7. Evaluation of the preferred concept design

The proposed preferred concept design detailed in Section 6 has been the subject of evaluation against the Pacific Highway Upgrade Program 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

Key issues arising from the preferred concept design are as follows:

- Impacts on threatened flora species.
- Fauna habitat fragmentation and loss of key habitat.
- Impacts on items of heritage significance.
- Impacts on items of Aboriginal significance.
- Impacts on and acquisition of private property.
- Access arrangements.

Appropriate mitigation measures and management strategies would be developed during the environmental assessment, project approval and detail design phases to further address these issues. These issues are discussed further in Section 7.3.

7.2 Pacific Highway Upgrade Program Objectives

The proposed concept design has been evaluated against the Pacific Highway Upgrade Program and project objectives detailed in Chapter 4, as per below 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

Pacific Highway Upgrade Program Objectives	Assessment criteria – a*chieved in preferred 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
	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
** 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. Mororo Road Rest area may remain.*		

Pacific Highway Upgrade Program objectives	Assessment criteria – *achieved in preferred concept design (Y/N)*	Y/N
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 minimum 1:20 year flood and up to 1:100 if possible	
	▪ 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
A route that supports economic development	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
	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
* *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. Mororo Road Rest area may remain.*		

Pacific Highway Upgrade Program objectives	Assessment criteria – a*chieved in preferred concept design (Y/N)*	Y/N
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.	Y
	Eliminate encroachment or direct impact on National Parks and wildlife estate	
	▪ National Parks and wildlife estate lands preserved with no encroachment.	Y
	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
	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 this rock may require specialist machinery or equipment and treatment to exposed batters such as geotextile reinforcement.

Borehole investigation (BH2 and BH3) at Whites Road 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 floodplain 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 floodplain, 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. Alternatively, 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. Erosion and instability are 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 are 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.

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

The 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 (e.g. 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.

Design hydraulic modelling is being finalised at the time of writing this report. The following discussions describe design criteria and likely design measures to be applied once the highway design event immunity and vertical alignment has been set.

The following design criteria will be implemented into hydraulic modelling for design of the proposed alignment:

- Immunity of the Pacific Highway to design flood events. This will set the design vertical alignment for the highway.
- Afflux upstream of any raised sections of highway.
- Stability and scour protection for culvert structures.

Confirmation from the RTA regarding the design criteria has been sought.

Design measures

It is anticipated that the following design measures will be required for hydraulic design of the Pacific Highway proposed design alignment:

Table 7.2 Hydraulic design measures

Highway Immunity Scenario	Likely Hydraulic Design Measures
Immunity is acceptable	Extension of existing culverts Potentially some protection works for culvert inlet/outlets as required
Immunity not acceptable	Extension of existing culverts Additional culverts/bridges required to reduce afflux upstream of the highway Potentially some protection works for culvert inlet/outlets as required

7.3.3 Water quality

The water quality results 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 Tabbimoble Canal 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 total suspended solids levels caused by the off-site loss of suspended solids from construction activities to watercourses throughout the study area.
- The risk of water quality impacts to small creeks draining to sensitive SEPP 14 wetlands (principally Tabbimoble Overflow, Creek at the southbound rest area and Tabbimoble Floodway 1).

The risk will be further addressed during the environmental assessment, project approval and detailed design phase.

7.3.4 Ecology: threatened flora

A comprehensive flora study was undertaken for the Iluka Road to Woodburn project, refer to Section 3.5 and the Ecological Assessment, 2007 for further details. The TSC and EPBC Acts were consulted to determine if any threatened species occurred within the study area. 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.
- By 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.
- Notwithstanding, the proposal has the potential to have a significant impact on threatened flora 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 located within the study area, south of New Italy. The proposed upgrade may result in the loss of a number of *Melaleuca irbyana* individuals. This potential loss may in turn constitute a significant impact on the species in terms of its total distribution and population size.

A number of options have been investigated to minimise potential impacts on the *Melaleuca irbyana.* The initial concept design was likely to impact on 40% of the existing population. The preferred concept design been altered to reduce this impact to 30% of the population through adjustments to batter slopes and vertical alignments.

Translocation for the affected 30% of the population is being investigated. Because it is difficult to identify precisely the type of habitat required by *Melaleuca irbyana*, it is considered advantageous to translocate individuals to a site adjoining the present population, such as the cleared paddock area outlined in Figure 3.6. There are some *Melaleuca irbyana* individuals in this area, indicating that the population may have extended across the paddock originally.

Due to *Melaleuca irbyana's* suckering habit it is considered likely that this species can be transplanted with a high survival rate, given proper site preparation and post-planting care and maintenance. To provide habitat suitable for long-term population viability the following habitat restoration measures are likely:

- Remove exotic species.
- Re-establish suitable plant community structure.
- Re-establish species composition.

This land is currently in private ownership and consequently land acquisition or tenure options may need to be investigated.

The potential impact and measures to minimise the effect such as those outlined above would be further addressed during the environmental assessment, project approval and detail design phases of the project.

Lindsaea incisa (a Fern)

A population of *Lindsaea incisa* is located within the study area, in the Mororo State Forest. This species is located about 40m from the existing highway in swamp sclerophyll forest (protected ecological community). The duplication occurs to the east of the existing highway and therefore would not result in a direct impact on the species. It is considered that a loss of, or disturbance to, *Lindsaea incisa* plants in Mororo State Forest would have the potential to have a significant impact on the species in terms of its distribution and population size. This issue would be further considered during the environmental assessment, project approval and detail design phases of the project.

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. The distance from the proposed upgrade means that this species is unlikely to be directly impacted. However, any 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 and this issue would be further considered during the environmental assessment, project approval and detail design phases of the project.

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. The distance from the proposed upgrade means that this species is unlikely to be directly impacted. However, any loss of this specimen may have a significant impact on the species in terms of its distribution and population size. This issue would be further considered during the environmental assessment, project approval and detail design phases of the project.

Prostanthera palustris (Swamp Mint Bush)

The stronghold of *Prostanthera palustris* is in Bundjalung National Park east of the study area. The distance from the proposed upgrade means that this species is unlikely to be directly impacted. However, any loss of the population near Tabbimoble may have a significant impact on the species in terms of its total distribution and population size. This issue will be further considered during the environmental assessment, project approval and detail design phases of the project.

Maundia triglochinoides

Maundia occurs at three locations within the study area. Preliminary assessment indicates that the preferred alignment would not directly impact on the populations. There is however the potential for adverse effects on *Maundia* arising from changes in hydrology, water chemistry and exotic plant invasion, particularly during construction. Therefore, the potential impact and measures to minimise the effect would be further addressed during the environmental assessment, project approval and detail design phases of the project.

Species likely to occur but not recorded

The species that have been listed as likely to occur but not recorded during the field investigations (Table 3.5) would be subject to further investigation during the environmental assessment, project approval and detail design phases of the project.

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 environmental assessment, approval and detail design phases of the project.

Possible mitigation strategies are discussed in Section 7.3.6.

7.3.5 Ecology – threatened fauna

A comprehensive fauna study was undertaken for the Iluka Road to Woodburn project, refer to Section 3.5 and the Ecological Assessment, 2007 for further details. 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.
- Some impacts are likely to be minimised by construction adjacent to the existing highway, such as:
  - Impacts on hollow trees
  - Impact on foraging resources
- The roadway has the potential to disrupt wildlife linkage between two separate areas of bushland located in a cleared landscape.
- The proposed concept design has the potential to further fragment areas of native vegetation and habitat.

The likely effects of the proposal and potential mitigation measures are discussed below.

Potential impacts on fauna

The results of the fauna study shown that the main potential ecological impacts associated with the proposed Iluka Road to Woodburn upgrade on fauna 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).
- Loss of or changes to the hydrology and water quality of aquatic habitat.
- 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.
- Subdivision and isolation of populations.

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 due to the loss of tree-hollow habitat and a wider road corridor.
- Grey-crowned Babbler due to the loss of large contiguous habitat.
- North Coast Bioregion Emu population due to loss of habitat and a wider corridor increasing the potential for road kills.
- Microchiropteran bats, including tree-roosting and cave-roosting species (the latter are likely to be roosting in drainage structures along the highway) due to habitat removal.
- Frogs, including Green-thighed Frog, Wallum Froglet and other frogs not recorded in the targeted frog survey due to habitat removal and changes to the hydraulic regime.

Clearing of land is likely to be required along much of the length of the road corridor. However, some of the corridor is already cleared to a width that would be adequate to accommodate the proposed upgrade, eliminating the need for further clearing in these locations. Nonetheless, the

overall effect would be to create a road corridor that would be up to 50 m wider than the existing road corridor, for the full length of the study area.

