8 Bio-Physical Issues

8.1 Topography / Hydrology

The geotechnical implications of the corridor options are addressed in *Working Paper No 3, Geotechnical desk study and field mapping study* (Connell Wagner, 2004d). This report divided the study area into two topographic zones: the hillside zone (areas above the 50m contour) and the lowland area (areas below 50m contour). The hillside zone comprises steep slopes and ridges which rise to approximately 150-250m AHD. Major ridge lines project from the Great Dividing Range such as the prominent ridge to the south of Coramba that ends as Roberts Hill. Numerous drainage channels that typically flow east to the lowland area, incise the hillside area. The majority of the steep slopes and ridges are either forested or used for banana cultivation, the latter favouring the north facing slopes that are more sheltered from the often strong southerly winds.

The lowland area is characterised by low undulating residual hills with gentle gradients and alluvial floodplains including backswamps and dunes. Coffs Creek and Newports Creek are the main creeks that cross the area from the upland area in the west to the sea.

The Existing Highway Upgrade is located almost wholly on the coastal lowland with the eastern ends of Macauleys ridge and Roberts Hill ridge being the only hillslopes of any note. In the case of the former, a tunnel scheme has been identified because of the steep terrain and development constraints along the corridor. The Inner Bypass options traverse more variable terrain which is generally at the footslopes of the main range that flank urban Coffs Harbour. As previously noted, this has influenced the highway design concepts to the extent that they could include tunnel sections through several large ridges where very deep cuttings would otherwise be required. The indicative earthworks quantities for both the Existing Highway Upgrade and the Inner Bypass (low and high cost scenarios) are presented in Section 6.

8.2 Geology and Soils

The underlying geological conditions as referenced by the NSW Department of Mineral Resources, are within the Dorrigo area, subdivided into three main metamorphic rock units including Coramba Beds, Brooklana Formation and Moonbil Siltstone.

The regional metamorphic grade increases from north to south. The rock types vary from lower grade feldspathic wackes in the north to higher-grade argillites and black siltstones in the south. The Coramba Beds overly the Brooklana Formation and both are strongly folded and faulted. The Coramba Beds comprise metamorphosed sedimentary rocks, and the Brooklana Beds comprise thin-bedded siliceous mudstone and siltstone. The Moonbil Siltstone consists mostly of alluvial and estuarine deposits.

The Soil Landscape comprises 'Suicide' associated with steep slopes and it is generally in excess of 1m thick. The steepness of the slopes and the potential for instability are of concern for any proposed foundations and cuttings. 'Megan', comprising silty clays, is generally in excess of 1m thick and is as widespread as Suicide across the study area, and is typically found on rolling hills. Major slope stability problems associated with Megan are rare. 'Ulong' is similar to Megan, but found on slightly flatter relief. As with Megan, the soil is characterised by low wet strength silty clays generally greater than 1m thick, and is only moderately erodible. 'Moonee' which is associated with footslopes and drainage plains, is not very widespread. Water tables are generally high within these soils and prone to seasonal waterlogging. Moonee is highly erodible and most likely compressible. Therefore is likely to cause settlement problems for fill embankments and culvert structures founded on the soil. Coffs Creek, Dairyville, and Newport Creek soils are found along the creek alignments and are associated with the creek floodplains. Coffs Creek soils are typically deep (greater than 1.5m) poorly drained alluvial gravels, sands, silts and clays. The areas are often waterlogged and have permanently high water tables, which would greatly influence fill embankments and culverts associated with the creek

crossings. Newports Creek soils are concentrated on the low-lying level floodplain areas adjacent to the Pacific Highway.

Acid Sulphate Soils (ASS) are typically associated with soils below 5m AHD and as such, areas of low risk potential ASS are concentrated along the Pacific Highway corridor. High risk areas have been identified north of Korora and adjacent to the railway line.

The DEC and CHCC were contacted regarding 'known' groundwater and soil contamination in and around the study area. These consultations indicated that no contaminated soils or groundwater were identified or recorded on their databases. Limited contamination testing conducted by Holmes and Holmes Pty identified no elevated levels of contaminants, indicating that the probability of large scale contamination within the study area is low.

The main geotechnical implications for the Existing Highway corridor are anticipated to be the variable geological structure at Macauleys Headland in the location of the tunnel. Detailed subsurface geotechnical investigation in this area would be required at the concept design stage. The Existing Highway Upgrade option also traverses the largest amount of Acid Sulphate Soil (ASS) and Potential Acid Sulphate Soil (PASS) soils of the two route options. Areas of high risk may be encountered adjacent to the Northern Railway line where it crosses the highway, however the impacts are not likely to be significant. The exact nature and extent of PASS and ASS will need to be identified by field investigation to be able to effectively quantify this issue.

Greater risks are anticipated with the Inner Bypass corridor due to the fact that it passes through variable and undeveloped terrain, requiring cuttings, tunnels and embankments. Detailed subsurface investigations would be required to provide further information on the underlying conditions. In locations where deep cuttings or tunnels are required, it is anticipated that variable geological structure would be present that would require detailed targeted investigation. Introduction of cuttings also has the potential to introduce soil stability issues. Fill embankments up to 30m high would be required at the approaches to major cuttings, the foundations of which may require treatment depending on the compressibility of material beneath

8.3 Biodiversity

An Ecological Assessment (*Working Paper No 5*) was prepared (Connell Wagner, 2004e) to examine the likely impacts associated with the Inner Bypass and the Existing Highway Upgrade corridors. This comparison consistently indicated that the Inner Bypass options are likely to have a higher impact on threatened species and vegetation of conservation significance compared with the Existing Highway Upgrade. This is the result of the Existing Highway Upgrade option traversing an existing road corridor through a largely developed and disturbed landscape. In those areas where vegetation clearing would be required, habitats are likely to be already degraded by edge effects and other disturbances associated with the existing roadway.

As part of the comparison of the Inner Bypass options, implications for threatened species have been grouped into broad habitat preferences, which in turn were based on vegetation types. The area of vegetation clearance for each of the Inner Bypass options is shown in Table 8.1.

Table 8.1 Estimate of Habitat Clearance

Grouping of Threatened Species	Option IS2 / IN2 (ha)	Option IS2 / IN1 (ha)	Option IS1 / IN2 (ha)	Option IS1 / IN1 (ha)
Coastal Vegetation Species	1.7 ha	1.7 ha	1.7 ha	1.7 ha
Mesic Community Species	4.9 ha	4.9 ha	5.2 ha	5.3 ha
Forest Fauna Total	8.3 ha	8.5 ha	8.7 ha	8.9 ha
Vegetation with winter flowering species	5.9 ha	6.3 ha	5.8 ha	6.2 ha
Total Vegetation Clearance	20.8 ha	21.4 ha	21.4 ha	22.1 ha

The likely impacts associated with each Inner Bypass option were generally similar in regard to vegetation clearance, the tree hollow resource and winter flowering trees. However, the report identified that the likely impacts associated with Options IS2 / IN1 and IS2 / IN2 were lesser than Options IS1 / IN1 and IS1 / IN2 in regard to Koala habitat and wildlife linkages.

The number of watercourses crossed by each of the options is shown in Table 8.2.

Table 8.2 Number of Water Habitats Crossed by Each Option

Habitat Type	Option IS2 / IN2	Option IS2 / IN1	Option IS1 / IN2	Option IS1 / IN1
Water Courses				
fringing vegetation	5	5	5	5
predominantly cleared lands	4	5	7	8
Large dams				
in vegetation	1	1	1	1
fringing vegetation	5	2	5	2
not vegetated	5	3	7	5

The features that provide the most suitable habitat for threatened aquatic species are watercourses with fringing vegetation and large dams set into vegetation or on the fringes of vegetation. Therefore, it would appear that bypass options involving the IN2 section have the highest potential level of impact on the habitats of threatened species associated with aquatic habitats.

Despite the differences in potential impacts, both the Inner Bypass options and the Existing Highway Upgrade would require the provision of fauna underpasses and/or overpasses due to the presence of wildlife linkages, which include a number of Koala movement corridors. However, in the case of an Existing Highway Upgrade, these would be of net benefit as they could potentially improve linkages already impacted on by the existing highway.

8.4 Air Quality

Diesel emissions are a topical and significant issue and are the subject of general community discussion and research. This issue has also been discussed at the CFG meetings.

A comparison between the likely air quality impacts of the Inner Bypass and Existing Highway Upgrade was undertaken by Holmes Air Sciences and is attached as Appendix D.

The report identified the key factors that must be considered when assessing air quality and its impacts. They include the number and location of sensitive receptors, percentage of heavy vehicles, roadway grade, degree of congestion and background levels of pollution. The overall impact is fundamentally dependent on the level of traffic on the road. There are generally fewer constraints for rural roads than for urban roads with respect to air quality as the receiving air environment is usually relatively unpolluted.

A key issue associated with the Existing Highway Upgrade is that increasing capacity would concentrate pollution in areas where there is a relatively large number of receptors. However, at least in the medium term, the Upgrade is likely to improve the current situation by reducing congestion, although this would depend on the volume of traffic, with potential benefits if traffic volumes are low.

The main impact of the Inner Bypass is the introduction of a new source of air pollution into the area. The level of traffic on the Inner Bypass compared with the existing highway would generally be moderate and the grades are unlikely to be an issue. The Inner Bypass would also improve the current situation on the bypassed section of the existing highway by reducing congestion.

The overall air quality impacts associated with the Existing Highway Upgrade are considered to be moderate, primarily due to the high impacts of the increased traffic and large number of receptors along the route. The impacts of the Inner Bypass are considered to be Moderate to Low with only moderate impacts anticipated on receptors along the route.

Greenhouse emissions would be directly proportional to the fuel consumed, affected by grade of the road and start-stop conditions. The assessment found there would be little difference between emissions for the Existing Highway Upgrade and the Inner Bypass.

Given that the study area is in a non-metropolitan, coastal location, air quality issues are unlikely to be a significant assessment criteria at the stage of identifying a Preferred Strategy. At the concept design and environmental impact assessment stage, following a decision on a preferred option, a detailed assessment of air quality expected during construction and operation of the proposal would be carried out. This would include computer-based dispersion modelling to predict roadside air quality.

9 Conclusions

The two Strategic Options under investigation as a future corridor for an upgrade of the Pacific Highway through Coffs Harbour include an upgrade of the existing highway to urban motorway standard along its current alignment, and an Inner Bypass around the western edge of the Coffs Harbour urban area. A range of parameters have been assessed in this report, to compare the feasibility and impacts of these options including the functional performance of the corridor, the socio-economic implications and the impacts on flora and fauna. The conclusions from the comparative assessment are discussed below.

The Existing Highway Upgrade would require major construction to an urban motorway standard involving substantial redevelopment of the existing highway corridor. The aim would be to create an access controlled motorway with parallel local service roads, and a series of local road crossings and interchanges. The Inner Bypass is a new corridor immediately to the west of urban Coffs Harbour and comprises two options to the south and two options to the north with a common cross over point in the vicinity of Coramba Road. These northern and southern sections are interchangeable and combine to form four potential route options between Englands Road and Korora Hill.

It is estimated that the Inner Bypass would result in a 16-39% reduction in the amount of the total traffic along the bypassed section of the Pacific Highway including a 34-51% reduction in the amount of heavy vehicle traffic in 2021. The Existing Highway Upgrade would retain the main road traffic flows in the existing corridor but would provide separation of local and through traffic on the adjacent service roads and motorway. Of the two schemes, the greatest benefits in terms of local and through traffic movements would be provided by the Inner Bypass, which would result in enhanced highway access and movement around the city centre.

The total estimated cost from Englands Road to the end of the existing dual carriageway highway at Sapphire for the Existing Highway Upgrade is $690M. For the Inner Bypass, the estimated cost over the same section of highway is $280 to $425M depending on the selected route sub-options. The road user benefit cost analysis indicated that the options provide similar economic returns. The Inner Bypass has a First Year Rate of Return (FYRR) of 3.5% to 5.2% depending on the sub-options chosen and a BCR of 0.62 to 0.93. In contrast, the Existing Highway Upgrade provides a FYRR of 4.9% and a BCR of 0.85. This indicates that neither option is an appreciably better investment proposition in terms of network travel efficiencies. Importantly, neither option would yield good economic returns in the short to medium term.

In terms of socio-economic implications, both the Inner Bypass and Existing Highway Upgrade options would require significant acquisition of private property. The property impacts associated with the Existing Highway Upgrade scheme would mainly result from the new interchanges, access ramps and service road arrangements in the built-up part of the city centre. Acquisition would be typically adjacent to the existing road reserve and some highway fronting properties would also lose their existing access to the highway. As a consequence, very high adverse impacts are anticipated in terms of urban land use and business activity. Substantial adjustments would be required to maintain access to local businesses and tourist facilities. There would also be adverse impacts in terms of community cohesion due to access restrictions along and across the highway. Negative impacts would also be experienced across a range of amenity effects. In general terms, the Existing Highway Upgrade would cause dramatic changes to the urban fabric of Coffs Harbour along the corridor including potentially severe impacts on the form and function of the CBD. There would be no impacts upon rural land use with this option.

While the Inner Bypass minimises direct impact upon existing urban land use in Coffs Harbour, there would be substantial adverse impacts on rural and rural residential areas in North Boambee, west Coffs Harbour and west Korora. The corridor would also have major implications for the development

plans of North Boambee, the early development stages of which are imminent. As such, there is still the opportunity to revise the plans to achieve a compatible land use mix along the corridor.
Construction and operation of the Inner Bypass would have a range of adverse impacts on the residential communities near the corridor, most notably in the form of amenity effects like traffic noise and visual impact. Due to the available space in the new corridor, opportunities exist to incorporate urban design features to provide visual and noise screening. Beneficial impacts are anticipated for local accessibility and amenity along the existing highway corridor, with the removal of through traffic including significantly reduced heavy vehicle movements, this will also produce benefits for CBD land use and property, and overall business activity and tourism. Redirecting through traffic around the city centre also provides opportunities for expansion of tourist and business facilities particularly to the west of the existing highway.

For the Existing Highway Upgrade, the works would be contained along the existing road corridor and as such, there would be minimal ecological impacts. In contrast, the Inner Bypass traverses several areas of native vegetation that support ecological functions. While there are opportunities to effectively mitigate ecological impacts (eg. provision of fauna underpasses and overpasses), it is likely the Inner Bypass would have higher ecological impacts than the Existing Highway Upgrade.

Despite the likely benefits to road users with the Existing Highway Upgrade option, it is concluded that the major adverse social impacts including community disruption, reduced amenity and the severe land use and business impacts in the main urban centre of Coffs Harbour would render this option unacceptable for the local community.

Table 9.1 provides a comparison of the two options against the principal objectives for the Pacific Highway Upgrade Program and the Coffs Harbour Highway Planning Strategy:

Table 9.1 Performance of Options Against Objectives of Pacific Highway Upgrade Program

Objective	Existing Highway Upgrade	Inner Bypass
Significant reduction in road accidents and injuries.	Improvements would be made to the road geometry within this highly constrained corridor. Local and through traffic would be more effectively separated. These measures would be expected to significantly reduce crash rates and improve pedestrian safety.	The dual carriageway geometry would be designed to RTA standards for optimal safety and transport efficiency. Coupled with the significant local and through traffic separation this option would be expected to provide the best outcome in terms of crash rates.
Reduced travel times	Travel times from Englands Road to the end of the dual carriageway at Sapphire would be reduced by 1.7minutes.	Travel times from Englands Road to the end of the dual carriageway at Sapphire would be reduced by 2.2minutes.
Reduced freight transport costs	This option would be expected to result in a saving of $0.86 per vehicle (from Englands Road to the end of the dual carriageway at Sapphire) due primarily to improved road geometry and traffic flow.	This option would be expected to result in a saving of $1.12 per vehicle (from Englands Road to the end of the dual carriageway at Sapphire) due primarily to improved road geometry and traffic flow.
Community satisfaction with the physical development of the route	Community input would be integrated into the design at all stages of project development. Construction activities would be protracted and result in a wide range of unavoidable community disruption and inconvenience. On completion of works, community access across the corridor would be restricted, with some dissatisfaction likely due to reduced freedom of movement. Inclusion of environmental mitigation measures more	Community input would be integrated into the design at all stages of project development. Construction activities would have minimal inconvenience beyond the immediate corridor area. A high level of community satisfaction is likely when the bypass is completed due to improved local accessibility. The new corridor would provide more opportunity to incorporate urban design and environmental outcomes sought by the community

Objective	Existing Highway Upgrade	Inner Bypass
	difficult along this highly urbanised corridor.	
A route that supports Economic Development	Introduction of major transport infrastructure would support continued regional economic development. Opportunities for access by through-traffic to facilities within the CBD would be reduced from the current situation, exacerbated by the loss of roadside parking. Direct property impacts and reduced access to many businesses along the corridor represents potentially significant adverse economic impact for Coffs Harbour. Major traffic corridor through main urban area would detract from future enhancement as business and tourist precinct	Introduction of major transport infrastructure would support continued regional economic development. Opportunity exists to promote new land use / development more compatible with a highway (eg especially North Boambee and west Korora). Changed traffic regime in CBD provides opportunities for enhanced business activity and precinct development. Removal of through traffic from main urban area would improve amenity and enhance Coffs Harbour as a tourist destination
Upgrade managed in accordance with ecologically sustainable development principles	The route maximises use of existing infrastructure and has negligible impact on rural and conservation / vegetation areas. However, significant negative impacts would occur in established business and community precincts through the main urban area of the City.	Corridor impacts on several areas of vegetation with ecological values. There is opportunity to effectively mitigate and compensate such impacts. Corridor traverses rural / urban fringe areas, much of which is subject to substantial land use change. There is scope for replanning to achieve compatible development outcomes. Enhanced traffic conditions along existing highway would be positive for sustaining / improving the main urban area as the key business and social centre of Coffs Harbour.
Effectiveness of expenditure objectives	Project cost and funding profile likely to mean numerous work stages and overall construction period of at least 6-7 years. Higher potential for local and through traffic problems through town especially in peak periods. Benefits to road users would be realised incrementally as new sections are complete.	Bypass could be constructed free of major traffic flows and opened within 4-5 years. Road user benefits would commence immediately upon opening

From this comparison of the options it is concluded that the Inner Bypass best satisfies most of the program outcomes. In tandem with the examination of key transportation, socio-economic and environmental factors, this reinforces the overall finding that an Inner Bypass corridor is the most suitable means of meeting future highway needs for Coffs Harbour and that it should be the basis of the Preferred Strategy for upgrading the Pacific Highway.

