

## 4. Route options

### 4.1 Community input to route options

The community and other stakeholders have provided input to the development of route options through a number of avenues since the commencement of the project. Community members and stakeholders have provided local information in relation to key constraints. Local residents and property owners have invaluable knowledge of ecological issues, the behaviour of floods and local waterways, and other aspects of the project. Visits to individual properties and discussion with property owners have greatly enhanced the team's appreciation of local and site issues and have enabled the potential impacts of options to be better identified.

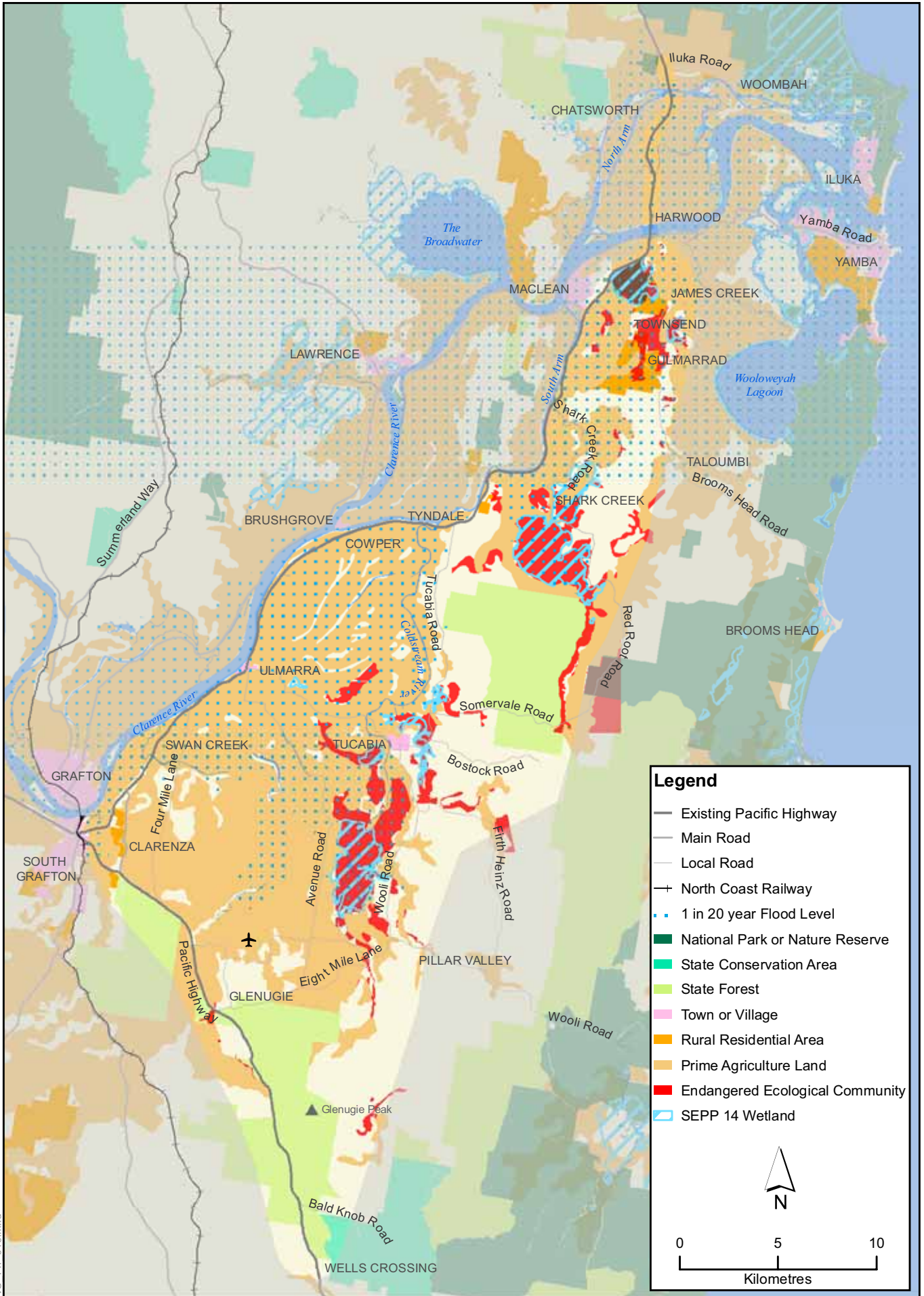
A number of route options were suggested by individuals. These were evaluated in a similar way to the long list of options, against the project and Pacific Highway Upgrade Program objectives, to determine whether they are potentially feasible options and if they presented any opportunities not identified in the long list options. The assessment of these options against the Pacific Highway Upgrade Program objectives is reported in the *Route Options Development Report* (RTA, 2005).

### 4.2 Development of route options between Wells Crossing and Harwood Bridge

The following section describes the options developed for the project between Wells Crossing and Harwood Bridge. The development of options between Harwood Bridge and Iluka Road is discussed in **Section 4.5**.

#### 4.2.1 Description of the long list route options

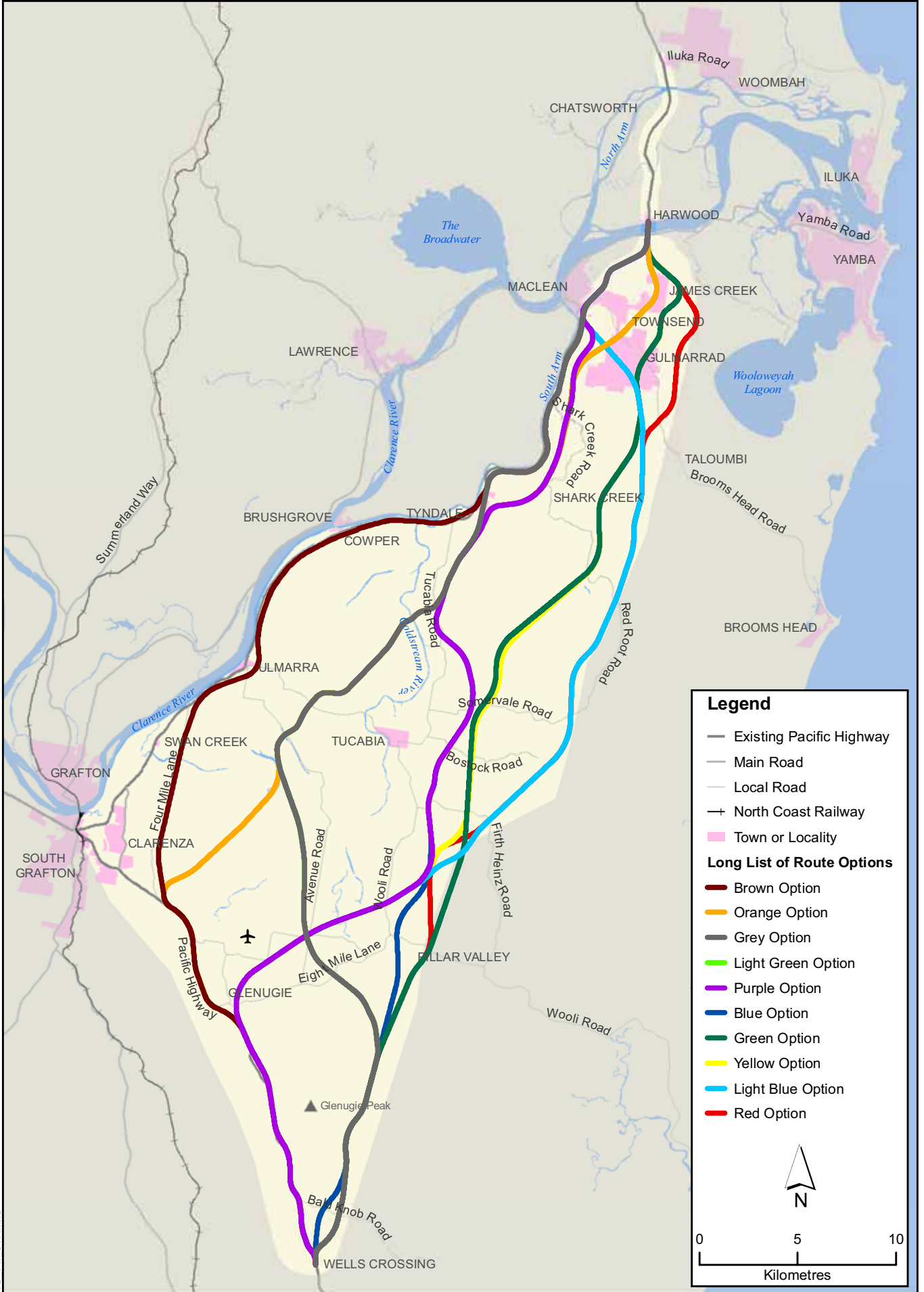
The approach to development of a long list of options is described in **Section 2.2**. Taking into account the key constraints in the study area (see **Figure 4-1**) and information from other preliminary investigations, a long list of ten potential route options was developed between Wells Crossing and the Harwood Bridge (**Figure 4-2**). The length and approximate traffic volumes for each of these routes are shown in **Table 4-1**.