It is important to note that the potential impacts of the Iluka Road to Woodburn are for the main part cumulative impacts, resulting from duplication of the highway along the existing alignment.

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 safety, geotechnical and other design requirements) to avoid significant habitat areas such as concentrations of hollow-bearing trees and locations of threatened plant species.
- Incorporating fauna underpasses and other fauna crossing provisions 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.
- Minimising sediment discharges and alterations to hydrological regime.
- Installation of directional/exclusion fauna fencing in appropriate locations.
- Landscaping and revegetation.
- Rehabilitation the site.
- Implementing traffic control and driver education (measures to reduce risk of road kill).

Fauna underpasses may be an option to mitigate 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.

Specific details of the mitigation measures to be applied are not known at this stage but would be developed during the environmental assessment, project approval and detail design stages of the project. Most of the measures listed above are typically employed in highway planning to reduce ecological impact.

7.3.7 Climate and air quality

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 other Pacific Highway projects indicate that atmospheric carbon monoxide concentrations are currently well below DECC criteria. This assumption is supported by previous studies carried out for PHPS's.

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. 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 k should be viewed as indicative.

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.

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 generally 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 already 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. A majority of the proposed deviation would not require any further private property acquisition.

Property acquisition requirements will not be finalised until the project has been subjected to the environmental assessment and planning approval stage. 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*. This typically takes place approximately 18 months prior to commencement of construction.

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. The area of land for each of the zones within the State Forests is outlined in Table 7.3.

Table 7.3 Forestry Management Zones

State Forest	FMZ Zone	AREA (m.sq.)	Area (ha)
Devils Pulpit SF	8	134	0.0134
Devils Pulpit SF	3B	28579	2.8579
Doubleduke SF	2	481	0.0481
Doubleduke SF	4	320	0.0320
Doubleduke SF	8	7772	0.7772
Doubleduke SF	3A	72825	7.2825
Doubleduke SF	3B	60682	6.0682
Mororo SF	8	4648	0.4648
Mororo SF	3A	30950	3.0950
Mororo SF	3B	12124	1.2125
Tabbimoble SF	8	841	0.0841
Tabbimoble SF	3A	4928	0.4928
Tabbimoble SF	3B	16508	1.6508

Source: Department of Primary Industries, 2005

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 ha cannot be resumed

without an Act of Parliament to amend the Forestry Act. Parcels having an area of less than 20 ha may however be acquired through internal DPI administrative process, to revoke the State Forest dedication. As can be seen in Table 7.3, the areas of 3(a) FMZ are considerably less than 20 ha with a maximum of 7.3 ha required from Doubleduke State Forest. The total 3(a) FMZ required for the Iluka Road to Woodburn project is 10.9 ha.

7.4.2 Land use

An assessment of the extent to which acquisition affects the management and operation of land was 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 area of land acquisition would be on residential properties 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. 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 by strip acquisition less than 100 m and typically 10 m to 20 m.
- Under the proposed concept design in its current form, no residences would be demolished although some residences would be up to 100 m closer to the road than they are at present.
- Most of the land fronting the highway, and which will directly impacted by highway upgrading, has a low agricultural land use capability and its current use is dominated by forestry or forest dominant reserves.

Overall, the potential impacts on agricultural (including cane farm) properties would be minor. The RTA would replace fencing where existing fences are affected. Most acquisitions 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.

7.5 Recreation and tourism

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 and two nature reserves which contain a number of camping areas under the control of the NPWS. To the south of the Pacific Highway provides access to Iluka and 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.