It is apparent that land use pressures in the vicinity of the Inner Bypass corridor will escalate in the short term, with the desire of land owners and developers to realise urban development opportunities permitted under existing planning instruments. This is especially the case for the North Boambee DCP area and also in west Coffs Harbour. In these circumstances, it is evident that specific planning action would need to be taken to protect the Inner Bypass corridor from future development. Therefore, subject to identification of the preferred sub-option, it is concluded that reservation of an appropriate strip of land should receive priority attention. It is acknowledged that such an outcome will necessitate review and replanning of at least some parts of the proposed new urban release areas. This review

would provide an opportunity to examine compatible urban / business land use scenarios adjacent to this major transport corridor.

10 References

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Appendix A

Cost Estimates

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 1 and Inner North 2 - Route A-0T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.89%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.36%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.04%	
Sub total	5,687,500	40%	2,275,000	7,962,500	3.3%	
2. Investigation and Design						
2.1 Investigation and Design	6,000,000	40%	2,400,000	8,400,000	3.47%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	750,000	40%	300,000	1,050,000	0.43%	
2.3 Client Representation	75,000	40%	30,000	105,000	0.04%	
Sub total	6,825,000	40%	2,730,000	9,555,000	3.9%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	960,000	40%	384,000	1,344,000	0.55%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	14,400,000	40%	5,760,000	20,160,000	8.32%	
3.3 Project Management Services	720,000	40%	288,000	1,008,000	0.42%	
3.4 Client Representation	72,000	40%	28,800	100,800	0.04%	
Sub total	16,152,000	40%	6,460,800	22,612,800	9.3%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	3.71%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.19%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.02%	
Sub total	6,330,000	50%	3,165,000	9,495,000	3.9%	
5. Construction						
5.1 Infrastructure - Environmental Works	7,500,000	35%	2,625,000	10,125,000	4.18%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	4,800,000	35%	1,680,000	6,480,000	2.67%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	38,669,202	35%	13,534,221	52,203,423	21.54%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	11,600,761	35%	4,060,266	15,661,027	6.46%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,965,045	25%	5,741,261	28,706,306	11.84%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	38,394,000	35%	13,438,000	51,832,000	21.39%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	-		-	-	0.00%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	3.20%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	1.11%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.67%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	8,000,000	40%	3,200,000	11,200,000	4.62%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.69%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.06%	Refer to Subsidiary Sheet for details
Sub total	143,979,008	34%	48,561,748	192,540,756	79.4%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.06%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.03%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.01%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	179,128,508	35%	63,246,798	242,375,306	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,123,750	2.11%
Site Management	$ 11,200,000	4.62%
Client Representation	$ 433,300	0.18%

Reality Checks (including contingency)

1. Cost $M/ km	$	20.95	11.57	km
			4	lanes
2. Cost $M/lane km	$	4.47	54.28	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,373	21,845	m2 - road bridges
4. Tunnels Cost/m			-	m
4. Earthworks $/m3	$	16.04	3,255,082	m3 (all inclusive rate)
5. Pavements $/m2	$	110.10	260,723	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 1 and Inner North 2 - Route A-2T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.16%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.27%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.03%	
				-		
Sub total	5,687,500	40%	2,275,000	7,962,500	2.5%	
2. Investigation and Design						
2.1 Investigation and Design	7,200,000	40%	2,880,000	10,080,000	3.11%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	900,000	40%	360,000	1,260,000	0.39%	
2.3 Client Representation	75,000	68%	51,000	126,000	0.04%	
				-		
Sub total	8,175,000	40%	3,291,000	11,466,000	3.5%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	720,000	40%	288,000	1,008,000	0.31%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	10,800,000	40%	4,320,000	15,120,000	4.66%	
3.3 Project Management Services	540,000	40%	216,000	756,000	0.23%	
3.4 Client Representation	54,000	40%	21,600	75,600	0.02%	
Sub total	12,114,000	40%	4,845,600	16,959,600	5.2%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	2.77%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.14%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.01%	
Sub total	6,330,000	50%	3,165,000	9,495,000	2.9%	
5. Construction						
5.1 Infrastructure - Environmental Works	6,900,000	35%	2,415,000	9,315,000	2.87%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	4,000,000	35%	1,400,000	5,400,000	1.66%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	29,315,158	35%	10,260,305	39,575,463	12.20%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	8,794,547	35%	3,078,092	11,872,639	3.66%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,965,045	25%	5,741,261	28,706,306	8.85%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	38,394,000	35%	13,438,000	51,832,000	15.97%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	75,500,000	35%	26,425,000	101,925,000	31.41%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	2.39%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.83%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.25%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	9,600,000	40%	3,840,000	13,440,000	4.14%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.52%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.04%	Refer to Subsidiary Sheet for details
Sub total	207,518,750	34%	70,880,658	278,399,408	85.8%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.04%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	239,980,250	35%	84,511,508	324,491,758	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,081,750	1.57%
Site Management	$ 13,440,000	4.14%
Client Representation	$ 429,100	0.13%

Reality Checks (including contingency)				
1. Cost $M/ km	$	28.05	11.57 km 4 lanes	
2. Cost $M/lane km	$	5.98	54.28	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,373	21,845	m2 - road bridges
4. Tunnels Cost/m	$	135,000	755	m
4. Earthworks $/m3	$	18.48	2,141,268	m3 (all inclusive rate)
5. Pavements $/m2	$	110.10	260,723	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South1 and Inner North 1 - Route B-0T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.89%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.36%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.04%	
Sub total	5,687,500	40%	2,275,000	7,962,500	3.3%	
2. Investigation and Design						
2.1 Investigation and Design	6,000,000	40%	2,400,000	8,400,000	3.47%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	750,000	40%	300,000	1,050,000	0.43%	
2.3 Client Representation	75,000	40%	30,000	105,000	0.04%	
Sub total	6,825,000	40%	2,730,000	9,555,000	3.9%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	960,000	40%	384,000	1,344,000	0.55%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	14,400,000	40%	5,760,000	20,160,000	8.32%	
3.3 Project Management Services	720,000	40%	288,000	1,008,000	0.42%	
3.4 Client Representation	72,000	40%	28,800	100,800	0.04%	
Sub total	16,152,000	40%	6,460,800	22,612,800	9.3%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	3.71%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.19%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.02%	
Sub total	6,330,000	50%	3,165,000	9,495,000	3.9%	
5. Construction						
5.1 Infrastructure - Environmental Works	7,500,000	35%	2,625,000	10,125,000	4.18%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	6,000,000	35%	2,100,000	8,100,000	3.34%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	41,498,024	35%	14,524,308	56,022,333	23.11%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	12,449,407	35%	4,357,293	16,806,700	6.93%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,245,448	25%	5,561,362	27,806,810	11.47%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	34,194,000	35%	11,968,000	46,162,000	19.04%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	-	#DIV/0!	-	-	0.00%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	3.20%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	1.11%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.67%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	8,000,000	40%	3,200,000	11,200,000	4.62%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.69%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.06%	Refer to Subsidiary Sheet for details
Sub total	143,936,880	34%	48,618,963	192,555,843	79.4%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.06%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.03%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.01%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	179,086,380	35%	63,304,013	242,390,393	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,123,750	2.11%
Site Management	$ 11,200,000	4.62%
Client Representation	$ 433,300	0.18%

Reality Checks (including contingency)

1. Cost $M/ km	$	21.82	11.11	km
			4	lanes
2. Cost $M/lane km	$	4.62	52.44	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,402	19,220	m2 - road bridges
4. Tunnels Cost/m			-	m
4. Earthworks $/m3	$	24.84	2,254,920	m3 (all inclusive rate)
5. Pavements $/m2	$	110.03	252,727	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 1 and Inner North 1 - Route B-1T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.42%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.30%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.03%	
Sub total	5,687,500	40%	2,275,000	7,962,500	2.8%	
2. Investigation and Design						
2.1 Investigation and Design	6,600,000	40%	2,640,000	9,240,000	3.20%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	825,000	40%	330,000	1,155,000	0.40%	
2.3 Client Representation	82,500	40%	33,000	115,500	0.04%	
	-					
Sub total	7,507,500	40%	3,003,000	10,510,500	3.6%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	800,000	40%	320,000	1,120,000	0.39%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	12,000,000	40%	4,800,000	16,800,000	5.81%	
3.3 Project Management Services	600,000	40%	240,000	840,000	0.29%	
3.4 Client Representation	60,000	40%	24,000	84,000	0.03%	
Sub total	13,460,000	40%	5,384,000	18,844,000	6.5%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	3.11%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.16%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.02%	
Sub total	6,330,000	50%	3,165,000	9,495,000	3.3%	
5. Construction						
5.1 Infrastructure - Environmental Works	7,200,000	35%	2,520,000	9,720,000	3.36%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	4,000,000	35%	1,400,000	5,400,000	1.87%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	40,169,321	35%	14,059,263	54,228,584	18.76%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	12,050,796	35%	4,217,779	16,268,575	5.63%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,245,448	25%	5,561,362	27,806,810	9.62%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	34,194,000	35%	11,968,000	46,162,000	15.97%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	39,000,000	35%	13,650,000	52,650,000	18.22%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	2.69%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.93%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.40%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	9,600,000	40%	3,840,000	13,440,000	4.65%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.58%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.05%	Refer to Subsidiary Sheet for details
Sub total	180,509,566	34%	61,499,403	242,008,969	83.7%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.05%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	213,649,566	35%	75,380,653	289,030,219	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,060,750	1.75%
Site Management	$ 13,440,000	4.65%
Client Representation	$ 427,000	0.15%

Reality Checks (including contingency)

1. Cost $M/ km	$	26.02	11.11	km
			4	lanes
2. Cost $M/lane km	$	5.51	52.44	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,402	19,220	m2 - road bridges
4. Tunnels Cost/m	$	135,000	390	m
4. Earthworks $/m3	$	36.58	1,482,594	m3 (all inclusive rate)
5. Pavements $/m2	$	110.03	252,727	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 2 and Inner North 2 - Route C-1T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.31%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.29%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.03%	
Sub total	5,687,500	40%	2,275,000	7,962,500	2.6%	
2. Investigation and Design						
2.1 Investigation and Design	6,600,000	40%	2,640,000	9,240,000	3.05%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	825,000	40%	330,000	1,155,000	0.38%	
2.3 Client Representation	82,500	40%	33,000	115,500	0.04%	
Sub total	7,507,500	40%	3,003,000	10,510,500	3.5%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	720,000	40%	288,000	1,008,000	0.33%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	10,800,000	40%	4,320,000	15,120,000	4.99%	
3.3 Project Management Services	540,000	40%	216,000	756,000	0.25%	
3.4 Client Representation	54,000	40%	21,600	75,600	0.02%	
Sub total	12,114,000	40%	4,845,600	16,959,600	5.6%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	2.97%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.15%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.01%	
Sub total	6,330,000	50%	3,165,000	9,495,000	3.1%	
5. Construction						
5.1 Infrastructure - Environmental Works	7,200,000	35%	2,520,000	9,720,000	3.21%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	3,600,000	35%	1,260,000	4,860,000	1.60%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	39,205,525	35%	13,721,934	52,927,459	17.48%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	11,761,658	35%	4,116,580	15,878,238	5.24%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,976,500	25%	5,744,125	28,720,625	9.48%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	31,434,000	35%	11,002,000	42,436,000	14.01%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	56,000,000		19,600,000	75,600,000	24.97%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	2.56%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.89%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.34%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	8,000,000	40%	3,200,000	11,200,000	3.70%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.55%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.05%	Refer to Subsidiary Sheet for details
Sub total	192,227,683	34%	65,447,639	257,675,322	85.1%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.04%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	224,021,683	35%	78,790,489	302,812,172	100%	

	Total Amount	% of Total Estimate
Project Management	$ 4,976,750	1.64%
Site Management	$ 11,200,000	3.70%
Client Representation	$ 418,600	0.14%

Reality Checks (including contingency)

1. Cost $M/ km	$	26.54	11.41	km
			4	lanes
2. Cost $M/lane km	$	5.65	53.64	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,445	17,355	m2 - road bridges
4. Tunnels Cost/m	$	135,000	560	m
4. Earthworks $/m3	$	15.49	3,416,523	m3 (all inclusive rate)
5. Pavements $/m2	$	110.10	260,850	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 2 and Inner North 2 - Route C-3T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	1.80%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.22%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.02%	
Sub total	5,687,500	40%	2,275,000	7,962,500	2.0%	
2. Investigation and Design						
2.1 Investigation and Design	8,400,000	40%	3,360,000	11,760,000	3.02%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	1,050,000	40%	420,000	1,470,000	0.38%	
2.3 Client Representation	105,000	40%	42,000	147,000	0.04%	
Sub total	9,555,000	40%	3,822,000	13,377,000	3.4%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	600,000	40%	240,000	840,000	0.22%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	9,000,000	40%	3,600,000	12,600,000	3.23%	
3.3 Project Management Services	450,000	40%	180,000	630,000	0.16%	
3.4 Client Representation	45,000	40%	18,000	63,000	0.02%	
Sub total	10,095,000	40%	4,038,000	14,133,000	3.6%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	2.31%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.12%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.01%	
				-		
Sub total	6,330,000	50%	3,165,000	9,495,000	2.4%	
5. Construction						
5.1 Infrastructure - Environmental Works	6,600,000	35%	2,310,000	8,910,000	2.28%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	3,200,000	35%	1,120,000	4,320,000	1.11%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	30,253,534	35%	10,588,737	40,842,271	10.47%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	9,076,060	35%	3,176,621	12,252,681	3.14%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,976,500	25%	5,744,125	28,720,625	7.37%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	31,434,000	35%	11,002,000	42,436,000	10.88%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	131,500,000	35%	46,025,000	177,525,000	45.52%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	1.99%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.69%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.04%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	9,600,000	40%	3,840,000	13,440,000	3.45%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.43%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.04%	Refer to Subsidiary Sheet for details
Sub total	256,690,094	34%	88,089,483	344,779,577	88.4%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.03%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	288,512,594	35%	101,443,733	389,956,327	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,165,750	1.32%
Site Management	$ 13,440,000	3.45%
Client Representation	$ 437,500	0.11%

Reality Checks (including contingency)				
1. Cost $M/ km	$ 34.18	11.41	km	
		4	lanes	
2. Cost $M/lane km	$ 7.27	53.64	lane km (includes 8 km of overtaking lanes)	
3. Structures Cost/m2	$ 2,445	17,355	m2 - road bridges	
4. Tunnels Cost/m	$ 135,000	1,315	m	
4. Earthworks $/m3	$ 16.28	2,508,789	m3 (all inclusive rate)	
5. Pavements $/m2	$ 110.10	260,850	Highway Pavement only	

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 2 and Inner North 1 - Route D-1T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	2.38%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.30%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.03%	
Sub total	5,687,500	40%	2,275,000	7,962,500	2.7%	
2. Investigation and Design						
2.1 Investigation and Design	6,600,000	40%	2,640,000	9,240,000	3.15%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	825,000	40%	330,000	1,155,000	0.39%	
2.3 Client Representation	82,500	40%	33,000	115,500	0.04%	
Sub total	7,507,500	40%	3,003,000	10,510,500	3.6%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	880,000	40%	352,000	1,232,000	0.42%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	13,200,000	40%	5,280,000	18,480,000	6.30%	
3.3 Project Management Services	660,000	40%	264,000	924,000	0.31%	
3.4 Client Representation	66,000	40%	26,400	92,400	0.03%	
Sub total	14,806,000	40%	5,922,400	20,728,400	7.1%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	3.07%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.15%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.02%	
Sub total	6,330,000	50%	3,165,000	9,495,000	3.2%	
5. Construction						
5.1 Infrastructure - Environmental Works	7,200,000	35%	2,520,000	9,720,000	3.31%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	5,600,000	35%	1,960,000	7,560,000	2.58%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	32,817,944	35%	11,486,280	44,304,224	15.09%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	9,845,383	35%	3,445,884	13,291,267	4.53%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,447,430	25%	5,611,858	28,059,288	9.56%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	28,578,000	35%	10,003,000	38,581,000	13.14%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	56,000,000	35%	19,600,000	75,600,000	25.75%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	2.64%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.92%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.38%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	8,000,000	40%	3,200,000	11,200,000	3.82%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.57%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.05%	Refer to Subsidiary Sheet for details
Sub total	182,538,757	34%	62,110,022	244,648,780	83.3%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.05%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	217,024,757	35%	76,529,672	293,554,430	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,144,750	1.75%
Site Management	$ 11,200,000	3.82%
Client Representation	$ 435,400	0.15%

Reality Checks (including contingency)				
1. Cost $M/ km	$ 26.59	11.04 km 4 lanes	
2. Cost $M/lane km	$ 5.63	52.16	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$ 2,478	15,570	m2 - road bridges
4. Tunnels Cost/m	$ 135,000	560	m
4. Earthworks $/m3	$ 20.47	2,164,719	m3 (all inclusive rate)
5. Pavements $/m2	$ 110.05	254,971	Highway Pavement only

Strategic Estimate - Summary Sheet

Project: Coffs Harbour Bypass - Inner Route South 2 and Inner North 1 - Route D-2T **Prepared by:** Connell Wagner
Project No: 65556 **Date:** 17-Feb-04 **Estimate Type:** Strategic

