

NSW Roads and Maritime Services

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE ENVIRONMENTAL IMPACT STATEMENT

MAIN VOLUME 1A

Chapter 4 – Project development and alternatives

Chapter summary

This chapter provides an overview of the alternatives and options that were considered during the development of the project.

The preferred alternative is to upgrade the Pacific Highway between Woolgoolga and Ballina as part of the Pacific Highway Upgrade Program. The preferred alternative was selected as it best meets the program objectives.

The preferred alternative would also meet the objectives of strategic planning and transport policies of the NSW and Australian governments, while also achieving a balance between environmental, social and economic impacts and benefits.

The route selection for the Woolgoolga to Ballina upgrade was carried out as four separate development projects between 2004 and 2011, as follows:

- Woolgoolga to Wells Crossing project
- Wells Crossing to Iluka Road project
- Iluka Road to Woodburn project
- Woodburn to Ballina project.

These previous development projects identified and evaluated route options and identified the preferred route. Each of these projects included extensive community and stakeholder consultation, with route options analysed using criteria developed by the then RTA and stakeholders, and considered against the project objectives.

The Woolgoolga to Ballina upgrade combines the preferred routes identified by each of these previous development projects to form the concept design for the project. In addition, further investigations and refinements have resulted in changes to the project design and boundary and changed the extent to which the project may affect properties in some areas. Minor adjustments in the road reserve would continue to be made during detailed design.

RMS 12.604A ISBN 978-1-922041-80-7



Contents

4.	Project development and alternatives4-1		
4.1	I.1 Alternatives considered		
	4.1.1 4.1.2	The base case ('do nothing')4-2Pacific Highway upgrade (the project)4-3	
4.2 Route options considered		tions considered	
	4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.6	Overview of methodology4-5Ecologically sustainable development4-8Woolgoolga to Wells Crossing4-9Wells Crossing to Iluka Road4-17Iluka Road to Woodburn4-26Woodburn to Ballina4-29	
4.3	3 Concept design of the project		
	4.3.1 4.3.2	Woolgoolga to Ballina project 4-39 Concept design review 4-39	
Refere	ences		

Tables and Figures	
Table 4-1: Route development process	4-5
Table 4-2: Short listed route options: Woolgoolga to Wells Crossing	-10
Table 4-3: Route option benefits and costs: Woolgoolga to Wells Crossing 4-	-12
Table 4-4: Short listed route options: Wells Crossing to Iluka Road 4-	-17
Table 4-5: Route option benefits and costs: Wells Crossing to Iluka Road 4-	-20
Table 4-6: Shortlisted route options: Woodburn to Ballina 4-	-29
Table 4-7: Route option benefits and costs: Woodburn to Ballina 4-	-33
Table 4-8: Refinements to the concept design of the project (July 2010 - October 2011) 4-	-40
Table 4-9: Refinements to the concept design of the project (October 2011 – March 2011). 4-	-41

Figure 4-1: Previous route development projects	. 4-6
Figure 4-2: Route development process	. 4-7
Figure 4-3: Short listed route options: Woolgoolga to Wells Crossing	4-11
Figure 4-4: Constraints influencing the project alignment: Woolgoolga to Wells Crossing	4-16
Figure 4-5: Short listed route options: Wells Crossing to Iluka Road	4-19
Figure 4-6: Constraints influencing project alignment: Wells Crossing to Iluka Road	4-25
Figure 4-7: Constraints influencing preferred route selection: Iluka Road to Woodburn	4-28
Figure 4-8: Shortlisted route options: Woodburn to Ballina	4-32
Figure 4-9: Constraints influencing project alignment: Woodburn to Ballina	4-38

4. Project development and alternatives

This chapter provides an overview of the alternatives and options that were considered during the development of the project. It outlines the route development and selection process, demonstrating how the preferred route was selected and further concept design refinements made to the project.

Di	rector-General's requirements	Where addressed	
Th an Er an	The Environmental Impact Statement must be prepared in accordance with ad meet the minimum requirements of Part 3 of Schedule 2 of the invironmental Planning and Assessment Regulation 2000 (the Regulation) ad include the following:		
٠	An analysis of feasible alternatives to the carrying out of the project	Section 3.1, 3.3 and 3.4	
•	An analysis of alternatives/ options considered, having regard to the project objectives (including an assessment of the environmental costs and benefits of the project relative to alternatives and the consequences of part approximately and the consequences of part approximately and the consequences of part approximately a	Section 4.1	
	or not carrying out the project)	Section 3.5.2	
٠	The provision of a clear discussion of the route development and selection process	Section 4.2	
٠	The suitability of the chosen alignment and whether or not the project is in the public interest.	Chapter 21 – Justification and conclusion	
Sı	upplementary Director-General's requirements	Where addressed	
Su Th of	upplementary Director-General's requirements ne following matters must be addressed in the environmental assessment the action:	Where addressed	
Su Th of	Applementary Director-General's requirements the following matters must be addressed in the environmental assessment the action: The background to the development of the action	Where addressed Section 3.1 Section 4.1 and 4.2	
Su Th of •	upplementary Director-General's requirements the following matters must be addressed in the environmental assessment the action: The background to the development of the action The consequences of not proceeding with the action	Where addressed Section 3.1 Section 4.1 and 4.2 Section 3.5.2	
Su Th of •	upplementary Director-General's requirements ne following matters must be addressed in the environmental assessment the action: The background to the development of the action The consequences of not proceeding with the action To the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including:	Where addressed Section 3.1 Section 4.1 and 4.2 Section 3.5.2	
Su Th of •	upplementary Director-General's requirements he following matters must be addressed in the environmental assessment the action: The background to the development of the action The consequences of not proceeding with the action To the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including: • if relevant, the alternative of taking no action; • a comparative description of the impacts of each alternative on the	Where addressed Section 3.1 Section 4.1 and 4.2 Section 3.5.2 Section 4.1.1	
Su Th of •	 Applementary Director-General's requirements The following matters must be addressed in the environmental assessment the action: The background to the development of the action The consequences of not proceeding with the action To the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including: if relevant, the alternative of taking no action; a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action; and sufficient detail to make clear why any alternative is preferred to 	Where addressed Section 3.1 Section 4.1 and 4.2 Section 3.5.2 Section 4.1.1 Section 4.2,	

4.1 Alternatives considered

Consideration of the strategic alternative ('do nothing') to the project is only briefly addressed here, given:

- The jointly funded Pacific Highway Upgrade program has been underway for 15 years and is over 50 per cent complete, with funding committed to complete a further 11 per cent and about another 7 per cent to commence by mid-2014
- Route selection of this section of highway between Woolgoolga and Ballina was finalised in 2010.
- Land acquisition for the section of highway will be complete by 2014 with over 64 per cent of the land acquisitions within the project boundary currently underway or already finalised
- There is strong commitment from both the Australian and NSW governments for completion of the Pacific Highway Upgrade program.

Consideration of the do nothing alternative and the preferred alternative in the context of achieving the project objectives as detailed in Table 3-1 is outlined and evaluated below.

4.1.1 The base case ('do nothing')

The base case involves retaining the existing highway, in its current configuration, as the main north– south transport corridor between Woolgoolga and Ballina, without any upgrade or safety works. The base case would involve only undertaking maintenance on the highway (eg line-marking, refurbishing the road pavement surface, and maintaining the verge and median).

Evaluation

The base case alternative is not considered to be a viable alternative to carrying out the project as it would not be able to accommodate the predicted growth in traffic. By 2024, the Pacific Highway coastal corridor will be serving a forecast coastal population of almost one million (DOTARS, 2007). There will be a consequent increase in local and regional passenger and freight movements, and continuing growth in through freight movements between Sydney and Brisbane.

The base case alternative would not be a viable alternative to carrying out the project as it would result in:

- The deterioration of traffic conditions and an increase in conflicts between local and through traffic, a decreased level of service and an increase in travel times and traffic delays, particularly during times of high traffic periods such as holiday periods
- A failure to address the unacceptably high accident record of this section of the highway, along with the associated social and economic accident costs
- An inconsistent road standard between Woolgoolga and Ballina following the upgrade of some sections of the Pacific Highway (Glenugie and Devil's Pulpit upgrades)
- Adverse environmental effects such as noise, vibration and reduced amenity, particularly in towns along the highway
- Increased freight transport costs
- Ongoing constraints on regional economic development due to deteriorating levels of access for both tourists and freight.

This 'do nothing' alternative would not meet the objectives of strategic planning and transport policies of the NSW and Australian governments.



Photo 1: Existing Pacific Highway, north of Parker Road, Wells Crossing

4.1.2 Pacific Highway upgrade (the project)

This alternative would involve upgrading the section of the Pacific Highway between Woolgoolga and Ballina to a four-lane dual carriageway standard, as part of the Pacific Highway Upgrade Program. The Pacific Highway Upgrade Program has been identified as being critical for economic growth along the NSW North Coast in the NSW State Infrastructure Strategy 2012–2032.

The Pacific Highway Upgrade Program – which involves upgrading the highway between Hexham and the Queensland border – commenced in 1996. As of April 2012, 346 of the 664 kilometres of highway have been upgraded.

Evaluation

The section of highway between Woolgoolga and Ballina is the main 'missing link' in the Pacific Highway Upgrade Program, and the benefits of the program would not be fully realised until the entire program is completed.

Although this alternative would have environmental, social and economic costs, particularly where the highway is upgraded on a new alignment, it is the preferred alternative because it best addresses the key transport needs for the Sydney–Brisbane corridor. In contrast to the other alternatives, this option would:

- Improve road safety for all road users due to the high standard design, including dual carriageways and controlled access conditions
- Improve travel times and transport efficiency for local and regional traffic, including freight transport between regional and capital centres
- Increase traffic capacity and improve the level of service along the highway, resulting in less congestion and fewer delays, especially during peak holiday periods

• Provide good economic outcomes for road users. As the benefits would be greater than the costs, this alternative would be a sound investment of public funds.