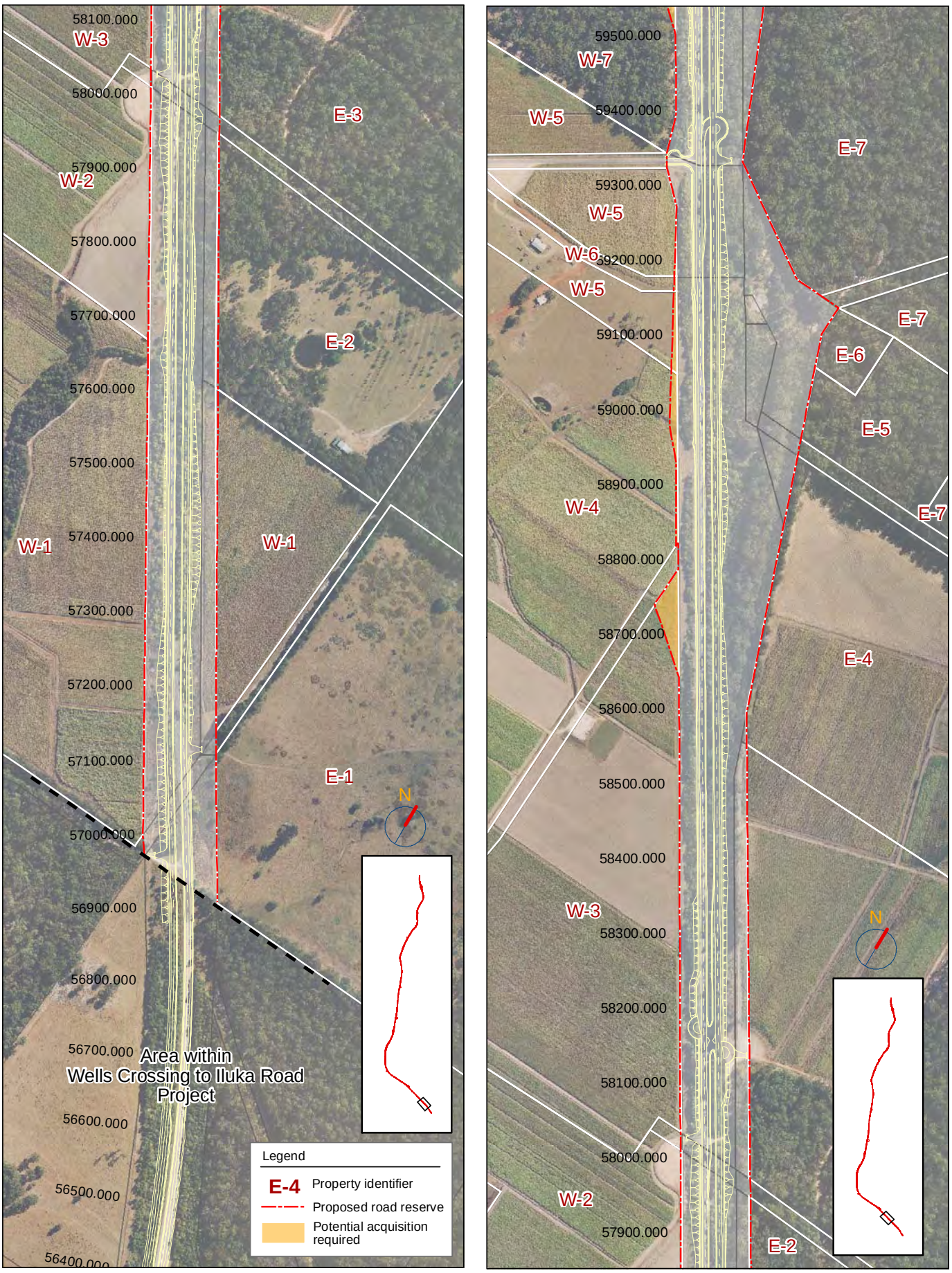

Figure 7.1a

Properties potentially affected by acquisition

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

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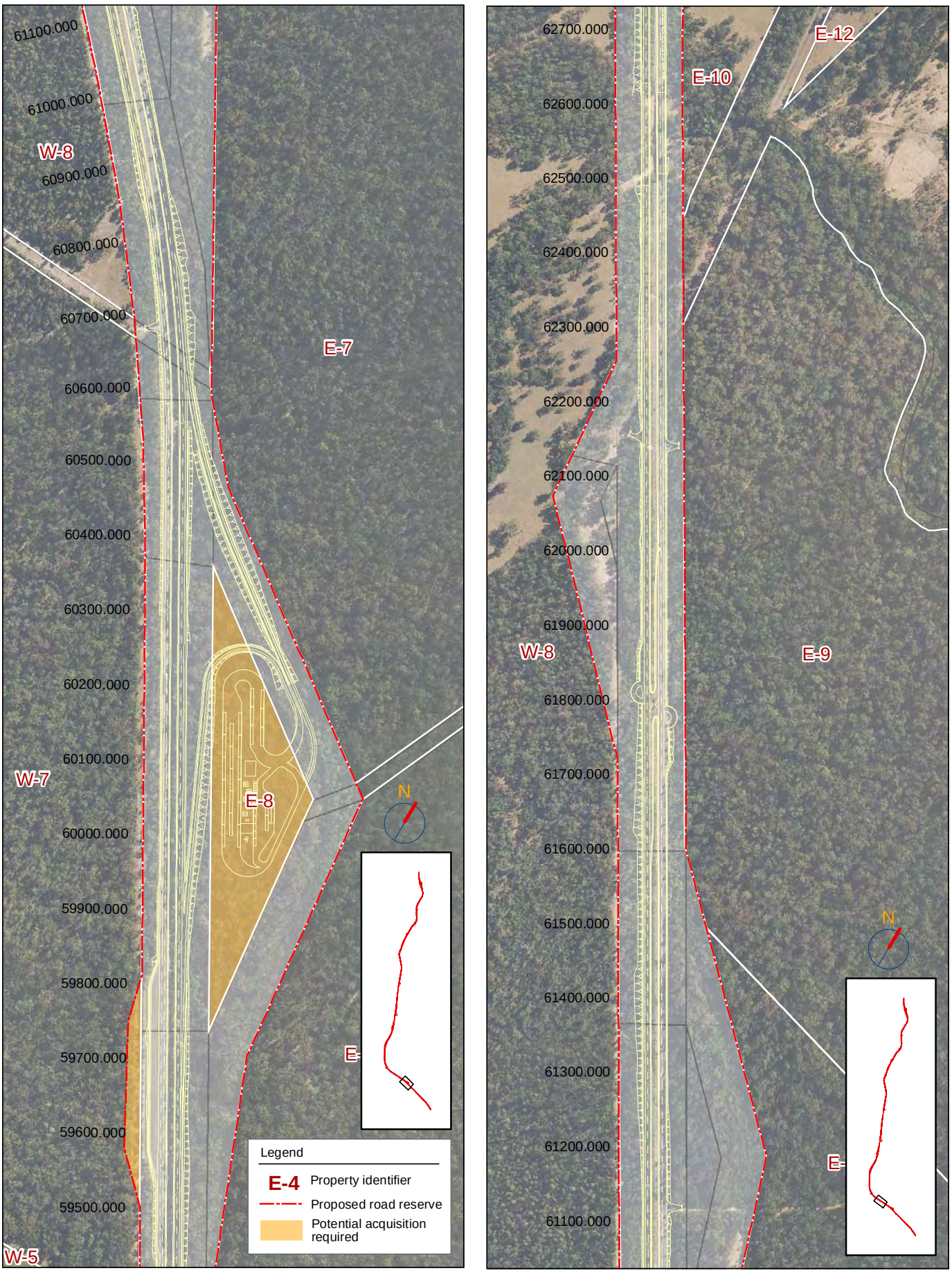

Figure 7.1b

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Properties potentially affected by acquisition

