

Chapter 6 The proposal design

This chapter initially presents the design criteria on which the concept design for the Proposal is based. An overview of the Proposal is then presented followed by discussion of key elements of the Proposal including bridges, intersections, and the provision for fauna movement. A comprehensive urban design and landscape strategy for the Proposal is presented. An economic evaluation of the Proposal concludes the chapter.

6.1 Approach to design

The description in this chapter of the Proposal is based on a concept prepared and refined as part of the design development process and is described in more detail in Working Paper No. 2.

The concept design is based on the road design guidelines that have been adopted for the Pacific Highway Upgrading Program and the accommodation of other influences including environmental issues, land management requirements, and service provision. The overall objective of the concept design is the development of a 'value for money' project from a broad community perspective.

Detailed design would be undertaken only if the proposal is approved. A requirement for the detailed design development process that follows project approval would be incorporation of the key principles established during the study and inherent in the concept design. The detailed design would also be required to meet the criteria on which the concept design was based and to take into account environmental constraints and mitigation measures identified in this EIS. Guidelines for the preparation of detailed designs are included in Section 6.19.

6.1.1 Urban design

The *Pacific Highway Urban Design Framework* (RTA 2005) contains the following urban design vision for the entire Pacific Highway upgrade project:

...a sweeping, vegetated highway, providing panoramic views to the Great Dividing Range and the rivers, forests, farmlands, and coastline of the Pacific Ocean. Sensitively designed to fit into the landscape and be unobtrusive. Characterised by simple, attractive road infrastructure.

Objectives have been developed to assist in delivery of this vision and these objectives formed the basis of the concept design development process. The objectives are further described in Section 6.14.

6.1.2 Road design criteria

The road design criteria applicable for the Proposal are those that are being used throughout the Pacific Highway Upgrading Program. These criteria were adopted for the concept design and would also apply for the detailed design should the Proposal proceed:

- four lane divided road with two 3.5 m lanes in each direction - the cross-section would be consistent with the standard cross-sections developed for the Pacific Highway Upgrading Program, including a 2.5 m left shoulder and a 0.5m median shoulder (widened to 1.0 m against traffic barriers) in each direction
- potential to reduce accidents to 15 crashes per 100 MVK over the upgrade length
- minimum design speed of 110 km/h on horizontal curves and 100 km/h on vertical curves

- median widths in accordance with design criteria dependant on type of barrier/fencing (i.e. normal depressed median width of 11 m, although this would vary in areas of deep cuttings, existing development, major structures and environmentally sensitive areas)
- meet or exceed B-Double vehicle requirements for travel along the highway as a through route but not generally for B-Doubles to make turns to or from the highway at intersections (exceptions are where B-Double usage of intersections already occurs or where catering for B-Doubles is considered desirable for existing or planned developments)
- intersections with the highway are to achieve Level of Service C or better for 100th Highest Hourly Volume after 30 years of operation
- desirable flood protection from 1 in 100 year Average Recurrence Interval (ARI) peak flood level and minimum flood protection from 1 in 20 year ARI peak flood level
- on-road provision for cyclists
- lighting where safety standards require such as at intersections and interchanges.
- consistent with the *Road Design Guide* (RTA 1996).

6.1.3 Other design influences

The concept design also incorporates responses to a range of other influences that are not necessarily reflected in specific design standards or criteria, including:

- input into design criteria from a multi-disciplinary approach involving DEC, DIPNR and DPI from the Proposal outset
- continue provision of access for local landowners or managers, especially where landholdings are severed by the Proposal
- provide median openings (U-turn facilities) at regular intervals to provide for emergency service vehicles as well as for local residents with 'left in, left out' access to the highway
- provide for safe movement of fauna across the highway where fauna movement corridors exist
- avoid or reduce the direct impact on, and thus permanent loss of, National Parks, State Forests and SEPP 14 wetlands
- reduce disruption to local and through traffic during construction
- maximise the use of the existing road reserves and existing road infrastructure where possible
- provide corridor consistent with biodiversity principles
- alignment consideration to mitigate effects on approved subdivisions, cultural heritage sites, visual impacts and property boundaries where possible
- geotechnical considerations
- soil erosion considerations.

6.2 Overview of the Proposal

The proposed highway upgrade extends 22.2 km from approximately 2.4 km south of Johns River to near Bobs Creek Road north of Herons Creek. The design features along the route are described below. The Proposal is shown in Figures 6-1A to 6-1N in plan and longitudinal section. The following overview description refers to the four discrete sections for the Proposal as described in Section 5.3 and shown in the study area (Figure 5-2):

- Johns River section (Figures 6-1A to 6-1C)
- Lake section (Figures 6-1C to 6-1H)
- Kew section (Figures 6-1I to 6-1K)
- Herons Creek section (Figures 6-1L to 6-1N).

Specific features of the Proposal are described in the following sections. These features include provision for fauna underpasses, drainage culverts, bridges, and modifications to the carriageway cross-section.

6.2.1 Johns River section

The Proposal would link with the proposed highway duplication between Coopernook and Moorland at the southern boundary of the property known as Camp Obadiah. At this point, the *Pacific Highway Upgrade Coopernook to Moorland environmental impact statement* (Connell Wagner 2000) shows the existing highway becoming the northbound carriageway with the new southbound carriageway on the east side. North of the tie-in, the northbound carriageway would transition across to the western side of the existing highway while the existing highway would become the southbound carriageway.

The existing highway would then be duplicated on the western side for a distance of about 1 km until the point where the proposed western bypass of Johns River diverges from the existing highway.

The Johns River bypass would be about 2.5 km long. It would pass about 250 m west of the Johns River township traversing an approved but largely undeveloped rural residential subdivision north of Stewarts River Road.

A grade-separated half-diamond interchange is proposed at Stewarts River Road. Northbound off- and on-ramps would connect to a roundabout on Stewarts River Road that would pass above the bypass on a bridge. Southbound traffic would be catered for by southbound ramps formed by the existing highway at each end of the bypass. The existing highway would revert to a two-way local road between the southbound off-ramp and on-ramp. Further details of access to and from Johns River are provided in Section 6.6.1.

The bypass would merge with the existing highway near Bulleys Road and Wharf Road, just to the south of the Stewarts River. A median opening is proposed in the vicinity of Bulleys Road but there would be no direct connection between the upgraded highway and Bulleys Road. Instead, Bulleys Road would be diverted to the south and would be connected to the elevated roundabout on Stewarts River Road, eliminating the need for an at-grade intersection at Bulleys Road.

A second bridge would be constructed over the Stewarts River to the west of and parallel to the existing bridge, with a similar length and span configuration.

6.2.2 Lake section

Between the Stewarts River bridge and the Camden Haven River bridge, the highway would be upgraded through construction of a new carriageway which would generally be located on the western side of the existing highway within the existing road reserve.

Immediately north of the Stewarts River, the available width for the Proposal is restricted by a high rock cutting on the western side and the Main Northern Railway line on the eastern side. The median width would transition from 11 m to 4.5 m over the length of the Stewarts River bridge and the narrow median would extend for about 1.3 km to Station 5300. Split-level carriageways with a median barrier and median retaining wall up to 3 m high are also proposed over this restricted section. Other structural elements are required between the southbound carriageway and the railway line within this restricted zone to protect the railway as follows:

- a second retaining wall up to 7 m high over a short length of about 100 m between Stations 4450 and 4550
- an engineered 1H:1V slope up to 4 m high over a length of about 250 m between Stations 4850 and 5100.

In the vicinity of Middle Brother Road, the median would widen again to 11 m with the new northbound carriageway on the western side of the existing highway alignment through to Passionfruit Gully. An at-grade T-intersection with median opening is proposed at Algona Road. The median is widened to accommodate turning semi-trailers at this intersection.

In order to avoid any requirement for land acquisition from Middle Brother National Park and to reduce the impact on vegetation, a narrow median (3 m wide) containing a wire rope barrier would be adopted for a 1 km section adjacent to the boundary of the National Park. A retaining wall up to 6 m high is also proposed between the southbound carriageway and the railway over a 150 m long section (Station 7400 to Station 7550) within this constrained zone.

North of Haydons Road, the median would widen again to 11 m and the new northbound carriageway would be located on the west side of the existing highway through to the Camden Haven River. An at-grade T-intersection with median opening is proposed at Watson Taylor Road.

The existing bridge at Stony Creek would be replaced by a new bridge in a similar position, with a second new bridge constructed on the west side for the northbound carriageway.

Charles Yard Road at present runs parallel to the existing highway for a distance of about 800 m before connecting at Station 11000. It is proposed to relocate the intersection to Station 10200 where sight distance would be improved. The road reserve containing the redundant section of Charles Yard Road would be utilised as a location for a new northbound rest area. The proposed location is south of Ross Glen Road and within the remaining road reservation between Station 10500 and Station 11000. It would cater for both heavy vehicles and light vehicles. The existing southbound rest area on the east side of the existing highway just to the north would not be affected by the highway upgrade and would be retained.

Ross Glen Road would be relocated to the south where improved sight distance is available and an at-grade T-intersection with median opening is proposed. The intersection incorporates a widened median to accommodate turning semi-trailers. The intersection would also provide access to the property to the east on which the Camden Haven airfield is located.

A new bridge would be constructed on the western side of the existing bridge over the Main Northern Railway line, about 500 m south of the Camden Haven River.

At the Camden Haven River, a second bridge would be constructed to the western (upstream) side of and parallel to the existing structure. The new bridge would have a similar length and span arrangement as the existing bridge. The new bridge would achieve the minimum clearance requirements specified by the NSW Waterways Authority (D R Meakin-Jones [Waterways Authority] 2001, pers. comm., 20 January), i.e. a minimum clearance of 4.5 m between Mean High Water and the soffit of the new bridge.

The NSW Waterways Authority and the DPI both advised that the two bridge piers from the previous bridge that remain in the Camden Haven River downstream of the existing bridge should be removed. Removal of these piers is proposed as part of the work described in this EIS (see Section 6.5.3).

6.2.3 Kew section

North of the Camden Haven River, the new carriageway would remain on the western side of the existing carriageway for a distance of about 500 m before crossing to the eastern side.

About 1.5 km north of the Camden Haven River (1.5 km south of Kew), the proposed bypass of Kew would diverge eastwards from the existing highway. The Kew bypass would be about 2.5 km long and would pass about 250 m east of the Kew township, at Ocean Drive.

A grade-separated half-diamond interchange is proposed at Ocean Drive. Southbound off- and on-ramps would connect to a roundabout on Ocean Drive that would pass above the bypass on a bridge. Northbound traffic to and from the bypass would be catered for by use of the existing highway at each end of the bypass. The existing highway would revert to a two-way local road between the northbound off-ramp and on-ramp. Further details about access to and from Kew are provided in Section 6.6.1.

At the southern diverge area, Sunnyvale Road would be realigned away from the northbound off-ramp diverge and would connect to the existing highway at a roundabout about 300 m further north. Bethesda Road would connect to the same roundabout.

At the northern end of the bypass, Herons Creek Road would not connect to the upgraded highway but would be diverted south along a frontage road on the western side of the highway that would also connect to Weeroona Place. The frontage road would connect to the existing highway at a T-intersection at the start of the northbound on-ramp, about 500 m north of Kew.

The Kew bypass would be in cut for about two-thirds of the length in order to reduce the visual and noise impacts on Kew. The maximum depth of the major cutting near Bethesda Road would be about 17 m while in the long cutting under Ocean Drive and to the north of Kew the maximum depth would be about 13 m. Split-level carriageways have been proposed in this cutting to reduce earthworks. The southbound carriageway would be about 2 m higher than the northbound carriageway for most of the length of this cutting, with the level difference taken up by a one-way slope on the 11 m wide median.