Item	Estimate ($) (excluding contingency)	Contingency %	Contingency Amount ($)	Estimate ($) (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						**This estimate excludes GST.**
1.1 Route / Concept / EIS / Reps Report	5,000,000	40%	2,000,000	7,000,000	1.99%	Refer to Subsidiary Sheet for details
1.2 Project Management Services	625,000	40%	250,000	875,000	0.25%	
1.3 Client Representation	62,500	40%	25,000	87,500	0.02%	
Sub total	5,687,500	40%	2,275,000	7,962,500	2.3%	
2. Investigation and Design						
2.1 Investigation and Design	7,800,000	40%	3,120,000	10,920,000	3.10%	Refer to Subsidiary Sheet for details
2.2 Project Management Services	975,000	40%	390,000	1,365,000	0.39%	
2.3 Client Representation	97,500	40%	39,000	136,500	0.04%	
Sub total	8,872,500	40%	3,549,000	12,421,500	3.5%	
3. Property Acquisitions						
3.1 Professional Services for Acquisitions	640,000	40%	256,000	896,000	0.25%	Refer to Subsidiary Sheet for details
3.2 Property Acquisition Costs	9,600,000	40%	3,840,000	13,440,000	3.82%	
3.3 Project Management Services	480,000	40%	192,000	672,000	0.19%	
3.4 Client Representation	48,000	40%	19,200	67,200	0.02%	
Sub total	10,768,000	40%	4,307,200	15,075,200	4.3%	
4. Public Utility Adjustments						
4.1 Adjust Utility Services	6,000,000	50%	3,000,000	9,000,000	2.56%	Refer to Subsidiary Sheet for details
4.2 Project Management Services	300,000	50%	150,000	450,000	0.13%	
4.3 Client Representation	30,000	50%	15,000	45,000	0.01%	
Sub total	6,330,000	50%	3,165,000	9,495,000	2.7%	
5. Construction						
5.1 Infrastructure - Environmental Works	6,900,000	35%	2,415,000	9,315,000	2.65%	Refer to Subsidiary Sheet for details
5.2 Infrastructure - Noise Mitigation	4,800,000	35%	1,680,000	6,480,000	1.84%	Refer to Subsidiary Sheet for details
5.3 Infrastructure - Earthworks	37,778,752	35%	13,222,563	51,001,315	14.49%	Refer to Subsidiary Sheet for details
5.4 Infrastructure - Drainage	11,333,625	35%	3,966,769	15,300,394	4.35%	Refer to Subsidiary Sheet for details
5.5 Infrastructure - Pavement	22,447,430	25%	5,611,858	28,059,288	7.97%	Refer to Subsidiary Sheet for details
5.6 Infrastructure - Bridges	28,578,000	35%	10,003,000	38,581,000	10.96%	Refer to Subsidiary Sheet for details
5.6a Infrastructure - Tunnels	95,000,000	35%	33,250,000	128,250,000	36.44%	Refer to Subsidiary Sheet for details
5.7 Infrastructure - Interchanges & Local Roads	5,750,000	35%	2,013,000	7,763,000	2.21%	Refer to Subsidiary Sheet for details
5.8 Infrastructure - Miscellaneous	2,000,000	35%	700,000	2,700,000	0.77%	Refer to Subsidiary Sheet for details
5.9 Infrastructure - General Activities	3,000,000	35%	1,050,000	4,050,000	1.15%	Refer to Subsidiary Sheet for details
5.10 Infrastructure - Site Management	9,600,000	40%	3,840,000	13,440,000	3.82%	Refer to Subsidiary Sheet for details
5.10 Project Management Services	1,200,000	40%	480,000	1,680,000	0.48%	Refer to Subsidiary Sheet for details
5.11 Client Representation	100,000	40%	40,000	140,000	0.04%	Refer to Subsidiary Sheet for details
Sub total	228,487,808	34%	78,272,190	306,759,997	87.2%	
6. Handover						
6.1 Project Data and Performance	100,000	35%	35,000	135,000	0.04%	Refer to Subsidiary Sheet for details
6.2 Project Management Services	45,000	35%	15,750	60,750	0.02%	Refer to Subsidiary Sheet for details
6.3 Client Representation	10,000	35%	3,500	13,500	0.00%	Refer to Subsidiary Sheet for details
Sub total	155,000	35%	54,250	209,250	0.1%	
TOTAL CONCEPT ESTIMATE	260,300,808	35%	91,622,640	351,923,447	100%	

	Total Amount	% of Total Estimate
Project Management	$ 5,102,750	1.45%
Site Management	$ 13,440,000	3.82%
Client Representation	$ 431,200	0.12%

Reality Checks (including contingency)

1. Cost $M/ km	$	31.88	11.04	km
			4	lanes
2. Cost $M/lane km	$	6.75	52.16	lane km (includes 8 km of overtaking lanes)
3. Structures Cost/m2	$	2,478	15,570	m2 - road bridges
4. Tunnels Cost/m	$	135,000	950	m
5. Earthworks $/m3	$	43.07	1,184,117	m3 (all inclusive rate)
6. Pavements $/m2	$	110.05	254,971	Highway Pavement only

Project: Coffs Harbour Bypass
Project No: 65556

Prepared by: Connell Wagner
Date: 17-Feb-04

Route Option / Combination

Item	Unit	IS1 & IN2 (A-0T)	IS1 & IN2 (A-2T) 2 Tunnels	IS1 & IN1 (B-0T)	IS1 & IN1 (B-1T) 1 Tunnel	IS2 &IN2 (C-1T) 1 Tunnel	IS2 & IN2 (C3T) (C-3T) 3 Tunnels	IS2 & IN1 (D-1T) 1 Tunnel	IS2 & IN1 (D2T) (D-2T) 2 Tunnels	Allocated Rate $
1. Project Development										
1.1 Route / Concept / EIS / Reps Report	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5,000,000
1.2 Project Management Services	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	625,000
1.3 Client Representation	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	62,500
Sub Total 1										
2. Investigation and Design										
2.1 Detail Design and Documentation	item	1.0	1.2	1.0	1.1	1.1	1.4	1.1	1.3	6,000,000
2.2 Project Management Services	item	1.0	1.2	1.0	1.1	1.1	1.4	1.1	1.3	750,000
2.3 Client Representation	item	1.0	1.2	1.0	1.1	1.1	1.4	1.1	1.3	75,000
Sub Total 2										
3. Property Acquisitions										
3.1 Professional Services for Acquisitions	item	1.2	0.9	1.2	1.0	0.9	0.75	1.1	0.8	800,000
3.2 Property Acquisition Costs	item	1.2	0.9	1.2	1.0	0.9	0.75	1.1	0.8	12,000,000
3.3 Project Management Services	item	1.2	0.9	1.2	1.0	0.9	0.75	1.1	0.8	600,000
3.4 Client Representation	item	1.2	0.9	1.2	1.0	0.9	0.75	1.1	0.8	60,000
Sub Total 3										
4. Public Utility Adjustments										
4.1 Adjust Utility Services	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6,000,000
4.2 Project Management Services	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	300,000
4.3 Client Representation	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	30,000
Sub Total 4										
5. Construction										
5.1 Infrastructure - Environmental Works										
Erosion and Sediment Control	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2,500,000
Compensatory Habitat	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2,000,000
Landscaping / Revegetation	item	1.0	0.8	1.0	0.9	0.9	0.7	0.9	0.8	3,000,000
Environmental Works Sub total										
5.2 Infrastructure - Noise Mitigation										
Noise Attenuation	item	1.2	1.0	1.5	1.0	0.9	0.8	1.4	1.2	4,000,000
Noise Mitigation Sub total										
5.3 Infrastructure - Earthworks										
Clearing	ha	57	54	64	63	61	59	58	56	15,000
Remove & Stockpile Topsoil	m^3	85,224	81,714	96,354	94,540	91,349	87,838	86,447	84,633	5
Cut to Fill	m^3	2,541,552	2,007,530	2,709,964	2,418,833	2,237,221	1,812,432	2,208,862	2,208,137	9
Extra Over for Rock Excavation	m^3	1,288,673	843,147	889,077	580,147	1,353,242	990,148	852,865	460,625	6
Material to Spoil or Mounds	m^3	713,530	244,186	254,496	177,263	1,179,302	696,357	245,772	147,712	6
Borrow/Imported Fill	m^3	-	110,448	709,540	1,113,502	-	-	289,916	1,171,731	9
Select Fill (300mm thick)	m^3	78,076	78,076	75,335	75,335	78,120	78,120	76,104	76,104	30
Geotextile	m^2	10,410	10,410	10,045	10,045	10,416	10,416	10,147	10,147	5
Rock Drainage Layer	m^3	3,123	3,123	3,013	3,013	3,125	3,125	3,044	3,044	35
Earthworks Sub total										
5.4 Infrastructure - Drainage										
Longitudinal Drainage	m	8,000	9,500	8,000	9,000	9,000	10,000	9,000	9,500	500
Transverse Drainage	m	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	1,500
Drainage Sub total										
5.5 Infrastructure - Pavement										
Main Carriageway Pavement	m^2	227,723	227,723	219,727	219,727	227,850	227,850	221,971	221,971	90
Coramba Road Interchange Pavement	m^2	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	90
Local Road Pavements	m^2	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	70
Pavement Sub total		260,723	260,723	252,727	252,727	260,850	260,850	254,971	254,971	86.10
5.6 Infrastructure - Structures										
Simple Bridges	m^2	13,240	13,240	10,615	10,615	8,190	8,190	6,405	6,405	1,600
Medium Bridges	m^2	8,605	8,605	8,605	8,605	9,165	9,165	9,165	9,165	2,000
Difficult Bridges	m^2	-	-	-	-	-	-	-	-	2,400
Bored Tunnel	m	-	755	-	390	560	1,315	560	950	100,000
Structures Sub total		21,845	22,600	19,220	19,610	17,915	18,670	16,130	16,520	
5.7 Infrastructure - Interchanges and Local Road Adjustments										
Half Interchange at Southern Connection	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,250,000
Full Interchange at Coramba Road (Less Pavement & Bridges)	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2,500,000
Half Interchange at Northern Connection	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,000,000
Local Road Adjustments	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,000,000
Local Roads Sub total										
5.8 Infrastructure - Miscellaneous										
Fencing / Signs / Furniture / Delineation	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2,000,000
Miscellaneous Sub total										
5.9 Infrastructure - General Activities										
Fauna Crossings/Protection Measures	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,000,000
Property Adjustments	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	500,000
Control of Traffic	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,500,000
General Activities Sub total										
5.10 Infrastructure - Site Management	item	1.0	1.2	1.0	1.2	1.0	1.2	1.0	1.2	8,000,000
5.11 Project Management Services	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1,200,000
5.12 Client Representation	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	100,000
Sub Total 5										
6. Project Handover										
6.2 Project Data and Performance	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	100,000
6.3 Project Management Services	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	45,000
6.4 Client Representation	item	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10,000
Sub Total 6										
TOTAL										

Base Amount (Excluding contingency)

Item	IS1 & IN2 (A-0T)	IS1 & IN2 (A-2T) 2 Tunnels	IS1 & IN1 (B-0T)	IS1 & IN1 (B-1T) 1 Tunnel	IS2 &IN2 (C-1T) 1 Tunnel	IS2 & IN2 (C3T) (C-3T) 3 Tunnels	IS2 & IN1 (D-1T) 1 Tunnel	IS2 & IN1 (D2T) (D-2T) 2 Tunnels	Contingency Allocation %
1. Project Development									
1.1 Route / Concept / EIS / Reps Report	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	40%
1.2 Project Management Services	625,000	625,000	625,000	625,000	625,000	625,000	625,000	625,000	40%
1.3 Client Representation	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	40%
Sub Total 1	5,687,500	5,687,500	5,687,500	5,687,500	5,687,500	5,687,500	5,687,500	5,687,500	
2. Investigation and Design									
2.1 Detail Design and Documentation	6,000,000	7,200,000	6,000,000	6,600,000	6,600,000	8,400,000	6,600,000	7,800,000	40%
2.2 Project Management Services	750,000	900,000	750,000	825,000	825,000	1,050,000	825,000	975,000	40%
2.3 Client Representation	75,000	90,000	75,000	82,500	82,500	105,000	82,500	97,500	40%
Sub Total 2	6,825,000	8,190,000	6,825,000	7,507,500	7,507,500	9,555,000	7,507,500	8,872,500	
3. Property Acquisitions									
3.1 Professional Services for Acquisitions	960,000	720,000	960,000	800,000	720,000	600,000	880,000	640,000	40%
3.2 Property Acquisition Costs	14,400,000	10,800,000	14,400,000	12,000,000	10,800,000	9,000,000	13,200,000	9,600,000	40%
3.3 Project Management Services	720,000	540,000	720,000	600,000	540,000	450,000	660,000	480,000	40%
3.4 Client Representation	72,000	54,000	72,000	60,000	54,000	45,000	66,000	48,000	40%
Sub Total 3	16,152,000	12,114,000	16,152,000	13,460,000	12,114,000	10,095,000	14,806,000	10,768,000	
4. Public Utility Adjustments									
4.1 Adjust Utility Services	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	50%
4.2 Project Management Services	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	50%
4.3 Client Representation	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	50%
Sub Total 4	6,330,000	6,330,000	6,330,000	6,330,000	6,330,000	6,330,000	6,330,000	6,330,000	
5. Construction									
5.1 Infrastructure - Environmental Works									
Erosion and Sediment Control	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	35%
Compensatory Habitat	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	35%
Landscaping / Revegetation	3,000,000	2,400,000	3,000,000	2,700,000	2,700,000	2,100,000	2,700,000	2,400,000	35%
Environmental Works Sub total	7,500,000	6,900,000	7,500,000	7,200,000	7,200,000	6,600,000	7,200,000	6,900,000	
5.2 Infrastructure - Noise Mitigation									
Noise Attenuation	4,800,000	4,000,000	6,000,000	4,000,000	3,600,000	3,200,000	5,600,000	4,800,000	35%
Noise Mitigation Sub total	4,800,000	4,000,000	6,000,000	4,000,000	3,600,000	3,200,000	5,600,000	4,800,000	
5.3 Infrastructure - Earthworks									
Clearing	852,243	817,136	963,539	945,404	913,485	878,378	864,468	846,333	35%
Remove & Stockpile Topsoil	426,122	408,568	481,769	472,702	456,743	439,189	432,234	423,167	35%
Cut to Fill	22,873,971	18,067,769	24,389,675	21,769,494	20,134,987	16,311,887	19,879,760	19,873,232	35%
Extra Over for Rock Excavation	7,732,039	5,058,884	5,334,465	3,480,883	8,119,451	5,940,890	5,117,191	2,763,748	35%
Material to Spoil or Mounds	4,281,179	1,465,117	1,526,976	1,063,581	7,075,811	4,178,143	1,474,633	886,272	35%
Borrow/Imported Fill	-	994,036	6,385,857	10,021,515	-	-	2,609,240	10,545,583	35%
Select Fill (300mm thick)	2,342,291	2,342,291	2,260,051	2,260,051	2,343,600	2,343,600	2,283,135	2,283,135	35%
Geotextile	52,051	52,051	50,223	50,223	52,080	52,080	50,736	50,736	35%
Rock Drainage Layer	109,307	109,307	105,469	105,469	109,368	109,368	106,546	106,546	35%
Earthworks Sub total	38,669,202	29,315,158	41,498,024	40,169,321	39,205,525	30,253,534	32,817,944	37,778,752	35%
5.4 Infrastructure - Drainage									
Longitudinal Drainage	9,667,301	7,328,789	10,374,506	10,042,330	9,801,381	7,563,383	8,204,486	9,444,688	35%
Transverse Drainage	1,933,460	1,465,758	2,074,901	2,008,466	1,960,276	1,512,677	1,640,897	1,888,938	35%
Drainage Sub total	11,600,761	8,794,547	12,449,407	12,050,796	11,761,658	9,076,060	9,845,383	11,333,625	
5.5 Infrastructure - Pavement									
Main Carriageway Pavement	20,495,045	20,495,045	19,775,448	19,775,448	20,506,500	20,506,500	19,977,430	19,977,430	25%
Coramba Road Interchange Pavement	720,000	720,000	720,000	720,000	720,000	720,000	720,000	720,000	25%
Local Road Pavements	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	1,750,000	25%
Pavement Sub total	22,965,045	22,965,045	22,245,448	22,245,448	22,976,500	22,976,500	22,447,430	22,447,430	
5.6 Infrastructure - Structures									
Simple Bridges	21,184,000	21,184,000	16,984,000	16,984,000	13,104,000	13,104,000	10,248,000	10,248,000	35%
Medium Bridges	17,210,000	17,210,000	17,210,000	17,210,000	18,330,000	18,330,000	18,330,000	18,330,000	35%
Difficult Bridges	-	-	-	-	-	-	-	-	35%
Bored Tunnel	-	75,500,000	-	39,000,000	56,000,000	131,500,000	56,000,000	95,000,000	35%
Structures Sub total	38,394,000	113,894,000	34,194,000	73,194,000	87,434,000	162,934,000	84,578,000	123,578,000	
5.7 Infrastructure - Interchanges and Local Road Adjustments									
Half Interchange at Southern Connection	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000	35%
Full Interchange at Coramba Road (Less Pavement & Bridges)	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	35%
Half Interchange at Northern Connection	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	35%
Local Road Adjustments	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	35%
Local Roads Sub total	5,750,000	5,750,000	5,750,000	5,750,000	5,750,000	5,750,000	5,750,000	5,750,000	
5.8 Infrastructure - Miscellaneous									
Fencing / Signs / Furniture / Delineation	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	35%
Miscellaneous Sub total	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	
5.9 Infrastructure - General Activities									
Fauna Crossings/Protection Measures	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	35%
Property Adjustments	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	35%
Control of Traffic	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	35%
General Activities Sub total	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	
5.10 Infrastructure - Site Management	8,000,000	9,600,000	8,000,000	9,600,000	8,000,000	9,600,000	8,000,000	9,600,000	40%
5.11 Project Management Services	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	40%
5.12 Client Representation	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	40%
Sub Total 5	143,979,008	207,518,750	143,936,880	180,509,566	192,227,683	256,690,094	182,538,757	228,487,808	
6. Project Handover									
6.2 Project Data and Performance	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	35%
6.3 Project Management Services	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	35%
6.4 Client Representation	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	35%
Sub Total 6	155,000	155,000	155,000	155,000	155,000	155,000	155,000	155,000	
TOTAL	$ 179,128,508	$ 239,995,250	$ 179,086,380	$ 213,649,566	$ 224,021,683	$ 288,512,594	$ 217,024,757	$ 260,300,808	

