7. Evaluation of the concept design

The proposed concept design detailed in section 6.4, has been the subject of a preliminary evaluation against the PHUP and project objectives and assessment criteria as well as the issues and constraints identified in this report. The key issues and overall results of the evaluation are discussed below.

7.1 Key issues

The evaluation has revealed a number of key issues arising from the proposed route concept design. These issues, which are discussed in detail in the relevant sections below, are:

- Crash rate target;
- Fauna habitat fragmentation and loss of key habitat;
- Impacts on threatened flora species during construction;
- Flood immunity;
- Disturbance of high risk potential acid sulphate soil during construction;
- Impacts on the New Italy Museum Complex and its cultural heritage significance;
- Impacts on and acquisition of private property; and
- Lower economic performance in terms of relative costs and benefits.

These, and other issues, will be fully documented and comprehensively assessed during the EIA phase, based on the refined concept design for the route. During this phase appropriate mitigation measures and ameliorative strategies will be developed to minimise potential impacts.

7.2 Assessment criteria

Assessment criteria for the option development process have been developed for the project objectives detailed in **section 4.1.3**. The assessment criteria, listed in **Table 7.1**, have been used to assess the relative performance of the preferred option and to assist in justifying the selection of the proposed concept design.

7.2.1 Evaluation against the objectives and assessment criteria

The proposed concept design has been evaluated against the PHUP and Project objectives detailed in **Chapter 4**, using the assessment criteria detailed in **Table 7.1**. The objectives and assessment criteria were considered throughout the route development process in order to ensure that the proposed concept design satisfies the requirements of the overall Pacific Highway upgrade program, and the project-specific objectives developed in consultation with the local community and government agencies.

Table 7.1 Evaluation of the proposed concept design against the objectives and assessment criteria

PHUP objectives	**Assessment criteria – a*chieved in proposed concept design (Y/N)***	**Y/N**
Significantly reduce road crashes and serious injuries	**Improvement in road safety**	
	▪ Comply with design and engineering safety standards.	**Y**
	▪ Retain existing rest areas.	**N/A***
	▪ Optimise number of direct access points onto highway.	**Y**
	▪ Optimise number of at-grade intersections.	**Y**
	▪ Provide emergency stopping bays.	**Y**
	Design to bypass sections of road with poor existing horizontal alignment	
	▪ Replace existing sections of sub-standard highway with new road that meets current RTA design standards.	**Y**
	Design to make allowance for future upgrade to Class M	
	▪ Identify locations for potential future interchanges, service roads, etc.	**Y**

* *Existing rest areas will be replaced with new high-standard rest areas catering for all road users, with one rest area for each direction of travel*

Cont.

PHUP objectives	**Assessment criteria – a*chieved in proposed concept design (Y/N)***	**Y/N**
	Identify property acquisition requirements for Class M corridor, including service roads	
	▪ Total Class M corridor requirements identified.	**Y**
	Provision of rest areas and truck parking bays at intervals as required by RTA design guidelines	
	▪ Retain or relocate existing rest areas and truck parking bays – in accordance RTA design guidelines.	**Y**
Reduce travel times and delay	**Minimise length of upgraded highway and travel times**	
	▪ Minimise route option length.	**Y**
	▪ Minimise travel time.	**Y**
	▪ Minimise vehicle operating costs.	**Y**
	Improve the reliability of travel times on the highway	
	▪ Achieve appropriate Level of Service.	**Y**
	▪ Ensure capacity to accommodate seasonal traffic variations.	**Y**
	Ensure upgrade is flood-proof for the 1:100 year flood	
	▪ Design for 1:100 year flood (subject to hydrology and hydraulics report).	**Y**
	Minimise disruption to traffic during construction	
	▪ Optimise length of highway under construction at one time.	**Y**
	▪ Maximise off-line construction where possible within corridor.	**Y**
	▪ Minimise cross-over points for new second carriageway.	**Y**
	▪ Utilise available RTA-owned 'controlled access road' land adjacent Devils Pulpit State Forest.	**Y**
	▪ Design to current RTA design standards within available RTA corridor/land assets.	**Y**
	Deliver travel benefits as soon as possible	
	▪ Ability to stage project works.	**Y**
	Optimise highway alignment and geometry	
	▪ Enable trucks and B-doubles to travel safely at maximum legal speed limit.	**Y**
Develop route that involves the community and considers their interest	**Achieve community acceptance of the selected route**	
	▪ Maintain community support for preferred option.	**Y**
	▪ Minimise severance across highway corridor.	**Y**
	▪ Minimise impacts on areas of cultural or archaeological significance.	**Y**
	▪ Minimise impact to native flora and fauna.	**Y**
	▪ Minimise businesses affected by potential acquisition.	**Y**
	▪ Minimise length of highway in visually sensitive (or medium-high visual quality) areas.	**Y**
	▪ Minimise number of properties that will experience noise that could require mitigation.	**Y**
	Improve/maintain existing traffic and access	
	▪ Improve local traffic circulation, safety, separation from highway traffic.	**Y**
	▪ Improve vehicle, cyclist and pedestrian facilities.	**Y**
	▪ Maintain/improve availability of safe access across the highway corridor for all residents.	**Y**
	▪ Direct access points and intersections onto the highway will be formalised to Class A standard.	**Y**
	▪ Traffic surveys and forecasts for future performance at key intersections indicate that the performance of intersections would be good with the proposed upgrade.	**Y**

Cont.

PHUP objectives	**Assessment criteria – a*chieved in proposed concept design (Y/N)***	**Y/N**
	Minimise property impacts	
	▪ Retain private property access on and off the highway.	**Y**
	▪ Minimise property acquisition and displacement impacts.	**Y**
	▪ Minimise number of sensitive land uses that may be subject to construction dust and other air quality impacts.	**Y**
	▪ Minimise impacts of altered flood flows.	**Y**
A route that supports economic development	**Maintain access to and from the highway for businesses and producers**	
	▪ Minimise distance from local producers to nearest highway access or interchange.	**Y**
	▪ Optimise highway to meet RTA flood requirements.	**Y**
	▪ Maintain access to Bundjalung National Park.	**Y**
	Provide access to New Italy for north and south-bound traffic on highway	
	▪ Minimise direct property impacts.	**Y**
	▪ Retain Driver Reviver facility.	**Y**
	Minimise impacts on high quality agricultural land and existing agricultural enterprises and resources	
	▪ Minimise number of properties with greater than 10% of land acquired by the preferred option.	**Y**
	▪ Minimise number of agricultural enterprises that will experience reduction in primary production.	**Y**
	▪ Minimise length of route encroaching on State Forests.	**Y**
Manage the upgrading in accordance with ecologically sustainable development principles	**Conserve biological diversity and ecological integrity**	
	▪ Minimise impact on threatened species and habitats.	**Y**
	▪ Minimise impact on endangered ecological communities (EEC).	**Y**
	▪ Mitigate against risk identified for loss of, or disturbance to flora and fauna, including threatened species during construction and operation.	**Y**
	Eliminate the threat of serious or irreversible environmental damage	
	▪ Minimise the area of high and moderate conservation value land affected.	**Y**
	▪ Develop a comprehensive Environmental Management Plan (for the construction phase).	**Y**
	▪ Minimise use of energy and non-renewable resources.	**Y**
	▪ Maintain or improve water movement across the highway corridor.	**Y**
	▪ Minimise disturbance of potential acid sulphate soils.	**Y**
	▪ Minimise potential for elevated total suspended solids levels in watercourses from construction.	**Y**
	▪ Minimise the risk of water quality impacts in small creeks draining to sensitive SEPP 14 wetlands.	
	Eliminate encroachment or direct impact on National Parks and wildlife estate	**Y**
	▪ National Parks and wildlife estate lands preserved with no encroachment.	
	Improve air quality and reduce greenhouse emissions	
	▪ Minimise travel distance, travel time and delays.	**Y**
	▪ Ensure atmospheric carbon monoxide concentrations would be well below Department of Environment and Conservation criteria.	**Y**
Provide best value for money	**Design to make allowance for future upgrade to Class M**	
	▪ Locations identified for potential future interchanges, service roads.	**Y**
	▪ Total Class M corridor requirements identified.	**Y**
	Minimise impacts on existing utility infrastructure	
	▪ Minimise cost of public utility adjustments.	**Y**
	▪ Maximise use of existing road infrastructure.	**Y**

Cont.

