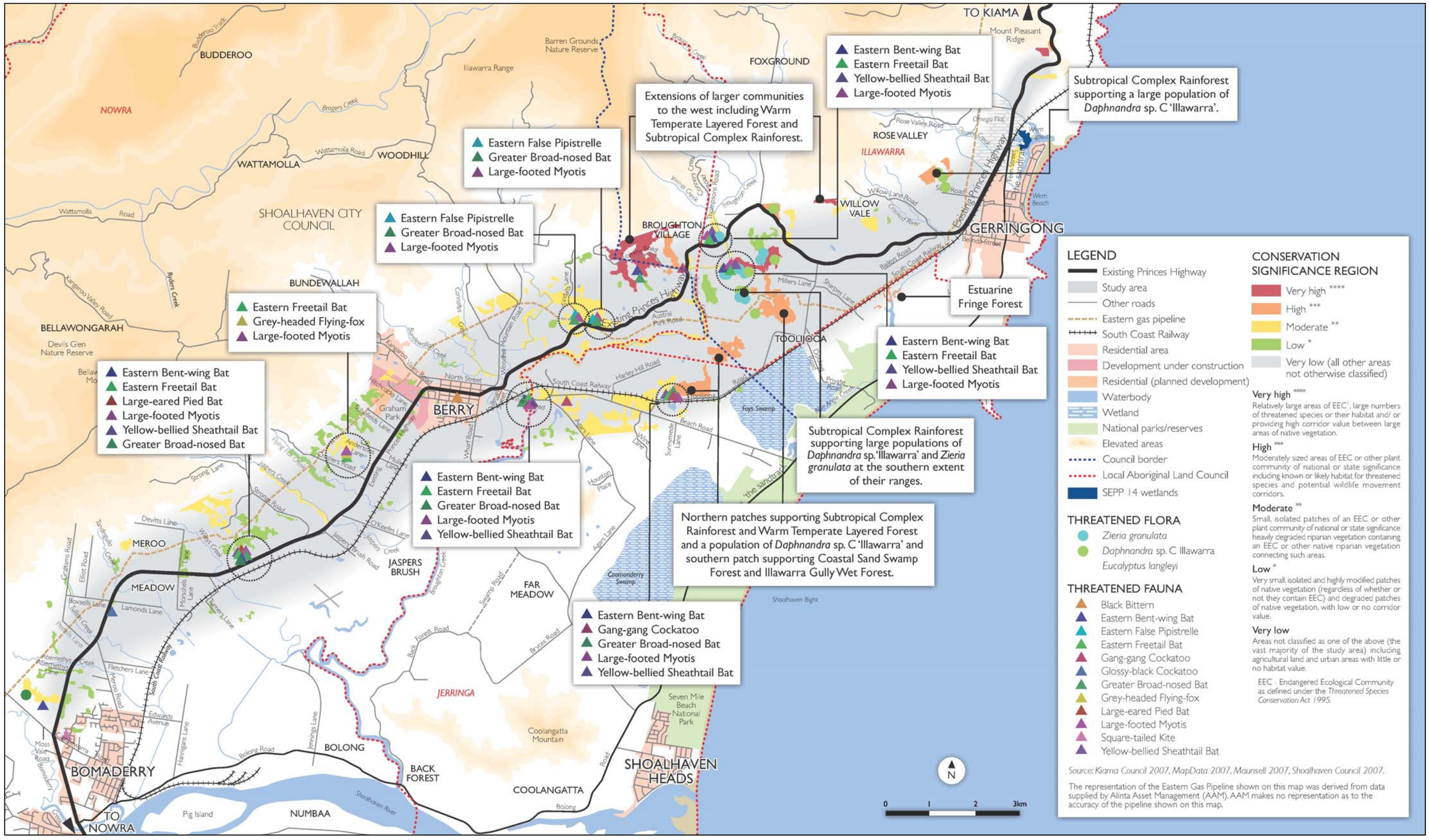


Table 3.2 Plant communities of the study area

Plant community	Conservation status		Equivalent EEC*
	TSC* Act	EPBC* Act	
Cleared land and paddocks	-	-	-
Coastal sand swamp forest	EEC*	-	Swamp sclerophyll forest
Currambene lowlands forest	-	-	-
Estuarine fringe forest	EEC*	-	Swamp oak floodplain forest
Floodplain swamp forest	EEC*	-	Swamp oak floodplain forest
Illawarra gully wet forest	-	-	-
Illawarra lowland woodland	EEC*	-	Illawarra lowlands grassy woodland
Riverbank forest	EEC*	-	River-flat eucalypt forest
South Coast grassy woodland	EEC*	-	Illawarra lowlands grassy woodland
Subtropical complex rainforest	EEC*	-	Illawarra subtropical rainforest
Warm temperate layered forest	-	-	-
Subtropical dry rainforest	EEC*	-	Illawarra subtropical rainforest
Coastal sand forest	-	-	-
Coastal warm temperate rainforest	-	-	-
Southern lowland wet forest	-	-	-

***EEC = Endangered ecological community**
***TSC = Threatened Species Conservation Act 1995**
***EPBC = Environmental Protection and Biodiversity Conservation Act 1999**

Fauna

A total of 158 animal species were recorded within the study area during the current survey. Native fauna comprised seven frog, nine reptile, 103 bird and 29 mammal species. Introduced species accounted for 6.3 per cent (10) of the total number of animals recorded, which included six bird and three mammal species.

67 threatened terrestrial animal species (previously recorded within 10 km of the study area on the Department of Environment and Climate Change 'Atlas of NSW Wildlife') and 11 species of migratory bird (listed in the *Environmental Protection and Biodiversity Conservation Act* protected matters database search for the local area) are included in this assessment[5].

[5] Note: threatened marine and pelagic (living in open oceans or seas rather than waters adjacent to land) species also recorded within the 10 km search area were discounted from the assessment.

3.5.4.2 Threatened species

10 threatened species, eight of which are new findings, were recorded within the study area during the current surveys:

- Glossy black-cockatoo.
- Gang-gang cockatoo.
- Yellow-bellied sheathtail bat.
- Eastern freetail bat.
- Grey-headed flying fox.
- Large-eared pied bat.
- Eastern false pipistrelle.
- Eastern bent-wing bat.
- Large-footed myotis.
- Greater broad-nosed bat.

Previous studies have also recorded the following three threatened species:

- Black bittern.
- Square-tailed kite.
- Yellow-bellied glider.

All of the species listed above are highly mobile and have large home-ranges and would use the study area to obtain food and possibly shelter. While some populations would occur as permanent residents (eg yellow-bellied glider and square-tailed kite) others would move in and out of the study area in response to changes in food resources and season (eg eastern bent-wing bat and gang-gang cockatoo).

3.5.4.3 Listed migratory species

Nine listed migratory bird species were observed or considered likely to occur in the study area. These include:

- White-bellied sea-eagle.
- Osprey.
- Fork-tailed swift.
- Black-faced monarch.
- Satin flycatcher.
- White-throated needletail.
- Rufous fantail.
- Clamorous reed-warbler.
- Latham's snipe.

3.5.4.4 Endangered populations

Part 2 of Schedule 1 of the *Threatened Species Conservation Act* lists endangered populations of flora and fauna. There are no endangered fauna or flora populations listed that occur within the study area.

3.5.4.5 Critical habitat

No areas of critical habitat for flora or fauna have been declared within the study area under either the *Environmental Protection and Biodiversity Conservation Act 1999* or the *Threatened Species Conservation Act 1995*.

One area of critical habitat for the plant species *Zieria baeuerlenii* may be declared under the *Threatened Species Conservation Act 1995*, within the Bomaderry Bushland (to the south of the study area). A total of 54 ha of the 230 ha remnant has been recommended for listing as critical habitat.

3.5.4.6 Wildlife corridors

The main corridor linkages within the study area are:

- Forest remnants extending from the escarpment into lower foothills along the western margin of the study area. These forest components are not part of a corridor across the study area, however, they are the edges of a major regional corridor to the west of the study area and are likely to provide habitat for a wide assemblage of native species. These include the Yellow-bellied glider, Olive whistler, Sooty owl, Spotted-tailed quoll, Long-nosed potaroo and Grey-headed flying fox.
- A potential corridor comprising patches of distinct or partially linked vegetation along Toolijooa ridge and Harley Hill, which is linked to some extent with vegetation along Broughton Creek.
- Broughton Creek flows from north to south and enters the study area near Foxground, passing east of Berry and enters the Shoalhaven River between Bolong and Back Forest. This is the only functional, although fragmented, north-south corridor within the study area. The vegetation comprises Illawarra Gully Forest on the lower slopes to the north and Floodplain Swamp Forest and Coastal Sand Swamp Forest on the flatter lowlands.
- Beach Road provides a narrow roadside corridor between Broughton Creek, east of Berry, and Seven Mile Beach national park, east of the study area.

These habitat corridors are likely to influence the movement and distribution of some species at the local scale, particularly species that have restricted habitat components (eg rainforest) within and surrounding the study area. Existing connections between habitat patches that occur on either sides and within the study area, should be maintained thereby retaining the limited amount of available habitat for resident species and preserving ecological functions.

3.5.4.7 Ranking of conservation significance

Although the majority of the study area comprises cleared grazing land of limited value for flora and fauna conservation, there are a number of patches of native vegetation scattered across the landscape. These mainly occur along the foothills of the escarpment on the western side of the study area, on rocky ridges and slopes along Toolijooa ridge, along creeks and also some patches of varying size at lower elevations.

Some of these vegetation patches contain endangered ecological communities and threatened plant species. The vegetation patches would also provide habitat for some threatened fauna, particularly relatively mobile fauna such as bats, and threatened microchiropteran bat species were detected within the study area during the course of the field investigations.

A range of criteria were applied to assess relative conservation significance. Areas consisting of cleared paddocks were deemed of very low significance and therefore represent nil or low constraint to the construction of a new highway. Outside of the cleared paddocks, native vegetation was ranked from 'low' to 'very high' in terms of its relative significance to flora and fauna conservation within the study area.

3.5.5 Aquatic ecology

A summary of the results of a study of the aquatic habitats and fauna associated with the watercourses in the study area follows. Preliminary habitat assessments, results of fish surveys and potential impacts on threatened species were used to define preliminary constraints.

3.5.5.1 Aquatic habitats

The study area occupies the far north-eastern section of the Shoalhaven River Catchment (Environmental Protection Agency 1997). Extensive parts have been cleared for agricultural use such as grazing and dairy farming resulting in considerable reduction of riparian vegetation. Many of the low lying watercourses around the tidal section of Broughton Creek had been modified for flood mitigation.

The northern part of the study area is composed of two minor drainages. Ooaree Creek and the Crooked River flow into Werri Lagoon and the Crooked River Lagoon respectively. South-west of Currys Mountain the study area is dominated by the drainage of Broughton Creek, a north-eastern coastal tributary of the Shoalhaven River.

Broughton Creek is fed by a number of smaller water courses that drain off the Illawarra ranges and a series of smaller landforms to the east that separate the drainage from Foys Swamp and Coomonderry Swamp, the latter of which is a State Environmental Planning Policy 14 coastal freshwater wetland.

South of Berry, and to the east of the Princes Highway and the railway, much of the floodplain has been altered by flood mitigation works. Broughton Creek is tidal along its course until just downstream of Berry, which lies within the study area. Downstream of the study area and the confluence of Broughton Creek and the Shoalhaven River there are a variety of important estuarine wetland habitats such as; seagrass beds, tidal flats, saltmarsh and mangroves (with many State Environmental Planning Policy 14 listed areas including the Comerong Island Nature Reserve).

Each waterway was classified according to NSW Fisheries guidelines. Broughton Creek provides the most important aquatic habitat within the study area as it is a Class 1 waterway along its length. Jaspers Creek, Broughton Mill Creek and some reaches of the Crooked River are all Class 2 waterways. Of the remaining sites, 13 were classified as Class 3 and 7 were classified as Class 4.

3.5.5.2 Aquatic habitats adjacent to, or downstream of the study area

There are a number of wetlands downstream of watercourses that pass through or originate in the study area. Potential impact of road construction that could impact on these downstream communities includes increases in turbidity, decreases in water quality and water flow. As such they have been considered in the assessment of route options.

Ooaree Creek discharges into Werri Lagoon which contains beds of the seagrasses *Ruppia sp*. and *Zostera capricorni* (West *et al.* 1985). Sections of Werri Lagoon are included in the State Environmental Planning Policy 14 Wetland No. 371a (Chafer 1997).

Similarly, the coastal lagoon of the Crooked River contained populations of the seagrass, *Z. capricorni* (West *et al.* 1985), saltmarsh, intertidal flats (Chafer 1997) and a small section of mangroves (The Ecology Lab, 1999).

To the south of and adjacent to Foys Swamp, is the State Environmental Planning Policy 14 listed Coomonderry Swamp. Coomonderry Swamp represents one third of all semi-permanent coastal freshwater wetland habitat in NSW (NSW National Parks and Wildlife Service 1998) and provides habitat for a diverse array of flora and fauna, including many threatened species, such as the Green and Golden bell frog (*Litoria aurea*).

In Broughton Creek, but outside the study area, there is a relatively continuous mangrove community (*Avicennia marina*) (NSW Fisheries 2004). The section of the Shoalhaven River downstream of the confluence with Broughton Creek supports a number of significant estuarine wetlands (many are State Environmental Planning Policy 14 listed), including the Comerong Nature Reserve which is extremely important for seabirds and migratory waders.

There are significant seagrass beds of Z. capricorni with some Halophila ovalis (West et al. 1985; NSW Fisheries 2004), mangrove habitat and saltmarsh communities, the latter of which appear to have declined in many places since earlier surveys in 1985 (NSW Fisheries 2004, Umwelt 2005).

3.5.5.3 Aquatic fauna

Previous studies identified 36 fish species could potentially exist within the study area. Of these, 33 are native species and three are exotic species. Two native species are listed as threatened (the Macquarie perch and the Australian grayling).

The *NSW Fisheries Management Act 1994* lists the Macquarie perch, *Macquarie australasica* as a vulnerable species. The Macquarie perch and the Australian grayling, *Prototroctes maraena* are listed under the *Environmental Protection and Biodiversity Conservation Act* as endangered and vulnerable respectively.

3.5.5.4 Threatened species

Two threatened species, the Macquarie perch and Australian grayling, may occur within the study area. Neither species was observed by The Ecology Lab in February 2007.

Grayling prefer watercourses with low turbidity and gravel substrates, and occupy lowland waterways up into high elevation reaches (McDowall 1996). Grayling also inhabit estuarine and marine habitats for six months as juveniles.

Macquarie perch are found in clear freshwater reaches containing deep rocky pools with upstream riffle and pool sequences for spawning (Allen *et al.* 2003). If populations of either species still persist within the study area they are most likely to be found in the Class 1 and Class 2 waterways, which include estuarine reaches for the juvenile grayling.

3.5.6 Climate and air quality

A summary of the air quality assessment study follows.

3.5.6.1 Atmospheric conditions relevant to dispersion modelling

Wind speed and direction

Assessing the air quality impacts of vehicle emissions requires information about the dispersion characteristics of the study area. In particular, data are required on wind speed, wind direction, atmospheric stability class[6] and mixing height[7].

Meteorological data was available from two sites in the vicinity of the Princes Highway. Data collected in 2000 was collected from a site located at Gerroa tip, which is approximately five kilometres to the south-west of Gerringong. The 2001 data were collected from a location on Beirnfels Road, approximately three kilometres to the south-west of Gerringong. The data was collected by the Holmes Air Sciences on behalf of Veolia Water in 2000 and 2001. Permission has been granted by Veolia Water to use the data for this assessment.

[6] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme as used in this study there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur at night time when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[7] The term mixed-layer height refers the height of the turbulent layer of air near the earth's surface, into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

The data consist of hourly records of wind speed, wind direction and temperature and has been prepared into a form suitable for dispersion modelling. The Beirnfels data has an unusually high percentage of calms (wind speed of 0.5 m/s or less) which has been attributed to some equipment malfunction in the spring and early summer. For this reason the data from the Gerroa tip was used in the air quality impact assessment.

At both locations, on an annual basis, the most common winds were from the west and north-east. In summer the winds are predominantly from the north-east, while in spring winds are predominantly from the west, west-north-west and north-east. In autumn and winter the winds are mainly from the west and west-north-west. In autumn there are also winds from the north-east. The annual average speed at the Gerroa tip was 2.4 m/s and there is an existing high wind warning in an already trafficked area on the existing highway at the north of the study area located at the top of the Kiama Bends.

3.5.6.2 Atmospheric stability

For the Gerroa tip dataset, a stability class was assigned to each hour of the meteorological data using concurrent cloud cover information and the method of Turner (1970).

Table 3.3 shows the frequency of occurrence of the stability categories expected in the area. The most common stability occurrences were calculated to be D class stabilities (20 per cent) which suggest that emissions will disperse quickly for a large proportion of the time.

Mixing height was determined using a scheme defined by Powell (1976) for daytime conditions and an approach described by Venkatram (1980) for night-time conditions. These two methods provide a good estimate of mixing height in the absence of upper air data.

Table 3.3 Frequency of occurrence of atmospheric stability classes at Gerroa tip (2000)

Stability class		% occurrence
A	(Unstable)	18.2
B	(Intermediate)	14.1
C	(Intermediate)	7.8
D	(Intermediate)	21.1
E	(Intermediate)	19.7
F	(Stable)	19.1
Total		100

3.5.6.3 Other relevant climatic averages

Rainfall and temperature

The study area is close to the coast and has a temperate climate with average minimum temperatures during winter rarely falling below of 6.2ºc. Average maximum temperatures are between 25.8ºc (summer) and 15.8ºc (winter). This climate is described as temperate with no dry season and a warm summer as is typical of Australia's south-eastern coastal regions.

Rainfall averages between 55 mm and 145 mm per month with much more of the rainfall occurring during summer and autumn months, than during winter. The total average annual rainfall has historically been 1134 mm per year. Intense rainfall is a characteristic of the region and in Gerringong the 1 in 20 year rainfall intensity for a 15 minute period is 156 mm/hr.

3.5.6.4 Fog and frost

Dew and frosts require very still air and clear skies. Clear skies allow the heat radiated from the earth to go straight out to space. If the air is moving very slightly, the very cold air close to the ground gets mixed with the warmer air above it. This could lead to air falling below the dew point temperature through a greater depth. When this happens, the water vapour condenses into water droplets that are suspended in the air, with visible fog the result. Fogs are most common near lakes and rivers where there is plenty of moisture in the air and on clear mornings after rain. A fog that forms in this way is called a radiation fog. There is another type of fog called convection fog, which is the type of fog that occurs on Bulli Tops. This type of fog can be more variable for shorter and longer periods and is not as restricted to time of day. Convection fog forms higher in the air when rising warmer air meets cooler air.

The study area experiences conditions suitable for the formation of fog, although the processes can be very site specific and rely upon the atmospheric moisture content and the exposure to solar radiation.

A detailed fog study is currently being undertaken including installation of remote fog monitors. Two locations, a monitoring site and a control site, have been selected in different areas in order to gain an appreciation of the impact of fog on different options.

The monitoring site is in Toolijooa at an elevation of 7.3 m and is known to experience a relatively high occurrence of fogs, especially during the summer. The control site is located within the road reserve of the existing Princes Highway adjacent to Broughton Creek, at an elevation of 37.2 m. Information gathered during this study has been used to inform the preferred route selection process and monitoring will continue to inform the environmental assessment of the preferred option.

To date the monitoring locations have not recorded significant findings that would deter the construction of the upgrade in either of the locations although a higher occurrence of fog events has been recorded at the Toolijooa site than the Broughton Creek location

3.5.6.5 Local air quality

The closest Department of Environment and Climate Change monitoring station was located at Croom Road in Albion Park, approximately 15 km north of Gerringong. This site was decommissioned early in 2005 and a new station was commissioned at Terry Reserve (Albion Park South) in December 2005. No data are currently available from the Albion Park South site.

3.6 Social and cultural environment

The description of the social and cultural environment includes cultural heritage, land-use, noise and vibration and urban design, landscaping and visual amenity.

3.6.1 Indigenous heritage

A summary of the heritage constraints with potential to impact on the development of route options is provided in **Figure 3.7**.

Today, Aboriginal people live throughout the Illawarra and South Coast as residents of the larger town and cities – Bega, Nowra and Wollongong, as well as maintaining communities on former reserves, and are found throughout the region in family groups. Communities of Aboriginal people are located at Orient Point (Jerrinja), Wreck Bay and Wallaga Lake, as well as on 'informal reserves' such as Browns Lane near Nowra and Murray's Flats outside Bega.

3.6.1.1 Places of known or reported historical and cultural Aboriginal significance

Four known or reported places which have, or may potentially have, historical and cultural significance to the local Aboriginal community occur in the study area:

- Two historical encampments at Berry and Broughton Village.
- Two cosmological, ceremonial and story places - the 'Little Mountain' or 'Dicky Wood's Meadow' Battle ground and Toolijooa Hill.

In addition, two European buildings in the study area, the David Berry Hospital and Bomaderry Children's Home, have significance to Aboriginal people.

Historical encampments

The following historical encampments occurred in the study area:

- Berry Encampment: A former historic encampment, was located on the western flats of Broughton Mill Creek, where the Berry Bowling Club is now situated (Barbara Timberry in December 2004).
- Aboriginal encampment at Brookside (Broughton Village): Information collected from a local community questionnaire for a previous highway upgrade option analysis revealed a local oral tradition that, *"Aboriginal people were known to have camped along the banks of Broughton Creek in the vicinity of 'Brookside' at Broughton Village until at least the turn of the century". It was added that, "artefacts have been observed and collected in this area in the past"*, suggesting that this location also was occupied in prehistory (Donlon 1991a:12).

Cosmological, ceremonial and story places

The Little Mountain or Dicky Wood's Meadow

An Aboriginal battle ground is recorded within the study area, in the vicinity of Broughton Village. This information comes from notes made in 1900 by Archibald Campbell from various interviews with a Shoalhaven Aborigine known as Buthring (in Organ 1990:470).

Campbell writes, *"Buthring says that one of the main battlefields the blacks used in the olden times was 'The Little Mountain' or 'Dicky Wood's Meadow' beside the creek, on the east side of Broughton Village. He said the different tribes from all directions used to fight there – mostly about women matters. 'Lots' of blacks were killed there in battle, and buried here and there about"* (in Organ 1990:470).

Toolijooa ridge

Toolijooa ridge is a locally prominent ridgeline which extends southwards from Currys Mountain, to the east of Foxground, to Toolijooa and Harley Hill in the south, adjacent to Foys Swamp on the coastal plain. Information collected from a local community questionnaire for a previous highway upgrade option analysis revealed a local oral tradition that, *"an old cattle trail now running along Toolijooa ridge and down towards the coast actually follows an old Aboriginal trail which had its origins in Foxground"*.

In addition, *"on Toolijooa Hill, close to this trail, there is thought to be a fairly open area associated with a stand of Lilli Pilli trees, a stone arrangement and bora ring. Stone artefacts have also been found by locals on the north saddle close to this trail"* (Donlon 1991:13).

This information is supported by a note on the Department of Environment and Climate Change site card for site 52-5-0399 compiled by Stuart Huys in 1999 during the Eastern Gas Pipeline investigations. He notes that artefactual deposits identified on the [Toolijooa – Harley Hill] spur are probably representative of *"sporadic movement"* by Aboriginal people utilising the spurline as an *"occasional walking route from the coastal hinterland down to the coastline around Gerroa"* (Department of Environment and Climate Change site card no. 52-5-0399).

Figure 3.7 Summary of heritage constraints

Figure 3.7 Summary of heritage constraints cont'd.

Recorded historical heritage items by type and individual heritage schedule

in the study area

Item			Statutory Listing					Non-Statutory Listing			
No.	Name	Location	HR	RC s170	RTA s170	Kiama LEP 96	Shoal LEP 85	RNE	HI	RAIA	NT (NSW)
1	Abernethys Creek bridge	Princes Highway, Bomaderry			✓						
2	*Alne Bank* homestead	Rose Valley, Gerringong				✓		✓(R)	✓		✓
3	Berry agricultural pavilion	Victoria St., Berry, DP 940561					✓				
Part of 4	Berry bank and post office group (PO and former ANZ/CBC bank)	Prince Alfred St., cnr. Queen St., Berry					✓	✓(R)	✓		✓
5	Berry community activities centre	Queen St., Berry								✓	
6	Berry courthouse, police sergeant's residence and lock-up	56-58 Victoria St., Berry, portion 10	✓				✓	✓(R)	✓	✓	✓
7	Berry district landscape conservation area (not mapped)	Embraces the coastline south of Kiama some 30km southward to Greenwell Point, the undulating coastal plain and the flood plain on both sides of the lower Shoalhaven river and including the steep, benched slopes rising up to the escarpment of the Illawarra plateau.						✓ (IP)			✓
8	Berry doctor's residence, surgery and gardens	Cnr. Alexandra and Princess St., Berry, lots 8 and 9, section 3, DP 8058					✓				
9	Berry Federation two storey brick residence	68 Princes Highway, Berry							✓		
10	Berry former Berry council chambers	Alexandria St., Berry, DP 940561					✓				
11	Berry general cemetery	South side of Kangaroo Valley Road, 1km west of Berry									✓
12	Berry Goulders formerly James Wilson store	97 Queen St. (cnr. Alexandra St.), Berry							✓		✓
13	Berry hospital (David Berry hospital, gatehouse and remnant rainforest)	Beach Road (85 Tannery Road), Berry	✓						✓		✓
14	Berry Innisfail residence	308 R.M.O. Princes Highway, Berry								✓	
15	Berry James Wilson Memorial fountain	Cnr. Prince Alfred and Queen St., Berry							✓		✓
16	Berry local history museum (former bank)	135 Queen St., Berry, lot 1, DP 221105	✓				✓	✓(R)			
17	Berry *Muir House* and stables	10 Prince Alfred St., Berry								✓	
18	Berry Pulman Street group	Pulman St., Berry – former cottage hospital / Wilson store (cnr. Princes Highway); Beatson House; Alexander? flats; hospital cottage; Alexander farmhouse; mill site							✓		✓
19	Berry railway station group	Station Road, Berry	✓	✓					✓		
20	Berry railway station group – movable relics	Station Road, Berry	✓	✓							
21	Berry residence	Princes Highway, Berry								✓	
22	Berry residence	62 Queen St., Berry								✓	
23	Berry residence	21 Albany St., Berry								✓	
24	Berry School of Arts	Alexandra St., Berry, lot 2, DP 623347								✓	
25	Berry showground group (including trees)	Alexandra St., Berry							✓		
26	Berry Sir John Hay Memorial fountain	Cnr. Alexandra and Victoria St., Berry							✓		✓
27	Berry Soldiers Memorial and Memorial Avenue	Alexandra St., Berry						✓ (IP)			
28	Berry two storey Victorian rendered brick shop?	Queen St., Berry							✓		
29	Berry Victorian Anglican church and memorial gates (St. Lukes Anglican church and rectory)	68-68a Princes Street, Berry							✓		✓
30	Berry Victorian school and school master's residence	Victoria St. and 40 Victoria St., lot 11, DP 882716, Berry					✓		✓		
31	Broughton Creek bridge	Princes Highway, Berry			✓						
32	Dry stone walls conservation area	Princes Highway between Kiama and Gerringong[1]. Distributed in the area between Kiama, Jerrara and Rose Valley[2].						✓ (IP)[1]			✓[2]
33	Hindmarsh family cemetery	Off Princes highway, at the rear of *Alne Bank* homestead (1)									✓
34	*Renfrew Park* estate	Princes Highway, Gerringong				✓			✓		✓

HR = NSW Heritage Office Heritage Register; **RC s170** = RailCorp section 170 Heritage & Conservation Register; **RTA s170** = Roads and Traffic Authority section 170 Heritage & Conservation Register; **Kiama LEP 96** = Kiama Local Environmental Plan 1996 – Schedule 2; **Shoalhaven LEP 85** = Shoalhaven Local Environmental Plan 1985 – Schedule 7; **RNE** = Register of the National Estate (R = Registered, IP = Indicative Place); **HI** = NSW Heritage Office Heritage Inventory; **RAIA** = Royal Australian Institute of Architects 20th Century Register of Significant Buildings; **NT** = National Trust of Australia (NSW).

