Part E – Impacts of the proposed Tugun Bypass on the socioeconomic environment

12. Land use, planning and transport

12.1 Introduction

The relationship between available transport systems and the development of land has been recognised for many years. The introduction of new transport infrastructure can stimulate the development of adjacent rural land for more intensive uses and, at the same time, the development of land will generate a demand for movement.

Where land has been reserved for a future road for many years, adjacent uses will often anticipate its implementation. The process of traffic modelling, which seeks to identify the anticipated effects of building a major new link in the road network, depends on an understanding that the movement generated by future land uses requires accommodation by the available infrastructure. This process is tempered by the application of planning and transport policies.

The following two chapters address these issues. Chapter 12 deals with land use issues and transport in general following the opening of the bypass. Chapter 13 focuses on potential impacts on the community, including effects resulting from the re-distribution of traffic to the proposed bypass and those occurring as a direct consequence of the introduction of major infrastructure to the area.

Other impacts, such as noise, air quality and visual effects, collectively influence the amenity of residents and business occupants who would be affected by the new road. The impacts of the individual environmental effects are described in detail in Chapters 9, 14 and 16, and in Technical Papers 10, 11 and 13.

12.2 Existing land uses

12.2.1 Overview

The area from the existing Stewart Road interchange to Boyd Street consists of land used for residential, industrial and community purposes; there is also some bushland. The land surrounding the proposed Tweed Heads Bypass interchange to the south of the alignment consists mainly of land used for residential, rural and industrial purposes. The land in between is used by Gold Coast Airport, a large proportion of which is undeveloped. This has been a result of operational needs of the airport such as the protection of the obstacle limitation surface and the incompatibility of residential development with airport operations.

Existing land uses in the area adjacent to the proposed bypass are shown in Figure 12.1.

12.2.2 Vacant/under construction

Land to the north and west of Boyd Street mainly consists of bushland, a large proportion of which has been approved for future urban development and residential subdivision.

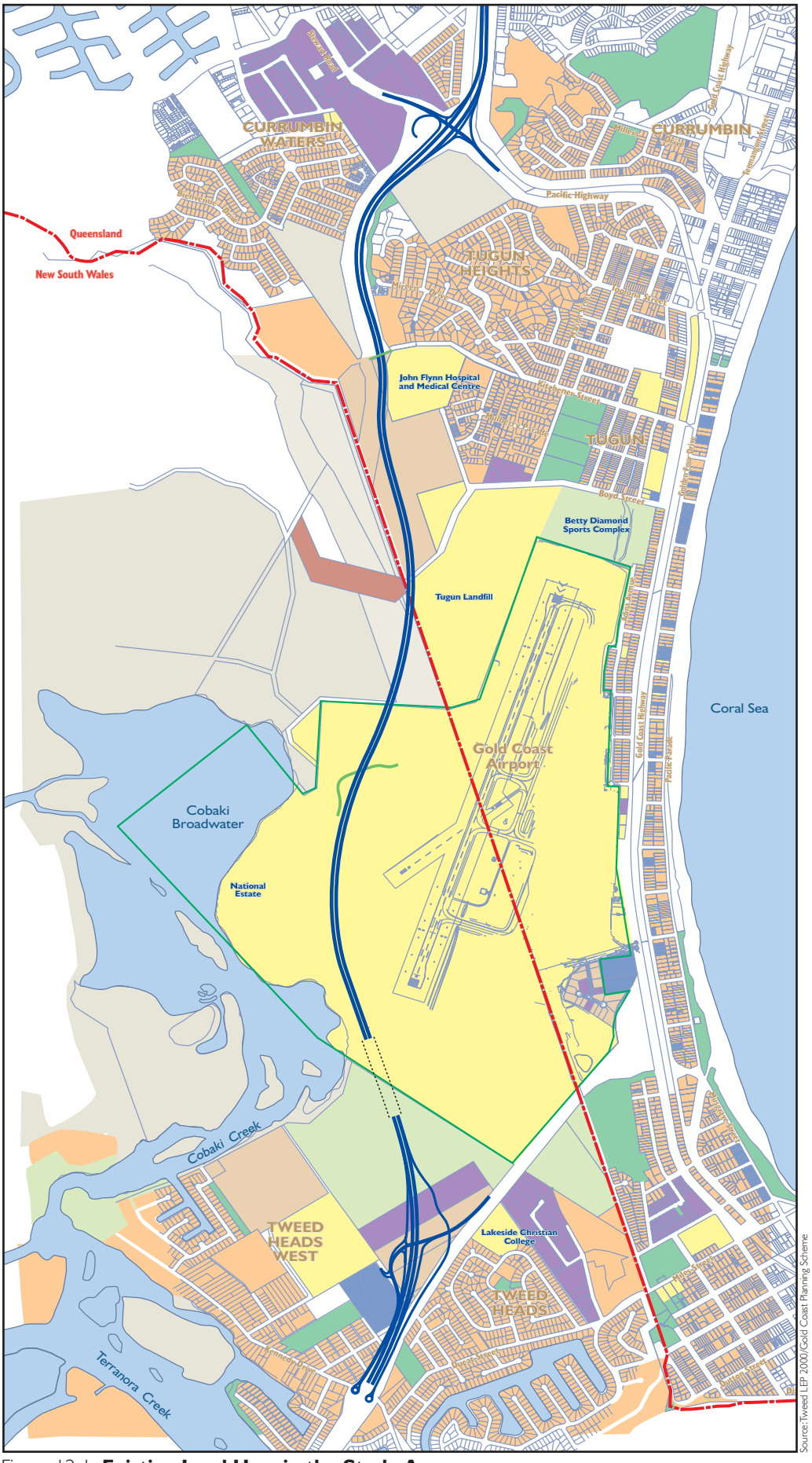


Figure 12.1 **Existing Land Uses in the Study Area**

12.2.3 Community and special uses

The airport generally consists of the major north-south runway, domestic and international terminal building, charter terminal, aviation support facilities, non-aviation commercial facilities to the east of the proposed alignment, and open space buffer areas and conservation areas to the west and south.

The John Flynn Hospital and Medical Centre, the major medical facility in the southern Gold Coast, is located to the north of Boyd Street. The bypass would pass directly to the west of the hospital.

Tugun Landfill is also adjacent to Boyd Street. This is owned and operated by the Gold Coast City Council. Solid waste has been deposited at the site since 1974. Prior to that, the site had been used for the deposition of municipal waste for a period for about 30 years. A sewage treatment plant, now downgraded to a pumping station, adjoins the landfill to the east.

Lakeside Christian College is located to the east of the proposed junction with the Tweed Heads Bypass. The school caters for children up to Year 7 and has approximately 200 students.

The Tweed Heads West Sewage Treatment Works located to the south of the Tweed Heads Pony and Hack Club and west of the proposed bypass.

The location of major community facilities in the area is shown in Figure 12.2.

12.2.4 Residential

The main areas of residential land consist of low-density residential development at the northern end of the proposed alignment (near the Stewart Road interchange), multi-unit residential development at Tugun Heights, and low-to-medium-density residential development at the Pacific Beach Estate. Low-rise detached dwellings also exist near the proposed Tweed Heads Bypass interchange.

The strip to the east of the Gold Coast Highway from Tugun to Coolangatta is predominantly residential, with a mix of low, medium and high density development. There is a strip of low density housing to the west of the Gold Coast Highway, south of Boyd Street. Access to this area is via a service road parallel to the highway.

Two large subdivisions are to be developed in areas adjacent to the proposed bypass. These are the Cobaki Lakes development and the Pacific Beach Estate, located to the west and east of the proposed alignment respectively. The developments would accommodate over 5,000 new dwellings.

12.2.5 Recreation

A number of sporting facilities and clubs are located south of Boyd Street, including the Betty Diamond Sporting Complex, which incorporates the Tugun Leagues Club, the Tugun Soccer Club, and a number of other sporting and public facilities.

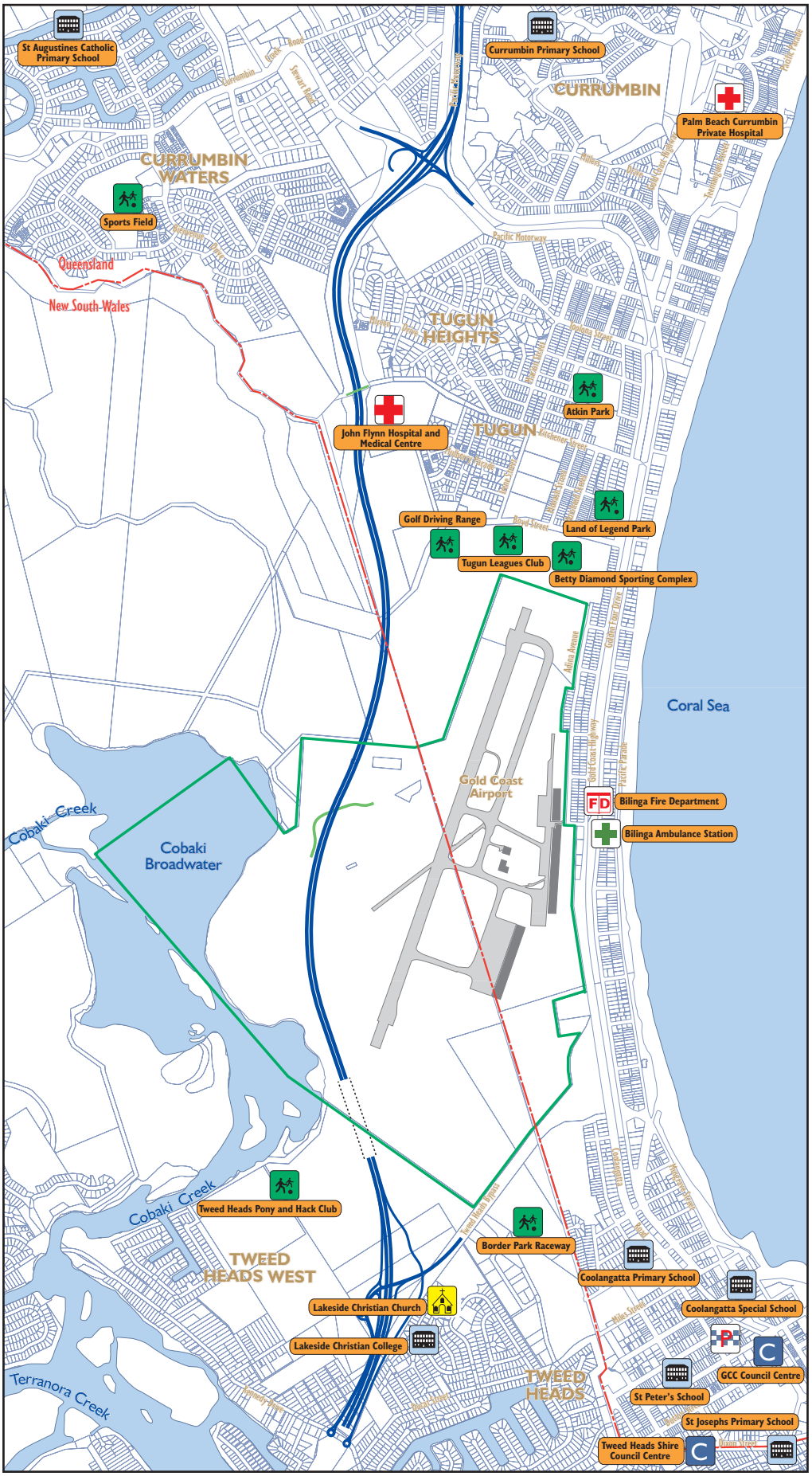


Figure 12.2 **Location of Major Community Facilities in the Study Area**

The Tweed Heads Pony and Hack Club is located on a large parcel of NSW Crown land adjoining the southern boundary of Gold Coast Airport. It consists of mainly cleared areas, with several paddocks, stables and yards, and trail riding areas.

The location of these recreation areas is shown in Figure 12.2.

12.2.6 Industry

The Currumbin Waters Industrial Estate is located at the northern end of the proposed Tugun Bypass corridor.

A small area of light industrial uses is located to the north of Boyd Street. This consists of a car park within a large shed for travellers using Gold Coast Airport, and small businesses in warehouse-type accommodation.

A sand-blasting operation was located at the southern end of the proposed bypass, adjacent to the junction with Tweed Heads Bypass. This operation has now closed.

The remainder of the property consist of semi-cleared land containing piles of disused scrap metal.

12.3 Implications for local planning strategies

Both Gold Coast City Council and Tweed Shire Council have acknowledged the importance of improving transport infrastructure in response to the increasing demand brought about by population and tourism growth. Their planning strategies have also shown a commitment to the development of an alternative inland transportation corridor to resolve safety and efficiency problems of the existing highway from north of Tugun to the Tweed Heads Bypass.

A large proportion of the alignment of the proposal between Boyd Street and Kennedy Drive is defined as an existing road reservation according to the local environmental plan and planning scheme for Tweed Shire and Gold Coast City respectively. Owing to the constraints identified during the impact assessment process, the alignment of the road has been amended for the EIS and, therefore, sections of the proposal are located outside the road reservation. This remaining land, with the exception of a number of private properties in the vicinity of the proposed junction with the Tweed Heads Bypass, is predominantly zoned for airport buffers and environmental protection purposes.

Existing generalised zoning in the area adjacent to the proposed Tugun Bypass is shown in Figure 12.3. These have been simplified for clarity to show the basic intention of each area of land. Further details on local planning strategies can be found in Technical Paper 15.

12.3.1 Gold Coast City

The Gold Coast planning scheme has reserved a corridor for the proposed Tugun Bypass under the community purposes domain. Under this scheme roads and associated works controlled by the state government as a state controlled road are identified as exempt development and so no development application is required for the Tugun Bypass proposal.

Figure 12.3 **Existing Generalised Zoning**

Gold Coast City Council's activity centre strategy and transport strategy provide objectives and directives for managing growth in the region, and acknowledge the need for an integrated approach to strategic planning.

The activity centre strategy aims to establish a framework of hierarchical town centres that minimises uneven development by providing a focal point for employment and urban development. This encourages mixed uses and subsequently reduces the need for cars by encouraging the use of other means of movement such as walking, cycling or public transport.

A desired environmental outcome of the *Gold Coast City Council Planning Scheme – Our Living City* (Gold Coast City Council 2003) is the provision of a safe, clean, accessible and affordable transport system that efficiently connects various parts of the city, and offers choice and convenience for residents and visitors. The transport strategy reinforces this outcome by aiming to achieve an efficient and flexible transport system to enable the optimal use of facilities and services located in and around activity centres.

Separating the different functions of road movements is seen as an important step in achieving greater access between existing residential areas and activity centres. This is also a key objective of the Tugun Bypass proposal, which seeks to create an alternative corridor for higher order (non-local) traffic movements.

12.3.2 Tweed Shire

The *Tweed Local Environmental Plan 2000* makes provision for a Tugun Bypass under the Special Uses 5(a) proposed classified road zone. However, the current alignment falls outside the existing corridor reserve. The permissibility issues relating to the alignment are discussed in Chapter 2.

The *Tweed Shire 2000+ Strategic Plan* (Tweed Shire Council 1996) provides guidelines for managing future growth in the area. The reduction in road congestion on coastal roads by the construction of an alternative inland transportation corridor is included as a desired outcome for infrastructure planning. The road network plans within the study area include the Cobaki Parkway servicing the Cobaki Lakes development, with a connection to the Gold Coast Highway at a signalised intersection at Boyd Street.

The *Tweed Shire 2000+ Strategic Plan* is based on the principle of integrating land use and transport. It has anticipated major residential growth in the shire, and identified several large areas for future urban development in areas to the west and north-west of Tweed Heads. Cobaki Lakes, which has a potential population of 14,000 residents, would be the largest new release area in the shire. The intention is to produce a series of self-contained centres in new residential neighbourhoods connected by a network of public transport and cycleways, thereby reducing dependence on private motor vehicles.

The road improvements brought about by the proposal would provide for future regional private and public transport and freight movements, and would assist the orderly development of urban release areas.

The proposed Tugun Bypass is, therefore, unlikely to have any major implications in terms of future land use planning in the Gold Coast and Tweed local government areas.

12.4 Land use and property impacts

Potential impacts on adjacent land uses owing to the proposed bypass include:

- loss of land (required for the road) which could have otherwise been available for alternative uses
- reduction in the availability of adjacent land for various uses because of the need to maintain buffer zones and environmental mitigation measures as a result of the new road
- change of access to areas of land that could stimulate a change of use or an intensification of existing development
- creation of a barrier to movement across the alignment that could inhibit the development of adjacent land if suitable mitigation measures are not included.

12.4.1 Land acquisition for development

Of the areas of land required to be acquired to enable construction of the proposed bypass, the majority (69%) is in public ownership, the Crown, the Commonwealth government, and both local councils. Approximately 27% is located within the site of Gold Coast Airport.

Details of the specific properties (or parts of the properties), which would need to be acquired, are set out in Appendix F and shown in Figure 12.4.

A total of 34 properties would be directly affected by the proposal. A section, or the whole, of these would be acquired to create the proposed corridor from the Stewart Road interchange to Kennedy Drive. Where an area considerably greater than necessary is acquired, due to the need to purchase whole properties instead of that part required for the proposal, the residual would either be sold on completion of the proposal, retained as compensatory habitat where appropriate, or rehabilitated as part of the landscape component of the bypass.

A small number of private residential properties would need to be acquired. The majority of these are small allotments with detached dwellings. Part of the area proposed for development at the Pacific Beach Estate would also be acquired.

Five commercial properties have been acquired, including the allotment accommodating the sand-blasting business on Parkes Road, two small allotments used for billboard advertising, and a small section of the Boyd's Bay Garden World Nursery.

Two properties with airport-related uses would be acquired, including some 14 ha of Commonwealth Airport Land currently leased to Gold Coast Airport Limited and two small allotments within the airport site leased by other organisations to accommodate navigation equipment.

Additional properties that would be affected by the proposal include road reserves owned by the NSW RTA, Tweed Shire Council, and NSW Crown land, one parcel of which is leased by the Tweed Heads Pony and Hack Club. The status of all property acquisition is shown in Appendix F.

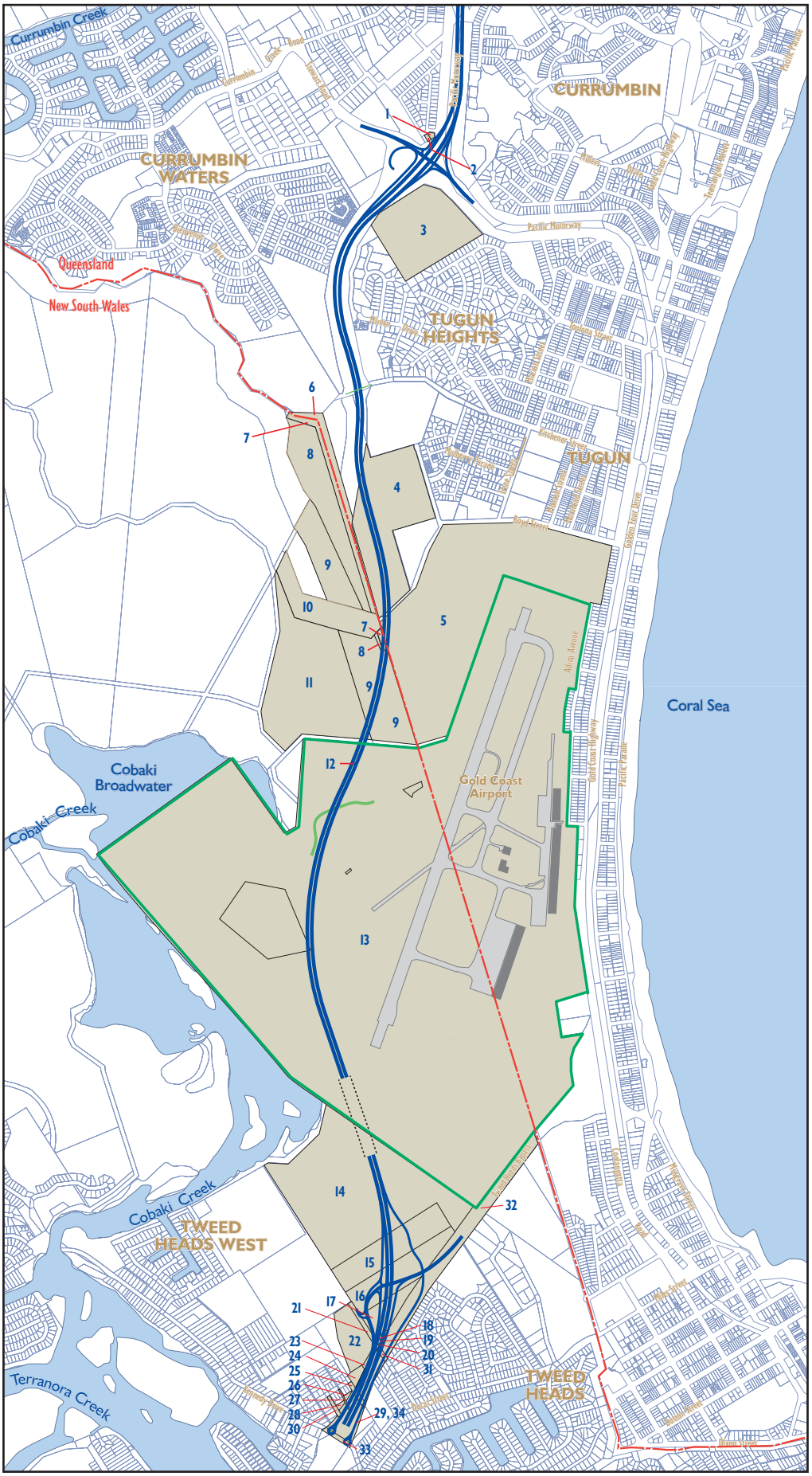


Figure 12.4 **Properties Affected by Loss of Land**

12.4.2 Means of acquisition

Land acquisition within the corridor will be on the basis of the procedures established in the relevant jurisdiction.

In Queensland, acquisition will be by negotiation between Main Roads and the land owner or the use of compulsory powers if an agreement cannot be reached. In NSW, the preferred approach for the acquisition of freehold land is by direct purchase by NSW RTA and, in the case of NSW Crown land, negotiation with the Department of Lands. Where an agreement cannot be reached with a private owner, the NSW RTA will exercise its powers of compulsory purchase for properties in NSW. The relevant procedures are set out in the *Land Acquisition (Just Terms) Compensation Act 1991*.

Procedures for the use of the land required for the corridor through Gold Coast Airport are more complex and have yet to be resolved. The land is owned by the Commonwealth government and is leased to Gold Coast Airport Limited for 50 years, with an option to extend for a further 49 years.

The acquisition process will be determined by the outcome of negotiations between all the relevant parties. These will need to be completed and an agreement reached prior to construction, and before approval of the proposal.

12.4.3 Improvements to access

Construction of the Tugun Bypass will result in improvements to access at the southern end of the proposal, adjacent to the Tweed Heads Bypass interchange.

A large parcel of land (15.8 ha) with a frontage to Cobaki Creek is zoned Industrial (4a) and has approval for a 46-lot subdivision. Current access to the site is poor, via residential streets from Kennedy Drive. There is no access along Parkes Drive. The new configuration of the interchange at Kennedy Drive would improve access to the area as a whole.

The Tugun Bypass will result in improved accessibility of the area to both the local and regional road network.

12.4.4 Airport uses

The proposed tunnel within the site of the Gold Coast Airport will have no land use impact as the land above the tunnel is proposed for airport-related uses. The bypass is laso recognised in the Gold Coast Airport Master Plan.

12.4.5 Buffer zones

The alignment of the proposal has been determined, in part, by the need to avoid penetrating the existing obstacle limitation surface at the airport. As a result, a tunnel is required and an appropriate buffer zone is needed so as not to compromise existing limitations.

12.4.6 Potential land use changes

Land adjacent to the proposed bypass corridor is predominantly undeveloped. However, the new road is unlikely to provide opportunities for changes in land use resulting from improvements in access. There are a number of reasons for this:

- There will be no new intersections between Stewart Road and the Tweed Heads Bypass and, therefore, no change in the accessibility of the land on either side of the proposed bypass.
- A significant proportion of the adjacent land is under the control of Gold Coast Airport Limited. Proposals for the development of this land are subject to the submittal of a major development plan for the airport site for the approval of the Commonwealth Minister for Transport and Regional Services.
- Other major developments in the vicinity are already approved, or are waiting for a decision on the proposed bypass prior to approval.

There is a strong possibility that some land in Tweed Heads West would be subject to future development. The presence of the bypass will have little effect on this prospect as the development could take place whether the proposed road went ahead or not.

The only significant land use change anticipated is at the area owned by Pacific Exchange Corporation (where residential development is planned), as much of this land will be required for the proposed bypass. The zoning of the affected areas will need to be changed from residential to transport corridor, thereby reducing the area available for future residential development.

Overall, implementation of the proposed Tugun Bypass is unlikely to exert any influence on land use change in the vicinity of the alignment. Its potential impact on future land uses at a regional scale is similarly limited, as the location of residential and employment generating activities is determined by a different process. The bypass is an example of the necessary transport infrastructure required following the establishment of land use patterns rather than being part of the process of development.

12.5 Impacts of operation on traffic and transport

Traffic modelling has been undertaken to determine the traffic changes from the proposed Tugun Bypass on the local area. The modelling has been based on Gold Coast City Council's strategic EMME/2 model (Gold Coast City Council 2002). The study area for the model also included the northern Tweed Heads area. The model has been modified where necessary to incorporate the latest demographic forecasts and road network enhancements with an allowance for likely future public transport mode share.

Three design years have been used for the traffic modelling, namely, opening year of 2007, 2017 and 2027 (10 and 20 years after opening respectively). The principal comparisons used in the EIS are with and without a four-lane Tugun Bypass in 2007, and with and without a four- or six-lane bypass in 2017. The assessment has been based on the morning and afternoon 2-hour peak period.

Detailed modelling results, including validation of the model, are available in Technical Paper 3. Key findings and results are summarised in the following sections.

12.5.1 Changes in traffic volumes

The number of vehicles estimated to use the proposed bypass, between Stewart Road and the Tweed Heads Bypass, for 2007, 2017 and 2027, is summarised in Table 12.1. This summary also includes estimated volumes along the Gold Coast Highway, with the bypass in place.

The estimated traffic volume for the proposed Tugun Bypass in 2017 is 59,600 vehicles per day. This represents a traffic split of 55% on the Tugun Bypass and 45% on the Gold Coast Highway.

In 2027, it is recognised that the corridor would be at or near capacity. At this time, it is estimated that about 80,000 vehicles per day may use the Tugun Bypass, with the remainder using the Gold Coast Highway. In this scenario, both the Tugun Bypass and the Gold Coast Highway are expected to be at or near capacity.

Table 12.1: Estimated traffic volumes with the proposed bypass

Section	2007	2017	2027
	(Level of service)	(Level of service)	(Level of service)
Tugun Bypass	46,000	59,600	79,900
Level of service (A–F)	C	C	E
Gold Coast Highway	38,900	48,100	64,500
Level of service (A–F)	C	E	F

12.5.2 Standard level of service

Standard level of service (LOS) describes operating conditions in a traffic stream. The conditions include speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and safety. The LOS provided varies depending on the type of road for the same traffic volumes. There are six LOS, A to F, with A representing the best operating conditions (free flow) and F the worst (forced or break-down flow). LOS D represents reasonable flow, approaching unstable flow, while LOS E represents traffic volumes at or close to the capacity of the road system with unstable flow (variable speeds) on occasions.

The proposed four-lane bypass would operate at a LOS C (good with some delays) in 2007 at opening to traffic. The level of service would decrease to a LOS of D (satisfactory with occasional delays) over about 20 years. By about 2027, it is anticipated the bypass would be at or near LOS E (operating near capacity, with frequent delays) with Gold Coast Highway operating at LOS F.

If the Tugun Bypass was not constructed, by 2007, a number of the key intersections on the Gold Coast Highway are forecast to be operating at a very poor level of service with extremely high average delays forecast at many locations in both the morning and evening peak periods.

12.5.3 Changes to operational performance

Identification of traffic-related impacts of the proposed Tugun Bypass has been based on comparisons of volume/capacity ratios and travel speeds for the morning and afternoon peak periods for the main model scenarios listed in Section 12.5. These comparisons are detailed in Technical Paper 3. Key findings of the assessment are summarised below.

Travel conditions in 2007

Predicted travel speeds on selected roads in the vicinity of the proposed Tugun Bypass have been modelled. The speeds are for the morning peak in 2007, with and without a new four-lane highway, and are detailed in Technical Paper 3.

The modelling found that traffic conditions on the Gold Coast Highway would improve following the opening of the proposed Tugun Bypass. Traffic would be free flowing with the bypass operating at about 50% of capacity during peak periods. In the absence of the bypass, congestion and delays on the Gold Coast Highway would persist.

The implementation of the proposal would result in some improvements to the surrounding road network or would have negligible impact.

Travel conditions in 2017

In the absence of the proposed bypass, traffic conditions on the Gold Coast Highway would deteriorate to a level of severe congestion with long delays. Demand would significantly exceed capacity, and travel speeds would be very low. However, with the bypass in place, traffic conditions on the highway would be free flowing and operating more freely than the present conditions.

The implementation of the proposal would either improve conditions on the remainder of the surrounding road network, or have a negligible effect, based on the results of the EMME/2 transport model. The only road expected to experience increases in traffic flows in 2017 would be Stewart Road during the morning peak.

Widening of Gold Coast Highway

Scenarios including the upgrade of the Gold Coast Highway to six lanes were also investigated. The outcome of these assessments for 2017 is that:

- the Gold Coast Highway corridor from Stewart Road to Kennedy Drive would need a capacity of 108,000 vehicles per day on an average weekday
- widening of the existing route via the Gold Coast Highway in the absence of the bypass would have little influence on traffic patterns, with travel times and congestion reduced only marginally. This is due to the absence of an alternative route.
- a four-lane Tugun Bypass would accommodate 55% of corridor traffic up to 2017
- widening the Gold Coast Highway to six lanes with the four-lane Tugun Bypass in place would have little effect on traffic conditions as sufficient capacity would be available to accommodate demand without the upgrade.

12.6 Impact of construction on traffic and transport

12.6.1 Changes in traffic volume

Although construction activities would be undertaken at some distance from existing roads, haulage of material to the site would add to the traffic on the existing highway and some local roads used as access to the alignment. Access to the construction site is proposed via Stewart Road, Boyd Street and Parkes Drive.

Chapter 7 outlines the construction requirements for the proposal and the management measures that would be implemented. Technical Paper 3 details the changes to traffic volumes as a result of the construction.

Overall, the impacts owing to construction traffic are expected to be negligible.

12.6.2 Impacts on the operation of public transport

There are bus routes along the eastern part of Boyd Street providing access to the John Flynn Hospital and Medical Centre, and the sporting and other facilities in the area. It is not expected that bus operations would be affected by the increase in traffic on Boyd Street during the construction period.

12.6.3 Provision for pedestrians and cyclists during construction

Impacts on pedestrians and cyclists are expected to be limited during the construction period. All existing pedestrian and cycle routes would be maintained with minor diversions where required.

Impacts will be limited to minor disruptions occurring over that part of the construction program requiring works.

12.7 Traffic management

12.7.1 During construction

Traffic management during construction will involve a major interface with the existing road network at the Tweed Heads Bypass.

This location will require staged construction and the provision of temporary road works under agreed traffic management and safety procedures. Other locations will be required in order to provide access for:

- workers, equipment and material delivery
- early construction of critical bridges along the alignment
- emergency and incident response
- maintenance of environmental elements along the alignment.

Construction activities will otherwise take place well clear of existing roads, and require only minor traffic management techniques at the minor access points. The contractor will be required to submit detailed traffic management plans for each section.

12.7.2 During operation

Changes in traffic flows resulting from implementation of the proposed bypass are expected to require the introduction of management measures in two areas:

- along the Gold Coast Highway to take advantage of the reduction in traffic demand and the wide corridor available
- in areas where traffic flows are expected to increase to gain access to the bypass.

Both these will require further study in collaboration with the communities affected once a decision is made on the future of the bypass. Implementation will be the responsibility of Main Roads and Gold Coast City Council.

12.8 Implications for ecologically sustainable development

12.8.1 The precautionary principle

The development of new transport infrastructure to address an existing congestion problem is likely to lead to the stimulation of new trips. It is reasonable to assume that some are currently suppressed by the knowledge that delays will occur which is in excess of the value placed on the trip by the potential traveller. The removal of this constraint means there is no longer a deterrent to travel. Current techniques do not enable estimates of new trips, stimulated solely by the introduction of new transport infrastructure, to be made. However, investigations elsewhere suggest that these would be smaller in number.

Detailed computer modelling of the traffic and transport implications of the proposal has been undertaken. Interpretation of the results shows that there would be no threat of serious or irreversible damage to the environment of the area as a consequence of the predicted changes.

12.8.2 Intergenerational equity

The proposal would create improved conditions in areas currently affected by high traffic volumes and congestion at certain periods. This would provide the opportunity for social and economic opportunities. Improvements would also be achieved for a range of transport modes, including buses, walking, cycling and taxis, and potentially for the provision of light rail. These benefits to varying degrees, would be available for future generations.

12.8.3 Conservation of biological diversity and ecological integrity

The traffic and transport changes resulting from the implementation of the proposal would have no significant impact on biological diversity or ecological integrity.

Table 12.2 summarises the implications of the proposal for ecologically sustainable development in relation to traffic and transport issues.

Table 12.2 Implications of traffic and transport impacts for ecologically sustainable development

Precautionary Principle	Inter-generational Equity	Conservation of Biological Diversity
Detailed computer modelling of the traffic and transport implications of the proposal has been undertaken. Interpretation of the results shows that there would be no threat of serious or irreversible damage to the environment of the area as a consequence of the predicted changes.	Implementation of the proposal would lead to improvements in the efficiency of the road network with minor effects in the surrounding area. This would produce benefits in terms of reductions in total vehicle hours travelled and the opportunities for the introduction of public transport infrastructure.	The traffic and transport changes resulting from the implementation of the proposal would have no significant impact on biological diversity or ecological integrity.

12.9 Conclusions

A corridor for the Tugun Bypass is included on the Tweed Heads Local Environmental Plan 2000. However, the route of the proposal has been realigned to minimise environmental impacts and would pass through land zoned predominantly for Special Uses (Airport), Rural and Open Space/Recreation. The Tugun Bypass would not affect any proposals included in local statutory planning documents and would not inhibit development strategies in place in Gold Coast City or Tweed Shire local government areas.

On opening, the Tugun Bypass would attract a significant proportion of traffic from the existing route along the Gold Coast Highway thereby alleviating existing traffic-related environmental impacts. In providing additional road capacity, the Tugun Bypass would create opportunities for the future provision of enhanced public transport facilities on the Gold Coast Highway and improve conditions for pedestrians and cyclists as through-traffic diverts to the new route.

13. Socio-economic impacts

13.1 Introduction

Based on the methodology and approach outlined in the previous chapter, the following sections deal with the community perceptions and responses to the proposal. The specifics of individual impacts such as noise and air quality are discussed in other sections of the EIS.

Social impacts due to the proposal can result from:

- changes to access patterns
- changes in amenity for individual community members from changes in traffic distribution
- issues relating to road safety
- perceptions of change.
- Potential social impacts associated with the proposed Tugun Bypass are discussed in the following sections in relation to the community likely to be affected.

13.2 Existing community

13.2.1 The study area

The proposed bypass is within the boundaries of the local government areas of Gold Coast City in Queensland and Tweed Shire in NSW. The study area has been defined, for the purposes of the socio-economic assessment, as including the statistical local areas of Bilinga, Coolangatta, Currumbin, Currumbin Waters, Tugun, and Tweed Shire Part A (including the suburbs of Tweed Heads, Tweed Heads West and Tweed Heads South).

13.2.2 Demographic profile

The most recent census was conducted by the Australian Bureau of Statistics during 2001, *Census of Population and Housing 2001*. Based on the results from this census, the Gold Coast City had an estimated resident population of 418,500 at June 2001. The estimated resident population of Tweed Shire at the same time was 74,380.

Gold Coast City Council had the second largest growth rate of any local government area in Australia, recording an average annual growth rate of 3.2% from 2000 to 2001, slightly lower than the previous period, which was 3.4%. In comparison, the Tweed Shire had an average annual growth rate of 1.9% between the 1996 census and 2001 census. These growth rates are higher than the Australian (1.2%), Queensland (1.7%) and NSW (1%) averages and are projected to continue. By 2011, the populations of Gold Coast City and Tweed Shire are forecast to be 520,000 persons and 92,000 persons respectively.

Table 13.1: Demographic characteristics within the study area (2001)

Characteristic	Local Area					
	Bilinga	Coolangatta	Currumbin	Currumbin Waters	Tugun	Tweed Shire Part A
Total Persons at Time of Census	1,802	7,233	2,785	9,333	5,150	47,489
Indigenous Population (%)	0.9	1.1	1.9	1.2	1.4	2.9
Age Structure (%)						
0-14 years	11.0	7.9	15.2	21.0	15.1	17.2
15-24 years	10.2	9.1	12.7	11.6	10.7	8.8
25-34 years	9.6	9.4	14.1	11.5	11.8	9.3
35-44 years	11.1	9.9	14.1	15.8	13.3	12.2
45-54 years	13.3	12.6	16.2	14.1	13.6	12.6
55-64 years	12.9	14.2	11.6	9.6	10.7	12.4
Over 65 years	31.9	36.9	16.1	16.4	24.8	27.5
Labour Force Participation (%)	43.8	40.2	62.3	58.4	52.4	44.8
Unemployment Rate (%)	18.7	14.8	9.5	10.1	10.9	12.2
Weekly Household Income (%)						
Less than $500	45.3	49.0	29.5	33.9	37.3	44.7
Greater than $1,000	20.4	14.1	27.0	25.9	22.0	17.8
Motor Vehicle Ownership Households (%)						
No Motor Vehicle	14.2	20.6	7.6	6.0	10.6	11.4
One Motor Vehicle	50.7	48.4	47.6	43.3	46.5	51.7
Two Motor Vehicles	19.9	12.7	27.7	34.0	28.1	24.1
Three Motor Vehicles	5.8	3.9	8.7	12.0	7.9	6.8
Family Structure (%)[1]						
Couple with Children	14.0	11.0	20.4	34.7	23.0	46.7
Couple without children	25.6	25.0	28.9	29.7	28.8	26.4
One Parent Family	9.6	10.5	10.6	10.5	10.5	12.5
Lone Person	42.3	42.3	29.7	18.8	28.7	10.4
Group Household	7.0	9.2	8.1	4.2	6.8	3.3
Other	1.5	2.0	2.3	2.1	2.2	0.1

Source: Australian Bureau of Statistics (2001 Census Data)
Note 1: Based on Australian Bureau of Statistics (1996 Census Data)

In August 2001, the total persons in the study area were estimated to be 73,800. Demographic characteristics for the study area, based on 2001 census information, are provided in Table 13.1. Demographic characteristics for the study area emerging from these data are outlined below:

- The local areas of Bilinga and Coolangatta are characterised by an older population. Compared to other parts of the study area and the Gold Coast, these local areas exhibit lower average incomes, lower workforce participation rates, higher unemployment rates, lower levels of motor vehicle ownership and a higher number of lone person households. This suggests a resident semi-retired or retired population.

- In comparison with other parts of the study area, Currumbin and Currumbin Waters are characterised by a younger population, with higher incomes, higher workforce participation rates, lower unemployment rates and higher levels of motor vehicle ownership. The predominant family structure within these areas comprise couples with children. This suggests a resident population of younger families in a more recently developed area.
- Although the community in the Tugun area has an older population age structure, with more than a third of all households with a weekly income below $500, the unemployment rate and the level of car ownership are not as low as those in Bilinga and Coolangatta. Household characteristics (couples with children and lone person households) are similar to those in Currumbin where average income levels are higher, suggesting a mixture of resident retirees and young couples.
- Although characterised by an older population, Tweed Shire Part A also has a high percentage of young people and the highest number of Aboriginal residents. Unemployment rates are similar to Tugun while weekly incomes are similar to Bilinga, suggesting the resident population is a mixture of retirees and young families.

The older established suburbs such as Tugun, Bilinga and Coolangatta along the coastal strip are characterised by a retired population who have probably been resident for many years. The more affluent, younger families are predominantly located in the recently developed suburbs of Currumbin and Currumbin Waters.

13.3 Community and social infrastructure

The Gold Coast Highway is a main route linking Queensland and NSW. The coastal strip along the highway between Tugun and Bilinga, comprises a mix of residential housing, accommodation facilities, community facilities and retail outlets. The predominant community land use in the study area is Gold Coast Airport, which is the main air transport gateway to the Gold Coast and Tweed region.

Community and social facilities

As discussed in Chapter 12, the study area is well served by community infrastructure. The area contains five schools catering for all age groups, a full range of local health services, including the John Flynn Hospital and Medical Centre, and emergency services include a fire station, police station, ambulance centre and Air Sea Rescue facility.

Sporting facilities include the Betty Diamond Sporting Complex and Tweed Heads Pony and Hack Club. The location of the community and social facilities throughout the study area is provided in Technical Paper 15 and shown on Figure 12.2.

Commercial, retail and industrial facilities

Coolangatta and Tweed Heads function together as a regional centre with Tugun as a district centre. Commercial development (retail mix) is mainly located at Tugun, adjacent to the Gold Coast Highway. Small scatters of commercial development are situated within the coastal strip at Currumbin, Tugun, Bilinga, Coolangatta and Tweed Heads. Industrial areas are located at the Currumbin Industrial Estate, the southern end of the alignment at Tringa Street and the Ourimbah Industrial Estate and in the vicinity of Gold Coast Airport associated with airport activities.

There are eight service stations along the existing highway that may be affected by the proposed bypass in terms of access changes or loss of trade.

13.3.1 Transport and economic environment

Transport network

The current functional road hierarchy in the southern Gold Coast region is dominated by the Gold Coast Highway and the Pacific Motorway. The latter accommodates a high proportion of through traffic, providing limited access conditions, relatively high traffic speeds and uninterrupted traffic flow. Conversely, the Gold Coast Highway involves high access frequency and regular interruption of through traffic flow. It carries a mix of through (longer distance) traffic as well as traffic requiring access to the local area. Both the Gold Coast Highway and the Pacific Motorway are considered higher order roads within the road structure of the southern Gold Coast region.

Local employment

The Gold Coast is an important employment centre in south-east Queensland. In 2001, the proportion of Gold Coast residents employed in the private sector (80.9%) was higher than for Queensland (78%) and Australia (76.9%). The main employment industries in Gold Coast City in 2001 were retail, property and business services, manufacturing, construction, accommodation, and cafes and restaurants.

The areas in the southern Gold Coast region with the highest number of jobs in 2001 were:

- western Currumbin Waters, Tugun (between Kitchener Street and Boyd Street), Coolangatta (south of Gold Coast Airport) and Tweed Heads, with in excess of 400 jobs/km^2
- Coolangatta (in the vicinity of Gold Coast Airport), with between 200 and 300 jobs/km^2
- Tugun (south of Boyd Street to the perimeter of Gold Coast Airport) and the southern end of Bilinga and Tugun, with between 100 and 200 jobs/km^2.

Projections for employment in 2011 indicate increased job availability for:

- Coolangatta (in the vicinity of Gold Coast Airport) and Tweed Heads West, with between 300 and 400 jobs/km^2
- Currumbin Waters (adjacent to the proposed alignment), with between 100 and 200 jobs/km^2
- Tugun (north of Kitchener Street), with between 200 and 300 jobs/km^2.

Similarly, regional and local plans applying to the study area identify employment focal points as the Gold Coast Airport, the regional centres of Coolangatta and Tweed Heads, industrial areas at Currumbin and Currumbin Waters and the tourist and recreational areas spread along the coastal strip.

Tourism

Tourism provides the Gold Coast and the northern Tweed Heads region with its highest proportion of revenue and largest number of employment opportunities. It is important in supporting residential and secondary industry growth. The Gold Coast is the most popular

destination for international visitors to Australia after Sydney. In 1997, 30% of the total visits to the Gold Coast were international visitors (Gold Coast City Council 1999).

The study area has a full range of accommodation types catering for the tourist market, from caravan parks and motels to luxury apartments. There are also a large number of private apartments, used as either a holiday retreat by their owners, or rented privately to tourists and local holiday makers. The majority of accommodation in the study area is along the coastal strip, on either the Gold Coast Highway or Golden Four Drive.

Local businesses

The majority of local businesses in the study area are located along the coastal strip with approximately 130 located along the Gold Coast Highway between the start of Golden Four Drive and north Kirra Beach. A cluster of shops is located at the corner of the Gold Coast Highway and Wagawn Street. Golden Four Drive provides access to a strip of apartments, surf shops and convenience stores.

13.4 Potential impacts and mitigation measures

13.4.1 Changes to access patterns

Changes to existing access patterns could affect vehicular, pedestrian and bicycle traffic. Changes to access patterns during construction would be of most concern where partial road closures and diversions are required, for example construction of the Tweeds Head Bypass interchange. These have the potential to create delays and cause difficulties in gaining access to local facilities and services.

Access disruptions could also occur at the construction site compound. If this compound is located in the vicinity of the Tugun Landfill as proposed, the main access to this site would be via Boyd Street. This could create conflicts between construction vehicles and local traffic in this area. The main access to the John Flynn Hospital and Medical Centre is via Boyd Street. Access to this facility would be maintained and the movement of emergency vehicles not hindered or subjected to delays during the construction period.

Boyd Street is also used to gain access to the Betty Diamond Sporting Complex and the Tugun Leagues Club. These are major community facilities used on a regular basis. In particular, the Betty Diamond Sporting Complex is used by local schools so there would be a steady weekday stream of users to the complex and access would need to be maintained. Along other parts of the proposed alignment, construction activities would be clear of existing roads and disruption to existing access patterns would be limited.

Partial road closures and diversions at the proposed Tweed Heads Bypass interchange would be managed by the use of diversions, the two-way service road near Kennedy Drive and limited construction activities at night. A Traffic Management Plan would be prepared to maintain access to facilities in the study area. Local residents would be kept informed of scheduled road works in their vicinity.

Elements to be incorporated in the Traffic Management Plan are provided in Technical Paper 3.

Overall the operation of the bypass would create considerable travel time savings between Stewart Road and Kennedy Drive and improve accessibility for the local community and the response time for emergency services.

Cyclist movement

The proposed Tugun Bypass would improve cycling conditions by:

- reducing vehicle traffic volumes on the Gold Coast Highway and its service roads, hence reducing the level of interaction between cars and bicycles
- increasing local accessibility for cyclists through an increase in green time allocated to side street intersections
- removing the majority of larger heavy vehicles from the Gold Coast Highway.

The Gold Coast Highway is currently the worst blackspot for accidents involving bicycles in the Gold Coast. The effect of substantial reduction in traffic volume is expected to result in a reduction in the number of accidents along this corridor.

In conjunction with Gold Coast City Council and a number of cycling groups, Main Roads would aim to provide improvements to the existing cycleways. It is the policy of Main Roads to prevent cyclists using motorways on safety grounds. The separation of cyclists and traffic accords with the NSW RTA's *NSW Bicycle Guidelines*. One of the major aims of the guidelines is to reduce encounters between cyclists and high volumes of fast moving traffic and the best practice method of achieving this is by separation.

Although bicycle access would not be provided along the bypass itself, provision for cyclists on the bridges over the bypass (Stewart Road and Tweed Heads Bypass) would result in an improvement in amenity, especially if future cycleways are linked to these connections.

Pedestrian movement

There is currently an observed high demand for pedestrian movements between the Tugun Heights area and the strip of commercial development and the beach on the eastern side of the Gold Coast Highway at Tugun. Pedestrians crossing the highway to make this trip are required to do so at the signalised pedestrian crossing at the Kitchener Street intersection with the Gold Coast Highway. Crossings at other locations are unsafe due to the width of the highway, the speed of traffic and the proportion of heavy vehicles in the traffic stream.

There are significant delays to pedestrians attempting to cross the Pacific Motorway at its junction with the Gold Coast Highway at Tugun due to the through traffic on the Gold Coast Highway which is allocated a large proportion of the green time for the intersection. There are also delays incurred by traffic on the Gold Coast Highway when pedestrians trigger the signals at Kitchener Street due to the width of the crossing and the clearance times required for this width.

Without the proposed Tugun Bypass, traffic volumes on the Gold Coast Highway would increase, requiring the highway to be widened at Tugun. This would result in increased difficulties for pedestrians crossing the highway.

Alternatives to reducing the volume of traffic on the Gold Coast Highway to improve pedestrian conditions include pedestrian underpasses or overpasses. Overpasses would introduce visual impacts in a landscape that is relatively flat, while underpasses would be susceptible to the effects of a relatively high water table as well as personal security issues associated with these facilities.

The construction of the proposed Tugun Bypass would provide opportunities to reduce the green time allocated to through traffic movements and hence reduce the delays for pedestrians

crossing the Gold Coast Highway. This would be possible in the short to mid-term, ultimately, as traffic increases, conditions would revert to the current situation. This would, in turn, reduce the incentive to cross the Gold Coast Highway at other locations, resulting in safety improvements.

An associated benefit to pedestrians would be an improvement to safety through a reduction in traffic using the service roads to avoid delays on the highway. In the long-term pedestrian overpasses may need to be provided.

13.4.2 Amenity changes

As discussed in previous chapters, the construction of the Tugun Bypass would have both positive and negative noise, vibration and air quality impacts for the local community. A change in the visual character of the area would also be experienced.

Chapter 14 outlines the potential noise and vibration impacts and mitigation measures. Changes to air quality and associated mitigation measures are outlined in Chapter 9 and changes to the visual landscape of the area are discussed in Chapter 16.

13.4.3 Road safety issues

Congestion caused by construction activities could potentially affect road safety. Construction traffic would be required to access the works from Stewart Road or the Tweed Heads Bypass interchange. However there would be a requirement for some traffic to access the site via Boyd Street. The use of Boyd Street as the access route to the construction site (if based at Tugun Landfill) has the potential to create road safety issues given that this residential street is used frequently by residents to reach the John Flynn Hospital and Medical Centre and Betty Diamond Sporting Complex.

The implementation of a Traffic Management Plan would help to maintain and improve road safety in the traffic area by:

- controlling access points for construction vehicles to reduce the likelihood of conflicts with other road users where possible
- designing access points with appropriate speed controls to minimise disruption to other road users
- providing appropriate signage and safety devices (such as temporary concrete barriers) in accordance with the relevant standards and guidelines
- avoiding excessive construction vehicle access during the peak travel times
- minimising disruption to through traffic to maintain consistent travel times where possible.

Overall, the reduction of traffic on the Gold Coast Highway and the removal of a large proportion of heavy vehicles would improve opportunities for safe bicycle and pedestrian facilities to be incorporated both along and across the highway from Currumbin to Coolangatta.

13.4.4 Transport and local business impact considerations

Transport and community

As discussed previously in the chapter, the construction of the Tugun Bypass would divert a significant amount of traffic away from the Gold Coast Highway, including heavy vehicles, therefore improving the amenity of local residents located within the vicinity of the Gold Coast Highway.

A study undertaken by the UK Department of the Environment assessed the levels of nuisance experienced at particular traffic volumes, particularly resulting from the construction of bypasses to a number of towns with populations ranging between 1,000 and 55,000.

Overall, taking both before and after observations into account, the single best indicator of levels of nuisance was the number of heavy trucks, although there was also a correlation with traffic flow and the percentage of heavy trucks in the traffic mix.

Large improvements in environmental conditions occurred in all the bypassed towns, especially small towns, due to the strong correlation between town size and the level of traffic relief.

The population of the area adjacent to the Gold Coast Highway where traffic reductions in excess of 50% would be experienced is about 11,300. Traffic reductions on the Gold Coast Highway and other local roads in the order of 55% and the removal of almost all heavy trucks would result in noticeable improvements in environmental conditions and the amenity of local residents and visitors.

Freight movement

The Pacific Motorway/Highway and Gold Coast Highway are strategic routes of national importance as they form one of the main road transport corridors between Brisbane, northern NSW regions and Sydney. Commercial vehicles, involved in transporting freight or conducting trade along the Gold Coast Highway, currently comprise 13% of vehicles using this corridor on a daily basis.

The delays incurred on the Gold Coast Highway through Tugun/Bilinga currently have an effect on the efficiency of freight movements in terms of both average travel time and the variability in travel times due to congestion and crashes.

The proposed bypass would attract longer distance, higher volume movements while there would still be some use of the Gold Coast Highway for local, smaller volume movements. Travel time and travel reliability benefits would accrue to both types of movements as a result.

The flow-on effects of the bypass would contribute to increased efficiency and cost savings for freight operators.

Tourism

The coastal strip between Burleigh and Tweed Heads caters to tourists, shopping and through traffic. This is a high turnover corridor with a number of entries and exits from the transport system to adjoining land uses.

By alleviating congestion along the Gold Coast Highway access to and travel along this corridor would ultimately be safer and less frustrating. A flow-on effect from these improvements to traffic conditions along the Gold Coast Highway may be improved local amenity and increased

attractiveness of the coastal beaches. The outcomes the proposed bypass offers the area include opportunities for increased tourism growth and the pursuit of recreational activities.

Local business centres

There are three centres located in the proximity of the proposal:

- Tugun
- Gold Coast Airport
- Coolangatta/Tweed Heads.

Each of these differ in character and function.

Tugun

A small centre located at the intersection of the Pacific Motorway and the Gold Coast Highway, Tugun Centre provides retail and tourist facilities for the residents of Currumbin, Tugun Heights, Tugun, Bilinga, visitors and tourists. The reduction in traffic flows along the Gold Coast Highway as a result of diversions onto the Tugun Bypass is not expected to affect turnover in the centre as it is primarily focussed on serving local needs. The removal of through traffic from the adjacent highway would provide the opportunity to improve local amenity for both residents and tourists with subsequent benefits for local businesses.

Gold Coast Airport

The airport provides a number of commercial facilities ancillary to its principal transport role and a substantial number of jobs which benefit the local community. While there are proposals for an expansion of mainly airport related commercial activities at this location, these are unlikely to be affected to any great degree by the presence of the Tugun Bypass and would increase in relation to overall future growth in the main activities of the airport. Access to the site would be improved as a result of reductions in traffic along the Gold Coast Highway and future changes to local infrastructure. This would improve conditions at the airport but would be unlikely to influence future growth.

Coolangatta/Tweed Heads

The two centres adjacent to the Queensland-NSW border have coalesced to form the largest centre in the southern Gold Coast serving a large hinterland predominantly located to the south. The main access to these centres from the south is along the Pacific Highway and Minjungbal Drive and via the Gold Coast Highway from the north. The completion of the Tugun Bypass would result in the diversion of through traffic from the Tweed Heads Bypass and the Gold Coast Highway. This traffic would not have been seeking a destination in Coolangatta and Tweed Heads. The resultant reduction in traffic volumes on the Gold Coast Highway would lead to a marginal improvement in access to the centres but it is doubtful that the construction of the bypass would have a more significant impact. Such changes are much more likely to result from future population growth in areas to the south and west of Tweed Shire.

Local businesses

A number of local businesses within the study area are likely to be indirectly affected by the proposed bypass. The diversion of through traffic from the Gold Coast Highway to the proposed Tugun Bypass would result in a loss of exposure for these local businesses and a

subsequent decline in passing trade for some. A random survey of local businesses along the Gold Coast Highway and Golden Four Drive was undertaken in February 2001 to canvass the views of business owners regarding the proposed bypass. Approximately 50% indicated that they relied on passing trade. Of these, approximately half considered that the loss of passing trade would have a negative impact on their business. The results of the survey are presented in Technical Paper 15.

While it is possible that some businesses may experience a decline in trade as a result of reduced exposure to passing traffic, improved amenity along the Gold Coast Highway may be beneficial for a number of local businesses along this corridor. Traffic travelling to Tugun, Bilinga or Coolangatta beaches would still use the existing Gold Coast Highway to gain access to these areas. In addition, improvements to local amenity arising from reduced traffic volumes are likely to increase tourist trade and attract the local community to frequent these areas on a more regular basis. Decreased traffic volumes would improve the overall amenity of the area providing benefits to local accommodation establishments.

Business sectors likely to benefit from the local amenity improvements created by the proposed bypass include the accommodation and tourism industries. Strategies such as focussing more on local trade, increasing advertising and diversifying product lines could be implemented by local businesses to minimise the effects of any loss of exposure to passing trade and improve the overall economic viability of the business.

In the short-term, local businesses (especially those catering to the needs of construction workers (food, drink, petrol and accommodation) can expect to benefit from the proposed bypass through increased patronage.

13.5 Implications for ecologically sustainable development

13.5.1 The precautionary principle

Consultation with the local community has taken place and concerns have been recorded. The proposal would provide significant improvements in some parts of the study area while other areas would experience impacts which would affect local amenity. Reduced traffic volumes on the Gold Coast Highway would create improvements to local amenity including decreased congestion, noise and improved air quality. The future consequences of the project are predictable and mitigation measures available.

13.5.2 Intergenerational equity

The implementation of the proposal would be beneficial to the majority of residents, with the improvements in community focus being passed to future generations. While the balance is positive a number of residents close to the new route would see some deterioration in their environment.

13.5.3 Conservation of biological diversity

Socio-economic and community impacts would have no effect on biological diversity.

The implications of the socio-economic impacts of the proposal on ecological sustainability are summarised in Table 13.2.

Table 13.2: Implications of socio-economic impacts for ecologically sustainable development

Precautionary principle	Intergenerational equity	Conservation of biological diversity
The concerns of the local community have been recorded and the potential impacts of the proposal on residents and businesses assessed. The future consequences of the proposal are known and appropriate mitigation measures available.	The introduction of the bypass would be beneficial to the majority of residents in the area although a small number would experience a reduction in their local amenity. Changes in amenity would be available to present and future generations if advantage is taken of the opportunities made available for improvement.	No effect on biological diversity.

13.6 Conclusions

The removal of 50% of the traffic and the almost complete removal of heavy vehicles from the existing Gold Coast Highway corridor would result in significant improvements in environmental conditions for the communities of Tugun and Bilinga. This would remove the delays currently experienced by pedestrians trying to cross the Gold Coast Highway and significantly improve the amenity value of the coastal strip. This would also provide opportunities for increased tourism growth.

The reduction in traffic will also improve access to the local business centres in the area, but some of the business may see a decline in passing trade. However the local amenity improvements would allow some business sectors to expand, particularly those involved in accommodation and tourism.