PHUP objectives	**Assessment criteria – a*chieved in proposed concept design (Y/N)***	**Y/N**
	Maximise economic benefits to offset costs	
	▪ Minimise construction cost.	**Y**
	▪ Minimise operation cost.	**Y**
	▪ Deliver earlier economic benefits.	**Y**
	▪ Maximise benefit/cost ratio for the preferred option.	**Y**
	▪ Optimise benefit/cost ratio of construction staging options.	**Y**
	▪ Maximise compatibility of the preferred option with broader long term land use and development strategies.	**Y**

Source: Connell Wagner, 2006.

7.3 Evaluation against biophysical constraints

7.3.1 Topography geology and soils

Topography

There are no significant topographic issues in the development of the proposed concept design. The existing Pacific Highway traverses low hills, undulating rises, broad valleys and alluvial plains, none of which would be classified as 'steep'.

Geological, geotechnical and soils

Within the undulating rises and low hills, moderate cuts and fills would be required. This may have the advantage of producing more suitable construction materials and hence reduce the requirement for expensive imported materials.

Field mapping at the Cypress Road straight indicates that excavation into highly weathered bedrock would be required in cut areas. Excavation into the rock may be an issue and appropriate machinery/equipment would be required.

Whites Road realignment: Borehole investigation (BH2 and BH3) indicates that cut materials would comprise loose to medium sand underlain by very stiff to hard clay. Testing identified that potential acid sulphate soil is present in this area, therefore an Acid Sulphate Soils Management Plan is required for any excavation in this zone.

The main concerns across lowland areas will be deeper compressible alluvial soils associated with creek flood plains. Shallow water tables, low bearing capacity and potential acid sulphate soil sub-grades may present constructability issues. Shallow water tables may be encountered across the Tabbimoble floodways.

Structures

Piled foundations, bored or driven, are expected to be the most appropriate foundation type for structures on deep alluvial soils.

Piled foundations, bored or driven, or shallow pad footings are expected to be suitable foundation types on the higher ground and undulating lands.

Fill embankments

Fill batters where possible would need to be constructed from material excavated from cuttings in the higher sections along the route. Fill batters should be constructed no steeper than 1 vertical to 2 horizontal for stability purposes but where feasible should be flattened to 1 vertical to 3 horizontal for ease of maintenance. Batter slopes should be topsoiled and grassed to reduce the possibility of erosion.

Fill embankments across the Tabbimoble floodways and the Clarence River flood plain are not expected to create potential settlement problems, as most of the settlement is expected to occur within the construction period due to the drainage provided by the intermittent sand layers. The absence of such a drainage sand layer at the northern end (Richmond River flood plain, between Trustums Hill and Tuckombil canal) and the presence of soft clay at depth may create potential settlement problems. Detailed investigation in this area would be required to assess the amount of settlement.

Any soft ground should be over-excavated and replaced with suitable material. Alternately, geogrids/geotextiles may be required. If over-excavation of softer ground is not possible, a bridging layer (with or without geogrid/geotextile depending on conditions) should be provided over the softer ground.

In soft/poor sub-grade area, a minimum embankment height of 1.5 m to 2.0 m should be adopted to assist with providing a suitable bridging layer over the sub-grade. Over-excavation is not recommended in potential acid sulphate soil areas.

Cuttings

Many existing cuttings show signs of soil erosion and weak rock material. The steeper batter slopes show signs of instability. The erosion and instability is generally associated with residual soil to highly weathered rock materials exposed in cuttings, and variable weathering of the layers of material. As part of any upgrading works all batter slopes from ground surface should be reduced to 1 vertical : 2 horizontal. In addition, the batter slopes should be topsoiled and revegetated to minimise erosion. More detailed investigation and assessment of cuttings and batter slopes is required prior to adoption in the design.

Variable weathering and eroding of material can present excavation suitability problems as well as variable founding conditions for structures. The material is therefore expected to be suitable for reuse as general fill material with the possibility of selectively stockpiling some of the more competent rock, for reuse as select fill quality material.

Final design of cut batters will rely on future detailed geotechnical investigations, consideration of long term maintenance requirements (including a whole of life assessment) and an assessment of risks to both workers and motorists.

Slope stability

Fill embankments are expected to be constructed of silty clay with scattered gravels of siltstone and less weathered sandstone, which is typical of the material likely to be excavated from the cuttings. It is therefore recommended that for stability purposes, batters constructed of this material be no steeper than 1 vertical : 2 horizontal.

Sub-grade materials

Over-excavation of the sub-grade and replacement with suitable material or the use of geogrids/geotextiles may be required in some of the alluvial backswamp areas. If over-excavation of softer ground is not possible, a bridging layer (with or without geogrid/geotextile depending on conditions) should be provided over the softer ground. In soft or poor sub-grade areas, a minimum embankment height of 1.5 m to 2.0 m should be adopted to assist with providing a suitable bridging layer over the sub-grade.

Erosion hazard

The fine-grained soils covering approximately 90% of the study area are extremely susceptible to high sheet and gully erosion when cleared of vegetation. However, the even topography associated with the corridor means that water run-off will be more easily controlled, therefore limiting erosion. Adequate protection of both cut batters and fill embankments would be provided, using measures such as revegetation, provision of cut-off drains, and landscaping.

7.3.2 Hydrology and hydraulics

A detailed assessment of the proposed concept design in respect of hydrology and hydraulics cannot be provided until the current study has been completed. This is dependent upon completion of aerial laser scanning to enable completion of development of the hydraulic models. However, a primary purpose of the hydrology and hydraulics study is to assist in the highway design process through determination of likely flood levels and prediction of flood volumes. Predicting the likely flood levels and flow volumes is critical for setting pavement levels for flood immunity, sizing of structures (eg culverts, pipes etc.), determining the required volumes and suitability of fill material, and ensuring that earthworks do not create a potential flood hazard upstream or downstream of the highway.

Development of the proposed concept design to date has incorporated 'sensitivity analysis' in setting theoretical pavement levels and embankment heights at existing low points along the route, solely in order to assist in estimation of project costs arising from the importation of fill material. At two of the lowest points along the existing highway (Tabbimoble Floodways 2/3 and the floodway approximately 1 km north of New Italy), the proposed concept design has been costed (preliminary estimate) at the existing pavement level and 600 mm above the existing pavement low point. While this does not provide certainty in relation to flood levels, it has enabled some estimating of fill quantities and associated costs, and provides for comparative benchmarking against which future estimates can be tested.

7.3.3 Water quality

The results of the water quality sampling and testing described in **section 3.2.4** indicate that the most important risks associated with the subsequent route development and construction phases of the project include:

- The potential for disturbance of high risk acid sulphate soil in the vicinity of SW14 during the construction phase;
- The potential for disturbance of low risk acid sulphate soil in the proposed construction corridor adjacent to creek SW12, with the potential for resulting acidic impacts to the creek;
- The potential for elevated TSS levels caused by the off-site loss of suspended solids from construction activities to watercourses throughout the study area; and
- The risk of water quality impacts to small creeks draining to sensitive SEPP 14 wetlands (principally SW3-4 and SW6-9).