Total Estimate (Including contingencies)

Item	IS1 & IN2 (A-0T)	IS1 & IN2 (A-2T) 2 Tunnels	IS1 & IN1 (B-0T)	IS1 & IN1 (B-1T) 1 Tunnel	IS2 &IN2 (C-1T) 1 Tunnel	IS2 & IN2 (C3T) (C-3T) 3 Tunnels	IS2 & IN1 (D-1T) 1 Tunnel	IS2 & IN1 (D2T) (D-2T) 2 Tunnels	Comments and Assumptions
1. Project Development									
1.1 Route / Concept / EIS / Reps Report	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	
1.2 Project Management Services	875,000	875,000	875,000	875,000	875,000	875,000	875,000	875,000	
1.3 Client Representation	87,500	87,500	87,500	87,500	87,500	87,500	87,500	87,500	
Sub Total 1	7,962,500	7,962,500	7,962,500	7,962,500	7,962,500	7,962,500	7,962,500	7,962,500	
2. Investigation and Design									
2.1 Detail Design and Documentation	8,400,000	10,080,000	8,400,000	9,240,000	9,240,000	11,760,000	9,240,000	10,920,000	
2.2 Project Management Services	1,050,000	1,260,000	1,050,000	1,155,000	1,155,000	1,470,000	1,155,000	1,365,000	
2.3 Client Representation	105,000	126,000	105,000	115,500	115,500	147,000	115,500	136,500	
Sub Total 2	9,555,000	11,466,000	9,555,000	10,510,500	10,510,500	13,377,000	10,510,500	12,421,500	
3. Property Acquisitions									
3.1 Professional Services for Acquisitions	1,344,000	1,008,000	1,344,000	1,120,000	1,008,000	840,000	1,232,000	896,000	
3.2 Property Acquisition Costs	20,160,000	15,120,000	20,160,000	16,800,000	15,120,000	12,600,000	18,480,000	13,440,000	
3.3 Project Management Services	1,008,000	756,000	1,008,000	840,000	756,000	630,000	924,000	672,000	
3.4 Client Representation	100,800	75,600	100,800	84,000	75,600	63,000	92,400	67,200	
Sub Total 3	22,612,800	16,959,600	22,612,800	18,844,000	16,959,600	14,133,000	20,728,400	15,075,200	
4. Public Utility Adjustments									
4.1 Adjust Utility Services	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	
4.2 Project Management Services	450,000	450,000	450,000	450,000	450,000	450,000	450,000	450,000	
4.3 Client Representation	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	
Sub Total 4	9,495,000	9,495,000	9,495,000	9,495,000	9,495,000	9,495,000	9,495,000	9,495,000	
5. Construction									
5.1 Infrastructure - Environmental Works									
Erosion and Sediment Control	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	
Compensatory Habitat	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	
Landscaping / Revegetation	4,050,000	3,240,000	4,050,000	3,645,000	3,645,000	2,835,000	3,645,000	3,240,000	
Environmental Works Sub total	10,125,000	9,315,000	10,125,000	9,720,000	9,720,000	8,910,000	9,720,000	9,315,000	
5.2 Infrastructure - Noise Mitigation									
Noise Attenuation	6,480,000	5,400,000	8,100,000	5,400,000	4,860,000	4,320,000	7,560,000	6,480,000	
Noise Mitigation Sub total	6,480,000	5,400,000	8,100,000	5,400,000	4,860,000	4,320,000	7,560,000	6,480,000	
5.3 Infrastructure - Earthworks									
Clearing	1,150,528	1,103,133	1,300,777	1,276,295	1,233,205	1,185,810	1,167,032	1,142,550	
Remove & Stockpile Topsoil	575,264	551,567	650,389	638,148	616,602	592,905	583,516	571,275	
Cut to Fill	30,879,860	24,391,488	32,926,061	29,388,817	27,182,233	22,021,047	26,837,676	26,828,863	
Extra Over for Rock Excavation	10,438,252	6,829,493	7,201,527	4,699,192	10,961,259	8,020,202	6,908,208	3,731,059	
Material to Spoil or Mounds	5,779,592	1,977,908	2,061,418	1,435,834	9,552,345	5,640,493	1,990,754	1,196,467	
Borrow/Imported Fill	-	1,341,948	8,620,906	13,529,045	-	-	3,522,474	14,236,537	
Select Fill (300mm thick)	3,162,093	3,162,093	3,051,069	3,051,069	3,163,860	3,163,860	3,082,232	3,082,232	
Geotextile	70,269	70,269	67,802	67,802	70,308	70,308	68,494	68,494	
Rock Drainage Layer	147,564	147,564	142,383	142,383	147,647	147,647	143,837	143,837	
Earthworks Sub total	52,203,423	39,575,463	56,022,333	54,228,584	52,927,459	40,842,271	44,304,224	51,001,315	Refer to Note 4.
5.4 Infrastructure - Drainage									Generally undulating rural landscape
Longitudinal Drainage	13,050,856	9,893,866	14,005,583	13,557,146	13,231,865	10,210,568	11,076,056	12,750,329	
Transverse Drainage	2,610,171	1,978,773	2,801,117	2,711,429	2,646,373	2,042,114	2,215,211	2,550,066	
Drainage Sub total	15,661,027	11,872,639	16,806,700	16,268,575	15,878,238	12,252,681	13,291,267	15,300,394	
5.5 Infrastructure - Pavement									Refer to Note 5.
Main Carriageway Pavement	25,618,806	25,618,806	24,719,310	24,719,310	25,633,125	25,633,125	24,971,788	24,971,788	Dual carriageways of 10.5m width assumed
Coramba Road Interchange Pavement	900,000	900,000	900,000	900,000	900,000	900,000	900,000	900,000	
Local Road Pavements	2,187,500	2,187,500	2,187,500	2,187,500	2,187,500	2,187,500	2,187,500	2,187,500	Assumes 10 major intersections at 2500m2
Pavement Sub total	28,706,306	28,706,306	27,806,810	27,806,810	28,720,625	28,720,625	28,059,288	28,059,288	
5.6 Infrastructure - Structures									Refer to Supplementary Sheet for details
Simple Bridges	28,598,000	28,598,000	22,928,000	22,928,000	17,690,000	17,690,000	13,835,000	13,835,000	
Medium Bridges	23,234,000	23,234,000	23,234,000	23,234,000	24,746,000	24,746,000	24,746,000	24,746,000	
Difficult Bridges	-	-	-	-	-	-	-	-	
Bored Tunnel	-	101,925,000	-	52,650,000	75,600,000	177,525,000	75,600,000	128,250,000	
Structures Sub total	51,832,000	153,757,000	46,162,000	98,812,000	118,036,000	219,961,000	114,181,000	166,831,000	
5.7 Infrastructure - Interchanges and Local Road Adjustments									
Half Interchange at Southern Connection	1,688,000	1,688,000	1,688,000	1,688,000	1,688,000	1,688,000	1,688,000	1,688,000	
Full Interchange at Coramba Road (Less Pavement & Bridges)	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	3,375,000	
Half Interchange at Northern Connection	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	
Local Road Adjustments	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	Assumes 2km at 10m average width and a bitumen surfaced flexible pavement.
Local Roads Sub total	7,763,000	7,763,000	7,763,000	7,763,000	7,763,000	7,763,000	7,763,000	7,763,000	
5.8 Infrastructure - Miscellaneous									
Fencing / Signs / Furniture / Delineation	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	Includes allowance for streetlighting at interchange and major intersections.
Miscellaneous Sub total	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	
5.9 Infrastructure - General Activities									
Fauna Crossings/Protection Measures	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000	
Property Adjustments	675,000	675,000	675,000	675,000	675,000	675,000	675,000	675,000	
Control of Traffic	2,025,000	2,025,000	2,025,000	2,025,000	2,025,000	2,025,000	2,025,000	2,025,000	
General Activities Sub total	4,050,000	4,050,000	4,050,000	4,050,000	4,050,000	4,050,000	4,050,000	4,050,000	
5.10 Infrastructure - Site Management	11,200,000	13,440,000	11,200,000	13,440,000	11,200,000	13,440,000	11,200,000	13,440,000	
5.11 Project Management Services	1,680,000	1,680,000	1,680,000	1,680,000	1,680,000	1,680,000	1,680,000	1,680,000	
5.12 Client Representation	140,000	140,000	140,000	140,000	140,000	140,000	140,000	140,000	
Sub Total 5	192,540,756	278,399,408	192,555,843	242,008,969	257,675,322	344,779,577	244,648,780	306,759,997	
6. Project Handover									Refer to Note 6.
6.2 Project Data and Performance	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	
6.3 Project Management Services	60,750	60,750	60,750	60,750	60,750	60,750	60,750	60,750	
6.4 Client Representation	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	
Sub Total 6	209,250	209,250	209,250	209,250	209,250	209,250	209,250	209,250	
TOTAL	$ 242,375,306	$ 324,491,758	$ 242,390,393	$ 289,030,219	$ 302,812,172	$ 389,956,327	$ 293,554,430	$ 351,923,447	

Notes:

ROADS AND TRAFFIC AUTHORITY

Supplementary Sheet - Earthworks Details

Project: Coffs Harbour Bypass
Project No: 64800
Prepared by: Connell Wagner
Date: 17-Feb-04

Earthworks Item	IS1 & IN2 (A-0T)	IS1 & IN2 (A-2T) 2 Tunnels	IS1 & IN1 (B-0T)	IS1 & IN1 (B-1T) 1 Tunnel	IS2 &IN2 (C-1T) 1 Tunnel	IS2 & IN2 (C3T) (C-3T) 3 Tunnels	IS2 & IN1 (D-1T) 1 Tunnel	IS2 & IN1 (D2T) (D-2T) 2 Tunnels
Clearing (Ha)	56.8	54.5	64.2	63.0	60.9	58.6	57.6	56.4
Topsoil Volume	85,224	81,714	96,354	94,540	91,349	87,838	86,447	84,633
Length of Tunnels	0	755	0	390	560	1,315	560	950
Volume of Tunnels	0	172,140	0	88,920	127,680	299,820	127,680	216,600
Cut Volumes (Bank m3) predicted by Moss (doesn't include tunnels)	3,184,983	1,897,624	2,192,931	1,330,960	3,221,135	2,139,857	1,970,060	899,813
Cut Volumes (Bank m3) predicted by Moss + tunnel volume	3,184,983	2,069,764	2,192,931	1,419,880	3,348,815	2,439,677	2,097,740	1,116,413
Total Length of Pavement (km)	11.57	11.57	11.11	11.11	11.41	11.41	11.04	11.04
Total Length of Bridges (km)	0.73	0.73	0.65	0.65	0.56	0.56	0.47	0.47
Length of Pavement (km) - excluding bridges	10.84	10.84	10.46	10.46	10.85	10.85	10.57	10.57
Volume of Pavement in Cuttings (cu.m)	36,436	36,436	35,156	35,156	36,456	36,456	35,515	35,515
Volume of Select Fill in Cuttings (cu.m.)	31,231	31,231	30,134	30,134	31,248	31,248	30,442	30,442
Rock Drainage Layer (cu.m.)	3,123	3,123	3,013	3,013	3,125	3,125	3,044	3,044
Adjusted Cut Volume (cu.m.)	3,221,683	2,107,868	2,222,694	1,450,368	3,383,105	2,475,371	2,132,163	1,151,562
Extra / Over Quantity for Rock Excavation (cu.m.)	1,288,673	843,147	889,077	580,147	1,353,242	990,148	852,865	460,625
Unsuitable Material in Cuttings (cu.m.)	322,168	210,787	222,269	145,037	338,310	247,537	213,216	115,156
Unsuitable Material below Cutting Floor (cu.m.)	13,880	13,880	13,393	13,393	13,888	13,888	13,530	13,530
Unsuitable Material beneath Embankment Foundations (cu.m.)	19,519	19,519	18,834	18,834	19,530	19,530	19,026	19,026
Total Volume Excavated (cu.m.)	3,255,082	2,141,268	2,254,920	1,482,594	3,416,523	2,508,789	2,164,719	1,184,117
Excavated Volume of Available Cut to Fill (cu.m.)	2,899,515	1,897,081	2,000,424	1,305,331	3,044,794	2,227,834	1,918,947	1,036,405
Fill Volumes (cu.m.) predicted by Moss	2,497,486	1,964,868	2,661,796	2,371,390	2,190,699	1,767,315	2,164,559	2,164,559
Volume of Pavement in Embankments (cu.m.)	54,653	54,653	52,735	52,735	54,684	54,684	53,273	53,273
Volume of Select Fill in Embankments (cu.m.)	46,846	46,846	45,201	45,201	46,872	46,872	45,663	45,663
Total compacted volume of select fill won from site (cu.m.)	78,076	78,076	75,335	75,335	78,120	78,120	76,104	76,104
Fill Required to Replace Unsuitable below formation (cu.m.)	33,399	33,399	32,227	32,227	33,418	33,418	32,556	32,556
Adjusted Compacted Volume Fill (cu.m.)	2,541,552	2,007,530	2,709,964	2,418,833	2,237,221	1,812,432	2,208,862	2,208,137
Compacted Volume of Cut to Fill Surplus (Shortfall)	357,962	-110,448	-709,540	-1,113,502	807,573	415,402	-289,916	-1,171,731
Total Unsuitable Material (Bank m3)	355,568	244,186	254,496	177,263	371,728	280,955	245,772	147,712
Percentage of Cut that is Unsuitable	10.92%	11.40%	11.29%	11.96%	10.88%	11.20%	11.35%	12.47%
Imported/Borrow Materials (Bank m3) required	0	110,448	709,540	1,113,502	0	0	289,916	1,171,731
Excess Fill & Unsuitable Material to Spoil or mounds (Bank m3)	713,530	244,186	254,496	177,263	1,179,302	696,357	245,772	147,712
Assumed Data								
Earthworks Bulking Factor =	1	1	1	1	1	1	1	1
Percentage of Route in Cut =	40%	40%	40%	40%	40%	40%	40%	40%
Formation Width (metres) in Cut =	32	32	32	32	32	32	32	32
Formation Width (metres) in Fill =	30	30	30	30	30	30	30	30
Percentage of Rock in Cuttings =	40%	40%	40%	40%	40%	40%	40%	40%
Percentage of unsuitable material above the formation level =	10%	10%	10%	10%	10%	10%	10%	10%
Percentage of cuttings requiring 300mm thick drainage layers =	10%	10%	10%	10%	10%	10%	10%	10%
Thickness of Select Fill Layer (m) =	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Average width of select layer	24	24	24	24	24	24	24	24
Average Depth of Unsuitable Material below formation level (m) =	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Average Depth of Unsuitable Material under embankments (m) =	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Rigid Pavement Depth (metres) =	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Rigid Pavement Width (metres) =	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Depth of Topsoil	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

ROADS AND TRAFFIC AUTHORITY

Supplementary Sheet - Bridge Details

Project: Coffs Harbour Bypass
Project No: 64800

Prepared by: Connell Wagner
Date: 17-Feb-04

Bridge Location	Span / Dimensions	Length of bridge Highway (m)	Rating	Calculated Deck Areas			Total Deck Area (m^2)
				Simple	Medium	Difficult	
IS1 & IN2 (A)							
Englands Road	Twin 2x15m + 1x20m x 10.5m	50	S	1,050			
Newports Creek	Twin 8x30m x 10.5m	240	S	5,040			
North Boambee Road	Single 2x30m + 1x20m x 8m		S	640			
Newports Creek (Northern Branch)	Twin 30m x 10.5m	30	S	630			
Coffs Creek & Coramba Road	Twin 2x40m + 3x30m x 14m	170	M		4,760		
Coffs Creek (at Interchange)	Single 3x20m x 14m		S	840			
Shephards Lane	Single 2x20m + 1x40m x 8m		M		640		
North Coast Railway	Twin 7x30 x 10.5m	210	S	4,410			
Property Access # 1 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 2 (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
West Korora Road (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
Bruxner Park Road	Single 2x15m + 1x40m x 8m		M		560		
Pacific Highway Connection	Single 3x30m + 1x40m x 10.5m		M		1,365		
Total Deck Area		**730**		**13,240**	**8,605**	**0**	**21,845**

IS1 & IN1 (B)

Englands Road	Twin 2x15m + 1x20m x 10.5m	50	S	1,050			
Newports Creek	Twin 8x30m x 10.5m	240	S	5,040			
North Boambee Road	Single 2x30m + 1x20m x 8m		S	640			
Newports Creek (Northern Branch)	Twin 30m x 10.5m	30	S	630			
Coffs Creek & Coramba Road	Twin 2x40m + 3x30m x 14m	170	M		4,760		
Spagnolos Road	Twin 30m x 10.5m	30	S	630			
Shephards Lane	Single 2x20m + 1x40m x 8m		M		640		
North Coast Railway	Twin 35 x 10.5m	35	S	735			
MacKays Road	Twin 30m x 10.5m	30	S	630			
Property Access # 1 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 2 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 3 (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
West Korora Road (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
Bruxner Park Road	Single 2x15m + 1x40m x 8m		M		560		
Pacific Highway Connection	Single 3x30m + 1x40m x 10.5m		M		1,365		
Total Deck Area		**645**		**10,615**	**8,605**	**0**	**19,220**