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Wells Crossing to Iluka Road  
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**Figure 4-1: Major constraints identified at the long list options stage**



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Wells Crossing to Iluka Road  
Upgrading the Pacific Highway

**Figure 4-2: Long list of route options**

■ **Table 4-1: Summary of long list options**

Option	Length (kilometres)	2021 AADT (all)	2021 AADT (heavy vehicles)
Blue	61	4600	1, 500
Brown/ Orange A*	69	10,500	2,400
Green	60	4600	1, 500
Grey	65	4600	1, 500
Light Blue	66	4600	1, 500
Light Green	65	4600	1, 500
Orange**	67	10,500	2,400
Purple	66	4600	1, 500
Red	60	4600	1,500
Yellow	65	4600	1, 500

\* The Brown option at the long list stage of the project became the Orange/A option at the route options stage (described in **Section 4.4**).

\*\* The Orange option at the long list stage of the project was not taken forward. The Brown option at the long list stage of the project became the Orange/A option at the route options stage.

#### **4.2.2 Assessment of the long list route options**

The long list options were assessed using the process described in **Section 2.3**. **Table 4-2** summarises the key advantages and disadvantages of the long list options, based on those that more closely follow the existing highway (westerly options) and those that are new routes (easterly options).

The summary demonstrates that the easterly options generally perform better than the westerly options in terms of travel time reduction for through traffic, project cost and social impacts. However, the westerly options perform better in terms of attracting local traffic (and therefore a higher volume of traffic overall), ecological impacts, and potential for staging. This level of assessment demonstrated that both the easterly and westerly options had potential advantages that warranted further consideration as part of the short list of route options.

■ **Table 4-2: Summary of long list options assessment**

Options	Key Advantages	Key Constraints
<b>Westerly options</b>	<ul style="list-style-type: none"> <li>■ Potential to attract a high proportion of highway traffic where connections to Grafton are improved.</li> <li>■ Greater opportunities to utilise sections of the existing highway.</li> <li>■ Opportunities to stage construction.</li> <li>■ Minimal impacts on remnant vegetation and fauna habitat.</li> <li>■ Greater potential for safety improvements due to high volumes of traffic that would use these routes.</li> </ul>	<ul style="list-style-type: none"> <li>■ Generally limited opportunities to reduce travel times due to longer project lengths.</li> <li>■ High risk of changes to flooding because a high proportion of route lengths are within the floodplain.</li> <li>■ Geotechnical constraints associated with soft soils within the floodplain.</li> <li>■ High project cost resulting from construction constraints (soils and flooding) and project lengths.</li> <li>■ High impacts on residences, farms and businesses that front the highway.</li> <li>■ Greater impacts on high value agricultural land.</li> <li>■ High potential for noise impacts due to the density of residences.</li> </ul>
<b>Easterly options</b>	<ul style="list-style-type: none"> <li>■ Direct routes with generally greater travel time reductions for through traffic.</li> <li>■ Mostly avoid the floodplain except around James Creek.</li> <li>■ Relatively low project cost due to short project distance and avoidance of major flooding and geotechnical constraints.</li> <li>■ Minimal impacts on higher density settlements along the highway and in established towns and villages.</li> </ul>	<ul style="list-style-type: none"> <li>■ Limited potential to attract high volumes of local traffic from the existing highway (likely to attract only through traffic, which is approximately 30-35% of total traffic).</li> <li>■ No or limited opportunities to stage construction.</li> <li>■ No or limited use of the existing highway.</li> <li>■ Some options would require large cut and fill volumes due to steep terrain.</li> <li>■ Low traffic volumes limit economic benefits.</li> <li>■ High impacts on areas currently unaffected by the existing highway.</li> <li>■ High potential to impact on remnant bushland, threatened species and habitat.</li> <li>■ Impacts on Glenugie and Newfoundland State Forests.</li> </ul>

### 4.3 Short listed route options

#### 4.3.1 Development of the short listed route options

Based on the findings of the long list route options assessment, a further analysis was made of the options to identify those that best met the Pacific Highway Upgrade Program and project objectives. That assessment identified the following options from the long list (shown on **Figure 4-2**) for potential inclusion in short list of feasible options:

- The Brown option, subsequently referred to as the Orange/A option.



- The Orange option (in the location shown at the long-list options stage), subject to further consideration of flooding and geotechnical constraints that may impose significant constraints to construction and cost.
- The Purple option, modified in the north to avoid Gulmarrad/Townsend by following the existing highway.
- The Green option, subject to further consideration of ways to reduce the potential for environmental impacts on the Pine Brush State Forest and Shark Creek SEPP 14 wetland.
- The Red option, modified in the vicinity of Wells Crossing to avoid direct impacts on the Yuraygir State Conservation Area and flora reserve within the Newfoundland State Forest.

Preliminary geotechnical assessments undertaken for the Orange option (in the location shown at the long-list options stage) indicated that the floodplain areas through which the option would pass contain highly compressible soils, which would require extensive pre-loading or expensive foundation construction methods. These factors, combined with the high embankments required to achieve flood immunity, were concluded to contribute substantially to a high cost and high degree of construction risk for this option. The Orange option (in the location shown at the long-list options stage) was subsequently excluded from the feasible options on the basis of these constraints.

The Green option is the shortest of the long list options and includes the shortest floodplain crossing, and therefore has the potential to deliver the greatest benefits for through traffic, at a lower cost than other options. However, significant constraints associated with this option included impacts on areas of conservation value in Pine Brush State Forest and the Shark Creek SEPP 14 wetland, high cost due to large earthworks volumes in some sections and high impacts on the rural residential areas of Gulmarrad and James Creek.