The Kew bypass would rejoin the existing highway about 800 m north of Kew and the new carriageway would be located on the western side of the existing highway. The new carriageway would remain on the western side for the next 1 km through to the Kew/Kendall Sewage Treatment Plant (STP).

6.2.4 Herons Creek section

From the STP, the new carriageway would transition across to the eastern side of the existing carriageway and remain there through to just beyond the Boral Timber mill at Herons Creek.

An at-grade T-intersection allowing all vehicle movements including U-turns is proposed at the entrance to the Egbert Egg property on the western side of the highway about 1 km north of the STP. The intersection incorporates a widened median to accommodate turning semi-trailers.

At-grade T-intersections are also proposed at Cluleys Road on the eastern side and Herons Creek Road on the western side. These two T-junctions would be separated by about 200 m. A wide median suitable for use by B-Doubles is proposed at the Herons Creek Road intersection to cater for B-Double traffic to and from the Boral Timber mill. The Cluleys Road intersection would accommodate turning semi-trailers.

There would be no direct impact on the Boral Timber mill landholding. North of the mill, the northbound carriageway would move to the western side of the existing highway and the new bridges across the Herons Creek floodway and Herons Creek would both be located on the western side.

The existing bridge at Herons Creek would be replaced by a new bridge in a similar position, with a second new bridge constructed on the western side for the northbound carriageway, parallel to the southbound bridge.

6.3 Carriageway and pavement design

The design of the Proposal would comply with all relevant RTA design requirements.

Typical cross sections are shown in Figures 6-2A to 6-2D. The proposed cross section consists of two carriageways, each with two 3.5 m wide traffic lanes and a 2.5 m wide left shoulder and 0.5 m median shoulder, generally separated by an 11 m wide median without a central barrier. Shoulder widths would be increased by 0.5 m where guard fencing or a barrier is located at the edge of shoulder. The only exception would be the left shoulder on bridges, where the 2.5 m shoulder would not be widened. The 11 m wide median would generally be depressed for drainage reasons and landscaped to assist in reducing headlight glare.

As described in Section 6.2.2 there are two lengths of the Proposal within the Lake section where the median width would be reduced and a median barrier would be provided. The first is immediately north of the Stewarts River where the median width would be reduced from 11 m to 4.5 m, split-level carriageways with a retaining wall up to 3 m high would be developed in the narrow median, and a retaining wall up to 7 m high would be constructed between the southbound carriageway and the Main Northern Railway line over a 100 m length. A Type F concrete barrier is proposed at the median edge of the northbound carriageway and at the outer edge of the southbound carriageway, split-level carriageways with a median retaining wall would be developed.

The second location where a narrow median is proposed is in the vicinity of the Middle Brother National Park where the available width for the Proposal is restricted by the National Park on the western side and the Main Northern Railway line on the eastern side. The median width would be reduced from the standard 11 m to 3 m with a wire rope barrier for a 1 km section. A barrier would also be provided between the southbound carriageway and the railway, including the 150m long section where a retaining wall up to 6 m high is proposed between the southbound carriageway and the railway.

Full strength pavement would be used for the highway travel lanes and the inner and outer shoulders. Preliminary pavement designs for a bound flexible pavement and a plain concrete pavement (PCP) have been prepared based on the 40-year pavement life specified by the RTA.

The bound flexible pavement option has the following structure:

- 30 mm open graded asphalt wearing course where low noise pavement is required
- 175 mm dense graded asphalt
- bitumen emulsion curing coat
- 250 mm lean mix concrete
- 7 mm bituminous sprayed seal
- 150 mm CBR30 upper selected material zone
- 150 mm CBR10 lower selected material zone.

The PCP rigid pavement option has the following structure:

- 30 mm open graded asphalt wearing course over 20 mm dense graded asphalt where low noise pavement is required
- 255 mm plain concrete base, undowelled
- two coats wax emulsion curing compound
- 150 mm lean mix concrete subbase
- 7 mm bituminous sprayed seal
- 150 mm CBR30 upper selected material zone
- 150 mm CBR10 lower selected material zone
- subgrade CBR3.

A whole-of-life economic analysis comparing the two options suggests that the rigid pavement would be cheaper. However, the decision would depend on relative costs at the time of construction, and this EIS is not predicated on rigid or flexible pavement.

No dedicated facilities for fauna crossings are deemed necessary although provision has made at ten locations for fauna to cross the upgraded highway, mainly by augmenting drainage culverts. Details are provided in Section 6.13 and in Chapter 10.

6.4 Cut and fill requirements

6.4.1 Cut and fill (including batter slopes)

Cut slopes would need to be formed in both soil and rock and an assessment has been made of suitable batter angles for each new cutting along the preferred option. This assessment has been based upon information from the ground investigation, geological mapping and kinematic analysis and observation of the performance of existing cut slopes in the area.

While cut slopes in soils of 3H:1V would be preferable due to the potential erodibility of the soil in the study area, cut slopes in soil of 2H:1V would be acceptable from stability considerations. In the interests of reducing the extent and volume of cuttings, cut slopes in soil of 2H:1V have generally been adopted on the understanding that topsoiling and stabilisation would be required during construction. Benches are proposed at approximately 7 m to 10 m intervals in the deeper cuts, depending on the rock stability, and at the rock/soil interface. The benches are proposed in accordance with standard RTA practice to improve stability and reduce long term maintenance.

Rock cut batters have been assessed based on slope stability and erodibility criteria and are generally relatively flat (flatter than 1H:1V) due in many instances to the fractured nature and adverse jointing present in the rock mass. The base of the rock slopes would have dish drains and verge widths related to the materials within the slope. It is anticipated that spot bolting would be required in some rock cuttings to stabilise isolated wedges. The location of these seams of rock would be confirmed during excavation.

A number of new fill embankments would need to be constructed along the Proposal. An assessment has been made of suitable batter angles for these new slopes, based upon information from the ground investigation. From stability considerations alone, maximum fill slopes should not exceed 2H:1V. In order to reduce the extent of earthworks, a 2H:1V fill slope has generally been adopted on the proviso that all fill batters will be topsoiled and grassed for stability. Flatter batters of 3H:1V have, however, been adopted on low fills and also on the approach embankments to the Stewarts River and the Camden Haven River where the flatter batter improves embankment stability on the soft soils.

The only location where steeper fill batters are proposed is between Station 4840 and Station 5100 where a section of 1H:1V fill has been provided between the highway and the railway so that fill from the highway embankment would not extend onto the railway. The steeper slope in this section would be up to 4 m high and would be achieved by an engineered slope using selected crushed rock materials and surface stabilisation.

Table 6-1 presents indicative volumes of cut and fill required for bulk earthworks in each section of the Proposal. There is a considerable excess of material from the Kew section but it is intended that this would be utilised on the other three sections where there is a shortfall. This situation has implications in terms of the order of construction of the sections (i.e. construction staging) as well as in the requirements for stockpile areas.

In addition to the bulk fill volume in Table 6-1, approximately 150,000 m³ of select fill would be required for construction of pavements. The excess material available from bulk earthworks would be suitable for use as select fill for pavements, resulting in an approximate overall balance of cut and fill for the Proposal.

It is noted that there are no major excavations in acid sulfate soils (ASS) or potential acid sulfate soils (PASS) in any sections and therefore this has not restricted the use of excess fill in other sections of the route. The only excavations in ASS or PASS would be minor excavations for sediment basins, drainage ditches and pile caps in the floodplain south of Stewarts River and in the Camden Haven River floodplain. Further details of the location of ASS and PASS as well as measures for construction management and treatment are described in Section 8.5.

Table 6-1 Indicative earthworks volumes

Section	Cut (m ³)	Fill (m ³)	Estimated Balance* (m ³)
Johns River	210,000	200,000	Approx balance
Lake	290,000	250,000	30,000 excess
Kew	520,000	295,000	230,000 excess
Herons Creek	90,000	220,000	130,000 shortfall
Total	1,100,000	960,000	130,000 excess

Quantities would be subject to refinement during detailed design

* Estimated balances not equal to the difference between cut and fill volumes due to influence of allowances for unsuitable material and bulking.

6.4.2 Sources of fill material

Material from excavations would be variable in quality but it is anticipated that, provided suitable methods of excavation are used, sufficient quantities of material won from excavations would be available and suitable for use in embankments as general fill and also as select fill for the top 0.3 m of embankments. Lower quality material could be used for landscape fill/noise mounds and in the lower layers of embankments. Minor adjustments could be made to the longitudinal grading of the highway upgrade if necessary during the detailed design stage to suit the results of further geotechnical investigations carried out at that time.

Sources of other construction materials such as pavement materials and aggregates for cement concrete and asphaltic concrete are discussed in Section 7.3.

6.5 Structures

6.5.1 Bridges

Several new bridges are proposed in addition to the retention of some existing bridges for the Proposal. On all new bridge structures the proposed pavement width is 10.5 m comprising left shoulder width of 2.5 m, two 3.5 m traffic lanes and a 1.0 m median shoulder (see Figure 6-2D). The existing and proposed bridges are:

- Stewarts River Road
 - A new 51 m long two-span bridge would be constructed for the Stewarts River Road overpass above the Johns River bypass.
- Stewarts River
 - The existing eight-span 9.2 m wide by 289 m long bridge (spans of 30.5 m, 6 x 38.0 m and 30.5 m) would be converted to one-way, two lane operation for the southbound carriageway. While the existing bridge is not as wide as the 10.5 m proposed for a single carriageway on new bridges, it would provide adequately for two lanes of traffic with a reduced left shoulder width (1.2 m rather than 2.5 m for new bridges). Widening of the existing bridge is not proposed.
 - A new eight-span 304 m long bridge (eight spans of 38.0 m) would be constructed for the northbound carriageway on the western side, adopting a similar span layout to that of the existing bridge except that the end spans would be slightly longer to avoid disturbing the existing abutments of the adjacent bridge. While the span configuration for the new bridge would match the existing bridge, the superstructure would not necessarily match the shape and form of the existing bridge (see Chapter 13).
- Stony Creek
 - The existing single span bridge is narrow and in poor condition, and would be replaced with a new single span 15.5 m long bridge with a similar new parallel bridge for the northbound carriageway to the west.
- Railway at Rossglen
 - The existing three-span 9.2 m wide by 42.3 m long bridge (spans of 12.4 m, 17.5 m and 12.4 m) would be converted to one-way, two lane operation for the southbound carriageway with a 1.2 m left shoulder (as for the Stewarts River bridge).
 - A new three span 42.5 m bridge with a similar span layout (spans of 12.5 m, 17.5 m and 12.5 m) would be constructed on the west side for the northbound carriageway.
- Camden Haven River
 - The existing six-span 9.2 m wide by 163 m long bridge (spans of 23.5 m, 4 x 29.0 m and 23.5 m) would be converted to a one-way, two lane operation for the southbound carriageway with a 1.2 m left shoulder as above.
 - A second six-span 174 m long bridge (6 spans of 29.0 m) would be constructed across the river on the western side for the northbound carriageway, adopting the same layout to that of the existing bridge except that the end spans would be slightly longer to avoid disturbing the existing abutments of the adjacent bridge. The span configuration for the new bridge would match the existing bridge, and the superstructure would be required to be similar in shape and form to the existing bridge (see Chapter 13).