I2W\1235.17.GE\28-09-07\MAR\REV-3

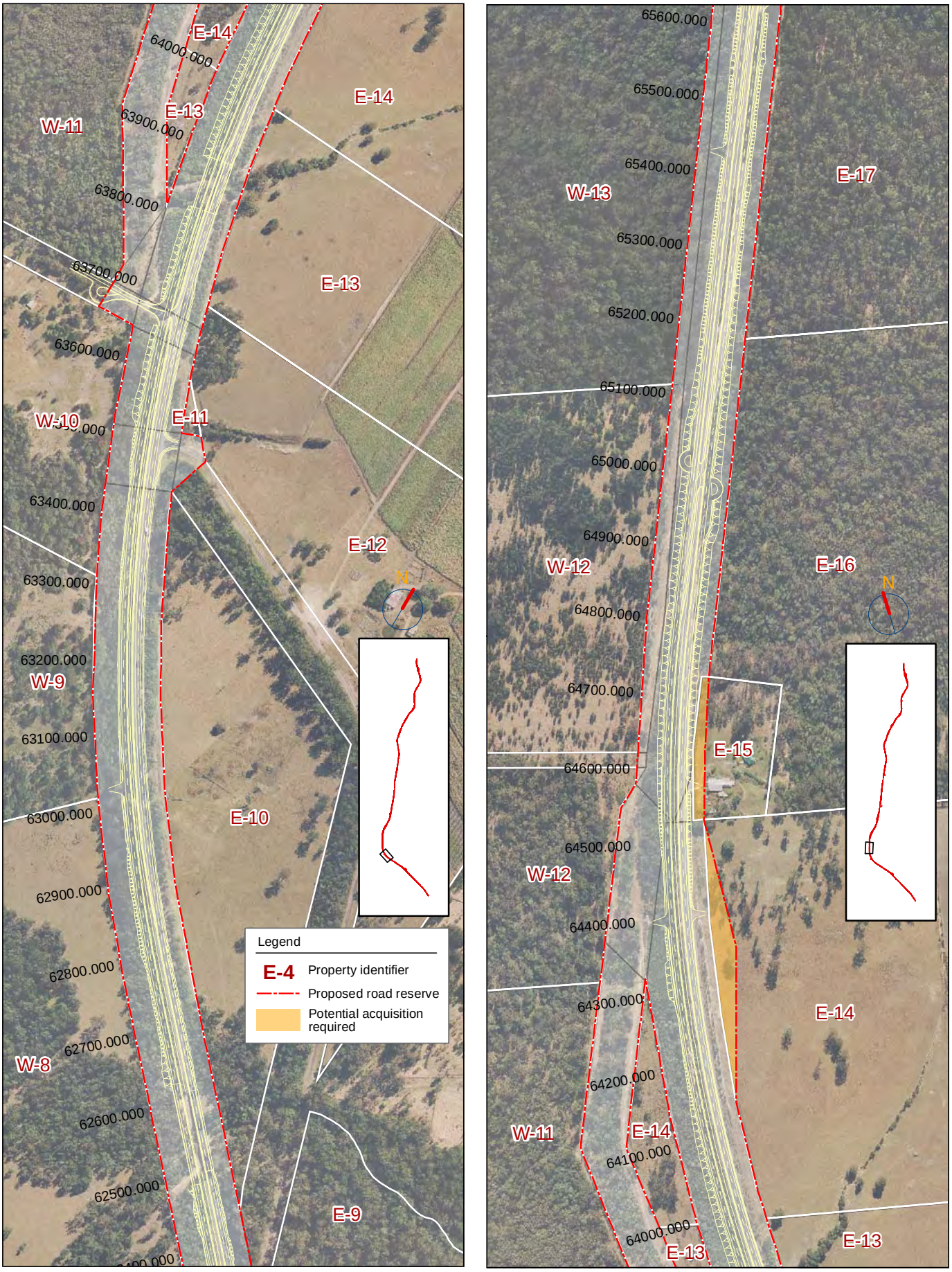

Figure 7.1c

Properties potentially affected by acquisition

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

I2W\1235.17.GE\28-09-07\MAR\REV-3

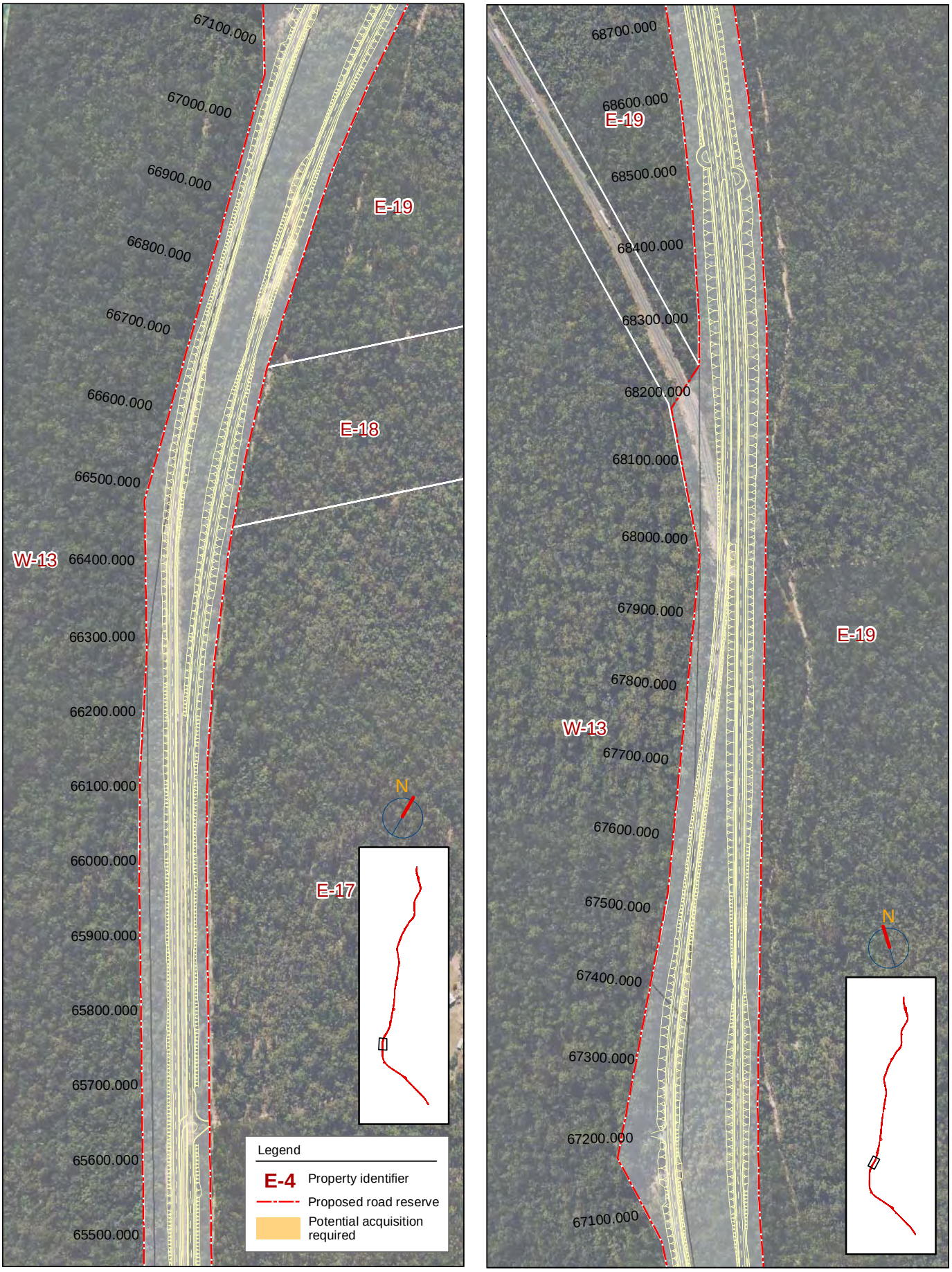

Figure 7.1d

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Properties potentially affected by acquisition

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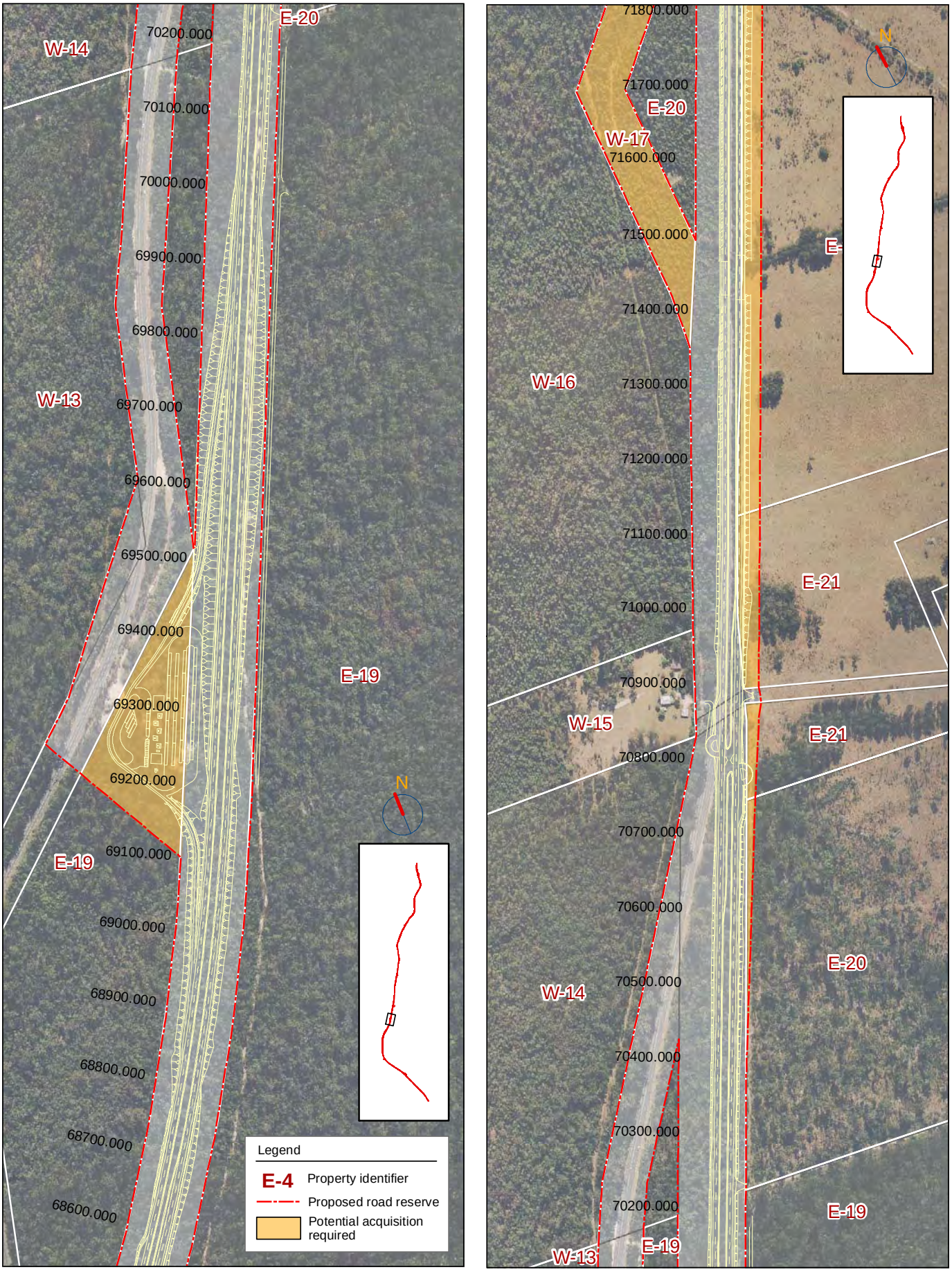


Figure 7.1e

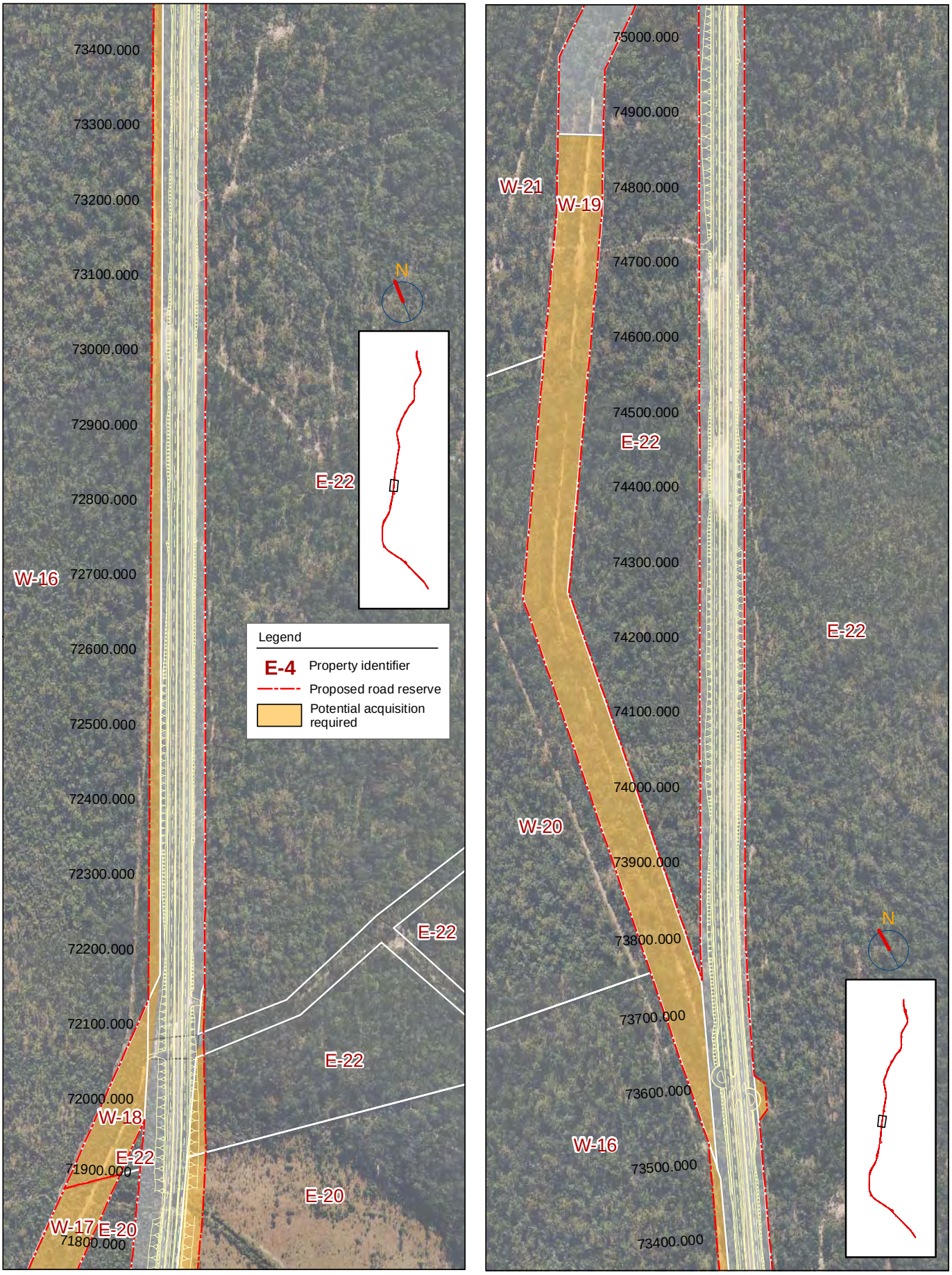
0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Properties potentially affected by acquisition