Operation of the Tugun Bypass would also create considerable travel time savings between Stewart Road and Kennedy Drive, improved accessibility for the local community and the response time for emergency vehicles. Flow-on effects of the bypass would also contribute to increased efficiency and cost savings for freight operators.

14. Noise and vibration

14.1 Introduction

When planning a major road project it is important to identify and address the impacts of road traffic noise on local communities. The EIS seeks to predict and minimise these impact both during construction and operation. The Tugun Bypass would move the flow of interstate and heavy vehicle traffic from the Gold Coast Highway to a new route to the west. Local traffic would continue to use the Gold Coast Highway corridor. At the northern end of the bypass the route passes close to residential areas not currently affected by noise from traffic. At the southern end residential areas close to the Tweed Heads Bypass are already affected by existing traffic noise, the Tugun Bypass will alter traffic flows and alter the distribution of road noise.

The noise likely to be generated by the bypass has been predicted from a computer noise model. It has taken account of likely traffic flows, road surfaces speed, percentage of commercial vehicles and the possible location of noise barriers and produced maps of traffic noise contours. Further details of the noise modelling process are discussed in Technical Paper 10.

The route of the bypass crosses land administered by NSW, Queensland and the Commonwealth. Each jurisdiction has slightly different standards and requirements for road traffic noise and this chapter assesses the effects in each jurisdiction. Technical Paper 10 provides a detail of the noise studies.

14.2 Queensland noise assessment

14.2.1 Noise monitoring locations

Seven monitoring locations in Queensland were selected to provide an indication of existing baseline noise levels at sensitive receptors along the proposed alignment. Noise logging was conducted over a series of continuous 24-hour periods. The locations are shown on Figure 14.1 while Technical Paper 10 provides more detail on the equipment and methods used.

14.2.2 Baseline noise monitoring results

The results of the noise monitoring are shown in Table 14.1. The key noise parameter is the $L_{A10\,(18\ hour)}$, this is the highest 10% of noise in each hour which is then averaged over the 18 hours. This sample time is typically used to describe the prevailing noise environment over a defined time period. The 18-hour period covers the time from 6:00 am to midnight.

The noise environment along the proposed alignment for the Queensland section of the Tugun Bypass includes contributions from road traffic, aircraft from Gold Coast Airport, birds, insects, wind movement in trees and general residential noise. Road traffic on the Pacific Motorway and Gold Coast Highway dominate ambient noise levels at the northern end of the alignment.

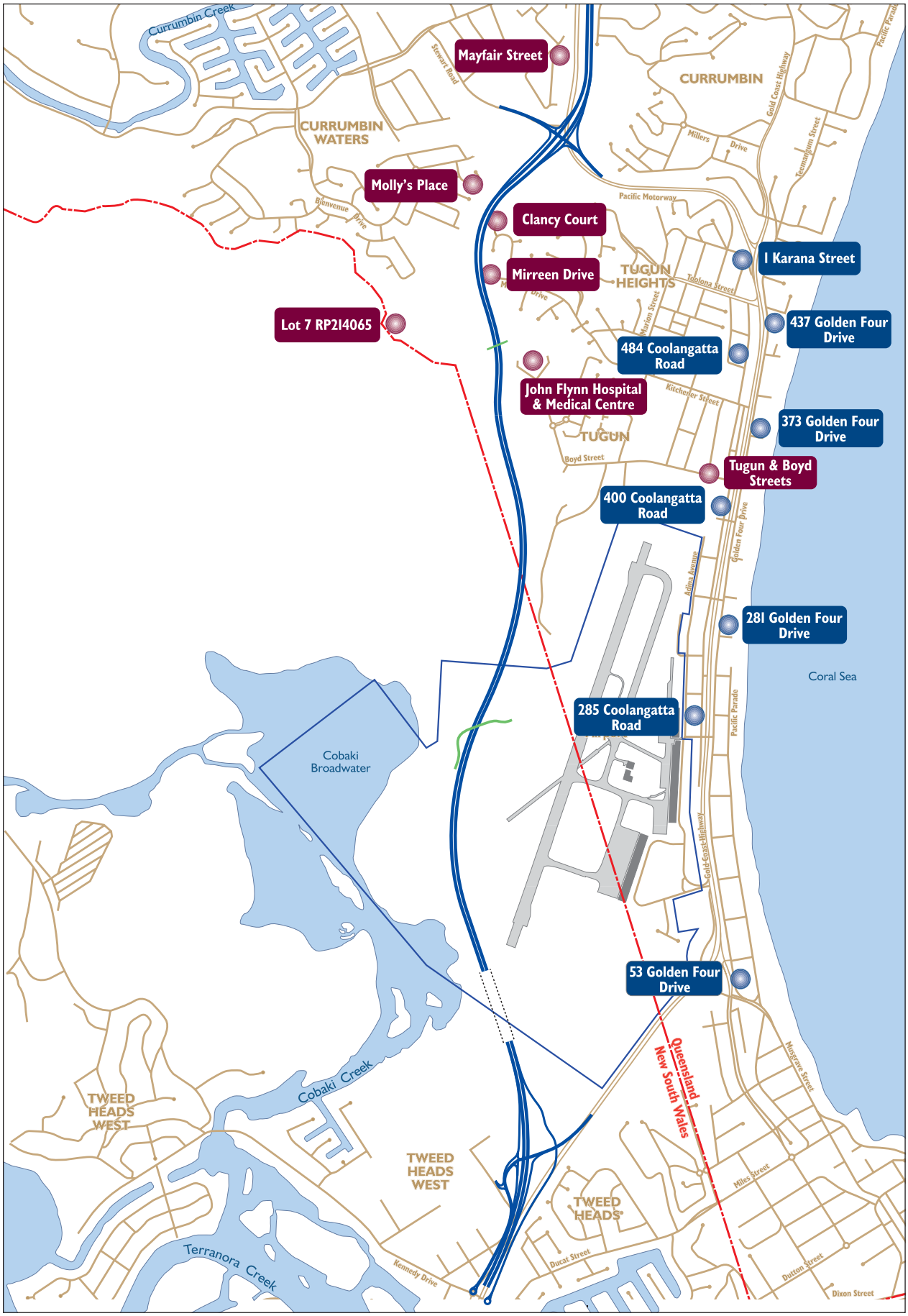


Figure 14.1 **Queensland Noise Monitoring Locations and Receptors**

Table 14.1: Summary of baseline noise monitoring – Queensland

Monitoring Locations	L_{A10} (18 hour)	L_{Aeq}(24 hour)	L_{A1}[1]	L_{A90}(11 hour)[2]	L_{A90}(4 hour)[3]	L_{A90}(9 hour)[4]
4 Mayfair Street	60	56	72	53	50	43
2/19 Mollys Place	43	44	73	36	33	28
29/5 Clancy Court	49	51	77	44	41	39
6/53 Mirreen Drive	43	45	71	34	34	30
Lot 7 RP214065	46	49	73	41	37	37
John Flynn Hospital and Medical Centre	55	61	89	51	50	41
Corner Tugun and Boyd Streets	59	57	73	51	51	48

Notes:
1: LA1 is an approximation of L_{Amax} derived as the maximum L1 level in any 15 minute sample in the monitoring period
2: LA90(11 hour) are average values for the daytime interval(7:00 am and 6:00 pm)
3: LA90(4 hour) are average values for the evening time interval (6:00 pm and 10:00 pm)
4: LA90(9 hour) are is average values for the night-time interval (10:00 pm and 7:00 am

14.2.3 Contribution of aircraft noise from Gold Coast Airport

Noise generated at airports is expressed as Australian Noise Exposure Forecast (ANEF). Contour maps showing the number of aircraft events louder than 70 decibels have been adopted as the standard, demonstrating the number of movements associated with single-event noise levels.

Figure 14.2 shows the current approved ANEF contours for Gold Coast Airport for 2020 aircraft traffic projections. The majority of the Queensland section of the Tugun Bypass proposal is located outside the ANEF 20 contour and it may therefore be assumed that road traffic would dominate the noise environment for most noise sensitive places located near the bypass corridor.

14.3 Assessing noise impacts.

14.3.1 Queensland criteria for noise impact assessment

Noise impacts from the proposed bypass would occur during both the construction and operation phases. To assess possible noise impacts the changes against existing noise levels are compared against established Queensland government criteria.

14.3.2 Construction noise and vibration criteria

There are no quantitative criteria specified in the *Environmental Protection Policy (Noise) 1997* relating to noise or vibration limits for construction activities.

The Queensland Environmental Protection Agency would therefore expect that the proponents of the project demonstrate that best practice environmental management would be applied to all aspects of construction activities.

Source: Coolangatta Airport - Final Master Plan (Gold Coast Airport Limited 2001).

Figure 14.2 **Approved ANEF Contours for Gold Coast Airport - 2020**

Best practice environmental management would be expected to include, (as a minimum) the following actions:

- Implementation of the recommendations given in AS2436–1981 'Guide to Noise Control on Construction Maintenance and Demolition Sites'
- restriction of construction hours wherever possible
- standard hours for noise from construction work in Queensland are:
  - Monday to Friday, 7:00 am to 6:00 pm
  - Saturday, 7:00 am to 12:00 pm if inaudible on residential premises, otherwise: 8:00 am to 12:00 pm
  - not on Sundays or public holidays.
- use of plant and equipment designed with inbuilt attenuation
- plant and equipment maintained in good working order and compliance with manufacturer's noise ratings for individual plant items
- installation of appropriate temporary noise attenuation infrastructure, where necessary (based upon advice from acoustic consultants)
- regular consultation with the community and keep them informed of up-coming works
- where possible build in operational noise mitigation measures early in the construction period that would provide early benefits in terms of reducing construction noise impacts
- the contractor(s) will develop an induction program on reducing construction noise.

In Queensland, construction of the bypass would be conducted under a Project Environmental Management Plan, which would require the construction contractor to operate under a Construction (Noise and Vibration) Management Plan. Main Roads will negotiate the Environmental Management Plan conditions with the Environmental Protection Agency during the detailed design of the project.

The community would be advised prior to any out–of–hours work being conducted.

14.3.3 Queensland operational road traffic noise criteria

The *Road Traffic Noise Management: Code of Practice* produced by Main Roads provides a set of criteria against which potential noise impacts can be assessed.

The criteria are initially based on whether the road project is:

- a new road
- an upgrade of an existing road
- an existing road with no road works
- a proposed land use development

Following the setting of these priorities consideration is then given to the scale of increase in noise levels from road traffic.

Table 14.2 provides a summary of criteria applied to the Queensland section of the proposed Tugun Bypass. Greater detail on the application of noise criteria can be found in Technical

Paper 10. Figure 14.3 shows the application of the criteria over the Queensland section of the alignment.

Table 14.2: Noise criteria applied to the Tugun Bypass – Queensland section

Road	Section	New road / redevelopment	Sensitive receptors	Noise criteria day (dB(A)) (Façade corrected)
Pacific Motorway/ Tugun Bypass	North of Stewart Road	Redevelopment	Residential	$L_{A10(18\text{-hour})}$ 68
Stewart Road	Intersection with Tugun Bypass	Redevelopment	Residential	$L_{A10(18\text{-hour})}$ 68
Tugun Bypass	South of Stewart Road	New Road	Residential	$L_{A10(18\text{-hour})}$ 60
Tugun Bypass	Park on Mirreen Drive cul-de-sac	New Road	Park	$L_{A10(12\text{-hour})}$ 63[1] (free-field)
Tugun Bypass	South of Stewart Road	New Road	John Flynn Hospital and Medical Centre	$L_{A10(1\text{-hour})}$ 48 (internal)[2]

Note 1: $L_{A10\ (12\ hour)}$ is the highest 10 % of noise measured each hour and averaged over the time period of 6:00 am to 6:00 pm.

2: $L_{A10\ (1\ hour)}$ is the highest 10 % of noise measured inside the building during the loudest hour (i.e. peak hour).

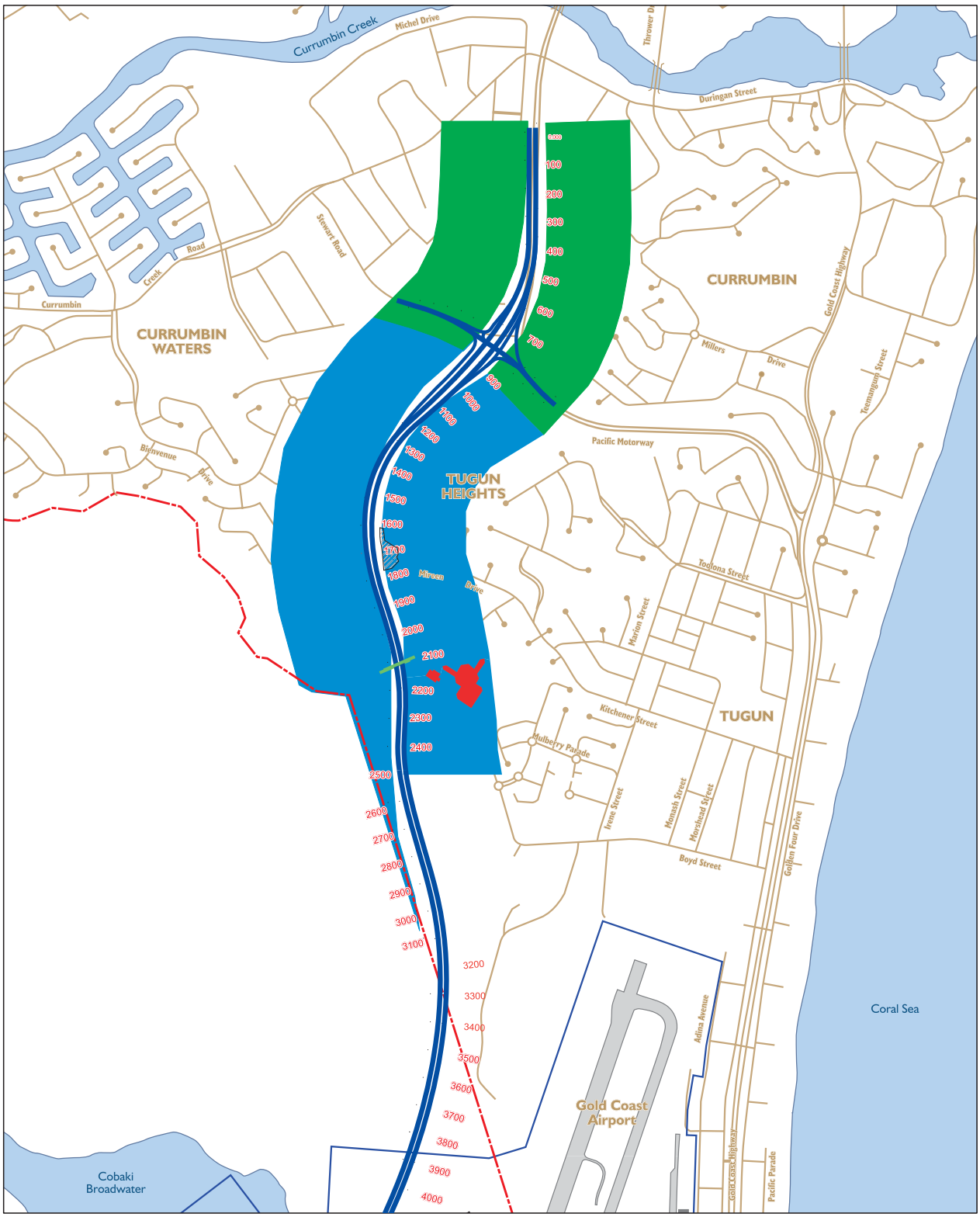
14.3.4 Computer modelling of future traffic noise

A computer model was used to assess the possible impacts of future traffic noise. The *Calculation of Road Traffic Noise* (CoRTN) (UK Department of Transport 1991) was selected as the noise calculation method for the operational traffic noise assessment. CoRTN is the standard road traffic noise calculation method in the *Road Traffic Noise Management - Code of Practice* (Main Roads 2000).

Three situations were modelled to satisfy the Queensland *Road Traffic Noise Management: Code of Practice.* They were:

- 2002 Traffic Horizon – No Tugun Bypass. Road traffic noise calculations for existing conditions on the Pacific Motorway at the northern end of the proposed alignment. Single point noise calculations were determined for the facades of buildings where baseline noise monitoring was carried out. A comparison of modelled and measured noise levels was conducted to verify the modelling methods used.
- 2017 Traffic Horizon – Tugun Bypass: A detailed assessment of the 2017 traffic horizon was undertaken. Mitigation options were designed to this horizon in accordance with noise criteria guidelines for Queensland.
- 2017 Traffic Horizon – No Tugun Bypass: A simplified assessment of road traffic noise generated on the existing Gold Coast Highway and Pacific Motorway without the Tugun Bypass in place.

The predicted noise levels were then assessed against the noise criteria. This allowed the assessment to identify where mitigation measures would be required.



0 1.0 Km

Figure 14.3 **Application of Criteria in Queensland**

- QLD, Residential. road redevelopment - Noise Criteria, day $L_{A10(18\text{-hour})}$ 68
- QLD, Residential. new road - Noise Criteria, day $L_{A10(18\text{-hour})}$ 60
- QLD, John Flynn Hospital. new road - Noise Criteria, day $L_{A10(1\text{-hour})}$ 48 (internal)
- Proposed Tugun Bypass
- Gold Coast Airport Boundary
- Queensland/NSW Border
- Proposed Access Bridges
- Tunnel

14.4 Noise mitigation options

Determination of suitable noise attenuation measures will give consideration to technical feasibility, cost effectiveness, aesthetics, equity, community consultation and practicality. Noise attenuation measures may include the following:

- road pavement surfaces (i.e. asphalt) that have proven low noise characteristics when considered against other road pavement surface types
- traditional noise barriers within the road reserve where reasonable and feasible
- innovative noise reducing measures (if determined to be technically feasible and cost effective), where traditional noise barriers and surface treatments do not provide adequate attenuation to achieve the road traffic noise levels defined by the Code of Practice.

If the relevant noise criteria cannot be reasonably achieved using the methods described above, further consideration may be given to the provision of noise attenuation measures outside the road reserve at Queensland Department of Main Roads' discretion.

14.5 Traffic noise predictions – Year 2017

14.5.1 Impacts on residential areas

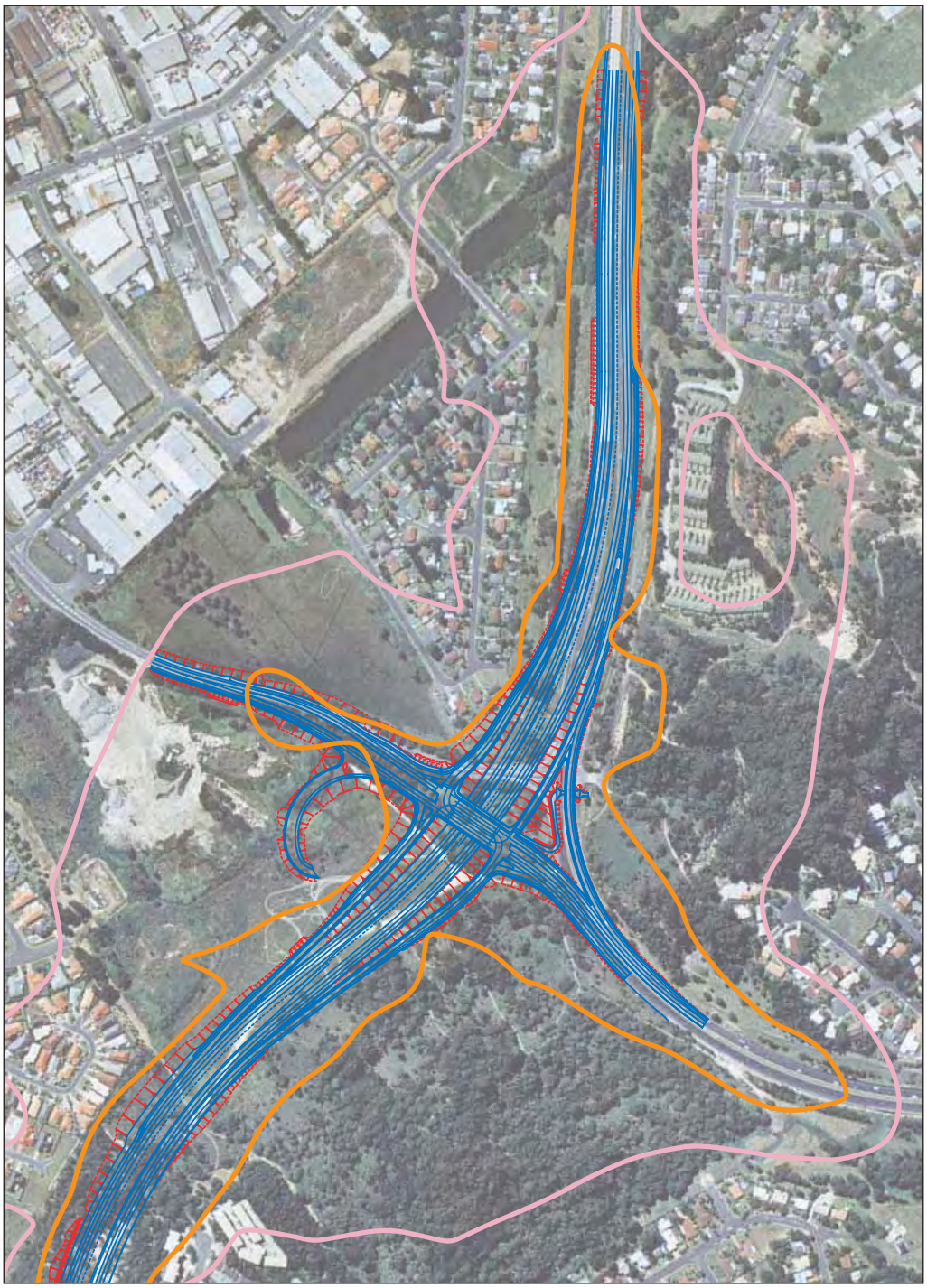
The results of the road traffic noise calculations provided predicted noise levels without the inclusion of any mitigation measures or existing noise barriers.

The results showed that almost all of the dwellings on Mitchell Avenue will comply with the $L_{A10\ (18\ hour)}$ 68 dB(A) criteria in 2017 with the existing noise mitigation treatments. The criteria were also achieved at all residences on the western side of the Pacific Motorway for this section, in Mayfair, Station, Jewel, Boundary and Reynton Streets.

The remainder of the alignment in Queensland was assessed against a criterion of 60 dB(A). Almost all of the multi-story apartment complexes on the western side of Tugun Hill are expected to exceed the criterion in 2017 without mitigation measures. On the western side of the alignment a large number of residential receptors are also expected to exceed the criterion of $L_{A10\ (18\ hour)}$ 60 dB(A) in 2017. Exceedances would occur at dwellings on Mollys Place, Neeson Place, Chippendale Crescent, Cannon Drive, Gilchrist Drive and Bienvenue Drive without mitigation measures. The majority of the receptors in this area are single storey, stand-alone or duplex housing of modern construction.

Figures 14.4 and 14.5 show the predicted traffic noise level contours in 2017 without mitigation measures.

Noise mitigation measures would need to be introduced in this area to enable the criterion to be met. The final configuration of such measures will be developed during the detailed design stage.



Road Carriageway
Road Cutting
Road Embankment
QLD 68 dBA +
QLD 60 dBA +
NSW with mit 60dBA (day) ▽
NSW no mit 60dBA (day) ▽
Commonwealth 65 dBA*
Commonwealth 60 dBA*
Commonwealth 55 dBA*

*LAeq (15 hour) (free field)
+ LA10 (18 hour) (facade corrected)
▽ LAeq (15 hour) (facade corrected)

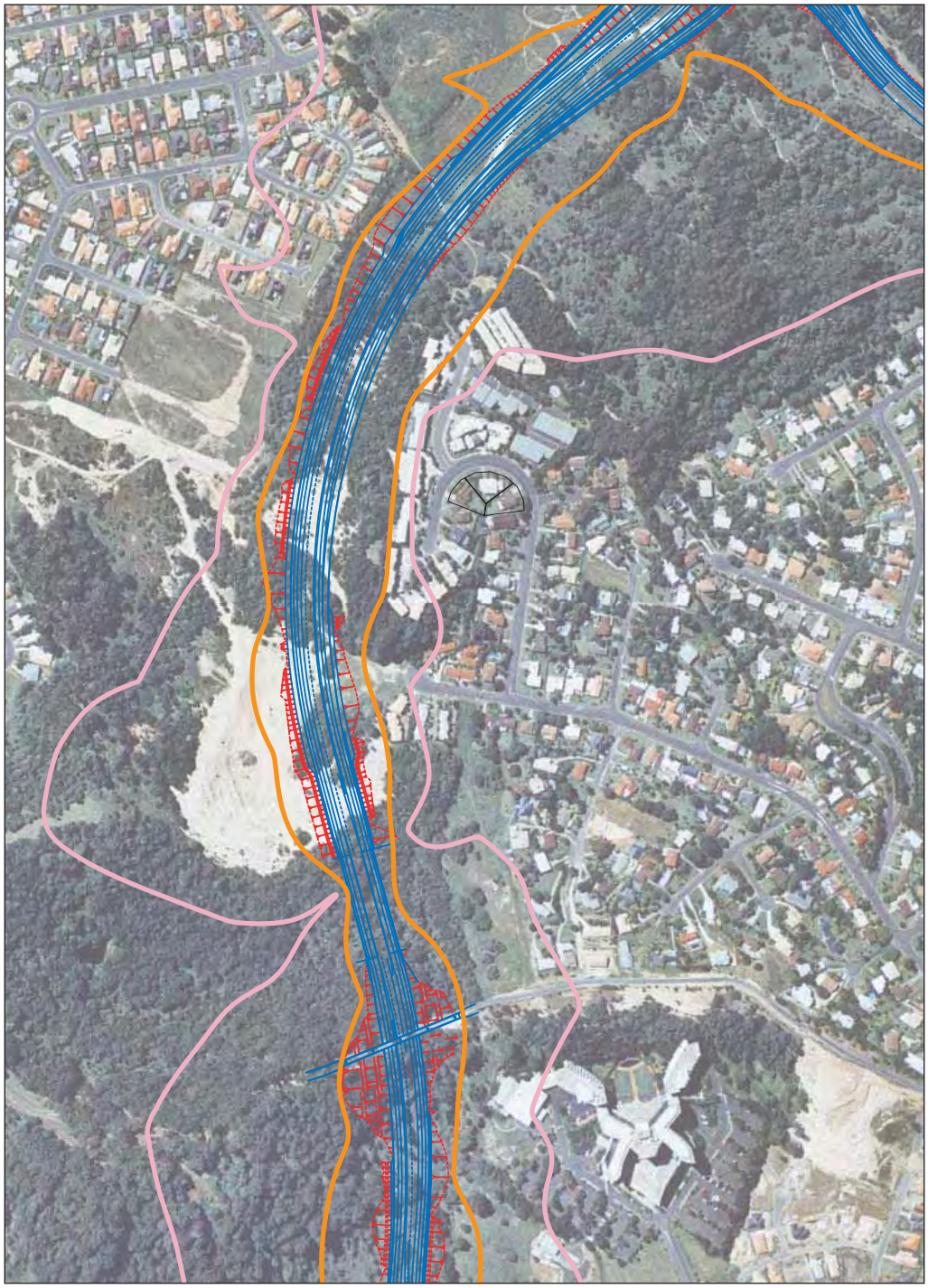
Photograph taken February 2000

0 not to scale
Metres

Figure 14.4 **Predicted 2017 Tugun Bypass Traffic Noise Contours Without Mitigation**

This grid noise map (GNM) provides graphical representation of noise levels. For more detailed results refer to the tabulated values in Technical Paper Number 11. This GNM was calculated on a grid spacing of 150 metres at a height of 2m above ground.

"The contours shown on this figure are calculated at 2 m above ground level, noise levels increase for floors of multi-storey buildings above this level"



Road Carriageway
Road Cutting
Road Embankment
QLD 68 dBA +
QLD 60 dBA +
NSW with mit 60dBA (day) ▽
NSW no mit 60dBA (day) ▽
Commonwealth 65 dBA*
Commonwealth 60 dBA*
Commonwealth 55 dBA*

*LAeq (15 hour) (free field)
+ LA10 (18 hour) (facade corrected)
▽ LAeq (15 hour) (facade corrected)

Photograph taken February 2000

0 not to scale
Metres

Figure 14.5 **Predicted 2017 Tugun Bypass Traffic Noise Contours Without Mitigation**

This grid noise map (GNM) provides graphical representation of noise levels. For more detailed results refer to the tabulated values in Technical Paper Number 11. This GNM was calculated on a grid spacing of 150 metres at a height of 2m above ground.

"The contours shown on this figure are calculated at 2 m above ground level, noise levels increase for floors of multi-storey buildings above this level"

14.5.2 Impacts on future residential areas

Pacific Beach Estate

The Pacific Beach Estate is located on Inland Drive, south of the John Flynn Hospital and Medical Centre. The residential capacity of the Pacific Beach Estate is currently unknown. The development is likely to consist of medium-density residential development located around the proposed Tugun rail station immediately north of Boyd Street. Main Roads criteria would be applicable for assessment of traffic noise. The closest location where background noise monitoring was undertaken was the Accommodation Building at the John Flynn Hospital and Medical Centre, to the north of the development. At this location, the average $L_{A90\ (8\ hour)}$ noise level over seven continuous days was 41.3 dB(A) (facade measurement).

At the time of assessment Pacific Beach Estate did not have sealed approval and so the 60 dB(A) criteria would apply to its development. The road shoulder of the proposed alignment has been designed to allow for the future construction of noise barriers by the developer.

14.5.3 Outdoor recreation areas

Park at the end of Mirreen Drive

A small park exists on the cul-de-sac of Mirreen Drive, adjacent to the proposed bypass. An open field receptor was modelled in the centre of this park. A free-field level of $L_{A10\ (18\ hour)}$ 55.1 dB(A) is predicted for 2017 with no mitigation in place. This level represents an increase of 12 dB(A) over the measured façade level $L_{A10\ (18\ hour)}$ 43 dB(A) (equivalent to 40.5 dB(A) free-field) recorded at Unit 6, 53 Mirreen Drive (approximately 50 m from the park receptor). Main Roads criterion for open recreation areas is $L_{A10\ (12\ hour)}$ 63 dB(A) (free-field). Converting the average maximum traffic noise level over 18 hours to the level over 12 hours the predicted $L_{A10\ (12\ hour)}$ level in 2017 is 57.1 dB(A), which complies with the criterion with no mitigation measures implemented.

John Flynn Hospital and Medical Centre

The hospital buildings at the John Flynn Hospital and Medical Centre are designed to be temperature controlled with the use of air conditioning, this means external windows and doors are not left open. Therefore the concern with regards to road noise is that the noise from the road does not raise internal noise levels beyond the internal design level. By knowing the noise level at the outside wall it is possible to calculate the internal noise level. Predicted $L_{A10\ (1\ hour)}$ facade noise levels for receptors at the John Flynn Hospital and Medical Centre did not exceed the external facade level equivalent to the internal design criterion. Table 14.3 shows $L_{A10\ (1\ hour)}$ noise levels for hospital receivers modelled for 2017 with no noise mitigation in place.

Table 14.3: Predicted noise levels for the John Flynn Hospital and Medical Centre – 2017 no mitigation

Receptor	Storey	Predicted 2017 $L_{A10\ (1\ hour)}$ facade noise levels (dB(A))	
		Facade	External noise level required to meet internal criterion
Main Hospital Building	1	61.2	74
	2	62.1	74
	3	63.2	74
	4	63.8	74
	5	64.5	74
	6	65	74
	7	65.5	74
	8	65.9	74
	9	66.3	74
	10	66.7	74
	11	67	74
Accommodation Building	1	60.7	74
	2	61.8	74
	3	63.1	74
	4	64.2	74
	5	64.8	74
	6	65.2	74
	7	65.6	74
	8	66	74
Radiotherapy Building	1	67.1	74
	2	68.6	74
	3	68.4	74

14.6 NSW noise assessment

14.6.1 Noise monitoring locations

Monitoring was carried out at seven monitoring locations along the NSW section of the proposed corridor. Five of the noise locations were suitable for validation of the model and the other two were used for construction noise level assessment. The locations are shown on Figure 14.6 and a summary of the noise monitoring is shown in Table 14.4. Further details of the noise monitoring are found in Technical Paper 10.

The local noise environment for the NSW section of the proposal is influenced by air traffic movements from Gold Coast Airport, birds, wind movements in trees and general residential noise. Aircraft generally fly away from the airport in a north-east direction towards the Currumbin Creek estuary. At the southern end of the proposal the dominant noise is generated by road traffic on the Tweed Heads Bypass.

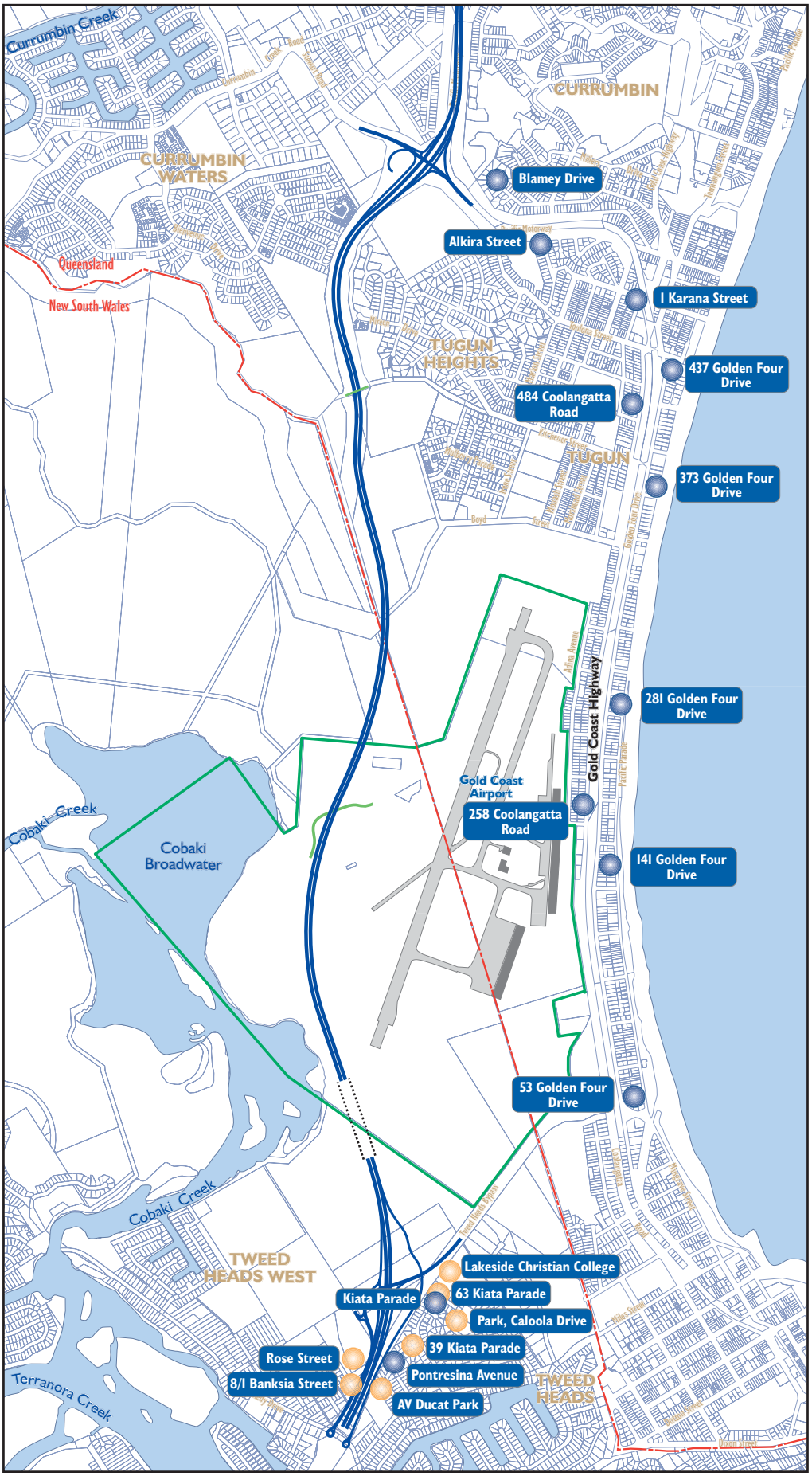


Figure 14.6 **NSW Noise Monitoring Locations**

14.6.2 Baseline noise monitoring results

Table 14.4: Summary of baseline noise monitoring NSW

Monitoring Location	Baseline noise level (dB(A))				
	$L_{Aeq\ (15\ hour)}$	$L_{Aeq\ (9\ hour)}$[1]	$L_{A90\ (11\ hour)}$[2]	$L_{A90\ (4\ hour)}$[2]	$L_{A90\ (9\ hour)}$[2]
63 Kiata Parade	71	67	59	52	37
8/1 Banksia Drive	67	64	58	51	38
Lakeside Christian College	-	66	-	-	-
39 Kiata Parade	-	64	-	-	-
AV Ducat Park[3, 4]	70.2	-	-	-	-
Vacant Land, Rose Street[3, 4]	69	-	-	-	-
Park, Caloola Street[3,4]	52.5	-	-	-	-

Note 1: Actual time period = 10:00 pm to 6:00 am, to exclude morning aircraft noise from 6:00 am to 7:00 am.
2: L_{A90} was determined as the percentile background noise level in accordance with the method of the NSW *Industrial Noise Policy 2000.*
3: Locations were attended monitoring for 15 minute time steps.
4: Aircraft noise was excluded from these measurements.

14.6.3 Contribution of aircraft noise from Gold Coast Airport

Noise-sensitive locations in NSW adjacent to the Tugun Bypass are mainly located between Australian Noise Exposure Forecast 20 and 25 contours. This zone is considered to be conditionally acceptable for residential, educational and medical facilities and public buildings.

14.7 Assessing noise impacts.

14.7.1 NSW criteria for construction noise impact assessment

Construction noise in NSW is regulated by local government and the NSW Department of Environment and Conservation, which administers the *Protection of the Environment Operations Act 1997*. Criteria for construction noise and vibration impacts are detailed in the *Environmental Noise Control Manual* (NSW Environment Protection Authority 1994).

The guidelines for noise from construction equipment set out three categories of assessment criteria, each of which depends on the period of exposure:

- short-term: for construction periods of four weeks or less, the L_{10} level of construction noise should not exceed the existing L_{90} background level by more than 20 dB(A)
- medium-term: for construction periods of more than four weeks but less than 26 weeks, the L_{10} level of construction noise should not exceed the existing L_{90} background level by more than 10 dB(A)
- long-term: for construction periods greater than 26 weeks, the L_{10} level of construction noise should not exceed the existing L_{90} background level by more than 5 dB(A)

Table 14.5 sets out daytime construction noise criteria with reference to background level $L_{A90\ (15\ minute)}$ measured along the proposed Tugun Bypass alignment.

Table 14.5 Summary of construction noise guideline criteria

Monitoring location[1]	Measured $L_{A90(15min)}$ dB(A)	Construction period guidelines ($L_{A10\ (15\ min)}$ dB(A))		
		< 4 Weeks	4 – 26 Weeks	> 26 Weeks
Daytime Noise Levels (7:00 am – 6:00 pm)				
A	59	79	69	64
B	58	78	68	63
Evening Noise Levels (6:00 pm – 10:00 pm)				
A	52	72	62	57
B	51	71	61	56
Night Noise Levels (10:00 pm – 7:00 am)				
A	37	57	47	42
B	38	58	48	43

Note 1:A. 63 Kiata Parade, Tweed Heads
B. 8/1 Banksia Drive, Tweed Heads West

As per the NSW RTA *Environmental Noise Management Manual* (2001) construction should also be limited to between the hours of 7.00 am and 6.00 pm Monday to Friday and 7.00 am and 1.00 pm on Saturday (if construction noise is inaudible at residential premises), otherwise 8.00 am to 1.00 pm on Saturday. No construction work is to take place on a Sunday or public holidays without prior consultation with affected properties. Where construction noise is inaudible at the nearest and/or most affected residential boundary, no time restrictions would apply.

Vibration criteria vary according to whether the activities being assessed are continuous in nature or intermittent. The effects of vibration are divided into three categories:

- disturbance to building occupants: this involves vibration in which the occupants or users of the buildings are inconvenienced or possibly disturbed. The *Environmental Noise Management Manual* (2001) presents vibration limits based on Australian Standard 2670.2-1990: *Evaluation of Human Exposure to Whole Body Vibration Part 2— Continuous and Shock Induced Vibration in Buildings*
- effects on building contents: this would involve vibration in which the building contents may be affected
- effects on building structures: this involves vibration in which the integrity of the building or structure itself may be compromised. German Standard DIN 4150, *Part 3 – 1986 Structural Vibration in Buildings — Effects on Structure* provides guideline levels of vibration velocity for evaluating the effects of vibration on structures.

In general, vibration criteria for human disturbance are more stringent than those for effects on building contents and structural damage. Hence compliance with the more stringent limits dictated by the first category would ensure that compliance is also achieved for the other two categories.

14.7.2 NSW operational traffic noise criteria

Residential properties

Road traffic noise criteria for NSW are contained in *Environmental Criteria for Road Traffic Noise* (NSW Environment Protection Authority 1999). Guidelines for the management of noise and implementation of noise criteria are provided in *Environmental Noise Management Manual* (NSW RTA 2001). Corridor noise criteria are set at $L_{Aeq\ (15\ hour)}$ 55 dB(A) during the day and $L_{Aeq\ (9\ hour)}$ 50 dB(A) at night for a new freeway or arterial road.

Corridor noise criteria are set at $L_{Aeq\ (15\ hour)}$ 55 dB(A) during the day and $L_{Aeq\ (9\ hour)}$ 50 dB(A) (façade-corrected) at night for a new freeway or arterial road. For the redevelopment of an existing freeway or arterial road, noise criteria are set at $L_{Aeq\ (15\ hour)}$ 60 dB(A) during the day-time and $L_{Aeq\ (9\ hour)}$ 55 dB(A) at night-time. These are referred to as 'base' criteria. Where these criteria are already exceeded, attempts should be made in the first instance to meet them. If this proves to be impractical and noise reduction measures to achieve these levels are not feasible, 'allowance' criteria, based on existing traffic noise levels are considered. Noise control treatments should be designed to allow an increase in road traffic noise of not more than 0.5 dB(A) for a new road or 2 dB(A) for the upgrade of an existing road. These are based on existing noise levels at the time of opening, individually calculated for each modelled received location.

Sensitive properties

Some land uses are considered to be 'sensitive' under the NSW Department of Environment and Conservation 'Environmental Criteria for Road Traffic Noise'. Buildings that are considered to be sensitive land uses are assessed internally, and open spaces are assessed under free-field conditions.

Additional criteria apply in NSW for areas containing sensitive land uses. These are set out in Table 14.6.

Table 14.6: Road traffic noise criteria for sensitive land uses, NSW

Sensitive land use	Criteria dB(A)	
	Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Hospital wards	$L_{Aeq\ (1\ hour)}$ 35(internal)	$L_{Aeq\ (1\ hour)}$ 35(internal)
Places of worship	$L_{Aeq\ (1\ hour)}$ 40(internal)	$L_{Aeq\ (1\ hour)}$ 40(internal)
Active recreation	Freeway/arterial roads $L_{Aeq\ (15\ hour)}$ 60 (free-field)	–
Passive recreation and school playgrounds	Freeway/arterial roads $L_{Aeq\ (15\ hour)}$ 55 (free-field)	–
Existing school classrooms	$L_{Aeq\ (1\ hour)}$ 45(internal)	–

Source: *Environmental Criteria for Road Traffic Noise*, NSW Environment Protection Authority 1999.

14.8 Construction noise assessment

14.8.1 Construction schedule and source levels

Plant and equipment

Construction plant and equipment expected to be employed on the project are listed in Table 14.7. The table gives likely usage at each of the major work sites together with the anticipated duration of the activities. The final construction and resource utilisation plans would be part of a Noise and Vibration Management Plan which will form part of the Contractors Environmental Management Plan and would require approval from the NSW Department of Infrastructure, Planning and Natural Resources before construction commences.

Table 14.7: Equipment expected to be used for various construction activities

Activity	Plant and equipment	Work site location[1]	Duration (months)
Demolition and Utility Works	Hydraulic hammers Trucks Excavators	Across the site as clearing and preparation work commences	3
Earthworks	Excavators Loaders Dump trucks Vibrating rollers Compactors	Chainage 2,500–7,700	18
Cut-and-cover Works	Diaphragm wall machines Excavators Concrete pumps Concrete agitators Carpenters/formwork Dump trucks and loaders Dewatering pumps Vibrating piling Hammers	Chainage 4,500–6,500	6 12 12 12 3 12 18 24 3
Haulage of Spoil	Dump trucks	Along the alignment	12
Delivery of Aggregates and Cement Products	Dump trucks		12
Bridges	Piling rigs Concrete pumps Carpenters/formwork Excavators/rock breaking	All bridges	Average of 3 months per bridge Average of 9 months per bridge
Surface Roadworks	Graders, water tankers, asphalt pavers and multi-tyred rollers	South of Boyd Street	4 to 6

Construction relating to surface activities would be limited to standard daytime work hours (7.00 am to 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturday, with no work on Sunday or public holidays, or as identified in the NVMP).

Work outside these hours may be required for:

- minimising disruption to airport operations
- relocation of utility services during hours of light traffic
- preparation of road diversions during off-peak hours
- construction of project elements which require temporary road closures outside normal hours in order to minimise disruption to traffic
- delivery of bulk items of equipment during off-peak periods to minimise disruption
- concrete cutting

If any activity needs to be undertaken outside the normal work hours the Department of Environment and Conservation and local residents would be consulted about the timing and duration prior to the work commencing. Additional noise attenuation measures may be required for equipment used during off-peak construction periods, depending on the nature and location of the work. Table 14.8 lists typical sound power levels for the plant items set out in Table 14.7.

Table 14.8: Summary of sound power levels for construction equipment

Plant item	L_{Amax} Sound Power Level (re 10^{-12} W dB(A))
Asphalt paver	114
Bulldozer CAT D7, D9, D10	113
Compressor 600 CFM	100
Concrete pump	109
Concrete truck	108
Crane-mounted drilling rig	117
Truck-mounted crane	110
30-tonne crane	110
Diaphragm wall rig	116
Dump truck	121
Excavator	111
Grader	110
Multi-tyred roller	115
Rockbreaker	122
Slurry treatment plant	120
Tipper	108
Water truck	113

Source: Richard Heggie Associates 2000.

Construction noise levels were predicted in terms of the maximum noise level parameter (L_{Amax}). The predicted L_{Amax} level was converted to a corresponding $L_{A10\ (15\ minute)}$ level for activities in the NSW section of the proposal.

The noise impact of construction activities relating to the bypass was assessed by calculating noise levels for representative noise-sensitive locations adjacent to the corridor working areas for the earthworks and surface roadworks phases of the proposal.

14.8.2 Construction noise levels

Surface construction impacts

Construction noise limits were determined for the receivers based on measured background noise levels for each section of the bypass proposal during the preferred construction hours and the anticipated duration of activities. Construction activities at any one location would generally not exceed six months in duration. Predicted construction noise levels are shown in Table 14.9. Noise levels which would exceed the appropriate limits are highlighted in bold type.

Table 14.9: Predicted noise levels for construction activities in daytime (without mitigation measures)

Construction activity	Receiver location	Criterion or goal[1] ($L_{A10(15\ min)}$)	Predicted construction noise level ($L_{A10(15\ min)}$)	
			Minimum	Maximum
Earthworks	Lakeside Christian College, Church	69	50	62
	Lakeside Christian College, School	69	40	85
	Kiata Parade	69	40	74
	Pontresina Avenue	69	43	81
	Moolua Avenue	68	44	77
	Ducat Street	69	49	71
	Honeysuckle Street	69	33	81
	Banksia Street	69	41	82
Surface Roadworks	Lakeside Christian College, Church	69	48	65
	Lakeside Christian College, School	69	37	80
	Kiata Parade	69	38	72
	Pontresina Avenue	69	41	77
	Moolua Avenue	69	41	81
	Ducat Street	68	47	69
	Honeysuckle Street	68	30	81
	Banksia Street	68	38	78

Note 1: Based on a period of construction activity less than 26 weeks. The L_{A10} level should not exceed the background level (L_{A90}) by more than 10 dB(A).

Predicted construction noise levels at a given location would depend on the number of plant items and equipment operating at any one time and the location relative to the receiver. As these levels would vary, both minimum and maximum noise levels for each work area are set out in the table.

The minimum level was determined with all plant items located at the furthermost distance within the work area, while maximum levels related to the nearest location relative to the receptor. All plant items were assumed to be working simultaneously, representing the worst-case scenario.

The predicted noise levels do not include the effects of any additional mitigation measures that may be installed on the equipment by the contractor.

Given the number of receptors where construction noise could exceed the limits by as much as 16 dB(A) in worst-case conditions, comprehensive mitigation strategies would need to be implemented prior to the start of construction. Some possible mitigation measures are listed in Table 14.10.

Table 14.10: Construction noise sources and possible mitigation measures

Plant	Source of noise	Possible remedies/alternatives	Typical reduction in noise level (dB(A))
Piling equipment	Pneumatic/diesel hammer or vibrator driver	Enclose hammer head and top of pile in acoustic screen	18-37
	Impact on pile	Use resilient pad (dolly) between pile and hammer head	5-10
	Cables, pile guides	Careful alignment of pile and rig	5
	Power unit	Silenced exhaust, use of acoustic screens	7
Heavy Plant	Engine	Silenced exhaust, closed enclosure panels	5-10
Compressor, Generator	Compressor, Generator	Acoustically dampen casing, acoustic screening	20
Batching Plant	Engine	Substitute electric motor	15-25
	Filling	Reduce height of drop for aggregates	-
Pumps	Engine pulsing	Acoustic screening	7-10
Pneumatic Rock Breakers	Tool	Fit a muffler or silencer to reduce the noise without impairing efficiency	20
	Bit	Use dampened bit to eliminate 'ringing'	-
	Air line	Leaks in air line should be sealed	-

Source: AS2436 – 1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites

While construction would be generally away from existing roads, haulage of material to the site would add to the traffic on the existing highway and some local roads used to provide access to the alignment.

General construction traffic generated by the workforce, visitors and other deliveries would not result in a significant increase in the traffic currently using the highway. Boyd Street, Stewart Road and Parkes Drive however, would be used as a major access to the project and an increase in traffic during construction would require appropriate management. The construction contractor would be required to provide appropriate traffic management at these locations.

During the importation of gravel and aggregates for pavement construction (as well as for the batching plant, should it be located at the main works compound), a maximum of 150 trucks per day would be required along Boyd Street to deliver material. This is expected to take place over 12 months towards the end of the overall construction period. It is anticipated that the operation of haul trucks along Boyd Street may require noise monitoring as part of the Noise and Vibration Management Plan, in order to assess and minimise the potential impacts on sensitive receivers in this area.

Haulage activities would be limited to standard daytime construction hours as identified in the Noise and Vibration Management Plan(7.00 am to 6.00 pm Monday to Friday and 8.00 am to

1.00 pm on Saturday, with no work on Sunday or public holidays), or as identified in the Noise and Vibration Management Plan.

If any activity needs to be undertaken outside the normal work hours then the Department of Environment and Conservation and local residents would be informed of the timing and duration prior to the work commencing.

14.8.3 Tunnel wall construction

A number of construction techniques could be used to construct the tunnel walls. One of the more common methods would be to use sheet piling techniques. However this would not be suitable for the Tugun Bypass tunnel. The piling rig would intrude into the obstacle limitation surface resulting in the airport having to close if construction was carried out during the hours of airport operation. The other option would be to undertake the piling during the airport curfew hours of 11:00 pm to 6:00 am, however this would result in noise levels significantly in excess of the NSW Department of Environment and Conservation criteria for sleep disturbance over a wide area. An alternative method would therefore have to be used for tunnel construction.

Two possible alternatives would be vibro-piling and the use of diaphragm walls. Vibro-piling may be suitable for the tunnel given the sandy nature of the underlying geology. The construction of diaphragm walls would result in significantly reduced construction noise levels when compared with both sheet piling and vibro-piling. Therefore it would be the preferred method of constructing the tunnel walls and has been used in the calculations of construction noise in the EIS.

Table 14.11 provides a comparison of noise levels for the various construction techniques.

Table 14.11: Noise levels from tunnel wall construction

Construction method	Receiver location	Night-time L_{AMAX} Criterion dB(A)	Predicted L_{AMAX} noise level from construction activity	
			Minimum	Maximum
Diesel hammer	63 Kiata Parade	52	68	77
	8/1 Banksia Drive	53	57	62
Vibratory system	63 Kiata Parade	52	47	56
	8/1 Banksia Drive	53	36	41
Diaphragm Wall	63 Kiata Parade	52	37	46
	8/1 Banksia Drive	53	26	31

14.9 Vibration during construction

14.9.1 Sources of vibration

No blasting is expected to be required during the construction of the bypass. However, other construction activities may give rise to ground vibration. The highest vibration levels are likely to result from:

- pile drivers
- heavy construction equipment

- vibrating steel-drummed rollers.

These are expected to be used during the construction of the bypass.

14.9.2 Vibration impacts

The extent to which vibration from the above sources is likely to cause nuisance or damage is primarily related to the separation distance between the source and the receiver. Because it is difficult to predict ground vibration levels accurately due to the dependence of vibration transmissibility upon the nature of the intervening soil between the source and receiver, it is normal to monitor vibration levels for sensitive receivers during construction and to maintain adequate separation distances where possible. Normally, maintenance of the required separation distance is the simplest method of ensuring that ground vibration nuisance or damage does not occur.

Main Roads specification MRS 11.51 12/99 recommends that nuisance from ground vibration and building damage is unlikely to occur if pile driving operations are conducted at distances greater than 60 m from the receiver. The potential for nuisance or minor damage due to vibration from heavy vibratory rollers is minimal, provided a buffer distance of at least 20 m is maintained between the source and the receiver.

14.10 Mitigation measures

14.10.1 Construction noise

A number of practical recommendations are outlined in Australian Standard 2436–1981 regarding the mitigation of construction noise. Strict adherence to NSW Environment Protection Authority hours of construction is the most important of these. Table 14.10 outlines other mitigation strategies that could be employed on the Tugun Bypass project as described in Australian Standard 2436–1981. In addition, wherever practical the noise barriers that will be required for the operational phase of the proposal will be constructed at the beginning of the construction process to provide additional noise protection.

A number of innovative technologies are also available where construction noise and vibration may be an issue. These include perimeter sawing, use of circular saw or diamond wire, water jet cutting, line drilling and splitting, ripping with excavators and grinding. Some of these may be appropriate for construction of the Tugun Bypass.

Table 14.12 gives the noise levels predicted if the mitigation techniques listed in Table 14.10 are used where appropriate. The noise reductions ranged from 5 dB(A) where space limited the attenuation options to equipment controls, to greater than 10 decibels where these controls could be used in combination with noise barriers and management techniques which would avoid grouped noise sources.

Table 14.12: Predicted noise levels for construction activities in daytime with mitigation measures

Construction activity	Receiver location	Criterion or goal[1] ($L_{A10(15\ min)}$)	Predicted construction noise level ($L_{A10(15\ min)}$)	
			Minimum	Maximum
Earthworks	Lakeside Christian College, Church	69	41	58
	Lakeside Christian College, School	69	31	**76**
	Kiata Parade	69	36	**69**
	Pontresina Avenue	69	34	**73**
	Moolua Avenue	68	35	**71**
	Ducat Street	68	39	**67**
	Honeysuckle Street	68	<30	**77**
	Banksia Street	68	31	**78**
Surface Roadworks	Lakeside Christian College, Church	69	41	58
	Lakeside Christian College, School	69	<30	**72**
	Kiata Parade	69	<30	**68**
	Pontresina Avenue	69	32	**73**
	Moolua Avenue	68	38	**65**
	Ducat Street	68	<30	**65**
	Honeysuckle Street	68	<30	**77**
	Banksia Street	68	<30	**74**

Note 1: Based on a period of construction activity of less than 26 weeks.

The level by which noise may exceed the criteria (see Table 14.9) indicates that most activities could be controlled to an acceptable noise level by standard treatments giving 5 dB(A) or more attenuation. These include the provision of noise barriers, equipment enclosures, the use of silencers and regular equipment maintenance.

Community-linked construction management may also be an effective strategy in certain locations. Previous experience has demonstrated that, when sufficient warning is provided, affected residents may be willing to accept excessive noise levels for a shorter duration rather than lower levels of noise over extended periods.

14.10.2 Vibration impacts

Structural damage to buildings from excessive ground vibration is unlikely, providing the construction works remain at a distance of between 20 to 60 m (depending on equipment use) from any sensitive buildings and blasting is not undertaken during construction.

Monitoring would be conducted during construction activities where there is considered to be potential for complaints regarding vibration which may exceed human disturbance criteria. All potentially affected buildings and other structures would be surveyed prior to the start of construction and on completion where this is considered necessary.

14.11 Road traffic noise in NSW

14.11.1 Noise modelling methods

Noise levels along the proposed Tugun Bypass were modelled for 2007 and 2017, 10 years after opening. To satisfy the *Environmental Criteria for Road Traffic Noise* (NSW Environment Protection Authority 1999), modelling also included a 2003 traffic horizon, which was used to compare modelled and measured noise levels of previously existing traffic in 2003, and 2007 and 2017 scenarios without the Tugun Bypass. The bypass was modelled as a four-lane highway for the 2007 and 2017 scenarios.

Noise contours were derived based on a procedure developed by the United Kingdom Department of Transport (1988) known as the *Calculation of Road Traffic Noise* (CoRTN). This has been adapted to Australian conditions and extensively tested by the Australian Road Research Board. As a result it is recognised and accepted by the NSW Department of Environment and Conservation. The procedure predicts noise levels for free-flowing traffic and a modified procedure has been developed which enables an accurate prediction of noise from high truck exhausts and engines to be taken into account.

The model forecasts $L_{A10\ (18\ hour)}$ and $L_{A10\ (1\ hour)}$ noise levels and the application of correction factors is required to assess predicted levels against other noise descriptors such as L_{eq}. The noise model takes into account:

- traffic volumes and heavy vehicle forecasts
- vehicle speed
- road gradient
- location of the noise sources on the two carriageways
- the differing heights of cars and trucks
- height and location of existing and proposed dwellings and other buildings
- relative levels and angles of view of the road from the receiver's position
- reflections from barriers, cuttings and roadside structures
- attenuation from barriers (natural and purpose-built) and cuttings
- the noise reduction for the use of an open graded asphalt road surface
- correction for shielding due to intervening buildings between the road and the modelled receivers.