- Access for Sunnyvale Road would continue to be available under the northern span of the Camden Haven bridges.
- Ocean Drive
 - A new four-span 56.0 m bridge (spans of 10.5 m, 2 x 17.5 m and 10.5 m) would be constructed for the Ocean Drive overpass above the highway.
- Herons Creek floodplain
 - The existing three-span 8.5 m wide by 32 m long bridge (3 spans of 10.7 m) over this floodway would be converted to a single direction, two-lane bridge for the southbound carriageway. Because of the narrow width of the existing bridge, allowance has been made for widening it to the 10.5 m proposed for new bridges. As noted in Chapter 4, further checks of the Herons Creek flood channel bridge would be carried out in the detailed design stage to confirm the structural adequacy of this bridge and that it can be retained with widening.
 - A new three-span 32 m long bridge with a similar span layout would be constructed on the western side for the northbound carriageway across the floodway. While the span configuration for the new bridge would match the existing bridge, the superstructure would not necessarily match the shape of the existing bridge (see Chapter 13).
- Herons Creek
 - The existing two-span 24.5 m long bridge across Herons Creek is narrow and in poor condition, and would be replaced with a new single span 24.5 m long bridge for the southbound carriageway and a similar new parallel bridge for the northbound carriageway.

Note that the bridge span arrangements defined above are based on initial functional layouts of the concept design as developed to allow the assessment of likely impacts. Minor adjustments may be made during the detailed design stage as described in Section 6.19.

6.5.2 Culverts

Apart from the bridge structures, 52 culverts would be required under the upgraded highway as described in Section 6.7. Of these, 17 would be reinforced concrete box culverts (RCBC) and the remainder pipe culverts. Culverts would be in accordance with RTA standard details apart from two culverts to be constructed within the Camden Haven floodplain. These will require special detailing during the final design phase to ensure that allowance is made for the expected settlements:

- south of the Camden Haven River at Station 12390 where the existing culverts would be extended under the new northbound carriageway with four 1200 mm diameter reinforced concrete pipes
- north of the Camden Haven River at Station 13060 where the existing sunken culverts would be replaced with one 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC.

6.5.3 Removal of piers of former bridge over Camden Haven River

Both NSW Waterways and the DPI (Fisheries) advised that the remaining piers of the former bridge across the Camden Haven River, just downstream of the existing bridge, should be removed. Removal of the old piers and the underwater debris on the riverbed is proposed and is assessed as part of this EIS. Refer to Figure 6-3.



Figure 6-3 Piers in Camden Haven River proposed to be removed

A reconnaissance dive reported on the condition of the two partially demolished piers located in the river immediately downstream of the current bridge and mounds of debris remaining after the removal of the seven other trestle piers.

The two piers now each consist of four approximately equal segments, with the pile cap located at 0.7 m below bed level for the northernmost pier (pier 6) and at 1 m below bed level for pier 5. Reinforced concrete rubble surrounds the two piers and the remaining seven pile trestle piers of the old bridge. The debris mounds peak at 1 m above the riverbed and taper into the surrounding silt riverbed over areas typically 4 m x 2 m. Beyond the debris mounds, the riverbed is comprised of river gravel overlain by soft silt.

Methods of removing the disused piers and pier rubble have been investigated including an assessment of the disturbance the operation would cause and methods to mitigate these impacts. A methodology reflecting best practice for removal of these piers and related underwater debris is described in Section 7.2.6.

6.5.4 Other structures

The only other structures required are earth-retaining structures within the Lake section where the Middle Brother National Park and/or the existing railway limit the possible extent of earthworks and necessitate the use of narrow medians and retaining structures. Four structures are required:

- A median retaining wall is required to separate the split-level carriageways just north of Stewarts River between Station 4300 and Station 5000. The maximum height of the retaining wall is 3 m. It is expected that this wall would be constructed as a piled wall because of the limited room available for construction under traffic.
- A second retaining wall is required between the southbound carriageway and the railway from Station 4450 to Station 4550. The wall would be up to 7 m high and would be founded in part on the existing batter between the highway and the railway. The form of the wall would be decided in the detailed design phase but it is expected that it would be

a piled wall to avoid excessive removal and replacement of the existing fill material. Preferably the piles would be socketed into rock at the base. Anchors could be added to reduce the number and diameter of piles.

- Over a length of about 250 m between Station 4850 and Station 5100, an engineered 1H:1V fill slope up to 4 m high is proposed to avoid the fill extending onto the existing railway. The slope would be constructed using rock material from excavations. For reasons of stability and to avoid erosion this slope would be faced with grouted stones/rock rip-rap or similar.
- In order to avoid any requirement for land acquisition from Middle Brother National Park and to reduce the impact on vegetation, a narrow median (3 m) containing a wire rope barrier would be adopted for a 1 km section adjacent to the boundary of the National Park. A retaining wall up to 6 m high is also proposed between the southbound carriageway and the railway over a 150 m long section (Station 7400 to Station 7550) opposite the Middle Brother National Park. The form of the wall would be as for the retaining wall between Station 4450 and Station 4550, described above.

6.6 Interchanges and local access arrangements

6.6.1 Interchanges

Johns River

A grade-separated half-diamond interchange is proposed at Stewarts River Road approximately 300 m to the west of Johns River. The proposed interchange incorporates a bridge on Stewarts River Road above the bypass. A northbound off-ramp and northbound on-ramp would connect to Stewarts River Road at an elevated roundabout and provide access to and from Johns River and areas to the west for northbound traffic. Bulleys Road would be diverted to the south and would also be connected to the elevated roundabout. Stewarts River Road would continue to connect with the former highway at the existing junction in Johns River.

Southbound traffic would be catered for by a southbound off-ramp from the existing highway just south of the Stewarts River where the bypass rejoins the existing highway alignment. A southbound on-ramp is proposed at the south end of the bypass to allow traffic to join the upgraded highway. The existing highway would revert to a two-way local road between the southbound off-ramp and on-ramp.

Kew

A grade-separated half-diamond interchange is proposed at Ocean Drive approximately 250 m to the east of Kew. The proposed interchange would provide for southbound traffic movements to and from the upgraded highway. Key features of the interchange are:

- Ocean Drive would pass above the bypass on a bridge.
- A southbound off-ramp and southbound on-ramp would connect to Ocean Drive at an elevated roundabout on Ocean Drive just to the east of the bypass.

Northbound local traffic is catered for by northbound ramps to and from the existing highway:

- Access to Kew for northbound traffic is provided by a northbound off-ramp near Sunnyvale Road where the bypass diverges away from the existing highway. The single lane exit ramp would meet the existing highway, Sunnyvale Road (north) and Bethesda Road at a roundabout about 300 m north of the diverge.

- A northbound on-ramp from the existing highway is proposed at the north end of the bypass to allow traffic to rejoin the upgraded highway. At the northern end of the bypass, Herons Creek Road would be diverted along a frontage road to the south that would also connect to Weeroona Place. The frontage road would join the existing highway at the start of the northbound on-ramp, about 500 m north of Kew.

The existing highway would revert to a two-way local road between the northbound off-ramp and on-ramp.

6.6.2 At-grade intersections, median openings and local access provisions

RTA policy where highways are being upgraded to dual carriageway standard is to restrict the frequency of median openings so that safety can be improved. The *Road Design Guide* (RTA 1996) suggests that median openings should be provided at 3 km to 5 km intervals, however, for the Proposal the minimum spacing has been reduced to 2 km or slightly less in some instances for the convenience of residents. Where possible, the median openings have been combined with at-grade intersections to reduce additional local travel distances.

Access to all existing properties would be maintained or reinstated as part of the proposed works but the result of the limited number of median openings is that some residents who currently have direct access to and from both directions of the highway will be provided with left-in/left-out connections to one carriageway only. Median openings, at-grade intersections or interchanges where U-turns would be possible are proposed at eleven locations along the highway within the Proposal area as summarised in Table 6-2.

Table 6-2 At-grade intersections, median openings and local access provisions

Station	Facility
About 0.6 km south of Proposal limits	Proposed median opening for adjoining Cooperbrook to Moorland project
Station 2500	Johns River interchange
Station 3600	Median opening/U-turn facility
Station 6400	Median opening/U-turn facility combined with Algona Road intersection
Station 8550	Median opening/U-turn facility combined with Watson Taylor Road intersection
Station 11650	Median opening/U-turn facility combined with Ross Glen Road intersection
Station 13650	Median opening/U-turn facility combined with local access connection near Glen Haven
Station 15800	Kew interchange
Station 17150	Median opening/U-turn facility
Station 19000	Median opening/U-turn facility combined with local access connection at Eggbert property
Station 20900/ Station 21100	Median opening/U-turn facility combined with Cluleys Road/Herons Creek Road intersections. The Herons Creek Road intersection would allow B-Double vehicles to make turns to and from the upgraded highway.
Station 22150	Median opening/U-turn facility combined with Bobs Creek Road intersection
About 1.4 km north of Proposal limits	Existing median opening at Bago Road intersection about 1.5 km north of the Bobs Creek road intersection.

Proposals would be subject to refinement during detailed design.

While the proposed highway upgrade is not a controlled access road, it is also RTA policy to limit the number of left-in/left-out connections as well as the number of median openings. This can be achieved by the construction of frontage roads on one or both sides of the upgraded highway that direct traffic from several properties to one access point with the highway. Local access roads have been considered where:

- there are several properties close together and a short frontage road would allow their access to be combined to one point
- direct access to the upgraded highway would be difficult as a result of changes in level
- sight distance is substandard and a frontage road is required to shift the access connection to a point where adequate sight distance is available
- a relatively short section of frontage road would allow property access or minor local access roads to be diverted to the proposed interchanges at Johns River and Kew, thus eliminating at-grade intersections and increasing the safety benefits of the interchanges.

Based on this approach, frontage roads have been proposed at the locations identified in Table 6-3. In addition, allowance has been made in the proposed land acquisition boundaries for frontage roads to be installed in the future at the locations shown in Table 6-3, but these frontage roads are not proposed as part of the EIS.

Table 6-3 Frontage road locations

Station	Frontage road description
Proposed as part of this Proposal	
2500 – 3500	Frontage road on west side of bypass diverts Bulleys Road to Johns River interchange
4900 – 5200	Frontage road on west side of upgraded highway. Shifts access point to the cut/fill line where good sight distance is available
5700 – 6100	Frontage road on west side of upgraded highway provides access connection for three properties
13600 – 14600	Frontage road on east side of upgraded highway provides access connection for three properties
14400 – 14700	Sunnyvale Road diverted on west side away from exit ramp diverge and connected to roundabout approximately 300 m north
16400 – 17200	Frontage road on west side of highway diverts Herons Creek Road south and Weeroona Place back to the Kew interchange.
21800 – 22150	Frontage road on west side of highway diverts school access to the Bobs Creek Road intersection
Provision for future frontage roads	
50 – 200	Frontage road on west side to combine access for four properties
400 – 1150	Frontage road on west side to combine access for four properties
19000 – 19450	Frontage road on west side to combine access for three properties
19700 – 20400	Frontage road on west side to combine access for four properties

Frontage road details would be subject to refinement during detailed design.

Based on these proposals for interchanges, intersections, median openings and frontage roads, the following impacts on local access would occur:

- Johns River section
 - Stewarts River Road would have connectivity to Johns River maintained
 - access to the highway would be enhanced from the west
 - Johns River residents would have slightly increased travel distances to access the upgraded highway.
- Lake section
 - additional travel distances of up to 3 km are expected for those residents who could not access the upgraded highway at Algona Road, Watson Taylor Road or Ross Glen Road.
- Kew section
 - all turning movements required for access to Kew would be catered for
 - minimal inconvenience is expected for traffic using Ocean Drive or Kendall Road as travel distances would be reduced or only slightly increased
 - residents with access directly onto the existing highway would incur additional travel distances because the connections at each end provide one-way access only. Depending on the location of the residence and the direction of travel, additional travel distances of up to about 1.5 km would occur for some movements.
- Herons Creek section
 - up to 2 km additional travel distances would be experienced by residents as there would be a limited number of median openings
 - direct access to the Herons Creek Public School would be provided from the Bobs Creek Road intersection.