Further assessment of the Green option was undertaken with the aim of reducing these impacts. Changes to the route of the Green option were made to address these issues and this option was included in the short list of feasible options. The Green option route was changed at the short list stage as follows:

- The southern end was realigned further west to avoid the Yuraygir State Conservation Area (this also applied to the Red option).
- The route was realigned further east in Pine Brush State Forest to minimise impacts on ecologically significant areas and avoid areas of steep terrain.
- The route around Gulmarrad and James Creek was realigned further to the east to minimise direct impacts on residential areas.

The short listed feasible route options, Brown, Purple, Green and Red and possible connections, are described and assessed in the *Route Options Development Report* (RTA, 2005) and are summarised below.

#### 4.3.2 Description of the short listed route options

Four route options were identified for consideration between Wells Crossing and Harwood Bridge. The options were re-named from those described at the long list stage for consistency between this project and other Pacific Highway Upgrade projects. The route options, shown on **Figure 4-3**, were:

- The Orange/A option, which is largely located adjacent to the existing highway, with the inclusion of deviations to avoid urban areas, towns and villages.
- The Purple/B option, which is partly a new route, and would partly involve upgrading of the existing highway.
- The Green/C option, which is entirely a new route in the east of the study area.
- The Red/D option, also an entirely a new route in the east of the study area.

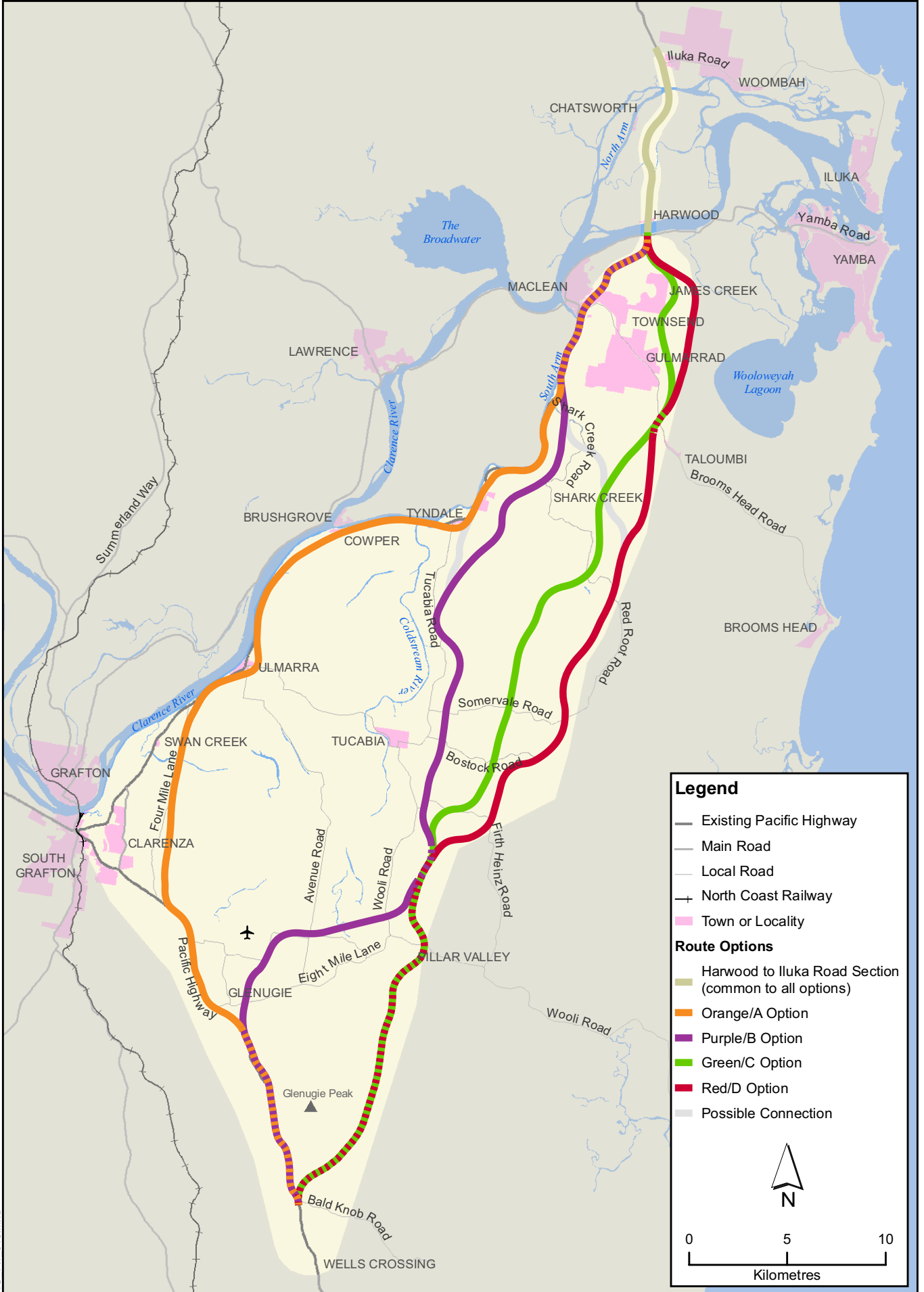
The options were reviewed and modified to improve their alignments, and to take into account the findings of further constraints analysis and the main issues that were identified in the long list assessment stage.

In addition to the four route options, two potential connections between options were also included in the assessment. These were a possible link between the Purple/B and Orange/A options in the vicinity of Tyndale and between the Red/D or Green/C options and the Purple/B option in the Shark Creek area. These connections provide increased flexibility in the selection of a preferred route for the project, by allowing sections of the route options to be combined.

At the route options stage, there was a need to have some flexibility in the route option alignments, to accommodate refinements. For each route option a nominal alignment was defined within a 250 metre wide corridor. The actual road reserve for the option would be approximately 100 metres wide and may be located anywhere within the corridor<sup>6</sup>. To enable comparative assessment of the direct impacts of the options, a nominal 100 metre wide road reserve was identified in the centre of each option corridor. Impacts reported for each option in this section are approximate and are provided to enable understanding of the relative impacts of each option.

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<sup>6</sup> The actual width of the acquired road reserve may vary depending on design requirements and environmental constraints.



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Wells Crossing to Iluka Road  
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**Figure 4-3: Route options**



#### 4.4 Assessment of the short listed route options

Further detail of the assessment of the short listed route options is included in the Working Papers and the *Route Options Development Report* (RTA, 2005). The following sections provide a summary of the assessment of each option based on those information sources.

##### 4.4.1 Orange/A option

The Orange/A option is the most westerly of the options considered. It is predominantly a new motorway adjacent to the existing Pacific Highway. The existing highway is to be retained as a local access road and alternative route to the upgraded highway. The Orange/A option includes an easterly deviation to avoid South Grafton, between Bom Bom State Forest and Swan Creek. It also includes a bypass of Ulmarra (following the route of the previously approved Ulmarra Bypass), and a deviation at Tyndale to avoid flooding and soft soils to the west and north of the town.

The Orange/A option is the longest option, at 69 kilometres long, and crosses 38 kilometres of floodplain, more than any other option. Bridges would be provided at Swan Creek, Coldstream River, Shark Creek and other minor creeks. The preliminary cost of the Orange/A option, estimated at the time of display of the route options in October 2005, was between \$1300 and \$1400 million in 2005 dollars.

**Table 4-3** provides an overview of the impacts of the Orange/A option, as assessed in the *Route Options Development Report* (RTA, 2005). The assessment of the route options has been refined since the release of the *Route Options Development Report*, and the impacts of the route options as reported in some working papers may differ from that reported in **Table 4-3**. The working papers should be referred to for the most up to date assessment of the route options.