Internal noise levels were modelled in accordance with the methods established in Australian Standard *3671 — 1989 Acoustics — Road Traffic Noise Intrusion — Building Siting and Construction* for more sensitive land uses such as the John Flynn Hospital and Medical Centre, Lakeside Christian Church and Lakeside Christian College.

The Lakeside Christian College comprises five buildings in a north-south alignment set back approximately 15 m from the existing Tweed Heads Bypass corridor. Four of these are one-storey demountable buildings, the fifth is a two-storey permanent building. Window treatments vary from louvres to aluminium sliding windows. There is one air-conditioned building in the school located to the south west of the church. In all other buildings the windows are kept open to provide ventilation.

In accordance with the *Environmental Criteria for Road Traffic Noise* (NSW Environment Protection Authority 1999), the criterion for an existing school is $L_{Aeq\ (1\ hour)}$ 45 dB(A) (internal) for classrooms.

14.11.2 Potential impacts

Existing residential development

Predicted noise levels at 2007 without mitigation measures other than a low-noise asphalt road surface indicated that 42 residences in NSW would exceed the daytime base criterion due to high traffic volumes. These residences are shown in Technical Paper 10. The allowance criterion would not be exceeded.

A method for determining whether noise mitigation, in addition to feasible traffic management and road design measures, could be considered reasonable is included in the *Environmental Noise Management Manual* (NSW RTA 2001). This method takes account of the significance of the changes in noise level and whether existing levels would be considered to be acute. Applying this method to the predicted noise levels at 2007 indicates that six residences would qualify for additional treatment. These residences are shown in Technical Paper 10. This would generally be on the basis that existing traffic noise levels were acute, i.e. .>60 $L_{eq\ (9\ hour)}$ or >65 $L_{eq\ (15\ hour)}$. Even though the proposal itself may reduce these levels, further reduction should be considered to be worthwhile.

A similar exercise was undertaken for 2017. As expected, the number of receivers at which the base criteria are exceeded increased due to the predicted growth in traffic. However, the allowance criterion was not exceeded.

A total of 67 modelled residences in NSW would exceed the day-time base criterion in 2017. These include 11 residences that would be exposed to acute levels of daytime traffic noise where noise mitigation measures would be considered reasonable. These residences are shown in Technical Paper 10.

Outdoor recreation areas

A.V. Ducat Park is located adjacent to the southern end of the proposed bypass. It experiences high noise levels from traffic on the Tweed Heads Bypass and predicted levels on opening of the Tugun Bypass are similar, rising by one decibel as a result of traffic growth up to 2017. Provision of mitigation measures introduced to reduce local residential noise exposure would also reduce noise levels in the park.

Internal noise levels

The opening of the Tugun Bypass would result in a reduction in noise levels at the Lakeside Christian College and Church. This would result from the reduced traffic levels on the northern section of the Tweed Heads Bypass. Nevertheless, noise levels at the school buildings at 2017 would be above the base criterion and it is considered reasonable to investigate methods of additional mitigation.

Calculated noise levels within the church at 2017 would be within the base level criterion and can be considered acceptable.

14.11.3 Noise level changes on the existing route

As a result of the operation of the proposed bypass, traffic flows on surrounding roads and particularly along the existing route, would change. Traffic assessments have indicated a reduction in the volume of traffic expected to use this route and this information has been used to determine the change in the acoustic environment along the Gold Coast Highway and the Tweed Heads Bypass.

The existing route – Pacific Motorway/Gold Coast Highway

The reduction in traffic volumes along the Pacific Motorway/Gold Coast Highway would result in an improved acoustic environment for residents living on both sides of the existing route. This reduction would be in the order of 3 dB(A) at 2007 and 2017 with the Tugun Bypass in place compared to the situation without it. While improvements of this magnitude would be noticeable immediately the bypass is opened to traffic (a reduction of three decibels is perceptible as an improvement in the acoustic environment) it is significant that these reductions are not immediately eroded by traffic growth over time. A reduction of some 40% in traffic using the existing route in 2007 compared to present volumes and only a small change (35% reduction) to 2017 is expected, indicating that the improvements brought about by the diversion of traffic to the Tugun Bypass would be maintained although noise levels would tend to increase slowly as a result of traffic growth.

Improvements in noise levels would be experienced by some 800 people living along the Pacific Motorway/Gold Coast Highway in those houses and units directly facing the traffic. Reductions in noise would also assist in improving the amenity of the public areas both for residents and visitors. No residences would experience an increase in noise.

Further reductions would be experienced by residents along the eastern side of the Tweed Heads Bypass to the north of the proposed Tweed Heads Bypass interchange. The magnitude of these reductions would diminish from north to south.

Tweed Heads Bypass

A number of receptors were selected along the Tweed Heads Bypass to assess the change in noise levels resulting from the operation of the Tugun Bypass. Noise levels were predicted with and without the bypass at 2017. Traffic speed and road surface conditions were assumed to be the same.

Reductions in noise levels would be experienced at those locations immediately to the south of the Lakeside Christian College, gradually reducing in benefit up to the southern end of Pontresina Avenue where the calculations indicate that the 2017 noise levels would be much the same with or without the Tugun Bypass.

Predicted changes at a range of receptors are listed in Table 14.13.

Table 14.13: Façade noise levels for receptors on the existing route, 2017.

Representative receiver	Floor	Façade facing	Façade noise level ($L_{A10\ (18\ hour)}$)		Change
			Without Tugun Bypass	With Tugun Bypass	
Pacific Motorway					
Alkira Street	One	north	70.3	69.9	-0.4
Blamey Drive	One	south-east	72.1	71.6	-0.5
Gold Coast Highway					
Karana Street	One	north-east	73.3	71.7	-1.6
	Two	north-east	75.5	73.9	-2.2
437 Golden Four Drive	One	south-west	73.4	71	-2.4
	Two	south-west	75.6	73.1	-2.5
484 Coolangatta Road	One	north-east	69.3	66.5	-2.8
	Two	north-east	71.4	68.6	-2.8
373 Golden Four Drive	One	south-west	74.4	71.9	-2.5
	Two	south-west	76.6	74.1	-2.5
281 Golden Four Drive	One	south-west	72.6	69.2	-3.4
	Two	south-west	74.7	71.3	-3.4
258 Coolangatta Road	One	north-east	73.6	70.2	-3.4
	Two	north-east	75.7	72.3	-3.4
141 Golden Four Drive	One	south-west	72.2	68.8	-3.4
	Two	south-west	74.4	71	-3.4
53 Golden Four Drive	One	south-west	66	65.4	-0.6
	Two	south-west	68.2	67.5	-0.7
Tweed Heads Bypass			Façade Noise Level ($L_{A10(18\ hour)}$)		
37 Kiata Parade	One	west	62.1	59.9	-2.2
51 Kiata Parade	One	west	64.9	59.3	-5.6
63 Kiata Parade	One	south-west	67.7	60.3	-7.4
1 Pontresina Avenue	One	west	63.6	60.7	-2.9
6 Pontresina Avenue	One	west	59.3	58.2	-1.1

14.11.4 Mitigation measures

Noise mitigation requirements vary along the proposed bypass according to the relevant state guidelines. Specific mitigation measures are described in Technical Paper 10. A general summary of these measures is given below.

Noise mitigation has been incorporated in the design of the proposal to some extent by consideration of the option to use a low noise pavement as the pavement surface for the carriageways and dense graded asphalt on selected interchange ramps. Further noise mitigation would most effectively be achieved by the use of roadside noise barriers in areas where dense residential development occurs adjacent to the proposal. Noise impact is usually confined to the row of houses closest to the proposal as these houses effectively shield residences located further away.

A combination of measures would be required to achieve the base criteria at Lakeside Christian College. A noise barrier would need to be erected between the Tweed Heads Bypass and the

church and school buildings. However this would not attenuate indoor noise to the required levels in the classrooms where open windows are needed for ventilation. Therefore, the use of an additional acoustic treatment would be considered to reduce predicted internal levels. This could be accomplished by replacing the louvred windows (on demountable buildings) with horizontal-sliding aluminium windows with glazing and providing mechanical ventilation in accordance with the Building Code of Australia.

Provision of noise barriers and architectural acoustic treatments are currently proposed for the Lakeside Christian College as part of the recommendations of the North Pacific Highway Noise Taskforce, however these measures have yet to be approved under the NSW Environmental Planning and Assessment Act.

Subject to a detailed assessment of practicality and feasibility issues, NSW RTA would adopt one or a combination of the preferred options to reduce the impacts of noise where levels are predicted to exceed the noise criteria. Finalisation of option selection and design would be undertaken as part of the detailed design phase on the basis of practicality, cost effectiveness, equity, aesthetics and community preferences. This would occur following local council and community consultation.

Forecast noise levels

The proposed bypass was assessed against the NSW Environment Protection Authority (1999) noise goals. Contours were generated for 2017 with mitigation measures in place.

For the section of the proposed Tugun Bypass in NSW both $L_{eq\ (15\ hour)}$ (daytime) and $L_{eq\ (9\ hour)}$ (night-time) criteria were used. Predicted traffic noise contours for the Tugun Bypass without mitigation measures in place are shown for 2017 on Figure 14.7.

14.11.5 Noise impacts with mitigation measures in place

NSW

With mitigation measures in place, the majority of facade noise levels in the vicinity of the proposed alignment would be reduced to below the legislative guidelines in the *Environmental Criteria for Road Traffic Noise* (NSW Environment Protection Authority 1999).

Receptors predicted to receive noise exceeding the criteria are located in the area adjacent to the proposed Tweed Heads Bypass interchange and two-way service road along the western side of the bypass. The excessive noise would be due in part to traffic movements on the service road, which would accommodate daily traffic in excess of 20,000 vehicles in 2017. Construction of barriers cannot result in compliance with the criteria due to flanking of noise around their southern end. Other means of achieving acceptable noise levels could be adopted in consultation with the residents affected.

These locations would experience noise levels in 2017 which would be considerably lower than in 2007 without the Tugun Bypass.

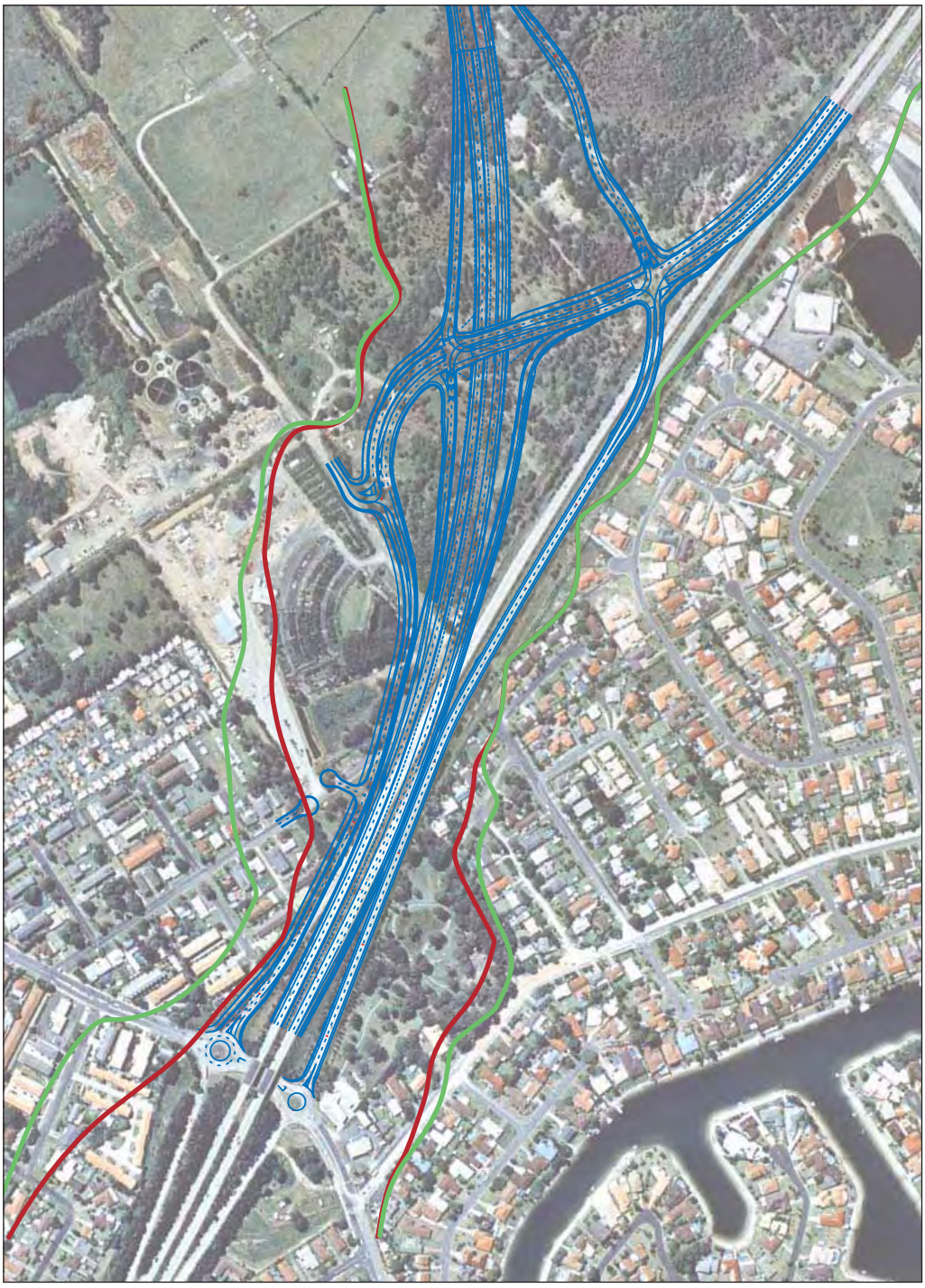


Figure 14.7 **Predicted 2017 Tugun Bypass Traffic Noise Contours**

This grid noise map (GNM) provides graphical representation of noise levels. For more detailed results refer to the tabulated values in Technical Paper Number 11. This GNM was calculated on a grid spacing of 150 metres at a height of 2m above ground.

A number of residences on Kennedy Drive would experience noise levels in 2017 above the base criteria. However, these would be higher without the Tugun Bypass which would result in a reduction (up to 20%) in traffic volumes along Kennedy Drive to the west of Tweed Heads Bypass. Traffic growth along Kennedy Drive would be predominantly a consequence of major urban development (Cobaki Lakes) taking place to the west. The construction of the Tugun Bypass would result in a reduction in traffic flows and some mitigation of noise levels along Kennedy Drive. However, traffic using the bypass would have little effect on noise levels in Kennedy Drive, which could only be mitigated by the introduction of barriers or other measures along Kennedy Drive itself.

14.11.6 Other related noise impacts

Cumulative impacts

Ambient noise levels for sensitive receptors located adjacent to the proposed Tugun Bypass corridor would include contributions from road, rail, aircraft and other local sources. The relative contribution from each of these would depend on the proximity of the receptor to the proposed road alignment and the aircraft noise contours at that location.

Since road and aircraft noise levels are conventionally quantified using different descriptors, it is not possible to derive a cumulative index to provide a combined noise exposure at a defined location. In addition, there are no recommendations on suitable cumulative criteria or assessment methods to determine the impacts of multiple transportation sources on sensitive receptors or on the community as a whole.

Aircraft impacts constitute single noise events resulting in high maximum levels. These levels are unlikely to be affected by the underlying continuous noise level generated by traffic on the Tugun Bypass.

The Cobaki Lakes development is potentially exposed to road and aircraft noise. However, aircraft noise would contribute little to local ambient levels, and NSW Department of Environment and Conservation road noise criteria for day and night periods would be appropriate. Provision of proposed mitigation measures to comply with this criterion would therefore satisfy cumulative requirements.

Noise-sensitive receptors adjacent to the southern end of the Tugun Bypass would be exposed to aircraft noise. However, the contribution to cumulative noise impacts is expected to be low and has been discounted in this assessment.

Road noise has been assessed using $L_{Aeq\ (15\ hour)}$ and $L_{Aeq\ (9\ hour)}$ parameters for day and night periods respectively. However, some receptors are also affected by aircraft noise, which is both measured using parameters incompatible with those used for road traffic and mitigated by a different organisation from that required to manage road noise impacts.

14.12 Commonwealth noise assessment

14.12.1 The affect of the development on noise exposure levels

The construction and operation of the Tugun Bypass will result in noise impacts on the surrounding environment within the airport. These impacts will arise during both the

construction and operational phases. Existing noise levels at the western side of airport are primarily influenced by aircraft noise with contributions from birds and wind.

14.12.2 Noise criteria

The Airports (Environment Protection) Regulations, 1997 provide the relevant criteria for noise levels from non-aircraft sources on airports. There are no criteria for construction noise specifically stated in the Airports (Environment Protection) Regulations although there is a general duty of care to prevent the generation of offensive noise. The relevant criteria with regard to road traffic noise at an airport, measured at a sensitive receptor should not exceed $L_{Aeq\ (24\ hour)}$ 60 dB(A) and $L_{Aeq\ (8\ hour)}$ 55 dB(A) between 10:00 pm and 6:00 am.

The western edge of the airport consists of flat, undeveloped land leading to the Cobaki Broadwater. There are no receptors in the area crossed by the alignment. The nearest receptors are residential properties some 2 km beyond the northern and southern boundaries of the airport. The nearest receptors on the airport are the terminal buildings some 2 km to the east.

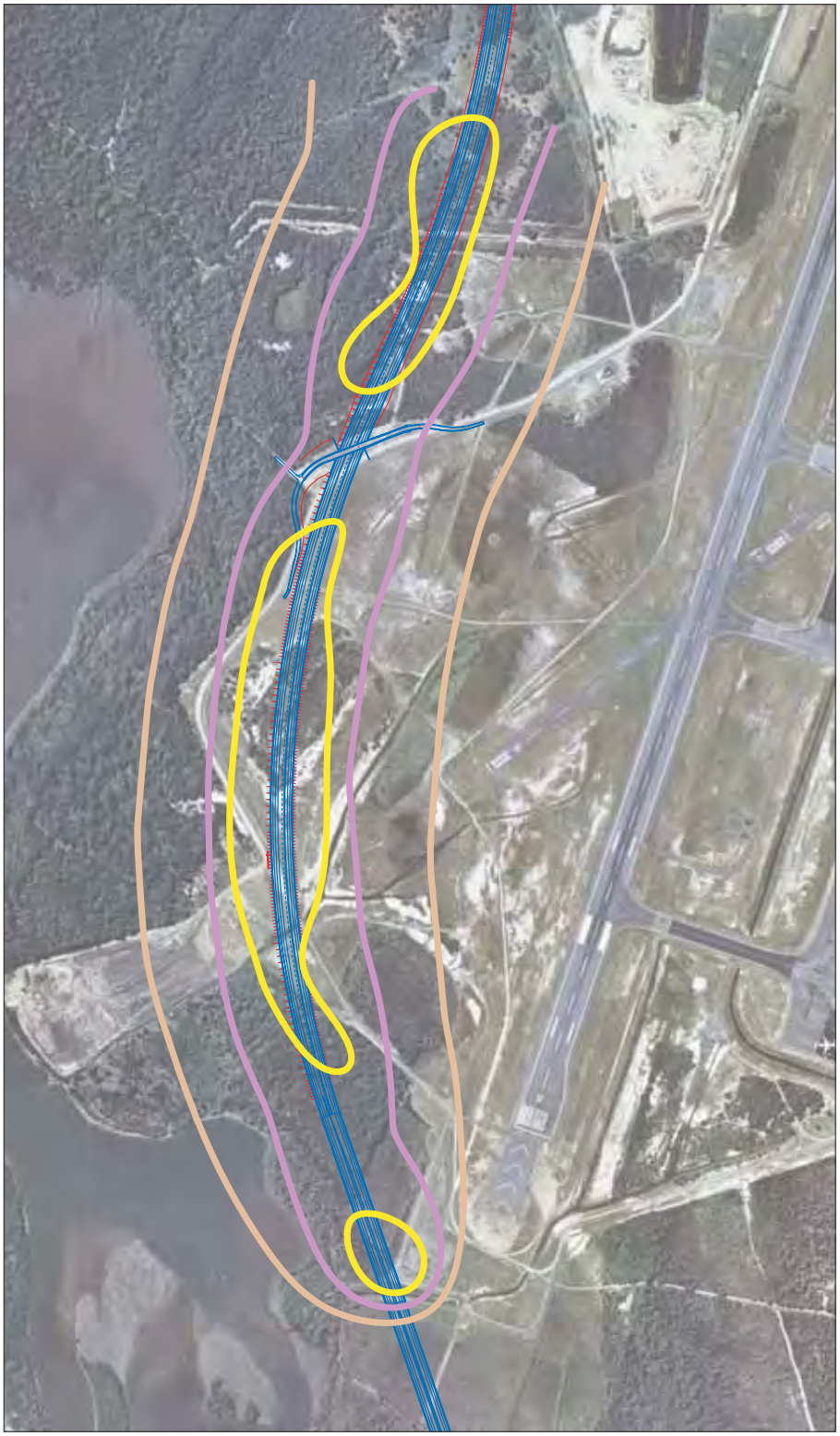
Since road and aircraft noise levels are conventionally quantified using different descriptors, it is not possible to derive a cumulative index to provide a combined noise exposure at a defined location. In addition, there are no recommendations on suitable cumulative criteria or assessment methods to determine the impacts of multiple transportation sources on sensitive receptors or the community as a whole.

14.12.3 Noise modelling

The lack of any existing receptors within 2 km of the alignment as it passes through the airport mean that there will be no noise impacts from the road on sensitive receptors on airport land. This is due to the attenuation of noise over distance, with the noise from the bypass decreasing the further away from the alignment measurements are taken, until the noise from the road is less than ambient noise at the recording point.

Although there are no receptors along the alignment within the airport the contour plots provide an indication of potential noise impacts on any future development in the Western Enterprise Precinct. Figure 14.8 shows the predicted noise contour plots for the airport. The plots show that noise from the road would result in a noise level of approximately 50 dB(A) at the junction of the Runway and Western Enterprise precincts which sits some 250 m from the edge of the road. This level rises closer to the road, reaching around 65 dB(A) some 30-40 m from the edge of the road. These noise levels would be compatible with the airport related and light industrial uses proposed in the Master Plan. (Note: the contour plots show a predicted $L_{Aeq\ (9\ hour)}$ dB(A) plot. When converted to a $L_{Aeq\ (24\ hour)}$ dB(A), as required in the Airports (Environment Protection) Regulations, the noise level will be lower).

Air Services Australia provide guidance on what is considered to be a compatible land use when the land use is related to the ANEF contours at an airport. The land use compatibility advice is presented in Table 14.14.



Road Carriageway
Road Cutting
Road Embankment
QLD 68 dBA +
QLD 60 dBA +
NSW with mit 60dBA (day) ▽
NSW no mit 60dBA (day) ▽
Commonwealth 65 dBA*
Commonwealth 60 dBA*
Commonwealth 55 dBA*

*LAeq (15 hour) (free field)
+ LA10 (18 hour) (facade corrected)
▽ LAeq (15 hour) (facade corrected)

Photograph taken February 2000

0 not to scale
Metres

Figure 14.8 **Predicted 2017 Tugun Bypass Traffic Noise Contours Without Mitigation**

This grid noise map (GNM) provides graphical representation of noise levels. For more detailed results refer to the tabulated values in Technical Paper Number 11. This GNM was calculated on a grid spacing of 150 metres at a height of 2m above ground.

Table 14.14: Land use compatibility advice

Building type	Acceptable	ANEF Zone conditional	Unacceptable
Houses, home units, flats, caravan parks	<20 ANEF	20 to 25 ANEF	>25 ANEF
Hotels, motels, hostels	<25 ANEF	25 to 30 ANEF	>30 ANEF
Schools, universities	<20 ANEF	20 to 25 ANEF	>25 ANEF
Hospitals, nursing homes	<20 ANEF	20 to 25 ANEF	>25 ANEF
Public buildings	<20 ANEF	20 to 30 ANEF	>30 ANEF
Commercial buildings	<25 ANEF	25 to 35 ANEF	>35 ANEF
Light industrial	<30 ANEF	30 to 40 ANEF	>40 ANEF
Other industrial	Acceptable in all ANEF zones		

The road would lie within the 25-40 ANEF noise exposure contours when passing through the airport. Vehicles travelling through the airport would not be stationary and so would only be exposed to noise from the occasional aircraft take off or landing, so the use of the land for a bypass would be compatible with the ANEFs.

Table 14.4 shows that commercial and only light industrial buildings should be included in an area exposed to this level of aircraft noise, so any development taking place close to the road would generally not be noise sensitive and therefore would be compatible with the bypass.

14.13 Implications for ecologically sustainable development

14.13.1 The precautionary principle

Existing noise levels have been monitored at representative locations along the proposed alignment of the bypass and adjacent to the Gold Coast Highway and the Tweed Heads Bypass. Predictions of future noise levels both during construction and following opening have been undertaken, and comparisons made with current criteria. Where required, mitigation measures have been defined and are included in the proposal. The provision of standard measures would not meet the necessary criteria in a small number of locations, and additional mitigation would be defined following a detailed assessment of practicality and feasibility. This is mainly due to high existing noise levels rather than the influence of the proposal. The consequences of the proposal are known and mitigation measures are available.

14.13.2 Intergenerational equity

Noise reductions along the Gold Coast Highway through Tugun and Bilinga would result in considerable improvements for local residents and visitors. A small number of residents would continue to experience noise levels exceeding the applicable criterion, with reasonable mitigation measures in place, although these would be below existing levels.

14.13.3 Conservation of biological diversity

There would be no impacts on biological diversity. The implications of noise and vibration impacts for ecological sustainability are summarised in Table 14.15.

Table 14.15: Implications of Noise and Vibration Impacts for Ecologically Sustainable Development

Precautionary principle	Intergenerational equity	Conservation of biological diversity
Noise monitoring and detailed modelling of expected changes has been undertaken. Residents and visitors along the existing highway would experience noticeable reductions in noise levels, while a small number of residents located adjacent to the southern end of the proposal would experience noise increases. Therefore a small area would experience irreversible increases in traffic noise. However the consequences are predictable and mitigation measures are available.	The environment along and adjacent to the existing highway would be enhanced due to a decrease in traffic noise, improving conditions for the future. No residents would experience noise increases as a result of the introduction of the Tugun Bypass although the applicable criterion may be exceeded in a small number of cases due to high existing levels.	Noise impacts would have no effect on biological diversity.

15. Cultural heritage

15.1 Introduction

Aboriginal people have been present in the northern NSW – south east Queensland region for at least 22,000 years. By approximately 2,500 years ago this area was populated by numerous language groups linked through extensive systems of marital exchange and ceremonial obligation. The first European people came to this area in the 1800's and initial activity was focused on the cedar trade. A cultural heritage assessment was undertaken to establish what sites of significance remained in the study area and to determine if any would be affected by the proposal.

The Indigenous view of the landscape is distinctly different to the Euro-centric view. When assessing Indigenous heritage values of places, it is vital to view the heritage values of Indigenous places in line with cultural views and differences. To do otherwise and consider Indigenous heritage in the same way as other heritage - does not accord proper respect for Indigenous cultural values, and misrepresents or undermines the significance of any such values. When assessing Indigenous heritage values of places, it is therefore imperative to take into account the interconnectedness of Indigenous sites, and any non-tangible relationships which may be associated with these areas.

This chapter reports the findings of the cultural heritage assessment and establishes the need for the development of a Cultural Heritage Management Plan. Full details of the cultural heritage assessment are found in Technical Paper 14.

15.2 Method and approach

The cultural heritage assessment of the proposed Tugun Bypass corridor, investigated Aboriginal and European cultural heritage issues for the entire length of the proposed bypass from Stewart Road to Kennedy Drive.

This chapter summarises the findings of the cultural heritage assessment of the Tugun Bypass proposal.

Tasks undertaken for the cultural heritage assessment include:

- a literature review to identify relevant cultural heritage data pertaining to the area potentially affected by the proposed development
- a search of relevant cultural heritage site registers and databases to compile a list of significant Aboriginal and European sites and places previously recorded in the area
- identification of Aboriginal Traditional Owners, Native Title claimants and other Aboriginal interest groups
- detailed and continuous consultation with all relevant groups throughout the study
- field surveys in conjunction with the relevant Traditional Owners to identify and record sites of cultural heritage significance
- assessment of the potential impact of the proposed bypass on places of cultural heritage significance.

15.3 Statutory obligations and policy

The Australian Government's heritage regime is predominantly managed through the operation of the *Environment Protection and Biodiversity Conservation Act 1999*. The *Environment Protection and Biodiversity Conservation Act 1999* established the National Heritage List and the Commonwealth Heritage List, while the Register of the National Estate is retained and maintained by the newly created Australian Heritage Council through the Australian Heritage Council Act 2003. The *Environment Protection and Biodiversity Conservation Act 1999* requires that actions taken on Commonwealth land that are likely to have a significant impact on the environment, or actions undertaken outside Commonwealth land that are likely to have a significant impact on the environment on Commonwealth land, will require approval. The definition of 'environment' is provided in s.528 of the *Environment Protection and Biodiversity Conservation Act 1999* and includes the heritage values of places, including places on the Register of the National Estate.

An area adjoining the Cobaki Broadwater, on the western side of Gold Coast Airport (within the airport boundary), includes Aboriginal occupation sites and shell middens and has been included in the Register of the National Estate. Under Section 391A of the *Environment Protection and Biodiversity Conservation Act 1999*, the Minister for the Environment and Heritage must have regard to information in the Register of the National Estate when making any decision under the *Environment Protection and Biodiversity Conservation Act 1999* to which the information is relevant. Less intact midden sites also exist outside the Register of the National Estate defined boundary on Commonwealth land and are also captured under the s.528 definition of the 'environment' under the *Environment Protection and Biodiversity Conservation Act 1999*.

15.4 Indigenous cultural heritage

15.4.1 Traditional Aboriginal occupation

Around 20 different dialects of the Bundjalung language are believed to have been spoken in traditional times in the area stretching from the Clarence River to as far north as the Logan River (Crowley 1978). Although the name 'Bundjalung' has been applied to the whole language area between the Logan and Clarence Rivers, this name is not acceptable to all who speak the language or whose ancestors spoke it (Sharpe 1998). As a result, the name Yugambeh is now applied to dialects spoken in south-east Queensland and north-eastern NSW, including the Gold Coast and Tweed Valley (Sharpe 1998).

Evidence indicates that the Minjungbal, a Bundjalung-speaking people, inhabited the Tweed River area, with the Kombumerri, who spoke dialects of the Yugambeh language, immediately to the north (O'Connor 1997). Interaction between the Minjungbal and Kombumerri is likely to have been frequent and sustained.

The locality surrounding the current Gold Coast Airport area is considered culturally significant as a traditional meeting and camping place of the Kombumerri and Minjungbal peoples. Interests in the study area today are represented by the following organisations:

- The Tweed Byron Local Aboriginal Land Council, a broad representative body incorporated under the NSW *Aboriginal Land Rights Act 1983*. Membership includes the Minjungbal people. The territory of the Tweed Byron Local Aboriginal Land Council extends along the coast from the Queensland–NSW border to Suffolk Park, south of Cape Byron

- Kombumerri Aboriginal Corporation for Culture is represented by the descendants of a family group that traditionally occupied the area between the Tweed and Coomera Rivers and west to the Numinbah Valley. This Corporation is currently working with other Yugambeh families to preserve the language, history and culture of the south-east Queensland and north-eastern NSW region
- Ngarang-wal Aboriginal Land Council which also represents Kombumerri interests in the study area
- Nganduwal Language Group, also known as the Moorung Moobah Traditional Owners
- Pooningbah Community Aboriginal Corporation, based at Fingal Head
- Eastern Yugembeh Native Title Group.

15.4.2 Native title and aboriginal land claims

Native title claim

As of November 2004 there were no native title determination applications, determination of native title or Registered Indigenous Land Use Agreements for the Tugun Bypass area.

Aboriginal land claim

An Aboriginal Land Claim (Number 3093) has been registered on behalf of the Tweed Byron Local Aboriginal Land Council. Its extent is shown on Figure 15.1. The section of the claim over the Boyd Street road reserve was refused in 1992 on the grounds that it was needed for an essential public purpose. The remainder of the claim (including DP755740-56, DP755740-57, two sections of DP755740-58 and DP755740-321) is still to be determined.

15.4.3 Aboriginal consultation and participation

Consultation during preparation of the EIS

Contact with Aboriginal representatives was initiated during the early planning phases of the project through individual consultation with known interested parties. Cultural heritage interests were further developed during the cultural heritage assessment program through direct contact (phone, meetings and survey) with individuals and communities who had expressed an interest (Traditional Owner groups and individuals).

The aim of the consultation program was to ensure that interested individuals and representatives from cultural heritage interest groups were provided with facilitated opportunities to contribute to the route development process.

The objectives of the program were to:

- provide an opportunity for interested parties to contribute to route development
- provide interested groups/individuals with the opportunity to become aware of, and to discuss, the design concept and its implications
- provide all interested parties with the opportunity to question the cultural heritage team regarding the issues involved
- develop community confidence in the consultation process

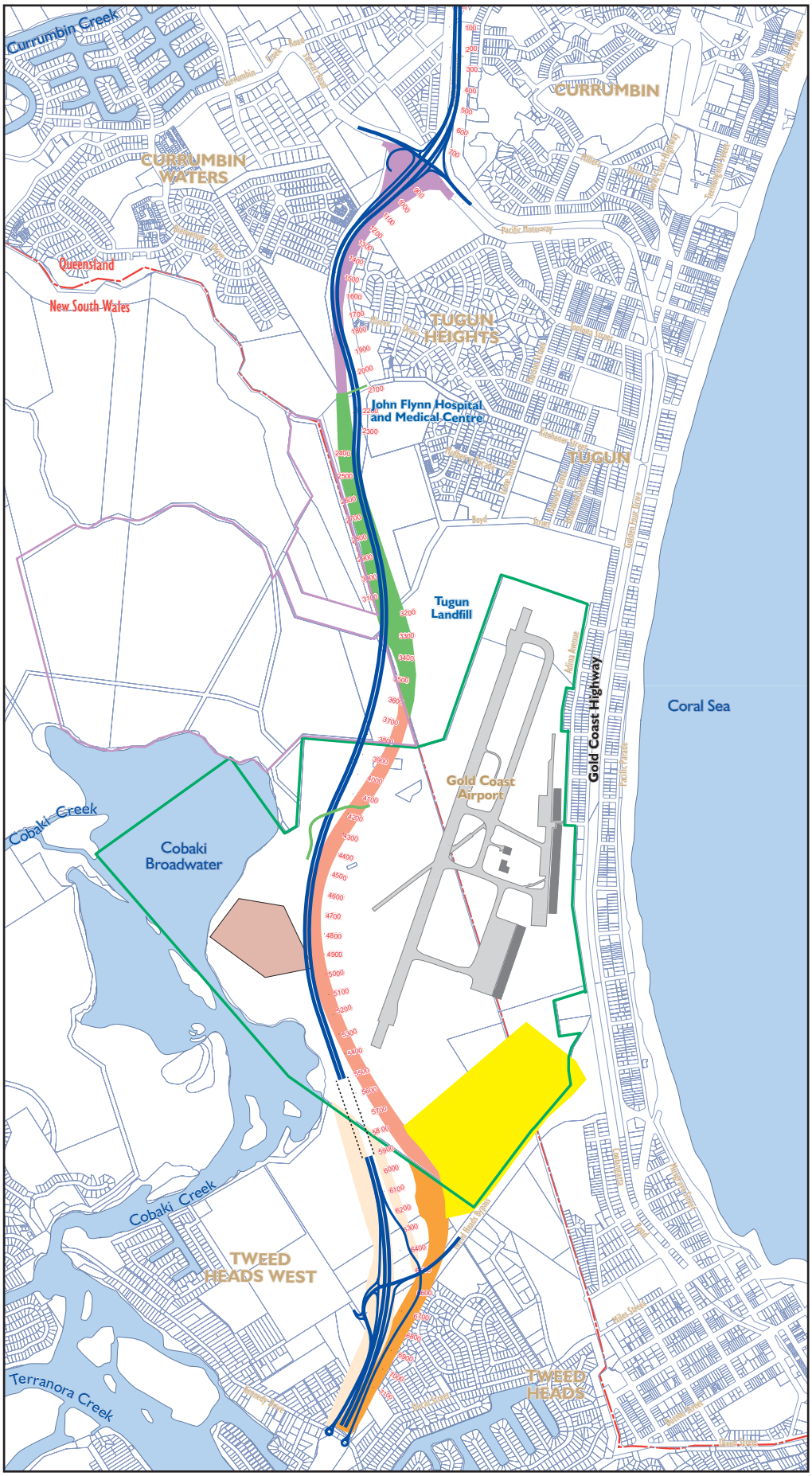


Figure 15.1 **Cultural Heritage Survey Zones**

- provide a mechanism whereby the community can provide direct comment on the cultural heritage issues.

Representatives from the following organisations have been involved in the cultural heritage consultation.

Queensland

- Environment Protection Agency (Cultural Heritage)
- Main Roads
- Kombumerri Aboriginal Corporation of Culture;
- Ngarang-wal Aboriginal Land Council
- Kalwun Development Corporation.

NSW

- National Parks and Wildlife Service (Cultural Heritage Registrar)
- NSW RTA (Aboriginal Program Consultant)
- Tweed Byron Local Aboriginal Land Council
- Pooningbah Community Aboriginal Corporation, through the Tweed Byron Aboriginal Land Council
- Nganduwal Language Group also known as the Moorung Moobah Traditional Owners.

Further details of the consultation activities undertaken are provided in Technical Paper 14.

Aboriginal groups and individuals consulted raised the following issues in relation to the proposed Tugun Bypass alignment.

- The general area was known to be a gathering place and an important food resource area. It is therefore important to local Traditional Owners.
- There is anecdotal evidence regarding the presence of a grave/graves in the vicinity of the Tweed Heads Pony and Hack Club at the southern end of the route. Although extensive enquiries were made, the only reference identified was to a location near an abandoned house. This area was inspected but no evidence of graves was found. However, in the opinion of the Traditional Owners, it is highly likely that there are gravesites in the general study area.
- The mangrove area adjacent to Cobaki Broadwater contains known and recorded middens, a complex of which lies in the National Estate area. It is believed that middens could extend east of the present mangrove line and would be affected by the proposed route. However, the eastern boundary of the mangrove fringe is less than 100 m from the airport perimeter in places. This area has undergone significant changes since development of the airport started and it is unlikely that intact middens would be located in the disturbed areas.
- There was concern that reliance on surface inspection alone does not adequately address the issue of buried material. Further testing and monitoring at the time of clearing were raised as important activities that would need to occur prior to any earthworks.
- The Kombumerri Corporation for Culture Museum contains thousands of stone artefacts collected from the Gold Coast area. One of these collections was undertaken in the 1960s by amateur archaeologists and local scout groups. Almost every visible stone was collected

around the John Flynn Hospital and Medical Centre area. The absence of surface artefacts in this area may be a reflection of this collecting activity.

15.4.4 Aboriginal heritage and potential impacts

Archaeological excavations in south-east Queensland and north-east NSW have revealed a long prehistory. The last two decades have witnessed a dramatic increase in archaeological research conducted in the area. Results of the research have established that Aboriginal occupation of this region extends back at least 22,000 years and a relatively good archaeological record has been demonstrated for the past 6,000 years.

The majority of archaeological sites recorded in the region are found on the coastal strip. This may reflect the emphasis of development in the area as more surveys have been conducted on the coastal plain and therefore more sites have been recorded. However, the ethnographic data supports the known archaeological evidence that large numbers of people did live for long periods on the coast, and large numbers of sites can be expected to exist as a result. For example, hundreds of Aborigines were reported to be living in the Tweed Valley in the early 1870s (Byrne 1945).

Aboriginal occupation of the hinterland has been dated from excavated material from archaeological sites in rock shelters. The closest of these to the study area is a large shelter known as Bushrangers Cave in the border ranges between Queensland and NSW. Excavation at this campsite has revealed that occupation might have begun around 10,000 years ago (Hall 1986). A salvage excavation of a Broadbeach burial ground, undertaken from 1965 to 1968, resulted in about 150 individuals being exhumed. These burials were dated from 1,200 years before present (BP) (Haglund 1976).

The first detailed investigation of an Aboriginal site on the Tweed Estuary was undertaken at Terranora about 7.5 km south of Gold Coast Airport (Barz 1982). The Terranora midden covered an area of 65 m by 11 m with a depth of 40 cm. It was located on a low spur which extended into the alluvial plain above the river channel. The burials found at the location were removed and reintered at the Tweed River Aborigine memorial (Piper 1994). The lowest unit had a date of approximately 600 years BP.

A midden dated to between 4,700 and 4,200 years BP has been investigated at Sextons Hill, 5.5 km south of Gold Coast Airport (Appleton 1993).

15.4.5 Archaeological record

The coastal strip, including the hinterland of northern NSW, is known to have been a major focus of Aboriginal occupation at the time of European settlement. This is substantiated by the number of recorded sites for this region on the NSW Department of Environment and Conservation Site Register. More than 100 Aboriginal sites have been recorded in the north-east corner of NSW within 30 km of Gold Coast Airport. Of these, 80 occur in the coastal zone and include shell middens, open campsites, isolated artefacts, burials, bora/ceremonial sites, stone quarries and a stone arrangement.

Known archaeological sites adjacent to the proposed alignment are shown on Figure 15.2 and are discussed in the following section.

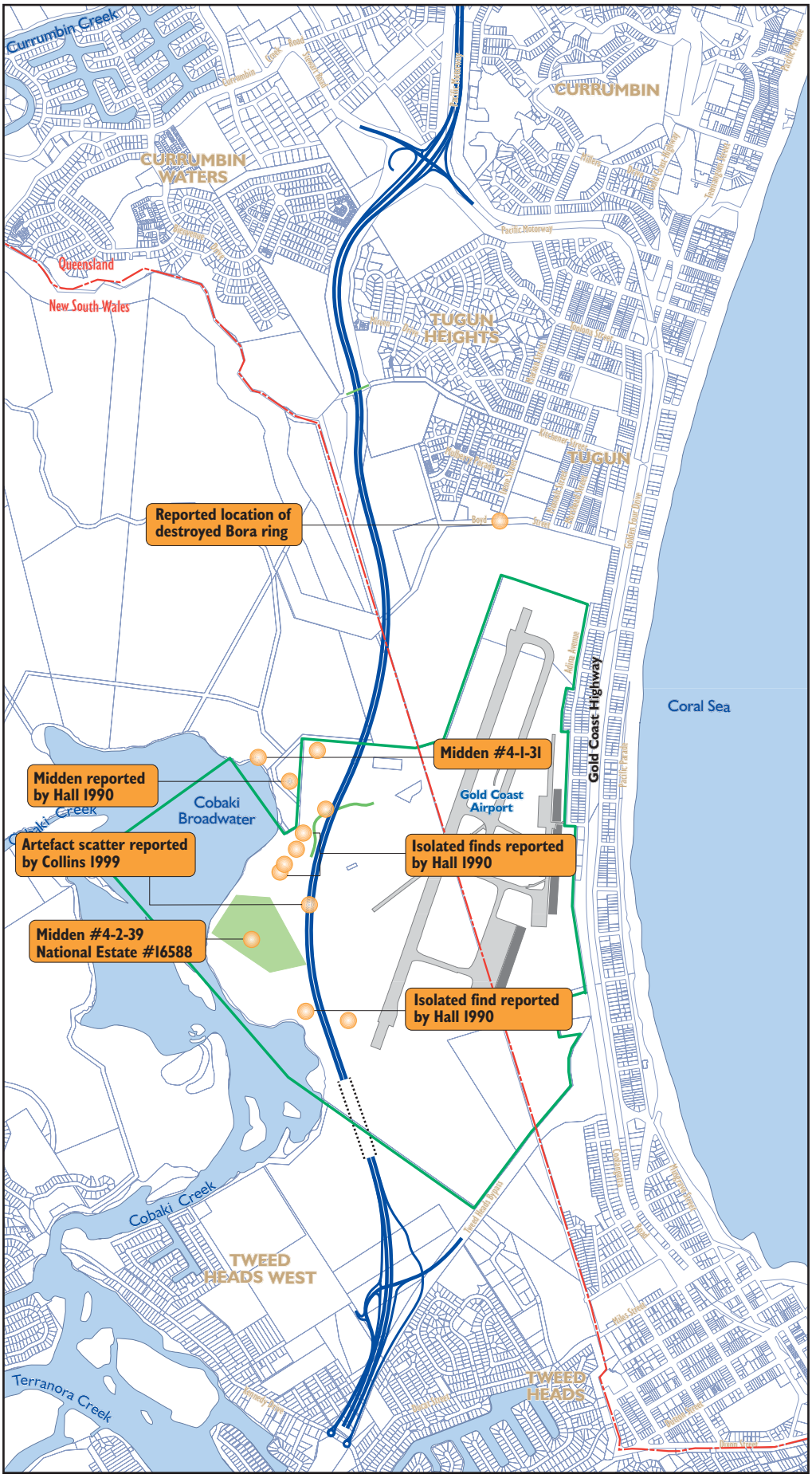


Figure 15.2 **Locations of Known Aboriginal Sites**

Destroyed bora ring (Queensland)

A destroyed bora ring has been reported at a location to the north of Gold Coast Airport at Tugun, Queensland within the Boyd Street road reserve. The existence of the bora ground is well known locally and is evidence that the area was used for large periodic gatherings. The site was destroyed during previous road construction works in the area.

Pathways between the rings, which made up a ceremonial ground, were common and were as important as the rings. Although the forest and scrub of the coast and the hinterland were largely impenetrable to European settlers, the Aborigines had well-defined centuries-old paths and tracks, which connected tribal areas. Some of these followed dreaming paths. They were well-defined across Beechmont Plateau to the coastal area, with others providing access for coastal people to the Bunya festival area. The proposal will have no further impact on the bora ring.

Midden (Number 4-2-39) (Commonwealth land)

A midden (Number 4-2-39) was recorded in 1985 on the foreshore of Cobaki Broadwater within the boundaries of Gold Coast Airport. The parcel of land encompassing the site was nominated in 1987 and listed in 1991 on the Register of the National Estate. In addition to its Aboriginal cultural significance, the site was deemed to represent one of the few remaining camping-midden sites in the Gold Coast–Tweed region and the only one known for Cobaki Broadwater (Lilley 1987). The site is a complex of stratified middens with stone artefacts and well-preserved deposits to a depth of up to 75 cm, situated on a low rise near Cobaki Broadwater. The National Estate area is approximately 9.5 ha in extent and the areas of vegetation around the boundary provide a buffer zone between the midden and the cleared airport precinct.

The National Estate midden complex has outstanding value to the local Aboriginal community as an educational resource and has intact cultural deposits that have considerable archaeological research potential. It is also the only estuarine midden complex that still retains much of its former environmental context.

The proposed corridor extends into the defined boundary of the National Estate area, affecting some 1200 square metres. This would be entirely within an area previously disturbed and would not affect the shell midden complex within the fenced, vegetated area.

Aboriginal representatives consulted on this matter have consented to the works going ahead, subject to monitoring by representatives of the Aboriginal community. The Commission therefore has no objections to these works.

Midden (Number 4-1-31) (NSW)

Another midden (Number 4-1-31) has been recorded near Cobaki Broadwater in NSW, immediately west of the airport boundary. The site is in poor condition and consists of a surface scatter of pipi, whelk and cockle shells, with a few small stone artefacts, extending for 120 to 150 m along a section of vehicle track. The midden would not be impacted by the proposal.

Disturbed stone artefact scatters and single artefacts

A cultural heritage study of the Gold Coast Airport site was undertaken by Hall (1990) as part of the master plan preparation. Surveys were conducted in undeveloped areas to the south and west of the main airport runway. In addition to locating midden number 4-2-39 (for a second time), stone artefacts and shellfish remains were found in elevated areas in the north-western

part of the National Estate area. Hall found that these were not as rich as in the National Estate area and some parts had been subject to sand extraction. Where shellfish were found in disturbed areas, Hall reported a lower level of archaeological integrity than those in the National Estate area. The survey results suggested that the construction of the airport, and mining and clearing activities, had destroyed most of the archaeological record of the area, with the exception of the National Estate area.

An assessment of the route options for the Tugun Bypass was undertaken in 1999. A field reconnaissance found three low-density stone scatters and a single isolated artefact. All were in disturbed contexts and were rated as having a low level of scientific/archaeological significance. However, representatives of the Kombumerri group consider that all sites in the area have high social and/or cultural significance and that the cultural landscape of which they were part is worthy of preservation (Collins 1999).

15.4.6 Importance of the area to the Traditional Owners

The Traditional Owners consider all the sites to be of high cultural/social significance. In their understanding, the artefacts and middens whether in situ, disturbed or displaced, reflect generations of use by their forebears and all form an integral part of the cultural landscape, which is considered worthy of protection and preservation.

The interrelationship of the material was recognised in discussions with representatives of the Kombumerri people who pointed out that had the general environment not been capable of supporting large numbers of people for long periods, the bora ground would not have been located there, nor the middens. It is well known that bora grounds were located in areas and at times where staple foods such as Bungwall Fern, molluscs or mullet and fresh water were in abundance. The food resources then were seen as integral to supporting the social and political structure of the time, which is evidenced by the presence of a bora ground.

The concept of the importance of the connection between resources, location, spiritual, political and social life is the most difficult to manage in the context of development. It is the one requiring the most respect and consideration. Consultation in this project has therefore been designed to discuss such matters and to try to identify the perceived impacts of the proposed development on these values. Continued consultation with the Traditional Owners is therefore an integral part of future phases.

15.4.7 Field surveys

Surface survey

An intensive surface survey of the study area was undertaken in October 2000. This involved inspection on foot of the ground surface within the study area. This type of survey is designed to identify all visible surface archaeological material and/or features. It is not ideal for determining if subsurface material exists although eroding and disturbed banks were carefully inspected to determine if any subsurface material was visible.

The survey was undertaken along the original C4 alignment, the centreline of which had been marked with pegs set at 100 m intervals. At the time of the field survey, route alternatives for the proposed Tweed Heads Bypass interchange were still being investigated. A broad survey of this area was therefore undertaken to allow for all possible alignment options. A more detailed investigation of the preferred alignment through this section was undertaken in June 2001. At this time this section of the proposed alignment was also surveyed for scarred trees.

The survey area was divided into four sections:

- Stewart Road to Kitchener Street
- Kitchener Street to Queensland–NSW border
- NSW Crown land and Gold Coast Airport
- Southern airport boundary to Tweed Heads Bypass.

These are shown on Figure 15.1.

No new sites were located along the original C4 alignment.

A site containing flaked stone artefacts, previously recorded by Collins (1999) and Hall (1990), was re-located during the survey. The site occurs in a highly disturbed area which has been artificially lowered. The artefact site lies within the proposed footprint. The management of this site will be negotiated through the cultural heritage management plan.

Areas along the route were identified as having high, moderate or low sensitivity, based on environmental setting and degree of disturbance.

- **Low sensitivity:** at this level there is very little chance that intact cultural deposits would be present even in those areas where they might be expected to have been in the past (for example in the airport grounds, immediately east of the Cobaki Broadwater). Also included in this category are those topographic areas (for example steep slopes) that seldom exhibit cultural material or deposits. The majority of the proposed bypass corridor falls into this level of sensitivity, having been extensively modified over the years.
- **Moderate sensitivity:** this level includes areas that Aboriginal people would have used in the past, but in such a manner that durable cultural materials (for example stone artefacts) would rarely have been deposited. Even though disturbance may be minimal, the probability of cultural materials or deposits in these areas is low. The area in this category is located in the corridor south of the John Flynn Hospital and Medical Centre. This portion is located on the lower slopes at the western edge of former wetlands. The area appears to have had slight impact (for example, by clearing) and its proximity to the wetlands (resource area) makes it possible that cultural materials may still be present, although covered by alluvial and colluvial processes.
- **High sensitivity:** this level includes areas that have a high sensitivity to Aboriginal people. The only area that falls in this category is located at the southern end of the proposed bypass, the National Estate. This has experienced the least level of impact and is characterised by sand deposits between the river and the coast. Stories of a burial (grave) in this region have been reported and at present cannot be discounted.

A map incorporating both the original C4 alignment and the proposed bypass alignment was used to highlight areas where significant changes to the alignment had occurred during the course of the study. As shown on Figure 15.1 the areas where the proposed alignment diverged from the original C4 alignment were:

- south of Boyd Street, to the west of the Tugun Landfill
- southern airport boundary fence to Tweed Heads Bypass.

Each of these revised areas was assessed by Bonhomme, Craib and Associates, according to the sensitivity rankings above, for the likelihood of finding cultural materials. The area to the south of Boyd Street has been assessed as moderately sensitive, and subsurface testing for cultural

materials would be undertaken along this section of the proposed alignment prior to any construction works. A Section 87 permit under the NSW *National Parks and Wildlife Act 1974* would need to be granted prior to any subsurface testing.

The possibility of burial/burials along the southern section of the alignment (between the southern airport boundary fence and the Tweed Heads Bypass) cannot be discounted. While this area is typical of locations where burial sites occur in coastal situations (sand deposits between the river and the coast) the degree of disturbance that has already occurred along a major portion of the proposed route suggest that the likelihood of finding burials in this area is low. Subsurface testing would be undertaken, according to Section 87 of the NSW *National Parks and Wildlife Act 1974* prior to the start of construction works.

No sites or issues were identified that would impose major constraints on the proposal. Few sites are expected to occur in the disturbed areas that make up a majority of the bypass route. Shell middens could occur but they are likely to have been disturbed and examples of such middens are preserved in the National Estate area. Any such sites that may be found along the route would be managed via a process of consultation and mitigation.

15.4.8 Further works prior to construction

Prior to construction works commencing, the following activities would be required to be undertaken:

- continued consultation with the Traditional Owners
- development, in consultation with Traditional Owners, of pre-construction protocols in the form of a cultural heritage management plan to deal with any existing or new material that might be discovered during pre-construction and construction. The Cultural Heritage Management Plan would incorporate the following:
  - emergency measures to be adopted in the event of an unexpected find during construction. All work would cease in the vicinity of the potential item and the appropriate bodies (NSW Department of Environment and Conservation, Queensland Environmental Protection Agency and/or commonwealth Department of Environment and Heritage depending on jurisdiction) would be contacted for further advice
  - on-site training for construction and site staff with respect to their cultural heritage responsibilities
  - if relevant, the preparation of detailed site plans showing areas which must not be disturbed
  - required mitigation measures if burials are found
  - specific communication procedures for response to cultural heritage matters including:

    establishing a 24-hour enquiries contact telephone number during periods when night works might be undertaken. At other times, the enquiries line would operate during normal business hours with an out-of-hours answering service

recording details of enquiries on a register

developing procedures for a quick response to enquiries by a suitably qualified person (for example a qualified archaeologist)

widespread advertising of the telephone number and advertisement of the timing of construction activities.

- testing of the following areas for subsurface deposits prior to ground clearance:
  - the western edge of the wetlands between chainages 2,500 and 3,200
  - south of the National Estate (between approximate chainages 4,600 and 4,800)
  - tunnel approach (between approximate chainages 5,000 to 5,500)
  - the southern area from the airport boundary to the junction with the existing Tweed Heads Bypass (between approximate chainages 6,000 to 6,700).

These are shown on Figure 15.1.

A diesel-powered sand auger could be used to its maximum depth (at least 2 m) at intervals of approximately 50 m to determine the presence of cultural materials. If such materials are identified, further open-area excavation and salvage may be required. This would be undertaken only after consultation with the appropriate Traditional Owners and the relevant state agency.

- Continued consultation with the Traditional Owners would be required. The recommendations and requirements for further work, and the precise technical activities that would be considered and undertaken during proposed pre-construction and construction would be discussed in full.
- Activity within the National Estate would be kept to a minimum. There would be no disturbance within the fenced-off, vegetated area of the site. Traditional Owners would be kept fully informed of any further issues that arise from subsequent changes to the proposed alignment. Section 30 advice (*Australian Heritage Commission Act 1975*) has been received from the Australian Heritage Commission in relation to the effect the proposed bypass is likely to have on the National Estate area. They have indicated that they have no objection to the proposal, provided there is consultation with Traditional Owners and monitoring during construction works.

15.5 European cultural heritage

15.5.1 Early European history

Evidence of the first European settlement in the area dates back to 1828. At that time most of the interest in the area was associated with the exploitation of timber resources.

The earliest written description of the region comes from Sir Joseph Banks, the botanist on James Cook's voyage in 1770. As the ship moved northwards along the coast, Banks described the area north of Fingal as 'very low land which looked like an extensive plain in which we supposed there to be a lagoon, in the neighbourhood of which were many fires' (Beaglehole 1968). It was not until John Oxley entered the Tweed River in 1823, in his quest for the site of a new penal settlement, that the first recorded direct contact between Europeans and the region's Aboriginal inhabitants occurred.

Sustained European presence began with the establishment of a penal settlement at Redcliffe, Moreton Bay, in 1824. In 1826, the commandant of the penal settlement, Captain Patrick Logan, travelled south and named one river the Darling. This name was changed in 1827 to the Logan. By 1828, the number of runaways who tried to escape south increased and a military post was established on the Tweed River. According to the evidence given by Alan Cunningham in February 1832 to the Select Committee on Secondary Punishment, the post was abandoned some time before he left Moreton Bay in September 1829 as a result of a 'rupture with the natives and since that period the natives have been particularly hostile' (Longhurst 1992). The Aborigines had apparently attacked some pine and cedar gangs employed near the spot, forcing them to retire.

Tugun: The early years

Cedar was being cut along the Tweed River in 1843 and the area rapidly became the colony's primary source of that timber. Terranora, on the Tweed River, was the centre for cedar cutters, with stores, inns and shipping facilities. Cedar cutting on the Tweed boomed in the 1860s when the southern rivers began to be cut out.

The pastoral occupation of the upper Albert and Logan Rivers, which had started in 1842, gradually affected the land along the coast, north of the Tweed River. The region was opened for free settlement in 1842, and about this time Beau Desert Station was established. This station was located in the area between the Logan River and the sea, and extended southwards to the present state border.

Alfred William Compigne acquired the leasehold of Nindooinbah Run in the Albert River area in 1848. This pastoral run was located adjacent to Beau Desert Station. In 1852, Compigne was issued with the leases for Run Numbers 5 and 6 known as Dungogie and Murry Jerry respectively. Dungogie included Currumbin Valley. In August 1852, both runs were transferred to William Duckett White of Beau Desert station. These however, were not part of the station, but were separate and used as breeding and heifer stations (Jones 1988).

