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RTA

Coffs Harbour bypass

Concept design report

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Concept Design Report
Coffs Harbour Bypass

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Contents

Executive summary

The Coffs Harbour Highway Planning Strategy (CHHPS) was launched in September 2001. The strategy addresses the need to upgrade the Pacific Highway between Sapphire and Woolgoolga, covering the city's northern beaches precincts, while planning for future traffic needs within the Coffs Harbour urban area. The CHHPS covers a study area from Sawtell in the south to Arrawarra in the north.

Planning for the CHHPS was initially funded by the NSW Government as part of the 10-year Pacific Highway Upgrading Program from 1996 to 2006. The CHHPS has been developed by the Roads and Traffic Authority (RTA) in consultation with other government agencies, Coffs Harbour City Council (CHCC) and the community.

Currently 277 kilometres of the Pacific Highway, of a total 679 kilometres, are double lane divided road. A further 77 kilometres are under construction. The remaining kilometres are either approved for construction or have had a preferred route identified.

The Pacific Highway is part of the AusLink National Network. By mid-2009 the New South Wales Government will have spent $2.45billion and the Australian Government $1.45billion towards the upgrade of the Pacific Highway. This is in addition to the $2.31 billion committed since 1996 to upgrade the Pacific Highway, of which the NSW Government committed $1.66 billion.

The study area for the CHHPS has been split into two sections as follows:

- Northern (Sapphire to Woolgoolga upgrade) section
- Southern (Coffs Harbour bypass) section

Preferred route alignment

The development of the preferred route on the southern or Coffs Harbour bypass section of the CHHPS is described in three reports previously prepared by Connell Wagner as follows:

- *Preliminary Concept Design Report* (March 2002)
- *CHHPS - Coffs Harbour Section - Strategy Report* (February 2004)
- *CHHPS - Preferred Option Report* (November 2004)

The preferred route comprises the previously displayed Inner South 1 (IS1) and Inner North 2 (IN2) route options and these have been further developed as a combined alignment from south of Englands Road, to the south of the city, through the North Boambee Valley and around the Coffs Harbour basin to Korora, on the northern outskirts of the city.

The Coffs Harbour bypass proposal also includes an upgrade of the existing arterial style dual carriageway highway between Korora Hill and the southern end of the Sapphire to Woolgoolga upgrade project to motorway (Class M) standard by rationalising local property access connections and incorporating a new local service road which would provide for safer access into properties and onto the highway.

Community submissions on preferred route

A number of submissions were received in response to the public display of the preferred route in December 2004. This display included the preferred route for the Coffs Harbour bypass section of the CHHPS in addition to the preferred route for the Sapphire to Woolgoolga upgrade in the northern section of the strategy area.

A total of 22 submissions were received, including multiple submissions from some groups and individual residents. Of the issues raised in the community feedback, the majority were in relation to the selection of the Coastal Corridor as the preferred route, with a number of submissions calling for

the adoption of alternative corridors and the removal of heavy vehicle traffic from the Coffs Harbour area.

Since the announcement of the preferred route and the ongoing development of the concept design, the RTA has continued consultations with Coffs Harbour City Council and directly affected landowners. This has resulted in a number of refinements to the route alignment, provision of special access arrangements where necessary and some additional features to the concept design where practical and feasible.

Purpose of this report

This *Concept Design Report* provides more specific detail of the concept design developed for the bypass proposal, including a synopsis of the key engineering features along the route, including road geometry, bridges and other major structures, provisions for flooding and drainage and preliminary noise mitigation proposals.

The report also details a range of additional investigations undertaken since the announcement of the preferred route and incorporates any changes arising from community submissions or from new or additional information as described above.

Design refinements to the preferred route

A number of refinements have been made to the preferred route which was announced in 2004.

An engineering concept design has been developed for the proposal in accordance with the Draft RTA Pacific Highway Design Guidelines and the RTA Road Design Guide, Austroads and other standards as required. The concept design has been refined to incorporate a range of traffic and transportation, geotechnical investigations, urban design, environmental constraints and a range of property access inputs and constraints

Key features of the concept design

Key features of the proposed bypass alignment and concept design is provided within the respective sections of the route alignment as follows:

- Southern section from Englands Road to Coramba Road
- Northern section from Coramba Road to Korora Hill
- Upgrade of existing Pacific Highway from Korora to Sapphire, connecting the bypass proposal to the Sapphire to Woolgoolga upgrade project.

Property access arrangements

The alignment for the bypass proposal would sever a number of properties over its 14.3km length. Most of these are on the sections with more rugged terrain where there are no local roads for alternate access either side of the bypass.

As a result, reinstatement of accesses to these severed properties would necessitate dedicated overpass or underpass structures in some locations and / or strip acquisition for access across other properties where more appropriate.

Definition of proposed road reserve corridor

The Coffs Harbour bypass proposal has been developed to the stage of a higher concept design so that the proposed boundaries of the road reserve corridor can be set to define future land acquisition requirements.

The proposed road boundaries would be provided to Coffs Harbour City Council by the RTA for incorporation into the new Local Environment Plan for formal zoning of the corridor for future road construction purposes.

Interchanges and local access connections

The proposed bypass would be constructed to motorway standard, with entry to / from the bypass limited to grade separated interchanges at key locations. These interchange facilities would provide for access to / from the proposed highway, the existing Pacific Highway and / or the local road network.

The concept design provides for a total of three interchanges over the length of the proposed bypass as follows:

- Southern interchange at Englands Road
- Central interchange at Coramba Road
- Northern interchange at Korora Hill

The Coffs Harbour bypass proposal also includes an upgrade of the existing arterial style dual carriageway highway between Korora Hill and the southern end of the Sapphire to Woolgoolga upgrade project to motorway (Class M) standard by rationalising local property access connections and incorporating a new local service road which would provide for safer access into properties and onto the highway.

Traffic and transport

A strategic assessment of the traffic and transport issues for the proposed Coffs Harbour bypass was undertaken by Connell Wagner at the corridor investigation phase of the project. This was previously documented and published in the *Strategy Report* (Connell Wagner, 2004) for the CHHPS.

This report revisits the traffic and transport issues, focusing on the preferred route and the recently developed proposals for interchanges and connections to the local road network. It draws on information provided in the *Strategy Report* but is updated where appropriate where new or additional information is available.

Geotechnical investigations

Geotechnical investigations were undertaken by Connell Wagner in 2006 to assist in the corridor definition of the preferred route for the proposed bypass. The scope of the investigation was developed to support the preliminary road concept design that had been developed for the preferred route option to that date.

The investigation was planned to target critical locations along the bypass that would be likely to have a significant impact on the width of the proposed road corridor. In particular, the two deep cuttings on high ridgelines on the northern section of the alignment were investigated in detail.

The geotechnical investigations provided a preliminary assessment of cut and fill batter designs and any associated specialised treatments on these major cuttings, as well as consideration of the feasibility of the alternative tunnel options to cross these ridgelines.

Bridges

As an accessed controlled road the proposed bypass would have complete grade separation from all local roads and property accesses, either as twin longitudinal bridges or a single transverse crossing as either an overpass or underpass. Other bridges are required at major creek crossings and the North Coast Railway Line.

A total of 31 bridges or underpass structures would be required on the bypass proposal and these have been nominated in terms of location, structure type and likely size and span configuration.

Deep cuttings at major ridgelines

A prominent feature of the horizontal alignment of the bypass proposal is that it passes through two major and two other substantial ridgelines as it traverses around the Coffs Harbour basin. The two major ridgelines crossed are north of Shephards Lane and west of Gatelys Road and the other substantial ridges are at the Roberts Hill ridgeline and immediately south of Bruxner Park Road.

The vertical alignment of the bypass proposal has been developed to provide a best fit through the natural terrain constraints and the resultant cutting depths on these four ridges would be substantial, ranging from 40 metres to 65 metres.

The excavation of major cuttings on the ridgelines pose risks in the following key areas:-

- Depth of excavation of the design and the ongoing maintenance of the cutting
- Large volumes of surplus fill which may be in excess of project requirements
- Potential negative urban design outcomes due to the wide expanse of clearing
- Difficulty in cost estimation/certainty of price

Potential tunnel construction

As an alternative to the excavation of deep cuttings, the feasibility of tunnels has been considered on three of the four major ridgelines. The rationale for consideration of tunnels instead of the earthworks on these major ridges is that the ridges are quite steep and that the resulting tunnels would be relatively short at less than 500 metres. As such any bypass tunnels would be less likely to require major ventilation and emission control systems.

With the provision of tunnels it would be possible to substantially lower the proposed vertical alignment in that vicinity, allowing the bypass to be lowered more sympathetically into the existing terrain either side of the major ridgelines, with consequent aesthetic and acoustic benefits.

Comparison of tunnels and deep cuttings

A comparison of the feasibility of tunnel structures, as an alternative to deep cuttings at the major ridgelines on the bypass route was undertaken as part of the concept design development.

The assessment included consideration of issues in relation to both tunnel and deep cutting construction and the potential costs and benefits of each. The practicality and comparative requirements for each of the two major ridgelines north of Shephards Lane and west of Gatelys Road was also assessed.

A decision on whether to proceed with tunnels through each of the nominated ridges would be undertaken at the time of detailed planning and environmental assessment of the bypass proposal. This would include further analysis of (then) current costs for tunnel construction and large earthworks operations, and an assessment of the urban design and socio-economic impacts of the options – including potential micro-climate impacts and impacts on agricultural and other properties.

In the interim period the proposed road reservation to be put forward by the RTA for incorporation within CHCC local planning instruments has been established using the conservative cut batter widths for the road formation through the deep ridges.

Additional investigations

A range of additional investigations have been undertaken to support the development of the concept design for the bypass proposal. These are outlined in subsequent sections of this report. The additional engineering and preliminary environmental investigations undertaken were as follows:

- Flooding and drainage.
- Noise mitigation.
- Urban design and landscaping.
- Ecology.

All of these investigations would be undertaken in greater detail as part of the environmental assessment of the bypass proposal.

1. Introduction

The Coffs Harbour Highway Planning Strategy (CHPPS) was launched in September 2001. The strategy addresses the need to upgrade the Pacific Highway between Sapphire and Woolgoolga, covering the city's northern beaches precincts, while planning for future traffic needs within the Coffs Harbour urban area. The CHHPS covers a study area from Sawtell in the south to Arrawarra in the north.

Planning for the CHHPS was initially funded by the NSW Government as part of the 10-year Pacific Highway Upgrading Program from 1996 to 2006. The CHHPS has been developed by the Roads and Traffic Authority (RTA) as part of this program, in consultation with other government agencies, Coffs Harbour City Council (CHCC) and the community.

Currently 277 kilometres of the Pacific Highway, of a total 679 kilometres, are double lane divided road. A further 77 kilometres are under construction. The remaining kilometres are either approved for construction or have had a preferred route identified.

The Pacific Highway is part of the AusLink National Network. By mid-2009 the New South Wales Government will have spent $2.45billion and the Australian Government $1.45billion towards the upgrade of the Pacific Highway. This is in addition to the $2.31 billion committed since 1996 to upgrade the Pacific Highway, of which the NSW Government committed $1.66 billion.

The study area for the CHHPS has been split into two sections as follows:

- Northern (Sapphire to Woolgoolga upgrade) section
- Southern (Coffs Harbour bypass) section

The preferred route for the CHHPS was announced in December 2004 and the proposed alignment within each section was placed on public display at that time. Since then, both sections of the CHHPS have remained at the preferred route stage but the current strategy implementation for each section is variable as follows:

- The Sapphire to Woolgoolga Upgrade section has been developed to the stage of a detailed concept design and the proposed upgrade was the subject of an environmental assessment that was placed on formal public exhibition from November 2007 to February 2008. A report on the submissions received following the exhibition of the environmental assessment was forwarded to the Department of Planning in June 2008.
- The concept design for the proposed Coffs Harbour bypass is to be placed on public display to provide another round of community input to the preferred route and the concept design. At the time of the preferred route display the State Government announced that it would work closely with CHCC to ensure the required land was reserved for the future construction of the preferred route at Coffs Harbour.

The focus of this report is the post-2004 development of the Coffs Harbour bypass, including a range of additional survey and geotechnical investigations, refinements to the concept design, detailed consideration of property access requirements and investigations into potential tunnel options through major ridgelines. All of these have been inputs to the definition of a proposed corridor for land reservation purposes.

Following display of the concept design the RTA will consider issues raised in any comments received. Once this process is finalised CHCC will be approached to take planning action to formally reserve the corridor. The boundaries of the corridor will be based on the final concept design.

Timing of construction will depend on funding availability. Once this is determined, the environmental assessment will commence and planning approval will then be sought. Further refinements may occur during the environmental assessment stage of the project and in response to community comments.

2. Project development

A wide range of potential highway corridors and route options were investigated during the development of the CHHPS. These have included options developed by the project team and options put forward by Coffs Harbour City Council (CHCC) and the community.

2.1 Corridor identification and selection

The options investigated for the CHHPS fall within three broad strategic corridors as follows:

- *Far Western Bypass*. A bypass of Coffs Harbour and Woolgoolga through the Orara Valley from Englands Road south of Coffs Harbour to Halfway Creek or Grafton. The investigation of the feasibility of this strategic option concluded that it could not be justified within the foreseeable planning future due to the relatively low traffic volumes predicted to use it, the very high cost and the lack of staging opportunities.

- *CHCC Preferred Corridor*. Options within a corridor adopted by CHCC in late 2003 as its preferred option for a bypass of Coffs Harbour and Woolgoolga. The feasibility assessment of this corridor found that options within the corridor, including the Coastal Ridge Way / Option A, are not viable as they present significant engineering challenges, provide poor functional performance, are high cost and provide poor value for money. The route options in this corridor also have very significant biophysical impacts on native flora and fauna and a landscape of Aboriginal significance.

- *Coastal Corridor*. Options along the coastal plain between Englands Road south of Coffs Harbour and Arrawarra Creek north of Woolgoolga, with a future extension as part of the Woolgoolga to Wells Crossing project.

Following a range of detailed planning and engineering investigations, community input and discussions with a range of government agencies, the Coastal Corridor was adopted as the preferred option for the CHHPS.

The preferred route within the Coastal Corridor is the alignment that combines the inner bypass options for Coffs Harbour (Options IS1 and Option IN2), upgrading of the existing highway from Korora to South Woolgoolga to dual carriageway and the Option E bypass of Woolgoolga.

2.2 Preferred route alignment

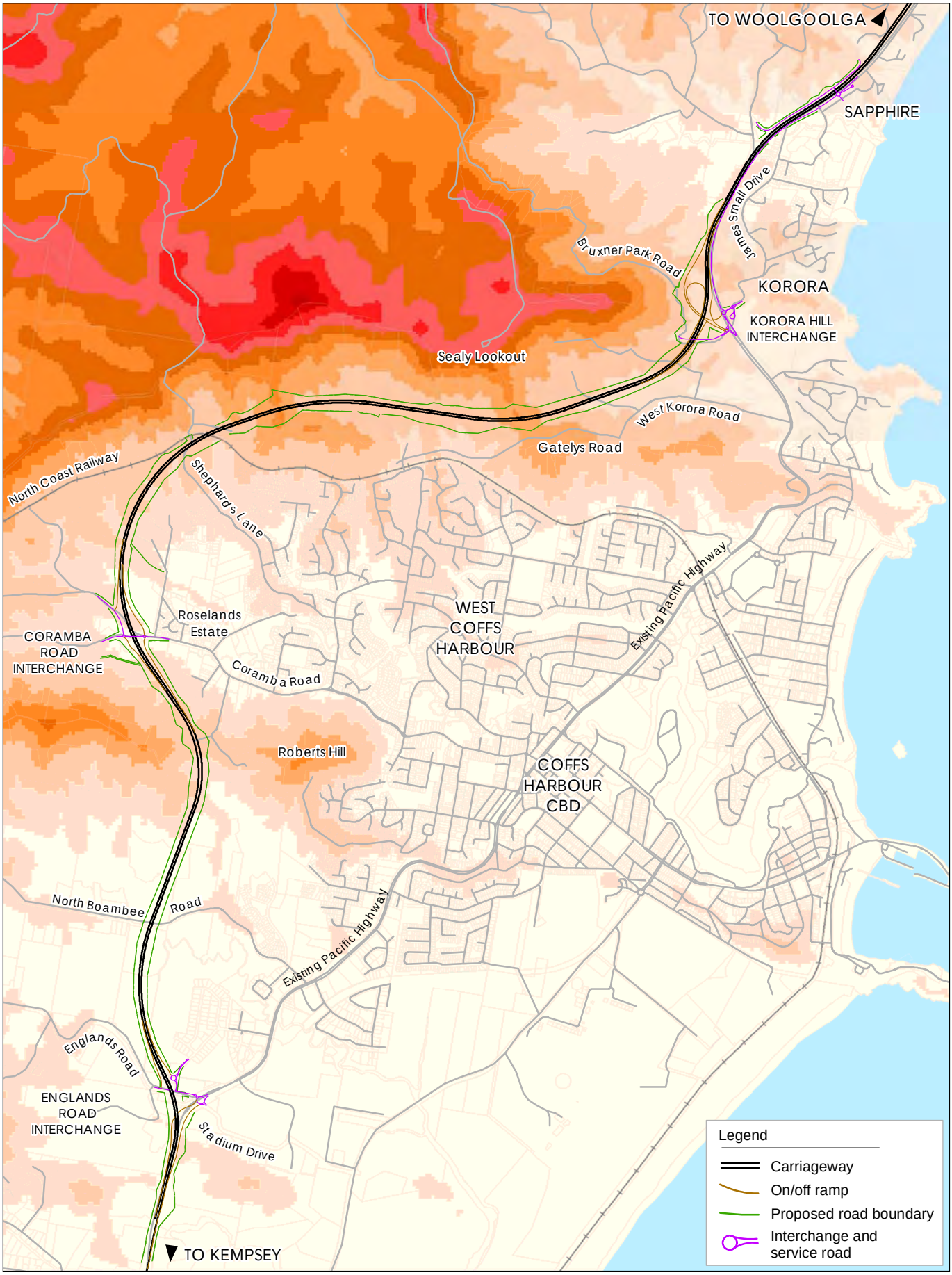
The development of this preferred route on the southern or Coffs Harbour bypass section of the CHHPS is described in three reports previously prepared by Connell Wagner as follows:

- *Preliminary Concept Design Report* (March 2002)
- *CHHPS - Coffs Harbour Section - Strategy Report* (February 2004)
- *CHHPS - Preferred Option Report* (November 2004)

The preferred route comprises the previously displayed Inner South 1 and Inner North 2 route options and these have been further developed as a combined alignment from south of Englands Road, to the south of the city, through to Korora on the northern outskirts of the city.

The preferred route for the Coffs Harbour bypass alignment is provided on a locality sketch of the Coffs Harbour area as Figure 2.1 overleaf.

The combined alignment passes through the North Boambee Valley and then, after passing through the Roberts Hill ridgeline, traverses around the foothills of the Coffs Harbour basin, to the west and



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Source: Cadastre (CHCC 2007)

Figure 2.1

Locality Sketch

S2W\F:\PROJECT\SAPPHIRE\COFFS_CDR_FIGURE2-1.MXD\26-08-08\MES\REV-1

north of the established and developing residential areas before rejoining the existing highway at Korora.

The Coffs Harbour bypass proposal also includes an upgrade of the existing arterial style dual carriageway highway between Korora Hill and the southern end of the Sapphire to Woolgoolga upgrade project to motorway (Class M) standard by rationalising local property access connections and incorporating a new local service road which would provide for safer access into properties and onto the highway.

2.3 Community submissions on preferred route

A number of submissions were received in response to the public display of the preferred route in December 2004. This display included the preferred route for the Coffs Harbour bypass section of the CHHPS in addition to the preferred route for the Sapphire to Woolgoolga upgrade in the northern section of the strategy area.

A total of 22 submissions were received in response to the display, including multiple submissions from some groups and individual residents. Of the issues raised in the community feedback, the majority were in relation to the selection of the Coastal Corridor as the preferred route, with numerous submissions calling for the adoption of alternative corridors and the removal of heavy vehicle traffic from the Coffs Harbour area.

A major submission was received from Coffs Harbour City Council (CHCC) relating to the regional impact of the CHHPS and requesting government assistance with other road network initiatives throughout the city. It also included a proposal (as did others) to upgrade the New England Highway as an alternative corridor for heavy freight traffic.

The major concern raised in the submissions directly referencing the route alignment or concept design of the bypass proposal was the potential impact on private property in general and on the banana industry in particular.

Responses to the submissions received can be seen in Appendix A to this report. During the ongoing development of the concept design since the announcement of the preferred route, the RTA has continued consultations with Coffs Harbour City Council and directly affected landowners. The issues raised in the submissions and ongoing consultation have assisted with the development of the concept design and have resulted in a number of refinements to the route alignment, provision of special access arrangements where necessary and some additional features to the concept design where practical and feasible.

2.4 Purpose of this report

This *Concept Design Report* provides more specific detail of the concept design developed for the bypass proposal, including a synopsis of the key engineering features along the route, including road geometry, bridges and other major structures, provisions for flooding and drainage and preliminary noise mitigation proposals.

The report also details a range of additional investigations undertaken since the announcement of the preferred route and incorporates any changes arising from community submissions or from new or additional information as described above.

A preliminary assessment of potential environmental impacts is also provided in relation to ecology and biodiversity potential, noise impacts and urban design and landscaping.

Finally, the report provides a detailed scope inventory for the project, outlining the key physical dimensions of the proposed bypass, required earthworks and construction quantities and an appraisal of the keys risks to the project identified at this stage of its development

2.5 Design refinements to the preferred route

An engineering concept design has been developed for the bypass proposal in accordance with the Draft Pacific Highway Design Guidelines and the RTA Road Design Guide, Austroads and other standards as required. The concept design has been refined to incorporate a range of traffic and transportation, geotechnical investigations, urban design, environmental constraints and a range of property access inputs and constraints.

Since the announcement of the preferred route in December 2004 a number of refinements have been made in conjunction with these inputs. These are summarised below and where necessary explained in further detail in the body of this report. Refinements made to the concept design since the announcement of the preferred route in December 2004 include:

- Development of merge and diverge lanes from the existing dual carriageway south of Englands Road to allow for dual lane connections for future access to / from the Coffs Harbour CBD.
- Configuration of the Englands Road interchange to provide direct access to the Isles industrial subdivision to / from the north.
- Vertical alignment adjustments at Roberts Hill ridge to optimise depth of cutting for proposed cut / cover tunnel structure.
- Adjustment of the preliminary interchange arrangement at Coramba Road, such that the proposed bypass was bridged by the local road adjustments. This in turn allowed all loading and unloading ramps to be in fill embankment, assisting with noise mitigation in the vicinity of Roselands Estate and surrounding areas.
- Development of alternative vertical alignments for possible tunnel construction north of Shephards Lane and west of Gatelys Road.
- Separation of the horizontal alignment through the potential tunnels to provide an additional width of residual rock between the respective tunnel barrels in each location. This additional width between tunnels is to provide for separate structural integrity of each barrel.
- Minor adjustments to the horizontal alignment in the West Korora valley to avoid direct impact on Jordans Creek
- Development and further refinement of the Korora Hill interchange, incorporating dual lane loading and unloading ramps to the north, intersections with James Small Drive (south), Bruxner Park Road and the future local access road from Korora to Sapphire.

2.6 Highway upgrade scenarios

Design standards for the Pacific Highway Upgrade Program require two lanes in each direction, separated by a median with a desirable width of 12 m. This median provides for a future third lane in each direction.

Two highway upgrade scenarios are being considered for various sections of the Pacific Highway Upgrade Program as follows:

- Arterial style highway (referred to as Class A) — two lanes in each direction (median width to accommodate future upgrading to three lanes in each direction), 100 km per hour posted speed, limited access condition roadway with at grade intersections.
- Motorway style highway (referred to as Class M) — two lanes in each direction (median width to accommodate future upgrading to three lanes in each direction), 110 km per hour posted speed, controlled access condition roadway with grade separated interchange access.

The upgrade of the Korora to Sapphire section to motorway standard provides a consistent link to the motorway standard Sapphire to Woolgoolga upgrade in the north, and the motorway standard Coffs Harbour bypass proposal to the south.

Further details of the Korora to Sapphire section are provided in Section 3.3 of this report.

3. Key features of concept design

Key features of the proposed bypass alignment and concept design is provided within the respective sections of the route alignment as follows:

- Southern section from Englands Road to Coramba Road
- Northern section from Coramba Road to Korora Hill
- Upgrade of existing Pacific Highway from Korora to Sapphire, connecting the bypass proposal to the Sapphire to Woolgoolga upgrade project.

The Coffs Harbour bypass proposal also includes an upgrade of the existing arterial style dual carriageway highway between Korora Hill and the southern end of the Sapphire to Woolgoolga upgrade project to motorway (Class M) standard by rationalising local property access connections and incorporating a new local service road which would provide for safer access into properties and onto the highway.

The upgrade of the Korora to Sapphire section to motorway standard provides a consistent link to the motorway standard Sapphire to Woolgoolga upgrade in the north, and the motorway standard Coffs Harbour bypass proposal to the south.

Engineering drawings produced for the concept design are provided for reference purposes in Appendix B to this report.

3.1 Englands Road to Coramba Road interchange

The proposed bypass would require some minor adjustments to the northern end of the Lyons Road to Englands Road dual carriageway section, to facilitate diverging and merging tapers south of the Englands Road interchange. This interchange is described in more detail in Section 4.1

The bypass alignment deviates from the existing highway just south of the existing Englands Road roundabout, aligning on a left hand curve to the east of the Coffs Harbour City Council waste depot and to the west of the Isles Industrial Park.

From this point the alignment swings to the north and crosses North Boambee Road and Roberts Hill Ridge approximately 100m west of Buchanans Road. It then proceeds in a north-westerly alignment toward Coramba Road, crossing near the Bennetts Road intersection.

Notable features of this 5.4 km length (between 9.3 km and 14.7 km) of the bypass proposal are as follows:

- Grade separated interchange in vicinity of Englands Road – for details refer to Section 4.1.
- Route primarily involves embankment construction through North Boambee Valley, with allowance for potential noise mounds on each side within the corridor width.
- Twin highway bridges over North Boambee Road at 12.2 km, although this arrangement could be reversed (North Boambee Road over highway) if deemed appropriate in future project development.
- A relatively gentle climb to the southern ridgeline of the Coffs Harbour basin – known as Roberts Hill ridgeline.
- A deep cutting (25 metres) is required through the Roberts Hill ridgeline at 13.7 km on a left hand curve for northbound carriageway.