I2W\1235.17.GE\16-07-08\MAR\REV-4



0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Figure 7.1f

Properties potentially affected by acquisition

I2W\1235.17.GE\28-09-07\MAR\REV-3

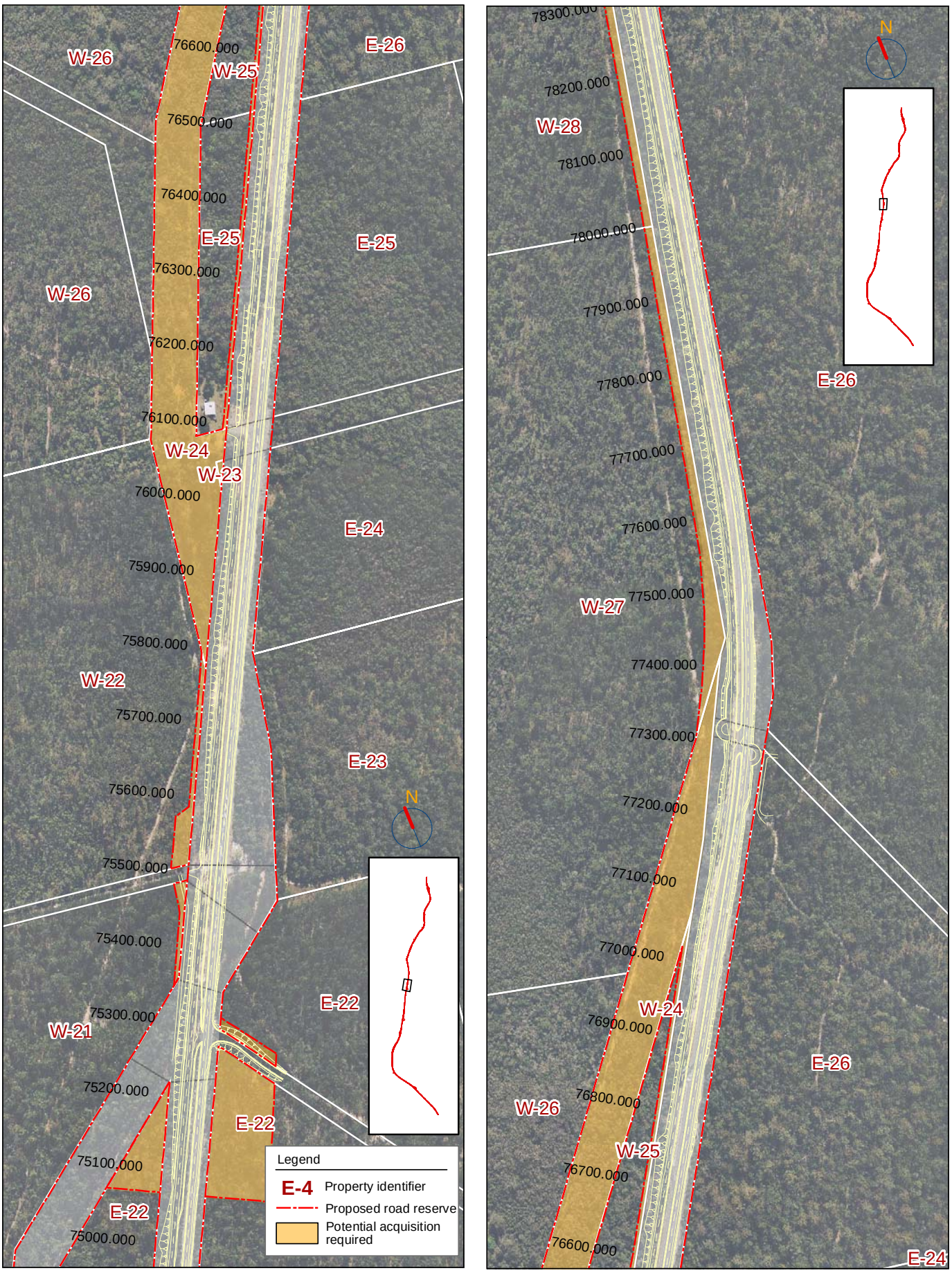


Figure 7.1g

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Properties potentially affected by acquisition