As a result, this alternative would also best meet the objectives of the Pacific Highway Upgrade Program, to:

- Reduce road accidents and incidents
- Reduce travel times
- Reduce freight transport costs
- Develop a route that involves the community and considers their interests
- Provide a route that supports economic development
- Provide best value for money.

This alternative would also meet the objectives of strategic planning and transport policies of the NSW and Australian governments, and achieve a balance between environmental, social and economic impacts and benefits.

Having regard to the project objectives and the resultant effects of not upgrading the Pacific Highway, the 'do nothing' option was rejected and the route selection process was commenced.



Photo 2: Section of the completed Glenugie upgrade, part of the Pacific Highway Upgrade Program

4.2 Route options considered

4.2.1 Overview of methodology

The route selection for the Woolgoolga to Ballina upgrade was carried out as the following four separate development projects between 2004 and 2011 (refer to Figure 4-1):

- Woolgoolga to Wells Crossing
- Wells Crossing to Iluka Road
- Iluka Road to Woodburn
- Woodburn to Ballina.

The four development projects identified feasible (short listed) route options, identified potential environmental and social issues within a broad study area (investigation corridor), consulted extensively with the community and stakeholders, and evaluated the route options to identify the preferred route. The options were evaluated against project specific criteria developed by the then RTA, the community and stakeholders, taking into consideration the project objectives (see Section 3.2).

The route development process for the project is shown in Table 4-1 and Figure 4-2.

Table 4-1: Route development process

Stage	Activities
Identification of route options	An investigation corridor was identified, and preliminary information on engineering, environmental, social and economic constraints was analysed. From this information, potential route options were identified. Feasible route options were then short listed for further investigation.
Evaluation of route options	The short listed options were compared in terms of functional, environmental, social and economic criteria, with input from the community and stakeholders.
Preferred route	The concept design for the preferred route was developed further and refined.
Concept design	Once the preferred route was selected, the concept design was developed further.

The route development process aimed to avoid or minimise overall impacts on biodiversity and social constraints to arrive at the preferred option which is assessed in detail in this EIS. Other environmental issues that were investigated included topography, geology and soils, drainage and flooding, water quality, planning, socio-economic and land use, Aboriginal cultural and non-Aboriginal heritage, noise, and visual character.

The route development process included consideration of the matters relevant under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Environmental Planning and Assessment Act 1979*.

During the route development process, the environmental and social studies were largely desktop (including searches of relevant databases including Commonwealth Department of Sustainability, Environment, Water, Population and Communities website based EPBC Act Protected Matters Search Tool). However, some field survey was also undertaken. Due to the considerable logistical and cost barriers involved in more extensive surveys, it was not reasonably practicable to undertake more extensive surveys at this stage of route development. However, sufficient investigations were undertaken to enable evaluation of the route options. This evaluation of options considered previous biodiversity studies (undertaken as part of the route selection and concept design development process). These studies form part of the reports listed and sourced later in this section. The biodiversity study (Working paper – Biodiversity (SKM, 2012)) undertaken for the EIS was also considered, particularly in relation to federally listed matters.

Preliminary assessment of these options was undertaken and included field investigations, specialist studies and community input from the community liaison group, stakeholder meetings and community information displays. These investigations and studies are identified in Figure 4-2.



- Upgrade completed to dual carriageway
- Upgrade under construction
- ----- Existing Pacific Highway

Figure 4-1: Previous route development projects



Figure 4-2: Route development process

Detailed information on the route selection and concept design development processes for these projects is provided in the following reports as identified in Figure 4-2:

- Woolgoolga to Wells Crossing Route Options Report (RTA, 2005a)
- Woolgoolga to Wells Crossing Preferred Route Report (RTA, 2006d)
- Woolgoolga to Wells Crossing Concept Design Report (RTA, 2008c)
- Wells Crossing to Iluka Road Route Options Development Report (RTA, 2005c)
- Wells Crossing to Iluka Road Preferred Route Report (RTA, 2006c)
- Wells Crossing to Iluka Road Concept Design Report (RTA, 2009)
- Discussion paper on Tyndale to Maclean alternative route (RTA, 2010)
- Tyndale to Maclean Alternative Alignment Decision Report (RTA, 2011)
- Iluka Road to Woodburn Concept Design Report (RTA, 2006a)
- Iluka Road to Woodburn Preferred Concept Design Report (RTA, 2008a)
- Woodburn to Ballina Route Options Development Report (RTA, 2005b)
- Woodburn to Ballina Upgrade Preferred Route Report (RTA, 2005c)
- Woodburn to Ballina Upgrade Concept Design Report (RTA, 2008b).

These reports and additional documents supporting the preferred route and concept design for the previous development projects, including methodology, working papers and outcomes of community and stakeholder involvement, are available on the RMS website:

http://www.rta.nsw.gov.au/roadprojects/projects/pac_hwy/index.html (click on Woolgoolga to Ballina).

In 2010, these four previous development projects were combined to form the Woolgoolga to Ballina upgrade for the purpose of seeking project approval for construction. The following sections describe the selection process of the preferred route for the previous development projects.

4.2.2 Ecologically sustainable development

The objectives of the Pacific Highway Upgrade Program and the project identify the need to consider the principles of ecologically sustainable development (ESD) in the development of the project. Throughout the route development process, ESD was a key consideration. It involved:

- Applying a precautionary approach to the identification of constraints, recognising that at this early stage of the project there was uncertainty in relation to the accuracy and completeness of data. Route options were developed and refined, to minimise impacts to known and potential biodiversity, heritage and social issues (identified in detail in the following sections)
- Conserving biological diversity and ecological integrity through the use of constraints mapping to identify known and potential ecological resources; and adopting the principle of avoiding impacts where possible and, where unavoidable, taking all reasonable steps to minimise impacts
- Considering the impacts on local communities and balancing these impacts against the project requirements and cost, ensuring that the actions of this generation do not compromise the quality of life of future generations
- Applying the principle of integration in assessing the route options, with a consideration of environmental, social and economic issues in the decision-making process.

The application of these principles in each of the evaluation of options for the development projects is outlined in the following sections.

4.2.3 Woolgoolga to Wells Crossing

The development of the preferred route for the Woolgoolga to Wells Crossing project commenced in November 2004. Route options were announced and placed on display for community comment in October 2005. The preferred route was announced on August 2006 and placed on display for community comment, and the Barcoongere Way and Luthers Road alignment was identified in May 2007 following further community, agricultural and environmental investigations. The concept design was displayed in April 2008.

Identification of alignment options

The investigation corridor for this project is located between Coffs Harbour and Grafton. The corridor commences at Arrawarra Creek south of the Tasman Street intersection and extends for 27.8 kilometres, over the Dirty Creek Range, to the intersection of the highway with Bald Knob Tick Gate Road. The corridor investigated was up to three kilometres wide, and generally surrounds the existing highway.

The range of possible alignments for this project was initially developed based on known constraints identified in the investigation corridor. The project was divided into five sections:

- Section A: This section is from Arrawarra Creek to the Tasman Street intersection. Key features
 within this section include connection to the Sapphire to Woolgoolga upgrade project, Wedding
 Bells State Forest and the village of Arrawarra
- Section B: This section is from the Tasman Street intersection to 500 metres south of Barcoongere Way. Key features within this section include the villages of Corindi Beach and Corindi, and the floodplains of Corindi River and associated tributaries
- Section C: This section is from 500 metres south of Barcoongere Way to 400 metres south of Falconers Lane. Key features within this section include Dirty Creek Range, extensive blueberry plantations and Newfoundland State Forest
- Section D: This section is from 400 metres south of Falconers Lane to, and inclusive of, the intersection with Lemon Tree Road. Key features within this section include Yuraygir State Conservation Area and the recently completed Halfway Creek duplication
- Section E: This section is from Lemon Tree Road to Bald Knob Tick Gate Road. Key features within this section include the locality of Halfway Creek, Yuraygir State Conservation Area, Newfoundland State Forest and Wells Crossing Flora Reserve.

Four feasible route options were short listed (known as the blue, green, purple, and orange options), with some of the options sharing a common corridor through some of the project sections (refer to Table 4-2 and Figure 4-3). In section C, the purple and orange options were on the same alignment; in section E, the green, purple and orange options were on the same alignment. All options start at Arrawarra Creek, following the existing highway alignment along the eastern edge of Wedding Bells State Forest. All options end at Bald Knob Tick Gate Road. (Further information on the route options can be found in the Woolgoolga to Wells Crossing Route Options Development Report (RTA, 2005d)).

Option	Description
Blue option	This option follows the existing highway alignment before crossing the Corindi River, where it deviates west across the Corindi River floodplain. It rejoins the existing highway south of Corindi before continuing along the existing highway through Corindi to Barcoongere Way where it diverts to the west. It crosses through Dirty Creek Range, deviating to the east of the existing highway at the southern tip of Newfoundland State Forest. It comes back to the existing alignment, incorporating the Halfway Creek duplication.
Green option	This option follows the existing highway alignment before crossing the Corindi River, where it deviates east across the Corindi River floodplain and east of Corindi. It rejoins the existing highway about one kilometre north of Corindi. It follows the existing highway to Barcoongere Way where it deviates to the east through Dirty Creek Range, rejoining the existing highway near Falconers Lane. It follows the existing highway alignment to Lemon Tree Road where it deviates to the east before rejoining the existing highway about 500 metres north of Luthers Road.
Purple option	This option follows the existing highway alignment before crossing the Corindi River, where It deviates west across the Corindi River floodplain. It diverts to the east of Corindi and rejoins the existing highway about one kilometre north of Corindi and follows this alignment to Barcoongere Way. It diverts to the west through Dirty Creek Range and rejoins the existing highway near Range Road. It follows the existing highway alignment to near Kungala Road where it deviates to the east, rejoining the existing highway alignment about 500 metres north of Luthers Road.
Orange option	This option follows the existing highway alignment, deviating to the west of the existing highway south of crossing the Corindi River. North of the Corindi River, it follows a relatively straight alignment to the west of Corindi. It rejoins the existing highway about 1.5 km north of Corindi and follows this alignment to about 500 metres south of Barcoongere Way before passing to the west through Dirty Creek Range and rejoins the existing highway near Range Road. It follows the existing highway alignment to near Kungala Road where it deviates to the east, rejoining the existing highway alignment about 500 metres north of Luthers Road.