TABLE 1

Heritage items in the study area

identified in the Shoalhaven City Council Heritage Study, 1995 - 1998

No.	Heritage Study ID	Name	Location	Level of identified significance
1	B079	*Eucalyptus pilularis* (blackbutt)	42 Kangaroo Valley Road, Berry	Local
2	B085	Harley Hill cemetery	Beach Road, Berry	Local
3	B086	*Woodside Park* farm and gatehouse	94b Tannery Road, Berry	Regional
4	B091	Tannery	Tannery Road, Berry	Local
5	B092	Broughton Creek channel	96 Wharf Road, Berry	Local
6	B095	*Populus nigra 'italica'* (9 Lombardy poplars)	Woodhill Mountain Road, Berry	Local
(4)	B097	*Populus nigra 'italica'* (Lombardy poplars)	Tannery, Berry	Local
7	B120	Glenvale (former Berry estate tenant's cottage)	A371 Princes Highway, Broughton	Local
8	B123	Weatherboard and Fibro farm house	11 Kangaroo Valley Road, Berry	Provisional
9	B150	*Woodbyne* (Former Jaspers Brush school house and school master's residence)	4 O'Keeffes Lane, Jaspers Brush	Local
10	B151	Federation Weatherboard farm house	80 Lamonds Lane, Meroo Meadow	Local
11	B152	*Glenview* farm house	210 Strongs Road, Jaspers Brush	Provisional
12	B153	*Corradale* farm house	155 Strongs Road, Jaspers Brush	Provisional
13	B154	Colonial style farm house	98 Jaspers Brush Road, Jaspers Brush	Provisional
14	B155	*Clover Hill* farm house	120 O'Keeffes Lane, Jaspers Brush	Provisional
15	B156	*Tara Dairies* farm complex	O'Keeffes Lane, Jaspers Brush	Local
16	B157	*Hosts* farm house and trees	Croziers Road, Jaspers Brush	Local
17	B160	Residence (former Meroo Meadow school and school master's residence)	C385 Princes Highway, Meroo Meadow	Local
18	B161	Meroo Meadow Union church	8 Boxells Lane, Meroo Meadow	Local
19	B162	*Pomona* farm and outbuildings	C360 Princes Highway, Meroo Meadow	Local
20	B163	Weatherboard and Iron Farm house and timber slab barn	100 Pestells Lane, Meroo Meadow	Provisional
21	B165	Victorian farm house	C265 Princes Highway, Meroo Meadow	Provisional
22	B166	*Mundroola* farm house	99 Pestells Lane, Meroo Meadow	Provisional
(21)	B167	Silo	C265 Princes Highway, Meroo Meadow	Provisional
23	B168	Federation farm house	55 Fletchers Lane, Meroo Meadow	Local
24	B177	*Oakleigh* farm house	Woodhill Mountain Road, Broughton Vale	Local
25	B178	*Broughton Hill Farm* house	78 Woodhill Mountain Road, Broughton Vale	Local
26	B180	*Glenloth*	96 Strongs Road, Jaspers Brush	Regional
27	B181	House	66 Jaspers Brush Road, Jaspers Brush	Regional
28	B002.03	*Constables Cottage*	A15 Princes Highway	Local
29	B087	*Managa* Federation, Queen Anne style farmhouse	A40 Princes Highway, Berry	Regional

Provisional = Further research required to ratify level of significance.
Note: 113 items located within the Berry town precinct are not shown.

TABLE 2

Heritage items in the study area

identified in the draft Kiama Heritage Inventory (DKHI) 2007

No.	SHI Inventory / DKHI ID	Name	Location	Level of identified significance
1	1860199 / KO5-16	*Alne Bank* homestead (2)	129-130 Rose Valley Road, Rose Valley	Local
2	1860233	*Aorangi* homestead	121 Princes Highway, Toolijooa	Local
3	1860234	*Athelstane* homestead	71 Dooley Road, Toolijooa	Local
4	1860111	Gerringong dairy co-op.	18 Belinda Street, Gerringong	Local
5	1860216	*Haselmere* homestead	272 Toolijooa Road, Toolijooa	Local
6	1860194	*Innisfail* homestead	252 Princes Highway, Toolijooa	Local
7	1860195	*Ivy Mount* homestead	24 Princes Highway, Gerringong	Local
8	1860197 KO7-14	*Karrawarra* homestead	73 Rose Valley Road, Rose Valley	Local
9	1860229	*Myra Mount* homestead and garden	Campbell Street, Gerringong	Local
10	1860152	Old stationmasters cottage	16 Belinda Street, Gerringong	Local
11	1860165	Toolijooa schoolhouse (former)	2 Victoria Street, (Cnr Belinda and Victoria Sts), Gerringong	Local
12	1860201/ KO5-15	Omega school (former)	49 Princes Highway Gerringong	Local
13	1860003/ Vol 2 Item 45	Renfrew Park residence (same as No. 34 in Table 3 - listed on Kiama LEP 1996)	151 Princes Highway, Gerringong	Local
14	1860238	*Strathmore* homestead	65 Willowvale Road, Willowvale	Local
15	1860240	*Warra Bank* homestead	21 Dooley Road, Toolijooa	Local

TABLE 3

Potential (non-indigenous) archaeological deposits

identified to date in study area

No.	Name	Location
A	Old Mill site	South of Tannery Road, Berry
B	Mill race and dam	Between Broughton Creek and Broughton Mill Creek, Berry
C	Double wharf site	On the north western bank of the junction of Broughton and Broughton Mill Creek, Berry
D	Hardwood or Berry wharf site	On the northern bank of Broughton Creek to the west of Wharf Road, Berry
E	Mananga (original) Tannery site	North of Tannery Road and east of Broughton Mill Creek, Berry Between Tannery Road and the South Coast railway line, adjacent to the west bank of Broughton Creek, Berry. Same site as No. 4 above in Shoalhaven City Council Heritage Study 1995-1998.

TABLE 4

3.6.2 European heritage

There are 62 recorded European heritage items in the vicinity of the study area listed on nine separate heritage registers and schedules (**Figure 3.7**). When duplicated listings from the eight separate heritage schedules are combined there is a total of 34 historical heritage items in the vicinity of the study area.

Of the 34 listings, 27 are within, or in the immediate vicinity of, the Berry Town precinct. Two are specific listings on both statutory and non-statutory heritage schedules:

- Alne Bank Homestead, Rose Valley, Gerringong, is listed on the Kiama Local Environmental Plan 1996, the Register of the National Estate, the NSW Heritage Inventory and the National Trust of Australia (NSW).
- Renfrew Park Estate, Princes Highway Gerringong is listed on the Kiama Local Environmental Plan 1996, the NSW Heritage Inventory and the National Trust of Australia (NSW).

Two of the listings cover broad areas, both of which are non-statutory heritage listings – listed on the register of the national estate and classified by the National Trust of Australia (NSW):

- Berry District Landscape Conservation Area.
- Dry Stone Walls Conservation Area.

One listing, the Hindmarsh Family Cemetery, at the rear of Alne Bank Homestead, in Rose Valley, is a Non-Statutory Heritage Listing classified by the National Trust of Australia (NSW).

Due to the paucity of detailed information contained in several of the above heritage schedules (for example, the dry stone walls conservation area), the findings of this desktop review need to be confirmed through contact with the relevant organisations and, as necessary, ground truthing in the field.

3.6.2.1 Shoalhaven City Council Heritage Study 1995 to 1998

In addition to the above 34 historical heritage items recorded on statutory and non-statutory heritage schedules, 142 items were identified in the *Shoalhaven City Council Heritage Study 1995 to 1998* (Peter Freeman P/L 1998) as being in the current Gerringong to Bomaderry study area and as warranting heritage recognition.

Of the 142 listings, 119 are within, or in the immediate vicinity of, the Berry town precinct. Nine are in the area of Meroo Meadow, nine are in the area of Jaspers Brush, two are in the area of Broughton Vale, two are in the vicinity of Broughton Village and one, the Berry / Bolong pastoral landscape, covers a broad area to the west and south of Berry.

Of those listings 123 are identified as having local heritage significance and six are identified as having regional heritage significance:

- A former Presbyterian Manse, 36 Victoria Street, Berry.
- A mid twentieth-century house and pool, 60 Queen Street, Berry.
- Woodside Park farm and gatehouse, 94B Tannery Road, Berry.
- Mananga farmhouse, A40 Princes Highway, Berry.
- Glenloth, 96 Strongs Road, Jaspers Brush.
- A house at 66 Jaspers Brush Road, Jaspers Brush.

13 are shown as provisional listings that require further research to ratify their level of heritage significance.

As with the recorded heritage items, there is some lack of detailed information for a number of the listings in the *Shoalhaven City Council Heritage Study* (for example, No. 11 – English Oak, Tannery Road, Berry) and the results of this desktop review will require confirmation through ground truthing in the field.

3.6.2.2 Kiama municipality

The Kiama Municipal Council has been conducting a review of non-Indigenous heritage items since 1998. It is currently in the final processes of developing a draft Local Environmental Plan amendment for heritage items and a revised heritage schedule. The council has provided details of 15 items from that draft that are within the Gerringong to Bomaderry study area.

Of the 15 listings, three are within the Gerringong town precinct (the Gerringong Dairy Co-op and the old Stationmaster's House both in Belinda Street, and the former Toolijooa Schoolhouse on the corner of Victoria and Belinda Streets) and the majority of the remainder are rural homestead sites. All of the 15 listings are assessed as having local heritage significance.

Of those 15 items, 14 are in addition to the above 34 historical heritage items recorded on statutory and non-statutory heritage schedules, and one, Renfrew Park, is a duplication of an already existing statutory listing.

In general, neither the above heritage registers nor heritage studies have identified any potential archaeological historical heritage places within the Gerringong to Bomaderry study area. As with above ground historical heritage places there is expected to be a considerable number of below ground archaeological sites / deposits within the study area.

3.6.2.3 Predictive historical archaeology statement

Unrecorded historic sites and features of heritage significance that may occur within the study area include:

- Buildings and structures focused in towns and along the early centres and corridors of occupation, industry, travel and transport.
- Structures of historical interest and heritage significance may be standing, ruined, buried, abandoned or still in use.
- Standing commercial and public buildings are most likely to survive within the towns and urban landscapes.
- Nineteenth-century structures, such as farm dwellings, outbuildings, selector's and timber-getters huts may survive as standing buildings, ruins or archaeological deposits and are most likely to survive on less developed rural properties, on early portion numbers, and in or near established farm building complexes.
- Former timber mills and associated infrastructure such as timber pole structures, remains of machinery, tracks and tramways may survive within state forests, and in valley clearings adjacent to forest areas.
- Traces of agricultural and industrial processing or extractive sites such as dairies, factories, and quarries may be found throughout agricultural lands on the valley floor and adjacent low ranges.
- Railway sites, features and infrastructure will be focused along the rail corridor.
- Sites associated with early roads will be closely associated with early cadastral road reserves, watershed ridgelines, and related to early river and creek crossing points.
- Archaeological sites such as the occupation remains of former dwellings including homesteads, houses and huts, will be distributed in close association with land settlement patterns, and correlated with favourable agricultural lands, trading nodes and transport corridors.
- Transport and access routes such as bridle paths, stock routes, and highway alignments of varying forms and ages, may survive as abandoned remnants adjacent to modern transport routes, or as alignments now followed by more modern or upgraded road and track infrastructure.

- Old fence lines (such as post and rail fencing) may occur along road easement boundaries and farmlands. Other indications of field systems, such as drainage channels and ridge and furrow ploughlands, are likely to survive in low lying agricultural ground, especially in areas that are now used for grazing, rather than cropping.
- Shipwrecks and the submerged remains of other structures or deposits, such as from wharves, jetties and piers, are likely to occur on river and creek banks and beds. Jetty wharf locations tend to cluster at towns and adjacent to industrial areas.

3.6.3 Land-use and property

Land-use constraints that have the potential to affect route options development are summarised in **Figure 3.8**.

3.6.3.1 Description of current land-use

In terms of land area, the study area is predominantly made up of agricultural land-uses, including vineyards, dairy and crop farming. As far as practical the types of agriculture as well as all other key land-uses in the study area are shown in **Figure 3.8**. This figure provides a reasonable basis for the analysis of potential key issues associated with either widening existing highway alignments or establishing new highway alignments as part of the upgrade. The key matters considered in the assessment of land-use constraints include:

- Existing land-uses (from aerial photography and site inspection).
- Future land-uses (from review of existing strategy documents).
- Land ownership (from database of ownership provided by Kiama and Shoalhaven councils, 2007).
- Key issues (opportunities and constraints) presented by land-uses identified.
- Potential mitigation measures to alleviate the key issues or potential impacts identified.

3.6.3.2 Agriculture

The predominant land-use in the study area, in terms of land area, is agriculture. Of the range of agricultural uses, dairy is the most prevalent, which is due to the region's soil, previous availability of land and climate being well suited to use for dairy farming. Other agricultural uses include horticultural activities such as corn, olives, coffee and nurseries. In recent decades, the region has experienced a shift towards diversification of agricultural land-uses, from traditional regional farming towards alternative uses of agricultural land, including organic farming and vineyards.

Land classification

The Department of Primary Industries data classifies land on its suitability for agricultural production. Land classification maps are produced by evaluating biophysical, social and economic factors that influence the use of land for agriculture.

In general, Class 1 lands are most suitable for agricultural production whilst Class 6 lands are least suitable. Classes 1, 2 and 3 apply to lands that are suitable for productive agriculture (horticulture, dairy, vineyards and the like).

In the study area, land that is identified as either Class 2 or 3 is located in:

- The area to the north-east of Gerringong (mainly Class 2 with some Class 3 land).
- A large portion of the study area south of Gerringong, from Gerringong along the railway line to Beach Road (Class 2).
- A large portion of the study area from north of Toolijooa along the south of the existing highway to Berry (Class 2 with a small pocket of Class 3).
- The area to the north of Berry (Class 2 with a small area of Class 3).
- A significant portion of the study area to the south of Berry extending both sides of the railway line and highway (Class 2).
- The area generally to the south of the existing highway, north of Bomaderry (Class 2).
- Significant portion of the study area immediately north of Bomaderry (Class 2).

Most of the study area between Bomaderry and Berry is Class 2 land, whereas between Gerringong and Berry approximately half of the study area is Class 2 or 3 lands. The following sections provide further discussion on the implications for productive agricultural land-uses in the study area. The preferred route selection has considered the impacts of route options on the continued productive use of all rural lands, with particular emphasis on the Class 2 and 3 lands.

Dairy

Dairy land-uses in the study area are generally focussed in the areas:

- To the west of the highway near Gerringong.
- Near the railway line from Gerringong to the southern extent of the study area.
- To the north and north-east of Bomaderry.

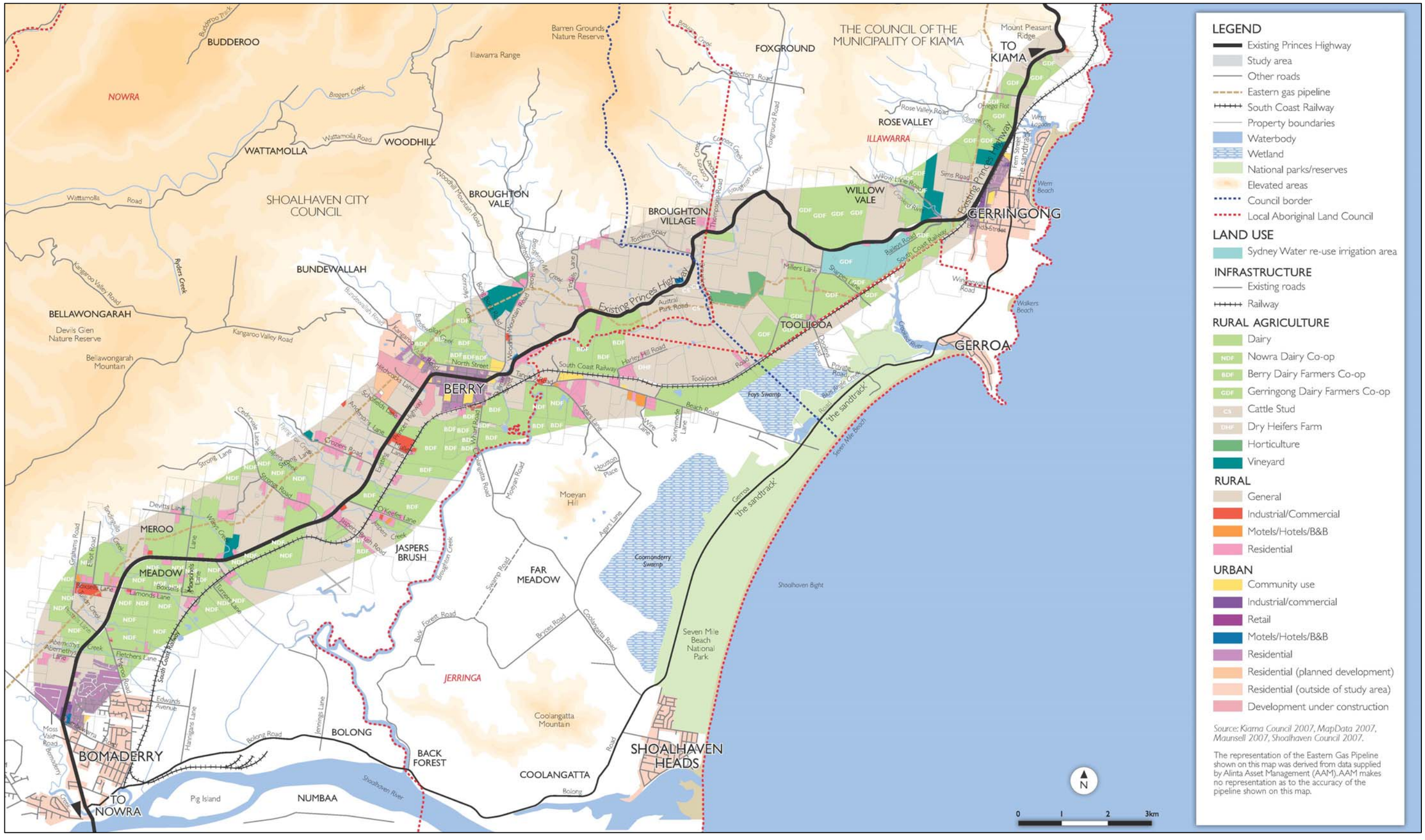
There are eight farmers in the Berry Dairy Co-op located within the study area who produce milk for South Coast Dairy. Disruption to these farmers could have an impact on the availability of South Coast Dairy milk supplies.

Dairy farming would be sensitive to severance as a result of a new alignment as it matches areas of Agricultural Land Class 2, which is described as being suitable for regular cultivation. Furthermore, in the planning focus meeting, Kiama Council (2006) stated that council does not wish to fragment agricultural land into smaller parcels. Another consideration is that within the one farm there are potentially different land values, eg high ground is considered more valuable as residences are built on the high ground, machinery is located on the high ground and cattle are sheltered on the high ground during flood events. There is also different value placed on different paddocks eg 'night' paddocks are close to the farmstead and the farmers move the cattle there every night.

According to the councils, land in the study area has increased in value, which puts pressure on agricultural land-uses to remain productive in order to avoid sale as non-productive land in smaller allotments. Council referred to a Commonwealth Scientific and Industrial Research Organisation report completed in 2005, which states that the climate will generally be hotter and drier, but rainfall will increase in the Kiama / Gerringong / Berry areas.

This means that agricultural land will again increase in value for use as farming. This requires protection of larger productive land holdings in this area to offset potential reductions in productivity in other areas of the state or region. The councils are aiming to restrict or prohibit urban development in agricultural areas and provide opportunities for diversification.

Figure 3.8 Land-use



Organic farming

There is one organic farm (shown as 'horticulture' on **Figure 3.8**) identified in the study area that is registered with the Organic Growers of Australia.

This farm is located in the Toolijooa area between the existing highway and railway and has edible bamboo, also has fruit and nut trees, Australian bush food, tropical fruit, livestock, poultry, eggs, gingko biloba, horses, goats and cattle. There are no organic farms in the study area that are registered with the Biological Farmers Association (Australian certified organic is the certification arm for the Biological Farmers Association) or the National Association Sustainable Agriculture Australia.

The farm is particularly significant as it has a dual purpose. It is also used for a mentoring program for disadvantaged children as well as a working farm.

Vineyards

There are five vineyards located in the study area:

- Roselea Vineyard.
- Crooked River Boutique Winery and Vineyard.
- Jasper Valley Wines.
- Silos Winery.
- Woodhill Mountain Wines.

There is significant investment in vineyards as the grapes take several years to grow and establish themselves to a point where they are able to be used for wine making. Vineyards are also tourist attractions as some of them have function centres, art galleries, accommodation and restaurants in addition to wine tastings and wine available for purchase.

Part of the attraction for tourists is the aesthetics associated with the location. An example of this is Crooked River Boutique Winery and Vineyard which is set on a hill overlooking the vineyard and surrounding landscape. The Silos Estate similarly has views from the cottages overlooking the vineyards.

3.6.3.3 Rural living and commerce

'Rural living and commerce' is used to describe the non-agricultural land-uses in the rural land areas of the study area. Such uses include hotels / motels, bed and breakfast accommodation, residential dwellings, retail and other similar land-uses. These land-uses are described in the following sections.

Other commercial activities

In rural areas, there are a number of additional commercial activities that would need to be considered regarding suitability of highway locations. Such land-uses include motels / hotels, resorts and bed and breakfasts.

Key commercial activities in the study area include five motels / hotels and 21 bed and breakfasts.

Motel / hotel accommodation is typically in built up areas that have visual exposure to the passing traffic as well as easy access to the main cities via major transport links. All of the motel / hotels except the Woodbyne Private Hotel are located in Berry town centre. The Woodbyne Private Hotel is not located in Berry town centre but does have visual exposure to the passing traffic as well as easy access via major transport links as it is located on the corner of the Princes Highway and O'Keefes Lane.

Bed and breakfast accommodation is typically distributed through non-urban areas rather than concentrated in the centre of town. Some of the main attractions for guests in bed and breakfasts are the scenery and the serenity.

Rural residential dwellings

Residential development comprises low density or isolated rural dwellings that are not part of a larger farm. Rural dwellings are generally scattered throughout the study area with little or no clustering.

Urban areas

The urban areas within the study area are Gerringong, Berry and Bomaderry. Gerringong has the character of a small coastal village, whereas Berry is a rural farming village. Bomaderry is part of Nowra-Bomaderry regional centre, but the study area retains a peri-urban character. This section describes the key issues associated with land-uses in the three unique urban areas.

3.6.3.4 Tourism

Tourism is an economic asset for the region. The study area is particularly popular for weekend trips for tourists from Sydney. Some of the attractions of the area include:

- Landscape and escarpment views.
- Scenic quality of the existing route.
- The Historic township of Berry with its arts and crafts, antiques and markets.
- Accessibility and proximity from Sydney.

Tourism is dependent on the natural environment and is playing an increasingly important economic and social role in the region.

3.6.3.5 Residential

Existing urban residential

Key characteristics of the residential components of Berry, Gerringong and Bomaderry are described in **Table 3.4**.

Table 3.4 Residential characteristics

Urban area	Characteristics
Bomaderry	• Peri-urban residential character. • Low density residential to east and west of highway, with development to west being of lower density. • Cul de sacs are prevalent in residential neighbourhoods, reducing accessibility.
Berry	• Rural hamlet comprising low density residential. • Residential surrounds Berry town centre in one distinct urban area, but with small pockets of residential to east (Pulman Street) and west (along Kangaroo Valley Road). Note: there is a large pocket of residential along Kangaroo Valley Road outside the study area, which is not considered in this analysis. • Some larger estates (rural residential type allotments) on edge of Berry urban area. • Residential generally on a grid road layout with good access.
Gerringong	• Coastal village residential character. • Residential separated from the Princes Highway by the southern railway line. • Cul de sacs dominate the road layout. • Dwellings are generally low density detached dwellings.

Planned future residential

Residential growth is planned in Gerringong and south of Gerringong (Kiama Council, Planning Focus Meeting 2006). There are also two significant residential developments in the study area, both of which have current development consent from Shoalhaven City Council and construction has commenced. These are:

- Huntingdale Estate and Graham Park Land Release Area.
- The Arbour, Berry Retirement (seniors living) Development.

3.6.4 Demographics and social-economic profiles

3.6.4.1 Existing social-economic profile

Indicators of the social-economic profile of the study area show that the northern (centred on Gerringong) and central (centred on Berry) sub-areas differ from the southern (Bomaderry) sub-area. In particular:

- Gerringong and Berry are focussed on supporting the tourism sector as well as the second home and retirement markets, whereas Bomaderry is closely aligned to the significant urban centre of Nowra and has a higher proportion of manufacturing and blue-collar type employment activities. Manufacturing accounts for 11 per cent of employment in Bomaderry compared to six to seven per cent in Gerringong and Berry (2006 data).
- Both Gerringong and Berry have a significantly higher proportion of the population over 65 years than Bomaderry (20 per cent and 28 per cent respectively compared to 17 per cent for Bomaderry and the NSW average of 14 per cent; 2006 data).
- Both Gerringong and Berry have a significantly lower unemployment rate than Bomaderry (3.6 per cent and 4.8 per cent respectively compared to 8.6 per cent for Bomaderry and the NSW average of 5.9 per cent; 2006 data).

Land in the rural areas between the three towns in the study area is primarily used for large lot dairy cattle farming, beef cattle farming and some vineyards. Many of the farms and dwelling houses on these agricultural land holdings are located close to the highway with direct highway access. There are a large number of 'hobby' and 'weekend' farms to the west of the highway, serviced by access roads adjoining the highway.

3.6.4.2 Previous studies of social-economic impacts

Previous studies (in 1991, 1998 and 2006) have identified a broad range of social-economic impacts associated with the Gerringong to Bomaderry route. The following were identified in all three studies: visual amenity, property impacts, rural lifestyle / amenity, pollution / air quality, and operational impacts.

A case study of relevance to the proposed bypass of Berry was the *1994 Bureau of Transport and Communications Economic Impact Study of Berrima and Mittagong* which were bypassed when the Hume Highway was upgraded. Berrima was in a similar situation to Berry, being a tourist destination in its own right with a number of historic buildings set in an attractive landscape. The results indicated that the completion of the bypass enhanced the tourist appeal of Berrima due to the reduction in traffic, particularly heavy vehicles, through the town which improved the general environment of the town.

A literature review has indicated that potential social-economic impacts in relation to the bypassing of a town are affected by the following matters:

- Proximity: The route should be close enough so that road users will stop at the town.
- Visibility: The route should, if possible, allow the town to be seen from the highway.
- Appropriate location of interchanges: Interchanges and intersections should have regard to business needs.
- Impact of proximity: The route should not be so close that the rural character of the town is compromised.