At the time Queensland separated from NSW (1859), the European population of the Tweed Heads – southern Gold Coast locality was confined to cedar cutters and the few inhabitants of Dungogie, the pastoral run established in the Tallebudgera Valley (Collins 1999). Little early interest was shown in the area between Nerang and the Tweed despite the development in 1862 of a large cotton plantation on the Nerang River. Access was limited to a few timber-getters tracks, one of which ran south-west from Currumbin across the present Tugun Hill to the vicinity of John Flynn Hospital and Medical Centre (Longhurst 1996).

A large part of south-east Queensland was opened up for selection with the introduction in 1861 of the Robertson Land Act, allowing grants of up to 1,280 acres, and the passing of the Crown Lands Alienation Act of 1868, providing for extensive resumption of leased runs. In 1861, much of Beau Desert Station was taken up as Agricultural Reserve and by 1867 large portions of the coastal runs of Dungogie and Murry Jerry had been surrendered. Dozens of selector families came onto the former Dungogie lands.

Much of the selection of the Currumbin Valley occurred between 1870 and 1885. The first selector was Samuel William Gray, who in 1870 selected almost 2,500 acres of land on the north and south banks of Currumbin Creek, effectively taking up all the best areas. The first permanent settler in Currumbin was Henry Jordan, who in 1874 took up 3,120 acres of the north side of Currumbin Creek for cattle grazing. Henry Eden, a timber merchant, took up land at the head of Currumbin Creek in 1882 (Horsman 1995). The coastline zone to the east of Gray's selection was soon after proclaimed a public reserve (Longhurst 1996).

In 1898 the Farrell family walked overland from Tallebudgera Township along a track now called Simpson Road to their selection just south of Currumbin Hill. They established a camp near the present-day automatic telephone exchange and started to clear land for a home and later for grazing paddocks for their small dairy herd. Their selection with its small slab home was the only farming property for many years in the area south of Currumbin to Coolangatta.

Currumbin township was surveyed and proclaimed in May 1887, but no development occurred until the railway was opened. The Dolans bought 203 acres of land in 1902 extending from Currumbin Creek to the Queensland–NSW border and began clearing for dairying (Horsman 1995).

The completion of the railway line to Tweed Heads in 1903 brought settlers and then holidaymakers to the area. The Lands Department decided on the name Tugun in 1910 and land was subdivided near the beach to allow auctions to take place. The first home in Tugun village was built in 1916. The construction of the coast road linking Southport to Coolangatta in the 1920s was a major impetus for the development of beach properties in areas such as Bilinga and Tugun. The railway operated until 1961.

The Seaside Hotel at Tugun was constructed by F.S. Charles in 1925, and changed hands over the years. The dairy and banana farms, which dated from the early years, disappeared as the land was subdivided into areas such as the Currumbin Estates in the late 1950s (MS Local History Library collection, Southport).

Construction of Gold Coast Airport

It was suggested that landing fields were required between Sydney and Brisbane as airline activity increased in the early 1930s. At the time, the mayor of Coolangatta lobbied for an aerodrome to be sited on a tract of swamp land across the railway line at Bilinga. Development of the airport began with construction of an emergency landing strip in 1936.

Construction of the landing strip commenced towards the end of the depression. Gravel from the Miles Street quarry was used to lay three gravel strips, and later grassed strips. Work was completed by 1938 and the site designated by the Department of Civil Aviation as Bilinga Aerodrome (Lower Tweed River Historical Society 1990).

Although only occasionally used, the strip was permanently maintained by Tom Norris. The aerodrome was not used during World War II. After the war, Queensland Airlines started an air service and it became evident that the airstrip needed to be upgraded. A crew from the Commonwealth Department of Works arrived in 1950 and commenced work to upgrade the airport.

The works supervisor was an experienced earthworks man and he considered the Bilinga job one of his hardest. The southern end was swamp and the northern end was a council rubbish tip (the tip was partially removed during the upgrade of the airport in 1950). Due to the conditions, earthmoving equipment was continually bogged for periods of a week or more.

The hill at the northern end of the runway was stripped down to gravel to provide the fill for the main runway. By 1952, the works were completed and Butler Airline was running a regular service to Sydney. The runway was extended in 1968 to accommodate DC9 and L-88 Electra aircraft. It was further developed in 1982 for wide-bodied aircraft.

European sites

The European history of the study area is predominantly related to development in the twentieth century. Historic material that still exists relates to the development of the coastal strip and the installation of infrastructure such as roads, bridges and the south coast railway. The railway was in use from 1903 to 1961 and was instrumental in opening up the area for the movement of produce and then facilitating the growth of the resort industry, which now underpins the Gold Coast economy. Development along the existing highway was stimulated by the post-war development of the area as a tourist destination. Small timber and fibro houses dating to the 1950s exemplify the development along the highway (Collins 1999).

No historic structures, relics or materials were identified along the proposed bypass alignment.

If any unexpected non-Indigenous places, objects, items or issues of potential cultural heritage are encountered during the course of construction works, works would cease and the Queensland Environment Protection Agency and/or NSW Heritage Office would be contacted, depending on jurisdiction. If the affected area is located within the boundaries of the Gold Coast Airport, the Commonwealth Department of the Environment and Heritage would be contacted.

Special value places

The Cobaki Broadwater can be considered to be a place of special value as it functions as an important fish nursery for the Tweed Estuary fishery. No other special value places are found within the study area.

15.6 Implications for ecologically sustainable development

15.6.1 The precautionary principle

The environmental assessment process has ensured that no known items or areas of cultural significance would be damaged or destroyed as a result of the proposed bypass. Consultation with local Aboriginal groups will continue through the pre-construction and construction phases of the project. Pre-construction protocols in the form of a cultural heritage management plan would also be developed in consultation with Traditional Owners to deal with any existing or new material that might be found.

15.6.2 Intergenerational equity

It is unlikely that the proposed bypass would have any long-term effects that would degrade the cultural heritage resources for future generations. Continued consultation with the Aboriginal community, the NSW Department of Environment and Conservation, the Queensland Environmental Protection Agency and the Australian Heritage Commission during the construction phase of the project would ensure that cultural heritage items are not irreparably damaged.

15.6.3 Conservation of biological diversity

Assessment of the significance of cultural heritage items and sites acknowledges the close connection between Aboriginal use and management of environmental resources and the maintenance of biological diversity.

The ecological sustainability implications of cultural heritage issues influenced by the proposal are summarised in Table 15.1.

Table 15.1: Implications of noise and vibration impacts for ecologically sustainable development

Precautionary principle	Intergenerational equity	Conservation of biological diversity
Consultation has been undertaken with local Aboriginal groups and the area along and close to the proposed alignment surveyed. Pre-construction protocols would be developed to ensure that no items or areas of cultural significance are damaged or destroyed. There would be no impacts on any listed European heritage item.	It is unlikely that the proposed bypass would result in the long-term degradation of local cultural heritage resources.	The maintenance of cultural heritage values would include a close connection with biological diversity.

15.7 Conclusion

There is a possibility of burial sites along the southern section of the alignment. This area is typical of locations where burial sites occur in coastal situations but past disturbance from sandmining and other activities suggest the likelihood is low. Shell middens occur in the study area and are preserved in the National Estate area. Although the possibility of burials is low subsurface testing is recommended prior to the start of the construction of the bypass.

A cultural heritage management plan will be developed in consultation with the Traditional Owners to deal with any material that might be discovered during the sub-surface testing or during construction.

No sites of European cultural significance were identified along the alignment.

16. Visual assessment

16.1 Introduction

The proposed Tugun Bypass is located in the vicinity of the Queensland and NSW border. The surrounding coastal region relies heavily on tourism to support its economy. Its visual appeal is of particular importance to how visitors perceive its attractiveness. Visitors bring certain expectations of the likely landscape character of the Gold Coast, with many anticipating a striking landscape, coastal views and high-density urban development.

The purpose of the assessment is to evaluate the proposed bypass in terms of visual impacts. Potential impacts are assessed based on the assumption that the suggested urban and landscape design strategies would be implemented that are outlined later in this chapter and Technical Paper 13.

This assessment considers all locations from where the proposed Tugun Bypass would be likely to be seen. This area has been defined here as the Tugun Heights visual catchment.

16.2 Existing visual environment

16.2.1 General context

The majority of the study area is located in bushland on the urban fringe of the Currumbin/Tweed Heads area. The edge of the urban area is exaggerated by its contrast with natural features such as Cobaki Broadwater. This is most apparent in the central section of the proposed bypass corridor where it is bordered by Gold Coast Airport to the east and Cobaki Broadwater to the west.

It is an area currently experiencing landscape change as the urban area extends into bushland. This can be identified in the new residential estates such as Cobaki Lakes and Pacific Beach Estate which are creeping into the bushland areas north and west of Boyd Street.

16.2.2 Landform and land use

The landform along the proposed bypass route undulates south from Stewart Road. It then rises at Tugun Heights and continues up to the ridge behind the John Flynn Hospital and Medical Centre, becoming flat immediately north of Boyd Street. John Flynn Hospital and Medical Centre is situated on the southern side of a forested ridge to the north of Boyd Street. This ridge visually separates most of the residential areas of Tugun Heights from areas further south.

The southern portion of the corridor comprises areas of vegetated land to the west of the main airport runway, and areas of native woodland associated with the Cobaki Broadwater. Tugun Landfill, located just to the north of the airport, is elevated several metres above the surrounding woodland and residential areas. There is an open space/cleared area to the north of Tugun Landfill zoned for future residential development, and the proposal would pass through part of this.

16.2.3 Views and landmarks

There are distant views of a number of local landmarks along many parts of the proposed route. These include views to elevated areas of Coolangatta such as Greenmount and Point Danger to the south-east, and very distant views of Mount Warning to the south-west. Other prominent features include the narrow coastal strip of Bilinga east of Gold Coast Airport where a number of high-rise apartments and Norfolk Island Pines are evident along the coastal edge. High-rise apartments at Coolangatta and Razorback Hill can also been seen to the south.

16.2.4 Landscape character and scenic quality

In general, the Tugun Heights visual catchment is highly urbanised along the eastern side, with a mix of natural areas and urban development to the west. The existing high-rise apartments, numerous commercial areas, residential developments and the infrastructure associated with the Gold Coast Highway and the Pacific Motorway/Highway contribute to a very urban character. The exception is Cobaki Broadwater, which provides natural green spaces within this urban area.

However, when compared to the many more attractive coastal sites in the surrounding area, the Tugun Bypass corridor is generally of low to moderate scenic quality with the more natural sites having the highest scenic quality.

Figure 16.1 illustrates potential areas of high to moderate visual and landscape sensitivity across the Tugun visual catchment.

16.3 Visual assessment

16.3.1 Visual impacts

The visual impact of the proposed Tugun Bypass has been determined by evaluating its effect in the context of the landscape sensitivity of the surrounding areas from which it may be visible.

The visual effect of the proposal is the interaction between the proposal and the existing visual environment along the corridor. A series of photomontages have been prepared to illustrate the way in which the proposal would relate to the existing topography and other features of the area. They include an indication of the landscape planting which would be included in the proposal. This would take some years to reach the scale shown in the illustrations. The proposals are shown on a series of recent (2001) oblique aerial photographs in Figures 16.2 to 16.5. These have not been amended to include a number of development proposals which may be implemented in the vicinity prior to the opening of the bypass to traffic.

Visual sensitivity was evaluated by assessing the degree to which any change to the landscape is likely to affect humans socially at various points of view within the visual catchment of the proposed bypass. It considers the sensitivity of a particular landscape type to changes necessary for the construction of a highway.

Proposed Tugun Bypass
Gold Coast Airport Boundary
Queensland/NSW Border
Proposed Access Bridges
Tunnel

Wide coastal and regional views would be possible for travellers
Sensitive Areas
9 Landscape Character Units
SQ: Scenic Quality

Landscape Character Units:

1. Tugun Heights residential area
2. Northern - western residential areas
3. Ridgeline spur and conservation area
4. Disused quarry and northern bushland / open space
5. Northern ridgeline and Hidden Valley
6. Hospital and Tugun residential area
7. Tugun Landfill / open space
8. Gold Coast Airport
9. Cobaki Broadwater and adjacent vegetation
10. Southern industrial / residential

0 1.0 Km

Figure 16.1 **Visual and Landscape Sensitivity Across the Tugun Catchment**

In order to assess the impact of the proposal on the varying types of landscape and visual environment, the route was divided into sections called landscape character units. Each unit was assessed considering three elements:

- the existing visual environment
- the proposed changes
- the impact of the proposal on visual and landscape quality.

The impact of the proposal has been evaluated based on the assumption that the Urban and Landscape Design Concept Plan would be implemented. The proposal is assessed in terms of two main aspects:

- direct impact on the existing landscape of the transport corridor
- impacts on existing views from the surrounding area.

16.3.2 Assessment methodology

When assessing each character unit, consideration was given to the following elements:

Landscape character

Landscape character refers to the particular type and aesthetics of a landscape. Elements which combine to create a landscape character type include landform, location, vegetation, land use and available views from and to the area. Landscape character identifies the main features that combine to form a sense of place for a location.

Scenic quality

Scenic quality measures the degree to which the visual aesthetics of a landscape are valued from a human perspective.

In terms of the overall landscape of the proposal study area, coastal and bushland views are likely to be preferred to those that are more urbanised such as roadways, infrastructure and commercial/industrial uses. These assumptions, however, are general and do not hold true for all viewers or all landscapes.

Three rankings have been used across the study area. Definitions of the rankings of scenic quality are as follows:

- Moderate – scenic quality is average in terms of surrounding landscape, representing a landscape type that could be expected to be of some value to most viewers and fairly pleasant to look at.
- Low–Moderate – scenic quality below average in terms of the surrounding landscape, representing a landscape type most viewers would find rather uninteresting.
- Low – scenic quality well below average in terms of the surrounding landscape, representing a landscape type most viewers would find uninteresting and, in some cases, unattractive.

Scenic quality considers both the immediate landscape plus the quality of views possible from that landscape. For example, during the assessment a different ranking is often given for areas

within the same landscape character unit, with this difference usually associated with parts of the unit that may have a different quality of views.

Visual and landscape sensitivity

The assessment also considers the sensitivity of the visual environment and the natural landscape in regard to highway development.

Locations with high and/or fixed viewing populations and sites that are visually prominent and/or elevated are normally the most visually sensitive to change. The potential for impact also usually increases as the position of the viewer becomes closer.

Natural landscapes most sensitive to change include environments with particular characteristics that are vulnerable to alteration and/or are subject to protection through environmental legislation. The wetlands in the study area are an example of a landscape type with a high sensitivity.

Urban and landscape design

Highways can cause a number of impacts related to urban design, landscape and visual change. Usually, greater contrasts between a road and the surrounding landscape will result in a higher visual impact. Characteristics of this impact can include:

- dramatic alterations to the natural landform, such as those that occur with highway cuttings and embankments
- the effect of introducing more, or new urban elements into a natural or rural landscape
- visual separation between adjacent areas, severance of communities and/or blocking views (where wider landscape views were formerly possible)
- landscape segregation between adjacent locations or communities
- a loss of familiar landscape features or character.

Urban and landscape design strategies have been suggested to reduce the potential negative visual impacts of the proposed bypass. A detailed description of each urban and landscape design is in Technical Paper 13.

Effects over time

The assessment also takes into account both the impact in the short-term (during construction as well as the first three years of operation) and the long-term (between five to ten years after opening). This allows for assessment of the impacts both before and after any planned landscape works have matured. Impacts could be expected to be highest during and immediately following road construction, with some impacts diminishing over time, as landscape works mature and viewers become more familiar with the permanent visual changes of the new highway.

Table 16.1: Landscape character units, impacts and mitigation measures along the proposed bypass

Landscape character units	Landscape character	Scenic quality	Visual and landscape sensitivity	Proposed changes, impacts and mitigation measures
1. Tugun Heights residential area	Residential area of Tugun Heights, with a small playground at the edge of the proposed bypass. Several locations have views towards the proposed bypass.	Low-moderate with the highest scenic quality at distant views.	Residential area immediately to the east is the most sensitive.	Views over new highway and Hidden Valley Bridge or views of sound barriers. Consult with community and provide additional screen planting to supplement existing vegetation if this is considered appropriate. Alternatively, retain distant views if preferred by occupants. Protect visual environment of small park and playground at end of Mirreen Drive. See Figure 16.2
2. North-western residential areas	Residential area of Currumbin Waters.	Low	Adjacent areas are sensitive to highway development.	No direct change. New screen planting along highway would be visible, but not the highway itself. Select screen planting to blend with the existing landscape and screen the existing sound barriers north of Stewart Road.
3. Disused quarry and northern bushland/open space	Disused quarry and surrounding section of native bushland and open space.	Low	No areas identified as sensitive.	The proposed bypass would be constructed on a fill embankment of various heights, reaching a maximum of about 5 m. There would also be sections of retaining wall along the eastern edge. Some views of Hidden Valley Bridge against vegetated backdrop expected to be quite imposing.
4. Northern ridgeline and Hidden Valley	Vegetated ridgeline north of Hidden Valley. There are several vantage points that allow distant views towards the coastline. The ridgeline is dominated by tall forest.	Moderate	Hidden Valley and the northern ridgeline behind the John Flynn Hospital and Medical Centre are both visually sensitive to possible view changes.	Visual changes will be associated with the proposed road cutting (from 35-130 m wide and up to 22 m deep) and Hidden Valley Bridge. Partly screened middle distance views of bridge from parts of Lot 7 on RP214065, with significant changes to entrance to property via bridge over new cutting, giving views along the new highway. Cutting evident to travellers and cutting and bridge evident from surrounding areas. Landscaped bands planted along the benches proposed for the cutting, spaced about 7 m apart.

Landscape character units	Landscape character	Scenic quality	Visual and landscape sensitivity	Proposed changes, impacts and mitigation measures
5 and 6. Hospital and Tugun residential areas	These units include the residential edge of Tugun and the John Flynn Hospital and Medical Centre. The landform is predominately flat. Wider views available from more elevated houses on the northern ridgeline.	Low, but increases to moderate where coastal views are possible.	Adjacent residential areas of Tugun and Tugun Heights and John Flynn Hospital and Medical Centre are visually sensitive to possible view changes.	No direct change, although there would be views to the proposed bypass from these units. Some loss of visual amenity for Hospital and Medical Centre. Landscape planting proposed along eastern edge of bypass. Views of highway until plants mature, with intermittent views remaining for some residents in the more elevated areas of Tugun Heights. Landscape cutting as for unit 4 above. Landscape works and sound barriers will screen highway from John Flynn Hospital and Medical Centre. Closest viewers are not permanent residents. See Figure 16.3.
7. Landfill/open space north of the airport	Tugun Landfill and cleared open space area to the north, zoned for future residential development.	Generally unattractive and has low scenic quality.	Not sensitive to highway development due to current land use and lack of people.	Minimal views to the proposed bypass due to lack of available viewpoints. Landscape plantings to the west of the bypass to blend with existing landscape. Shrubs and groundcover in the central median and forest plantings of shrubs and low trees to the east to screen the landfill from proposed residential areas and travellers. These plantings also screen the proposed sound walls from the view of Tugun residents and the Hospital and Medical Centre. At the southern end, coastal heath plantings where the view opens up across the airport towards the coastal strip.
8. Gold Coast Airport	Gold Coast Airport, including the runway and terminal building. Includes the narrow strip of Bilinga with a large number of high rise apartments.	Low, but the available views of coastline are attractive.	The mid- to long- distance views, from the western side of the Gold Coast Highway and airport terminal, are sensitive.	A 60 m corridor of vegetation is to be cleared and the highway elevated up to 2m for 2km. Some sections of bypass visible from airport terminal and high rise apartments. Significant affect on scenic quality during construction, improved as rehabilitation works mature. Not intrusive due to low level of road. Proposed to reinstate vegetation corresponding with existing adjacent types along entire western edge of highway through this unit. Low coastal heath plantings along the eastern side to maintain views towards the coast.

Landscape character units	Landscape character	Scenic quality	Visual and landscape sensitivity	Proposed changes, impacts and mitigation measures
9. Cobaki Broadwater and adjacent vegetation	An area of native woodlands and wetlands associated with the Cobaki Broadwater and the existing native vegetation within the Gold Coast Airport site. The landform is flat and vegetation is dense with mid-to long- distance views along the eastern edge.	Low-moderate.	Cobaki Broadwater and associated native vegetation are sensitive to highway development in visual and landscape terms.	A 60 m corridor of vegetation is to be cleared and the highway elevated up to 2m for 2km. This will detract from the current landscape character. The impact will be minimised by locating the highway along the edge of the vegetation to avoid a more invasive alignment, and through the proposed plantings (see unit 8 above). See Figure 16.4
10. Southern industrial/ residential unit	Light industrial area of Tweed Heads including Border Park Raceway. This zone is surrounded by a large area of housing. Razorback Hill and its informal lookout are approximately 1 km south of the proposal. Tweed Heads west contains a mixture of land uses. Landform is low-lying and views are minimal	Low-moderate, since long- distance views to the north are possible.	Residential areas immediately to the south are sensitive to highway development due to their close proximity.	The only direct visual effects will be associated with small road changes. Indirect visual changes will result from the construction of the Tweed Heads Bypass Interchange. Feature shrub and groundcover plantings would be included on the embankments associated with the on- and off-ramps along both sides of the bypass, as well as along the approach ramps. Surface treatments or motifs are proposed to improve the potentially bland appearance of retaining walls on the north side of the interchange. Views from some areas on the southern side of the interchange would probably be improved as a result of the greater distance to the interchange than to the existing Tweed Heads Bypass, providing an opportunity to establish a vegetated area between residences and the interchange, and to screen sound barriers if they were needed. See Figure 16.5 For more elevated residences at various locations south of the Tweed Bypass, the proposed interchange will be more evident, but will be seen as an extension to the existing highway and urban structure.

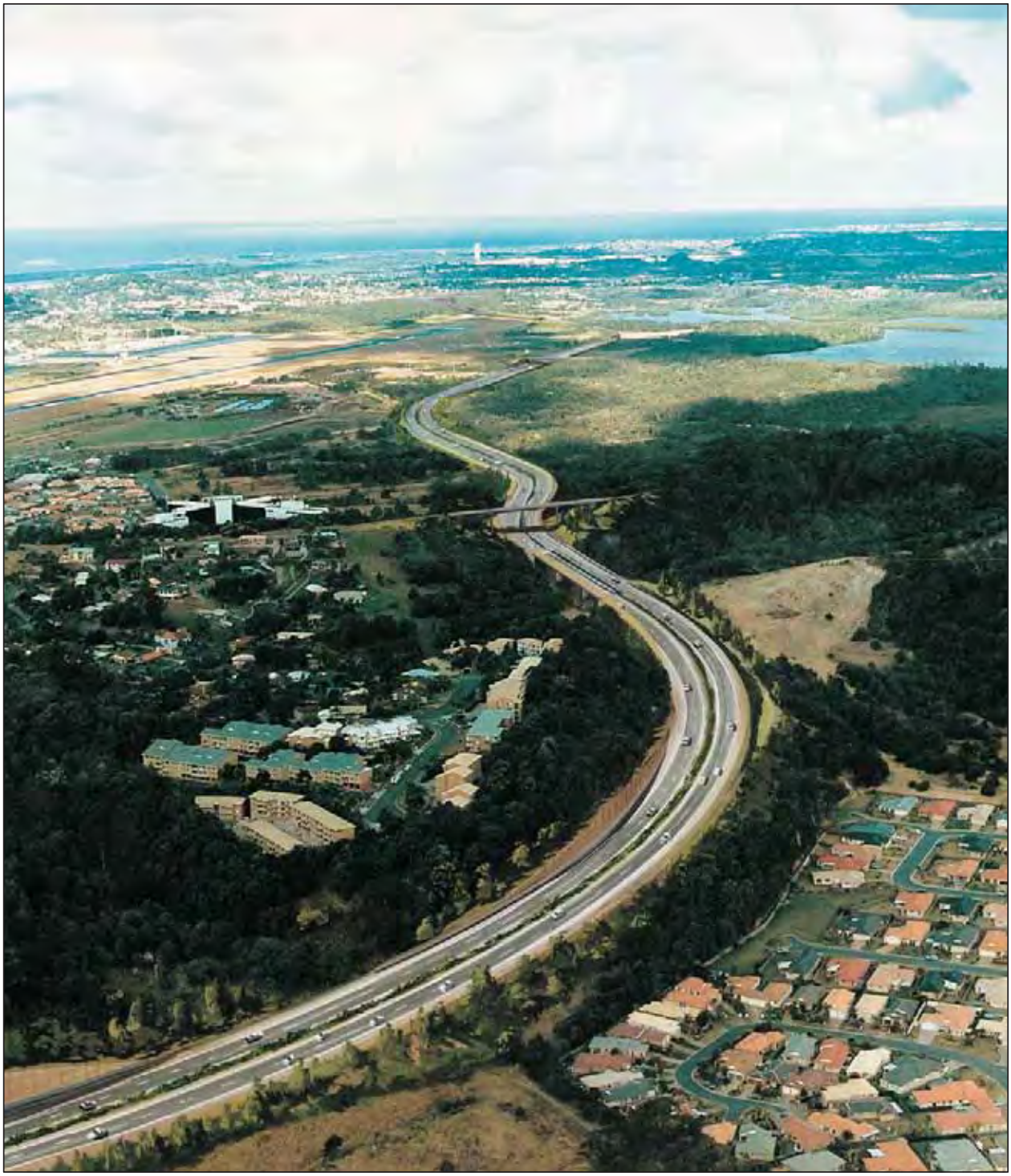


Figure 16.2 **View to the South with Clancy Court in the Foreground and John Flynn Hospital and Medical Centre in the Middle Ground**

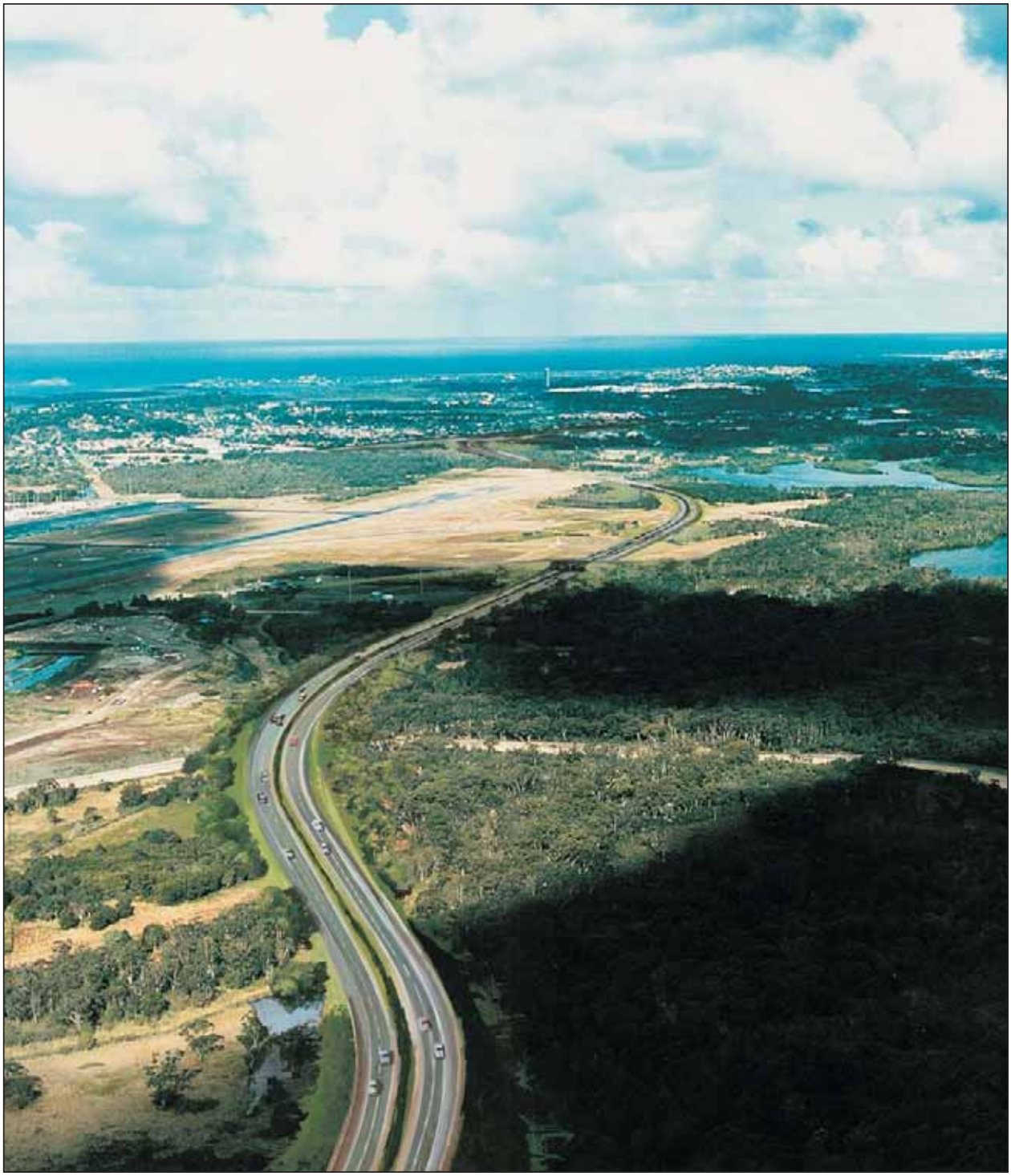


Figure 16.3 **The Tugun Bypass looking South from Tugun Heights**

Figure 16.4 **View of the Proposed Tugun Bypass Crossing Gold Coast Airport to Enter the Tunnel at the Southern End of the Main Runway**

Figure 16.5 **View of the Tweed Heads Bypass Interchange Looking Towards Coolangatta**

16.4 Impact assessment and mitigation measures

16.4.1 Assessment by landscape character units

The whole of the study area has been divided into ten landscape character units based on their differing physical characteristics. They have been numbered from north to south as shown on Figure 16.1. The assessment of visual impacts takes into consideration the landscape character and visual quality of the existing environment, the proposed changes associated with the proposal and impacts on the existing landscape of the transport corridor and to existing views from the surrounding area.

A general assessment of each unit, and summaries of the impacts that the project will create and the mitigation measures proposed, are outlined in Table 16.1. Detailed descriptions of each unit, the impacts and proposed mitigation measures are provided in Technical Paper 13.

16.4.2 Views from major landmarks and viewing locations

Due to the importance of tourism to the local economy, any visual impact that may detract from the scenic value of important viewing locations and landmarks has been assessed. Details of these assessments are included in Technical Paper 13.

Greenmount Point, Rainbow Bay and Point Danger

Some distant views to the proposed bypass would be possible from vantage points around the Greenmount Point, Rainbow Bay and Point Danger areas. Foreground and mid-ground views from Greenmount are of the nearby beaches, with more distant views along the northern coastline to Surfers Paradise. Views over the inland areas are also possible, providing a green contrast to the coastline. Inland views include those over Gold Coast Airport and of the distant forested hinterland, which forms a strong backdrop to the more urbanised coastal zone. The large cutting proposed in the ridge to the north of the John Flynn Hospital and Medical Centre would also be visible in the distance from these vantage points, although it would comprise a very small new element. The cutting would remove part of the existing vegetated backdrop to the hospital and this would affect long-distance views of this location.

In view of the considerable distance from the cutting and the coastal views that are possible in other directions, it is unlikely that the proposed highway would have a notable impact on views from these locations.

Coolangatta and Kirra

Views similar to those described above are also possible from a number of locations around Coolangatta and Kirra.

The cutting would be evident in the distance from these locations. It would appear as a light-coloured formation, just west of the hospital. The road below this is likely to be fully screened by proposed landscape plantings. Due to the distance of any potential viewers from these locations, and the more impressive coastal views that lie in other directions, it is not anticipated that there would be a measurable impact on these viewpoints.

Bilinga

There would be some views of the Tugun Bypass from the high-rise apartments in Bilinga, to the east of Gold Coast Airport. The higher apartments would have more extensive views, but the distance to bypass, combined with the extensive nature of the views available, would ensure that the proposed bypass has little impact on the scenic quality of views from these apartments.

Currumbin Hills

There would be some distant views towards the highway from some elevated areas of Currumbin Hills, located approximately 2 km away at the nearest point. Residents here would possibly see parts of the proposed bypass north of the Hidden Valley bridge, extending to the Stewart Road interchange. However, considering this distance, plus the growth of landscape works over time, there would be little visual impact to these residents.

Elevated areas of Tweed Heads

The elevated residences on the northern side of Razorback Hill would have distant views of the proposed bypass near the John Flynn Hospital and Medical Centre and of the new cutting beside it. Similar views would also be possible from the Tom Beaston Lookout on top of Razorback Hill. The light colour of the new cutting near the John Flynn Hospital and Medical Centre would be evident, but its distance of some 5 km means that its visual impact would be low from this area.

16.4.3 Traveller experience

Tugun Bypass

Overall, the journey along the Tugun Bypass would provide a varied and sequential experience for travellers, which would highlight the significance of the state border crossing. Features will include and views from the Hidden Valley bridge to the east, distant views and intermittent closer views of the Gold Coast Airport and Cobaki Broadwater, and some panoramic views to the coast. Other significant aspects will be the tunnel and descent and ascent past the retaining walls in the approaches, the Tweed Heads Bypass interchange, the new cutting south of the Stewart Road interchange, and sound barriers at various locations. Potential negative impacts associated with the necessary sound barriers would be reduced to some extent by the recommended treatment of these walls.

This variety in traveller experience along the Tugun Bypass assists in meeting the objective of minimising accidents caused by driver fatigue.

Interchange

Other traveller views to consider are those from the proposed interchange, when travellers and pedestrians are using exit ramps.

The Tweed Heads Bypass interchange would provide travellers towards Coolangatta with attractive views of the coastline as they move northwards.

Lighting

Lighting required for the Tugun Bypass would also have a visual impact on adjacent areas and the corridor. However, it would be confined mainly to areas in the vicinity of the interchanges

with impacts in some other locations possible. All lighting would be designed to comply with airport operational requirements. Most residents would be protected from direct light as a result of intervening landscape works and noise barriers. However, some would experience increases in lighting over present levels.

Lighting would also mean that the proposed Tweed Heads Bypass interchange on the proposed bypass could be seen at night from a number of distant viewing locations, including elevated areas of Coolangatta and high-rise apartments at Bilinga.

16.5 Implications for ecologically sustainable development

16.5.1 The precautionary principal

The introduction of major infrastructure developments into relatively undeveloped areas will inevitably result in permanent changes to the visual environment. Potential visual impacts have been assessed and landscape proposals developed to assist in minimising the contrast between the large scale structures required for the proposal and the surrounding landscape through which it would pass.

16.5.2 Intergenerational equity

The visual character of the area along the proposed alignment would be permanently changed. The visual impact of the bypass would also gradually change over time as the landscape proposals mature and the community becomes used to its presence.

16.5.3 Conservation of biological diversity

The planting proposals would include both native and exotic material as appropriate. The mix of native plants would be designed to reinforce existing vegetation supporting species diversity in the area.

The implications of visual impacts of the proposal on ecological sustainability are summarised in Table 6.2.

Figure 16.6 Implications of noise and vibration impacts for ecologically sustainable development

Precautionary principle	Intergenerational equity	Conservation of biological diversity
A detailed visual assessment of the environment through which the proposed bypass would traverse has been undertaken including a consideration of the impacts of the proposal on existing visual quality and long distance views of the new road. The construction of the bypass would result in permanent visual and landscape impacts on the existing environment. However, means of mitigating the impacts are available.	The visual character of the environment through which the bypass would traverse would be permanently changed.	Planting included in the proposal would assist in maintaining the species diversity of native plants in the area.

16.6 Conclusions

Overall, the proposed Tugun Bypass would result in impacts on the surrounding environment in terms of urban design, landscape and scenic effects. These impacts would be of greater significance to viewers in the vicinity of the new highway, particularly those at the John Flynn Hospital and Medical Centre, who would experience amenity impacts associated with the highway and screened views of the rear of the adjacent noise barriers.

Many of these impacts would be mitigated over time, with proposed landscape screen plantings maturing.

Visual and landscape impacts would occur to the edge of the Cobaki Broadwater vegetation affected by the highway, with some permanent loss of the inherent landscape value of this location. These impacts would also be mitigated over time, as a result of proposed landscape works along the highway through this section and additional rehabilitation plantings in the vicinity of Cobaki Broadwater.

The proposed bypass would, however, provide urban and landscape design opportunities for a highway design that highlights the positive features of the area and the important gateway function of the state border crossing in particular. It would also provide access to views that would not otherwise be available to travellers through the area.

An extensive landscape works program integrated with the construction stages of the proposed bypass would create a landscaped setting along many sections of the highway. Where noise barriers and tunnel approach walls are proposed they would also be architecturally treated to create an attractive urban setting that reflects aspects of the surrounding landscape.

Part F – Cumulative impacts and environmental management

17. Cumulative impacts

17.1 Introduction

Cumulative impacts are changes to the environment that are caused by an action in combination with other past, present and future human actions. Under this definition, an action is any project or activity of human origin. The technical studies completed as part of this EIS have assessed cumulative impacts associated with the proposal. The study area used for the various assessments has extended beyond the footprint of the proposal and has encompassed an area 1km wide either side of the alignment. This has ensured that impacts beyond the immediate footprint have been assessed.

This chapter takes the assessment of cumulative impacts one stage further and considers the interaction of the proposal with other known and proposed developments in or close to the study area. It sets out the methodology used for the assessment and then identifies other projects or activities that are proposed in the area. The assessment then identifies the likely cumulative impacts each project or activity could have on the key environmental issues identified in the EIS.

17.2 Methodology

A framework for the assessment of cumulative impacts has been developed for the proposal. The following rules were applied to the assessment:

- there must be an environmental effect from the bypass proposal for it to be further assessed
- the environmental effect must be demonstrated to operate cumulatively with the environmental effects of other projects or activities
- it must be known that the other projects or activities have been, or would be, carried out and are not hypothetical.

17.2.1 Setting boundaries

Setting boundaries is the process of establishing limits to the area and period to be assessed for cumulative impacts. There are two types of boundaries — spatial (how far?) and temporal (how long into the past and future?). For the bypass proposal, the temporal boundary used has been from 2004 to 2017. 2004 provides an indication of existing conditions while 2017 defines a point at which the bypass would have been operating for 10 years.

For the spatial boundary, a number of areas have been used. Firstly, the study area used in the EIS provides a defined and well-researched area in which most of the impacts associated with the bypass proposal are known to occur. A wider regional study area has also been used to include the areas where there could be possible interactions with other proposals or activities. The regional boundaries vary from issue to issue — for example, for flora and fauna the boundary needs to reflect ecological requirements rather than artificial boundaries.

17.2.2 Identifying other proposals and activities

The identification of other proposals and activities must consider the certainty of whether the proposal or activity would proceed. Included in this assessment are those proposals that have a high probability of proceeding and already have approval, or are already under regulatory review for approval. Also included are those reasonably foreseeable activities such as those proposals identified in an approved development plan. Induced actions that can reasonably be expected to occur as a result of the bypass have also been included. Proposals or activities that are hypothetical have not been included in the assessment.

17.2.3 Identifying key environmental issues

The key environmental issues associated with the proposal have been identified in Parts D and E of the EIS. The environmental issues most likely to be subject to cumulative impacts are assessed in this chapter. They are:

- flora and fauna
- surface water, groundwater and acid sulphate soils
- air quality
- traffic flows.

17.2.4 Assessing cumulative impacts and mitigation

The assessment of cumulative impacts is focused on the key environmental issues associated with the proposed bypass. Data from the existing EIS studies provides the basis for the assessments while evaluation of effects such as space crowding and time crowding are considered.

Regional "nibbling" effects cannot usually be dealt with on a project by project review basis. Regional changes to the environment — such as loss of native vegetation — can often be quantified, but it is difficult to determine the significance of the effects from a single proposal in a regional context. For this to be done, there needs to be regional plans, strategies and programs in place that clearly establish what is and isn't acceptable. These are available for more localised areas, such as the planning schemes prepared by local councils, but frequently they are not integrated into a regional or statewide plan.

17.3 Other proposals and activities

17.3.1 Other road projects

Two road projects to the north and south of the Tugun Bypass proposal have been identified. The two projects are the Pacific Motorway upgrade from Nerang to Tugun and the Banora Point upgrade.

To the north of the Tugun Bypass proposal the Pacific Motorway consists of two lanes in each direction. As part of Main Roads commitment to providing the community with the transport and infrastructure it needs, this section will be upgraded to provide three or four lanes in each direction. The timing of the upgrade is not finalised at present.

Subject to approval the proposed Banora Point upgrade would provide a high standard 1.3 km dual carriageway south of Tweed Heads, as part of the Pacific Highway upgrade. It would be wider than the existing road to accommodate three lanes in each direction. It would connect the Chinderah Bypass to the Tweed Heads Bypass, significantly improving safety and traffic congestion on the highway immediately south of the Tugun Bypass proposal.

17.3.2 Robina to Coolangatta rail link

The Queensland government is committed to achieving better transport outcomes in the region through the implementation of the *Integrated Regional Transport Plan for South East Queensland* and Transport 2007.

The proposed rail extension from Robina to Coolangatta has three stages — the northern stage, which runs from Robina to Stewart Road and covers most of the route; a short stage from Stewart Road to a proposed station at Tugun; and the southern stage, which runs from the proposed Tugun Station to the airport terminal area of Gold Coast Airport. Figure 17.1 shows the alignment of the rail link.

Queensland Transport has completed Part A of the Robina to Tugun draft impact assessment study. This covered the proposed northern stage of the rail link from Robina to Stewart Road and was released for public comment in March 2003. It is proposed that Part B which will be released during 2005 and will cover the section from Stewart Road through to the Gold Coast Airport.

The planning and design criteria for the rail link would be based on Queensland Transport and Queensland Rail requirements. A rail design speed of 160km/h has been used wherever possible in the section north of Tugun. However design speed from Stewart Road to the south would be complicated by a range of factors including terrain, property and airport constraints. The need for road and rail design compatibility within a narrow footprint would also place restrictions on speed. It is likely that a single track would be constructed initially with provision for duplication. The rail corridor would be 20 to 30 m wide, depending on the earthworks required. The corridor would pass under Stewart Road following an alignment to the west of the bypass. It would continue in a tunnel under Hidden Valley and emerge on the eastern side of the road alignment near the John Flynn Hospital and Medical Centre. Current concepts propose a rail station immediately north of Boyd Street. South of the station, the single track rail alignment would be immediately east of the bypass alignment until the approach to the road tunnel. Here the rail alignment would also enter another tunnel and would curve around under the runway to the terminal of Gold Coast Airport.

17.3.3 Gold Coast Airport Limited runway extension

Approval is currently being sought for an extension to the main runway at Gold Coast Airport. This runway is called the 14/32 runway. The extension would require an additional 458 m of pavement to be constructed at the southern end of the airport. The runway extension would be 45 m wide with 7.5-metre-wide sealed shoulders on each side, and would be located within a 300-metre-wide graded runway strip.

The runway extension project also proposes the construction of a new parallel taxiway to connect the runway to the terminal areas. The taxiway extension would be 23 m wide with 10.5-metre-wide sealed shoulders on each side, and would be located within a 47.5-metre-wide taxiway strip. The route of the perimeter access road would be altered to ensure that safe access would be maintained around the airport site for operational and emergency situations.

The runway could potentially be extended further to provide a 2,858 m runway, and the current obstacle limitation surface used for the protection of prescribed airspace is based on the 2,858 m option. Gold Coast Airport Limited has not yet sought permission for this additional extension.

17.3.4 Development of airport precincts

The master plan for the Gold Coast Airport includes a land use plan that divides the site into a number of precincts. The final master plan proposes development of the airport facilities and infrastructure to meet future demand from airport users. It sets out the types of development that would be acceptable in each precinct. No firm development proposals are included in the master plan, but it provides a framework for possible future development until 2020.

The precinct immediately adjacent to the Cobaki Broadwater is recognised for its environmental values. It is Gold Coast Airport Limited's intent for this area to remain free from commercial development and to protect its ecological and environmental values.

The western precinct is identified as being suitable for airport-related activities such as air freight and aircraft maintenance, and for commercial development. This precinct includes a corridor for the Tugun Bypass and the rail link.

The terminal precinct is to be developed and operated as an area for the handling of aircraft, passengers and freight. The precinct would help promote the airport as a key tourist and business gateway to the region. A business park is included as a future development opportunity for this precinct. The final master plan shows a possible location for this to the south of the existing terminal building on land along the eastern edge of the airport. The precincts are shown on Figure 17.3.

17.3.5 Cobaki Lakes development

Cobaki Lakes is a very large development to the west of the alignment located just inside NSW. The development has approval from Tweed Shire Council. The 1999 master plan for the development proposed a gross developable area of 284.5 ha, with 1162 residential lots, 531 green street lots and 202 duplex lots, providing a total of 2260 units with capacity to accommodate 14,000 residents.

An amendment to the Tweed local plan was made in 2003 to allow for changes of land use within the development area.

17.3.6 Boyd Street overpass

The Cobaki Lakes development would be serviced by two main arterials, Piggabeen Road in NSW and the Cobaki Parkway. The Cobaki Parkway would be a western extension of the existing Boyd Street access track. This would require an overpass over the bypass capable of carrying four lanes of traffic. The overpass is not part of the Tugun Bypass proposal, and if it proceeds, would be developed by others. It would also require separate approvals.

Figure 17.1 **Proposed Tugun Bypass and Robina to Tugun Rail Link**

Figure 17.2 **Gold Coast Airport Limited Runway Extension**

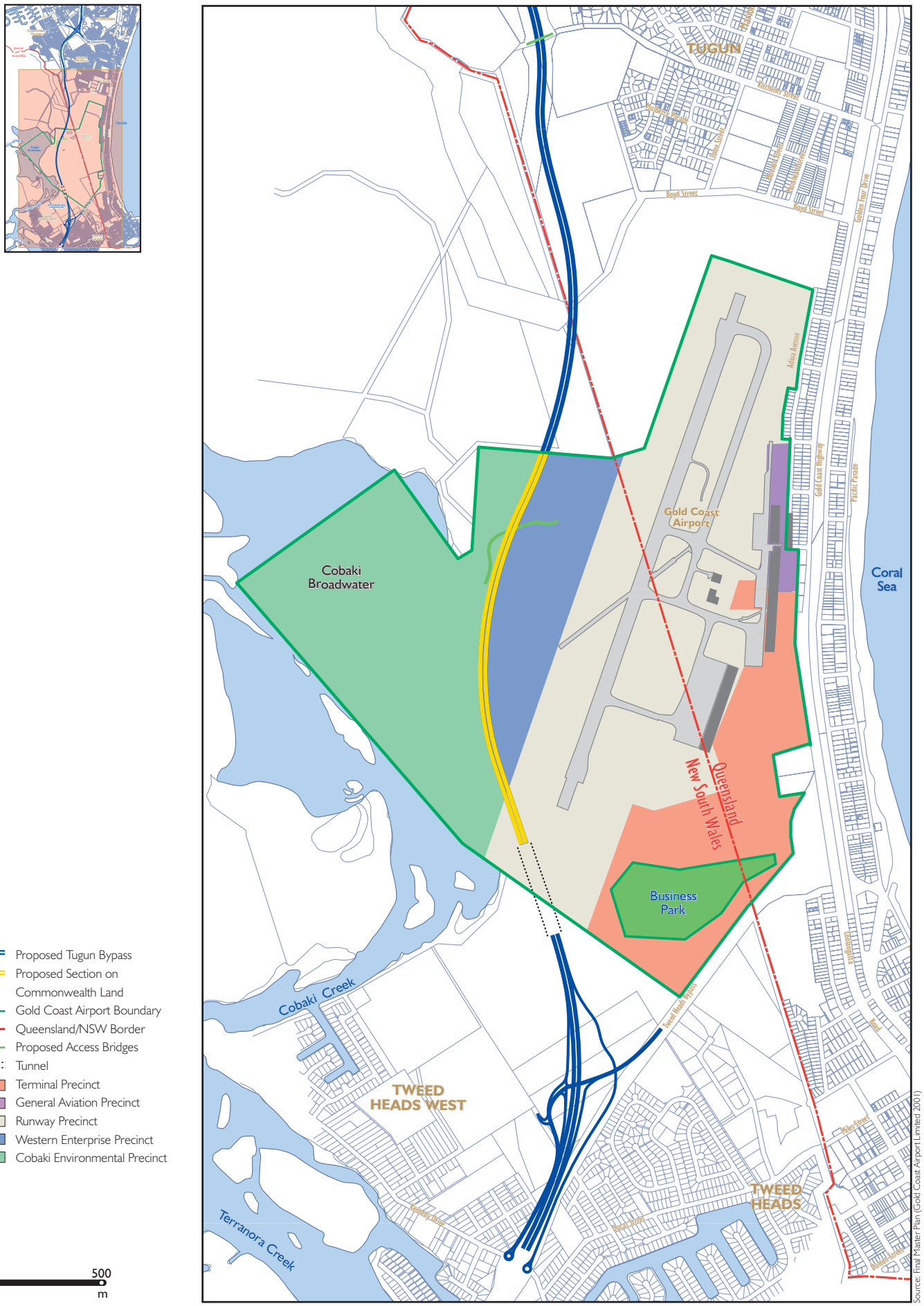


Figure 17.3 **Location of Various Precincts Detailed in the Gold Coast Airport Master Plan**

17.3.7 Development of Pacific Beach Estate Stage II

Stage II of the Pacific Beach Estate development is located adjacent to the John Flynn Hospital and Medical Centre, and would consist of a medium-density residential development, located around the proposed Tugun Rail Station. A commercial component is also included and is located in the north-east corner of the site. It may contain a service station, tavern and motel. Community services, including a nursing home and child-care centre, have also been proposed.

17.3.8 Industrial development proposals in West Tweed Heads

Tweed Shire Council is considering that, in the longer term, land around the Tweed Heads Pony and Hack Club at the southern end of the proposed bypass be zoned for industrial uses (Spiller Gibbens Swan Pty Ltd 2001). This area is currently zoned for open space and special use. Council is continuing its assessment of the feasibility of commercial/industrial development in this area.

In addition to development at the airport, other areas with potential for commercial or industrial uses include 16 ha of vacant land known as the Tringa Street Industrial Estate in Tweed Heads West, and an industrial subdivision on a site adjacent to the Tweed Heads West Sewage Treatment Plant.

17.4 Impacts and mitigation

17.4.1 Flora and fauna

The proposed route transects an area of south-east Queensland and north-east NSW that is recognised for its high environmental values. When all the various ecological values of the study area are taken into account, the area can be considered to be of national significance for nature conservation. However, its importance has not been recognised to any great degree as evidenced by the lack of formal legal status for the area as a nature reserve or national park. The compensatory habitat package proposed as part of the Tugun Bypass proposal offers an opportunity for greater control and management of the conservation values of the area. This would require agreement and input from a number of stakeholders, but presents an opportunity to improve the long-term viability of the natural environment in the area.

A number of other projects or activities have been either approved or proposed in the study area. The following section reviews these and assesses their potential cumulative impacts on the flora and fauna.

Robina to Coolangatta rail link

Timing for the construction of the proposed rail extension is not known at this stage, but is expected to be a number of years after construction of the Tugun Bypass. The rail corridor would remove approximately 15 ha of vegetation and associated habitat. Table 17.1 details the types of vegetation that would be lost while Table 17.2 details the types of habitat that would be removed.

Table 17.1: Habitat and vegetation loss from rail corridor

Vegetation type	Area removed (hectares)
Dry Blackbutt Forest	0.13
Ironbark/Mahogany Forest	0.25
Scribbly Gum Forest	0.02
Swamp Mahogany Forest	1.7
Swamp Mahogany/Brushbox Forest	0.07
Swamp Mahogany Paperbark Forest	0.01
Paperbark Forest	0.9
Swamp Oak Forest	0.5
Scribbly Gum Mallee Heathland	0.6
Tree Broom heathland	0.7
Wet Heathland	0.3
Slashed heathland	1.7
Weedy Grassland	2.8
Cleared Land	6

Table 17.2: Habitat types removed by the rail corridor

Habitat type	Area removed (hectares)
Dune Forest	0.02
Ridge forest	0.38
Rainforest	0
Swamp forest	3.18
Disturbed swamp forest	0
Mangrove	0
Heathland	1.6
Sedgeland	0
Saltmarsh	4.5
Disturbed open ground	0
Cleared/urban	6

Individuals from three regionally significant plant species, Blunt-leaved Wattle, Lemon-scented Baeckea and *Strangea linearis*, would be removed as a result of the proposed rail line construction.

With construction of the proposed rail line, additional structures will be required to align with the wet/dry culverts and the frog underpasses of the bypass. Until monitoring of the effectiveness of the wet/dry culverts is complete it is uncertain what effect this will have. However, the rail corridor will be some distance to the east of the road and there will be open space between the two footprints. However, it would further fragment and divide populations of significant species.

The additional width associated with the rail footprint would remove habitat of the Wallum Sedge Frog, Wallum Froglet and Common Planigale. Mitigation measures for the Common Planigale are not possible because of the surrounding constraints of the tunnel and ramps. Therefore, the risk to the population is likely to increase with the removal of a higher proportion of habitat.

Gold Coast Airport Limited runway extension

The area required for the runway extension is shown in Figure 17.2. Much of this area is cleared grassland to the south of the existing runway. The eastern portion of the area includes 2.8 ha of regrowth vegetation that would be removed by the taxiway extension. This area is potential habitat for a number of species, including the Eastern Grass Owl.

To ensure that the obstacle limitation surface is maintained, trees to the south of the runway extension would be trimmed or removed, as has occurred since the 1980s.

Both the road tunnel and runway extension would form a barrier to two potential subregional fauna corridors and would reduce areas of connectivity to vegetated areas around the Cobaki Broadwater. After both structures have been built, a 100-metre-wide corridor would remain between the remnants to the east and the Cobaki Broadwater. This would be revegetated once construction is complete and would continue to allow passage to ground-dwelling birds, small mammals and other species. If the runway were further extended to 2,858 m this corridor would be reduced to 20 m.

As part of the approvals for the runway extension Gold Coast Airport Limited will develop a vegetation management plan for the area to the south of the runway. The plan will manage vegetation in this area to ensure there is no intrusion into the obstacle limitation surface. This plan of management will also incorporate management measures for the Tugun Bypass proposal.

Proposed development of airport precincts

The proposed development of the western precinct would remove the heathland and disturbed grassland that make up vegetation communities in this precinct. This would result in the removal of the majority of known and potential habitat for the Wallum Sedge Frog, most likely resulting in only one of known sub-populations surviving to the west of the bypass.

Cobaki Lakes development

The Cobaki Lakes development is surrounded to the south, east and north by vegetated NSW Crown land that is zoned for environmental protection in the Tweed Shire local plan. It lies in the centre of what is considered to be a major regional fauna corridor extending from Cobaki Broadwater through to the NSW Crown Land Border Reserve and to the Mount Cougal — Boyds Butte area. The Cobaki Lakes development requires 150 ha of cleared and vegetated land. It would also create a barrier to fauna movement along the corridor through loss and fragmentation of habitat. Species of significance likely to be affected by this development are the Long-nosed Potoroo, Squirrel Glider, Masked Owl, Glossy Black Cockatoo, other threatened bird species and, potentially, the Swordgrass Brown Butterfly.

The proposed Tugun Bypass passes to the east of NSW Crown land through disturbed land. The provision of fauna-exclusion fencing in this area would act as a barrier to east–west movement, although there is little native vegetation to the east. Fencing and the lack of underpasses in this area would deter domestic dogs from the proposed Pacific Beach Estate

reaching the Long-nosed Potoroo habitat. If the Boyd Street overpass were to proceed, it is suggested that it incorporate two underpasses to facilitate the north–south movements of the Long-nosed Potoroos known to occur in the area.

The species most at risk of cumulative impacts in this area is the Long-nosed Potoroo. Even though the Potoroo study (Lewis, Bali & Brown 2003) has shown that the actual population size is likely to comprise 55 to 85 individuals, this should still be considered as a small population subject to possible extinction by stochastic events. Of particular concern is the 12 ha area of habitat located north of the Cobaki Lakes development access track where 14 out of 27 individuals were captured during recent studies. Results from this study have shown that the access track has split the population into two, with no evidence of individuals crossing the track. Continued development in this area would further isolate this area, making the subpopulation more susceptible to extinction through habitat loss and disturbance, predation and fire. Furthermore, failure to mitigate drainage impacts associated with the access track has caused seasonal flooding to the north, and resulted in a loss of some Long-nosed Potoroo habitat.

Boyd Street overpass

If constructed, the Boyd Street overpass should include underpasses for Long-nosed Potoroos, although the effectiveness of these is unknown. These are experimental in nature and would need to be monitored, however they have been used elsewhere and have proven effective for some native species. They would need to be designed to maximise the probability of Long-nosed Potoroos using them, and be at least 60 m in length. There has only been one unconfirmed record of a Long-nosed Potoroo using a 20 m underpass at Brunswick Heads (Linda Gibson, Australian Museum Business Services). The ideal location for the underpasses would be at a point some 500 m along the access track from the border. The Boyd Street overpass is not part of the Tugun Bypass proposal.

The Long-nosed Potoroo is currently under threat from habitat loss and fragmentation, and predation by introduced species. Predation would be expected to increase with completion of the Cobaki Lakes development. The incidence of dogs and cats in adjacent NSW Crown land would also increase as the area becomes populated. As a Critical Weight Range species, Long-nosed Potoroos are particularly susceptible to predation by these introduced species. The provision of fauna-exclusion fencing along the proposed bypass would deter domestic dogs and cats from residential areas to the east from accessing Long-nosed Potoroo habitat.

While the proposed bypass is unlikely to have a significant impact on this population, the addition of fragmentation and edge-effects associated with the Cobaki Lakes development and possible Boyd Street overpass may result in the extinction of this regionally significant population. It is, therefore, critical that compensatory measures are implemented to improve habitat quality and reduce threats to this species. The NSW RTA and Main Roads would implement all possible measures in areas where they have ownership or control; however, some of the measures would require implementation by others. These measures are shown in Figure 10. 8 and include:

- providing predator control fencing along both sides of Boyd Street extension once operational
- providing predator control fencing around the Cobaki Lakes development area once construction commences
- implementing a fox control program on NSW Crown land

- preparing and implementing a fire management plan for the Crown Land, taking into account the habitat requirements of the Long-nosed Potoroo by prescribing a mosaic of 'patch' burning, and preventing catastrophic wildfires
- constructing two underpasses under the Boyd Street overpass, if built.

Without compensatory measures, there is a risk that the Long-nosed Potoroo population would be significantly affected by cumulative impacts, probably resulting in local extinction. If the bypass isn't built then the threats to the population would still exist and no compensatory measures would be undertaken.