Matters of national environmental significance in the Woolgoolga to Wells Crossing study area

A protected matters search which identifies matters of national environmental significance as listed under the EPBC Act 1999, was undertaken for the project in September 2012. In addition, information from previous field surveys and assessments undertaken as part of the route option process (refer to Woolgoolga to Wells Crossing Route Options Report (RTA, 2005d)) were reviewed to identify matters of national environmental significance within the study area. The research identified:

- The following species may be present in the study area:
 - Osprey (Pandion haliaetus) EPBC Act listed Migratory species
 - Oxleyan Pygmy Perch (Nannoperca oxleyana) EPBC Act listed endangered species
 - Eastern Freshwater Cod (*Maccullochella ikei*) EPBC Act listed endangered species (in Halfway Creek and tributaries)
 - Giant barred Frog (Mixophyes iterate) EPBC Act listed endangered species
 - Grey-Headed Flying Fox (*Pteropus poliocephalus*) EPBC Act listed vulnerable species
 - Spotted-tailed Quoll (*Dasyurus maculatus maculatus* (SE population)) EPBC Act listed endangered population
 - Southern Swamp Orchid (Phaius australis) EPBC Act listed endangered species
- Known presence of Square fruited Ironbark (*Euclatypus tetralerua*) EPBC Act listed vulnerable species
- Solitary Islands Marine Park is situated downstream of Arrawarra Creek and Arrawarra Gully



Figure 4-3: Short listed route options: Woolgoolga to Wells Crossing

Evaluation of options

Preliminary assessment of these options was undertaken and included field investigations, specialist studies (including assessment of Commonwealth listed matters of environmental significance) and community input from the community liaison group, stakeholder meetings and community information displays.

All options would impact on primary, secondary and supplementary Koala feed trees, Square fruited Ironbark and would cross potential Oxleyan Pygmy Perch habitat around Corindi Creek and its tributaries.

The environmental benefits and costs of each option are detailed in Table 4-3.

Table 4-3: Route option benefits and costs: Woolgoolga to Wells Crossing

Option	Advantages/ benefits	Disadvantages/ costs
Blue option	 Would make maximum use of the existing highway Would minimise impacts, acquisition and vegetation removal (including removal of the Commonwealth listed Eucalyptus tetrapleura in Newfoundland State Forest and Wells Crossing Flora Reserve Would follow the existing highway across Corindi River, minimising impacts to potential Oxleyan Pygmy Perch (a Commonwealth listed threatened species) habitat. 	 Would widen the highway through Corindi village, which may restrict local access Would have the greatest noise impact on Corindi village Would impact on the most number of properties. These would be potentially affected by strip acquisition.
Green option	 Would be a westerly bypass of Corindi village Would have low noise impacts on Corindi village Would require acquisition of the least number of properties Would be the shortest and straightest option resulting in lower construction costs Would follow the existing highway across Corindi River, minimising impacts to the Commonwealth listed Oxleyan Pygmy Perch potential habitat. 	 Would cut through Newfoundland State Forest and the edge of Wells Crossing Flora Reserve, requiring acquisition and vegetation removal (including removal of the Commonwealth listed Eucalyptus tetrapleura Would have the deepest cuttings through Dirty Creek Range (up to 40 m). Would impact on known presence and habitat of Commonwealth listed Koala (<i>Phascolarctos cinereus</i>).
Purple option	 Would pass to the west of Corindi village Would impact the fewest sensitive noise receivers. 	 Would cut through Newfoundland State Forest and the edge of Wells Crossing Flora Reserve, requiring acquisition and vegetation removal (including removal of the Commonwealth listed Eucalyptus tetrapleura Would require acquisition of a high number of properties and, potentially, a large land area Would require re-alignment of the Halfway Creek duplication Would have the longest floodplain crossing, resulting in greater potential for flooding impacts and need for longer, costlier bridges Would be the most expensive option.
Orange option	 Would be a westerly bypass of Corindi village Would be the shortest floodplain crossing, reducing the chance of flooding the highway and reducing the need to incorporate bridge structures. 	 Would require construction of two new carriageways for the majority of the option Would cut through Newfoundland State Forest and the edge of Wells Crossing Flora Reserve, requiring acquisition and vegetation removal (including removal of the Commonwealth listed <i>Eucalyptus tetrapleura</i>)

Option	Advantages/ benefits	Disadvantages/ costs
		 Would require acquisition of the greatest land area of private and public land Would require re-alignment of the Halfway Creek duplication Would require the greatest removal of vegetation, including endangered ecological communities (EEC) Would potentially impact on habitat on the Commonwealth listed Osprey (<i>Pandion haliaetus</i>).

Community feedback

The evaluation of the short listed route options (see Table 4-3), took into consideration community member, stakeholder and the project team views through a series of workshops. (Further information can be found in the Woolgoolga to Wells Crossing Preferred Route Report (RTA, 2006d).) These included a value management workshop in which the options were analysed against three criteria:

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

The workshop recommended that the orange option required further investigation of a number of issues (including impacts on Aboriginal heritage and ecology) and should be pursued with the following refinements:

- Between Corindi River and Range Road: Straighten the option on a new alignment, rather than connecting back to the existing highway
- Near Kungala Road and Luthers Road: Locate the option closer to the existing highway to minimise vegetation loss.

Further investigations and analysis

The project team developed a 'refined orange option' based on these refinements, and further engineering, ecological and heritage investigations were undertaken.

The project team then undertook a route selection workshop that analysed the four original short listed route options and the refined orange option to select a preferred route. The route options were analysed against functional, community and environment criteria to satisfy the Pacific Highway Upgrade Program objectives. The route options were then considered in conjunction with a construction cost estimate to determine which option would provide the best value for money.

The route was selected based on a balance of community feedback, outcomes of the value management workshop and RMS' own technical investigations and review. The preferred route option for each section is identified in the following sections.

Section A

The refined orange option was selected for section A. It was considered to be better to the other options because it would:

- Re-use the existing highway as a southbound carriageway in a class A upgrade scenario
- · Make maximum use of the existing road reserve
- Allow for the staged construction of the highway upgrade over time to better suit traffic growth and demand
- Result in similar potential noise impact relative to the existing highway for those residential receivers located within a 500-metre radius of the existing highway
- Represent the best value for money overall.

However, this option would potentially impact potential habitat for the Commonwealth listed threatened species Koala and Oxleyan Pygmy Perch.

Sections B and C

In sections B and C, the refined orange and orange options were chosen for further investigation to minimise the impacts on biodiversity, agricultural land and rural residential properties. This combination of options resulted in the identification of a localised wider corridor across the Corindi River floodplain. This combination of options was considered to be superior to the other options in section B because it would:

- Provide the opportunity to select a preferred road alignment with the shortest travel time for both light and heavy vehicles up the ascent of Dirty Creek Range
- Present the lowest engineering risk as it would involve the shortest crossing of the Corindi floodplain and areas of soft soils. This would result in the shortest length of bridging for floodwater mitigation and areas requiring soft soil treatment
- Have some ecological impacts, for which mitigation can be provided
- · Have the lowest overall noise impact on communities
- Have the least impact in terms of severance through the townships of Corindi and Corindi Beach (ie would have the greatest separation between the proposed road corridor and these residential areas)
- Avoid key areas of known cultural sensitivity
- · Potentially better satisfy overall community expectations
- Allow the existing highway to be used as a local access road and minimise the need to build new local roads
- Represent the best value for money overall.

Similarly, this combination of options was considered to be superior to the other options in section C because it would:

- Provide the opportunity to select a preferred road alignment with the shortest travel time for both light and heavy vehicles up the ascent of Dirty Creek Range
- Present the lowest engineering risk as it would minimise the extent of areas involving the widening of existing cuttings under traffic
- Have the lowest overall noise impact
- Not impact on Newfoundland State Forest
- Result in the lowest overall capital cost when combined with the preferred route in section B
- Represent the best value for money overall.
- Sections B and C would also impact on potential Koala habitat.

Section D

In section D, the blue option was selected as the preferred route because it would:

- Maximise the use of existing assets (particularly the Halfway Creek duplication) and those sections of the existing highway that comply with the design standards for the Pacific Highway Upgrade
- Represent the best value for money overall.

Section D would impact on Koala habitat.

Section E

A combination of blue, refined orange and orange options was selected for further investigation in section E, due to a number of identified constraints. A widened corridor was identified from 60 metres south of Kungala Road to about 1.1 kilometres north of Kungala Road.

This widened corridor was subject to further investigations including ecological and Aboriginal heritage, engineering design, and consultation with potentially affected parties to determine the final alignment of the preferred route.

Section E would impact on populations of the Commonwealth listed threatened species *Eucalyptus tetrapleura* and Koala habitat.

Preferred route

The preferred route was announced in August 2006 and consisted of the orange, refined orange and blue options.

The preferred route would have potential impacts on the Commonwealth listed threatened species Koala, Oxleyan Pygmy Perch and Square-fruited Ironbark. However, the preferred route was selected as it maximised the use of the existing highway infrastructure and provided a lesser engineering risk by minimising crossing areas of soft soils and having the shortest crossing through the Dirty Creek Range.

The preferred route starts at Arrawarra Creek just south of Tasman Street, and follows the existing highway, before deviating to the west. It passes to the west of Post Office Lane and bypasses the Corindi community on a new alignment before rejoining the existing highway north of Range Road, where a full interchange is proposed. It then follows the existing highway until the Halfway Creek duplication. North of Halfway Creek, it generally follows the existing highway until Bald Knob Tick Gate Road.