- Roberts Hill ridge is proposed to be reinstated after initial cutting / earthworks construction for reduced visual impact and fauna passage. This would require a cut and cover tunnel structure on the bypass carriageways at this location – refer Section 8 for details.
- Traverse through banana plantations north of Roberts Hill ridgeline
- Grade separated four way interchange at Coramba Road – for details refer to Section 4.2.

3.2 Coramba Road interchange to Korora interchange

This bypass alignment north of Coramba Road features a western sweep of the West Coffs Harbour basin, providing separation between the alignment and the large tracts of residential areas that are prominent between Coramba Road and the North Coast Railway.

On the approach to Shephards Lane the alignment swings to the east, before passing below Shephards Lane and over the railway, east of its tunnel below Shephards Lane.

The route then passes through and behind a major ridgeline at 17.2 km, which descends from Bruxner Park and Sealy Lookout, which provides shielding from the a number of the residential areas of West Coffs Harbour.

The alignment then passes through a second major ridgeline at 19.2 km, near the western end of Gatelys Road, before aligning to the north-east through the West Korora Valley and then swinging to the north to rejoin the existing Pacific Highway at Korora Hill.

Notable features of this 7.2 km length (between 14.7 km and 21.9 km) of the bypass proposal are as follows:

- Large right hand sweep around Coffs Harbour basin between Coramba Road and Gatelys Road.
- A series of cuttings (10 – 20 metres deep) through a number of ridge spur lines, with prominent left to right cutting profiles between 15.3 km and 16.2 km.
- Cutting through Shephards Lane at 16.45 km, with an overpass required for continuation of that road north of the railway line.
- Major elevated (viaduct) structure over North Coast Railway from 16.5 km to 16.7 km.
- Crossing of a very high ridge, to be referred to as Shephards Lane ridge, east of railway crossing at 17.2 km.
- North of this ridgeline the alignment is mostly within a remote valley parallel to Mackays Road.
- Within this valley there are a number of property accesses to be reinstated – refer Section 3.4 for details.
- At the eastern end of the valley, there is a traverse of a second very high ridgeline, near Gatelys Road, at 19.2 km.
- Alternative vertical alignments have been developed for cutting and tunnel solutions on each of the very deep ridgelines at 17.2 km and 19.2 km – for details refer Section 8.
- North of Gatelys Road the alignment swings north-east through the West Korora Valley.
- A deep cutting (up to 35 metres) is required through the ridgeline immediately south of Bruxner Park Road.
- A major interchange is proposed at Korora Hill (between 20.4 km and 21.9 km), incorporating Bruxner Park Road, James Small Drive (south) and the proposed local access road between Korora and Sapphire – for details refer Section 4.3.

3.3 Korora interchange to Sapphire

The existing Pacific Highway between Korora Hill and Sapphire is currently an arterial style dual carriageway with a number of intersections for local road connections as follows:

- Old Coast Road to the west
- James Small Drive (north) to the east
- Access to Opal Cove to the east
- Seaview Close to the west
- Campbell Close to the west (this intersection will revert to left in / left out as part of the Sapphire to Woolgoolga Upgrade project)

This 1.7 km length (between 21.9 km and 23.6 km) connects the Coffs Harbour Bypass proposal to the Sapphire to Woolgoolga Upgrade project and includes the proposed temporary connections from the existing dual carriageway to the new carriageways at the southern end of the Sapphire to Woolgoolga project.

As outlined at the beginning of Section 3 of this report, the concept design for the Korora to Sapphire section has been further developed to a full Class M (Motorway) standard as part of the Coffs Harbour Bypass development.

The Korora to Sapphire extension to the bypass proposal is described in greater detail in Section 4.4.

3.4 Property access arrangements

The alignment for the bypass proposal would sever a number of properties over its 14.3km length. Most of these are on the sections with more rugged terrain where there are no local roads for alternate access either side of the bypass.

As a result, reinstatement of accesses to these severed properties would necessitate dedicated overpass or underpass structures in some locations and / or strip acquisition for access across other properties where more appropriate.

A description of specific property access arrangements along the bypass alignment is as follows:

- A local access road is proposed from properties on the western side of the existing highway immediately south of the regional waste facility to a temporary left-in / left-out only junction with the proposed northbound off-ramp for the Englands Road interchange. The temporary left-in / left-out only junction would be closed when alternative access becomes available from future development of the properties.
- A local access road is proposed from properties on the eastern side of the existing highway immediately south of Stadium Drive to a temporary left-in / left-out only junction with the proposed southbound on-ramp for the Englands Road interchange. The temporary left-in / left-out only junction would be closed when alternative access becomes available from future development of the properties.
- A local access road is proposed from the southern end of Buchanans Road, west along the proposed cut/cover ridge line reinstatement at Roberts Hill Ridge at 13.7 km which provides access to severed properties west of the bypass proposal.
- Strip acquisition is proposed from Bennetts Road across these properties for access to a fourth property at 14.5km, immediately south of the Coramba Road intersection.
- Strip acquisition is proposed from Spagnolos Road to the bypass at 15.45 km, where an overbridge structure is proposed and a section of property access road is required parallel to the bypass, along a bench in the earthworks cut profile between 15.5 km and 16.0 km.
- A property access road is proposed within the bypass corridor immediately east of the railway line, connecting on existing access to a severed property north of the bypass at 16.9 5km.

- Where the bypass alignment passes through the Mackays Road valley there are numerous properties either severed or their existing access is cut. On the 2 km length between the two major ridgelines, two property access underpasses and discrete sections of property access roads (within the bypass corridor) are proposed as follows:
  - Property underpass at 17.75 km.
  - A property access road parallel to the bypass on the northern side between 17.45 km and 18.3 km.
  - A property access road parallel to the bypass on the southern side between 17.6 km and 17.85 km, connecting to Mackays Road.
  - Property underpass at 18.55 km, connecting to a property access parallel to the bypass on the northern side between 18.55 km and 18.75 km.
- To the north of the Gatelys Road ridgeline, where the alignment passes through the West Korora Valley, a property access underpass is proposed at 19.7 km, connected to West Korora Road by an access road parallel to the bypass, on the southern side between 19.7 km and 19.85 km.

3.5 Definition of proposed road reserve corridor

The Coffs Harbour Bypass proposal has been developed to the stage of a detailed concept design so that the proposed boundaries of the road reserve corridor can be set to determine future land acquisition requirements.

The proposed road reserve corridor takes in to account all spatial requirements for the proposed bypass as follows:

- All bypass carriageways, interchange ramps and local cross road adjustments.
- Whole earthworks footprint (cut and fill batters) including conservative allowances for potentially very deep cuttings at major ridgelines.
- Allowances for noise mitigation and associated landscaping to provide acoustic and visual screening.
- Longitudinal and transverse bridge structures.
- Property access underpasses and overpasses and sections of parallel property access roads.
- Proposed water quality structures.

Detailed plans with an aerial photo background showing the key features of the concept design and the proposed boundaries of the road reserve corridor are provided in Appendix C.

The proposed road boundaries would be provided to Coffs Harbour City Council by the RTA for incorporation into the new Local Environment Plan for formal zoning of the corridor for future road construction purposes.

4. Interchanges and local access connections

The proposed bypass would be constructed to a motorway standard with entry to / from the bypass limited to grade separated interchanges in key locations along the route. These interchange facilities would provide for access to / from the proposed highway, the existing Pacific Highway and / or the local road network.

The concept design provides for a total of three interchanges over the length of the proposed bypass as follows:

- Southern interchange at Englands Road
- Central interchange at Coramba Road
- Northern interchange at Korora Hill

A description of the location, functionality and layout of each interchange is provided in the following sections.

In addition to these interchanges the bypass proposal would also include an upgrade of the existing arterial style dual carriageway highway between Korora and Sapphire to motorway standard, to be consistent with the proposed Coffs Harbour Bypass and the Sapphire to Woolgoolga Upgrade. A description of the proposal for the Korora to Sapphire upgrade is included in this section of the report.

The detailed plans in Appendix C include the layouts of the three interchanges and the proposal for the Korora to Sapphire upgrade.

4.1 Englands Road interchange

The southern interchange at Englands Road provides for all movements to/from the existing Pacific Highway in that area. With the proposed bypass to be configured as a northern continuation of the existing Lyons Road to Englands Road dual carriageway, the key movement to be provided for is the major traffic flow to / from the city centre as a northbound unloading ramp.

The interchange would also provide for travel to / from the northern part of the city to / from industrial areas north of Englands Road and various destinations east of the Pacific Highway, such as sporting complexes, Southern Cross University and the airport via Stadium Drive.

Features of the Englands Road interchange are as follows:

- Two lane northbound unloading ramp for access from the existing Lyons Road to Englands Road section of the highway to Coffs Harbour. The unloading ramp would pass under the bypass carriageways and connect to the existing Englands Road / Stadium Drive roundabout.
- Southbound loading ramp from the existing Englands Road / Stadium Drive roundabout to the existing Lyons Road to Englands Road section of the highway. The ramp would be two lanes south of the roundabout and merge to one lane before joining the highway.
- The bypass carriageways would pass over Englands Road.
- North facing ramps would be provided with northbound loading from Englands Road and southbound unloading connected to a local road roundabout on Isles Drive.

4.2 Coramba Road interchange

The central interchange at Coramba Road provides for all movements to/from the proposed bypass in that area.

Features of the Coramba Road interchange are as follows:

- South facing ramps (northbound unloading and southbound loading) connected to a realigned Coramba Road at roundabouts either side of the proposed bypass.
- Coramba Road would pass over the bypass carriageways.
- Bennetts Road would be connected to the western roundabout, with Coramba Road off the northern leg of that roundabout.
- A southbound unloading ramp connected directly to the eastern roundabout.
- A northbound loading ramp would be provided from the western section of Coramba Road.

4.3 Korora Hill interchange

The northern interchange at Korora Hill is to provide for multiple connections to/from the existing Pacific Highway and the proposed local access road which is included as part of the upgrade of the section between Korora and Sapphire. The primary function of the interchange is to allow travel to/from the proposed bypass to the northern precincts of Coffs Harbour, notably developing residential areas at Korora and Sapphire and nearby tourist resorts and other destinations.

Features of the Korora Hill interchange are as follows:

- Two lane north facing ramps (northbound loading and southbound unloading) for access to/from the Pacific Highway north of Coffs Harbour
- Each of the north facing ramps connects to a roundabout with the existing Pacific Highway, the local access road to Korora and Sapphire and Bruxner Park Road.
- South facing ramps (northbound unloading and southbound loading) to provide access from / to the proposed bypass.
- The northbound unloading ramp is proposed as an anti-clockwise loop passing under the bypass carriageways and connecting to the proposed local access road at a roundabout, which also connects to a relocated James Small Drive (south).
- The northbound unloading ramp also passes over the southbound unloading ramp.
- The southbound loading ramp would be accessed by a left turn manoeuvre from the northbound loading ramp. A slip lane is provided around this roundabout for local access traffic.
- The northbound loading ramp is aligned very wide to pass outside of the northbound unloading ramp.

4.4 Korora to Sapphire upgrade

North of the proposed Coffs Harbour Bypass it is proposed to upgrade the existing Pacific Highway from Korora to Sapphire to motorway standard. This would connect to the proposed dual carriageway and parallel local access road at Sapphire and ultimately provide for continuous travel at Class M standard between Englands Road, south of Coffs Harbour and Arrawarra Beach Road, north of Woolgoolga.

Features of the Class M motorway development between Korora and Sapphire are as follows:

- Reconfiguration of the existing dual carriageway at Korora to provide two Pacific Highway carriageways and a local access road.
- As a result of the tightly constrained road reserve widths between Korora Public School and Korora Nature Reserve, retaining walls may be required to minimise cut/fill batters. The relocation of the existing bus interchange facility to James Small Drive south of Korora and removal of the existing pedestrian overpass would also be required.
- All local traffic, including school drop offs / pick ups would be from the local access road (parallel to the highway) through Korora.
- A new section of local access road would be provided east of the Pacific Highway from Pine Brush Creek to Sapphire, inclusive of intersections with James Small Drive (north), the access road to Opal Cove and Fernleigh Avenue. This new access road would connect with the Sapphire local access road which would be part of the Sapphire to Woolgoolga Upgrade.
- A new section of local access road would also be provided west of the Pacific Highway between Old Coast Road and Campbell Close, with the interim connection of Campbell Close to the Pacific Highway (northbound) removed at that point.
- All access from west of the Pacific Highway would be via an underpass connecting the western and eastern local access roads at the Fernleigh Avenue intersection.

5. Geometric road design

5.1 Design standards

The general standard for concept design of the Coffs Harbour Bypass proposal is based on the draft Pacific Highway Design Guidelines (RTA, 2005) to ensure that a consistent form and quality of road asset is delivered along the whole Pacific Highway corridor from near Newcastle to the Queensland border. These design standards may be subject to further refinement at the detailed design phase of the proposal.

5.2 Geometric design parameters

A summary of the design parameters adopted for the Coffs Harbour Bypass are provided in Table 5.1.

Table 5.1 Design parameters

Design Parameter	Pacific Highway Design Guidelines
Design Speed	110km/h
Stopping Sight Distance	210m
Minimum Radius of Horizontal Curves	750m (1200m desirable)
Maximum Gradient	6% (4.5% desirable)
Minimum K value for Crest Curves (Stopping Sight Distance)	95
Minimum K value for Sag Curves (Headlight Sight Distance)	35

Further details of the horizontal and vertical alignment for the bypass proposal, including an assessment of sight distance deficiencies and non-conformities are provided in the following sections.

Plan and Longitudinal Sections from the concept design set of drawings are provided in Appendix B.

5.3 Horizontal alignment

A summary of the horizontal curvature of the route alignment with a description of the location and directional orientation of the bypass is provided in Table 5.2 below.

Table 5.2 Horizontal alignment details and location description

From	To	Radius (m)	Description
10.3km	10.9km	800 L	Departure from existing highway at Englands Road
11.1km	12.2km	1400 R	Alignment traversing to the north, south of North Boambee Road
13.1km	14.0km	870 L	North westerly swing through Roberts Hill Ridge on approach to Coramba Road
14.4km	16.7km	1256 R	Long wide sweep west of residential areas between Coramba Road and North Coast Railway
17.0km	18.0km	1960 R	Large radius curve through Shephards Hill ridge into Mackays Road valley
18.7km	19.6km	1820 L	Large radius curve through Gatelys Road Ridge in West Korora valley
20.1km	21.2km	800 L	North easterly swing through major ridge on approach to Bruxner Park Road
21.3km	21.7km	820 R	Alignment connection to existing highway at Korora Hill
22.2km	22.7km	1020 R	Existing highway at Old Coast Road and Pine Brush Creek
23.0km	23.6km	1600 L	Existing highway and connection to Sapphire to Woolgoolga Upgrade

5.4 Vertical alignment

As was the case with the horizontal alignment, the vertical alignment for the bypass proposal has been designed to meet the required criteria whilst fitting to the existing terrain in a manner that allows the design speed of 110km/hr to be maintained.

In advance of any discussion on potential tunnel construction on the bypass proposal the commentary in this section is related to the design profiles for cut and fill earthworks construction only. The relative merits of tunnel construction in relation to vertical alignment are discussed in Section 8.

Constraints on the vertical alignment of the bypass proposal were as follows:

- Matching the existing terrain and maintaining a practical combination between maximum gradients and limits on depth of cuttings and heights of embankment construction.
- Location and configuration of interchanges and ramp connections.
- Location and height of proposed overpasses and alignments of connecting side roads. The minimum vertical clearances adopted and provided for separation of bypass traffic and local traffic at bridge structures are:
  - 5.3 metres for full carriageway width on the main carriageways for all bypass interchanges and overpasses.
  - 4.6 metres for all local road underpass structures.
  - 3.6 metres for all local property access underpass structures.
- The objective to achieve a balance in earthworks materials (cut/fill volumes) for construction requirements.

In general terms the vertical profile of the proposed carriageways has comfortably met the maximum gradient requirement (6%) with the majority of gradients below the desirable 4.5%. There are a total of four locations where the proposed vertical alignment exceeds 4.5% as follows:

- 6% on northbound climb toward Shephards Lane and the North Coast Railway, in advance of the traverse through the first major ridgeline at 17.2 km.
- 4.8% on southbound approach to same ridgeline at 17.2 km.
- 5.4% on southbound approach to the second major ridgeline at 19.2 km.
- 5.2% on southbound climb to Korora Hill on the existing highway.

As a result of the modest gradients on the bypass proposal no provision has been made for auxiliary or passing lanes on the uphill sections.

The limitations on the road gradients to meet design speed guidelines and the depth of the major ridgelines that the alignment passes through has resulted in potentially very deep cuttings (60 m – 70 m) in two locations at 17.2 km and 19.2 km. These cutting heights could be reduced by maximising all four approach gradients at 6%, however the nature of the surrounding terrain would dictate that approach embankments would become too high and visually intrusive.

Potential tunnel options which assist in minimising the vertical grade, and avoid the deep cuttings described above are discussed in Section 8 of this report.

5.5 Cross section

The cross section parameters adopted for the bypass proposal are provided in Table 5.3. These show typical lane, shoulder and verge width combinations for the bypass with design speed of 110km/hr and typical batter treatments for the project.

Table 5.3 Cross section details

Design Parameter	Pacific Highway Design Guidelines
Traffic Lanes	3.5 metres
Shoulder – Nearside (no traffic barrier)	2.5 metres
– Nearside (with traffic barrier)	3.0 metres
– Offside	0.5 metres
Verge	1.5 metres (incl. SO Kerb)
Depressed Median (incl. median shoulders)	12.0 metres (depressed)
Cut Batters in earth	Generally 2:1 H:V
Cut Batters in rock	Generally up to 0.5:1 H:V
Fill Batters	Generally 2:1 H:V

It should be noted that the highly variable terrain constraints along the length of the Coffs Harbour Bypass has necessitated a range of cross section configurations which includes preliminary allowances for noise mounds

The full range of typical cross-sections along the proposed Coffs Harbour Bypass proposal are shown on drawings T01 to T03 in Appendix D to this report.

5.6 Cross carriageway access

Emergency crossover access has been nominated at two locations on the bypass alignment, nominally between the three interchange proposals. The facilities proposed would be a combination median crossover, stopping bays and u-turn facilities. The locations proposed are as follows:

- 12.8 km – 12.9 km, north of North Boambee Road.
- 18.1 km – 18.2 km, between the major ridgelines north of Shephards Lane and at Gatelys Road.

The facilities would provide for the turning of emergency vehicles in the event of an accident or the management of bypass flows onto the alternative carriageway in the event of a major incident on the bypass.

6. Traffic and transport

A strategic assessment of the traffic and transport issues for the proposed Coffs Harbour Bypass was undertaken by Connell Wagner at the corridor investigation phase of the project. This was previously documented and published in the Strategy Report (Connell Wagner, 2004) for the CHHPS.

This section of the Concept Design Report revisits the traffic and transport issues, focusing on the preferred route and the recently developed proposals for interchanges and connections to the local road network. It draws on information provided in the Strategy Report but is updated where appropriate where new or additional information is available.

The updated traffic and transport assessment for the proposed bypass includes:

- Existing and future traffic volumes on the Pacific Highway with and without the proposed bypass.
- The estimated levels of heavy vehicle traffic attracted to the bypass proposal
- Other operational issues such as travel times and dangerous goods transportation.
- Analysis of the interchanges proposed for the bypass.

The following sections summarise the findings from this assessment.

6.1 Existing and future traffic volumes

Historical traffic volumes on the existing Pacific Highway through Coffs Harbour are available in the RTA published documentation *Traffic Volume Data for Hunter and Northern Regions 2004* in relation to the following sites.

- Site 04.146, immediately north of Sawtell Road (south of Englands Road).
- Site 04.250, north of High Street in the Coffs Harbour CBD
- Site 04.990, at the railway overbridge north of Orlando Street
- Site 04.150, south of Moonee Beach Road

These historical volumes, from 1995 to the most recently published figures in 2004, are provided in Table 6.1, with volumes quoted as Average Annual Daily Traffic (AADT), measured in axle pairs. This measure would tend to be higher than the actual number of vehicles on the existing highway due to the presence of heavy vehicles with multiple axles.

Table 6.1 Historical traffic volumes on existing Pacific Highway (AADT)

Site	Location	1995	1998	2001	2004
04.146	South of Englands Road		22,303	27,471	28,842
04.250	Coffs Harbour CBD	25,710	25,275	27,394	39,287
04.990	At railway bridge north of Orlando Street				44,213
04.150	South of Moonee Beach Road	16,332	16,156	20,171	20,868

Points to note from these historical traffic volumes and subsequent growth observations are as follows:

- Traffic volumes on the existing highway have been generally higher south of Coffs Harbour than north of the town.
- Higher daily volumes quoted at the railway bridge north of Orlando Street can in part be attributed to the local shopping precinct and cross traffic movements between Bray Street and Park Beach Road.

Specific vehicle classification surveys were also undertaken at a range of locations north and south of Coffs Harbour for the CHHPS in May 2001, May 2005 and October 2005. These surveys measured light vehicles and a range of heavy vehicle classifications over a week long period on each occasion.

The data collected from these surveys specifically relevant to the bypass proposal is summarised in Table 6.2. Average daily volumes for two way traffic are provided for 7 days and for a 5 day week to demonstrate higher volumes from Monday to Friday.

Table 6.2 Surveyed two way traffic volumes (vehicles per day)

Location	May 2001 (vpd)	May 2005 (vpd)	October 2005 (vpd)
South of Englands Road			
Total vehicles (7 day average)	Not surveyed	Not surveyed	24,951
Total vehicles (5 day week average)			26,872
Light vehicles (5 day week average)			23,666
Heavy vehicles (5 day week average)			3,206
Heavy vehicles (5 day week %)			11.9%
North of Opal Cove			
Total vehicles (7 day average)	15,963	18,704	Not surveyed
Total vehicles (5 day week average)	16,849	19,861 [1]	
Light vehicles (5 day week average)	15,077	17,220	
Heavy vehicles (5 day week average)	1,772	2,641	
Heavy vehicles (5 day week %)	10.5%	13.3%	

1. Close correlation with 2006 volume quoted in S2W Environmental Assessment of 20,508 vehicles south of Headlands Road, approx 1 km north.

Observations on the data summarised in Table 6.2, in conjunction with that presented in Table 6.1, are as follows:

- For traffic south of Englands Road the traffic volume surveyed in late 2005 is comparable to the AADT figure quoted for 2004 in Table 6.1
- Traffic volumes of up to 27,000 vpd and 20,000 vpd on sections south and north of Coffs Harbour confirm the warrant for dual carriageways on the respective approaches to the main city centre.
- 12% to 14% of the total traffic through the study area are heavy vehicles
- There was a one-off increase during 2002/2003 as a result of the opening of the Pacific Highway to B-double traffic, which resulted in a one-off increase in the number of heavy vehicles on the highway.
- Continued growth at approximately 3% linear per annum would see up to a 40% - 50% increase in traffic volumes on the existing Pacific Highway over a 15 - 16 year period to 2021.This generally consistent with future traffic projections and modelling discussed in Section 6.2 of this report.

6.2 Predicted bypass traffic volumes

In order to assess how the traffic volumes along the existing Pacific Highway through Coffs Harbour would change upon completion of the proposed bypass, a traffic modelling software package was used. Coffs Harbour City Council (CHCC) has its own in-house traffic network model to assist with its future road planning. This TRACKS model was used for the investigations leading to the *Strategy Report*. The results of this earlier modelling, undertaken by CHCC on behalf of the RTA, are revisited in this section.

The earlier modelling looked at network scenarios for the years 2001 and 2021 with and without the bypass proposal. The future base case (2021) did have a number of local network improvements completed before the bypass modelling was implemented. As such the future model depicted the bypass impact on a different network to what currently exists.

Improvements that were proposed in the future network were as follows:

- Completion of the Hogbin Drive link from Sawtell to Park Beach, including duplication from Stadium Drive to Arthur Street.
- North Boambee link road system connecting North Boambee Road to Coramba Road and the local road network further north toward Bray Street.
- Completion of the Mastrocolas Road extension.

Each of these local road network improvements would reduce traffic volumes on the existing Pacific Highway as local traffic has new alternatives to the spine road that the existing highway currently represents. Of these, the dominant local arterial route would be Hogbin Drive which is parallel to the existing highway to the east.

During the preparation of this report the Coffs Creek link section of Hogbin Drive between Harbour Drive and Orlando Street was open to traffic and this is expected to provide immediate relief to the existing highway through the CBD and the Park Beach area. While formalised traffic counts for the new section of Hogbin Drive are not as yet available, anecdotal advice from Coffs Harbour City Council is that approximately 12,000 vehicles per day are utilising the new route, providing traffic reductions to both the existing highway and the local road through the Coffs Harbour jetty area.

The output from the TRACKS model for 2021 is summarised in Table 6.3. This provides a reference case for the bypass proposal in relation to the existing Pacific Highway and Hogbin Drive, showing expected substantial traffic growth on these routes up to 2021 and the predicted migration to the bypass proposal as if it was completed at that time.

Table 6.3 TRACKS modelling of bypass proposal (2021)

Location	2021 Base Case (vpd)	2021 With bypass (vpd)
Proposed Bypass		
Between Englands Road and Coramba Road	-	14,000 [1]
Between Coramba Road and Korora Hill	-	15,000 [1]
Pacific Highway		
South of Englands Road	38,328	40,057
North of Coff Street	35,566	29,401
North of Bray Street	45,074	35,286
North of Bruxner Park Road	35,693	21,623
Hogbin Drive Extension		
Along the Coffs Creek link	22,083	16,136

1. Projected figures on bypass proposal in *Strategy Report* rounded for the purposes of this report

The modelling results shown in Table 6.3 indicate that 14,000 – 15,000 vpd would use the bypass if it was completed by 2021. This traffic would mostly come from the existing Pacific Highway and Hogbin Drive. The Strategy Report provided an estimate of through traffic on the bypass of 7,000 – 8,000 vpd, indicating that approximately 50% of the traffic on the bypass is generated by local trips in and around the city.

The predicted volumes on the bypass also confirm that there is ample capacity provided by the four lane dual carriageway. Even with high growth rates expected from future urban development in and

around Coffs Harbour a notional bypass capacity of 40,000 – 45,000 vpd would not be reached for 20 to 30 years after opening. The concept design provides for future upgrades to six lanes from within the wide median if required.