As part of this project, the *Route Option Development Report (November 2007)* contains the results of a preliminary social-economics study of the area. To further differentiate the seven short-listed options, additional investigations were carried out on likely impacts specific to businesses.

3.6.4.3 Potential social-economic impacts

To allow a better understanding of each of the potential impacts, six impact categories have been developed as follows:

- Community identity and interaction – how the project could change the structure of the community and the manner in which the community may respond to the project. Issues and concerns raised by the community to date include:
  - Community connections.
  - Severance.
  - Uncertainty.
  - Land-use-agricultural.

- Amenity impacts – impacts on the existing levels of amenity in localities along the proposed route, particularly through loss of flora and fauna, noise and vibration, visual effects, and pollution / air quality. Issues and concerns raised by the community to date include:
  - Operational impacts.
  - Increase in heavy vehicle traffic.
  - Construction impacts.
  - Flooding.
  - Noise.
  - Water.
  - Air quality.
  - Visual amenity.
  - European and Indigenous heritage.

- Road related impacts – including road safety, road closures and changes and provision of access to new road. Issues and concerns raised by the community to date include:
  - Cycleways.
  - Road safety.
  - Increase in road traffic.
  - Access.

- Economic (local and regional) – including impacts on employment, local business impacts, impacts on agricultural / farm lands, and effects on household finances. Issues and concerns raised by the community to date include:
  - Impacts on business.
  - Aboriginal employment.
  - Adequate access roads to support economic activity and encourage tourist traffic.

- Community and special social group needs – impacts on community health and facilities and services for special groups (eg disabled, Indigenous).

- Impacts of property and land acquisition – particularly in regard to reduced subdivision potential with reduction in lot sizes.

3.6.5 Noise

A summary of the acoustic assessment of the study area and the impact of the seven short-listed options follows.

The *Preliminary Traffic Noise and Vibration Assessment Report* prepared as *Appendix N* of the *Route Options Development Report (November 2007)* provides a comparison between upgrading the existing road and constructing:

- A new road in rural and urban areas.
- A bypass around Berry

Other than the Princes Highway the only other major noise source in the area is the South Coast railway line.

3.6.5.1 Preliminary noise assessment

The two basic parameters used in the acoustic assessment were:

- Number of residential properties or other sensitive noise receivers potentially affected.
- The change in noise level (both increase and decrease) from the existing situation at each of those receivers.

Noise sensitive receivers identified in the preliminary acoustic assessment are identified in **Figure 3.9**.

Where possible, routes should provide the maximum possible offset distance between these noise receivers and the road.

At a basic level, without considering noise mitigation measures such as shielding, the minimum offset distance should be approximately 250 m between a new road and residential receiver. This minimum distance can be reduced significantly with the use of mitigation and noise treatment.

Such measures will be investigated in detail during the concept design and environmental assessment of the preferred route. However, mitigation measures which can be considered in the event of noise impact include, among others, noise walls, noise mounds, landscaping treatment in the form of plantings and architectural treatments such as the installation of double glazing and noise proofing.

Unattended noise monitoring using automated noise loggers was carried out at a number of locations in the study area between 8 February and 19 February 2007 as part of the preliminary assessment. Short-term attended monitoring (using a hand held noise monitoring device) was also conducted and a description of the acoustic environment at each location documented.

Noise monitoring locations were selected so as to enable the characterisation of the currently experienced noise environment across the whole study area, in locations both near the existing Princes Highway and in areas that are distant from the existing road. Monitoring locations are shown in **Figure 3.10**.

3.6.5.2 Summary of findings of the noise assessment

Rural locations

A rural section with approximately 90 receivers was investigated during the preliminary assessment to compare the indicative impact of constructing a new route in a region that currently experiences low noise levels, with the impact of upgrading the existing route. The results of the assessment indicate that the perceived impact of a new route may be significantly higher than an upgrade of an existing route, even if the measured noise levels along the route are similar.

From a noise impact assessment perspective a new route in a rural area, away from the existing alignment, would only be beneficial overall if a significant number of receivers experience an individual benefit (ie a reduction in noise levels) and the impact on newly affected receivers can be minimised with mitigation and sufficient offset distances.

Where possible, in predominantly rural areas, the road upgrade should follow the existing route to minimise the overall perceived change in noise levels, unless a route can be identified where sufficient mitigation can be successfully implemented.

Figure 3.9 Noise sensitive receivers

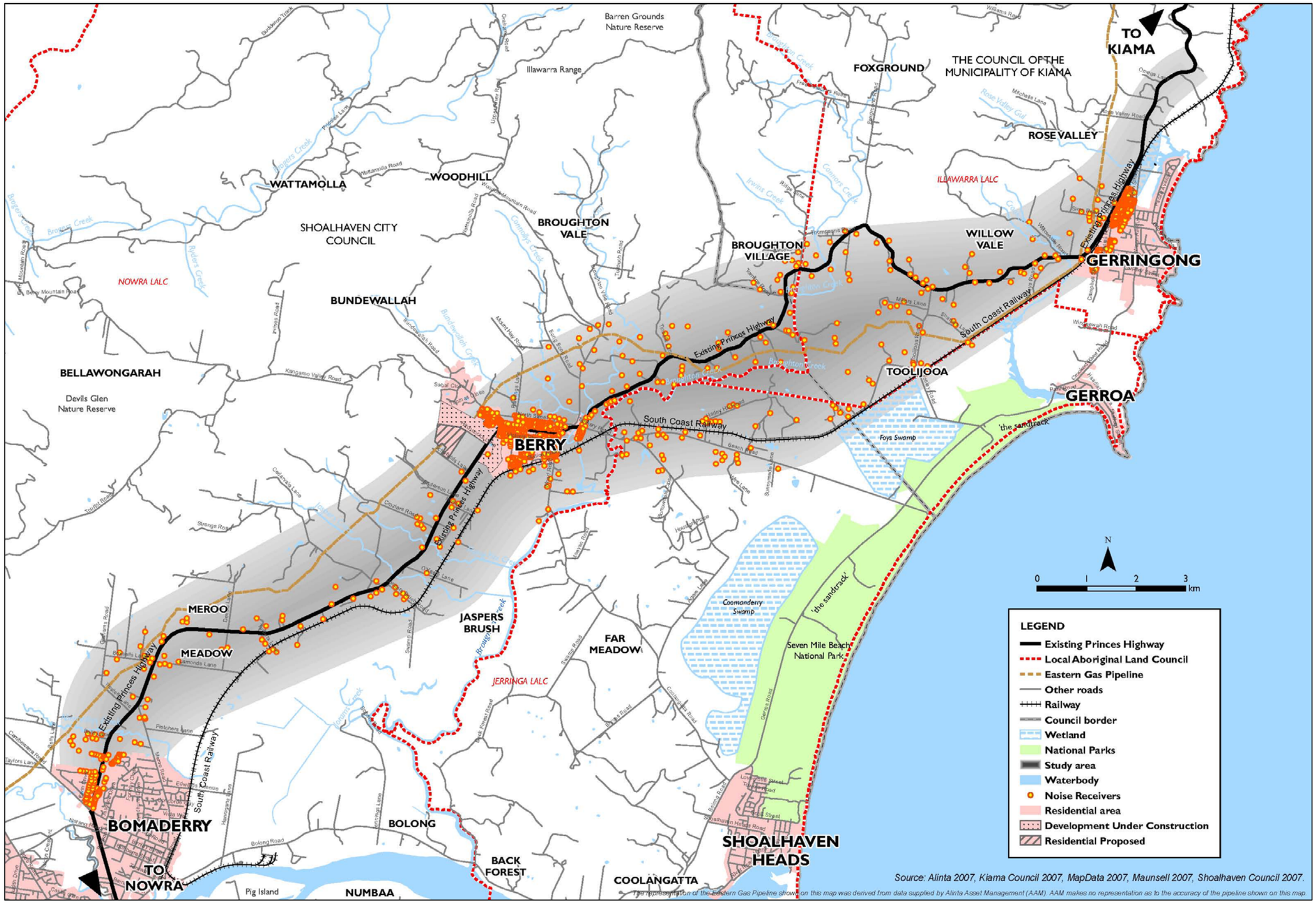
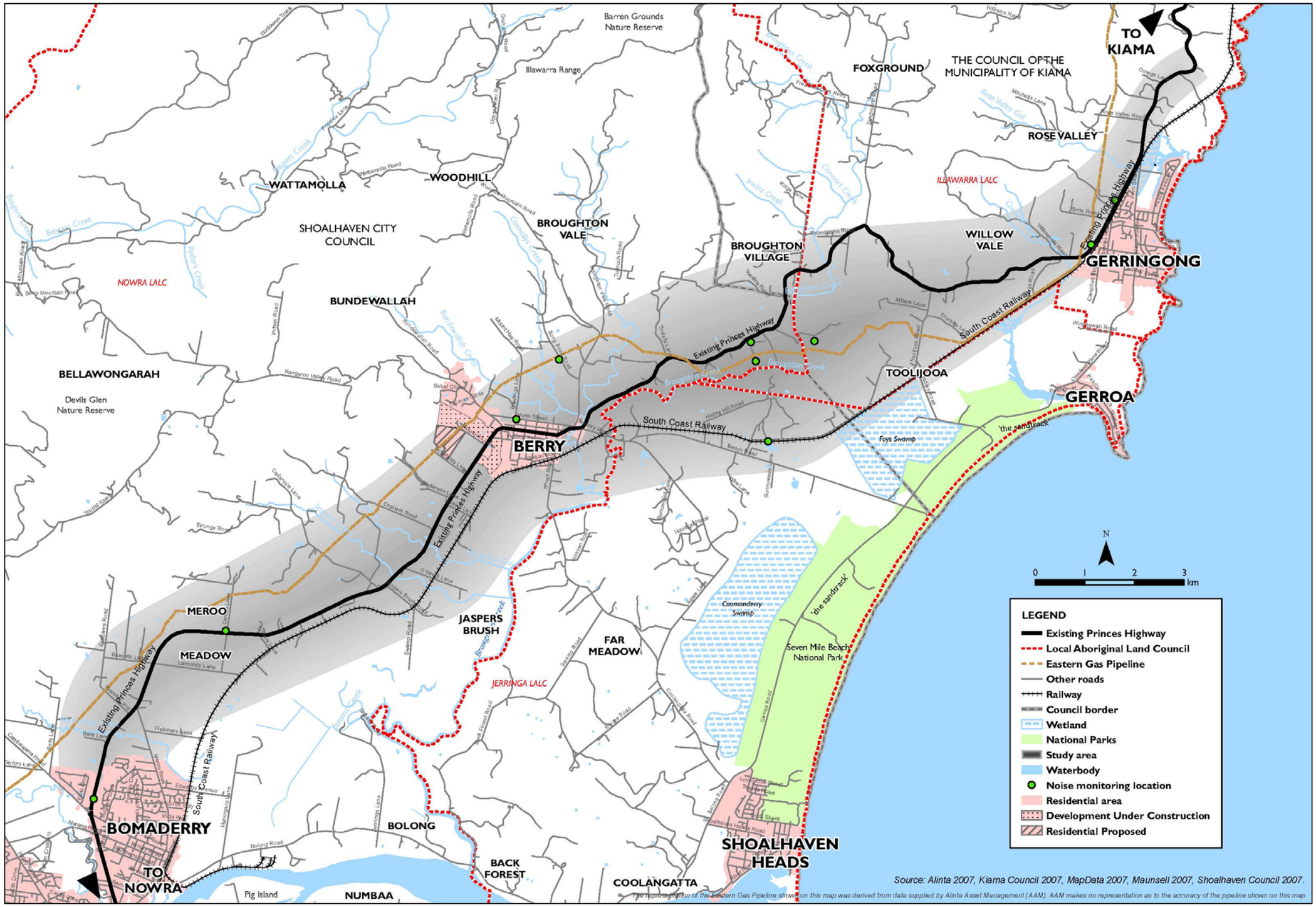


Figure 3.10 Noise monitoring locations



Berry

Based on predicted future noise levels (experienced by an upgrade of the existing road under 2016 traffic flows) bypass options to the north and south of Berry would reduce the overall perceived noise levels for existing noise affected receivers in the Berry area compared with an alternative option of upgrading the existing alignment through Berry, or an existing parallel street within the town.

Over the wider study area, a bypass of a township may provide a significant enough benefit to a large enough number of residences within that town, to outweigh the potential detrimental affects of any increases in noise in the rural areas.

3.6.6 Urban design, landscape and visual amenity

A summary of the potential visual impacts associated with the upgrade options follows.

3.6.6.1 Landscape setting

The study area is set within the coastal hinterland between Gerringong and Bomaderry. For the most part the topography is flat to undulating, with the main exceptions being a series of spurs connecting with the much higher elevations to the west of the study area that comprise the southern end of the Illawarra Escarpment. Beyond the study area to the east, there are also several isolated areas of higher ground, including Coolangatta Mountain near Shoalhaven Heads.

The largest human influence on the landscape within the study area has been the agricultural practices that have occurred since European settlement. Much of the study area has been heavily cleared and utilised for agricultural purposes, mainly grazing. Agriculture in the Shoalhaven area was originally dominated by large estates on land grants (such as Alexander Berry, Coolangatta).

The predominant form of agriculture since the second half of the nineteenth century has been dairying which has resulted in a characteristic landscape over large parts of the study area, of cleared rolling pasture with prominent cultural plantings marking farmhouse locations, and in some cases property boundaries. Corridors of native vegetation are often retained along drainage lines within the pastureland, whilst isolated native trees particularly larger specimens of figs and cabbage tree palms, also occur.

More extensive areas of native vegetation occur on some of the higher points within the study area, including hills near Broughton Village and on some of the spurs connecting with the higher escarpment areas to the west.

Historically the scale and character of settlement patterns were dependent on the distribution of small dairy farms. The towns of Gerringong, Berry and Bomaderry all developed as a consequence of dairying in the area as did the smaller rural settlements. The settlement pattern today generally conforms to this historical pattern with the main exception being the significant urban expansion of Bomaderry, the northern fringe of which is situated within the study area.

Gerringong is located at the northern end of the study area. The character of the town reflects its rural history as well as its location on an extremely scenic section of coastline. Despite recent growth Gerringong retains the character and scale of a coastal village. The rolling topography within the town affords regular and expansive views of the coastline and hinterland. The Princes Highway bypasses Gerringong with the highway and adjacent railway line forming the western boundary of Gerringong urban development. The presence of the highway has little influence on the amenity of the central part of the town, with the main commercial precinct being approximately 750 m from the highway.

Berry is largely contained within a historical street grid, with some rural residential subdivision occurring on the fringes. Gerringong has expanded generally to the south and west but all development occurs on the eastern side of the existing Princes Highway. The contribution of built form to the landscape includes early vernacular buildings, churches and public schools, Victorian residences and a range of buildings, silos, drainage schemes and structures, as well as more modern residential development on urban fringes and commercial strip development on the northern approaches to Bomaderry.

Bomaderry also developed as a rural settlement, having its beginnings on the northern bank of the Shoalhaven River. The town became the end of the South Coast railway line when the section from Bombo to Bomaderry was built in the 1890's. The older parts of the town are laid out on a grid on the western side of the railway station.

More recent urban expansion with a suburban character has occurred in a generally northward direction. The northern part of the town, which also includes commercial development along the Prince Highway coincides with the parts of Bomaderry that are in the study area. The existing Princes Highway separates North Nowra and Bomaderry.

3.6.6.2 Landscape context

The natural landscape setting of the study site and the greater context of the NSW South Coast is a constant interaction of ocean and beach, rocky headland, coastal plain and escarpment and mountain ranges. Other than the permanent presence of the ocean the other landscape elements vary greatly in scale and interact in many different but ultimately harmonious combinations. The existing highway is an experience and element that is layered into this landscape. The landscape contextual character provides for many experiences and interpretations. There is the sense of prosperity with stately trees (both indigenous and exotic) it is also enveloping and soothing, with tree covered escarpments and meandering creeks and rivers that nurture with the fertile coastal plains, lakes and wetlands.

The existing highway reveals all of this complex and harmonious landscape to the user. The coast is often present in distant views as are the open fertile coastal plains. The creek lines are often engaged as the highway closely follows the varying topography and the scale of the many roadside trees is always impressive.

3.6.6.3 The existing Princes Highway journey

The landscape as experienced by road users travelling along the existing Princes Highway alignment between Gerringong and Bomaderry is described here. The existing experience will be an important reference point against which the experience gained by users of the upgraded highway can ultimately be assessed. The journey is discussed in terms of a southbound travel direction. It should be noted that the current Princess Highway is mostly single lane each way with posted speeds varying from between 50 – 100 km/h.

The study area is reached from the north after travelling through the recently completed North Kiama Bypass and the section of highway known as the Kiama Bends, the latter of which provides a dramatic road user experience with extensive views of the Pacific Ocean and close proximity to the steep rain forested slopes on the western side of the highway in this area. The first views of the study area are gained from near Mount Pleasant, where the highway begins a long straight downslope with expansive views of the coast, Seven Mile Beach National Park, the pastureland of the study area, and the mountains to the west.

Upon reaching the lower elevations south of Gerringong, the highway traverses relatively flat pastureland before rising into the higher elevations west of Willow Vale. This section of the highway tends to be slow and winding with a sense of enclosure created by natural vegetation on the sides of the highway punctuated with occasional broader views to the landscape beyond.

The highway then descends to undulating pastureland north of Berry. In this area there are expansive lateral views of the coastal lowlands to the east and the vegetated mountains to the west.

Berry is reached relatively suddenly with the main street appearing to the road user after immediately rounding a bend in the highway at the entrance to the town. The Berry main street (Queen Street) is single lane in each direction, with a single parking lane on either side of the road.

It is lined with a series of shops, cafes and pubs, with many of the buildings being heritage listed, providing significant character to the town centre. The presence of high traffic volumes within the main street is the only significant detractor from the experience of travelling through the town. The backdrop of the mountains is a dominant landscape feature from within the town, with the higher elevations being prominent above the rooflines of the commercial main street buildings.

To the south of Berry the route continues to follow the undulating pastoral landscape with generally open views except for several significant avenues of mature trees fringing the highway. The vegetated slopes of Cambewarra Mountain become prominent in this area, with view to the east being across the pastureland of the Broughton Creek / Shoalhaven River floodplain.

The entrance to Bomaderry comprises a relatively abrupt transition from a pastoral landscape to an urban landscape dominated by commercial development (such as car yards) of low visual quality.

Beyond the study area to the south the highway passes through continuous urban development until it is south of Nowra where a predominantly forested landscape begins. The main feature of interest in this area is the crossing of the Shoalhaven River via a landmark steel truss bridge, which also forms the gateway to Nowra.

3.6.6.4 Landscape constraints analysis

Visual constraint analysis has been carried out to assist in the route options development process. The visual constraint analysis evaluates three main factors influencing the likely visual impact of the road.

These factors are:

- Land cover.
- Slope.
- Visibility.

By combining these three factors in a geographical information system, a broad picture can be gained of the likely visual impact of the road at any point in the study area. This analysis can be viewed on its own, but is also designed to be incorporated into the overall constraint analysis and route option development process. The components of the visual constraint analysis are described below.

Land cover

Land cover refers to both human land-uses and the vegetation cover that occurs across the study area. A new or upgraded highway will result in different levels of change to the landscape depending on the nature of the land cover in a given area.

Generally, a highway passing through vegetated areas will result in a greater change to the landscape than one passing through unvegetated areas because of the clearing required and possible corridor effect that would be created. Similarly, areas with concentrations of residents represent a land cover type that is less compatible with highway development than those that are sparsely settled. For the purposes of this analysis, the following constraint values were applied to the various land cover types:

Table 3.5 Visual constraints values applied to land cover types

Land-use type	Constraint value
Urban areas	high constraint
Vegetation	high constraint
Rural residential	medium constraint
Rural	low constraint
Railway	low constraint
Roads (other than existing Princes Highway)	low constraint
Existing Princes Highway	no constraint

Slope

Slope is important in identifying levels of visual constraint largely because of the correlation between slope and the volume of earthworks required. Generally, the steeper the terrain, the greater the level of cut and fill that is required and therefore the greater the amount of change to the landscape.

Localised factors particularly the horizontal angle of the road in relation to that of the slope will influence the actual magnitude of landscape change. When assessing levels of visual constraint at a broad level with no predetermined road alignment, it is reasonable to assume that the steeper the slope, the greater the constraint. Constraint categories for slope are detailed in **Table 3.6**.

Table 3.6 Constraint values assigned to slope analysis

Slope	Constraint value
20%+	high constraint
10-20%	medium constraint
5-10%	low constraint
0-5%	no constraint

The divisions between the categories are based on an intuitive evaluation of the likely impact that a road of the type in question would have when aligned perpendicular to the aspect of the slope. The no constraint level is where little or no cut or fill would be required, while the highest constraint level represents a level of cut or fill that under any circumstances would be regarded as resulting in a high level of visual impact.

Visibility

It can be reasonably assumed that the more a highway can be seen, the greater the level of potential visual impact. Areas of higher visibility within the study area have therefore been assigned higher levels of landscape constraint.

The visibility analysis was undertaken using a Geographical Information System based viewshed analysis. 43 viewpoints were selected that represented the range of views to the study area. These included points both within and outside of the study area, and were selected on the basis of being vantage points and/or where there are concentrations of people. There are therefore larger numbers of points located around towns such as Berry.

A viewshed analysis was carried out for each viewpoint that identified the area that could be potentially seen from the point based on terrain only. Potential obstruction from buildings and vegetation was not taken into account. Each of the 43 separate viewshed analyses were then combined to produce a composite analysis that gives an overall estimate of relative visibility across the study area. Areas that could be viewed from the largest number of viewpoints were deemed to be areas of highest constraint from a visibility point of view.

Table 3.7 Constraints values applied to visibility analysis

Visibility	Constraint value
Visible from more than 15 viewpoints	high constraint
Visible from between 9 and 14 viewpoints	medium constraint
Visible from between 4 and 8 viewpoints	low constraint
Visible from between 0 and 3 viewpoints	no constraint

4.0 Design considerations

4.1 Design criteria

Together with the characteristics discussed in **Chapter 3**, the design considerations form the basis of the guidelines and parameters which the preferred option must satisfy. This chapter presents the design criteria which apply to this project and the preferred option.

4.1.1 Engineering design criteria

Standard national and state guidelines apply and cover the categories including:

- RTA corporate policies.
- Occupational health and safety.
- Road design.
- Traffic.
- Environmental policies.
- Road safety.

4.1.2 Design life

The economic analysis of the options considers the design life of various infrastructure assets which comprise the preferred option. The design life requirements are developed and applied to all stages of the project including concept design, detailed design and construction. Ecologically sustainable development principles and analysis are also considered in the design life.

4.1.3 Flood immunity

The design must ensure that the appropriate level of flood immunity is provided. The RTA guidelines require that the pavement wearing surface remains above the water level during the design flood event. This project requires:

- A target of 1:100 year flood event for new alignments (Class M).
- For routes following the existing alignment (Class A) the minimum target is at least a 1:20 year flood event.

4.2 Technical criteria

Minimum technical criteria for the upgrade have been stipulated by the RTA. These incorporate standards and design guidelines required to achieve the project objectives.

The stipulated technical criteria for the upgrade are summarised in **Table 4.1**

Table 4.1 Technical criteria

Feature	Upgrade	Local roads / service roads
Design speed	• Minimum 110 km/h horizontal alignment. • Minimum 100 km/h vertical alignment.	• Minimum 60 km/h horizontal alignment. • Minimum 60 km/h vertical alignment.
Cross section	• Minimum four lane single carriageway with appropriate median treatments to provide physical separation of opposing traffic.	• As per RTA Road Design Guide and to match adjoining road conditions and council requirements.
Flood immunity	• Target of 1 in 100 year flood event for new alignments. • A minimum target of at least a 1:20 year flood event for upgrades of existing alignments.	
Interchanges	• Cater for 25 m B-double trucks where appropriate.	

4.3 Flooding and drainage

Flood investigations have been undertaken to develop an understanding of the existing historical flood patterns and the potential impact of the project. The investigations involved the following:

- A review of existing flood modelling and historical studies of the major surface drainage systems within the study area.
- Additional flood modelling where required within the study area to complete the study.

4.3.1 Peak flow determination

Within areas covered by either the *North Street Berry Bypass Environmental Impact Statement (ERM, 1997)* or the *Broughton Creek Flood Study (SMEC 2004)*, peak flows for the 1 in 100 year Annual Recurrence Interval Storm event were adopted from these flood studies where possible. The peak flows were checked against the *Probabilistic Rational Method in Australian Rainfall and Runoff (1999)* where required.

For areas not included in the above studies, peak flows were calculated using the Probabilistic Rational Method in Australian Rainfall and Runoff. Rainfall Intensity-Frequency-Duration Curve Parameters for Berry, Bomaderry / Nowra and Gerringong areas were determined from *Australian Rainfall and Runoff (Vol 2)* and used to calculate the design peak flows.

4.3.2 Flood level determination

Existing flood levels were obtained from the *Broughton Creek Flood Study (SMEC 2004)*. For other creek crossing locations not covered in the study, HEC-RAS steady flow simulation was used to estimate the existing flood level. For Crooked River, the Rational Method (in Australian Rainfall and Runoff) was used to determine peak flows for use in steady flow data in HEC-RAS analysis to calculate the design flood levels. No existing drainage structures, either at the highway or railway line, were included in this modelling.

4.3.3 Road level and watercourse crossing requirements

The preferred option crosses numerous watercourses and floodplains. This provides an opportunity to control the flow during flood events with the provision of drainage structures (such as culverts and bridges) within the road embankment to ensure upstream water levels (afflux) are mitigated to acceptable levels. For some minor tributaries, there may be opportunity to mitigate downstream water levels by redirection of the tributary.

Simple analysis was utilised to assess preliminary drainage crossing structure details as well as the water levels upstream and downstream of those road crossings. Bridges and culverts were included in the existing models and limited techniques were used to determine the preliminary crossing opening requirements and to determine indicative road embankment levels.

The following design assumptions were adopted for determining preliminary road embankment levels and watercourse crossing requirements for the route options:

- Road pavement levels were determined with a 500 mm minimum freeboard height above the 100 year Annual Recurrence Interval flood level.
- Due to the relative flatness of the floodplain at the Crooked River lower area, the existing railway line embankment level was assumed to act as a flow control with the road embankment levels set approximately 300 mm above the railway line along this route.
- The road pavement through Omega Flat was set at the existing Princes Highway level plus an additional 1500 mm.

4.3.4 Groundwater issues

Groundwater issues are discussed in relation to the following areas within the study area.

4.3.4.1 Omega Flat

The preferred option passes through the Omega Flat floodplain area which includes Ooaree Creek. This area is generally low lying and is characterised by deep soft soils, high probability of acid sulphate soils and shallow groundwater. The construction of drainage structures such as culverts and storage basins in this area may require excavation below the water table and may intersect zones of acid sulphate soils. Mitigation measures such as cut-off walls or re-injection may be required in this area to reduce the risk of lowering the water table. Construction methods adopted in these estuarine soft soils should avoid creating barriers to the lateral flow of shallow groundwater. These measures would increase the cost of construction in this area.

4.3.4.2 Broughton Creek upper catchment

The preferred option in this area may include some sections of significantly deep cuttings or tunnels to traverse some of the elevated ridgelines and hills. Tunnels of approximately 40 m depth below ground level may be required to negotiate the ridgeline between Toolijooa and Foxground.