Refinement of the preferred route

Following the announcement of the preferred route, further investigations were undertaken to refine the widened corridors across sections B, C and E. (These investigations are discussed in detail in the Woolgoolga to Wells Crossing Preferred Route Report – Barcoongere Way and Luthers Road Areas (RTA, 2007)). The corridor was refined to further reduce property, agricultural and Aboriginal heritage impacts.

Following the investigations, the refined orange option was selected as the preferred route in sections B and C, while the orange and blue options were chosen as the preferred route in section E.

The following design refinements were also identified during this phase:

- Changes were made to the horizontal alignment to reduce impacts on residential properties and the Wells Crossing Flora Reserve
- Changes were made to Eggins Drive to make it a through road to connect to Corindi Beach.

The design refinements would result in reduced ecology impacts on Wells Crossing Flora Reserve, including minimising the removal of *Eucalyptus tetrapleura* (a Commonwealth listed threatened species.

The (final) preferred route would have a number of benefits. In particular, it would:

- Involve the shortest crossing over the Corindi floodplain and have lower ecological impacts that could be mitigated
- Have minimal impact on areas of Aboriginal heritage sensitivity and would not require acquisition of land from the local Aboriginal Land Council
- Minimise the amount of soft soil areas traversed, reducing the need for preload embankments prior to and/or during construction
- Provide the shortest travel time around the Dirty Creek Range
- Have a minimal/manageable impact on the operation of the blueberry farm at Dirty Creek
- Have no impact on the Yuraygir State Conservation Area
- Incorporate the previously upgraded section of highway at Halfway Creek.

The key constraints that influenced the selection of the project alignment between Woolgoolga and Wells Crossing are shown in Figure 4-4.



Figure 4-4: Constraints influencing the project alignment: Woolgoolga to Wells Crossing

Wells Crossing to Iluka Road

Investigations into the Wells Crossing to Iluka Road project commenced in November 2004. Short listed route options were announced and placed on display for community comment in October 2005. The preferred overall route was announced in September 2006, with the concept design announced and placed on display for community comment in January 2009. In October 2010, following community feedback, an alternative alignment between Tyndale and Maclean was announced and placed on display for community comment. The alternative route was adopted in August 2011.

Identification of alignment options

The investigation corridor for the project extended from Wells Crossing in the south to Iluka Road in the north and from South Grafton in the west to Pillar Valley in the east. It was mostly located to the east of the existing Pacific Highway.

Possible alignments were identified using constraints mapping, preliminary investigations within the study area, and other project requirements such as design standards. These alignments were tested to consider social, environmental and physical constraints. Options suggested by the community were also considered.

The Wells Crossing to Iluka Road project was separated into two sections:

- Wells Crossing to Harwood Bridge
- Harwood Bridge to Iluka Road.

Between Wells Crossing and Harwood Bridge, four short listed route options were identified from the long list of possible route corridors. These were known as the orange (A), purple (B), green (C) and red (D) options (refer to Table 4-4 and Figure 4-5).

These options were further refined to achieve a balance between social, environmental and design parameters. The route options involved a combination of upgrading along the existing alignment and new alignments. All options rejoined the existing highway alignment south of Harwood Bridge.

Between Harwood Bridge and Iluka Road, a common corridor was identified predominantly to the east of the existing highway.

Option	Description
Orange (A)	This was the most westerly of the route options considered. It mostly involves a new dual carriageway adjacent to the existing highway, with an easterly deviation between Bom Bom State Forest and Swan Creek, a new alignment east from South Grafton deviating away from Grafton, a bypass of Ulmarra and a deviation at Tyndale.
Purple (B)	This option follows the existing highway from Wells Crossing to the northern end of Glenugie State Forest. From here it deviates north, passing east of Grafton Airport bypassing Grafton and Ulmarra, continuing to the north-east on a new alignment before rejoining the existing highway alignment south of Maclean.
Green (C)	This option deviates from the existing highway at Bald Knob Tick Gate Road, north of Wells Crossing, and generally follows the eastern side of the study area in a more direct alignment than the Purple (B) option, rejoining the existing highway south of Harwood Bridge.
Red (D)	This option follows the Green (C) option alignment until south of Firth Heinz Road, where it follows a more easterly alignment, bypassing all towns on the existing highway until rejoining the existing highway alignment at Harwood Bridge.

Table 4-4: Short listed route options: Wells Crossing to Iluka Road

Matters of national environmental significance in the Wells Crossing to Iluka Road study area

A protected matters search which identifies matters of national environmental significance as listed under the EPBC Act 1999, was undertaken for the project in September 2012. In addition, information from previous field surveys and assessments undertaken as part of the route option process (refer to Wells Crossing to Iluka Road Route Options Development Report (RTA, 2005a)) reviewed to identify Commonwealth listed matters of national environmental significance within the study area. Issues identified were:

- The following species may occur within the study area:
 - Sandstone Rough-barked Apple (Angophora robur) EPBC Act listed vulnerable species
 - Koala (*Phascolarctos cinereus*) EPBC Act listed vulnerable species
 - Giant Barred Frog (*Mixophyes iterates*) EPBC Act listed endangered species
 - Eastern Freshwater Cod (*Maccullochella ikei*) EPBC Act listed endangered species (may occur within some of the larger pools within the study areas)
 - Spotted-tailed Quoll (*Dasyurus maculatus maculatus* (SE population)) EPBC Act listed endangered population
- Eucalyptus tetrapleura (EPBC Act listed vulnerable species) is known to occur in the study area
- EPBC Act listed Critically-Endangered EEC, Lowland Rainforest of Sub-Tropical Australia may occur within the study area.



Photo 3: View south from Maclean towards Tyndale across Shark Creek basin



Figure 4-5: Short listed route options: Wells Crossing to Iluka Road

Evaluation of options

Preliminary refinement and assessment of these options was undertaken and included field investigations, specialist studies and community input from the community liaison group (CLG), stakeholder meetings and community information displays.

All options would impact on known habitat of the Commonwealth threatened species Square- fruited Ironbark through the Glenugie State Forest, with the red option impacting on a patch in the Pine Brush State Forest. All options would impact on primary, secondary and supplementary Koala feed trees, with the orange option, following the existing highway and through agricultural areas, would impact the least on this habitat.

The environmental benefits and costs of each short listed route option are detailed in Table 4-5.

Table 4-5: Route option benefits and costs: Wells Crossing to Iluka Road

Option	Advantages/ benefits	Disadvantages/ costs
Orange (A)	 Widening of existing road corridor would have minimised community impacts at Maclean and Townsend Bypass around Ulmarra would remove highway traffic from the town Would remove the least amount of significant native vegetation and EEC Would impact least on potential and known habitat for the Commonwealth listed threatened species Eucalyptus Tetrapleura and Angophora Robur. Would impact least on known Koala habitat 	 Would be the longest crossing over the Clarence River floodplain Would be the most expensive option due to the additional length and floodplain bridges required Would affect the largest amount of prime agricultural land Would affect the largest number of residences Encroachment on Yaegl Nature Reserve. Impact on the Upper Coldstream Nationally Important Wetland
Purple (B)	 Would have least impacts on prime agricultural land near Tucabia Would have the least impact on high value habitat (102 ha) compared with the red and green options. 	 Would remove the largest amount of EECs around Coldstream River and Pillar Valley Creek. Would impact on waterways such as Coldsteam River and Chaffin Creek which have a high ecological value. Would impact on high quality forested habitats between Pine Brush and Bondi Hill Would impact on areas of known and potential habitat for <i>Angophora robur</i>.
Green (C)	 Would be the shortest crossing over Clarence River floodplain, resulting in reduced flooding impacts and requiring less bridging and embankments Would attract a high volume of traffic from the existing highway resulting in reduction in road traffic and noise levels. 	 Would impact on the high value fauna corridor between Yaegl Nature Reserve and the coast Would have noise and visual impacts on the Pillar Valley, Gulmarrad and James Creek communities Would directly impact on Shark Creek wetland Would directly impact on Pine Brush State Forest Would directly affect SEPP 14 wetlands at Shark Creek Impacts on the most high value habitat (255 ha) Would impact on areas with the potential to contain Lowland Rainforest EEC Would have a greater impact on areas of known and potential habitat for <i>Eucalyptus tetrapleura</i> and Angophora Robur Would impact on potential Koala (<i>Phascolarctos cinereus</i>) habitat.

Option	Advantages/ benefits	Disadvantages/ costs
Red (D)	 Would avoid direct impact on the Gulmarrad rural residential area Would be a relatively flood-free route Would attract a high volume of traffic from the existing highway resulting in reduction in road traffic and noise levels. 	 Would impact on high value fauna corridor between Yaegl Nature Reserve and the coast Would have the second largest impact on high value habitat (220 ha) Would result in noise and visual impacts on the Pillar Valley and James Creek communities. Would have a greater impact on areas of known and potential habitat for Eucalyptus Tetrapleura and Angophora Robur Would impact on potential Koolo (<i>Phageolaratea</i>)
		<i>cinereus</i>) habitat.

Community feedback

The evaluation of the feasible short listed route options occurred with input from the community and stakeholders, further investigations and a number of workshops. (Further information can be found in the Wells Crossing to Iluka Road Preferred Route Report (RTA, 2006c)).

A value management workshop was held to help identify a preferred route. Overall, there was no preferred route recommended. However, additional traffic analysis was recommended as being required before a preferred route could be selected. In the workshop, a number of refined route options were put forward, including a 'refined purple' option, 'refined green' option and 'refined red' option.

An alternative alignment was also presented by a number of community members. This alternative included an inland highway route following the alignment of the Summerland Way between Wells Crossing and Casino. This alternative would be mostly through NSW State forests, and therefore faster to build.

