5 Traffic and Transport Issues

5.1 Introduction

A strategic assessment of the traffic and transport issues for the Existing Highway Upgrade and Inner Bypass corridor options has been undertaken for the purpose of identifying some of the key parameters and differences associated with the operation and performance of each option. Issues that have been considered include:

- Existing and future traffic volumes with and without the proposed upgrade / bypass options
- The extent to which each option is effective in removing through traffic from local roads
- The estimated levels of heavy vehicle traffic attracted to each option
- Future intersection performance
- Other operational issues such as heavy vehicle travel times and crash rates

The following sections summarise the findings from this assessment.

5.2 Existing and Future Traffic Volumes

5.2.1 TRACKS Model

In order to assess how the traffic volumes along the existing Pacific Highway through Coffs Harbour would change with either the Existing Highway Upgrade or the Inner Bypass, a traffic modelling software package has been used. Coffs Harbour City Council (CHCC) has in recent years developed its own in-house model from a software package called TRACKS to assist with its future road planning. For consistency with earlier studies completed in March 2002 as part of the initial route planning activities for the CHHPS, it was decided that the TRACKS model would be used for the current investigations. The results of this traffic modelling, which has been undertaken by CHCC on behalf of the RTA, are presented in this section.

TRACKS is a conventional, four-step transport network model with features suited to strategic planning applications. It uses road network models established by the modeller for a particular evaluation year, in conjunction with land use data and associated trip estimation (generation), distribution and assignment models, to provide corresponding estimates of 24-hour traffic volumes and travel statistics for the evaluation year. The traffic volumes and travel statistics produced by the model are for an average, non-holiday working weekday on roads throughout the Coffs Harbour LGA.

It is necessary to validate the model by comparing the difference in modelled traffic volumes and travel statistics (eg. travel times and distances) with actual volumes and statistics for an existing road / land-use network, before using it to produce forecasts for future years and alternative road / land-use networks. This exercise was undertaken by CHCC using a combination of traffic data that had been previously collected for the purpose of developing the model, in conjunction with traffic data collected by the RTA specifically as part of the earlier investigations completed in March 2002 for the CHHPS. Adjustments were made to the model as necessary in order to achieve an acceptable model validation.

As with the earlier studies completed in March 2002, traffic models were run for the base year of 2001 and the future year of 2021 only, corresponding to those years for which CHCC currently has estimates of land use data. Land use data is not available beyond 2021. For each of the modelling years (2001 and 2021), road network models were developed for the base case (ie. without any new highway corridor) and for each of the options (Existing Highway Upgrade and Inner Bypass corridor options) under consideration.

The base case road networks included the present-day road network together with other planned improvement works expected to be completed within the modelling timeframe. For 2021, this included all of the works proposed in the Coffs Harbour Future Road Network Plan (ie. the extension of Hogbin Drive across Coffs Creek and its upgrading to 4 lanes between Stadium Drive and Arthur Street, the Mastracolas Road extension and the North Boambee Valley link road system). For the 2001 base network, the conservative assumption was made that it included the eastern components of the future road network only (ie. as above, but excluding the Mastracolas Road extension and the North Boambee Valley link road system).

The option networks included the same improvements as the corresponding base network, plus the particular corridor option under consideration. Details of the network configurations and connections proposed for the Existing Highway Upgrade and for the Inner Bypass are discussed in other sections of this report. In the case of the Inner Bypass, all of the alternative layouts provide the same connectivity to the adjoining road network and differ only in their route alignment and method of construction (eg. tunnels vs cuttings). Each of the Inner Bypass route options under consideration would therefore be expected to attract similar volumes of traffic. For this reason, a single, generic option has been adopted for the Inner Bypass corridor for traffic modelling purposes.

In addition to the general features of the modelling framework outlined above, there were some specific improvements applied to this round of modelling which differ from those adopted in the previous modelling completed in March 2002 as part of the initial corridor planning activities for the CHHPS. Of these, the most significant improvements include:

- Modifications to the trip matrices used in the model to address the under-reporting of through trips in the previous 2002 modelling, identified in the Peer Review undertaken by Arup.
- Adoption of a 2-class assignment for the route evaluation process. This methodology enables the separate reporting of through trips which was not possible in the previous modelling undertaken in 2002.
- The use of an approach-level assignment in place of the movement-based assignment method used previously in the 2002 modelling.
- The addition of a minor improvement to the 2001 base network, and a series of "Do-Minimum" improvements to the 2021 base network in order to remove excessive delays at specific intersections.

The above changes to the modelling framework mean that the results from the current round of modelling are not directly comparable with those produced from the modelling undertaken in 2002.

5.2.2 Total Traffic Volumes and Through Traffic

An origin-destination survey (OD) was conducted to identify the existing volumes of traffic travelling through the urban area of Coffs Harbour. Survey sites were located south of Lyons Road and at Opal Cove on the Highway and west of Spagnolos Road on Coramba Road. Vehicles which passed any two of these survey sites within a time period of 2 hours were identified as through vehicles. Details of the survey are presented in a report by Traffic and Transport Surveys Pty Ltd entitled *Coffs Harbour Traffic Study, Origin-Destination Survey & Auto-count Survey, Final Report, September 2001 (TTS, 2001).*

The volumes of through traffic identified from these surveys were used to establish the base through trip matrices within CHCC's model, from which changes in the level of through trips along specific routes arising from the addition of each of the road improvement options could then be identified.

The results of the traffic modelling for the Base Case and each of the options at 2001 and 2021 are presented in CHCC's report entitled *Analysis of Alternative Coffs Harbour Pacific Highway Network Options Against the Base Case Networks: Forecast Years 2001 and 2021, Final Report - July 2003 (CHCC, 2003).*

Table 5.1 summarises the modelled traffic volumes for the Base Case and each of the Existing Highway Upgrade and Inner Bypass options. The modelled through traffic volumes are shown in brackets next to the total traffic volumes predicted to use each link.

Based on Table 5.1, the following conclusions can be drawn:

- Modelled traffic volumes on the existing Pacific Highway between Englands Road and the end of the existing dual carriageway at Sapphire range between approximately 21,000 vehicles per day (vpd) north of James Small Drive (south) and 34,000 vpd north of Bray Street for the Base Case in 2001. By 2021, traffic volumes on the existing highway are predicted to range between 28,000 vpd south of Halls Road and 45,000 vpd north of Bray Street.
- With the addition of the Inner Bypass to the road network, traffic volumes would decrease on the bypassed section of the Pacific Highway by 13%-35% in the year 2001, to levels ranging from approximately 13,500 vpd north of James Small Drive (south) to 26,000 vpd north of Bray Street. By 2021 the reductions are slightly higher at between 16%-39%, with volumes on the bypassed section ranging from between 21,500 vpd north of James Small Drive (south) to 35,000 vpd north of Bray Street. The volumes in the latter case are at approximately the same levels as the Base Case in 2001 (ie. existing levels).
- Estimated traffic volumes on the Inner Bypass range from approximately 6,000 vpd to 9,000 vpd in the year 2001, depending on the section of the bypass being considered. By 2021, the volumes are predicted to increase to between approximately 12,000 vpd and 17,000 vpd, exceeding the planning thresholds for a 2-lane bypass and indicating the warrant for construction of a 4-lane divided carriageway bypass.
- With the Existing Highway Upgrade option, traffic volumes generally decrease on the section of the upgraded highway adjacent to the proposed service roads. Local Traffic would generally divert to these service roads, or remain on the old bypassed sections of the highway (eg. On the section through McCauleys Headland). Traffic volumes on the upgraded Highway in 2001 range between approximately 10,000 vpd north of Coff Street to 33,000 vpd north of Bray Street. Similar reductions occur in 2021, except on the section north of Bray Street where volumes are predicted to increase slightly (by 11%) relative to the Base Case. Overall, traffic volumes ranging between 17,000 vpd north of Coff Street and 50,000 vpd north of Bray Street are predicted to occur in 2021.
- Modelled traffic volumes on the Hogbin Drive Extension at the section passing over Coffs Creek are estimated to be of the order of 17,000 vpd in 2001, increasing to approximately 22,000 vpd by 2021 for the Base Case. These volumes are also expected to reduce with each of the options. For the Inner Bypass option, volumes are predicted to reduce by 19% in 2001 and 27% in 2021, to levels of 14,000 vpd and 16,000 vpd respectively. For the Existing Highway Upgrade option, volumes reduce by 43% in 2001 and 47% in 2021 relative to the Base Case, to levels of 10,000 vpd and 12,000 vpd respectively. Traffic volumes on the Hogbin Drive Extension at 2021, with either of the options, would therefore be the same or less than the levels of traffic predicted to use the link in the Base Case at 2001.

Table 5.1 Modelled 2-Way Daily Traffic Volumes in 2001 and 2021 (Total and Through Traffic)[(1)]

Location	Average Daily Traffic Volumes– Base Case (veh/day)		Average Daily Traffic Volumes– Inner Bypass (veh/day)[2]		Average Daily Traffic Volumes – Existing Highway Upgrade (veh/day)[2]	
	2001	2021	2001	2021	2001	2021
Inner Bypass Corridor						
Between Englands Road and North Boambee Road	N/A	N/A	7,833 (4,443)	13,744 (8,256)	N/A	N/A
Between North Boambee Road and Coramba Road	N/A	N/A	9,264 (4,443)	16,901 (8,256)	N/A	N/A
Between Coramba Road and Mastracolas Road Extension	N/A	N/A	6,261 (3,976)	12,045 (7,389)	N/A	N/A
Between Mastracolas Road Extension and Northern I/C	N/A	N/A	7,685 (3,976)	14,752 (7,389)	N/A	N/A
Pacific Highway						
South of Englands Road	25,486 (4,443)	38,328 (8,256)	26,776 (4,443)	40,057 (8,256)	27,541 (4,443)	40,504 (8,256)
South of Halls Road	22,031 (2,387)	27,993 (2,093)	16,919 (0)	23,596 (0)	25,592 (4,443)	34,401 (5,915)
North of Coff Street	25,496 (1,407)	35,566 (2,331)	22,132 (0)	29,401 (0)	10,267 (3,183) [(3)]	16,741 (5,915) [(3)]
North of Bray Street	34,347 (2,856)	45,074 (3,915)	26,309 (0)	35,286 (0)	33,371 (3,976)	49,877 (7,389)
North of Arthur Street	28,306 (3,976)	44,095 (7,389)	20,600 (0)	29,388 (0)	22,360 (3,976)[(4)]	36,950 (7,389)[(4)]
North of James Small Drive (S)	20,752 (3,976)	35,693 (7,389)	13,509 (0)	21,623 (0)	20,752 (3,976)	35,693 (7,389)
North of Headland Road	18,084 (3,976)	31,745 (7,389)	18,337 (3,976)	30,511 (7,389)	17,633 (3,976)	30,451 (7,389)
North of Moonee Beach Road	16,020 (3,976)	26,509 (7,389)	16,020 (3,976)	26,509 (7,389)	16,020 (3,976)	26,509 (7,389)
North of Bucca Road	15,566 (3,976)	26,161 (7,389)	15,566 (3,976)	26,161 (7,389)	15,566 (3,976)	26,161 (7,389)
Hogbin Drive Extension						
Along the Coffs Creek link	17,074 (2,056)	22,083 (3,822)	13,897 (0)	16,136 (0)	9,813 (0)	11,811 (0)

1 Figures in brackets are "through traffic" volumes
2 Note that the traffic predicted to use the bypass (for the Inner Bypass option) or the Upgraded Highway (for the Existing Highway Upgrade option) is expected to experience a lower crash rate than the traffic using the existing highway, due to the improved road geometry and provision of road safety measures.
3 These figures are for the Upgraded Highway only and do not include traffic on the adjacent local service roads.
4 These figures are for the Upgraded Highway. In addition, some traffic remains on the old Pacific Highway over McCauleys Headland.