IS2 & IN2 (C)

Englands Road	Twin 2x15m + 1x20m x 10.5m	50	S	1,050			
Newports Creek # 1	Twin 2x20m x 10.5m	40	S	840			
Newports Creek # 2	Twin 30m x 10.5m	30	S	630			
North Boambee Road	Single 2x15m + 1x40m x 8m		M		560		
Newports Creek (Northern Branch)	Twin 30m x 10.5m	30	S	630			
Coffs Creek & Coramba Road	Twin 2x40m + 3x30m x 14m	170	M		4,760		
Shephards Lane	Single 2x20m + 1x40m x 8m		M		640		
North Coast Railway	Twin 7x30 x 10.5m	210	S	4,410			
Property Access # 1 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 2 (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
West Korora Road (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
Bruxner Park Road	Single 2x15m + 1x40m x 8m		M		560		
Pacific Highway Connection	Single 3x30m + 1x40m x 10.5m		M		1,365		
Total Deck Area		**560**		**8,190**	**9,165**	**0**	**17,355**

IS2 & IN1 (D)

Englands Road	Twin 2x15m + 1x20m x 10.5m	50	S	1,050			
Newports Creek # 1	Twin 2x20m x 10.5m	40	S	840			
Newports Creek # 2	Twin 30m x 10.5m	30	S	630			
North Boambee Road	Single 2x15m + 1x40m x 8m		M		560		
Newports Creek (Northern Branch)	Twin 20m x 10.5m	20	S	630			
Coffs Creek & Coramba Road	Twin 2x40m + 3x30m x 14m	170	M		4,760		
Spagnolos Road	Twin 30m x 10.5m	30	S	630			

ROADS AND TRAFFIC AUTHORITY

Supplementary Sheet - Bridge Details

Project: Coffs Harbour Bypass **Project No:** 64800					**Prepared by:** **Date:**	Connell Wagner 17-Feb-04	
Shephards Lane	Single 2x20m + 1x40m x 8m		M		640		
North Coast Railway	Twin 35 x 10.5m	35	S	735			
MacKays Road	Twin 30m x 10.5m	30	S	630			
Property Access # 1 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 2 (Provisional)	Twin 30m x 10.5m	30	S	630			
Property Access # 3 (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
West Korora Road (Provisional)	Single 2x20m + 1x40m x 8m		M		640		
Bruxner Park Road	Single 2x15m + 1x40m x 8m		M		560		
Pacific Highway Connection	Single 3x30m + 1x40m x 10.5m		M		1,365		
Total Deck Area		**465**		**6,405**	**9,165**	**0**	**15,570**

Appendix B

Detailed Economic Analysis

DETAILED ECONOMIC ANALYSIS

PROJECT NAME: COFFS HARBOUR UPGRADE STRATEGY

PARAMETER VALUES

General	
Base Year (for discounting purpose)	2018
Modelling Period (years)	20
Annual Expansion Factor	350
Discount Rate	4%
Evaluation Period (years from opening)	30
Travel Cost Parameters	
VOC per Vehicle Km	$0.27
Value of Time per hour	$23.03
Accident Costs per MVKT	
Weighted Average Cost for a road network	$61,500

CAPITAL COST ($M)

Existing Highway Upgrade	Inner Option (B-0T)	Inner Option (C-3T)
$690	$280	$425

NETWORK MODEL DATA (Average Weekday)

	Base		Existing - Ultimate Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	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	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	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2	49.4	50.2

PRESENT VALUE OF CHANGE IN MAINTENANCE COSTS ($M)

Scenario	30 Year Period	20 Year Period	10 Year Period
Existing Highway Upgrade	2.52	1.99	1.22
Inner Option (B-0T)	2.45	1.93	1.19
Inner Option (C-3T)	2.52	1.99	1.22

RESULTS OF ECONOMIC ANALYSIS

Scenario	PVC ($M)	30 Year Period			20 Year Period			10 Year Period			FYRR
		PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	
Existing Highway Upgrade	$627	$790	$160.25	1.25	$549	-$80.05	0.87	$254	-$373.73	0.41	5.19%
Inner Option (B-0T)	$264	$380	$113.32	1.42	$273	$6.40	1.02	$144	-$121.12	0.54	5.62%
Inner Option (C-3T)	$392	$375	-$19.46	0.95	$269	-$124.23	0.68	$143	-$249.76	0.36	3.78%

TRAVEL AND ACCIDENT COSTS ($M)

	Base		Existing Highway Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	2001	2021	2001	2021	2001	2021
Vehicle Operating Costs	$0.467	$0.704	$0.465	$0.699	$0.467	$0.704	$0.467	$0.704
Travel Time Costs	$0.817	$1.246	$0.771	$1.142	$0.806	$1.197	$0.806	$1.197
Accident Costs	$0.106	$0.160	$0.106	$0.159	$0.106	$0.160	$0.106	$0.160
Daily Travel Costs	$1.390	$2.110	$1.342	$2.000	$1.379	$2.062	$1.379	$2.062
Annual Travel Costs	$487	$738	$470	$700	$483	$722	$483	$722

YEARLY CASH FLOWS ($M) - BENEFITS

Year	Base	Base Discounted	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2001	$487		$470		$483		$483	
2002	$499		$481		$494		$494	
2003	$512		$493		$506		$506	
2004	$524		$504		$518		$518	
2005	$537		$516		$530		$530	
2006	$550		$527		$542		$542	
2007	$562		$539		$554		$554	
2008	$575		$550		$566		$566	
2009	$587		$562		$578		$578	
2010	$600		$573		$590		$590	
2011	$613		$585		$602		$602	
2012	$625		$596		$614		$614	
2013	$638		$608		$626		$626	
2014	$650		$619		$638		$638	
2015	$663		$631		$650		$650	
2016	$675		$642		$662		$662	
2017	$688		$654		$674		$674	
2018	$701		$665		$686		$686	
2019	$713	$686	$707	$680	$698		$698	
2020	$726	$671	$713	$659	$710		$710	
2021	$738	$656	$718	$639	$722		$722	
2022	$751	$642	$724	$619	$734	$627	$734	
2023	$764	$628	$728	$599	$746	$613	$746	$613
2024	$776	$613	$733	$579	$758	$599	$758	$599
2025	$789	$599	$744	$566	$770	$585	$770	$585
2026	$801	$586	$756	$552	$781	$571	$781	$571
2027	$814	$572	$767	$539	$793	$557	$793	$557
2028	$827	$558	$779	$526	$805	$544	$805	$544
2029	$839	$545	$790	$513	$817	$531	$817	$531
2030	$852	$532	$802	$501	$829	$518	$829	$518
2031	$864	$519	$813	$488	$841	$505	$841	$505
2032	$877	$506	$825	$476	$853	$493	$853	$493
2033	$890	$494	$836	$464	$865	$480	$865	$480
2034	$902	$482	$847	$452	$877	$468	$877	$468
2035	$915	$470	$859	$441	$889	$456	$889	$456
2036	$927	$458	$870	$430	$901	$445	$901	$445
2037	$940	$446	$882	$419	$913	$433	$913	$433
2038	$952	$435	$893	$408	$925	$422	$925	$422
2039	$965	$423	$905	$397	$937	$411	$937	$411
2040	$978	$413	$916	$387	$949	$400	$949	$400
2041	$990	$402	$928	$376	$961	$390	$961	$390
2042	$1,003	$391	$939	$366	$973	$380	$973	$380
2043	$1,015	$381	$951	$357	$985	$369	$985	$369
2044	$1,028	$371	$962	$347	$997	$360	$997	$360
2045	$1,041	$361	$973	$338	$1,009	$350	$1,009	$350
2046	$1,053	$351	$985	$328	$1,021	$340	$1,021	$340
2047	$1,066	$342	$996	$319	$1,033	$331	$1,033	$331
2048	$1,078	$332	$1,008	$311	$1,045	$322	$1,045	$322
2049	$1,091	$323			$1,056	$313	$1,056	$313
2050	$1,104	$315			$1,068	$305	$1,068	$305
2051	$1,116	$306			$1,080	$296	$1,080	$296
2052	$1,129	$297					$1,092	$288
Discounted Costs								
10 Year Period	$5,659	$5,794	$6,212	$5,957		$5,650		$5,516
20 Year Period	$10,072	$10,322	$11,098	$10,549		$10,050		$9,802
30 Year Period	$13,451	$13,795	$14,865	$14,075		$13,415		$13,076
Present Value of Benefits								
10 Year Period				$254		$144		$143
20 Year Period				$549		$273		$269
30 Year Period				$790		$380		$375

YEARLY CASH FLOWS ($M) - CAPITAL COSTS

Year	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2018	$115.0	$115.0	$70.0	$70.0	$65.0	$65.0
2019	$115.0	$110.6	$70.0	$67.3	$90.0	$86.5
2020	$115.0	$106.3	$70.0	$64.7	$90.0	$83.2
2021	$115.0	$102.2	$70.0	$62.2	$90.0	$80.0
2022	$115.0	$98.3			$90.0	$76.9
2023	$115.0	$94.5				
Total	**$690**	**$627**	**$280**	**$264**	**$425**	**$392**

DETAILED ECONOMIC ANALYSIS

PROJECT NAME: COFFS HARBOUR UPGRADE STRATEGY

PARAMETER VALUES

General	
Base Year (for discounting purpose)	2018
Modelling Period (years)	20
Annual Expansion Factor	350
Discount Rate	7%
Evaluation Period (years from opening)	30
Travel Cost Parameters	
VOC per Vehicle Km	$0.27
Value of Time per hour	$23.03
Accident Costs per MVKT	
Weighted Average Cost for a road network	$61,500

CAPITAL COST ($M)

Existing Highway Upgrade	Inner Option (B-0T)	Inner Option (C-3T)
$690	$280	$425

NETWORK MODEL DATA (Average Weekday)

	Base		Existing - Ultimate Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	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	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	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2	49.4	50.2

PRESENT VALUE OF CHANGE IN MAINTENANCE COSTS ($M)

Scenario	30 Year Period	20 Year Period	10 Year Period
Existing Highway Upgrade	1.73	1.48	1.02
Inner Option (B-0T)	1.54	1.32	0.91
Inner Option (C-3T)	1.54	1.32	0.91

RESULTS OF ECONOMIC ANALYSIS

Scenario	PVC ($M)	30 Year Period			20 Year Period			10 Year Period			FYRR
		PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	
Existing Highway Upgrade	$587	$500	-$88.39	0.85	$387	-$200.64	0.66	$204	-$383.26	0.35	4.92%
Inner Option (B-0T)	$254	$238	-$16.85	0.93	$190	-$64.79	0.75	$114	-$140.69	0.45	5.23%
Inner Option (C-3T)	$370	$229	-$142.61	0.62	$183	-$188.27	0.49	$110	-$260.91	0.30	3.47%

TRAVEL AND ACCIDENT COSTS ($M)

	Base		Existing Highway Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	2001	2021	2001	2021	2001	2021
Vehicle Operating Costs	$0.467	$0.704	$0.465	$0.699	$0.467	$0.704	$0.467	$0.704
Travel Time Costs	$0.817	$1.246	$0.771	$1.142	$0.806	$1.197	$0.806	$1.197
Accident Costs	$0.106	$0.160	$0.106	$0.159	$0.106	$0.160	$0.106	$0.160
Daily Travel Costs	$1.390	$2.110	$1.342	$2.000	$1.379	$2.062	$1.379	$2.062
Annual Travel Costs	$487	$738	$470	$700	$483	$722	$483	$722

YEARLY CASH FLOWS ($M) - BENEFITS

Year	Base	Base Discounted	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2001	$487		$470		$483		$483	
2002	$499		$481		$494		$494	
2003	$512		$493		$506		$506	
2004	$524		$504		$518		$518	
2005	$537		$516		$530		$530	
2006	$550		$527		$542		$542	
2007	$562		$539		$554		$554	
2008	$575		$550		$566		$566	
2009	$587		$562		$578		$578	
2010	$600		$573		$590		$590	
2011	$613		$585		$602		$602	
2012	$625		$596		$614		$614	
2013	$638		$608		$626		$626	
2014	$650		$619		$638		$638	
2015	$663		$631		$650		$650	
2016	$675		$642		$662		$662	
2017	$688		$654		$674		$674	
2018	$701		$665		$686		$686	
2019	$713	$667	$707	$661	$698		$698	
2020	$726	$634	$713	$623	$710		$710	
2021	$738	$603	$719	$587	$722		$722	
2022	$751	$573	$725	$553	$734	$560	$734	
2023	$764	$544	$730	$520	$746	$532	$746	$532
2024	$776	$517	$734	$489	$758	$505	$758	$505
2025	$789	$491	$746	$465	$770	$479	$770	$479
2026	$801	$466	$758	$441	$781	$455	$781	$455
2027	$814	$443	$769	$418	$793	$432	$793	$432
2028	$827	$420	$781	$397	$805	$409	$805	$409
2029	$839	$399	$792	$376	$817	$388	$817	$388
2030	$852	$378	$804	$357	$829	$368	$829	$368
2031	$864	$359	$815	$338	$841	$349	$841	$349
2032	$877	$340	$827	$321	$853	$331	$853	$331
2033	$890	$322	$838	$304	$865	$314	$865	$314
2034	$902	$306	$850	$288	$877	$297	$877	$297
2035	$915	$290	$861	$273	$889	$281	$889	$281
2036	$927	$274	$873	$258	$901	$267	$901	$267
2037	$940	$260	$884	$245	$913	$252	$913	$252
2038	$952	$246	$896	$231	$925	$239	$925	$239
2039	$965	$233	$907	$219	$937	$226	$937	$226
2040	$978	$221	$919	$207	$949	$214	$949	$214
2041	$990	$209	$930	$196	$961	$203	$961	$203
2042	$1,003	$198	$942	$186	$973	$192	$973	$192
2043	$1,015	$187	$953	$176	$985	$181	$985	$181
2044	$1,028	$177	$965	$166	$997	$172	$997	$172
2045	$1,041	$167	$976	$157	$1,009	$162	$1,009	$162
2046	$1,053	$158	$988	$149	$1,021	$154	$1,021	$154
2047	$1,066	$150	$999	$140	$1,033	$145	$1,033	$145
2048	$1,078	$142	$1,011	$133	$1,045	$137	$1,045	$137
2049	$1,091	$134			$1,056	$130	$1,056	$130
2050	$1,104	$127			$1,068	$123	$1,068	$123
2051	$1,116	$120			$1,080	$116	$1,080	$116
2052	$1,129	$113					$1,092	$109
Discounted Costs								
10 Year Period	$4,358	$4,591	$5,359	$5,154		$4,477		$4,248
20 Year Period	$6,916	$7,291	$8,532	$8,145		$7,101		$6,733
30 Year Period	$8,391	$8,851	$10,374	$9,874		$8,612		$8,162
Present Value of Benefits								
10 Year Period				$204		$114		$110
20 Year Period				$387		$190		$183
30 Year Period				$500		$238		$229

YEARLY CASH FLOWS ($M) - CAPITAL COSTS

Year	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2018	$115.0	$115.0	$70.0	$70.0	$65.0	$65.0
2019	$115.0	$107.5	$70.0	$65.4	$90.0	$84.1
2020	$115.0	$100.4	$70.0	$61.1	$90.0	$78.6
2021	$115.0	$93.9	$70.0	$57.1	$90.0	$73.5
2022	$115.0	$87.7			$90.0	$68.7
2023	$115.0	$82.0				
Total	**$690**	**$587**	**$280**	**$254**	**$425**	**$370**

DETAILED ECONOMIC ANALYSIS

PROJECT NAME: COFFS HARBOUR UPGRADE STRATEGY

PARAMETER VALUES

General	
Base Year (for discounting purpose)	2018
Modelling Period (years)	20
Annual Expansion Factor	350
Discount Rate	10%
Evaluation Period (years from opening)	30
Travel Cost Parameters	
VOC per Vehicle Km	$0.27
Value of Time per hour	$23.03
Accident Costs per MVKT	
Weighted Average Cost for a road network	$61,500

CAPITAL COST ($M)

Existing Highway Upgrade	Inner Option (B-0T)	Inner Option (C-3T)
$690	$280	$425

NETWORK MODEL DATA (Average Weekday)

	Base		Existing - Ultimate Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	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	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	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2	49.4	50.2

PRESENT VALUE OF CHANGE IN MAINTENANCE COSTS ($M)

Scenario	30 Year Period	20 Year Period	10 Year Period
Existing Highway Upgrade	1.26	1.15	0.86
Inner Option (B-0T)	1.04	0.94	0.71
Inner Option (C-3T)	1.01	0.92	0.69

RESULTS OF ECONOMIC ANALYSIS

Scenario	PVC ($M)	30 Year Period			20 Year Period			10 Year Period			FYRR
		PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	
Existing Highway Upgrade	$551	$349	-$202.85	0.63	$293	-$259.13	0.53	$172	-$379.76	0.31	4.79%
Inner Option (B-0T)	$244	$160	-$85.46	0.65	$137	-$107.58	0.56	$91	-$153.70	0.37	4.86%
Inner Option (C-3T)	$350	$149	-$202.09	0.42	$129	-$222.58	0.37	$85	-$265.52	0.24	3.19%

TRAVEL AND ACCIDENT COSTS ($M)

	Base		Existing Highway Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	2001	2021	2001	2021	2001	2021
Vehicle Operating Costs	$0.467	$0.704	$0.465	$0.699	$0.467	$0.704	$0.467	$0.704
Travel Time Costs	$0.817	$1.246	$0.771	$1.142	$0.806	$1.197	$0.806	$1.197
Accident Costs	$0.106	$0.160	$0.106	$0.159	$0.106	$0.160	$0.106	$0.160
Daily Travel Costs	$1.390	$2.110	$1.342	$2.000	$1.379	$2.062	$1.379	$2.062
Annual Travel Costs	$487	$738	$470	$700	$483	$722	$483	$722