The then Roads and Traffic Authority undertook an analysis of this alternative (RTA, 2006b) and found it would not be a viable alternative to upgrading the Pacific Highway because:

- It would not take a large volume of traffic off the Pacific Highway, with less than 25 per cent of Pacific Highway traffic estimated to be attracted to the inland route
- Given the high volume of traffic remaining on the Pacific Highway, the highway would still require upgrading and ongoing investment to correct deficiencies, improve road safety, address community amenity issues and meet future traffic demands
- The cost of the route (estimated at \$4.0–4.2 billion in 2006 dollars) would be greater than the cost of the Pacific Highway Upgrade Program (\$3.0–3.2 billion in 2006 dollars) and would not be justified by the predicted traffic use. In addition, it would have to be completed in one stage, diverting funding and delaying required upgrades on the Pacific Highway
- This alternative would still introduce noise and visual impacts to communities that are not currently exposed to high traffic levels.

That route as a viable alternative was discounted in that analysis and it was not considered further in the route selection process

Further investigations and analysis

The project team then held a route selection workshop to help identify the preferred route. The consideration of route options was based on:

- Review of the assumptions, criteria and weightings used at the value management workshop
- Analysis of findings of additional investigations and findings of the original route option investigations
- Review of issues raised by the community on the route options

• Further analysis and comparison of route options using the same general approach as was used in the value management workshop, but using revised criteria and weightings (specifically to address the Pacific Highway Upgrade Program and project objectives).

The route selection workshop concluded that the best option was the refined purple option combined with a package of measures to improve the safety of the existing highway. This option was selected as it would avoid the key risk areas of ecology and flooding, and meet a balance of functional, social and local economic and environmental criteria.

The advantages of the refined purple option are that it would:

- Achieve the best balance across a range of issues in relation to the objectives of the Pacific Highway Upgrade Program and the Wells Crossing to Iluka Road project
- Avoid direct impacts on prime agricultural land between Four Mile Lane and Cowper
- Avoid high-flood-risk areas in Swan Creek, Ulmarra and Cowper and the majority of the Coldstream Basin floodplain
- Avoid areas of soft soils and acid sulfate soils on the Coldstream floodplain
- · Avoid areas important to local farmers as flood refuge for livestock
- Minimise the impact on threatened ecological communities and to the Yaegl Nature Reserve
- Avoid impacts on important wildlife corridors linking to the wetland areas in the north of the study area
- Avoid wetlands protected under SEPP 14, and maintain conditions that are important to aquatic species, and other plant and animal species
- Avoid areas of known Aboriginal and non-Aboriginal heritage significance.

Between Harwood Bridge and Iluka Road, the highway was to be upgraded adjacent to the existing highway. However, due to issues raised in community submissions to the public display in October 2005, additional studies were undertaken (refer to Wells Crossing to Iluka Road Preferred Route Report (RTA, 2006c)) to investigate bridge options and the feasibility of diverting the highway around Harwood to avoid potential impacts on the village.

The options analysed included:

- Option 1: Upgrading the existing highway through Harwood
- Option 2A: An alignment to the east of Harwood Mill (to connect to the refined purple option to the south)
- Option 2B: An alignment to the east of Harwood Mill (to connect to the refined red option to the south)
- Option 3: An alignment west of Harwood.

Option 1 (upgrading the existing highway) was found to be preferable to the other options, and was selected as the preferred route.

In addition, this option would minimise any impacts to Commonwealth listed matters.

Preferred route

The preferred route was announced in January 2006. The route begins at Bald Knob Tick Gate Road, duplicating the existing alignment. At an interchange south of Eight Mile Lane the route diverts to the north-east, passing east of Grafton Airport to Old Six Mile Lane, passing to the north-east. The route crosses the Coldstream River north of Wants Lane and Sandy Crossing, continuing to Wooli Road. The route then turns to the north, following the edge of the range between Wooli Road/Tucabia Road and Bondi Hill (Tyndale). An interchange at Tyndale would connect the alignment back to the existing highway before generally duplicating the existing highway alignment through to Harwood Bridge, with a full interchange at Yamba Road. North of Harwood Bridge, the route generally follows the existing highway alignment, crossing the Serpentine Channel and the North Arm before connecting with the Iluka Road to Woodburn project.

The preferred route would impact on a population of the Commonwealth listed threatened species *Angophora robur*, however the route would also avoid important fauna movement corridors and habitats (including SEPP 14 wetlands) and avoid areas of high flood risk.

Refinement of the preferred route

Following the announcement of the preferred route in September 2006, further investigations and concept design refinements were undertaken.

The alignment of the preferred route in the areas around the Coldstream River crossing, west of Wooli Road, and the area immediately east of the Wooli Road crossing, were subject to further investigation and potential refinement following consultation with affected property owners.

Field investigations during the concept design phase also identified further potential changes to the route alignment in the following areas:

- Bald Knob Tick Gate Road to Glenugie interchange
- · Between Glenugie and Pillar Valley
- Between Tucabia and Tallowwood Lane.

These refinements formed part of the concept design that was made public in January 2009 (RTA, 2009). These are discussed below.

Bald Knob Tick Gate Road to Glenugie interchange

Two possible alternative alignments between Bald Knob Tick Gate Road and Glenugie interchange were assessed with the aim of reducing the impact on the Commonwealth listed threatened species *Eucalyptus tetrapleura*. However, these alternative alignments did not have any clear benefits over the preferred route (including reducing the removal of *Eucalyptus tetrapleura*) so were not pursued.

Between Glenugie and Pillar Valley

Alternative alignments between Glenugie and Pillar Valley were identified at a community workshop held in April 2007. An alternative alignment that followed the preferred route closely, with a slight realignment east, was adopted between Old Six Mile Lane and Wants Lane. This alignment would minimise flooding and drainage issues and improve property management.

Between Tucabia and Tallowwood Lane

Between Tucabia and Tallowwood Lane, alternative alignments were assessed to minimise impacts on threatened ecological communities and to avoid impacts on residences. An alternative alignment was adopted and located the preferred route to the west to reduce the fragmentation of the high quality threatened ecological communities, avoid acquisition of one residence and be better aligned to property boundaries.

Glenugie upgrade

As part of the Wells Crossing to Iluka Road project, the Glenugie upgrade was further developed and constructed as a separate project. The Glenugie upgrade consisted of seven kilometres of dual carriageways extending from Franklins Road to Eight Mile Lane, about 15 kilometres south of Grafton. The environmental assessment for the Glenugie upgrade was placed on exhibition in August 2009 and project approval for construction was granted in December 2009. Construction on the Glenugie upgrade was completed and opened to traffic in 2011.

Tyndale to Maclean

After the release of the Wells Crossing to Iluka Road Concept Design Report (RTA, 2009), the sugarcane industry expressed concerns regarding the impact of the preferred route between Tyndale and Maclean on high-yielding cane land. RMS worked with local cane growers and affected landowners to investigate the feasibility of an alternative option that would avoid the high value cane land along the South Arm of the Clarence River. An alternative alignment was developed to deviate to the east of the existing Pacific Highway just north of Tyndale and reconnect with the existing highway near Maclean. The discussion paper on Tyndale to Maclean alternative route (RTA 2010) presented the outcomes of the investigations undertaken for the alternative alignment in comparison to the

preferred route that had been announced. Community comments on the discussion paper were invited between 25 October 2010 and 26 November 2010.

A hybrid option was identified by some community members. This option followed the same alignment as the alternative alignment to the south of Shark Creek, while to the north of Shark Creek it deviated to follow the alignment of the 2006 preferred route (duplicating the existing highway). Consideration of this option by the project team concluded that it would:

- Still present concerns associated with slips, differential settlement, construction under traffic and loss of high value cane land
- · Have a greater impact on endangered ecological communities
- Result in an increase in the number of homes/ residences lost when compared to the alternative alignment
- Be likely to require significant bridging over Shark Creek and its floodplain
- Only offer the opportunity to upgrade to a motorway standard of highway initially between Tyndale and Shark Creek rather than between all of the section between Tyndale and Maclean.

Two technical workshops were held by RMS in 2011 to review and evaluate the alignment options. A comparative assessment of the key functional, social and local economic, natural environmental and cost attributes of the route options was initially undertaken at the workshop in January 2011 and the assessment was reviewed and considered further at the May 2011 workshop.

The decision on the Tyndale to Maclean alternative alignment was made in consideration of the original investigations of the Wells Crossing to Iluka Road project, feedback from the community on the discussion paper and also with consideration of the detailed investigations undertaken as part of the Woolgoolga to Ballina project.

In August 2011, the proposed alignment was adopted as the preferred route between Tyndale and Maclean because this route alignment would:

- Impact fewer residences
- · Minimise property severance and impact to farm operations
- Have a lesser impact on higher quality cane land
- Provide functional benefits including:
 - Being safer to construct (no construction under traffic)
 - Present fewer sub-surface construction risks (eg settlement)
 - Better cut to fill balance allowing material to be sourced primarily from within the project boundary
 - Better long-term bank stability
 - Enable early treatment of areas of soft soils
- Allow construction as a motorway standard of highway immediately on opening, delivering safety, traffic and transport, and economic benefits.

The key constraints that influenced the selection of the project alignment between Wells Crossing and Iluka Road are shown on Figure 4-6.



Figure 4-6: Constraints influencing project alignment: Wells Crossing to Iluka Road

4.2.4 Iluka Road to Woodburn

The development of the preferred route for the Iluka Road to Woodburn project commenced in 2004 and the concept design was released in 2006 and placed on display for community comment. The preferred concept design was displayed in July 2008.