The existing highway through the Johns River and Kew townships would serve as a local road after the opening of the Proposal and it is anticipated that the bypassed sections would revert to local road status under the care and control of the Greater Taree City Council (for the existing highway at Johns River) and Hastings Council (existing highway at Kew). Preliminary discussions have been held with both councils regarding works on the existing highway prior to handover. Further discussions are required with both councils during the detailed design phase to agree on the scope and extent of works on the bypassed sections of the highway prior to handover.

6.6.3 Rail access

The Main Northern Railway line extends for the full length of the Proposal. While relocation of the railway would not be required and all existing railway crossings would be maintained, there are several locations within the Lake section where acquisition of part of the existing rail reservation would be required and/or works would be required in close proximity to the existing railway line. At some locations the proposed works would affect existing rail access for repairs and maintenance and alternative access arrangements have been developed. The proposed access arrangements are shown on Figure 6-1C to 6-H and are further described below:

- Station 1000 – 1200

At this location the existing highway would be retained as the southbound on-ramp allowing southbound traffic from Johns River to rejoin the upgraded highway. The proposed works would be only marginally closer to the existing railway and acquisition of rail land would not be required. Access to the railway for repairs and maintenance would not be affected.

- Station 4350 – 4650

Acquisition of part of the rail reservation would be required over a length of about 300 m on the north side of the Stewarts River. Within this section a retaining wall would be required between the southbound carriageway and the railway from Station 4450 to Station 4550.

The Proposal would affect access to the railway and a new rail access track has been proposed on the east side of the existing railway. It would extend about 1 km south from the existing timber bridge (Salvation Bridge) at Station 5200.
- Station 4850 – 5150

Acquisition of part of the rail reservation would be required over a length of about 300 m immediately to the south of Salvation Bridge. The acquisition would accommodate the highway fill batter as well as a proposed sedimentation basin.

Access to the railway would be affected by the Proposal and a new access track would be provided on the east side of the railway line as described above.
- Station 6400 – 6650

Minor acquisition of part of the rail reservation would be required over a length of about 250 m opposite Algona Road to accommodate earthworks.

Access to the railway between Stations 6400 and 8100 would be affected by the Proposal. Construction of a new rail access track on the east side of the railway is therefore proposed between the existing railway level crossing at Station 5950 and Watson Taylor Road at Station 8400.
- Station 7000 – 7600

Minor acquisition of part of the rail reservation would be required over a length of about 600 m opposite Middle Brother National Park. The acquisition is necessary because of the constraint presented by the National Park, and would be required to accommodate the earthworks as well as construction of the proposed retaining wall between the southbound carriageway and the railway over a 150 m long section from Stations 7400 to 7550.

Access to the railway in this section would be provided by the new rail access track on the east side of the railway as described above.
- Station 7900 – 8100

Minor acquisition of part of the rail reservation would be required to accommodate earthworks over a length of about 200 m opposite Haydons Road. Access to the railway in this section would be provided by the new rail access track on the east side of the railway as previously described.
- Station 8400 – 8850

Acquisition of a triangle of railway land on the north side of the existing Watson Taylor Road would be required to accommodate the realignment of Watson Taylor Road as well as sedimentation basins on either side of Stony Creek.

Access to the railway in this section would be available from the realigned Watson Taylor Road.
- Station 10100 – 10600

Minor acquisition of part of the rail reservation would be required over a length of about 500 m opposite the realigned Charles Yard Road intersection to accommodate sedimentation basins.

Existing access to the railway for repairs and maintenance in this section would not be affected.

- Station 10950 - 11300

Minor acquisition of part of the rail reservation would be required over a length of about 350 m opposite the proposed northbound rest area.

Existing access to the railway in this section would not be affected.

6.7 Drainage and water quality treatment

6.7.1 Major catchments

The major catchments at the Stewarts River, Camden Haven River and Herons Creek were assessed in relation to design requirements to accommodate key drainage/hydrological characteristics (see Working Paper No. 4). The key design implications are as follows:

- Stewarts River – Duplication of existing 289 m long bridge opening with an equal or greater opening would be required. The 1 in 100 year afflux resulting from the duplication with a second bridge of approximately the same length would be minimal, estimated at 10-12 mm.
- Camden Haven River – Raise highway slightly on the flood plain to the north of the river would achieve protection from the 1 in 100 year flood level. Duplication of existing 163 m long bridge opening with an equal or greater opening would be required. The 1 in 100 year afflux resulting from the duplication with a second bridge of approximately the same length would be minimal, estimated at 12-15 mm.
- At Herons Creek the Proposal would incorporate the following:
 - existing highway would be raised to provide protection from the 1 in 100 year ARI flood level
 - duplication of existing Herons Creek 32 m long floodway bridge opening
 - replacement of existing 24 m long Herons Creek bridge with new single span 24 m long bridge and a duplicate 24 m span bridge on the west side
 - to reduce the afflux resulting from raising the level of the existing highway, upgrade culvert at Station 21280 from 0.45 m diameter pipe to three 3.0 m x 2.1 m box culverts.

By adopting these measures the afflux in a 100 year ARI event would generally be less than 100 mm and would not affect any existing residences. However, there would be a maximum afflux of 180 mm in a localised undeveloped area immediately to the southwest of the Herons Creek Road intersection (Station 20950). Refer to Section 2.4 of Working Paper No. 4 for further details.

6.7.2 Minor catchments

Minor catchments have been assessed and proposals are presented in Table 6-4. Further details are included in Working Paper No. 4. A total of 52 culverts are proposed along the highway upgrade to ensure that permanent and temporary water flows are appropriately conveyed under both carriageways in a 100 year flood event.

In some cases, adjustments to culvert sizes have been made as noted to better accommodate fauna crossing requirements. It should also be noted that three existing culverts under the railway line immediately downstream of the upgraded highway in the Lake section appear to be undersized. It is recommended that these rail culverts, at Stations 6010, 10710 and 11370 should be upgraded as noted in Table 6-4. The deficiency in the size of these existing rail culverts is independent of the highway upgrade and no specific allowance for these works has been included in the cost estimates.

Table 6-4 Culverts for minor catchments

Culvert No.	Station	Feature	Culvert size for drainage	Note
1	140	Watercourse	One 1.35 m diameter RCP	
2	600	Watercourse	Two 0.75 diameter RCPs	
3	850	Watercourse	One 2.4 m x 1.2 m RCBC	
4	1018	Minor watercourse	One 0.525 m diameter RCP	
5	1325	Watercourse	One 2.4 m x 1.2 m RCBC	Include raised ledge to provide a dry passage for fauna
6	2100	Washtub Creek tributary	One 1.5 m diameter RCP	
7	2450	Washtub Creek	Two 2.4 m x 1.2 m RCBCs	
8	2690	Washtub Creek tributary	One 1.5 m diameter RCP	
9	3300	Watercourse	One 2.4 m x 1.2 m RCBC	
10	3500	from Bulleys Road	One 0.60 m diameter RCP	
11	4500	Minor watercourse	One 0.45 m diameter RCP	
12	4950	Yaralin watercourse	Two 1.2 m diameter RCPs	
13	5060	Minor watercourse	Two 1.2 m diameter RCPs	
14	5660	Passionfruit Gully	Three 3.0 m x 3.0 m RCBCs	Raise invert of one cell to provide a dry passage for fauna
15	5770	Minor watercourse	One 0.9 m diameter RCP	
16	6010	Minor watercourse	One 1.05 m diameter RCP	In addition, one 0.6 m diameter pipe downstream under railway at Station 6100 should be upgraded to one 1.35 m minimum diameter RCP
17	6460	Minor watercourse	One 0.9 m diameter RCP	
18	6810	Minor watercourse	One 0.75 m diameter RCP	
19	7180	Small creek	Two 2.4 m x 1.2 m RCBCs	
20	7460	Minor watercourse	One 0.60 m diameter RCP	
21	7720	Small creek	Two 1.8 m x 1.2 m RCBCs	Increase size of one cell to 1.8 m x 1.8 m and raise invert slightly to provide a dry passage for fauna
22	7940	Minor watercourse	One 0.75 m diameter RCP	
23	9160	Minor watercourse	One 0.90 m diameter RCP	
24	9360	Watercourse	One 0.75 m diameter RCP	
25	9800	Minor watercourse	Two 1.8 m x 1.2 m RCBCs	
26	9950	Watercourse	One 2.4 m x 1.2 m RCBC	
27	10240	Minor watercourse	One 0.90 m diameter RCP	
27a	10505	Minor watercourse	One 0.45 m diameter RCP	
28	10710	Small creek	Two 2.4 m x 1.2 m RCBCs	1.5 m diameter RCP culvert under rail downstream should be replaced with two 2.4 m x 1.2 m RCBCs
29	11040	Minor watercourse	One 0.75 m diameter RCP	
30	11370	Small creek	Two 1.8 m x 1.2 m RCBCs	Downstream culvert under rail should be replaced with two 1.8 m x 1.2 m RCBCs
31	11600	Minor watercourse	One 0.90 m diameter RCP	
32	11950	Minor watercourse	One 0.90 m diameter RCP	

Culvert No.	Station	Feature	Culvert size for drainage	Note
33	12390	Watercourse	Extend culverts under new northbound carriageway using a buried connection chamber and four 1.2 m diameter RCPs	
34	13060	Minor watercourse	One 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC	Proposed fauna crossing - one cell raised for dry passage The additional height in one cell would allow it to function as a stock crossing as well
35	13770	Minor watercourse	One 1.05 m diameter RCP	
36	14290	Watercourse	Two 1.5 m diameter RCPs	
37	14550	Minor watercourse	One 0.90 m diameter RCP	
38	15170	Watercourse	One 0.75 m diameter RCP	Provide a dedicated 1.5 m x 1.5 m RCBC fauna crossing with invert raised to provide dry passage, in addition to the 0.75 m diameter RCP provided for drainage
39	15450	Watercourse	One 1.5 m diameter RCP	
40	16000	Minor watercourse	One 0.75 m diameter RCP with drop inlet	
41	16200	Minor watercourse	One 0.75 m diameter RCP with drop inlet	
42	16790	Minor watercourse	One 0.90 m diameter RCP	
43	17210	Minor watercourse	One 0.90 m diameter RCP	Increase size to 2.0 m x 2.0 m RCBC for fauna crossing
44	17830	Watercourse	One 0.90 m diameter RCP	
45	18210	Watercourse	One 1.2 m diameter RCP	
46	18560	Watercourse	One 0.75 m diameter RCP	
47	19010	Minor watercourse	One 0.75 m diameter RCP	
48	19510	Walkers Creek	Two 4.0 m x 3.2 m RCBCs	Provide a raised shelf for dry passage of fauna
49	20010	Minor watercourse	One 0.90 m diameter RCP	
50	21060	Small creek	One 1.8 m x 1.2 m RCBC	
51	21280	Minor watercourse	Three 3.0 m x 2.1 m RCBCs	
Note:		RCBC - Reinforced Concrete Box Culvert RCP - Reinforced Concrete Pipe Culvert sizes and locations would be subject to refinement during detailed design.		

6.7.3 Water quality control

As the Proposal crosses the Stewarts River, Camden Haven River, Herons Creek and other waterways, and passes close to several National Parks and SEPP 14 wetlands, particular attention has been given in the concept design to environmental measures that would be implemented to meet DEC guidelines for runoff discharge.