- The levels of through traffic currently using the Highway are also shown in the table. With the Hogbin Drive extension in place, through traffic constitutes only 5% to 25% of the total volumes on the Pacific Highway between Englands Road and the end of the existing dual carriageway at Sapphire for the Base Case in 2001, ranging between approximately 1,400 vpd north of Coff Street and 4,000 vpd north of James Small Drvie (south) . By 2021 these volumes are predicted to double (although as a proportion of the total traffic the through traffic remains approximately the same), with through traffic on the Pacific Highway ranging from approximately 2,300 vpd north of Coff Street to 7,400 vpd north of James Small Drive (south). Through traffic using the parallel route of Hogbin Drive, is estimated to range from approximately 2,000 vpd (12% of the total traffic) in 2001 to slightly less than 4,000 vpd (17%) by 2021 at the Coffs Creek link.
- The impact of adding the Inner Bypass is that all of the through traffic from both the bypassed section of the Pacific Highway and also Hogbin Drive would divert to the Inner Bypass. The resulting volumes of through traffic predicted to use the Inner Bypass range from approximately 4,000 vpd to 4,500 vpd in 2001, representing 48% to 64% of the total traffic predicted to use the bypass, and from 7,500 vpd to 8,250 vpd in 2021 representing 49% to 61% of the total traffic. The balance of the traffic is local traffic with origins / destinations in the Coffs Harbour area.
- The Existing Highway Upgrade option also results in the attraction of all of the through traffic from Hogbin Drive, with through traffic using the upgraded Highway predicted to range from 12% to 31% of the total traffic in 2001, and 20% to 35% of the total traffic in 2021. The resulting volumes of through traffic on the Highway Upgrade range from approximately 3,000 vpd to 4,500 vpd in 2001, increasing to between 6,000 vpd and 7,400 vpd by 2021.

5.2.3 Heavy Vehicle Volumes

The TRACKS model used by CHCC is a strategic transport model developed to examine the effects of land use, population and network changes at a relatively broad level. As such, the CHCC model in its current form does not provide estimates of heavy vehicle movements, and how these might change with the addition of the Inner Bypass or Existing Highway Upgrade options.

A spreadsheet-based assessment of heavy vehicle movements has therefore been undertaken for the future modelling year of 2021 only. This has been done using the model outputs in Table 5.1 in conjunction with vehicle classification surveys undertaken along the existing Pacific Highway at 3 sites in 2001 as follows:

- Site 1 – South of Lyons Road
- Site 2 – At Opal Cove
- Site 3 – North of Bucca Road

The vehicle classification surveys were undertaken in accordance with the Austroads Vehicle Classification System which assigns each vehicle to 1 of 12 classes (or 'bins') based on its axle configuration. Classes 1 and 2 represent light vehicles comprising cars, vans, wagons, 4WDs, utilities, motorcycles, bicycles and towed vehicles (trailers, caravans, boats). Classes 3 to 12 represent heavy vehicles, with classes 3 to 5 comprising rigid vehicles (flatbed trucks, buses and other medium commercial vehicles), classes 6 to 11 comprising articulated vehicles (trucks and buses), semitrailers and B doubles. Class 12 comprises of road trains, which are not permitted on the Pacific Highway. Based on an average of the survey results, rigid vehicles and articulated vehicles/ B Doubles comprised approximately 41% and 59% respectively of the total number of heavy vehicles at the time of the survey.

Night time (i.e. between 10.00pm and 7.00am) heavy vehicle volumes were extracted from the survey results for the above locations. Total heavy vehicle traffic volumes during the night time were similar for the three locations, ranging between 462 vpd and 489 vpd. The data confirms the expectation that the majority of the night time heavy vehicle traffic is longer distance through traffic.

Based on these survey results, it was estimated that, during the night time period (10.00 pm to 7.00 am) in 2001, approximately 450 heavy vehicles per day were through traffic which would be attracted to the Inner Bypass and Existing Highway Upgrade options. The balance of night time heavy vehicle traffic (estimated to be approximately 30 vpd) was estimated to be vehicles servicing Coffs Harbour which would either remain on the existing highway with the addition of the Inner Bypass to the network or, in the case of the Existing Highway Upgrade option, use the adjacent service roads proposed as part of this option. The night time heavy vehicle volumes for each of the options and on the bypassed highway (in the case of the Inner Bypass option) in the future year of 2021 were then estimated from the 2001 volumes by applying a compound growth rate of 3% per annum.

The volume of heavy vehicle traffic during the daytime (i.e. between 7.00 am and 10.00 pm) using either the Inner Bypass or Existing Highway Upgrade was estimated by assuming that the average proportion of heavy vehicle traffic currently using the existing highway during this period, would also apply to these routes. This proportion was then applied to the total traffic volumes predicted (from the modelling undertaken by CHCC) to use either the Inner Bypass / Existing Highway Upgrade options or the bypassed existing highway (in the case of the Inner Bypass option), as summarised in Table 5.1, to estimate the corresponding daytime heavy vehicle volumes.

The daytime and night time heavy vehicle volumes were subsequently combined to yield the total daily heavy vehicle volumes in 2021 predicted to use either the Inner Bypass / Existing Highway Upgrade options or the bypassed existing highway (in the case of the Inner Bypass option). The results are presented in Table 5.2.

Vehicle classification surveys were also undertaken south of Woolgoolga between June and August 2003 in association with a reduction of the speed limit in the area. Recorded volumes of heavy vehicles averaged 1,580 per day. Rigid vehicles averaged 670 vpd or 42% of the total number of heavy vehicles, articulated vehicles (excluding B-Doubles) averaged 750 vpd or 48% of the total number of heavy vehicles and B-Doubles averaged 160 vpd or 10% of the total number of heavy vehicles.

Based on Table 5.2, the following conclusions can be drawn:

- The levels of heavy vehicle traffic in the Base Case at 2021 are estimated to range between approximately 3,100 vpd south of Halls Road to slightly less than 4,500 vpd north of Bray Street (11% and 10% of total daily traffic volumes respectively).
- The addition of the Inner Bypass is predicted to result in substantial reductions of between 34% and 51% in the levels of heavy vehicle traffic along the bypassed section of the Pacific Highway. The resulting heavy vehicle volumes along the bypassed section of the Highway in 2021 are estimated to range between slightly less than 1,800 vpd north of James Small Drive (south) to 2,900 vpd north of Bray Street (approximately 8% of total daily traffic volumes). These compare with a maximum estimated volume of heavy vehicles of 4,000 vpd south of Englands Road (approximately 10% of total daily traffic volumes).

Table 5.2 Estimated 2-Way Daily Heavy Vehicle Traffic Volumes in 2021

Location	Average Daily Volumes - Base Case (veh/day)	Average Daily Volumes– with Inner Bypass (veh/day)(1)	Average Daily Volumes – with Existing Highway Upgrade (veh/day)(1)
Inner Bypass Corridor			
Between Englands Road and North Boambee Road	N/A	1,862	N/A
Between North Boambee Road and Coramba Road	N/A	2,118	N/A
Between Coramba Road and Mastracolas Extension	N/A	1,720	N/A
Between Mastracolas Extension and Northern I/C	N/A	1,955	N/A
Pacific Highway			
South of Englands Road	3,901	4,040	4,078
South of Halls Road	3,061	1,956	3,590
North of Coff Street	3,659	2,403	2,143(2)
North of Bray Street	4,462	2,894	4,847
North of Arthur Street	4,366	2,414	3,799(3)
North of James Small Drive (S)	3,684	1,789	3,684
North of Headland Road	3,365	3,263	3,258
North of Moonee Beach Road	2,941	2,941	2,941
North of Bucca Road	2,913	2,913	2,913
Hogbin Drive Extension			
Along the Coffs Creek Link	n.a.(4)	n.a.(4)	n.a.(4)

1. Note that the traffic predicted to use the bypass (for the Inner Bypass option) or the Upgraded Highway (for the Existing Highway Upgrade option) is expected to experience a lower crash rate than the traffic using the existing highway, due to the improved road geometry and provision of road safety measures.
2. These figures are for the Upgraded Highway only and do not include traffic on the adjacent local service roads.
3. This volume is for the main highway; a small volume of heavy vehicle traffic would also remain on the old Pacific Highway over McCauleys Headland.
4. n.a = not available

- Estimated heavy vehicle volumes on the Inner Bypass in 2021 range from approximately 1,700 vpd to 2,100 vpd depending on the section of the bypass being considered. This represents approximately 14% of the total daily traffic predicted to use the Inner Bypass.
- With the Existing Highway Upgrade option, heavy vehicle volumes also generally reduce on the section of upgraded highway adjacent to the proposed service roads, reflecting the diversion of some heavy vehicle traffic with a local origin / destination in Coffs Harbour to these service roads. The reductions of between 13% and 41% are lower than those associated with the Inner Bypass option however, reflecting the relatively high proportions of longer-distance heavy vehicle traffic within the overall heavy vehicle numbers. This longer-distance traffic would remain on the upgraded Pacific Highway. The resulting heavy vehicle volumes in 2021 are estimated to range between approximately 2,100 vpd north of Coff Street to 4,800 vpd north of Bray Street (13% and 10% of total daily traffic volumes respectively).

5.3 Future Intersection Performance

A detailed analysis of the future performance of the intersections for the Base Case and each of the options has not been undertaken for this assessment. However, some general observations can be made based on the TRACKS modelling undertaken and by considering the proposed form of the new intersections for each scheme.

The operation of the Highway through Coffs Harbour, now and projecting into the future, will be primarily governed by the operation of the intersections, most of which are currently at-grade junctions and result in delays to all traffic as it passes through and across the area. With the substantial growth in local traffic in future years arising from developments in areas such as the North Boambee Valley and also further to the north in the Moonee Urban Release areas, a considerable strain will be placed on the existing infrastructure within Coffs Harbour, requiring improvements to be made to a number of the intersections.

The strategic network modelling undertaken using TRACKS identified a number of intersections where "Do-Minimum" improvements were required in order to address excessive delays that were otherwise predicted to occur. These improvements would need to be implemented progressively as the performance of the intersections deteriorates. Consequently, these improvements have been considered to be minor projects in their own right and the estimated cost of these improvements has not been included in the estimates prepared for any of the options.

5.4 Other Operational Issues

5.4.1 Heavy Vehicle Travel Times

An assessment of heavy vehicle travel times has been undertaken for the Inner Bypass and Existing Highway Upgrade options to assess the relative performance of each option. The analysis has been undertaken between the common points of Englands Road and the end of the existing dual carriageway at Sapphire under assumed free-flow conditions.