Identification of alignment options

The investigation corridor for the Iluka Road to Woodburn project included the land on either side of the existing highway between Iluka Road, Woombah and Woodburn, including the Mororo, Devils Pulpit, Doubleduke and Tabbimoble state forests, the Tabbimoble Floodway and New Italy. The southern limit of the study area was at Iluka Road, while the northern limit was at Tuckombil Canal, south of Woodburn. Between Iluka Road to Woodburn no options outside of the existing alignment were considered. The reasons for that were:

- With the exception of short substandard alignment sections, the existing Pacific Highway generally follows a route that is capable of being upgraded and/or duplicated to satisfy the then RTA's minimum requirements for travel speeds, sight distance and flood immunity without significant impact on private land or State forest
- Alternative alignments outside the investigation corridor would achieve little in terms of travel time saving or other benefits, and would incur very high property acquisition costs
- Alternative alignments outside the investigation corridor are likely to have a significant impact on the biophysical environment including potential impacts on Commonwealth listed threatened flora and fish (Oxleyan Pygmy Perch) species
- Alternative alignments outside the investigation corridor are not likely to exhibit any substantial biophysical, socio-economic or engineering advantages when compared with possible routes inside the study area, which use the existing highway route where possible.

For these reasons, no route options were assessed. Rather, the project team sought to develop the concept design within the investigation corridor with input from the community and specialist investigations.

Preferred route

The preferred route was announced in 2006. The concept design generally involved duplicating the existing highway and providing short sections of new dual carriageway at locations where the existing alignment was found to be below the standard for the Pacific Highway Upgrade Program. These locations included a five-kilometre section adjacent to Devils Pulpit State Forest and Pine Road (this section now forms part of the Devils Pulpit upgrade project which has already been approved and is now under construction) and a two-kilometre section at Cypress Road. Improvements to the curvature of the road were also proposed at a number of locations, including Whites Road and north of Gap Road.

Refinement of the preferred route

After announcement of the preferred route, refinements to the design was made, focussed on minimising ecological and heritage impacts while maintaining local access and improving road safety and flood immunity. Route refinements included:

- Designing the Iluka Road access to connect to the Wells Crossing to Iluka Road project, with Banana Road connecting to the Iluka Road interchange via a new slip road
- · Adding bus stops to the egress side of selected local roads
- Including U-turn facilities just north of Mororo Road, at Jacky Bulbin Road, Whites Road and Nortons Road
- Retaining the existing rest area just north of Mororo Road, with the proposed southbound rest area moved 30 metres north to reduce environmental impacts
- Adding median right turn at Cypress Road
- Adding a merge taper at Serendipity Road

- Reducing a cutting at New Italy to decrease impact on the area, including on a stand of *Melaleuca irbyana* (Swamp Tea-tree)
- Realigning the road between Cypress Road and New Italy Road to reduce land acquisition and impact on a historic mango orchard. A retaining wall was added to the concept to eliminate the need for a batter adjacent to the orchard and historic stone well
- Combining four property accesses (300 to 600 metres north of Cypress Road) into one point of access
- Formalising the parking area at New Italy to enable parking for 60 vehicles
- Realigning the curve at Gap Road to reduce impacts on the western side
- Adding a service road from Wondawee Way to Trustums Hill Road
- Changing the interchange south of Woodburn to include two roundabouts and provide for future north-facing ramps.

These refinements were announced as part of the Iluka Road to Woodburn Preferred Concept Design Report (RTA, 2008a).

The key constraints that influenced the project alignment between Iluka Road and Woodburn are shown in Figure 4-7.



Photo 4: View of Pacific Highway north from the Minyumai Road intersection



Figure 4-7: Constraints influencing preferred route selection: Iluka Road to Woodburn

4.2.5 Woodburn to Ballina

The development of the preferred route for the Woodburn to Ballina project commenced in 2004. The short listed route options were announced and placed on display for community comment. The preferred route was announced in November 2005, and placed on display for community comment. The concept design was displayed in March 2008.

Identification of alignment options

The investigation corridor for the Woodburn to Ballina project extended from the southern side of Tuckombil Canal to the intersection of the Pacific Highway with the Bruxner Highway. From Woodburn, north towards Wardell, the eastern extent of the investigation corridor comprised land between the existing highway corridor and the coast. To the west, it extended into the Tuckean Nature Reserve, about 1.5 kilometres northwest of Bagotville Road. From Wardell, north to the Bruxner Highway intersection, the study area was constrained by the Blackwall Range to the west and the need to link to the Ballina bypass.

The range of possible alignments was developed from a review of known constraints in the investigation corridor. Engineering design principles, road design software and community input also assisted in the development of possible alignments. The project was divided into three sections, from south to north:

- Section 1: Between Tuckombil Canal and south of Broadwater
- Section 2: Between a point south of Broadwater to north of Wardell, and crossing the Richmond River
- Section 3: Between the Pacific Highway north of Wardell and the Pacific Highway intersection with Bruxner Highway joining the Ballina bypass.

A range of short listed route options was then identified based on these alignments. There were three short listed options in section 1 (known as options 1A, 1B and 1C), six short listed options in section 2 (known as options 2A, 2B, 2C, 2D, 2E and 2F) and two options in section 3 (known as options 3A and 3B). These options are described in Table 4-6 and shown in Figure 4-8). The route options all pass through the Broadwater National Park on the existing highway alignment to minimise impacts on the national park.

Section	Option	Description
Section 1	1A	This option begins on the existing Pacific Highway about three kilometres south of Woodburn, and is generally located parallel and east of the existing highway. It crosses the Tuckombil Canal and generally proceeds north-east to 400 metres east of Woodburn. It is then generally parallel and to the east of the Richmond River, between the existing highway and Lang Hill, until McDonalds Creek where it follows the existing highway alignment through Broadwater National Park.
	1B	This option is similar to option 1A except it goes east of Lang Hill, and then rejoins the existing highway just north of McDonalds Creek.
	1C	This option begins from the existing Pacific Highway about three kilometres south of Woodburn, crosses the Tuckombil Canal and goes north-east generally 1700 metres east of Woodburn. The route travels north-east around the eastern side of Lang Hill and then joins the existing highway north of McDonalds Creek where it then follows the existing highway alignment through the Broadwater National Park.
Section 2	2A	This option begins on the existing highway at the northern end of Broadwater National Park and heads north-west towards Rileys Hill. The route then curves to the north and crosses the Richmond River, passing west of Alleys Hill before bridging the Tuckean Broadwater. It then heads north-east and parallel to Bagotville Wardell Road. The route turns to the north near the Wardell communication tower. The route generally passes to the east of the toe of the Blackwall Range. Near the base of Tuckombil Mountain the alignment crosses Thurgates Lane and heads north-east. The route heads east through the Wardell Heath towards the existing Pacific Highway, and then turns to the north-west near Coolgardie Road.

Table 4-6: Shortlisted route options: Woodburn to Ballina

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

Section	Option	Description
	2B	This option begins at the northern end of the Broadwater National Park and turns northward away from the existing Pacific Highway and crosses the Richmond River west of Pelican Island. The route travels north and north-east to the Tuckean Broadwater. From the Tuckean Broadwater, the route generally heads northward before following the alignment of option 2A to the east of the Wardell communication tower.
	2C	This option begins at the northern end of the Broadwater National Park and turns eastward. The route passes to the west of Cooks Hill. After passing Cooks Hill, it heads north and crosses the Richmond River west of Goat Island. North of the Richmond River the route heads north-west before following the alignment of option 2A from Thurgates Lane.
	2D	This option begins at the northern end of the Broadwater National Park and turns eastward. At Broadwater, the route is located on the western side of Cooks Hill. After passing Cooks Hill, the route heads north and crosses the Richmond River west of Goat Island. North of the Richmond River the route heads north through the Wardell Heath and circles to the west around Wardell before rejoining the existing highway at the Coolgardie Road intersection.
	2E	This option is similar to option 2D except at the northern end of Broadwater National Park the route turns east and heads to the east of Cooks Hill. After passing Cooks Hill the route turns north-west and follows the alignment of option 2D on the southern banks of the Richmond River.
	2F	This option begins at the northern end of the Broadwater National Park and turns eastward. At Broadwater the route is located on the western side of Cooks Hill. At Pine Tree Road, the route heads north-east. Near Goat Island the route heads more northward towards Wardell. At Carney Lane, the route turns north-west to cross the Richmond River south of Little Pimlico Island. North of the Richmond River, the route turns northward and joins the existing highway, following the highway alignment until the Coolgardie Road intersection.
Section 3	3A	This option begins north of Coolgardie Road, along a new alignment, around the Blackwall Range escarpment. The route then follows the existing highway near Uralba and duplicates the highway until the Bruxner Highway intersection.
	3B	This option begins north of Coolgardie Road, duplicating the existing Pacific Highway until the Bruxner Highway intersection.

Matters of national environmental significance in the Woodburn to Ballina study area

A protected matters search which identifies matters of national environmental significance as listed under the EPBC Act 1999, was undertaken for the project in September 2012. In addition, information from previous field surveys and assessments undertaken as part of the route option process (refer to Woodburn to Ballina Route Options Development Report (RTA, 2005b)) reviewed to identify Commonwealth listed matters of national environmental significance within the study area. Issues identified were:

- The following species may occur within the study area:
 - Osprey (Pandion haliaetus) EPBC Act listed Migratory species
 - Booroolong Frog (Litoria booroolongensis) EPBC Act listed endangered species
 - Olongburra Frog (Litoria olongburensis) EPBC Act listed endangered species
 - Pink Underwing Moth (Phyllodes imperialis) EPBC Act listed endangered species
 - Mitchells Rainforest Snail (Thersites mitchellae) EPBC Act listed endangered species
 - EPBC Act listed Critically Endangered EEC (Lowland Rainforest of Sub-tropical Australia)
- Known or potential habitat is present within the study area for the following species:
 - Rusty Rose Walnut (Endiandra hayesii) EPBC Act listed vulnerable species
 - Red Lily Pily (Syzigium hodgkinsoniae) EPBC Act listed vulnerable species

- Rough-shelled Bush Nut (Macadamia tetraphylla) EPBC Act listed vulnerable species
- Rose Apple (Syzygium moorei) EPBC Act listed vulnerable species
- Thorny Pea (Desmodium acanthocladum) EPBC Act listed vulnerable species
- Hairy Joint -grass (Arthraxon hispidus)- EPBC Act listed vulnerable species
- Oxleyan Pygmy Perch (Nannoperca oxleyana) EPBC Act listed endangered species
- Long-nosed Potoroo (Potorous tridactylus tridactylus) EPBC Act listed vulnerable species
- Koala (Phascolarctos cinereus) EPBC Act listed vulnerable species
- EPBC vulnerable species Grey-headed Flying- fox colony within 250 metres of the study area.