The most sensitive points for control of runoff are:

- the major bridges over the Stewarts River, Camden Haven River and Herons Creek
- Passionfruit Gully and other drainage lines that flow into National Parks such as Watson Taylors Lake (Crowdy Bay National Park) and SEPP 14 wetlands on the eastern, downstream side of the Proposal
- areas where the Proposal lies close to SEPP 14 wetlands No. 544a and No. 544c.

Where the above areas were identified as being most vulnerable to runoff from the highway or disturbed areas and where the terrain suited installation of basins, surface runoff from the road would undergo sufficient treatment using a system of water quality control ponds incorporating traps to contain spills of hazardous materials and ensure that runoff meets relevant guidelines for discharge into wetlands or watercourses. The locations of sedimentation basins were selected taking into account geotechnical, hydrologic, hydraulic, soil conservation and other environmental issues such as avoiding mature trees wherever possible (see Figures 6-1A to 6-1N). Basins have been located as close as possible to the waterway, maximising the capture of site run-off and minimising the area of cleared land.

As shown in Table 6-5, a total of 42 basins are proposed. These basins would all be used during the construction phase but on completion of construction and establishment of vegetation, 19 of the basins would be removed while the remaining 23 basins would be retained during the operation phase of the upgraded highway. Basins have been defined as either standard basins or as longitudinal basins. Standard sediment basins generally have a length three to four times greater than their width. In flatter areas such as the Camden Haven River flood plain, longitudinal basins (long narrow basins) would be more suitable than the standard basins as they reduce the requirement to acquire additional land and involve less disturbance to existing vegetation. Proposed locations of the various basin types are shown in Table 6-5.

Further details of proposed sedimentation basins during construction and water quality control ponds during the operation phase are provided in Working Paper No. 2.

Table 6-5 Sedimentation basins

Station	Feature	Location ⁽¹⁾	Type of basin ⁽²⁾	Adopted basin	
				Total capacity (m ³)	Type ⁽³⁾
140	Watercourse	NW	Longitudinal	110	C
		SW	Longitudinal	40	C
600	Watercourse	NW	Standard	262	C
850	Watercourse	NW	Standard	49	C
2100	Washtub Creek Tributary	SW	Longitudinal	962	C
2450	Washtub Creek	SW	Longitudinal	413	C+O
2690	Washtub Creek Tributary	SW	Standard	116	C
3260	Watercourse	NW	Longitudinal	34	C
		SW	Longitudinal	419	C
4200	Stewarts River	N	Standard	104	C+O
4000	Stewarts River	S	Standard	844	C+O
4960	Yaralin watercourse	SW	Standard	352	C
5060	Watercourse	NE	Longitudinal	507	C+O
5660	Passionfruit Gully	SW	Standard	419	C+O
6010	Minor watercourse	NW	Standard	406	C+O
7945	Minor watercourse	NW	Standard	565	C
8770	Stony Creek	NW	Longitudinal	202	C+O
		NE	Standard	186	C+O
		SW	Standard	520	C+O
		SE	Longitudinal	605	C+O
9970	Watercourse	SW	Standard	56	C+O
10250	Minor watercourse	NE	Longitudinal	140	C+O
		SE	Longitudinal	329	C
11600	Minor watercourse	NW	Standard	93	C+O
		SW	Standard	62	C
12800	Camden Haven River	NW	Longitudinal	256	C+O
12550	Camden Haven River	SW	Longitudinal	151	C+O
13060	Old Cattle Crossing	NW	Longitudinal	481	C+O
		NE	Longitudinal	319	C+O
13790	Minor watercourse	NW	Longitudinal	165	C+O
		NE	Longitudinal	112	C
14300	Watercourse	NE	Standard	198	C
15470	Watercourse	NW	Standard	2153	C+O
		NE	Standard	134	C+O
17850	Watercourse	SW	Standard	221	C
19510	Walkers Creek	SW	Standard	51	C+O
20010	Minor watercourse	NW	Standard	144	C
		NE	Standard	269	C
21070	Small Creek	SW	Longitudinal	312	C
		SE	Standard	312	C
21465	Herons Creek Flood Channel	SW	Standard	177	C+O
21550	Herons Creek	NW	Standard	77	C+O

(1) Location with respect to culvert/waterway: NW = north-west side of highway etc

(2) Type of basin: Standard = standard basin with length three to four times width
Longitudinal = Longitudinal basin = long narrow basin suitable for flat areas

(3) C = Construction phase only, C+O = Construction and Operation phases

(4) Proposals would be subject to refinement during detailed design.

6.8 Utilities

Utility services (in particular fibre optic and coaxial cables and water and effluent mains) would be affected by the Proposal in numerous locations and would require relocation or protection. An estimate of the adjustment and protection costs has been made and is included in the Proposal cost estimate (see Section 6.16). The most significant impacts on utility services are shown in Table 6-6.

Table 6-6 Impacts on utilities

Station	Impact
Telstra	
0 to 1400	Coaxial cable along proposed highway may require relocation.
14500 to 15000	Optic fibre crossing in proposed deep highway cutting would require 'live' relocation.
15230	Optic fibre crossing in proposed shallow fill would require lowering and protection.
15800	Optic fibre along Ocean Drive to be raised into new Ocean Drive fill embankment and into Ocean Drive overbridge crossing of highway.
16350 to 16600	Optic fibre crossing in proposed deep cutting would require 'live' relocation. Alternatively, to avoid the above 'live' relocations, the Sydney-Brisbane optic fibre route may be cut over and relocated to the eastern boundary from Station 12800 to Station 18500.
16400 to 22200	Coaxial cable route occurs in a number of cuttings and fills and may require relocation over this full length.
Optus	
12800	Optic fibre crossing in front of new northern Camden Haven bridge abutment and may require protection.
17050	Optic fibre crossing in fill under Herons Creek Road to be protected.
18500	Optic fibre crossing in fill to be protected.
NextGen	
18500	Optic fibre crossing in shallow fill to be protected.
Sewerage	
16550 to 17100	0.2 m diameter rising main and effluent main under proposed highway in fill to be relocated.
Water	
15800	0.375 m diameter and 0.225 m diameter water mains along Ocean Drive to be raised into new Ocean Drive fill embankment and into Ocean Drive overbridge crossing of highway.
16600 to 17000	0.15 m diameter and 0.10 m diameter water mains under proposed highway in fill to be relocated.
18800 to 19400	0.15 m diameter water main under proposed highway and side road to be relocated.

Impacts and proposals would be subject to refinement during detailed design.

As part of its small township sewage scheme, Hastings Council proposes to provide a sewage system for Herons Creek township. Hastings Council has engaged a consultant to carry out the design development works associated with collection of sewage from the township and transfer, via pump and rising main, to the Kew-Kendall sewage treatment plant on the east side of the highway just to the north of Kew. While Council does not have an agreed construction schedule for the rising main, it may be constructed prior to construction of the Proposal. Information on the Proposal has been provided to Council and its consultant to ensure that the rising main is located where it would be clear of the Proposal and associated works, and would not require later relocation or protection.

6.9 Lighting, fencing and signposting

For safety and consistency with other Pacific Highway Upgrades, roadway lighting would be provided at the grade-separated junctions at Johns River and Kew. Lighting would be in accordance with Part 12 - Roadway Lighting Guide - of the *Guide to Engineering Practice* (AUSTROADS 1988) and the Australian Standard for Road Lighting (AS 1158). The most energy efficient lighting technology would be used wherever technically and economically feasible.

Interchange areas to be lit in accordance with these standards would include:

- merge and diverge areas (eight in total)
- ramps
- roundabouts at Johns River and Kew.

In addition, flag lighting is proposed at all T-intersections incorporating median openings. The flag or guidance lighting would be as described in AS 1158.1.1 (Isolated intersections and junctions). It would not achieve the lighting levels proposed at interchanges but is primarily aimed at identifying in advance the existence of the intersections for motorists travelling at night. Due to the width of the road, two or three street light fittings may be required at each intersection.

A summary of proposed flag lighting locations is shown in Table 6-7.

Table 6-7 At-grade intersections with flag lighting

Station	Facility
6400	Median opening/U-turn facility combined with Algona Road intersection
8550	Median opening/U-turn facility combined with Watson Taylor Road intersection
11650	Median opening/U-turn facility combined with Ross Glen Road intersection
13650	Median opening/U-turn facility combined with local access connection near Glen Haven
19000	Median opening/U-turn facility combined with local access connection at Eggbert property
20900/ 21100	Median opening/U-turn facility combined with Cluleys Road/Herons Creek Road intersections.
22150	Median opening/U-turn facility combined with Bobs Creek Road intersection

Proposals would be subject to refinement during detailed design.

The road reserve would be fenced on both sides in a manner consistent with adjoining land uses to prevent unauthorised pedestrian access and inadvertent intrusion by wildlife or stock. Where fauna activity is unlikely, post and wire fencing would generally be provided. Where boundaries are unchanged, post and wire boundary fences already exist in most cases and would be retained. Where new fencing is required, in areas requiring land acquisition for example, a new standard 5-wire fence would generally be provided at the acquisition boundary.

In some areas, this fencing would be of the fauna exclusion ('floppy top') variety to ensure that Koalas and other native fauna are not able to wander onto the roadway but are directed to the crossings provided. The proposed locations of fauna-proof fencing are as developed in Working Paper No. 7. The proposed fauna fencing locations are summarised in Table 6-8. These locations take into consideration fauna movements associated with:

- the regional continuity of habitat in the area
- the size and location of habitat present on either side of the highway

- the locations of structures facilitating fauna movements, such as RCBC and bridge openings (refer Section 6.13) and the species likely to need or use the fauna movement facilities
- the current and possible future land uses on either side of the highway
- the feasibility of construction with respect to engineering constraints.

The fencing should be located on both sides of the highway (as close as practicable) to guide animals to and through the movement structures and to prevent access onto the highway. In most areas the fauna-proof fencing would be supplemented by an existing post and wire boundary fence or, where new acquisition is required, by a new standard 5-wire fence located at the new acquisition boundary.

Where the vegetation strip between the acquisition boundary and the extent of earthworks decreases to less than about 15 m, consideration should be given to relocating the floppy topped fencing to the property boundary.

On private land the post and wire boundary fences would generally extend across fauna crossing locations. While the wire fence would act as a partial barrier to some species, particularly larger animals, some form of fencing would be necessary in most cases for boundary delineation and control of any stock.

Fence locations shown in Table 6-8 are indicative only. Final fence types and locations would be subject to negotiations with adjacent landowners during the detailed design stage of the Proposal but would generally be in accordance with the principles described above.

Further details of fauna provisions are provided in Chapter 10 and in Section 6.13 as well as in Working Paper No. 7.

Road signage would be determined during the detailed design stage and would conform to prevailing RTA practice. Discussions would be held with Greater Taree and Hastings Councils during the detailed design stage of the Proposal in relation to any particular signage requirements prior to the exits to Johns River and Kew. An objective of any such signage would be to alert motorists to the facilities and attractions available in both townships and the Camden Haven region (see also Chapter 17).

Table 6-8 Proposed fauna fencing locations

Section	Station of proposed fauna crossing	Station of southern limit of fencing	Station of northern limit of fencing	Length of highway requiring fencing (metres each side of highway)
Johns River	1325	1200	1570	370
Lake	5660	5600	5700	100
	7750	7000	7900	900
	8770	8600	9100	500
Kew	12780	no fauna fencing proposed since road elevated with steep embankments		
	13070	no fauna fencing proposed since road elevated with steep embankments		
	15170	15000	15300	300
Herons Creek	17200	17050	17500	450
	19510	19450	19700	250
	21465	21300	21600	300

Proposals would be subject to refinement during detailed design.