I2W\1235.17.GE\28-09-07\MAR\REV-3

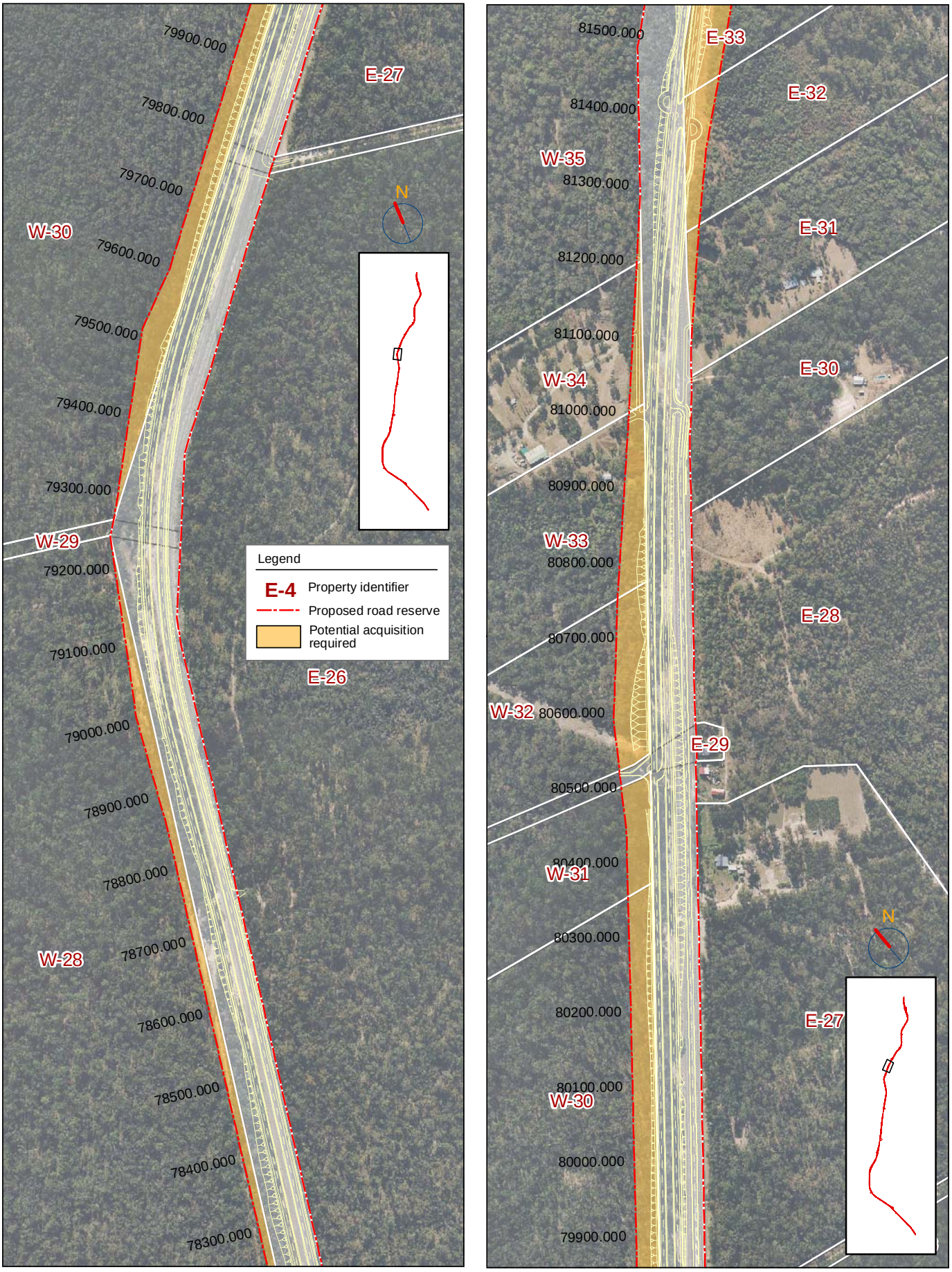


Figure 7.1h

Properties potentially affected by acquisition

0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

I2W\1235.17.GE\16-07-08\MAR\REV-4

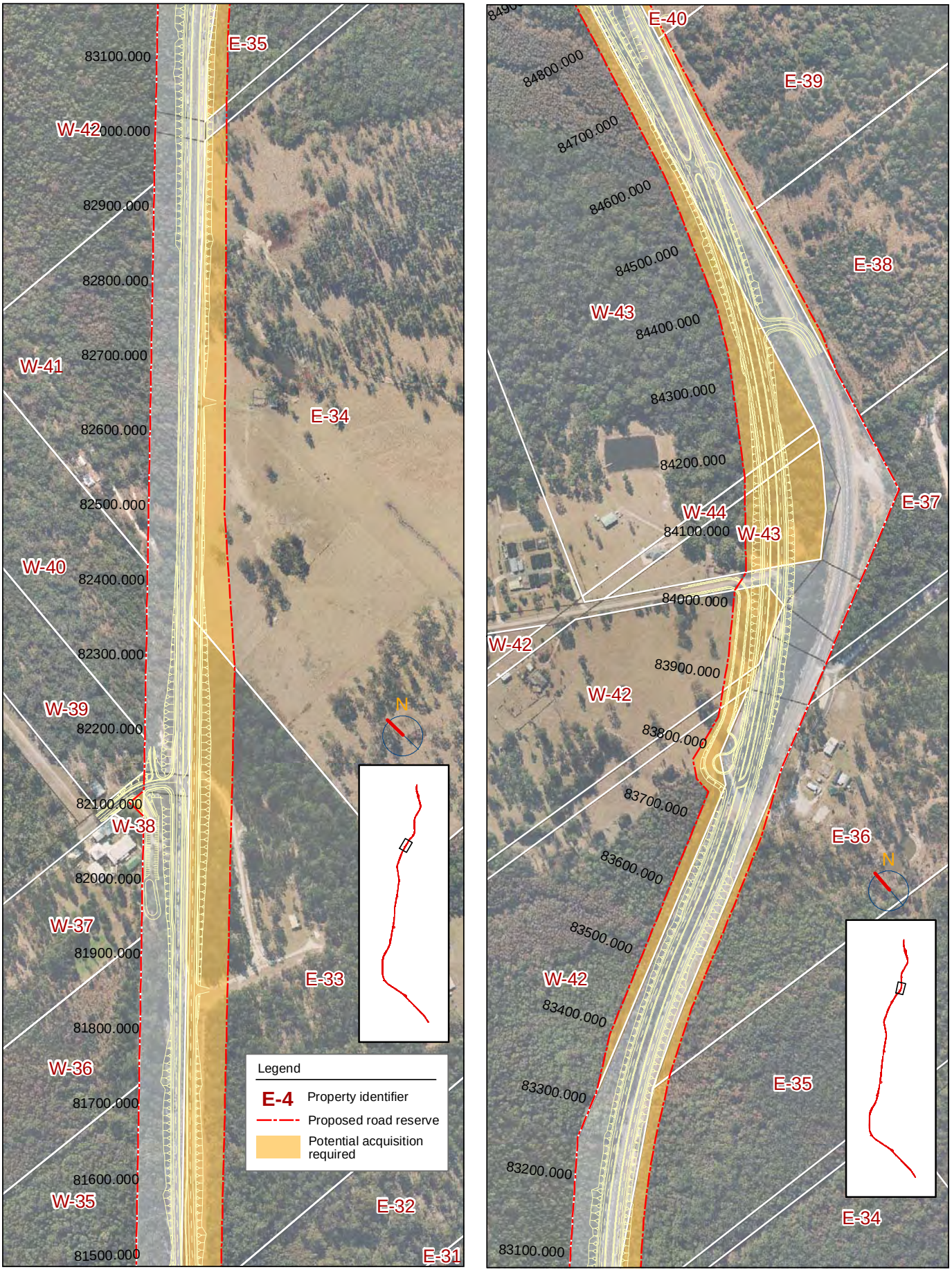


Figure 7.1i

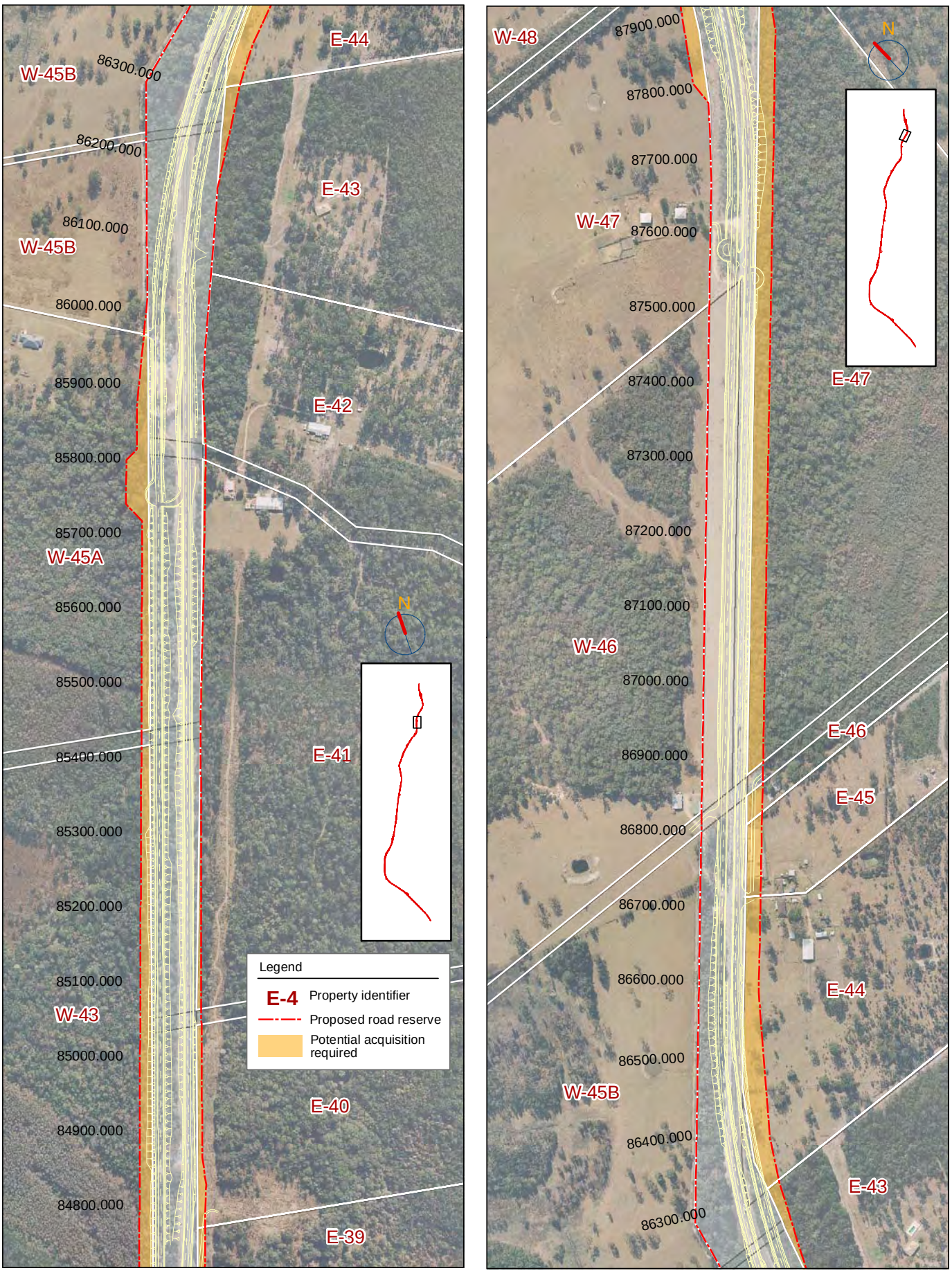
0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

