

Clarence River flooding

The type of rainfall event that results in flooding in the Lower Clarence River floodplain is usually a long duration event in the order of several days. Due to the large size of the Clarence River catchment upstream of Grafton, the flooding behaviour of the Lower Clarence River floodplain is dominated by the flow from the upper catchment. The inflows from the smaller tributary catchments downstream play only a minor role in flood behaviour. The 100 year Average Recurrence Interval (ARI) peak flow in the Clarence River upstream of Grafton (at Mountain View) is in the order of 19,000 m³/s, which dominates the total 100 year peak ARI inflow (cumulative total of 23,700 m³/s).

Flooding in the lower Clarence River floodplain occurs from essentially three sources:

- Rainfall over the Clarence River catchment upstream of Grafton.
- Rainfall over the local catchments that enter the river downstream from Grafton.
- Propagation of an ocean storm tide into the lower reaches of the river.

The catchment upstream of Grafton dominates flooding of low-lying areas in terms of both peak flood levels and duration of inundation. Clarence River floods typically occur from low rainfall intensity events that last several days or even weeks, and flows can be sustained for periods ranging from several days to weeks. The Coldstream River, which has a reasonable size catchment of its own, is generally dominated by floodwaters from the Clarence River backing up the Coldstream and inundating the Coldstream Basin.

Flooding of the Clarence River Floodplain generally occurs over an extended period of days or weeks depending on the intensity. The speed of the floodwaters also varies enormously from fast (2-5 m/s) in the river and across levees, to almost still in backwaters. In some locations, speed will vary considerably during an event depending on where the floodwaters are coming from at the time.

Storm tide propagation into the lower reaches of the Clarence River can cause extensive inundation of areas and influence flooding as far as Maclean. The occurrence of a Clarence River flood and a storm tide together can significantly exacerbate the flooding in these areas, although consensus is that the probability of both storm tide and river flood peaking at the same time is very low.

Local catchment flooding

The catchments of Glenugie and Shark Creeks, and Coldstream River, are prone to floods of significantly shorter duration than that for the Clarence River. This is due to their smaller catchment size and shorter length. The flood waves in these tributaries are significantly dampened once the flood waters reach the wider and more substantial floodplains of the Clarence River. Typically, critical storm durations of two to nine hours are experienced.

Flooding within the local catchments can still occur when the Clarence River is not in flood. The local catchments are susceptible to shorter duration events of several hours to half a day with higher rainfall intensities. On the lower floodplains the peak flood levels may not be as high as those from Clarence River backwaters, but the peak flows are likely to be higher from these more intense, shorter duration events. The timing of the flood waves from the different sources also plays an important role in the inundation behaviour. During a widespread rainfall event, the local catchments typically will peak first with flooding from the Clarence occurring in the days following. The probability that the Clarence peak and a local catchment peak coincide is considered very low.

There remain significant areas of elevated floodplains in the local catchments that are not, or are only slightly, influenced by the Clarence River. Crossings within the Clarence floodplain are likely to have the height of the embankment set by the Clarence River backwaters, while the local flood flows will control the size of the cross-drainage structures.

5.3.3 Water quality

Overview

The Clarence River itself forms part of the western boundary of the study area for the project from Grafton to Harwood. There are several main tributaries of the Clarence River and other minor water courses that traverse the study area.

In the south of the study area, Coldstream River and Chaffin Creek traverse the study area. Based on the ANZECC (2000) guidelines, the upstream sections of these waterways have lowland river properties while further downstream they are estuarine. Pillar Valley Creek, Swan Creek, Bom Bom Creek, Dundoo Creek and Alipou Creek are smaller creeks with lowland river characteristics in the southern and western sections of the study area. Further north in the study area, waterways include Shark Creek (south of Maclean), the Clarence River, Serpentine Channel (which separates Harwood and Chatsworth Islands) and the North Arm. These are all classified as estuarine according to the ANZECC (2000) guidelines.

Existing water quality

Existing water quality data on the Clarence River and its tributaries are limited but available sources of information have been reviewed.

The Northern Rivers Water Quality Assessment (EPA, 1996) and State of the Rivers and Estuaries Report (DLWC, 2001) have generally similar conclusions. The water quality of the Clarence River varied between upstream sites (near Grafton) and downstream sites (near Iluka). The Clarence River near Grafton was assessed in these reports to have 'poor' water quality, failing to comply between 25-49 per cent of the time. Further downstream the water quality improved slightly with a

“fair” rating assigned to the Clarence River at Ulmarra Ferry. Water quality of the Clarence River near Iluka generally achieves a ‘good’ rating.

The water quality of both Shark Creek and Serpentine Channel was classified as ‘very poor’, predominantly due to consistently low dissolved oxygen saturation levels. Coldstream River generally had low dissolved oxygen (mean 43.8 per cent) and high nitrogen levels at the upstream and downstream sites respectively. Turbidity and pH were also rated poorly for Shark Creek by the State of the Rivers and Estuaries report.

The Coldstream River was assessed by the State of the Rivers and Estuaries report as having poor water quality in the upper reaches. This was attributed to fair to poor ratings for turbidity, nutrients, dissolved oxygen and faecal coliform levels. The downstream sub-catchment of Coldstream Creek, also had an overall rating of poor, but this was due to faecal coliform levels alone. The pH, turbidity and nutrients were rated as good.

Forests NSW assessed water quality within Champions Creek, which passes through Pine Brush State Forest. That assessment concluded that water quality was being affected by logging operations. High levels of suspended solids and low levels of dissolved oxygen were the primary factors contributing to that assessment, and these results may not be indicative of water quality over extended time periods.

Two dry weather water samples have been undertaken to date as part of providing data on route options, in April and June 2005. Water quality was assessed at a total of 33 monitoring locations in the vicinity of the route options. Water quality results were then compared to the ANZECC/ARMCANZ (2000) guidelines for protection of aquatic ecosystems. Specific findings of these water samples have been related to the assessment of the route options in **Section 1**.

Some general indicators of water quality across the study area were obtained from sampling undertaken to date. Generally, water quality at the sample sites complies with the ANZECC/ARMCANZ (2000) guidelines. In some locations non-compliance with some water quality variables was identified.