It is anticipated that monitoring during the Environmental Assessment phase of the project will be undertaken at all of the monitoring locations not sampled during the initial baseline investigation, to provide baseline water quality data on these sites. Ideally this monitoring should be undertaken during or immediately after a prolonged period of rain to ensure that sufficient water is available from which to obtain representative samples.

7.3.4 Ecology: threatened flora

The results of the ecology study showed that clearing of native vegetation (a 'Threatening Process' under the TSC Act) would be minimised under the project as proposed. In following the existing highway footprint as closely as possible, the proposed concept design will support a strategy of minimised native vegetation clearing, and protection of EECs. However, the proposal would still be likely to have a significant impact on threatened species.

The likely overall effect of the proposed concept design on threatened flora species, either recorded in the study area or considered likely to occur (by virtue of the existence of suitable habitat), is summarised in the following paragraphs.

Melaleuca irbyana (Small-leaved Paperbark)

A population of Melaleuca irbyana is already known to exist in the study area. It is considered that the proposed upgrade may result in the loss of a number of Melaleuca irbyana individuals. This has the potential to constitute a significant impact on the species in terms of its total distribution and population size. This potential impact would need to be fully assessed at the EIA stage including the possibility of providing appropriate control measures to minimise the impact to this population.

Lindsaea incisa (a Fern)

A population of Lindsaea incisa is already known to exist in the study area. It is considered that a loss of, or disturbance to, Lindsaea incisa plants in Mororo State Forest has the potential to have a significant impact on the species in terms of its distribution and population size. This potential impact would need to be fully assessed at the EIA stage including the possibility of providing appropriate control measures to minimise the impact to this population.

Cyperus aquatilis (a Sedge)

The population of Cyperus aquatilis in the study area appears to be part of a larger population extending north east into Tabbimoble Swamp Nature Reserve and Bundjalung National Park. It is considered that loss of, or disturbance to, Cyperus aquatilis plants in the study area has the potential to have a significant impact on the species in terms of its distribution and population size. This potential impact would need to be fully assessed at the EIA stage including the possibility of providing appropriate control measures to minimise the impact to this population.

Oberonia titania (an Orchid)

The single plant recorded at Nortons Road would not represent a viable population, however other plants may occur in the locality. It is considered that the loss of this specimen may have a significant impact on the species in terms of its distribution and population size. This potential impact would need to be fully assessed at the EIA stage including the possibility of providing appropriate control measures to minimise the impact to this population.

Prostanthera palustris (Swamp Mint Bush)

Although the stronghold of Prostanthera palustris is in Bundjalung National Park east of the study area, the loss of the population near Tabbimoble may have a significant impact on the species in terms of its total distribution and population size. This potential impact would need to be fully assessed at the EIA stage including the possibility of providing appropriate control measures to minimise the impact to this population.

Species likely to occur but not recorded

A detailed assessment has not been made of the likely impact of the proposed concept design on the additional 18 threatened flora species identified as likely to occur in the study area, but which were not recorded.

Established populations of particular species, if occurring within the area likely to be affected by road construction would be subject to detailed assessment during the EIA phase of the project.

Other identified species

The other threatened flora species identified during the field surveys are located outside the area that would be affected by the proposed upgrade.

7.3.5 Ecology - threatened fauna

Fragmentation of habitats

The results of the fauna study showed that diminished habitat continuity has the potential to disrupt movement and decrease the total amount of habitat available. A roadway can also have a similar effect by disrupting a wildlife linkage between two separate areas of bushland located in a cleared landscape.

Although the existing highway already bisects the habitats in the study area, the proposed concept design has the potential to further fragment areas of native vegetation.

Loss of tree hollow resource

Hollow bearing trees are a critical habitat feature for a number of threatened species, providing breeding and/or sheltering habitat. Hollow bearing trees are more common in older stands, gullies, vegetation that has not been logged and on flat terrain. Habitats with high productivity have also been noted to support a higher number of hollow bearing trees.

Loss of foraging resources

A number of threatened fauna species require winter flowering to supply food year-round, or to coincide with migratory movements. As such, the presence or absence of winter flowering species is considered a limiting factor for a number of threatened fauna.

Potential impacts on fauna

The results of the fauna study shown that the main potential ecological impacts associated with the proposed Pacific Highway upgrade include:

- Direct mortality of, or injury to, fauna during vegetation clearing;
- Loss of, or disturbance to, essential fauna habitat features, such as tree hollows, roost sites within culverts and under bridges, foraging habitat (particularly winter-flowering eucalypts);
- Increase in the barrier effect posed by the existing highway, as a barrier to movement and genetic dispersal and exchange;
- Increased fragmentation, removal, modification and isolation of habitats; and
- Subdivision and isolation of populations.

The likely specific impacts on individual species of fauna cannot be determined until a detailed impact assessment is undertaken. These assessments will be undertaken during the environmental impact assessment phase of the project.

However, based on the work completed to date, there are a number of fauna species considered likely to be at risk from the project including, but not limited to:

- Hollow-dependent fauna such as the Squirrel Glider, Brush-tailed Phascogale, Yellow-bellied Glider, Masked Owl, Powerful Owl, Brown Treecreeper and Glossy Black-cockatoo.
- Grey-crowned Babbler.
- North Coast Bioregion Emu population.
- Microchiropteran bats, including tree-roosting and cave-roosting species (the latter are likely to be roosting in drainage structures along the highway).
- Frogs, including Green Thighed Frog and barred frogs.

Fauna underpasses may be an option to mitigate against some of the impacts on terrestrial fauna. However, consideration also needs to be given to mitigating the impacts on arboreal fauna, particularly gliders. Squirrel Gliders have been recorded gliding up to 50 m, while Yellow-bellied Gliders are known to glide as much as 100 m.

Substantial clearing of land is likely to be required along the majority of the length of the road corridor. Some of the corridor is already cleared to a width that would be adequate to accommodate the proposed upgrade. However, the overall effect would be to create a road corridor that would be, on average, approximately 50 m wider than the existing road corridor, for the full length of the study area.

The presence of the existing Pacific Highway means that many if not all of the above impacts are likely to be already occurring. Widening the highway corridor is likely to increase the cumulative impact by removing an extensive area of habitat, and by increasing the barrier effect posed by the highway.

7.3.6 Ecology - mitigation and amelioration measures

Mitigation and amelioration measures may include, but not necessarily be limited to:

- The minimisation of vegetation clearance and disturbance, as far as practicable;
- Narrowing the road footprint (wherever possible, and subject to geotechnical and design constraints) to avoid significant habitat areas, such as concentrations of hollow-bearing trees and locations of threatened plant species;
- Incorporating fauna underpasses into the road design, and including dual purpose drainage structures that can act as 'default' fauna underpasses;
- Minimising construction phase disturbance of bat roost sites, such as culverts and bridges;
- Installation of directional/exclusion fauna fencing in appropriate locations;
- Landscaping and revegetation;
- Site rehabilitation;
- Traffic control and driver education (measures to reduce risk of road kill).

Specific details of the mitigation measures to be applied are not known at this stage but will be developed during the EIA stage of the project. Most of the measures listed above are typically employed in highway planning to reduce ecological impact.

Field surveys undertaken for the preliminary assessment were conducted during autumn and winter (March-July 2005). Further targeted summer surveys have recently been carried out (February – March 2006) to assess the occurrence of species for which the surveys undertaken to date were seasonally inappropriate. The summer surveys have targeted spring-summer flowering plant species that are undetectable outside their flowering period, as well as frogs and reptiles that are generally inactive during the cooler months. The findings from these surveys, which are yet to be documented, will enable the distribution and population of threatened flora species to be refined.

7.3.7 Climate and air quality

As discussed in **section 3.2.6**, air quality monitoring is not routinely carried out in sparsely populated rural areas and no specific air quality assessment has been carried out during the concept design development phase of the project. However, the results of studies carried out for the Woodburn to Ballina section of the Pacific Highway indicate that atmospheric carbon monoxide concentrations would be well below DEC criteria.