Heavy vehicle numbers on the existing highway and the bypass proposal are not discretely identified in the TRACKS model. A separate spreadsheet analysis was previously used to predict heavy vehicle numbers on the bypass and this was described in detail in the Strategy Report.

In general terms, heavy vehicle volumes on the existing highway are approximately 10% -12% of total traffic and this includes small trucks, commercial vehicles and buses, as well as larger trucks, semi-trailers and B-doubles.

The bypass proposal would remove through heavy vehicle movements from the existing highway but heavy vehicles would continue to pass through the city to service the commercial and industrial precincts, as well as keeping the population supplied with food, fuel, retail items and building materials.

Estimates of the heavy vehicle volumes expected to use the bypass proposal, and the projected reductions on the existing highway are provided in Table 6.4 below.

Table 6.4 Projected heavy vehicle volumes on bypass proposal (2021)

Location	2021 Base Case (vpd)	2021 With bypass (vpd)
Proposed Bypass		
Between Englands Road and Coramba Road	-	2,100
Between Coramba Road and Korora Hill	-	2,200
Pacific Highway		
South of Englands Road	3,901	4,040
North of Coff Street	3,659	2,403
North of Bray Street	4,462	2,894
North of Bruxner Park Road	3,684	1,789

The projected volume of heavy vehicles on the bypass proposal at 2,100 – 2,200 per day would equate to approximately 15% of the total traffic expected to use the bypass in 2021.

6.3 Travel time savings

The *Strategy Report* (Connell Wagner, 2004) provided an analysis of potential travel time savings between the bypass proposal and the alternative high standard upgrade of the existing Pacific Highway. With the existing highway currently catering for the majority of local and through traffic, with numerous sets of traffic signals at key intersections, travel through the city is slow at most times of the day, particularly so in peak periods. At night time the reduced amount of local traffic across the highway at signalised junctions does allow for reduced travel times, although speed limits still apply and major time savings are not available.

By contrast, the bypass proposal would be free flowing, capable of 110km/hr design speeds and as such travel times would be expected in the order of 9 minutes on the new route. Travel time surveys (Connell Wagner, 2002) undertaken previously provided trip time data for day, peak and night time vehicle trips along the existing highway. These were undertaken in both directions and the resultant data indicated a high degree of fluctuation depending on delays at existing traffic signals.

With the increase in through and local traffic in recent years, the trip times (12 – 14 minutes) from earlier surveys would now be considered to be a minimum. With projected travel times on the existing highway as identified in Table 6.5 and assuming free flow conditions on a future bypass, the resultant

travel time savings would be between 3 and 8 minutes for light vehicles and between 4 and 10 minutes for heavy vehicles, depending on the time of day.

Table 6.5 Projected travel time savings

Scenario	Existing highway	Proposed bypass	Time saving
Light Vehicles – daytime	12 – 14 minutes	9 minutes	3 – 5 minutes
Light Vehicles – peak hour	14 – 17 minutes	9 minutes	5 – 8 minutes
Light Vehicles – night time	11 – 13 minutes	9 minutes	2 – 4 minutes
Heavy vehicles – daytime	13 – 16 minutes	9 minutes	4 – 7 minutes
Heavy vehicles – peak hour	16 – 19 minutes	9 minutes	7 – 10 minutes
Heavy vehicles – night time	12 – 15 minutes	9 minutes	3 – 6 minutes

6.4 Transport of dangerous goods

A preliminary qualitative risk assessment for the transport of dangerous goods in tunnels was previously conducted by Connell Wagner as part of the preferred route development for the bypass proposal. Working Paper 8 – Dangerous Goods Assessment (RTA February 2004) investigated a range of scenarios for dangerous goods transport along the existing Pacific Highway and the proposed bypass.

The report concluded that any major upgrade of the existing highway would reduce the current level of risk associated with dangerous goods transport through the city. Construction of a free flowing bypass would further reduce this risk. The assessment made no quantitative estimate of the probability of incidents involving dangerous goods vehicles and the level of associated risk for the road users and the surrounding community.

However, the report identified that removing traffic from the existing highway would relocate some of the risks from the community adjacent to the Pacific Highway, to the community adjacent to the proposed bypass. Dangerous goods vehicles would, however, continue to use the Pacific Highway if they are prevented from entering the potential tunnels along the bypass.

In the event that tunnels are ultimately incorporated into the bypass proposal, a separate, quantitative risk assessment would need to be conducted to determine the level of risk associated with the transport of dangerous goods through these tunnels and the acceptability of that risk for road users.

6.5 Interchange functionality and analysis

The proposed interchanges would facilitate local traffic access to the proposed bypass for travel north and south of the city. However, the dominant destination for local traffic would continue to be the Coffs Harbour CBD and its associated commercial and employment areas.

As such, the proposed interchange ramps to / from Coffs Harbour at the southern and northern interchanges would require dual lane capacity to provide for the continuation of dominant traffic flows to / from the city centre. The concept design for these interchanges has allowed for two lane ramps in the relevant direction, northbound unloading and south bound loading at Englands Road and the converse, southbound unloading and northbound loading at Korora Hill. At each of these locations the opposing ramps have been developed as single lane roads only.

At the proposed central interchange at Coramba Road the traffic volumes leaving and entering the bypass would be substantially lower and in that location a single lane only has been provided for each of the four ramps.

The concept design provides for roundabouts at the connection points to the existing local road network. This is to cater for turning movements between the bypass ramps and the local road and to minimise delays for through movements across (over / under) the bypass.

Detailed traffic analysis of the interchange intersections has not been undertaken for the southern and central interchanges. The projected traffic volumes are expected to be comfortably accommodated by the facilities proposed as follows:

- The existing Englands Road roundabout would be the primary access intersection for the interchange. Two lane entry and departure legs would be provided as at present. At this location the existing two lane circulating roundabout would operate with less traffic than it does currently once bypass traffic is removed.
- The Coramba Road interchange would feature two single lane roundabouts for the intersections either side of the bypass. These would cater for traffic leaving and entering the bypass as well as through movements on Coramba Road.

At the northern end of the bypass proposal at Korora Hill, the proposed configuration of the interchange is more complex, with loading and unloading ramps interacting with existing intersections at James Small Drive and Bruxner Park Road and the proposed local access road through Korora.

A number of interchange layouts and options were investigated prior to the adoption of the interchange concept as shown in Appendix C. The proposed layout includes two roundabouts east of the bypass alignment as follows:

- A roundabout connecting the northbound unloading ramp and a relocated James Small Drive to the proposed local access road
- A roundabout connecting the north facing ramps to the existing highway south of the interchange, inclusive of connections to the new local access road and to Bruxner Park Road.

Due to the complexity of the interchange, traffic analysis of the proposed intersections was undertaken to confirm that it would operate efficiently with future traffic volumes on the bypass and the other roads in the vicinity. This analysis included an optional slip lane for the proposed local access road through the primary roundabout at Bruxner Park Road.

Results of the analysis for the interchange layout as shown is summarised in Table 6.6. Results are quoted on the basis of Level of Service (LoS) for the relevant intersection, with LoS E or below representing severe congestion.

Table 6.6 Intersection performance at Korora Hill interchange (2021)

Intersection type and location	Morning peak	Mid-day peak	Afternoon peak
Roundabout at James Small Drive	LoS A	LoS A	LoS A
Roundabout at Bruxner Park Road	LoS F	LoS B	LoS C
Roundabout at Bruxner Park Road (with slip lane)	LoS B	LoS B	LoS C

The results shown in Table 6.6 confirm that the interchange would operate satisfactorily for the layout as proposed. Alternative layouts may be considered in the detailed planning phase and similar analysis would be undertaken at that point on any alternatives proposed.

7. Geotechnical investigations

Geotechnical investigations were undertaken by Connell Wagner in 2006 to assist in the corridor definition of the preferred route for the proposed bypass. The scope of the investigation was developed to support the concept design that had been developed for the preferred route option to that date.

The investigation targeted critical locations along the bypass that would be likely to have a significant impact on the width of the proposed road corridor. In particular, the two deep cuttings on high ridgelines north of Shephards Lane and west of Gatelys Road on the northern section of the alignment were investigated in detail.

The Geotechnical investigations were to provide a preliminary assessment of cut and fill batter designs and any associated specialised treatments on these major cuttings, as well as consideration of the feasibility of the alternative tunnel options to cross these ridgelines.

The key outcomes of the geotechnical investigations were:

- A detailed appraisal of the regional geology and soil landscapes along the preferred route alignment.
- Presentation of factual geotechnical data collected.
- Analyses and discussion of key geotechnical issues relating to the investigated cut and fill areas.
- Recommendations on potential batter slopes for corridor definition purposes.
- Assessment of the feasibility of tunnelling options, in terms of constructability, at the nominated locations.

This section of the report focuses on the outcomes of the geotechnical investigations and their implications for the concept design and future construction planning, particularly in relation to the comparison between deep cuttings and potential tunnel options.

7.1 Geology and soils

The underlying geological conditions of the Coffs Harbour area, as referenced by the NSW Department of Mineral Resources, are subdivided into three main metamorphic rock units as follows:

- Coramba Beds
- Brooklana Formation
- Moonbil Siltstone.

The regional metamorphic grade increases from north to south. The rock types vary from lower grade feldspathic wackes in the north to higher-grade argillites and black siltstones in the south.

The Coramba Beds overly the Brooklana Formation and both are strongly folded and faulted. The Coramba Beds comprise metamorphosed sedimentary rocks, and the Brooklana Beds comprise thin-bedded siliceous mudstone and siltstone. The Moonbil siltstone consists mostly of alluvial and estuarine deposits.

The proposed alignment is shown on the Coffs Harbour 1:100,000 geological sheet to traverse three geological units. The primary units are the Coramba and Brooklana Beds. The third unit within the route alignment consists mostly of alluvial and estuarine deposits, termed Quaternary Alluvium.

The Coramba Beds comprise lithic and feldspathic sandstone, minor siltstone, siliceous siltstone, mudstone, metabasalt, chert, jasper, rare calcareous siltstone and felsic volcanic rocks. The Brooklana

Beds comprise thin bedded siliceous mudstone and siltstone with rare lithic sandstone, locally chert, jasper, magnetite bearing chert and metabasalt.

The Quaternary Alluvium unit consists mostly of alluvial and estuarine deposits that have been further defined as outwash alluvium and stream alluvium or sand swamps and sand plains.

Acid Sulphate Soils (ASS) are typically associated with soils below 5 metres AHD. As such, areas of low risk potential ASS are concentrated along the existing Pacific Highway corridor, with high risk areas identified north of Korora and adjacent to the railway line in Coffs Harbour. ASS are not expected to be a high risk potential on the bypass proposal.

7.2 Comments and recommendations from geotechnical investigations

The comments and recommendations arising from the geotechnical investigations for the key areas of the bypass proposal are outlined in the report under the following categories.

- Earthworks
- Fill embankments
- Cuttings and batter slopes
- Potential tunnels
- Further geotechnical input

A summary of these inputs to the concept design development is included in the following sections.

7.2.1 Earthworks

Earthworks for the bypass proposal would possibly include major excavation (up to 65 metres) and high embankments (up to 30 metres). A relatively thin layer of surface soils and fills, generally less than 5 metres thick was encountered over the investigated areas. As such the majority of excavation would be in rock conditions.

Based upon the available results of the investigation the majority of the excavation would be through medium to very high strength, fractured argillite. A general assessment of the rippability (or rock excavation by large dozers) of this rock was undertaken.

This general assessment indicates that excavation of the upper units of rock material should be possible using a D9 dozer whilst a larger dozer such as a D10 would be progressively required for excavation of the lower portions of the cuttings until blasting would be required in the deeper sections of the various cuttings.

At this stage of the bypass development it was recommended that the following assumptions be applied for comparative cost estimating purposes.

- Zone 1 0 – 10 metres deep - rippable using a D9 or larger bulldozer
- Zone 2 10 metres – 20 metres deep - partly rippable using a D10 or larger bulldozer, partly requiring blasting
- Zone 3 Greater than 20 metres deep - blasting required.

In the design development for the road reserve corridor definition the following additional notes were made for consideration:

- Topsoil would be required to be stripped and allowance for this should be made in earthworks balance calculations;
- Over excavation of hard rock in the base of cuttings would be required to form drainage layers;

- Processing of hard rock would be required to produce engineered fill materials such as rock fill, select fill and aggregates.

7.2.2 Fill embankments

Significant fill embankments, possibly up to 30 metres high are proposed for the proposed bypass. The fill embankments over the bypass route can be split in to two categories, namely hillside embankments and lowland embankments.

The key geotechnical considerations for hillside and lowland embankments are as follows:

- Hillside embankments
  - Internal stability of large embankments
  - Global stability of existing slopes where embankments are constructed on sloping ground
  - Potential obstruction of existing hillside drainage paths with associated risks of damming action of embankment and piping of embankment toes
  - Bearing capacity of potentially weaker founding strata in areas not investigated
  - Embankment settlements
- Lowland embankments
  - Internal stability of large embankments
  - Bearing capacity of potentially weaker founding strata in areas not investigated
  - Embankment settlements

7.2.3 Cuttings and batter slopes

Acceptable batter slopes for cuttings are dictated by a number of considerations including the rock mass strength, structure, height of cutting and tolerable levels of risk. The identified risks with cuttings and batter slope design and recommended suitable batter designs for use at this stage of the bypass development are summarised as follows:

- Global stability assessment – the results of an empirical global batter slope analysis were subjected to statistical analysis. It was found that any variability was most pronounced in the upper layers where a cutting could be in material varying from soil to high strength rock. For the purposes of the current concept design development, global batter slopes were adopted as outlined in Table 7.1

Table 7.1 Global batter slope angles

Depth	Global batter slope	Approximate inter-bench batter slope
0 metres – 5 metres	2H:1V	2H:1V
5 metres – 20 metres	1.5H:1V	0.85H:1V
Greater than 20 metres	1H:1V	0.35H:1V

- Detailed batter slope recommendations – the maximum and minimum batter slopes arising from the modelling were compared and a recommendation made for an adopted overall batter slope. Extending the global profile for 0 – 20 metres as outlined in Table 7.1 above down to a depth of 30 metres would capture nearly all of the cuttings on the bypass proposal, with only the very deep cuttings requiring further detailed assessment as outlined below and in Section 8.3.
- Benching height and width - a preliminary bench layout of 4.5 metre wide benches at a vertical spacing of 7 metres is proposed, subject to other inputs.
- Face support - to provide preliminary indication of the potential support requirements basic estimates were derived from the available information. These were that an initial estimate of 20%-30% of the excavation area may require full facial support in the form mesh and / or shotcrete and further areas may require spot rock bolting.

- Slope stability assessment - the RTA Guide to Slope Risk Analysis guidelines set out a systematic procedure for analysing the risks associated with potential slope instability. The recommended concept design batters are expected to have an Assessed Risk Level (ARL) for small rock fall type failures (less than 0.5 metres in size) of ARL4.
- Rockfall measures - A preliminary rock fall analysis was undertaken for two model batter slopes to assist in preliminary estimation of risk associated with fretting / ravelling of the slope faces and protection of the bypass carriageways from rock falls. At this stage it is recommended that allowance be made for a 2.0m high catch fence on the lowest bench with additional face treatment of the lowest batter.

7.2.4 Potential tunnels

An alternative option to deep cuttings at major ridges on the bypass proposal is to provide tunnels. Based upon the available borehole information from the Geotechnical investigations undertaken in 2006, a preliminary analysis was undertaken from a geotechnical perspective for tunnel alternatives at two locations.

The proposed tunnel options assessed from a geotechnical perspective included two twin barrel tunnels as follows:

- Tunnel 1 instead of a deep rock cutting between Ch 17.0 km and 17.3 km – known as Shephards Lane ridgeline.
- Tunnel 2 instead of a deep rock cutting between Ch 18.9 km and 19.35 km – known as Gatelys Road ridgeline.

The moderate to high strength of the rock mass and its quality are not expected to be a significant constraint to tunnelling. Both tunnels are expected to be able to be excavated by either conventional drill and blast techniques or by using tunnel augers. When assessing relative costs of the two methods, the following must be considered:

- Abrasion test results varied from 3.5 to 4.2 which is described as very to extremely abrasive to cutting tools.
- Due to the proximity to the Coffs Harbour urban area, drill and blast activities would be limited to daylight hours whereas a tunnel auger excavation would probably run 24 hours a day.
- Due to the high rock strength it is expected that a heavy duty tunnel auger would be required.
- For tunnel auger excavation, a high voltage power supply would be required.
- Groundwater inflows may be a major consideration and will require further investigation should the tunnelling options be adopted.

Based upon this preliminary assessment, it was confirmed that tunnels would represent a viable alternative to deep cuttings at the major ridgelines. However, significant additional investigation and design work would be required before the tunnel options could be adopted. Further details on the potential for tunnel construction and a comparison with deep cuttings at these locations are discussed in Section 8 of this report.

7.2.5 Future geotechnical input

The focus of the geotechnical investigations to date has been on the areas of the deep cuttings at the major ridgelines because the design slope of the required cut batter faces will potentially have a significant impact on the width of the required road corridor.

It is expected that further investigations will be required to support all subsequent stages of the project development including:

- Detailed concept design and environmental assessment.
- Detailed design development and contract documentation.
- Construction management.

8. Bridges and other major structures

This section presents a summary of the proposed bridges and other structures required for the proposed Coffs Harbour Bypass. This includes detailed consideration of a number of deep cuttings at major ridgelines along the bypass length and the impact that the cutting depths and widths may have on the concept design and future engineering development of the project. The potential for these ridges to be tunnelled has also been investigated in detail as part of the concept design development.

8.1 Bridges

As an accessed controlled road the proposed bypass would have complete grade separation from all local roads and property accesses, either as twin longitudinal bridges or a single transverse crossing. Other bridges would be required at major creek crossings and over the North Coast Railway Line.

The bridges that have been nominated for the bypass proposal at the concept design stage have been developed in conjunction with the proposed horizontal and vertical alignment. The factors that have influenced the bridge development to date were as follows:

- Preliminary hydrological investigations for creek crossings
- Urban design considerations in relation to underpass or overpass deliberations
- Clearance requirements to the bypass carriageways, local roads or interchange ramps.
- Likely span configuration in relation to site specific constraints

A total of 31 bridges would be required on the Coffs Harbour Bypass proposal, including the upgrade of the section between Korora and Sapphire. Table 8.1 details the location and type of bridge structures that have been incorporated into the concept design.

Table 8.1 Location of proposed bridge structures [1]

Chainage	Type	Description
10.6 km	Interchange ramp	Twin bridges over northbound off-ramp
10.8 km	Local road crossing	Twin bridges over Englands Road
11.7km	Creek crossing	Twin bridges over Newports Creek (south)
12.2 km	Local road crossing	Twin bridges over North Boambee Road
12.5 km	Creek crossing	Twin bridges over Newports Creek (north)
14.6 km	Creek crossing	Twin bridges over Coffs Creek
14.6 km	Creek crossing	Additional bridges for south facing ramps over Coffs Creek
14.7 km	Local road overpass	Interchange bridge on Coramba Road
15.5 km	Property access	Property access road overpass
16.4 km	Local road overpass	Local access road bridge on Shephards Lane
16.6 km	North Coast Railway	Twin bridges (elevated structures) over North Coast Railway
17.8 km	Property access	Property access underpass through bypass embankments
18.6 km	Property access	Property access underpass through bypass embankments
19.7 km	Property access	Property access underpass through bypass embankments
20.7 km	Local road crossing	Twin bridges over Bruxner Park Road
20.7 km	Local road crossing	South facing ramp bridges over Bruxner Park Road
20.9 km	Interchange ramps	Twin bridges over both northbound ramps
20.9 km	Interchange ramp	Northbound off-load bridge over southbound off-load ramp
22.4 km	Creek crossing	Two new local access road bridges over Pine Brush Creek
23.1 m	Local road crossing	Twin bridges over local access road connection at Fernleigh Avenue

1. Bridge locations and types subject to refinement at detailed design stage of bypass proposal.

Further details of these bridges, including overall length, width and deck areas are provided in Section 13 of this report, pertaining to the project scope for the bypass proposal.

The current development of the proposal is such that the structures have been nominated in terms of location, structure type and likely size and span configuration. At this point no structural or foundation design has been undertaken or no other details or design inputs have been considered.

For each bridge structure, a number of aspects would be taken into consideration in the next stage of project development. Issues considered for each structure would include the following:

- Confirmation of bridge type and construction methodology to be adopted.
- Confirmation of span configuration and clearance requirements.
- Detailed investigation of geotechnical conditions.
- Structural design of substructure and superstructure.
- Detailed investigations of hydrologic and hydraulic conditions at creek crossings.
- Bridge features (both superstructure and substructure) would be consistent with the *Pacific Highway Urban Design Guidelines* (RTA 2005).
- Adoption of environmental requirements including fisheries, water quality and / or heritage.
- Incorporation of safety in design and development of OH&S procedures for construction and maintenance.

8.2 Retaining walls

There would be a number of major and minor retaining walls required on the bypass proposal and its extension to connect to the Sapphire to Woolgoolga upgrade.

Some retaining walls would be required at bridges and interchanges, with the retention of abutments instead of spill through batters, likely in key areas such as at Englands Road. These would be detailed in any future bridge design, and as part of the detailed design.

The future development of the highway between Korora and Sapphire to motorway standard would provide for an ultimate six lane Pacific Highway over Korora Hill in addition to a two lane local access road on the eastern side. However, the alignment is very tightly constrained between the Korora Public School and the Korora Nature Reserve, either side of the existing highway.

Over this section the existing dual carriageway features a number of wide bus lanes and bus shelters that form an interchange arrangement with a pedestrian overbridge for access to either side. The concept design allows for the proposed earthworks to be retained in these areas and walled engineering solutions have been adopted to minimise property and environmental impact.

In addition to retaining walls at Korora Hill, there is residential and commercial development adjacent the existing highway through the Opal Cove area on the approach to Sapphire. There are numerous properties and accommodation outlets on the western side of the highway and residential areas on the eastern side.

As a result of these tight constraints additional walls would be required between the proposed highway upgrade and the local access roads in this area and a narrow, walled underpass would feature between eastern and western local access roads at the Fernleigh Avenue intersection.

8.3 Deep cuttings at major ridgelines

In addition to bridges and retaining walls, the bypass proposal would also require the excavation of a number of road cuttings, including four that would warrant notation as being major structures in their own right.

As outlined in Section 5.3, a prominent feature of the horizontal alignment of the bypass proposal is that it passes through two major and two other substantial ridgelines as it traverses around the Coffs Harbour basin. The two major ridgelines crossed are north of Shephards Lane and west of Gatelys Road and the other substantial ridges are at the Roberts Hill Ridgeline and immediately south of Bruxner Park Road.

The vertical alignment of the bypass proposal has been developed to provide a best fit through the natural terrain as outlined in Section 5.4. The resultant cutting depths on these four ridges would be substantial, ranging from 40 metres to 65 metres.

Details of the location and depth of the potential cutting at each of these ridges are provided in Table 8.2.

Table 8.2 Deep cuttings at major ridgelines

Chainage	Location Description	Maximum Cut	Comments
13.7 km	Roberts Hill Ridgeline	40 metres	Southern ridgeline of Coffs Harbour Basin
17.2 km	North of Shephards Lane	65 metres	Major ridgeline from Bruxner Park
19.2 km	Gatelys Road Ridgeline	65 metres	Major ridgeline from Bruxner Park
20.4 km	South of Bruxner Park Road	40 metres	Lower end of ridgeline

The excavation of major cuttings on the ridgelines as described in Table 8.2 pose risks in the following key areas:-

- Depth of excavation of the design and the ongoing maintenance of the cutting
- Large volumes of surplus fill which may be in excess of project requirements
- Potential negative urban design outcomes due to the wide expanse of clearing
- Difficulty in cost estimation/certainty of price

The more traditional earthworks (cut / fill) solution on the bypass proposal would feature some of highest cuttings constructed by RTA and a number of aspects would need to be considered in detail as follows:

- Global stability of whole excavation.
- Local stability issues, including the need for rock bolting or soil nails.
- Cut batter (slope) design and spacing and sizing of berms for drainage and access for maintenance.
- Provision of rock fall zones and fences
- Necessity for cut face protection and maintenance

8.4 Potential tunnel construction

As an alternative to the excavation of the deep cuttings, the feasibility of tunnels has been considered on three of the four major ridgelines described in Table 8.2.

The rationale for consideration of tunnels instead of the earthworks on these major ridges is that the ridges are quite steep and that the resulting tunnels would be relatively short at less than 500 metres.

As such any bypass tunnels would be less likely to require major ventilation and emission control systems and as a result could be cost effective.

With the provision of tunnels it would be possible to substantially lower the proposed vertical alignment in that vicinity, allowing the bypass to be lowered more sympathetically into the existing terrain either side of the major ridgelines, with consequent aesthetic and acoustic benefits. The concept design drawings provided in Appendix B demonstrate the differences in vertical alignment for the earthworks and tunnel alternatives

In addition to potential benefits of tunnels, it is expected that the longer term detailed planning of the bypass proposal would see more community demands for an environmentally sensitive and less intrusive highway alignment, especially given the highly urbanised settings within Coffs Harbour.

The potential tunnel locations and types that were subject to an initial feasibility investigation were as follows:

- A cut / cover structure on the cutting through the Roberts Hill ridge at 13.7 km. This ridge is prominent from numerous vantage points around the city and a cutting would be prominent. In addition, the Roberts Hill ridgeline is a recognised fauna corridor and with this structure type the backfill material over a constructed tunnel section would be used to reinstate the ridgeline.
- As an alternative to the very deep cutting proposed for the major ridge north of Shephards Lane (17.2 km), twin tunnels could be adopted, using either bored or drill and blast construction techniques. The length of the tunnel would be approximately 350 metres and this arrangement would also allow a lower vertical alignment than with the cutting design.
- As an alternative to the very deep cutting that would be required for the major ridge west of Gatelys Road (19.2 km), twin tunnels could be adopted, using either bored or drill and blast construction techniques. The length of the tunnel would be 500 metres and this arrangement would also allow a lower vertical alignment than with the cutting design.
- A tunnel was not investigated on the fourth substantial ridgeline crossed by the bypass proposal, just south of Bruxner Park road at 20.4 km. The bypass alignment is at the eastern extremity of that ridgeline and there is a marked difference in the height of the cutting on either side of the proposed highway. This side cutting configuration would reduce the practicality of a tunnel in this location and the larger volume of cutting material from this particular ridge would be readily utilised at the nearby Korora Hill Interchange.