To the north of Toolijooa, there are two licensed bores located close to the ridge. Further investigation will be undertaken to determine the effect, if any, of deep cuttings or tunnels on groundwater flows.

4.3.4.3 Berry floodplain area

In the areas to the north and north-east of Berry a small number of bores access water bearing zones over a wide range of depths including shallow fractured rock layers. Further investigations will be made into potential impacts on the bores in this area, as a result of localised lowering of the water table at any proposed cuttings.

4.3.4.4 Shoalhaven River upper catchment

Areas of soft soils and acid sulphate soils and shallow groundwater occur mainly to the south of the existing railway line.

The preferred option in this area follows the existing highway alignment, north of the existing railway, with no significant cut or fill. Therefore there are no likely significant impacts on or from groundwater in this area.

4.4 Project urban design objectives

The following urban and regional design objectives will continue to be considered and applied during the development of the preferred option:

- Provide a flowing highway alignment that is responsive and integrated with the landscape.
- Protect the natural systems and ecology of the corridor.
- Protect and enhance the heritage and cultural values of the corridor.
- Respect the communities and towns along the road.
- Provide an enjoyable, interesting highway with strong visual connections to the Pacific Ocean, immediate hinterland and the mountains to the west.

4.5 Geotechnical considerations

4.5.1 Geotechnical conditions

The geologic and soil conditions over the study area are described in **Chapter 3**. A discussion of the design considerations associated with the geologic and soil conditions likely to be encountered on the preferred option follows.

4.5.1.1 Soils

Soils requiring particular design attention are those with potential to be soft and compressible, those containing iron sulphides, or those unstable on slopes. Those soils classified as either estuarine or alluvial have potential to be soft and compressible and contain iron sulphides. Deep colluvial soils on the steep side slopes of ridges have potential for instability.

Estuarine soils are located at Omega Flat in the northern part of the study area. The preferred option crossing Omega Flat will be constructed on fill formation in order to provide flood immunity. Embankments constructed on deep and soft estuarine clay deposits are subject to larger settlements than those on non-estuarine soft soils. Special ground treatment will be required in these areas to drain and compress the soil below the road formation.

Alluvial soils are present in the Shoalhaven River floodplain, creeks, and other low-lying areas. Areas classified as high risk acid sulphate soils are indicative of areas of soft and compressible alluvial or estuarine soils. The areas where soft and potentially compressible soil deposits are located, on or near the preferred option, include:

- The Ooaree Creek floodplain (Omega Flat), north of Gerringong.
- The Crooked River floodplain, east of Toolijooa Road, south of the existing highway and south-west of Gerringong.
- The Shoalhaven River / Broughton Creek floodplain, between Berry and Bomaderry and generally lying to the south or east of the current South Coast railway line.

More targeted studies will be required to determine the extent and depth of soft soils in these areas. Accordingly, the extent and type of ground treatment required will be determined following more targeted studies. A conservative approach has been used to determine cost estimates for ground treatment.

Deep colluvial soils on the steep side slopes of ridges and gullies could pose a slope stability risk. Potential slope instability can be addressed in design with appropriate batter slopes and engineering treatment.

4.5.1.2 Rock

The rock present in the study area does not pose significant issues for design consideration. Volcanic tuff underlain by sandstone is the predominant rock group in the study area. Some drilling and blasting is anticipated in deeper cuttings or where isolated latite boulders are encountered in the northern part of the study area. High strength sandstone is likely to be suitable for tunnelling (see **Section 4.5.3**). It is anticipated that the majority of cut material would be suitable for general fill and select fill after some crushing on-site.

4.5.2 Ground treatment options

Where the preferred option traverses potentially soft soil areas, a range of treatments are available to ensure that settlement criteria are achieved, and an acceptable factor of safety against embankment failure is achieved.

A number of potential treatments for construction of embankments on soft soils are available as shown in **Table 4.2**.

Table 4.2 Potential treatments for road formation on soft soils

Treatment	Method	Advantages	Disadvantages
Preloading	Early placement of embankment material to induce settlements prior to operational phase.	• Reduces settlements during operation phase. • Inexpensive if fill material is readily available.	• Planning and duration required (years). • Material required early. • Limited strength gain in foundation material without other treatment.
Vertical drainage (wick drains)	Placement of vertical drainage pipes to allow water to drain from the consolidating material.	• Accelerates consolidation settlements. • Increased rate of strength gain (relative to preload alone).	• Potential impact upon hydrogeology. • High material and installation costs.
Lightweight fills	Utilisation of a lightweight embankment material reduces ground contact stress and resulting settlements.	• Reduces total settlement. • Reduces instability. • Rapid construction.	• High cost. • Potential buoyancy and environmental impact.
Piled raft	Partial structural solution transferring vertical loads to lower levels through a combination of a raft foundation and the use of piles.	• Reduces settlement. • Significantly reduces instability issues. • Limited footprint leading to a possible reduction in land requirements. • Overall time reduction.	• Moderate cost. • Availability of low cost (timber) piles.

Table 4.2 Potential treatments for road formation on soft soils cont'd

Treatment	Method	Advantages	Disadvantages
Piled viaduct	Full structural solution transferring vertical loads to competent material at depth.	• Negligible settlement. • No stability impact. • Minimal surface drainage impact. • Possible reduction in land requirements. • Overall time reduction.	• High cost. • Deep foundations difficulties.
Flattening batters	Flatter batter angle of embankment improves stability.	• Reduces stability impact. • Inexpensive.	• Larger footprint. • Increased fill quantities.
Geotextile reinforcement	Synthetic material providing tensile reinforcement against horizontal strains in the lower part of an embankment.	• Improve stability. • Inexpensive (relative to piled solutions). • Possible reduction in land requirements.	• Greater control over fill material required. • Limited reduction in overall settlement.

4.5.3 Suitability for tunnelling

Toolijooa ridge is the dominant ridgeline extending from Foxground to Toolijooa and Harley Hill and effectively bisects the study area. The Pink and Green routes both negotiate this ridge – in deep cutting and tunnel respectively. The existing highway begins to ascend the ridge approximately 500 m east of the intersection with Toolijooa Road.

The combination of the ridge terrain and the requirement for high standard road geometry makes tunnelling a viable option. The 'north saddle', through which the Green route passes in tunnel, is a dip in the ridge where the effective width of the ridge is narrowest. This location offers the best opportunity to locate a short tunnel.

Limited preliminary field testing and reference to the Wollongong Geologic Map Sheet, indicates that material encountered in this section of the ridge belongs to the Permian Age Shoalhaven Group, specifically Kiama trachytic tuff with pebbly bands. At greater depth, the material is likely to be Berry formation with siltstones, shales, and sandstones with conglomerate layers. The layer thickness of these materials can be very thick. Both rock types are high strength with widely spaced jointing and are considered suitable for tunnelling.

More extensive field testing is proposed to determine the properties of the rock with a greater degree of certainty. The information provided by field testing will assist in the determination of preference for either the Pink or Green route.

4.6 Ecologically sustainable development

4.6.1 Integrating the principles of ecologically sustainable development

The principles of ecologically sustainable development as defined in the *NSW Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Act Regulation 2000* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* need to be considered during all aspects of the project development including the further development of the preferred option.

As outlined in **Section 1.10**, the principles of ecologically sustainable development defined in the legislation require:

- Decision-making processes to effectively integrate both long-term and short-term environmental, economic, social and equitable considerations.
- Consideration of the precautionary principle.
- Consideration of inter-generational equity.
- Conservation of biological diversity and ecological integrity.
- Improved valuation, pricing and incentive mechanisms to be considered.

The principles of ecologically sustainable development are being considered in the development of the preferred option to achieve the optimum engineering design outcome and the consideration of environmental, social and economic issues in the environmental assessment.

4.7 Property and land-use impacts

4.7.1 Severance of land-uses

Severance of land-use would occur where the preferred option passes through a land holding bisecting the holding into distinct parts (note: this does not include acquisition of land through widening of existing road / rail corridors). The impacts of the severance of land could include (but are not limited to):

- Reduction or elimination of land productivity if commercial activities (agriculture, retail, industrial and the like), due either to the reduction in size of the overall holding or restricting access between the two separated parcels of land (eg for stock access or for crop maintenance).
- Creation of residual lots that, due to their small size or characteristics, have little or no productive use (eg steep land that was otherwise used for grazing and now has limited accessibility).
- Impacts on amenity of dwellings or commercial operation (eg restaurants in rural areas).
- Highway edge effects will be increased, such as to water quality impacts and vehicle emissions, which may be located closer to sensitive land-uses (eg organic farms and vineyards).

The fragmentation of productive agricultural land was considered in the preferred option selection process. It was considered important to preserve agricultural areas for food production and diversification, and to support the dairy industry.

4.7.2 Agricultural land

Classes 1, 2 and 3 apply to lands that are suitable for productive agriculture (horticulture, dairy, vineyards and the like) that, according to the Department of Primary Industries, should be protected from development for non-productive land uses where possible. The selection of the preferred option considered the impacts on land that is identified as suitable for regular cultivation either Class 1, 2 or 3. There is no Class 1 agricultural land in the study area.

4.7.3 Dairy

Fragmentation of productive agricultural land was a key issue for the selection of the preferred option, particularly as the locations of productive farming units identified in this study generally match the locations of Class 2 agricultural land.

Potential mitigation measures for retaining the productivity of dairy farms include (but not limited to) establishing underpasses or overpasses to enable farmers to transfer stock from one paddock to the next. Any over / under pass would require discussions with the landowner to identify the most suitable location and design for the stock route.

It is important to retain access for trucks to dairy farms in the area. Further development of the preferred option will ensure that access to farms is not eliminated through closing of roads or altering of geometry to the extent of restricting truck access without providing an alternative solution.

4.7.4 Vineyards

Where the preferred option passes in close proximity to vineyards, a strip acquisition from these properties may be required. Mitigation measures will be considered where run off and vehicle emissions have the potential to impact on grape growing as well as the amenity of the vineyard for visitors.

4.7.5 Commercial activities

The key economic drivers of access and exposure will be considered in the further development of the preferred option, particularly where the upgrade is located adjacent to, or in the vicinity of, businesses dependent on access to the highway. Mitigation measures would be considered to preserve amenity. The rural aesthetic and landscape heritage values of the study area are important to the identity of the area for residents and visitors. Noise and visual treatments are likely to be required.

4.7.6 Existing residential land uses

Residential land-uses are extremely sensitive to the development / expansion of roads and highways. Impacts include:

- Lifestyle and setting – The rural aesthetic and landscape heritage value is important to the identity of the area for residents and visitors.
- Noise and vibration – The study area is almost entirely rural and semi-rural in nature and rural areas experience low levels of noise, particularly at night. Preserving the amenity of all residences would necessitate noise mitigation during construction and possibly (dependent on the proximity of dwellings to the selected route) during operation.
- Visual impacts – Adequate visual amelioration will be important to preserve the existing character of residential areas.
- Access – Access to all residential properties would be required to remain. Establishing a controlled access highway near residential land-uses would necessitate changes to current accesses.
- Retirement villages – A number of retirement villages are situated on the southern and western periphery of Berry. These land-uses are sensitive to safety and other amenity impacts and should be avoided if possible.
- Existing urban areas in Berry – It is preferable that the preferred option be separated from existing residences in Berry. Mitigation measures will be implemented to preserve amenity (both perceived and actual).

- Existing urban areas in Bomaderry – Established areas of Bomaderry would be unsuitable for development of a new highway alignment due to high number of separate land ownerships and potential impacts on amenity of existing residents. The preferred option is considered the most appropriate route in this vicinity.

4.8 Construction resources and materials

The preferred option avoids most of the floodplains and low lying areas in the study area. Further design development of the preferred option will consider earthworks cut-fill balances to eliminate or reduce the need to either borrow material to cover shortfalls or spoil surplus material and to reduce onsite transportation.

Material from excavations would be variable in quality and the preliminary geotechnical studies have shown that sufficient quantities of material won from excavations should be available and suitable for use in embankments as general fill.

4.8.1 Materials

The construction of the preferred option would require a number of different materials including:

- Earthworks materials.
- Pavement materials.
- Concrete.
- Aggregates for concrete.
- Sand.
- Water.
- Cement.

4.8.2 Sources of construction materials

4.8.2.1 Earthworks

Cut and fill balance is one aspect to be considered in the determination of the order in which sections of the preferred option are to be constructed. Decisions regarding the order in which sections are to be constructed will influence the design of those sections - with the aim of achieving a cut to fill balance in each section. The material in the cuttings is expected to be suitable for fill embankments. Additional fill material is currently available from quarries in Tomerong and Falls Creek, although haulage through Nowra of substantial quantities of material would have an impact on traffic. Other materials such as overburden and fines are currently quarried at Dunmore, Bombo, Bass Point and Albion Park.

4.8.2.2 Pavement materials

Heavily bound or rigid pavements, or a combination of both, may be used on the preferred option. For the main carriageways, an asphalt wearing course over a heavily bound blast furnace slag base, or plain or continuously reinforced concrete pavements are feasible. Heavily bound pavements have been used successfully by RTA previously in the region. Blast furnace slag is readily available from Port Kembla as a by-product of the steel making process.

Binders

Bitumen is currently available from refineries at Clyde and Kurnell. Asphalt may be batched on site if construction stages are of sufficient size to justify significant set up costs.

Cement is currently available from Berrima and Port Kembla. Concrete for road pavements is usually batched on site for rural highway projects.

Base course

Quarries in Dunmore, Bombo and Bass Point may be sources of road base material, concrete aggregates and sand.

Select fill material

The material from cuttings is expected to be high strength sandstone which when crushed would be suitable for the selected material zone which supports the road pavement. Where the proposed alignment corresponds to the existing alignment, there is opportunity for the existing pavement to be reused as select material.

Crushed sandstone suitable for select fill material is currently available at existing quarries such as Hellhole Pit at Falls Creek and Tomerong Quarry.

4.8.2.3 Aggregate

Aggregate for asphalt and concrete is currently available at quarries in Bass Point, Dunmore and Bombo.

4.8.2.4 Sand

Sand is currently available from quarries at Bass Point, Dunmore, and Bombo. Sand quarries are also situated at Mittagong and Kurnell.

4.8.2.5 Water

It is anticipated that water would be sourced from local town supplies, local creeks and water courses. It may also be sourced from sedimentation ponds constructed for the works. Approvals from Department of the Environment and Climate Change and NSW Fisheries would be required before any water is removed from local creeks.

Sydney Water supplies Gerringong from the Gerringong reservoir located at the northern extremity of the study area.

Shoalhaven Water operates a water network in the Shoalhaven Local Government Area. This includes the towns of Berry and Bomaderry. Water is provided to Berry from reservoirs located on Kangaroo Valley Road, approximately 400 m west of the intersection with Bundewallah Road. Water is supplied to Bomaderry from a reservoir located outside the study area.

Table 4.3 Summary of construction materials currently available locally

Material type	Supplier	Location
Fill	Sourced from cutting	Various
Select material	Sourced from cutting or redundant highway pavements Tomerong Quarry Hell Hole Quarry	Various Tomerong Falls Creek
Base and sub-base	Tomerong Quarry Pioneer Boral Hanson Construction Materials Australian Steel Mill Services	Tomerong Shellharbour Dunmore Bass Point Port Kembla
Bitumen	Shell Caltex	Clyde Kurnell
Sand	Rocla Pioneer Boral Hanson Construction Materials Australian Steel Mill Services Dunmore Soil and Sand	Kurnell Mittagong Shellharbour Dunmore Bass Point Port Kembla Dunmore
Aggregate	Pioneer Boral Hanson Construction Materials Australian Steel Mill Services Dunmore Soil and Sand	Shellharbour Dunmore Bass Point Port Kembla Dunmore
Water	Town water Local creeks and water courses Sedimentation ponds	Gerringong, Berry and Bomaderry Various
Cement	Blue Circle Southern Morgan Cement International	Berrima Port Kembla

4.8.3 Haulage of materials and manufactured items

Transport of imported materials would be via the Princes Highway, local roads and potentially the South Coast Railway. Transport of fill materials should be by scrapers for short hauls and semi-trailers or haulage trucks with trailers for longer hauls. Large off-road earth moving equipment can be used where the preferred option is remote from the existing highway alignment.

4.8.4 Effect on depletion of resources

Balancing cut and fill would reduce the resources required for the project. The principles of ecologically sustainable development require that all resources are used as effectively as possible. This includes re-using materials on site eg rock and redundant sections of the existing pavement and using bi-products from other industry eg fly ash and slag.

4.8.5 Batching plants

Batching plants for asphalt and concrete could be required. These would be operated under separate environmental approvals and located at least 40 m from any water-course and outside any sensitive areas.

4.8.6 Ownership and planning approvals

Existing licensed quarries have planning approval from the relevant local government agency. Any new quarries or new asphalt or concrete batch plants would be assessed as part of the environmental assessment for the preferred route.

5.0 Preferred options selection process

5.1 Options development process

The identification of a preferred option has been carried out in line with a generally recognised route options development and selection process. Following the development of a comprehensive set of project objectives (detailed in **Section 1.4**) the route options development process included:

- Identification of physical, environmental and social constraints.
- Qualitative assessment of a long-list of potentially feasible options.
- Rejection of any option which is fundamentally flawed.
- Comparison of the performance of the remaining short-list of options against a defined benchmark.
- Identification of the best performing option.

The development of the options from a long to a short-list was based on a qualitative and quantitative assessment of the relative impacts of each option and followed four defined phases:

- Determination of a long-list of options.
- Preparatory assessments.
- Route options development workshop.
- Public exhibition of a determined short-list of options for community feedback.

5.2 Phase I: Determination of a long-list of options

Work has been carried out since 1990 on developing route options for this study area. A study was carried out in 2004 and 2005 using a computer software package called QUANTM. This study recommended a number of feasible corridor for further analysis. This was a desk top study primarily based on topography and engineering principles. Fauna/flora, heritage, utilities, visual amenity, noise, social and economic impacts were only given some consideration where they were obvious.

This current study has used the previous assessments as the basis for potential feasible routes from Gerringong to Bomaderry. The route options development process applied up-to-date field work and other analyses to these potentially feasible corridors. The corridors identified by the QUANTM study underwent a critical analysis to assess whether any of the routes within these corridors were fundamentally flawed and/or if there were any other potentially favourable solutions which should be assessed. The latter was carried out by applying rudimentary engineering and route selection principles[8]. It was determined at this stage that none of the previously considered routes should be ruled out due to basic flaws. Flaws could include crossing areas of sensitive ecology and heritage items, impacting on land already zoned for other uses; and having a significant negative impact on the economic viability of land-use.

In addition to previously considered options, additional routes were identified by the project team and included in the 'long-list' of route options which were then assessed. The long-list of route options is shown on **Figure 5.1**.

5.3 Phase 2: Preparatory assessments

The long-list of route options developed in Phase 1 was independently assessed by technical specialists in the project team in their area of expertise prior to the route options development workshop (see below). Each specialist was required to undertake preparatory assessments of the routes to identify potential impacts beforehand, maximising the efficiency of the workshop. This assessment was carried out subsequent to preliminary constraints assessment in the study area for each discipline. The preparatory assessments included:

- Assessment against the project objectives (this involved a detailed assessment of the routes against the objectives and the constraints).
- Identification of preliminary 'negotiable' and 'non-negotiable' issues[9].
- Identification of preliminary discards of route options.
- Identification of preliminary route preferences.

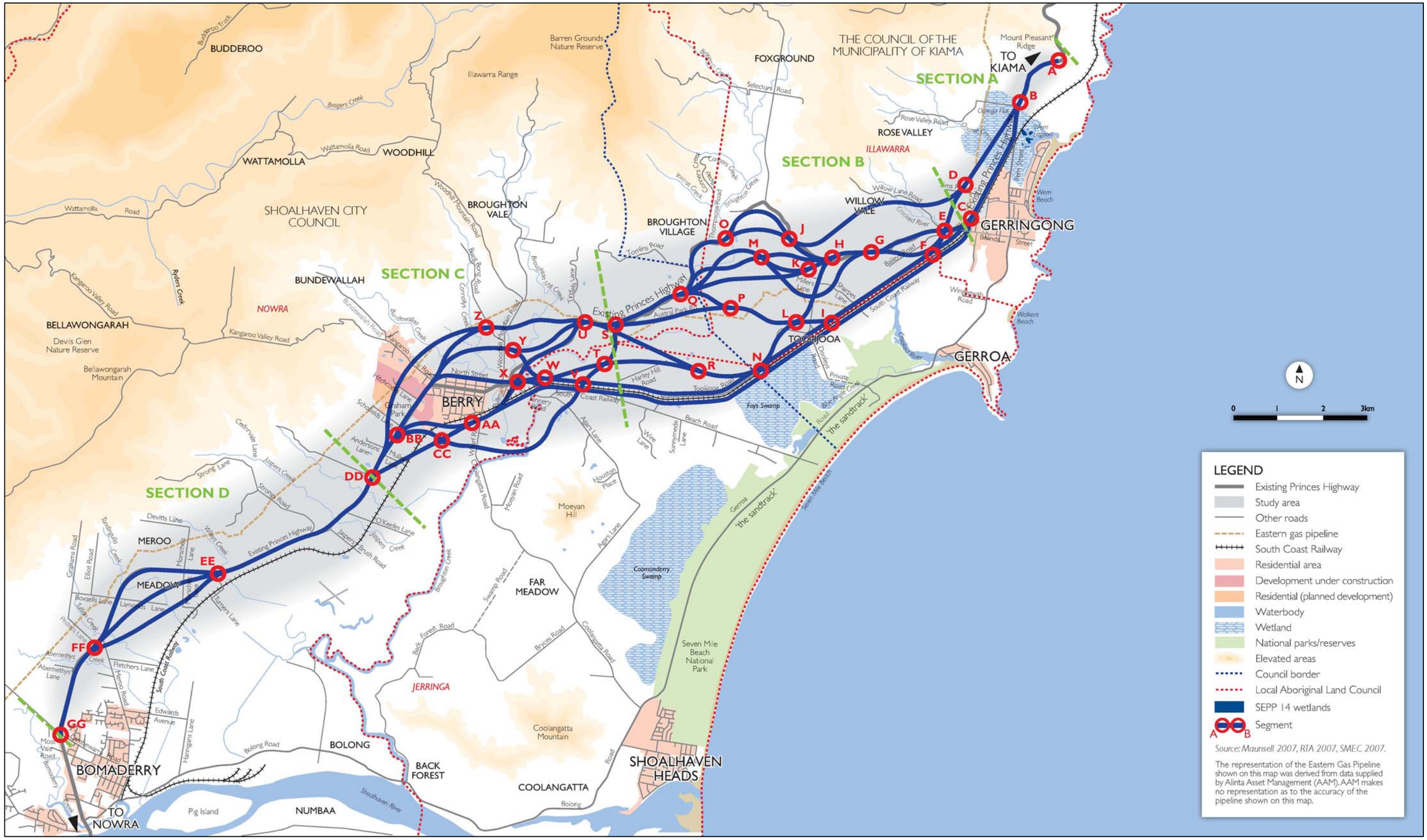
The specialist investigations categories comprised:

- Community / input.
- Urban and visual landscape.
- Alignment, staging and access.
- Social-economic.
- Water quality and aquatic ecology.
- Flooding and drainage.
- Indigenous and non-Indigenous heritage.
- Air quality.
- Climate.
- Utilities.
- Statutory planning and zoning.
- Land-use.
- Noise and vibration.
- Terrestrial ecology.
- Ground conditions.
- Cost.
- Sustainability.
- Traffic.

[8] The rudimentary engineering and route selection principles include: applying conforming road geometry; balancing earthwork quantities; limiting the size of cuts and fills; providing perpendicular bridge and structure crossings; and avoiding poor ground conditions.

[9] Non-negotiable is the term applied to critical factors which categorically discount a route from further assessment.

Figure 5.1 Long-list of route options



5.4 Phase 3: Route options development workshop

A route options development workshop was conducted following the preparatory assessments in order to facilitate the assessment and short-listing of feasible routes. The workshop was carried out over several days and attendees included key project team members from Maunsell and the RTA and specialists representing each of the categories above.

At the workshop, the specialists summarised their preparatory work which included:

- An explanation of the category.
- An explanation of features of a route which would be beneficial and undesirable relative to that category.
- A preliminary assessment of what are the critical issues ie those which fundamentally influence the choice of route.
- An explanation of the study area relative to that category.
- General findings of the long-list of routes.
- Specific findings, analysis, assessment and initial preferences.
- Each specialist also considered additional routes which may or may not have been presented for assessment.
- Identification of non-negotiable issues which discarded a route from further analysis.

The workshop provided an opportunity for participants to appreciate issues arising from other specialist categories resulting in a balanced assessment between specialist areas and issues.

Due to the number and complexity of the long-list of routes, and to facilitate the assessment of the options, the study area was split into four geographical areas:

- Section A - Mount Pleasant to south Gerringong.
- Section B - south Gerringong to north Berry.
- Section C - Berry Township.
- Section D - south Berry to Bomaderry.

Some route options straddle Sections B and C. These were grouped as 'Section B/C'.

The route within each of the above areas were assessed in turn to determine how they met the project objectives. This included identification of routes which failed to meet critical objectives and were therefore discarded. This was done by assessing the routes against a theoretical 'base case'. The base case was defined as the upgrade of the existing road to two lanes in each direction and conforming geometry ie to desirable minimum horizontal and vertical alignment and conforming cross section (this assumed the provision of a service road where necessary to fulfil controlled access objectives). Section B/C was assessed against the base case for Sections B and C combined.

A simple comparison exercise was performed for every route comparing on a scale how well, 'relative to the base case', the route meets the project objectives.

The scale was as follows:

5	significantly better
4	moderately better
3	no better / no worse
2	moderately worse
1	significantly worse
0	non-negotiable = > discard

For each objective, combinations of specialist categories were applicable ie a route may have attracted a different outcome for each specialist category for a specific objective. The workshop process included debate on each of these scenarios and determined a collective result.

An initial workshop was held over three days, which produced a provisional short-list of options and identified issues which required further detailed analysis. A one day 'validation' workshop was held with the same attendees to closer examine the provisional short-list and review the findings of the additional analysis. The validation workshop added one and removed one option from the provisional short-list. The RTA reviewed this list and moved one of the discarded options back into the short-listed options for display to the public.

The key issues and the outcomes of the workshop process were collated and documented in the *Route Options Development Report (November 2007)*. Critical factors affecting the assessments are shown on **Figure 5.2**. Comparative performance of each of the routes was carried out using the results of the assessment against the base case.

Table 5.1 presents a summary of the workshop process findings. The first category of routes taken forward to the short-listing stage comprised those which best met the objectives of the project. Routes not taken forward comprise those which performed poorly on balance (relative to the other routes compared in each section). Discarded routes comprise those which had one or more critical issues or flaws, rendering these options prohibitive to construct.