It can be assumed that total emissions from vehicles would increase as the volume of highway traffic increases. An assessment of the likely impacts of the predicted increase in traffic volumes on air quality will be made during the environmental assessment phase of the project.

7.4 Property and land use effects

7.4.1 Property effects

The potential impacts to private property have been assessed for this report based on a conservative estimate of the likely extent of the upgraded road reserve. At the time of preparing this report, the proposed concept design has been developed to a preliminary level, and will be subject to refinement. Therefore, the potential extent of property impact indicated in **Figures 7.1a** to **c** should be viewed as indicative.

Many of the parcels of land identified in **Figures 7.1a** to **c** may not be directly affected by the proposed alignment but would be close to the edge of the proposed highway formation (whether that be the road edge, a cutting or an embankment). All potentially affected property owners will be contacted in writing by the RTA as part of the concept design display and the potential impacts discussed in more detail.

One of the design aims of this project is to minimise property impact, and therefore the proposed concept design does not deviate significantly from the existing highway alignment through the majority of the study area. Where private property is affected, the impact would be acquisition of narrow strips of land along the highway frontage. The proposed highway upgrade would not result in any severance or isolation of private property. Any acquisition of agricultural land is likely to be minor and would not have a significant impact on the viability of individual agricultural holdings.

The only proposed notable deviation from the existing highway alignment is within a 3 km corridor east of the existing highway adjacent to Devils Pulpit State Forest. The land is owned by the RTA, having been purchased for the specific purpose of diverting the Pacific Highway around a short section of the existing highway where the alignment is not suitable for upgrading to dual carriageway. The proposed deviation would not require any further private property acquisition.

A total of 35 properties are potentially impacted by the preferred highway route, comprising 31 privately owned properties and small sections of Devils Pulpit, Tabbimoble and Doubleduke State Forests.

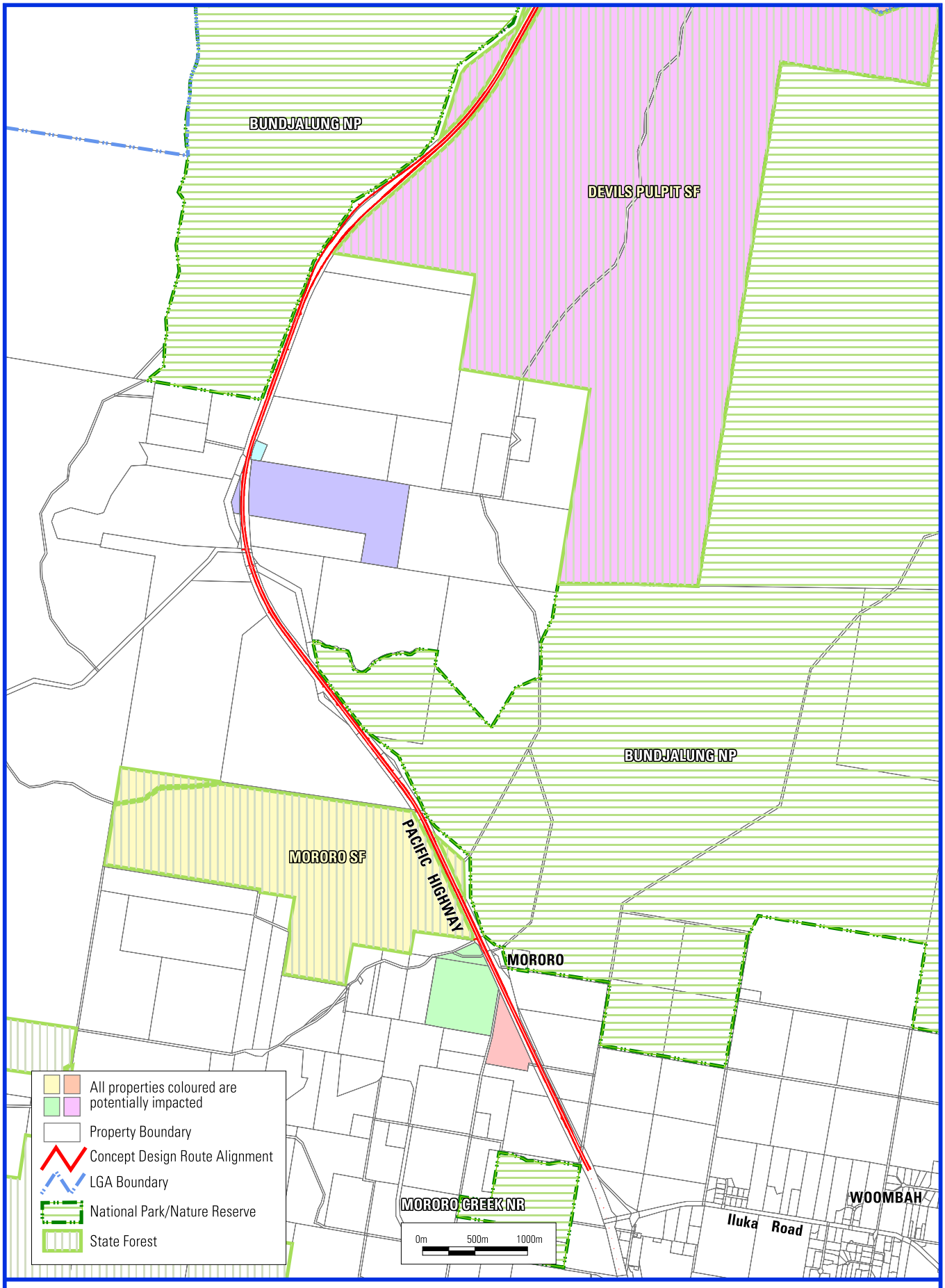
Property acquisition will not be finalised until the actual alignment and design for the proposed Pacific Highway upgrade are determined. Property acquisition for the project will then be negotiated between the RTA and affected private landowners, in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*.

Property accesses will be maintained at all times during and after construction either directly to the new highway, via side roads or by a service road.