Key water quality issues appear to relate to dissolved oxygen, turbidity and pH levels. Overall, water quality appears to improve in the lower reaches of the river systems. This may be associated with tidal flushing in estuarine reaches of the Clarence River and major tributaries, which assists in removing or diluting pollutants. Pressures from rural and urban land use are contributing to high levels of bacterial contamination (presumably from sewage and stock faeces). High levels of nutrients and turbidity are likely to be related to rural land practices that are expected to be common across much of the study area, such as clearing, tillage and fertiliser application.

5.3.4 Ecology

Ecological studies undertaken to date have included collection of data on ecological conditions in the study area and surrounds, desktop assessment and assignment of ecological values, and field assessment to verify the data and desktop analysis, to gain an understanding of ecological conditions across the study area. Given the size of the study area, investigations have focused on providing a general understanding of ecological conditions, as a basis for assessment of the route options. Both terrestrial and aquatic investigations have been undertaken. **Figure 5-8** provides a general overview of features of ecological significance in the study area and surrounding land.

Vegetation types and endangered ecological communities of the study area

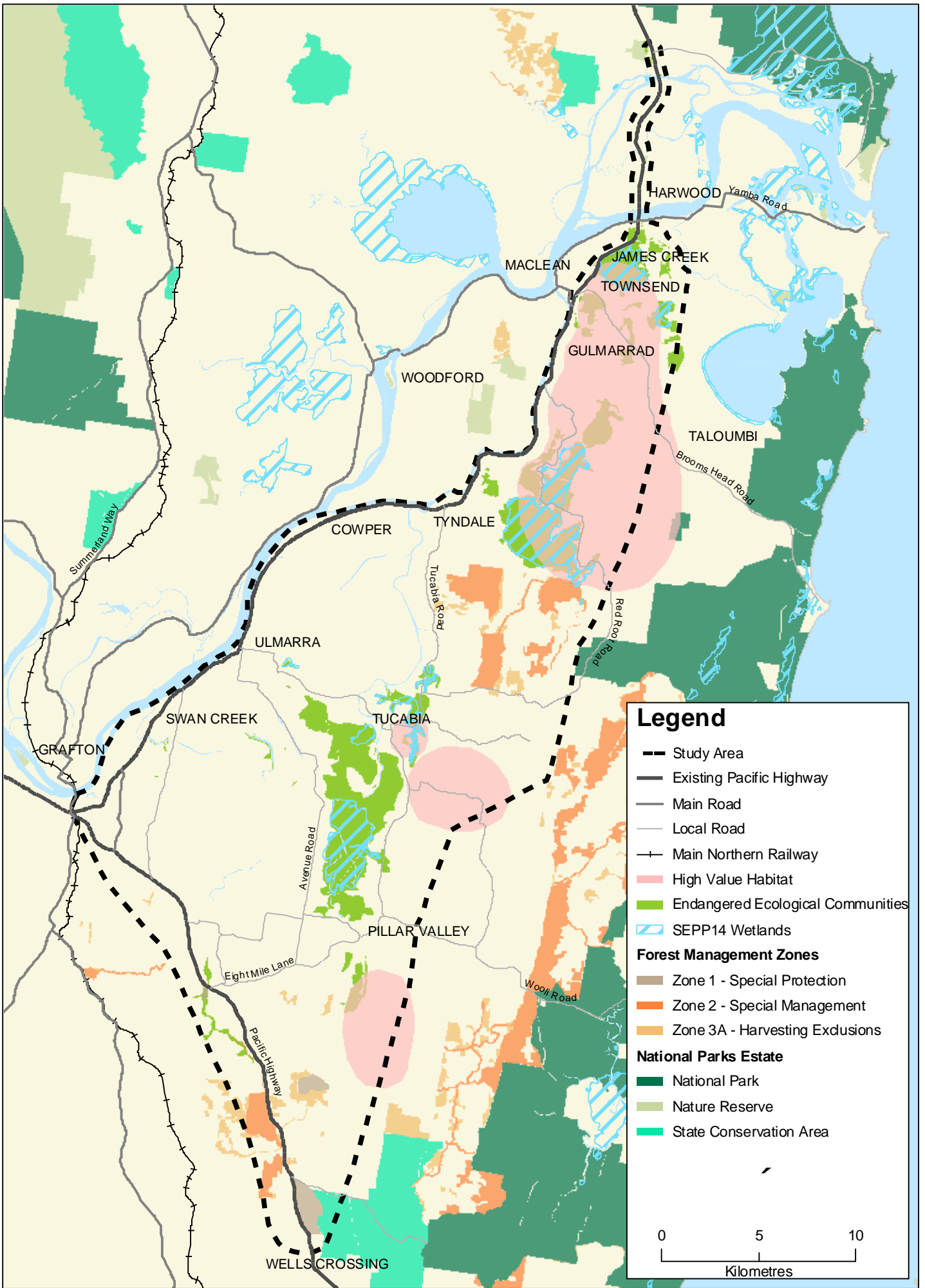
Within the study area there are at least six broad vegetation types identified from the preliminary surveys, with a minimum of 10 vegetation associations recorded. Several of the communities recorded are considered as representative of vegetation types classified as Endangered Ecological Communities listed under the *Threatened Species Conservation Act, 1995* and additionally as vegetation of local and regional significance. The relevant communities are summarised in **Table 5-4**.

Table 5-4 Broad vegetation types of the study area

Vegetation Type	Dominant Species	Site(s) Recorded
Woodland / Open Forest	<i>Corymbia henryi</i> , <i>Eucalyptus fibrosa</i> , <i>Eucalyptus moluccana</i> , <i>Eucalyptus siderophloia</i> ,	1, 3, 21, 25
	<i>Eucalyptus pilularis</i> , <i>Eucalyptus microcorys</i> , <i>Angophora subvelutina</i> , <i>Eucalyptus planchoniana</i> , <i>Banksia</i> spp.	8, 16, 21
	<i>Eucalyptus signata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus microcorys</i> , <i>Angophora subvelutina</i>	8, 16,21
Moist Open Forest*	<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> , <i>Corymbia intermedia</i> , <i>Eucalyptus acmeniodes</i> , <i>Lophostemon suaveolens</i> , <i>Callistemon salignus</i> ,	2, 7, 10, 13, 17, 18
Swamp Forest*	<i>Eucalyptus robusta</i> , <i>Melaleuca quinquenervia</i> , <i>Lophostemon suaveolens</i> , <i>Casuarina glauca</i>	6, 11, 15, 23
	<i>Casuarina glauca</i> , <i>Melaleuca quinquenervia</i>	9, 12
Freshwater Wetlands*	<i>Eleocharis</i> spp., <i>Baumea</i> spp.	near 12
	<i>Juncus</i> spp.	near 20
Lowland Rainforest*	<i>Aphananthe philippinensis</i> , <i>Ficus</i> sp., <i>Grevillea robusta</i> .	20
Disturbed / Grazing Land	Primarily comprised of introduced grasses and herbaceous species.	19

* Denotes communities that are classified as Endangered Ecological Communities under the *Threatened Species Conservation Act*.