YEARLY CASH FLOWS ($M) - BENEFITS

Year	Base	Base Discounted	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2001	$487		$470		$483		$483	
2002	$499		$481		$494		$494	
2003	$512		$493		$506		$506	
2004	$524		$504		$518		$518	
2005	$537		$516		$530		$530	
2006	$550		$527		$542		$542	
2007	$562		$539		$554		$554	
2008	$575		$550		$566		$566	
2009	$587		$562		$578		$578	
2010	$600		$573		$590		$590	
2011	$613		$585		$602		$602	
2012	$625		$596		$614		$614	
2013	$638		$608		$626		$626	
2014	$650		$619		$638		$638	
2015	$663		$631		$650		$650	
2016	$675		$642		$662		$662	
2017	$688		$654		$674		$674	
2018	$701		$665		$686		$686	
2019	$713	$648	$707	$643	$698		$698	
2020	$726	$600	$713	$590	$710		$710	
2021	$738	$555	$719	$540	$722		$722	
2022	$751	$513	$725	$495	$734	$501	$734	
2023	$764	$474	$730	$453	$746	$463	$746	$463
2024	$776	$438	$734	$415	$758	$428	$758	$428
2025	$789	$405	$746	$383	$770	$395	$770	$395
2026	$801	$374	$758	$353	$781	$365	$781	$365
2027	$814	$345	$769	$326	$793	$336	$793	$336
2028	$827	$319	$781	$301	$805	$311	$805	$311
2029	$839	$294	$792	$278	$817	$286	$817	$286
2030	$852	$271	$804	$256	$829	$264	$829	$264
2031	$864	$250	$815	$236	$841	$244	$841	$244
2032	$877	$231	$827	$218	$853	$225	$853	$225
2033	$890	$213	$838	$201	$865	$207	$865	$207
2034	$902	$196	$850	$185	$877	$191	$877	$191
2035	$915	$181	$861	$170	$889	$176	$889	$176
2036	$927	$167	$873	$157	$901	$162	$901	$162
2037	$940	$154	$884	$145	$913	$149	$913	$149
2038	$952	$142	$896	$133	$925	$137	$925	$137
2039	$965	$130	$907	$123	$937	$127	$937	$127
2040	$978	$120	$919	$113	$949	$117	$949	$117
2041	$990	$111	$930	$104	$961	$107	$961	$107
2042	$1,003	$102	$942	$96	$973	$99	$973	$99
2043	$1,015	$94	$953	$88	$985	$91	$985	$91
2044	$1,028	$86	$965	$81	$997	$84	$997	$84
2045	$1,041	$79	$976	$74	$1,009	$77	$1,009	$77
2046	$1,053	$73	$988	$69	$1,021	$71	$1,021	$71
2047	$1,066	$67	$999	$63	$1,033	$65	$1,033	$65
2048	$1,078	$62	$1,011	$58	$1,045	$60	$1,045	$60
2049	$1,091	$57			$1,056	$55	$1,056	$55
2050	$1,104	$52			$1,068	$51	$1,068	$51
2051	$1,116	$48			$1,080	$47	$1,080	$47
2052	$1,129	$44					$1,092	$43
Discounted Costs								
10 Year Period	$3,402	$3,684	$4,671	$4,499		$3,593		$3,316
20 Year Period	$4,917	$5,328	$6,770	$6,477		$5,190		$4,788
30 Year Period	$5,579	$6,048	$7,694	$7,345		$5,889		$5,430
Present Value of Benefits								
10 Year Period				$172		$91		$85
20 Year Period				$293		$137		$129
30 Year Period				$349		$160		$149

YEARLY CASH FLOWS ($M) - CAPITAL COSTS

Year	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2018	$115.0	$115.0	$70.0	$70.0	$65.0	$65.0
2019	$115.0	$104.5	$70.0	$63.6	$90.0	$81.8
2020	$115.0	$95.0	$70.0	$57.9	$90.0	$74.4
2021	$115.0	$86.4	$70.0	$52.6	$90.0	$67.6
2022	$115.0	$78.5			$90.0	$61.5
2023	$115.0	$71.4				
Total	**$690**	**$551**	**$280**	**$244**	**$425**	**$350**

DETAILED ECONOMIC ANALYSIS

PROJECT NAME: COFFS HARBOUR UPGRADE STRATEGY

PARAMETER VALUES

General	
Base Year (for discounting purpose)	2018
Modelling Period (years)	20
Annual Expansion Factor	350
Discount Rate	7%
Evaluation Period (years from opening)	30
Travel Cost Parameters	
VOC per Vehicle Km	$0.27
Value of Time per hour	$23.03
Accident Costs per MVKT	
Weighted Average Cost for a road network	$61,500

CAPITAL COST ($M)

Existing Highway Upgrade	Inner Option (B-0T)	Inner Option (C-3T)
$621	$252	$383

NETWORK MODEL DATA (Average Weekday)

	Base		Existing - Ultimate Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	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	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	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2	49.4	50.2

PRESENT VALUE OF CHANGE IN MAINTENANCE COSTS ($M)

Scenario	30 Year Period	20 Year Period	10 Year Period
Existing Highway Upgrade	1.73	1.48	1.02
Inner Option (B-0T)	1.54	1.32	0.91
Inner Option (C-3T)	1.54	1.32	0.91

RESULTS OF ECONOMIC ANALYSIS

Scenario	PVC ($M)	30 Year Period			20 Year Period			10 Year Period			FYRR
		PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	
Existing Highway Upgrade	$528	$500	-$29.74	0.94	$387	-$141.98	0.73	$204	-$324.60	0.39	5.47%
Inner Option (B-0T)	$228	$238	$8.52	1.04	$190	-$39.42	0.83	$114	-$115.32	0.50	5.81%
Inner Option (C-3T)	$333	$229	-$105.63	0.68	$183	-$151.29	0.55	$110	-$223.92	0.33	3.86%

TRAVEL AND ACCIDENT COSTS ($M)

	Base		Existing Highway Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	2001	2021	2001	2021	2001	2021
Vehicle Operating Costs	$0.467	$0.704	$0.465	$0.699	$0.467	$0.704	$0.467	$0.704
Travel Time Costs	$0.817	$1.246	$0.771	$1.142	$0.806	$1.197	$0.806	$1.197
Accident Costs	$0.106	$0.160	$0.106	$0.159	$0.106	$0.160	$0.106	$0.160
Daily Travel Costs	$1.390	$2.110	$1.342	$2.000	$1.379	$2.062	$1.379	$2.062
Annual Travel Costs	$487	$738	$470	$700	$483	$722	$483	$722

YEARLY CASH FLOWS ($M) - BENEFITS

Year	Base	Base Discounted	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2001	$487		$470		$483		$483	
2002	$499		$481		$494		$494	
2003	$512		$493		$506		$506	
2004	$524		$504		$518		$518	
2005	$537		$516		$530		$530	
2006	$550		$527		$542		$542	
2007	$562		$539		$554		$554	
2008	$575		$550		$566		$566	
2009	$587		$562		$578		$578	
2010	$600		$573		$590		$590	
2011	$613		$585		$602		$602	
2012	$625		$596		$614		$614	
2013	$638		$608		$626		$626	
2014	$650		$619		$638		$638	
2015	$663		$631		$650		$650	
2016	$675		$642		$662		$662	
2017	$688		$654		$674		$674	
2018	$701		$665		$686		$686	
2019	$713	$667	$707	$661	$698		$698	
2020	$726	$634	$713	$623	$710		$710	
2021	$738	$603	$719	$587	$722		$722	
2022	$751	$573	$725	$553	$734	$560	$734	
2023	$764	$544	$730	$520	$746	$532	$746	$532
2024	$776	$517	$734	$489	$758	$505	$758	$505
2025	$789	$491	$746	$465	$770	$479	$770	$479
2026	$801	$466	$758	$441	$781	$455	$781	$455
2027	$814	$443	$769	$418	$793	$432	$793	$432
2028	$827	$420	$781	$397	$805	$409	$805	$409
2029	$839	$399	$792	$376	$817	$388	$817	$388
2030	$852	$378	$804	$357	$829	$368	$829	$368
2031	$864	$359	$815	$338	$841	$349	$841	$349
2032	$877	$340	$827	$321	$853	$331	$853	$331
2033	$890	$322	$838	$304	$865	$314	$865	$314
2034	$902	$306	$850	$288	$877	$297	$877	$297
2035	$915	$290	$861	$273	$889	$281	$889	$281
2036	$927	$274	$873	$258	$901	$267	$901	$267
2037	$940	$260	$884	$245	$913	$252	$913	$252
2038	$952	$246	$896	$231	$925	$239	$925	$239
2039	$965	$233	$907	$219	$937	$226	$937	$226
2040	$978	$221	$919	$207	$949	$214	$949	$214
2041	$990	$209	$930	$196	$961	$203	$961	$203
2042	$1,003	$198	$942	$186	$973	$192	$973	$192
2043	$1,015	$187	$953	$176	$985	$181	$985	$181
2044	$1,028	$177	$965	$166	$997	$172	$997	$172
2045	$1,041	$167	$976	$157	$1,009	$162	$1,009	$162
2046	$1,053	$158	$988	$149	$1,021	$154	$1,021	$154
2047	$1,066	$150	$999	$140	$1,033	$145	$1,033	$145
2048	$1,078	$142	$1,011	$133	$1,045	$137	$1,045	$137
2049	$1,091	$134			$1,056	$130	$1,056	$130
2050	$1,104	$127			$1,068	$123	$1,068	$123
2051	$1,116	$120			$1,080	$116	$1,080	$116
2052	$1,129	$113					$1,092	$109
Discounted Costs								
10 Year Period	$4,358	$4,591	$5,359	$5,154		$4,477		$4,248
20 Year Period	$6,916	$7,291	$8,532	$8,145		$7,101		$6,733
30 Year Period	$8,391	$8,851	$10,374	$9,874		$8,612		$8,162
Present Value of Benefits								
10 Year Period				$204		$114		$110
20 Year Period				$387		$190		$183
30 Year Period				$500		$238		$229

YEARLY CASH FLOWS ($M) - CAPITAL COSTS

Year	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2018	$103.5	$103.5	$63.0	$63.0	$58.5	$58.5
2019	$103.5	$96.7	$63.0	$58.9	$81.0	$75.7
2020	$103.5	$90.4	$63.0	$55.0	$81.0	$70.7
2021	$103.5	$84.5	$63.0	$51.4	$81.0	$66.1
2022	$103.5	$79.0			$81.0	$61.8
2023	$103.5	$73.8				
Total	**$621**	**$528**	**$252**	**$228**	**$383**	**$333**

DETAILED ECONOMIC ANALYSIS

PROJECT NAME: COFFS HARBOUR UPGRADE STRATEGY

PARAMETER VALUES

General	
Base Year (for discounting purpose)	2018
Modelling Period (years)	20
Annual Expansion Factor	350
Discount Rate	7%
Evaluation Period (years from opening)	30
Travel Cost Parameters	
VOC per Vehicle Km	$0.27
Value of Time per hour	$23.03
Accident Costs per MVKT	
Weighted Average Cost for a road network	$61,500

CAPITAL COST ($M)

Existing Highway Upgrade	Inner Option (B-0T)	Inner Option (C-3T)
$794	$322	$489

NETWORK MODEL DATA (Average Weekday)

	Base		Existing - Ultimate Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	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	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	34,989	51,996
Average Speed (km/hr)	48.8	48.2	51.4	52.2	49.4	50.2	49.4	50.2

PRESENT VALUE OF CHANGE IN MAINTENANCE COSTS ($M)

Scenario	30 Year Period	20 Year Period	10 Year Period
Existing Highway Upgrade	1.73	1.48	1.02
Inner Option (B-0T)	1.54	1.32	0.91
Inner Option (C-3T)	1.54	1.32	0.91

RESULTS OF ECONOMIC ANALYSIS

Scenario	PVC ($M)	30 Year Period			20 Year Period			10 Year Period			FYRR
		PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	PVB ($M)	NPV ($M)	BCR	
Existing Highway Upgrade	$675	$500	-$176.37	0.74	$387	-$288.61	0.57	$204	-$471.24	0.30	4.28%
Inner Option (B-0T)	$292	$238	-$54.90	0.81	$190	-$102.84	0.65	$114	-$178.75	0.39	4.54%
Inner Option (C-3T)	$425	$229	-$198.09	0.54	$183	-$243.75	0.43	$110	-$316.38	0.26	3.02%

TRAVEL AND ACCIDENT COSTS ($M)

	Base		Existing Highway Upgrade		Inner Option (B-0T)		Inner Option (C-3T)	
	2001	2021	2001	2021	2001	2021	2001	2021
Vehicle Operating Costs	$0.467	$0.704	$0.465	$0.699	$0.467	$0.704	$0.467	$0.704
Travel Time Costs	$0.817	$1.246	$0.771	$1.142	$0.806	$1.197	$0.806	$1.197
Accident Costs	$0.106	$0.160	$0.106	$0.159	$0.106	$0.160	$0.106	$0.160
Daily Travel Costs	$1.390	$2.110	$1.342	$2.000	$1.379	$2.062	$1.379	$2.062
Annual Travel Costs	$487	$738	$470	$700	$483	$722	$483	$722

YEARLY CASH FLOWS ($M) - BENEFITS

Year	Base	Base Discounted	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2001	$487		$470		$483		$483	
2002	$499		$481		$494		$494	
2003	$512		$493		$506		$506	
2004	$524		$504		$518		$518	
2005	$537		$516		$530		$530	
2006	$550		$527		$542		$542	
2007	$562		$539		$554		$554	
2008	$575		$550		$566		$566	
2009	$587		$562		$578		$578	
2010	$600		$573		$590		$590	
2011	$613		$585		$602		$602	
2012	$625		$596		$614		$614	
2013	$638		$608		$626		$626	
2014	$650		$619		$638		$638	
2015	$663		$631		$650		$650	
2016	$675		$642		$662		$662	
2017	$688		$654		$674		$674	
2018	$701		$665		$686		$686	
2019	$713	$667	$707	$661	$698		$698	
2020	$726	$634	$713	$623	$710		$710	
2021	$738	$603	$719	$587	$722		$722	
2022	$751	$573	$725	$553	$734	$560	$734	
2023	$764	$544	$730	$520	$746	$532	$746	$532
2024	$776	$517	$734	$489	$758	$505	$758	$505
2025	$789	$491	$746	$465	$770	$479	$770	$479
2026	$801	$466	$758	$441	$781	$455	$781	$455
2027	$814	$443	$769	$418	$793	$432	$793	$432
2028	$827	$420	$781	$397	$805	$409	$805	$409
2029	$839	$399	$792	$376	$817	$388	$817	$388
2030	$852	$378	$804	$357	$829	$368	$829	$368
2031	$864	$359	$815	$338	$841	$349	$841	$349
2032	$877	$340	$827	$321	$853	$331	$853	$331
2033	$890	$322	$838	$304	$865	$314	$865	$314
2034	$902	$306	$850	$288	$877	$297	$877	$297
2035	$915	$290	$861	$273	$889	$281	$889	$281
2036	$927	$274	$873	$258	$901	$267	$901	$267
2037	$940	$260	$884	$245	$913	$252	$913	$252
2038	$952	$246	$896	$231	$925	$239	$925	$239
2039	$965	$233	$907	$219	$937	$226	$937	$226
2040	$978	$221	$919	$207	$949	$214	$949	$214
2041	$990	$209	$930	$196	$961	$203	$961	$203
2042	$1,003	$198	$942	$186	$973	$192	$973	$192
2043	$1,015	$187	$953	$176	$985	$181	$985	$181
2044	$1,028	$177	$965	$166	$997	$172	$997	$172
2045	$1,041	$167	$976	$157	$1,009	$162	$1,009	$162
2046	$1,053	$158	$988	$149	$1,021	$154	$1,021	$154
2047	$1,066	$150	$999	$140	$1,033	$145	$1,033	$145
2048	$1,078	$142	$1,011	$133	$1,045	$137	$1,045	$137
2049	$1,091	$134			$1,056	$130	$1,056	$130
2050	$1,104	$127			$1,068	$123	$1,068	$123
2051	$1,116	$120			$1,080	$116	$1,080	$116
2052	$1,129	$113					$1,092	$109
Discounted Costs								
10 Year Period	$4,358	$4,591	$5,359	$5,154		$4,477		$4,248
20 Year Period	$6,916	$7,291	$8,532	$8,145		$7,101		$6,733
30 Year Period	$8,391	$8,851	$10,374	$9,874		$8,612		$8,162
Present Value of Benefits								
10 Year Period				$204		$114		$110
20 Year Period				$387		$190		$183
30 Year Period				$500		$238		$229

YEARLY CASH FLOWS ($M) - CAPITAL COSTS

Year	Existing Highway Upgrade	Existing Highway Upgrade Discounted	Inner Option (B-0T)	Inner Option (B-0T) Discounted	Inner Option (C-3T)	Inner Option (C-3T) Discounted
2018	$132.3	$132.3	$80.5	$80.5	$74.8	$74.8
2019	$132.3	$123.6	$80.5	$75.2	$103.5	$96.7
2020	$132.3	$115.5	$80.5	$70.3	$103.5	$90.4
2021	$132.3	$108.0	$80.5	$65.7	$103.5	$84.5
2022	$132.3	$100.9			$103.5	$79.0
2023	$132.3	$94.3				
Total	**$794**	**$675**	**$322**	**$292**	**$489**	**$425**

Appendix C

Air Quality Constraints for Roadway Locations

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Coffs Harbour Section

Air Quality Constraints for Roadway Locations

February 2004
Reference: 1093.71.GE

Connell Wagner

AIR QUALITY CONSTRAINTS FOR ROADWAY LOCATIONS: COFFS HARBOUR HIGHWAY PLANNING, COFFS HARBOUR SECTION

February 2004

Prepared for
Connell Wagner Pty Ltd

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TABLES

FIGURES

1 INTRODUCTION

This report has been prepared by Holmes Air Sciences for Connell Wagner Pty Ltd. It provides a consideration of issues which affect and potentially constrain the location of roadways from an air quality perspective. The report addresses the following issues.