Figure 5.2 Critical factors affecting the route options

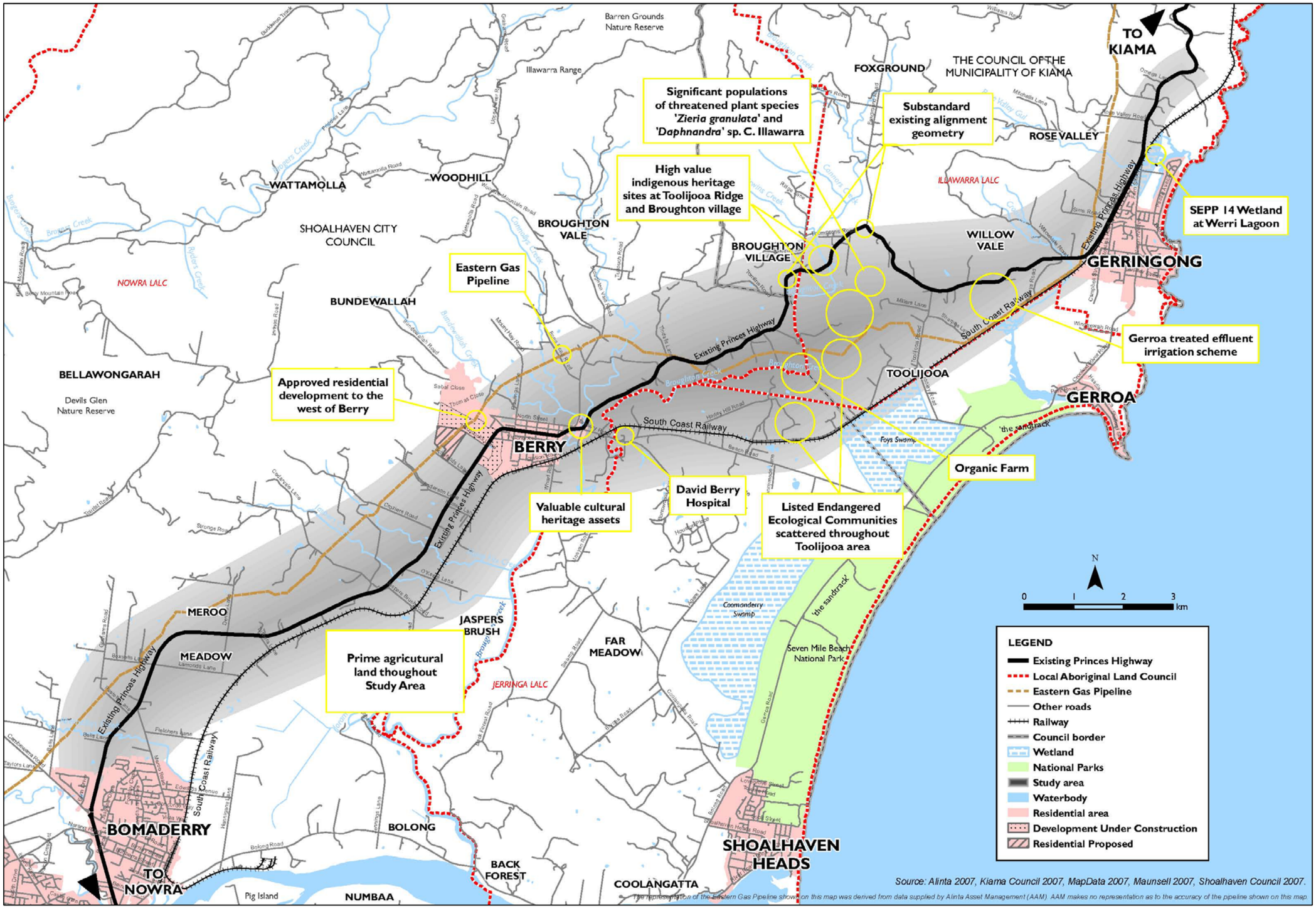


Table 5.1 Summary of workshop process findings

Short-list of routes	Combined score	Presentation name
Section A		
A-B-C	18	Red
Section B		
C-E-G-H-K-M-Q-S	20	Green
C-E-G-H-J-O-Q-S	18	Pink
C-F-I-tunnel-P-Q-S (west)	18	Yellow
Section C		
S-U-Z_2-BB-DD	23	Blue
S-U-X-N. Str.-BB-DD	26	Orange
Section B/C		
C-F-I-N-V-W-X-N. Str.-BB-DD (west)	16	Brown
Section D		
DD-EE_1-FF-GG	18	Purple

Routes not taken forward	Combined score
Section A	
A-B-D	11
Section B	
C-F-I-N-R-S (west)	17
C-E-G-H-L-N-R-S	14
C-E-G-H-L-N-R-S	16
C-E-G-H-K-Q-S	17
Section C	
S-U-Y-BB-DD	20
S-T-W-Y-BB-DD	14
S-T-W-X-N. Str.-BB-DD	16
S-U-X-AA-BB-DD	18
S-U-X-AA-CC-DD	18
S-T-V-CC-BB-DD	16
S-T-V-CC-DD	15
S-T-V-AA-CC-BB-DD	15
Section B/C	
C-F-I-N-R-T-W-X-N. Str.-BB-DD (west)	16
Section D	
DD-EE_2-FF-GG	14
DD-EE_3-FF-GG	14

Routes discarded
Section B
C-F-I-N-R-S (east)
C-F-I-L-P-S
C-E-G-H-L-P-Q-S
C-E-G-H-M-Q-S
C-E-G-M-Q-S
C-E-G-H-K-M-Q-S
D-J-O-Q-S
C-F-I-tunnel-P-Q-S (east)
Section C
S-U-Z_1-DD
Section B/C
C-F-I-N-V-W-X-N. Str.-BB-DD (east)
C-F-I-N-V-W-X-AA-CC-DD (east)
C-F-I-N-V-CC-DD (east)

5.5 Description of short-listed options

The seven short-listed options were formed along the entire study area by combining different routes from each of the sections. The short-listed options are shown in **Figure 5.3**.

Section A - Mount Pleasant to south Gerringong

One route was short-listed for Section A. The Red route follows the existing highway alignment subject to relatively minor adjustments to meet the required design and safety parameters. This route is common to all options.

Section B - south Gerringong to north Berry

Three routes emerged as being better than others within Section B.

The Pink route generally follows the existing highway alignment except for the section past Foxground. The existing highway alignment is particularly poor in this location and has to be improved to meet the required design and safety parameters.

The Green route is the same as the Pink route apart from the section between Toolijooa Road and Austral Park Road. The Green route follows a more direct alignment and passes under the Toolijooa ridge 'north saddle' in a 350 m long tunnel.

The Yellow route follows an alignment parallel to the South Coast railway line until just past the dwellings at Toolijooa. The route then turns to follow a north-west alignment. It passes under the Toolijooa ridge 'south saddle' in a 350 m long tunnel before meeting and following the existing highway corridor at Austral Park Road for the remainder of Section B.

Section C - Berry Township

Two routes emerged as being better than others within Section C.

The Blue route follows a circular arc from Tindalls Lane, bypassing Berry in the north and passing close to the western edge of the main town at Kangaroo Valley Road. The Blue route then follows the existing highway alignment until the southern end of the section at Croziers Road.

The Orange route[10] provides an upgrade of the existing highway alignment north of Berry and then follows the North Street corridor as it bypasses Berry. North Street itself would remain a local road. Shortly before the western end of North Street, the route turns to the south, crossing Kangaroo Valley Road and following the existing highway until the southern end of the section at Croziers Road.

Section B/C – south Gerringong to south Berry

The Brown route traverses Sections B and C and runs along the western side of the railway line from south of Gerringong to the north of Berry. It heads westwards from the David Berry Hospital and crosses the existing highway, Broughton Mill Creek and Woodhill Mountain Road. It then continues along the North Street corridor. Shortly before the western end of North Street, the route turns to the south, crossing Kangaroo Valley Road and following the existing highway until the southern end of the section at Croziers Road. North Street would remain a local road.

Section D - south Berry to Bomaderry

One route was short-listed for Section D. The Purple route follows the existing highway alignment from Croziers Road to its junction with Cambewarra and Moss Vale Roads at Bomaderry, subject to relatively minor adjustments to meet the required design and safety parameters. This route is common to all options.

[10] A modified Orange route was also examined at a later stage. This is further discussed in Chapter 7.0.

Figure 5.3 Short-listed options

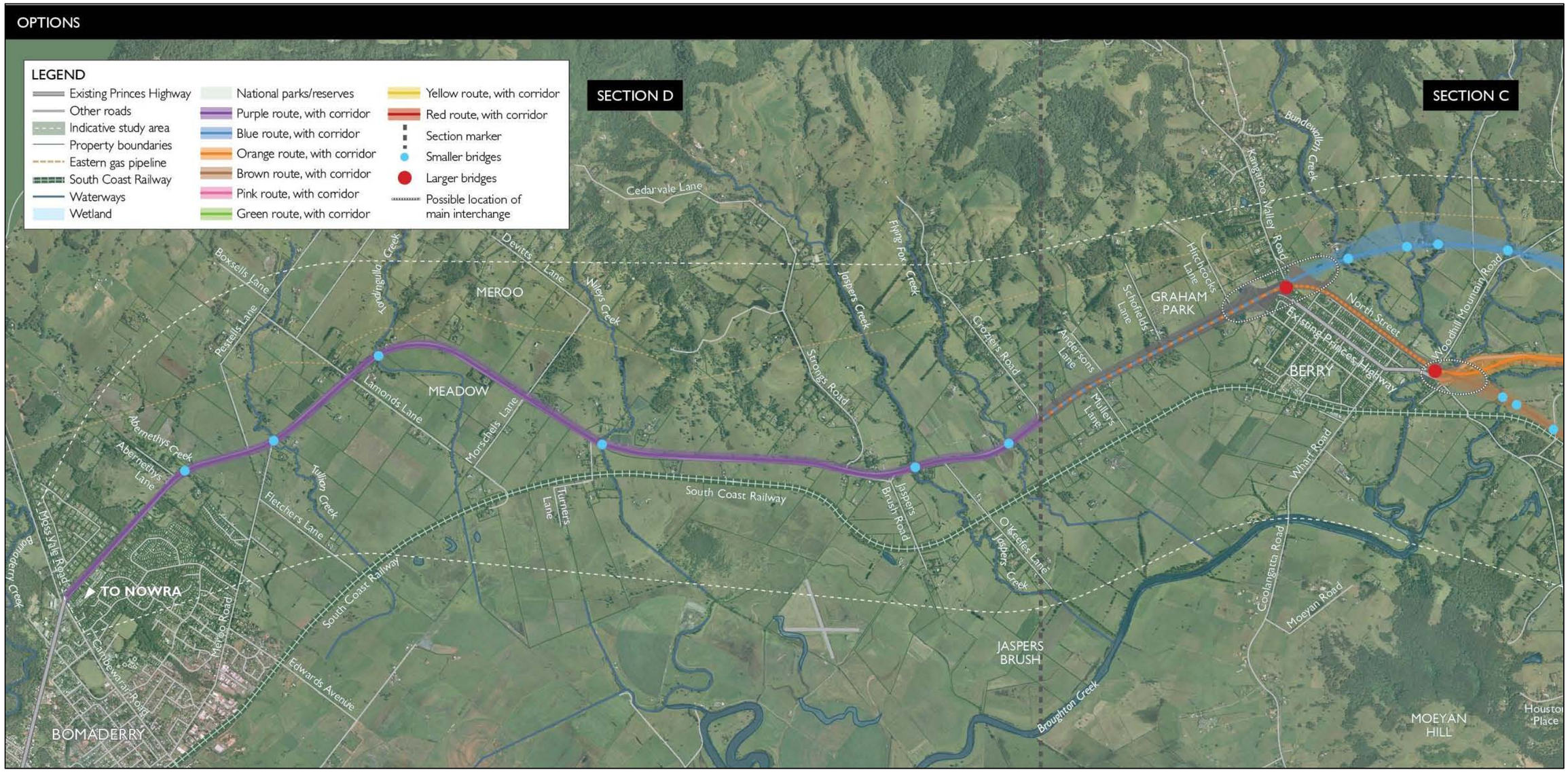
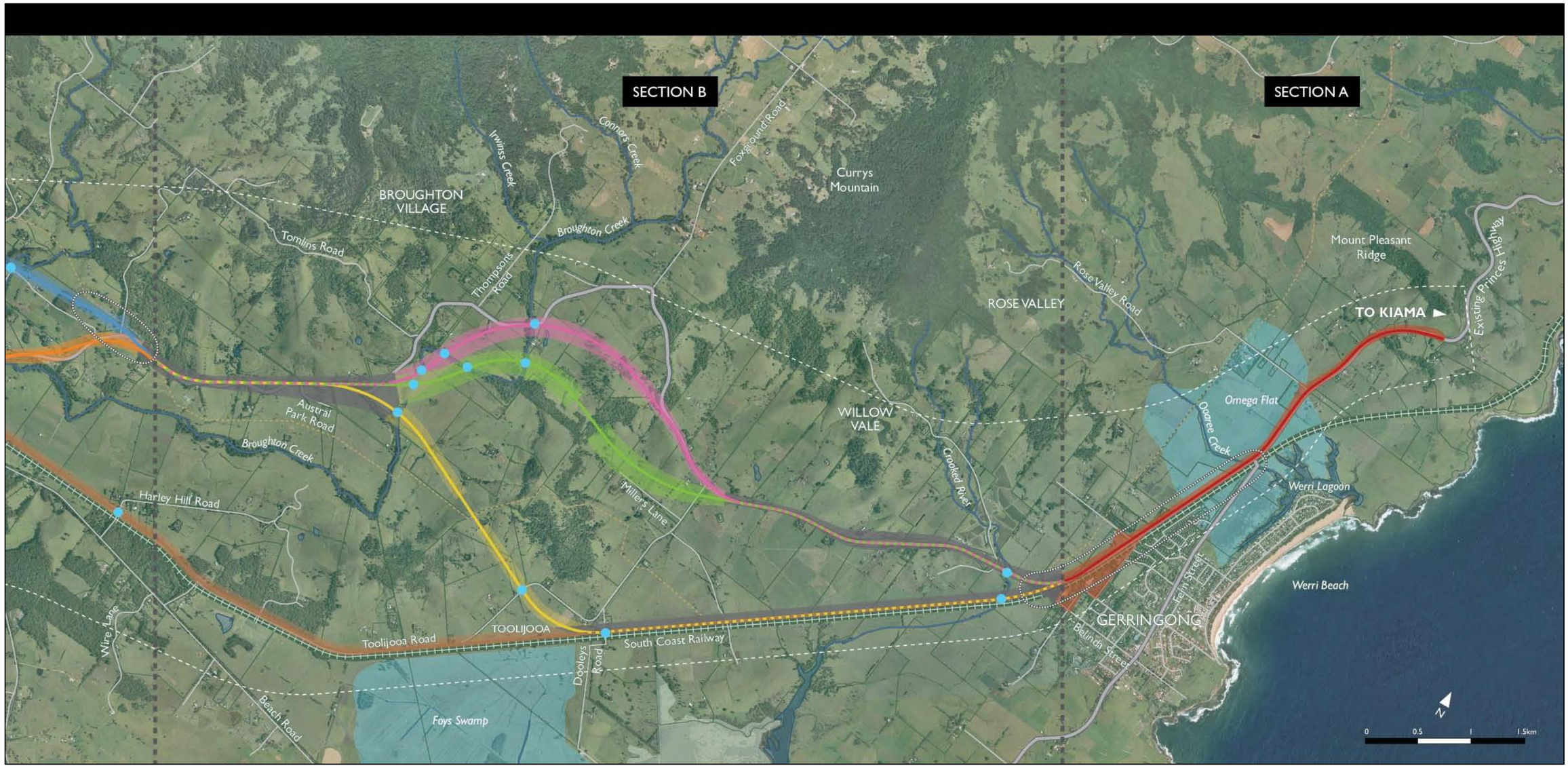


Figure 5.3 Short-listed options cont'd



5.6 Summary

Combinations of the Pink, Green and Yellow routes from Section B, with the Blue and Orange routes from Section C formed six of the short-listed options. The Brown route traversing Sections B and C provided a seventh option.

The seven short-listed options were publicly displayed between 26 November 2007 and 29 February 2008 for community feedback. Following the *RTA's Community Involvement and Practice Notes and Resources Manual (July 1998)* and principles established with the local community in 2006, the consultation program focused on involving the community and stakeholders in information gathering and understanding of the options and the potential impacts, constraints and opportunities presented by these options. Consultation at this time included a diverse range of information resources, workshops and interviews to increase participation. **Chapter 6** outlines the consultation activities and outcomes in more detail.

The technical studies carried out on the seven options together with the community feedback were considered at the route options value management workshop. The findings as presented in **Chapter 7**.

5.7 Peer review process

Following the display period, an independent peer review of the route options selection process was completed in April 2008 in response to concerns from some community members that the short-listed options did not include a route to the south of Berry.

The peer review concluded that the route options selection process undertaken by the project team was well founded and consistent with good practice following all steps required to complete a comprehensive assessment of each route, including community consultation, stakeholder workshops and detailed specialist advice.

The review also recommended more detailed cost estimates of the routes to the south of Berry be undertaken to confirm whether or not these routes were feasible when considered as part of an overall option from Gerringong to Bomaderry. These routes to the south of Berry had previously been eliminated after initial investigations found they were not cost effective when evaluated against other possible routes around Berry.

The recommended additional cost estimates were prepared and confirmed that a route to the south of Berry is not cost effective, even when considered as part of an overall option. This validated the findings of the route options development process and a route to the south of Berry was not carried forward. **Table 5.2** presents the results of the additional cost comparisons.

In summary, when combined with the Brown route, the southern Berry bypass routes are between 1.2 and 1.5 times more expensive than the Brown route and they perform no better than the worst performing short-listed route combination (Yellow and Blue).[+]

[+] Correction – The media release advising southern route cost analysis results, issued on 4 July 2008, contained an error in ratio figures. The ratio figures presented in **Table 5.2** are accurate.

Table 5.2 Peer review of the cost estimates

Route	Level 2 Estimate	Level 3 estimate	
	Estimate ratios relative to the Brown route for provisionally short-listed options and southern Berry bypass options	Estimates and ratios relatives to the Brown route for final short-listed options and southern Berry bypass options	
	Ratio	Ratio	$million
Brown and outer Berry southern bypass	1.4*	1.5*	647*
Brown and inner Berry southern bypass	1.3*	1.3*	544*
Yellow and blue**	1.2	1.3	545
Green and modified Orange***	1	1.1	495
Brown	1	1	435
	• This level of estimate is appropriate when verifying the feasibility and affordability of routes at the preliminary concept design stage as reported in the *Route Options Development Report, Appendix A*. • Based on broad assessment of quantities. • Contains no contingency or planning and development cost.	• Most current estimate. • Based on more refined preliminary concept design. • Considers refined design, quantities and probabilistic assessment of risk and contingency. • Contains planning and development costs.	

* Cost estimates for the inner and outer southern bypass routes have been determined consistent with the preparation of estimates used for the review of provisionally short-listed options (refer column 1). Indicative more refined cost estimates for the inner and outer southern bypass routes have been based on routes with similar attributes and features consistent with the approach used to develop estimates for option comparisons (refer column 2).

** Worst performing and highest cost combination from Sections B and C – considering functional, environmental, socio-economic and value for money performance.

*** Best performing combination from Sections B and C – considering functional, environmental, socio-economic and value for money performance.

6.0 Community and stakeholder engagement

6.1 Consultation program overview

The RTA considers a meaningful and engaging community consultation program as an essential component of the Gerringong to Bomaderry Princess Highway upgrade.

The project's consultation program has been prepared in accordance with the *RTA's Community Involvement and Practice Notes and Resource Manual (July 1998)* and recognises the *RTA's Community Involvement Policy*. Approximately 14,000 people reside or own property in the study area. The program has been designed to inform and engage the whole community in a constructive, transparent and fair process during each stage of the project.

The consultation program has been designed to establish two way communications with the community and stakeholders throughout the preferred option selection and approvals process. At each stage of the project the consultation activities proactively inform the community and stakeholders with the aim of increasing public understanding of the project and participation in consultation activities. This ensures the project benefits from the input of local knowledge and priorities and the project team gains greater insight into issues, potential mitigation strategies and opportunities to improve project outcomes.

An overview of the consultation program is detailed below:

- Commencing in March 2006, the RTA initiated the first stage of consultation by issuing the first community update, announcing the commencement of the project and expressing its desire to involve the community in the options and route selection study process.
- In May 2006 and in preparation for the letting of the contract for the study, the RTA conducted the first workshops and displays. These was focused on working with the community and stakeholders to establish a set of principles to guide the consultation process and the selection of communication tools. The consultation also identified local priorities for the project and what was valued by the community in the study area. The results are documented in the *Community Consultation Report (2006)*.
- In 2007 the consultation program focused on informing community and stakeholders about the route options investigations and gathering community input as to the constraints and opportunities in the study area. Consultation conducted as part of the route options selection study included community information sessions in February 2007, interest group workshops in April 2007 and specialist information sessions in August 2007. These activities enabled the project team to consider community and stakeholder perspectives in the development and assessment of the long-list of options and selection of the short-list of options as documented in the *Route Options Development Report (November 2007)*.
- A preliminary social-economic impact assessment, completed as part of the *Route Options Development Report (November 2007)*, also provides important background information about the demographics and social and economic context of the study area. This study was considered in the selection of short-listed feasible options and is documented in *Appendix F* of the *Route Options Development Report (November 2007)*.
- In late November 2007 the project launched a three month display of seven short-listed options for public comment. Following guidelines established in 2006, the consultation program focused on involving the community and stakeholders in information gathering and understanding of the options and the potential impacts, constraints and opportunities presented by these options. Consultation at this time included a diverse range of information resources, workshops and interviews to increase participation.
- Communication tools such as staffed and static displays and the 24 page options display brochure aimed to support the community's opportunity to be well informed. The brochure used graphics and plain English text to the fullest extent to increase readership and effective communication to the broad community.

6.1.1 Consultation program objectives

The consultation program aims to provide optimum opportunities for community and stakeholder involvement. Program objectives are to:

- Support and maintain the current RTA community involvement process.
- Ensure an open, accountable and transparent community involvement process.
- Ensure all potentially directly affected property owners and interested stakeholders are provided with sufficient information about the project and the likely impacts so that they can provide informed input.
- Ensure appropriate and direct communication with property owners in relation to access to and investigations on landholdings within the study area by study team members.
- Encourage community support and involvement in the project to facilitate better and more generally accepted outcomes through innovative communication methods.
- Provide a range of accessible opportunities for stakeholders, interested groups and the wider public to contribute to the project through issues identification, information provision and options evaluation.
- Build an ongoing relationship between the RTA, its contractors and stakeholders in order to gain long-term support for the project and in particular the preferred option.

6.1.2 Consultation program tools

The following list provides a summary of the communication and consultation tools established for use across the life of the project. The selection and design of these tools was guided by consultation with the community in the initial the May 2006 workshops. Use of these tools has been tailored to meet the specific needs of each stage of the project.

The key tools used in the consultation program included:

- Permanent shop front information at the project office located at Broughton Court 3/113 Queen Street, Berry.
- Toll free community information contact line (1800 506 976).
- Project website www.rta.nsw.gov.au > Construction and maintenance > Regional maintenance > Southern > Princes Highway upgrade: Gerringong to Bomaderry.
- Dedicated project e-mail address Gerringong_to_Bomaderry@maunsell.com.
- Project database to record all correspondence relevant to the project, including contact details and issues raised during the life of the project.
- Quarterly community update newsletters or correspondence.
- Community information sessions and public workshops.
- Targeted focus group workshops.
- Interest group meetings.
- Face-to-face meetings with individuals / proprietors of potentially directly affected properties and businesses.
- Involvement of community participants in value management workshops.

- Information displays (staffed and un-staffed).
- Advertisements in the local press.
- Mail-outs (addressed and un-addressed).
- Community feedback forms.
- Acceptance of written submissions.

6.2 Community and Stakeholder engagement activities

A range of consultation activities have been undertaken during the project familiarisation, route options development and options display phases. These activities are summarised in the following section.

6.2.1 Activities during the project familiarisation and route options development phase

Key community engagement activities conducted during the project familiarisation and route options development phases comprised:

- The distribution of community updates in March 2006, September 2006, January 2007, April 2007, July 2007 and November 2007.
- Workshops and information stands in May 2006.
- A planning focus meeting with representatives from various agencies and stakeholder groups in September 2006.
- Property access letters for field investigations sent in January 2007.
- Community information sessions in February 2007.
- An interest group workshop in April 2007.
- Individual meetings with local councils, local Aboriginal representatives, Chambers of Commerce, and other local interest groups.
- Specialist information sessions in August 2007.
- A project office was opened in Berry in July 2007.
- Establishment of a 1800 free call number.
- Establishment of a project email address.
- Establishment of a project web page.

6.2.2 Activities undertaken during the options display period

The following list summarises consultation activities conducted during the route options display period conducted between 26 November 2007 and 29 February 2008.

Pre Christmas period – Monday 26 November to Friday 21 December 2007:

- Courtesy phone contact with potentially directly affected landowners one day prior to the public announcement of short-listed options.
- Media announcement of short-listed options.
- Community update booklet distributed to more than 11,000 properties in the study area.
- Individual meetings with potentially directly affected landowners.
- Group meetings with potentially directly affected landowners.
- Berry project office staffed with project team members and displaying a topographical model of the study area and options. The office was open to all community members from Monday, 26 November to Friday, 21 December 2007 where the community could access information and discuss the project.
- Static displays at: Shoalhaven City Council, Kiama Fair and Nowra Fair through to 29 February 2008.

Post Christmas period - Monday 7 January to Friday 29 February 2008

- Continued individual meetings with potentially directly affected landowners and other community members.
- Berry project office staffed with project team members open each Thursday and Friday where the community could access information and discuss the project.
- Staffed displays at Kiama Fair and Nowra Fair shopping centres on 31 January 2008.
- February 2008 information sessions at Gerringong (2 February – Gerringong Town Hall), Berry (9 February – Berry School of Arts) and Bomaderry (16 February – Bomaderry Community Hall). Each information session was held from 10 am – 3 pm. Information sessions included provision of 3-D animated drive throughs of each option and route.
- Five workshops were held in late February 2008 to specifically examine each of the following areas: agriculture, environment and heritage, business and community / social considerations. Community members were invited to register their interest in workshops by phoning the project information line.

6.3 Collection of community feedback

During the route options display period the consultation program used a range of methods to collect feedback with the aim of making participation more accessible for a range of community members.

Community members and stakeholders were able to provide feedback through the following channels:

- Interviews – with potentially directly affected property owners and other community members.
- A structured feedback form.
- Written submissions – in all interactions the project team encouraged community members to contribute their views in a range of ways including email, facsimile, letter or other written format.

Consultation resulted in a high level of community participation and the project's receipt of 996 submissions. Approximately 15,000 community updates were distributed across the study area during the options display period, and approximately 3500 people made contact with the project. Contact was made by calling the community information line or visiting the staffed displays, project office, community information sessions, interviews and forums. Community members and stakeholders were able to share their knowledge of the area and discuss ideas and concerns about the project including specific issues relating to their properties as well as broader community issues.

A summary of contact between the project and community members / stakeholders during the display period is presented in **Table 6.1**.

Table 6.1 Communications with the community and stakeholders during the display period

Communications method	Incoming	Outgoing
Project information line (1800 506 976)	275	233
Letters	162	198
E-mails	66	29
Faxes	3	3
Route Options Development Report	16	16
Website hits	2100+	-
Petitions	2	-
Visits to staffed displays	400+	-
Visits to project office	3000+	-
Interviews	214	-
Potentially directly affected property owner forums	80+	
Targeted focus group workshops	53 attendees	-

6.3.1 Submissions received

The options were displayed for public comment from Monday 26 November 2007 until Friday 29 February 2008. A total of 996 submissions were received in respect to the options. **Table 6.2** provides a break-down of submission per correspondence type.