For the purposes of the analysis it has been assumed that the effects of grade on either of these options are minimal, since the maximum grades are not sustained over long distances and would therefore not significantly affect the speed of a heavy vehicle. The main influence on travel time would therefore be the posted speed limit, which is assumed to be 100 kph along the Inner Bypass, and either 80 kph through the main built-up areas or 100 kph elsewhere along the new motorway that is an assumed part of the Existing Highway Upgrade option.

Based on the above, an average speed for heavy vehicles of 95 kph has been adopted for travel along the Inner Bypass option between Englands Road and the end of the existing dual carriageway at Sapphire. Assuming an average length between the various alternative route alignments for this option of approximately 14.3 km, this equates to an estimated travel time for heavy vehicles of 9.0 minutes.

By comparison, assuming average speeds for heavy vehicles travelling along the Existing Highway Upgrade of 75 kph between Englands Road and James Small Drive North (approx. 10.5 km) and 95 kph between James Small Drive North and the end of the existing dual carriageway at Sapphire (approx. 1.8 km), this equates to an estimated travel time for heavy vehicles of 9.5 minutes.

The additional length of the Inner Bypass option relative to the Existing Highway Upgrade option is therefore offset by the higher average speed that could be sustained along its length, resulting in a travel time for heavy vehicles on the Inner Bypass that is approximately the same as for the upgraded Highway between the same points.

By comparison, actual truck travel time recorded on the existing highway between Englands Road and the end of the existing dual carriageway at Sapphire in November 2002 was 11.2 minutes.

5.4.2 Crash Rates

A reduction in the existing crash rate along the Pacific Highway, which is currently in the order of 51 crashes per 100 million vehicle kilometres travelled (100MVKT), is anticipated to occur with the implementation of either of the new corridor options. This is because a proportion of the traffic under each of the options would transfer from the existing Highway, with its multiple at-grade intersections, local access provisions and mix of vehicle types and trip purposes, to a new high-standard dual carriageway with improved alignment and grade-separated interchanges at all key intersections.

The traffic modelling results presented in Table 5.1 indicate that the Inner Bypass Option attracts between approximately 12,000 vpd and 17,000 vpd from the Pacific Highway and other parallel routes in the year 2021 depending on the section of bypass under consideration. An even higher volume of traffic, ranging from slightly less than 17,000 vpd north of Coff Street to as high as 50,000 vpd north of Bray St, is predicted to use the Upgraded Highway in 2021 if this option proceeds. With a crash rate of 15 crashes per 100MVKT typically targeted for new dual carriageway alignment sections where limited access is provided, traffic attracted to either the Inner bypass or the Upgraded Highway would be expected to experience a lower crash rate than if it remained on the existing highway network.

Based on this simple comparative analysis, it is evident that the crash rates experienced within the Coffs Harbour LGA as a whole are expected to reduce with the implementation of either of the schemes.

5.4.3 Transport of Dangerous Goods

A risk assessment has been conducted to compare the likelihood and severity of potential incidents involving dangerous goods vehicles for the two corridors (Connell Wagner, 2004g). The assessment involved calculation of incident likelihood for the options as well as an assessment of potential consequences for sensitive receptors.

The likelihood of an incident involving a dangerous goods vehicle was defined in terms of the number of years between incidents or crashes. The assessment concluded that the Existing Highway Upgrade has the least likelihood of a serious incident involving dangerous goods (1 in 97 years) and the existing highway with no upgrade (base case) has the greatest likelihood of an incident (1 in 28 years). The assessment also found that the Inner Bypass would reduce the likelihood of a dangerous goods vehicle incident on the bypassed section of the highway through Coffs Harbour due to the decrease in total traffic and dangerous goods vehicles in that corridor.

In terms of incident consequences, the adopted indicator is the area of built-up / densely populated land that can potentially be impacted on by a dangerous goods incident. This area is located within a 250m radius of the incident location, and is referred to as being within the "radius of fatal consequence". The smaller the built up area in proximity to the route, the less severe the outcome. For the existing population / land use situation, the option with the least consequence would be IS2 / IN2. The option with greatest consequence would be the existing unimproved Pacific Highway (base case) with 292 hectares of adjacent urban land use potentially impacted. Considering future urban development, the option with least consequence would be Inner Bypass option IS1 / IN1 with 155 hectares of built-up area being potentially impacted.

The tunnels considered as part of Highway Upgrade and Inner Bypass options are relatively short, being less than 600 metres long. The severity of a tunnel incident is dependent on a range of matters including the tunnel design, operational features and management practices. The likelihood of a serious incident including a vehicle carrying dangerous goods (eg an LPG explosion) in the subject tunnels ranges from about 1 in 2000 years to about 1 in 7200 years, the range essentially depending on the total tunnel length of an option.

The overall risk ranking for the options was determined through a combination of the likelihood and consequence data. When future urban development is considered, the highest risk option is the existing unimproved Pacific Highway (base case) while the lowest risk options are the Inner Bypass options IS1 / IN1 and IS1 / IN2, both having an overall medium-low risk rating.

An initial quantitative assessment of fatality potential has indicated that the likelihood of a person experiencing a fatality in any of the tunnel sections is influenced primarily by the length of time spent in the tunnel and also by the length of the tunnel sections.

The risk assessment has identified that all of the upgrade options would significantly reduce the risks of incidents involving dangerous goods vehicles when compared to the current base case situation (i.e. the unimproved Pacific Highway).

While this assessment has concentrated on highway options for Coffs harbour, the results are also broadly applicable to comparable options of Woolgoolga.

6 Cost and Economic Evaluation

6.1 Existing Highway Upgrade

6.1.1 Approach to Cost Estimating

The cost estimate for the Existing Highway Upgrade option between Englands Road and the end of the existing dual carriageway highway at Sapphire is strategic in nature and has not been prepared in the same manner as the estimates for the possible bypass routes within the inner corridor. This is because the design concepts as described in Section 5 are schematic in nature with only preliminary engineering definition that would be subject to significant refinement and development in the event that the existing highway becomes the preferred strategic option.

As such, the estimate has been prepared as a series of lump sum elements based on costs associated with the construction-comparable infrastructure components. The elements include the construction of numerous grade separated interchanges, major realignment and widening and / or lowering of certain sections, provision of a bored tunnel at Macauleys Headland, the provision of numerous service roads and access roads adjacent to the assumed urban motorway component as well as provision of key east / west links. These potential road infrastructure components are outlined in more detail in the following section.

The lump sum strategic costs are based on current costs for similar items on other highway upgrades, and are sufficient to allow a valid comparison with the Inner Bypass corridor options. Because of the preliminary nature of the estimate, the highly urban setting of the corridor and the difficulties associated with constructing the components under the high volumes of traffic using the highway, an overall contingency factor of 35% has been applied.

6.1.2 Scope Definition

The scope definition of the Existing Highway Upgrade as developed to date is as generally described in Section 4 and summarised in Table 6.1.

Table 6.1 Scope

Item	Quantity
Total route length / New Construction length	11.4/11.0km
Tunnels – No / Length	1 / 550m
Pavement Area – Highway	330,000m^2
Pavement Area – Service and Local Roads	237, 000m^2
Bridges – Deck Area	10,000m^2
Earthworks – cut to fill	1.2 million m^3
Highest Embankment	10m
Deepest Cutting	12m
Maximum Grade	8%
N^o of interchanges	9

6.1.3 Cost Estimates

The cost estimate for the Existing Highway Upgrade between Englands Road and the end of the existing dual carriageway highway at Sapphire comprises lump sum elements appropriate to the scope of construction activity required for the relevant component of this option. The cost estimates for each of the component works are contained in Table 6.1.

In broad terms, the total cost estimate of $690M represents an average unit cost of just over $50 M per kilometre for a complete new urban motorway and associated facilities. It does not include major commercial reconstruction where the highway may be widened, particularly through the Coffs Harbour CBD.

Table 6.2 Existing Highway Upgrade - Strategic Cost Estimate Summary

Location	Description of Works	Cost Estimate Commentary	Estimated Cost ($M)
Englands Road / Stadium Drive Interchange	Pacific Highway overpass of existing roundabout and construction of ramps for northbound and southbound traffic	Major interchange over existing roundabout	25
Service road – Stadium Drive to Cook Drive	Provide intersection works left in and left out only from Pacific Highway. Construct two way service road parallel to the Pacific Highway for hospital and industrial / commercial access	Local road connections for hospital access and industrial / commercial area	6
North Boambee / Cook Drive Interchange	Pacific Highway overpass of new roundabout and reconstruction of North Boambee Road and Cook Street	Reconstruction and realignment of existing intersection in conjunction with interchange	35
Service Road – Hurley Drive to Thompsons Road	Construct two way service road link for hospital access	Local road connections for industrial / commercial area	4
Thompsons Road / Interchange	Pacific Highway overpass of new roundabout and reconstruction of Halls Road and Thompsons Road legs.	Reconstruction and realignment of existing intersection in conjunction with interchange	35
Highway realignment and widening	Realign and widen Pacific Highway between Thompsons Road and Combine Street	Realignment to provide improved curve radii	40
Combine Street Interchange	Pacific Highway overpass of reconstructed Combine Street	Major interchange over lowered Combine Street	30
Service Road – Combine St to Little St	Upgrade two way service road link for access to motels	Local road connections for motel access	2
Service Road – Elizabeth St to Moonee St	Construct two way service road link with significant property acquisition	Major local road connection to Moonee Street	10
Highway realignment and widening	Realign and widen Pacific Highway between Little St / Maclean St and Coffs St	Reconstruct highway – possibly in lowered slot arrangement to facilitate overpasses and local traffic separation	60
Park St to Moonee St Overbridge	Construct land bridge over Pacific Highway connecting Park St and Moonee St	East West access to CBD – land bridge to be raised and very wide – possible pedestrian friendly zone	10
Service Road - Park St to Coffs St	Construct two way service road link	Service road connection on western edge of CBD. North / south access adjacent upgraded highway	4
Coramba Rd to Harbour St Overbridge	Construct land bridge, over Pacific Highway connecting Coramba Rd and Harbour St	East West access to CBD – land bridge to be raised and very wide – possible pedestrian friendly	10

Location	Description of Works	Cost Estimate Commentary	Estimated Cost ($M)
		zone	
Beryl Street Interchange	Construct overpass and associated ramps over Pacific Highway connecting Beryl St and Showground. Reconstruct and realign Beryl St, provide new roundabouts and connecting roads.	Major interchange required north of Coffs Creek. Numerous connecting local and access roads east and west of upgraded highway.	50
Service Road - Beryl St to Bray St	Construct one and two way service roads parallel to the Pacific Highway between Beryl St and Bray St	Provision of local access and service roads west of upgraded highway.	6
Service Road – Showground to Orlando St	Construct one and two way service road parallel to the Pacific Highway between The Showground and Orlando St	Provision of local access and service roads east of upgraded highway.	6
Bray Street Interchange	Construct new roads, an overpass and associated ramps over Pacific Highway connecting Bray St and Orlando St. Reconstruct and realign existing roads, provide new roundabouts and connecting roads. Provide connection between Orlando St and Park Beach Plaza through existing railway embankment.	Major interchange required for Bray / Orlando intersection and connection from Orlando to Park Beach Road. Numerous connecting local and access roads east and west of upgraded highway.	40
Macauleys Headland Tunnel	Construct 550m of two way tunnel and approaches	Major tunnel construction required for alignment and traffic capacity improvements across very distinctive local landform feature	70
Macauleys Headland existing highway	Provide road widening, access and egress ramps and bridge	Adjustments to existing highway to provide ramps over tunnel approaches	10
Service Road – Pacific Bay	Construct two way service road parallel to the Pacific Highway or major left in / left out intersection only for access and regress from Pacific Bay	Service road access or left in / left out intersection	3
Bruxner Park Interchange	Construct Pacific Highway overpass of new roundabout and reconstruction of James Small Drive and Bruxner Park Road .	Major interchange over Pacific Highway at Korora	30
James Small Drive North Interchange	Construction of roundabouts, access and egress roads and a bridged overpass of the Pacific Highway.	Major interchange over Pacific Highway at Opal Cove	25
		Lump Sum Item Sub-Total	**$511M**
		Allow 35% Contingency	**$179 M**
		Total Strategic Estimate of Cost	**$690 M**

6.2 Inner Bypass Corridor Options

6.2.1 Approach to Cost Estimating

The RTA requires that project cost estimates be prepared in accordance with the RTA Project Estimating Manual (December 2001). This manual sets out current RTA methodology and procedures for preparing strategic, concept and detailed estimates of cost. It also provides guidance on the selection of appropriate contingencies for the various stages of development of the project and the identified risks. The Manual also specifies the review and concurrence roles of the RTA Project Management Office (PMO), to project cost estimates.