- Background to the study
- Discussion of air quality issues associated with traffic emissions
- Discussion of factors which will affect roadway emissions
- A consideration of alternative options for the Coffs Harbour Highway Planning Strategy

2 BACKGROUND TO THE STUDY

Connell Wagner is currently assessing alternative options for the upgrade to the Pacific Highway in the Coffs Harbour local government area (LGA). This report focuses on those route options identified in the Coffs Harbour (Southern Sections). Holmes Air Sciences has been asked by Connell Wagner to provide technical input into the external/environmental factors that influence the emissions of motor vehicles and their subsequent impacts.

3 EMISSIONS FROM MOTOR VEHICLES AND THEIR HEALTH IMPACTS

Emissions from motor vehicles have the potential to affect human health. The main impetus for reducing vehicle emissions is to minimise health impacts from what are major contributors to pollution levels in most urban environments.

Air pollutants emitted from traffic include:

- Carbon monoxide (CO)
- Nitrogen oxides (NO_x) comprising mainly a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2)
- Particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) including polycyclic aromatic hydrocarbons (PAHs), and
- Hydrocarbons including benzene, xylene, toluene, 1,3-butadiene and odours.

Other pollutants such as sulphur dioxide and lead are also emitted from motor vehicles but because of the low sulphur[1] content of motor vehicle fuels the resulting ground-level concentrations of sulphur dioxide are unlikely to have a significant impact on public health. Similarly, since the introduction of unleaded petrol in 1986,

[1] It is relevant to note that legislation to reduce the sulphur content of diesel fuels in Australia has been introduced and in January 2003, the mandated sulphur level was decreased from 5000 ppm to 500 ppm. This is being done to assist in reducing the emissions of particles from diesel vehicles rather than to deal with a sulphur dioxide problem. It will of course have the benefit of further lowering the ambient concentrations of sulphur dioxide and although this will be beneficial it is not the primary motive for the action. A further reduction from 500 ppm to 50 ppm is planned for 2005.

emissions of lead from traffic have now decreased to levels where they are unlikely to have a significant impact on public health. Other emissions, such as carbon dioxide and water vapour, also occur but these are generally not considered to be air pollutants although carbon dioxide needs to be considered in the context of greenhouse effects.

As well as these primary pollutants, motor vehicle emissions are associated with the formation of photochemical smog primarily composed of ozone (O_3). Ozone is formed through a complicated set of reactions involving reactive hydrocarbons, oxides of nitrogen and sunlight. The net result of these reactions, which mainly occur in the presence of sunlight, is to produce ozone and nitrogen dioxide (NO converted over time to NO_2) and other oxidation products, which are collectively referred to as photochemical smog. As noted above nitrogen oxides are comprised mainly of NO and NO_2. Generally, NO is not considered to be harmful to human health at the concentrations typically found in urban environments, including heavily trafficked areas. Nitrogen dioxide however is a recognised air pollutant and has the potential to cause adverse effects on health at concentrations that sometimes occur within urban environments.

The quantity of emission that occurs from a vehicle depends on a number of factors including the size of the engine and type of fuel and power needs which in turn depend on vehicle size, road grade, vehicle speed and vehicle acceleration and driver habits. In addition, emissions depend on the age of the engine and its state of tune and on the air pollution control equipment fitted.

Emissions from vehicles have been gradually reduced since 1976 when Australian Design Rule (ADR) 27A came into effect. This was the first vehicle design rule specifically intended to reduce motor vehicle emissions, in particular, emissions of hydrocarbons and carbon monoxide.

The next major control on motor vehicle emissions was implemented in 1986 with the introduction of unleaded petrol and ADR 37. Using unleaded fuel served a dual purpose. It removes the emission of lead and allows the fitting of catalytic converters to petrol engines (catalytic converters are rendered ineffective when contaminated by lead). The use of oxidation catalytic converters led to dramatic reductions in emissions of CO and hydrocarbons. Three-way catalytic converters also became common at approximately the same time and these also resulted in significant reductions in emissions of NO_x. Three-way catalysts are now used for all new vehicles.

Other improvements in engine design including on-board computer control of various engine operating parameters such as ignition timing, fuel injection rates and more advanced ignition systems, have served to improve motor vehicle energy efficiencies and reduce motor vehicle emissions substantially since 1976. Some of these gains in engine efficiency and improved emissions controls have been lost due to the greater use of vehicle air conditioners, increased popularity of vehicles with automatic transmissions and larger vehicles and more importantly, the increased population living in the urban areas and greater distances travelled per capita.

The emissions limits under the ADRs do not fully reflect the reduction in emissions that has actually occurred. For example many cars produced after 1986 employ three-way catalytic converters. Three way catalytic

converters were legally required after 1990. These controls significantly reduce the emission of NO_x as well as CO.

However, while the reduction in emissions from individual vehicles has been significant, so too has the increase in vehicle kilometres travelled (VKT) within most urban airsheds in Australia. Therefore the challenge for regulators of urban airsheds is to ensure that the gains from reduced vehicle emissions are not lost through proportionally greater increases in vehicle usage.

There has been considerable focus in recent years on the health impacts of fine particulate matter. Much of this concern is based on investigations carried out in the US, with the view to quantifying the health risks associated with both long-term and short-term exposure to airborne particulate matter. The study is colloquially referred to as "The Six Cities Study" from the original work by **Dockery et al. (1993)**, which determined a relationship between fine particulate matter (defined as particles smaller than 2.5 ?m in diameter) in the air and mortality in six US cities.

The basic findings of the Six Cities Study are that there is an increase in mortality with increasing concentrations of fine particulate matter. The conclusions appear to be robust and have been supported by subsequent studies and as far as can be determined are not confounded by other known variables. It is important to note that the observed association between fine particles and mortality is statistical. The particles are not the primary cause of death, but are one of many environmental and other risk factors.

While the air quality goals from particulate matter do not refect their chemical composition, it is nevertheless recognised that not all particles are the same in terms of health impacts. Emissions from diesel vehicles are a major contributor to particle pollution in urban environments and, in addition, the particles are associated with carcinogenic material, including polyaromatic hydrocarbons.

These factors are particularly relevant in urban environments. All of the health risk studies that have been undertaken have been in industrialised cities. In a rural environment, the background level of particulate matter from motor vehicle emissions will be substantially lower than the general background in a city such Sydney. Nevertheless, it is prudent to design roadways, particularly those which are likely to carry a high percentage of heavy vehicles, to minimise exposure for nearby residences.

4 DESIGN FEATURES

Air quality impacts associated with roadway projects are influenced by the following factors:-

- The total volume and mix of roadway traffic
- Local dispersion conditions
- Speed on the road
- Roadway design including:
  - grade
  - presence and design of traffic lights and intersections

- proximity to sensitive receptors such as residences, schools, hospitals, etc.

The first two factors are major determinants of air quality impacts and these are largely out of the control of roadway builders. However there is some opportunity to improve air quality impacts with roadway design.

Table 1 shows the relative impacts of grade on different vehicle emissions. This information has been drawn from **PIARC** (**1995**). The emissions for light duty petrol vehicles (LDV) and heavy duty diesel vehicles (HDV) are presented for speeds of 60km/h, 70km/h, 80km/h and 90km/h. In general, the reduction in emissions by travelling down increased grades is more than offset by the increase in emissions travelling up the increased grade. Therefore in principle, as traffic will be travelling in both directions, the lower the grade, the lower the overall emissions.

Emissions per vehicle from heavy vehicles are substantially higher than those from light vehicles. The relative increase in CO emissions with grade is greater for light vehicles than for heavy vehicles, with up to a 10-fold increase with 6% grade for light vehicles travelling at 90 km/h. The relative increase in NO_x is similar for both vehicle types with a 2-3 fold increase with steep grade. There are no data available in this database for particulate emissions from light petrol vehicles. For steep grades, such as 6%, the particulate emissions from heavy vehicles are increased about four times over emissions on the flat at speeds of 60 km/h.

Table 1 : Changes in emissions with change of grade

	LDV emissions (g/h)			HDV emissions (g/h)		
At 60km/h						
Grade (%)	CO	NO×	Particulates	CO	NOx	Particulates
-6	30.7	2.7	NDA[1]	219.6	475.7	29.7
-4	44.8	6.4	NDA	219.6	475.7	29.7
-2	59.0	10.1	NDA	219.6	475.7	29.7
0	59.0	13.6	NDA	439.2	951.3	59.3
2	88.5	15.2	NDA	581.9	1392.7	76.6
4	173.8	27.2	NDA	748.3	1907.6	96.8
6	277.9	36.6	NDA	930.4	2471.6	118.9
At 70km/h						
Grade (%)	CO	NOx	Particulates	CO	NOx	Particulates
-6	31.7	3.1	NDA	230.9	547.6	32.5
-4	46.4	7.4	NDA	230.9	547.6	32.5
-2	61.0	11.6	NDA	230.9	547.6	32.5
0	61.0	15.7	NDA	462.1	1094.9	65.0
2	122.0	22.0	NDA	621.7	1644.3	86.5
4	244.0	31.5	NDA	804.4	2262.2	110.7
6	366.0	42.3	NDA	NDA	NDA	NDA
At 80 km/h						
Grade (%)	CO	NO×	Particulates	CO	NOx	Particulates
-6	32.8	3.8	NDA	242.8	616.5	35.2
-4	47.9	9.0	NDA	242.8	616.5	35.2
-2	63.0	14.2	NDA	242.8	616.5	35.2
0	63.0	19.2	NDA	485.6	1233.0	70.4
2	173.3	28.8	NDA	663.1	1919.5	97.2
4	308.7	38.4	NDA	862.9	2655.2	126.1
6	491.4	51.6	NDA	NDA	NDA	NDA
At 90 km/h						
Grade (%)	CO	NO×	Particulates	CO	NOx	Particulates
-6	35.5	5.0	NDA	NDA	NDA	NDA
-4	51.9	11.5	NDA	NDA	NDA	NDA
-2	68.3	18.4	NDA	NDA	NDA	NDA
0	68.3	24.9	NDA	NDA	NDA	NDA
2	228.8	37.4	NDA	NDA	NDA	NDA
4	404.7	49.8	NDA	NDA	NDA	NDA
6	686.4	67.0	NDA	NDA	NDA	NDA

1. NDA = No data available

Emissions increase as vehicles accelerate away from traffic lights.

5 DESCRIPTION OF ROUTE OPTIONS

The following route options are under consideration.

1. Pacific Highway upgrade. The concept for an "ultimate" upgrade of the existing highway through Coffs Harbour is based on contemporary urban motorway schemes and has been developed to provide a dual-carriageway facility with grade-separated interchanges at key locations for local east-west traffic movements. These would be complemented by the provision of local north-south service roads or adjustments to existing local roads for access to properties and businesses along the existing corridor.
2. Inner corridor bypass options. Two indicative route options have been identified in the inner corridor. Each is between 11.0 and 11.4km long with a common 'cross-over point' in the vicinity of Coramba Road, near its intersection with Bennetts Road. The north and south sections of the options are interchangeable and combine to form four variants of the two main alignments.

The factors considered in ranking these options with respect to air quality are:-

- Number and location of sensitive receptors
- Percentage of heavy vehicles
- Roadway grade
- Degree of congestion
- Background levels of pollution

How critical these factors are will depend on the level of traffic using the road. It is unusual for rural roads to cause major air quality impacts, due to the generally much lower contribution from other sources and the opportunity (in many although not all instances) to locate the carriageway at a reasonable distance from sensitive receptors. In addition there can be less daily traffic on a rural road than on a major arterial road/freeway in an urban environment.

Generally, there are fewer constraints for rural roads than for urban roads with respect to air quality as the receiving air environment is usually relatively unpolluted. Exceptions to this can be in areas where there is agricultural burning and in centres where wood fires are used extensively for home heating in winter. However, the level of impact of a particular roadway project cannot be quantified without estimating emissions from current and projected traffic and quantifying the number and locations of receptors. Nevertheless some general comparisons between the options can be considered as follows:

- If the existing highway is upgraded to provide more capacity (8-lane equivalent) with free traffic flow, it concentrates pollution in one area where there are a relatively large number of receptors. However, at

least in the medium term, the upgrade is likely to improve the current situation by reducing congestion. The overall effect may be neutral or better with respect to air quality, or may not be significantly worse, if levels of traffic are low.

- Building a bypass in an urban fringe location (such as the Inner Bypass option) that is largely unpolluted with a moderate number of receptors would introduce a new source of pollution to the area. This is unlikely to be a problem as the level of traffic on the Inner Bypass compared with the existing highway would generally be moderate and the grades are unlikely to be an issue. It would also improve the current situation on the bypassed section of the existing highway by reducing congestion.

A further issue for consideration is the effect of route selection on greenhouse emissions. These will be directly proportional to the fuel consumed and are affected in a similar way to other emissions by the factors discussed above, that is, grade and stop-start conditions. The length of the trip is also a factor in fuel consumption and the longest route has the potential for the highest greenhouse emissions, all other factors remaining equal. In this case, the Inner Bypass is marginally longer and therefore would have marginally higher greenhouse emissions.

Table 2 provides a summary of the relative benefits and disbenefits of the two options

Table 2 : Ranking of route options on the basis of air quality impacts

Assessment factor	Existing Highway	Inner Bypass
No of receptors along route	High	Moderate
No of vehicles (total)	High	Moderate
No of Vehicles (heavy)	Low	Low
Existing air quality	High	High
Effect of grades on emission levels	Low	Low
Congestion relief on existing highway	High	High
Overall potential for impacts of air emissions	Moderate	Moderate-low

To determine the relative impacts of the different bypass options on air quality along the Pacific Highway, 2021 traffic volumes were analysed using the CALINE4 roadway model. The impact of each bypass scenario on nine sections of the Pacific Highway was considered. The data was processed to predict the CO, NO_2 and PM_{10} concentrations at 0m, 10m, 20m, 30m and 50m from the kerb. All concentration estimates were predicted to be below the NSW Department of Environment and Conservation (DEC) (previously the EPA) goals for each pollutant.

The highest emissions in each case were at the kerbside, and these values are summarised for each pollutant in **Figures 1 to 3**. It can be seen from these figures that it is difficult to make generalisations about the relative benefits of the bypass options, since different options cause the highest predicted concentrations along

different sections of the highway. This is because of differences in projected traffic volumes between the sections, and the number of heavy vehicles predicted to travel on the highway in 2021. The volumes of total and heavy vehicle traffic projected for 2021 are shown in **table 3.**

Table 3 : Average daily traffic on the Pacific Highway for bypass options

	No bypass		Inner Bypass		Existing Highway Upgrade	
	TOTAL	**HEAVY**	**TOTAL**	**HEAVY**	**TOTAL**	**HEAVY**
South of Englands Road	38,328	3,901	40,057	4,040	40,504	4,078
South of Halls Road	27,993	3,061	23,596	1,956	34,401	3,590
North of Coff Street	35,566	3,659	29,401	2,403	16,741	2,143
North of Bray Street	45,074	4,462	35,286	2,894	49,877	4,847
North of Arthur Street	44,095	4,366	29,388	2,414	36,950	3,799
North of James Small Drive (S)	35,693	3,684	21,623	1,789	35,693	3,684
North of Headland Road	31,745	3,365	30,511	3,263	30,451	3,258
North of Moonee Beach Road	26,509	2,941	26,509	2,941	26,509	2,941
North of Bucca Road	26,161	2,913	26,161	2,913	26,161	2,913

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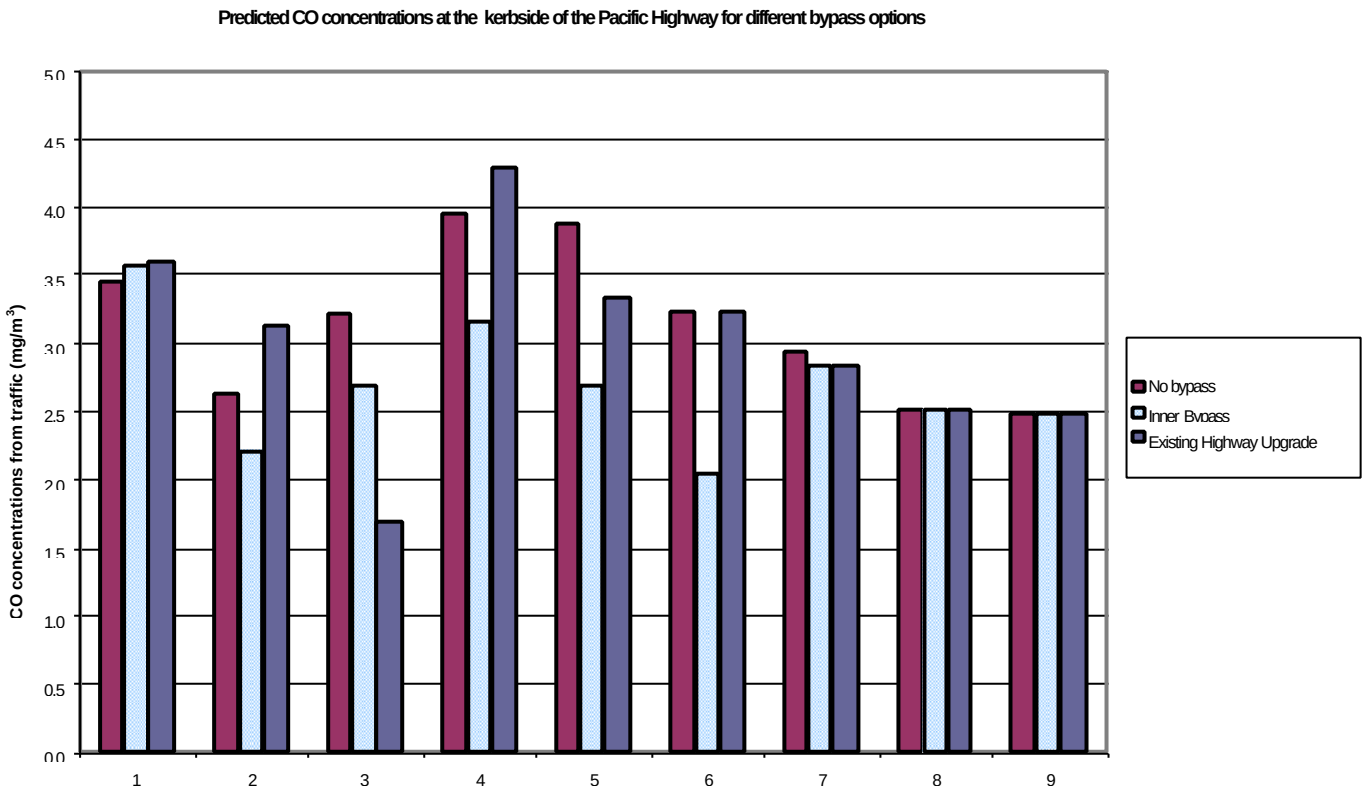
Predicted CO concentrations at the kerbside of the Pacific Highway for different bypass options
CO concentrations from traffic (mg/m3)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
8
9
No bypass
Inner Bypass
Existing Highway Upgrade