State Forests

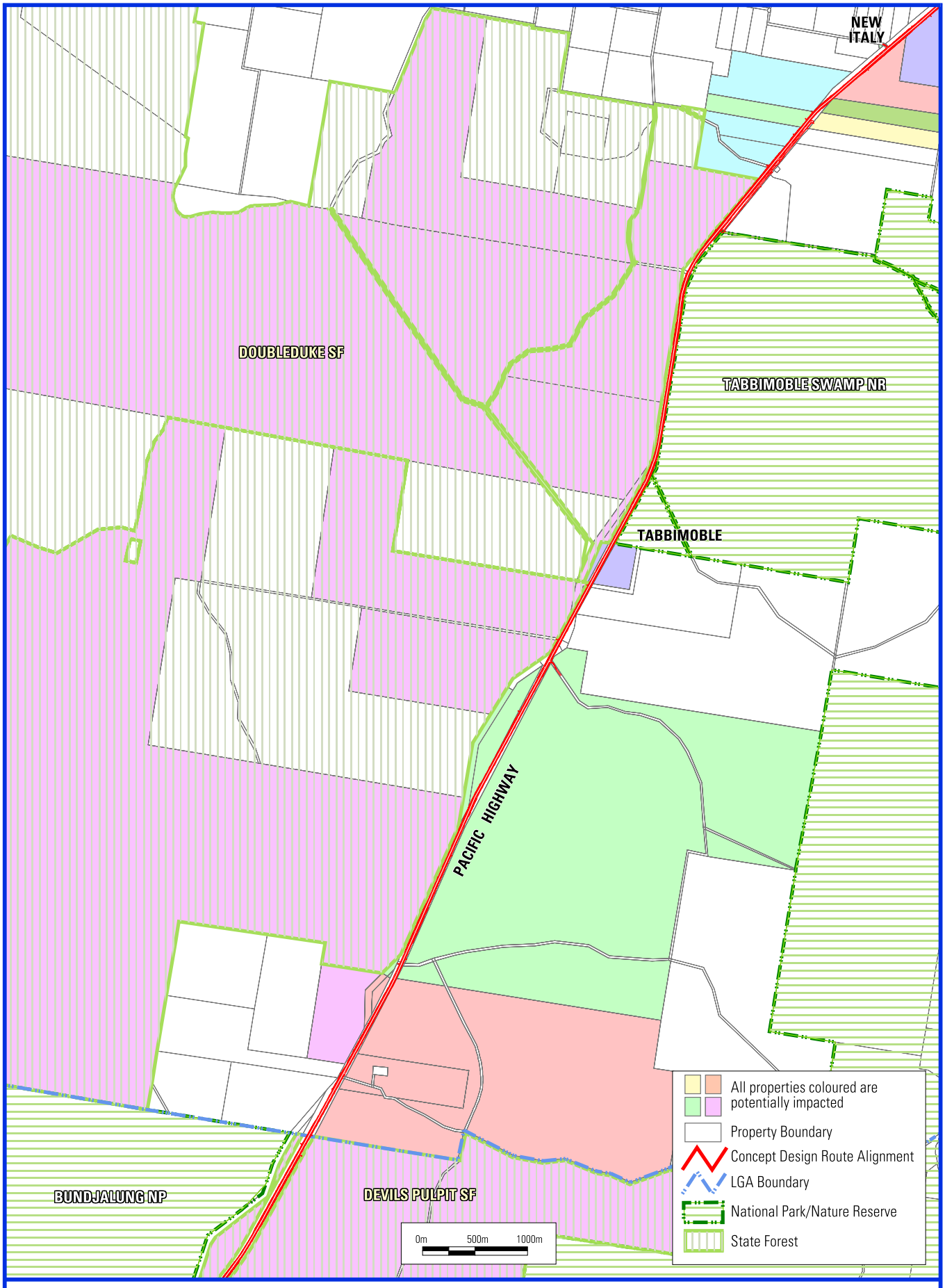
Where the proposed concept design requires the acquisition of land within State Forests, the acquisition process is partially governed by the Forest Management Zones (FMZ) applying to the affected parcel(s) of land. The DPI (NSW Forests) manages forests according to a zoning system which defines those areas to be used for log production, conservation, recreation, scenic protection and other categories as relevant. Land within FMZ 3(a) – Harvesting Exclusions is protected under the *Forestry Act 1916*, and a parcel of land within the 3(a) FMZ having an area greater than 20 hectares cannot be resumed without an Act of Parliament to amend the Forestry Act. Parcels having an area of less than 20 hectares may however be acquired through internal DPI administrative process, to revoke the State Forest dedication.

Some land within the 3(a) FMZ is likely to be affected by the proposed concept design. However, until detailed design progresses further to enable more accurate assessment of the area of affected land within each State Forest that is zoned 3(a), the procedure for acquisition of



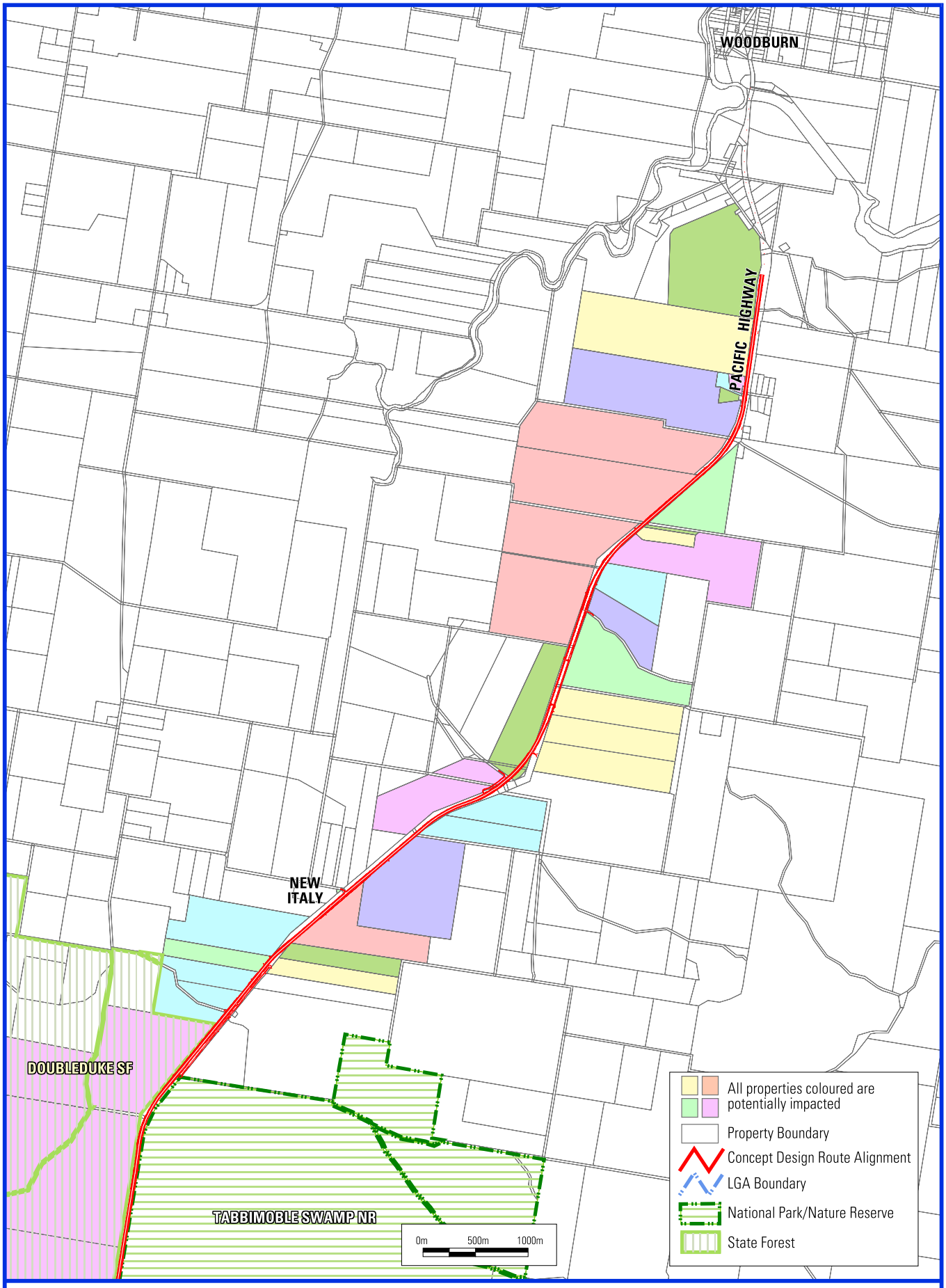
ILUKA ROAD TO WOODBURN
CONCEPT DESIGN REPORT

FIGURE 7.1a
POTENTIALLY IMPACTED PROPERTIES



ILUKA ROAD TO WOODBURN
CONCEPT DESIGN REPORT

FIGURE 7.1b
POTENTIALLY IMPACTED PROPERTIES



ILUKA ROAD TO WOODBURN
CONCEPT DESIGN REPORT

FIGURE 7.1c
POTENTIALLY IMPACTED PROPERTIES

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these lands can not be finalised. Discussions with DPI (NSW Forests) have commenced in this regard and will continue as the concept design is developed further.

7.4.2 Land use

An assessment of the extent to which acquisition affects the management and operation of land has been undertaken as part of the Iluka Road to Woodburn project. The assessment also examined the potential effect of the proposal on current and future land use.