Table 6.2 Total number and format of submissions received

Submission	Number
Written submissions (includes emails, letters, faxes and written documents.)	242
Interviews	208
Feedback forms	546
Total	**996**

While the majority of submissions were received from within the study area a number of submissions were also received from other geographical areas.

6.3.2 Methodology for submission analysis

The project team has prepared a *Submissions Report (October 2008)* documenting all the issues and comments raised by the community and stakeholders in the 996 submissions received. This report provides a response to each issue and is available on the project website at www.rta.nsw.gov.au > Construction and maintenance > Regional maintenance > Southern > Princes Highway upgrade: Gerringong to Bomaderry.

Submission data was recorded in a custom built database which allows sorting by issues, sub-categories, routes and options. All submissions have been reviewed in detail, with the issues raised and contact details recorded in the submissions database. Submission data has been reviewed by the project team to check the range of issues and perspectives on constraints and opportunities has been considered in conjunction with completed technical studies.

From the 996 submissions received, over 4000 separate issues were recorded. These issues were categorised by topic, to allow similar issues to be grouped together. All of the issues were allocated to one of the five following categories:

- Functional (highway engineering and design).
- Environment.
- Economic.
- Social.
- Process.

The submissions data base provided each of the above five categories with in excess of 20 sub-categories which were used to accurately sort and consolidate issues. This allowed like issues to be grouped together and be addressed consistently.

Specific issues were referred to the appropriate technical project team member for a co-ordinated response. This process enabled all questions relating to a specific issue to be addressed by the relevant team member with the appropriate expertise.

Each submission has been assigned a unique stakeholder identification number to allow issues to be tracked. This unique stakeholder number is confidential and will be provided to the author of the submission. Where numerous submissions were received from the same community member, one stakeholder identification number has been assigned to that community member. Where submissions have been made anonymously they have all been assigned the same stakeholder identification number:

6.3.2.1 Synopsis of community values and challenges

The following provides a summary of key issues raised in submissions.

Functional issues

When discussing functional (design and engineering) issues submissions explored topics related to the appropriate provision of access on and off the highway, into and between properties and to towns, during both the construction and operational phases of the highway upgrade. Submissions also highlighted the need for the preferred option to address road safety for vehicles, pedestrians and cyclists. A high number of submissions also suggested that the preferred option selection closely examine the potential to use the existing highway to minimise impacts to new area's and agricultural land, together with the possibility of retaining the existing highway as a 'slow road' for tourism and local access. Submissions also raised the need to avoid or minimise impacts on clusters of existing residential development and community cohesion.

Environmental issues

A high number of submissions requested that the design responds to the area's environmental values and assets in an appropriate and sensitive manner. Specifically the submissions highlighted the need for the flora and fauna and biodiversity values of the region to be protected. Many specific environmental features were referenced including the maintenance of wildlife corridors, wetlands, water bodies, endangered ecological communities. Many submissions also reinforced the need to carefully consider the flooding characteristics and history of the region so that this information can be assessed in the preferred option selection. A dominant issue raised in a majority of submissions has been the potential for noise and visual impacts to rural and residential properties, towns and environmental features including the escarpment and regional views and amenity.

Social issues

The majority of submissions clearly stated the importance of protecting the village character and heritage of the region, the townships and the communities within the study area. This includes ensuring the community cohesion, networks and support which currently exists within these communities is not compromised by selection of a preferred route. Submissions also raised serious concerns over property values affected by the highway upgrade. Submissions reference personal stress, the importance of communicating clear project timeframes, fair property acquisition and effective impact mitigation.

Economic issues

Submissions reflect a high awareness and concern for maintaining the economic viability of the region through business, agriculture and tourism industries. A large number of submissions reinforced the need for any highway upgrade to support tourism within the region. Some submissions viewed the highway upgrade as an opportunity to promote the region's tourism initiatives and strategy. Appropriate access and interchanges for Gerringong and Berry are considered important to business sector performance. Many submissions raised concerns over the potential impact to individual farm and agricultural sector viability. Fragmentation of agriculture land, access arrangements and property acquisition are seen as key considerations. Broadly submissions view the area's natural and rural environmental values as key economic assets which need to be protected.

Process issues

Submissions included a range of comments regarding the project's route options development process. Some submissions debated the relative merits of including alternate routes, such as an option south of Berry. Many submissions referenced the importance of a timely resolution of the preferred option selection and project delivery timeframes. In addition submissions also reinforced the importance of transparency in the selection process and the high value of ongoing community and stakeholder consultation in each stage of the project. A small number of submissions extended discussion of process issues by questioning the appropriateness of comparing options at this stage of the project in the absence of detailed environmental assessments of each option.

6.4 Value management workshop

A value management workshop was held for the upgrade on 14, 15 and 16 May 2008.

Community and stakeholder input was an important consideration during the value management workshop. Participants of the value management workshop were presented with a summary of the values, priorities and issues which have been raised by the community for considerations during the options display period. The value management workshop developed assessment criteria and considered each option's functional (engineering and design), environmental, social and economic constraints and opportunities.

Community input was presented for consideration at the workshop through the *Value Management Workshop Background Paper (May 2008)* and presentations which are documented in the *Value Management Workshop Report (May 2008)*. The background paper and presentations summarised the initial analysis of the submissions received in response to the options display. Stage one analysis of submissions included the review of each submission, identifying and categorising issues raised about the project, options and routes.

For verification these trends were compared with outcomes from five community and stakeholder workshops conducted during the options display. As a further check for consistency these trends were also compared with outcomes from earlier stages of the project's consultation program completed in 2006 and 2007. These comparisons found consistency and therefore the summary of trends prepared for the value management workshop was considered a reliable reflection of the range of community perspectives.

6.5 Conclusion

The RTA considers a meaningful and engaging community consultation program as an essential component of the upgrade. The project's consultation program aims to inform and engage the whole community in a constructive, transparent and fair process. It encourages public participation at each stage of the project including the preferred option selection and the environmental assessment and concept design planned to commence in 2009.

Consultation activities undertaken for the options display included community information sessions, workshops, forums, the project office and interviews. These provided community members with direct access to project team members and a range of opportunities to discuss the project in a supportive environment. Events aimed to share an understanding of the opportunities and considerations of each option. Discussions explored all functional, environmental social and economic constraints and considered individual properties, localised areas, townships and the greater region.

The opportunity to participate in the consultation process has been embraced by community members, organisations, government agencies and other stakeholders, as represented by the large number of submissions received during the options display period.

The project team greatly appreciates the contribution community members have made through their involvement – expressing their views and exploring all issues and aspects of the process. Public participation plays an important role in achieving the best outcome for the whole community.

7.0 Value management process

7.1 Introduction

A three day value management workshop was held on 14, 15, and 16 May 2008. The purpose of this workshop was to bring together a wide range of stakeholder interests and expertise to review the outcomes of the investigations undertaken to date and, on the balance of issues and consideration of the options against agreed assessment criteria, to recommend a direction for further investigation to progress the project's development.

The value management workshop is one input into the process of determining the preferred route for the project. The other inputs comprise the technical studies and community and stakeholder feedback.

The workshop objectives were:

- Clarify the objectives of the project.
- Examine the short-listed options developed to meet the project objectives.
- Recommend a preferred direction to the RTA to progress the project.

An independent facilitator from the Australian Centre for Value Management (ACVM) chaired the workshop. A copy of the *Value Management Workshop Report (Australian Centre for Value Management, May 2008)* can be viewed on the project website at: www.rta.nsw.gov.au > Construction and maintenance > Regional maintenance > Southern > Princes Highway upgrade: Gerringong to Bomaderry.

7.2 Workshop activities

The workshop process builds on the various perspectives of the workshop participants and on the detailed and specialist knowledge of each. The workshop included representatives from:

- Department of Planning.
- Department of Environment and Climate Change.
- Kiama Municipal Council.
- Illawarra Aboriginal Land Council.
- Community participants.
- Maunsell study team.
- Department of Primary Industries.
- Shoalhaven City Council.
- PHOCUS.
- TOLL (heavy transport industry).
- NSW Police Service.
- Roads and Traffic Authority.

There were three main activities or processes associated with this value management workshop:

- Review of information.
- Development of assessment criteria.
- Evaluation of options.

7.2.1 Review of information

The review of information involved briefing the workshop participants regarding the characteristics of the study area, the existing highway and the project objectives for the upgrade of the highway. The project objectives are:

- Improve road safety.
- Improve efficiency of the Princes Highway: Gerringong to Bomaderry.
- Support regional and local economic development.
- Provide value for money.
- Enhance potential beneficial environmental effects and manage potential adverse environmental impacts.
- Optimise the benefits and minimise adverse impacts on local social environment.

The various stakeholders identified from their personal view points (individually, then within focus groups, and finally collectively) what was most important to them about the Princes Highway upgrade between Gerringong and Bomaderry. This 'What's important?' list, shown in **Table 7.1**, together with the project objectives, was used in the workshop to develop assessment criteria for the various routes in the study area.

Table 7.1 What's important list

No.	What is most important to value management workshop participants about the Gerringong to Bomaderry upgrade
1.	Consider the input of tourism and impact of the new highway on traffic and local business.
2.	Uninterrupted flow of travel on the road.
3.	Road safety for all (pedestrians, cyclists, access to farm gates, etc).
4.	Road efficiency (ie, incident management, travel time, operating cost, capacity, passing lanes, carbon emissions, grades, etc).
5.	Staging of construction to minimise business impact.
6.	Staging construction as a priority for achieving safety and budget targets.
7.	Conserve and compliment Indigenous and non-indigenous cultural heritage values.
8.	Effect on agricultural land (especially economic impacts) including its visual importance and agricultural landscape values.
9.	Lowest carbon footprint (new highway and the residual road).
10.	Removing through traffic from Berry (those who have no reason to enter Berry) and enhance the sustainability of Berry.
11.	Understanding the true extent of township and enabling community connectivity particularly with the 'isolated' communities.
12.	Protecting the lifestyle of current and planned communities (ie, minimising noise, severance, etc).
13.	Protecting heritage, especially environmental landscape, endangered species, aged trees, etc.
14.	Protecting ecologically endangered communities and the natural values of flora and fauna (including wetland catchment swamps).
15.	Having a solution that is appropriate today and meets the needs in 50 years time, allowing community to 'grow and prosper'.
16.	The infrastructure is done properly (do it right the first time).
17.	Understanding Aboriginal community expectations and how they will be met.
18.	That noise impacts are minimised.
19.	Climate change impacts are considered in the solution.
20.	Obtaining best value for money.
21.	Providing multi-user rest areas.
22.	Participation, understanding, ownership and acceptance by the community that the preferred option is the best result.
23.	That life cycle costs and impacts are minimised.
24.	Ensuring the project is 'affordable' to government (ie, staging, etc).
25.	Minimising the impact to the community by utilising the existing highway where appropriate.
26.	Providing a project capable of being approved.
27.	Enhancing the economic benefits that a new highway can provide.
28.	Avoiding significant flora and fauna habitats at an early stage in the process.
29.	Managing flooding and water quality issues.
30.	Minimising the impact of construction on ground water table.
31.	Minimising the impacts to ecologically endangered communities, threatened species, native vegetation and wildlife corridors

Table 7.1 What's important list cont'd.

No.	What is most important to value management workshop participants about the Gerringong to Bomaderry upgrade
32.	Identifying 'value-adds' the highway brings to the community from a social and economic perspective.
33.	Providing an effective freight corridor linking Sydney and the South Coast.
34.	That visual impacts are minimised and we keep/enhance the visual 'wow' factor of the area.
35.	Minimising impacts during construction (ie, delays, safety issues, etc).
36.	Managing additional traffic using the 'Sandtrack' route during construction.
37.	Minimising community impact considerate to environment, social and business aspirations and provide a fit-for-purpose highway.
38.	Adopting and promoting sustainable development principles.
39.	Providing reasonable access to properties and communities.
40.	Minimising direct property access to the routes.
41.	Reduce adverse or maintain or improve environmental outcomes.
42.	Providing the ability to incorporate future changes in technology.
43.	Providing a solution consistent with the Princes Highway vision (ie, functional, look, feel, purpose, etc).
44.	Providing lower grades and minimising bends.
45.	Eliminating the sub-standard alignment at Foxground and Berry's main street from the highway.
46.	That all geotechnical issues are identified, dealt with and/or avoided.
47.	Preserving agricultural cultural heritage.
48.	Maintaining the visual relationship and connectiveness between Berry and the escarpment.
49.	That the community participants at value management participate and observe a process that is without bias.
50.	That the project incorporates and consolidates truck parking, rest areas, RTA inspection areas and commercial enterprises (linked to item 21).
51.	That the project is easily constructable.
52.	Managing the best use of material with appropriate pavement design (ie, no wastage, etc).
53.	Community submissions are considered and the process provides a sound rationale for decisions made (transparent).
54.	Providing a low maintenance asset (ie, appropriate batter designs, etc).
55.	Recognising the heritage and other values of the David Berry Hospital and Camp Quality park.
56.	A solution is considered that factors in future growth.
57.	Maintaining the agricultural capacity at a regional level.
58.	Avoiding loss of agricultural resource resulting in land-use change.
59.	Minimising severance of agricultural land ownership.
60.	Recognising the importance of maintaining the project delivery timeframe.

7.2.2 Assessment criteria

Assessment criteria were developed and weighted under three key perspectives:

- Functional.
- Socio-economic.
- Natural and cultural environment.

These were based on the list of what participants valued as most important as well as the project objectives for the highway upgrade. The criteria agreed for weighting were:

Functional perspective

A. Route length, grade efficiency, travel time and vehicle operating cost.
B. Potential for delays for traffic during construction.
C. Constructability and ease of construction.
D. Minimise number of accesses (controlled and direct).
E. Vertical and horizontal alignment – including orientation.
F. Overall network safety – new and residual roads.

Socio-economic perspective

A. Minimise impact on agricultural lands and business – areas, classes, numbers and severance.
B. Loss of residences in communities – consequential viability of communities.
C. Connectivity and accessibility impacts for communities.
D. Impact on views, from communities, of road.
E. Road traveller experience and 'wow' factor impacts.
F. Impact on community facilities / amenity service.
G. Impacts on non-agricultural businesses.

Natural and cultural environment perspective

A. Impact on threatened species.
B. Impact on endangered ecological communities.
C. Impact on habitats and wildlife corridors.
D. Impacts on wetlands and catchments of wetlands.
E. Impact on Indigenous heritage.
F. Impact on non-Indigenous heritage.
G. Impact on surface water quality.
H. Assessment of carbon footprint size.
I. Noise impacts.
J. Potential to change flooding characteristics.
K. Impact on ground water.
L. Climate change impact / vulnerability.

7.2.3 Evaluation of options

For sections of the study area where multiple routes exist (Sections B and C), focus groups assessed how the routes performed in a relative sense against each of the weighted criteria. For sections where only one route had been short-listed (Sections A and D), focus groups undertook an assessment of issues and considered whether fatal flaws could be identified.

Evaluation of the routes in Sections B and C identified three option combinations for further assessment. Strategic costs were then presented and discussed. The workshop group was then in a position to draw conclusions from the overall assessment which included the strategic cost estimates and benefit / cost ratios.

The workshop group reached a consensus on which routes (and therefore options) should progress and what conditions should apply to their assessments. They also recommended a clear direction and way forward for the project.

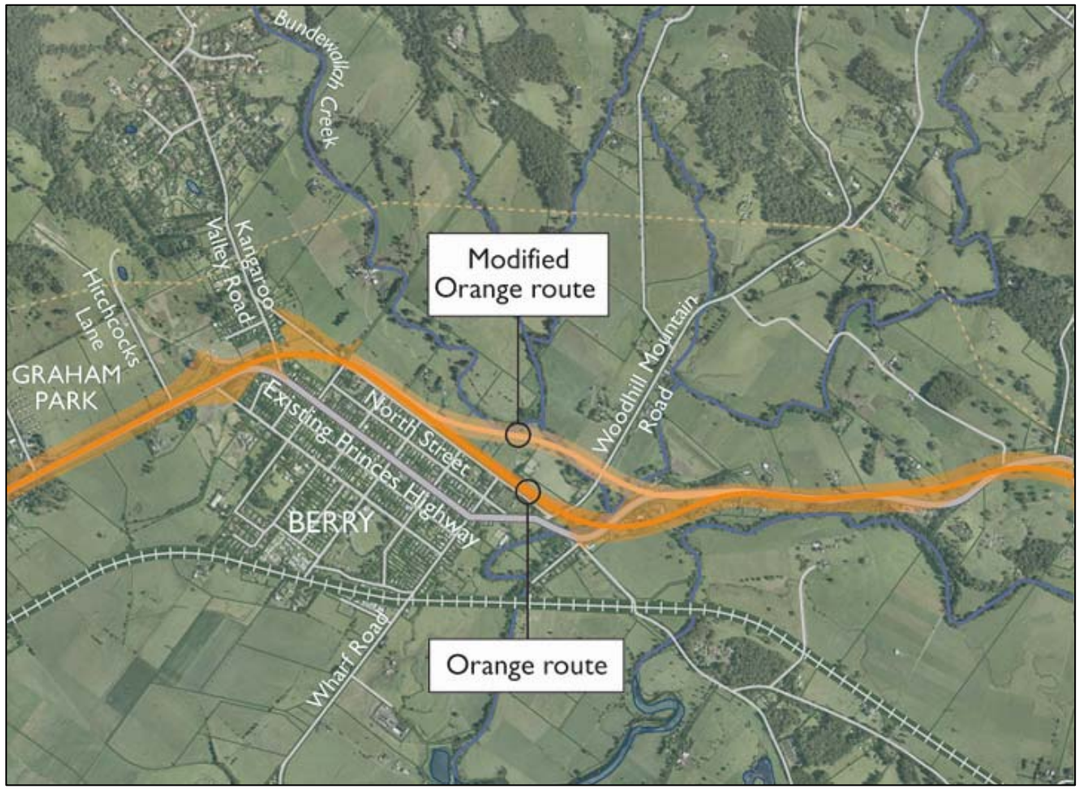
7.3 The modified Orange route

The value management workshop scope was aligned to the short-listed options which were placed on public exhibition in November 2007. Discussion followed regarding a modification to the Orange route that would avoid / minimise cultural and social impacts. This had been considered by the project team previously as a permutation of the Orange route. It had also been proposed by several respondents during the route options display period. It was decided that there was a risk of a viable option being assessed and lost if the modification was not considered in this value management workshop.

The Orange route had attracted considerable concern from the community in relation to how it impacted the David Berry Hospital and a number of non-Indigenous heritage places and archaeological sites in the Pulman Street and Tannery Road European heritage precinct at the northern end of Berry. There was also a considerable impact on the Sportsground and the Camp Quality Memorial park. Refer to **Chapter 9** for further details on the modified Orange route.

Based on this advice, the value management workshop group agreed to add the modified Orange route to the assessment process together with the Orange route.

Figure 7.1 Modified Orange route



Based on this advice, the value management workshop group agreed to add the modified Orange route to the assessment process together with the Orange route.

7.4 Workshop outcomes and conclusions

By the end of the workshop, the participants had:

- Confirmed the objectives for the Princes Highway upgrade between Gerringong and Bomaderry, which reflect what the project must do to be successful in achieving its purpose, and agreed that the achievement of those objectives would address the problems being experienced along this part of the highway.
- Identified what was most important about the project to each of the stakeholder participants in the value management workshop.
- Identified assumptions being made about the project from various perspectives and assessed whether it was safe to proceed with planning based on these assumptions or whether they needed to be resolved as planning proceeded.
- Identified and weighted assessment criteria under three key perspectives (functional; socio-economic; and natural and cultural environment) based on what participants considered most important and the highway upgrade project objectives. These were developed for use in the assessment of the short-listed routes and subsequently their various combinations.
- Reviewed single routes in Section A and Section D, raised issues and confirmed that there were no fatal flaws in these routes – ie the Red route and the Purple route.
- Assessed and comparatively ranked the alternative routes within Section B and Section C in order to build a further, shorter list of 'complete' options.
- Drawn the following conclusions from the assessment of alternative routes within Section B and Section C:
  - In Section B remove the Yellow route from further evaluation because of its relatively poor performance when assessed against the Pink and Green routes under the functional and socio-economic criteria. In addition it had the highest capital cost, by a substantial degree, compared to the Pink and Green routes.
  - In Section C remove the Orange route from further evaluation (assuming confirmation of the feasibility of the modified Orange route is assured) because it performs poorly against socio-economic and natural and cultural environment criteria when compared to modified Orange route.
  - In Section C remove the Blue route from further evaluation because it performs significantly worse against socio-economic and natural and cultural environment criteria when compared to both the modified Orange route and the Orange route.
- Agreed on a number of further short-listed, 'complete' options for evaluation over Sections B and C of the study area. These were agreed as:
  - Pink / modified Orange option.
  - Green / modified Orange option.
  - Brown option.
- Assessed these three 'complete' options using the assessment criteria and ranked the performance of each option. Strategic cost estimates and benefit cost ratios for each option were also compared.
- Concluded the following as a result of undertaking the assessment:
  - The Pink / modified Orange and the Green / modified Orange routes were unanimously recommended by the workshop group to move forward to the next stage of development, subject to the issues raised and documented in the workshop being addressed.
  - The Red route in Section A and the Purple route in Section D are appropriate to move forward to the next stage of development, with no fatal flaws identified.
  - The Blue route in Section C should not be further pursued on socio-economic and environmental impact grounds particularly the impact on agricultural land.
  - The Yellow route in Section B should not be further pursued as the other routes in Section B were seen to be more superior socio-economically and on cost benefit grounds.
  - The Brown route in Sections B and C should not be further pursued as it was seen to be deficient on environmental, constructability, functionality and socio-economic grounds, and left a considerable residue of existing highway which will continue to have safety problems.
  - The modified Orange route in Section C provides heritage, geometric and socio-economic benefits and should be further pursued (in lieu of Orange route) subject to proving its feasibility.
  - Further work is required to address the access arrangements on the project eg, access to properties, to Berry, to Gerringong, etc.
- Identified a number of issues which need to be resolved as planning proceeds. These were recorded for the benefit of the project team follow-up.

7.5 Further actions and investigations

At the conclusion of value management workshop the following steps were identified to assist in the identification of a preferred route:

- Make recommendation that the Red route in Section A and the Purple route in Section D form part of the preferred option.
- Carry out further actions identified at this value management workshop including:
  - Confirm the feasibility of the modified Orange route.
  - Review the grade on the Pink and Green routes south of Belinda Street.
  - Refine the cost data for the Pink and Green routes.

Refer to **Chapter 10** The Next Steps for the status of actions and investigations.

Not used

8.0 Preferred option selection process

8.1 Selection approach

The preferred option was determined after collective consideration of the following:

8.1.1 Technical input

A number of key environmental, engineering and economic issues influence the location and design of the preferred option. Preliminary investigations have been carried out and have included reviews of studies from previous investigations into the upgrade, including:

- The 1991 Gerringong to Berry Route Study.
- 1998 North Street Berry Bypass Corridor.
- 2004/05 Quantm Study from Kiama to Nowra.

The current investigations comprise a review of existing background data, fieldwork and analysis to provide a more thorough understanding of the physical, social and economic aspects of the study area. Specialist studies conducted during the route options development phase are presented in the *Route Options Development Report (November 2007)* and a summary of findings and constraints is presented in **Chapter 3**. Studies included:

- Geotechnical.
- Topography, geology and soils.
- Urban design, landscape and visual amenity.
- Traffic, transport and road safety.
- Public utilities and services.
- Social-economic.
- Flora and fauna (terrestrial and aquatic).
- Water quality.
- Cultural heritage (Indigenous and non-Indigenous).
- Flooding and drainage.
- Land-use and planning.
- Noise and vibration.
- Climate and air quality.

The following additional specialist studies have been undertaken since the initial route options development stage to input into evaluation of route options and the selection of a preferred option:

- Ongoing fog monitoring in two locations to determine the impacts of fog on the route options in terms of a route differentiator and for input into the environmental assessment of a preferred option.
- Oral history survey of the study area to gain an appreciation and document the Aboriginal and European heritage in the study area.
- Additional traffic surveys to gather more base data to feed into the traffic models used to determine access movements to and within the towns of Gerringong and Berry including public holidays.
- Additional industry stakeholder interviews to further develop the Preliminary Social-Economic Impacts Report prepared as Appendix F of the Route Options Development Report (November 2007). The study involved both qualitative and quantitative methods, using a combination of discussions with business owners / managers and experience gained from other similar highway upgrade projects.
- Additional cultural knowledge holder interviews held with a panel of agreed cultural knowledge providers as accepted by the Aboriginal Focus Group.
- Site walk with representatives from the Aboriginal Focus Group to obtain cultural knowledge along the preferred option and to evaluate potential route differentiators between the Pink and Green routes in Section B.
- Considerations of ecologically sustainable development and appraisal of the short-listed options to assess the impacts of climate change.

8.1.2 Community feedback and submissions

Community engagement is a key aspect of this project. The broader community has had the opportunity to make a demonstrable input to the process throughout each stage of the project to ensure that the requirements and aspirations of the community are understood and considered.

The program and summary of key consultation activities and findings are outlined in **Chapter 6**. The consultation program to date has culminated in the collection of community submissions following the display of short-listed route options between November 2007 and February 2008. A detailed review of submissions received and the project team response to those submissions is provided in the *Submissions Report (October 2008)*. Key areas for consideration in determining a preferred option included:

- **Functional issues** generally including access to the highway and properties; road safety for vehicles, pedestrians and cyclists; maximising the use of existing highway to minimise land take; and the issue of maintaining community cohesion and minimising community severance.
- **Environmental issues** including environmental values and assets; the protection of flora and fauna and biodiversity issues such as wildlife corridors, wetlands, water bodies and endangered ecological communities; flooding; regional character and history; and noise and visual impacts.
- **Social issues** including community cohesion and community networks; property values and property acquisition; project timeframes; and impact mitigation.
- **Economic issues** with particular reference to business viability; agriculture; tourism; appropriate access to the towns of Gerringong and Berry; and the protection of environmental values as key economic assets.
- **Process issues** including the validity of the route options development process; effective and appropriate consultation; and the timely resolution of the preferred option selection.

Community consultation is ongoing and the RTA has made a commitment to involve the community at all stages of the project.

8.1.3 Value management workshop

A summary of the value management process and workshop findings is provided in **Chapter 7**. The purpose of this workshop was to bring together a wide range of stakeholder interests and expertise to review the outcomes of the investigations undertaken to date and, on the balance of issues and consideration of the options against agreed assessment criteria, to recommend a direction for further investigation to progress the project's development.

The workshop group reached a consensus on which routes (and therefore options) should progress and what conditions if any should apply to their assessments. They also recommended a clear direction and way forward for the project.

8.2 Selection of a preferred option

The preferred option has been selected as the option that both performs well across a combination of the technical input, community feedback and the findings of the value management process and which best meets the project objectives.

8.3 Recommendation of preferred option

The recommended preferred route is shown in **Figure 8.1** and a detailed description is provided in **Chapter 9**.