6.10 Noise attenuation measures

The predicted impact of road traffic noise from the Proposal is described in Chapter 19. In order to meet the relevant criteria for road traffic noise for residential and other sensitive land uses, noise attenuation measures would be implemented along certain sections of the Proposal to assist in reducing traffic noise levels. In particular, the following noise mitigation measures are proposed:

Johns River

A 3.5 m high mound with a 1 m high noise wall on the top is proposed on the east side of the bypass to the north of Stewarts River Road. The mound would have 2H:1V slopes on each side and would be 1.5 m wide at the top. The mound and wall would extend from the overpass embankment at Station 2550 for a length of about 400 m to Station 2960. From Station 2960 to Station 3300 there would be no wall and the mound tapers from 3.5 m down to zero height.

Low noise pavement is also proposed on both carriageways through Johns River from Station 2400 to Station 3950.

Kew

A 3 m high noise wall is proposed on the west side to the south of Ocean Drive. The wall would extend from the cutting at Station 15370 to the Ocean Drive embankment at Station 15800, a total length about 430 m.

North of Ocean Drive on the west side a 3 m high mound is proposed. The mound would start at the north side of Ocean Drive at Station 15820 and would extend through to Station 16000 at 3 m height. It would taper from 3 m high to zero between Station 16000 and Station 16150.

Low noise pavement is also proposed on both carriageways through Kew from Station 15000 to Station 16600.

In addition, a 3 m high mound is proposed on east side to south of Ocean Drive. This mound is proposed in response to both urban design and noise issues since it could not be justified on noise criteria alone. It would start near the end of the cutting at Station 15060 and end near the start of the long cutting at Station 15520.

Herons Creek

A 3 m high noise wall is proposed on the west side of the upgraded highway past the school. The wall would extend from Station 21650 to Station 21980.

Low noise pavement would be adopted past the Herons Creek township from Station 20340 to Station 21450.

These attenuation measures are also discussed in Chapter 19. The final form, location and extent of noise mitigation measures would be subject to discussions with the community and councils but would generally be in accordance with the principles described above.

6.11 Pedestrian and cyclist facilities

Provision for pedestrian and cyclist movements across the highway is incorporated with the provision for local vehicle access. This includes improved pedestrian and cyclist safety via raised pedestrian/cycle footways incorporated in the Ocean Drive and Stewarts River Road overbridges. Separate raised footways are also proposed beside the western shoulder of the Herons Creek and Herons Creek floodway bridges to replace the existing timber footbridges used by Herons Creek Public School students.

No separate off-road provision for pedestrians or cyclists would be provided within the road reserve along this section of the Pacific Highway. Long distance cyclists would be able to use the sealed 2.5 m wide left shoulder that would generally be provided on both carriageways. This sealed shoulder width is consistent with RTA guidelines for road shoulder usage by cyclists where the 85th percentile vehicle speed is 100 km/h (refer Section 3.3.8 of the RTA *Road Design Guide*). The shoulder width would be increased by 0.5 m to 3.0 m where guard fencing or a barrier is located at the edge of shoulder. The only exception would be the left shoulder of new bridges, where the shoulder would not be widened from 2.5 m. The shoulder would also be available to vehicles stopping because of a breakdown or other reason.

The 2.5 m wide shoulder would be continuous across new bridge structures. The only locations where the 2.5 m wide left shoulder would not be available would be across the existing bridges at the Stewarts River (289 m long), Rossglen railway (42.3 m) and at the Camden Haven River (163 m long), all of which are retained for the southbound carriageway. There is no footway on these bridges and the available carriageway width between barriers is 9.2 m. Maintaining the 1.0 m wide median shoulder and two 3.5 m lanes would allow a 1.2 m wide left shoulder for cyclists or emergency stopping. Over these bridges the shoulder width would be below desirable standards for uses by cyclists. The cost of widening these existing bridges to provide the full 2.5 m left shoulder would be prohibitive and is not proposed, however, further consideration will be given during the detailed design phase to the positioning of lane and shoulder markings within the available 9.2 m width. Reducing the median shoulder width and/or the lane widths would provide some scope to increase the left shoulder width without the cost of bridge widening.

Southbound cyclists would have an alternative route along the existing Pacific Highway through Johns River and northbound cyclists would have an alternative route along the existing highway through Kew. The pavement width on the existing highway at both Johns River and Kew is wide enough to allow re-linemarking with adequate shoulder widths for southbound and northbound cyclists respectively given the reduced traffic volumes on these sections of road.

6.12 Rest areas

The *Pacific Highway Upgrading Program - Strategic Assessment* (SKM 2000) assessed existing rest areas and identified where new rest areas should be provided. For the section of highway within the study area this document proposed a new northbound heavy vehicle rest area of approximately 0.7 ha in the vicinity of the Camden Haven River, and retention of an existing southbound heavy vehicle rest area located just south of the Camden Haven River.

Subsequently the report *Pacific Highway F3 (Freeway) Truck Rest Area Strategy* (RTA 2003b) established that the new northbound rest area in the vicinity of the Camden Haven River should provide facilities for both heavy vehicle and light vehicle users. The report also included a requirement for parking areas for light and heavy vehicles to be separated, but the other facilities can be shared. Facilities to be provided included:

- parking for ten light vehicles
- parking for eight to ten B-Doubles

- deceleration lanes to RDG requirements
- acceleration lanes only in circumstances where they are necessary (i.e. poor sight distance to exit)
- toilets to the new 'Pacific Highway' design
- seating and shelter (usually 3 sets)
- shade for vehicles (using current trees if available).

In addition, existing rest areas along the existing highway in the study area would be retained where they are not affected by the Proposal and where safe access to and from the upgraded highway would be available.

Based on the above guidelines the Proposal incorporates the following measures in respect of rest areas:

- retention of:
 - existing southbound heavy vehicle rest area 0.75 km south of the Rossglen turnoff, Station 11200 to Station 11500. This is a developed off-highway rest area with access ramps to and from the existing highway. Access to the rest area would continue to be available following the highway upgrade. This rest area is a designated rest area in the *Strategic Assessment* and a landscape upgrade of the rest area is proposed as part of the highway upgrade. Refer to Working Paper No. 9 for further details
- closure of:
 - existing heavy vehicle rest area 100 m north of Rossglen turnoff, Station 12100. The new northbound carriageway passes through the middle of this rest area and retention would not be possible. It would be replaced by the new northbound rest area proposed at Station 10700 to 11000 as described below. The existing toilets would be relocated to the new northbound rest area.
 - an existing southbound heavy vehicle rest area about 0.3 km south of Haydons Road at Station 7600. This rest area comprises a widened shoulder over a length of about 100m. According to the *Strategic Assessment* this rest area should be retained, however this would not be possible due to the width restrictions imposed by the Middle Brother National Park and the adjacent railway.
- construction of:
 - new northbound heavy vehicle rest area located to the south of Ross Glen Road, Station 10700 to Station 11000. The proposed location of the new northbound rest area is about 1.2 km south of the bridge over the railway line. The rest area would be accommodated within the existing road reserve and would be facilitated by relocating the Charles Yard Road connection to the highway by about 800 m further to the south. Layouts for the proposed rest area would be developed during the detailed design stage and would incorporate the parking and other facilities listed above. The area available is in excess of the 0.7 ha suggested in the *Strategic Assessment*. Adequate sight distance is available at the exit from the rest area and an acceleration lane would not be required.

The detailed design of rest areas would follow the *Road Environment Safety Update 23 Rest Area Best Practice Design Guide* (RTA 2004a).

6.13 Provision for fauna movement

A summary of the provisions that have been made in the concept design to allow for the safe movement of fauna across the highway corridor, together with the rationale for each measure, is presented in Table 6-9. Provision for fauna movement is proposed only through use of bridges and other drainage structures such as culverts. Based on ecological and regional connectivity issues (see Chapter 10), there are no 'purpose specific' fauna underpasses or overpasses proposed, although some culverts have been augmented or enlarged based on fauna connectivity requirements.

Table 6-9 Location and type of fauna crossings

Approx. Station	Proposed culvert size for drainage	Proposed adjustment to suit fauna
1325	One 2.4 m x 1.2 m RCBC	Raised ledge for dry passage of fauna
5660	Three 3.0 m x 3.0 m RCBCs to be lengthened	Invert of one cell raised for dry passage of fauna
7720	Two 1.8 m x 1.2 m RCBCs	Size of one cell increased to 1.8 m x 1.8 m RCBC
8790	Duplicate existing 15.2 m span bridge	Single span bridge, no special adjustment required
12630	174 m span bridge over Camden Haven River	Northern span of bridges allows fauna to cross under the highway - no special adjustment required
13060	Replace existing sunken culvert with one 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC	Invert of one cell raised for dry passage of fauna
15170	0.75 m diameter pipe	Additional 1.5 m x 1.5 m RCBC fauna crossing with invert raised to provide dry passage for fauna
17210	0.9 m diameter pipe	Culvert size increased to 2 m x 2 m RCBC
19510	2 x 4.0 m x 3.2 m RCBC	Raised shelf provided for dry passage of fauna
21465	32 m span bridge over Herons Creek floodway	Bridge structure allows fauna to cross under the highway - no special adjustment required

Proposals would be subject to refinement during detailed design.

As noted in Section 6.9, the proposed highway reservation would be fenced on both sides with fauna exclusion fencing and/or stock-proof fencing in all relevant locations. The fauna-exclusion fencing would assist in directing fauna to the crossings provided and the proposed extent of this fencing is summarised in Table 6-8.

The crossings should also aim to provide dry passage for fauna either through the inclusion of a raised walkway within existing culverts or through the positioning of new cells. Proposals are described generally in Table 6-9 and would be further developed in the detailed design stage of the proposed highway upgrade.

Further consideration of the need for design features to facilitate safe fauna movement across the bypass is given in Chapter 10.

Additionally, a number of other bridges and drainage structures included in the Proposal but not mentioned above may also function as fauna movement facilities, especially for smaller fauna. These additional locations are not listed above due to the lack of suitable habitat on at least one side of the preferred route, or because they do not provide connectivity within a wider regional context (see Working Paper No. 7).

6.14 Landscape and urban design concept plan

The *Pacific Highway Urban Design Framework* (RTA 2005) contains six urban design objectives to assist in delivery of the urban design vision presented in Section 6.1.1. These objectives are:

- to provide a flowing road alignment that is responsive and integrated with the landscape
- to provide a well-vegetated, natural road reserve
- to provide an enjoyable interesting highway
- to value the communities and towns along the road
- to provide consistency-with-variety in road elements
- to provide a simplified and unobtrusive road design.

These objectives have underpinned the development of the urban design and landscape concept presented in Working Paper No. 9 and summarised in Chapter 13. The landscape and urban design concept is illustrated in Figures 6-4A to 6-4N which represent the proposed urban and landscape concept for the Proposal. Figures 6-4O and 6-4P show the proposed layouts at the Johns River and Kew interchanges respectively.

Particular ways in which the urban design objectives have been incorporated in the development of the concept design of the Proposal include:

- The townships of Johns River and Kew are proposed to be bypassed, to achieve key road design requirements, and safety and amenity improvements for these communities.
- The existing road formation would be retained as one carriageway for most of the remaining length, while the second carriageway would be constructed alongside. This would limit the amount of disturbance of vegetation and contribute to a well-vegetated, natural road reserve
- The noise mound that would separate the Johns River bypass from the township would also contribute as a visual mitigation measure.
- A narrow median with split-level carriageways would be implemented over the section to the north of the Stewarts River bridge. As well as adding an interesting design element, this allows the existing high rock cutting (300 m long and up to 15 m high) to be retained undisturbed, and also allows the retaining wall between the upgraded highway and the railway to be reduced in height.
- The vertical alignment of the proposed Kew bypass has been lowered to reduce the visual impact of the bypass on the township of Kew to the west and the Glen Haven subdivision to the east of the bypass. The lower profile is supplemented by the addition of earthen mounds and noise walls on both sides of the bypass to further reduce the visual impact on these communities.
- Split-level carriageways are also proposed on the Kew bypass to the north of Ocean Drive to better integrate the design with the topography and to reduce the footprint of the disturbed area.