Photo 5: Image of Olongburra Frog (Litoria olongburensis) (courtesy of 'teejaybee' 2010)



Figure 4-8: Shortlisted route options: Woodburn to Ballina

Evaluation of options

Preliminary assessment of these options included field investigations, specialist studies and community input. The environmental benefits and costs of each of the shortlisted route options are listed in Table 4-7.

Table 4-7: Route option benefits and costs: Woodburn to Ballina

Option	Advantages/ benefits	Disadvantages/ costs
Option 1A	 Would have the least impact on native vegetation and potential Koala habitat. 	 May result in noise and visual impacts due to its proximity to Woodburn Has the potential to affect an Aboriginal massacre site.
Option 1B	 Would have the largest impact on agricultural properties (grazing and cane farming). 	Has the potential to affect an Aboriginal massacre site.
Option 1C	 Would affect the least number of land parcels Would have the least visual and noise impacts on Woodburn. 	 Would affect large areas of Dry Sclerophyll and Swamp Sclerophyll forest (identified as primary Koala feed trees).
Option 2A	• Would have better amenity outcomes than other options for Broadwater.	 Would have the greatest impact on SEPP 14 areas and other wetlands and would require two major river crossings Would impact on known and potential habitat for Commonwealth listed threatened flora species (including <i>Endiandra hayesii, Macadamia</i> <i>tetraphylla, Syzigium hodgkinsoniae</i> and Oxleyan Pygmy Perch (<i>Nannoperca</i> <i>oxleyana</i>)).
Option 2B	Would have better amenity outcomes than other options for Broadwater and Wardell.	 Would have a long crossing through the Tuckean Broadwater and high value wetland. Would impact on known and potential habitat for Commonwealth listed threatened flora species (including <i>Endiandra hayesii, Macadamia tetraphylla, Syzgium moorei, Desmodium acanthodladum, Syzigium hodgkinsoniae, Arthraxon hispidus</i> and Oxleyan Pygmy Perch (<i>Nannoperca oxleyana</i>)).
Option 2C	 Would have better amenity outcomes than other options for Wardell. 	 Would cross a large area of high value fauna habitat including for Koalas Would impact on known and potential habitat for Commonwealth listed threatened flora species (including <i>Endiandra hayesii, Macadamia tetraphylla, Syzigium hodgkinsoniae</i> Long nosed Potoroo (<i>Potorous tridactylus tridactylus</i>), <i>Arthraxon hispidus</i> and Oxleyan Pygmy Perch (<i>Nannoperca oxleyana</i>)).

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

Option	Advantages/ benefits	Disadvantages/ costs
Option 2D	 Would avoid impacts on farmland used for cropping Would not require any major flood alleviation structures Would have one of the least impacts on endangered ecological communities (relative to the other options) including potential Koala habitat. 	 Would cross a large area of high value fauna habitat Would sever Aboriginal-owned land and affect five known Aboriginal heritage sites Would have the highest noise impacts on rural residential properties to the northwest of Wardell Would impact on known and potential habitat for Commonwealth listed threatened species <i>Macadamia tetraphylla</i>, Oxleyan Pygmy Perch (<i>Nannoperca oxleyana</i>), Long nosed Potoroo (<i>Potorous tridactylus tridactylus</i>), <i>Arthraxon hispidus</i> and Koala (<i>phascolarctos cinereus</i>).
Option 2E	• Would have the least visual impact on Broadwater as it passes to the east of Cooks Hill.	 Would affect three known Aboriginal heritage sites and an area where there is high potential for more sites to occur Would impact on known and potential habitat for Commonwealth listed threatened species <i>Macadamia</i> <i>tetraphylla</i> and Oxleyan Pygmy Perch (<i>Nannoperca oxleyana</i>).
Option 2F	• Would have the least impact on native vegetation and threatened ecological communities including potential Koala habitat.	 Would have the highest number of waterway crossings (seven) Would have the greatest visual impact on Broadwater Would be the most expensive option.
Option 3A	 Provided better constructability through avoiding the soft soils along the existing highway. 	 Would affect the most residences. Would have a greater impact on critical EEC Lowland Rainforest Would impact on Arthraxon hispidus.
Option 3B	 Would make greatest use of the existing highway and have the least impact on agricultural properties. 	 Would have greater noise impacts than Option 3A Would impact on Arthraxon hispidus.

Community feedback

An alternative route was also presented by a number of community members. This alternative route was intended as a 'flood-free' route. The project team undertook an analysis of the route, including desktop studies for environmental issues (including geology, hydrology) and engineering constraints. Due to the potential impact, preliminary field surveys and assessments for ecology and Aboriginal heritage (with some members of the local Aboriginal community) were also undertaken.

This analysis is detailed in Woodburn to Ballina Route Selection Study: Investigations into the Community Alternative Route (Hyder, 2005), which is an appendix to the Woodburn to Ballina Preferred Route Report (RTA, 2005c).

The analysis indicated that this 'flood-free' alternative route would have substantial impacts on terrestrial and aquatic ecology and Aboriginal heritage. It was recommended that it should not be included as a short listed option. The route would also have a greater impact on Broadwater National Park and Bundjalung National Park than any other route option and could not be justified on that basis.

The shortlisted route options were put on public display and comments invited from the community. A value management workshop was held in July 2005, to analyse the route options against the following five key criteria: environment, heritage, functional, social and noise, and business and economic. The route options were analysed and a number of key issues raised that would need to be addressed in further phases of the project.

The key recommendations from the workshop were:

- Support for option 1C as the preferred route for section 1 (subject to further investigations to minimise biodiversity impacts)
- Support for option 3B as the preferred route for section 3 (subject to confirming road, the footprint and impact on sugarcane land)
- For section 2, options 2A and 2B not to be considered further due to their environmental impacts. Options 2C, 2D, 2E and 2F considered to be possibly preferred options, subject to further reduction of impacts on biodiversity and Aboriginal heritage
- Support for the community alternative route to be further analysed.

Further investigations and analysis

Following the value management workshop, further investigations were undertaken to attempt to minimise potential environmental, agricultural and Aboriginal heritage impacts.

The community alternative route was also re-assessed by the study team. The assessment (refer to Appendix A of the Woodburn to Ballina Preferred Route report (RTA, 2005c)) concluded that due to the environmental and Aboriginal heritage impacts and statutory requirements relating to impacting on national parks, it should not be considered further.

The study team then re-evaluated the route options against the analysis criteria and selected the preferred route, as outlined below.

Section 1

Option 1C (refined to avoid land subject to a Native Title claim and to reduce agricultural impacts) was selected as the preferred route for Section 1. There would be no changes to impacts to Commonwealth listed matters. Option 1C was selected because it would:

- Have less noise and visual impact on existing and potential future residential areas of Woodburn
- Provide a good visual and landscape design outcome
- Have the lowest impact on agricultural lands
- Have acceptable ecological impacts, for which mitigation can be provided
- · Have the lowest known and potential Aboriginal heritage impact
- Be the cheapest option to construct, while providing the greatest road user benefits
- Have the shortest length in flood-affected areas and require the shortest length of bridging for floodwater mitigation.

Section 2

A combination of options 2C and 2E (refined to avoid Jali Local Aboriginal Land Council land and reduce ecological impacts) was selected as the preferred route in section 2. Reduction in ecological impacts included avoiding the Wardell Heath, habitat for Commonwealth listed threatened species including the Olongburra Frog, Koala and Grey-headed Flying-fox.

Options 2C and 2E were selected because they would:

- Have fewer significant impacts than the other options
- Have less noise and visual impact on Broadwater and Wardell than options 2D and 2F, resulting in better overall amenity
- Avoid impact on SEPP 14 wetlands, and have less impact on high quality vegetation than options 2A, 2B and 2D
- · Have less ecological impacts than the displayed option 2C
- Have less impact on agricultural land (particularly regionally significant agricultural land) than option 2F
- Not require the acquisition of Jali land
- · Have the shortest length in flood-affected areas

- Provide good road user benefits for a reasonable construction cost
- Provide the opportunity for a flood-free route connecting Evans Head to the highway.

However, this preferred route would still impact on Commonwealth listed threatened species Oxleyan Pygmy Perch and Hairy Joint-grass.

Section 3

Option 3B (unrefined) was selected as the preferred route for section 3. It was preferred to option 3A because it would:

- Have less noise and visual impacts on communities, resulting in better overall amenity (eg at Whytes Lane West)
- · Be the cheaper option to construct, while providing the greatest road user benefits
- Retain the highway on its existing route (using the existing asset which is suitable for upgrading).

The options selected for the preferred route were broadly consistent with those options recommended during the value management workshop.

Preferred option

The route begins south of Woodburn and extends north-east on a new alignment. It crosses Tuckombil Canal on a 350-metre long bridge. Between Woodburn and Broadwater, the route continues north-east through agricultural land and close to the edge of the Broadwater National Park. North of Lang Hill, the route follows the western edge of Broadwater National Park before rejoining the highway to duplicate the existing alignment through the national park.

In the vicinity of Broadwater, the route is to the east of Cooks Hill and west of the national park. North of Cooks Hill, the highway turns to the north-west and passes across the Richmond River. The route then proceeds to the west of Laws Hill, before continuing north-west to the Blackwall Ranges.