Properties potentially affected by acquisition

I2W\1235.17.GE\28-09-07\MAR\REV-3



0 100m 200m

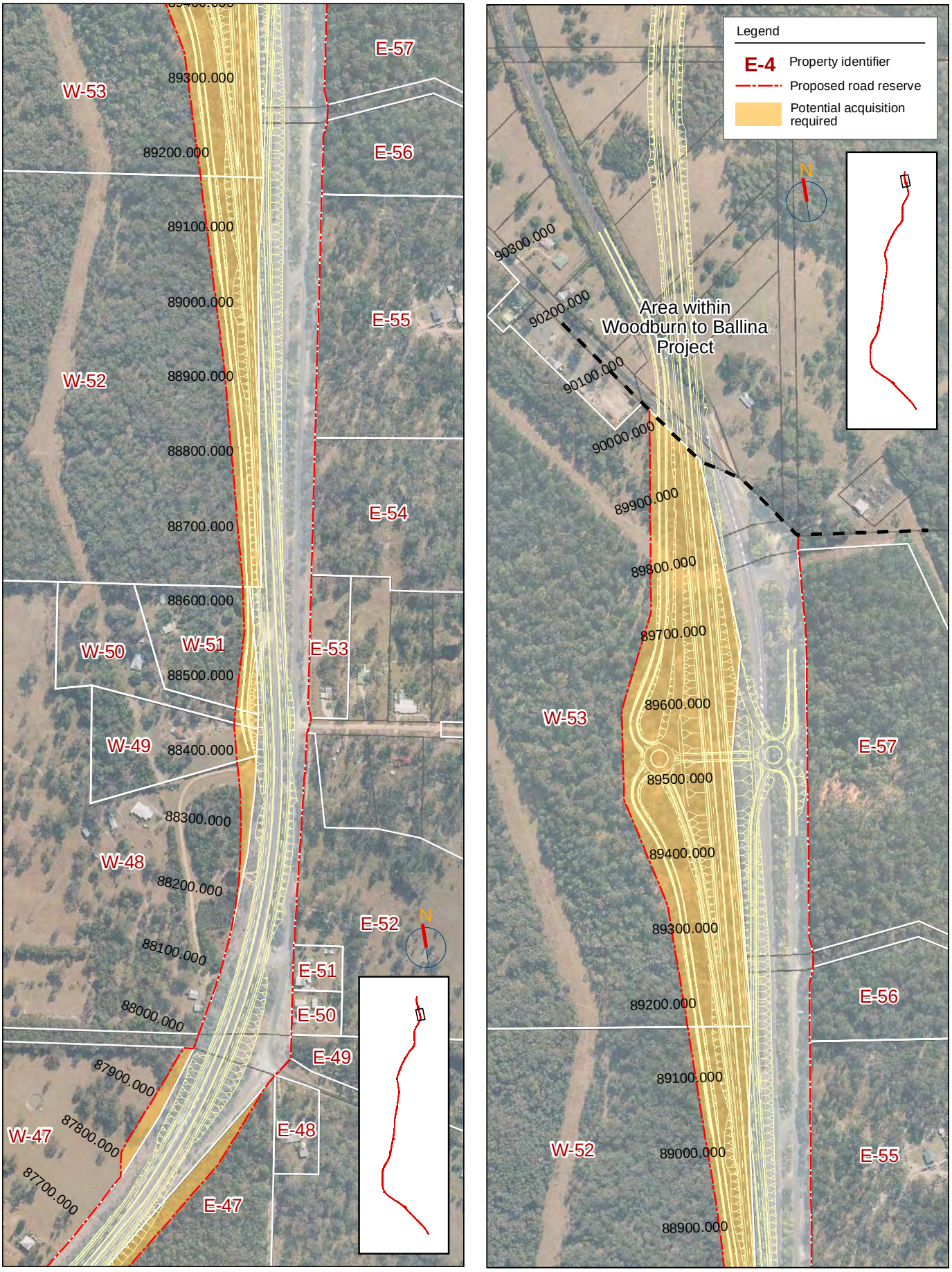
SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

I2W\1235.17.GE\16-07-08\MAR\REV-4

Figure 7.1j

Properties potentially affected by acquisition



0 100m 200m

SCALE 1:7,000 @ A4

Source: Base data - Roads & Traffic Authority 2007

I2W\1235.17.GE\16-07-08\MAR\REV-5

Figure 7.1k

Properties potentially affected by acquisition

7.6 Public utilities

A number of utilities would be affected by the route, including electricity pylons, street lighting 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 Telstra Sydney to Brisbane fibre optic cable meanders across both sides of the highway and a total of 11.2 km of this asset would need to be relocated. 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 without disruption to telecommunications users.

The impact on assets owned by Clarence Valley and Richmond Valley Councils is considered minor and would not pose any significant disruption to service users as they are principally surface drainage for roadways.

7.7 Indigenous heritage

The results of the indigenous heritage field survey discussed in Section 3.7 found 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 an existing high level of disturbance due to construction of the existing highway, agricultural activity and timber harvesting in the adjoining forests.

Local Aboriginal Land Councils and associated Elders groups were contacted prior to carrying out Indigenous heritage field surveys, and a representative of each organisation provided field survey assistance as required. Additionally, in order to determine whether any sites/places of particular significance or concern would be affected by the proposed highway upgrade, consultation was undertaken with local Elder and Native Title claimant (the late) Lawrence Wilson. Mr 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. Approximately 78% of the study area's length was walked as part of the survey and a further 8% had been included in past survey 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 the burial site near The Gap Road, and the scarred tree near New Italy, are protected.

The scarred tree identified in Section 3.7 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

7.8.1 Heritage listings

A heritage study was undertaken as part of the Iluka Road to Woodburn project. The study area includes one item listed on the NSW State Heritage Register, the New Italy settlement, (Museum complex property) refer to Section 3.8 and the Iluka Road to Woodburn Non-Indigenous Heritage Assessment, RTA 2008).

The Museum complex property would be unaffected by acquisition. However, access arrangements to the complex would change, with the existing access closed for safety reasons and access provided via Swan Bay New Italy Road. The importance of access to the site, which functions as a driver reviver location and provides funds for ongoing management of this cultural asset, is acknowledged. Any detrimental effects to the car park would be addressed through the formalisation of parking spaces. Signage would also be provided.

Vineyard Haven and New Italy School Site and residence are listed on the State Heritage Register adjacent to the study area,1.5 km and 4 km respectively, (refer Figure 3.9). The proposal would not directly affect any aspect of Vineyard Haven nor the school site and residence.

7.8.2 Proposed listing of New Italy Settlement landscape on NSW Stage Heritage Register

The project would not affect properties that are currently listed on any heritage listing. However, discussion has commenced regarding the potential listing of the whole of the New Italy Settlement landscape and curtilage on the NSW State Heritage Register. The project would affect the proposed New Italy Settlement landscape and curtilage under both Class A and M scenarios as the curtilage directly abuts the road reserve.

Ongoing discussions with the community, Richmond Valley Council and the State Heritage Office are being held with regard to the New Italy curtilage, Roders well and mango trees (Figure 3.9) and the likelihood of heritage listing for these items. As a result of these discussions, the alignment has been moved further east as part of the refinements to the concept design. Broader changes to the alignment are constrained by the Tabbimoble Swamp Nature Reserve, which is protected under NSW legislation for its ecological values and because of the importance of retaining the driver reviver facility at New Italy.

There would be no direct impacts on Roders well or the historic mango tree plantings under the Class A scenario, although these items would be located within the road reserve. Further consideration under the Class A and M scenarios would be undertaken during the detail design, environmental assessment and project approval phases of the project.

7.9 Acoustic environment

7.9.1 Road traffic noise assessment goals

The noise goals applicable to the project are located in the DECC 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 developments, 'baseline' noise assessment goals of 60dB(A) daytime and 55dB(A) night-time are required to be addressed. 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 or 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.

7.9.2 Noise prediction

The noise predictions for the Iluka Road to Woodburn section 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 during the environmental assessment and project approval phases of the project.

There are approximately 75 residential dwellings located within 260 m of the existing and proposed upgraded road alignments.

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:

- Generally increase by 1dB(A) at the road opening (2016) due to traffic growth.
- Generally increase by 2dB(A) 10 years after road opening (2026), 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.