■ **Table 4-3: Summary assessment of the Orange/A option**

Criteria	Assessment of the Orange/A option
Road safety	<ul style="list-style-type: none"> <li>■ Orange/A option is designed to achieve the target crash rate of 15 crashes per 100 million vehicle kilometres travelled and to substantially reduce the severity of crashes.</li> <li>■ Would provide safety benefits to local traffic and through traffic as the majority of local traffic would use the Orange/A route in preference to the existing highway.</li> </ul>
Traffic, transport and access	<ul style="list-style-type: none"> <li>■ Would attract approximately 90% of traffic from the existing highway.</li> <li>■ Potential interchanges at Bom Bom and north of Swan Creek to provide access to Grafton.</li> <li>■ Potential interchange south of Harwood Bridge to access Maclean and Yamba.</li> <li>■ Approximately 75% of all heavy vehicles are semi-trailers or B-Doubles and the majority of these would use the Orange/A option rather than the existing highway.</li> <li>■ Approximate travel time saving of 8 minutes from Wells Crossing to Harwood.</li> <li>■ Existing highway would be retained as an alternative route and to provide access to properties.</li> </ul>
Engineering	<ul style="list-style-type: none"> <li>■ Would meet required design standards including 110km/h design speed.</li> <li>■ Potential for staged construction due to proximity to existing highway.</li> <li>■ Cost estimate between \$1300-1400 million (in 2005 dollars).</li> </ul>
Topography, geology and soils	<ul style="list-style-type: none"> <li>■ Relatively flat terrain reduces earthworks volumes and ensures that gradients would meet design standards.</li> <li>■ More than half the route length is within the floodplain, in areas of soft soils, requiring pre-loading or specific foundation designs to prevent settlement of fill.</li> <li>■ High potential to encounter acid sulphate soils.</li> </ul>
Drainage and flooding	<ul style="list-style-type: none"> <li>■ Approximately 38 kilometres within the Clarence floodplain.</li> <li>■ Road embankments across the floodplain would be typically two to three metres high, but up to six metres high in some locations.</li> <li>■ Approximately 20-25 bridges would be required within the floodplain.</li> <li>■ Another ten bridges would be required across creeks outside the floodplain.</li> <li>■ Substantial quantities of fill material would need to be imported for embankment construction.</li> </ul>
Water quality	<ul style="list-style-type: none"> <li>■ Water quality conditions at creek crossings generally within ANZECC/ARMCANZ (2000) guideline levels.</li> <li>■ Some creeks exhibit low dissolved oxygen and pH levels, and high concentrations of turbidity.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>■ Ecological impacts are relatively minor compared to other options, as the majority of the route passes through highly disturbed floodplain areas.</li> <li>■ Approximately one kilometre of the Orange/A option passes through high value habitat (around Yaegl Nature Reserve).</li> <li>■ Minor impacts on Yaegl Nature Reserve and SEPP 14 wetland would be mitigated by specific design measures to minimise the road footprint.</li> <li>■ Impacts on Glenugie State Forest are mainly edge effects associated with widening and minor re-alignment of the existing highway.</li> </ul>

Criteria	Assessment of the Orange/A option
Planning and land use	<ul style="list-style-type: none"> <li>■ Approximately 175 houses, mainly fronting the existing highway, would potentially be acquired.</li> <li>■ Land use impacts mainly relate to widening of the existing highway - edge effects rather than severance of properties, except along Four Mile Lane.</li> <li>■ Severance of rural properties between Bom Bom and Swan Creek would impact on prime agricultural land.</li> <li>■ Dairy farms and grazing land would be impacted by edge effects of widening the existing highway in the Ulmarra and Swan Creek areas.</li> <li>■ Substantial edge effects on cane farms would result in the north of this option.</li> <li>■ Approximately 465 hectares of prime agricultural land would be affected.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>■ Potential direct impacts on three Aboriginal sites of high significance.</li> <li>■ Potential impacts on four European heritage sites of high significance.</li> <li>■ Potential indirect impacts on three European heritage sites of high significance.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>■ Approximately 50 residences potentially affected by night-time noise levels exceeding the NSW DEC criteria for redeveloped roads, excluding those that would be acquired as part of the project.</li> </ul>
Visual	<ul style="list-style-type: none"> <li>■ Close to existing highway and major residential centres, meaning that this option is visible to a high concentration of people and would impact on the most properties.</li> <li>■ Embankment severs the relationship of properties with the river.</li> <li>■ Impacts are focused on existing area of disturbance, but would be substantially increased as a result of the scale of required road infrastructure to meet design requirements.</li> </ul>

As the Orange/A option follows the existing Pacific Highway for the most part, impacts would be associated with intensification of transport infrastructure and activity within the existing road corridor, as opposed to creation of a new corridor in areas where major transport infrastructure is otherwise absent. In terms of the overall context of the study area, upgrading of the existing corridor provides some strategic advantages. These include:

- Good performance in terms of achieving the safety objectives of the Pacific Highway Upgrade Program, through a significant decrease in the overall number of accidents on the road network (up to 50 per cent), as a result of approximately 90 per cent of traffic (local and through traffic) choosing to use the new highway, which would be constructed to higher safety standards.
- A greater overall travel time saving for all vehicles using the current highway corridor, including local traffic and through-traffic.<sup>7</sup>

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<sup>7</sup> Compared to other options, the Orange/A option would result in greater travel time savings for local traffic, but less travel time savings for through-traffic. Because of the high proportion of local traffic that uses the Pacific Highway, the overall travel time saving for all vehicles would be greater than for other options.

- Improvements to the efficiency overall of freight movement through the corridor, including a higher standard road that avoids towns and would result in travel time and cost savings for long distance freight, and provide a more direct, higher standard route for local freight to access Grafton.
- Opportunities to stage the development of the highway.
- Relatively small increases in noise impacts resulting from widening of the existing road corridor as opposed to creation of new areas of road traffic noise affectation for other route options.
- Along Four Mile Lane new noise exposure would result from this option.
- Around Ulmarra and Tyndale noise exposure would be changed as a result of bypasses of these towns causing new or increased noise exposure.
- Avoidance of impacts on areas of significant ecological value, in particular severance of habitat corridors and areas of contiguous remnant vegetation.

It is important to understand the scale of widening and upgrading of the existing road reserve that would be required to meet the design standards for the Pacific Highway Upgrade Program. The Orange/A option would comprise a new dual carriageway motorway adjacent to the existing highway, and as a result would require major widening of the road reserve to accommodate the new road, and service roads on one or both sides for local traffic.

The Orange/A option performs poorly against the community objectives of the Pacific Highway Upgrade Program because of:

- High potential risk of changes to flooding regimes.
- Direct acquisition of a large number of residences and businesses fronting the existing highway, as well as indirect impacts to residences that would be located close to the road.
- Encroachment of the substantially widened road reserve into areas of high value for agricultural production within the Clarence Valley floodplain.
- Reinforcement of the barrier imposed by the existing highway corridor on the development of functional and physical connections between Maclean and the areas of Gulmarrad, Townsend and James Creek.

#### **4.4.2 Purple/B option**

The Purple/B option follows the existing highway from Wells Crossing to the northern end of the Glenugie State Forest. Just south of Eight Mile Lane, it deviates north, passing near Grafton Airport and turning east to cross Wooli Road to the north-west of Pillar Valley. From here the Purple/B option heads north on the western side of the Pillar Range and the Pine Brush State Forest. The Purple/B option skirts to the south and east of Tyndale and Bondi Hill and then to

the east of the existing cane fields before rejoining the existing highway alignment just north of Shark Creek. From here the option follows the existing highway through to Harwood Bridge.