Not used

Figure 8.1 Preferred option

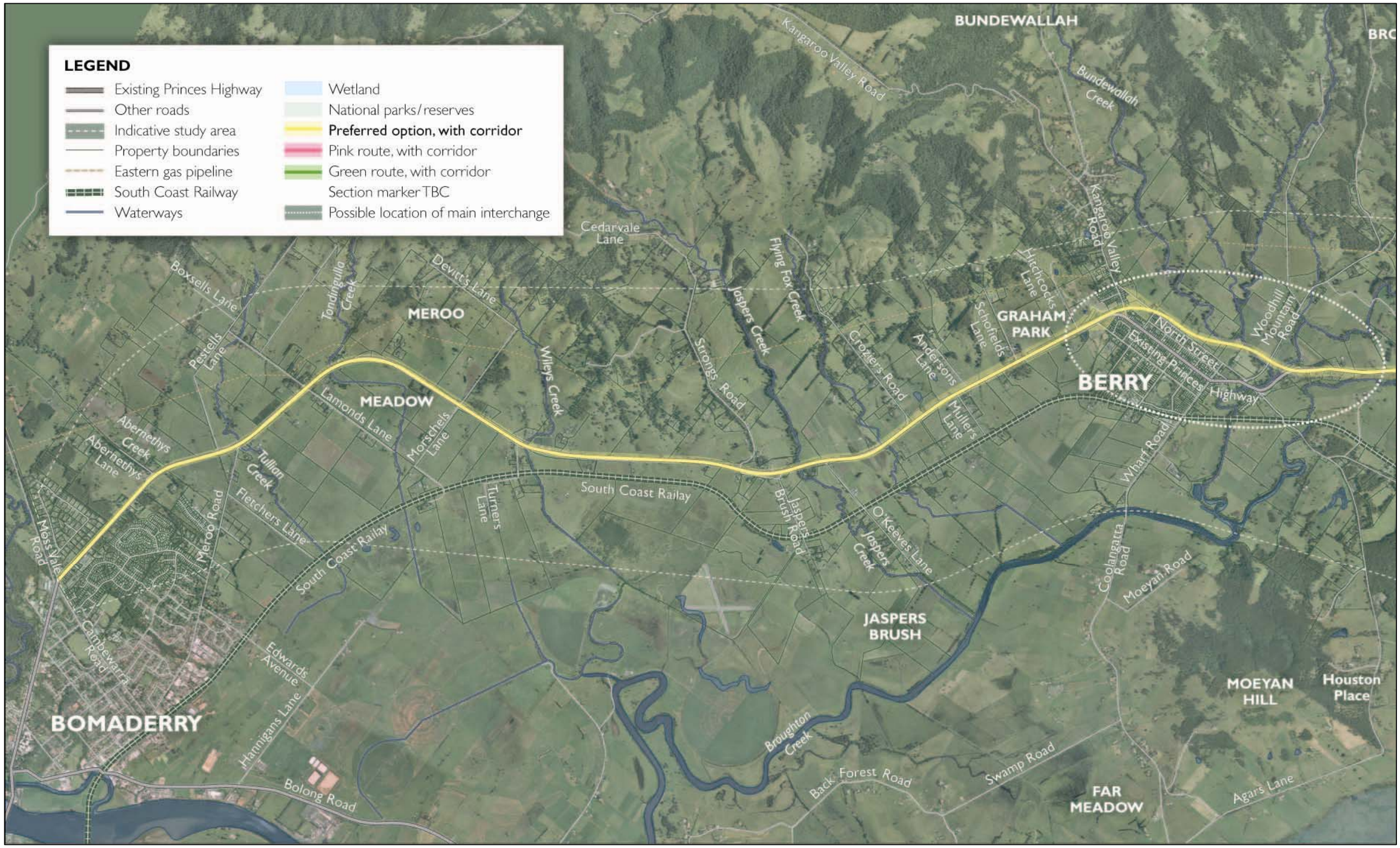


Figure 8.1 Preferred option cont'd.

Not used

9.0 The preferred option

9.1 Description of the preferred option

With reference to **Figure 5.3**, the preferred option is the combination of the following displayed short-listed routes:

- Red route from Section A.
- The common sections of the Pink and Green routes (from Belinda Street to Toolijooa Road and Austral Park Road to Tindalls Lane) from Section B.
- The divergent sections of the Pink and Green routes (from Toolijooa Road to Austral Park Road) from Section B.
- Modified Orange route from Section C.
- Purple route from Section D.

The option is described as a corridor of varying width. The varying width of the corridor indicates that the current design within the corridor is preliminary only and may move within the corridor as further investigations are undertaken and the design is refined.

9.2 Overview of the preferred option

9.2.1 Section A (Mount Pleasant to south Gerringong)

In this section the entire preferred option follows the existing highway alignment. The four-lane carriageway with physical separation of traffic will descend from Mount Pleasant to Omega Flat at a similar grade to the existing highway – in the order of eight per cent. (Consideration will be given to a northbound climbing lane where grades are steep.) The crossing of Omega Flat will be raised on earth embankment to achieve a minimum of 1 in 20 year flood immunity. The vertical alignment will be improved to meet design standards from Omega Flat to Belinda Street

The interchange options for Gerringong will be located in this section. An objective will be to achieve a minimum of 1 in 20 year flood immunity. To improve road and rail safety and efficiency, none of the interchange options will retain the rail level crossing at Fern Street. Refer to **Chapter 10** for more information regarding the access options being considered and the process of selecting a preferred access option for Gerringong. Access to local roads and properties will be considered as part of the concept design.

9.2.2 Section B (south Gerringong to north Berry)

Two routes have been identified as preferred in this section – the Pink and Green routes. The Pink and Green routes are common and follow the existing highway alignment from Belinda Street to near Toolijooa Road. Over this length both routes would meet the requirements for 'A Class' standard.

The Pink and Green routes diverge near Toolijooa Road. The Pink route continues to follow the existing ascending highway alignment until the existing alignment becomes significantly sub-standard for the proposed design speed. At this point, approximately one kilometre south of Foxground Road, the Pink route cuts through the peak of the ridge and descends to Broughton Creek in a long sweeping curve. This curve crosses Broughton Creek three times before ascending a ridge to rejoin the existing highway alignment at Austral Park Road. From this point the Pink route is common with the Green route and generally follows the existing highway to approximately 500 m east of Tindalls Lane.

After diverging from the Pink route near Toolijooa Road, the Green route avoids climbing the ridgeline and instead takes a flatter grade into the reaches of a relatively narrow section of the ridge. At this point the Green route passes into a 350 m long tunnel. The Green route emerges from the tunnel and curves southward to cross Broughton Creek three times in a similar manner to the Pink route. The Green route ascends a ridge (immediately east of Austral Park Road) to meet the Pink route and is common with the Pink route for the remainder of Section B.

Further field work, studies and cost estimates are required to assist with the determination of preference for either the Pink or Green routes over the length where they diverge. The further studies to be undertaken are described in more detail in **Chapter 10**.

9.2.3 Section C (Berry township)

A modified Orange route has been identified as preferred in this section. A modification to the Orange route was investigated prior to the value management workshop following considerable concern from the community with regards to potential impacts on the Pulman Street heritage precinct and the sports ground. The modified Orange route was considered and recommended by the value management workshop participants. For more detail regarding the development of the modified Orange route, refer to **Chapter 7**.

From approximately half a kilometre east of Tindalls Lane the preferred option generally follows the existing highway corridor for three kilometres before leaving the western slope of the ridge over a bridge structure in the vicinity of the existing roadside stockpile site. The bridge extends over Broughton Mill Creek, Woodhill Mountain Road and runs along the north side of Bundewallah Creek for approximately 300 m before crossing the creek. The preferred option then turns towards Albany Street where it follows the gazetted road corridor along the northern side of North Street.

Opposite George Street, the preferred option begins to turn south-west crossing Kangaroo Valley Road in cutting before rejoining the existing highway alignment opposite Mark Radium Park. Kangaroo Valley Road crosses the preferred option on an overbridge close to natural ground surface.

South of Kangaroo Valley Road the remainder of the preferred option in Section C follows the existing highway alignment. The vertical alignment will be 'smoothed' to meet design standards – resulting in new embankments and cuttings.

The interchange options for Berry will be located in this section. An objective will be to achieve a minimum of 1 in 20 year flood immunity. Access to local roads and properties will be considered as part of the concept design. Refer to **Chapter 10** for more information regarding the access options being considered and the process of selecting a preferred access option for Berry.

9.2.4 Section D (south Berry to Bomaderry)

In this section the entire preferred option follows the existing highway alignment.

The existing horizontal alignment will require little correction. Some vertical curves are substandard and will be upgraded. This will involve balancing earthworks and making the best use of existing road pavement and drainage structures where practicable. Widening on one or both sides of the existing highway will be considered to minimise impacts on adjoining properties and to make the best use of the existing road pavement and road reserve. It is expected that work will be carried out under traffic in this section.

9.3 Traffic and transportation issues

9.3.1 Road safety and access strategy

A key objective of this project is to improve road safety. The manner in which local roads and properties join the upgraded highway influences the potential for crashes. The access strategy needs to balance travel efficiency with a need to improve road safety. A significant improvement in road safety can be achieved by limiting the potential for vehicle conflict at access points.

Separating opposing traffic with a physical barrier and limiting cross-median turn movements is a key design feature to significantly improve road safety. A physical median barrier lessens the likelihood of head-on crashes – the most severe type. Restricting the number of cross-median movements, such as right turns into driveways, also lessens the potential for vehicle conflict. To achieve these aims the current access arrangements for local road junctions and property access must be reviewed and rationalised.

Two classes of highway upgrade define the degree to which access is permitted; 'A Class' and 'M Class'. The access arrangements for each class are:

- 'A Class' (Arterial): Limited direct access for local roads and properties.
- 'M Class' (Motorway): No direct access for local roads and properties. Local roads pass over or under the upgraded highway or are terminated and property access is via the local road network.

'A Class' standards apply to sections of the preferred option where the upgraded highway follows the existing highway alignment. 'M Class' standards apply to those sections where the upgraded highway follows a new alignment.

Cross-median movements for some local road junctions and property accesses will not be permitted. The need for cross-median access will be considered together with the corresponding road safety implications. Some property accesses will be consolidated to a single service road connecting to a local road or directly to the upgraded highway. U-turn facilities will be appropriately spaced with good sight distance and grade to allow safe cross-median movements. U-turn facilities may be combined with local road junctions. Not all local road junctions will have cross-median access.

The preferred access options (interchanges) for the towns of Gerringong and Berry are currently being investigated and assessed. Interchanges for Gerringong and Berry will be grade separated.

9.3.2 Traffic and transport efficiency

There are two key aspects of traffic and transport for the preferred option:

1) Change in traffic volume and distribution within the region.
2) Heavy vehicle efficiency.

The preferred option will change the way that traffic moves through and within the local region. The upgraded highway will be of a significantly higher standard and offer improved travel times compared to the existing highway. This will encourage motorists to use the upgraded highway in preference to the 'Sandtrack' and other local roads and will reduce the traffic volume in Gerringong and Berry.

9.3.2.1 Section A (Mount Pleasant to south Gerringong)

The horizontal alignment of this section of the preferred option is relatively good however the existing steep grade of approximately eight per cent from Mount Pleasant to Omega Flat would remain. It is not possible to lessen this grade. Further analysis will consider the provision of a third lane (climbing lane) for the northbound direction. Particular attention will be paid to providing appropriate measures to manage the potential for higher speeds on the relatively steep down grades in the southbound direction. This will also be considered as part of the road safety strategy.

Currently the 'Sandtrack' and the highway offer similar travel times over the length of the study area. This means that a significant proportion of motorists elect to travel through Gerringong and along the 'Sandtrack' in preference to the existing highway. Regardless of the interchange arrangement selected for Gerringong, through traffic in Gerringong will be dramatically reduced when the highway is upgraded. The amenity and road safety in Gerringong will be improved as a result.

A grade separated interchange for Gerringong will improve road safety and efficiency by eliminating points of conflict.

9.3.2.2 Section B (south Gerringong to north Berry)

Two routes are currently preferred in this section – the Pink and Green routes.

On the Pink route at Foxground the vertical grade is in the order of eight percent and the horizontal curve transitions from a radius of approximately 1200 m to 900 m. To ensure an acceptable level of road safety, careful consideration would be given to the horizontal curve transition, the superelevation and the need for a climbing lane(s) at this location together with appropriate measures to manage potential high downhill speeds.

The Green route is common with the Pink apart from the more direct alignment between Toolijooa Road and Austral Park Road passing through the hillside and over the Broughton Creek floodplain. The vertical grade achieved by tunnelling through the hillside, in the order of one per cent, is significantly easier than the Pink route, resulting in greater efficiency and safety. The maximum grade of the Green route is six per cent in a section that is common with the Pink route.

Regardless of which route emerges as part of the preferred option, the residual section of the existing highway from approximately Toolijooa Road to Austral Park Road will revert to a local road. Properties and local roads will continue to connect to the residual section of highway. Where the preferred option severs an existing property access, provision will be made for the access to continue to connect to the existing highway. The method of connecting the residual section of highway to the upgraded highway is still to be determined.

9.3.2.3 Section C (Berry township)

The preferred option in this section improves the existing alignment with a series of gentle horizontal curves following the ridgeline from Tindalls Lane to the roadside stockpile site immediately north of Berry. The proximity to Berry along the North Street corridor will provide a more urban highway characteristic.

Currently the highway passes through the centre of Berry. Regardless of the interchange arrangement selected for Berry, through traffic in Berry will be dramatically reduced with the construction of the preferred option. The amenity and road safety in Berry will be significantly improved as a result. Travel times will also be greatly improved in this section with the bypass of Berry.

A grade separated interchange for Berry will improve road safety and efficiency by eliminating points of conflict.

9.4 Engineering issues

9.4.1 Section A (Mount Pleasant to south Gerringong)

Structures

Significant structures in this section are associated with the interchange option selected for access to Gerringong. Refer to **Chapter 10** for further details of the interchange options for Gerringong.

Ground conditions

Widening of the existing road corridor will be required. Depending on the optimum balance in terms of land-use and acquisition, sections of fill and cut earthworks will be required. Some lengths of existing cut slopes exhibit minor instability. Sections of retaining features such as soil nails and rock bolts may be required. Underlying rock in some areas has been classified as 'very high strength' rock. Some cuttings along this option may require blasting.

The Omega Flat area comprises estuarine soils with high probability of soft soils and acid sulphate soils.

Flooding and drainage

In the low lying areas of Omega Flat, immediately north of Gerringong, the existing highway is prone to occasional flooding. Pursuant to design requirements the upgrade is required to be flood immune. The level of the existing highway will need to be raised in some areas and reconstruction and or widening of existing transverse drainage structures will be necessary.

Major public utilities

Major public utilities in this area comprise fibre optic cables, the Eastern Gas Pipeline, high voltage overhead power lines, and Sydney Water Corporation water main. The water main has recently been relocated to the eastern side of the highway as part of routine maintenance.

The Eastern Gas Pipeline crosses the existing highway to the west of the Belinda Street intersection. Interference with this significant piece of infrastructure will be avoided by aligning the upgraded highway and any interchange ramps above existing ground level.

Earthworks

Two discrete portions exist in this section. To the north, earthworks comprise short lengths of relatively low fill embankments and shallow cut excavations. Rock won from cuttings will provide a valuable source of fill construction materials for the low-lying Omega Flat section. Omega Flat has typical floodplain characteristics with estuarine soils. Preliminary geotechnical investigations indicate that soft soil treatments will be required to manage long-term settlements in the Omega Flat area. These treatments could include mini-piles or preloading and surcharging with wick drains. The presence of acid sulphate soils requires particular consideration in relation to project risk.

In the vicinity of Sims Road there is potential to lower the alignment into cutting to win additional fill material and introduce an interchange. The adjacent rail line is also in cutting at this location.

At the current intersection with Belinda Street there is potential to raise the alignment to allow an interchange ramp to pass under the upgraded highway and connect to Belinda Street before the rail line underpass.

9.4.2 Section B (south Gerringong to North Berry)

Structures

The Pink route requires bridge structures over the Crooked River and three crossings of Broughton Creek. These crossings should be relatively straightforward and the alignment should suit standard bridge design and construction methods.

The Green route requires similar structures to the Pink route. The Green route requires a tunnel of approximately 350 m in length. Preliminary geotechnical investigations indicate that underlying rock is fine grained sandstone of high strength. This readily lends itself to modern tunnelling techniques such as the use of a road header. The option would most likely require twin tunnels with each carrying one direction of traffic.

Ground conditions

The Pink route crosses the floodplain of Crooked River and although information available indicates mostly alluvial material exists there is a possibility of acid sulphate soils being present. Immediately further south, the Pink route climbs to higher ground (ie away from the low lying and soft soil conditions) and requires cuttings producing relatively good quality earthwork materials. The option passes Foxground in a combination of embankments and cuttings. Alluvial soils are likely to be encountered in the Broughton Creek floodplain before better ground conditions are met along the bottom of the ridges leading towards the southern end of this section.

The Green route is as per the Pink route except for the large fill embankment leading up to the tunnel through the north saddle of the Toolijooa ridge. As discussed above, the underlying bedrock is relatively well suited to tunnelling. The large cutting on the Pink route, and the tunnels on the Green route, have potential to interfere with ground water conditions. Further investigation of the possible effects on groundwater will be undertaken.

Flooding and drainage

The low lying areas are all flood prone and suitable treatments are required to deal with the affects. These include raising the finished road level above the required flood immunity level and providing adequate cross drainage.

Each of the water courses encountered along these options would require bridges or culverts to meet flood mitigation requirements.

Major public utilities

Major public utilities in this section comprise fibre optic cables and the Eastern Gas Pipeline.

In the south and close to Austral Park Road, the Pink and Green routes follow the existing highway alignment which is close to the Optus fibre optic cable. This cable may require relocation and/or protection. The Pink and Green routes require a crossing of the Eastern Gas Pipeline in embankment conditions in the vicinity of an existing crossing just north of Tindalls Lane. This crossing would involve similar construction and protection techniques.

Earthworks

The Pink and Green routes primarily require an upgrading of the existing highway. This may involve widening the existing formation or, where horizontal and vertical alignments are sub-standard, complete reconstruction.

The most significant feature of the Pink route is a large cutting commencing at the property or area called Kellyong just north of the existing Foxground junction. This cutting is approximately 900 m long and has a maximum depth of 27 m.

The tunnel on the Green route significantly reduces the extent of large scale earthworks.

With further design development, the Pink and Green routes are likely to achieve a balance between cut and fill earthworks material.

9.4.3 Section C (Berry township)

Structures

The preferred option in this section requires a relatively long (in the order of 600 m) low-level structure to span Broughton Mill Creek, Woodhill Mountain Road, and Bundewallah Creek. The height of this structure is largely dictated by the clearance required over Woodhill Mountain Road. Further hydrological investigations will reveal if it is possible to introduce short sections of earth embankment to lessen the length of structure required.

Considerable care will be necessary to develop a slender and unobtrusive design that fits into the landscape. Placing the upgraded highway in cutting at the eastern approach to the bridge will reduce the height of the bridge.

A bridge will be required to carry Kangaroo Valley Road over the preferred option which is in cutting at this location. Kangaroo Valley Road will remain at its current level with opportunities to maintain a similar street-level connection to Queen Street.

Ground conditions

The ground conditions encountered in this section are generally favourable. Preliminary geotechnical investigations indicate that there is a low risk of encountering acid sulphate soils.

Flooding and drainage

The main characteristic of the preferred option in this section with regards to flooding and drainage is the traverse of the Broughton Mill and Bundewallah Creek floodplains. The northern part of the preferred option is located on a ridgeline and is unaffected by flood. Careful consideration will be given during future more detailed studies into flood detention measures which may bring benefits to the town during flood events. Transverse drainage structures may be sized to control the flow from upstream and therefore manage the rate of flooding downstream and potentially reduce the probability of creeks overtopping. The preferred option in particular has the potential to provide this benefit in regard to Town and Bundewallah creeks, however this would require close examination later in the study process.

Major public utilities

The major public utilities interacting with the preferred option in this section comprise the Eastern Gas Pipeline, Optus and Telstra fibre optic cables, and water mains servicing Berry.

The Eastern Gas Pipeline is in close proximity to the preferred option in the vicinity of Tindalls Lane. At this point the preferred option is diverging from the Eastern Gas Pipeline alignment. Optic fibre cables are located on Woodhill Mountain Road and Kangaroo Valley Road. Water mains are located on Kangaroo Valley Road and North Street. These services will require adjustment and/or protection.

Earthworks

As discussed above, in the northern or eastern parts of this section the preferred option is either close to the existing ground level or requires cuttings, with the exception of a significant cutting and embankment just to the south of Tindalls Lane. As the preferred option descends and crosses the Broughton Mill Creek and Bundewallah Creek floodplains, large earth embankments are avoided through the use of a bridge.

Preliminary geotechnical studies suggest that the majority of soil and rock encountered in this section would provide a good material for road building. Although it is likely that some soft soil conditions would be encountered, at this stage, acid sulphate soil is not considered to be a significant risk.

9.4.4 Section D (south Berry to Bomaderry)

Structures

The existing bridges over Flying Fox, Jaspers and Abernethys creeks will require augmentation, reconstruction or duplication.

Apart from Meroo Road at Bomaderry, no grade separated crossings are envisaged, however further investigation of local access, traffic data and land-use may require consideration of a local road under or overpass.

Ground conditions

The preferred option in this section traverses an area between the Shoalhaven floodplain and the lower reaches of the Cambewarra Range. Preliminary geotechnical investigations indicate that there is a low risk of encountering acid sulphate soils and soft soils over the length of this option.

Flooding and drainage

As the preferred option traverses an area between the Shoalhaven floodplain and the lower reaches of the Cambewarra range, it is not subject to inundation by flood. As with other upgraded sections of the existing highway located on elevated ground, the preferred option will exceed the requirement to achieve at least a 1 in 20 year flood immunity without the need to raise the road on earth embankment.

Major public utilities

The major public utilities interacting with the preferred option in this section comprise the water mains servicing Jaspers Brush, Meroo Meadow, and Bomaderry. There are multiple water main crossings of the existing highway which are relatively minor and will be adjusted or protected as necessary.

Earthworks

Some of the small crests on the existing highway are too ‘sharp’ and will need to be ‘smoothed out’. This will result in the construction of a series of cuttings and embankments to produce an acceptable grade. Overall the earthworks will be balanced for this section of the preferred option.

9.5 Statutory planning and land-use

9.5.1 Section A (Mount Pleasant to south Gerringong)

Planning and legislation

The existing road reserve in Section A where much of the preferred option will be located, is zoned a combination of Arterial Road and 9(a) Arterial Road widening under the Kiama Local Environmental Plan. Adjoining land to the west is zoned 1(a) Rural ‘A’. These zones do not preclude the upgrade of the Princes Highway as such works would be permissible with development consent. However, development in the Rural 1(a) zone should minimise the fragmentation of rural land of prime crop and pasture potential, and strip acquisition along the route is consistent with this.

It should be noted that under the 7(b) Environmental Protection (wetlands) zone road works are prohibited under the Kiama Local Environmental Plan. Land to the north of Gerringong on the eastern side of the existing Princes Highway is currently zoned 7(b). This zoning will have an impact on the access arrangement to Gerringong should an option be developed that incorporates the existing Fern Street. This will be considered in more detail through the access value management process.

The preferred option in Section A will have minimal impact on regional and local development and is consistent with local and state planning policies.

Land-use and property impacts

Widening will be required for the construction of the preferred option, but impacts of property acquisition and severance will be minimised generally by widening one side of the existing highway. Careful consideration will be given to the dairies and the vineyard to the west of the existing highway. Additional land along the existing highway corridor adjacent to Gerringong has been designated as road. A highway upgrade along the option is likely to meet community expectations.

9.5.2 Section B (south Gerringong to north Berry)

Planning and legislation

Both of the currently preferred options in Section B pass largely through land zoned as 1(a) Rural under both the Kiama and the Shoalhaven Local Environmental Plans. The road is permissible with consent under both Local Environmental Plan zonings.

Land-use and property impacts

The Pink and Green routes will have an impact on property severance and land acquisition as they diverge from the existing alignment, but this is generally limited to the relatively short offline sections through the Toolijooa and Foxground areas as they share a common corridor with the existing highway for much of their length.

However there may also be some acquisition required for small lot rural residential properties fronting the existing highway in order to upgrade the existing alignment to meet the required road design standards. Of the two options, the Green route would have a lesser impact in terms of direct property acquisition because it incorporates a section of tunnel through the Toolijooa ridge.

The Pink route would also require a larger footprint than the Green route to incorporate the large cutting and embankment required to negotiate the steep terrain to the west of Toolijooa ridge.

Both options sever rural allotments and there are some direct impacts on rural dwellings associated with the options at the Toolijooa Road junction where it diverges from the existing highway and on western side of the ridge.

9.5.3 Section C (Berry township)

Planning and legislation

The road is permissible with consent along preferred option in Section C, and the option utilises existing road corridor provisions to the north of Berry along North Street.

The option is in accordance with current and planned land-use in that it makes use of part of the existing road corridor immediately north of North Street. To a certain degree this option has been expected by the community for some time, due to the gazettal of the corridor, subsequent purchase of significant sections by the RTA and a previous assessment of a Berry bypass. This expectation would have changed slightly with the modification of the original Orange route to the north-west of the sports fields, but this is generally perceived as a positive modification as it maintains community access to the sports fields and preserves the Pullman Street historical precinct.

Land-use and property impacts

The preferred option has a minor impact in terms of land-use and property impacts because it utilises much of the existing highway reserve. Where it diverts from the existing alignment, it runs largely along a gazetted road corridor apart from the section to the north-west of the sports fields and as the option curves back towards North Street.

9.5.4 Section D (south Berry to Bomaderry)

Planning and legislation

The existing road would be upgraded almost entirely within land zoned 1(b) Rural (Arterial and Main Road Protection) under the Shoalhaven Local Environmental Plans. The zoning objectives of preserving views and managing road access will be adopted along this option. The option through Section D will be permissible with development consent.

Land-use and property impacts

The impacts of property acquisition and severance will be minimised as most sections of the existing highway have adjacent land designated as road reserve. Access to properties and local roads will be maintained, but controlled to meet road design and road safety standards. Impact on and access to Meroo Meadow Union Church at Boxsells Lane, Meroo Meadow, will be considered as concept design and the environmental assessment progress and some residential properties in close proximity to the existing highway in Section D may need to be acquired depending on the level of direct or indirect impact.

9.6 Environmental issues

9.6.1 Section A (Mount Pleasant to south Gerringong)

Water quality

Impacts on water quality in Section A are minimised by upgrading the existing highway. Some existing drainage structures may need to be augmented to achieve flood immunity but there are no major waterway crossings required for this option. Water quality management of Ooaree Creek, Omega Flat and Werri Lagoon and associated State Environmental Planning Policy 14 Wetland will be considered in detail prior to concept design of the preferred option and will be assessed as part of the environmental assessment for the preferred option.

Terrestrial ecology

The preferred option will have minimal impact on terrestrial ecology in Section A. Little or no clearing of vegetation with conservation significance will be required and little or no significant habitat occurs adjacent to the existing highway in this section.

Aquatic ecology

The option will have little or no impact on aquatic ecology. No major waterway crossings are required and aquatic habitat impacts will be minimal. There may be some augmentation of drainage structures which will not have a significant impact on sensitive aquatic habitats although this will be further assessed during the environmental assessment of the preferred option, with particular regard to downstream impacts on Werri Lagoon and adjacent SEPP 14 wetlands.

Heritage

There will be minimal impact on cultural heritage values. The area immediately surrounding the existing highway has low archaeological sensitivity. There are two European heritage items identified in the Draft Kiama Heritage Inventory in the vicinity of the existing highway in Section A, Renfrew Park residence and the former Omega School. Potential impacts on these will be carefully considered during concept design and environmental assessment of the preferred option.