It is possible that once options are refined and more detailed field investigations are undertaken, additional vegetation communities will be differentiated. However, at the broad scale of assessment required for this stage of the project, the vegetation communities mapped as part of this study generally correspond to broad scale mapping of the area sourced from the Department of Environment and Conservation.



Legend

- Study Area
- Existing Pacific Highway
- Main Road
- Local Road
- + Main Northern Railway
- High Value Habitat
- Endangered Ecological Communities
- SEPP14 Wetlands

Forest Management Zones

- Zone 1 - Special Protection
- Zone 2 - Special Management
- Zone 3A - Harvesting Exclusions

National Parks Estate

- National Park
- Nature Reserve
- State Conservation Area

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Figure 5-8 Ecologically significant areas

Much of the pre-European lowland floodplain areas of the Clarence River would have historically comprised lowland rainforest, swamp forests, wetlands and wet floodplain eucalypt forests. The vast majority of the vegetation was cleared from the area and throughout the North Coast bioregion due to the fertile soil types suitable for agriculture and proximity to the river and coast for transport and settlement. As a result of past clearing and modification, several vegetation communities of the NSW North Coast Bioregion have been scheduled as endangered ecological communities under the *Threatened Species Conservation Act*. The endangered ecological communities recorded within the study area during the preliminary surveys include:

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion.
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Lowland Rainforest on floodplain in the NSW North Coast Bioregion.

Other endangered ecological communities, potentially present in the study area, but not identified during field investigations, include:

- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions.

Within the study area there are numerous small and isolated remnant fragments of these community types scattered throughout the floodplain. Additionally, there are some large intact and undisturbed remnant stands of high ecological importance. The large stands are often associated with wet depressions containing wetland and swamp forest communities, several of which are located within the boundaries of SEPP 14 wetlands. The small stands of vegetation more commonly exist as scattered and occasional remnant stands or small regrowth patches. The distribution of endangered ecological communities across the study area, based on investigations undertaken to date, is illustrated at **Figure 5-8**.

Conservation reserves

There are several state forests and ecologically significant areas within the study area. The existing highway alignment from Wells Crossing to Grafton passes through the Glenugie State Forest and Bom Bom State Forest and the eastern boundary of the revised study area passes to the east of the

Pine Brush State Forest. These forests contain areas that are identified as having high conservation values, as discussed in **Section 5.4.2**. The Yuraygir State Conservation Area is located at the southern tip of the study area, and adjoins land within Newfoundland State Forest that is identified as a flora reserve. The Yaegl Nature Reserve is located to the east of Maclean and the existing Pacific Highway. The Yuraygir National Park is located beyond the eastern boundary of the study area.

Nine ecologically significant wetlands listed under SEPP 14 occur within the study area. These wetlands are primarily located in the central and eastern parts of the study area near Pillar Valley, Tucabia and Shark Creek.

Fauna habitats

Several broad fauna habitat types are represented throughout the study area, of varying quality and importance for fauna species represented in the local area. These are summarised in **Table 5-5**.

Table 5-5 Habitat conditions in the study area

Habitat type	Characteristics
Forest and woodland habitats	<ul style="list-style-type: none"> ▪ Well represented in the study area, comprising all remnant vegetation areas. ▪ Largely contained in the south and east in Glenugie and Pine Brush State Forest and connecting forests east of Tucabia. Continues to the north east of the study area along the steeper slopes and gullies of the Shark Creek Range and contiguous with Yuraygir National Park further east to the coast. ▪ Capacity to support a wide range of species (including threatened species) and support breeding, sheltering, feeding and freshwater habitat values. ▪ High quality forest habitats exist to the east of Tucabia in the Bostocks gully and Chaffin Creek area north to Champions Creek, along the foothills and escarpments of Shark Creek Range and along Brooms Head Road and connecting to the east into Yuraygir National Park.
Riparian areas	<ul style="list-style-type: none"> ▪ Includes moist forest, rainforest and mangrove elements along the Clarence River and larger tributaries, in agricultural areas that have been heavily depleted due to past clearing of the floodplain. ▪ Important for fauna movement and refuge. ▪ Weed invasion is a problem, but habitats are generally diverse. ▪ Examples occur along the Clarence River and Coldstream River, Shark Creek, and Glenugie Creek.
Swamp forest	<ul style="list-style-type: none"> ▪ Vegetation retained or established in low-lying areas adjoining creeks, wetlands and rivers. ▪ Generally isolated fragments, with the best-preserved areas of swamp forest occur around low-lying wetlands (including SEPP 14 wetlands) and as small remnant patches on the Clarence River floodplain. ▪ Well represented throughout the Tyndale and Tucabia areas and include Crowsnest Swamp, and Morans Swamp. ▪ Swamp forests provide habitat for common and threatened amphibians and waterfowl and waders as well as aerial nectivores during the peak flowering period. They also provide breeding habitat for insects and therefore are an important resource in terms of the provision of food for insectivorous fauna. Mammal fauna are generally restricted to bats and macropods that are capable of moving across cleared lands to access the isolated remnants of this habitat.