The Purple/B option is 66 kilometres long and would be constructed to Class M standards. Interchanges would be located at the existing highway near Eight Mile Lane, and south of Harwood Bridge. The preliminary cost of the Purple/B option was estimated at the time of display of the route options in October 2005 to be between \$950 and \$1050 million in 2005 dollars.

The Purple/B option crosses approximately 13 kilometres of floodplain with at least one carriageway designed to be above the 1 in 20 year flood level. Bridges would be provided at Coldstream River, Chaffin Creek, Shark Creek and other minor creeks.

**Table 4-4** provides a summary of the impacts of the Purple/B option, as assessed in the *Route Options Development Report* (RTA, 2005). The assessment of the route options has been refined since the release of the *Route Options Development Report*, and the impacts of the route options as reported in some working papers may differ from that reported in **Table 4-4**. The working papers should be referred to for the most up to date assessment of the route options.

■ **Table 4-4: Summary assessment of the Purple/B option**

Criteria	Assessment of the Purple/B option
Road safety	<ul style="list-style-type: none"> <li>■ Purple/B option is designed to achieve the target crash rate of 15 crashes per 100 million vehicle kilometres travelled and to substantially reduce the severity of crashes.</li> <li>■ Some improvement in traffic safety for traffic using the existing highway from reductions in traffic volumes and heavy vehicle volumes on the existing highway.</li> </ul>
Traffic, transport and access	<ul style="list-style-type: none"> <li>■ Would attract only small volumes of local traffic from the existing highway.</li> <li>■ Approximately 30-35% of vehicles are through traffic and would use the Purple/B route.</li> <li>■ Approximately 50% of heavy vehicles are through traffic and would use the Purple/B route.</li> <li>■ Approximately 75% of heavy vehicles are semi-trailers or B-Doubles and approximately 60% of these are through traffic that would use the Purple/B option rather than the existing highway.</li> <li>■ Travel time saving for through traffic from Wells Crossing to Harwood would be approximately 10 minutes.</li> <li>■ Potential interchange locations include Glenugie and south of Harwood Bridge.</li> </ul>
Engineering	<ul style="list-style-type: none"> <li>■ Would be designed to achieve the road design standards for the Pacific Highway Upgrade project, including 110km/h design speed.</li> <li>■ Some opportunities for staged construction, from Wells Crossing to Glenugie and from Shark Creek to Harwood Bridge.</li> <li>■ Cost estimate of between \$950-1050 million (in 2005 dollars).</li> </ul>

Criteria	Assessment of the Purple/B option
Topography, geology and soils	<ul style="list-style-type: none"> <li>■ Generally undulating terrain outside the floodplain for the majority of this route would provide good conditions for road construction.</li> <li>■ Sections of this route within the floodplain and affected by soft soils, requiring pre-loading or specific foundation designs to prevent settlement of fill.</li> <li>■ Areas of large earthworks volumes would be limited to Bondi Hill, around Tyndale.</li> </ul>
Drainage and flooding	<ul style="list-style-type: none"> <li>■ Approximately 13 kilometres of this route would be within the floodplain.</li> <li>■ Significant fill volumes would be required to provide the required flood immunity in some sections between Tyndale and Shark Creek.</li> <li>■ Embankments would be typically 1.5 to 2.5 metres high within the floodplain, and up to five metres high between Tyndale and Shark Creek.</li> <li>■ Approximately six to eight bridges would be required within the floodplain.</li> <li>■ Approximately 20 bridges would be required to cross creeks outside the floodplain.</li> </ul>
Water quality	<ul style="list-style-type: none"> <li>■ Water quality of creeks where crossings would be required is generally good, with the exception of low dissolved oxygen at some sites.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>■ Minor impacts on Yaegl Nature Reserve and SEPP 14 wetland are able to be mitigated by specific design measures to minimise the road footprint.</li> <li>■ Impacts on Glenugie State Forest include edge effects and severance of the north-western area of the forest.</li> <li>■ Impacts on endangered ecological communities would occur in the floodplain areas around Coldstream River and Pillar Valley Creek.</li> <li>■ Severance of areas of high habitat value to the east of Tucabia and around Bondi Hill and Shark Creek (approximately ten kilometres in total).</li> <li>■ Impacts on important habitat corridors would occur around the Coldstream wetlands.</li> <li>■ Impacts on Endangered Ecological Communities would be relatively high within the floodplain.</li> </ul>
Planning and land use	<ul style="list-style-type: none"> <li>■ Approximately 35 houses would be potentially directly affected.</li> <li>■ Potential impacts on urban areas would be limited to indirect impacts through Townsend associated with duplication of the existing alignment.</li> <li>■ Approximately 265 ha of prime agricultural land would be affected, including grazing land around the Coldstream River and sugar cane farms around Shark Creek.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>■ Overall heritage impacts would be low, relative to other options.</li> <li>■ Two Aboriginal sites of low significance would be potentially directly impacted.</li> <li>■ One Aboriginal site of moderate significance and one site of low significance would be potentially indirectly affected.</li> <li>■ Two European sites of high significance would be potentially indirectly affected.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>■ Approximately 30 dwellings would be affected by night time noise levels exceeding NSW DEC criteria for new roads, excluding those that would be acquired as part of the project.</li> </ul>



Criteria	Assessment of the Purple/B option
Visual	<ul style="list-style-type: none"> <li>■ Visual impacts through bushland and rural areas would be relatively high as a result of major new road infrastructure in areas that are currently characterised by a lack of development and human modification. However, low population density would reduce the severity of these impacts.</li> <li>■ Provides a diverse and varied visual experience for road users.</li> <li>■ Utilises existing highway alignment at its southern and northern limits, however, visual impacts on the local area would be greater than currently resulting from the existing road due to the scale of the infrastructure required to meet design standards.</li> <li>■ Generally follows the edges of land use units, thereby integrating with its surroundings.</li> </ul>

The Purple/B option in part follows the existing highway and in part would be a new route corridor. The combination of route selection strategies for this option provides some strategic advantages in the context of the study area. These include:

- Opportunities for staging of construction.
- Utilising sections of the existing highway that have relatively good alignments and flood immunity, thus offering value for money.
- Avoiding core areas of high habitat value in the east of the study area.
- Effective bypasses of towns along the existing highway including Swan Creek, Ulmarra and Tyndale, improving travel time and minimising the risk of accidents.
- Avoiding the impacts of a new route corridor through areas of future urban or rural residential growth, including Clarenza and Gulmarrad/James Creek.
- A reduction in night time noise on the existing highway (in sections where the Purple/B option is a new route), as a result of heavy vehicles using the Purple/B option.
- Potential to tie in with the existing highway at several locations, should travel demand require it, to maximise accessibility opportunities to local centres.

The Purple/B option would have the potential to result in new and adverse impacts associated with the creation of a major new road corridor in areas that are currently not subject to road traffic impacts. The split of traffic between the existing highway and the Purple/B option would result in two major transport corridors through the study area. The new corridor would create new effects in addition to the existing highway, which would continue to have substantial impacts due to the relatively high volume of remaining traffic. Particular community and environmental impacts of the Purple/B option, when assessed against the objectives of the Pacific Highway Upgrade Program, include:

- Noise and visual impacts would be introduced to parts of the study area that are relatively undeveloped and remote.