Given the level of design development for the proposals, the cost estimate format adopted for this report corresponds to the RTA Strategic / Preliminary Concept Cost Estimate. Accordingly provision for contingencies in the range of 30% to 35% of the base estimate is considered appropriate. The RTA specified format for a Strategic Cost Estimate divides the project cost into six (6) major cost components as follows:

1. Project Development (covering the work required to obtain project approval)
2. Investigation and Design (covering the design and documentation of the project for construction)
3. Property Acquisitions
4. Public Utility Adjustments
5. Construction (including management during construction)
6. Handover (covering project completion and the handing over of completed assets to the responsible maintaining Authority).

The strategic cost estimates for the Inner Bypass routes being considered have adopted contingency allowances ranging between 25% and 50%, with contingencies averaging approximately 32% of the base cost of each route option within the corridor. Contingency allowances for non-construction items and construction items are generally in the order of 35% to 40%.

6.2.2 Scope Definition

The scope definition for potential routes within the Inner Bypass corridor between Englands Road and the end of the existing dual carriageway highway at Sapphire includes the construction of the road infrastructure as described below:

Component Length and Pavement Area

The approximate length of the two northern and two southern route components, and the various north / south combinations forming the Inner Bypass route options, are shown in Table 6.3. The table also lists approximate pavement areas for each option and each north / south component. It is assumed that the highway carriageway would consist of two divided 10.5m pavements.

Table 6.3 Component Length and Pavement Areas

Inner Corridor Route	Combined Options	Route Length (km)	Pavement Area [1] (m²)
IS1	-	4.64	91,500
IS2	-	4.58	92,700
IN1	-	6.38	129,300
IN2	-	6.98	137,200
IS1 & IN2	A	11.6	228,700
IS1 & IN1	B	11.0	219,700
IS2 & IN2	C	11.5	230,100
IS2 & IN1	D	11.0	222,000

[1] Pavement area figures are exclusive of bridge deck areas.

Bridges

The path of the Inner Bypass Corridor traverses several creeks, major and minor roads, as well as the North Coast Railway. As such, various sections of bridging are required for the various options. The location and indicative size of required bridges are shown in Table 6.4.

Table 6.4 Bridges

Bridges Locations	North / South Route Combinations Bridge Deck Area (m²)				Comments
	A	B	C	D	
Englands Road	1050	1050	1050	1050	Twin 2x15m + 1x20m @ 10.5m wide
Newports Creek #1	840	840	840	840	Twin 2x20m @ 10.5m wide
Newports Creek #2	420	420	420	420	Twin 20m @ 10.5m wide
North Boambee Road 1	640	640			Single 2x30m + 1x20m @ 8m wide
North Boambee Road 2			560	560	Single 2x15m + 1x40m @ 8m wide
Newports Creek (Nrth Branch)	630	630	420	420	Twin 30m @ 10.5m wide
Coffs Creek & Coramba Road	4760	4760	4760	4760	Twin 2x40 + 3x30m @ 14m wide
Spagnolos Road		210		210	Twin 10m @ 10.5m wide
Shephards Lane	640	640	640	640	Single 2x20m + 1x20m @ 8m wide
North Coast Railway		735		735	Twin 35m @ 10.5m wide
North Coast Railway	4410		4410		Twin 7x30m @ 10.5m wide
MacKays Road		630		630	Twin 30m @ 10.5m wide
Property Access # 1 (Provisional)	630	630	630	630	Twin 30m @ 10.5m wide
Property Access # 2 (Provisional)		630		630	Twin 30m @ 10.5m wide
Property Access # 3 (Provisional)	640	640	640	640	Single 2x20m + 1x20m @ 8m wide
West Korora Road (Provisional)	640	640	640	640	Single 2x20m + 1x20m @ 8m wide
Bruxner Park Road	560	560	560	560	Single 2x15m + 1x20m @ 8m wide
Pacific Highway Connection	1365	1365	1365	1365	Single 3x30m + 1x40m @ 10.5m wide
Total	**21,845**	**19,220**	**17,355**	**15,570**	

Tunnels

Route options A and B both traverse the low saddle in Roberts Hill ridge and a relatively shallow cutting would result. However, aesthetic considerations may dictate that this cutting be replaced by a tunnel. The IS1 traverse through this area would lend itself to a covered open excavation if necessary, possibly as a cut and cover tunnel or land bridge concept. This is yet to be thoroughly investigated (depending on route deliberations) and as such, at this point it has been assumed that a cutting would suffice.

On route options C and D, the more westerly path of the southern component, traverses further up the Roberts Hill ridgeline where the terrain is significantly higher. To achieve a desirable vertical alignment through this area, a cutting 103m deep and 560m long would be necessary. Such a cutting is not viable or desirable and inclusion of a bored tunnel for this route component is considered essential.

As it is not feasible to provide a cutting of the magnitude required at Roberts Hill ridge on Inner Corridor Route IS2, a 560m long tunnel is proposed for this section, which is common to Options C and D. In other locations where deep cuttings in excess of 50m are required to achieve desirable vertical alignment, the provision of optional tunnels has been investigated. The location and length of both the essential and optional tunnels are shown in Table 6.5.

The various options have been notated with the suffix T and a number indicating the number of tunnels to be incorporated for that option.

Table 6.5 Inner Bypass Corridor – Tunnel Option Combinations

North / South Route Combination	Option	Tunnel Proposals / Options	Length of Tunnel	Total Length of Tunnel
IS1 and 1N2	A – 0T	–	–	–
IS1 and 1N2	A – 2T	Shephards Lane Ridge Gatelys Road Ridge	340 415	755
IS1 and 1N1	B – 0T	–	–	–
IS1 and 1N1	B – 1T	Gatelys Road Ridge	390	390
IS2 and 1N2	C – 1T	Roberts Hill Ridge	560	560
IS2 and 1N2	C – 3T	Roberts Hill Ridge Shephards Lane Ridge Gatelys Road Ridge	560 340 415	1315
IS2 and 1N1	D – 1T	Roberts Hill Ridge	560	560
IS2 and 1N1	D – 2T	Roberts Hill Ridge Gatelys Road Ridge	560 390	950

Earthworks

The earthworks volumes for the route options incorporating the essential tunnel, and those options with and without the optional tunnels, are shown in Table 6.6. These quantities have been calculated by adjusting the earthworks volumes computed by the MXRoad models of the route options to allow for subgrade replacement, unsuitable cut materials and pavement, select fill, topsoil and rock drainage layer volumes.

It should be noted that by providing tunnels it has been possible to lower the proposed gradeline of the road in the adjacent area by up to 18m, thus reducing the quantity of fill required.

Table 6.6 shows that while cut volumes are significantly reduced, required fill volumes are not reduced by the same amount, and consequently, the earthworks balance for some routes have a substantial deficit of available cut to fill.

Table 6.6 Raw Earthworks Incorporating Tunnels

Combined Route Option	Cut Volumes (m^3)	Tunnel Bore Volumes (m^3)	Total Earthworks Volumes (m^3)	Fill Volumes (m^3)	Cut to Fill Surplus (m^3)
A – 0T	3,184,983	0	3,184,983	2,497,486	687,497
A – 2T	1,897,624	172,140	2,069,764	1,964,868	104,896
B – 0T	2,192,931	0	2,192,931	2,661,796	- 468,865
B – 1T	1,330,960	88,920	1,419,880	2,371,390	- 951,510
C – 1T	3,2211,35	127,680	3,348,815	2,190,699	1,158,116
C – 3T	2,139,857	299,820	2,439,677	1,767,315	672,362
D – 1T	1,970,060	127,680	2,097,740	2,164,559	- 66,819
D – 2T	899,813	216,600	1,116,413	2,164,559	- 1,048,146

In relation to these raw earthworks figures it should be noted that any surplus material would be available for use as acoustic mounds and / or aesthetic screening of the proposed route. Following selection of the Preferred Option, the concept design could be refined, in part by lowering the road, to provide a better earthworks balance with surplus material to be used for these purposes.

6.2.3 Cost Estimates

The cost estimate comprises a combination of quantities and lump sum items appropriate to the scope of construction activity required by each option. An outline of the approach taken to determine the rates for use in the conceptual definition of the bypass routes has been provided in previous sections.

The cost estimates prepared for each Inner Bypass route option are provided as detailed spreadsheets in Appendix B to this report. The costs under the main cost centres detailed in the estimates are summarised in Tables 6.7 and 6.8. The amounts shown in these tables include the contingency allowance and have been rounded to the nearest $1M.

No provision has been included in the cost estimates of the Inner Bypass options for any upgrading of the bypassed sections of the existing Highway to cater for the traffic that would remain on these sections of the existing Highway.

Table 6.7 Inner Corridor Bypass Options - Cost Estimate Summary Breakdown

Item	Estimated Cost Centre	Option Estimated Cost ($M)							
		A-0T	A-2T	B-0T	B-1T	C-1T	C-3T	D-1T	D-2T
1	Project Development	8	8	8	8	8	8	8	8
2	Investigation and Design	10	11	10	10	11	13	10	13
3	Property Acquisitions	23	17	23	19	17	14	21	16
4	Public Utility Adjustments	10	10	10	10	10	10	10	10
5	Construction	193	278	193	242	258	344	245	307
6	Project Handover	1	1	1	1	1	1	1	1
	Total	**$245**	**$325**	**$245**	**$290**	**$305**	**$390**	**$295**	**$355**

Table 6.8 Inner Corridor Bypass Options - Construction Infrastructure Costs Breakdown

Item	Estimated Cost Center	Option Estimated Cost ($M)							
		A-0T	A-2T	B-0T	B-1T	C-1T	C-3T	D-1T	D-2T
5.1	Infrastructure – Environmental Works	10	9	10	10	9	9	10	9
5.2	Infrastructure – Noise Mitigation	6	5	8	5	5	4	8	6
5.3	Infrastructure – Earthworks	52	39	56	54	53	41	44	51
5.4	Infrastructure – Drainage	16	12	17	17	16	12	13	15
5.5	Infrastructure – Pavement	28	28	27	27	28	28	28	28
5.6	Infrastructure – Structures (Bridges)	52	52	46	46	42	42	38	39
5.6	Infrastructure – Structures (Tunnels)	-	102	-	52	76	178	75	128
5.7	Infrastructure – Interchanges and Local Road Adjustments	8	8	8	8	8	8	8	8
5.8	Infrastructure – Miscellaneous	3	3	3	3	3	3	3	3
5.9	Infrastructure – General Activities	4	4	4	4	4	4	4	4
5.10	Infrastructure - Site Management	11	13	11	13	11	13	11	13
5.11	Project Management Services	2	2	2	2	2	2	2	2
5.12	Client Representation	1	1	1	1	1	1	1	1
	Total	**$193**	**$278**	**$193**	**$242**	**$258**	**$344**[1]	**$245**	**$307**

1 – Figures do not add up to the total due to rounding errors.