The route then travels around areas of Wardell Heath before going east to join the existing highway about four kilometres north of Wardell. The route then follows the existing highway alignment to connect with the Ballina bypass upgrade.

The preferred route would impact on a number of Commonwealth listed threatened species including the critically endangered Lowland Rainforest ecological community, *Arthraxon hispidus* and other threatened flora species and threatened fauna species including Oxleyan Pygmy Perch. However, the preferred route was selected as it provided the least adverse noise and visual impacts to townships and rural residential areas, minimised impacts to agricultural land and minimised crossing high flood risk areas.

Refinement to the preferred route

After announcement of the preferred route, a number of design refinements were made. These were made publicly available in the Woodburn to Ballina Upgrade Concept Design Report (RTA, 2008b). In summary, the design refinements involved:

- Reducing impacts on Broadwater National Park in consultation with the former Department of Environment and Climate Change
- Reconsidering the design of interchanges at Woodburn, Broadwater and Wardell following community feedback. The Woodburn interchange was designed to include south-facing ramps with no ramps at Woodburn–Evans Head Road (which would remain a local road overpass). This arrangement would encourage Evans Head traffic to pass through Woodburn, retaining its function as a service town. The interchange at Broadwater, would only have north-facing ramps, with southbound traffic travelling south through Woodburn before accessing the highway. This would result in Woodburn motorists unable to access the northbound carriageway until 10 kilometres further north on the existing highway, and Broadwater motorists needing to travel on the existing highway to Woodburn to access the upgraded highway

- At Broadwater interchange, maintaining access to Broadwater Sugar Mill, tourists and Evans Head residents accessing Ballina via a flood-free route
- At Wardell, constructing a full interchange with north- and south-facing ramps to provide full transport connectivity from south of Wardell to Ballina
- Altering the alignment around Woodburn–Evans Head Road to reduce the potential impact on Rous Water's water supply bores. This route realignment would also reduce the impact on the Swamp Schlerophyll Forest threatened ecological community
- Altering the alignment across McDonalds Creek to reduce the impact on the highest value habitat areas for the Commonwealth listed threatened fish species Oxleyan Pygmy Perch
- Including three fauna land-bridges: two within Broadwater National Park and another near Meridian Heights to facilitate and protect fauna movement between Wardell Heath and Coolgardie Scrub
- Refinements to improve public and private access, as identified in consultation with property owners and at a value engineering and risk management workshop. Refinements included private property access for severed properties or changes to public roads to improve safety or access.

The key constraints that influenced the selection of the project alignment between Woodburn and Ballina are shown on Figure 4-9.



Photo 6: View north to Tuckombil Canal located north of Woodburn



Figure 4-9: Constraints influencing project alignment: Woodburn to Ballina

4.3 Concept design of the project

4.3.1 Woolgoolga to Ballina upgrade

In March 2010, the NSW Government provided funding to continue planning for the upgrade of the Pacific Highway between Woolgoolga and Ballina.

A project team was formed to:

- · Review and refine the concept designs for the four previously developed projects
- Combine the four previously development projects into one overall upgrade design
- · Confirm land acquisition needs and initiate negotiations with landowners
- Undertake an environmental impact assessment of the project.

KEY TERM: Concept design

Initial functional layout of a concept, such as a road or road system, to provide a sufficient level of understanding to later establish detailed design parameters.

4.3.2 Concept design review

The concept design review undertaken as part of the project consisted of the following two phases:

- Design review phase July 2010 October 2011: The four previous development project designs were combined into one design, with some refinements. A refined concept design went on display for community comment in October 2011
- Design review phase October 2011 March 2012: Further refinements to the design were investigated based on community, government agency and stakeholder feedback and results of environmental investigations. These changes were displayed in March 2012 with associated community information sessions being held.

The process of refining the concept design is ongoing based on stakeholder feedback and the environmental impact statement process and would continue into the detailed design phase. Further discussion on the detailed design phase and potential refinements to the design are identified in section 5.3.22 of this EIS.

These phases and the key refinements made to the design are provided below.

Design review phase July 2010 - October 2011

The design review process between July 2010 and October 2011 undertook the following tasks:

- · Combined the four previous development project designs and identified any design issues
- Confirmed the alignment for the length of the project and designed appropriate connections to the completed section at Halfway Creek and the detailed designs for the Glenugie and Devils Pulpit upgrades
- Designed practical, safe and economic temporary connections (tie-ins) to the existing highway to facilitate the staged construction and opening of the project
- Checked conformity with RMS' Road Design Guide (RTA, 2009)
- Confirmed motorway standard design requirements, including the overall footprint and property acquisition requirement
- Refined the project boundary based on updated cadastral information.

Based on the above, a number of refinements to the concept design were identified. These refinements were adopted where the design team considered there would be an improvement or opportunity for social, environmental, functional and/or cost outcomes.

Table 4-8 identifies the refinements to the concept design and the benefits to the project provided.

Table 4-8: Refinements to the concept design of the project (July 2010 – October 2011)

Refinement in the design	Benefit to the project
Widening Eggins Drive, Corindi Beach (to be 7 m wide plus shoulders).	Brought the design in line with RMS Road Design Guide for service roads.
Provision of an overbridge to highway for Sherwood Creek Road.	Connected Sherwood Creek Road (west of the highway) with the local road network (Eggins Drive east of the highway) following the redesign of the interchange at Arrawarra as part of the Sapphire to Woolgoolga upgrade project.
Provision of two roundabouts at the interchange at Range Road. The interchange was also moved.	Improved performance and safety, and enabled construction to be undertaken away from the existing Pacific Highway.
Altering the interchange at Eight Mile Lane to reduce the number of bridge structures, lengthen one bridge structure.	Reduced the realignment required of Picaninny and Pheasant creeks.
Moving the highway alignment 50 metres east near Pillar Valley in accordance with revised flood modelling.	Reduced the number of bridge structures and the cost of bridges structures.
Altering the interchange at Tyndale to improve the safety of the steep and sharp exit for traffic going to Grafton from the southbound off-ramp.	Improved safety of the interchange and led to an overall reduction in the size of the interchange footprint and the height of the cutting. The interchange also reduced the impact to Commonwealth listed threatened species <i>Angophora robur</i> .
Identification of temporary connections required from the project to the existing Pacific Highway at Tyndale and at the Richmond River at Broadwater.	Facilitates vehicular connection from the project to the existing highway where staged construction would be completed.
Refining the alignment between Tyndale and Maclean. In light of the further assessment on the alignment between Tyndale to Maclean (refer to section 4.2.4), further alignment and boundary refinements were made.	Confirmed alignment boundaries.
Routing the local access road at Goodwood Street over the highway at the Maclean interchange.	Reduced the height of the main alignment, with potential amenity benefits and less fill requirements.
Inclusion of a roundabout at Jubilee Street, Townsend.	Improved traffic flow and safety at the interchange for Townsend residents.
Changes to interchange layouts at Harwood and Yamba.	Provided improved local traffic flow.
 Provision of two roundabouts at the following interchanges: Iluka Road, Woombah Evans Head Road, Broadwater Coolgardie Road, Wardell 	Improved the performance of the interchange and improved road safety.
Moving the southbound rest area at Mororo 1km north.	Avoided sensitive vegetation previously impacted by the rest area design.
Addition of a new fauna overpass and rope crossing at Tabbimoble Nature Reserve.	Improved interconnectivity between two forested areas and for a major fauna corridor.
Reviewing private property access, service road layouts and overpasses/underpasses for local roads	Provided appropriate property access.

Refinement in the design	Benefit to the project
Minor changes in vertical alignment (ie removal of vertical curves from bridges where possible).	Reduced the cost of the project and improves the ease of construction.
Change of some waterway culverts to bridges.	Reduced impacts on key fish habitat.
Identification of the location of water quality basins and land acquisition required.	Allows adequate land to be acquired for the construction and operation of ancillary features.
Changes to the number, alignment and length of a number of bridges along the route flowing more comprehensive flood modelling across the project.	Reduced the bridge structures required and cost without increase in flooding risk.

These refinements have resulted in changes to the project boundary and changed the extent to which the project may affect properties in some areas.

Design review phase October 2011 – March 2011

After the concept design was put on display in October 2011, further design refinements were incorporated into the concept design, as a result of feedback received from this display. Table 4-9 identifies those changes.

Table 4-9: Refinements to the concept design of the project (October 2011 – March 2011)

Refinement in the design	Benefit to the project
Providing wide medians at three locations (Corindi, Halfway Creek and Tabbimoble).	To facilitate fauna movement across the upgrade in key arboreal fauna movement corridors.
Realigning the project alignment near Halfway Creek.	To avoid impacts to the existing operational service station.
Including a heavy vehicle checking station at Halfway Creek.	To ensure adequate provision for checking Pacific Highway traffic is provided on this section of the highway.
Modification of the north facing (on-load) ramps of the interchange at Tyndale.	To provide a more efficient and free-flowing traffic arrangement.
Provision of improved local road access at Six Mile Lane and a change to the main carriageway alignment	To improve access to properties on the northern side of Six Mile Lane.
Realigning the alignment near Gap Road and realigning the service road travelling south from New Italy – Swan Bay Road.	To avoid substantial impact to customer parking in front of the New Italy museum.
Realignment of the main carriageway north of the Richmond River.	To avoid impact on a number of Aboriginal heritage sites.

There have also been a number of minor modifications to the boundary of the project, largely as a result of a request by landowners to allow continued function of those particular parcels of land.

Ongoing design review and refinements

The concept design would continue to be refined during the planning approval and detailed design phases of the project. Refinements may be as a result of community feedback, stakeholder consultation, property acquisition or where significant benefits (either environmental or functional) would be achieved.

Areas of further investigation and possible design refinement are identified in relevant key issue assessment chapters. These are indicative only and would not be the only areas of investigation, with additional investigations resulting from community, government agency and stakeholder feedback to the EIS.

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