- Severance of rural properties from Glenugie to Shark Creek and impacts on cane farms from widening of the existing highway corridor from Shark Creek north.
- Risks associated with flooding particularly around Shark Creek.
- Impacts on endangered ecological communities would be high relative to other options.
- Fragmentation of the western extent of the habitat of the coastal Emu sub-population.

#### 4.4.3 Green/C option

The Green/C option deviates from the existing highway at Bald Knob Road, north of Wells Crossing and generally follows the eastern side of the study area . The Green/C option passes through the Pine Brush State Forest and would require a large bridge across the Shark Creek SEPP 14 wetland north of the forest. In the north, the Green/C option is located east of Gulmarrad, Townsend and James Creek and rejoins the existing highway south of the existing Harwood Bridge.

The Green/C option is approximately 60 kilometres long of which five kilometres crosses the Clarence River floodplain, in the north around James Creek and Gulmarrad, and at Shark Creek. Within the floodplain, at least one carriageway would be designed above the 1 in 20 year flood level. Bridges would be provided at Coldstream River, Chaffin Creek, Shark Creek and other minor creeks. The preliminary cost of the Green/C option was estimated at the time of display of the route options in October 2005 to be between \$700 and \$800 million in 2005 dollars.

**Table 4-5** summarises the impacts of the Green/C option.

#### ■ **Table 4-5: Summary assessment of the Green/C option**

Criteria	Assessment of the Green/C option
Road safety	<ul style="list-style-type: none"> <li>■ The Green/C option is designed to achieve the target crash rate of 15 crashes per 100 million vehicle kilometres travelled and to substantially reduce the severity of crashes.</li> <li>■ Improved road safety for traffic using the existing highway from reductions in traffic volumes and heavy vehicle volumes on the existing highway.</li> </ul>
Traffic and transport	<ul style="list-style-type: none"> <li>■ The Green/C option is the shortest of the route options.</li> <li>■ Would attract very little local traffic from the existing highway.</li> <li>■ Approximately 30-35% of vehicles would be through traffic and would use the Green/C option.</li> <li>■ Approximately 50% of heavy vehicles are through traffic would use the Green/C option.</li> <li>■ Approximately 75% of heavy vehicles are semi-trailers or B-Doubles and approximately 60% of these are through traffic that would use the Green/C option rather than the existing highway.</li> <li>■ The travel time saving for through traffic between Wells Crossing and Harwood Bridge would be approximately 13 minutes.</li> <li>■ Potential interchange locations include Bald Knob Road and south of Harwood Bridge.</li> </ul>

Criteria	Assessment of the Green/C option
Engineering	<ul style="list-style-type: none"> <li>■ Would be designed to achieve the standards required for the Pacific Highway Upgrade Program, including 110km/h design speed.</li> <li>■ No opportunities for staged construction.</li> <li>■ Cost estimate of between \$700-800 million (in 2005 dollars).</li> </ul>
Topography, geology and soils	<ul style="list-style-type: none"> <li>■ Generally topography and soils present minimal constraint to the Green/C option.</li> <li>■ Floodplain soils would be traversed for relatively short distances around Shark Creek and north of Brooms Head Road - some potential to encounter soft soils and acid sulphate soils.</li> <li>■ Earthworks volumes would be significant, but cut and fill volumes would be balanced.</li> </ul>
Drainage and flooding	<ul style="list-style-type: none"> <li>■ Approximately five kilometres of this option would be within the floodplain, around Shark Creek and north of Brooms Head Road.</li> <li>■ Embankments would be typically two to three metres high, and up to six metres high in some locations in the floodplain.</li> <li>■ Two bridges would be required within the floodplain, and a further 20 bridges across creeks outside the floodplain.</li> </ul>
Water quality	<ul style="list-style-type: none"> <li>■ Water quality of creeks along this route option is relatively good, with the exception of low dissolved oxygen and pH levels in Shark Creek.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>■ Ecological impacts of this option would be high.</li> <li>■ High potential for impacts on high value fauna habitat and fauna corridors for approximately 25 kilometres of this option, in particular around Pillar Valley, Shark Creek, and Brooms Head Road.</li> <li>■ Direct impacts on the Shark Creek SEPP 14 wetland.</li> <li>■ Impacts on remnant endangered floodplain vegetation communities in the Shark Creek and Gulmarrad areas.</li> <li>■ Impacts on identified habitat links between high ecological value areas within the Pine Brush State Forest.</li> </ul>
Planning and land use	<ul style="list-style-type: none"> <li>■ Approximately 5 houses would be potentially acquired.</li> <li>■ Impacts on approximately 115 ha of prime agricultural land, mainly north of Brooms Head Road.</li> <li>■ High impacts on productive areas of Pine Brush State Forest.</li> <li>■ Potential impacts on rural communities around Pillar Valley, Bostock Road, Gulmarrad and James Creek Road.</li> <li>■ Impacts on the SEPP 14 wetland could require separate development approval.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>■ Overall heritage impacts would be moderate to high.</li> <li>■ Potential direct impacts on one site each of high and moderate European heritage significance,</li> <li>■ Potential direct impacts on five Aboriginal sites of low significance.</li> <li>■ Potential indirect impacts on two European heritage sites of high significance.</li> <li>■ Potential indirect impacts on one Aboriginal site of moderate significance.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>■ Approximately 30 dwellings would be affected by noise levels in excess of the NSW DEC criteria for night time noise, for new roads, excluding those that would be acquired as part of the project.</li> </ul>

Criteria	Assessment of the Green/C option
Visual	<ul style="list-style-type: none"> <li>■ Visual impacts through bushland and rural areas would be relatively high as a result of major new road infrastructure in areas that are currently characterised by a lack of development and human modification. However, low population density would reduce the severity of these impacts.</li> <li>■ Some areas would require large cuts and fills which have the potential to be visually prominent.</li> <li>■ Impacts in bushland areas would be mitigated to a degree by topography and shielding by vegetation.</li> <li>■ Would not provide a variety of visual experience for road users.</li> <li>■ Sections of the Green/C option around Gulmarrad and James Creek are relatively close to rural residential development and therefore have moderate to high visual impacts in these areas.</li> </ul>

The Green/C option would be an entirely new road corridor, from Wells Crossing to Harwood Bridge. The main impacts associated with the Green/C option would relate to the construction of this new corridor through areas that are generally remote and retain a rural and bushland character.

In the context of the study area, a new route corridor provides some strategic advantages in addressing the Pacific Highway Upgrade Program objectives. These include:

- Achievement of significant travel time and transport cost savings for through traffic.
- A direct route for through traffic, which would also separate through and local traffic, enabling the existing highway to be utilised as a high standard dedicated local access road.
- Reduction in the number of accidents overall in the transport corridor as a result of the high standard of the new road and reduction in traffic volumes (particularly heavy vehicles) on the existing highway.
- Minimal flood risk and provision of a relatively flood free route as an alternative to the existing Pacific Highway, which is highly flood affected.
- Minimising impacts on local communities by avoidance of further impacts on more densely settled urban areas in the west of the study area.
- A minor reduction in daytime noise impacts for properties along the existing highway, and a significant reduction in night time noise impacts along the existing highway as a result of heavy vehicles using the new road.

However, the Green/C option would have the potential to result in new and adverse impacts associated with the creation of a major new road corridor in areas that currently are not subject to road construction and traffic impacts. The road would provide little direct benefit to these communities.

The main impacts in this regard include:

- Impacts on areas of ecological value, including additional severance of habitat links and corridors, and areas of remnant vegetation that are contiguous throughout the east of the study area.
- Severance of rural properties and new noise and visual affectation in areas that are currently not exposed to impacts from major infrastructure.
- Limited opportunities for local access to the new highway.