6.15 Ancillary construction facilities

In addition to the physical footprint of the permanent works for the Proposal, the construction contractor would require land for a range of construction-related facilities and activities, including site compounds for offices and storage of plant and equipment, batch plants, crushing plants and stockpile areas.

Suitable sites for these facilities as well as a description of impacts and mitigation measures are described in Section 7.4.

6.16 Proposal cost estimate

Based on the design described in this EIS, the total cost of the Proposal on completion has been estimated at \$223 million (see Table 6-10). The estimate was reviewed in March 2005 but is still based on February 2001 dollar costs for easier comparison with the RTA's initial strategic cost estimates.

Table 6-10 Proposal cost estimate summary

RTA Job Cost Item	Description	Estimated Cost (including contingencies)
Job 1	Project Development	\$7.1 million
Job 2	Investigation and Design	\$4.8 million
Job 3	Property Acquisition	\$19.8 million
Job 4	Public Utility Adjustments	\$8.6 million
Job 5	Construction	\$181.1 million
Job 6	Project Handover	\$1.9 million
Total		\$223.1 million say \$223 million

Note: Estimate revised March 2005 but based on February 2001 dollar costs

6.17 Road user economic evaluation

6.17.1 Types of road user benefits

A road user cost benefit analysis was undertaken for the Proposal based on a total estimated project cost of \$223 million (including RTA management costs and land acquisition). There are three particular ways in which road user benefits accrue in major road projects. These, in fact, are estimates of future costs that would have accrued if the Proposal did not proceed, and thus become cost savings which accrue as a result of implementing the Proposal. These three areas are:

- **Value of time (VOT)** savings that represent the value of travel time of the road users. Benefits can arise if, as a result of the Proposal, the average speed of vehicles is increased and/or the trip length is reduced. In both cases, there is a resultant decrease in trip time that can be valued in dollar terms. This represents a major source of benefit for many road upgrading projects.
- **Vehicle operating cost (VOC)** savings are estimates of the change in operating costs for different vehicles based on the changed road conditions resulting from the Proposal. The future VOC is estimated for the existing and changed road conditions based on VOC curves for normal and heavy vehicles operating at different speeds on average grades. Where the new road conditions permit significantly higher speeds (for example, due to improved alignment), the VOC may be higher.
- **Accident cost** savings are estimated based on the historical record of accidents in the road corridor and projected into the future based on forecast traffic growth. Changes in the future accident profile are estimated based on experience with similar projects implemented in the past where post implementation studies have been carried out.

Maintenance saving benefits may also occur if major maintenance or upgrading an existing road can be avoided or delayed by the construction of a new road. In the case of Moorland to Herons Creek, if an upgrade of the highway were not provided, the following maintenance and upgrading of the existing alignment would be required in the short to medium term (five to ten years):

- major pavement rehabilitation of the highway along the length of the route
- on-going maintenance of the roadway
- improvements to intersections, including channelisation and turning lanes, to increase safety and efficiency of the road
- improvements to and/or introduction of environmental controls especially in areas adjacent to SEPP 14 wetlands and National Parks
- maintenance and possible upgrade of the bridges across waterways.

The Base Case option of retaining the existing highway includes allowances for the cost of rehabilitating the existing pavement and for on-going maintenance of the existing highway.

Note that this section represents a road user economic evaluation only. Broader economic impacts are considered in Chapter 17.

6.17.2 Approach to analysis

Generally the approach to estimating the benefits of the Proposal has been conservative such that benefits would be underestimated where uncertainty existed.

A discounted cash flow (DCF) analysis has been undertaken to estimate the costs and benefits associated with the Proposal in comparison to retaining the existing Pacific Highway as a Base Case option.

Results are quantified in terms of the following criteria:

- Net Present Value (NPV) is the present value of costs less the present value of benefits over the life of a project using a discount rate of 7%. Projects are worthwhile where the present value of benefits exceeds the present value of costs, i.e. NPV is positive.
- Benefit Cost Ratio (BCR) is the present value of costs divided by the present value of benefits using a discount rate of 7%. A BCR greater than 1 indicates a project is worthwhile. Economic worth as measured by BCR generally follows that measured by NPV.
- Internal Rate of Return (IRR) is the discount rate at which the present value of project benefits equals the present value of project costs. A low IRR indicates that project benefits (which usually occur throughout the life of a project) only match project costs (which usually occur largely at the start of a project) if the discount rate is small; a high IRR indicates that project benefits exceed project costs at ordinary discount rates. Accordingly, economically attractive projects have high IRRs.
- First Year Rate of Return (FYRR) is a measure of the present value of the benefits achieved in the first full year of a project's operation divided by the present value of the capital costs incurred to achieve this. It is expressed as a percentage and is typically used to determine the best start date for a project. If a project has a FYRR below the discount rate (e.g. 7%) then the implementation of the project might be better deferred until the FYRR either equals or exceeds the discount rate.
- NPV/CC is the NPV divided by the capital costs of a project. It is a convenient measure of economic performance (as measured by NPV) that differentiates between projects with different capital costs. In dividing NPV by capital cost, the result provides a measure of the efficiency of benefit production, in terms of capital expenditure. Unless the capital cost of a project involves delayed expenditure then $NPV/CC = BCR - 1$.

Analysis was conducted for a 35 year time period (2006 to 2040) using a real discount rate of 7%. A 30-year operation period has been taken with construction taking place over the five years 2006-2011.

The analysis of road user benefits was conducted in accordance with standard RTA procedure as outlined in *Economic Analysis Manual, Version 2* (RTA 1999d). Parameters used incorporated the RTA's updates up to and including October 2004 and are discussed in Working Paper No. 2.

6.17.3 Results of road user economic analysis

Economic evaluation

The analysis revealed that, at a discount rate of 7%, the Proposal would return a Benefit Cost Ratio in the order of 3.5, with a net present value of \$355 million (see Table 6-11). This indicates that the Proposal would be economically viable.

Table 6-11 Results of the economic evaluation for the Proposal

Economic parameter	Result
Benefit-cost ratio	3.5
Net present value	\$355 million
Discount rate	7%
Internal rate of return	17.0%
First year rate of return	13.1%

Road user benefits

A summary of the road user benefits is presented in Table 6-12. The primary source of road user benefits over a 5-year construction period and a 30-year operational period from 2006 to 2040 is in travel time cost savings.

Table 6-12 Summary of total road user benefits, 2006 to 2040 (Present Value @ 7%)

Project case	Capital costs	Maintenance costs	Vehicle operating costs	Travel time costs	Accident costs	Net cost
Base case (existing highway)	-	\$15.1 million	\$568 million	\$883 million	\$26.9 million	\$1493 million
Highway upgrade proposal	\$153 million	\$4.8 million	\$526 million	\$440 million	\$14.6 million	\$1138 million
Difference	-\$153 million	\$10.3 million	\$42 million	\$443 million	\$12.3 million	\$355 million

6.18 Property acquisition and compensation

6.18.1 Property details

The locations of all properties in the immediate vicinity of the proposed upgrade are shown in the Property Reference Maps, Figures 6-5A and 6-5B. Details of each property referenced on these figures are summarised in Table 6-13.

Existing and proposed property boundaries in the vicinity of the alignment are shown in Figures 6-1A to 6-1N. Where acquisition from a property would be required for the Proposal, an acquisition area has been added to the last column of Table 6-13.

Land acquisition totalling almost 70 ha would be required from 69 private landowners and 8 government departments or agencies including Department of Lands (Crown Land), RTA, Rail Corporation New South Wales (RailCorp), Department of Infrastructure, Planning and Natural Resources (incorporating the department previously known as Land and Water Conservation), NSW Department of Primary Industries (Forests NSW), Bunyah Local Aboriginal Land Council, Hastings Council and the NSW Department of Education.

Table 6-13 Summary of land acquisition requirements

Property Reference No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
Johns River section				
1	Pacific Highway Moorland	DP 703878 Lot 8	1.4	
2	Pacific Highway Moorland	DP 703878 Lot 8	0.6	
3	Pacific Highway Moorland	DP 778395 Lot 9	4.5	
4	Pacific Highway Moorland	DP 778395 Lot 10	28.2	
5	Pacific Highway Moorland	DP 614983 Lot 5	0.4	
6	Railway	-	-	
7	Pacific Highway Johns River	DP 845868 Lot 28	2.1	
8	Pacific Highway Johns River	DP 819425 Lot 2	25.2	
9	Pacific Highway Johns River	DP 819425 Lot 1	4.7	
10	Pacific Highway Johns River	DP 754448 Lot 233	49.5	2.00
11	Purfleet Taree Local Aboriginal Land Council, Pacific Highway Johns River	DP 754448 Lot 212	2.4	
12	65 Stewarts River Road Johns River	DP 801893 Lot 2	8.1	1.57
13	Crown Land, Pacific Highway Johns River	-	-	2.83
14	63 Stewarts River Road Johns River	DP 801893 Lot 1	6.3	2.07
15	43 Stewarts River Road Johns River	DP 739704 Lot 1	2.0	0.32
16	23 Stewarts River Road Johns River	DP 739704 Lot 2	3.4	1.85
17	21 Stewarts River Road Johns River	DP 308795 Lot 1	0.1	
18	15 Stewarts River Road Johns River	DP 879623 Lot 283	2.7	
19	7 Stewarts River Road Johns River	DP 879623 Lot 284	0.5	
20	50 Stewarts River Road Johns River	DP 1000354 Lot 3	2.3	
21	38 Stewarts River Road Johns River	DP 1027117 Lot 4	1.4	0.04
21	22 Stewarts River Road Johns River	DP 1027117 Lot 6	22.1	6.59
22	12 Stewarts River Road Johns River (RTA-owned)	DP 1000354 Lot 2	1.4	0.56
23	8 Stewarts River Road Johns River	DP 1000354 Lot 1	1.6	0.06
24	24 Stewarts River Road Johns River	DP 1027117 Lot 5	28.2	0.49
25	DIPNR, Pacific Highway Johns River	DP 754448 Lot 125	2.8	1.12