Figure 1

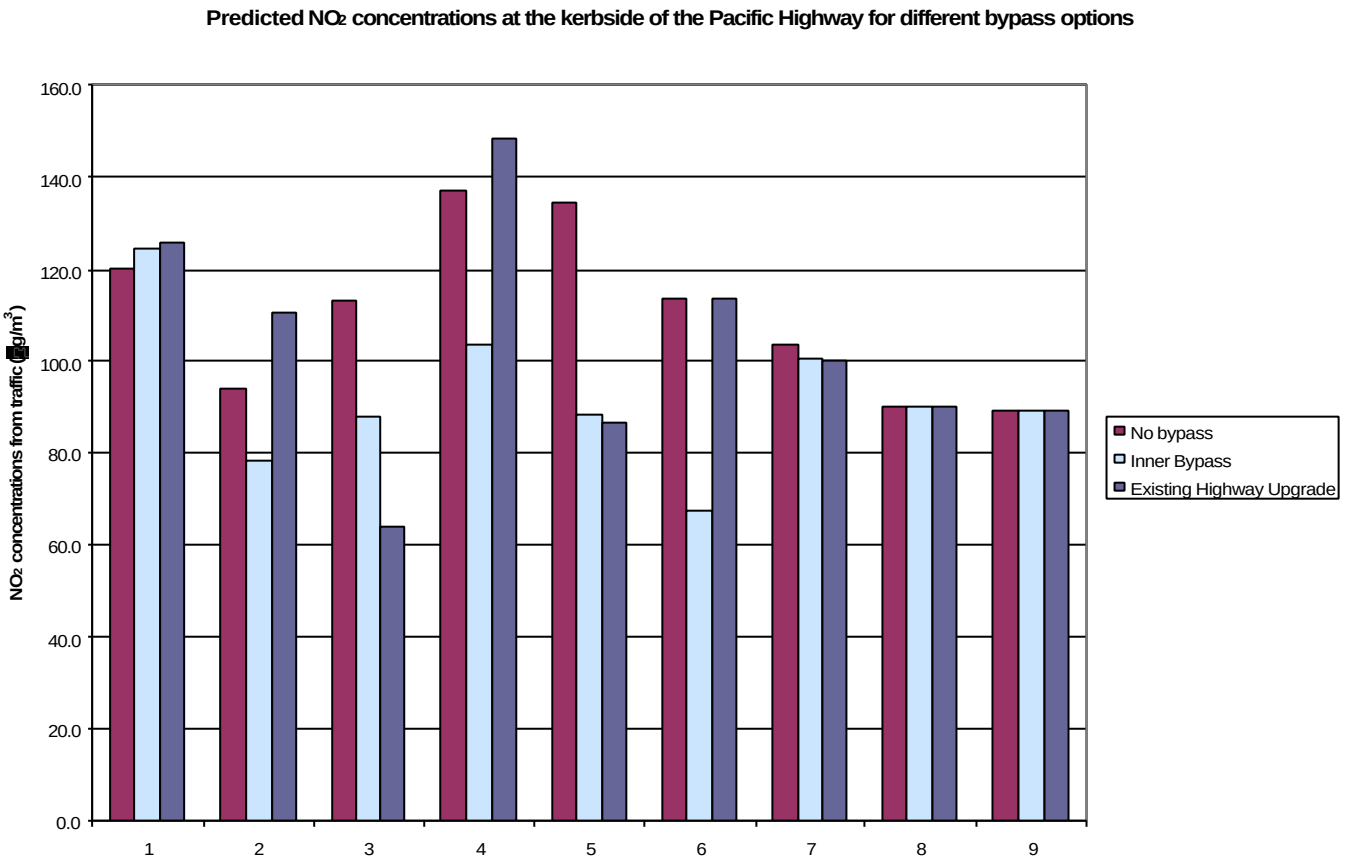
Predicted NO2 concentrations at the kerbside of the Pacific Highway for different bypass options
NO2 concentrations from traffic (µg/m3)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
1
2
3
4
5
6
7
8
9
No bypass
Inner Bypass
Existing Highway Upgrade

Figure 2

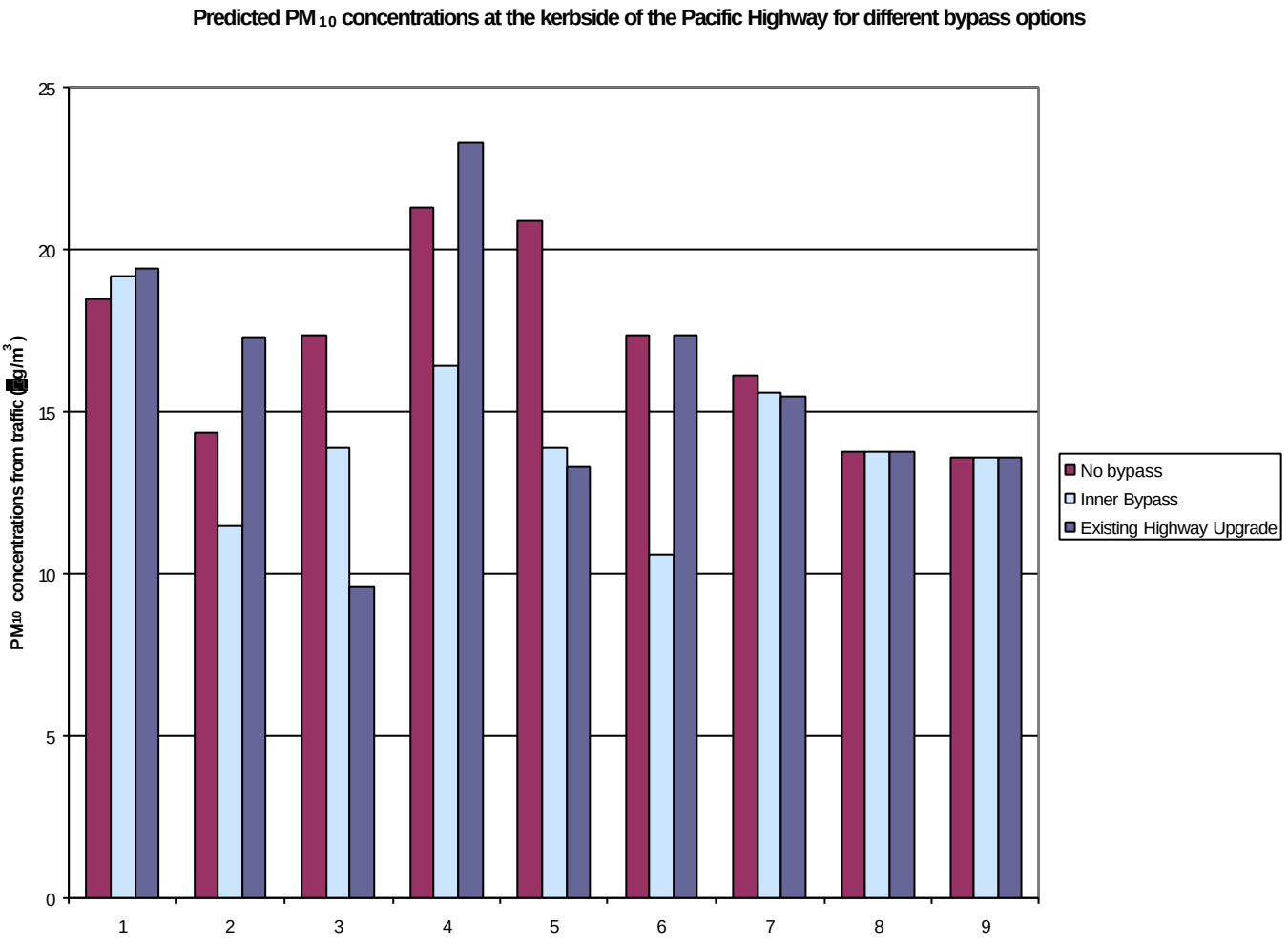
Predicted PM10 concentrations at the kerbside of the Pacific Highway for different bypass options
PM10 concentrations from traffic (µg/m3)
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
No bypass
Inner Bypass
Existing Highway Upgrade

Figure 3

Appendix D

Wilkie Fleming Agriculture Report

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Coffs Harbour Highway Planning Strategy

Agricultural Land Assessment - Southern Coffs Harbour Section

Existing Highway Upgrade and Inner Bypass Options

Prepared by Alan Hartley

February 2004

Connell Wagner

Inner North and Inner South Options

The Inner North and Inner South routes skirt around the city of Coffs Harbour and traverse slopes and small valley basins. In general terms, the steep slopes have been used for bananas where the slopes are protected from strong cold winds, and have remained under forest or been cleared for grazing elsewhere.

For the properties impacted on by the Inner Bypass Options, land-use patterns have been identified by aerial photo mosaic interpretation and site investigations. The results of this survey are detailed in Table 1 below.

Table 1: Property and Land Use Impacts

Sector	Indicative Land Use					
	bananas	**mixed banana, horticulture pasture**	**Minor crop grazing, forestry**	**Forestry and grazing**	**Forestry**	**Other**
Combined northern link to Pacific Highway	11	10	1	0	0	1
Inner North 2	6	11	11	0	0	5
Inner South 1	3	3	6	0	0	1
Inner North 1	7	5	11	0	0	7
Inner South 2	1	3	2	1	0	9
Combined southern link to Pacific Highway	0	0	0	1	0	14
Inner South 1, Inner North 2	**20**	**24**	**18**	**1**	**0**	**21**
Inner South 2, Inner North 1	**19**	**18**	**14**	**2**	**0**	**31**
Inner South 2, Inner North 2	**21**	**24**	**14**	**2**	**1**	**29**
Inner South 1, Inner North 1	**21**	**18**	**18**	**1**	**0**	**23**

Northern Combined Link

The combined link traverses agricultural properties inland from Korora and Macauleys beach. Most of these grow bananas or other horticultural crops including small blocks of avocado on steep slopes. However, the banana blocks are small and the affected properties are not part of a consolidated banana growing belt. Those 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.

Inner North 2

The northern part of this sector traverses banana farms forming a consolidated area of upper slope banana plantings. The growing area has been selected for it freedom from frost though the slope is exposed to the south east. After the route crosses the railway line, the properties are used mainly for grazing though there are small areas of avocado on steeply terraced slopes and minor area of other horticulture. Properties lower in the valley are used for grazing.

Inner South 1

This sector crosses Coramba Road and passes through a consolidated banana growing area on favourable north facing slopes. While the property land use impact (Table 1) shows six banana and horticulture properties directly affected, the impact is likely to be greater since it could affect spraying operations by opening up edge effects along the highway where spray drift would be a potential hazard. A deep cut through the top of the ridge could also create turbulence and change the temperature and wind pattern on properties not directly affected by road construction.

Land on the southern slope is used mainly for grazing with a few forest remnants.

Inner North 1

The northern part of this sector follows the railway route around the base of the ridge. While the alignment crosses a number of banana growing properties, it does so low on the slope, leaving most of the plantings on the upper slopes unaffected. The location could, however, have a contingent impact on management by restricting or altering current spraying practice. After it crosses the railway line, the route traverses mainly grazing land near the valley bottom, where urban development is currently expanding.

Inner South 2

This sector crosses Coramba road and is similar in its impacts to the Inner South 1 sector in that it transects a consolidated banana growing region on favourable northern slopes. The same potential impact contingencies apply. The banana farms have their pack sheds and water supplies downslope and the plantings upslope. This pattern of contingent banana growing farms is favourable for disease and pest control management.

On the Boambee side, there is a large forest area on the southern ridge crest and upper slope. Downslope, the agricultural land use in the affected 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. There are a number of small farm dams along the valley floor.

Southern Combined Link

The combined sector location traverses land used for grazing but most properties support non- agricultural land use.

Impact Analysis

Inner North 1&2 and Inner South 1&2

The land around the Coffs Harbour urban area is steep to very steep above small valley basins. Bananas have been grown successfully on the most protected slopes to avoid strong cold winds and frost. Management of the crop is favoured where neighbouring properties are also involved in banana growing so that co-operative contracts for essential disease control spraying can be negotiated, and interface effects with non-compatible land uses are prevented. Quarantine is an important facet of banana management since major diseases can be transmitted on infected plant material and can be transported by vehicle or on foot.

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 beach.

Avocados are still grown on very steep orchards but production from this immediate catchment is very small and insignificant from an industry perspective. The areas of other horticultural crops such as mango, vines, citrus and berries are very small.

This investigation suggests that the most important facet of land management for the banana industry is maintaining as far as possible contiguous plantings on the remaining favoured slopes. In this regard, the least impact on bananas (and other horticultural crops) would derive from a combination of the Inner South 1 and Inner North 1, which girdle the city residential suburbs. While the numbers of properties affected are similar on all options and combinations, those options utilising the eastern sectors leaves more of the consolidated areas of plantings intact.

Upgrading the existing highway

Agricultural properties along the existing highway are used mainly for grazing, but there has been extensive incursion by subdivision for industrial and residential development to the point where the agricultural significance of the land has been largely subsumed by other forms of land use.

Appendix

Worksheets containing details of the land use allocation developed at this stage of investigations for individual blocks along the routes are included as Appendix 1.

APPENDIX 1

WILKIE FLEMING AGRICULTURAL LANDS REPORT:
COFFS HARBOUR SECTION

PRELIMINARY ASSESSMENT FOR INNER NORTH AND INNER SOUTH OPTIONS.

Land Use on Affected Properties							
Section	**Property**	**banana**	**Mixed banana, horticulture, pasture**	**Grazing, minor field crop, forestry**	**Grazing, forestry**	**Forestry**	**Miscellaneous**
Northern Section	1	1					
Combined	2				1		
	3	1					
	4	1					
	5	1					
	6	1					
	8	1					
	9	1					
	10	1					
	11						
	12	1					
	13	1	1				
	14		1				
	16		1				
	17		1				
	19		1				
	31		1				
	32		1				
	33		1				
	35		1				
	40		1				
	41		1				
	42	1					
subtotal		**11**	**11**	**0**	**1**	**0**	**0**
Inner North 2	24		1				
	29			1			
	44		1				
	28			1			
	26						1
	37						1
	18		1				
	34		1				
	22		1				
	36						1
	21	1					
	20	1					
	7	1					
	15	1					

Section	Property	banana	Mixed banana, horticulture, pasture	Grazing, minor field crop, forestry	Grazing, forestry	Forestry	Miscellaneous
	43	1					
	39	1					
	38						1
	25		1				
	23		1				
	46		1				
	30		1				
	55		1				
	56			1			
	62			1			
	63			1			
	64			1			
	65			1			
	72			1			
	70			1			
	76			1			
	79			1			
	80						1
	81		1				
subtotal		**6**	**11**	**11**	**0**	**0**	**5**
Inner North 1	24		1				
	44		1				
	50		1				
	49		1				
	45						1
	52						1
	60						1
	61						1
	59						1
	57	1					
	58	1					
	53	1					
	54	1					
	51	1					
	48	1					
	47	1					
	55		1				
	67			1			
	68			1			
	66			1			
	69						1
	73						1
	71			1			
	75			1			
	70			1			
	76			1			
	77			1			

Section	Property	banana	Mixed banana, horticulture, pasture	Grazing, minor field crop, forestry	Grazing, forestry	Forestry	Miscellaneous
	78			1			
	79			1			
	74			1			
subtotal		**7**	**5**	**11**	**0**	**0**	**7**
Inner South 1	82						1
	83		1				
	87		1				
	88	1					
	90	1					
	89	1					
	94		1				
	98			1			
	97			1			
	99			1			
	100			1			
	101			1			
	110			1			
subtotal		**3**	**3**	**6**	**0**	**0**	**1**
Inner South 2	82						1
	85		1				
	84	1					
	95		1				
	96		1				
	97			1			
	102						1
	103						1
	104						1
	105						1
	106						1
	107						1
	108						1
	109						1
	CRW51				1		
	110			1			
subtotal		**1**	**3**	**2**	**1**	**0**	**9**
Southern Common	112				1		
Section	113						1
	114						1
	114						1
	116-126						11
subtotal		**0**	**0**	**0**	**1**	**0**	**14**