#### **4.4.4 Red/D option**

The Red/D option is the most easterly of the options. It deviates to the north from the existing highway at Bald Knob Road, and generally follows the eastern edge of the study area. It is located generally east of the Pillar Range and runs to the east of Pine Brush State Forest and the Shark Creek SEPP 14 wetland. The Red/D option is located east of Gulmarrad, Townsend and James Creek. It rejoins the existing highway alignment at the southern end of the existing Harwood Bridge.

This option is approximately 60 kilometres long, crosses nine kilometres of floodplain and is an entirely new road corridor. Within the floodplain, at least one carriageway would be designed above the 1 in 20 year flood level. Bridges would be provided at Coldstream River, Chaffin Creek and other minor creeks. The preliminary cost of the Red/D option estimated at the time of display of the route options in October 2005, was between \$700 and \$800 million in 2005 dollars.

**Table 4-6** provides a summary of the impacts of the Red/D option, as assessed in the *Route Options Development Report* (RTA, 2005). The assessment of the route options has been refined since the release of the *Route Options Development Report*, and the impacts of the route options as reported in some working papers may differ from that reported in **Table 4-6**. The working papers should be referred to for the most up to date assessment of the route options.

■ **Table 4-6: Summary assessment of the Red/D option**

Criteria	Assessment of the Red/D option
Road safety	<ul style="list-style-type: none"> <li>■ The Red/D option is designed to achieve the target crash rate of 15 crashes per 100 million vehicle kilometres travelled and to substantially reduce the severity of crashes.</li> <li>■ Improved road safety for traffic using the existing highway from reductions in traffic volumes and heavy vehicle volumes on the existing highway.</li> </ul>
Traffic, transport and access	<ul style="list-style-type: none"> <li>■ Would attract minimal volumes of local traffic from the existing highway.</li> <li>■ Approximately 30-35% of vehicles are through traffic and would use the Red/D option.</li> <li>■ Approximately 50% of heavy vehicles are through traffic and would use the Red/D option.</li> <li>■ Approximately 75% of heavy vehicles are semi-trailers or B-Doubles and approximately 60% of these are through traffic that would use the Red/D option rather than the existing highway.</li> <li>■ The travel time saving for through traffic between Wells Crossing and Harwood Bridge would be approximately 13 minutes.</li> <li>■ Potential interchange locations include Bald Knob Road and south of Harwood Bridge.</li> </ul>
Engineering	<ul style="list-style-type: none"> <li>■ Would be designed to achieve the standards required for the Pacific Highway Upgrade Program, including 110km/h design speed.</li> <li>■ No opportunities for staged construction.</li> <li>■ Cost estimate of between \$700-800 million (in 2005 dollars).</li> </ul>
Topography, geology and soils	<ul style="list-style-type: none"> <li>■ Generally topography and soils present minimal constraints.</li> <li>■ Areas of floodplain soils would be traversed around Red Root Road and north of Brooms Head Road - some potential to encounter soft soils and acid sulphate soils.</li> <li>■ Earthworks volumes would be significant, but cut and fill volumes would be balanced.</li> </ul>
Drainage and flooding	<ul style="list-style-type: none"> <li>■ Approximately nine kilometres of this option would be within the floodplain, around Red Root Road and north of Brooms Head Road.</li> <li>■ High flood flow velocities exist in floodplain areas around Red Root Road.</li> <li>■ Embankments would be typically two to three metres high, and up to four metres high in some sections of the floodplain.</li> <li>■ Between six and eight floodplain bridges would be required, plus another 25 to 30 bridges across creeks outside the floodplain.</li> </ul>
Water quality	<ul style="list-style-type: none"> <li>■ Water quality is generally good in the vicinity of this option, with the exception of low dissolved oxygen and high turbidity in some locations.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>■ Ecological impacts of this option would be high.</li> <li>■ High potential for impacts on high value fauna habitat and fauna corridors for approximately 22 kilometres of this option, in particular around Pillar Valley, east of Pine Brush State Forest, and around Brooms Head Road.</li> <li>■ Impacts on identified habitat links between high ecological value areas within the Pine Brush State Forest.</li> </ul>
Planning and land use	<ul style="list-style-type: none"> <li>■ Approximately 10 houses would be potentially acquired.</li> <li>■ Impacts on approximately 220 ha of prime agricultural land, mainly north of Brooms Head Road and around Red Root Road.</li> <li>■ Potential impacts on rural communities around Pillar Valley, Bostock Road and James Creek Road.</li> <li>■ Minor impacts on Glenugie State Forest and grazing land in the south of this option.</li> </ul>



Criteria	Assessment of the Red/D option
Heritage	<ul style="list-style-type: none"> <li>■ Overall heritage impacts would be low.</li> <li>■ Potential direct impacts on three Aboriginal sites of low significance.</li> <li>■ Potential indirect impacts on two Aboriginal sites of high significance and one site of moderate significance.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>■ Approximately 30 dwellings would be affected by noise levels in excess of the NSW DEC criteria for night-time noise for new roads, excluding those that would be acquired as part of the project.</li> </ul>
Visual	<ul style="list-style-type: none"> <li>■ Visual impacts through bushland and rural areas would be relatively high as a result of major new road infrastructure in areas that are currently characterised by a lack of development and human modification. However, low population density would reduce the severity of these impacts.</li> <li>■ Southern and middle sections traverse forested terrain, free from development and therefore have low visual impact.</li> <li>■ Alignment does not provide a variety of experience for road users.</li> <li>■ Approach to Clarence River crossing traverses sugar cane growing region and would result in visual fragmentation of this strong landscape unit.</li> </ul>

The Red/D option would be an entirely new road corridor from Wells Crossing to Harwood Bridge. The main impacts of the Red/D option would relate to the construction of a new road corridor through areas that are generally remote and that retain a rural and bushland character.

In the context of the study area, a new route corridor provides some strategic advantages that can contribute to the achievement of the Pacific Highway Upgrade Program objectives. These include:

- Achievement of significant travel time and transport cost savings for through traffic.
- A direct route for through traffic, which would also separate through and local traffic, enabling the existing highway to be utilised as a high standard dedicated local access road.
- Reduction in the number of accidents overall in the transport corridor as a result of the high standard of the new road and reduction in traffic volumes (particularly heavy vehicles) on the existing highway.
- Minimal flood risk and provision of a relatively flood free route as an alternative to the existing Pacific Highway, which is highly flood affected.
- Avoidance of further impacts on more densely settled urban areas in the west of the study area.
- A minor reduction in daytime noise impacts for properties along the existing highway, and a significant reduction in night time noise impacts on the existing highway as a result of reductions in heavy vehicle volumes.

The Red/D option would have the potential to result in new and adverse impacts associated with the creation of a major new road corridor in areas that currently are not subject to road construction and traffic impacts. The road would provide little direct benefit to these communities. The main impacts in this regard include:

- Impacts on areas of ecological value, including additional severance of habitat links and corridors, and areas of remnant vegetation that are contiguous throughout the east of the study area.
- Severance of rural properties and new noise and visual affectation in areas that are currently not exposed to impacts from major infrastructure.
- Limited opportunities for local access to the new highway.

#### **4.4.5 Connections between options**

Two potential connections between route options, which enable sections of the route options to be combined, were assessed. These are:

- Between the Purple/B and Orange/A options to the south and east of Tyndale.
- Between the Green/C or Red/D options and the Purple/B option in the vicinity of Shark Creek.