8.5 Tunnel structure options

The first of these potentially feasible tunnel locations, at Roberts Hill ridgeline, would involve a relatively short and shallow tunnel, whereas the tunnels north of Shephards Lane and near Gatelys Road would be alternatives to very deep cuttings. Based on these contrasting depths and likely lengths of tunnel construction, the two distinct tunnel types are described in the following sections.

8.5.1 Cut and cover tunnel option – Roberts Hill ridgeline

At the Roberts Hill ridgeline a relatively short and shallow tunnel would replace the proposed earthworks cutting, which otherwise would produce a very prominent “v-notch” in the ridgeline. The proposed tunnel replacement would be approximately 80 metres long, or about three seconds of travel time, to eliminate the need for ventilation or emergency access requirements. This would also provide an appropriate width of ridge reinstatement for a recognised existing fauna corridor.

A number of strategic options were considered for a cut and cover structure as follows:

- A single arch structure to clear span both carriageways.

- Twin parallel arch structures to imitate potential horizontal bored tunnels on other ridges along the bypass route.
- A land bridge arrangement using transverse bridge girders as the top, or roof, of the tunnel.
- A longitudinal reinforced concrete structure utilising a central wall to minimise lateral span requirements.

Of these options it was considered likely that any proposal to clear span both carriageways and the central median would be cost prohibitive. As such, the single arch option and the transverse bridge girder option did not merit further consideration.

The twin parallel arch structures were not considered further on the basis that the horizontal curvature through the ridgeline (radius 870 metres) would impinge on sight distance through the southbound arch and this would need to be larger, requiring substantially greater separation between the carriageways and a wider overall footprint. It should be noted that the other tunnel proposals are on much larger radius curves.

As such, a preliminary proposal for the Roberts Hill ridgeline tunnel structure would utilise reinforced concrete rectangular sections, with a height of 10 metres to reduce the weight of proposed backfill.

It is expected that the cut and cover structure would be constructed generally as follows:

- Undertake temporary earthworks to expose the cutting floor to the required depth below the proposed bypass road level (for pavement and drainage).
- Construction of a major overpass structure, specifically designed to allow a portion of the Roberts Hill ridgeline to be reinstated.
- Backfilling beside, around and over the tunnel structure, possibly using some lightweight fill, but with enough regular earth fill and soil to allow native vegetation to be established.
- Install fauna fencing of the proposed vegetative corridor for fauna movement and for safety at the induced portals at either end of the tunnel.
- Construction of a proposed property access road across the reinstated ridgeline, separate to the proposed fauna corridor.

8.5.2 Driven tunnels at deep ridgelines

At the deep ridgelines north of Shephards Lane and west of Gatelys Road, more traditional horizontally driven tunnels could be considered. With the depth to the crest of the respective ridges being up to 65 metres there would be ample cover (or rock mass) over the tunnels to allow for twin barrel excavation through the ridges. This would likely require appropriate rock bolting and stabilisation of the roof of the tunnel and possible lining of the tunnel perimeter as construction proceeds.

A key issue for tunnel construction on these ridges is the location and depth of the proposed portal areas. The transition between earthworks cuttings on the approach to the tunnels would need to incorporate a transverse excavation, or cut face, that would form the tunnel portal. This area would need to be excavated and stabilised prior to the commencement of tunnelling.

Images of typical portal construction on another tunnel on the Pacific Highway are provided in Figure 8.1 and Figure 8.2.

Figure 8.1 Typical portal construction and support

Figure 8.2 Completed tunnel portal – ridge line intact

The primary options for excavation of the long tunnels are as follows:

- Drilling of pilot, or small bore tunnels, around the perimeter of the tunnel barrels and the excavation of the bulk of the tunnel cross section by a tunnel auger. This would require a high voltage power source for the construction.
- Horizontal drill and blast of the rock material would not require a major power source but would be slower than excavation by a tunnel auger.

- Both options would likely require appropriate rock bolting and stabilisation of the roof of the tunnel and possible lining of the tunnel perimeter as construction proceeds.

Because of the relatively short tunnel length required at both ridges, construction by tunnel boring machine may not be practical.

The most appropriate method for tunnel construction and excavation of earth and rock material from the tunnel sections would be determined during future project development. There are numerous factors to consider in determining the most efficient construction technique including:

- Detailed analysis of rock type and structure through final tunnel elevations
- Availability of power sources for major machinery
- Impact of drilling and blasting operations on neighbouring properties
- Assessment of construction duration and permissibility of longer working hours

Further key aspects relating to the feasibility of tunnel construction at these two ridgelines is provided in the following comparison between tunnels and deep cuttings.

8.6 Comparison of tunnels and deep cuttings

A comparison of the feasibility of tunnel structures, as an alternative to deep cuttings at the major ridgelines on the bypass route was undertaken as part of the concept design development.

The assessment included consideration of issues in relation to both tunnel and deep cutting construction and the potential costs and benefits of each. The practicality and comparative requirements for each of the two major ridgelines north of Shephards Lane and west of Gatelys Road was also assessed.

8.6.1 Tunnels

Key tunnel constructability issues identified as part of the assessment are as follows:

Tunnel geometry

- Twin tunnels carrying unidirectional traffic.
- Length of tunnels – 350 metres at Shephards Lane and 450 metres at Gatelys Road.
- Consideration of tunnel cross section – 2 lane tunnel or 3 lane tunnel.
- Tunnels to be separated by horizontal alignment adjustments to allow for a minimum of 12 metres of residual rock material between respective barrels.
- Cross passages would be required at 120 metre spacings.

Tunnel civil works

- Excavation assumed to be by drill and blast techniques or by tunnel auger.
- Expected primary support requirements (Type 1) - rock bolting and shotcrete.
- Secondary support requirement, lining by cast in situ concrete (Type 2) – variable extent of Type 2 support covered under cost estimates.
- Final lining, drained with drip sheds as necessary.
- Reinforced concrete portal collars, for aesthetic reasons.

Tunnel ventilation

- The tunnel would be ventilated by induced airflow, under normal traffic conditions.
- Portal discharge would be acceptable and no air stacks would be required.

- Longitudinal ventilation would be provided, with jet fans to be above traffic envelope, to be used as required for incident operation only.

Tunnel fire protection

- Pressurised fire main, supplied by storage tanks on the ridgeline above tunnels.
- Deluge system to be installed for fire suppression following any incident.
- Storage tanks to supply fire mains and deluge system, with storage volume of approximately 400,000 litres, say 2 x 10 metre diameter tanks 2.5 metres high.
- Fire detection system to immediately detect any fire incident.

Lighting

- Standard tunnel lighting system complete with transition lighting zones adjacent to the portals and internal lighting zone.

Electrical systems

- Two high voltage supplies from independent sources to be provided in vicinity of the tunnels.
- Each supply serves a substation for high voltage supply to the site, each serving substations located adjacent to tunnel portal.

Communications and control systems

- Closed circuit television to be provided.
- Emergency telephone system to be provided.
- Tunnel control is integrated into an existing staffed traffic centre.

Due to the relatively short lengths of the proposed tunnels (compared to those on metropolitan motorways) it is expected that the mechanical and electrical services could be proportionately higher than in a longer tunnel project. This would be highly variable depending on the following:

- Distance to suitable power supplies.
- Distance to suitable water supplies.
- Safety related systems deemed necessary for tunnels 350 metres and 450 metres long.

Further issues identified as part of the assessment which would require consideration in any future detailed planning of the proposed tunnels were as follows:

- Location of plant rooms
- Access to tunnel portals and ridgeline infrastructure
- Permitting of dangerous goods and fire protection
- Management of tunnel closure
- Ongoing land-use above tunnel and property ownership
- Future capacity requirements

8.6.2 Deep cuttings

The constructability and issues associated with deep cuttings on the major ridgelines were also assessed. This assessment included a cost estimating and risk assessment analysis.

Key points considered as part of the cost estimating and risk assessment analysis. were as follows:

- Depth of cutting and variability of material with depth, with excavation progressively more difficult at greater depths.
- Volume of rock to be excavated and options for treatment of rock material.

- Quantities of excavated material and distances to be hauled to proposed fill locations.
- Height, spacing and width of earthworks berms
- Treatment of batter faces and quantities of rock bolting required for slope stabilisation.

The following assumptions were made for the purpose of estimating the costs for the individual cuttings. These were:

- 100m topsoil over cut material.
- Ripping of material to a depth of 10 metres (Zone 1).
- Heavy ripping from 10 metres to 20 metres (Zone 2).
- Blasting below a depth of 20 metres (Zone 3).
- Bulking factors for expected rock content were 1.0 for Zone 1 material and 1.2 and 1.35 for Zone 2 and Zone 3 material respectively.
- Approximately 20% of the steeper batter faces would require shotcrete facing and rock bolting as cut slope stabilisation treatments.

The quantities for each zone of material were calculated and a range of unit rates were applied for excavation, haulage, placement, treatment of rock and other activities. A number of scenarios were tested to assess the risk and the potential cost impact from each scenario. The resultant cost increases were used to provide contingency allocations to the expected cost of the cutting for comparison with the expected tunneling costs.

- Scenario 1 allows 15% increase in Zone 1 and Zone 2 quantities from benching changes.
- Scenario 2 allows for 50% of Zone 2 material to be blasted
- Scenario 3 allows for double the area of batter stabilisation treatment to the base case.
- Scenario 4 allows the disposal off site as spoil of 10% of the total cut volume. Assumes that the unprocessed rock will be spoiled.
- Scenario 5 allows for rock bulking factor increasing from the base value of 1.20 to 1.35.

The outcome of these sensitivity tests was a weighted average contingency of for quantity variations of 18% and this together with an assumed 10% contingency for adopted unit rates, gave a total contingency factor on top of the base cost for each cutting of 28%.

8.6.3 Cost comparisons

A summary of the cost estimating methodology for the cutting and tunnel solutions is as follows:

- For the tunnels options a range of costs were prepared based on assumed values for tunnel lining and support requirements. Assumed quantities for the primary support (Type 1) were varied in three steps from 75% to 95%, with the Type 2 support reducing from 25% to 5%. As such three scenarios were investigated for both 2 lane and 3 lane tunnel configurations
- For the earthworks cuttings a base cost was estimated from the calculated construction quantities for each cutting and a 28% contingency was applied for quantity potential variations and unit rate increases. An additional cost was also applied to the earthworks solution for the extra land required over and above that required for the tunnel solution

A summary of the range of costs estimates for tunnels and the expected costs for earthworks cuttings, with contingencies and additional land acquisition costs is provided in Table 8.1.

Table 8.1 Preliminary tunnels versus earthworks cost estimates (2006)

Ridge location	Tunnel estimates	Earthworks estimate
Shephards Lane		
2 Lane tunnel	$30.6 M to $36.2 M	
3 Lane tunnel	$40.4 M to $50.3 M	
Earthworks cutting (1)		$34.1 M
Gatelys Road		
2 Lane tunnel	$38.5 M to $45.6 M	
3 Lane tunnel	$51.1 M to $66.0 M	
Earthworks cutting (1)		$49.3 M

Notes:
1) Two lanes in each direction with provision for future 3rd lane in median.

A decision on whether to proceed with tunnel construction on each of the three nominated ridges would be at a time nearer to construction.

As this decision has not yet been made, the proposed road corridor has been defined assuming cuttings through the prominent ridgelines as described above. The corridor width may be further reduced in those areas should the decision be made to proceed with tunnels as opposed to cuttings.

9. Flooding and drainage

The natural terrain of the of the Coffs Harbour region is such that the Great Dividing Range is very close to the coast, with the majority of existing development on the narrow coastal strip. The existing highway predominantly follows the coastal strip through the city, crossing the lower extent of two main ridge lines at Roberts Hill and Macauleys Headland.

All of the proposed bypass alignment is to the west of the existing highway and the section from Korora to Sapphire is an upgrade of the existing dual carriageway. The bypass proposal and its extension to Sapphire traverse four discrete valleys or water catchment systems that flow from west to east across the proposed alignment. The four main catchments and the major streams that the bypass proposal crosses are as follows:

- North Boambee valley / Newports Creek
- Coffs Harbour basin / Coffs Creek
- West Korora valley / Jordans Creek
- Korora basin / Pinebrush Creek

Preliminary hydrologic and hydraulic calculations have been undertaken for the provision of transverse drainage across the bypass proposal. This has been undertaken for a 1 in 100 ARI year, or a 1% AEP event. The nature of the sub-catchments and the location of the proposed alignment in the foot slopes of the terrain have resulted in relatively small catchments and peak discharges. The required drainage structures on the majority of creek lines can be limited to medium sized pipe and box culverts.

The exception would be two main creek crossings of Newports Creek and Coffs Creek which would require bridge structures to pass peak discharges from lesser storm events.

A summary of the features of the sub-catchments within the four main catchments is provided in the following sections.

- North Boambee valley provides five sub-catchments upstream of the bypass proposal from Englands Road to Roberts Hill Ridge, ranging in size from 1.5 ha to 805 ha. The largest of these is Newports Creek (805 ha) which crosses the bypass south of North Boambee Road. A second branch of Newports Creek crosses the bypass proposal north of North Boambee Road and this catchment (320 ha) would also require a bridge structure.
- The Coffs Harbour basin would create the majority of sub-catchments on the bypass proposal. A total of 19 sub-catchments ranging in size from 1.5 ha to 258 ha are generated by the bypass alignment. All of these sub-catchments are the upper tributaries of West Coffs Creek and North West Coffs Creek with the proposed alignment crossing minor branches of these two main arms of Coffs Creek. The major sub-catchment is the West Coffs Creek arm (258 ha) and this would require multiple bridges for the proposed bypass and interchange ramps with Coramba Road.
- The West Korora basin generates a further 6 sub-catchments which drain to Jordans Creek. These are relatively minor, ranging in size from 7 ha to 20 ha.
- The Korora Basin consist of two sub-catchments of 661ha and 20ha requiring only one major creek crossing at the existing Pine Brush Creek and new bridges would be required for the new local access roads at this location.

Full details of the various catchments, peak discharge calculations and proposed drainage structures are provided in tabular format in Appendix E.

As further input to the flooding and drainage component of the bypass development, two flood studies as commissioned by CHCC have been reviewed. Detailed analyses of both Newports Creek and Coffs

Creek have been undertaken by Webb McKeown and a synopsis of the findings of two separate reports is provided below.

The Coffs Creek Flood Study (Webb McKeown, 2001) was prepared to assess the flooding behaviour on the township of Coffs Harbour. Coffs Harbour has been subject to many flooding incidents and the Coffs Creek Flood Study is a direct result of extensive damage that occurred in November 1996. Up to this time it was a widely held belief that a significant rainfall gradient existed at Coffs Harbour but this was never fully investigated until this report. The flood study was seen as an opportunity to expand on the impact that the rainfall gradient has on the predicted flood levels and correlate the revised data to existing and observed flood levels, in particular the November 1996 flood.

A sensitivity analysis was also done on ocean level effects. An assumption was required for the outlet channel capacity due to the dynamic nature of sediment movement at the mouth of the creek. The report concluded that tidal conditions for the 1% AEP do not affect the flood levels greatly beyond the Grafton Street Bridge on the Pacific Highway.

The results of the Coffs Creek study conclude that the rainfall gradient appears to increase the flood levels by 0.3 to 0.4 m in the non-tidal reaches of Coffs Creek and 0.6 to 0.7m in the tidal reaches. The flood levels reported are for the best estimate gradient. However, the variation in the flood profiles can only give an accuracy of flood levels to ±0.4m.

It is noted that the bypass alignment is well upstream of any major flooding confluence for Coffs Creek or any potential tidal impacts. As such, structures for the proposed bypass would be designed to pass a 1% AEP event with provision for larger events with additional spans if necessary.

Bridge structures are proposed where flows are expected to be greater than 50 cubic metres per second. All bridge structures have been initially sized with an assumed depth of 2m in the 1% AEP storm event.

The bridge structures nominated for the bypass proposal and the Coramba Road interchange ramps in the vicinity of the Coffs Creek crossing point are as follows:

- 2 x 20 metre spans for the bypass proposal over Coffs Creek based on the above assumptions of a 2m water depth, with an additional 2 x 20 metre spans required based on the alignment of the creek at the crossing point and the need to provide greater flood immunity on a steep enclosed catchment.
- Similarly, 4 x 20m spans would be required on the south facing interchange ramps over Coffs Creek.

The combined North Boambee Creek and Newports Creek Flood Study (Webb Mckeown, 2007) analysed one dimensional flood behaviour of North Boambee Creek and Newport Creek. A range of design storms including the Probable Maximum Flood (PMF), 0.2%, 0.5%, 1%, 5%, 10%, 20% AEP storms were modelled and calibrated to recorded and observed flood levels for the November 1996 flood event. A number of sensitivity analyses were also conducted.

In determining boundary conditions and inputs, assumptions were made based on the previous Coffs Creek Flood study. Tailwater conditions for the 1% AEP were adopted for the PMF, 0.5%, 0.2%, and 1% AEP design. An assumed constant tailwater level of 1metre AHD was adopted for smaller event storms. Rainfall gradients derived in the Coffs Creek Flood Study were utilised since the topography is similar to Coffs Creek with the Great Dividing Range still in close proximity to the coastline.

As a result the calculated 1% AEP flood level, just upstream of the existing highway at Newports Creek, was nominated as 6.7metres AHD. This level is greater than that noted in previous flood studies conducted on Newports Creek by 1.0 metre. As outlined in the flood study report, this variation is mainly due to the change in the tail water condition and the application of a rainfall gradient across

the catchment. This level indicates that Newport Creek at the existing highway is nearing the extent of the tidal limit.

The proposed alignment is approximately 1km upstream of the existing highway at Newports Creek indicating that it is unlikely to be affected by tidal actions. Hence, the bypass proposal would not affected by downstream conditions. There would be two creek crossings over branches of Newports Creek requiring the following minimum bridge sizes:

- 2 x 20 metre spans over the southern arm of Newports Creek, although a longer bridge of 4 x 20 metre spans may be required with detailed flood modelling and this has been allowed for in sizing of the bridge.
- 2 x 20 metre spans over the northern arm of Newports Creek, subject to detailed design.

10. Noise mitigation

A key consideration in the development of any major urban highway development is the generation and mitigation of road traffic noise. During the development and assessment of the route options for the bypass proposal, Wilkinson Murray conducted a Strategic Noise Assessment, incorporating a review of road traffic noise issues associated with the route alignment, existing residential precincts and future urban development areas in the vicinity of the route (Wilkinson Murray, 2004).

The assessment was undertaken in accordance with the Department of Environment and Conservation (DEC) *Environmental Criteria for Road Traffic Noise (ECRTN)* guidelines. The criteria for the proposed bypass were (and currently remain) as follows:

- New Freeway / Arterial Road
  - LAeq 15hr (day time) = 55dBA
  - LAeq 9hr (night time) = 50dBA

These noise levels are termed the *Base Criteria* which should be achieved where feasible and practicable. The road traffic noise assessment is normally conducted at a projected 10 years after the road development has been opened to traffic. However this was not practicable for the Coffs Harbour Bypass project assessment because of the considering the 20 years plus timeframes associated with the development.

The Wilkinson Murray report identified that, without noise mitigation, the Base Criteria of 50dBA at night time would be achieved at between 500 metres and 800 metres from the edge of the alignment, depending on the topography, gradient and receiver elevation, with distances of up to 1 km being possible in specific situations.

It was apparent that some residential receivers already encroach within this distance of the bypass proposal and future land releases also extend within this range of the proposed alignment. It was assessed that noise barriers or mounds would typically be required to mitigate road traffic noise to existing receivers or to allow future development closer to the bypass.

However, high barriers may not be acceptable or suitable in his semi rural / rural residential environmental. As such it was reported that landscaped mounds, possibly incorporating low barriers, would be a more suitable arrangement in this environment from an urban design perspective. It was also noted that low noise road surfacing options could be proposed in specific noise sensitive areas.

With noise mitigation measures in place it was noted by Wilkinson Murray that the Base Criteria of 50dBA at night-time would be achieved at between 50 metres and 350 metres from the edge of the alignment, once again depending on the topography, gradient and receiver elevation.

Further investigation and detailed noise modelling of the bypass alignment, surrounding terrain and the location and height of residential and other receivers would be undertaken during further development of the bypass proposal.

10.1 Noise mitigation strategy

The strategy developed for noise mitigation on the bypass proposal is generally in accordance with the recommendations and opportunities suggested by Wilkinson Murray in its Strategic Noise Assessment. The overall strategy for noise mitigation on the concept design as developed to date is as follows:

- Maximise shielding of the bypass by use of existing terrain and the cut / fill configuration of the road alignment – indications within the Wilkinson Murray assessment is that this could be up to a 50% reduction in the zone of noise impact.

- Consider further shielding of the proposed alignment by the adoption of tunnels through major ridgelines instead of cuttings. This allows the height of embankment construction in adjacent valleys to be lowered.
- Provide noise mounds or combinations of mounds and low noise walls in noise sensitive areas such as North Boambee valley, north of Coramba Road near Spagnolos Road and through the Mackays Road valley.
- Use of elevated interchange ramps to provide noise mitigation in where the alignment is in close proximity to the Roselands Estate near the Coramba Road interchange.
- Adoption where necessary of sections of noise wall where mounds are not practical, such as the elevated structure over the North Coast Railway and on sections of the Korora to Sapphire upgrade.

10.2 Noise mitigation proposals

Preliminary noise mitigation proposals have been identified during the concept design development in confirmation of the proposed strategy and in anticipation of the results of future detailed noise modelling.

These noise mitigation proposals would be subject to detailed modelling and the application of a practicality and feasibility assessment during future development of the bypass proposal. Future noise mitigation measures would be defined and developed in accordance with the NSW Government's Environmental Criteria for Road Traffic Noise at the RTA's Environmental Noise Management Manual.

Details of the location and type of the preliminary noise mitigation proposals are outlined in Table 10.1.

Table 10.1 Preliminary noise mitigation proposals [1]

Chainage	Type	Comments
11.6 km – 12.9 km	Noise Mound / Landscaping	N/B Carriageway though North Boambee valley
11.6 km – 13.2 km	Noise Mound / Landscaping	S/B Carriageway though North Boambee valley
14.5 km – 15.2 km	Interchange Ramps	Effective noise mounds at Coramba Road interchange
15.5 km – 16.4 km	Noise Mound / Landscaping	S/B Carriageway on fills up to Shephards Lane
16.5 km – 16.7 km	Noise Wall / Bridge	S/B Carriageway on North Coast Railway Bridge
17.4 km – 18.9 km	Noise Mound / Landscaping	S/B Carriageway through Mackays Road valley
21.7 km – 22.4 km	Sections of Noise Wall	Between S/B carriageway and local road at Korora
22.7 km – 23.3 km	Sections of Noise Wall	Between S/B carriageway and local road at Opal Cove

1. Subject to further investigation and refinement during detailed design phase.

11. Urban design and landscaping

During the development and assessment of the route options for the bypass proposal, Hassell Consultant carried out a strategic urban design and visual assessment of the study area to identify and undertake a comparative assessment of visual impact, user experience and urban impact of the corridor options (Hassell, 2004).

Throughout the corridor refinement and route identification process, the urban designers worked closely with the engineering team to identify key landscape and urban design issues and the options were progressively refined in response to those issues.

The following key landscape and urban design principles were used as the basis for assessing the existing visual environment of Coffs Harbour in the context of the proposed bypass.

Landform

- Undulating landscapes have a greater diversity of visual experience than flat landscapes.
- Higher undulating landscapes may be more visually prominent and are therefore more visually sensitive than flat landscapes.

Vegetation

- Homogenous vegetation types strengthen the landscape character of an area.
- Forest has a greater screening capacity than open grassland.

Land use

- Land use types are often closely associated to landform types and influence vegetation cover.

Urban structure

- The Coastal Range and spur ranges (e.g. Roberts Hill Ridge) provide a natural boundary to urban expansion.
- The existing highway divides the urban area physically.
- The maintenance of an active and successful retail / commercial district for the city is dependent upon minimising restrictions on pedestrian movements and limiting vehicular traffic flow.

The Hassell study identified the visual baseline for the study area as being made up of landforms comprising the coastal flats (containing the majority of development), coastal foot slopes, and upper ranges and valleys. These features provide a natural boundary to urban expansion within the city.

Vegetation that contributes to the visual and scenic character of the landscape is closely linked to these landforms. Coastal wetlands and estuarine systems are interspersed with cleared land amongst urban, commercial and light industrial development. Further inland beyond the urban development there is a mix of cleared and agricultural land (mostly banana production) and remnant woodland, with dense forest prominent within the upper ranges and valleys.

The coastal foot slopes between the forested upper ranges and the coastal flats comprises urban development, rural residential and agricultural land interspersed with areas reserved for recreation and conservation. It is through this landscape that the proposed bypass alignment is located.

A preliminary urban design and visual assessment was also conducted by Hassell to assess the likely implications of the proposed bypass in terms of visual impact, road user experience and urban design impact.

Visual impact

It was assessed that the bypass proposal would have visual impacts due to the introduction of a new highway formation through a predominantly rural residential area. It was indicated that there may be potentially very significant visual impacts associated with the proposed bypass, particularly at the point where it crosses over Roberts Hill ridge. These impacts would be intense for adjacent properties but also apparent from a broader landscape perspective.

However, it was noted that the visual impacts could be reduced by a cut and cover tunnel arrangement or a vegetated fauna overpass as discussed in Section 8.4. The road is also likely to be visible from viewing points at Red Hill and Roberts Hill, and would be visible where it passes over the ridge to the north of the rail line, and where it runs along the base of the foothills. The intersection with the existing highway at Englands Road, may also have visual impacts on adjacent properties.

Each of the visual impact concerns identified by Hassell has been considered during the subsequent development of the concept design. Whilst the proposed bypass will be able to be viewed from a number of locations a number of measures have been considered to mitigate the impact as follows:

- The original location of the preferred route within the natural terrain would shield it from a high proportion of the Coffs Harbour urban area.
- The potential for tunnel construction and lower embankments though adjoining valleys would further shield the alignment.
- The provision of dual function noise and landscaping mounds in sensitive areas will allow effective camouflaging of the bypass.
- Key areas of connectivity with the existing road network would be afforded specific urban design treatments during future stages of project development.

Road user experience

The journey for motorists along the bypass alignment would provide new views of Coffs Harbour from the various ridges and elevated sections through the North Boambee Valley and the Coffs Harbour basin, with further views of bushland and the coast at locations along the route.

Drivers and passengers for the first time would see the expanse of the city from the west, incorporating distant coastal views. In addition the journey along the bottom of the Bruxner Park / Sealy Lookout escarpment would be a new experience for motorists.