The assessment concluded that the greatest impacts on land use would potentially occur at three rural residential areas between New Italy and The Gap Road, where existing curves in the highway are to be eased so as to meet the RTA's minimum design standards. Acquisition of strips of land would be required at these locations from the frontages of some residential properties.

The likely 'worst case' scenario in terms of impact on residential properties would be at Whites Road, where the road corridor boundary would be realigned along the arc of the curve, up to 100 m west of the existing road boundary. There are two large rural residential properties situated on the north and south sides of Whites Road, adjacent to the highway in this location, each of which would be subject to some acquisition of land under the proposed concept design. The property on the northern side of Whites Road would potentially require acquisition of a wedge-shaped strip of land approximately 700 m long, and up to 100 m wide, tapering to a point approximately 700 m north of Whites Road. Most of this land is currently heavily wooded.

Other rural residential properties would be affected in a similar manner, although for most, the width of the 'strip' would be considerably less than 100 m. Under the proposed concept design in its current form, no residences would be demolished. Some residences would be closer to the road than they are at present, and any impacts resulting from the new road alignment, such as increased road noise or visual impacts, would be fully assessed and mitigated during the impact assessment and detailed design phases of the project.

All affected landowners would be fairly compensated under the law as discussed above in **section 7.4.1**.

The potential impacts on agricultural properties would be minor. Most acquisition would be in the form of strip acquisition along the frontage to the existing highway. This would not generally affect the management of the properties. However access arrangements would need to be considered for the construction stage.

7.4.3 Fencing and access

The RTA would replace fencing where existing fences are affected. It would also provide both temporary and permanent access where this is impacted in consultation with the affected landholders. For most properties, access to the highway is by way of internal access roads, private driveways or minor local roads. The proposed concept design allows for left-in, left-out access to all private properties and local roads, with T-intersections at those local roads carrying higher volumes of local traffic. Provision for truck and trailer access would be considered in the design of intersections to take account the requirements for rural properties.

Liaison with Forests NSW has commenced, with a view to determining access requirements and providing for State Forests in highway design. Logging operations are infrequent, and while the duration of each logging operation can be measured in months, Forests NSW has indicated that it anticipates no disruption to its operations as a consequence of the proposed highway upgrade.

The ongoing commercial activities at New Italy can be protected by providing planned safe access and suitable parking.

Property access will be maintained at all times during and after construction either directly to the new highway, via a side road or a service road.

7.5 Recreation and tourism

As discussed in **section 3.4** of this report, the immediate study area is not in itself a significant destination for recreation or tourism. The Pacific Highway through the study area does however provide access to Bundjalung National Park, two nature reserves, and the coastal town of Iluka. Iluka is a recreation and tourism destination, while Bundjalung National Park contains a number of camping areas under the control of the NPWS. To the north, the coastal town of Evans Head is accessed via Woodburn.

The proposed concept design is not considered likely to result in any significant impact on these or any other north coast recreation and tourism facilities, other than to better facilitate travel to and from holiday and recreational destinations. Potential impacts on the New Italy Museum Complex are discussed below in **section 7.8**.

7.6 Public utilities

A number of utilities would be affected by the route, including a number of electricity pylons, street lights and telecommunication infrastructure.

Most of the services feeding the communities along the route are overhead and can be relocated relatively easily and with little disruption to residents. However the main Sydney to Brisbane fibre optic cable, owned by Telstra, straddles the route and may need to be relocated in places. Prior to construction, sections of the cable may need to be diverted to enable works to proceed without risk to communications services. There are no substantial impediments to diversion of sections of cable, and it is considered that this can be successfully achieved with little or no disruption to telecommunications users. Should any temporary disconnection of services be required during construction, this would be managed during periods of lowest network traffic, such as early in the morning.

The impact on utilities and services owned by Clarence Valley and Richmond Valley Councils is considered minor and would not pose any significant disruption to service users.

7.7 Indigenous heritage

The results of the Indigenous heritage field survey discussed in **section 3.8** indicate that the study area contains a low density of archaeological sites, probably indicative of resource gathering activities, but also reflecting that the study area has suffered an overall high level of disturbance due to construction of the existing highway, agricultural activity and timber harvesting in the adjoining forests.

Co-ordinators of all Local Aboriginal Land Councils were contacted prior to carrying out Indigenous heritage field surveys, and a representative of each Council provided field survey assistance as required. In order to determine whether any unidentified sites/places of particular significance or concern would be threatened by the proposed highway upgrade, consultation was undertaken with all Aboriginal group representatives involved in the survey, as well as with local Elder and Native Title claimant Lawrence Wilson. Lawrence Wilson was acknowledged by all groups as the only person known to them with detailed traditional knowledge of the study locality.

The survey focused on reasonably intact well-drained land beyond the highway reserve boundaries, however, 78% of the study area's length was walked and a further 8% has been included in past study areas. It is concluded that the study area is unlikely to contain any significant undetected Aboriginal sites, and that undetected evidence will most likely be restricted to a low level background distribution of stone artefacts, few of which will be in a primary depositional context. Local Indigenous representatives involved in the field surveys have indicated their support for the study's conclusions, and raised no objections to the project proceeding, provided that the burial site near The Gap Road, and the scarred tree near New Italy, are protected.

The scarred tree identified in **section 3.8** is a sufficient distance from the existing highway to ensure that it would not be affected by any of the works required for the proposed Pacific Highway upgrade.

7.8 European heritage

The study area includes two items listed on the NSW State Heritage Register, the New Italy settlement and Vineyard Haven.

Chapter 8 of the 2002 New Italy Settlement Conservation Management Plan (CMP) provides conservation management recommendations for the New Italy Museum Complex, as part of the New Italy Settlement site. Of particular relevance to this project are the management measures relating to the use of the site, and especially the use of the site for a driver reviver location, which brings travellers to the museum complex. Recommendation 2 of section 8.4 of the 2002 CMP identifies the driver reviver facility as a valuable tool for the promotion of the site and promotes the continued use of the site for this purpose.

The proposed concept design would increase the footprint of the highway such that the formation would come closer to the eastern boundary of the museum complex portion of the New Italy settlement. It is likely that the proposed concept design would have an impact on access arrangements for patrons to the museum complex and would require relocation of the existing parking facilities. It should be noted that the existing parking facilities are located within the Pacific Highway road reserve and are not part of the New Italy complex as noted on the heritage register.

The proposal would not directly affect any aspect of Vineyard Haven, which is located approximately 1.5 km to the west of the existing Pacific Highway alignment.

7.9 Visual amenity

It is anticipated that the visual impact would be relatively minor, given the rural nature of the environment, the topography, and the nature of the upgrade. A full visual amenity and impact assessment will be undertaken as a component of the EIA and during the detailed design stage. Visual amenity would be in the form of planting and earth bundings (where appropriate) sensitive to the surrounding environment.

7.10 Acoustic environment

7.10.1 Road traffic noise assessment goals

The noise goals appropriate to the project are located in the DEC publication Environmental Criteria for Road Traffic Noise and the RTA's Environmental Noise Management Manual. The goals are described below.

'Baseline' goals

For arterial road/freeway upgrades and re-developments, 'baseline' noise assessment goals of 60dB(A) daytime and 55dB(A) night-time are recommended. The goals are applicable at a distance of 1m from the most exposed external residential building facade at the road opening and 10 years after opening.

'Allowance' goal

Where the existing traffic noise exceeds the 'baseline' goals, the 'allowance' goal requires the proposed road upgrades/re-developments be designed so as not to increase the 'future existing levels' by more than 2dB(A). The 'future existing levels' are the noise levels resulting from 10-year traffic growth on the existing roads if there were no upgrades/re-developments.

'Acute' noise exposure

Where feasible and reasonable, consideration should be given to reduce the external traffic noise levels where the predicted future noise levels (10 years after road opening) exceed the 'acute' noise exposure levels of 65dB(A) daytime and 60dB(A) night-time.