Habitat type	Characteristics
Freshwater wetlands, lagoons and estuarine areas	<ul style="list-style-type: none"> ▪ Represented by a variety of different habitats from relatively natural freshwater creeks to open lagoons in cleared agricultural lands to grazed ephemeral reed and sedge areas. ▪ Common on the floodplain south of Brushgrove and around Ulmarra, such as Harrington Lagoon and Swan Creek. Frequented by waterfowl and other wetland birds capable of moving distances in search of food. ▪ Impacts from cattle grazing and agricultural chemicals are evident and some habitats are completely devoid of natural vegetation. ▪ Provide habitat for threatened fauna including the Black-necked Stork, Brolga, Magpie Goose and Comb-crested Jacana. Black-necked Stock nest sites in the study area include Crows nest Swamp, Chaffin Creek, the lower Coldstream area and Swan Creek. ▪ Fresh and estuarine waterways are well represented in the region, ranging from major permanent streams such as Coldstream River and Shark Creek. ▪ Provide a diversity of fish habitats as well as habitat for fauna dependent on aquatic and semi aquatic habitats, eg. frogs, some reptiles, mammals and several common wader and waterbird species. ▪ Estuarine fauna habitats in the study area include open water, intertidal sandflats, sandy shores, mangrove forests and phragmites (reed) vegetation. Such habitats are important nursery, refuge and feeding grounds for a range of commercial and recreational fish and crustacean species and provide important habitat for bird groups such as waders, waterfowl, cormorants, pelicans, herons, oystercatchers and their allies. The threatened Osprey is known from the study area.
Modified grasslands and pastures	<ul style="list-style-type: none"> ▪ These habitats provide fewer important features for fauna and comprise a lower fauna diversity as a result of the degree of clearing and modification. ▪ Generally devoid of significant vegetation or habitat for threatened species, except for small remnants and some isolated trees. ▪ Dominated by common agricultural and disturbance tolerant fauna species and introduced fauna. ▪ Large dead trees are often selected as preferred nest sites for raptors including the threatened Osprey.

Assessment of the condition of aquatic habitats was also undertaken within the study area. NSW Fisheries (1999) provides guidance on classification of freshwater habitats. The guidelines define habitat based on four categories, from Class 1 (major fish habitat) to Class 4 (unlikely fish habitat).

Waterways were assessed at 35 separate locations across the study area. Surveyed waterway locations were classified as either Class 1 or Class 2. Class 1 locations, providing high quality estuarine or freshwater aquatic habitats within the study area, include:

- Chaffin Creek (at both sample locations).
- The Clarence River.
- Coldstream River (at the confluence with Clarence River, near Tucabia and at Reserve Road).
- Serpentine Channel.
- Shark Creek (at Stokes Road).
- Swan Creek at Four Mile Lane and downstream of Wilcox Bridge.

The waterways of the lower Clarence region illustrate a diversity of environmental condition and form. A characteristic of most waterways is a continuum of decreasing in-stream and riparian condition with distance downstream as streams that originate within forested headwaters enter

freehold agricultural land where land clearance, grazing and intensive horticultural farming such as sugar cane is prevalent. While waterways in the study area exhibit relatively good aquatic habitat values, key issues include predation or competition by exotic species such as *Gambusia*, poor quality riparian zones impacted by grazing and clearing, and degradation of freshwater and estuarine wetland habitats. Key features of importance in terms of aquatic habitat values include:

- The interface between freshwater and saline sections of waterways, important in terms of breeding and nursery habitats, particularly for species that transition between fresh and saline water as part of their breeding cycle.
- Permanent pools in intermittent waterways such as Chaffin Creek, the Coldstream River and Pillar Valley Creek.
- Potential habitat for threatened aquatic species including widespread wetland habitat for the Giant Dragonfly, and potential habitat in permanent pools for the Eastern Freshwater Cod.

Species of conservation significance

Records have been obtained for threatened aquatic and terrestrial species and populations previously recorded from a 10 kilometres radius of the study area. The documented locations of threatened flora and fauna species within the study locality was reviewed and compiled. The data sources used in this review included but were not limited to the following:

- DEC Atlas of NSW Wildlife Database.
- Results of previous surveys within the study area (Clancy 2003).
- NPWS (1999) Threatened Species Management Guidelines.
- CANRI and Fish files database.
- Records published in scientific journals, reports and general flora and fauna distribution text.
- Results of local environmental studies, including studies prepared by consultants, local government authorities, biological organisations, universities and other sources.
- Discussions with personnel from the DEC (incorporating the former NPWS) and Department of Primary Industries (NSW Forests and NSW Fisheries).
- Anecdotal reports from authorities, local naturalists and the local community.

Important threatened fauna habitats in the study area are summarised in **Table 5-6**.

Table 5-6 Fauna habitats of conservation value

Forest habitats	Floodplain habitats
<ul style="list-style-type: none"> ▪ Area 1. The foothills and escarpment of Shark Creek Range continuing east to Yuraygir National Park, west to Tyndale Swamp and north to Gulmarrad. ▪ Area 2. East of Tucabia in the Bostocks gully and Chaffin Creek area north to Champions Creek. ▪ Area 3. Upper Pillar Valley Creek area. 	<ul style="list-style-type: none"> ▪ Crowsnest Swamp, Ellis Swamp, Colletts Swamp and Morans Swamp, these are all connected and occur south of Tucabia on the western side of the Wooli Road (SEPP 14). ▪ Tyndale Swamp (SEPP 14). ▪ Chaffin Swamp adjacent to Tucabia Road. ▪ Wetland / reedland habitat of conservation value to the south of Maclean.

Several important wildlife corridor linkages are located within the study area and are relevant to the assessment of the route options. The most important corridors identified in the investigation area include:

- Habitat linking the Coast Range to Shark Creek Range. This corridor provides an east west link between Yaegl Nature Reserve and the habitats around Gulmarrad across to Yuraygir National Park to the east of the investigation area.
- From the Coast Range over the Pillar Ridge and across to Crowsnest Swamp.

Many smaller local wildlife corridors and links also occur throughout the investigation area. Those close to roads are often identified by wildlife roadkill black spots. One of these black spots has been identified on the existing Pacific Highway between Yaegl Nature Reserve on the east side and habitat to the north of Maclean of the west side of the highway.

The Emu *Dromaius novaehollandiae* population in the NSW North Coast Bioregion and Port Stephens Local Government Area has been listed as an endangered population on Part 2 of Schedule 1 of the *Threatened Species Conservation Act*. An isolated population of the coastal Emu population, estimated to be less than 100 individuals, is found east of Bungawalbin and Tucabia, between Red Rock and Evans Head. Yuraygir National Park and surrounding areas are a stronghold for this population and the Sandon / Brooms Head area is particularly important as one of two main breeding areas. The NPWS has reported Emu road mortalities on Sandon Road in Yuraygir National Park and Brooms Head Road. Several submissions from the community have highlighted the importance of the coastal Emu population in the study area.