Urban impact

Hassell assessed that the proposed bypass may have some impacts on the urban structure of Coffs Harbour but these were considered to be low and may result in some positive outcomes. Key factors assessed were as follows:

- The bypass proposal runs through an area of planned urban expansion at its southern end in the North Boambee area. Potential division of this area could be mitigated through replanning of the future development.
- The bypass corridor also traverses the West Coffs Urban Release Area. The corridor would reduce the size of this area only slightly as the foot slopes of the range already provide a physical barrier to the area. The potential impact of the bypass proposal could be mitigated in the planning of the future urban development.
- It is suggested that proposed bypass may result in some positive impacts on the existing highway though the CBD and surrounding retail and commercial precincts. Removal of though traffic volumes, particularly heavy vehicles from the CBD area would allow further opportunities for traffic management to improve the urban amenity of the area.

12. Ecological overview

An Ecological Assessment (Connell Wagner, 2004) of the proposed bypass options was undertaken at the preferred option stage of the bypass development and included as part of the CHHPS Strategy Report.

A comparison between the potential bypass corridors indicated that the preferred bypass option would be likely to have a higher impact on threatened species and vegetation of conservation significance compared to the alternative, which was at that point, an existing highway upgrade through Coffs Harbour.

This was primarily because the existing highway passing through mainly developed lands, and hence the upgrade scenario would require less clearing and where clearing is necessary, these habitats are likely to be already degraded by edge effects and other disturbances associated with the existing roadway.

As part of the preliminary comparison of the earlier inner bypass options, implications for threatened species were grouped into broad habitat preferences, which in turn were based on vegetation types. Comparisons between the options revealed little or no difference in clearing requirements and this was not a major factor governing the nomination of the preferred route alignment.

The area of vegetation clearance for the preferred route alignment, now fully developed as the concept design, is shown in Table 12.1.

Table 12.1 Estimate of habitat clearance

Grouping of threatened species	Estimated Bypass proposal impact(ha)
Coastal vegetation species	1.7 ha
Mesic community species	5.2 ha
Forest fauna total	8.7 ha
Vegetation with winter flowering species	5.8 ha
Total vegetation clearance	21.4 ha

In consideration of aquatic fauna, the natural features along the route that provide the most suitable habitat for threatened aquatic species are watercourses with fringing vegetation and large dams set into vegetation or on the fringes of vegetation.

The bypass proposal had the highest potential level of impact on the habitats of threatened species associated with aquatic habitats.

The number of watercourses crossed by the bypass proposal is shown in Table 12.2.

Table 12.2 Number of water habitats crossed by bypass proposal

Habitat type	Bypass proposal
Water courses:	
- with fringe vegetation	5
- predominantly cleared lands	7
Large dams:	
- in vegetation	1
- with fringe vegetation	5
- not vegetated	7

The earlier ecological assessment identified that the bypass proposal would impact koala habitat and wildlife linkages. Ecological impacts and proposed mitigation measures would be further defined in the environmental assessment for the proposal.

In order to mitigate potential adverse impacts on existing fauna corridors, the concept design has been developed to incorporate fauna underpasses where necessary (viz koala habitat west of Isles industrial sub-division) and the provision of longer span bridges at the major watercourses. The final development of the proposed bypass would allow for the presence of wildlife linkages, which include a number of Koala movement corridors.

The provision of tunnels (cut / cover) at Roberts Hill Ridge and (bored or drill and blast) north of Shephards Lane and west of Gatelys Road would maintain the ridge fauna passages that are currently used by fauna. This is an important consideration of the overall assessment of the viability of tunnel construction on the project.

13. Project scope details

This section provides an outline of the strategic position and overall scope of the Coffs Harbour Bypass proposal, including the extent of work required in preparation for construction and a synopsis of the major construction elements which will largely define the final cost of the proposal.

13.1 Strategic scope

The bypass proposal fits strategically within the ongoing Pacific Highay Upgrade Program which is now part of the AusLink National Network. The proposal is a longer term connection between other highway upgrade works in the Coffs Harbour regional area as follows:

- South of Coffs Harbour
  - Warrell Creek to Urunga upgrade (in planning)
  - Raleigh deviation (complete)
  - Bonville upgrade (open to traffic September 2008)
  - Lyons Road to Englands Road (complete)
- North of Coffs Harbour
  - Sapphire to Woolgoolga upgrade (environmental assessment complete)
  - Woolgoolga to Wells Crossing (concept design complete)

The bypass proposal from Englands Road to Korora Hill and its extension as a motorway upgrade from Korora to Sapphire would complete a high standard dual carriageway through the Coffs Harbour urban area and connect to motorway standard sections of the highway south and north of the city. A summary of the strategic scope for the bypass proposal and the extension to Sapphire are outlined in Table 13.1.

Table 13.1 – Strategic scope of bypass proposal

Bypass Feature	Scope Element
Length of new dual carriageway	11.1 km
Length of new interchange ramps	9.7 km
Length of existing highway upgrade	1.8 km
Length of new local access road	3.5 km
Length of local road adjustment	2.1 km
Total earthworks volume without driven tunnels	4.5 million m3
Total earthworks volume with driven tunnels	3.0 million m3
Total length of potential driven tunnels	770 metres
Total area of new pavement	338,000 m2
Total area of new bridge deck	19,900 m2

13.2 Construction planning

Construction planning and pre-construction activities would generally commence three to four years before construction was to commence. This would take the form an environmental assessment, and a detailed design .

A brief description of the various construction planning and pre-construction phases is outlined in the following sections.

13.2.1 Project development

It is expected that further project development for the bypass proposal would be necessary beyond the concept design phase as completed to date. This would possibly include further tuning of the alignment (most likely the vertical profile) to further minimise impacts or to optimise the design, but staying within the proposed road reserve corridor.

Other activities to be completed in the further project development phase would be as follows:

- Further community consultation and stakeholder involvement in the project development.
- Comprehensive environmental studies and preparation of an Environmental Assessment (EA) in accordance with NSW and Commonwealth planning legislation.
- Detailed concept stage scope report and cost estimate.
- Confirmation and enactment of proposed project delivery strategy.

13.2.2 Investigation and design

Detailed investigations and detailed design and documentation would be necessary for the bypass proposal, the exact detail of which would be dependent on the adopted project delivery strategy. Notwithstanding, the detailed investigations and design which would need to be undertaken prior to construction would be as follows:

- Detailed survey of the whole bypass corridor.
- Detailed geotechnical investigations.
- Additional hydrologic and hydraulic investigations as necessary to input into final bridge design.
- Detailed road design, bridge design and other structural design, possibly including tunnels.

The detailed road design would includes the cost of the geometric design and the design of drainage, construction staging and miscellaneous items such as traffic barriers, street lighting, signposting, linemarking and all necessary ancillary items

13.2.3 Property acquisition and adjustments

The entire bypass road reserve would have to be acquired from the existing land owners and dedicated as public road or freeway. The acquisition process would need to be completed prior to commencing construction.

A total of 128 properties have been identified as requiring partial or full acquisition for the proposed bypass corridor and its extension to Sapphire. Programmed acquisition would be undertaken at appoint nearer to construction, however under some circumstances, the RTA can purchase land in accordance with its preferred route policy. All property acquisition would undertaken in accordance with the Land Acquisition (Just Terms) Compensation Act 1991.

13.2.4 Public utility adjustments

The bypass proposal would affect various public utilities along its length, with the major impact expected to be at either end of the route where it is proposed to widen and realign the existing Pacific Highway and where the bypass intersects various local roads.

Public utilities which would be impacted by the bypass proposal are as follows:

- Country Energy high voltage transmission lines and low voltage distribution lines.
- Coffs Harbour City Council water mains and sewer mains.
- Existing street lighting which may need to be relocated or amplified in certain areas

- Telstra communications cables, expected to be a combination of fibre optic and copper cabling.

Investigations to date have not included a comprehensive review of existing public utilities or development of relocation strategies. Detailed consultations and proposals for relocation or protection of various utilities would be undertaken as a pre-construction activity nearer to construction.

13.3 Construction quantities

A range of preliminary construction quantities (materials or manufactured items) that would be required to build the bypass proposal have been scoped for preparaton of preliminary cost estimates and as a reference case for future construction planning.

The actual length of the bypass proposal and associated works such as interchanges, local road adjustments and property access roads are well defined as outlined in Table 13.1. By adopting standard widths for the majority of these roads, total areas of pavement and wearing surface can be readily calculated.

Table 13.1 also references concept design level quantities for the earthworks necessary for road construction, as well as a summary of the bridges to be incorporated into the bypass proposal. The following sections give describe more detail of the bypass scope inventory within the key construction elements of:

- Earthworks
- Bridges
- Pavement
- Drainage

13.3.1 Earthworks

As outlined in Section 8 of this report, the total earthworks for the bypass proposal would be significantly different with or without tunnel structures through the main ridgelines. With the potential provision of tunnels at the major ridgelines north of Shephards Lane and west of Gatelys Road the volume of earth generated at these locations would be substantially reduced. In addition, the opportunity to lower the vertical alignment would also result in a reduction of embankment fill volumes in the valleys either side of these ridges.

The estimated earthworks quantities for the alternative options are presented in the Table 13.2. The quantities have been calculated by adjusting the earthworks volumes computed by the three dimensional design model of the bypass alignment to allow for the pavement and select material zone. The refined earthwork quantities also allow for subgrade replacement, unsuitable cut materials and rock drainage layer volumes.

Table 13.2 – Indicative earthworks quantities [1]

Earthworks quantities	Without tunnels	With tunnels
Clearing and grubbing	70 Ha	60 Ha
Topsoil	85,400 m3	82,000 m3
Total cut volumes	4,400,000 m3	3,000,000 m3
Rock treatment / processing	1,760,000 m3	760,000 m3
Select fill material	78,400 m3	78,400 m3
Rock drainage layer	3,100 m3	3,100 m3

1. Subject to refinement and further assessment at detailed design stage.

13.3.2 Bridges

The location, type and a brief description of the various bridges to be included within the bypass proposal were identified in Section 8 and Table 8.1. This section repeats this list of bridges with the preliminary sizes (width / length / deck area) for each to provide a scope definition for these major structures. Table 13.3 identifies the proposed bridges and their dimensional features.

Table 13.3 Proposed bridge structures and preliminary sizing [1]

Chainage	Description	Width (m)	Length (m)	Area (m^2)
10.6 km	Twin bridges over northbound off-ramp	10.5	50.0	1,050
10.8 km	Twin bridges over Englands Road	10.5	50.0	1,050
11.7km	Twin bridges over Newports Creek (south)	10.5	80.0	1,680
12.2 km	Twin bridges over North Boambee Road	10.5	40.0	840
12.5 km	Twin bridges over Newports Creek (north)	10.5	40.0	840
14.6 km	Twin bridges over Coffs Creek	10.5	80.0	1,680
14.6 km	Bridges for south facing ramps over Coffs Ck	8.0	80.0	1,280
14.7 km	Interchange bridge on Coramba Road	16.0	60.0	960
15.5 km	Property access road overpass	8.0	60.0	480
16.4 km	Local access road bridge on Shephards Lane	11.0	80.0	880
16.6 km	Twin bridges over North Coast Railway	10.5	210	4,410
17.8 km	Property access underpass	4.0	10.0	160
18.6 km	Property access underpass	4.0	10.0	160
19.7 km	Property access underpass	4.0	10.0	160
20.7 km	Twin bridges over Bruxner Park Road	10.5	40.0	840
20.7 km	South facing ramp bridges over Bruxner Park Road	8.0	40.0	640
20.9 km	Twin bridges over both northbound ramps	10.5	40.0	840
20.9 km	Northbound off-load bridge over southbound off ramp	8.0	40.0	640
22.4 km	New local access road bridges over Pine Brush Ck	11.0	50.0	1100
23.1 m	Twin bridges over local access road at Fernleigh Ave	10.5	10.0	210
			Total Deck Area	19,900 m^2

1. Bridge locations and sizes subject to refinement at detailed design stage of bypass proposal.

13.3.3 Pavements

The new dual carriageway for the bypass proposal would require a heavy duty pavement to meet RTA specifications for the Pacific Highway upgrade. This would most likely be a rigid concrete pavement with potentially an asphalt wearing surface. It is likely that this pavement would also be required for all of the proposed interchange ramps.

It is proposed that local road adjustments and new local access roads would be constructed considering specifications of Coffs Harbour City Council.

The estimated quantities of heavy duty and other pavement materials required to construct the bypass proposal and associated road works are presented in Table 13.4.

Table 13.4 – Indicative pavement quantities [1]

Pavement Type	Total Area
Heavy duty - new dual carriageway	210,900 m2
Heavy duty - new interchange ramps	82,400 m2
New local access road	29,700 m2
Local access road adjustment	18,700 m2

1. Pavement types and areas subject to further investigation at detailed design phase.

13.3.4 Drainage

Drainage of the proposed bypass and the natural landform either side of the road footprint would be provided by a series of pipe and box culvert structures, in addition to the bridges proposed at major creek lines. Drainage would be designed in two categories as follows:

- Transverse drainage of natural streams and creek below and through the road embankments.
- Longitudinal drainage of road cuttings and the road surface.

Transverse drainage in the form of precast reinforced concrete box culverts or circular pipes are to be provided at all low points in the natural terrain, wherever possible passing through the bypass embankments as natural, or clean, water flows. The culverts would be designed to control water velocity and erosion at outlets.

Longitudinal drainage would be provided through the road cuttings to convey stormwater runoff to the cut / fill interface where run-off from the carriageways would be passed through a sedimentation basin to collect water and allow the settlement of nutrients before discharge to natural streams.

The estimated lengths of drainage pipes and culverts, as well as other drainage infrastructure for the bypass proposal are provided in Table 13.5.

Table 13.5 – Indicative drainage quantities [1]

Transverse Drainage	Quantities
Pipe culverts	5880 metres
Box culverts	800 metres
Longitudinal Drainage	**Quantities**
Pipe culverts	8000 metres
Drainage pits	300 each
Subsurface drainage	16600 metres
Sedimentation basins	50 each

1. Subject to further investigation at detailed design phase.

13.3.5 Miscellaneous items

The following additional miscellaneous items would also form an integral part of the bypass proposal:

- Fencing of the bypass road boundaries
- Lighting the proposed bridges, interchanges and intersections
- Installation of guardfence and / or wire rope barriers along the tops of the bypass embankments
- Directional and regulatory signposting
- Pavement Markings

Full details of the required scope in each of these key areas would be developed as part of the detailed design phase of the project.

14. References

Connell Wagner (2002) *Coffs Harbour Highway Planning Strategy – Preliminary Concept Design Report,* March 2002

Connell Wagner (2002) *Travel time surveys*

Connell Wagner (2004) Working Paper No 5: *Ecological Assessment*

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Department of Environment and Climate Change (DECC) *Environmental Criteria for Road Traffic Noise (ECRTN) Guidelines*

Hassell (2004) *Strategic Urban Design and Visual Assessment*

RTA (2001) *Coffs Harbour Highway Planning Strategy,* September 2001

RTA (2004) *Traffic volume data for the Hunter and Northern Regions*

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Webb, McKeown & Associates (2001) *Coffs Creek Flood Study*, May 2001

Webb, McKeown & Associates (2007) *Boambee Creek and Newports Creek Flood Study,* January 2007

Wilkinson Murray (2004) *Strategic Noise Assessment*

Appendix A

Report on submissions received following announcement of preferred route

Consideration of submissions on the Preferred Route

The Preferred Route of the Coffs Harbour Highway Planning Strategy was announced in December 2004 and placed on public display until Wednesday 2 February 2005. The Preferred Option Report was made available at some display locations during this period and was also available on the RTA website. Following the display of the Preferred Route, 22 submissions were received from individuals and organisations with an interest in the project. The respondents are listed in Table A.1.

Table A.2 provides a summary of the issues raised in the submissions received. Issues raised include: route options, traffic and access, economic analysis, planning and land use, concept design, community consultation, agriculture, noise and vibration, socio-economic issues and urban design and landscaping.

The RTA's responses include (where appropriate) how these issues have and/or will be addressed in the subsequent phases of the development of the strategy.

Table A.1: Submission respondents

Submission No.	Respondent
1	John Townsend
2	R Sharpe
3	Steven and Sabine Kelley
4	Bruce and Carolyn Winter
5	Kersten Tuckey
6	Andrew Fraser
7	David Jeffery
8	G. Rossi
9	Ray Cooper
10	Daniel Standing
11	Ray Cooper
12	Luke Hartsuyker
13	Rebecca Pickering
14	Margaret Murphy
15	Ian Hogbin
16	John Soltau
17	Sue/ Mark Sheath
18	Ron Dorman
19	Coffs Harbour City Council (CHCC)
20	Bruce Scanlon
21	Woolgoolga Area Residents (WAR)
22	WIRES

Table A.2: Responses to submissions

Sub No.	Comment	Response
Support Proposal		
1,5	▪ I believe that the chosen corridor offers good value for money ▪ I give full support for an inner bypass option	Noted
Route options		
2, 3 ,7, 8, 13, 14, 16, 18, 19	▪ We're looking forward to the real bypass plans soon ▪ We only support the route option of CHCC preferred corridor including Option A which resolves all issues ▪ Upgrade of the existing highway and a proper western bypass of Coffs Harbour ▪ There is the option to upgrade the existing highway or put in a proper bypass west of the coastal range. ▪ The recommended route is totally unsatisfactory to the citizens of the area and is only a short-term solution. The area needs a proper bypass. ▪ All residents in Coffs Harbour and Woolgoolga were lobbying for the coastal ridge option which is a long-term solution to a problem. ▪ The use of tunnelling for a far western option is creditable as it would quieten environmentalists as most of the vegetation could be retained. Another solution to plan a highway through mountainous terrain, is a bridged highway between two mountain tops ▪ Council expresses its dissatisfaction with the preferred route announcement and seeks a commitment from the state government for a future far western bypass of Coffs Harbour (from Coffs Harbour south to a point north of the Coffs Harbour LGA) ▪ The RTA pre-selected the Inner Route and they then recommended the inner route. This route is not the best option whether measured financially, socially or environmentally.	The Coffs Harbour Highway Planning Strategy has been developed to address the need to upgrade the Pacific Highway between Sapphire and Woolgoolga while planning for future traffic needs within the Coffs Harbour area. Since planning for the strategy began in September 2001, a wide range of potential highway corridors and route options has been investigated. These options have included options developed by the project team and options put forward by Coffs Harbour City Council and the community. The options investigated for the strategy fall into three broad strategic corridors: ▪ Far Western Bypass. A bypass of Coffs Harbour and Woolgoolga generally through the Orara Valley from Englands Road south of Coffs Harbour to Halfway Creek or Grafton. ▪ Coffs Harbour City Council Preferred Corridor. Options within a corridor adopted by council in late 2003 as its preferred option for a bypass of Coffs Harbour and Woolgoolga. ▪ Coastal Corridor. Options along the coastal plain between Englands Road south of Coffs Harbour and Arrawarra Creek north of Woolgoolga, with a future extension to Halfway Creek. The assessment of the three broad strategic corridor options found that the Coastal Corridor was the most feasible corridor option because it would: ▪ Have good functional performance (provide substantial road safety improvements and travel time savings) while still providing opportunities to separate through and local traffic. ▪ Provide the best balance between functional, environmental, social and economic factors. ▪ Have moderate and manageable biophysical impacts. ▪ Have relatively minor and manageable heritage impacts. ▪ Be lower cost than the other corridor options.

	▪ The Value Management Workshop recommended Options IS2 and IN2 go forward for further consideration (as stated in the RTA media release 10 August 2004). But the RTA preferred route option includes IS1 rather than IS2.	▪ Give the best value for money and have fair economic performance. ▪ Provide good construction staging opportunities that could be provided within funding program limitations. The investigation of the feasibility of a far western option concluded that it could not be justified within the foreseeable planning future due to the relatively low traffic volumes predicted to use it, the very high cost and the lack of staging opportunities. The feasibility assessment of the Coffs Harbour City Council Preferred Corridor found that options within the corridor, including the Coastal Ridge Way / Option A proposal, were not viable options for the strategy as they: ▪ Present significant engineering challenges. ▪ Provide poor functional performance. ▪ Are high cost and provide poor value for money. ▪ Have very significant impacts on native flora and fauna and a landscape of Aboriginal significance. The suggested inclusion of major tunnels or very long and elevated bridge structures on the far western option would significantly increase the cost of the option and further impair its poor economic performance. The option of upgrading the existing highway through Coffs Harbour to an urban motorway was investigated during the development and assessment of possible route options for the strategy. The investigation found that the upgrade of the existing highway does not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area. Investigations undertaken for the strategy, the submissions received from the display of the route options, comments received from government agencies and the recommendations of the value management workshops held in April 2003 and August 2004 were considered during the selection of the preferred route. Sub options IS1 and IS2 were identified and assessed for the southern part of the Coffs Harbour section of the strategy. Following consideration of all the available information, IS1 was preferred over IS2 as: ▪ IS1 has lower engineering risks, with greater flexibility and certainty as a tunnel is not required

		through the Roberts Hill Ridge. ▪ There would be additional ongoing operational costs associated with a tunnel through the Roberts Hill Ridge on IS2. ▪ IS1 can be refined to further reduce potential noise, visual and other impacts. ▪ The transport benefits of both options are similar. ▪ The potential impact of IS1 on likely future landuses is similar to IS2, and this can be mitigated by replanning the development of the North Boambee Valley. ▪ IS1 would cost $65M ($2003) less than IS2 and provides better value for money.
7	Respondent provided a selection of reasons why the conclusion to recommend the Inner Bypass of Coffs Harbour is "unsafe" (referring to the *Coffs Harbour Highway Planning Strategy Report* February 2004 which evaluates the Inner Bypass corridor options against an upgrade of the existing highway through Coffs Harbour): ▪ Four out of five traffic efficiency tests rank the existing highway upgrade better than the inner route ▪ An analysis of 19 factors including noise, air quality, rural land impact, tourism, geology and soils, visual impact etc show that parameters for both options are mostly adverse. It is very subjective exercise to rank these factors. ▪ The existing highway upgrade can expect "to significantly reduce crash rates and improve pedestrian safety" whilst the inner route would only "be expected to provide the best option in terms of crash rates". The inner route will not improve pedestrian safety or crashes on the existing highway ▪ Annual time savings on the existing highway upgrade are 1.585 million hours, and only 0.738 million hours for the inner route	The assessment of an upgrade of the existing highway through Coffs Harbour to an urban motorway standard found that the upgrade would have major adverse social impacts including community disruption, reduced amenity and severe landuse and business impacts in the main urban centre of Coffs Harbour. The assessment concluded that an upgrade of the existing highway does not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area. While the existing highway upgrade performed better than the inner route options in relation to traffic efficiency tests, the existing highway upgrade did not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area. Both the Inner Bypass and upgrading of the existing highway were assessed against a range of socio-economic and ecological factors. The assessment concluded that an upgrade of the existing highway does not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area. There would not be any pedestrian access to the Inner Bypass. All pedestrian access would be via the existing highway. The existing highway would become a local road and pedestrians would have access along the road. The removal of through traffic from this road would result in improved traffic and pedestrian conditions. The figures quoted are estimated travel time and travel distance savings in 2021. Although an upgrade of the existing highway provides greater travel time and distance savings (benefits) than the Inner Bypass, the construction cost for the upgrade of the existing highway ($690M in $2003)

	• The Existing Highway Upgrade results in Annual Travel Savings of 5.975million km compared with the Inner Route with 0.73 million km.	is substantially higher than the construction cost of the preferred route (Inner Bypass Options IS1 and IN2) ($280M to $360M in $2003 including interchange at James Small Drive north). The lower cost preferred route option ($280M in $2003) provides a higher economic return, with a Benefit Cost Ratio (BCR) of 0.93, than an upgrade of the existing highway (BCR of 0.85). The BCR for the higher cost preferred route option ($360M in $2003) has not been calculated.
	• The fuel, pollution and carbon costs of the Inner Route are enormous.	A comparison between the likely air quality impacts of the Inner Bypass and an upgrade of the existing highway found that: ▪ An upgrade of the existing highway would concentrate pollution in areas where there is a relatively large number of receptors. However, at least in the medium term, the upgrade is likely to improve the current situation by reducing congestion. The overall impacts associated with an upgrade of the existing highway are considered to be moderate, primarily due to the high impacts of the increased traffic and large number of receptors along the route. ▪ The main impact of the Inner Bypass would be the introduction of a new source of air pollution into the area. The Inner bypass would also improve the current situation on the bypassed section of the existing highway by reducing traffic volumes and congestion. The overall impacts of the Inner Bypass are considered to be moderate to low with only moderate impacts anticipated on receptors along the route. ▪ Greenhouse emissions would be directly proportional to the fuel consumed, affected by the grade of the road and start-stop conditions. There would be little difference between emissions for the upgrade of the existing highway and the Inner bypass.
	▪ For Freight Transport Costs there will be Annual Travel Time savings of $36.5 million for the existing highway upgrade, but a cost of $0.2 million for the inner route.	The figure quoted for travel time savings of the Inner Bypass in 2021 is incorrect. The annual travel savings for the Inner Bypass is $17.0M in 2021. It should be noted that these travel time savings are for all vehicles including freight vehicles. Although an upgrade of the existing highway provides greater travel time savings (benefits) than the Inner Bypass, the construction cost for the upgrade of the existing highway ($690M in $2003) is substantially higher than the construction cost of the preferred route (Inner Bypass Options IS1 and IN2) ($280M to $360M in $2003 including interchange at James Small Drive north). The lower cost preferred route option ($280M in $2003) provides a higher economic return, with a Benefit Cost Ratio (BCR) of 0.93, than an upgrade of the existing highway (BCR of 0.85). The BCR for the higher cost preferred route option ($360M in $2003) has not been calculated.