7.10.2 Noise prediction

The noise predictions for this assessment are preliminary and for the purpose of developing conceptual noise control options. The noise predictions take account of projected traffic growth and changes to the road alignment. It was assumed that traffic speeds would be 110 km/h.

Detailed noise predictions will be undertaken when details of the vertical and horizontal road alignments, cuttings, embankments, etc are finalised.

There are approximately 75 residential dwellings located within 260 m of the existing and proposed upgraded road alignments (**Figure 3.12a** and **b**).

For the purpose of this assessment, a desktop study based on the calculation of road traffic noise (CORTN) modelling procedures was undertaken and shows that existing road traffic noise levels would:

– increase by 1dB(A) at the road opening (2016) due to traffic growth;
– increase by 2dB(A) 10 years after road opening, due to traffic growth;
– decrease by 1–4dB(A) at about 17 dwellings in 2016, due to the proposed road upgrade being further from the existing residents;
– increase by 1–3dB(A) at about 16 dwellings in 2016, due to the road being closer to existing residents.

7.10.3 Noise assessment

The predictions show that, for the majority of dwellings along the study route, the increase in future road traffic noise levels (ten years after opening) would be within 2dB(A) and satisfy the 'allowance' goals as outlined in **section 7.10.1**.

For a small number of dwellings along the study route, future road traffic noise (ten years after opening) could increase by up to 5dB(A) and noise mitigation would need to be considered in order to satisfy the 'allowance' assessment goal.

Where feasible and reasonable, consideration should be given to reducing the external traffic noise levels to the 'acute' noise exposure levels of 65dB(A) daytime and 60dB(A) night time (10 years after road opening). Results of the noise measurements and preliminary calculations have shown that approximately 50 properties are likely to experience higher than the acute noise levels.

7.10.4 Conceptual noise control options

Noise mitigation options that could be considered for the proposal include quieter road surfaces, acoustic barriers/mounds and treatment to individual dwellings. Final noise mitigation measures would be developed during the preparation of the environmental assessment, in consultation with landowners.

For the purpose of minimising truck pass-by noise levels, it is proposed that road design factors such as curvature and gradient (which contribute to the need for application of engine compression brakes, acceleration and deceleration), and pavement surface type, be taken into consideration at the road design stage.

Road construction works could cause localised noise and vibration impacts at exposed dwellings. These impacts would be minimised with the implementation of a Construction Noise and Vibration Management Plan.

7.11 Traffic

7.11.1 Traffic forecasts

An analysis of the future highway traffic volumes and associated future traffic and transport conditions has been undertaken for the following scenarios:

– Base case (do minimum) -
This scenario represents the existing highway and, in addition, includes all recent and proposed wire rope installations along the median of the highway from Ch75.4 km to Ch91.4 km (south of Tuckombil Canal).

– Proposal – Class A upgrade
This upgrade proposal represents the scenario with the highest volume of traffic that could potentially use the upgraded Pacific Highway. If the highway is upgraded at some time in the future to Class M or Motorway standard (with grade-separated intersections and a local service road), local traffic would be diverted to the parallel local service road, thereby reducing the overall highway traffic volume.

Forecasting method

Future traffic volumes were predicted based on historic traffic volumes and the annual growth in traffic between 1991 and 2001, using the linear growth method. It is assumed that this annual increase represents the underlying rate of traffic growth that occurred in the study area prior to the opening of the Pacific Highway upgrade between Yelgun and Chinderah.

It is also assumed that this historical rate of traffic growth will continue to occur in the future. Therefore, the historical growth rate has been applied to the 2005 AADT figures from Table 2.1, to predict traffic volumes in the future years of 2016 (theoretical opening year for the proposed upgrade) and 2036 (20 years after opening).

The higher rate of growth in the intervening period between 2001and 2005 represents the impact of the Yelgun to Chinderah upgrade on the volumes of traffic (and in particular heavy vehicles) using the Pacific Highway.

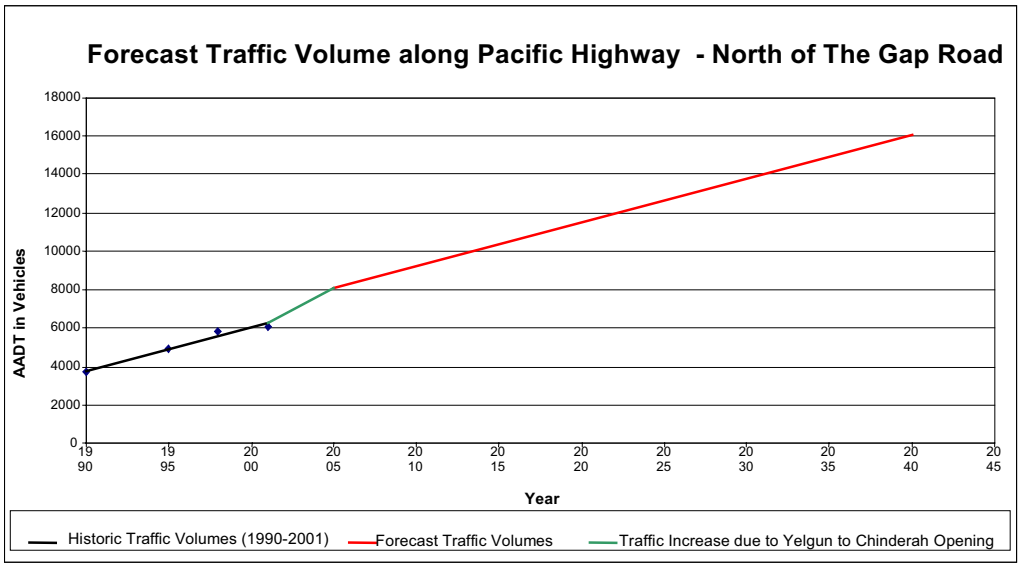
Lastly, it is assumed that no major land use developments are proposed within the study area during the analysis period. Therefore, no increase in local traffic is expected to occur.

Figure 7.2 illustrates the forecast traffic volumes as per the above method and assumptions. The forecasts are based on the AADT as calculated for the traffic counts taken north of The Gap Road, which represents the highest volumes.

As illustrated in **Figure 7.2**, the AADT volume along the highway is predicted to be 10,600 vehicle movements in 2016 during the opening year of the proposed duplication and associated improvements, and 15,190 vehicle movements in 2036 (20 years after opening). Of these total volumes, heavy vehicle movements make up approximately 2,060 per day in 2016 and 2,960 in 2036. Both the total and heavy vehicle traffic movements are therefore predicted to increase by approximately 88% in 2036 compared to existing traffic levels.

Based on the historical growth rates and the linear forecasts, these results indicate that, even for the increased traffic volume, the highway is likely to operate at an excellent LOS (LOS A) for the proposed Class A highway upgrade up to 2036.

Figure 7.2 Forecast traffic volumes along the Pacific Highway



Source: Connell Wagner, 2005.

7.11.2 Future performance at intersections

The proposed Class A upgrade would include at-grade 'Seagull' type T-intersections at a number of locations including two of the three existing intersections where traffic surveys were carried out (see **section 2.2**). An analysis of the future performance of the key intersections for the design hour (100th highest hour) has been undertaken for the base case (ie the 'do minimum' option as described in **section 4.1.2**). The analysis of future performance of the intersections at Jacky Bulbin Road and Swan Bay New Italy Road under a 'do minimum' scenario revealed the following results:

– In 2016, the performance of these key intersections under the base case is acceptable (LOS C or better); and
– In 2036, the performance remains acceptable (LOS C) for all intersections.

It is evident from the above that the performance of the existing intersections in the base case would deteriorate over time to a level at which sufficient gaps would potentially not be available for traffic to enter safely into the main traffic stream along the highway. This would occur in particular during the holiday periods (on which the analysis is based), but could also occur during the peak hour periods on a normal (average) day by 2036.