5.3.5 Climate and air quality

Existing conditions

Climatic data were obtained from the NSW Bureau of Meteorology weather stations at Grafton, Yamba and Glenugie. In general, the recorded temperatures are similar at all stations, however, the inland stations of Grafton and Glenugie show greater daily temperature variation than Yamba, which is subject to the moderating effect of the coast. Rainfall fluctuates seasonally, with greater

rainfall in the summer and autumn months and less rainfall during late winter and early spring. Generally, Yamba experiences greater total rainfall per annum and more rainy days than Grafton and Glenugie. Mean annual rainfall ranges from 1051 mm in Grafton to 1459 mm in Yamba.

There is limited information regarding existing air quality within the study area. Long-term monitoring is not usually undertaken outside metropolitan and/or industrial areas, because pollutants typically do not exist in concentrations that would cause adverse environmental or health impacts. The study area contains a large proportion of rural areas and air quality is generally good.

A number of environmental impact assessments which have been undertaken for the upgrade of the Pacific Highway include short-term air quality monitoring of carbon monoxide (CO) adjacent to the highway. These studies have shown that CO concentrations measured close to the Pacific Highway are well below the relevant DEC eight hour criteria of nine parts per million.

Air quality considerations

Construction activities have the potential to result in dust emissions which may impact on nearby sensitive receivers, in particular residences. Wherever ground is disturbed, or spoil is handled, there is the potential for the generation of dust.

Once operational, emissions from the upgraded highway would comprise mainly hydrocarbons, carbon monoxide, NO_x and particulate matter. The level of concentration of vehicle emissions and their subsequent impacts in the immediate vicinity of the proposal depends on the traffic volume, vehicle speed and make-up (eg percentage of heavy vehicles) as well as the ability of the local environment to disperse emissions.

Individual assessment of the air quality impacts of each the route options has been undertaken but is not reported in **Section 1** because air quality impacts of the route options would all be well below criteria established by the DEC. Concentrations would diminish with distance from the road, resulting in negligible impacts. As such, none of the route options is assessed as likely to result in air quality impacts that would even approach the standards set by the DEC.

Climate considerations

Fog has been identified as an important issue in the design of the road, and has implications for the assessment of the route options. Fog can present a significant safety hazard for road traffic, and consideration should be given to the occurrence of fog in the study area. A desktop level assessment of potential fog conditions has been undertaken as part of the climate and air quality assessment.

Specific fog data are not available across the study area from Bureau of Meteorology sources. The Bureau of Meteorology records the occurrence of fog at 9am and 3pm daily at Grafton Olympic

Pool. A local resident in the Pillar Valley area has been collecting records of fog and mist occurrences in the local area for the period from January 2003 to April 2005 (Griffin and Dunlop, *pers comm* to RTA, 28 April 2005).

In Grafton, more fog days are recorded during the cooler months with the highest number of fog days recorded during the month of June. This contrasts with data for Pillar Valley provided by Griffin and Dunlop, which indicates more days of fog or mist during the months of February and March. Anecdotally, Griffin and Dunlop suggest that:

"...fog is very common particularly in valleys along the eastern margin, the far north-eastern hills and the southern hills of the study area where the incidence of fog is increased by radiative cooling, compression by descending air, and mixing of the low air layers by slight winds up the valleys."

It is not possible to accurately determine differences in fog patterns across the study area, due to lack of historic data. However, most parts of the study area are prone to fog, with the most affected areas likely to be the valley regions in the east and south of the study area. These areas are likely to experience radiative or ground fog. The low lying plains in the centre of the study area are also likely to be prone to radiative or ground fog.

5.4 Social and economic characteristics

5.4.1 Social context

Population

The study area is located entirely within the Clarence Valley local government area (LGA), which comprises the former LGAs of Grafton, Maclean, Pristine Waters and Copmanhurst. Parts of the former Grafton, Maclean and Pristine Waters LGAs fall within the study area. These former LGAs have populations of approximately 17,000 people, 18,000 people and 11,000 people respectively. The former Maclean Shire is one of the fastest growing rural local government areas in NSW, with a growth rate of approximately 1.8 per cent per annum (Maclean Shire Council website). Pristine Waters former local government area also experienced relatively strong growth in the period from 1996-2001. The population within the former Grafton local government area is relatively stable. However, it is important to note the role that Grafton plays as the major centre in the Clarence Valley, and that substantial population growth is occurring in areas surrounding Grafton that are reliant on Grafton itself for employment and services.

Population characteristics for the study area have been derived from the 2001 Census of Population and Housing (ABS, 2001) for the former Statistical Local Areas (SLAs) of Grafton, Maclean and Pristine Waters (Ulmarra), as shown in **Table 5-7**.

Table 5-7 Populations characteristics in the Clarence Valley

Population Characteristic	Grafton	Maclean	Pristine Waters - Ulmarra	NSW
2001 Population	17,430	17,050	6,600	6,371,745
1996 Population	17,110	15,987	6,147	6,038,696
% growth 1996-2001	1.9	6.6	7.4	5.5
Median age (years)	38	46	39	35
Population aged 15 years or over (%)	78	81	76	79
Population aged 65 years or over (%)	17	24	13	13
Median weekly household income	\$500-599	\$400-499	\$400-499	\$800-999
Unemployment Rate (%)	12.1	13.6	19.6	7.2
% ATSI	5.3	3.6	3.3	1.9
% speaking language other than English at home	5.4	5.3	5.8	18.8

Source: ABS, 2001; DIPNR, 2004

Population characteristics of Clarence Valley residents differ from the NSW averages in several key ways:

- There have been relatively large population increases within the Maclean and Ulmarra areas, compared with little growth around Grafton.
- Relatively low weekly household incomes when compared with averages for NSW. This again relates to the large elderly population and to the rural occupations of many residents.
- A higher than average median age and, for Grafton and Maclean, substantially higher proportions of the population aged over 65 years than for NSW as a whole, reflecting the large numbers of retirees in the area.
- A marked absence of youth in the 20-24 year age groups, and to a lesser extent, those aged 25-34 years, who leave the area in search of employment or education opportunities elsewhere. This follows a similar pattern to other SLAs on the Mid-North Coast region.
- 4-5 per cent of the population identifying as being of Aboriginal or Torres Strait Islander backgrounds, compared with around 2 per cent for NSW.
- Fewer non-English-speaking residents than average for NSW. The four largest groups of non-English-speaking residents are from the United Kingdom, New Zealand, The Netherlands and Germany.