7.9.3 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.

For eight dwellings along the study route, future road traffic noise (10 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 of 2dB(A) above 'future existing levels' (ten year traffic growth).

Where feasible and reasonable, consideration would 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.

7.9.4 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. Noise mitigation measures would be developed at the environmental assessment planning approval phases of the project, in consultation with landowners.

For the purpose of minimising truck pass-by noise levels, 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 have and will be taken into consideration in the road design.

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.

7.10 Traffic

7.10.1 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 2007 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 represent the impact of the Yelgun to Chinderah upgrade on the volumes of traffic (and in particular heavy vehicles) using the Pacific Highway.

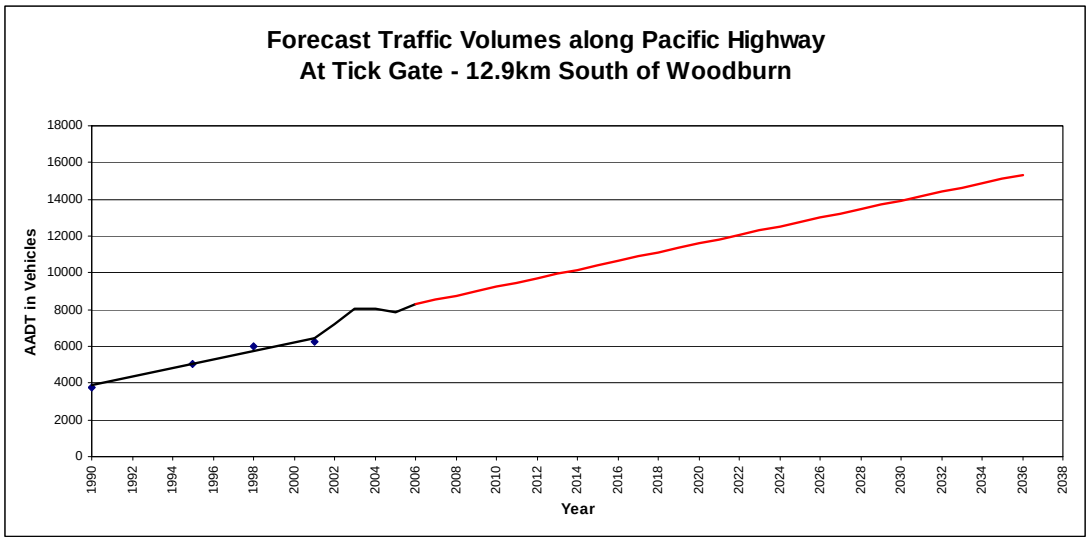
Lastly, it is assumed that no major land use developments are proposed within the study area during the analysis period. Therefore, no increase in local traffic is expected to occur.

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 11,020 vehicle movements in 2016 (the assumed opening year of the proposed duplication and associated improvements), and 15,720 vehicle movements in 2036 (20 years after opening). Of these total volumes, heavy vehicle movements make up approximately 2,187 (20%) per day in 2016 and 3,120 (20%) in 2036. Both the total and heavy vehicle traffic movements are therefore predicted to increase by approximately 80% 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, 2007.

7.10.2 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 2.1). An analysis of the future performance of the key intersections for the design hour (100th highest hour) has been undertaken for the proposal. The analysis of future performance of the intersections at Jacky Bulbin Road and Swan Bay New Italy Road revealed that the performance of the key intersections remains good (LOS B) for the key intersections in 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, 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.

7.11 Summary and conclusions

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

7.11.1 Soils and geotechnical

- 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.
- Excavation into this rock may require specialist machinery or equipment and treatment to exposed batters such as geotextile reinforcement.
- Potential acid sulphate soils would have to be managed in accordance with an approved Acid Sulphate Soil Management Plan.
- The fine-grained soils covering approximately 90% of the study area are extremely susceptible to high sheet and gully erosion when cleared of vegetation. Adequate protection of both cut batters and fill embankments would need to be provided, using measures such as revegetation, provision of cut-off drains, and landscaping.

7.11.2 Flooding

- There are recognised flood-prone locations that require bridging to meet the RTA's prescribed design standards.

7.11.3 Source of materials

- Sourcing of imported fill materials (if required) may be an issue for embankment construction. There is currently a surplus of materials in general which may lend to material being exported to the projects to the north and south. The linear nature adjacent to the existing highway may restrict the method materials are transported due to limited haulage loading on public highways.

7.11.4 Water quality

- The potential exists for disturbance of high risk acid sulphate soil during the construction phase.
- The potential exists for elevated total suspended solids levels caused by the off-site loss of suspended solids from construction activities to watercourses throughout the study area.
- There is high risk of water quality impacts to small creeks draining to sensitive SEPP 14 wetlands.

7.11.5 Ecology

- By 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.
- Notwithstanding, the proposal has the potential to have a significant impact on threatened flora species. 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.
- Approximately 30% of the *Melaleuca irbyana* population south of New Italy would be potentially affected by the project. Mitigation measures, such as translocation, require further investigation.
- Threatened species of frog such as Wallum froglet and Green-thighed frog may be affected by the proposed upgrade through direct disturbance of habitat or changes to the hydrological regime.
- Hollow bearing trees provide important habitat for threatened species and numbers are likely to be reduced during vegetation clearance for the duplication.
- The roadway has the potential to disrupt wildlife linkage between two separate areas of bushland located in a cleared landscape.
- The proposed concept design has the potential to further fragment areas of native vegetation and habitat.

7.11.6 Air quality

- Results of air quality studies carried out for other Pacific Highway upgrade projects indicate that atmospheric carbon monoxide concentrations would be well below DECC criteria. Further assessment will be undertaken during the environmental assessment phase of the project but are expected to be within allowable limits.

7.11.7 Land use and property effects

- 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.
- The greatest area of land acquisition would be on residential properties 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. 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 by strip acquisition less than 100 m and typically 10 m to 20 m.
- Under the proposed concept design in its current form, no residences would be demolished although some residences would be up to 100 m closer to the road than they are at present.
- 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 67 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.

7.11.8 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.

7.11.9 Public utilities

- The main Telstra Sydney to Brisbane fibre optic cable meanders across both sides of the highway and a total of 11.2 km of this asset would need to be relocated.

7.11.10 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.
- Two Potential Archaeological Deposit sites were identified during the indigenous heritage investigations and would require further investigation prior to construction.
- A burial site is located within the study area but away from the existing highway near The Gap Road. The preferred concept design results in a net increase of distance to the burial site from the highway.

7.11.11 European heritage

- The proposed highway upgrade would come closer to the New Italy Museum Complex, (without requiring acquisition), 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.
- The potential impact on Roders well and mango trees under the Class M scenario will require further investigation at the environmental assessment, approval and detail design phases of the project.

7.11.12 Acoustic environment

- A preliminary noise assessment has been undertaken as part of the project planning. Following highway construction, 16 dwellings would be 5 m to 42 m closer to the highway alignment. With the combined effects of traffic growth and reduced distance separation, the predicted road traffic noise levels of 8 of these dwellings could increase by up to 1-3dB(A) in 2016 and a further 2dB(A) in 2026 and may require noise mitigation.
- Noise mitigation options would be developed in consultation with landowners.

7.11.13 Traffic

- The analysis of future highway traffic volumes and associated future traffic and transport conditions predicts the AADT volume along the highway to be 11,020 vehicle movements in 2016, and 15,720 vehicle movements in 2036 (20 years after opening). Of these total volumes, heavy vehicle movements make up approximately 2,187 per day in 2016 and 3,120 in 2036.
- The highway is likely to operate at an excellent LOS (LOS A) for the proposed Class A highway upgrade up to 2036.
- 'Seagull' type T-intersections are proposed for the proposed Class A upgrade at a number of locations including Jacky Bulbin Road, Serendipity Road and Swan Bay New Italy Road.
- The analysis of future performance of the intersections at Jacky Bulbin Road and Swan Bay New Italy Road revealed that the performance of the key intersections remains good (LOS B) for the key intersections in 2036.

7.11.14 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. This access will be modified and signage installed. The ongoing viability of the Museum Complex is an important objective of this project.

7.11.15 Summary

The preferred concept design for the Iluka Road to Woodburn project has been subjected to a preliminary evaluation and assessment. The following issues are considered as key items:

- Impacts on threatened flora species.
- Fauna habitat fragmentation and loss of key habitat.
- Impacts on items of heritage significance.
- Impacts on items of Aboriginal significance.
- Impacts on and acquisition of private property.
- Access arrangements.

These items will be subject to further consideration, investigations and assessment during the environmental assessment, approval and detail design phases of the project.