Stage II Pacific Beach Estate development

The proposed Tugun Bypass would result in the removal of two individuals of Little Wattle from the Queensland–NSW population. This species is considered to be 'vulnerable' in Queensland and the individuals that would be removed may represent the southernmost population of this species in that state. It is also likely that the proposed bypass would result in the removal of some individuals of Match Sticks in Queensland. The exact location and numbers of the Queensland population is not known because the slashing activities in the area make individuals difficult or impossible to locate. Although not listed in Queensland, NSW or Commonwealth legislation, this species is considered to be of state significance in Queensland as, prior to this study, it was thought to be extinct here.

Potential habitat in the vicinity for both these species may be found on the proposed Pacific Beach Estate. As these species are already growing in disturbed communities, the proposed bypass is unlikely to have secondary impacts on the retained population. Cumulative impacts from the Pacific Beach Estate may, however, place both populations at risk of extinction unless these species can be incorporated into rehabilitation plans. As such, the cumulative impacts from the proposed bypass have been assessed to be regional for the Little Wattle and state for Match Sticks.

Industrial development proposals

Development of these areas may result in habitat loss in an area of regional conservation significance at the southern end of the proposed Tugun Bypass. It would also form a barrier along two potential subregional corridors, and reduce connectivity to vegetated areas around the Cobaki Broadwater. Ecological impacts would need to be addressed when appropriate approvals are sought to rezone this land.

17.4.2 Surface water, groundwater and acid sulfate soils

The construction of the road tunnel by the cut-and-cover method would result in significant impacts to groundwater levels if no measures are adopted to control the drawdown. The most significant impact would be the exposure of acid sulfate soils, which could then generate acidic runoff. There would then be potential for this run off to enter the Cobaki Broadwater and surrounding wetlands. Mitigation measures to control groundwater levels and manage acid sulfate soils are detailed in Chapter 8. This section reviews the possible cumulative impacts to surface water, groundwater and acid sulfate soils that could occur as a result of the runway extension and rail tunnel.

Gold Coast Airport Limited runway extension

The proposed runway extension and tunnel cross natural drainage lines that feed surface water run-off to the Cobaki Broadwater and fringing wetlands. The extension to the runway would include new culverts and drains to ensure that the existing drainage patterns are maintained. The access ramps to the road tunnel would require the diversion of run-off from a small catchment at the southern end of the runway. The diversion would join the drainage line running across the top of the northern end of the tunnel and direct the diverted flow to its original discharge area.

The effects of the tunnel on groundwater levels in the area have been modelled, however there has been no modelling of the effects of the runway and the tunnel. The effect of the runway extension and its possible influence on groundwater recharge also needs to be considered. The run-off from the current runway discharges to the surface at its edges. Here it infiltrates into the underlying sands and recharges the aquifer. The overall effect is similar to groundwater conditions without the runway. Therefore the runway extension would not significantly affect groundwater conditions once built as the line recharge that exists would continue along the new extension.

The runway extension would be built on approximately 2 m of fill to ensure that it has immunity from a 1-in-50-year flood event. However the placement of a large amount of material onto the soil has potential to cause compaction in the underlying ground. The alluvial sands and gravels making up the underlying soil and aquifer do not compact easily owing to their granular nature and, apart from some slight compaction at the surface, the sands and gravels would retain their high permeability, thereby ensuring that the surface water would continue to recharge the aquifer.

Robina to Coolangatta rail link

The future rail tunnel under the runway was included in the groundwater modelling to check its possible influence on the local groundwater system. The design of the tunnel considered was a driven tunnel passing under the runway towards the passenger terminal. The rail tunnel is, in essence, an impermeable tube that is driven through the sands and gravels, leaving permeable layers above and below it. When this was included in the groundwater model, it showed that groundwater flows would continue uninterrupted above and below the tunnel towards the Cobaki Broadwater. The tunnel would be located close to the road tunnel and flows that pass the rail tunnel would then meet the road tunnel. Here the cross drains would ensure that flows continue.

The northern rail tunnel under Hidden Valley would be constructed through the steep hills and ridges that are underlain by brown greywacke and argillite. Due to their texture they have a very low permeability and any groundwater in these rocks flows in fracture zones. Bores installed to a depth of 30 m in the ridge behind the John Flynn Hospital and Medical Centre were dry on drilling and were still dry three months after installation.

The construction of the northern rail tunnel is therefore unlikely to have any impact on local groundwater conditions.

17.4.3 Air quality

Air emissions, including pollutants and greenhouse gases, and the resulting impacts on air quality, have been modelled for the proposed bypass. The models show that, under worst-case conditions, pollutant concentrations (particularly for carbon monoxide and oxides of nitrogen)

would exceed applicable guidelines at a number of locations without the bypass, but are not likely to exceed any guidelines if the bypass is constructed, even under worst-case conditions. The bypass is, therefore, considered likely to have a positive impact on air quality along the roads most affected by the project.

Emissions of greenhouse gases have been modelled for the Gold Coast region to include the effects of changed traffic flows that are expected to occur on sections of the road network outside the immediate project area. The bypass is expected to result in some increases in total traffic and hence total emissions as a result of attracting traffic from other areas or making trips easier. This would be offset by reducing the emission rates of vehicles through reduced congestion, improved average speeds, less time spent idling at intersections, and less start–stop driving. The regional model shows a small increase in total greenhouse emissions in 2007 with the bypass constructed, and a small decrease in 2017. These small changes in emissions are probably not significant when viewed against the likely accuracy of the combined traffic and emission estimation models that have been used to estimate total emissions and the total emissions in the area. The project is, therefore, considered to generate an insignificant cumulative impact on greenhouse gas emissions.

17.4.4 Changes to traffic flows

The proposed Banora Point upgrade to the south and the upgrading of the Pacific Motorway to the north will not generate any significant negative cumulative effects on traffic flows. The effects will be positive for road users as travel times will be reduced and delays minimised as improvements on the road network provide increased levels of service. This is further discussed in Technical Paper 3.

Impacts on sensitive receptors such as residential areas at the northern and southern ends of the proposal would remain the same, as the upgrades would not generate significant increases in traffic flows as they simply provide additional capacity to the current road network.

The construction of a new or upgraded road often produces changes in traffic flows and also results in the generation of new trips. The generation of new trips is termed 'induced travel demand'. This section examines induced travel demand and the possible cumulative effects resulting from the integration of the bypass with the remainder of the road network of south-east Queensland and northern NSW.

Changes to existing travel patterns would occur as a result of the bypass. These would include drivers changing route to take advantage of the new road and increased numbers of people choosing to travel at peak period. In addition to these changes there would be a number of new trips resulting from people choosing to travel because of the new road. The current levels of congestion are likely to suppress a number of trips at present as the inconvenience of the delays outweighs the need. With the delays removed, these trips then become more likely.

Current traffic modelling techniques are not able to estimate induced travel demand, but studies suggest that they are a small percentage of total flows (Standing Advisory Committee on Trunk Road Assessment 1994).

New roads often induce land use changes as a response to the increased accessibility of an area. In the case of the Tugun Bypass, land use planning has already made provision for this with the approval of the Cobaki Lakes development and Stage II of the Pacific Beach Estate development. Given the level of planning already in place, it is unlikely that there would be other significant land use changes in the immediate area.

17.4.5 Rail noise

The construction of the Robina to Coolangatta rail Link will result in a change to the local noise environment. It is difficult to model and predict the likely cumulative effects of the rail as the characteristics of noise from each source are very different. Road noise tends to contribute a continuous level of noise to the environment while the rail would result in a short peak of increased noise levels as individual trains pass. The reaction of individuals to the different noise characteristics also varies with some people habituating to the continuous character of the road noise while becoming sensitized to the intermittent peaks of rail noise. For other individuals the reverse is true. Therefore it is not possible to accurately predict what the effects will be, however the approvals for the proposed Robina to Coolangatta Rail Link would need to assess the impacts of rail noise.

17.5 Cumulative impacts on mitigation measures

A number of mitigation measures have been introduced to reduce the impacts associated with the construction and operation of the bypass. The mitigation measures have been included in the concept design for the proposal and are detailed in chapter 18. The mitigation measures have been designed to operate as close as possible to the point of impact and the majority are included within the footprint of the proposal.

Other future developments taking place close to the bypass may compromise the effectiveness of these mitigation measures, and so this section of the EIS examines the interactions between future developments and the mitigation measures for the bypass.

The alignment of the bypass has been altered to avoid, as much as possible, the areas with important environmental values to the west. The footprints of other proposed projects or activities within the study area are to the east of the alignment, the exception to this being the Cobaki Lakes Residential Development to the north west of the Cobaki Broadwater. Therefore it is those mitigation measures to the east of the alignment and those with the aim of providing connectivity between the east and west that will most at risk from other developments.

Drainage lines and wet/dry culverts

Where the alignment of the bypass crosses natural drainage lines culverts would be installed to ensure that the flows are maintained. In some areas the alignment also crosses between known breeding areas for the Wallum Sedge Frogs. In these areas wet/dry culverts will be installed to provide connectivity between breeding areas on the eastern and western sides of the alignment. These will also function to provide passage to other species, such as small mammals.
The Tugun to Coolangatta rail link and the development of the Western Precinct by Gold Coast Airport are two future developments that would require land to the east of the alignment. Once built the railway and the Western Precinct would result in the removal of all suitable frog habitat immediately east of the alignment. The wet/dry culverts would therefore no longer connect areas of habitat once these proposals are complete.

Relocation and translocation plans

Prior to start of construction flora and fauna will need be removed from the footprint and transplanted or relocated to adjacent areas of suitable habitat. If these individuals are moved to areas that will be required for other future developments the habitat will therefore eventually be removed. All relocations and transplantations will therefore be to the west of the alignment into areas where no future projects or activities are proposed.

17.6 Conclusions

The development of the Tugun Bypass proposal has been guided by the principle of delivering infrastructure while protecting the environment. The preparation of the EIS has involved detailed assessment of all environmental issues associated with the study area. The assessment adopted a large study area to ensure that impacts away from the immediate footprint of the proposal were also considered.

The results from the studies provided a framework for assessing the impacts of the proposal and those of associated proposals and activities. At the start of the process, the study area was known to have a number of high environmental values, particularly those associated with flora and fauna. The studies have confirmed this and have also provided additional data and information. The studies have, therefore, greatly increased knowledge of the environment of the study area.

Other known or proposed activities or developments that could lead to cumulative impacts have been assessed in this chapter. The two residential developments proposed either side of the alignment, close to the NSW–Queensland border, would lead to significant cumulative impacts on the high ecological values of the area if they were to proceed without any mitigation measures. The Tugun Long-nosed Potoroo population would be most at risk from these developments, with or without the bypass proposal.

The package of mitigation measures has included a number of commitments to work with surrounding developments to improve the management of conservation issues in the area. This includes the integration of the Gold Coast Airport Limited vegetation management plan for the southern end of the obstacle limitation surface with vegetation management measures for the Tugun Bypass. The compensation package would help to secure the ecological values of the area for the future by dedicating a substantial area to conservation.

18. Environmental management and monitoring

18.1 Introduction

Safeguards detailed in this EIS aim to minimise and or mitigate, as far as is practical, the potential negative environmental, economic and social effects of the proposal. Similarly, terms and conditions of subsequent regulatory permits, approvals and/or licenses may detail similar or additional requirements. Implementation of these safeguards, terms and or conditions (environmental measures) would be instrumental in achieving legislative compliance and a high level of environmental performance. This would be time specific, and may be most effective during different delivery phases of the road proposal.

In accordance with the joint *Guidelines for an Environmental Impact Statement on the Proposed Tugun Bypass* this chapter describes the outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing.

18.2 Environmental management framework

The Tugun Bypass project would be delivered using the design, construct and maintain delivery model as developed by the NSW RTA. As such, the NSW RTA environmental management system would be the most efficient process to integrate project specific environmental measures.

The NSW RTA has developed an environmental management system consistent with the principles of the ISO 14,000 series of standards. Specific to road infrastructure, this system includes a framework, which designates environmental requirements and responsibilities at different stages of project delivery. Through quality controlled documentation, this facilitates the systematic and logical implementation of all environmental measures specific to a road project.

Core documents of this system include:

- Environmental Impact Assessment Policy, Guidelines and Procedures
- NSW RTA QA Specification G36 – Environmental Protection (Management System)
- detailed drawings.

The NSW RTA manual, *Environmental Impact Assessment Policy, Guidelines and Procedures* recommends that formal documentation of environmental measures occurs on completion of environmental impact assessment. Two documents are defined, namely the Project Environmental Management Plan and the Construction Environmental Management Plan. Procedures (EIA06) for the preparation of these plans, the development of associated tender documents and the handover of environmental responsibilities are also detailed within this manual.

The NSW RTA *QA Specification G36 – Environmental Protection (Management System)* is a 'model' specification that details the requirements of the contractor's corporate environmental

management system and environmental management plan for a road project. The specification may be amended with additional, project specific requirements through customisation of boxes within text and annexures.

Detailed drawings identify the design and location of the road project. As a tender document, subsequent requirements contractually bind the contractor. This allows specific environmental measures to be integrated during detailed design and subsequently formed or recognised during construction.

18.2.1 The project environmental management plan

The Project Environmental Management Plan (PEMP) would be the primary document to ensure environmental management obligations are met by:

- collating the environmental measures identified during environmental impact assessment
- detailing the procedure and format for integration of environmental measures consistent with a defined delivery process
- defining the timing of implementation of environmental measures, specific to delivery phase
- assigning environmental management responsibilities
- facilitating environmental evaluation and auditing of the effectiveness of environmental measures and environmental conformance/performance of the project.

In consultation with the NSW RTA and other administering authorities, the preparation of the Project Environmental Management Plan would be the responsibility of Main Roads. Development would occur during detailed design and on completion, would be reviewed and/or certified by the Project Manager and Environmental Advisor as being complete.

18.2.2 Contractor's environmental management system

In NSW the State government issued a publication titled the *Environmental Management System Guidelines*. This publication sets out key parameters for contractors to set up corporate environmental management systems, initially applying to projects greater than $10 million, and for all contractors to prepare environmental management plans prior to starting works. These guidelines generally apply the principles of ISO 14000.

In relation to state controlled road works, the NSW RTA has increased this requirement to include works greater then $2 million. As the capital expenditure of the proposed Tugun Bypass in NSW would exceed this threshold, all contractors would be contractually required to have a Corporate Environmental Management System. This would be a contractual requirement during the construction of the Tugun Bypass through the integration of NSW RTA *QA Specification G36 – Environmental Protection (Management System).*

18.2.3 Construction Environmental Management Plan

The Construction Environmental Management Plan is the contractors commitment to environmental management of works as defined by the contract and binding law. A Construction Environmental Management Plan usually operates in association with the Project Environmental Management Plan to provide overall management of a projects environmental obligations.

The Construction Environmental Management Plan framework for the Tugun Bypass would be defined by the NSW RTA *QA Specification G36 – Environmental Protection (Management System)*. This specification requires the contractor to submit a Construction Environmental Management Plan for the work as part of its Quality Plan, at least 10 working days prior to the proposed commencement of any construction work. No construction works are to commence until the Construction Environmental Management Plan is submitted and the Superintendent releases the Hold Point. Consideration of the suitability of the Construction Environmental Management Plan would be undertaken in consultation with the Project Manager and Environmental Advisor prior to release.

The Construction Environmental Management Plan would contain procedures for effective communication with the NSW RTA and Main Roads project managers, government authorities and the local community. The elements of the plan would include:

- assignment of responsibilities for planning, implementing, maintaining, assessing and monitoring environmental controls
- copies of approvals, licences and permits to meet statutory requirements
- details of potential environmental impacts and operational control measures which are to be implemented to comply with statutory requirements and to provide environmental protection
- details of how environmental protection would be maintained for sub-contractor activities
- an environmental monitoring program and report forms for recording all monitoring activities including periodic inspections of the adequacy of operational controls, together with measurements for aspects where compliance limits have been specified
- location of environmental controls
- supplementary environmental management plans for environmental protection and operational control
- objectives and targets for environmental performance
- details of communications procedures including the methods proposed to undertake community consultation, communication with government authorities, the NSW RTA and Main Roads
- emergency response procedures for mitigating environmental damage and procedures for planning restoration activities
- details of training and awareness programs for personnel working on the proposal
- details of how changes to environmental management documentation and data would be identified and communicated to relevant personnel
- a formal document control procedure that details the process and authorised personnel for changing and issuing the Construction Environmental Management Plan
- mechanisms for regular evaluation of environmental performance
- an environmental auditing program.

18.2.4 Supplementary environmental management plans

Amendment of NSW RTA *QA Specification G36 – Environmental Protection (Management System)* permits the requirement of supplementary environmental management plans. As part of the Construction Environmental Management Plan, these supplementary plans further ensure the

protection of specific environmental matters and operational control during construction and operation. As contractual requirements, these supplementary plans regulate the contractor. Supplementary plans to be developed for the Tugun Bypass proposal would include:

- soil and water management plan including an erosion and sediment control plan
- noise and vibration management plan
- contaminated land management plan
- flora and fauna management plan including threatened species management plans
- air quality management plan
- cultural heritage management plan
- acid sulfate soils management plan
- groundwater management plan
- traffic management plan
- hazard and risks management plan
- landscape plan.

The supplementary environmental management plans would detail how impacts of construction activities would be managed to avoid or minimise impacts on the surrounding environment. They would be consistent with and link to the Construction Environmental Management Plan.

18.3 Environmental mitigation measures

In accordance with the Commonwealth Department of Environment and Heritage *Guidelines for an Environmental Impact Statement on the Proposed Tugun Bypass*, the following section describes a consolidated list of proposed mitigation measures. Due to the cross-jurisdictional nature of the proposal, the administrating authority responsible for reviewing each mitigation measure (prior to overall approval by the Department of Infrastructure, Planning and Natural Resources of the Construction Environmental Management Plan) and the organisation subsequently responsible for their implementation will be determined after the conditions of approval have been obtained. Table 18.1 details the mitigation measures.

The above referenced guidelines also require that the anticipated cost of mitigation measures is determined and documented. Table 18.2 presents these details.

18.4 Environmental monitoring

Environmental monitoring programs will form an integral part of the environmental management framework. The data from the monitoring programs would allow the proposal's environmental performance to be measured against the objectives and targets set out in the environmental management system and plans. Table 18.3 sets out the monitoring programs proposed, the parameters to be monitored, their trigger values and response activities.

Table 18.1: Summary of mitigation measures and management controls

	Pre-construction	During Construction	Post-Construction
Noise and vibration			
	Develop a Noise and Vibration Management Plan as part of the Construction Environmental Management Plan. This plan would demonstrate that best practice environmental management is applied to all aspects of construction activities. Best practice environmental management would be expected to include (as a minimum) the following: • restriction of construction hours • use of plant and equipment designed with inbuilt attenuation • plant and equipment maintained in good working order and compliance with manufacturer's noise ratings for individual plant items • installation of appropriate temporary noise attenuation infrastructure, where necessary, based on advice from acoustic consultants • regular consultation with the community to keep them informed of up-coming works • operational noise mitigation measures to be built, where possible, early in the construction period to provide early benefits in terms of reducing construction noise impacts • development of an induction program on reducing construction noise. All buildings and structures which could potentially be subject to structural damage from excessive ground vibration would be surveyed prior to the start of construction and on completion where this is considered necessary. Identify control types, location and timing for implementation. Integrate requirements of approvals, licenses and/or permits. Integrate construction requirements into tender documents.	Develop, implement, monitor and audit Construction Environmental Management Plan (and associated Noise and Vibration Management Plan). Construction relating to surface activities and haulage activities would be limited to NSW Department of Environment and Conservation standard hours of construction (7 am to 6 pm Monday to Friday and 8 am to 12 pm on Saturday, with no work on Sunday or public holidays) or as identified in the Noise and Vibration Management Plan. If any activity needs to be undertaken outside the normal work hours the Department of Environment and Conservation and local residents would be consulted about the timing and duration prior to the work commencing. Additional noise attenuation measure may be required for equipment used during off-peak construction periods, depending on the nature and location of the work. Noise barriers required for the operational phase of the proposal would be constructed at the beginning of the construction process to provide additional noise protection. Standard noise treatments such as the provision of noise barriers, equipment enclosures, the use of silencers and regular equipment maintenance would be used to control noise from construction activities. Use of innovative technologies such as perimeter sawing, use of circular saw or diamond wire, water jet cutting, line drilling and splitting, ripping with excavators and griding would be considered where construction noise and vibration may be an issue. Monitoring would be conducted during construction activities where there is considered to be potential for complaints regarding vibration which may exceed human disturbance criteria.	Maintenance of controls.

	Pre-construction	During Construction	Post-Construction
Landscape			
	Development a suitable Landscape Plan and specification in accordance with Main Roads /NSW RTA design guidelines and administrating authorities. Determine and develop translocation plan (terrestrial and aquatic) as a component of the Flora and Fauna Management Plan. Co-ordinate endemic seed collection (within footprint) and subsequent propagation prior to construction. Integrate requirements of approvals, licenses and/or permits. Define hydromulching specification including progressive staging. Require mulching of cleared and grubbed native vegetation. Integrate construction requirements into tender documents. Coordinate declared plant audit and eradication program three months prior to construction. A local nursery would be appointed to collect a representative sample of native seeds from the area of the footprint and to propagate them. These species would then be used for landscaping.	Implement, monitor and audit contract requirements. Areas for seedling/planting would be fully prepared, free of weeds, and with existing soil reused as extensively as possible. Soil used for seedling/planting, including both site soil and any imported topsoil, would be tested for quality before use. Any additives recommended to ensure optimal plant growth would be specified and included. It is expected that a slow-release fertiliser and a soil-saturation aid would be used to improve tree growth rates, if appropriate, and that tree guards would be used to protect plants as necessary. Road edges and any other areas disturbed during construction would be revegetated with local native plant species where practical.	Maintain in accordance with contract requirements. A 12 month maintenance program would be undertaken for all landscape works, and would include watering, weeding, pruning, mowing and replacement of any failed plants. If necessary, the program would continue until the landscaping is fully established. Following this initial establishment period, only minor annual maintenance and weed control would be required, this would form part of the 10 year maintenance program under the DCM contract.
Air Quality			
	Develop an Air Quality Management Plan as part of the Construction Environmental Management Plan. Ensure that all temporary facilities are designed to minimise generation of dust, smoke and other particulates.	Construction activities to be undertaken in accordance with the requirements of the Project Environmental Management Plan, the Air Quality Management Plan and any licence conditions relating to air pollution. Mitigation measures to manage air quality during construction would include: • applying water by truck sprays on all exposed areas as required to minimise dust emissions • restricting dust-generating activities, such as topsoil removal, during high winds or during stable conditions with winds blowing toward adjacent residences • siting the construction compounds away from existing dwellings	Undertake monitoring of air quality as part of the ongoing environmental monitoring program. Air quality monitoring would include carbon monoxide concentrations and visibility levels in the tunnel.

Pre-construction	During Construction	Post-Construction
	• avoiding spillages and achieving prompt cleanup when required • covering haul vehicles moving outside the construction site • restricting the speed of construction vehicles, where required • checking particulate emissions from diesel vehicles and undertaking regular maintenance • prohibiting burning or incineration on site • monitoring dust near adjacent dwelling using dust gauges or other suitable ambient monitoring techniques to determine whether controls are being applied appropriately.	
Contaminated Land (including Tugun Landfill, Airport dump sites and sandblasting area)		
A Contaminated Land Management Plan to be developed as part of the Construction Environmental Management Plan. Prior to the start of construction, soil at identified contaminated areas including the Tugun Landfill, Airport dump sites and the sandblasting area would be tested for polynuclear aromatic hydrocarbons, total petroleum hydrocarbons, tributyl-tin (sandblasting area only) and metals. Further geotechnical and groundwater studies of the Tugun Landfill area to be completed. The current landfill management concept plan to be refined with new data and included in the detailed design.	The exposed waste would be capped with clay to a thickness of 0.5 m. The excavated area would be backfilled to the top of the works for drainage purposes. Material used for backfilling would have a low permeability to prevent leachate seeping through to the surface. The work area would be surrounded with an impermeable bund and all surface water/leachate would be collected for treatment or appropriate disposal. All excavated waste would be disposed of to a suitable containment cell or disposed of off site to a suitable facility. Work method statements would be prepared detailing safe work practices for construction workers involved in the excavation and transport of solid waste and the environmental protection measures required. These would be prepared in consultation with the NSW Department of Environment and Conservation, Queensland Environmental Protection Agency and/or Gold Coast Airport Limited depending on jurisdiction.	Monitoring of groundwater conditions would continue during the site stabilisation phase.

	Pre-construction	During Construction	Post-Construction
Flora and fauna			
Clearing of native vegetation	A Flora and Fauna Management Plan would be prepared during the detailed design phase to address vegetation protection issues. Protection measures would include installing temporary fencing to at least beyond the radius of the tree canopy (where possible), and minimising vehicle movements and preventing stockpiling within this vegetation zone. All contractors involved in construction would be thoroughly briefed on the importance and techniques of vegetation protection before any works.	Removal of vegetation would be restricted to the development footprint. Any additional clearing would be subject to future environmental impact assessment approval processes. Where possible, those areas that are already relatively disturbed would be used in preference to clearing nature vegetation. Where an area of native vegetation is required to be cleared and then revegetated post-construction the following measures would be applied: • the boundary would be fenced and the area cleared • seeds and other propagative material would be collected from native species present • where cleared vegetation is to be placed in windrows, these would not be allowed to abut those areas of native vegetation to be retained • topsoil would be stockpiled in long, low piles adjacent to works to maximise the viability of seed stock in the soil. Prior to clearing the footprint, the following protocol would be followed to check for species of conservation significance: • surveys targeting plant species of conservation significance would be undertaken by a qualified botanist • seeds from all threatened plants required to be removed would be collected once approval is obtained to enable potential propagation and re-establishment of threatened species in the area • marking of all threatened species, parawebbing and/or fencing of plants of significance or the footprint near the populations would be undertaken prior to construction to ensure that vehicles and other direct disturbances associated with road construction do not encroach into adjacent habitat containing significant species • a protocol for the removal and possible translocation of plants of conservation significance would be developed in consultation with the Queensland Environmental Protection Agency, NSW Department of Environment and Conservation and/or Commonwealth Department of Environment and Heritage, depending on jurisdiction.	Re-vegetated areas to be monitored until they are fully established.

	Pre-construction	During Construction	Post-Construction
Relocation of plant species	A strategy for the translocation of plants would be prepared by the NSW RTA in consultation with the Queensland Environmental Protection Agency, NSW Department of Environment and Conservation and/or Commonwealth Department of Environment and Heritage, depending on jurisdiction and incorporated into the Flora and Fauna Management Plan.	All affected plant species of regional or state conservation significance would be translocated to areas of suitable habitat as close to their original location as possible. In the case of Chinese Burr, all plants would be removed during clearing and transplanted into appropriate habitats nearby and the topsoil containing the seed bank would be spread in adjacent areas. In the case of Little Wattles and Match Sticks, individuals requiring removal would be translocated to suitable nearby habitat.	All relocated plant species to be monitored to ensure they are fully established.
Relocation of animals	A relocation plan would be developed as a component of the Flora and Fauna Management Plan. This would include a protocol for the removal and treatment of injured animals. The plan would be developed in consultation with the Queensland Environmental Protection Agency, Commonwealth Department of Environment and Heritage and the NSW Department of Environment and Conservation.	Before the removal of any vegetation begins, measures would be taken to remove as many mammals as possible to safety. These include: • surveys targeting mammals and other species would be undertaken by a qualified ecologist • traps would be set to capture as many individuals as possible. Captured individuals would be relocated to suitable areas of habitat nearby • a fauna rescue frameworks for clearing has been developed by the NSW RTA in consultation with the NSW Department of Environment and Conservation and would be used as the basis during this project • during pre-clearing surveys bark would be removed from old growth paperbarks after bats have left roost sites (i.e. under the bark) to begin foraging at dust to prevent individuals from being injured or killed during clearing • once cleared, the footprint would be fenced with animal-proof fencing.	Requirements for post release monitoring to be agreed with the Queensland Environmental Protection Agency, Commonwealth Department of Environment and Heritage and the NSW Department of Environment and Conservation, depending of jurisdiction.
Hollow bearing trees	Protocols for the removal of hollow bearing trees and the relocation of hollows would be developed as a component of the Flora and Fauna Management Plan.	The hollow-bearing portion of the trees be removed after felling and re-instated in adjacent areas. If any hollows are damaged or destroyed during clearing, then appropriately designed nest boxes would be affixed to standing trees in the vicinity. All hollow-bearing trees to be felled would be clearly marked, and their species and approximate dimensions catalogued so that hollows and nest boxes can be affixed to similar standing trees.	Use of relocated hollows and nest boxes to be monitored until area has stabilised after completion of construction.

	Pre-construction	During Construction	Post-Construction
		Reinstated hollows and nest boxes would be placed in intact forest near the preferred alignment. The actual placement would taken into account the density and dispersion of existing hollows, would be examined in detail in the Flora and Fauna Management Plan, and would be discussed with relevant landowners and the NSW Department of Environment and Conservation. Small hollows should be replaced with nest boxes designed for bats. The nest boxes would have an overhanging roof and internal baffles, and internal and external walls would be lined with flyscreen to improve grip. Medium-sized hollows should be replaced with nest-boxes designed for Squirrel Gliders and Brush-tailed Phascogales. Nails used to attach nest boxes should not be galvanised or coated and should not contain zinc to avoid poisoning the trees. Metal strapping that allows for tree expansion should be used to attach nest boxes. Boxes should be placed between 4 and 8 m above the ground and oriented to minimise penetration by rainfall and sunlight. Boxes should be placed away from main access tracks to minimise the chances of them falling and injuring anyone.	
Wallum Sedge Frogs	Undertake further studies to finalise location of artificial frog ponds. Include locations and construction method in the detailed design. Develop a species management plan for the Wallum Sedge Frog as a component of the Flora and Fauna Management Plan.	Artificial frog ponds would be built up with materials taken from the alignment. This would ensure that suitable substrate materials form the base of the ponds. This would also minimise the depth of the excavations below ground level so avoiding saline intrusion from the Cobaki Broadwater. The minimum size of the ponds should be 15-20 m in length and 5-8 m in width. Ponds should be constructed to a minimum depth of 1.5 m with a gradient sloping to 0.3 m at the pond edges. A slow release liner, similar to those used in dam construction and sedimentation traps, would be used in the ponds to increase the permanency of surface water (>80% time). Construction works would be undertaken during a dry period (spring) leading up to a pronounced rainfall event (normally summer).	A Wallum Sedge Frog monitoring program to measure effectiveness of ponds, fencing and underpasses would will be developed in consultation with GCAL, the Queensland Environmental Protection Agency, Commonwealth Department of Environment and Heritage and the NSW Department of Environment and Conservation, depending on jurisdiction and detailed in the Operation Environmental Management Plan.

	Pre-construction	During Construction	Post-Construction
		Edges of the ponds to be planted with edges and rushes (such as *Restio* species) from the alignment. Vegetation would be removed by a process known as "slabbing'. Slabbing depth should be at least 30 cm to ensure organic layers are collected. The source sites for slabbing should include any existing *Restio* vegetation at the artificial pond sites and where applicable, augmented from areas with dense *Restio* along the proposed alignment. The existing frog pond to the west of the alignment is only sparsely vegetated and would be enhanced by supplementary planting of appropriate vegetation, predominantly rushes such as *Restio* and *Baumea* species. Planting would be done by hand to minimise damage to the pond. Two culverts would be constructed under the bypass to maintain connectivity between areas of Wallum Sedge Frog habitat on either side of the alignment. These culverts would be 1 m high and 3 m wide, with their length varying between 50 and 60 m. The design of the base of the culverts would need to encourage the use of these structures by frogs. One option is to include a central channel in the culvert that would hold water. Frog exclusion fencing would be constructed to keep frogs off the road and direct them into the culverts. This fencing would consist of a solid sheet of durable material measuring approximately 400 mm high, with a small overhang at the top.	
Long-nosed Potoroos	Develop a species management plan for the Long-nosed Potoroo as a component of the Flora and Fauna Management Plan.	Key components of the species management plan prepared for the Tugun Long-nosed Potoroo population would be: • installation of animal proof fencing along the boundaries of potoroo habitat • installation of fencing along both sides of the Boyd Street access track • a fox control program would be initiated and maintained on NSW Crown land • a fire management plan for the NSW Crown land taking into account the habitat requirements of the potoroo by prescribing a mosaic of 'patch' burning and the prevention of catastrophic wildfires would be prepared and implemented.	A monitoring program to check on the effectiveness of the management plan and to monitor the status of the population would be prepared and implemented and detailed in the Operation Environmental Management Plan. Selective burning of understorey vegetation would be undertaken annually. Fox control program maintained. Population surveys to be undertaken every two years for six years.

	Pre-construction	During Construction	Post-Construction
Groundwater			
	A Groundwater Management Plan would be developed as a sub component of the Construction Environmental Management Plan. The plan would detail measures to control groundwater drawdown. Further geotechnical bores to be sunk and pump testing to be undertaken to aid detailed design.	Groundwater drawdown would be managed by a series of re-injection spikes along either side of the working area. These would pump groundwater collected from the working area back into the ground so ensuring that the pre-construction levels of groundwater are maintained. The number of spikes can be varied to take account of inflows of groundwater and the pace of construction can be regulated to ensure that it doesn't overwhelm the re-injection system. This system would ensure that groundwater lowering would not extend beyond 5 m either side of the construction area. All other water collected in the excavations such as rainfall and seeping groundwater would be pumped to a holding pond. The water would be tested prior to discharge to ensure that its pH is similar to the receiving water.	Cross-tunnel drains would allow free groundwater movement across the tunnel to maintain existing flows and levels. Monitoring of groundwater levels and movement to be undertaken.
Soils and Water			
	A Soil and Water Management Plan, which includes an Erosion and Sediment Control Plan would be developed as part of the Construction Environmental Management Plan, prior to the start of construction. This would include: • adopting best management practices for the control of erosion sediments and pollution during the construction period • ensuring that the construction of the proposal minimises impacts on existing water quality of surrounding catchments. All erosion and sediment controls (including sedimentation basins) would be designed to be consistent with the requirements of *Managing Urban Stormwater – Soils and Construction* (NSW Landcom 2004). They would also be designed to dry out quickly after rainfall events. Design of constructed wetland treatment systems to be finalised and incorporated into detailed design. Program construction activities to minimise the area of disturbed ground, which is exposed to erosion at any one time.	Obtain necessary licenses for the installation of pollution control devices. Prior to construction commencing, diversion drains or diversion channels would be formed around the disturbed area. Clear water would be diverted away from the disturbed areas. Drainage structures such as waterways catch drains and sediment basins would be installed prior to the commencement of bulk earthworks in order to allow existing flows to pass through the construction zone without mixing with flows from the site. The contractor would be required to protect all stockpiles of erodible material against erosion by temporary seeding, together with the provision of other standard erosion and sediment control measures. Batters would be vegetated as soon as practicable after excavation to mitigate any erosion potential. Erosion control would be necessary on any steep fill embankments and on road excavation that leave a cut surface. These embankments would require treatment to ensure stability. Where seeding/planting is proposed on banks that are steeper than two horizontal to one vertical, prior to landscaping the banks would be stabilised by erosion-control matting and covered with mulch to improve their final appearance.	Routine maintenance of constructed wetlands to be undertaken. This would include: • collecting litter from swales • periodic removal of excess silt • cutting and planting of reeds.

	Pre-construction	During Construction	Post-Construction
Topsoil			
	Locations for all topsoil stockpiles and procedures required for management would be included as a component of the Construction Environmental Management Plan.	Following appropriate testing, all topsoil suitable for reuse would be removed to temporary locations along the alignment. Any topsoil stripped from the site during construction should be stored in a way that retains maximum soil quality. Measures to achieve this includes, the establishment of vegetative cover for stabilisation during storage, and protection from traffic. Any soil imported to the site would be from an approved source. All stockpiles of potentially erodible material would be protected by temporary seeding, together with standard erosion control measures.	
Water Quality			
	A water quality monitoring program would be prepared as part of the Soil and Water Management Plan. Safeguards developed to ensure safe storage of fuel and chemicals.	The contractor would develop emergency procedures that would minimise the effects of any spills of hazardous materials. All fuel or chemicals would be stored in a bunded area capable of holding at least 110% of the volume of the materials stored and would be at a level above a 1:10 year flood. Wastewater from on-site amenities to be pumped to sewer. Monitoring of surface water would continue during the construction phase and would maintain the program established during the pre-construction phase. In addition it would have the objectives of identifying if water quality problems are occurring as a result of the construction activities and of demonstrating compliance with legal and other monitoring requirements. In the event that any results are elevated more frequent monitoring would be undertaken and would trigger an investigation into its cause and remedial measures if necessary. Parameters monitored during the construction phase would be considered in the Construction Environmental Management Plan in consultation with regulatory agencies	Water quality monitoring would continue after opening of the bypass. The objectives for this stage of the monitoring program would be to assess and manage impacts on receiving waters as the site stabilises, and to assist in determining when the site has stabilised any that any criteria imposed as part of the approval conditions are being met. Sampling frequency would be monthly until results show that all or parts of the site have stabilised, at which point the monitoring frequency may be reduced or monitoring discontinued. Parameters monitored during the operational phase would be considered in the operational Environmental Management Plan in consultation with regulatory agencies.

	Pre-construction	During Construction	Post-Construction
Acid Sulfate Soils			
	An Acid Sulfate Soils Management Plan would be prepared, based on guidelines devised by the Acid Sulfate Soil Management Advisory Committee. This would be a sub-plan within the Construction Environmental Management Plan. The plan would include: • establishing background trends in groundwater chemistry, as site-specific criteria need to be developed, rather than relying on guideline levels. • controlling soil pH by treatment with agricultural lime in bunded areas, and regular testing of pH levels and rates of acid generation • controlling groundwater pH based on regular monitoring to determine the level of treatment necessary • maintaining existing low pH conditions as suitable for 'acid' frogs.	If suitable, materials excavated from the tunnel construction would be used as road embankment materials and would therefore require treatment to control acid generation. Acid neutralisation is considered the most effective treatment option. The treatment process would be as follows: • A site-specific sampling and testing program would be established before construction. The program would follow the guidelines from the Acid Sulfate Soils Management Manual and the Queensland Acid Sulfate Soils Investigation Team. • Liming rates would be based on the results of the testing program. The amount of lime required would be based on the formula kg$CaCO_3$/tonne soil = kg H_2SO_4/tonne soil. In estimating the lime requirement, a factor of safety would be allowed for inefficient mixing of lime. • Stockpiles of lime would be kept on site at all times. The supply would be covered and stored in a bunded area. Similarly, a supply of lime would be kept to treat any acid leachate. • Before placement of excavated materials, the base of the embankment pad would be limed with a precautionary amount of fine agricultural lime at a minimum rate of 2.5 tonnes/ha. • Excavated material would be placed in the embankment area within one day of excavation. • Material would be spread to a maximum thickness and covered with the required amount of lime as determined from the acid sulphate soil analysis. • Soils would be dried out to allow trafficking and mixing. Thorough mixing and aeration is essential and testing trials would be conducted before the layer is compacted. • The final profile of the embankment would be covered with topsoil and vegetated to restrict the ingress of water to minimise the possibility of leachate being generated in the embankment. • Naturally low pH conditions in the south of the airport would be maintained.	Incorporation of cross-tunnel drains to allow free groundwater movement across the tunnels to maintain existing flows and levels. Monitoring of placed material during site stabilisation phase to ensure all controls are effective.

	Pre-construction	During Construction	Post-Construction
		Toe drains would be constructed along embankments where treated acid sulfate soil materials have been placed. These would collect any run-off or leachate and direct it to a holding pond. Any discharge from the holding pond would be tested for pH before release. If the pH of the pond is lower than the receiving water, the pond would be dosed with slaked lime until the pH is brought to acceptable levels. In order to minimise the oxidation of potential acid sulfate soils during construction of the tunnel, groundwater pumped from the excavation would be reinjected into the ground immediately adjacent to the works. This would ensure that the surrounding soils remain saturated and free of oxygen. The pumping system would be sealed to minimise the possibility of oxidation of the groundwater All other water collected in the excavations, such as rainfall and seeping groundwater would be pumped to a holding pond. The water would be tested before discharge to ensure that its pH is similar to the receiving water.	
Cultural Heritage			
	Development, in consultation with Traditional Owners, of a Cultural Heritage Management Plan to deal with any existing or new material that might be discovered during the sub-surface testing or during construction. The Cultural Heritage Management Plan would contain specific procedures for respond to cultural heritage matters. This plan would include: • emergency measures to be adopted in the event of an unexpected find during construction • on-site training for construction and site staff with respect to their cultural heritage responsibilities • the preparation of detailed site plans showing areas which must not be disturbed • required mitigation measures if burial sites are found • specific communication procedures for response to cultural heritage matters.	Measures agreed in the Cultural Heritage Management Plan to be implemented. Activity within the National Estate would be limited to the disturbed eastern edge. There would be no disturbance within the fenced-off, vegetated area of the site. Traditional Owners would be kept fully informed of any further issues that arise from subsequent changes to the proposed alignment. If any unexpected European cultural heritage items are encountered during the course of construction works, works would cease and the Queensland Department of Natural Resources Mines and Energy (Cultural Heritage Coordination Unit) and/or NSW Heritage Office would be contacted, depending on jurisdiction.	

	Pre-construction	During Construction	Post-Construction
	Sub-surface investigations would be undertaken prior to the start of construction. This is to be undertaken in consultation with the Traditional Owners. The following areas would be tested for sub-surface deposits prior to ground clearance: • the western edge of the wetlands between chainages 2,500 and 3,200 • south of the National Estate (between approximate chainages 4,600 and 4,800) • tunnel approach (between approximate chainages 5,000 and 5,500) • the southern area from the airport boundary to the junction with the existing Tweed Heads Bypass (between approximate chainages 6,000 to 6,700). A diesel-powered sand auger could be used to its maximum depth (at least 2 m) at intervals of approximately 50 m. If cultural materials are identified, further open-area excavation and salvage may be required. The would be undertaken only after consultation with the appropriate Traditional Owners and the relevant state agency.		
Waste Management			
	Specific requirements for waste minimisation and management during construction and operation of the proposed bypass would be set out in the construction and operation environmental management plans. The Construction Environmental Management Plan would specify waste management measures to be followed during the construction period by the contractor as a condition of contract. It would also propose that the contractor be required to reuse material, wherever possible, and incorporate recycling programs as appropriate. The reduction of waste generated by the proposal would involve: • balancing of earthworks, as far as possible, thereby minimising the import of extra fill • ensuring that existing roads adjacent to the proposal would, where possible, remain intact, to reduce the need for additional pavement	Any waste generated in the project would be contained within the compound boundaries. Waste, which could not be reused or recycled would be removed at regular intervals to an appropriate location authorised to reuse, recycle or dispose of the waste material. The recuse of waste products during construction would include: • chipping and mulching vegetation cleared for road construction purposes and reusing it as an organic base for revegetation • ensuring that topsoil, stripped before the earthworks phase of the construction period, is free of weeds and then stockpiled • reusing topsoil as part of a landscape strategy, using appropriate management techniques • placing selected vegetation around environmental significant areas	

	Pre-construction	During Construction	Post-Construction
	• encouraging and educating employees to reduce waste wherever possible. In line with NSW RTA *QA Specification G36* – contractors would be required to purchase and use recycled content materials where cost and performance competitive, or at least the environmental equivalent of the non-recycled alternative.	• ensuring that any soil unsuitable for use in road embankments is used in mounding for noise mitigation, where practical. The recycling of waste products during construction would include: • Recycling waste created during construction of the proposal would involve; providing on-site rubbish-sorting facilities by the contractor, and recycling wastepaper, metals and glass; collecting and delivering disused or damaged concrete kerbs, medians, asphalt and similar material to crushing and recycling plants. If excess or unsuitable material is to be disposed of off-site, sampling/analysis would be undertaken if materials are suspected to be contaminated. If contaminants are found it would be disposed of to an authorised facility.	
Traffic and Access			
	A Traffic Management Plan will be prepared as part of the Construction Environmental Management Plan. Traffic management measures to be incorporated in the traffic management plan include: • control of access points for construction vehicles to reduce the likelihood of conflicts with other road users, where possible • designing access points with appropriate speed controls to minimise disruption to other road users • providing appropriate signage and safety devices (such as temporary concrete barriers) in accordance with the relevant standards and guidelines • avoiding excessive construction vehicle access during peak travel times • minimising disruption to through traffic to maintain consistent travel times where possible.	Traffic management measures, to ensure safe passage of vehicles around the site, would be put in place by the construction contractor. The main access to the John Flynn Hospital and Medical Centre would be maintained and the movement of emergency vehicles not hindered or subjected to delays. Partial road closures and diversions at the proposed Tweed Heads Bypass interchange would be managed by the use of diversions, the two-way service road near Kennedy Drive and limited construction activities at night. Local residents would be kept informed of scheduled road works in their vicinity. All existing pedestrian and cycle routes would be maintained with minor diversion where required.	Changes in traffic flows resulting from the implementation of the proposed bypass are expected to require the introduction of management measures in two areas: • along the Gold Coast Highway • in areas where traffic flows are expected to increase to gain access to the bypass. Both these would require further study in collaboration with the communities affected. Implementation would be the responsibility of Main Roads and Gold Coast City Council.

	Pre-construction	During Construction	Post-Construction
Hazard and Risk			
	A Hazard and Risk Management Plan would be prepared detailing safe working practices for construction workers involved in the excavation and transport of the solid waste. The management plan would provide details of protective clothing required, hygiene procedures and any action to be taken should accidental exposure occur.	All health and safety requirements to be implemented by the contractor.	In the event of a spill of hazardous material in the tunnel this would be collected in the sumps. The traffic control centre monitoring the traffic in the tunnel would have a cut off switch, which would disable the pumps in the sumps. The spilt material would then be pumped out of the sumps and disposed of to an appropriate treatment facility.
Construction Facilities			
	In identifying sites for construction compounds and temporary batching facilities the following criteria should be addressed: • central to a substantial portion of the works • located with ready access to the local road network • within the road reserve or in areas where this type of land use is permitted • separated from the nearest residence by at least 200 m, or in a location where it can be demonstrated that no adverse impact would occur at the nearest residence • not located within 100 m of any drain that discharges into the wetland, or mitigation measures that are provided • located in excess of 100 m from a designated wetland • of low conservation significance for flora and fauna • sufficiently large to allow effective operation of the plant • located above an appropriate flood level • on relatively level ground • selected so that the use of construction facilities does not affect land use of adjacent properties.	Each construction compound would be lit at night for security and protection. All work undertaken on temporary sites would be subject to satisfying site-specific environmental criteria, implementing mitigation measures, and meeting local authority requirements. Temporary facilities would be for the exclusive use of the proposed bypass project, and would be removed on completion of the project. Once the facilities are no longer required, the sites would be restored to acceptable conditions, as agreed with the land owner.	

	Pre-construction	During Construction	Post-Construction
Documentation			
	Project Environmental Management Plan to be developed and certified. Project Environmental Management Plan to: • require NSW RTA QA Specification G36 to be included as tender document • require one copy of each environmental approval, permit and or licence into tender documents • integrate Queensland and Commonwealth legislative requirements into NSW RTA QA Specification G36.		

Note: Recommend review of the timing for mitigation measures/management controls. They need to align with the NSW RTA delivery model.

Table 18.2: Cost of mitigation measures

Environmental Issues	Mitigation Measure	Estimated Cost
Noise	Erection of noise barriers	$12,100,000
	Architectural improvements to properties	$400,000
	Noise monitoring program following the opening of the bypass	$200,000
Landscaping	Native plant collection program	$30,000
	Post construction monitoring	
Air Quality	Installation of carbon monoxide monitoring equipment in the tunnel	$100,000
Flora and fauna	Relocation and Construction including: • Relocation of plant species • Relocation of animal species • Relocation of hollow trees and installation of nest boxes • Construction of artificial frog ponds	$250,000
	Clearing controls	$50,000
	Installation of wet/dry culverts for frog passage	$170,000
	Installation of frog proof fencing	$650,000
	Fox control program on Crown land	
	Selective burning program of potoroo habitat	
	Animal proof fencing around Long-nosed Potoroo habitat	$380,000
	Monitoring program for measuring effectiveness of mitigation measures	$250,000
	Purchase of land for compensatory habitat	$4,300,000
Cultural Heritage	Sub-surface archaeological survey of alignment	$175,000
Water Quality	Construction of sedimentation basins for the construction period	900,000
	Construction of artificial wetlands for the operation period	$900,000
	Water quality monitoring program for pre-construction, construction and operational phases	$90,000
Groundwater	Use of re-injection spears during construction of the tunnel	$240,000
	Cross drains included in tunnel construction	$180,000
	Groundwater quality monitoring program	$47,000
Acid sulfate soils	Test and treat	$3,200,000
Landfill treatment	Excavation and treatment	$2,800,000
Total		$27,412,000

Table 18.3: Environmental monitoring programs

Aspect	Phase	Program	Parameters	Trigger value	Response activities
Surface water quality	Pre-construction	Two events would be undertaken before construction begins. This would occur when at least 25 mm of rainfall occurs in less than 24 hours. The following parameters would be measured at the 11 monitoring sites:	• pH • aluminium • total phosphorous • total nitrogen • conductivity/salinity • turbidity • dissolved oxygen • total suspended solids • oil and grease • temperature • major iron chemistry • expected organic contaminants • metals (copper, zinc, lead, nickel, cadmium and chromium) • ammonia • total petroleum hydrocarbon	ANZECC Water Quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Environment and Heritage.	Pre-construction monitoring is to establish baseline conditions. Any exceedances of guideline values would be noted accordingly and would not be considered due to road construction activities.
	Construction	Monitoring of surface water would continue during the construction phase and would maintain the program established during the pre-construction phase. In addition other new sites may be introduced to take account of particular construction activities, for example temporary sedimentation basins would require checking for:	• pH • turbidity • dissolved oxygen • (TSS if turbid) • colour • conductivity • petro-film prior to any discharge.	ANZECC water quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Soil and Water Management Plan would contain procedures for reporting and remedial action in the event of any exceedances

Aspect	Phase	Program	Parameters	Trigger value	Response activities
	Operation	Water quality monitoring would be continued to assess residual impacts in the first 12 months after opening. Sampling frequency would be monthly until results show that all or parts of the site have stabilised at which point the monitoring frequency may be reduced or discontinued.	Assess and manage impacts on receiving waters as the site stabilises and assist in determining when the site has stabilised	ANZECC water quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Operation Environmental Management Plan would contain procedures for reporting and remedial action in the event of any exceedances
Groundwater Quality	Pre-construction	A groundwater quality monitoring program would be implemented prior to the start of construction and detailed in the Groundwater Management Plan. As groundwater levels are very close to surface two surface water monitoring locations would also be used for monitoring groundwater	Parameters that would be measured would include: • pH • conductivity • dissolved oxygen • total suspended solids • ammonia • temperature • metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg) • total kjedhal nitrogen (TKN) • nitrate • nitrite • Fe and Al	ANZECC water quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Pre-construction monitoring is to establish baseline conditions. These conditions would be recorded in the Groundwater Management Plan. Any exceedances of guideline values would be noted accordingly.
	Construction	Monitoring of groundwater would continue during the construction phase and would maintain the program established during the pre-construction phase.	• water level monitoring • sampling parameters listed above	ANZECC water quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Groundwater Management Plan would contain procedures for reporting and remedial action in the event of any exceedances

Aspect	Phase	Program	Parameters	Trigger value	Response activities
	Operation		• assess and manage impacts on receiving waters as the site stabilises and assist in determining when the site has stabilised • water level monitoring • sampling parameters listed above	ANZECC water quality guidelines plus any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Operation Environmental Management Plan would contain procedures for reporting and remedial action in the event of any exceedances
Noise	Pre-construction	Baseline noise monitoring would be undertaken near sensitive receptors. Baseline data would be used to assess compliance during construction and operation of the bypass.	LA_{10} and LA_{90} would be assessed. Noise loggers would be used outside sensitive receptors. Monitoring would be undertaken in accordance with: • AS 1055.1-1997: *Acoustics - Description and Measurement of Environmental Noise - General Procedures;* • AS 2659.1-1988: *Guide to the Use of Sound Measuring Equipment - Portable Sound Level Meters* • Main Roads and NSW RTA guidelines	Not applicable. Baseline data only.	Pre-construction monitoring is to establish baseline conditions. Any exceedances of guideline values would be noted accordingly.
	Construction	Monitoring for noise and vibration would be conducted during construction activities where there is considered to be potential for complaints regarding noise and vibration which may exceed human disturbance criteria.	LA10 and LA90 should be assessed over a minimum of two days at complainant's property.	Validated noise complaint.	Noise and Vibration Management Plan would contain procedures for reporting and remedial action in the event of any exceedances
	Operation	Noise monitoring would continue after the opening of the bypass. Monitoring locations would be reviewed at the beginning of the operational phase	LA_{10} and LA_{90} should be assessed over a minimum of two days at complainant's property.	Reference to appropriate state legislation	Operation Environmental Management Plan would contain procedures for reporting and remedial action in the event of any exceedances

Aspect	Phase	Program	Parameters	Trigger value	Response activities
Air quality	Pre-construction	Air quality monitoring would be continued to assess residual impacts in the first 12 months after opening	At sensitive receptors: • dust deposition • PM_{10} and $PM_{2.5}$ • total suspended particulates Adjacent tunnel: • carbon monoxide	Not applicable. Baseline data only.	Pre-construction monitoring is to establish baseline conditions. Any exceedances of guideline values would be noted accordingly.
	Construction	Baseline monitoring will be undertaken near sensitive receptors. Baseline data will be used to assess compliance during construction and operation of the bypass	At sensitive receptors: • dust deposition • PM_{10} and $PM_{2.5}$ • total suspended particulates Adjacent tunnel: • carbon monoxide	Sensitive receptors Applicable state legislation guidelines Adjacent tunnel 15-minute carbon monoxide exposure of 87 ppm	Construction Environmental Management Plan would contain procedures for reporting and remedial action in the event of any exceedances
	Operation	Monitoring of air quality in relation to the tunnel will continue throughout the operation of the bypass.	Adjacent tunnel: • carbon monoxide	15-minute carbon monoxide exposure of 87 ppm	Operator's environmental management plan would contain procedures for reporting and remedial action in the event of any exceedances
Flora and fauna	Pre-construction	A monitoring program would begin prior to construction to monitor the use of roost sites of the Grey-headed Flying Fox on the Cobaki Broadwater. The program would continue during the construction and early operational phases to determine if there is any evidence of changes in usage attributable to disturbance from the proposal.	• species • number • breeding activity (maternity vs. non-breeding) • proportion of mixed species • fly out times and direction • physical camp description	Any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Flora and Fauna Management Plan would contain procedures for reporting and non-compliance of contract requirements and approval conditions.

Aspect	Phase	Program	Parameters	Trigger value	Response activities
	Construction and Operation	The following should be monitored during construction and operation:	• size and distribution of the Tugun Long-nosed Potoroo population • use of frog culverts and effectiveness of frog-exclusion fencing • swamp orchid colonies • Common Planigale population • Wallum Sedge Frog and Wallum Froglet populations • translocated individuals of Little Wattle, Match Sticks and Chinese Burr	Any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Flora and Fauna Management Plan would contain procedures for reporting and non-compliance of contract requirements and approval conditions.
Acid sulfate soils	Pre-construction	An acid sulfate soils survey would be undertaken to determine the presence of actual or potential acid sulfate soils, which might be disturbed. From this information liming rates for any disturbed acid sulfate soils could be determined.	Using COMBINED (SPOCAS) METHOD test for: • Titratable Actual Acidity (TTA) • Titratable Peroxide Acidity (TPA) • Titratable Sulfidic Acidity (TSA). • SPOS (sulfur trail)	Queensland and NSW acid sulfate soil guidelines. Any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	An acid sulfate soil monitoring report should be provided after the assessment. This information should then be incorporated into an Acid Sulfate Soil Management Plan. The Acid Sulfate Soil Management Plan would form part of the Construction Environmental Management Plan.
	Construction	The above information would be incorporated into a detailed Acid Sulfate Soils Management Plan.	Discharge, adjacent and ground water quality: • pH; • conductivity; • aluminium • iron • treated ASS Using COMBINED (SPOCAS) METHOD test for: • Titratable Actual Acidity (TTA) • Titratable Peroxide Acidity (TPA) • Titratable Sulfidic Acidity (TSA). • SPOS (sulfur trail) Results above should show neutralisation has been achieved.	Queensland and NSW acid sulfate soil guidelines. Any approval conditions issued by NSW Department of Infrastructure, Planning and Natural Resources or Commonwealth Department of Environment and Heritage	Acid Sulfate Soil Management Plan would form part of the Construction Environmental Management Plan and would contain procedures for reporting and remedial action in the event of any exceedances.

Aspect	Phase	Program	Parameters	Trigger value	Response activities
	Operation		Refer water quality monitoring: • pH • iron • aluminium • conductivity	Queensland and NSW acid sulfate soil guidelines.	Operation Environmental Management Plan would contain procedures for reporting and remedial action in the event of any exceedances
Cultural heritage	Pre-construction	A Cultural Heritage Management Plan would be developed in conjunction with Traditional Owners and/or local Aboriginal groups.	Pre-construction monitoring to be carried out if stipulated in Cultural Heritage Management Plan.	As stated in the Cultural Heritage Management Plan and in accordance with applicable State legislation and guidelines	
	Construction		Monitoring criteria to be developed and agreed with Traditional Owners and in accordance with applicable State legislation and guidelines. The use of Aboriginal monitors would be stipulated in the Cultural Heritage Management Plan	As stated in the Cultural Heritage Management Plan and in accordance with applicable State legislation and guidelines	Cultural Heritage Management Plan would form part of their Construction Environmental Management Plan and would contain procedures for reporting and remedial action.
	Operation		Operational monitoring to be carried out if stipulated in Cultural Heritage Management Plan.	As stated in the Cultural Heritage Management Plan and in accordance with applicable State legislation and guidelines	If required the Cultural Heritage Management Plan may be applicable to the operation phase of the Bypass. If no Cultural Heritage Management Plan is in place, the Operation Environmental Management Plan would contain procedures for reporting and remedial action.

Part G – Justification of the proposal

19. Economic assessment

19.1 Introduction

There are three components to the assessment of major transport infrastructure proposals:

- engineering feasibility, determined predominantly by the cost required to develop a technically competent proposal and implement it
- environmental and social effects, both positive and negative, many of which cannot be converted into monetary terms at a project level
- economic impacts relating to the costs and benefits that would arise from the construction and operation of the proposal.