6.3 Economic Evaluation

6.3.1 Economic Analysis

This section of the report presents the key inputs and outputs of a conventional Road User Benefit Cost Analysis (RUBCA) undertaken to assess the economic viability of the Existing Highway Upgrade option and the Inner Bypass option. The economic analysis has been undertaken based on the RTA's *Economic Analysis Manual (2002)* using a spreadsheet-based method. The analysis provides results for the key economic indicators used to assess these types of projects, including Net Present Value (NPV) and Benefit Cost Ratio (BCR). The analysis has not attempted to quantify, in dollar terms, intangible factors such as environmental or social costs and benefits. These are addressed in qualitative terms elsewhere in the review.

The analysis presented in this report is based on information from a number of sources as follows:

- Strategic project cost estimates and cashflows prepared by Connell Wagner.
- Network travel statistics including vehicle-kilometres travelled (VKT) and vehicle-hours travelled (VHT) obtained from the TRACKS modelling undertaken by CHCC.
- Unit costs and other economic parameters obtained or derived from the RTA *Economic Analysis Manual (2002).*

For the Inner Bypass corridor, a number of sub-options were developed as outlined above. In view of the strategic stage of investigation, the economic analysis has been undertaken for the lowest capital cost option and the highest capital cost option only.

6.3.2 Basic Parameter Values

Base Year
The base year considered for discounting purposes is year 2018. This year was chosen to align with the anticipated commencement of construction for the alternative schemes, thereby reducing the timeframe over which future costs would need to be discounted.

Discount Rate
A discount rate of 7% has been used to discount future capital costs and road user costs to the base year. Discount rates of 4% and 10% have also been used for the purpose of sensitivity analysis for both options.

Modelling Period
As reported in Section 5, traffic modelling was carried out by CHCC using the TRACKS model for a twenty year period from 2001 to 2021. Models were run for the base case (do nothing) in each year and for each of the development options under consideration.

Evaluation Period
An evaluation period of 30 years from opening has been used for the economic analysis. In the case of the Existing Highway Upgrade, where staged opening of the scheme has been assumed, the 30 year period is assumed to apply from the opening of the first stage.

Annualisation Factor
An annualisation factor of 350 has been used to convert the average weekday travel statistics output by the TRACKS model to annual figures. The factor was derived from the analysis of a nearby permanent counting site operated by the RTA, and accounts for the daily and seasonal departures from an average weekday traffic volume that are known to occur in the area.

Traffic Growth and Extrapolation of Travel Statistics

Growth in local traffic is accounted for in the traffic model based on the future land use projections within the Coffs Harbour LGA and associated assumptions about traffic generation. For through-traffic, values of 4.5% per year compounding from 2001 to 2006 and then 2.7% compounding until 2021 have been used based on the results obtained from regional modelling undertaken by the RTA as part of the development of the Pacific Highway Upgrading Program.

The level of traffic growth that occurs in the traffic model translates into changes in the key travel statistics (vehicle hours travelled and vehicle kilometres travelled) between the modelling years. The annual rate of change so-calculated has been used as the basis for extrapolating the travel statistics beyond 2021 in order to provide annual statistics over the entire '30 years beyond opening' evaluation period.

6.3.3 Travel Cost Parameters

Unit rates for rural conditions have been used for the travel time cost and vehicle operating cost (VOC) parameters in this study in accordance with advice obtained from the Economic Services and Support Branch of the RTA.

For each of the analyses, composite rates have been used based on a weighted average value for a 'combined' class of vehicles. This was necessary because the TRACKS model only provides aggregated outputs for the key travel statistics with no differentiation between vehicle types or trip purpose. While this is considered to be a reasonable approximation for a strategic-level assessment and is sufficient to enable the differentiation of competing options, it is recognised that it may have some influence on the absolute values obtained from the economic analysis.

The rural composite values used in this study are $23.03 per vehicle hour for travel time and 27.00c per vehicle kilometre for VOC (both values in 2002 prices).

The travel time value has been derived by adjusting the weighted average value calculated in Appendix B, Table 17 of the RTA *Economic Analysis Manual* to reflect the actual proportion of vehicle types (light vehicle and heavy vehicle proportions) exhibited in the study area. Traffic counts undertaken in 2001 as part of the original CHHPS investigations were used for this purpose.

The VOC value was derived using the same vehicle classification data in conjunction with the Austroads Arterial Stop/Start Model. This has the form:

$$C = A + B/V$$

where

A, B are model coefficients (assessed to be 24.03 and 140.59 respectively)
C = cents/km
V = travel speed.

An average network speed of 48km/hr was adopted for the composite value, based on the average network speeds derived from the travel statistics output by the TRACKS model.

6.3.4 Accident Rate Values

A composite value across all road types has been adopted for this economic analysis on the basis that accident savings are expected to make only a very small contribution to the total benefits and are therefore not a critical element in the analysis. A value of $61,500 per million vehicle kilometres travelled has been used in the assessment.

6.3.5 Project Costs for RUBCA

The estimated project costs for the Existing Highway Upgrade are $690M (including an allowance for contingencies), as shown in Table 6.2. These costs allow for all construction works proposed between (and including) the new Englands Road/Stadium Drive Interchange at the southern end of the scheme and the end of the existing dual carriageway highway at Sapphire at the northern end of the scheme.

Cost estimates for the Inner Bypass (viz. lowest and highest cost options) are shown in Table 6.7. Options A-OT and B-0T are the lowest cost Inner Bypass options ($245M) and Option C-3T is the highest cost option ($390M). The cost estimates for the Inner Bypass options only include the costs of new construction between (and including) the proposed interchange near Englands Road at the southern end to the proposed northern interchange at Korora Hill. They do not include any allowance for construction works beyond the northern tie-in to the existing Highway at Korora Hill. For the purposes of the economic analysis, an adjustment to the cost estimates for the Inner Bypass options was therefore necessary to ensure that the start and end points for the upgrade improvements corresponded to those used for the Existing Highway Upgrade, thereby enabling an equitable comparison to be made. This entailed the inclusion of an additional allowance for the costs of constructing a grade-separated interchange at James Small Drive North, estimated at $25M as per Table 6.2, ($35M inclusive of contingencies).

The resulting cost estimates used for the economic analysis are summarised in Table 6.9.

Table 6.9 Estimated Project Costs used for Economic Analysis ($2003)

Existing Highway Upgrade	Inner Bypass – Lowest Cost	Inner Bypass – Highest Cost
$690M	$280M	$425M

6.3.6 Cash Flows

With respect to the construction time frame, it was assumed that the Existing Highway Upgrade project would be constructed as an accelerated project and would be constructed with an annual budget that is higher than the highest annual budget typically applied to a Pacific Highway Upgrade Project (typically $80-$90M). On this basis, a 6 year construction time frame has been assumed for the Existing Highway Upgrade option. For the Inner Bypass options, 4 year and 5 year construction time frames were assumed for the lowest cost and highest cost scenarios respectively. The associated cash flows are summarised in Table 6.10.

Table 6.10 Construction Cash Flow ($2003)

Year	Existing Highway Upgrade ($M)	Inner Bypass – Lowest Cost ($M)	Inner Bypass – Highest Cost ($M)
2018	$115	$70	$65
2019	$115	$70	$90
2020	$115	$70	$90
2021	$115	$70	$90
2022	$115		$90
2023	$115		
Total	**$690**	**$280**	**$425**

6.3.7 Maintenance Costs

An allowance for future routine and periodic maintenance has been made in the analysis based on a typical maintenance schedule and associated unit costs for a concrete pavement surface specified in the RTA *Economic Analysis Manual*. The maintenance schedule and unit costs used are summarised in Table 6.11.

Table 6.11 Maintenance Schedule and Unit Costs ($1999)

Treatment	Year	Cost per m^2 of pavement
Routine Maintenance	1-30 inclusive	$0.15
Cross stitching 20m cracks	2, 6, 12, 20	$0.06
0.5% slab replacement	2, 5, 10, 15, 20, 25, 28, 30	$1.03
Cross stitching 40m cracks	28	$0.12
Remove and Replace Sealant	10, 20, 30	$2.19
30% retexture	20	$0.84

6.3.8 TRACKS Model Output

The key travel statistics produced by the TRACKS model that are used directly in the economic analysis are vehicle hours travelled (VHT) and vehicle kilometres travelled (VKT). These statistics are provided for each of the modelling years for the base case (do nothing) and the option modelled. They represent network-wide, 24 hour estimates of total VHT and VKT in the Coffs Harbour LGA for all vehicle types and trip purposes (ie. composite values), and are for an average working weekday. A summary of the travel statistics obtained from the TRACKS model is provided in Table 6.12.

Table 6.12 Network Travel Statistics

	Base Case		Existing Highway Upgrade		Inner Bypass	
	2001	2021	2001	2021	2001	2021
Vehicle Kilometres of Travel (VKT)						
Vehicle Travel	1,729,672	2,605,764	1,721,215	2,588,693	1,728,102	2,607,849
Vehicle Hours of Travel (VHT)						
Vehicle Hours	35,477	54,103	33,479	49,573	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2

6.3.9 Road User Savings

Road user savings for a conventional transport project are measured in terms of the reduction in road user costs that arise from building an option compared to the base case scenario of doing nothing. The road user costs assessed for this purpose include:

- Vehicle Operating Costs (VOC)
- Travel Time Costs
- Accident Costs

The changes in VOC, travel time and accident costs were derived from the network travel statistics provided in Table 6.12, by assessing the difference in costs for each analysis year between the base case and each improvement option. Values for intermediate years not specifically modelled were derived by means of interpolating between the values obtained for the modelled years. Values beyond year 2021 were extrapolated using the inferred annual rates of change observed in the VKT and VHT data for the 2001 to 2021 modelling period.

The resultant time-stream of road user cost savings (or increases) were discounted to constant dollar values in the base year and summed over the 30 year evaluation period from opening, to provide the total present value of benefits for each option (PVB). A similar process of discounting and summation was carried out for the capital and maintenance costs previously identified, to provide the equivalent present value of costs (PVC) for each option.

6.3.10 Summary of Economic Analysis Results

A summary of the results for the economic analysis in terms of Net Present Value (NPV) and Benefit Cost Ratio (BCR) is provided in Table 6.13. These were calculated from the estimates of PVB and PVC assessed in accordance with the method outlined in the previous section. The First Year Rate of Return (FYRR) is also provided. Detailed spreadsheets used in the analysis are attached in Appendix C.