6 The proposal design

Property Reference No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
26	Pacific Highway Johns River	DP 122836 Lot 1	6.6	
27	Pacific Highway Johns River	DP 391437 Lot 0	0.1	
28	27 Bulleys Road Johns River	DP 787622 Lot 5	28.4	0.32
29	9 Wharf Road Johns River	DP 589513 Lot 3	4.7	
30	26 Bulleys Road Johns River	DP 706429 Lot 42	1.8	0.34
31	75 Bulleys Road Johns River	DP 816026 Lot 43	10.8	0.03
32	Pacific Highway Johns River	DP 260424 Lot 4	1.4	
33	Pacific Highway Johns River	DP 260424 Lot 5	0.1	
Sub-total Johns River section				20.18
Lake section				
34	Bulleys Road Johns River	DP 816026 Lot 45	2.5	0.03
35	Railway	-	-	0.56
36	Bulleys Road Johns River	-	11.7	
37	20 Yaralin Close Johns River	DP 716380 Lot 1	2.2	0.05
38	99 Middle Brother Road Johns River	DP 716380 Lot 2	40.5	
39	14 Middle Brother Road Johns River	DP 260425 Lot 2	12.6	
40	14 Middle Brother Road Johns River	DP 260425 Lot 2	4.0	0.04
41	Opposite Middle Brother Road	-	3.0	
42	Pacific Highway Passionfruit Gully	DP 615876 Lot 1	1.0	
43	Pacific Highway Passionfruit Gully	DP 260425 Lot 4	28.3	0.46
44	Pacific Highway Passionfruit Gully	DP 588647 Lot 2	4.1	0.33
45	Pacific Highway Passionfruit Gully	DP 588647 Lot 1	4.1	0.40
46	17 Algona Road Middle Brother	DP 249033 Lot 1	4.3	0.17
47	10 Algona Road Middle Brother	DP 249033 Lot 2	2.1	
48	24 Caringal Drive Middle Brother	DP 249033 Lot 3	2.0	0.21
49	26 Caringal Drive Middle Brother	DP 249033 Lot 4	2.0	0.07
50	31 Caringal Drive Middle Brother	DP 249033 Lot 5	10.1	
51	Middle Brother National Park	-	-	
52	Railway, south of Algona Road	-	-	
53	Railway, south of Watson Taylor Road	-	-	0.76
54	4149 Pacific Highway Middle Brother	DP 809818 Lot 20	6.9	1.47
55	100 Pacific Highway Middle Brother	DP 609955 Lot 1	6.6	
56	4151 Pacific Highway Middle Brother	DP 552057 Lot 2	20.0	
57	Railway, north of Watson Taylor Road	-	-	0.89
58	110 Pacific Highway Middle Brother	DP 754418 Pt Lot 20	15.3	
59	Pacific Highway Middle Brother	DP 754418 Pt Lot 146	1.1	
60	Pacific Highway Middle Brother	DP 754418 Pt Lot 33	6.5	
61	Pacific Highway Middle Brother	DP 754418 Pt Lot 146	2.3	
62	Middle Brother State Forest, opposite stockpile	-	-	0.71
63	Railway, opposite Middle Brother State Forest	-	-	0.33
64	Middle Brother State Forest	-	-	0.06
65	Middle Brother State Forest	-	-	
66	Middle Brother State Forest, Ross Glen Road diversion	-	-	1.47
67	Pacific Highway Rossglen	DP 264366 Lot 11	5.5	0.67
68	Pacific Highway Rossglen	DP 264366 Lot 11	7.1	
Sub-total Lake section				8.68

Property Reference No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
Kew section				
69	10 Pacific Highway Kew	DP 706258 Lot 28	5.3	
70	Road Reserve (RTA-owned)		0.7	
71	Road Reserve (RTA-owend)		0.4	
72	Pacific Highway Kew	DP 706258 Lot 29	0.3	0.09
73	Pacific Highway Kew	DP 706258 Lot 30	1.2	0.16
74	Pacific Highway Kew	DP 706258 Lot 24	38.0	0.08
75	20 Pacific Highway Kew	DP 706258 Lot 27	37.4	0.02
76	4738 Pacific Highway Kew	DP 706258 Lot 23	18.6	0.81
77	Pacific Highway Kew	DP 706258 Lot 26	0.1	0.02
78	Pacific Highway Kew	DP 706258 Lot 25	0.0	
79	4740 Pacific Highway Kew	DP 733145 Lot 2	32.8	0.91
80	Pacific Highway Kew	DP 712854 Lot 1	3.7	0.15
81	Bethesda Road Kew	DP 733145 Lot 1	6.6	1.61
82	550 Pacific Highway Kew	DP 587919 Lot 3	0.2	0.21
83	550 Pacific Highway Kew	DP 587919 Lot 3	0.5	0.03
84	560 Pacific Highway Kew	DP 754405 Lot 148	0.9	0.02
85	Bunyah Local Aboriginal Land Council, Bethesda Road Kew	DP 823801 Lot 327	3.2	0.52
86	570 Pacific Highway Kew	DP 564615 Lot 2	12.0	0.94
87	9 Bellbird Close Kew	DP 855169 Lot 41	1.5	0.03
88	11 Bellbird Close Kew	DP 855169 Lot 40	1.5	0.08
89	13 Bellbird Close Kew	DP 855169 Lot 39	1.4	0.18
90	10 Bellbird Close Kew	DP 855169 Lot 38	1.5	0.49
91	8 Bellbird Close Kew (RTA owned)	DP 855169 Lot 37	2.6	0.90
92	NSW Police, 20 Tathra Road Kew	DP 754405 Pt Lot 62	1.0	
93	12 Tathra Road Kew	DP 710749 Lot 6	5.9	2.00
94	20 Ocean Drive Kew	DP 557965 Lot 2	6.1	2.27
95	40 Ocean Drive Kew	DP 569595 Lot 1	4.2	
96	640 Pacific Highway Kew	DP 557965 Lot 1	2.0	0.21
97	53 Ocean Drive Kew	DP 602511 Lot 5	2.0	
98	Pacific Highway Kew	DP 578792 Lot 4	0.2	
99	4928 Pacific Highway Kew	DP 775532 Lot 7	37.0	6.74
100	4928 Pacific Highway Kew	DP 729726 Lot 1	0.3	
101	Pacific Highway Kew	DP 578792 Lot 4	9.1	0.72
102	Pacific Highway Kew	DP 1047707 Lot 35	53.3	1.05
103	22 Weeroona Place Kew	DP 570233 Lot 2	1.5	0.19
104	22 Weeroona Place Kew	DP 570233 Lot 2	15.8	
105	300 Pacific Highway Kew	DP 567240 Lot 1	4.0	0.85
106	300 Pacific Highway Kew	DP 567240 Lot 1	19.8	0.01
107	Hastings Council (south part of STP), Pacific Highway Herons Creek	DP 879080 Lot 100	103.4	1.45
108	Pacific Highway Kew	DP 883598 Lot 73	5.3	2.26
Sub-total Kew section				25.01

Property Reference No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
Herons Creek section				
109	Pacific Highway Herons Creek	DP 883598 Lot 74	22.0	1.99
110	Hastings Council (north part of STP), Pacific Highway Herons Creek	DP 879080 Lot 100	17.5	1.27
111	Pacific Highway Herons Creek	DP 248577 Lot 5	10.9	0.39
112	5220 Pacific Highway Herons Creek	DP 1046693 Lot 5	71.9	0.53
113	5233 Pacific Highway Herons Creek	DP 248577 Lot 4	11.0	0.45
114	5220 Pacific Highway Herons Creek	DP 1046693 Lot 4	15.6	0.50
115	5275 Pacific Highway Herons Creek	DP 248577 Lot 3	10.9	0.21
116	Pacific Highway Herons Creek	DP 573043 Lot 1	96.6	1.32
117	5277 Pacific Highway Herons Creek	DP 248577 Lot 2	10.9	0.11
118	5301 Pacific Highway Herons Creek	DP 754405 Lot 298	10.4	0.14
119	Pacific Highway Herons Creek	DP 517560 Lot 1	0.0	0.01
120	830 Pacific Highway Herons Creek	DP 617135 Lot 4	44.4	1.45
121	5329 Pacific Highway Herons Creek	DP 569272 Lot 3	10.1	0.37
122	5353 Pacific Highway Herons Creek	DP 608795 Lot 2	10.1	0.33
123	5376 Pacific Highway Herons Creek	DP 571398 Lot 1	3.4	0.60
124	5377 Pacific Highway Herons Creek	DP 608795 Lot 1	5.9	0.23
125	DIPNR, Cluleys Road Herons Creek	DP 1024922 Lot 7001	5.6	1.33
126	5403 Pacific Highway Herons Creek	DP 754405 Lot 286	6.1	
127	5409 Pacific Highway Herons Creek	DP 754405 Lot 269	0.2	
128	Pacific Highway Herons Creek	DP 754405 Lot 263	2.1	0.11
129	851 Pacific Highway Herons Creek	DP 883538 Lot 1	15.4	1.67
130	Pacific Highway Herons Creek	DP 611102 Lot 1	2.6	0.63
131	420 Pacific Highway Herons Creek	DP 619562 Lot 2	2.6	1.05
132	5494 Pacific Highway Herons Creek	DP 754444 Lot 7	15.9	
133	Pacific Highway Herons Creek	DP 754403 Lot 47	1.2	
134	DIPNR, Pacific Highway Herons Creek	DP 48119 Lot 58	0.3	
135	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 26	0.1	0.04
136	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 26	0.8	0.27
137	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 33	0.6	0.06
138	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 41	0.2	0.11
139	Bunyah Local Aboriginal Land Council, Pacific Highway Herons Creek	DP 48119 Lot 57	2.8	
140	NSW Dept of Ed. & Training, Herons Creek	DP 754403 Lot 36	0.7	
141	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 54	0.7	0.37
142	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 55	0.1	0.05
143	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 52	0.4	
144	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 51	1.7	0.03
145	Burrawan State Forest	-	-	0.02
146	Bunyah Local Aboriginal Land Council, Pacific Highway Herons Creek	DP 47928 Lot 56	9.3	0.43
147	Burrawan State Forest	-	-	
Sub-total Herons Creek section				16.05
Total all sections				69.92

6.18.2 Land acquisition process

Land required for the Proposal would be acquired in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*. The RTA acquires property required for road works in accordance with its Land Acquisition Policy, a copy of which is included in Appendix B of this EIS. This policy sets out the procedures for acquisition and the conditions that apply to acquisition, compulsory acquisition and hardship acquisition.

6.19 Guidelines for detailed design

6.19.1 General guidelines

The concept design on which this EIS is based is an initial functional layout developed as part of the design development process. It addresses and responds to all constraints and principles identified and established as part of this study. The concept design is intended to define a robust and buildable concept that provides:

- a definition of property acquisition requirements sufficient to allow acquisition to proceed
- a clear description of the design principles, extent of impacts and impact mitigation requirements
- a sound and clear basis for the later development of detailed designs to the standard required to support the construction contract.

Detailed design would be undertaken only if the proposal is approved and would take into account environmental constraints and mitigation measures identified in this EIS. Matters raised in representations would be considered and could result in adjustments to the design as a condition of the proposal proceeding. In addition, alternative approaches derived from the greater knowledge of detailed design or the passage of time may be suggested in relation to elements of the concept design. Consequently, it is possible that the detailed design may vary from the concept design description provided in this chapter.

6.19.2 Key issues for detailed design

The objective of these guidelines for detailed design is to ensure that the design development process that follows project approval adequately incorporates the key principles established during the study and inherent in the concept design.

The development of detailed design would be required to:

- be consistent with the design criteria and design principles on which the concept design was based as described in the EIS and any subsequent Representations Report
- address any unresolved issues associated with the development of the concept design as proposed in the EIS and any subsequent Representations Report
- meet any Conditions of Approval arising from the EIS approval process, unless changes to the Conditions of Approval are subsequently agreed
- incorporate community and Government agency requirements by the implementation of a consultation plan aimed at identifying and resolving issues of concern to Agencies, the community and other groups
- avoid identified environmentally sensitive areas and significant species wherever possible
- develop and refine mitigation measures

- appropriately develop and incorporate the urban design strategy and landscape concept developed in Working Paper No. 9 into the detailed design
- establish detailed proposals for construction delivery method and construction staging addressing buildability, traffic capacity and safety during construction, geotechnical issues, all relevant RTA specifications and design requirements, current guidelines, and policies and practicality/cost effectiveness
- incorporate the construction concepts and environmental management requirements presented in this EIS and any subsequent Representations Report
- address risk management during construction and operation
- provide a level of definition sufficient to support a construction contract that will meet all RTA's requirements for the completed highway upgrade
- ensure that the detailed design allows for safe and cost effective maintenance of Proposal during operation in accordance with Occupational Health and Safety requirements and relevant RTA specifications.