Population projections provided by DIPNR for the period 2001 to 2031 are shown in **Table 5-8**.

Table 5-8 Projected populations and average annual growth rates in Clarence Valley

SLA at 2001 Census	2001	2031	Average annual growth %	Share of region population %	
				2001	2031
Grafton	17,430	15,290	-0.4	6.2	4.2
Macleean	17,050	24,150	1.2	6.1	6.6
Pristine Waters – Ulmarra	6,600	8,280	0.8	2.4	2.3
Pristine Waters – Nymboida	4,440	5,260	0.6	1.6	1.4
Copmanhurst	4,570	6,640	1.3	1.6	1.8

Source: DIPNR, 2004

Population projections from DIPNR (2004 release) indicate that the following trends are likely:

- Reductions between 2001 and 2031 in the proportion of the population aged 0-14 and an increased proportion of the population aged over 65 years.
- On current projections, the proportion of residents aged over 65 years in 2031 will be 38 per cent in Macleean, and between 32-34 per cent for the other Clarence Valley areas.
- By 2031, the median age of Macleean Shire is expected to be at least 57 years.
- Grafton is the only area on the Mid-North Coast expected to experience a decline in its population, from around 17,400 in 2001 to 15,300 in 2031, an average of -0.4 per cent per annum.
- Copmanhurst and Macleean are expected to experience higher than average population growth rates over this period.

Community services and facilities

Grafton plays an important role in the Clarence Valley area as a service and administrative centre. The *Clarence Valley Social Plan* (October 2001) describes the relationship of the major towns in the region in terms of the functional hierarchy contained in the *North Coast Urban Planning Strategy*.

Under the Social Plan, Grafton is defined as the sub-regional centre for the Clarence Valley. It is the major centre for services to the sub-region of Grafton, Copmanhurst, Macleean, Nymboida and Ulmarra. Macleean is the major district centre for the sub-region. Grafton and Macleean each have higher order services such as a hospital, TAFE facility, community health centre and high schools. Rapid growth in the Macleean area is necessitating the development of more community services, particularly in the areas of health and aged care. Yamba, to the east of the study area on the coast, has also grown rapidly in recent years, and this is placing pressure on community services both within Yamba and in Macleean and Grafton.

5.4.2 Land use and settlement patterns

Existing land use in the study area is predominantly rural. A range of productive rural uses exist reflecting the diverse topography, geology and soils, and ecology of the area. Farming has traditionally centred on broad scale cropping and grazing activities. However, diversification into niche production such as orchards and small scale cash crops has occurred in some areas.

Settlement has traditionally been concentrated in towns and villages along the Pacific Highway and Clarence River, such as Grafton, Ulmarra, Swan Creek, Tyndale and Maclean. Other areas of relatively concentrated settlements include South Grafton, Clarenza, Wells Crossing, Pillar Valley, Tucabia, Cowper, Tyndale, Harwood, Chatsworth, Townsend and Gulmarrad. In more recent years, population growth has shifted towards rural residential areas and rural small holdings, resulting in growth in semi-urban areas at the fringes of larger towns, and other more scattered rural communities on smaller rural properties.

Existing land use is illustrated on **Figure 5-9**. Further discussion of the major land uses in the study area is provided in the following sections.