Table 6.13 Results of the Economic Analysis

Parameters	Existing Highway Upgrade	Inner Bypass	
		Lowest Cost	Highest Cost
Discount Rate	7%		
Present Value of Costs ($M)	$587	$254	$370
First Year Rate of Return (FYRR)	4.9%	5.2%	3.5%
10 Year Period			
Present Value of Benefits ($M)	$204	$114	$110
Net Present Value ($M)	($383)	($141)	($261)
Benefit Cost Ratio	0.35	0.45	0.30
20 Year Period			
Present Value of Benefits ($M)	$387	$190	$183
Net Present Value ($M)	($201)	($65)	($188)
Benefit Cost Ratio	0.66	0.75	0.49
30 Year Period			
Present Value of Benefits ($M)	$500	$238	$229
Net Present Value ($M)	($88)	($17)	($143)
Benefit Cost Ratio	0.85	0.93	0.62

From Table 6.13, it is evident that:

- The Inner Bypass (lowest cost option) provides the highest economic return, with a BCR of 0.93 and a FYRR of 5.2%. The Existing Highway Upgrade option has a BCR of 0.85 and a FYRR of 4.9%. The Inner Bypass (highest cost option) provides the lowest economic return, with a BCR of 0.62 and FYRR of 3.5%.

- The economic viability of both the Existing Highway Upgrade and the Inner Bypass (highest cost option) is marginal even in the longer term, as evidenced by the low BCR's obtained with opening delayed until 2022.

6.3.11 Sensitivity Analysis

A sensitivity analysis was undertaken for all options. The sensitivity analysis examined the effect on the NPV and BCR of adopting alternative discount rates of 4% and 10% (in line with standard sensitivity testing requirements), the effect of reducing the capital cost estimates by

10%, and also the effect of increasing the capital cost values by 15%. The results of the sensitivity testing are reported in Table 6.14, while detailed spreadsheets used in the analysis are included in Appendix B.

Table 6.14 Results of Sensitivity Analysis (30 year analysis period)

Parameter	Net Present Value ($M)	Benefit Cost Ratio
Existing Highway Upgrade Option		
4% Discount Rate	160	1.25
10% Discount Rate	(203)	0.63
10% Reduction in Capital Cost	(30)	0.94
15% increase in Capital Cost	(176)	0.74
Inner Bypass – Lowest Cost		
4% Discount Rate	113	1.42
10% Discount Rate	(85)	0.65
10% Reduction in Capital Cost	9	1.04
15% increase in Capital Cost	(55)	0.81
Inner Bypass – Highest Cost		
4% Discount Rate	(19)	0.95
10% Discount Rate	(202)	0.42
10% Reduction in Capital Cost	(106)	0.68
15% increase in Capital Cost	(198)	0.54

From Table 6.14 it is observed that:

- A significant change in the BCR values occurs when different discount rates are applied. Reducing the capital cost by 10% results in the BCR for the Inner Bypass (lowest cost) increasing to 1.04, while a 15% increase in the capital cost would reduce the BCR to 0.81.

- Reducing the capital cost by 10% would also result in the BCR increasing to 0.94 for the Existing Highway Upgrade. However, an increase of 15% in the capital cost would reduce the BCR to 0.74.

7 Socio-Economic Issues

This section summarises a range of social and economic issues related to each of the highway corridor options. A more detailed account of the potential impacts and main differences between the options is contained in the referenced Working Papers.

7.1 Statutory and Strategic Planning Issues

The statutory and strategic planning implications of the corridor options are addressed in *Working Paper No 1: Statutory and Strategic Planning Issues* (Connell Wagner, 2004f). This paper reviews the NSW planning framework and assorted local planning and land use issues of relevance to assessing the feasibility of the Inner Bypass and Existing Highway Upgrade options. The Working Paper also discusses the implications of the route options for future strategic planning in the Coffs Harbour LGA, the permissibility of a road proposal in the areas covered by the options and the methods available for reserving land for the adopted highway corridor/s.

Development within the Coffs Harbour LGA is subject to the provisions of Coffs Harbour Local Environmental Plan (LEP) 2000. Both the Inner Bypass and the Existing Highway Upgrade corridors traverse or are in the vicinity of numerous land-use zones including rural, residential, business, special uses, open space, environmental protection and National Parks and Nature Reserves. Under the savings provisions of clause 7 of the LEP, roadworks can be undertaken without the need for development consent and are thus subject to the provisions of Part 5 of the Environmental Planning and Assessment Act (EP&A Act).

The provisions of other statutory and strategic documents / instruments were reviewed in terms of relevance to the options. These included:

- NSW Government *Action for Transport 2010, Action for Air, Road Safety 2010*
- State Environmental Planning Policies (SEPPs)
- North Coast Regional Environmental Plan (NCREP)
- North Coast Urban Planning Strategy – Into the 21st Century (1995)
- North Coast Road Strategy (1993)
- Upgrading the Pacific Highway Discussion Paper and Pacific Highway Strategic Assessment
- Coffs Harbour Urban Development Strategy (1996)
- Coffs Harbour Council Rural Residential Strategy (1999)
- Draft Rural Lands Strategic Plan (November 2001)
- Korora Draft Local Environmental Plan (2001)
- North Boambee Valley Development Control Plan (1996)

Related legislation potentially applicable to the planning and assessment of highway proposals at the detailed planning stage includes:

- *Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (Commonwealth)*
- *Protection of the Environment Operations Act 1997*
- *Threatened Species Conservation Act 1995*
- *Fisheries Management Act 1994*
- *Native Vegetation Conservation Act 1997*
- *Heritage Act 1977*
- *National Parks and Wildlife Act 1974*
- *Water Management Act 2000*
- *Contaminated Land Management Act 1995*

Both the Inner Bypass Existing Highway Upgrade options would require significant land acquisition. The impact of the Existing Highway Upgrade scheme would mainly result from the new interchanges, access ramps and service road arrangements needed in the built up part of the city centre. Property acquisition would be required in some sections along the existing road reserve and some properties would lose their existing frontage and access to the highway.

Although the direct land use impacts associated with the Existing Highway Upgrade option would be substantially less than for the Inner Bypass in terms of land take, there are still potentially significant land use planning implications, especially for the main city centre. With the envisaged changes to access and the progressive intensification of traffic activity along the corridor, there is the likelihood of substantial changes in property market forces leading to major land use change over time. The nature and extent of such change is difficult to predict, but would need to be anticipated by Council.

In contrast, the Inner Bypass options would impact mainly on existing rural agricultural and rural residential land uses. The areas already identified as urban release / investigation areas at North Boambee, West Coffs and Korora are all fundamentally affected by the Inner Bypass options and substantial replanning of the urban and rural strategies would be required. In this regard, it would be necessary for Council and the community to reconsider the most appropriate land-use mix for these areas, where practicable, so they can be compatible with a major new highway. Notwithstanding these significant planning and land use implications, there are opportunities (especially with the North Boambee area) to identify alternative future land use scenarios that could be of major long-term benefit to the community.

Previous information releases on the CHHPS have identified the need, in the event of an Inner Bypass corridor being adopted, to reserve land before further land use change and urban growth precludes such opportunity. The bypass corridor would need to be integrated into revised land use plans for future urban and rural residential release areas. The EP&A Act enables various statutory procedures for reserving land and the most appropriate means for doing so will be identified following the selection of the Preferred Option.

With the review of Council's Urban Development Strategy currently underway, it is timely that the highway planning strategy be resolved concurrently with strategic land use planning.

7.2 Agricultural Land Use Effects

The Existing Highway Upgrade is unlikely to affect any agricultural lands. In contrast, the Inner Bypass corridor traverses a number of agricultural properties. Wilkie Fleming & Associates carried out an assessment of the impact of the Inner Bypass options on agricultural land. The assessment was a desk-top study relying on aerial photo interpretation and limited site examination. The report is attached as Appendix D.

The study focused on banana plantations that are located predominantly on the steep slopes above the small valley basins where the slopes are protected from strong cold winds. Banana plantations are favoured where neighbouring properties are also involved in banana growing to prevent interface effects with non-compatible land uses.

Agricultural lands along the Inner Bypass corridor, including banana plantations, were identified by Wilkie Fleming & Associates (2004) and include:

- *Southern Common Link:* The common link from Englands Road through to the North Boambee valley traverses land used for grazing, but most properties support non-agricultural land use.
- *Inner South 1:* South of Coramba Road the route passes through a consolidated banana growing area on favourable north facing slopes. Three banana and three horticulture properties would be

affected. The impact on the banana properties is likely to be increased by creation of a cut at the top of the ridge, altering temperature and wind patterns. Spraying operations could also be affected due to proximity to the highway.

- *Inner South 2:* From Coramba Road the route passes through a consolidated banana growing area on favourable northern slopes with banana farm packing sheds and water supplies down the slope. The provision of a tunnel at Roberts Hill Ridge significantly reduces the number of banana growing properties affected (this assessment has been carried out without the inclusion of the tunnel option). The route would affect one banana, three mixed banana/horticulture and three properties used for minor crops, forestry and grazing. The agricultural land use in the eastern end of the North Boambee valley is mainly grazing with only small plantings of horticultural crops, including mango, citrus, avocado, banana, vines and berries.
- *Inner North 1:* Although this alignment crosses seven banana-growing properties, it runs low on the slope near the railway line, leaving most of the plantings unaffected. North of the rail line the route traverses predominantly grazing land in an area of expanding urban development.
- *Inner North 2:* From Coramba Road, this alignment crosses properties used mainly for grazing, with small areas of avocado on steeply terraced slopes and minor areas of other horticulture. Further north, it crosses six banana properties that form a consolidated area of upper slope plantings. This area is generally free from frost, despite the slope being exposed to the south-east.
- *Northern Common Link:* The alignment crosses from the Coffs harbour basin into the Korora basin and mainly traverses small blocks of bananas (11 properties) or other horticultural crops (10 properties), including avocado on steep slopes. However, the banana blocks are small and the affected properties are not part of a consolidated banana-growing belt. Those blocks near Korora have extensive areas under grass, which may indicate that bananas are already being phased out entirely, or the land rested for management reasons on these exposed slopes.

The area of consolidated banana-growing lands immediately around Coffs Harbour has been contracting as urban development has expanded along the main roads. There is evidence of bananas no longer being grown on upper slopes above western Coramba Road and inland from Korora Hill. The agricultural investigation also identified that the key factor in land management for the banana industry is maintaining contiguous plantings on the slopes.

Table 7.1 provides details of the area of agricultural land directly affected by the Inner Bypass route options, and agricultural lands within 300m aerial spraying buffer zone as provided by the Department of Agriculture.

Table 7.1 Agricultural Land Take Inner Bypass

Agricultural land	Area (ha)			
	IS1	IS2(1)	IN1	IN2
Direct land take (& 5m construction buffer)				
Banana lands	6.9	1.9	30.2	41.6
Agricultural lands	21.0	20.2	15.3	10.2
Total	27.9	22.1	45.5	51.7
Land within 300m				
Banana lands	80.6	42.0	268.9	340.1
Agricultural lands	225.5	222.5	150.8	106.1
Total	306.1	264.5	419.7	500.2

Source: Connell Wagner, 2003c
(1) Includes tunnel through Roberts Hill ridge

A combination of the Inner South 2 and Inner North 1 would minimise impacts on the current areas of banana plantation and other horticultural activities. As noted above, the Existing Highway Upgrade would have negligible impact on agricultural lands.