The connection between the Purple/B and Orange/A options is located near Tyndale. The connection is approximately five kilometres long, has a generally north-south alignment and passes to the east of the village of Tyndale.

The connection between the Green/C or Red/D options and the Purple/B option is up to 9.5 kilometres long, depending on whether it connects from the Red/D or Green/C options. It allows the easterly options to connect with the existing highway corridor west of Gulmarrad and Townsend rather than passing to the east of these towns. The connection traverses the Shark Creek Range before crossing the floodplain around Shark Creek closer to the existing highway. The connection is located as far south as practical in order to minimise potential impacts on the rural residential developments in Townsend and Gulmarrad.

### **4.5 Harwood Bridge to Iluka Road section**

#### **4.5.1 Development of the route corridor**

Between Harwood Bridge and the Iluka Road intersection, the initial RTA strategy for upgrading the highway involved widening the existing highway to accommodate a dual carriageway road. This section of the project would be developed to Class A standard, and this would be achieved by duplicating the existing highway and bridges. This approach maximises the use of existing assets and enables staged development of this section of the project. Route

options that involve a new road corridor (to avoid impacts on Harwood) were investigated (see **Section 6.2**), but are not consistent with the RTA's strategy and do not perform as well as upgrading along the existing alignment when considered against the objectives of the project.

Duplication of the existing highway would include construction of new two lane bridges at Harwood and the North Arm, and a new single carriageway duplication of the existing highway. Minor re-alignment of the existing highway would be required in some locations to achieve design standards or to minimise impacts.

Provision has been made to develop this section of the road to full motorway (Class M) standard in the future. This would require two new carriageways plus the existing highway, which would potentially operate as a local road. Upgrading to Class M standard would require two additional bridges over the Clarence River.

Under both Class A and Class M scenarios, a full interchange would be provided at Iluka Road. Under a Class A configuration, at grade access to the road may be provided at intersections with some local roads. Under Class M configuration, local access would be via a separate road which would run parallel to the upgraded highway and connect with other local roads.

Through Harwood, impacts would be potentially greater as a result of widening the existing highway to the west. For the purposes of assessment, a nominal road reserve has been identified to the east of the existing highway.

For the Class M standard road, two new two-lane bridges would be provided across the Clarence River, and one new two lane bridge at the North Arm. This would require two new carriageways to be constructed adjacent to the existing highway. North of approximately Carroll Lane (on Chatsworth Island) to just south of Iluka Road, the existing highway is a four lane single carriageway road. This section would be likely to require reconstruction to provide separate carriageways for the upgraded highway and any required local roads.

#### **4.5.2 Assessment of the Harwood Bridge to Iluka Road section**

The impacts of an upgrade to Class M standard have been assessed based on a 100 metre wide road reserve. The existing road reserve is generally around 40-50 metres wide and it would need to be widened to accommodate the new road and local roads. As with options between Wells Crossing and Harwood, a 250 metre wide corridor was identified at the route options stage of the project, centred on the nominal road reserve. This was to provide flexibility in the design of the road to respond to issues that may arise as the project progresses.

The Harwood to Iluka Road section is approximately 10.5 kilometres long, including potential intersection and approach works that may extend to the north of the Iluka Road intersection. At least one carriageway would be above the 1 in 20 year flood level.

The preliminary cost of the Harwood to Iluka Road section was estimated at the time of public display of the route options in October 2005 to be between \$400 and \$450 million in 2005 dollars.

**Table 4-7** summarises the impacts of the project between Harwood Bridge and Iluka Road, as assessed in the *Route Options Development Report* (RTA, 2005). The assessment of this section of the project has been refined since the release of the *Route Options Development Report*, and the impacts of the project as reported in some working papers may differ from that reported in **Table 4-7**. The working papers should be referred to for the most up to date assessment of the Harwood to Iluka Road section.

■ **Table 4-7: Summary assessment of the project between Harwood Bridge and Iluka Road**

Criteria	Assessment of the upgrade between Harwood Bridge and Iluka Road
Road safety	<ul style="list-style-type: none"> <li>■ This section of the project is designed to achieve the target crash rate of 15 crashes per 100 million vehicle kilometres travelled and to substantially reduce the severity of crashes.</li> <li>■ Substantial improvement in traffic safety for traffic using the existing highway.</li> </ul>
Traffic, transport and access	<ul style="list-style-type: none"> <li>■ Would be utilised by the majority of local and through traffic.</li> <li>■ Travel time saving would be small.</li> <li>■ Full interchange would be provided at Iluka Road, with other interchanges subject to traffic demand.</li> </ul>
Engineering	<ul style="list-style-type: none"> <li>■ Would be designed to achieve the standards required for the Pacific Highway Upgrade Program, including 110km/h design speed.</li> <li>■ Potential for staged construction initially to Class A, with full upgrade to Class M should demand require it.</li> <li>■ Preliminary cost estimate is \$400-450 million (in 2005 dollars).</li> </ul>
Topography, geology and soils	<ul style="list-style-type: none"> <li>■ Mostly located in compressible floodplain soils across Harwood and Chatsworth Islands.</li> <li>■ High potential to encounter soft soils and acid sulphate soils.</li> <li>■ Earthworks volumes would be significant, with large volumes of fill.</li> </ul>
Drainage and flooding	<ul style="list-style-type: none"> <li>■ Approximately ten kilometres of this section of the project would be within the floodplain across Harwood Island and Chatsworth Island.</li> <li>■ Embankments would typically be two to three metres high, but up to 4.5 metres high in some locations in the floodplain.</li> <li>■ Between six and eight floodplain bridges would be required, plus another three bridges across creeks outside the floodplain.</li> </ul>
Water quality	<ul style="list-style-type: none"> <li>■ Water quality is generally good in the Clarence River and North Arm.</li> </ul>
Ecology	<ul style="list-style-type: none"> <li>■ Ecological impacts of this option would be low.</li> <li>■ Some potential for impacts on remnant mangrove and saltmarsh communities and aquatic habitats at river and creek crossings.</li> </ul>

Criteria	Assessment of the upgrade between Harwood Bridge and Iluka Road
Planning and land use	<ul style="list-style-type: none"> <li>■ Approximately 21 houses would be potentially directly affected by an upgrade to the east of the existing highway.</li> <li>■ Impacts on approximately 95 ha of prime agricultural land, mainly edge effects on cane farms.</li> <li>■ Potential impacts on Harwood village, which would be greater for the upgrade to the west of the existing highway.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>■ Potential indirect impacts on the heritage values of sites within Harwood village including Harwood Island School and a house.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>■ Based on upgrading to the east of the existing highway, approximately 14 dwellings would be affected by noise levels in excess of the NSW DEC criteria for night-time noise, for redeveloped roads, excluding those that would be acquired as part of the project.</li> </ul>
Visual	<ul style="list-style-type: none"> <li>■ Through Harwood Island and Chatsworth island the project traverses cane farms and would result in visual fragmentation of this strong landscape unit.</li> </ul>

The main impacts associated with this section of the project are direct land take, mainly of cane farming land, and potential changes to flooding behaviour, which may include flood depths, flow velocities, inundation durations and flow paths. Impacts such as noise have the potential to increase at some locations as a result of bringing traffic closer to existing residences. The new crossing of the Clarence River at Harwood would have potentially substantial visual impacts. However, the crossing also presents opportunities to enhance the visual identity of the highway through a structure that becomes a local landscape feature.