The economic assessment includes all those effects which can be reliably described in monetary terms, so that a conclusion can be reached on whether the investment of resources in the proposal is sound.

19.2 Methodology

The economic assessment technique used, cost–benefit analysis, is a method of measuring and evaluating the relative merits of public investment projects in support of sound economic decisions. It is a well-established method and one that considers the discounted costs and benefits accruing to the community as a whole. This evaluation uses a road-user cost–benefit analysis framework that does not attempt to place a monetary value on the environmental and social effects of the proposal. The latter are considered in descriptive terms, usually in relationship to accepted criteria, in Parts D and E of the EIS.

The economic assessment has been undertaken in accordance with the *Project Evaluation Guidelines* issued by Queensland Treasury in 1997. As the proposal also crosses land under Commonwealth and NSW jurisdiction, reference has also been made to the *Handbook of Benefit–Cost Analysis* (Commonwealth Department of Finance 1991) and *NSW Government Guidelines for Economic Appraisal* (NSW Treasury 1997). In addition, the *Economic Analysis Manual* (NSW RTA 1999) and the *Cost Benefit Analysis Manual for Road Infrastructure Investment* (Main Roads 1999a) have also been used for the derivation of specific technical detail.

These publications are consistent in terms of overall approach, differing only slightly in relation to technical detail. These include variations in the values assigned to time and the use of discount rates. Sensitivity testing was undertaken to determine the potential effects of variations in capital costs and discount rates.

Economic assessment of environmental and social changes brought about by the proposal has not been undertaken here because:

- the value of environmental and social changes are perceived by individuals in an aggregated manner when conventional techniques require the assessment of individual effects. In most cases, it is difficult to assign monetary values to these effects, particularly at a project level, with the agreement of the wider community.
- monetary values placed on individual environmental effects are usually derived from secondary sources such as house price changes as a result of traffic noise. In complex urban

situations, it is not appropriate to attribute a single cause to any such effect. Changes in house price driven by other factors such as supply and demand, interest rates, etc.

- the proportion of total monetary benefits attributable to environmental effects is very small — a recent assessment of a major urban road project (Spiller Gibbins Swan Pty Ltd 2001) suggested that noise impacts would comprise less than minus 0.1%of total benefits and air-quality impacts would be negligible. These compare with vehicle operating cost savings of 18.2% and road user time savings of 63.6%.
- disaggregated environmental effects are assessed in great detail in EISs and associated documentation. These relate mainly to externalities that affect parties other than those directly involved in the supply and use of the additional facilities. The economic assessment deals predominantly with user costs and benefits not analysed elsewhere in such documents.

This separation clarifies the assessment process by avoiding any potential for double counting.

19.2.1 The base case

The base case provides a common point of reference against which to measure the incremental costs and benefits of the proposal. In the case of the Tugun Bypass, its definition requires careful consideration as special circumstances apply. The clearest definition of the base case would be what would need to be done in the absence of the bypass to accommodate future traffic demand. As the do-nothing option, which is often used as the base case, is not realistic here (its remaining life is limited to a few years when it would cease to accommodate travel demand under acceptable conditions) other non-bypass options need to be considered. As the options through Tugun–Bilinga are limited, the only realistic alternative would be an upgrade of the existing highway from Stewart Road to its intersection with the Tweed Heads Bypass.

A realistic base case would, therefore, comprise a staged upgrade of the existing highway from four to six lanes initially and ultimately to eight lanes. Even this would have a limited life of perhaps 10 to 15 years. The only available options beyond this would be the provision of the bypass as described in the EIS or the completion of one of the A options described in Chapter 5 and discarded during the assessment. The effect of the limited upgrade would be to postpone the construction of the bypass or the implementation of a major upgrade of the existing highway to accommodate future traffic demand.

The net present values listed in Table 19.1 relate to the proposed Tugun Bypass and indicate its net worth to the community (present value of benefits less present value of costs). The cost–benefit ratio provides a value indicating the extent to which the benefits exceed the costs. Cost–benefit ratios in excess of 5 suggest that the base case used in the comparison is either ineffective in producing sustained travel benefits or is too costly, as is the case of some of the more major upgrades.

In practice, any measures to address growing congestion on the Gold Coast Highway through Tugun–Bilinga in the absence of the bypass would be incremental and of reasonable cost. These would, however, be of limited life, with additional actions required after 10 to 15 years of use. The necessary capacity required could then be achieved only by the introduction of the bypass, either in the form described as the proposal in the EIS, or one of the options which, for various reasons, have been rejected to date.

The base case is therefore defined for the purposes of the economic assessment as an upgrade of the Gold Coast Highway to six lanes in 2007. The evaluation period would realistically be restricted to 15 years, but has also been undertaken for 30 years as required by the guidelines.

19.2.2 The proposal case

The proposal case included in this assessment comprised the construction of the Tugun Bypass with four lanes in 2007 with no changes throughout two evaluation periods (15 and 30 years, respectively). An assessment period of 15 years has been used because the base case, as currently defined, would cease to produce benefits after this period.

19.2.3 Costs of the proposal

The economic assessment focuses on the road component of the proposal. Project-related costs include all labour, capital, land and other resources required to plan and implement the proposal, together with those costs required to operate and maintain the investment throughout its useful life.

Construction cost is estimated to be $360 million (out-turn dollars) spread over a period of four years up to the opening in 2007. Maintenance includes the resurfacing every seven years at a cost of $2.5 million. By comparison, the upgrade of the Gold Coast Highway by the addition of two extra lanes would cost $36 million.

Operating costs, mainly relating to the tunnel, would be approximately $1 million per year for electricity supply and communication charges. In addition, maintenance works relating to lighting, cleaning, ventilation systems, high- and low-voltage switchgear and transformers, stand-by diesel generators, pumps and control systems would be required. Some of these works would require traffic management, leading to lane closures. An additional $0.5 million per year has been included for these activities. Maintenance and lighting costs along the balance of the route have been estimated to total $0.5 million per year. Total annual maintenance and operating cost of the proposal is therefore expected to be $2 million.

19.2.4 Proposal benefits and other effects

Benefits are the intended effects of the proposal. These are primarily related to the efficiency of the transport system (reduced vehicle operating costs and travel times) and its safety (costs of accidents avoided). These are experienced directly by the user of the road network. Proposals also have other effects, both positive and negative. Typically these are social and environmental, and are mainly experienced by third parties.

The types of benefits and other effects considered in the economic assessment are:

- travel time savings
- operating cost savings
- accident cost savings
- road damage savings.

Time savings

Travel time savings have been derived from the transport model constructed for this proposal. This provides morning and afternoon peak, inter-peak and off-peak travel time savings resulting from the construction of the Tugun Bypass. These are aggregated to provide daily travel time savings and converted to annual values.

Monetary values have been derived by applying the value of time of $18.10 per vehicle hour. This is based on the values contained in Appendix B of the NSW RTA *Economic Analysis Manual*. These are the most recent available (2002) and are similar to those in the Main Roads *Cost Benefit Analysis Manual for Road Infrastructure Investment*.

Operating cost savings

Operating cost savings have been derived by taking into account the difference in annual vehicle kilometres travelled and the effect of stop-start driving conditions on the existing route, compared to free-flowing conditions on the proposed bypass. Reducing the need to decelerate and accelerate leads to lower fuel consumption and lower vehicle operating costs. The calculation of vehicle operating costs is based on values contained in Appendix B of the NSW RTA *Economic Analysis Manual.*

Accident cost savings

Accident cost savings were based on an analysis of crash data for the Gold Coast Highway and average crash costs for particular types of roads. Data for the previous nine years suggests that the Gold Coast Highway can be characterised as a relatively safe urban arterial, although injury rates are slightly higher than those for a four-lane divided road, such as the proposed bypass. This is expected to be safer owing to the high level of access control proposed, improved separation of pedestrians and vehicles, and the high geometric standards adopted. A cost of $17,000 per million vehicle kilometres travelled has been adopted, compared to $14,700 per million vehicle kilometres travelled for the existing highway. This is based on values for average accident costs for freeway and urban arterial road conditions contained in Appendix B of the NSW RTA *Economic Analysis Manual.*

Road damage savings

Road damage savings were calculated using changes in vehicle distance travelled as a result of the construction of the Tugun Bypass.

Other impacts (both positive and negative) resulting from the proposal, not included in the economic assessment, are:

- noise effects
- other amenity effects on local residents
- air pollution and greenhouse gas impacts
- pedestrian and other severance effects
- business community and road-user effects during construction
- impacts on the natural environment.

These effects are assessed descriptively using available and scientifically acceptable methods as described in Sections D and E of the EIS.

19.3 Economic evaluation

19.3.1 Basic parameters

The economic evaluation is undertaken by comparing the stream of benefits generated by the proposal over the evaluation period with its costs over the same period. As this requires a comparison to be undertaken over different periods, a process of discounting of future benefits and costs to a common level ($2003) is necessary. This is because construction costs are concentrated at the beginning, followed by a much lower level of recurring costs relating to operation and maintenance, while the benefits occur regularly over an extended period.

Discounting is a method of taking account of the real costs of funds and other resources that might otherwise have been used to generate benefits of a different kind. This approach takes account of the opportunity costs associated with resources and investment. A real discount rate of 6% is assumed in this analysis. This has been adjusted to exclude inflation.

The following parameters have been used in the analysis:

- evaluation periods of 15 and 30 years from the year of opening
- monetary values expressed in 2003 dollars
- discount rate of 6%.

As these parameters have a considerable influence on the results of the cost–benefit analysis, sensitivity testing to indicate the robustness of the results has been carried out by examining the effects of increasing the capital costs of the proposal and varying discount rate applied to the analysis.

Table 19.1: Summary of assessed economic impacts — net present value at 6% ($million at 2003 prices)[1]

	15-year evaluation			30-year evaluation		
	Net present value	Percentage of		Net present value	Percentage of	
		Cost	Benefit		Cost	Benefit
Capital and operating costs	322	100		332	100	
Road-user time saving	720		91	1,861		94
Vehicle operating cost savings	35		4	53		3
Accident reduction	34		4	59		3
Maintenance cost savings	–		–	(1)		(>1)

1: The results relate to a base case of a six-lane Gold Coast Highway and a proposal case of a four-lane Tugun Bypass.

19.3.2 Assessed economic impacts

Table 19.1 summarises the various categories of cost and benefit included in the economic assessment. It shows that the largest contributions to the benefits generated by the Tugun Bypass are expected to come from savings in road-user travel time.

19.3.3 Aggregate impacts and outcomes

Table 19.2 shows the results of the analysis for the two scenarios:

- Scenario A — Tugun Bypass (four lanes) and Gold Coast Highway (four lanes) compared to Gold Coast Highway (six lanes) over 15-year assessment period
- Scenario B — Tugun Bypass (four lanes) and Gold Coast Highway (four lanes) compared to Gold Coast Highway (six lanes) over 30-year assessment period.

The Tugun Bypass would generate positive net present values for each of the scenarios tested. These are summarised in Table 19.2. The cost–benefit ratios for the proposal based on road-user benefits, including accident reductions, range from 2.5 to 5.9. The variation in both net present value and cost–benefit ratio relates to the length of the assessment period reflecting the effectiveness of the base case. The period between year 15 and year 30 would produce high road-user time savings for the proposal case in comparison with the base case, resulting in an increased cost–benefit ratio.

Table 19.2: Measures of economic worth of the Tugun Bypass

Scenario	Net present value ($ million 2003)	Cost–benefit ratio
A	467	2.5
B	1,640	5.9

19.3.4 Sensitivity analysis

The overall sensitivity of the findings has been tested by changing two of the main input parameters. Table 19.3 shows the impacts of changing the discount rate, and Table 19.4 the impacts of changes to capital costs of the proposal for each of the scenarios.

The results of the sensitivity tests show that the proposal is robust and would continue to generate a surplus of benefit over cost even if the most significant components of the assessment are revalued.

Table 19.3: Impacts of changes in discount rates on net present value and cost–benefit ratio ($million 2003)

Scenario	Discount rate		
	4%	6%	8%
Net present value			
A	615	467	349
B	2422	1,640	1,122
Cost–benefit ratio			
A	2.9	2.5	2.1
B	8.0	5.9	4.5

Table 19.4: Impacts of changes in capital costs on net present value and cost-benefit ratio

Scenario	Change in capital cost	Net present value ($million 2003)	Cost-benefit ratio
A	Increase 10%	433	2.2
	Increase 25%	382	1.9
B	Increase 10%	1606	5.4
	Increase 25%	1,555	4.7

19.4 Conclusions

There are many impacts that are not amenable to assessment in economic terms. Since most of these cannot be expressed in monetary terms, they cannot be reliably ranked in relation to the defined economic impacts. Nevertheless, the results of the economic analysis indicate that a net economic benefit would still be achieved even if unquantified environmental and other adverse impacts attracted a total cost ranging exceeding $400 million in discounted present values. In fact, the unquantified impacts include both the beneficial and adverse effects of the proposed Tugun Bypass.

The proposal would be an economically sound use of resources. The Tugun Bypass would generate positive net present values in all the scenarios tested. Positive values are also maintained at all discount rates and variations in capital costs investigated.

20. Environmental sustainability

20.1 Objectives

Environmental and planning legislation, together with many Commonwealth, state and local government policy documents, provide objectives for the appropriate environmental outcomes of proposals. These guidelines generally reflect the four principles of ecologically sustainable development:

- the precautionary principle
- intergenerational equity
- conservation of biological diversity and ecological integrity
- improved valuation, pricing and incentive mechanisms.

The principles of ecologically sustainable development have been an integral part of the route selection process, the development of the concept design, environmental assessment of potential impacts and the development of environmental mitigation and management measures. This chapter provides a detailed summary of how the principles of ecologically sustainable development have been applied to the Tugun Bypass proposal.

20.2 Achievement of the environmental sustainability objectives

20.2.1 The precautionary principle

The precautionary principle deals with certainty in decision making. It requires that planning for the bypass adopts best practice environmental assessment techniques, and the proposal adopts best practice environmental goals, standards and measures to minimise the risks associated with potential threats of environmental damage.

The precautionary principle has been applied through the whole process in that route identification and selection, and environmental assessment has relied on the best available technical information. The use of best available technical information coupled with best-practice environmental standards, goals and measures have also been relied on in the development of mitigation measures to minimise the risks associated with threats of environmental damage. In addition, the surveys and studies for this assessment have been derived from consultations with authorities and other stakeholders. In many cases, worse-case assumptions have been used. Local anecdotal information has also been acknowledged to ensure that local conditions are understood.

In particular, the precautionary principle has been incorporated into the route selection and environmental assessment through:

- detailed assessment of strategic alternatives to the Tugun Bypass proposal
- detailed assessment of the risk-weighted consequences of various options for the design of the Tugun Bypass
- identification and detailed assessment of potential threats of serious or irreversible damage

- identification and management of potential hazards and risks
- identification of measures to mitigate environmental impacts
- identification of a program and procedures to monitor and audit the environmental outcomes predicted in the EIS.

Despite there being some residual uncertainty and lack of sufficient data in relation to a small number of impacts, mitigation measures have been proposed to offset the impacts. For example, it is not certain if Wallum Sedge Frogs would use the wet/dry culverts designed for them, but they would be included in the bypass design. Monitoring of the study area would continue up to and beyond the construction period until the area becomes stabilised after the opening of the bypass. This would allow new mitigation measures to be introduced and existing measures to be adapted, if required.

20.2.2 Intergenerational equity

The proposal has sought to ensure that the long-term adverse effects of the proposal are minimised so that the future generations are able to have the same or enhanced benefits compared to those enjoyed today. Environmental issues associated with road usage include the generation of greenhouse gases, fuel consumption, generation of waste, economic benefits associated with decreased travel times, and improved road safety.

The generation of carbon dioxide is a major contributor to the greenhouse effect. Equipment used for the construction of the bypass would generate exhaust gases including carbon dioxide. These would be offset by the fuel efficiencies that would occur once the bypass is opened. By 2017, 10 years after the bypass opens, 196,000 tonnes of greenhouse gases would be saved from being emitted into the atmosphere.

Through the construction process, the generation of waste would be minimised; where this is not possible, waste would be recycled, reused or disposed of to an approved facility.

The proposal would benefit the community by providing improvements in safety (for pedestrians and cyclists as well as vehicle safety), access and amenity for both existing and future generations.

Future generations would also continue to have access to employment markets, services and recreational opportunities with the construction of the bypass. The improvements in amenity that would occur would also generate new employment prospects as tourism and leisure activities increase.

20.2.3 Conservation of biological diversity and ecological integrity

The environmental values of the study area have had a significant influence on the route selection and design development process. Impacts on the biodiversity of the study area have been avoided as far as possible and mitigated through design development and other measures.

The total footprint for the project covers an area of 79.6 ha, and within this there are 45.2 ha of native vegetation communities that would be removed. Impacts on native vegetation communities have been minimised by realigning the route to avoid areas of native vegetation and utilising areas of cleared land, where possible.

The detailed design phase would see further refinement to the proposal footprint with the width reduced to a minimum to prevent clearing of native vegetation.

Individuals from 10 species of legislative significance would be removed by the proposal. For nine of the species this amounts to only one or two plants requiring relocation. The exception is the Chinese Burr, which would require a large number of individuals to be removed, resulting in a high local impact as the population would be fragmented. However the species is likely to regenerate quickly and a translocation program would be implemented.

Approximately 0.02 ha from the edge of a State Environmental Planning Policy Number 14 wetland would be lost, however the margins of the wetland consist of highly degraded Swamp Oak Woodland and the more sensitive communities are not affected by the proposal.

Management of water quality issues has been integral to the design of the bypass and best practice surface water quality management measures have been included. This would prevent any significant impacts on the Cobaki Broadwater and its fringing wetlands.

Individuals of several threatened fauna species may be directly or indirectly impacted by the proposal. Of these the Wallum Sedge Frog and Common Planigale would be most significantly impacted by the proposal. The Wallum Sedge Frog has a restricted distribution in the wallum heath and sedgelands on the eastern side of the Cobaki Broadwater. The proposal would remove 4.7 ha of its habitat and create a barrier between known breeding ponds. Artificial breeding ponds would be constructed to compensate for the loss of habitat and wet/dry culverts would be installed beneath the bypass to provide connectivity between areas of habitat.

The Common Planigale has been found in a number of areas of the study area, but the greatest concentration is found on Commonwealth Airport land at the southern end of the airport. The proposed bypass would fragment this population. Mitigation is difficult because of the entry/exit ramps to the tunnel in this area. Prior to construction a capture program would be implemented for the Common Planigale and individuals would be relocated to areas of suitable habitat nearby.

The proposal passes along the eastern edge of known Long-nosed Potoroo habitat and requires the removal of 0.5 ha of the habitat. The proposal itself is not considered to be a major threat to the population. However in conjunction with the impacts on the population from other projects and activities in the area the cumulative effects can be considered to be regionally significant. In order to protect the population a number of mitigation measures would be implemented including fencing, fox control selective burning and monitoring of the population.

A compensatory habitat package has been developed to offset the residual impacts on the flora and fauna of the study area. The package is of a similar habitat quality and type to key habitat that would be removed and contains a regionally significant koala population. It also forms a strategically located link connecting habitat around the Cobaki Broadwater. The compensatory habitat package provides an opportunity for the establishment of a continuous area of land having environmental protection around the Cobaki Broadwater.

20.2.4 Improved valuation, pricing and incentive mechanisms

The principle of improved valuation, pricing and incentive mechanisms was adopted for the development of methodologies for this assessment, and would be adopted for the operation of the proposal. While the cost–benefit analysis does not attempt to place a monetary value on the residual, environmental and social effects of the proposal, the cost of measures to mitigate

environmental and social impacts is realised in the environmental planning and construction costs.

The total cost of the Tugun Bypass proposal, including route selection, environmental impact assessment, property acquisition and construction is $360 million. Of the total approximately $27 million would be spent on environmental assessment and environmental works such as landscaping, noise barriers, constructed wetlands and flora and fauna mitigation. Not included in this cost are the additional costs associated with changes to design that have been undertaken as a result of community and environmental concerns. Design changes have included the redesign of the Hidden Valley bridge and a change on construction method to minimise impacts on the ground and realignments to avoid orchids, frog and potoroo populations.

21. Justification

Earlier sections of the EIS have identified the need for the proposal, provided a description of what the bypass would be like, assessed the likely impacts, and provided mitigation measures. This section discusses the justification for the proposal.

21.1 Achievement of proposal objectives

The route selection process set out two objectives that were to be met by the Tugun Bypass. These were:

- a road corridor to separate interstate freight traffic and other interstate traffic from local and tourist traffic along the coast
- a road with a 100 km/h posted speed limit to align with the existing Pacific Motorway 110 km/h speed limit from Brisbane to Nerang, and with the current planned upgrading of the Pacific Highway south to Sydney.

The construction of the bypass along a route to the west of the existing Gold Coast Highway would provide an alternative route for heavy vehicles and separate interstate traffic from local and tourist traffic.

The bypass would provide a motorway-standard link across the NSW–Queensland border with a posted speed of 100 km/h.

The bypass alignment has been designed to accommodate a future rail extension. The rail development would be subject to a separate approvals process if it proceeds. At the same time as the bypass construction a concrete slab will be built over part of the area of the proposed runway extension. If ultimately the railway proceeds then the slab would enable a railway tunnel to be built under the runway without excavating the runway.

21.2 Justification of the proposal

The Tugun Bypass proposal is recognised as being of national importance and is included in the Federal government's *AusLink White Paper* as well as regional transport plans for south- east Queensland. It is also compatible with the objectives of the NSW Pacific Highway Upgrading Program. The network also acts as the primary interstate route between NSW and Queensland, and so is important for the efficient movement of freight around the country.

The traffic and transport studies for this assessment have identified that the local road network at Tugun is currently operating at unacceptable levels in peak periods owing to congestion and delays. With no reasonable alternative route, congestion on the Gold Coast Highway would only increase as demand increases. This would severely impair mobility for both local and regional traffic and directly impact on the economic activity in the region.

The proposed Tugun Bypass, the proposed Banora Point Upgrade and the Brunswick to Yelgun Upgrade would link the current high standard sections of the Pacific Highway, which runs from Ewingsdale in NSW to the Queensland border, to the Pacific Motorway, which runs through to Brisbane.

The proposal's justification stems from economic, environmental and social considerations. Benefits are realised in the form of:

- road-user benefits — savings in vehicle operating costs, travel times and reduced accidents
- community benefits — enhanced amenity for the Tugun and Bilinga communities, improved pedestrian and cycle facilities, and opportunities to provide public transport systems such as dedicated bus lanes and/or light rail
- economic benefits — regional economic benefits from additional economic activity and employment induced by construction, more efficient movement of freight, and an improved local economy through improved accessibility
- environmental benefits — opportunities to protect and manage areas of valuable ecological resource for conservation use.

The construction of the Tugun Bypass would provide an alternative corridor for heavy vehicles and take them away from the residential areas of Tugun and Bilinga. The bypass would also separate interstate traffic from local traffic resulting in lower traffic volumes on the local roads and improved levels of amenity and safety. This would also benefit cyclists and pedestrians. Conflicts between local and through traffic, as is currently the case, would be removed. There would also be significant improvements in amenity, including reduced noise levels, improvements in access and better air quality

Travel times from the border to the Pacific Motorway would be greatly reduced. Modelling of future traffic flows show that significant delays of greater than 30 minutes would be commonplace by 2017 without the bypass; with the bypass, travel times from the border to the Pacific Motorway would be reduced to 5 minutes.

The detailed economic assessment of the Tugun Bypass is presented in Chapter 18, and is based on a 30-year evaluation period. In essence, the savings to the community are $59 million in avoiding accidents and $1,861 million in reduced travel times (these figures are based on net present values). If the bypass were not built, then the $1,920 million in savings becomes the potential cost to the community of not proceeding with the proposal. The cost is also reflected in the continually lower level of service leading to increased frustration among users.

The results of the assessment have shown that the study area can be considered to be of major importance when considering environmental values, and various rare and endangered species are found there. The only formal recognition of the conservation significance of the area is recognition under the Tweed *Local Environmental Plan*, which aims to protect littoral rainforests and wetlands. The compensatory habitat package and the mitigation measures present an opportunity to dedicate a large area of remnant native vegetation to conservation use and significantly improve the ecological management of the area.

The proposed Tugun Bypass would provide the missing link in the interstate highway between Brisbane and Sydney and, by separating through and local movement functions, would result in an improvement in both the safety and efficiency of these movements. The proposed Tugun Bypass provides an appropriate balance between social and biophysical factors and would provide substantial road user economic benefits. Management measures have been proposed to ensure that the identified adverse impacts of the proposal can be mitigated and the environment adequately protected.

References

Albert Shire Council 1995, *Albert Shire Planning Scheme*.

Appleton J. 1993, The Archaeological Investigation of a Shell Midden at Sextons Hill, South of Tweed Heads, North Coast NSW, Final Report: The Analysis and Conclusion, prepared for Ian Hill & Associates.

ARRB Transport Research 1998, Integrated Transport Strategies' Role in Local Government, Proceeding of the 18th AITPM Conference, *Major Events – Traffic and Transport Planning,* Hotel Sofitel, Melbourne, 5-6 June 1997, ARRB Transport Research, Perth.

Australian and New Zealand Environment and Conservation Council (ANZECC) 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* National Water Quality Management Strategy Paper Number 4, Canberra.

Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council 1992, *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites.*

Australian Bureau of Statistics 1996, *Census of Population and Housing,* Canberra.

Australian Bureau of Statistics 2001, C*ensus of Population and Housing*, Canberra.

Australian Network for Plant Conservation Translocation Working Group 1997, *Guidelines for the Translocation of Threatened Plants in Australia,* Australian Network for Plant Conservation, Canberra.

AUSTROADS (formerly NAASRA) 1984, Grade Separated Interchanges – A Design Guide.

AUSTROADS 2003, Rural Road Design, Guide to the Geometric Design of Rural Roads.

Bali, R., Lewis B. and Brown K. 2003, The Status and Distribution of the Cobaki Long-nosed Potoroo Population.

Barz R.K. 1982, Terranora 19: An Estuarine Midden at Tweed Heads NSW, in: *Coastal Archaeology in Eastern Australia,* ed. S. Bowdler, Australian National University, Canberra.

Beaglehole J.C. (ed) 1968, *Cook J. The Voyage of the Endeavour 1768-1771,* Cambridge University Press.

Briggs J. and Leigh J. 1996, *Rare or Threatened Australian Plants*, CSIRO, Canberra.

Burbidge N.T. 1960, The Phytogeography of the Australian Region, *Australian Journal of Botany, 9*: 75-212.

Bureau of Transport and Communications Economics 1995, *Greenhouse Gas Emissions from Australian Transport. Long-Term Projections,* Bureau of Transport and Communications Economics Report 88, Australian Government Publishing Service, Canberra.

Byrne J.J.1945, *Tweed Daily,* December 18 1945, p3.

California Department of Transportation 1989, CALINE-4 – A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways.

Coffey Partners 1995, *South East Queensland Air Emissions Inventory*, Report Number E260/1BB.

Collins J. 1999, Pacific Highway Tugun to Tweed Heads Bypass Route Selection Study: Cultural Heritage Assessment, prepared for Connell Wagner Pty Ltd.

Commonwealth Department of Finance 1991, *Handbook of Benefit – Cost Analysis*.

Commonwealth Department of Transport and Regional Services 2004, *Auslink White Paper.*

CORINAIR 1995, Inventaire des Emissions de Dioxide de Soufre, d'Oxydes d'azote et do Composes Organiques Volatils ans la Communaute Europeane en 1985, Commission Europeane, Luxembourg.

CRC for Catchment Hydrology 1998, Managing Urban Stormwater Using Constructed Wetlands.

Crowley T. 1978, *The Middle Clarence Dialects of the Bandjalang,* Australian Institute of Aboriginal Studies, Canberra.

D.J. Douglas & Partners Pty Ltd 1994, Environmental Investigation, Coolangatta Airport.

Donaldson K and MacNee W. 1996, *The Free Radical Activity of Ultrafine Materials and PM10 as a Factor of their Adverse Health Effects,* discussion paper of the Biomedicine Research Group and Unit of Respiratory Medicine at the University of Edinburgh.

Environment Australia 2000, *Review of Fuel Quality Requirements for Australian Transport*, prepared by Coffey Geosciences.

Fairfull S. and Witheridge G. 2003, Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings.

FRC Environmental 2001, *Tugun Bypass Proposal – Aquatic Flora and Fauna*, prepared for PPK Environment & Infrastructure, Brisbane.

Garnett S.T. and Crowley G.M. 2000, *The Action Plan for Australian Birds,* Environment Australia, Canberra.

German Standard 1986, DIN450 Part 3, Structural Vibration in Buildings – Effect on Structure.

Gold Coast Airport Limited 1999, Coolangatta Airport Environmental Strategy.

Gold Coast Airport Limited 2001, Coolangatta Airport, Final Master Plan.

Gold Coast City Council 1987, *Gold Coast Area Transport Study,* prepared by GHD.

Gold Coast City Council 1990, *Lower Tweed Transportation Study*, prepared by Denis Johnson and Associates.

Gold Coast City Council 1992, Pacific Highway Bypass (West of Coolangatta Airport) Route Determination Study, prepared by GHD.

Gold Coast City Council 1994, City of Gold Coast Planning Scheme.

Gold Coast City Council 1996, Gold Coast Bicycle Network Strategy.

Gold Coast City Council 1998a, *Gold Coast City Activity Centre Strategy*, prepared by Veitch Lister Consulting Pty Ltd.

Gold Coast City Council 1998b, Gold Coast City Transport Plan - Transport Master Plan 1999 to 2030.

Gold Coast City Council 1999, Our Community A Social Profile of the City of Gold Coast.

Gold Coast City Council 2001, Gold Coast Bicycle Network Operational Plan.

Gold Coast City Council 2002, *EMME/2 Model*.

Gold Coast City Council 2003, Draft Living City – Gold Coast Planning Scheme.

Griffith S.1993, *Conservation Status of Coastal Plant Communities,* report to the NSW National Parks and Wildlife Service.

Haglund L.1976, *An Archaeological Analysis of the Broadbeach Burial Ground*, University of Queensland Press: St Lucia.

Hall H. J.1986, 'Exploratory Excavation at Bushrangers Cave Site LA: AII, 6,000 year-old Campsite in Southeastern Queensland: Preliminary Results', *Australian Archaeology*, 22:88–102.

Hall H.J. 1990, An Assessment of Aboriginal Sites at the Coolangatta Airport, report to Gutteridge Haskin and Davey.

Hero J.M. Phillips S. and Shoo L. 2000, *Survey for Reptiles, Amphibians and Mammals Inhabiting Coastal Lowland Areas Associated with the Proposed Tugun Bypass*, Final Report, prepared for Queensland Department of Main Roads, revised August 2001.

Hero J.M. Phillips S. and Shoo L. 2001a, *Survey for Reptiles, Amphibians and Mammals Inhabiting the Northern Section of the Proposed Tugun Bypass,* Final Report, prepared for PPK Environment & Infrastructure, Brisbane, revised August 2001.

Hero J.M. Phillips S. and Shoo L. 2001b, *Surveys of Planigales, Eastern Long-eared Bat and Wallum Sedge Frogs within the Proposed Tugun Bypass,* Final Reports, prepared for PPK Environment & Infrastructure, Brisbane, revised August 2001.

Hero J.M., Shoo L. and Phillips S. 2001c, *Amelioration and Monitoring Measures for the Conservation of Herpetofauna Along the Proposed Tugun Bypass*, Additional Report, prepared for PPK Environment & Infrastructure, Brisbane, August.

Holmes 1997, *Air Quality Monitoring Program,* NSW Roads and Traffic Authority.

Holmes K.T., Holmes N.W. and Jones R. 1998, *Generic Monitoring Studies to Provide a Database for Assessing Roadway Impacts,* 14th International Conference of the Clean Air Society of Australia and New Zealand, Melbourne.

Horsman M.J.1995, Patterns of Settlement: Development and Land Usage: Currumbin Valley 1852-1915, Unpublished M.A. Thesis, St Lucia.

Ingram G. 2004, *Review of Mitigation Measures: Wallum Sedge Frog: Proposed Tugun Bypass,* report prepared for Parsons Brinckerhoff Australia by Biodiversity Assessment and Management Pty Ltd.

Kingston M.B., Turnbull P.W., Hall P.W., Boulton S.C. and Storey R.J. 1999, *Tweed Vegetation Management Plan,* Volume 1, prepared for Tweed Shire Council.

Kroes E., Daly A., Gunn H. and van der Hoom T. 1996, The Opening of the Amsterdam Ring Road, *Transportation,* 23:71-82.

Leda Manorstead 1999, Cobaki Lakes Master Plan.

Lewis B. 2004, *Systematic Surveys for the Coastal Planigale* (Planigale maculate) *on Crown Land and a Detailed Habitat Appraisal of the Tugun/Cobaki Locality,* report prepared for Parsons Brinckerhoff (Brisbane) and Department of Main Roads (Nerang) by Lewis Ecological Surveys.

Lilley I. 1987, *Cobaki Village Archaeological Assessment,* prepared for Cameron MacNamara Pty Ltd.

Longhurst R. 1992, *Taming A Plateau – A History of the Beechmont District,* compiled and edited by Robert Longhurst, Beechmont Centenary Association.

Longhurst R.1996, From Tallebudgera to the Tweed,- An Early History of the Southern Gold Coast, Gold Coast City Council.

Lower Tweed River Historical Society 1990, *The Log Book Journal of the Lower Tweed River Historical Society,* Issue April/June Number 11.

Marchant S. and Higgins P.J. 1993, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 2: Raptois to Lapwings, Oxford University Press, Melbourne.

National Environment Protection Council 1998, National Environment Protection Measure for Ambient Air Quality.

National Greenhouse Gas Inventory Committee 1998, National Greenhouse Gas Inventory Workbook for Energy.

NOREDO, NOROCO and NSW Department of Planning 1998, *Northern Rivers Regional Strategy*, Final Report of Phase One.

NSW Department of Land and Water Conservation, 1:25,000 Acid Sulphate Soil Risk Maps for Tweed Heads (9641 S4) and Bilambil (9541 S1).

NSW Landcom 2004, *Managing Urban Stormwater: Soils and Construction,* 3rd Edition, Sydney.

NSW Department of Land and Water Conservation 1998, *The Constructed Wetlands Manual*.

NSW Department of Planning 1985, State Environmental Planning Policy Number 14 – Coastal Wetlands.

NSW Department of Planning 1988, North Coast Regional Environmental Plan.

NSW Department of Planning 1989, Hazardous Industry Planning Advisory Paper Number 3 - Risk Assessment.

NSW Department of Planning 1990, Hazardous Industry Planning Advisory Paper Number 4 - Risk Criteria for Land Use Safety Planning.

NSW Department of Planning 1992, State Environment and Planning Policy Number 33 - Hazardous and Offensive Development, NSW Government.

NSW Department of Planning 1995a, State Environmental Planning Policy Number 44 - Koala Habitat Protection, NSW Government.

NSW Department of Planning 1995b, North Coast Urban Development Strategy.

NSW Department of Planning 1995c, North Coast Urban Planning Strategy, Into the 21st Century.

NSW Department of Planning 1996, *EIS Guidelines-Roads and Related Facilities*, NSW Department of Planning, Sydney.

NSW Department of Public Works 1990, *Tweed Entrance Feasibility Report: Environmental Consideration of Options,* draft report prepared by Environmental Management Pty Ltd, WS Rooney & Associates and Glen Holmes & Associates.

NSW Department of Public Works 1991, *Lower Tweed Estuary River Management Plan. Technical Summary,* Report Number 91053 prepared by PWD.

NSW Department of Transport 1998, Action for Transport 2010 – An Integrated Transport Plan for NSW.

NSW Environment Protection Authority 1994, *Environmental Noise Control Manual*, 94/31.

NSW Environment Protection Authority 1995a, Contaminated Sites: *Guidelines for Consultants Reporting on Contaminated Sites.*

NSW Environment Protection Authority 1995b, Contaminated Sites Sampling Design Guidelines.

NSW Environment Protection Authority 1997, *State of Environment Report*, NSW Environment Protection Authority, Sydney.

NSW Environment Protection Authority 1998, *Action for Air,* NSW Environment Protection Authority 98/16, Air Policy Section, Chatswood.

NSW Environment Protection Authority 1999, *Environmental Criteria for Road Traffic Noise*, 99/3.

NSW Environment Protection Authority 2000, *NSW Industrial Noise Policy,* NSW Environment Protection Authority00/1.

NSW Fisheries 1999, Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures (Eds. S Faithful and S Carter).

NSW Government 1998, Environmental Management System Guidelines.

NSW National Parks and Wildlife Service 1998, *Policy for the Translocation of Threatened Fauna in NSW*, National Parks and Wildlife Service, Threatened Species Management Information Circular Number 6, Sydney.

NSW Roads and Traffic Authority 1988, *Road Design Guide*, Road Technology Branch.

NSW Roads and Traffic Authority 1992, *North Coast Road Strategy*, Sydney, December.

NSW Roads and Traffic Authority 1997, Upgrading the Pacific Highway: Ten Year Pacific Highway Reconstruction Program, Discussion Paper, Sydney.

NSW Roads and Traffic Authority 1998, Community Involvement Practice Notes and Resources Manual.

NSW Roads and Traffic Authority 1999, *Beyond the Pavement*.: RTA Urban and Regional Design Practice Notes.

NSW Roads and Traffic Authority 1999, *Economic Analysis Manual.*

NSW Roads and Traffic Authority 2001, Environmental Noise Management Manual.

NSW State Rail Authority and Queensland Railways 1991, Coastal Rail Connection, Sydney – Brisbane, Rail Corridor Study, Robina – Murwillumbah, prepared by GHD.

NSW Treasury 1997, NSW Government Guidelines for Economic Appraisal.

O'Connor R. 1997, The Kombumerri - Aboriginal People of the Gold Coast, Rory O'Connor, Queensland.

Parker P. 1999, Cobaki Lakes Project Development Application Number 2 – Parcels 11-21 Inclusive: Species Impact Statement, prepared for Leda Manorstead Pty Ltd.

Parsons Brinckerhoff 2003, Robina to Tugun Rail Impact Assessment Study Part A: Robina Station to Stewart Road, Queensland Transport.

Parsons Brinckerhoff 2004, *Assessment of Former Landfill Sites,* Gold Coast Airport.

Pearman G.I. 1999, *Progress in Climate Science and its Role in Greenhouse Policy,* Australian Institute of Engineers National Conference.

Pease B.C. and Grinberg A. 1995, *NSW Commercial Fisheries Statistics 1940 to 1992*, NSW Fisheries.

Phillips S. and Callaghan J. 1995, 'The Spot Assessment Technique for Determining the Significance of Habitat Utilisation by Koalas' in: *Proceedings of a Conference on the Status of the Koala in 1995,* Australian Koala Foundation, Brisbane.

Piper A. 1994, An Archaeological Assessment in Relation to an Upper Tweed River Management Plan, Part 1, Barneys Point Bridge-North, report to the NSW Public Works Department.

Queensland Department of Main Roads 1997a, *Roads Landscape Manual*.

Queensland Department of Main Roads 1997b, *Road Project Environmental Management Processes Manual*, Technology and Environment Division.

Queensland Department of Main Roads 1999a, Cost Benefit Analysis Manual for Road Infrastructure Investment.

Queensland Department of Main Roads 1999b, *Pacific Highway at Tugun - Route Selection Report*, prepared by Connell Wagner.

Queensland Department of Main Roads 1999c, Public Consultation Policy, Standards and Guidelines.

Queensland Department of Main Roads 1999d, Standard Specification for Environmental Management (MRS11.51).

Queensland Department of Main Roads 2000, Road Traffic Noise Management – Code of Practice.

Queensland Department of Main Roads 2001, *Road Planning and Design Manual*.

Queensland Department of Main Roads 2002, Tugun Bypass Stage 1 Environmental Impact Assessment.

Queensland Environmental Protection Agency 1999, A Strategy for Improving Air Quality in South East Queensland

Queensland Environmental Protection Agency 1998, Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland.

Queensland government 1998, South East Queensland Regional Framework for Growth Management.

Queensland Transport 1992, South East Queensland Household Travel Survey.

Queensland Transport 1995, Investigation of the Proposed Rail Connection, Robina – Coolangatta, prepared by GHD.

Queensland Transport 1996, South East Queensland Freight Study.

Queensland Transport 1997a, Integrated Regional Transport Plan for South East Queensland.

Queensland Transport 1997b, *Southern Gold Coast – Tweed Corridor Study, Needs Paper*, prepared by Connell Wagner.

Queensland Transport 1998a, *Southern Gold Coast – Tweed Corridor Study*, Final Report, prepared by Connell Wagner.

Queensland Transport 1998b, Southern Gold Coast – Tweed Corridor Study – Land Use and Transport Study.

Queensland Transport 2001a, Transport 2007 - *An Action Plan for South East Queensland*.

Queensland Transport 2001b, Queensland Transport Road Crash Database.

Queensland Treasury 1997, Project Evaluation Guidelines.

Reeves D. 2001, *Survey for the Giant Dragonflies,* Petalura gigantea *and* Petalura litarea *and the Swordgrass Brown Butterfly* Tisiphone abecona morrisi, prepared for PPK Environment & Infrastructure, Brisbane.

Richard Heggie Associates 2000, *Cross City Tunnel Noise and Vibration*, Technical Paper.

Sandpiper Ecological Surveys 2001a, *Assessment of the Impact of the Proposed Tugun Bypass.: Terrestrial and Estuarine Birds*, prepared for Queensland Department of Main Roads.

Sandpiper Ecological Surveys 2001b, *Tugun Bypass Assessment of Impacts on Birds: Boyd Street Interchange to Stewart Road,* prepared for PPK Environment & Infrastructure, Brisbane.

Scotts D. 2000, Key Habitats and Corridors for Fauna as a Framework for Regional Biodiversity Conservation Planning in North-east NSW, Conference. Royal Australian Planners Institute (North-eastern NSW Branch), Coffs Harbour, NSW.

Seaton A. Macnee W. Donaldson K. and Godden D. 1995, Particulate Air Pollution and Health Effects. *Lancet,* 345:176-8.

Seinfeld J.H. and Pandis S,N. 1998, *Atmospheric Chemistry and Physics*, John Wiley, New York.

Sharpe M. 1998, *Dictionary of Yugamebeh, Including Neighbouring Dialects,* Australian National University, Canberra, Pacific Linguistics Series C-139.

Spiller Gibbins Swan 2001, *Coolangatta Airport Enterprise Park Feasibility Study*, Tweed Economic Development Corporation.

Standing Advisory Committee on Trunk Road Assessment 1994, *Trunk Roads and the Generation of Traffic and Government Response,* Department of Environment, Transport and the Regions, London.

Standing Advisory Committee on Trunk Road Assessment 1999, *Transport and the Economy,* Department of the Environment, Transport and the Regions, London.

Standards Australia 1981, AS 2436: Guide to Noise Control on Construction, Maintenance and Demolition Sites.

Standards Australia 1989, AS 3671: Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction.

Standards Australia 1990, AS 2670.2: Evaluation of Human Exposure to Whole Body Vibration – Continuous and Shock Induced Vibration in Buildings.

Standards Australia 1999, AS/NZS 4360: *Risk Management*.

Standards Australia 2000, AS 2012: Acoustics – Aircraft Noise Intrusion – Building Siting and Construction.

Stanisic J. 2001, *Survey for the Land Snail* Thersites mitchellae *Proposed Tugun Bypass Route,* prepared for PPK Environment & Infrastructure, Brisbane.

Stewart A.C., Pengilley M.R., Brian R., Haley J.J. and Mowle M.G. 1982, Motor Vehicle Emissions into the Sydney Air Basin, in Carras J.N. and Johnson G.M. (eds), *The Urban Atmosphere – Sydney, A Case Study*, proceedings of a conference organised by the CSIRO Division of Fossil Fuels, Leura, 5-6 May.

Stone Y., Ahern, C.R. and Blunden B. 1998, *Acid Sulfate Soil Manual,* NSW Acid Sulfate Soil Management Advisory Committee.

Streeton J.A. 1997, *A Review of Existing Health Data on Six Air Pollutants,* prepared for the National Environment Protection Council.

Tweed Shire Council 1987, *Local Environmental Plan*.

Tweed Shire Council 1995a, Development Control Plan Number 17, Cobaki Lakes.

Tweed Shire Council 1995b, *Tweed Bicycle Plan*.

Tweed Shire Council 1996, Tweed Shire 2000+ Strategic Plan.

Tweed Shire Council 1997, Lower Tweed River Transportation Study.

Tweed Shire Council 1999a, Section 94 Constraints Plan 22 – Cycleways.

Tweed Shire Council 1999b, Tweed Native Vegetation Plan.

Tweed Shire Council 2000a, *Potential Industrial Land Investigation in Tweed Shire*, Corporate Research Office, Strategic Planning Unit, Tweed Shire Council.

Tweed Shire Council 2000b, Tweed Local Environmental Plan 2000.

UK Department of Transport (Welsh Office) 1988, *Calculation of Road Traffic Noise* (CoRTN), HMSO, London.

United States Environmental Protection Agency 1991, *Volatile Organic Compounds from Ou-Road Vehicles,* Washington DC.

United States Environmental Protection Agency 2001, *Code of Federal Regulations – Title 40 – Protection of the Environment*, Volume 14, Part 87.

Walsh K.J.E., Jackett D.R. and Hock A.B. 1998, *Global Warming and Sea Level Rise on the Gold Coast*, CSIRO Division of Atmospheric Research and Division of Marine Research, prepared for Gold Coast City Council.

Warren J. 1994, Flora and Fauna Assessment – Phase 1 Residential Development at Cobaki Lakes, prepared for Ray Corporation Pty Ltd.

WBM Oceanics 1991, *Cobaki Development Water Quality Study,* prepared for Calsonic Management Services.

Williams D.F., Carras J.N., Shenouda D., Drummond M.S., and Langgen A.L. 1994, *Traffic Generated Pollution Near Roads and Highways: Models and Measurements*, CSIRO, Coal and Energy Technology, North Ryde.

Legislation

Commonwealth

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 – 1986.

Airports Act 1996.

Airports (Environment Protection) Regulations 1997.

Airports (Protection of Airspace) Regulations 1996.

Australian Heritage Commission Act 1975.

Civil Aviation Act 1988

Civil Aviation Regulations 1998

Endangered Species Protection Act 1992.

Environment Protection and Biodiversity Conservation Act 1999.

Environment Protection (Impact of Proposals) Act 1974.

Environmental Reform (Consequential Provisions) Act 1999.

Native Title Act 1993.

NSW

Aborigines Act 1969.

Aboriginal Land Rights Act 1983.

Crown Lands Act 1989.

Environmental Planning and Assessment Act 1979.

Environmental Planning and Assessment Regulation 1994.

Environmentally Hazardous Chemicals Act 1985.

Fisheries Management Act 1994.

Fisheries Management Amendment Act 1997.

Heritage Act 1977.

Land Acquisition (Just Terms) Compensation Act 1991.

Local Government Act 1993.

National Parks and Wildlife Act 1974.

Native Vegetation Conservation Act 1997.

Noxious Weeds Act 1993.

Protection of the Environment Operations Act 1997.

Roads Act 1993.

Threatened Species Conservation Act 1995.

Waste Minimisation and Management Act 1995.

Water Management Act 2000.

Water Management (General) Regulation 2004

Queensland

Aboriginal Cultural Heritage Act 2003

Agricultural Chemical Distribution Control Act 1966.

Cultural Record (Landscapes Queensland and Queensland Estate) Act 1987.

Environmental Protection Act 1994.

Environment Protection (Air) Policy 1997.

Environmental Protection (Noise) Policy 1997.

Environmental Protection Regulation 1998.

Explosives Act 1999.

Integrated Planning Act 1997.

Land Act 1994.

Nature Conservation Act 1992.

Nature Conservation (Wildlife) Regulation 1994.

Queensland Heritage Act 1992.

State Development and Public Works Organisation Act 1971.

Transport Infrastructure Act 1994.

Transport Operations (Road Use Management – Dangerous Goods) Regulation 1998.

Vegetation Management Act 1999.

Vegetation Management Regulation 2000.

Appendix A

Guidelines for an environmental impact statement on the proposed Tugun Bypass

Director-General's requirements

GUIDELINES

FOR AN ENVIRONMENTAL IMPACT STATEMENT

ON THE PROPOSED TUGUN BYPASS

November 2004

Environment Protection and Biodiversity Conservation Act 1999 (C'th)
Airports Act 1996 (C'th)
Environment Planning and Assessment Act 1979 (NSW)
Threatened Species Conservation Act 1995 (NSW)
Transport Infrastructure Act 1994 (Qld)

GUIDELINES FOR AN ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED TUGUN BYPASS

A INTRODUCTION

1 Background

The Queensland and New South Wales governments are seeking approval to construct and operate a new motorway between Currumbin in Queensland and Tweed Heads in NSW, with provision for possible future rail link.

The proposed motorway, referred to as the Tugun Bypass, will be approximately 6.5km in length, extending from the Pacific Motorway at Stewart Road, Currumbin to join the existing Pacific Highway on Tweed Heads Bypass, just north of Kennedy Drive. The Bypass traverses the Gold Coast Airport to the west of the main runway and passes under the proposed runway extension through a tunnel. A preferred alignment has been delineated but environmental assessment of the proposal is based on a 2km wide corridor.

The proposed bypass would involve the construction and operation of a four-lane restricted-access motorway with a central median to separate north-south traffic flows at a posted speed of 100 km/h. The median would be wide enough to allow future upgrading to six lanes. A grade separated interchange would be provided at the Tweed Heads Bypass in NSW and connect to the Stewart Road interchange at Currumbin in Queensland. These would provide for all movements and provide connections to the local road network.

At the southern end of the bypass, the proposed alignment crosses an area covered by the obstacle limitation surface (OLS) of the Gold Coast Airport. OLS's ensure a required level of safety for the operation of the airport and no structure is permitted to intrude into this area. A tunnel would be provided to comply with this requirement.

The need to provide for a future Queensland gauge rail link to the Airport Terminal was a consideration in delineating the proposed alignment, however, the proposed future construction and operation of a rail link is a separate action, except for protection works beneath the proposed runway extension to allow a rail tunnel to be constructed in the future without disturbing the runway. No date has been set and no funding has been allocated at this stage for development of the rail link. Gold Coast Airport is Commonwealth property currently leased to Gold Coast Airport Limited (GCAL).

The proposed bypass requires approval under the following legislation:

Environment Protection and Biodiversity Conservation Act 1999 (C'th)
On 11 August 2003 the Minister's delegate determined that approval was required for the proposed action (EPBC 2003/1122). The controlling provisions are:

- sections 18 and 18A (Listed threatened species and communities).
- sections 26 and 27A (Protection of the environment from actions involving Commonwealth land).

Airports Act 1996 (C'th)
The proposal may require approval of a major development plan by the Australian Minister for Transport and Regional Services under the Airports Act 1996 for that portion on Commonwealth land leased by GCAL. Under Section 160 of the *Environment Protection and Biodiversity Conservation Act 1999*, the Minister must obtain and consider advice from the Minister for the Environment and Heritage before deciding whether to approve the major development plan.

Environment Planning and Assessment Act 1979 (NSW)
It is expected that the EIS will be assessed under Part 5 of the NSW *Environment Planning and Assessment Act 1979*. An amendment to State Environmental Planning Policy No 63, Major Transport Projects, is required to enable that assessment. As an EIS is being prepared by the NSW Roads and Traffic Authority (jointly with the Queensland Department of Main Roads) as both the Proponent and Determining Authority, approval of the Minister for Infrastructure and Planning is required in accordance with Division 4 Part 5 of the Act.

Where it is found that there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, a Species Impact Statement (SIS) must be prepared and concurrence obtained from the Director-General of the Department of Environment and Conservation. While these guidelines summarise the information required in a SIS, detailed requirements are set out in the Director-General's Requirements issued by the NSW Department of Environment and Conservation.

Transport Infrastructure Act 1994 (Qld)
The Queensland Minister for Transport and Main Roads has decided that the Queensland section of the bypass will be constructed, maintained and operated under Section 29 of the *Transport Infrastructure Act 1994.* This means that approval is required from the Director-General of the Queensland Department of Main Roads following an environmental impact assessment of the proposal by the Department.

To meet these approvals, the EIS should be written to meet the requirements for:
- an EIS under the *Environment Protection and Biodiversity Conservation Act 1999 (C'th)*
- an EIS under the *Environment Planning and Assessment Act 1979 (NSW)*
- a Species Impact Statement (SIS) under the *Threatened Species Conservation Act 1995 (NSW)*
- environmental impact assessment under the *Transport Infrastructure Act 1994 (Qld)*

The EIS will also be written to support the environmental assessment of a major development plan under the *Airports Act 1996 (C'th).* The major development plan will form a separate document. The SIS will be written as a stand-alone document but will form a separate volume within the EIS.

2 General content, format and style

The EIS should be a stand- alone document. It should contain sufficient information about any relevant studies or investigations to avoid the need to search out previous or supplementary reports.

The EIS should enable interested stakeholders and the assessing agencies to understand the consequences of the proposed development. Information provided in the EIS should be objective, clear, succinct and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The body of the EIS is to be written in a clear and concise style that is easily understood by the general reader. Technical jargon should be avoided wherever possible and a

full glossary should be included. Cross-referencing should be used to avoid the unnecessary duplication of text.

Detailed technical information, studies or investigations necessary to support the main body of text should be included as appendices to the EIS. Any additional supporting documentation and studies, reports or literature not normally available to the public from which information has been extracted, should be made available at appropriate locations during the period of public display of the EIS.

Where information is given in the EIS, the source of the information, how recent the information is, how the reliability of the information was tested, and the uncertainties (if any) in the information should all be stated.

If it is necessary to make use of material that is considered to be of a confidential nature the proponent may request that such information remain confidential and not be included in any publicly available document.

The EIS should state the criteria adopted in assessing the relevant aspects of the proposal and its impacts - such as, compliance with relevant legislation, policies and standards; community acceptance; or the maximisation of benefits or minimisation of risks.

The level of analysis and detail in the EIS should reflect the level of significance attached to the expected potential impacts. Priority should be given to major issues associated with the proposal and matters of lesser concern should be dealt with only to the extent required to demonstrate that they have been considered. Any and all unknown variables or assumptions made in the assessment must be clearly stated and discussed. The extent to which the limitations, if any, of available information may influence the conclusions of the assessment should also be discussed.

The EIS should be written so that any conclusions reached can be independently assessed. To this end all sources must be appropriately referenced using the Harvard standard.

The main text of the EIS should include a list of abbreviations, a glossary of terms and appendices containing:

. a copy of these guidelines;
. a list of persons and agencies consulted during the preparation of the EIS;
. contact details for the referral agency; and
. the names of, and work done by, the persons involved in preparing the EIS.

Maps, diagrams and other illustrative material should be included in the EIS. The EIS should be produced on A4 size paper capable of being photocopied, with maps and diagrams of A4 or A3 size. The EIS should also be made available on a CD-ROM.

Information about species listed under the EPBC Act should be provided in electronic format to DEH when the finalised EIS is submitted. The provision of this information will help facilitate decision-making under the EPBC Act and assist in the protection and recovery of species and communities. Guidance to the proponent about standards and formats for the data is provided at Attachment 1.

B CONTENTS OF THE EIS

A detailed table of contents will be necessary showing all headings

1 Executive Summary

The Executive Summary is to include a brief outline of each Chapter within the EIS via text and dot point. It is recommended that the Executive Summary is written as a stand-alone document, able to be reproduced on request for interested parties who may not wish to read or purchase the EIS as a whole.

The summary should be a concise outline of the matters discussed in the main body of the document, to allow the reader to quickly obtain a clear understanding of the proposal, its environmental implications and management objectives. The summary should include:

- the title of the proposal;
- the name and address of the proponent and the person taking the action;
- a brief description of the background to and need for the proposal (including a discussion on alternatives and reasons for selecting the alignment);
- a brief description of the proposal (location, context in the region and existing environment);
- a description of the principal environmental impacts (both adverse and beneficial); and
- a statement of the environmental management principles and monitoring procedures proposed.

2 Introduction

The main body of the EIS should be introduced with:

- a clear definition of the objectives of the proposal;
- a description of the proposed transport corridor, preferred bypass alignment and regional setting (including surrounding tenure and land use and the interrelationship between the road and rail corridor);
- an explanation of the scope, aim and legislative basis for the EIS (including a brief outline of the reason for joint Qld, NSW and Commonwealth assessment and the role of the EIS in the governments' decision-making process);
- a description of the studies/surveys/consultations conducted in developing the proposal and preparing the EIS (results of studies and detailed comments resulting from the consultation should be included as appendices);
- priority environmental and management issues;
- authority, responsibilities and implementation of the EIS; and
- a brief explanation of the structure of the document;

3 Background and Need for Proposal

The EIS should discuss the background to the proposal, and provide a comprehensive explanation of the need for, and justification of, the proposal. This should include the following:

3.1 Planning and Strategic issues

The EIS should:

- identify land use and planning instruments (local, regional, State and Commonwealth) and policies relevant to areas affected by, and adjoining, the proposal including:
  - an assessment of the proposal's compatibility with those land uses and instruments;
  - details of any environmental assessment of the proposed action that has been, or is being, carried out under the scheme, plan or policy;
  - how the instruments provide for the prevention, minimisation and management of any relevant impacts;
- analyse the proposal's interaction with local and regional planning aims and strategic implications for population growth and future urban expansion and identify potential land use conflicts
- describe how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action
- identify and assess direct and indirect property impacts. Details should be provided for any land which may require acquisition or an easement
- identify and assess direct and indirect impacts upon Crown Land including a review of any Native Title claims
- describe the objectives of the proposal including predicted traffic volumes on the new road and effects on traffic volumes through Tugun, Coolangatta and Tweed City and on the Pacific Highway
- consider the cumulative impacts of the proposal with other local and regional road and rail projects including proposals to upgrade the Pacific Highway, and
- discuss broad indicators of sustainability such as reduced car mode journeys, reduced car travel distance, reduced air pollution and reduced energy consumption.

3.2 Approvals

The EIS should

- describe any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;
- describe other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action and how these requirements will be met;

3.3 Alternatives to taking the action

The EIS should include an analysis to the extent reasonably practicable of any feasible alternatives to the proposal including:

- identifying the alternatives considered, including doing nothing, alignment and design standard options, demand management and traffic management and combinations of these
- identifying alternative interchange arrangements between the Bypass and the Pacific Highway in NSW
- evaluating the alternatives against community, environmental and economic considerations, including a comparative description of the impacts of each alternative on the matters protected by the controlling provisions of the *Environment Protection and Biodiversity Conservation Act 1999*
- providing sufficient detail to make clear why any alignment is preferred to another.