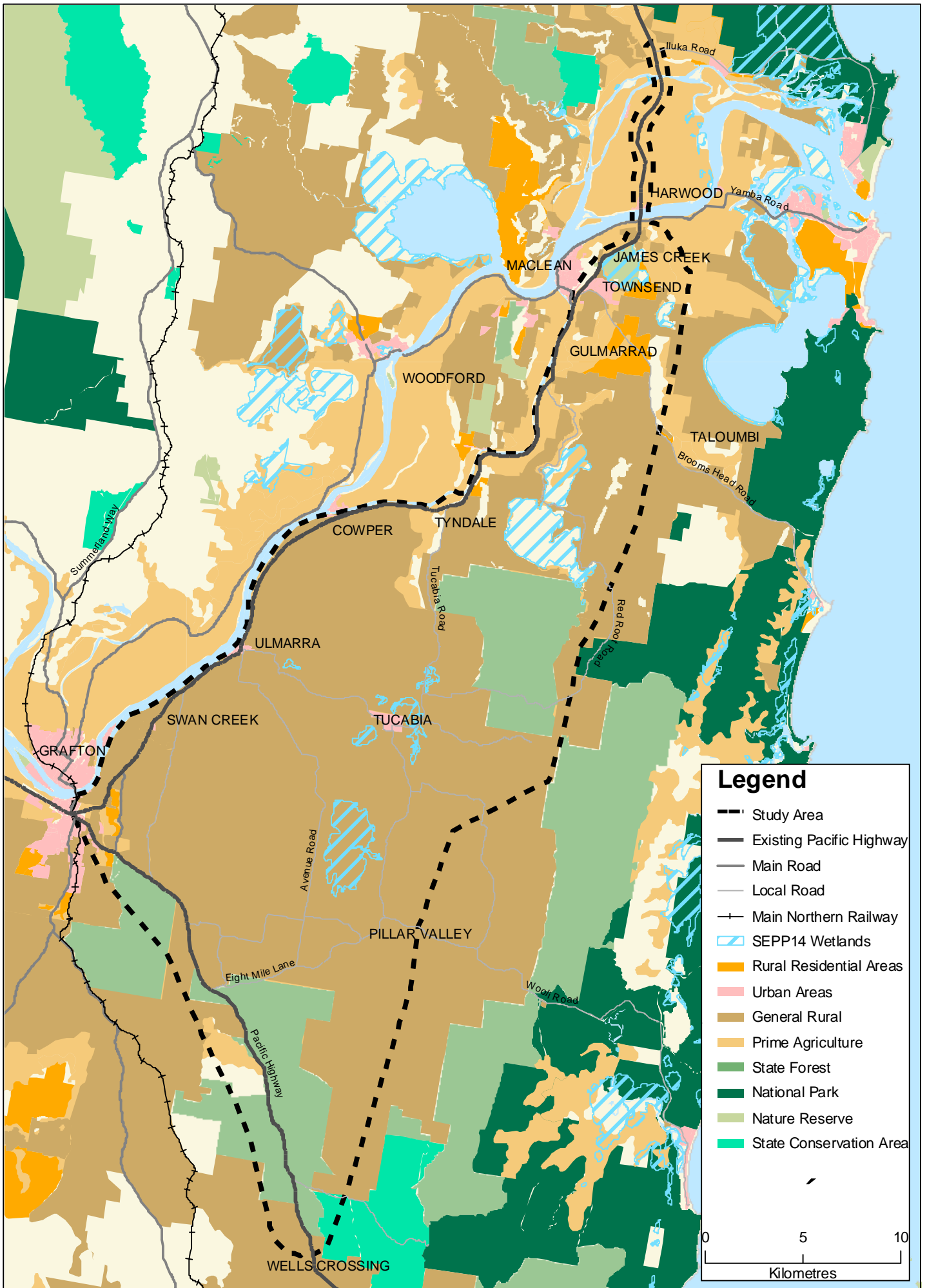
Urban land

Urban areas and villages within the study area are generally small and sparsely spread. The major urban centres in the Clarence Valley; Grafton, Maclean and Yamba are outside the study area. The study area touches the fringe of the South Grafton urban area fronting the existing Pacific Highway. Towns and villages in the study area south of Harwood Bridge include Swan Creek, Ulmarra, Cowper, Tyndale, Tucabia, and the area comprising Townsend, Gulmarrad and James Creek. The town of Harwood is located on Harwood Island, north of the Clarence River. Chatsworth village is just outside the study area on Chatsworth Island.

Rural residential areas

There are two main areas of rural residential development within the study area. These are Clarenza, to the east of Grafton, and Gulmarrad/James Creek, to the east of Maclean. Rural residential development is a relatively recent land use in the study area in the context of historic patterns of development.

Substantial areas of land zoned for rural residential purposes exist in the Gulmarrad and James Creek areas. Development in this area has been proceeding rapidly in recent years. Building activity is ongoing and new subdivisions are being constructed. Lot sizes are typically around half a hectare, with single dwellings. Land use is primarily residential, and rural production in Gulmarrad is virtually non-existent. The James Creek rural residential area is zoned for rural small holdings and it is developing in segments as a rural residential area similar in character to Gulmarrad.



WC_Ro_015

Wells Crossing to Iluka Road
Upgrading the Pacific Highway

Figure 5-9 Land use in the study area

Rural dwellings are also concentrated along the existing Pacific Highway and other main roads in the study area including Coldstream Road, Woolli Road (around Pillar Valley) and Tucabia Road. This reflects a historic pattern of development that has arisen from rural settlement and agricultural use in the area. It also reflects the historic importance of the highway as the main local access route within the district. The majority of these dwellings, outside of towns and villages, are the residences of farmers who own or manage properties that front the highway, predominantly either for grazing or cane farming.

Agriculture

The main agricultural activities in the study area are grazing, dairying and cropping. Grazing land extends across much of the southern section of the study area, to around Cowper, and in the hilly country in the east of the study area. Beef and dairy cattle are the predominant stock. Sugar cane is the predominant rural land use in the low lying lands north of Cowper. Harwood and Chatsworth Islands are almost entirely occupied by cane farming. Harwood mill is the main cane mill in the area and all cane from the district is processed there. Maintenance of access routes from surrounding cane farms to the Harwood mill is therefore an important consideration in limiting impacts on the cane industry.

Sugar cane has some specific requirements in terms of growing conditions. While it is generally grown on low lying and flood-prone land, it is important that the cane fields do not remain inundated for long periods of time, as this rots the cane and can ruin the crop. Maintaining good drainage to allow rain and flood water to drain from cane farms is therefore important.

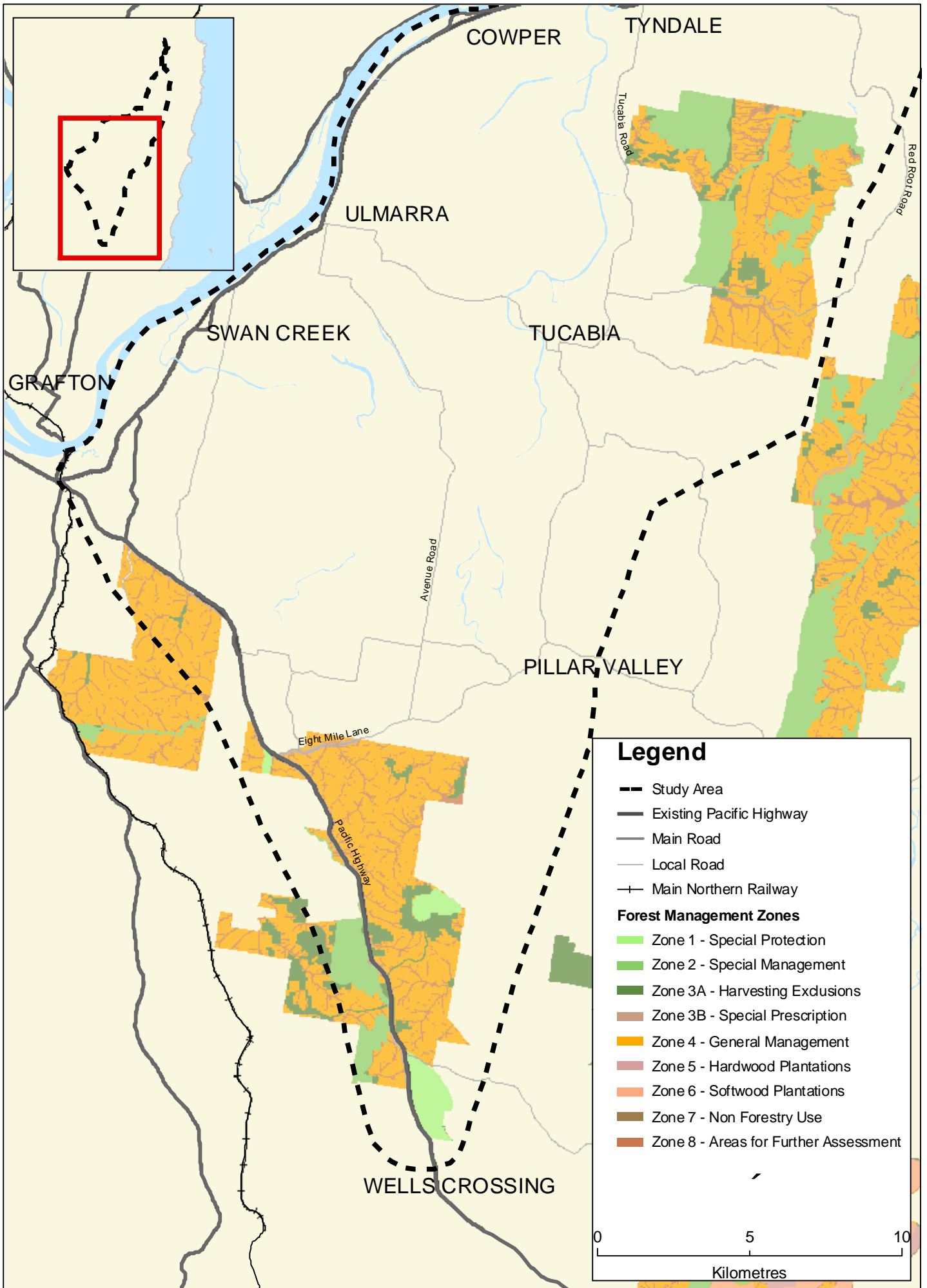
Horticulture is also an important part of the local agricultural economy. A variety of fruit, nut and berry crops are grown in the area. Other uses include plant nurseries, forage crops, cereals and vegetables. The Clarence Valley is also one of the main soybean cropping areas on the north coast.