7.3 Urban Land Use and Property

Land use along the existing highway corridor up to Korora is predominantly urban and a major upgrade of the existing highway in this area is likely to require acquisition of properties, particularly through the city centre. On-street parking and standing zones along the highway, which are currently used by local shoppers, would be adversely affected.

From the Englands Road end of the Existing Highway corridor, the land use is predominantly lower density industrial / commercial, becoming more dense residential / commercial further north from Thompsons Road to Park Avenue, before reaching the main city centre / CBD precinct. Land use returns to residential / commercial between Marcia Street and Arthur Street, then gradually becomes sparser alongside the highway as the pattern changes to rural residential / tourist uses. Urban development is progressively replacing these less built-up areas, especially along the eastern side of the highway.

The main areas of property acquisition would most likely occur in the section from Halls Road / Thompsons Road through to the North Coast Railway Line. Existing development in this area forms a hard edge with the existing highway boundary. A major highway redevelopment in this area would require total or partial acquisition of a numerous commercial and residential properties on both sides of the road. Further acquisitions be required for the development of local service roads and ramps to the new highway although the tunnel scheme through Macauleys Headland would largely avoid direct impact on urban development in the area.

Increasing the capacity for traffic through the centre of Coffs Harbour may result in a short-term devaluation of land adjacent to the highway. However, the Existing Highway Upgrade is likely to create opportunities for businesses to refocus their access and exposure away from the Highway to allow improved trading conditions and accessibility.

While the Inner Bypass passes through substantial lengths of rural lands, it also traverses the North Boambee and West Coffs urban release areas and the Korora investigation area. These are described further in *Working Paper No 1: Statutory and Strategic Planning Issues (Connell Wagner, 2004f)*. Potential impacts arising from the Inner Bypass include the potential isolation of land to the west of the bypass and potential reduction in its value for future development. Conversely, there is the potential that properties to the west of the bypass could benefit from improved accessibility with a bypass and this could be attractive for some land use and development.

7.4 Traffic Noise

Wilkinson Murray conducted a strategic review of traffic noise issues associated with the Inner Bypass and Existing Highway Upgrade, information from which is contained in: *Working Paper No 4*, *Strategic Noise Assessment* (Wilkinson Murray, 2004).

This report identified that the existing noise levels at the closest residential receivers along the existing highway are already above the Department of Environment and Conservation (DEC) base criteria for 'Redeveloped Roads'. Selected road surfacing materials and the use of noise barriers in the vicinity of all residential areas would be required to reduce noise levels for residential receptors. Barrier heights of perhaps 6m would be required to meet the DEC base criteria at receivers set back 40m, which is unlikely to be feasible from an urban design perspective.

The review by Wilkinson Murray indicated that the Existing Highway Upgrade would affect the lowest total number of residences due to the fact the impacts would be confined to one corridor, affecting only those residences already affected by traffic noise. However, the presence of the existing development immediately adjacent the highway would make opportunities for noise mitigation difficult.

For the Inner Bypass the Base Criteria of 50dBA at night time would be achieved at 100-900m from the edge of the alignment without noise mitigation, depending on the topography, gradient and receiver elevation. Residential receivers already encroach this distance and land release also extends into these areas. The noise assessment identified that Inner North 1 and Inner South 1 would affect a greater number of existing receivers and land already zoned for residential purposes than Inner South 2 and Inner North 2. For the Inner North 2 and Inner South 2, there is also a greater opportunity to provide the buffer zones required.

Noise barriers or mounds would typically be required to allow development closer to the bypass. High barriers may not be acceptable or suitable in his semi rural/rural residential environmental. Landscaped mounds, possibly incorporating low barriers, would be a more suitable arrangement in this environment from an urban design perspective. With noise mitigation the Base Criteria of 50dBA at night time would be achieved at 50m-450m from the edge of the alignment, depending on the topography, gradient and receiver elevation.

The Inner Bypass would remove a high proportion of heavy vehicles at night time from the existing highway. However, this would mean an increase in the overall number of residences affected by traffic noise. Noise barriers or mounds would almost certainly need to be installed and consideration would need to be given to appropriate land use zonings in the vicinity of the new corridor. The Inner Bypass does provide some opportunities for use of the surrounding topography, including tunnels and lowering of the road gradeline to shield the road from the adjacent residential development both acoustically and visually.

In summary, the Existing Highway Upgrade would prevent additional residences being exposed to traffic noise. However, there would be limited opportunities to effectively mitigate any noise increases along the highway due to the close proximity of development to the road. Construction of the Inner Bypass would introduce traffic noise impacts into a rural / urban fringe environment, with Inner South 1 and Inner North 1 impacting a greater number of existing properties than the Inner North 2 and Inner South 2 corridors. The Inner North 2 and Inner South 2 routes pass nearer the middle of the North Boambee Urban Release area and the West Coffs Urban release area respectively, providing greater opportunities for the incorporation of noise mitigation measures for future residential development.

7.5 Visual Amenity

The *Urban Design and Visual Assessment* (*Working Paper No 2)* was prepared by Hassell (Hassell, 2004) to assess the existing visual and urban environment and the likely implications of the Inner Bypass and Existing Highway Upgrade options in terms of visual impact, road user experience and urban design impact.

7.5.1 Visual impact

The primary visual impacts from the Existing Highway Upgrade option would result from the grade-separated interchanges and other significant engineering structures, particularly through the city centre. The increased width of the highway, adjacent service roads and ramps would cause significant changes to the existing urban environment.

The Inner Bypass would have visual impacts due to the introduction of a new highway formation through a predominantly rural residential area. There are potentially very significant visual impacts associated with the Inner Bypass, particularly at the point where it rises over Roberts Hill ridge. These impacts would be intense for adjacent properties but also apparent from a broader landscape perspective. However, the visual impacts could be reduced by cut and cover tunnel or vegetated fauna overpass as discussed in Sections 4.2 and 6.2.2 above. The road is also likely to be visible from viewing points at Red Hill and Roberts Hill, and would be visible where it passes over the ridge to the north of the rail line, and where it runs along the base of the foothills. The intersection with the existing highway at Englands Road, may also have visual impacts on adjacent properties.

7.5.2 Road User Experience

The journey along the Inner Bypass corridor would provide views from the various ridges, with further views of bushland and the coast at locations along the route. The Existing Highway Upgrade would provide fewer benefits for those travelling along it, due to the potential introduction of noise walls and the less varied experience of the surrounding environment.

7.5.3 Urban Impact

Both the Existing Highway Upgrade and the Inner Bypass corridor would result in impacts on the urban structure of Coffs Harbour. The main impacts upon the existing urban structure of the Existing Highway Upgrade are confined to the CBD and surrounding retail/commercial precinct contained between the proposed grade separated interchanges at Combine and Orlando Streets. These may be fragmented by an upgrade of the existing highway.

Distinct urban areas have been identified on either side of the highway. The areas to the east of the existing highway are nearing development capacity with further expansion prevented by the physical barriers of the coastline to the east and the highway to the west. Traffic currently flows from east to west across the highway at a number of controlled intersections and the Existing Highway Upgrade would further control and possibly reduce the number of crossings.

The Inner Bypass runs through an area of planned urban expansion at its southern end in the North Boambee area. Potential division of this area could be mitigated through replanning of the future development. The central part of the Inner Bypass corridor also traverses the West Coffs Urban Release Area. The Inner Bypass corridor would reduce the size of this area only slightly as the foot slopes of the range already provide a physical barrier to its size. The urban impact of the Inner Bypass could be mitigated in the planning of the future development.

The comparative assessment of the 'significance' or level of impact on the surrounding character for the two corridor options is provided as an indication of the ability of the environment to absorb the new highway works. The findings of the assessment are presented in Table 7.2.

Table 7.2 Comparative Assessment of Options

Corridor Option	Visual Impact	User Experience	Urban Impact
Existing Highway Upgrade	High	High	High
Inner Bypass	Medium	Low	Low

Classification:

- High – little or no capacity to absorb impact of proposed elements resulting in a major change to the surrounding character
- Medium – moderate ability to absorb proposed elements which are considered in keeping with surrounding character
- Low – will have little impact on surrounding character and may result in some positive outcomes.

7.6 Socio–Economic Issues

A socio-economic assessment was carried out to compare the likely implications of each corridor option on the socio-economic characteristics and structure of the community in the proximity of the study area. The full report can be found in *Working Paper No 6: Socio-Economic Assessment* (Connell Wagner, 2004c).

The socio-economic assessment involved:

- development of a profile of the socio-economic characteristics of the community in the vicinity of the strategic options based on a review of data and literature including census data and Council records
- documentation of community attitudes towards the proposed upgrading of the highway based on the results of the stakeholder involvement program undertaken to date. Documentation of these attitudes allows expressed community sentiment and feeling to be incorporated into the analysis of socio-economic issues
- analysis of the likely implications of upgrade options on socio-economic characteristics and structure of the study area, including consideration of quantifiable impacts such as property effects and issues which are not so easily quantified such as community cohesion and amenity effects

Community input has been provided through regular meetings of the Community Focus Group (CFG). In February 2003, CFG members were asked to identify key socio-economic issues in terms of advantages and disadvantages of the proposed Existing Highway Upgrade and Inner Bypass corridor options against the following issues:

- community cohesion
- amenity effects
- access and movement patterns
- land use and property
- effect on business activity
- tourism

It is recognised that each of the options would have adverse impacts in some locations and beneficial impacts at others. The assessment has considered the concerns raised by the community and based the assessment on the likely overall impacts on each of the above issues. Table 7.3 provides an overall ranking on each of the socio-economic issues assessed.

Both options would have negative impacts in terms of community cohesion and amenity, which commonly result from the physical, visual and pollution impacts associated with major highways, particularly those near residential areas. These impacts may be offset to some extent by improved access to, and movement in the city centre. The access improvements obtained from both options would also be beneficial to tourism.

The Inner Bypass would have less impact than an upgrade of the existing highway in terms of community cohesion due to the lower adjacent population concentration. In terms of providing accessibility and facilitating movement in and around Coffs Harbour, the Inner Bypass has an advantage over an upgrade of the Existing Highway. Increasing the capacity of the existing Pacific Highway would result in the city centre being further divided and dominated by the increased scale of this major spine road. The Inner Bypass would also provide benefits by removing through traffic from the city centre and providing better access to rural and residential properties and facilities.

The Inner Bypass would have a negative impact on rural communities on the outskirts of the Coffs Harbour urban area. The planned urban expansion areas at North Boambee and west Coffs Harbour would also be adversely affected. Tourism and eco-tourism facilities adjacent to the bypass may also be adversely affected by the introduction of infrastructure and the associated disturbance.