The provision of 'Seagull' intersections at Jacky Bulbin Road, Serendipity Road and Swan Bay New Italy Road for the proposed concept design would increase the intersection capacity and safety at these locations relative to the base case. Since the performance of the highway would be good (LOS A at 2036 for the concept design as discussed in **section 2.2.3**), sufficient breaks would be available for traffic to enter into the traffic stream travelling along the highway. Therefore, the future performance of these intersections is expected to be good with the proposed upgrade.

7.12 Socio-economic assessment

7.12.1 Road user benefits

Road user benefits for a road transport project are typically measured in terms of the reduction in road user costs that arise from building an option compared to the base case scenario of doing nothing (or doing only minimum improvements in the case of this project, in order to allow for necessary safety improvement works which are already programmed and which will occur whether or not any of the upgrade options proceed).

Travel cost parameters

Table 7.2 shows the travel cost parameters that have been used in the economic analysis to estimate vehicle operating, travel time and accident costs. Rural cost parameters have been used to estimate the travel costs for vehicles travelling along the highway, based on the economic parameters for 2003 within the Economic Analysis Manual (RTA).

Table 7.2 Travel cost parameters

Item	Cost
Vehicle Operating Costs per vehicle km • Base case (2 lane highway) • Proposal (dual carriageway)	 $0.38 $0.33
Value of time per hour	$27.59
Accident cost per crash	$139,000

Source: Connell Wagner, 2005.

Construction costs

The estimated cost of construction for the proposed concept design is $236 million.

Maintenance costs

An allowance for future routine and periodic maintenance has been made in the analysis based on a typical maintenance schedule and associated unit costs for a concrete pavement surface specified in the *Economic Analysis Manual* (RTA). The maintenance schedule and unit costs used are summarised in **Table 7.3**.

Table 7.3 Maintenance schedule and unit costs

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

Source: Connell Wagner, 2005.

The salvage value of the pavement beyond the 30 year period from opening is assumed to be zero.

7.12.2 Business impacts

The New Italy Museum Complex is the only site on the Pacific Highway between Iluka Road and Woodburn relying solely on the highway for its income. The facility relies on attracting passing motorists, and potential changes to its accessibility to or from the highway may influence the decisions of motorists as to whether they choose to stop at New Italy.

The physical impacts of the proposed concept design on New Italy will be better defined at detailed concept engineering design stage, after a preferred route has been decided. As a general statement, the ongoing viability of the New Italy Museum Complex is considered an important objective for this project, given the local historical and cultural significance of the centre. The ongoing design of the project will take these considerations into account.

7.13 Summary and conclusions

The proposed concept design has been subjected to a preliminary evaluation in respect of all of the issues so far identified as being relevant to the project. There are eight issues which could be described as key items in terms of potential negative or harmful impacts, or where the proposed concept design does not achieve the stated objectives. These are:

- Crash rate objective as outlined by the RTA;
- Fauna habitat fragmentation and loss of key habitat;
- Impacts on threatened flora species;
- Flooding;
- Disturbance of high risk potential acid sulphate soil during construction;
- Impacts on the New Italy Museum Complex and its cultural heritage significance;
- Impacts on and acquisition of private property; and

In summary, the overall performance of the proposed concept design can be assessed as follows:

7.13.1 Biophysical issues

– While soils and geotechnical conditions are not ideal for major highway construction, based on the studies undertaken to date the existing ground conditions do not pose any major constraints to the development of the proposed concept design. Potential acid sulphate soils would have to be managed in accordance with an approved Acid Sulphate Soil Management Plan.
– Hydrological and hydraulic modelling are not yet complete. However, there are recognised flood-prone locations that require bridging to meet the RTA's prescribed design standards.
– Sourcing of imported fill materials may be an issue for embankment construction, given that there is likely to be a material deficit, and there are a number of Pacific Highway projects in development concurrently, many of which will also be in deficit.
– Further information about local flooding behaviour will greatly assist in progressing the design of a preferred option.
– Existing water quality in the creeks and rivers is fair to poor. The proposed highway upgrade could affect water quality, particularly during construction.
– The proposal has the potential for impacts on threatened flora and fauna, as the study area displays high species diversity and a number of threatened plant and animal species. The main potential ecological impacts include habitat fragmentation, increased barrier effects through corridor widening, subdivision and isolation of populations.
– Results of air quality studies carried out for other Pacific Highway upgrade projects indicate that atmospheric carbon monoxide concentrations would be well below DEC criteria. Further assessment will be undertaken during the environmental assessment phase of the project but are expected to be within allowable limits

7.13.2 Land use and property effects

– The proposed concept design is considered to have a minor potential impact on land use except for three rural residential areas between New Italy and The Gap Road, where strip acquisition would bring the road corridor edge closer to some houses. The potential impacts on agricultural properties are minimal. Forests NSW has indicated that there would not be any likely disruption to its operations as a consequence of the proposed highway upgrade.
– The proposed route does not deviate significantly from the existing highway alignment and therefore the potential property impacts are minimal. There are 35 parcels of private property where narrow strips of land along the highway frontage would potentially be affected. The proposed highway would not result in any severance or isolation of private property.

7.13.3 Recreation and tourism

– There is likely to be minimal negative impact on recreation and tourism as a result of the proposal as there are few facilities along this section of the highway.

7.13.4 Public utilities

– Public utilities along the route would be relocated relatively easy and with little disruption to residents.

7.13.5 Indigenous heritage

– The study area contains a low density of archaeological sites and it is most likely that any undetected evidence will be a low-level background distribution of stone artefacts. A scarred tree identified near New Italy would not be affected by the proposed highway upgrade.

7.13.6 European heritage

– The proposed highway upgrade would come closer to the New Italy Museum Complex, and the existing car parking facilities would require relocation. The Museum Complex and surrounding area is covered by the 2002 New Italy Settlement CMP. Recommendations have been provided by the CMP for the highway upgrade project and cover car parking, signage, the Driver Reviver and a thorough assessment of the potential heritage impacts on the Museum Complex.

7.13.7 Visual amenity

– Opportunities have been identified for enhancement of the visual amenity of the study area. Enhancements include those to the natural environment through revegetation and landscaping, improvements to facilities and incorporating visual treatments into the design of the highway.

7.13.8 Acoustic environment

– A preliminary noise assessment has been undertaken as part of the project planning. Following highway construction, 16 dwellings would be 5 – 42m closer to the highway alignment. With the combined effects of traffic growth and reduced distance separation, the predicted road traffic noise levels at these 16 dwellings would increase by up to 4dB(A) in 2016 and 5dB(A) in 2026 and may require noise mitigation.
– Noise mitigation options would be developed in consultation with landowners and could include quieter road surfaces, acoustic barriers/mounds and treatment to individual dwellings.

7.13.9 Traffic

– The analysis of future highway traffic volumes and associated future traffic and transport conditions predicts the AADT volume along the highway to be 10,600 vehicle movements in 2016, and 15,190 vehicle movements in 2036 (20 years after opening). Of these total volumes, heavy vehicle movements make up approximately 2,060 (19.4%) per day in 2016 and 2,960 (19.5%) in 2036.
– 'Seagull' type T-intersections are proposed for the proposed Class A upgrade at a number of locations including the key intersections of Jacky Bulbin Road and Swan Bay New Italy Road. Traffic surveys and forecasts for future performance at these intersections indicates that the performance of the intersections would be good with the proposed upgrade.

7.13.10 Socio-economic assessment

The New Italy Museum Complex relies solely on passing motorists along the highway for its income and access to the Museum Complex would need to be maintained for survival of this business. A full assessment of the potential impacts on this business will be undertaken when the preferred route has been decided and during the Environmental Assessment phase of the project. The ongoing viability of the Museum Complex is an important objective of this project.