	▪ The existing highway upgrade will have a "negligible impact on rural, conservation/ vegetation areas" while the inner route "impacts on several areas of vegetation with ecological values"	While it is acknowledged that the Inner Bypass would have greater ecological impacts that an upgrade of the existing highway, the existing highway upgrade did not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area. Mitigation measures would be put in place to mitigate negative ecological impacts that could result due to the preferred route. These mitigation measures would be investigated further during the environmental assessment stage of the project.
	▪ An existing highway upgrade will allow numerous work stages with benefits realised incrementally as new sections are complete whilst the inner route offers little opportunity for staging.	While the Inner Bypass may not provide opportunities to stage construction, it would enable the construction of the road without disruption to traffic along the current Pacific Highway, except at locations where the bypass joins to the existing highway. A major upgrade of the existing highway would result in severe disruption to traffic during construction of the upgrade.
	▪ Neither option would yield good economic returns in the short to medium term.	The Coffs Harbour Highway Planning Strategy has been developed (in part) to plan for future traffic needs within the Coffs Harbour area. It is acknowledged that neither option would be economic in the short to medium term.
	▪ For the inner route, there would be substantial adverse impacts on rural and rural residential areas in North Boambee, west Coffs Harbour and west Korora. The corridor would also have major implications for the development plans of North Boambee. The residential development plans in the Korora area are ignored.	It is acknowledged that the Inner Bypass would have impacts on rural and rural residential areas in North Boambee, west Coffs Harbour and west Korora. Both the Inner Bypass and upgrade of the existing highway would require significant acquisition of private property. The property impacts associated with an upgrade of the existing highway would result from the new interchanges, access ramps and service road arrangements in the built-up part of the city centre. Acquisition would be typically adjacent to the existing highway and some properties fronting the highway would loose their existing access to the highway. As a consequence, very high adverse impacts are anticipated in terms of urban landuse and business activities. Substantial adjustments would be required to maintain access to local businesses and tourist facilities. There would also be adverse impacts in terms of community cohesion due to access restrictions along and across the highway. Negative impacts would also be experienced across a range of amenity effects. In general terms, an upgrade of the existing highway would cause dramatic changes to the urban fabric of Coffs Harbour along the corridor, including potential severe impacts on the form and function of the Coffs Harbour CBD. Overall, an upgrade of the existing highway would have significantly greater socio-economic impacts than the Inner Bypass and did not merit further consideration due to its socio-economic

		impacts on the Coffs Harbour urban area. The RTA accepts that the preferred Inner South 1 option will impact on Council's current planning for the North Boambee Valley area. The RTA supports the replanning of this area being undertaken as soon as possible. The RTA concurs with Council's proposal to review the current planning for and prepare new Development Control Plan(s) (DCPs) for the North Boambee Valley. Subject to the proposed DCP(s) including adequate and appropriate measures to protect the required corridor for the preferred route of the Coffs Harbour bypass through the North Boambee Valley, the RTA also agrees to contribute up to $58,000 (excl. GST) towards the cost of the review.
	▪ The inner route would have a range of adverse impacts on the residential communities near the corridor, most notably in the form of amenity effects like traffic noise and visual impacts. The existing highway upgrade maintains the adverse impact to the community adjacent to the existing highway.	It is acknowledged that the Inner Bypass would have a range of adverse impacts on the residential communities near the corridor. However, due to the space available in the new corridor, opportunities exist to incorporate urban design features to provide visual and noise screening. Beneficial impacts are also anticipated for local accessibility and amenity along the existing highway corridor, with the removal of through traffic including significantly reduced heavy vehicle movements. These will also produce benefits for landuse and property in the Coffs Harbour CBD, and overall business activity and tourism. Overall, an upgrade of the existing highway would have significantly greater socio-economic impacts than the Inner Bypass and did not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area.
	▪ Based on the overall economic analysis in the report, the lowest cost Inner route is best, followed by existing highway upgrade then the highest cost inner route. However, the lowest cost inner route was not a proposition and was not selected, making the existing highway upgrade best.	The construction cost for the upgrade of the existing highway ($690M in $2003) is substantially higher than the construction cost of the preferred route (Inner Bypass Options IS1 and IN2) ($280M to $360M in $2003). The lower cost preferred route option ($280M in $2003) provides a higher economic return, with a Benefit Cost Ratio (BCR) of 0.93, than an upgrade of the existing highway (BCR of 0.85). The BCR for the higher cost preferred route option ($360M in $2003) has not been calculated. However, the existing highway upgrade did not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area.
	▪ The existing highway upgrade would prevent additional residences being exposed to traffic noise.	The Inner Bypass would reduce nightime noise levels along the existing highway through Coffs Harbour as it would remove a high proportion of heavy vehicles at night from the highway. While the Inner Bypass would result in an increase in the overall number of residences affected by traffic noise, it does provide some opportunities for use of the surrounding topography, including

		tunnels and lowering of the road gradeline to shield the road from the adjacent residential development both acoustically and visually. Where required, noise mitigation measures such as low noise pavement , noise barriers and architectural treatments could be introduced as part of the project design in accordance with Practice Note iv of the ENMM to ensure noise levels at residences meet appropriate ECRTN (DECC; Environmental Criteria for Road Traffic Noise) criteria. Due to the space available in the new corridor, opportunities exist to incorporate urban design features to provide visual and noise screening, where required. Overall, an upgrade of the existing highway would have significantly greater socio-economic impacts than the Inner Bypass and did not merit further consideration due to its socio-economic impacts on the Coffs Harbour urban area.
	▪ In the section on Discounted Cash Flow (DCF), the report uses a discount factor for the base analysis of 7% and then sensitivity analysis is applied at 4% and 10%. Seven percent is too high. The discounted rate should be a long term bond rate and should be 5-5.5%. The use of a high discount rate appears to be deliberate because it makes the inner route look more attractive. At a 4% DCF rate, the existing highway upgrade has the best ranking DCF and middle ranking Benefit Cost Ratio.	The economic analysis was undertaken based on the RTA's Economic Analysis Manual which advises that a discount rate of 7% is appropriate for NSW projects, and that sensitivity testing should be undertaken at discount rates of 4% and 10%.
	▪ In the section on Sensitivity to Increases in Costs any increase in capital costs does not change the "rankings" but makes all the projects even less attractive. The capital costs of all projects seem to blow-out!	The sensitivity analysis examined the effect on the economic assessment of adopting alternative discount rates of 4% and 10% (in line with standard sensitivity testing requirements) and the effect of reducing or increasing the capital cost estimates. The sensitivity analysis did not alter the rankings of the options assessed
7	The respondent has undertaken a review of the preferred route options report and found that the following issues are not even considered: ▪ For the inner route, the loss of rate income to CHCC has not been built into the cash flow analysis or the BCR. This is not mentioned as one of the adverse impacts for either route. The cost to the community is estimated to be over $2 billion	It is understood that the estimate of "over $2 billion in lost prime residential land" came from an assessment of the lost opportunities to the urban development industry in the Coffs Harbour Local Government area arising from the Coffs Harbour Highway Planning Strategy. As a copy of the assessment has not been provided, the RTA is not able to review or comment on the document.

	in lost prime residential land. The factor was completely ignored in the analysis.	The economic evaluation of the Inner Bypass options and upgrade of the existing highway was a Road User Cost Benefit Analysis (RUCBA) undertaken based on the RTA's Economic Analysis Manual. The RUCBA methodology is an industry standard assessment and is used to provide a consistent comparison between options within a project and with other road projects. The RUCBA methodology does not, and is not intended to, assess non road user benefits and costs, including estimates of lost opportunities to the urban development industry. The benefits from the future operation of the road are derived from savings in travel time, vehicle operating costs and accident costs. The cost includes construction costs, utility adjustment costs, maintenance costs and land acquisition costs. It does not include potential value of land for other uses.
	▪ No provision has been included in the cost estimates of the inner route options for any upgrading of the bypassed sections of the existing highway to cater for traffic that would remain on these sections of the existing highway - why not? The costings for the existing highway upgrade include $25M-$35M for a grade separated interchange at James Small Drive North- this is an example of bias.	Traffic predictions indicate that, with the Inner Bypass and Council's Ring Road system (including the Hogbin Drive Extension) in place, traffic volumes on the existing highway through Coffs Harbour would be similar to current levels. As, there would be no requirement to upgrade the existing highway with the preferred Inner Bypass route, no provision for an upgrade has been included in the cost estimate for the Inner Bypass. The cost of a grade-separated interchange at James Small Drive North ($35M including contingencies) was included in the cost estimates for both the Inner Bypass and an upgrade of the existing highway. It is relevant to note that the current concept design for the preferred route does not include an interchange at this location.
	▪ No consideration of diesel pollution has been made (esp. for Korora School). No analysis of greenhouse gas emissions has been included.	An air quality monitoring site was established at Korora in close proximity to the existing dual carriageway highway and opposite the Korora School. Results from this monitoring site show that the air quality close to the highway is well within National Environment Protection Measures (NEPM) guidelines. An analysis of greenhouse gases in relation to the Coffs Harbour bypass would be undertaken during the environmental assessment stage of the project. The preferred approach to addressing road-based air quality impacts is through improved road design (as is the case with the Inner Bypass) and through state or region wide strategies, such as: ▪ Progressive tightening of vehicle air emission standards. ▪ In service inspections to ensure vehicle muffler / exhaust systems are well maintained.

	▪ Selection of either option locks the highway onto the coastal plain forever and probably puts the construction of a proper western bypass off the agenda permanently. The adverse social impacts for both routes have not been included in the analysis.	▪ Integration of transport and land use planning. It is anticipated that over time the turnover in the vehicle fleet would see progressive removal of less efficient vehicles from the roads, thereby reducing vehicle emissions. Emissions and associated air quality pollutant levels would also be expected to improve due to improved fuel consumption and associated combustion technologies. The preferred route for the Coffs harbour Highway Planning Strategy was announced in December 2004. The assessment of the three broad strategic corridor options found that the Coastal Corridor was the most feasible corridor option because it would: ▪ Have good functional performance (provide substantial road safety improvements and travel time savings) while still providing opportunities to separate through and local traffic. ▪ Provide the best balance between functional, environmental, social and economic factors. ▪ Have moderate and manageable biophysical impacts. ▪ Have relatively minor and manageable heritage impacts. ▪ Be lower cost than the other corridor options. ▪ Give the best value for money and have fair economic performance. ▪ Provide good construction staging opportunities that could be provided within funding program limitations. The investigation of the feasibility of a far western option concluded that it could not be justified within the foreseeable planning future due to the relatively low traffic volumes predicted to use it, the very high cost and the lack of staging opportunities. The feasibility assessment of the Coffs Harbour City Council Preferred Corridor found that options within the corridor, including the Coastal Ridge Way / Option A proposal, were not viable options for the strategy as they: ▪ Present significant engineering challenges. ▪ Provide poor functional performance. ▪ Are high cost and provide poor value for money. ▪ Have very significant impacts on native flora and fauna and a landscape of Aboriginal significance. It is noted that the Department of Planning has recently released a draft Strategy for the Mid

		North Coast to 2031 (Draft Mid North Coast Regional Strategy) and that Coffs Harbour City Council is also preparing a Settlement Strategy for the City to 2031. As the preferred route would cater for anticipated traffic volumes well into the second half of this century, the need and/or route for a future western bypass of the coastal plain would not need to be investigated within the timeframes of the Strategies currently being developed for the North Coast Region and the City.
Eastern Distributor (planned to link to Hogbin Drive)		
22	▪ The planned road would pass through Council owned land between Brodie Drive and Watsonia Avenue would directly impact an area particularly rich in wildlife and habitat. If habitat is removed, this richness of wildlife will surely die. ▪ Should the nest trees of Ospreys near Wingara Drive be removed or compromised by the roadworks, expert advice will be needed to provide substitute breeding habitat for them. ▪ Many smaller ground dwelling species of reptile and small marsupials have their habitat in the Coffs Creek riparian zone and could be impacted by the Proposal ▪ If possible, underpasses will need to be planned to allow use by a variety of species and have fencing which channels fauna movement towards the underpasses and keeps it from getting onto the roadway. ▪ The planting of native species along roadsides is not a substitute for existing habitat. ▪ WIRES believe that planning of roadways must include protective fencing barriers and also suggest that a wide strip of clear, well-lighted buffer zone area border each roadway to minimise the disorienting impact of wildlife being “blinded and frozen” by headlights and may deter some animals from attempting to cross the road.	The extension of Hogbin Drive was developed and constructed by Coffs Harbour City Council. As it will assist in the management of traffic on the existing Pacific Highway through Coffs Harbour until the preferred route for the southern (Coffs Harbour) section of the Coffs Harbour Highway Planning Strategy is constructed, the Federal and State Governments have both contributed $5 million to the project.
Traffic and access		
4, 19	▪ A program of works is required on the Pacific Highway north of Coffs Harbour which addresses existing safety issues and provides improvements to the existing highway pending completion of the highway upgrade. ▪ There is currently congestion at the James Small Drive and	Over recent years the RTA has carried out remedial safety works on the highway north of Coffs Harbour, including intersection and road clear zone improvements. While the Coffs Harbour Highway Planning Strategy is planning for the future traffic needs within the Coffs Harbour urban area, the RTA also undertakes periodic road safety reviews of the

	Opal Cove Resort Road intersections with the Pacific Highway, the increase in local development would result in extra vehicles accessing the Pacific Highway.	existing highway to identify and prioritise shorter-term road safety improvements. Further road safety improvements on the existing highway north of Coffs Harbour will be identified and prioritised as part of this process.
5, 9, 11, 15, 19	▪ I would like to see a substantial improvement on the rail network and refocus freight movement from road to rail ▪ Railway should be used more extensively thus reducing the heavy vehicles on the roads ▪ Why not re-direct heavy vehicles onto the New England Highway? ▪ Heavy vehicles should be returned to the New England Highway that has a smaller population ▪ Removal of heavy vehicles including shifting heavy vehicles to the New England highway and providing a subsidy for trucks who travel along it. ▪ Council seeks a commitment for consideration of a fuel rebate or subsidy system or any other measures including rail, to encourage heavy vehicle operators to use the New England Highway	The Pacific Highway Upgrade Program is focused on major improvement of the Pacific Highway between Hexham and the Queensland border. The program objectives and the State and Commonwealth strategies that it is based on also deal with the broader environmental context of the highway. The objectives of the program address a range of key issues, in particular the reduction of road crashes and injuries, but also community interests, economic development, value for money, transport efficiency and ecologically sustainable development. The AusLink 'Sydney – Brisbane Corridor Strategy' (2007) in particular considers the transport and freight efficiencies of not only the Pacific Highway, but also the North Coast rail line and the New England Highway, all of which are integral parts of the Sydney – Brisbane transport corridor. This study identifies that the Pacific Highway is the key transport mode in this region. It also highlights the fact that the North Coast railway is unlikely to meet the future inter-regional transport task even if major rail infrastructure upgrades were to occur. The upgrade of rail networks is the responsibility of the relevant rail transport/ infrastructure authorities rather than the RTA, which is responsible for the development and maintenance of the road network in NSW. Any decision on the upgrading of the rail network, as well as the timing and availability of funding for such works would rest with the State and/or Commonwealth authorities responsible for the rail network and is, therefore, outside the scope of the strategy. It is also relevant to note that only a relatively small proportion of the heavy vehicle traffic on the Pacific Highway is purely Sydney-Brisbane traffic, as the North Coast area of New South Wales generates a large volume of freight movement in itself. A reasonable amount of the heavy vehicle traffic on the Pacific Highway is of inter/intra regional nature, having either an origin/destination or a number of pick-up/drop-off points within the North Coast area. Road freight in Australia is increasing in order to meet the needs of major population centres such as Brisbane and Sydney, as well as population growth areas in between. In this regard, the Pacific Highway has been and will continue to be one of the major freight roads in Australia, and improving freight efficiencies is one of the primary objectives of the Upgrading Program.
9,11,12	▪ B-doubles should not have been allowed on the roads. No road is built to safely contain these vehicles	Road freight in Australia is increasing in order to meet the needs of major population centres such as Brisbane and Sydney, as well as population growth areas in between. In this regard, the

	▪ We all know the danger to all road uses that heavy vehicles pose and it will only become worse as time passes ▪ Rumours that B-triples would be allowed on the highway ▪ Feasibility of closing the Pacific Highway to B-doubles	Pacific Highway has been and will continue to be one of the major freight roads in Australia, and improving freight efficiencies is one of the primary objectives of the Upgrading Program. Access onto the southern (Coffs harbour) section of the strategy would be provided at grade separated interchanges at Englands Road, Coramba Road and James Small Drive. As through traffic would be attracted to the new highway, the existing highway through Coffs Harbour would become a local road. The use of the new highway by through traffic and the separation of local and through traffic would improve road safety for all vehicles. There is no current proposal for the designation of the Pacific Highway for use by B-triples.
15, 19	▪ Congestion through Coffs Harbour is a concern. The completion of the Coffs Harbour internal ring road system as important to assist highway traffic flow. As such the Government should meet funding to complete the Hogbin Drive road. ▪ Council seeks a commitment for immediate funding for completion of the Hogbin Drive extension	The RTA, in conjunction with Coffs Harbour City Council, would continue to manage the existing highway through Coffs Harbour until the preferred route for the southern section of the Coffs Harbour Highway Planning Strategy is constructed. The recently completed extension of Hogbin Drive across Coffs Creek forms part of the management of the existing highway. The extension was jointly funded by the NSW and Australian Governments and Coffs Harbour City Council.
19	▪ The Korora to Hearnes Lake Road option maintains the reliance of the Pacific Highway for local and through traffic. Ensure that provision of a local/ service road parallel to the Pacific Highway upgrade is included where possible in the Korora to Hearnes Lake Road section of proposed upgrade.	The Concept Design for the northern (Sapphire to Woolgoolga) section of the strategy includes provision for local access roads for the full length of the project to facilitate the separation of local and through traffic. The concept design provides for a local access road parallel to the existing highway between Nautilus Resort, Sapphire and Graham Drive South, Emerald Heights. Graham Drive would function as a local access road between Emerald Heights and Hearnes Lake Road and the existing highway would function as a local access road between Hearnes Lake Road and the northern end of the project at Arrawarra.
15	▪ Government should provide recurrent funding to establish more regular public transport services to remove local traffic from the Pacific Highway. ▪ Council request funding for the completion of the Northern Beaches Cycleway as part of the Pacific Highway Upgrade Program.	The provision of recurrent funding to establish more regular public transport services to remove local traffic from the Pacific Highway is outside the scope of the Coffs Harbour Highway Planning Strategy. The concept design for the Preferred Route for the Highway Planning Strategy includes a 2.5m shoulder to cater for cyclists, a combined footpath / cycleway on key overbridges and any necessary works to rectify impacts on existing cycleways. THE RTA will liaise with Council to ensure that the proposed combined footpath / cycleway facilities on key overbridges are consistent with Council's cycleway strategy for the northern beaches area. Council's Northern Beaches Cycleway Project is a separate project to the Highway

		Planning Strategy. Council may wish to seek financial assistance for the project from other sources, e.g. The RTA Cycleway Program and/or the Coastline Cycleway Program.
Economic analysis		
6	▪ The cost benefit analysis was completed prior to the opening of Chinderah bypass and does not include the increase in heavy vehicles as a result.	Changes that have occurred since the Preferred Route for the Coffs Harbour Highway Planning Strategy was announced in December 2004 have included: ▪ Increases in the cost of major highway upgrade projects. ▪ Changes to the design of some route options – including the Preferred Route for the strategy. ▪ Changes to the volume of traffic (including heavy vehicle traffic) using the highway. In late 2007, the RTA considered if the Preferred Route for the strategy still provided the best value for money. The economic studies were redone and it was concluded that the coastal corridor would: ▪ Provide substantial road safety improvements and travel time savings. ▪ Be lower cost than the other corridor options. ▪ Give the best value for money and have fair economic performance.
15	▪ The projected cost is larger than other regional road construction and there is no certainty that Government can afford to build the road into the future	The Coffs Harbour Highway Planning Strategy has been developed to address the need to upgrade the Pacific highway between Sapphire and Woolgoolga while planning for future traffic needs within the Coffs Harbour area. The programme and timing for the southern (Coffs Harbour) section of the Strategy would be considered in conjunction with the programme for and priority of other major upgrade works on the Pacific Highway. Timing of the work would also be subject to funding arrangements for the upgrade of the highway beyond June 2009.
Planning and land use		
6, 8, 16, 19	▪ The route selected greatly hinders opportunities for development along the Coffs Coasts. It has sterilised the land for short term agricultural use and stymied future development of the land. ▪ No other use for affected banana lands as CHCC will not permit building within 150 metres from the highway ▪ The route cuts into several prepared future master development plans for housing or industrial expansion and is too close to well-established semi rural areas ▪ The Preferred Route directly impacts on the proposed North	While it is acknowledged that the Preferred Route would have impacts on agricultural land and land with the potential for future development, it was the most feasible option because it would: ▪ Have good functional performance (provide substantial road safety improvement and travel time savings) while still providing opportunities to separate through and local traffic. ▪ Provide the best balance between functional, environmental, social and economic factors. ▪ Have moderate and manageable biophysical impacts. ▪ Have relatively minor and manageable heritage impacts. ▪ Be lower cost than the other corridor options. ▪ Give the best value for money and have fair economic performance.

	Boambee valley release area. Council is seeking funding from RTA for replanning of North Boambee Valley and the west Coffs Future Investigation area. ▪ IN2 option and Option E impact on land that has been identified by Council for the construction of a water reservoir. ▪ The detailed design for IN2 should take into consideration of the proposed West Coffs detention basin.	▪ Provide good construction staging opportunities that could be provided within funding program limitations. The RTA accepts that the preferred Inner South 1 option will impact on Council's current planning for the North Boambee Valley area. The RTA supports the replanning of this area being undertaken as soon as possible. The RTA concurs with Council's proposal to review the current planning for and prepare new Development Control Plan(s) (DCPs) for the North Boambee Valley. Subject to the proposed DCP(s) including adequate and appropriate measures to protect the required corridor for the preferred route of the Coffs Harbour bypass through the North Boambee Valley, the RTA also agrees to contribute up to $58,000 (excl. GST) towards the cost of the review. It is understood that Council's planning for the West Coffs Extension Area has not been progressed to the same degree as its planning for the North Boambee Valley and that Council is currently investigating development constraints and potential lot yields. Consequently, this area may not require the same amount of replanning as the North Boambee Valley. Council may wish to clarify the extent of replanning works necessitated by the Preferred Route. Based on discussions with Council's staff, the RTA understands that there is no requirement for any RTA involvement in the review of the need for and location of proposed water reservoirs in west Coffs Harbour and south Woolgoolga. However, the RTA would be pleased to provide any relevant information available to it to assist Council with this activity. The RTA will liaise with Council during the refinement of the concept design for the Coffs Harbour section of the upgrade to ensure that all relevant matters, including the proposed west Coffs Harbour detention basins, are considered.
8, 10, 15, 17, 19	▪ No compensation given to owners unless they are directly affected by the highway ▪ Landowner does not wish to sell ▪ The selection of a route now should see home owners compensated now so they can move on with their lives ▪ The property owners wish for the RTA to buy their property under the hardship provisions of the *Land Acquisition (Just Terms) Compensation Act 1991* ▪ Council request that acquisition of land should occur	The Project has been designed to minimise, to the extent possible, property acquisition. However, the RTA acknowledges that acquisition of private property is a sensitive issue for affected residents. The RTA can acquire private properties required for road purposes under the terms of the *Roads Act 1993*. The *Roads Act* only provides for the RTA to acquire land "directly affected" by the road proposal. The acquisition of land by the RTA can be done either by negotiation and private sale or through

	immediately upon the rezoning of land ▪ Council requests a commitment from the Minister for Roads to further negotiation with the RTA on property impacts of Option E.	a compulsory acquisition process. All Property acquisition would be undertaken in accordance with the RTA's Land Acquisition Policy and the *Land Acquisition (Just Terms) Compensation Act 1991* which encourages the purchase of land by negotiation rather than using a compulsory acquisition process. The Land *Acquisition (Just Terms) Compensation Act 1991* outlines relevant matters to be considered in determining the amount of compensation to which a person is entitled. The *Land Acquisition (Just Terms) Compensation Act 1991* also ensures that appropriate market value, including any special values of a property are considered when determining the level of compensation a person would receive, including for agricultural properties. When considering acquisition arrangements for businesses (such as banana farms), the RTA takes into account the economic viability of the business and the opportunities available to maintain the required standard of access to the property. The RTA can acquire land required for road purposes even if the landowner objects. Compulsory acquisition requires a recommendation by the Minister for Roads and approval by the Governor. The RTA generally acquires property: ▪ After a project has been approved, and ▪ When funds are available for acquisition. In certain circumstances the RTA may acquire property earlier under the "hardship" provisions of the *Land Acquisition (Just Terms Compensation) Act* or under the RTA's *Preferred Option Hardship Acquisition Policy*. An owner who considers he or she will suffer hardship may apply to the RTA to acquire the land. The property owned by the respondent who requested an acquisition under the hardship provisions of the *Land Acquisition (Just Terms) Compensation Act 1991* has been purchased by the RTA. Following the display of the concept design for the Coffs Harbour bypass, the RTA will consider issues raised in any comments received. Once this process is finalised, Coffs Harbour City Council will be approached to take planning action to formally reserve the corridor. Clause 20 of Coffs Harbour City Council's LEP 2000 includes provisions for property owners to

		initiate acquisition of their properties by the RTA once the land is rezoned for road. Provision of the details of the road boundaries will enable Council to undertake planning action to reserve the required corridor for the preferred route for this section of the Strategy and facilitate the RTA's ability to acquire properties directly affected by the proposal under Clause 20 of Coffs Harbour City Council's LEP 2000.
Concept design		
12	▪ A production of a computer simulation of the RTA's final route selection prior to it being presented to the Minister	Computer models were used in the development of all route options and the concept design for the Preferred Route. For Pacific Highway upgrade projects, the RTA has generally only prepared computer simulations for the display of the environmental assessment of the upgrade. A computer simulation was displayed with the display of the environmental assessment for the Sapphire to Woolgoolga section of the Coffs harbour Highway Planning Strategy.
15, 19	▪ Coffs Harbour already has a dual lane highway so the upgrade would not occur in many many years. In this time it is possible that the route chosen would change. ▪ Coffs Harbour bypass has a timeframe of 20 years- which would potentially leave the Coffs Harbour urban area with traffic and road safety problems for an unacceptably long period of time. Council seek that the bypass be begun within a 5 year timeline. ▪ The preferred route option provides the potential for effective deviation of through traffic around the existing Coffs Harbour and Woolgoolga urban areas. This could provide greater opportunity for Council and the RTA to investigate traffic management and main street treatments on the highway to better cater for local traffic movement.	The Coffs Harbour Highway Planning Strategy has been developed to address the need to upgrade the Pacific highway between Sapphire and Woolgoolga while planning for future traffic needs within the Coffs Harbour area. The programme and timing for the southern (Coffs Harbour) section of the Strategy would be considered in conjunction with the programme for and priority of other major upgrade works on the Pacific Highway. Timing of the work would also be subject to funding arrangements for the upgrade of the highway beyond June 2009. The RTA, in conjunction with Coffs Harbour City Council, would continue to manage the existing highway through Coffs Harbour until the preferred route for the southern section of the Coffs Harbour Highway Planning Strategy is constructed. The recently completed extension of Hogbin Drive across Coffs Creek forms part of the management of the existing highway. The extension was jointly funded by the NSW and Australian governments and Coffs Harbour City Council.
19	▪ The preferred route option does not provide for interchanges at Mastracolas Road and at North Boambee Road. No funding has been included for the upgrade of North Boambee Road, Mastracolas Road and Coramba road	The proposal for the Coffs Harbour bypass section of the Strategy is to provide a facility that allows for all traffic movements at both the southern and northern ends of the proposal and at the junction of the proposal and Coramba Road. The two access options considered for the southern end of the proposal were :- • A full grade separated interchange at Englands Road which caters for all movements (as

		shown in Community Update No.6), or • A half grade separated interchange at Englands Road which allows northbound vehicles to exit the proposal and southbound vehicles to enter the proposal with a half grade separated interchange at North Boambee Road which allows northbound vehicles to enter the proposal and southbound vehicles to exit the proposal (as shown in Community Update No.4). The two access options considered for the northern end of the proposal were :- • A full grade separated interchange at Korora Hill which caters for all movements (as shown in Community Update No.6), or • A half grade separated interchange at Mastrocolas Road which allows northbound vehicles to exit the proposal and southbound vehicles to enter the proposal with a half grade separated interchange at Korora Hill which allows northbound vehicles to enter the proposal and southbound vehicles to exit the proposal (as shown in Community Update No.4). In discussions, Council staff have advised that Council considers that interchanges at North Boambee Road and Mastrocolas Road would provide better opportunities for managing local traffic. However, the utilisation of half interchanges at North Boambee Road and Mastrocolas Road to provide better opportunities for managing local traffic would increase the use of the proposed highway for short length local traffic movements with the resultant conflict between through and local traffic on the highway. In addition, the attraction of additional local traffic to the proposed highway would inevitably increase traffic volumes on the road and could reduce the level of service of the road and/or require upgrading to six lanes to be brought forward. Compared to half interchanges at Englands Road and North Boambee Road, a full interchange at Englands Road would provide improved access to the Coffs Harbour Health Campus, Regional Waste Facility, Isles Drive Industrial area, Southern Cross University, John Paul College, International Sports Stadium, Coffs Harbour Airport and other adjacent traffic generating developments for traffic travelling to and from the north on the proposed highway. In addition, a half interchange at North Boambee Road would direct additional traffic onto this residential street with resultant road safety issues and potential noise impacts on local residents and adjacent developments, including Bishop Druitt College.