Table 7.3 Assessment of Socio-economic Issues

Issue	Pacific Highway Upgrade	Inner Bypass Corridor Option (IS1)	Inner Bypass Corridor Option (IS2)	Inner Bypass Corridor Option (IN1)	Inner Bypass Corridor Option (IN2)
Community Cohesion	High Adverse	Low Adverse	Low Adverse	Low Adverse	Low Adverse
Amenity Effects	High Adverse	High Adverse	Moderate Adverse	High Adverse	Moderate Adverse
Access and Movement Patterns – local traffic	Moderate Adverse	High Beneficial	High Beneficial	High Beneficial	High Beneficial
Access and Movement patterns – through traffic	Moderate Beneficial	High Beneficial	High Beneficial	High Beneficial	High Beneficial
Rural Land Use and Property	No effect	Moderate Adverse	Moderate Adverse	Moderate Adverse	High Adverse
Urban Land Use and Property	High Adverse	Low Beneficial	Low Beneficial	Low Beneficial	Low Beneficial
Business Activity	Moderate Adverse	Low Beneficial	Low Beneficial	Low Beneficial	Low Beneficial
Tourism	Low Beneficial	Low Beneficial	Low Beneficial	Low Beneficial	Low Beneficial

In summary, providing the negative impacts associated with amenity and future urban expansion and on adjacent tourism facilities are appropriately identified and managed, the Inner Bypass would provide greater benefits in terms of socio-economic considerations than an upgrade of the existing highway, with fewer adverse impacts on the wider community.

7.7 Indigenous Heritage

An assessment of Indigenous Heritage issues undertaken by Archaeological Consultant Jacqueline Collins is contained in *Working Paper No 7a*. (Collins, 2004). The review of background information and initial consultation with Aboriginal organisations undertaken in conjunction with this assessment has revealed no permanent Aboriginal heritage constraints with respect to either of the Inner Bypass options.

Along the Existing Highway corridor, the greatest area of potential concern is in the vicinity of Coffs Creek and the Wongala Estate. Before the Wongala Estate was built, a large Aboriginal camp existed on the southern side of Coffs Creek in the Carralls Gully area. This camp extended west across the present Fitzroy Oval to the bend in the creek approximately 150m east of the present highway opposite Beryl Street. Aborigines also camped on the northern side of Coffs Creek where the showground is now located. As shown in the Existing Highway Upgrade concept (Figure 4.1A), the proposed roundabout and service roads opposite Beryl Street lie to the west of the showground and the bend in the creek and are unlikely to present permanent Aboriginal heritage constraints. The Wongala Estate near the Land Council office (east of the Arthur Street interchange) was built subsequently. The proposed roadworks at the Arthur Street interchange are within the existing road reserve and would not impact on this area.

For the most part, the Inner Bypass traverses a highly disturbed landscape that offers little potential for the preservation of *in situ* Aboriginal archaeological sites. A number of specific areas where archaeological potential is assessed to be moderate or high have been identified, but no archaeological sites are currently known on either option. Two stone artefacts have been recorded within 50m of the common southern end, presenting the possibility that similar materials may be intercepted by the options themselves. The areas of predicted archaeological sensitivity are predictions only and require field testing. Even though there are currently no Aboriginal cultural heritage constraints to development of either option, this situation could change if a significant site is detected during future field survey.

There are areas of some historical Aboriginal social value that would be impacted by development of the common northern end of the Inner Bypass. Sites of high traditional significance also occur to the north and south of this section of corridor. On this basis, the Coffs Harbour and District LALC / Gumbala Julipi Elders representatives have thus advised that realignment to avoid these sites is not considered warranted or desirable. No preference has been expressed in relation to either of the northern or southern sections of the corridor.

From a scientific perspective, the presence of undisturbed or minimally disturbed cultural material would be central to determining the significance level of any archaeological site that may be intercepted by the options, and the constraints that any such site/s would ultimately pose to development of an Inner Bypass. While it is recognised that the archaeological resource of both options would have been disturbed and depleted as a result of land clearance and long-term agricultural activities, due to lower-gradient topography and a seemingly lower overall order of disturbance, Inner South 1 and Inner North 1 are at this stage considered to have more potential to contain significant archaeological sites relative to Inner South 2 and Inner North 2.

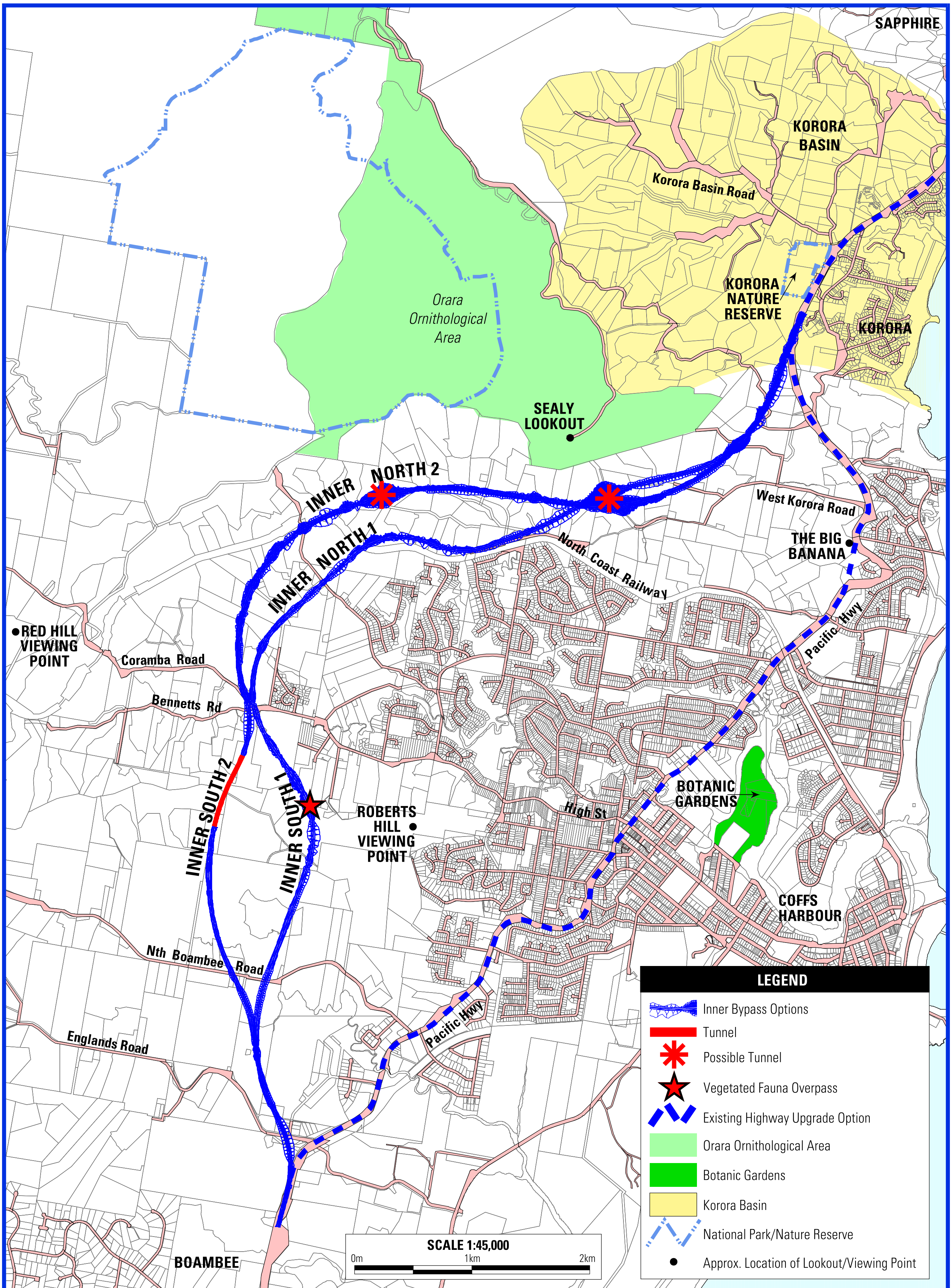
Further Aboriginal community consultation and an archaeological field survey of all areas where construction disturbance is anticipated would need to be undertaken as part of any future Environmental Impact Assessment of the Preferred Option. The cultural heritage value of all sites and places which would be directly or indirectly affected by an adopted route should then be assessed in close consultation with the Aboriginal community and management strategies developed accordingly.

7.8 Non-Indigenous Heritage

The non-indigenous heritage issues of the corridor options are addressed in: *Working Paper No 7b, Non-Indigenous Heritage Assessment* (Connell Wagner, 2004h). This identified that there are numerous heritage places / items listed within the LEP, REP and National Trust register located mainly within the urban area and away from the Pacific Highway. It is unlikely that these items would be affected by either the Existing Highway Upgrade or an Inner Bypass.

There are two areas of cultural heritage significance listed on the *Register of the National Estate* which lie in close proximity to the Inner Bypass corridor and the existing Pacific Highway corridor, as shown in Figure 7.1. These are the Korora Nature Reserve (registered place) located on the western side of the Highway at Korora, and the Orara Ornithological Area which is listed as an indicative place (currently being assessed) by the Australian Heritage Commission. Located along Bruxner Park Road, this area is approximately 5,755ha in size and is located approximately 5km north-west of Coffs Harbour. The nominated area is a moist hardwood forest supporting high bird diversity.

Another relevant literature source reviewed was the *Coffs Harbour Coastal Landscape Heritage Study* (Coffs Harbour City Council 1995) in which a community values assessment process identified fourteen places of landscape heritage value likely to be sufficient to warrant inclusion in the Register of the National Estate. Those in the vicinity of the Inner Bypass include Sealy Lookout and all lookouts giving views of Coffs Harbour and its setting, including viewing points at Red Hill and Roberts Hill. Both the Inner Bypass and the Existing Highway Upgrade options pass through the scenic landscape of the Korora Basin. In addition the Big Banana was considered to be of importance to the community. To



COFFS HARBOUR HIGHWAY PLANNING
COFFS HARBOUR SECTION
STRATEGY REPORT

FIGURE 7.1
NON INDIGENOUS HERITAGE

date, the recommendations from this study have no statutory heritage implications. The likely impact of the Inner Bypass on relevant viewing points has been considered in the visual impact assessment (Hassell, 2004).

It is quite possible that as yet unidentified sites of non-indigenous heritage significance could exist in the study area in the form of relics associated with past occupation and land use. Under the provisions of the *NSW Heritage Act 1977*, items which are related to the settlement of NSW which are greater than 50 years of age are defined as 'relics' and a permit is required from the Heritage Council before disturbance of such items can take place.

Neither of the corridors would have a direct impact on protected heritage sites. However, the Inner Bypass does lie within 250m of the Orara Ornithological area. However, given the extent of vertical separation between the Inner Bypass located at the base of the escarpment and the Orara Ornithological Area at the top of the escarpment, it is unlikely there would be any noise and light pollution impacts.

Both options would be visible from prominent viewing points in Coffs Harbour. The most significant viewing point is Sealy Lookout, considered by the community as being worthy of inclusion in the Register of National Estate. Although the Inner Bypass is within 500m of Sealy Lookout at its northern end, the visual impact of the Existing Highway Upgrade (over 1.5km away) is likely to be greater. Neither of the northern Inner Bypass options can be seen from Sealy Lookout, due to the vertical separation mentioned above, and the only parts which are visible is where it passes over Roberts Hill ridge and traverses the North Boambee Valley to the south of Roberts Hill ridge. The visual impact of the Inner Bypass would be limited due to the proposed vegetated fauna overpass at Roberts Hill ridge (refer Section 4.2) and the distance between Sealy Lookout and the north Boambee Valley.