The alternatives discussion should include a separate section on the comparative evaluation of the options referenced as options "B4" (wholly within Queensland) and "C4". The discussion should also include a detailed explanation of the environmental, economic and social constraints that have determined the preferred alignment within the C4 corridor.

4 The Proposal

All components of the proposal (including infrastructure requirements, engineering requirements, management, maintenance) should be described in detail under 'construction' and 'operation' of the bypass. The description should be based on the preferred alignment for the Bypass within the proposed corridor but should indicate any significant changes to construction techniques that would be required should a different alignment be used.

Emphasis should be given to those components with the most potential for significant short and long term environmental impacts. Where appropriate, the text should be supported by maps, figures, diagrams and tables. Detailed technical information should be included in the appendices. Underlying assumptions and forecast reliability should also be discussed.

The description of the proposal should include, but not be restricted to:

- the preferred location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts, including locations and use of ancillary facilities such as works compounds and batch plants
- a description of construction methods including:
  - road construction techniques;
  - spoil management and the source of construction materials including fill and road pavement materials; and
  - methods of crossing and constructing within or over waterways and wetlands.
- description of operational and infrastructure requirements (such as the road network, bridge, causeways, emergency facilities, power);
- description of the physical requirements for construction (types, quantities, sources and availability of construction materials such as water, aggregate, cement, fabrication products);
- construction program and management by phases/project/package, including:
  - sourcing and transport of construction materials
  - extent of vegetation clearance, site preparatory works, earthmoving, building, demolition / relocation
  - construction standards, techniques, site management and supervision (including on-site storage and handling of materials)
  - resultant construction wastes and disposal methods
  - arrangements for prevention of soil erosion, soil conservation measures and rehabilitation including the management of Acid Sulfate Soils
  - construction procedures for river/creek crossings
  - identification of partial or complete road closures and their duration. Traffic and access management methods for closures should be outlined
  - identification of the temporary use of public reserves including the area occupied and duration of occupation
- a description of facilities for cyclists and pedestrians

5 Existing Environment

A description of the existing environment within the Tugun Bypass proposed corridor and associated areas is required to serve as a baseline against which impacts and management of the proposal and alternatives can be assessed. The extent of the discussion and description should be guided by the need to fully explain the environment in terms of expected and potential impacts and the identification and implementation of management plans.

All field studies should be carried out using appropriate scientific practices and standards (including statistically sound methods).

5.1 Aspects of the physical environment:

- relevant climate and atmospheric conditions (precipitation, evaporation, wind, temperature, seasonal variability, flooding)
- geology, topography, geomorphology, relevant soil characteristics (erodibility, compaction, potential and actual acid sulfate soils etc)
- hydrology (surface and groundwater systems, catchment and drainage regime, flow and discharge rates, water quality)
- existing noise levels
- past and present land use and land access
- site contamination

5.2 Aspects of the biological environment (including coastal and tidal areas):

Conduct baseline surveys, and consult relevant databases and listings by scientific committees established under the Queensland *Nature Conservation Act 1992*, NSW *Threatened Species Conservation Act 1995*, the NSW *Fisheries Management Act 1997* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Surveys for listed threatened species must be conducted by recognised scientific experts and in accordance with best field survey practice and analysis standards. The surveys should reflect seasonal variation.

Describe:

- the major habitats, communities and flora / fauna species
- ecological relationships, including the conservation status of species or associations
- other sensitive environments, areas of significance and conservation (breeding sites, seasonal habitats, wetlands etc)
- obligations/listings under Territory, national and international registers, conventions or agreements
- level of vegetation clearance/disturbance
- feral animals/vermin and weeds/plant pathogens
- aquatic and estuarine environment (potential impacts on Cobaki Broadwater)

Prepare a list of species and vegetation communities that were recorded in the study area. Also identify which threatened species, populations and ecological communities are likely to occur based on the presence of suitable habitat and/or previous sightings.

Evaluate the likely significance at a regional, State and national level of any populations of threatened species and, for areas under NSW jurisdiction, apply an Assessment of Significance (under section 5A of the NSW *Environment Planning and Assessment Act 1979*) to each threatened species, population or ecological community, or their habitats, that may be affected by the proposal. The EIS must justify any decision to not apply this test to all of the threatened species, populations or ecological communities identified.

If recovery plans for identified listed threatened species exist, relevant information such as known threatening processes should be included.

Where the proposal affects NSW SEPP 14 – Coastal Wetlands, identify the wetland habitats including:

- a vegetation survey map (preferably at a scale of 1:4000) to indicate any rare or threatened plant species
- an assessment of the conservation status of each mapped wetland vegetation community including their conservation status within the State's reserve system
- adjoining wetland habitats (including those not mapped under SEPP 14)
- the extent of any weed infestation
- a fauna survey describing the fish, birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) etc. of the area and the occurrence of any rare or threatened and protected species
- a description of surface and groundwater quality and the hydrologic regime

5.3 Aspects of the cultural environment:

Describe:

- areas nominated for listing and listed in the Register of the National Estate
- archaeological and heritage places and objects under relevant legislation
- areas with special values (eg. landscape/visual environment, historic heritage value, recreational/commercial value, fisheries)
- sites of significance to the Aboriginal population and culture including areas which possess significant cultural/spiritual values to Aboriginal people (which may not be limited to physical occupation or use) and inter-relationships between such sites and values.

5.4 Aspects of the socio-economic environment:

Describe:

- social factors (lifestyle, existing trends, social issues)
- existing and proposed land ownership and uses (including government, health, education, town planning/zoning, service, residential, pastoral, agricultural, tourism, commercial, industrial, recreational, mining, Aboriginal land, commercial and industrial)
- physical infrastructure
- a description of the existing noise environment and identification of sensitive receptors
- assets on Gold Coast Airport that may be impacted by the proposal

This section should also include a clear assessment of what information is known, where information is lacking and what additional studies are planned post EIS to further baseline knowledge and refine impact assessment and predictions, and management plans.

6 Environmental Impacts

The EIS should discuss the proposal in terms of the results of the studies conducted, resource assessment, carrying capacity, ecological integrity and predicted impacts.

The discussion should cover effects on the biophysical and socio-economic environment at the local, regional and national levels as appropriate. The text should reflect the effects during construction and operation. Generally the discussion should use the same descriptors used to describe the existing environment.

Direct, indirect, short-term and long-term, temporary and irreversible, adverse and beneficial effects should be discussed and quantified where possible. This should also include an assessment of the level of significance of the impact and a discussion on cumulative impacts, in particular, those that would result from the construction of the rail corridor. The reliability and validity of forecasts and predictions, confidence limits and margins or error should be indicated as appropriate. Interactions between impacts on the biophysical and socio-economic environments, both individually and collectively, should be covered.

Where mitigation measures are proposed to address any of the described impacts, the following should be provided:

- a description and an assessment of the expected or predicted effectiveness of the mitigation measures;
- any statutory or policy basis for the mitigation measures;
- the cost of the mitigation measures;
- an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;
- the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;
- a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.

Aspects relevant to the environmental assessment include:

- workforce (numbers / timings, infrastructure required, services support, accommodation, work / storage sites, transport routes)
- earthworks, construction, quarries, borrow pits, clearing, soil erosion, compaction, contaminated land, salination and acid sulphate soils
- dust, noise, vibration
- transport, storage and disposal of construction materials and waste
- hydrology (drainage, sediment loads, water table, water quality, flooding)
- conservation and sensitive areas, flora and fauna
- cultural heritage, archaeology
- feral animals and weeds
- aesthetics
- fires
- accidents, emergencies, pollution spills (materials, fuel, oil, waste)
- dangerous goods transport, storage and disposal
- local, regional communities (social, infrastructure, services, employment, recreation, economic regime)

- public access (private and commercial)
- road transport

The following issues need to be addressed in the assessment:

Flora and fauna
The EIS should contain an assessment of impacts to flora and fauna (terrestrial and aquatic), particularly critical habitats, threatened species, populations, ecological communities, and their habitats listed under the Queensland *Nature Conservation Act 1992*, NSW *Threatened Species Conservation Act 1995*, the *Fisheries Management Act 1997* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

This should include an assessment of the implications of these impacts on the regional, State and national conservation status of threatened species and ecological communities. The assessment should involve the following steps:

1. identify any applicable assessment guidelines issued and in force under Section 94A of the *Threatened Species Conservation Act 1995* or, subject to Section 5C of the *Environment Planning and Assessment Act 1979*, and Section 220ZZA of the *Fisheries Management Act 1997*
2. describe the types and condition of habitats in, and adjacent to, the land affected by the proposal
3. describe impacts on any threatened species, populations or ecological communities, or their habitats that are likely to be significantly affected by the proposal. A SIS must be prepared for an threatened species, populations or endangered ecological communities or their habitats where it is found that there is likely to be a significant effect for species in areas under NSW jurisdiction in accordance with any requirements of the Director-General of the Department of Environment and Conservation and/or Director-General of NSW Fisheries.

The assessment should include a full description of any compensatory habitat package developed for loss of flora and fauna habitats as a result of the proposal and how it relates to the species, populations or communities affected. The assessment should also consider the consistency of the proposal with any recovery plans for species or ecological communities approved under the *Nature Conservation Act 1992*, *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1997*and *Environment Protection and Biodiversity Conservation Act 1999*.

SEPP14 Wetlands (NSW)
Discuss the environmental impacts of the proposal including:
- an assessment of changes to plant and animal species composition
- design features that guard against disturbance to vegetation, fauna, water quality and the hydrologic regime
- design measures that address any likely public use impacts expected from the development (e.g. increased litter and gross pollutants)

Describe the measures proposed to offset losses in wetland values or other environmental impacts, such as the preparation of a management plan to maintain or enhance wetlands not affected by the proposal, and

Assess the need to provide compensatory habitat for SEPP 14 wetlands in accordance with the Department of Infrastructure, Planning and Natural Resource's SEPP 14 – Coastal Wetlands – Compensatory Wetlands Policy.

Commonwealth land
The assessment should clearly distinguish any impacts on Commonwealth land. This should include an assessment of the impact of the proposal on the operation of the Gold Coast Airport.

Water quality and hydrology
Water quality and hydrology (surface and groundwater) and flooding should be assessed including:

- measures to avoid or minimise construction and operation impacts on water quality, particularly in the Cobaki Broadwater and associated wetlands
- erosion and sedimentation control including the design and location of sedimentation basins (temporary or permanent) and any associated effects on groundwaters and acid sulfate soil management
- construction and operation effects of the road on surface and groundwater flows including the tunnel and any associated dewatering and re-injection proposals
- the management of acid sulfate soils, with particular reference, as appropriate, to the NSW ASSMAC "Acid Sulfate Soil Manual" (1998) or relevant Queensland requirements, including impacts on aquatic species of increased acidity in waterways
- the need for a licence(s) under the NSW *Water Act 1912* or the *Water Management Act 2000*
- an assessment of any alterations to flooding characteristics, and
- the level of flood protection provided to the tunnel and the effects of flooding on the tunnel.

Traffic and transport
Traffic and transport impacts during construction and operation should be assessed including:

- truck movements during construction and impacts on local roads
- the traffic capacity of the proposal and its ability to cater for predicted growth
- issues associated with the proposed tunnel, including risks and limitations (if any) on dangerous loads, and
- an assessment of facilities for cyclists and pedestrians against NSW policy and practice for provision for cyclists on major roads. Any alternatives to provision for cyclists on the bypass must include a consideration of relative times and safety issues.

Noise and vibration
The EIS should contain a detailed assessment of noise and vibration impacts during construction and operation with reference, as appropriate, to the NSW EPA's *Environmental Criteria for Road Traffic Noise* or relevant Queensland requirements. The assessment should include:

- identification of construction noise and vibration impacts
- identification of operation noise and vibration impacts, and
- a description of reasonable and feasible mitigation measures for both construction and operation and their associated effects. The EIS should state how it would be decided which noise mitigation measures to implement.

Other

- The need for specific management measures for road construction and operation in areas adjoining the existing landfill should be discussed, including leachate management.
- A description of the greenhouse gas cycle of the project including estimates of net tonnages of greenhouse gas to be produced both during construction and operation. The description should also identify methods such as alternative fuel sources for construction machinery to reduce greenhouse gases.

7 Monitoring and Reporting

The need for environmental impacts to be monitored during and after construction should be determined during the EIS. Any baseline monitoring that may be required before construction begins should also be identified. The parameters to be monitored, and their response trigger values and response activities, should also be identified.
This section should also identify and describe the monitoring programs, procedural and compliance audit programs and reporting requirements and arrangements to be implemented to demonstrate the effectiveness of management and monitoring (linked to the environmental management system/environmental management plan procedures).

8 Consultation and studies

Describe research and investigations undertaken in the course of evaluating the need, feasibility, design and management of the Tugun Bypass, including baseline studies undertaken. Describe any further studies, investigations, consultations, reports, either proceeding, or intended in regard to the construction and operation of the proposal.

Provide details of any consultation about the action, including:

- any consultation that has already taken place;
- proposed consultation about relevant impacts of the action;
- if there has been consultation about the proposed action — any documented response to, or result of, the consultation;
- identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.

9 Environmental record of person proposing to take the action

Provide details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:
(a) the person proposing to take the action; and
(b) for an action for which a person has applied for a permit, the person making the application.

If the person proposing to take the action is a corporation, provide details of the corporation's environmental policy and planning framework.

10 Glossary

11 References

12 Appendices

Attachment 1 - Data Formats and Standards

The provision of information about species listed under the *Environment Protection and Biodiversity Conservation Act 1999* in an electronic format will help facilitate decision-making under the Act and assist in the protection and recovery of species and communities.

Information may be presented as database point records or spatially referenced data. All datasets and their attributes must be appropriately documented and metadata associated with datasets should be developed in consultation with the Department of the Environment and Heritage (DEH).

Data provided to DEH in electronic format should accord with the following:

PREFERRED DATA TRANSFER FORMATS:

Vector spatial data:

- ESRI ArcSDE export files or ESRI ArcView shapefiles

Raster spatial data:

- ESRI ArcINFO export files (GRID), ArcINFO ASCIIGRID files or georeferenced image files in commonly used formats such as JPEG, TIFF or BIL

Tabular data:

- Oracle export format, MS Access 2000 or 97, flat ASCII files with comma delimited fields or as MS Excel spreadsheets

Data can be provided by CD-ROM or transferred electronically over DEH's public FTP site. Very small sets of data may be provided as e-mail attachments. All data should be scanned for viruses.

DATA QUALITY:

Data should be checked and repaired / updated to ensure that it meets the following minimum standards.

Vector spatial data:

- No slivers, unclosed polygons, missing label-points, duplicate arcs, dangles, gaps nor edit masks.
- Data cleaned with an appropriate tolerance. Arcs densified appropriate to its scale.
- Data accurate to a level appropriate to its publication scale.

Raster spatial data:

- No artefacts from vector data overlays such as line work or text.
- Data accompanied by information on number of bands, rows and columns to allow it to be easily reconstructed.

	Tabular data: – Understandable, rationally constituted (eg. a data table should not be so large as to be unusable). – Avoid code sets where possible. If these need to be used, provide look-up tables describing these. – No spaces (except between words in standard text fields), slashes nor ampersands, and dates with full 4 digit year field. – Accurate in accordance with the supplier's attribute standards and internally consistent. – Table item names not identical to Oracle keywords, and should be 8 characters or less in length.
SPATIAL DATA REFERENCE SYSTEMS – MAP PROJECTIONS:	All spatial data should be georeferenced. – It is preferred that data are provided in geographic coordinate system, ie. latitude and longitude, in decimal degree units. – If a map projection is used, specify the type of map projection and all of its parameters.
PREFERRED SPATIAL DATA REFERENCE SYSTEMS – DATUMS:	All spatial data to have a datum specified in its georeferencing: – Geocentric Datum of Australia (GDA), WGS84 or GRS80 datums. For most spatial purposes these three datums are identical. – If unable to provide data based on any of the above datums, use: AGD66 or AGD84 for mainland data, and WGS72 for marine or external territories. The datum used for the data must be clearly specified.

Department of
Infrastructure, Planning and Natural Resources

Contact: Lisa Mitchell
Phone: 02 9762 8152
Fax: 02 9762 8707
Email: lisa.mitchell@dipnr.nsw.gov.au

Our ref: S99/01179
Your ref: ltr of 22 Sept 2004

General Manager, Pacific Highway
Roads and Traffic Authority
Pacific Highway Office
PO Box 546
GRAFTON NSW 2460

Attention: Mr R Higgins

Dear Sir

Subject: Proposed Environmental Impact Statement for Tugun Bypass

Thank you for your letter of 22 September 2004 seeking Director-General's Requirements DGRs) for the Tugun Bypass Environmental Impact Statement (EIS). It is noted that the Roads and Traffic Authority (RTA) proposes to prepare the EIS under Part 5 of the *Environmental Planning and Assessment Act 1979* (the Act). DGRs were previously issued for this proposal to the consultants Parsons Brinckerhoff on behalf of the Queensland Department of Main Roads. Those DGRs were issued under Part 4 of the Act which is a different statutory process to that now proposed. This letter provides the DGRs for the proposal as requested by the RTA.

Attachment No 1 outlines the statutory matters that must be included in any EIS under clauses 229 and 230 of *Environmental Planning and Assessment Regulation 2000* (the Regulation). Under Clause 231 of the Regulation the Director-General requires that the EIS address:

- issues raised at the Planning Focus Meeting in Coolangatta on 19 June 2000
- issues raised during consultation for the proposal
- the Department's EIS Guidelines for *Roads and Related Facilities*. The Guidelines are available for purchase from the Department's Information Centre, 20 Lee St, Sydney (phone 02 9762 8044), and
- the key issues identified below. This is not an exhaustive list of issues but an initial identification of key issues.

Issues addressed in the EIS should be prioritised according to their importance in the decision making process. The level of analysis of issues should reflect the significance of their impacts and relevance for the proposal.

You should note that clause 231 of the Regulation requires that you re-consult the Director-General about the EIS preparation should the EIS not be exhibited within two years of the date of this letter.

Key Issues

Planning and Strategic

The EIS should:

- identify land use and planning instruments (local, regional, State and Commonwealth) relevant to areas affected by, and adjoining, the proposal including the North Coast REP, Tweed LEP 2000 and the Gold Coast Airport. This should include an assessment of the proposal's compatibility with those land uses and instruments
- analyse the proposal's interaction with local and regional planning aims and strategic implications for population growth and future urban expansion and identify potential land use conflicts
- identify and assess direct and indirect property impacts. Details should be provided for any land which may require acquisition or an easement
- identify and assess direct and indirect impacts upon Crown Land including a review of any Native Title claims
- describe the objectives of the proposal including predicted traffic volumes on the new road and effects on traffic volumes through Tugun, Coolangatta and Tweed City and on the Pacific Highway
- consider the cumulative impacts of the proposal with other local and regional road projects including proposals to upgrade the Pacific Highway, and
- discuss broad indicators of sustainability such as reduced car mode journeys, reduced car travel distance, reduced air pollution and reduced energy consumption.

Alternatives

The EIS should include an analysis of alternatives to the proposal including:

- identifying the alternatives considered, including doing nothing, alignment and design standard options, demand management and traffic management and combinations of these
- identifying alternative interchange arrangements between the Bypass and the Pacific Highway in NSW, and
- evaluating the alternatives against community, environmental and economic considerations.

The alternatives discussion should include a separate section on the comparative evaluation of the options referenced as options "B4" (wholly within Queensland) and "C4".

Construction

A description of all construction activities and their impacts should be provided including:

- the extent of clearing
- a description of construction methods including:
  - road construction techniques
  - spoil management and the source of construction materials including fill and road pavement materials
  - methods of crossing and constructing within or over waterways and wetlands
- locations and use of ancillary facilities such as works compounds and batch plants
- identification of partial or complete road closures and their duration. Traffic and access management methods for closures should be outlined
- identification of the temporary use of public reserves including the area occupied and duration of occupation
- soil and water management including acid sulfate soils, and

- a construction program. This should include specific identification of the duration of activities through or adjoining residential areas.

Ecology - General

The EIS should contain an assessment of impacts to flora and fauna (terrestrial and aquatic), particularly critical habitats, threatened species, populations, ecological communities, and their habitats listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1997* (FM Act). The assessment should involve the following steps:

i. conduct baseline surveys, and consult relevant databases and listings by scientific committees established under the TSC Act and FM Act
ii. identify any applicable assessment guidelines issued and in force under Section 94A of the TSC Act or, subject to Section 5C of the EP&A Act, and Section 220ZZA of the FM Act
iii. describe the types and condition of habitats in, and adjacent to, the land affected by the proposal
iv. prepare a list of species and vegetation communities that were recorded in the study area. Also identify which threatened species, populations and ecological communities are likely to occur based on the presence of suitable habitat and/or previous sightings
v. apply an Assessment of Significance (under section 5A of the EP&A Act) to each threatened species, population or ecological community, or their habitats, that may be affected by the proposal. The EIS must justify any decision to not apply this test to all of the threatened species, populations or ecological communities identified in step iv), and
vi. prepare a Species Impact Statement (SIS) for any critical habitats and threatened species, populations or ecological communities, or their habitats that are likely to be significantly affected by the proposal. A SIS must be prepared in accordance with any requirements of the Director-General of the Department of Environment and Conservation and/or Director-General of NSW Fisheries.

The assessment should include a full description of any compensatory habitat package developed for loss of flora and fauna habitats as a result of the proposal and how it relates to the species, populations or communities affected.

Ecology – SEPP 14 Wetlands

Where the proposal affects SEPP 14 – Coastal Wetlands:

- identify the wetland habitats including:
  - a vegetation survey map (preferably at a scale of 1:4000) to indicate any rare or threatened plant species
  - an assessment of the conservation status of each mapped wetland vegetation community including their conservation status within the State's reserve system
  - adjoining wetland habitats (including those not mapped under SEPP 14)
  - the extent of any weed infestation
  - a fauna survey describing the fish, birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) etc. of the area and the occurrence of any rare or threatened and protected species
  - a description of surface and groundwater quality and the hydrologic regime
- discuss the environmental impacts of the proposal including:
  - an assessment of changes to plant and animal species composition
  - design features that guard against disturbance to vegetation, fauna, water quality and the hydrologic regime
  - design measures that address any likely public use impacts expected from the development (e.g. increased litter and gross pollutants)

- describe the measures proposed to offset losses in wetland values or other environmental impacts, such as the preparation of a management plan to maintain or enhance wetlands not affected by the proposal, and
- assess the need to provide compensatory habitat for SEPP 14 wetlands in accordance with DIPNR's SEPP 14 – Coastal Wetlands – Compensatory Wetlands Policy (Attachment No. 2).

Water Quality, Hydrology and Flooding

Water quality and hydrology (surface and groundwater) and flooding should be assessed including:

- measures to avoid or minimise construction and operation impacts on water quality, particularly in the Cobaki Broadwater and associated wetlands
- erosion and sedimentation control including the design and location of sedimentation basins and any associated effects on groundwaters and acid sulfate soil management
- construction and operation effects of the road on surface and groundwater flows including the tunnel and any associated dewatering and re-injection proposals
- the management of acid sulfate soils with particular reference to ASSMAC "Acid Sulfate Soil Manual" (1998) including impacts on aquatic species of increased acidity in waterways
- the need for a licence(s) under the *Water Act 1912* or the *Water Management Act 2000*
- an assessment of any alterations to flooding characteristics, and
- the level of flood protection provided to the tunnel and the effects of flooding on the tunnel.

Traffic and Transport

Traffic and transport impacts during construction and operation should be assessed including:

- truck movements during construction and impacts on local roads
- the traffic capacity of the proposal and its ability to cater for predicted growth
- issues associated with the proposed tunnel, including risks and limitations (if any) on dangerous loads, and
- a description of facilities for cyclists and pedestrians including a clear assessment against NSW policy and practice for provision for cyclists on major roads. Any alternatives to provision for cyclists on the bypass must include a consideration of relative times and safety issues.

Noise

The EIS should contain a detailed assessment of noise and vibration impacts during construction and operation with reference to the NSW EPA's *Environmental Criteria for Road Traffic Noise.* The assessment should include:

- a description of the existing noise environment and identification of sensitive receptors
- identification of construction noise and vibration impacts
- identification of operation noise and vibration impacts, and
- a description of reasonable and feasible mitigation measures for both construction and operation and their associated effects. The EIS should state how it would be decided which noise mitigation measures to implement.

Other

- The need for specific management measures for road construction and operation in areas adjoining the existing landfill should be discussed, including leachate management.

- A description of the greenhouse gas cycle of the project including estimates of net tonnages of greenhouse gas to be produced both during construction and operation. The description should also identify methods such as alternative fuel sources for construction machinery to reduce greenhouse gases.

In preparing the EIS, you should approach relevant State and Commonwealth government agencies, councils and appropriate community groups and take into account any comments they may have regarding the proposal.

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), approval of the Commonwealth Minister for the Environment is required for actions that may have a significant impact on matters of National Environmental Significance, except in circumstances which are set out in the EPBC Act. Approval from the Commonwealth is in addition to any approvals under NSW legislation.

Please do not hesitate to contact either Lisa Mitchell (02 9762 8152) or Jan Parsons (02 9762 8107) should you have any queries.

Yours sincerely

Jan Parsons
Manager, Transport/Water
Major Infrastructure Assessments
As delegate for the Director-General

Encl.

Appendix B

Combined EIS guidelines checklist

NSW Director General's requirements checklist

Appendix B

Combined EIS guidelines checklist

Section Component	Requirements	EIS Chapter	Technical Paper
Background	The proposed bypass requires approval under the following legislation:		
	• Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, sections 18 and 18A and sections 26 and 27A	2	1
	• *Airports Act 1996*, for the portion on Commonwealth land leased by GCAL	2	1
	• NSW *Environmental Planning and Assessment Act 1979*	2	1
	• Queensland *Transport Infrastructure Act 1994 (QLD)*	2	1
General content, format and style	The EIS should be a stand alone document. It should contain sufficient information about any relevant studies or investigations to avoid the need to search out previous or supplementary reports.	EIS Document	N/A
	The EIS should enable interested stakeholders and the assessing agencies to understand the consequences of the proposed development. Information provided in the EIS should be objective, clear, succinct and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The body of the EIS is to be written in a clear and concise style that is easily understood by the general reader. Technical jargon should be avoided wherever possible and a full glossary should be included. Cross-refining should be used to avoid the unnecessary duplication of text.	EIS Document	N/A
	Detailed technical information, studies or investigations necessary to support the main body of the text should be included as appendices to the EIS. Any additional supporting documentation and studies, reports or literature not normally available to the public from which information has been extracted, should be made available at appropriate locations during the period of display of the EIS.	EIS Document	All Technical Papers
	Where information is given in the EIS, the source of the information, how recent the information is, how the reliability of the information was tested, the uncertainties (if any) in the information should all be stated.	EIS Document	All Technical Papers
	If it is necessary to make use of material that is considered to be of a confidential nature the proponent		

Section Component	Requirements	EIS Chapter	Technical Paper
	may request that such information remain confidential and not be included in any publicly available document.		
	The EIS should state the criteria adopted in assessing the relevant aspects of the proposal and its impacts - such as, compliance with the relevant legislation, policies and standards; community acceptance; or the maximisation of benefits or minimisation of risks.	EIS Document	All Technical Papers
	The level of analysis and detail in the EIS should reflect the level of significance attached to the expected potential impacts. Priority should be given the major issues associated with the proposal and matters of lesser concern should be dealt with only to the extent required to demonstrate that they have been considered. Any and all unknown variables or assumptions made in the assessment must be clearly stated and discussed. The extent to which the limitations, if any, of available information may influence the conclusions of the assessment should also be discussed.	EIS Document	All Technical Papers
	The EIS should be written so that any conclusions reached can be independently assessed. To this end all sources must be appropriately referenced using the Harvard standard.	References	
	The main text of the EIS should include a list of abbreviations, a glossary of terms and appendices containing:	Glossary and Abbreviations	
	• a copy of these guidelines	Appendix A	
	• a list of persons and agencies consulted during the preparation of the EIS	Appendix D	
	• contact details for the referral agency; and	Executive summary	
	• the names of, and work done by, the persons involved in preparing the EIS	Appendix F	
	Maps, diagrams and other illustrative material should be included in the EIS. The EIS should be produced on A4 size paper capable photocopied, with maps and diagrams of A4 or A3 size. The EIS should also be made available on a CD-ROM.	EIS Document & CD	
Executive summary	title of proposal	Executive Summary	
	name and address of proponent and the person taking action	Executive Summary	
	brief description of the background and the need for the proposal (including a discussion on alternatives and reasons for selecting the alignment)	Executive Summary	
	a brief description of the proposal (location, context in	Executive	

Section Component	Requirements	EIS Chapter	Technical Paper
	the region and existing environment)	Summary	
	a description of the principle environmental impacts	Executive Summary	
	a statement of the environmental management principles and monitoring procedures proposed	Executive Summary	
Introduction	clear definition of the objectives of the proposal	Chapter 1	
	a description of the proposed transport corridor, preferred bypass alignment and regional setting (including surrounding tenure and land use and the interrelationship between the road and rail corridor)	Chapters 1, 6, 12, 17	Technical Paper 16
	an explanation of the scope, aim and legislative basis for the EIS (including a brief outline of the reason for joint Queensland and NSW, and Commonwealth assessment and the role of the EIS in the government' decision-making process)	Chapter 2	Technical Paper 1
	a description of the studies/surveys/consultations conducted in developing the proposal and preparing the EIS (results of studies and detailed comments resulting from the consultation in appendices)	Chapters 3, 8-18 Appendix D	All Technical Papers
	priority environmental and management issues	Chapter 18	
	authority, responsibilities and implementation of the EIS	Chapters 2 and 18	
	brief explanation of the structure of the document	Chapter 1	
Background and need for the proposal			
Planning and strategic issues	identify land use and planning instruments (local, regional, State and Commonwealth) and policies relevant to areas affected by, and adjoining the proposal including:	Chapter 12	Technical Paper 16
	• an assessment of the proposal's compatibility with those land uses and instruments:	Chapter 12	Technical Paper 16
	• details of any environmental assessment of the proposed action that has been, or is being carried out under the scheme, plan or policy	Chapter 2	Technical Paper 1
	• how the instruments provide for the prevention, minimisation and management of any relevant impacts	Chapters 12 and 18	Technical Paper 16
	analyse the proposal's interaction with local and regional planning aims and strategic implications for population growth and future urban expansion and identify potential land use conflicts affected by the action	Chapters 12 And 17	Technical Paper 16
	describe how the action relates to other actions (of which the proponent should reasonably be aware) that have been, or are being taken or that have been approved in the region affected by the action	Chapter 17	

Section Component	Requirements	EIS Chapter	Technical Paper
	identify and assess direct and indirect property impacts (provide details for any land which may require acquisitions or easements)	Chapter 12 Appendix E	Technical Paper 16
	identify and assess direct and indirect impacts upon Crown Land including a review of Native Title claims	Chapters 8–18	Technical Paper 4–16
	describe the objectives of the proposal including predicted traffic volumes on the new road and effects on traffic volumes through Tugun, Coolangatta and Tweed City and on the Pacific Highway	Chapters 1, 12, and 20	Technical Paper 4
	consider the cumulative impacts with other local and regional road and rail projects including proposals to upgrade the Pacific Highway	Chapter 17	
	discuss broad indicators of sustainability such as reduced car mode journeys, reduced car travel distance, reduced air pollution and reduced energy consumption	Chapter 7, 9 and 12	Technical Papers 4 and 12
Approvals	describe any approval that has been obtained from a State, Territory of Commonwealth agency/authority (other than an approval under the Act) including any conditions that apply to the action	Chapter 2	Technical Paper 1
	describe any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply and how these requirements will be met	Chapter 2	Technical Paper 1
Alternatives to taking the action	identify the alternatives considered, including doing nothing, alignment and design standard options, demand management and traffic management and combination of these	Chapters 4, 5, 6 and 12	Technical Paper 4
	identify alternative interchange arrangements between the Bypass and the Pacific Highway	Chapter 6	Technical Paper 3
	evaluate the alternatives against community, environmental and economic considerations, including a comparative description of the impacts of each alternative on the matters protected by the controlling provisions of the *Environment Protection and Biodiversity Conservation Act 1999*	Chapter 5	
	provide sufficient detail to make it clear why any alignment is preferred to another	Chapter 5	
	include a separate section on the comparative evaluation of the options referenced as options 'B4' (wholly within Queensland) and 'C4'. The discussion should include a detailed explanation of the environmental, economic and social constraints that have determined the preferred alignment within the C4 corridor	Chapter 5	
The proposal	include the preferred location of any works to be undertaken, structures to be built of elements of the	Chapters 6	Technical

Section Component	Requirements	EIS Chapter	Technical Paper
	action that may have relevant impacts, including locations and use of auxiliary facilities	and 7	Paper 3
	a description of construction methods including:	Chapter 7	Technical Paper 3
	• road construction techniques	Chapter 7	Technical Paper 3
	• spoil management and the source of construction materials including fill and road pavement materials,	Chapter 7	Technical Paper 3
	• methods of crossing and constructing within or over waterways and wetlands	Chapter 6	Technical Paper 3
	description of operational and infrastructure requirements (road network, bridge, causeway, emergency facilities, power)	Chapter 6	Technical Paper 3
	description of the physical requirements for construction (types, quantities, sources and availability of construction materials such as water, aggregate, cement, fabrication products)	Chapter 7	Technical Paper 3
	construction program and management by phases/project/package, including:	Chapter 7	
	• sourcing and transport of construction materials	Chapter 6 and 7	Technical Paper 3
	• extent of vegetation clearance, site preparatory works, earthmoving, building, demolition/relocation	Chapter 7 Chapter 10	Technical Paper 3 Technical Paper 13
	• construction standards, techniques, site management and supervision (including on-site storage and handling of materials)	Chapter 7 Chapter 8	Technical Paper 3
	• resultant construction wastes and disposal methods	Chapter 7	Technical Paper 3
	• arrangement for prevention of soil erosion, soil conservation measures and rehabilitation including the management of acid sulphate soils	Chapter 8 and 18	Technical Paper 3 Technical Paper 5
	• construction procedures for river/creek crossings	Chapter 6	Technical Paper 3
	• identification of partial or complete road closures and their duration. Traffic and access management methods for closures should be outlined	Chapter 6	Technical Paper 4
	• identification of the temporary use of public reserves including the area occupied and duration of occupation	Chapters 6, 7 and 12	Technical Paper 4
	describe the facilities for cyclists and pedestrians	Chapter 6	Technical Paper 4

Section Component	Requirements	EIS Chapter	Technical Paper
Existing environment	describe the existing environment within the Tugun Bypass corridor and associated areas which will be used as a baseline against which impacts and management can be assessed.	Chapters 8–18	Technical Papers 5–16
	fully explain the environment in terms of expected and potential impacts and the identification and implementation of management plans	Chapters 8–18	Technical Papers 5–16
Aspects of the physical environment	relevant climate and atmospheric conditions precipitation, evaporation, wind, temperature, seasonal variability, flooding)	Chapters 8 and 9	Technical Papers 8, 9 and 12
	geology, topography, geomorphology, relevant soil characteristics (erodibility, compaction, potential and actual acid sulphate soils)	Chapter 8	Technical Papers 5 and
	hydrology (surface and groundwater systems, catchment and drainage regime, flow and discharge rates, water quality)	Chapter 8	Technical Papers 8, 9 and 10.
	existing noise levels	Chapter 14	Technical Paper 11
	past and present land use and land access	Chapters 12 and 13	Technical Paper 16
	site contamination	Chapter 8	Technical Paper 7
Aspects of the biological environment (including tidal/coastal areas)	describe the major habitats, communities and flora/fauna species	Chapter 10	Technical Paper 13
	describe ecological relationships, including the conservation status of species or associations	Chapter 10	Technical Paper 13
	outline other sensitive environments, areas of significance and conservation (breeding sites, seasonal habitats, wetlands)	Chapter 10	Technical Paper 13
	obligations/listings under Territory, national and international registers, conventions or agreements	Chapter 10	Technical Paper 13
	level of vegetation clearance/disturbance	Chapter 10	Technical Paper 13
	feral animal/vermin and weeds/plant pathogens	Chapter 10	Technical Paper 13
	aquatic and estuarine environment (potential impacts on Cobaki Broadwater)	Chapter 10	Technical Paper 13
	field species lists for fauna and flora, identify threatened species, populations, ecological communities	Chapter 10	Technical Paper 13
	evaluate the likely significance at a regional, State and	Chapter 10	Technical

Section Component	Requirements	EIS Chapter	Technical Paper
	national level of any populations of threatened species and apply an assessment of significance (under Section 5A of the Environmental Planning and Assessment Act) to each threatened species, population or ecological community or their habitats, that may be affected by the proposal.		Paper 13 SIS
	include relevant information from any recovery plans	Chapter 10	Technical Paper 13
	where the proposal affects SEPP 14, include:		
	• vegetation survey map to indicate any threatened flora species (1:4000)	Chapter 10	Technical Paper 13
	• an assessment of the conservation status of each mapped wetland vegetation community	Chapter 10	Technical Paper 13
	• adjoining wetland habitats (including those not mapped under SEPP 14)	Chapter 10	Technical Paper 13
	• the extent of any weed infestation	Chapter 10	Technical Paper 13
	• a fauna survey describing the fish, birds, reptiles, amphibians and mammals of the area and the occurrence of any threatened species	Chapter 10	Technical Paper 13
	• a description a surface and groundwater quality and hydrological regime	Chapters 8 and 10	Technical Papers 9, 10 and 13
Aspects of the cultural environment	describe areas nominated for listing and listed in the Register of the National Estate	Chapter 15	Technical Paper 15
	archaeological and heritage places and objects under relevant legislation	Chapter 15	Technical Paper 15
	areas with special values (landscape/visual, environment, recreational/commercial value, fisheries)	Chapters 8, 10 and 16	Technical Papers 13, 16 and 15
	sites of significance to the Aboriginal population/culture	Chapter 15	Technical Paper 15
Aspects of socio-economic environment	describe social factors (lifestyle, existing trends, social issues)	Chapter 13	Technical Paper 16
	existing and proposed land ownership and uses (including government, health, education, town planning/zoning, service, residential, mining, Aboriginal land, commercial and industrial)	Chapters 12 and 13	Technical Paper 16
	describe physical infrastructure	Chapter 12	Technical Paper 16
	a description of the existing noise environment and identification of sensitive receptors	Chapter 14	Technical Paper 11

Section Component	Requirements	EIS Chapter	Technical Paper
	assets on Gold Coast Airport that may be impacted by the proposal	Chapter 17	
	include a clear assessment of information known, where information is lacking and what additional studies are planned post EIS to further baseline knowledge and management plans	Chapter 18	
Environmental impacts	discuss and quantify direct, indirect, short-term and long-term, temporary and irreversible, adverse and beneficial effects	Chapters 8–18	Technical Papers 5–16
	include an assessment of the level of significance of the impact and a discussion on cumulative impacts	Chapter 17	
	where mitigation methods are proposed, provide:		
	• a description, and an assessment of the expected or predicted effectiveness of the mitigation measures	Chapters 8–18	Technical Papers 5–16
	• any statutory or policy basis for the mitigation measures	Chapters 8–18	Technical Papers 5–16
	• the cost of the mitigation measures	Chapter 18	
	• an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing	Chapter 18	
	• a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the impacts of the action	Chapter 18	
	• the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program		
	Aspects relevant to the environmental assessment include:		
	• workforce (number/timings, infrastructure required, services support, accommodation, work/storage sites, transport routes)	Chapter 7	Technical Paper 3
	• earthworks, construction, quarries, borrow pits, clearing, soil erosion, compaction, contaminated land salination and acid sulphate soils	Chapter 7	Technical Paper 3
	• dust, noise, vibration	Chapter 14	Technical Paper 11
	• transport, storage, and disposal of construction materials and waste	Chapter 7 and 18	Technical Paper 3
	• hydrology (drainage, sediment loads, water table, water quality, flooding)	Chapter 8	Technical Paper 8, 9 and 10
	• conservation and sensitive areas, flora and fauna	Chapter 10	Technical Paper 13
	• cultural heritage, archaeology	Chapter 15	Technical Paper 15

Section Component	Requirements	EIS Chapter	Technical Paper
	• feral animals and weeds	Chapter 10	Technical Paper 13
	• aesthetics	Chapter 16	Technical Paper 16
	• fires		
	• accidents, emergencies, pollution spills (materials, fuels, oil, waste)	Chapters 11, 17 and18	Technical Paper 17
	• dangerous goods transport, storage and disposal	Chapters 11, 17 and 18	Technical Paper 17
	• local, regional communities (social, infrastructure, services, employment, recreation, economic regime)	Chapter 12	Technical Paper 16
	• public access (private and commercial)	Chapters 6 and 12	Technical Papers 4 and 16
	• road transport	Chapter 12	Technical Paper 4
	• the assessment should also consider the consistency of the proposal with any recovery plans for species or ecological communities approved under the *Nature Conservation Act*, *Threatened Species Conservation Act, Fisheries Management Act* and *Environment Protection and Biodiversity Conservation Act.*		
	Address the following issues in the assessment:		
Flora and fauna	identify any applicable assessment guidelines issued and in force under Section 94A of the *Threatened Species Conservation Act* or, subject to Section 5C of the *Environment Planning and Assessment Act* and Section 220ZZA of the *Fisheries Management Act*	Chapter 10	Technical Paper 13
	describe the types and condition of habitats in, and adjacent to, the land affected by the proposal	Chapter 10	Technical Paper 13
	describe impacts on any critical habitats and threatened species, populations or ecological communities, or their habitats that are likely to be significantly affected by the proposal. A SIS must be prepared for areas under NSW jurisdiction in accordance with any requirements of the Director-General of the Department of Environment and Conservation and/or NSW Fisheries	SIS	
	include a description of any compensatory habitat package, and how it relates to the species, populations and communities affected.	Chapter 10 SIS	Technical Paper 13
SEPP 14 Wetlands	Discuss the environmental impacts of the proposal including:		
	• an assessment of changes to plant and animal species composition	Chapter 10	Technical

Section Component	Requirements	EIS Chapter	Technical Paper
		SIS	Paper 13
	• design features that guard against disturbance to vegetation, fauna, water quality and the hydrologic regime	Chapters 6, 8, 10 and SIS	Technical Papers 8, 9 10 and 13
	• design measures that address any likely public use impacts expected from the development (e.g. increase litter and gross pollutants)	Chapter 8 and 11	Technical Papers 8 and 9
	describe measures to offset losses in wetland values or other environmental impacts	Chapter 10 SIS	Technical Paper 13
	assess the need to provide compensatory habitat for SEPP 14 in accordance to compensatory Wetlands Policy	Chapter 10	Technical Paper 13
Commonwealth land	include an assessment of the impact of the proposal on the operation of the Gold Coast Airport	Chapters 6, 12 and 17	Technical Paper 16
Water quality and hydrology	Assessment should include:		
	measures to avoid or minimise construction and operation impacts on water quality, particularly in the Cobaki Broadwater and associated wetlands	Chapters 8 and 10	Technical Papers 8, 9, 10 and 13
	erosion and sedimentation control including the design and location of sedimentation basins (temporary or permanent) and any associated effects on groundwater and acid sulphate soil management	Chapters 6 and 8	Technical Papers 3, 6, 8, 9 and 10
	construction and operation effects of the road on surface and groundwater flows including and tunnel and any associated dewatering and re-injection proposals	Chapter 8	Technical Papers 3, 8, 9 and 10
	the management of acid sulphate soils with particular reference to ASSMAC "ASS Manual" (1998) incl impacts on aquatic species of increase acidity in waterways	Chapter 8	Technical Paper 6
	the need for a licence(s) under the *Water Act 1912* or the *Water Management Act 2000*	Chapters 2 and 8	Technical Paper 1
	an assessment of any alternations to flooding characteristics	Chapter 8	Technical Paper 8
	the level of flood protection provided to the tunnel and the effects of flooding on the tunnel	Chapters 6 and 8	Technical Papers 3 and 8
Traffic and transport	Assessment should include:		
	truck movements during construction and impacts on local roads	Chapters 7 and 12	Technical Paper 4 and 16
	the traffic capacity of the proposal and its ability to cater for predicted growth	Chapter 12	Technical Paper 4
	issues associated with the proposed tunnel, including	Chapters 6	Technical

Section Component	Requirements	EIS Chapter	Technical Paper
	risks and limitations (if any) on dangerous loads	and 11	Papers 3 and 17
	an assessment of facilities for cyclists and pedestrians against NSW policy and practice for provision for cyclists on major roads. Any alterations to provision for cyclists on the bypass must include a consideration of relative times and safety issues.	Chapter 6	Technical Paper 4
Noise and vibration	Assessment should include:		
	identification of construction noise and vibration impacts	Chapter 14	Technical Paper 11
	identification of operation noise and vibration impacts	Chapter 14	Technical Paper 11
	a description of reasonable and feasible mitigation measures for both construction and operation and their associated effects. The EIS should state how it would be decided which noise mitigation measures to implement.	Chapter 14	Technical Paper 11
Other	the need for specific management measures for road construction and operation in areas adjoining the existing landfill should be discussed, including leachate management	Chapter 8	Technical Paper 7
	a description of the greenhouse gas cycle of the project including estimates of net tonnages of greenhouse gas to be produced both during construction and operation. The description should also identify methods such as alternative fuel sources for construction machinery to reduce greenhouse gases.	Chapters 7 and 9	Technical Paper 12
Monitoring and reporting	identify any baseline monitoring that may be required before construction begins	Chapters 8–18	Technical Papers 4–16
	identify parameters to be monitored and their response trigger values and response activities	Chapters 8–18	Technical Papers 4–16
	identify and describe the monitoring programs, procedural and compliance audit programs and reporting requirements and arrangements to be implemented to demonstrate the effectiveness of management and monitoring (linked to the environmental management system/ environmental management plan	Chapters 8–18	Technical Papers 4–16
Consultation and studies	describe research and investigations undertaken in the course of evaluating the need, feasibility, design and management of the Tugun Bypass, including baseline studies undertaken.		
	describe any further studies either proceeding or intended		

Section Component	Requirements	EIS Chapter	Technical Paper
	provide details of any consultation about the action including:		
	• any consultation that has already taken place	Chapter 3	Technical Paper 2
	• proposed consultation	Chapter 3	Technical Paper 2
	• any documented response to or result of consultation	Chapter 3	Technical Paper 2
	• identification of affected parties, including a statement mentioning any communities that may be affected and describing their views	Chapter 3	Technical Paper 2
Environmental record of person proposing to take the action	provide details of any proceedings under a Commonwealth, state law for the protection of the environment of the conservation and sustainable use of natural resources against:	Appendix G	
	• the person proposing to take the action	Appendix G	
	• for an action for which a person has applied for a permit, the person making the application	Appendix G	
	If the person proposing to take the action is a corporation, provide details of the corporation's environmental policy and planning framework.	Appendix G	
Glossary			
References			
Appendices			

Appendix B

NSW Director General's requirements checklist

Section Component	Requirements	EIS Chapter	Technical Paper
Approvals	approach relevant State and Commonwealth government agencies, councils and appropriate community groups and take into account any comments they may have regarding the proposal	Chapters 2 and 3	Technical Papers 1 and 2
	approval from the Commonwealth Minister for the Environment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), for actions that may have a significant impact on matters of National Environmental Significance, except in circumstances which are set out in the EPBC Act.	Chapter 2	Technical Paper 1
Planning and strategic issues	identify land use and planning instruments (local, regional, State and Commonwealth) and policies relevant to areas affected by, and adjoining the proposal, including:	Chapters 2, 4 and 12	Technical Paper 16
	• the North Coast REP, Tweed LEP 2000 and the Gold Coast Airport	Chapters 2, 4 and 12	Technical Paper 16
	• an assessment of the proposal's compatibility with those land uses and instruments	Chapters 2 and 12	Technical Paper 16
	analyse the proposal's interaction with local and regional planning aims and strategic implications for population growth and future urban expansion and identify potential land use conflicts affected by the action	Chapters 12 and 17	Technical Paper 16
	identify and assess direct and indirect property impacts (provide details for any land which may require acquisitions or easements)	Chapter 12 Appendix E	Technical Paper 16
	identify and assess direct and indirect impacts upon Crown Land including a review of Native Title claims	Chapters 8–18	Technical Paper 4–16
	describe the objectives of the proposal including predicted traffic volumes on the new road and effects on traffic volumes through Tugun, Coolangatta and Tweed City and on the Pacific Highway	Chapters 1, 12 and 20	Technical Paper 4
	consider the cumulative impacts with other local and regional road and rail projects including proposals to upgrade the Pacific Highway	Chapters 12 and 17	Technical Paper 4
	discuss broad indicators of sustainability such as reduced car mode journeys, reduced car travel distance, reduced air pollution and reduced energy consumption	Chapters 9, 12, 17 and 20	Technical Papers 4 and 12

Section Component	Requirements	EIS Chapter	Technical Paper
Alternatives to taking the action	identify the alternatives considered, including doing nothing, alignment and design standard options, demand management and traffic management and combination of these	Chapters 3, 5, 6 and 12	Technical Paper 4
	identify alternative interchange arrangements between the Bypass and the Pacific Highway in NSW	Chapter 6	Technical Paper 3
	evaluate the alternatives against community, environmental and economic considerations	Chapter 5	
	include a separate section on the comparative evaluation of the options referenced as options 'B4' (wholly within Queensland) and 'C4'.	Chapter 5	
Construction	a description of the extent of clearing	Chapter 10	Technical Paper 13
	a description of construction methods including:	Chapter 7	Technical Paper 3
	• road construction techniques	Chapter 7	Technical Paper 3
	• spoil management and the source of construction materials including fill and road pavement materials,	Chapter 7	Technical Paper 3
	• methods of crossing and constructing within or over waterways and wetlands	Chapters 6 and 7	Technical Paper 3
	locations and use of ancillary facilities, such as work compounds and batch plants	Chapters 6 and 7	Technical Paper 3
	identification of partial or complete road closures and their duration. Traffic and access management methods for closures should be outlined.	Chapter 6	Technical Paper 16
	identification of the temporary use of public reserves including the area occupied and the duration of occupation	Chapters 6, 7 and 12	Technical Paper 4
	soil and water management, including Acid Sulphate Soils	Chapters 8, 17 and 18	Technical Papers 3, 6-10
	a construction program. This should include specific identification of the duration of activities through or adjoining residential activities	Chapter 7	
Environmental impacts			
Ecology - General	the EIS should contain an assessment of impact to flora and fauna (terrestrial and aquatic), particularly critical habitats, threatened species, populations, ecological communities and their habitats listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1997* (FM Act).	Chapter 10 SIS	Technical Paper 13
	assessment should involve the following steps:		

Section Component	Requirements	EIS Chapter	Technical Paper
	i. conduct baseline surveys, and consult relevant databases and listings by scientific committees established under the TSC Act and FM Act	Chapter 10 SIS	Technical Paper 13
	ii. identify any applicable assessment guidelines issued and in force under Section 94A of the TSC Act of, subject to Section 5C of the EP&A Act, and Section 220ZZA of the FM Act	Chapter 10 SIS	Technical Paper 13
	iii. describe the types and condition of habitats in, and adjacent to, the land affected by the proposal	Chapter 10 SIS	Technical Paper 13
	iv. prepare a list of species and vegetation communities that were recorded in the study area. Also identify which threatened species, populations and ecological communities are likely to occur based on the presence of suitable habitat and/or previous sightings.	Chapter 10 SIS	Technical Paper 13
	v. apply an Assessment of Significance (under section 5A of the EP&A Act) to each threatened species, population or ecological community, or their habitats, that may be affected by the proposal. The EIS must justify any decision to not apply this test to all of the threatened species, populations or ecological communities identified in set iv).	Chapter 10 SIS	Technical Paper 13
	vi. prepare a Species Impact Statement (SIS) for any critical habitats and threatened species, populations or ecological communities, or their habitats that are likely to be significantly affected by the proposal. A SIS must be prepared in accordance with any requirements of the Director-General of the Department of Environment and Conservation and/or Director General of NSW Fisheries	SIS	
Ecology – SEPP 14 Wetlands	If the proposal affects SEPP 14 – Coastal Wetlands:		
	Identify the wetland habitats including:		
	• a vegetation survey map (preferably at a scale of 1:4000) to indicate any rare or threatened plant species	Chapter 10	Technical Paper 13
	• an assessment of the conservation status of each mapped wetland vegetation community including their conservation status within the State's reserve system	Chapter 10	Technical Paper 13
	• adjoining wetland habitats (including those not mapped under SEPP 14)	Chapter 10	Technical Paper 13
	• the extent of any weed infestation	Chapter 10	Technical Paper 13
	• a fauna survey describing the fish, birds (both indigenous and migratory), reptiles, amphibians and mammals (including bats) etc. of the area and the occurrence of any rare or threatened and protected species	Chapter 10	Technical Paper 13
	• a description of surface and groundwater quality and the hydrologic regime	Chapters 8 and 10	Technical Papers 9, 10 and 13
	discuss the environmental impacts of the proposal including:		

Section Component	Requirements	EIS Chapter	Technical Paper
	• an assessment of changes to plant and animal species composition	Chapter 10 SIS	Technical Paper 13
	• design features that guard against disturbance to vegetation, fauna, water quality and the hydrologic regime	Chapters 6, 7, 8 and 10 SIS	Technical Papers 8, 9, 10 and 13
	• design measures that address any likely public use impacts expected from the development (e.g. increased litter and gross pollutants)	Chapters 8 and 11	Technical Papers 8 and 9
	describe the measures proposed to offset losses in wetland values or other environmental impacts, such as the preparation of a management plant to maintain or enhance wetlands not affected by the proposal	Chapter 10 SIS	Technical Paper 13
	assess the need to provide compensatory habitat for SEPP 14 wetlands in accordance with DIPNR's SEPP 14 – Coastal Wetlands – Compensatory Wetlands Policy (Attachment No. 2)	Chapter 10	Technical Paper 13
Water quality and hydrology	Assessment should include:		
	measures to avoid or minimise construction and operation impacts on water quality, particularly in the Cobaki Broadwater and associated wetlands	Chapters 8, 10 and 11	Technical Papers 6, 8, 9, 10 and 13
	erosion and sedimentation control including the design and location of sedimentation basins (temporary or permanent) and any associated effects on groundwater and acid sulphate soil management	Chapters 6 and 8	Technical Papers 3, 6, 8, 9 and 10
	construction and operation effects of the road on surface and groundwater flows including and tunnel and any associated dewatering and re-injection proposals	Chapter 8	Technical Papers 3, 8, 9 and 10
	the management of acid sulphate soils with particular reference to ASSMAC "ASS Manual" (1998) including impacts on aquatic species of increase acidity in waterways	Chapter 8	Technical Paper 6
	the need for a licence(s) under the *Water Act 1912* or the *Water Management Act 2000*	Chapters 2 and 8	Technical Paper 1
	an assessment of any alterations to flooding characteristics	Chapter 8	Technical Paper 8
	the level of flood protection provided to the tunnel and the effects of flooding on the tunnel	Chapters 6 and 8	Technical Papers 3 and 8
Traffic and transport	Assessment should include:		
	truck movements during construction and impacts on local roads	Chapters 7 and 12	Technical Paper 4 and 16
	the traffic capacity of the proposal and its ability to cater for predicted growth	Chapters 12 and 13	Technical Papers 4

Section Component	Requirements	EIS Chapter	Technical Paper
			and 16
	issues associated with the proposed tunnel, including risks and limitations (if any) on dangerous loads	Chapters 6 and 11	Technical Papers 3 and 17
	a description of facilities for cyclists and pedestrians including a clear assessment against NSW policy and practice for cyclists on major roads. Any alterations to provision for cyclists on the bypass must include a consideration of relative times and safety issues.	Chapter 6	Technical Paper 4
Noise and vibration	Detailed assessment of noise and vibration impacts with reference to NSW EPA's Environmental Criteria for Road Traffic Noise including:		
	a description of the existing noise environment and identification of sensitive receptors	Chapter 14	Technical Paper 11
	identification of construction noise and vibration impacts	Chapter 14	Technical Paper 11
	identification of operation noise and vibration impacts	Chapter 14	Technical Paper 11
	a description of reasonable and feasible mitigation measures for both construction and operation and their associated effects. The EIS should state how it would be decided which noise mitigation measures to implement.	Chapter 14	Technical Paper 11
Other	the need for specific management measures for road construction and operation in areas adjoining the existing landfill should be discussed, including leachate management	Chapter 8	Technical Paper 7
	a description of the greenhouse gas cycle of the project including estimates of net tonnages of greenhouse gas to be produced both during construction and operation. The description should also identify methods such as alternative fuel sources for construction machinery to reduce greenhouse gases.	Chapters 7 and 9	Technical Paper 12

Appendix C

Submission of Environmental Impact Assessment

Submission of
Environmental impact statement (EIS)

Prepared under the Environmental Planning and Assessment Act 1979 Section 112

EIS prepared by	
name	Mark Kunzer
qualifications	BSc, MSc
address	Parsons Brinckerhoff 12th Floor IBM Centre 348 Edward Street Brisbane Qld 4000
in respect of	Proposed new Tugun Bypass from Currumbin in Queensland to Tweed Heads in New South Wales
Part S – Activity Proponent	
Applicant name	Queensland Department of Main Roads 36-38 Cotton Street (PO Box 442) NERANG QLD 4211 NSW Roads and Traffic Authority 21 Prince Street PO Box 546 GRAFTON, NSW 2460
land on which activity to be carried out (Ins no. DP/MPS, vol/foll etc proposed development)	All or part of 34 properties listed in Tables G1 of Appendix G of Volume One of the EIS. These properties are shown on Figure 12.4 of Volume One of the EIS. Construction and operation of a four-lane restricted access highway from north of Boyd Street, Tugun, Queensland to Tweed Heads Bypass, Tweed Heads, NSW. This proposal relates to those sections of the proposal located in NSW. These include a section of the highway south of the Queensland/NSW border, the Tweed Heads Bypass interchange and works relating to the existing Kennedy Drive interchange. Or ☐ map(s) attached
environment impact statement	☒ an environmental impact statement (EIS) is attached
certificate	I declare that I have prepared the contents of this Environmental Impact Statement and to the best of my knowledge: ▪ it is in accordance with clauses 230 and 231 of the *Environmental Planning and Assessment Regulation 2000*; and ▪ it contains all available information that is relevant to the environmental assessmentof the activity to which the Statement relates; and ▪ the information which it contains is neither false nor misleading.
signature	
name	Mark Kunzer
date	15/11/2004

Appendix D

Summary of issues raised during community and stakeholder consultation

Appendix D

Summary of issues raised during community and stakeholder consultation

Table D1: Issues raised during community and stakeholder consultation

Issue		Section addressed	
		Chapter in EIS	Technical Paper
Community and Stakeholder Issues	• the location of the route alignment (particularly around the Cobaki Broadwater area);	CH 5,6	TP 3, 13
	• impacts on flora and fauna;	CH 10	TP 13
	• the endangered species along the route;	CH 10	TP 13
	• air and water quality;	CH 8, 9	TP 9, 12
	• visual impacts;	CH 14	TP 14
	• noise impacts;	CH 6, 14	TP 11
	• the complexity, and detail, of the approvals processes;	CH 2	TP 1
	• study progress and updates;	N/A	N/A
	• acid sulphate soils;	CH 8	TP 6
	• the impact of disturbing the Tugun Landfill;	CH 8	TP 7
	• tunnelling impacts;	CH 6, 7, 8	TP 3, 5, 8, 9, 10
	• the location of interchanges along the alignment;	CH 6	TP 3
	• cycling facilities;	CH 6, 12	TP 3, 4
	• processes involved in completing an SIS;	CH 2, 10	TP 1,13
	• property acquisition requirements;	CH 12, 13	TP 1, 3, 16
	• Gold Coast Airport Limited's role in the approvals process;	CH 2	TP 1
	• salinity;	CH 8	TP 6, 9, 10
	• funding for the proposed Tugun Bypass;	CH 6, 20	N/A
	• the need for compensatory habitat;	CH 10	TP 13
	• impacts on ground and surface water;	CH 8	TP 9, 10
	• accidents or major spills;	CH 11	TP 17
	• flooding; and	CH 8	TP 8
	• timing of construction.	CH 6, 7	TP 3

Appendix E

Pacific Highway at Tugun Route Selection Report Chapters 10 and 11

10. Evaluation of Options

The road and rail options for Tugun have been evaluated through the technical studies reported in the previous sections. The impacts of the options are summarised in the impact matrix presented in Appendix C.