		Compared to half interchanges at Mastrocolas Road and Korora Hill, a full interchange at Korora Hill would provide improved access to the residential areas, tourist facilities and other adjacent traffic generating developments in the Diggers Beach, Korora and south Sapphire areas for traffic travelling to and from the south on the proposed highway while providing adequate access to the Park Beach Plaza and Homebase areas via the existing highway. Overall, full grade separated interchanges at Englands Road and Korora Hill would provide improved access to the major traffic generating developments at the northern and southern ends of the Coffs Harbour section of the upgrade than the alternative half interchange options. Consequently, the preferred access arrangements for the Coffs Harbour section of the Strategy are :- • A full grade separated interchange at Englands Road which caters for all movements, • A full grade separated interchange at Coramba Road which caters for all movements, and • A full grade separated interchange at Korora Hill which caters for all movements. In principle, the reconstruction and/or upgrading of local roads would only be appropriate where the Preferred Route results in an increase in traffic volumes which would warrant the reconstruction and/or upgrading of these roads. As the preferred access arrangements for the Coffs Harbour section of the Strategy are full grade separated interchanges at Englands Road, Coramba Road and Korora Hill it would be difficult to justify upgrading North Boambee Road and Mastrocolas road as part of the highway upgrade project. A more detailed traffic study of the Preferred Route would be required to determine the impact on the local road network and consequently, the need for any reconstruction and/or upgrading of these roads. This traffic study would be an input into the environmental assessment of the Preferred Route for the Coffs Harbour section of the Highway Upgrade Strategy. Any identified works would be undertaken in conjunction with the construction of the project.
19	▪ Option E would impact on the Hearnes Lake development area ▪ Option E would have a high impact on existing properties	These comments relate to the northern section of the Sapphire to Woolgoolga Pacific Highway upgrade.

	along the corridor.	The Project has been designed to minimise, to the extent possible, property acquisition, with only the land required for the roadway being acquired. Section 14.2 of the Sapphire to Woolgoolga environmental assessment addresses the issue of potential urban growth / development areas identified within the *Draft Mid North Coast Regional Strategy* and *Coffs Harbour City Council's Our Living City Strategy*. The Proposal has been designed to facilitate growth within the identified areas through the placement of interchanges in strategic (future development) locations (including the south Woolgoolga and Hearnes Lake areas). The *Hearnes Lake/ Sandy Beach Development Control Plan* area would be affected by the Proposal by mostly strip acquisitions, which affect perimeter sections of those properties such that there would be minimal impacts on the development potential of these areas. This impact has been reduced since the preferred route announcement in 2004 through refinements to the design during the environmental assessment phase.
Community consultation		
7	▪ The Coffs Harbour Highway Planning- Strategic Report February 2004 showed the investigative process had to be seriously distorted to produce the desired result. Report has a selective use of facts, subjective and incorrect conclusions, incorrect statements, window dressing, ignorance of facts and bias.	The Coffs Harbour Highway Planning- Strategic Report February 2004 was prepared by specialist consultants with the best information available. It has also been undertaken in consultation with relevant government agencies.
3, 8, 11	▪ Shortcomings of the planning process, disregard for local community and bias in decision-making ▪ Community members were not listened to ▪ All the meetings that were attended were nothing more or less than window dressing	A comprehensive community consultation strategy has been implemented throughout the course of the project involving individuals, the general community and businesses. Consultation activities have included community meetings, shopfront exhibitions, distribution of newsletters to stakeholders and the wider community, and maintenance of a project website. Avenues to consult with the project team have been available throughout the duration of the project via the project information line (free call). The consultation process has involved a broad cross-section of the community, and as such the RTA considers that it is aware of and has considered the majority of the issues raised during the project development process. Concerns raised during the route options display were considered as part of the route selection process. The RTA has sought to provide extensive and rigorous assessment and consideration of environmental impacts, community concerns and technical requirements in determining the

		optimum route, alignment and design for the Project. All options developed by the community or Council have been considered, including the community developed Coastal Ridgeway Proposal which was assessed in the *Review of the Coastal Ridgeway Proposal Report* released in February 2004 and the Coffs Harbour City Council Preferred Corridor which was assessed in the *Coffs Harbour City Council Preferred Corridor Feasibility Assessment* released in June 2004. The *Preferred Option Report* released in November 2004 includes a summary of the route options considered during the development of the strategy.
10	▪ Would the RTA pay for the loss of income for a landowner who had to attend a meeting during work hours	The RTA does not reimburse costs or loss of income arising from attendance at meetings.
12	▪ When will a Value Management workshop be held on the Coastal Ridgeway Option	It is not intended that additional Value Management workshops would be held after the announcement of the preferred route. The *Preferred Option Report* released in November 2004 includes a summary of the route options considered during the development of the strategy.
21	▪ The Value Management Workshop on 4 August 2004 failed to incorporate on the day both the cost and benefit cost ratio (BCR) into a summary table for comparisons during the "Judgement Phase". ▪ The RTA stance that almost half of the invitees of the August 2004 VMW were local community representatives is misleading. It is a fact that of the 25 actual participants of the workshop, only 4 were representing the "local" community that actually live or work in the area impacted by options C, C1 and E. ▪ At the VMW, in certain cases, Option A was used as a baseline. It should not have been, and options C, C1 and E should have been judged and compared on their own positive or negative attributes. ▪ It is noted that the validity of rankings for socio-economic and environmental assessments were tested for sensitivity by adjustment of weightings. However unless proper variable interaction methodology is used (eg. full or fractional factorial experimentation) where the assessment category in question is tested against a combination high and low rankings for each other assessment, the sensitivity tests were invalid.	The Value Management Workshop for the Sapphire to Woolgoolga section of the Coffs Harbour Highway Planning Strategy held on 4 August 2004 was a continuation of the Value Management Workshop held in April 2003 and considered additional route options developed after the April 2003 Workshop. Approximately half of the invitees to the workshop (13 out of 30) were representatives of the local community. In comprising almost half of the invitees, the local community was given the opportunity to have a significant involvement in the Workshop and its recommendations. Unfortunately, two Council representatives, one representative of the local business community and local indigenous community and one representative of State Forests were unable to attend. Bearing in mind that the purpose of the workshop is to bring together all stakeholders with an interest in a project, it is considered that the workshop in August 2004 provided for adequate and appropriate representation of the local community, The August 2004 Value Management Workshop evaluated and compared the performance of options C, C1 and E against the agreed functional, environmental and socio-economic performance criteria. Following discussions, and for consistency, workshop participants *"agreed to use the same assessment categories (functional, environmental and socio-economic performance), assessment criteria and weightings used in the April 2003 workshop to evaluate Option C1 and Option E against Option C with sensitivity testing on the outcome by varying the weightings of rural land impacts and amenity effects in the socio-economic category."* (Sapphire

	▪ By reducing the VMW to one rather than two days sacrificed the quality and validity of participant input. During the "information phase" the only stakeholders to present background information were the RTA and Connell Wagner. There should have been presentations from other stakeholders representing eg. community and agricultural interest and this was not done ▪ We contend that we were under an obligation to recommend a preferred option limited to either route C, C1 or E. That "recommending a preferred option to progress the project" was a fourth bullet point of the agenda. In addition, there was considerable opposition to one work group not wishing to make a recommendation. ▪ VMW did not apply a valid triple bottom line assessment to options C, C1 and E.	to Woolgoolga Value Management Workshop Report April 2003.). While there was some discussion during the workshop of the earlier options A and B they were not included in the assessment. Typically, the key activities of two day Value Management Workshops for major highway upgrade projects would comprise: ▪ Day 1 – The provision of background information and the selection of assessment criteria and weightings. ▪ Day 2 – Evaluation of the route options against the agreed assessment criteria. As the participants at the August 2004 workshop agreed to use the same assessment categories criteria and weightings used in the April 2003 workshop, it is considered that the three route options assessed at the workshop (Options C, C1 and E) could be adequately and appropriately assessed at a one day workshop. During the "information phase" of the workshop, details of the route options being considered were presented to the workshop by the project team. Participants were provided with the opportunity to seek additional information and/or clarification, should they wish to do so and provide a comment from their perspective. A representative of Coffs Harbour City Council also presented Council's perspective on the options being considered. Throughout the course of the workshop, all participants were provided with opportunities to raise issues, provide information to the attendees and express their opinions. During the course of the Workshop, attendees broke into five sub-groups to assess issues in detail. Whenever possible, each sub-group comprised a mix of representatives of the project team, government agencies and the local community. The sub-groups reported back to the rest of the Workshop, which then discussed, and if considered appropriate, adjusted the findings before adopting them as the consensus findings of the whole. Where a consensus could not be obtained, alternative findings were recorded and the overall outcome was reviewed to determine its sensitivity to the alternative findings. The methodology used in the August 2004 workshop to test the sensitivity of the outcome to the socio-economic and environmental assessments is a commonly used and appropriate methodology for these types of comparative assessments. The sensitivity testing undertaken at the workshop tested the sensitivity of the relative performance (or ranking) of the options against

		an agreed likely range of both the "score" for the impact of Option E on rural lands and the weighting given to "Rural Lands Impacts". This testing demonstrated that the relative performance (or ranking) of the options was not sensitive to these changes in "score" or weightings. Consequently, no benefit would be obtained by using a more detailed and sophisticated sensitivity testing methodology. One of the objectives of the Workshop was to recommend a preferred option to progress the project. To facilitate this objective, the five sub-groups were asked to consider and recommend a preferred option to be taken forward. However, it was not a requirement that each sub-group recommend an option. While four of the five sub-groups preferred Option E, the other sub-group felt that a preference could not be drawn. Subject to any questions being relevant and courteous, attendees at the workshop were entitled to ask any of the sub-groups to explain why they came to their conclusion. All of the available data, including the cost and economic performance (BCR) data, for each of the options was available when the 5 sub-groups made their assessments and selected their recommended outcome. The result of this process was a valid and appropriate 'triple bottom line' assessment.
20	▪ We have found some RTA staff to be untruthful and misleading in some things that they have said during such meetings	The RTA considers that it has been open and honest with all its dealings in regard to the strategy – including its dealings with the community and the respondent.
21	▪ Community updates do not provide an accurate summary of information. Update 5 fails to summarise in like manner the biophysical impacts for the coastal route options C, C1 and E. These facts are not revealed in full or abbreviated form in the Update when comparing CHCC preferred route options with the "coastal route options C, C1 and E."	Community Update 5 was released to present a summary of findings of the assessment of the feasibility of options within the Coffs Harbour City Council's preferred corridor. This feasibility assessment was undertaken in response to CHCC request to investigate potential routes within the "CHCC Preferred Corridor". The scope of the report was a feasibility assessment in terms of functional, socio-economic and biophysical parameters. A summary of the biophysical impacts of Supplementary options C1 and E are outlined in Community Update No. 4.
Agriculture		
8	▪ Impact on prime banana farms in the Coffs Harbour basin	While it is acknowledged that the Preferred Route would have impacts on banana farms in the Coffs Harbour basin, it was the most feasible option because it would: ▪ Have good functional performance (provide substantial road safety improvement and travel time savings) while still providing opportunities to separate through and local traffic.

		▪ Provide the best balance between functional, environmental, social and economic factors. ▪ Have moderate and manageable biophysical impacts. ▪ Have relatively minor and manageable heritage impacts. ▪ Be lower cost than the other corridor options. ▪ Give the best value for money and have fair economic performance. ▪ Provide good construction staging opportunities that could be provided within funding program limitations.
Noise and Vibration		
9	▪ How can anyone lessen the noise generated by heavy vehicles so close to dwellings and beaches	Preliminary noise mitigation measures have been incorporated into the design and include noise mounding, noise walls and landscaping at appropriate locations. Further noise measurements and determination of any noise mitigation measures would be undertaken prior to construction. This would include any new areas of residential development that are approved prior to the approval of the highway project. These locations would be incorporated in the noise assessment during detail design phase and further noise mitigation measures would be identified as and when required. All noise management measures will be developed in accordance with the RTA's *Environmental Noise Management Manual* (ENMM) guidelines. Noise mitigation measures such as low noise pavement , noise barriers and architectural treatments could be introduced as part of the project design in accordance with Practice Note iv of the ENMM to ensure noise levels at residences meet appropriate ECRTN (DECC; Environmental Criteria for Road Traffic Noise) criteria.
19	▪ Seek a higher standard of noise impact assessment for reconstruction of the Pacific Highway in the existing highway corridor. ▪ A clear set of guidelines relevant to the noise contours should be provided by the RTA together with a suitable package of compensation measures for those severely affected.	The RTA will design noise mitigation measures to comply with the *Environmental Criteria for Road Traffic Noise* (ECRTN) Guidelines current at the time of approval of the project and will take into consideration the adopted recommendations of the Noise Taskforce. After the project has been opened to traffic, noise modelling will be undertaken to verify the effectiveness of the noise mitigation measures and, if necessary, additional measures would be implemented to ensure compliance with the guidelines. A detailed noise assessment has been undertaken for the highway duplication between Korora and Hearnes Lake Road as part of the environmental assessment investigations for the Sapphire to Woolgoolga Pacific Highway Upgrade project.

		The noise assessment has been undertaken in accordance with the *Environmental Noise Management Manual* (ENMM) to meet the NSW *Government Environmental Criteria for Road Traffic Noise* criteria. The noise assessment and the environmental assessment outlined the potential noise mitigation measures and potential locations. These included low noise pavement, noise walls, noise mounding and where necessary (to meet requirements under the ECRTN), architectural treatments to properties.
Socio-economic		
9, 18	▪ We are still expected to live with the noise and air pollution generated by large volumes of traffic. In the future, this traffic will only become much heavier. ▪ Most of the residents affected by noise are also badly affected by fallout from diesel exhaust.	The RTA will design noise mitigation measures to comply with the *Environmental Criteria for Road Traffic Noise* (ECRTN) Guidelines current at the time of approval of the project and will take into consideration the adopted recommendations of the Noise Taskforce. After the project has been opened to traffic, noise modelling will be undertaken to verify the effectiveness of the noise mitigation measures and, if necessary, additional measures would be implemented to ensure compliance with the guidelines. Preliminary noise mitigation measures have been incorporated into the design and include noise mounding, noise walls and landscaping. Refined noise mitigation measures such as low noise pavement ,noise barriers and architectural treatments could be introduced as part of the project design in accordance with Practice Note iv of the ENMM to ensure noise levels at residences meet appropriate ECRTN (DECC; Environmental Criteria for Road Traffic Noise) criteria. An air quality monitoring site was established at Korora in close proximity to the existing dual carriageway highway. Results from this monitoring site show that the air quality close to the highway is well within National Environment Protection Measures (NEPM) guidelines. The Preferred Route would introduce an improved vertical and horizontal alignment compared to the existing highway and would also provide for a more consistent speed environment and improved traffic flow which would be expected to result in a decrease in vehicle emissions (including those of heavy vehicles) and associated air quality pollutant levels associated with traffic.

		Vehicle emission impacts are most effectively managed at source via vehicle fuel standards and vehicle maintenance and emissions testing. The preferred approach to addressing road-based air quality impacts is through improved road design (as is the case with the Preferred Route) and through state or region wide strategies, such as: ▪ Progressive tightening of vehicle air emission standards. ▪ In service inspections to ensure vehicle muffler/exhaust systems are well maintained. ▪ Integration of transport and land use planning. In addition, it is anticipated that over time the turnover in the vehicle fleet would see progressive removal of less efficient vehicles from the roads, thereby reducing vehicle emissions. Emissions and associated air quality pollutant levels would also be expected to improve from 2011 to 2021 due to improved fuel composition and associated combustion technologies. With the proposed upgrade, emission rates and associated pollutant levels would generally decrease in comparison to conditions without the upgrade.
14	▪ When the construction of the proposed Woolgoolga bypass commences, I will be subjected to construction noise and constant dust ▪ When the Woolgoolga bypass is completed, we will be subjected to 24 hours a day noise from trucks and other vehicles.	Construction impacts relating to the Woolgoolga bypass were addressed, including mitigation strategies, in the Sapphire to Woolgoolga Pacific Highway Upgrade environmental assessment. Construction impacts would be temporary and transient along the length of the project. The RTA would prepare a construction environmental management plan to manage any potential environmental impacts as a result of construction of the Proposal. Amenity for residents during construction would be managed through the implementation of various management plans that aim to manage environmental aspects (such as air quality and noise). During the construction phase, the RTA would continue to consult with the community and proposes to implement a community consultation system for the responsive and pro-active management of complaints. The environmental assessment for the Sapphire to Woolgoolga upgrade also identified noise mitigation measures for the Woolgoolga bypass. A low noise pavement and noise walls are proposed in the vicinity of the respondent's residence. These noise mitigation measures would result in the noise levels complying with the levels set out in the ECRTN.
9	▪ When environmental factors are being considered, surely the	All routes were assessed using a triple bottom line of functionality, environmental and socio-

	welfare of human beings should be the first and most important consideration.	economic issues. The Preferred Route was identified as the most feasible option because it would: ▪ Have good functional performance (provide substantial road safety improvement and travel time savings) while still providing opportunities to separate through and local traffic. ▪ Provide the best balance between functional, environmental, social and economic factors. ▪ Have moderate and manageable biophysical impacts. ▪ Have relatively minor and manageable heritage impacts. ▪ Be lower cost than the other corridor options. ▪ Give the best value for money and have fair economic performance. ▪ Provide good construction staging opportunities that could be provided within funding program limitations.
11	▪ Sleep deprivation is a serious health issue, air pollution is also a great concern to the community and also has serious health implications	Preliminary noise mitigation measures have been incorporated into the design and include noise mounding, noise walls and landscaping. Further noise assessments would be undertaken during the planning approval stage of the project and develop noise mitigation measures that would meet appropriate ENMM (RTA; *Environmental Noise Management Manual*) and ECRTN (DECC; *Environmental Criteria for Road Traffic Noise*) criteria. The policy outlines the findings of several studies into the effect of traffic noise on sleep disturbance and offers a recommendation on frequency of internal maxima which "are not likely to significantly affect health and wellbeing". An air quality monitoring site was established at Korora in close proximity to the existing dual carriageway highway. Results from this monitoring site show that the air quality close to the highway is well within National Environment Protection Measures (NEPM) guidelines. The Preferred Route would introduce an improved vertical and horizontal alignment compared to the existing highway and would also provide for a more consistent speed environment and improved traffic flow which would be expected to result in a decrease in vehicle emissions (including those of heavy vehicles) and associated air quality pollutant levels associated with traffic.

		Vehicle emission impacts are most effectively managed at source via vehicle fuel standards and vehicle maintenance and emissions testing. The preferred approach to addressing road-based air quality impacts is through improved road design (as is the case with the Preferred Route) and through state or region wide strategies, such as: ▪ Progressive tightening of vehicle air emission standards. ▪ In service inspections to ensure vehicle muffler/exhaust systems are well maintained. ▪ Integration of transport and land use planning. In addition, it is anticipated that over time the turnover in the vehicle fleet would see progressive removal of less efficient vehicles from the roads, thereby reducing vehicle emissions. Emissions and associated air quality pollutant levels would also be expected to improve from 2011 to 2021 due to improved fuel composition and associated combustion technologies. With the proposed upgrade, emission rates and associated pollutant levels would generally decrease in comparison to conditions without the upgrade.
11	▪ Tourist industry would suffer	Upgrading the Pacific Highway would provide economic growth for the area through increased freight efficiency, travel times and level of service. The flow-on benefits for the Coffs Harbour area include decreased transportation costs and times, better access for goods and services to markets as well as opening/ strengthening access to inter regional markets. The Project could improve access to tourist facilities and attractions through improved road safety and reduced travel times. Bypassing Coffs Harbour would also improve the amenity of the township, and could potentially benefit many businesses catering for short and long stay highway travellers. RTA would consult with Coffs Harbour City Council during the planning approval phase, in regards to providing appropriate signage on the highway for Coffs Harbour and other centres. This would be consistent with the RTA's signposting guidelines and signposting along the Pacific Highway generally.
19	▪ There has been an increase in heavy vehicle movements on the Pacific Highway as a result of the completion of key Pacific Highway upgrade projects. Economic loss to towns on the New England highway due to reduction in traffic	The AusLink 'Sydney – Brisbane Corridor Strategy' (2007) in particular considers the transport and freight efficiencies of not only the Pacific Highway, but also the North Coast rail line and the New England Highway, all of which are integral parts of the Sydney – Brisbane transport corridor. This study identifies that the Pacific Highway is the key transport mode in this region.

	volumes have not been assessed and should be included in consideration of options for the management of Sydney-Brisbane road freight	Only a relatively small proportion of the heavy vehicle traffic on the Pacific Highway is purely Sydney-Brisbane traffic, as the North Coast area of New South Wales generates a large volume of freight movement in itself. A reasonable amount of the heavy vehicle traffic on the Pacific Highway is of inter/intra regional nature, having either an origin/destination or a number of pick-up/drop-off points within the North Coast area. Road freight in Australia is increasing in order to meet the needs of major population centres such as Brisbane and Sydney, as well as population growth areas in between. In this regard, the Pacific Highway has been and will continue to be one of the major freight roads in Australia, and improving freight efficiencies is one of the primary objectives of the Upgrading Program.
Urban Design		
19	▪ Urban design measures should be implemented and compensation sought for impact on the Coffs Coast Regional Waste facility.	Urban design measures would be developed during the planning approval phase for the highway upgrade which would consider the views both onto and from the road – including views of the Regional Waste Facility from the highway and vis-versa. The RTA also understands that some landscaping is included in the upgrading of the facility. All Property acquisition would be undertaken in accordance with the RTA's Land Acquisition Policy and the *Land Acquisition (Just Terms) Compensation Act 1991*.
19	▪ Urban design measures should be implemented on the existing highway through the Coffs Harbour city centre and Woolgoolga urban areas and at deviation points from the existing highway.	The RTA has provided funding assistance to Council for the preparation of the draft "Coffs Harbour Gateway Strategy" and has funded/contributed to the pedestrian safety measures proposed in the Strategy. Traffic predictions indicate that, even with the Preferred Route and Council's Ring Road system (including the Hogbin Drive Extension) in place, the existing highway through Coffs Harbour would need to be able to cater for traffic volumes that are similar to current levels. Consequently, the scope for a major urban redesign of the existing highway through the Coffs Harbour CBD may be limited. With the preferred Option E bypass for Woolgoolga in place, the existing highway through the township would still need to be able to continue to function as an urban collector road connecting the areas between Hearnes Lake Road and Arrawarra and would need to be able to cater for traffic volumes that are similar to current levels. Consequently, the scope for a major urban redesign of the existing highway through Woolgoolga may also be limited.

		As these sections of the existing highway will need to continue in their current role until the Preferred Route is completed, any identified urban design improvements would need to occur after the highway upgrades have been opened to traffic. The interchanges that would provide connections between the Preferred Route and the existing road network would be designed to cater for the predicted volumes of through and local traffic and would incorporate appropriate urban design, signposting and landscape treatments. The RTA typically incorporates gateway statements into interchange(s) / intersection(s) that provide access to existing urban centres that have been bypassed. These gateway statements would be provided as part of the construction of the project. The potential for future implementation of urban design measures along the highway in the Coffs Harbour and Woolgoolga city centres and of Gateway Structures at deviation points from the existing highway will be discussed with Council as part of the RTA's ongoing liaison with Council in regard to the Highway Planning Strategy.