No items of Indigenous cultural heritage significance or potential archaeological deposits (PAD) have been recorded in the vicinity of the preferred option in Section A. However feedback from the Aboriginal Focus Group (AFG) and the site walkover conducted in June 2008, suggests that there may be significant cultural value attached to the Omega Flat and Ooaree Creek areas that will be traversed by the preferred option. Consultation and liaison with the AFG will be ongoing throughout concept design and environmental assessment to ensure that Aboriginal cultural values in these areas are appropriately addressed.

Noise and vibration

The preferred option follows the existing road corridor and is not likely to cause a significant change in the noise environment for the overall community. There may be a minor increase in noise levels at some locations where the upgraded highway moves closer to some residents.

There may also be some increased noise impact for residents in Gerringong depending on the preferred access arrangement. These impacts will be assessed and evaluated through the Gerringong and Berry access value management workshop process.

Urban design, landscape and visual amenity

In Section A the preferred option will have a visual impact as it descends the high ground from Mount Pleasant and crosses Omega Flat. Reinforcement of the openness of the landscape is appropriate where expansive views of pastureland from the highway are desirable. Ocean and pastoral views will be maintained on the descent from Mount Pleasant.

As the preferred option is based on an upgrade of the existing highway, the long-term impact could be expected to be similar to that of the existing highway. However immediately following completion the impact is likely to be greater as the wider formation will be noticeable and appear 'new'. The eastern edge of the 'new' corridor provides the opportunity for cultural landscape plantings to define the western edge of Gerringong.

By upgrading the existing highway many of the urban design objectives can be satisfied as both the natural and cultural landscape have been changing within this corridor for some time. The key urban design initiatives of the preferred option will:

- Protect and enhance the heritage and cultural values of this section of the corridor, by limiting the increased footprint of the highway corridor.
- Respect and respond to Gerringong by providing safe and improved access.
- Integrate the enjoyment of the existing journey by maintaining the strong visual connections to the ocean, hinterland and mountains while descending the Mount Pleasant ridge and passing through the unique Omega Flat area adjacent to Werri Lagoon.

The urban and landscape design of this section will have a mixture of rural and semi-urban highway characteristics. There is likely to be a grade separated interchange with potential for a significant bridge structure. Careful integration of these elements will take into account the existing landscape that dominates the current highly valued visual experience.

9.6.2 Section B (south Gerringong to north Berry)

Water quality

The two preferred options in Section B, Pink and Green routes, both cross the Crooked River and cross Broughton Creek three times. Potential impacts on water quality and downstream habitat value will be considered in detail through the concept design and environmental assessment of the preferred option. The upgrade is not expected to have a significant impact on water quality and aquatic ecology through careful design and best practice environmental management.

Terrestrial ecology

Significant ecological impacts associated with an option passing across Toolijooa ridge are largely negated by the Green route as it passes in tunnel under a significant area of endangered ecological community and some significant populations of known threatened species. There would however be some minor impact caused by earthworks required at the northern portal of the tunnel. Amelioration of potential impacts will be addressed as concept design develops to ensure that measures can be incorporated proactively rather than reactively as an outcome of the environmental assessment.

Both the Pink and Green routes would avoid a known area of highly significant vegetation located adjacent to the existing highway on the western side at Foxground, but both would have marginal impact on patches of native vegetation and corridor values. The Pink route would have some impact on a small patch of low significance vegetation to the west of Toolijooa ridge.

As discussed in **Section 3.4** a number of wildlife corridors exist in the study area and the Pink route would have some impact on the movement of fauna species in a significant fauna movement corridor across Toolijooa Ridge. The Green route would avoid this through the inclusion of the tunnel. Potential impacts of the Pink route are being evaluated and the feasibility of providing a land bridge across the cutting on the Pink route is being assessed as an additional investigation developed in the value management process (refer **Chapter 10**).

Aquatic ecology

The Pink and Green routes include three crossings of Broughton Creek and one crossing of Crooked River that will require careful design and best practice environmental management.

Heritage

Both options in Section B run in proximity to the archaeologically sensitive Toolijooa ridge, which has Indigenous heritage implications. Feedback from the Aboriginal Focus Group (AFG) and the site walkover conducted in June 2008 confirms the significant cultural value attached to Toolijooa ridge and a number of sites in the vicinity of the Section B options, namely 'The Little Mountain' or 'Dicky Wood's Meadow' battleground in the vicinity of Broughton Village, trading tracks from the escarpment to the coast and a former Aboriginal Encampment at Brookside.

Consultation and liaison with the AFG will be ongoing throughout concept design and environmental assessment to ensure that potential conflicts in these areas are addressed appropriately.

The two preferred options largely avoid European heritage sites, but those in the vicinity of both options include 'Sedgeford', 'Brookside', and some feeding stalls and dairy at 'Gembrook', at Broughton. The bridge carrying the existing highway over Broughton Creek is heritage listed. The Pink route also has the potential to impact this bridge.

Noise and vibration

As the Pink route largely follows the existing highway it would have the least change to current noise patterns. Although the Green route passes further away from the total number of receivers, the relative impact is significant as it would bring noise closer to receivers which currently enjoy relative quiet. Residences adjacent to the existing highway would enjoy a reduction in noise with both preferred options. However, as the existing highway would remain operational, they would be impacted by some noise from more than one direction.

Urban design, landscape and visual amenity

The alignment of the Pink route stays close to the existing Princes Highway alignment which is highly responsive to the natural varied and sloped terrain in this area. The option traverses areas of slope that average between 20 – 30 per cent, with some areas greater than 30 per cent.

The project objectives require a broad scale flowing alignment to meet safety and design speed criteria. This results in a significant cut embankment on the northern slope of the Toolijooa ridge in an area of high visibility. Large cut embankments in the order of 30 m deep and 900 m long in such areas may appear to be visually unbalanced with the natural landform.

The Pink route will clearly address some of the urban design objectives, but at the same time will provide a challenge in relation to other objectives. While the alignment flows to some extent the large cutting will not easily integrate with the natural landform and may not visually support the natural systems and ecology of the corridor.

Maintaining an alignment within the existing highway corridor will help to protect the heritage and cultural values of the corridor by reducing land severance and avoiding areas of significant habitat.

The Green route provides a similar flowing alignment to that of the Pink route, but the integration of a tunnel will significantly reduce the visual impact to the ridgeline and protects the natural ecology and cultural values of the corridor although a cutting would still be required to accommodate the south bound portal. This cutting would be smaller in size than the cutting required by the Pink route.

The Green route consistently addresses and satisfies the urban design objectives for the upgrade. While there is no precedent in the area to date for vehicular tunnels, the tunnel required for the option would to some degree be consistent with existing tunnels utilised by the South Coast railway line at numerous locations.

The alignment of the Pink and Green routes are common once they reach Austral Park Road and generally follow the existing highway alignment until the start of Section C. A large cutting will be required for the preferred option in this area due to the close proximity of the existing highway alignment to the lower slopes of the escarpment. Urban design mitigation measures would be considered as the design evolves to minimise the visual impact of this cutting.

9.6.3 Section C (Berry township)

Water quality

The level of impact of the preferred option in Section C on water quality is expected to be minimal as the appropriate level design integration and best practice environmental management will be applied throughout the next stages of the project. A significant structure would be required for the preferred option to cross Broughton Mill Creek and Woodhill Mountain Road as it descends from the ridgeline to the north of Berry and continues across Bundewallah Creek to the north-west of the sports fields.

Terrestrial ecology

The preferred option has a marginal impact on a patch of moderate significance vegetation along the western side of the existing highway near Tindalls Lane.

Aquatic ecology

As outlined above, the preferred option requires major waterway crossings to the north of Berry potentially impacting on aquatic ecology and riparian stability. This will be managed during the next stages of the project through careful design consideration and environmental management.

Heritage

The preferred option has incorporated a modification since the value management process that alleviates the potential heritage impacts associated with the Pulman Street heritage precinct to the east of Berry. There may be some minor impact associated with the preferred access arrangement at the northern end of town, but these will be considered in detail through the Berry access value management process and it is expected that impacts will be minimal.

Noise and vibration

The preferred option runs adjacent to the northern extent of Berry and will require the consideration of noise mitigation measures, particularly along North Street to alleviate potentially significant impacts to the adjacent residences. The extent of these mitigation measures will be assessed in detail through progressive concept design and environmental assessment of the preferred option.

Notwithstanding this, the preferred option provides a bypass of the main thoroughfare of Berry, Queen Street, which is expected to reduce the noise impacts currently associated with through traffic in the town itself.

Urban design, landscape and visual amenity

The preferred option has minor visual impact as it follows the existing highway alignment and the North Street corridor for much of its length. Distant views are afforded as it descends from the ridgeline to the north of Berry and continues across Bundewallah Creek to the north-west of the sports fields. Subtle curves with large radii provide variety, flow and integration with the existing landscape.

By upgrading the existing highway alignment for much of its length, many of the urban design objectives can be satisfied as both the natural and cultural landscape contexts have been changing within this corridor for some time. Upgrading the existing corridor also aids in protecting and enhancing the heritage and cultural values of the area by limiting the increased footprint of the highway.

The alignment of the preferred option is flowing and responsive to the subtle nuances of the natural landscape. An enjoyable journey would be provided for the motorist with visual connections to the coast and plains to the east and the hinterland and mountains to the south and south-west.

The portion of the preferred option that bypasses Berry along North Street is immediately adjacent to the township and careful consideration of pedestrian circulation and connectivity would need to be considered in the context of the urban design objectives at future design stages. It is likely that due to the proximity to Berry and potential for noise mitigation features, the option would have a semi-urban 'feel' along North Street. The selection of access locations to and from Berry requires careful consideration of the objectives of urban and regional design in order to manage potential visual impacts. This will be managed through the Berry access value management process and it is expected that with appropriate design consideration, impacts will be minimal.

9.6.4 Section D (south Berry to Bomaderry)

Water quality

Impacts on water quality are minimised by upgrading the existing highway to accommodate the preferred option in Section D. Some existing drainage structures may need to be widened to achieve flood immunity. This includes the reconstruction, augmentation or duplication of existing structures at Flying Fox Creek, Jaspers Creek and Abernethys Creek.

Appropriate precautions and mitigation measures will be implemented during construction of this structure and for the future operation of the upgrade. These precautions and measures will ensure minimal impact on water quality. The precautions and measures will be the subject of a water quality management plan to be developed as part of this study.

Terrestrial ecology

The preferred option will have minimal impact on terrestrial ecology. Some clearing of roadside vegetation with conservation significance will be required. Little or no significant habitat occurs adjacent to the existing highway in this section, although there are some recordings of threatened fauna in the vicinity of the existing highway, at Meroo Meadow and in the vicinity of Abernethys Lane in the south.

Aquatic ecology

The preferred option will have little or no impact on aquatic ecology.

Waterway crossings will be required at Flying Fox Creek, Jaspers Creek and Abernrthys Creek. These will be in the form of reconstruction, augmentation or duplication of existing structures and appropriate precautions and mitigation measures will be implemented to minimise impacts on aquatic habitats.

Heritage

There may be some impact on European cultural heritage values in the vicinity of Meroo Meadow as a result of upgrading the existing highway and some high archaeological value land associated with riparian corridors, particularly in the south of Section D. These potential impacts will be further assessed as part of the environmental assessment of the preferred option.

Noise and vibration

An upgrade of the existing route will have minimal impact on receivers as the noise environment will not change significantly other than minor increases, possibly associated with an increase in road traffic speed or proximity to the upgraded highway.

Urban design, landscape and visual amenity

The preferred option follows the existing highway which has three lanes and wide shoulders in some locations. It is also accommodated in a relatively generous existing road reserve. As the option requires relatively little change to the existing alignment it will have a low visual impact on the surroundings. Value of visual amenity to the driver will be relatively unchanged and care will be taken to limit clearance of existing mature trees, which will support the local fauna.

By upgrading the existing highway many of the urban design objectives can be satisfied as both the natural and cultural landscape context have been changing within this corridor for some time. The key urban design initiatives of the preferred option will:

- Protect and enhance the ecological and cultural values of this section of the corridor, by limiting the increased footprint of the highway.
- Respect and respond to Bomaderry by providing safe and improved access and minimising potential effects on the existing built environment of the town.
- Maintain the enjoyment of the existing journey for the motorist with strong visual connections to the flood plain, hinterland and the mountains beyond.

9.7 Community issues

9.7.1 Section A (Mount Pleasant to south Gerringong)

Community issues surrounding the preferred option in Section A relate primarily to access. It is fair to report that the community at large are uncomfortable with the present arrangements of the Fern Street and Belinda Street intersections and access to properties along the Mount Pleasant ridge.

The location and form of access is very important to the continued social and business well being of Gerringong. Access to the town is being assessed in detail separately through a value management workshop process and will take into account feedback from the community.

9.7.2 Section B (south Gerringong to north Berry)

The Pink and Green routes follow the existing highway in Section B for much of their length. As with any option comprising upgrading of the existing highway, community issues include provision of safe and convenient access. Severance of land area in the Broughton Creek floodplain is a concern as is property acquisition which will be necessary along widened sections of the existing highway. The Green route will have a reduced degree of community impact as severance is reduced through use of a tunnel under Toolijooa ridge where the Pink route utilises a large cutting.

9.7.3 Section C (Berry township)

The preferred option in Section C provides a bypass of Berry and removes through traffic from the town centre, which currently includes a high proportion of heavy vehicles. Much of the associated noise and air pollution will be removed from Queen Street, the town's main thoroughfare.

Many of the community issues raised during the short-listed route options display period have been alleviated with the modification of the Orange route. These issues were associated with impacts on the Pulman Street heritage precinct to the east of town and severance of the sports fields from town.

Some community perception of severance of the township as it extends up Kangaroo Valley Road remains, but this will be addressed by concept design and the arrangement of access at the southern end of town to and from the upgrade. Access between the town centre and Kangaroo Valley Road will be improved as the upgrade passes under Kangaroo Valley Road. The Kangaroo Valley Road bridge will remain close to its existing grade and there will be the opportunity for the provision of improved pedestrian and bicycle access to and from town through the design of the bridge.

The preferred option as it proceeds along the North Street corridor will have some community impacts in terms of potential visual intrusion and increased noise levels for the North Street residents. These potential impacts and appropriate levels of mitigation will be addressed through the preferred option concept design and environmental assessment.

9.7.4 Section D (south Berry to Bomaderry)

Community feedback on the preferred option through Section D has been limited to:

- Convenient access.
- Safe access.
- An upgrade alignment which removes blind summits and local road intersections.
- Concerns relating to property acquisition and property price effects.

As discussed above, the final design of the preferred option will include combinations of different widening techniques to optimise land acquisition. This will also include minimising clearing of valuable flora and fauna habitats.

9.8 Social-economic issues (study area wide)

An industry stakeholder survey was conducted in March 2008 to supplement the Preliminary Social-Economic Impacts Report prepared as *Appendix F* of the *Route Options Development Report (November 2007)*. The study involved both qualitative and quantitative methods, using a combination of discussions with business owners / managers and experience gained from other similar highway upgrade projects. The study has found that there are three principal categories of business which could be potentially impacted by the preferred option throughout the study area including:

- Agricultural businesses located on properties that are potentially directly affected, ie land acquisition may be required or the property access is directly affected by the preferred option, mainly dairy and beef cattle farming. These businesses could be affected by loss of productive land; changes to the size and shape of paddocks (through strip acquisitions or severance of properties); changes to farming conditions as a result of the road development affecting flooding behaviour, water supply, etc.; and changes to access between different parts of the property.
- Retail businesses in the towns of Gerringong and Berry serving mainly passing traffic. Previous studies of highway upgrading impacts have shown that the most affected businesses were those directly serving the needs of the motorist, ie motor vehicle services (particularly service stations), food and beverage outlets and to a lesser extent, accommodation establishments.
- Retail businesses outside of the urban areas, such as wineries and bed and breakfast establishments, which could be affected by changes to access to/from the highway and/or by changes to the amenity of their locations from visual and noise impacts resulting from the highway upgrade.

There are a number of mitigation measures that will be investigated and implemented where appropriate [11] as part of the development of the preferred option throughout the study area. These measures include consideration of:[12]

- Highway underpasses for the movement of cattle and machinery and equipment within and between farms.
- Truck access to, from and between farms to facilitate the efficient transport of agricultural inputs and products.
- Interchanges and other access points, and effective signage at these locations, to encourage through-traffic to pass through the urban areas of Gerringong and Berry and their shopping precincts.
- Arrangements, including effective signage, for access to retail businesses located outside of the Gerringong and Berry townships, both during highway upgrade works and following construction of the upgraded highway.
- Highway design features to maintain the amenity and character of the study area to support tourism development, particularly to ameliorate visual and noise impacts of the upgraded highway.
- An economic development strategy to manage an adjustment period associated with changed traffic volumes and movement patterns for businesses in Gerringong and Berry following the opening of the upgrade.

9.9 Preliminary concept design cost estimates and economic appraisal

9.9.1 Cost estimating approach

The preliminary concept cost estimates have been prepared in accordance with the *RTA's Draft Estimating Manual, 2006*. The manual requires the project cost estimates to be divided into the following six categories:

Category	Includes
Project development	The effort required to obtain project approval.
Investigation and design	The current route selection and concept design phase and subsequent detailed design and documentation phases.
Property acquisition	The cost to purchase land required for road reserve.
Public utility adjustment	The relocation or protection of existing public utilities.
Construction	• Environmental. • Noise mitigation. • Earthworks. • Drainage. • Pavement. • Bridges and structures. • Tunnel works. • Provision for traffic. • Miscellaneous.
Handover	The effort and documentation required at the completion of the project to hand over completed assets to the responsible management ant maintenance authority.

[11] Measures that are feasible, effective and reasonable to provide.

[12] It is acknowledged that some of these measures will be included directly as part of this project and some as 'by-products', eg. initiatives by Council.

The RTA's policy is to produce estimates that have a 90 per cent confidence of not being exceeded at any project stage. Probabilistic estimation techniques using Monte Carlo analysis were used to determine a contingency for the preferred options and to determine the 90 per cent confidence cost estimate figure.

As certainty with design detail, quantities, and rates improve, the proportion of contingency in the estimate will diminish. The reported preliminary concept design cost estimates therefore include a relatively large allowance for risk and unknowns.

9.9.2 Cost estimate

Two cost estimates for the preferred option have been prepared. One includes the Pink route and the other the Green route.

The cost estimates for the preferred option have been calculated in 2008 dollars. Previous cost estimates presented during the route options phase were calculated in 2007 dollars. An escalation factor of 5.6% has been applied to account for an increase in rates from June Qtr 2007 to June Qtr 2008. Source is Australian Bureau of Statistics, Producer Price Indexes, Road and bridge construction (4121) NSW.

Because probabilistic estimating methods run thousands of differing scenarios based on the likelihood and consequence of risks occurring for each cost item, it is not possible to indicate a fixed contingency amount against each cost item.

Table 9.1 provides a breakdown of the preferred option cost without the risk model applied. The effect on the total with the application of the risk model is reported at the bottom of the table. This is the 90 per cent confidence interval cost estimate reported for the preferred option.

Table 9.1 Preliminary concept design cost estimate for the preferred options

Estimate cost item	Preferred option including the Pink route (000)'s	Preferred option including the Green route (000)'s
Project development	$10,300	$11,714
Investigation and design	$26,690	$30,354
Property acquisition	$35,266	$32,862
Public utility adjustments	$2,175	$2,101
Environmental controls	$5,920	$5,969
Noise mitigation	$9,063	$9,428
Earthworks	$102,924	$93,253
Drainage	$43,773	$43,446
Pavements	$91,752	$90,479
Bridges and structures	$135,726	$134,443
Tunnel works	Nil	$74,030
Provision for traffic	$17,926	$17,021
Miscellaneous	$34,740	$34,783
Principal arranged insurance	$4,440	$5,050
Primary testing	$6,660	$7,574
Project management services	$29,581	$33,642
Client representation	$592	$673
Handover	$48	$55
Total (without risk model)	$560,000	$630,000
Total (with risk model)	$800,000	$890,000

9.9.3 Economic appraisal results

9.9.3.1 Introduction

The appraisal models all cash flows over a 36-year period, including the six years of construction between 2010 and 2015, at a (real) discount rate of seven per cent per annum. All cash flows have been discounted to 2008. The discounted cash flows from the 'without project' case and each of the development options were subsequently used in the calculation of the economic indicators. Three economic indicators were calculated as outputs of the economic appraisal to evaluate the relative attractiveness for each of the development options. A brief description of each indicator is provided as follows.

Net Present Value: measures the difference between benefits and costs, whilst accounting for the timing of benefits and costs. Net cash flows are discounted at the prescribed discount rate of seven per cent, reflecting the notion that future benefits and costs have less value compared to current benefits and costs. A project with a Net Present Value greater than zero would be considered desirable, with the project having the highest modelled Net Present Value being the most desirable.

Net Present Value Per Dollar of Investment: measures the return on a dollar of investment. The Net Present Value per Dollar of Investment is calculated by dividing the net present value by the present value of investment (construction costs have been used as the proxy for investment). A project with a Net Present Value per Dollar of Investment greater than zero would be considered desirable, with the project having the highest modelled Net Present Value being most desirable.

Benefit Cost Ratio: measures the return received per dollar of costs. The Benefit Cost Ratio is calculated by dividing the present value of all benefits by the present value of all costs. A project with a Benefit Cost Ratio greater than one would be considered desirable, with the project having the highest Benefit Cost Ratio being most desirable.

The Net Present Value per Dollar of Investment and Benefit Cost Ratio provide a scale in which to compare the relative attractiveness of different projects where the level of expenditure varies between projects.

It is important to note that the above economic indicators, individually, have various weaknesses in assessing the optimum project. Hence, the RTA and NSW Treasury Guidelines suggest a range of economic indicators to ensure the best outcome is selected.

9.9.3.2 Economic appraisal results

The results for the preferred options are shown in **Table 9.2**. Both preferred options produce positive economic returns.

Table 9.2 Economic appraisal results for the preferred options

Preferred option	NPV* ($ million)	BCR*	NPVI*
Preferred option including the Pink route	113.9	1.19	0.19
Preferred option including the Green route	58.4	1.09	0.09

Source: Maunsell estimates

Note: Note all costs and benefits are discounted to June 2008 values using a 7 per cent discount rate.

***NPV = Net Present Value**

***BCR = Benefit Cost Ratio**

***NPVI = Net Present Value per Dollar of Investment**

9.9.4 Sensitivity analysis

A sensitivity analysis was conducted on key parameters used to underpin the model to test the robustness of inferences made. Sensitivity tests were conducted on the following parameters:

- Level of traffic; minus 20 per cent.
- Construction costs; plus 20 per cent.
- High discount rate; 10 per cent.
- Low discount rate; 4 per cent

The results of the economic appraisal are shown in **Table 9.3**. For simplicity, only the Benefit Cost Ratio results have been generated.

Table 9.3 Sensitivity analysis (Benefits Cost Ratio's by preferred option

Option combination	Base case	Traffic -20%	Increased capex (+20%)	10% discount rate	4% discount rate
Preferred option including the Pink route	1.19	0.95	1.04	0.82	1.83
Preferred option including the Green route	1.09	0.87	0.91	0.76	1.69

The results suggest that the economic appraisal results are sensitive to the variables tested under the different scenarios although the ranking of the preferred options does not change.

Not used

10.0 The next steps

The preferred option, as it is described in this report, has been announced by the Minister for Roads. Concept design and environmental assessment of the preferred option will now commence.

A number of additional investigations, studies, and assessments will progress in parallel to address the following:

- Adoption of either the Pink or Green route as part of the overall preferred option.
- Adoption of preferred interchange options for Gerringong and Berry.

These tasks are described in more detail below. The community will be involved and kept informed of the progress of these tasks. It is expected that these tasks will be resolved and the preferred option refined in the first quarter of 2009. The findings will be publicly released at that time

10.1 Preference for Pink or Green route

The route options development process recommended that the Pink and the Green routes move forward to the next stage of development subject to the issues raised and documented in the value management workshop being addressed.

The Pink and Green routes are the same except for the length between Toolijooa Road and Austral Park Road. Additional investigation is required to determine which one best meets the project objectives over the length where they differ.

The value management workshop recommended that the cost data for the Pink and Green routes be refined. This was because the Green route generally performs better against the project objectives than the Pink route, however is more costly. The following investigations / studies are currently underway to further differentiate them:

- Review the cost estimate assumptions and allowances.
- Review the need for climbing lanes on both routes.
- Undertake targeted geotechnical investigations to better understand the rock, soil, and groundwater conditions.
- Further investigate the flora and fauna issues and needs.
- Consider further the potential Indigenous heritage impacts.
- Consider further the visual and urban design limitations and opportunities.

It is envisaged that determination and subsequent announcement of which one is selected to form part of the preferred option will be made in the first quarter of 2009.

10.2 Interchange options

A number of interchange options for access to Gerringong and Berry have been developed.

The preferred interchange options will be identified by following a similar process to that used to identify the preferred highway upgrade option. Hence, the preferred interchange options will be identified following collective consideration of the following:

- Technical input.
- Community feedback and submissions.
- Value management studies including a workshop.

Technical studies and prior feedback from the community have informed the development of the interchange options. The options will be on public display, and submissions will be sought from the community, in October 2008. The feedback received from the community will be considered at the value management workshop planned to be held in November 2008. It is anticipated that a preferred interchange options for Gerringong and Berry will be identified in the first quarter of 2009.

10.3 Further project development and community consultation

Concept design and environmental assessment of the preferred option including the interchange options will follow the announcement of the preferred option by the Minister for Roads.

Community consultation will continue throughout 2009 as part of concept design development and environmental assessment of the preferred option. The driving focus of consultation will be to continue involving the community and stakeholders in gathering input and feedback on potential impacts and management measures addressed in the environmental assessment.

Further ground survey, geotechnical, ecological, and other investigations will be undertaken to provide input into the refinement of the design and environmental assessment. The RTA will then submit the concept design and environmental assessment of the preferred option to the Department of Planning for approval under the *Environmental Planning and Assessment Act 1979 (EP&A Act)*.

The scope of environmental assessment required for the proposal will be determined in consultation with Department of Planning with input from relevant public authorities and local Councils. The statutory planning and approvals requirements of the project are outlined in more detail in **Chapter 3**.

Thus far, the key issues are identified as environmental and social therefore it is crucial that the approvals process selected provides a robust and transparent assessment to satisfy legislative requirements and community expectations.

When completed, the environmental assessment will be publicly exhibited and submissions would be sought from the community. It is anticipated that this would be in late 2009. The RTA may be required to prepare a report on the submissions received and revise any environmental commitments documented in the environmental assessment. The RTA would also consider design modifications to the project to minimise environmental impacts. The Department of Planning may request the RTA to display a preferred project report identifying any modifications.

10.4 Implementation strategy

An indicative implementation strategy has been considered and will be developed together with the development of the preferred option. The implementation strategy will include the programming for the design, environmental assessment approval process, property acquisition and construction of the upgrade. The community will continue to be consulted and informed.

10.5 Other Studies

Since the short-listed routes were displayed earlier this year, other studies have been ongoing. These are described below:

- Oral history; interviews have been conducted with senior community members to capture a historic record of the area and influences on and from the highway.
- Aboriginal knowledge holder interviews; interviews have been held with elders to record the Aboriginal history in the area.
- Spring surveys; surveys are underway (September to November 2008) to record flora and fauna extents along the preferred option.

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