The selection of a preferred option for detailed impact assessment was undertaken at a Value Management workshop in August 1999. The workshop involved representatives of NSW and Queensland agencies from local, State and Commonwealth government.

This section provides an overview of the main impacts of each option and documents the outcomes of the Value Management process.

10.1 Impacts of Options

An assessment of the impacts of each of the options has been undertaken and is reported in the previous sections of this report. A summary of impacts is provided in Appendix C.

From the assessment undertaken to date, the main impacts of the options are discussed below.

10.1.1 Do Nothing

The anticipated growth in traffic movements on the combined corridor of the Gold Coast Highway and the Pacific Highway from the current level of 47,000 vehicles per day to 70,000 vehicles per day within the next ten years will place significant demands on the existing corridor.

The upgrading of the Pacific Highway corridor to the north into Brisbane and to the south through northern NSW will increase overall travel speeds on the Pacific Highway route.

Without additional capacity and grade separation of intersections, the level of service provided by the Tugun section of the highway will continue to degrade leading to increased congestion, decreased travel times and a reduction in travel safety.

Even with the achievement of the SEQ Integrated Regional Transport Plan private vehicle growth reduction targets and sub-regional public transport initiatives including the Robina to Coolangatta Airport Railway, there will be a need to "do something" in the Tugun area where the existing corridor is heavily constrained and is catering to local traffic, Gold Coast/Coolangatta district traffic and inter regional and inter state traffic on the Pacific Highway route.

10.1.2 Option A – Upgrade Existing Corridor

Option A would involve providing additional capacity within the existing corridor and grade separation of all intersections. The rail corridor for this option would be similar to the rail corridor proposed for the B options.

The main impacts and issues associated with Option A are:

> this option performs poorly against transportation and road network criteria having the lowest travel speed and highest travel times of the options and would result in significant changes to local access;

> construction issues would be significant due to the need to maintain the existing corridor during the construction period and the high number of residential frontages to the construction zone;

> direct property and land use impacts would be moderate and mainly associated with new intersections however indirect impacts on the residential, business, tourist accommodation and community services land uses fronting the corridor would be significant;

> the reinforcement of the existing severance of the highway on the communities of Tugun and Bilinga would result in high social impacts;

> a significant number of residential properties would be affected by increased noise and a reduction in air quality;

> the option would have the least impact on the natural environment and cultural heritage of all options;

> the option would have limited impacts on the operations of the airport and the draft Airport Master Plan; and

> a satisfactory railway corridor could be developed in conjunction with the option following the partial bypass (option B) alignment.

The A option has a construction cost of $118.2 million and a BCR of 1.4.

10.1.3 Option B – Partial Bypass

Two partial bypass options have been assessed, with both options providing a bypass of Tugun then joining the existing corridor south of the Boyd Street intersection with the Gold Coast Highway. The B1 option would utilise the existing corridor south of Boyd Street whilst the B2 options would run parallel and west of the existing corridor. Both options allow for a future railway to be developed adjacent to the road corridor.

B1 Option

The main impacts and issues associated with the B1 option are:

> transport network benefits would be achieved north of Boyd Street where the Gold Coast Highway/Pacific Highway intersection and the Tugun business centre is relieved of regional traffic but travel time and travel speed benefits are less than for the C options;

> significant construction issues south of Boyd Street within the existing corridor;

> the B1 option affects community and sporting facilities north of the airport and the future railway has a significant effect on residential properties between the airport and the existing highway;

> significant social issues are raised by the further severance of the Bilinga community, west of the existing highway;

> B1 has less impact on noise sensitive places than the A option but significantly higher impact than the C options;

> B1 has less impact on noise sensitive places than the A option but significantly higher impact than the C options;

> B1 has minimal impact on the natural environment and cultural heritage;

> there is minimal impact on airport operations with some loss of airport land in the Terminal Precinct east of the existing terminal buildings; and

> a satisfactory railway corridor could be developed in conjunction with the B1 option, east of the airport.

The B1 option has a construction cost of $205.3 million and a BCR of 1.5.

B2 Option

The B2 option would be constructed west of the existing corridor south of Boyd Street and would therefore involve acquisition of the majority of residences between the existing highway and the airport for the road construction.

The additional issues associated with the B2 option compared to Option B1 are:

> traffic network and safety benefits from the separation of local and regional traffic, although weave zones will be required for access to and from the Gold Coast Highway;

> reduced construction issues due to the separation of the existing and new road corridors;

> significant property and land use impacts east of the airport involving residential, business and community facilities; and

> significant social impacts associated with the dislocation of the Bilinga community located east of the existing highway.

The B2 option has a construction cost of $165.2 million and a BCR of 1.2.

10.1.4 C Options – Full Bypass

The C options involve a bypass of both the Tugun and Bilinga areas with both the road and rail corridors located west of Coolangatta Airport.

The impacts and issues common to the C options are:

> their high performance against transportation and road network criteria due to the separation of local and regional traffic, the provision for well designed, grade separated intersections and the shorter route which results in travel time savings;

> the least construction issues of all options due to ability to construct the full facility with minimal impacts on the existing corridor and the urban development fronting the existing corridor;

> property impacts, land use impacts and social impacts are significantly less than the A and B options for both road and rail ;

> impacts on noise sensitive places are significantly less than the A and B options;

> impacts on the natural environment and cultural heritage would be greater than the A and B options;

> all C options have implications for the Coolangatta Airport Master Plan but none would affect airport operations;

> all C options allow for a future rail link to the airport terminal precinct via a route west of the airport.

Option C1

C1 is the most westerly of the C options and crosses Cobaki Broadwater. Compared to options C2 and C4, option C1:

> performs marginally better on transport grounds due a shorter length;

> involves a bridge structure across Cobaki Broadwater;

> has greater impacts on the natural environment including the Cobaki Broadwater;

> has the highest potential of all C options to affect cultural heritage material; and

> has the least impact on the Coolangatta Airport Master Plan of all the C Options.

Option C1 has a construction cost of $138.4 million and a BCR of 1.9.

Option C2

Option C2 is the most easterly of the western options and is closest to the main runway. The option would pass in tunnel under the future southern extension of the main runway. Compared to options C1 and C4, Option C2:

> has the least impact on the natural environment of all the C Options although potential impacts on groundwater flows associated with the tunnel structure would need to be investigated;

> has the least potential of all C options to affect cultural heritage material; and

> has the highest impact on the Coolangatta Airport Master Plan of all the C options.

Option C2 has a construction cost of $173.2 million and a BCR of 1.5.

Option C4

Option C4 follows the alignment of Option C1 then combines with the C2 alignment near the southern end of the Coolangatta airport site to pass under the future runway extension. Compared to options C1 and C2, Option C4:

> has least impact on the Coolangatta Airport Master Plan of all the C options;

> has less impact on the natural environment than option C1; and

> has less potential to affect cultural heritage material than Option C1.

Option C4 has a construction cost of $156.8 million and a BCR of 1.9.

The impacts of the individual options were considered in detail in the Value Management workshop when the selection of a preferred route was made. The workshop process and outcomes are discussed in Section 10.2.

10.2 Value Management Workshop

A two day value management workshop was held at Coolangatta on 11 and 12 August 1999 to address route selection for Pacific Highway options at Tugun. Representatives of various stakeholders were present. The workshop was facilitated by Dr David Stephens of Strategic Thinking Pty Ltd. A copy of the workshop report is included in Appendix J.

A strategic diagnosis was carried out prior to the value management workshop in which a SWOT analysis (strengths, weaknesses, opportunities and threats) in relation to the project to date was evaluated. From these, critical issues were identified. Topics to be covered by the workshop presenters were identified.

Draft project objectives, value management workshop objectives and project scope were also formulated. These were confirmed at the value management workshop proper and are examined in detail in sections in the body of the report.

The value management methodology, in addition to the strategic diagnosis, comprising the traditional "job plan" was worked through during the one-day session.

A Discussion Paper (Connell Wagner 1999), which contained background information and details of all options was made available to participants in the week prior to the workshop.

The information stage of the workshop comprised, in addition to the presentations by participants, a structured question and answer session and a functional analysis section, which identified seven areas to be idea generated. The idea generation produced 235 ideas which ultimately were converted into a series of working lists. This included design notations which represented stakeholders' needs and were, by consensus, to be included as part of the preliminary concept design.

Similarly a preliminary risk assessment was undertaken. Eight risk categories were identified by the value management study participants. A significant number of specific major risks were identified in relation to these categories. For these major risks it was considered necessary to develop a pro-active action plan as a post workshop activity.

In addition to the design notations a number of items were identified which are to be developed into a specific action plan also as a post workshop activity.

The main finding of the workshop was to arrive at a ranking of the options in terms of preference for a preferred route. The workshop was conducted in accordance with New South Wales Treasury guidelines.

10.3 Overall Project Objective

At the strategic diagnosis meeting prior to the value management study, a draft of the overall objective for the project was identified and then confirmed at the workshop as follows:

"To provide a transport corridor that improves, for the long term, road traffic operations along the Pacific Highway between Tugun and Tweed Heads and allows for optimal future expansion of rail".

10.4 Value Management Workshop Objectives

The value management workshop objectives were also formulated as a result of a strategic diagnosis meeting carried out preceding the value management study. They were considered at the workshop and with changes were confirmed as follows:

> Agree upon a final list of generic alternatives for the transport corridor
> Agree upon a list of evaluation criteria to discern between the options
> Agree upon weightings relevant to the evaluation criteria, and the range of sensitivity testing on those weightings
> Rank the options in terms of preference
> Refine the ranked option 1 to accommodate suggested improvements

10.5 Value Management Participants

The participants for the workshop were identified from the local, State and Commonwealth agencies having jurisdiction in the area and which may have a role in project approvals. Due to the cross border location and the proximity to Coolangatta Airport, the group was large with 25 participants, but it was considered necessary to extend the range of participants in this case to provide credibility to the findings and to ensure true stakeholder representation was achieved. Representatives attended from the following organisations and agencies:

> Tweed Shire Council
> Gold Coast City Council
> Commonwealth Department of Transport and Regional Services
> Environment Australia (Commonwealth)
> NSW Roads and Traffic Authority
> Qld Department of Main Roads
> NSW NPWS
> NSW Department of Land and Water Conservation
> NSW Environment Protection Authority
> NSW Department of Urban Affairs and Planning
> Queensland Transport
> Qld Environmental Protection Agency
> Gold Coast Airport Limited
> Connell Wagner

The facilitation team was led by Dr David Stevens of Strategic Thinking Pty Ltd.

It should be noted that the Environment Australia representative and one of the Department of Transport and Regional Services (Commonwealth) representatives left the workshop on the second day after the conclusion of the Sensitivity Testing of the Option Evaluation Matrix.

10.6 Scoping and Information

The scoping and information phases of the workshop are reported in Appendix J.

10.7 Initial Evaluation Criteria

The workshop participants identified a set of potential evaluation criteria. It was explained that the final selection of evaluation criteria must reflect items that enable comparative evaluations to be made against potentially conflicting design solutions. 21 such evaluation criteria were identified and are listed below in Table 10.1.

Table 10.1 Initial List of Evaluation Criteria

Evaluation Criteria	Rejected or Retained
1.rail optimisation	Rejected
2.heritage (land title)	Rejected
3.environmental impact	Retained but the word "natural" was added as a prefix
4.wetlands	Rejected
5.flora (threatened)	Rejected
6.fauna	Rejected
7.vegetation	Rejected
8.noise impact	Rejected
9.water quality	Rejected
10.air quality	Rejected
11.social impact	Retained
12.economic impact	Rejected
13.urban design	Rejected
14.land use planning	Retained
15.engineering	Rejected
16.airport operation	Accepted but operation was changed to impact
17.traffic efficiency	Accepted but traffic was changed to transport
18.visual impact	Retained
19.safety	Retained
20.flexibility (for future)	Rejected
21.political acceptability	Rejected

10.8 Final Evaluation Criteria

The final list of evaluation criteria agreed by the workshop participants are listed below in Table 10.2, with their definitions tabled immediately to the right of the evaluation criteria.

Table 10.2 Definitions of Evaluation Criteria

Evaluation Criteria	Definition
1.natural environmental impact	Loss / fragmentation / degradation of habitat
2.social impact	Loss of houses, community facilities and lifestyle
3.local land use planning	Land use potential / mix for the future
4.airport impact	Degree to which the airport operations are restricted (as a key facility)
5.transport efficiency	to meet local and regional transport needs for the long term
6.visual impact	Prominence of cuttings, structures, noise walls, etc.
7.safety	The accident potential for all road users (loss of life)

10.9 Paired Comparisons: Weighting the Options

A standard process of comparing each criteria against another and establishing the more "important", criteria was adopted. By using this process, and after extensive discussion, a weighting for each of the criteria was arrived at. The weightings are indicated below in Table 10.3. It should be noted that

considerable time was taken in the construction of this matrix as ultimately all compared comparisons and the consequential weightings had to be done by consensus.

Table 10.3 Paired Comparisons

Evaluation Criteria		A	B	C	D	E	F	G	Frequency	Weighting
Natural environmental impact	A		A	A	A	A	A	G	5	24
Social impact	B			B	B	E	B	G	3	14
Local land use planning	C				D	E	C	G	1	5
Airport impact	D					E	D	G	2	10
Transport efficiency	E						E	G	4	20
Visual impact	F							G	0	-
Safety	G								6	27
	Weighting Factor =								21	100

10.10 Option Evaluation Matrix

By taking each of the evaluation criteria and then rating each of the options on each of the evaluation criteria and multiplying that rating by the weighting, a weighted and rated evaluation criteria was arrived at. (Ratings are based on a scale of 1 to 10 for each alignment option). Again this process was carried out on a consensus basis. The final evaluation matrix arrived was then retested on any significant conflict between the stakeholders on specific ratings of the evaluation criteria on the options.

Because visual impact had a frequency on the matrix of zero, it was deleted as an evaluation criteria.

After carrying out this process for all of the evaluation criteria, total weighted criteria were established. A summary of the option evaluation matrix is shown in Table 10.4.

Table 10.4 Option Evaluation Matrix

Evaluation Criteria	Weighting	Options					
		A (Upgrade Existing)	B (Partial By-pass)	C1 (Cobaki Crossing)	C2 (Tunnel Closest to Airport)	C4 (Hybrid C1 / C2)	B2 (Realigned - Partial Bypass)
Natural environmental impact	24	240/10	192/8	24/1	120/5	96/4	192/8
Social impact	14	42/3	28/2	98/7	112/8	112/8	28/2
Land use planning	5	15/3	20/4	15/3	20/4	30/6	25/5
Airport impact	10	70/7	60/6	40/4	20/2	80/8	50/5
Transport efficiency	20	40/2	80/4	140/7	180/9	180/9	10/5
Safety	27	54/2	81/3	243/9	162/6	189/7	108/4
Total Weighted Criteria		461	461	560	614	687	503
Weighted Ranking		5	5	3	2	1	4

The highest ranking option was Option C4.

10.11 Value Ratio Ranking

There was a general feeling among the participants that construction costs should be considered in order to substantiate the matrix. However, since the available figures for construction costs were estimates (to be confirmed at a later date), it was decided that the figures for construction costs should

be tabled separately from the Option Evaluation Matrix in Table 10.4. The construction costs shown below (Table 10.5) are the revised construction cost estimates presented on day 2 which included allowances for habitat compensation and compensation for the loss of GCCC and GCAL land.

Table 10.5 Value Ratio Ranking

Evaluation Criteria	Weighting	Options					
		A (Upgrade Existing)	B (Partial By-pass)	C1 (Cobaki Crossing)	C2 (Tunnel Closest to Airport)	C4 (Hybrid C1/C2)	B2 (Realigned)
Construction Cost (incl. acquisition ($M)		108	125	138	173	157	135
Value Ratio		4.3	3.7	4.1	3.5	4.4	3.7
Value Ratio Ranking		2	4	3	6	1	4

The highest ranking option based on the cost estimates provided at the workshop, was Option C4.

10.12 Highest Ranking Option

The outcome of the evaluation of options by all stakeholder representatives at the workshop was that Option C4 was the highest ranking option. Sensitivity testing of the evaluation matrix following the selection of Option C4 confirmed this option as the highest ranked option.

The remainder of the workshop was directed towards the refinement of the highest ranked option to accommodate improvements suggested by participants.

10.13 Route Refinement

The route refinement recommendations including the preliminary risk assessment and action planning are reported in the workshop report in Appendix J.

These recommendations included a wide range of suggestions by agency representatives to minimise and manage impacts during the design and construction phase.

Recommendations were made within the following broad categories:

> minimise environmental impact/help reduce habitat fragmentation;
> maximise land use potential;
> minimise airport impact;
> minimise property impact;
> integrate project components; and
> streamline approval process.

The action list of recommendations will be used to refine the concept design during detailed impact assessment phase of the project.

The preliminary risk assessment involved the identification of risk categories and risk areas followed by the identification and qualification of the perceived risks. Major, moderate and minor risks were identified within the risk categories of:

> political;
> legal;
> community;
> environmental;
> approvals;

- funding;
- technical/engineering; and
- administration.

11. Conclusions

The conclusions of the route selection report are as follows:

> traffic modelling has predicted strong growth in traffic volumes on the existing Gold Coast Highway/Pacific Highway corridor at Tugun;

> traffic movements are expected to increase from a current level of 47,000 vehicles per day to 70,000 vehicles per day within the next ten years;

> congestion delays and poor level of safety on the existing corridor can be expected to worsen over time as traffic volumes increase;

> the level of service on the Tugun section of the Pacific Highway route can be expected to significantly degrade, particularly compared to other sectors of the route to the north and south of Tugun where significant upgrading is both planned and under construction to improve traffic conditions on the Pacific Highway between Sydney and Brisbane;

> there is a demonstrated need to increase capacity, reduce delays and increase road safety in the Tugun area for both local and regional traffic;

> a full range of options have been examined including railway corridor options. All options previously examined in the Southern Gold Coast Tweed Corridor Study have been re-examined in greater detail. A new option (option B2) recommended by Tweed Shire Council has also been evaluated;

> preliminary investigations have been undertaken of the environmental, social and economic impacts of the options. Further investigations will be necessary as part of the detailed impact assessment of the project;

> the evaluation of options and selection of a preferred option was undertaken in a Value Management workshop involving representatives from organisations and agencies at the Commonwealth, State and Local government levels in both NSW and Queensland.

> the outcome of the Value Management workshop was that Option C4 was the highest ranking option in terms of the agreed evaluation criteria and the weightings assigned by the workshop participants to those criteria; and

> a set of recommendations were made by workshop participants for the refinement of Option C4 to minimise environmental impacts.

It is recommended that Option C4 be adopted by the Commonwealth, NSW and Queensland governments as the preferred option for the route of the Pacific Highway at Tugun.

Further, it is recommended that formal impact assessment of the C4 option commence under a joint process to satisfy the impact assessment requirements of the Commonwealth, NSW and Queensland.

Appendix F

Properties affected by the proposal

Appendix F

Properties affected by the proposal

The following properties would need to be acquired either in full or in part, or an agreement required between the proponent and landholders, in order for the proposal to proceed. Figure 12.4 shows the location of the properties.

Table E1 Properties to be affected by the proposal

Number (refer to Figure 12.4)	Property description	Property owner	Property area (m^2)	Approximate area to be acquired (m^2)	Zoning	Current use	Status
1	32RP112932 (Qld)	Main Roads	814	814	Residential	Residential	AC
2	33RP112932 (Qld)	Main Roads	607	607	Residential	Residential	AC
3	6 RP196131 (Qld)	Gold Coast City Council	144,352	480	Future Urban	Vacant	AC
4	6RP855719 (Qld)	Pacific Exchange Corporation	240,345	110,140	Future Urban	Vacant	AR
5	3 RP837321 (Qld)	Gold Coast City Council	533,333	6,688	Special Use	Tugun Landfill	AR
6	Boyd Street (Qld)	Gold Coast City Council	Road Reserve	2,604	Road Reserve	Quarantine Area	BA
7	7046 DP92695 (NSW)	Crown Land	25,443	2,005	Environmental Protection/ Special Use	Quarantine Area	BA
8	321 DP755740 (NSW)	Crown Land	101,712	1,146	Environmental Protection/ Special Use	Vacant	BA
9	Land north and east of Lot 58DP755740 (710 DP726654) (NSW)	Crown Land	670,822	78,247	Environmental Protection/ Special Use	Vacant	BA
10	Boyd Street (NSW)	Tweed Shire Council	69,285	1,735	Special Use/ Environmental Protection	Vacant	BA
11	58 DP755740 (NSW)	Crown Land	245,937	5,032	Environmental Protection/ Special Use	Vacant	BA
12	4 DP854935 (Commonwealth)	Commonwealth of Australia	397	397	Special Use	Sublease to Gold Coast Airport	BA
13	2 DP535537 (Commonwealth)	Commonwealth of Australia	3,803,416	150,257	Special Use/ Environmental Protection	Gold Coast Airport	BA
14	319 DP755740 (NSW)	Crown Land	382,379	49,146	Open Space/ Environmental Protection/ Special Use	Tweed Heads Pony and Hack Club	BA

Number (refer to Figure 12.4)	Property description	Property owner	Property area (m^2)	Approximate area to be acquired (m^2)	Zoning	Current use	Status
15	17 DP8655 (NSW)	Main Roads	81,535	28,950		Vacant	AC
16	1 DP226067 (NSW)	Main Roads	69,164	59,027	Rural	Vacant	AC
17	3 DP226067 (NSW)	Main Roads	28,833	28,833	Rural/ Special Use	Vacant	AC
18	1 DP412404 (NSW)	Main Roads	650	650	Residential	Vacant	AC
19	5 DP226067 (NSW)	Main Roads	1,238	1,238	Rural/ Special Use	Vacant	AC
20	6 DP226067 (NSW)	Main Roads	20	20	Rural	Vacant	AC
21	Parkes Drive (NSW)	Tweed Shire Council		5,626	Road Reserve	Road	BA
22	6 DP849367 (NSW)	Caveda Pty Ltd	37,757	5,934	Special Use	Vacant	AR
23	Rose Street (NSW)	Tweed Shire Council	2,534	1,2,534	Road Reserve	Vacant	BA
24	10 DP719753 (NSW)	Tweed Shire Council	4,097	4,097	Open Space/Road Reserve	Open Space	BA
25	Banksia Street	Tweed Shire Council		220	Road Reserve	Road	BA
26	1 SP43056 (NSW)	Main Roads	1,081	379	Residential	Residential	AC
	2 SP43056 (NSW)				Residential	Residential	AC
	3 SP43056 (NSW)				Residential	Residential	AC
	4 SP43056 (NSW)				Residential	Residential	AC
	5 SP43056 (NSW)				Residential	Residential	AC
27	Road Reserve (NSW)	Tweed Shire Council		38	Road Reserve	Road	BA
28	1 SP41959 (NSW)	Main Roads	1,280	76	Residential	Residential	AC
	2 SP41959 (NSW)				Residential	Residential	AC
	3 SP41959 (NSW)				Residential	Residential	AC
	4 SP41959 (NSW)				Residential	Residential	AC
	5 SP41959 (NSW)				Residential	Residential	AC
	6 SP41959 (NSW)				Residential	Residential	AC
29	18 DP255367 (NSW)	NSW RTA	33,479	33,479	Special Use	Tweed Heads Bypass	BA
	19 DP255367 (NSW)						
	20 DP255367 (NSW)						
	21 DP255367 (NSW)						
	22 DP255367 (NSW)						

Number (refer to Figure 12.4)	Property description	Property owner	Property area (m^2)	Approximate area to be acquired (m^2)	Zoning	Current use	Status
	23 DP255367 (NSW) 24 DP255367 (NSW) 25 DP255367 (NSW) 26 DP255367 (NSW) 27 DP255367 (NSW) 28 DP255367 (NSW) 49 DP10436 (NSW) 50 DP10436 (NSW) 51 DP10436 (NSW) 1 DP10297 (NSW) 1 DP207594 (NSW) 1 DP410364 (NSW)						
30	Honeysuckle Street (NSW)	Tweed Shire Council		401	Road Reserve	Road	BA
31	Parkes Drive (NSW)	Crown Land	1,356	1,356	Special Use	Road	BA
32	10 DP226067 (NSW) 11 DP226067 (NSW) 12 DP226067 (NSW) 13 DP226067 (NSW) 14 DP226067 (NSW) 15 DP226067 (NSW)	Tweed Shire Council	39,790	39,790	Special Use	Tweed Heads Bypass	BA
33	Kennedy Drive (NSW) (including 29DP255367)	Tweed Shire Council	2,992		Special Use	Road	BA
34	1 DP559828	NSW RTA			Special Use	Road	BA

Note: Current as of June 2003

AC = Acquisition complete

AR = Acquisition required

BA = By agreement

Appendix G

Study team

Appendix G

Study team

Tugun Bypass Alliance study team

Alliance Leadership Team

Derek Skinner	Main Roads
Eddie Peters	Main Roads
Jack Donaghey	Main Roads
Mike Wilke	Parsons Brinckerhoff
Phil Clutterbuck	Main Roads
Roger Pattison	Parsons Brinckerhoff
Greg Steele	Parsons Brtinckerhoff
Wes Stevenson	NSW RTA
Dave Rankin	Parsons Brinkerhoff

Tugun Management Team

Phil Clutterbuck	Project Director
Doug Robinson	Project Manager
Lydia Czosnowska	Approvals Manager
Mark Kunzer	Environment and Planning Coordinator
Hugh Donaldson	Engineering Coordinator
Leisa Prowse	Community Consultation Coordinator
Kent Kieseker	Integration Manager

Integrated Alliance Team

Parsons Brinckerhoff

Environment and Planning	**Engineering**	**Traffic and Transport**	**Graphics and Drafting**
David Fingland	Roy Wade	Damien Bitzios	Jemay Carillo
Allison Rushton	Steve Williams	Jason Van Paassen	Leanne Balodis
Tim Carlton	Hugh Donaldson	Kristian Kirk	Alastair Moir
Ann Perkins	Peter Mathers	Tim Brown	Luceta Goyena
Tony Duncan	Brian Keller	Noel Kay	Fran Golding
Dave Davis	Michael Shipman	Michelle Mee	Daniel Bykiw
Tatia Zubrinich	Craig Ridgeway		Trent Talbot
David Hannah	Brad Tite		Vicki Zillman
Meredith Woodland	Dean Toomey		Ruth Ridgway
Ainslie Just	Mark Le Pla		Geoff England
Robert Scott	Tim Jennings		
Stacey Brodbeck	Michael Salu		
Holly Bryant	Adrian Bulcock		
Ben Skerman	Damian Bicknell		

Economics	**Community Consultation**	**Technical and Office Support**
Glen d'Este	Catherine Singleton	Margie Jones
Mark Williams	Naomi Cavanagh	Karina Curry
Leon Drewe	Robert Allen	Anne Kelly
	Kate Gilmore	

Peer Review

Gerard Ryan	Manager	SKM	Groundwater
David Fingland	Environment		
Hugh Donaldson	Engineering		
Eppell Olson	Traffic		
Shaun Nugent	Structures		
Arthur Hall	Noise		
Libby Paholski	Consultation		
Linda White	Consultation		
Evans and Peck	Capital Costs		

Specialist Sub-Consultants

Flora and Fauna

Ecosence Consulting	Renata Bali
Eco Pro	Khaalyd Brown
Sandpiper Ecological Surveys	David Rohweder
Queensland Museum	John Stanisic
Griffith University	Jean-Marc Hero
	Luke Shoo
Biolink	Steve Phillips
Ben Lewis Surveys	Ben Lewis
Deniss Reeves	
FRC Environmental	John Thorogood
FRC Environmental	Carolyn Conacher
Biodiversity Assessment and Management Pty Ltd	Glen Ingram
	Adrian Caneris

Air Quality

Katestone Scientific	Mark Kanowski

Hydrology and Surface Water Quality

WBM Oceanics Australia	Leon Rowlands
	Greg Rogercamp

Noise

Wilkinson Murray	Rob Bullen

Indigenous and Non Indigenous Cultural Heritage

Bonhomme Craib and Associates	Teresa Bonhomme
	John Craib

Photomontages and Artists Impressions

A1 Architectural Perspectives	Christine Hayes-Brown
Phillip Beggs Illustrations	Phillip Beggs

Appendix H

Environmental record of the proponents

Appendix H

Tugun Bypass Commonwealth Requirements

Environmental Record of the NSW RTA

Environmental Protection Biodiversity Conservation Regulations 2000

Reg 5.04; Schedule 4 Item 6

6.01 Environmental record of person proposing to take the action

Provide details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:

(a) the person proposing to take the action; and

(b) for an action for which a person has applied for a permit, the person making the application.

6.02 If the person proposing to take the action is a corporation, provide details of the corporation's environmental policy and planning framework.

NSW RTA Response

The NSW RTA is a major infrastructure agency with responsibility for the delivery of a substantial road and bridge development and maintenance program. Within this context it is submitted that the NSW RTA has a good environmental record which is largely due to the commitment of its staff to environmental outcomes and the systems it has put in place.

There have however been occasions where successful proceedings have been brought against the NSW RTA for offences concerning environmental harm under environmental protection legislation and there have also been instances where penalty infringement notices have been issued under such legislation. The RTA has searched its records of such instances and the available details are provided below:

- Environmental Protection Authority v Roads and Traffic Authority of New South Wales [1998] NSWLEC 3 – The Court found that RTA grit blasting operations on the Wallaby Rock Bridge over the Turon River near Bathurst resulted in material containing paint, limestone and copper slag grit entering the river. This amounted to an offence under the *Clean Waters Act, 1970*.

  On 2 February 1998 the court imposed a penalty of $30,000 and awarded the EPA $6000 in costs. In determining the penalty to be imposed the Court considered the following:

  - the harm to the environment which was found to have occurred
  - the absence of measures to prevent, control or mitigate harm
  - that the NSW RTA should reasonably have foreseen that contamination of the river was possible by paint flakes and grit falling from the bridge
  - that the NSW RTA was in control of the operation
  - the NSW RTA's early guilty plea

- the fact that the NSW RTA had no prior record which, given the extent of its operations and responsibilities, signified a good record and care of environmental matters.
- the extensive clean-up undertaken by the NSW RTA at a cost of $125,000 coupled with evidence that the affected environment had been restored
- the review of RTA procedures and the existence of a training system which should help prevent a similar occurrence in the future.

Subsequent to the incident, the requirements for effective management of the environment were communicated to all relevant staff through workshops, training courses and site visits. Relevant systems were also reviewed:

- Penalty Infringement Notice (P8669550) issued 3 June 1998 - $600 fine for inadequate sediment controls at a NSW RTA site on the corner of Stoney Creek Road and King Georges, Beverly Hills.
- Penalty Infringement Notice (Z0578326) issued 21 February 2000. $1500 fine for the inappropriate cleaning of a bitumen sprayer at a roadside stockpile site near Bowenfels. The infringement was for cleaning the sprayer at a location which created the potential to pollute an onsite drain and possibly other waters. Routine maintenance contractors working for the NSW RTA are now required to specifically address this issue in the relevant Contractor Environmental Management Plan.
- Penalty Infringement Notice (reference number not available) issued 18 January 2002. A subcontractor working on the Tandys Lane Upgrade, Pacific Highway, employed an incorrect sediment basin pump out procedure and in doing so breached a condition of an Environmental Protection Licence. The issues raised by this incident have been used within the NSW RTA to illustrate the importance of adhering to environmental protection procedures.

Further to the above, third parties have previously commenced civil proceedings in the Land and Environment Court against the NSW RTA alleging breaches of the *Environmental Planning and Assessment Act (NSW), 1979* and seeking injunctions restraining the NSW RTA from carrying out work. These kind of proceedings brought against the NSW RTA and which have been determined by the Court include:

- Drummoyne Municipal Council v Roads and Traffic Authority Of New South Wales (1989) 67 LGRA 155
- Liverpool City Council v Roads and Traffic Authority Of New South Wales and Interlink Roads Pty Ltd (1991) 74 LGRA 265
- Fay v Roads and Traffic Authority Of New South Wales (No 2) (1991) 25 ALD 201
- Residents of Blacktown and Seven Hills Against Further Traffic Inc v Roads and Traffic Authority Of New South Wales (1996) LEC 40106 0f 1996
- Transport Action Group Against Motorways Inc v Roads and Traffic Authority and Another (1999) 46 NSWLR 598

To the NSW RTA's knowledge, the Land and Environment Court has not made any formal declarations of breach in the period since the constitution of the NSW RTA by the *Transport Administration Act, 1988*. In the Liverpool Council proceedings the Court made a finding that the NSW RTA had breached section 112 of the *Environmental Planning and Assessment Act (NSW), 1979* but declined to order any injunction. In each of the other cases, the Land and Environment Court did not make any findings of breach of the *Environmental Planning and Assessment Act (NSW), 1979* and did not order an injunction against the NSW RTA.

A copy of the NSW RTA Environmental Policy is provided at Tab A.

Details of the NSW RTA's environmental planning and management processes provided at Tab B.

NSW RTA Environmental Policy, Guidelines and Procedures

Introduction

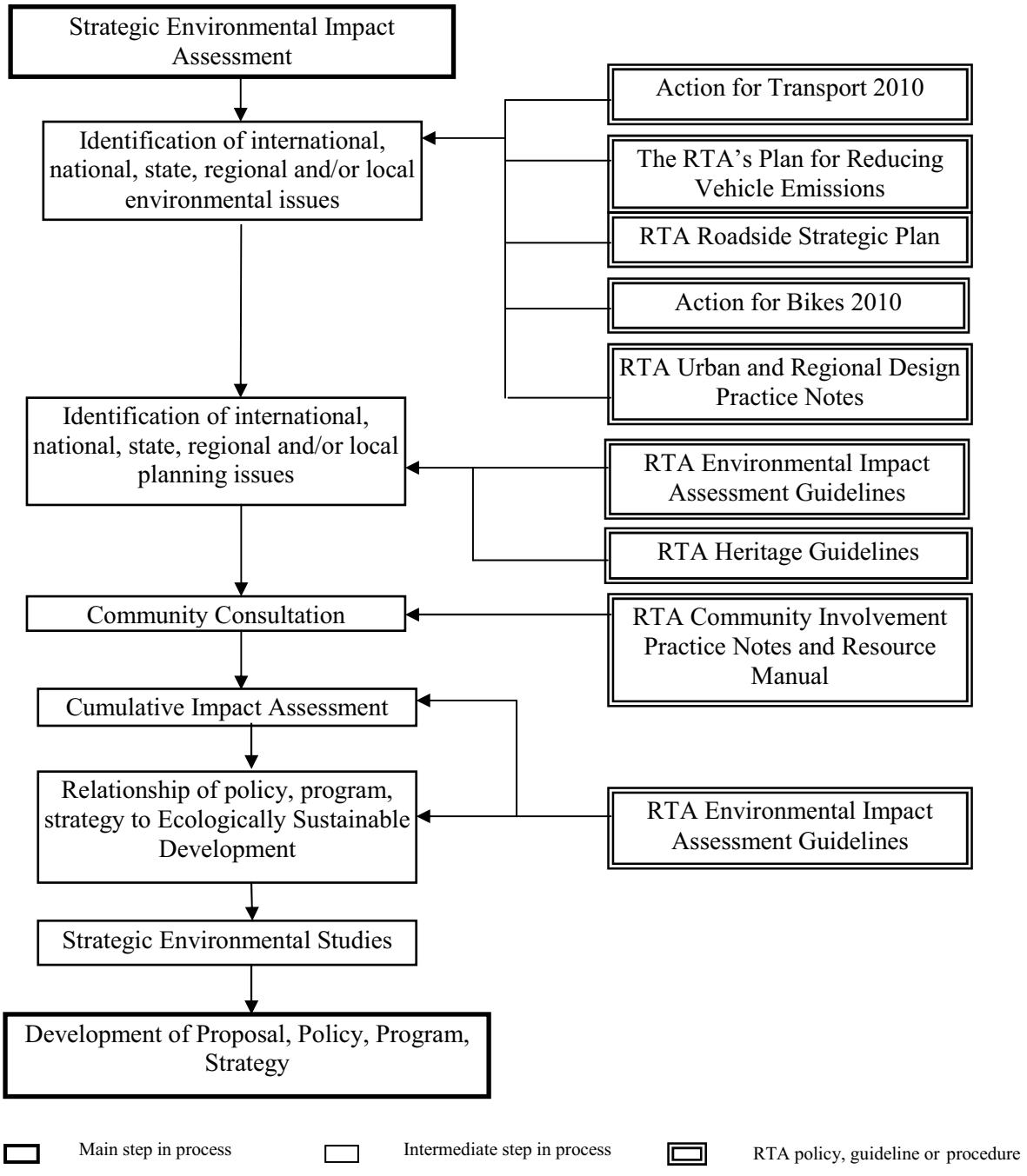
To ensure that the NSW RTA meets its environmental obligations and commitments, a number of specific environmental policies, guidelines and procedures have been developed and implemented.

The following sections indicate how these policies, guidelines and procedures apply to and influence the NSW RTA's project development, construction and maintenance processes.

Network Planning

Network planning examines broad scale land use and transport planning issues. It is a crucial component in establishing the need for a proposal, policy, program or strategy. At this broad level of planning, Strategic Environmental Impact Assessment may be used to identify and evaluate the likely environmental impacts of proposals, policies, programs and strategies by considering international, national, state, regional and/or local planning and environmental matters.

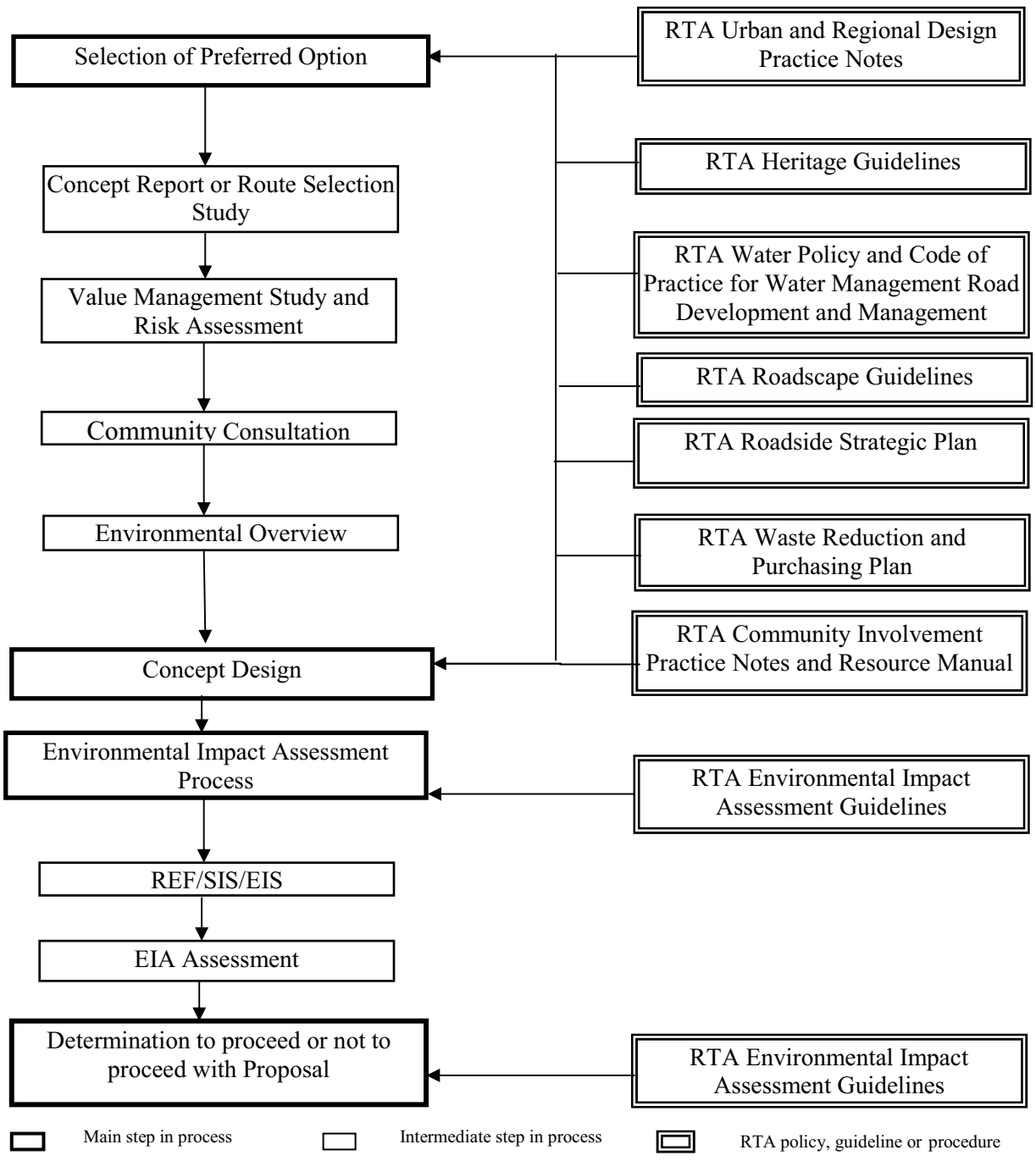
Network Planning Process Map



Concept Development and EIA

Once a need for a proposed activity (whether construction or maintenance) has been established, the Concept Development and EIA process examines all feasible options to meet the need, identifies the preferred option, develops a concept design, undertakes detailed environmental impact assessment of the preferred option and determines whether the project should proceed or not.

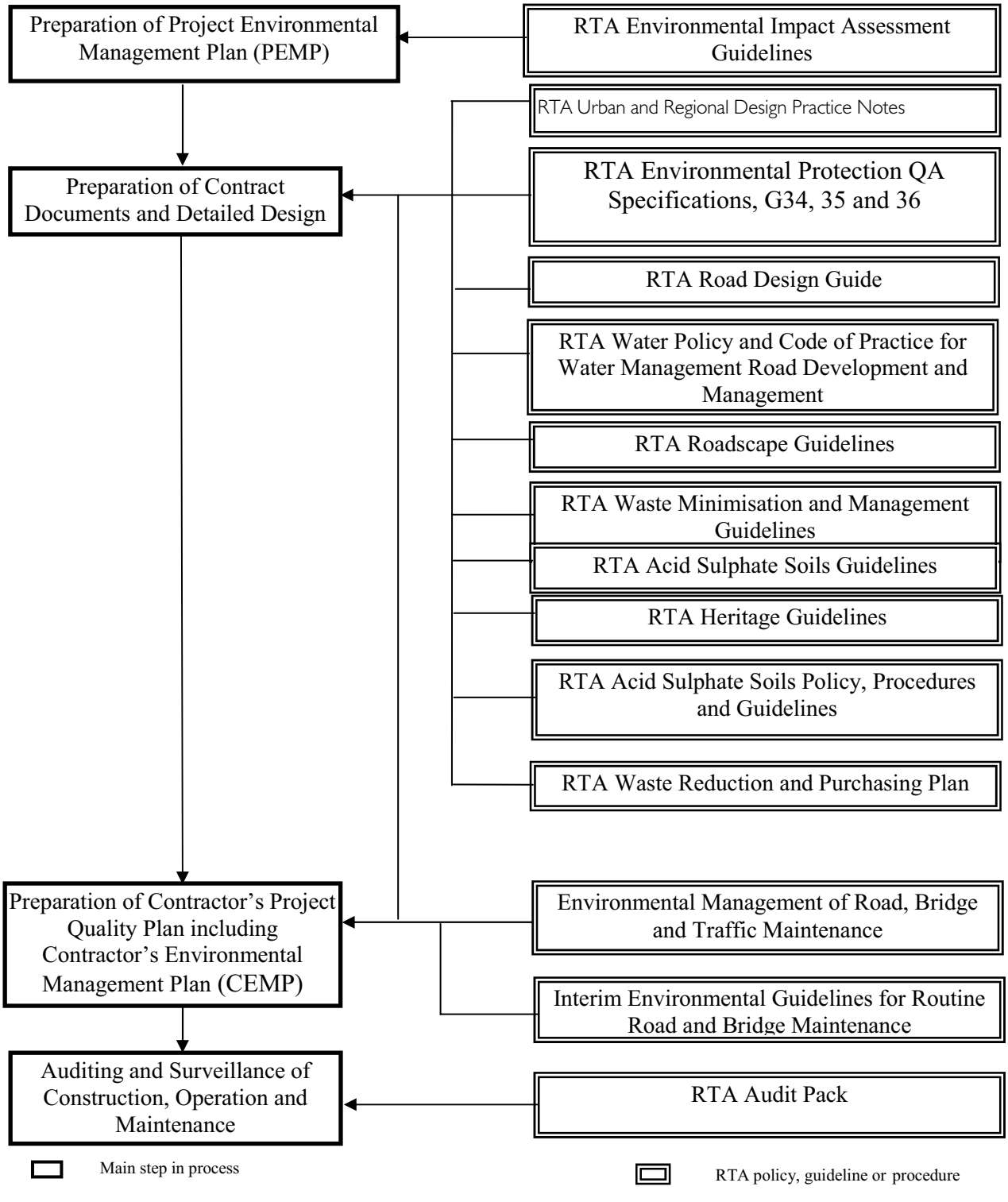
Concept Development and EIA Process Map



Design Development and Contract Management

Design development and contract management includes detailed design, preparation and assessment of tenders, contract management and auditing. This process map ensures that the environmental measures required as conditions of project approval in assessment and determination of the REF or EIS are implemented during Project Implementation.

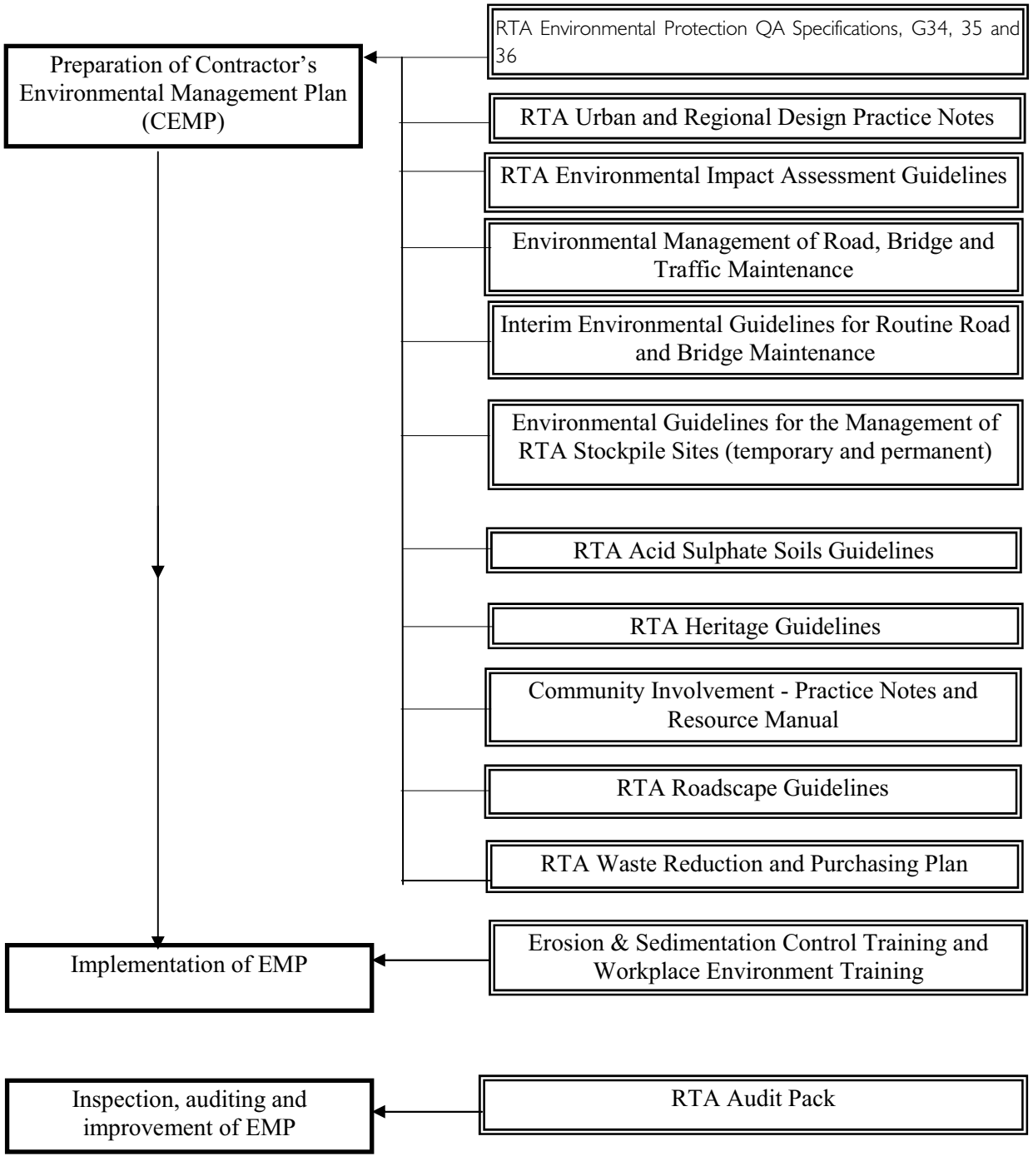
Design Development and Contract Management Process Map



Construction, Operation or Maintenance

Once a need for a proposed activity (whether construction or maintenance) has been established, the Concept Development and EIA process examines all feasible options to meet the need, identifies the preferred option, develops a concept design, undertakes detailed environmental impact assessment of the preferred option and determines whether the project should proceed or not.

Construction, Operation or Maintenance Process Map



Queensland Department of Main Roads environmental record

Main Roads has never been prosecuted for an offence under a Commonwealth, State or Territory Law for the protection of the environment or sustainable use of natural resources.

However, in July 2001 Roadtek (Main Road's commercial construction arm) received an infringement notice from Brisbane City Council for leaving a small amount of material (a cubic metre of soil) in a location (urban intersection) that meant is could potentially erode (in the case of rain) into the nearby stormwater system.

Roadtek did not defend the claim and paid the relevant fine.

They have not received an infringement notice since.

Department of Main Roads Environmental Planning Policies and Practices

Main Roads recognises both the statutory requirement and community expectation for maintaining and upgrading the State-controlled road network in an environmentally sensitive manner. In addition, Main Roads strives for continual improvement of all practices including their environmental performance. In order to achieve this, a coordinated approach to environmental management with well-defined processes is in place.

Environmental Policies and Strategies

Main Roads have a number of policies and strategies that provide overall direction for environmental planning and management with the department. These include:

- Roads Connecting Queenslanders:
  - outlines strategic long-term direction for Queensland road system and Main Roads
  - environmental management to support environmental conservation.
- Main Roads Strategic Plan 2002 – 2007:
  - identifies specific strategies which deliver Main Roads outcomes including environmental conservation.
- Environmental Management Policy and Strategy 1997 (2002 –2007 Draft):
  - identifies the need for an adequate level of environmental assessment for all construction projects, and the development and implementation of environmental management plans.

As part of the Environmental Management Policy and Strategy Main Roads commits itself to the following environmental policy:

"Main Roads is committed to the protection of the environment by observing the Government's policy of ecologically sustainable development.

Main Roads will contribute to sustainable development in the provision of transport infrastructure through constant improvement in environmental performance, the commitment and involvement of all its employees, and by fulfilling the requirements of State and National strategies and legislation."

Operational Policies

In addition to the overall direction provided by broad environmental policies detailed above Main Roads also have a number of operational policies, which set the standard for the management of specific environmental issues within the organisation. These operational policies include:

- clearing with in road boundaries
- cultural heritage

- landscaping
- traffic noise pollution
- awareness signage for significant areas
- weed and pest management (draft).

Environmental Process Manuals and Guidelines

To facilitate the implementation of these policies a number of manuals and guidelines are in place. Environmental planning and management processes are outlined in the Road Project Environmental Processes Manual (1997). This manual outlines the environmental processes for road activities through their network planning, concept and development, implementation and finalisation, maintenance and network administration phases.

It details the preferred process for environmental assessment and management for activities undertaken by Main Roads, and for activities carried out by other developers within the State-controlled road reserve. The manual also assists in raising the awareness of the environmental issues that may affect or be affected by such activities and the process of decision-making and management. Figure 1 illustrates the various documents developed to ensure effective environmental management of road projects.

As the manual represents current Main Roads 'best practice', it is updated and maintained as necessary. In addition to the Road Project Environmental Processes Manual Main Roads have a number of other documents that support environmental management. These documents include (in no particular order):

- Environmental Legislation Register
- Total Project Cost Control Guidelines
- Preconstruction Processes Manual
- Road Planning and Design Manual
- Draft Drainage Design Manual
- Cultural Heritage Manual
- Road Landscape Manual
- Roads in the Wet Tropics Manual and Road Maintenance Code of Practice for the Wet Tropics World Heritage Area
- Code of Practice for the Management of Road Traffic Noise
- IPA Planning Scheme Manual
- IDAS Manual for Main Roads as an Applicant
- Guidelines for Assessment of Road Impacts of Development Proposals
- Public Consultation Policy & Guidelines
- Standard Contract documentation (e.g. Environmental Management—MRS 11.51)
- Fauna Sensitive Road Design—Volume 1: Past and Existing Practices.

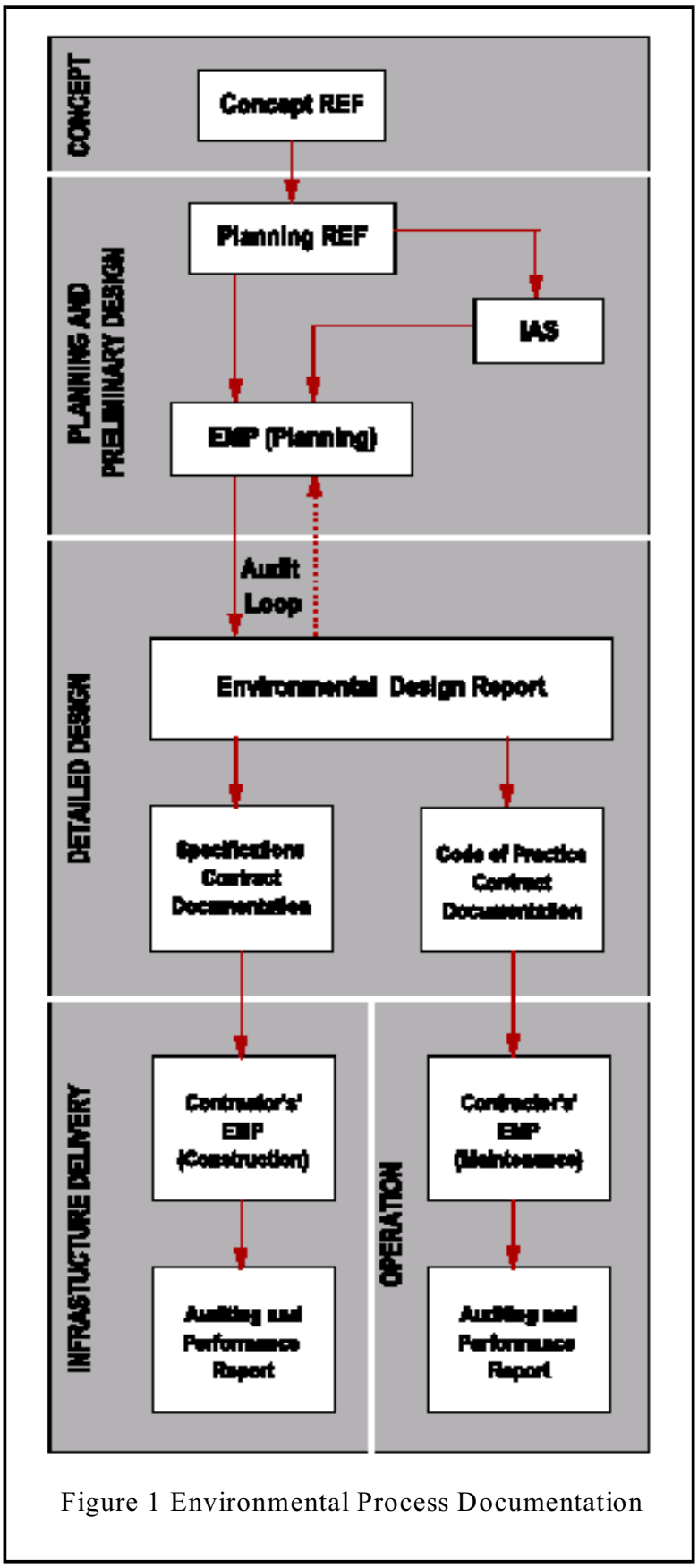


Figure 1 Environmental Process Documentation