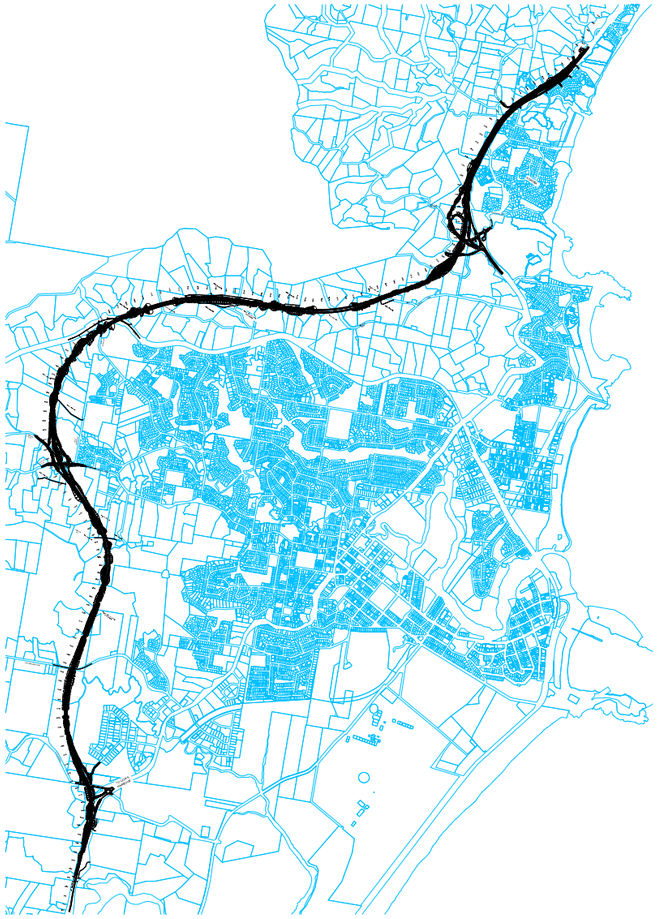
Appendix B

General Arrangement, Plan and Longitudinal Sections

ROAD AND TRAFFIC AUTHORITY OF NEW SOUTH WALES

COFFS HARBOUR BYPASS
PREFERRED ROUTE OPTION CONCEPT DESIGN
VOLUME 1 - ROADWORKS

LOCALITY PLAN



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SURVEYED

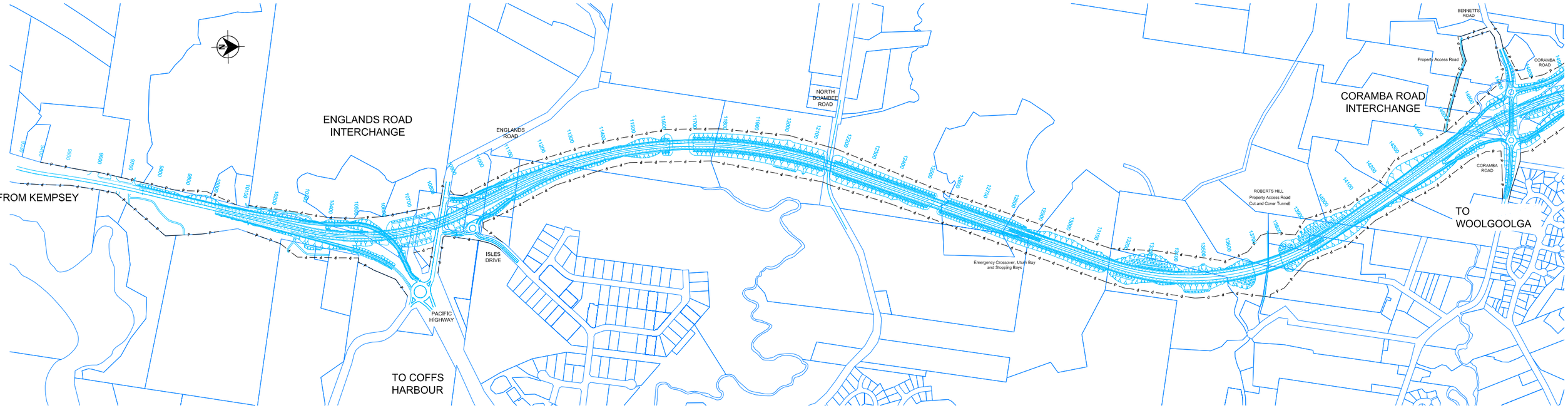
SURVEYOR: NAME

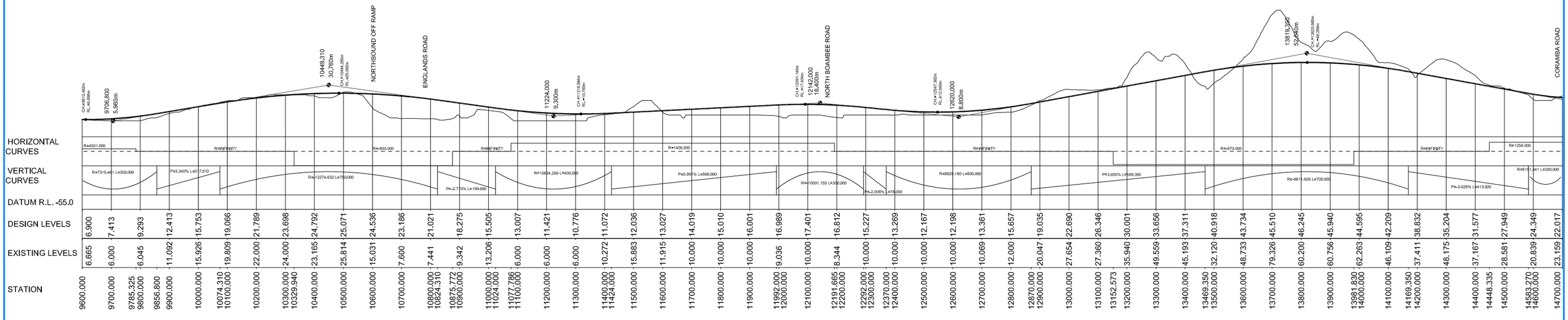
SURVEY REFERENCE: NUMBER

THE DESIGN HAS BEEN PREPARED IN ACCORDANCE WITH PROJECT DESIGN SERVICES QUALITY SYSTEM AND THE CLIENT'S BRIEF

DESIGNED	REVIEWED	RECOMMENDED	ACCEPTED FOR CONSTRUCTION
SIGNATURE:	SIGNATURE:	SIGNATURE:	SIGNATURE:
NAME:	NAME:	NAME:	NAME:
POSITION:	POSITION:	POSITION:	POSITION:
DATE:	DATE:	DATE:	DATE:

SET NO.





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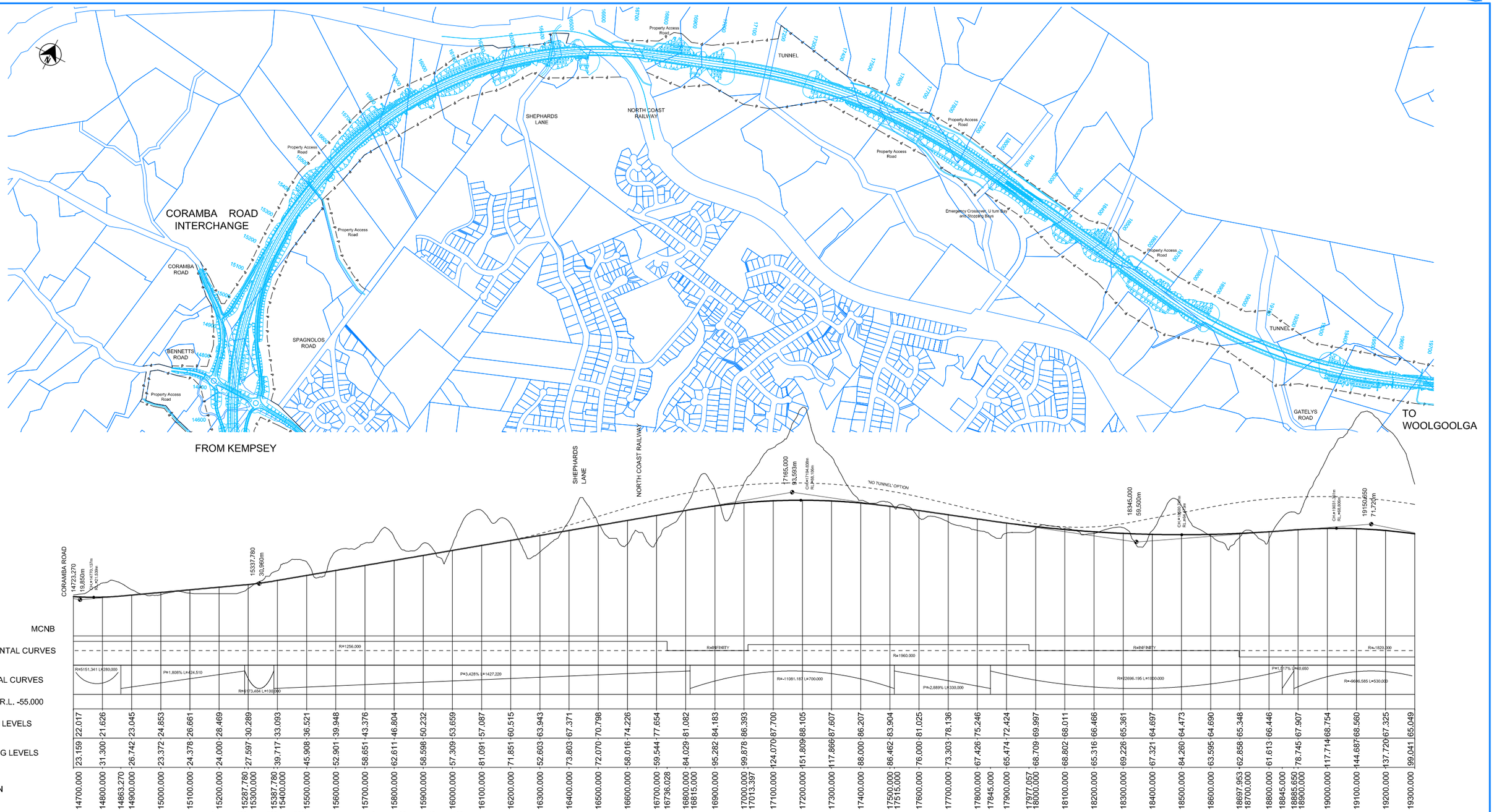
COFFS HARBOUR BYPASS - PREFERRED ROUTE - TUNNEL OPTION - Sheet 1 of 3

PRINT DATE - 25-08-08



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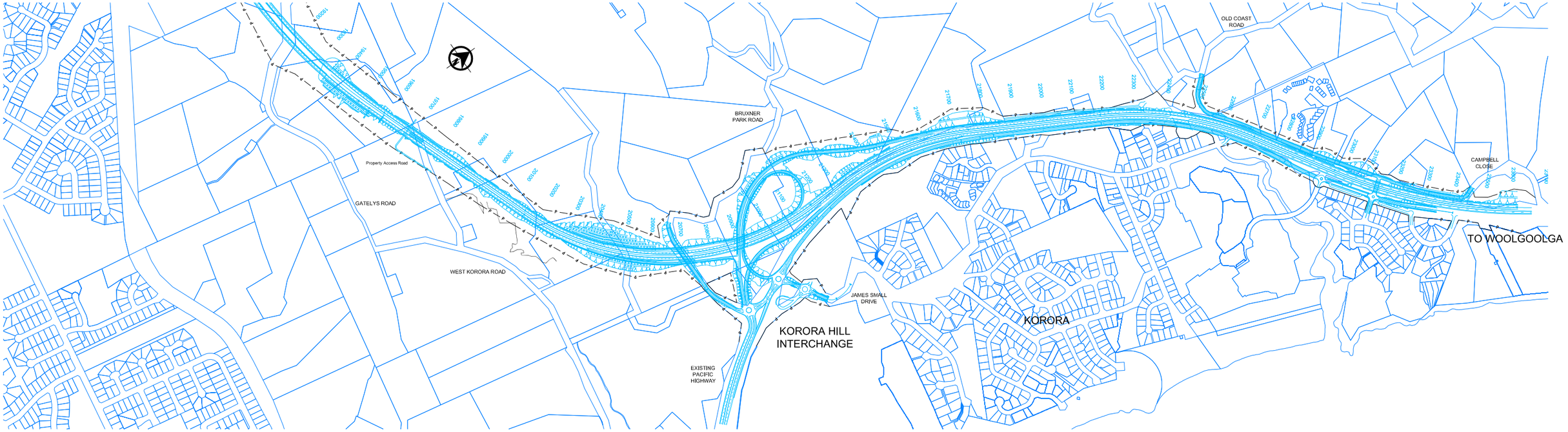

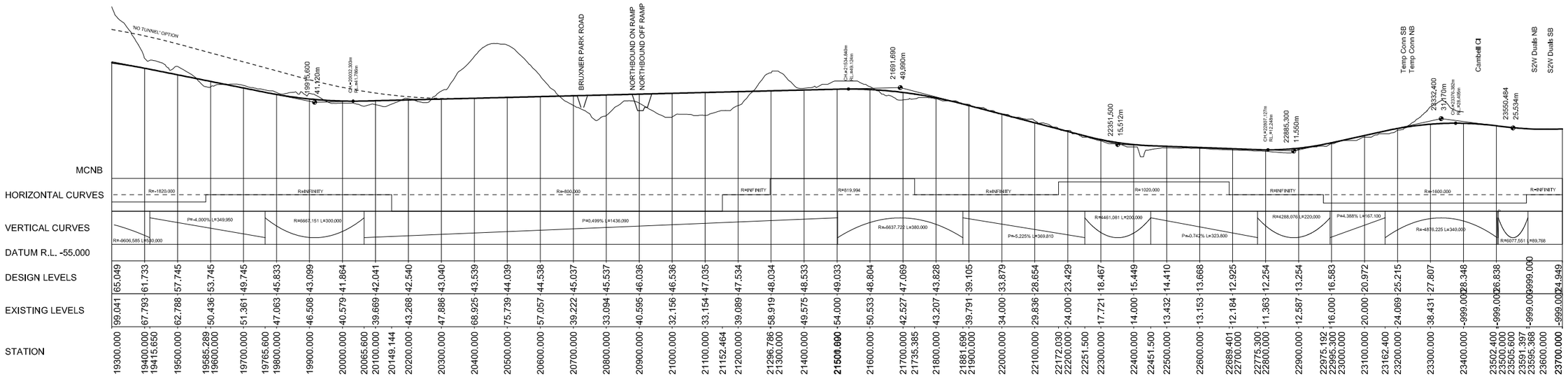

COFFS HARBOUR BYPASS - PREFERRED ROUTE - TUNNEL OPTION - Sheet 3 of 3

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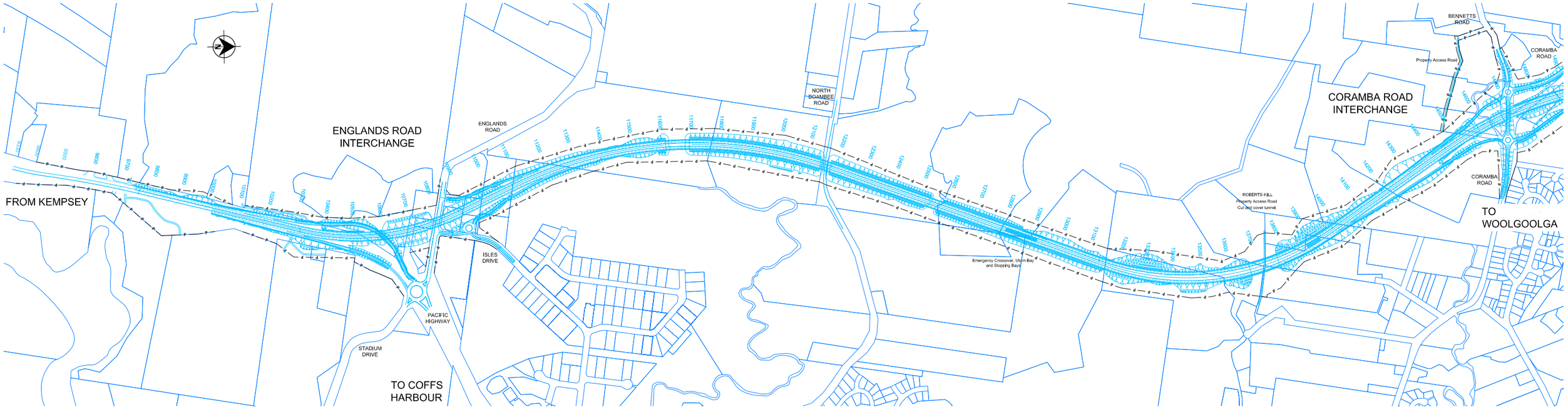

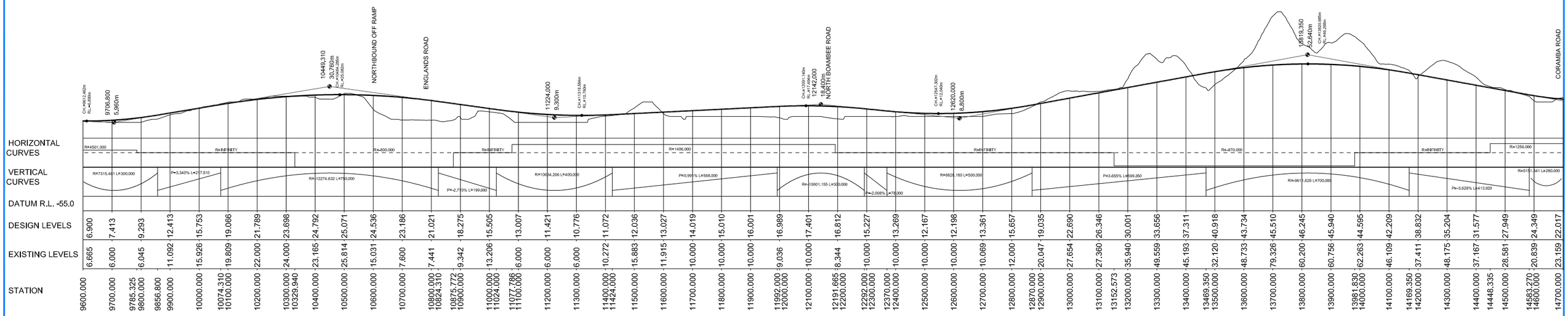

COFFS HARBOUR BYPASS - PREFERRED ROUTE - NO TUNNEL OPTION - Sheet 1 of 3

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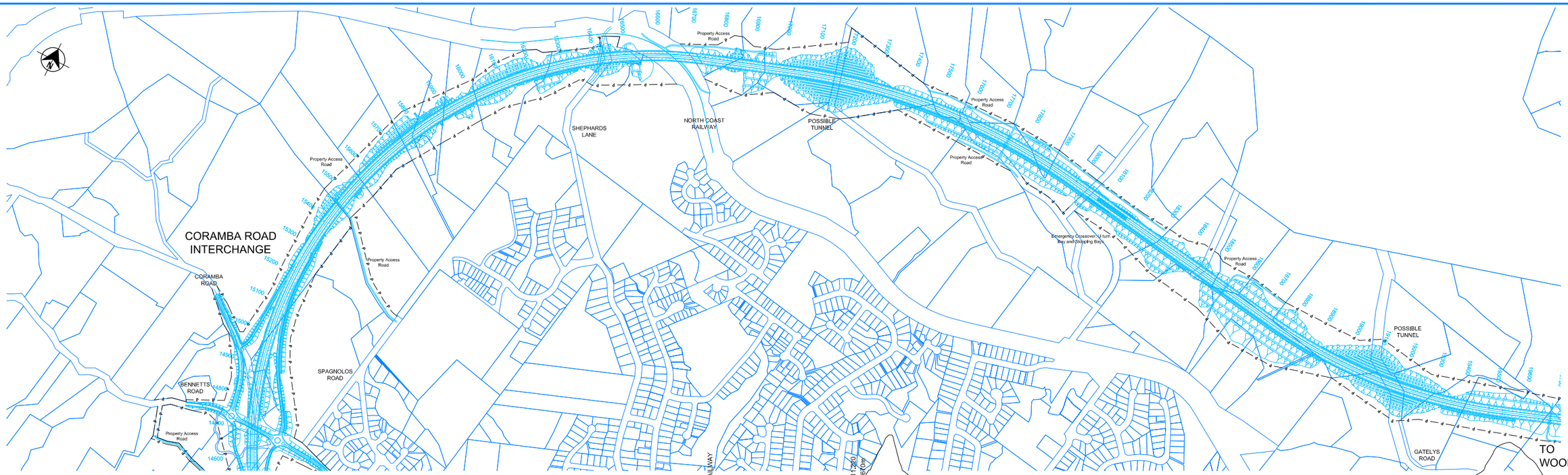

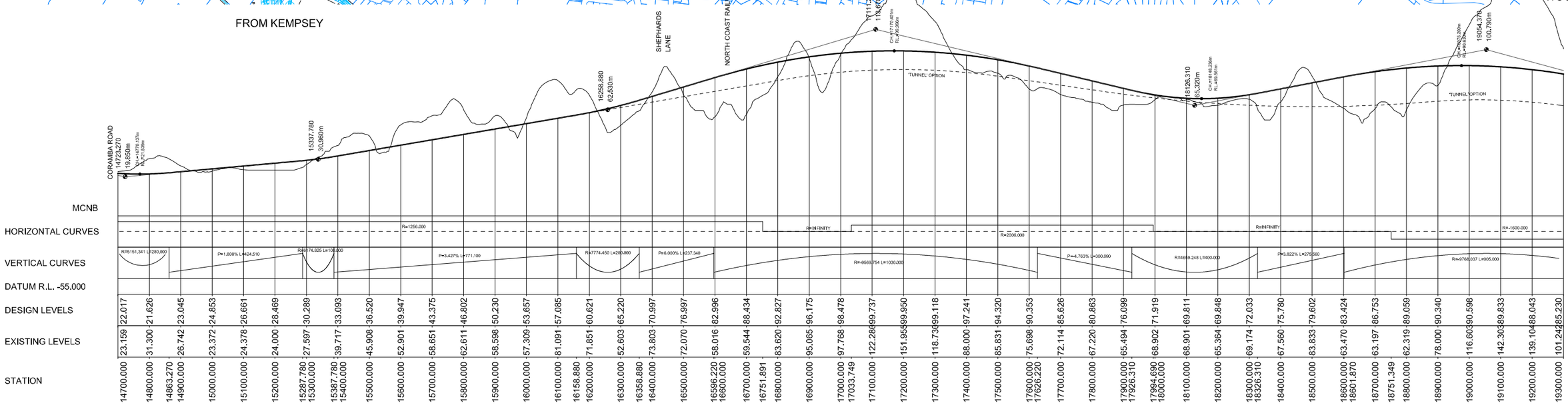

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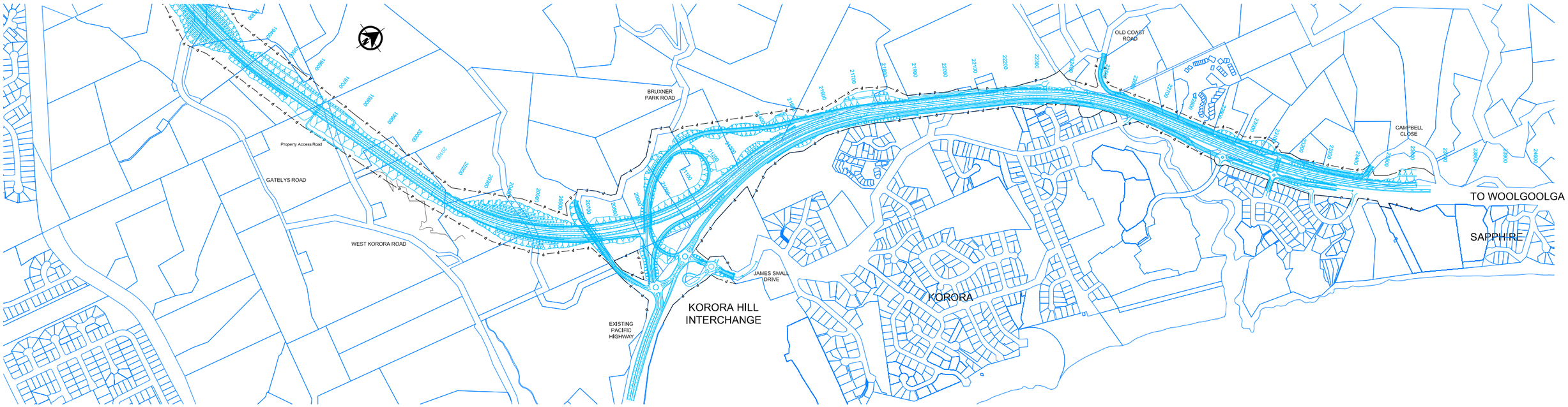

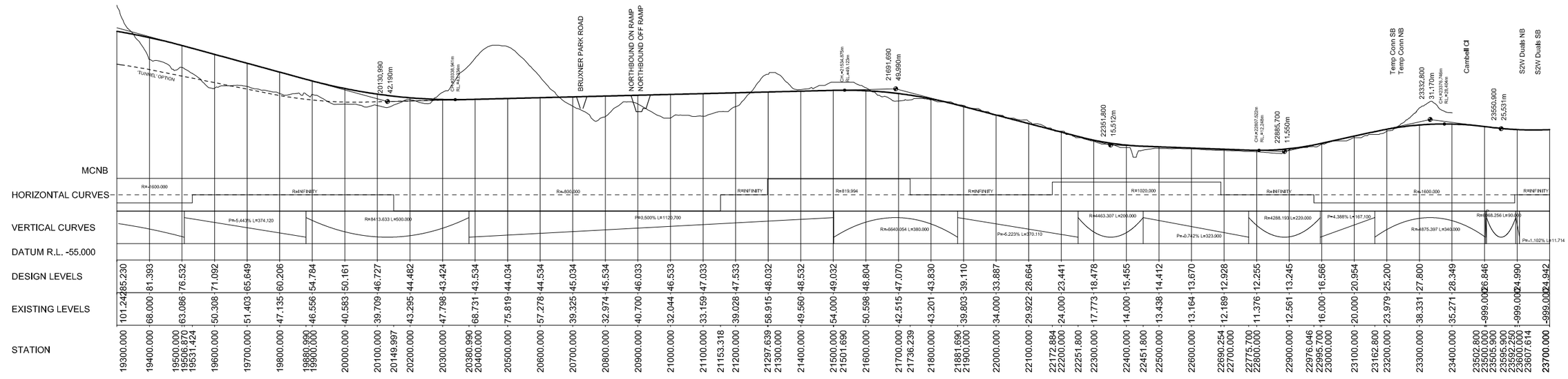

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HORIZ.

0 20 40 60m
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VERT.

COFFS HARBOUR BYPASS - PREFERRED ROUTE - NO TUNNEL OPTION - Sheet 3 of 3

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