Forestry

State Forests occupy substantial areas within the south and east of the study area. The main State Forests are Glenugie State Forest, Newfoundland State Forest, Bom Bom State Forest and Pine Brush State Forest.

Land use activities within State Forests include timber harvesting, conservation, scientific research and recreation. Forest Management Zones have been adopted by NSW Forests to assist in the management of State Forests, and are illustrated for the State Forests in the study area on

Figure 5-10.



WC_Ro_016

Figure 5-10 Forest management zones

There are also two plantations on private land in the study area. These include a joint venture plantation west of the existing Pacific Highway south of South Grafton, and a plantation in the Clarenza area between the highway and Centenary Drive. No accurate statistics are available on native forestry on private land, as approval is only required for clearing of more than two hectares per annum (under the *Native Vegetation Conservation Act, 1997*). It is likely that some farmers supplement their income through sustainable native forestry. This is likely to be more common in the east of the study area, where timber resources on private land are higher quality than on the floodplain.

National parks, state conservation areas and nature reserves

Three areas of land reserved under the *National Parks and Wildlife Act, 1974* are located within the study area:

- The Yuraygir State Conservation Area is a large reserve that joins the Yuraygir National Park and Newfoundland State Forest, and is partly within the study area. It is former state forest land that has been transferred to the national parks estate.
- The Yaegl Nature Reserve near Maclean is entirely within the study area. It is a large wetland that is also identified under SEPP 14, and contains relatively high quality remnant floodplain and wetland vegetation communities, also likely to be listed under the *Threatened Species Conservation Act*.
- The Mororo Creek Nature Reserve is located to the west of the Pacific Highway in the vicinity of the Iluka Road intersection, partly within the study area.

Highway related land uses

The historical development of towns and other settlements in the area has been focused on major rivers and roads. The Pacific Highway is the major land-based transport route in the area, providing for local and regional access. Substantial through traffic generates demand for services and facilities including retail, accommodation, petrol and vehicle related services (towing and repairs). Many of these uses rely on passing trade, and as such are situated on the highway to benefit from direct exposure. The main highway related uses include:

- Service stations in locations including South Grafton, Swan Creek, Ulmarra and Tyndale.
- Motels and caravan parks such as those at South Grafton, Ulmarra and Tyndale.
- Convenience food outlets at South Grafton.
- Tourist related uses such as the Ferry Park visitors centre and restaurant south of Maclean, the visitor information centre at South Grafton, and tourist focused shops and restaurants in Ulmarra.

Extractive industries and mines

There are several areas where quarrying operations are concentrated within the study area. These are generally on the more elevated areas, although there is some evidence of quarrying on the floodplain, possibly for sand. There is no evidence of mining operations in the study area. The main quarrying areas that appear to be active are located in the south-east of the study area in the hilly areas south of Pillar Valley, south of Tyndale, again within the small range and between Gulmarrad and James Creek. The main extractive resources in the study area are likely to be sand and gravel.

5.4.3 Public utilities

The major public utilities known within the study area from consultation with utilities companies include:

- A mobile phone tower at Glenugie.
- A 132kV line located midway between the existing highway intersection with the Gwydir Highway at South Grafton and Four Mile Lane.
- A 33kV line that runs along the northern side of Brooms Head Road.
- An optical fibre telecommunications cable to the west of Centenary Drive in Clarenza.

There are no known major water, sewer or gas utilities within the study area. Further investigation into the locations of utilities and other infrastructure would be undertaken in later stages of the project.

5.4.4 Indigenous heritage

Aboriginal groups in the study area

The study area falls within the boundaries of the Grafton-Ngerrie and Yaegl Local Aboriginal Land Councils (LALC). The Birrigan Gargle LALC also has an interest in the north-east of the study area. The general region is also recognised as part of the Barangayir Nation Aboriginal community, which is represented in the Grafton area by the Barra Way Wajid traditional owners group. Several tribal and elders groups also have an interest in the study area, including the Nungera Cooperative Society, the Ulungundahi Elders Group and the Yamboora Aboriginal Corporation.

The two major tribal groups in the study area are the Gumbainggar and the Yaygir. The exact boundaries of these groups are unclear, however, it is apparent that they both have an interest in the study area. These areas are bounded to the north by the Badjelong (Bandjalong) tribal group and the south by the Dangaddi tribal group.

Indigenous heritage within the study area

From the findings of previous archaeological studies, consultations with Aboriginal groups and general knowledge of Aboriginal settlement patterns on the north coast, Navin Officer Heritage consultants developed a predictive model for the study area to determine the likely occurrence of indigenous heritage sites. **Figure 5-11** illustrates the broad-scale predictive model developed for the study area, with the moderate to high sensitivity areas described in **Table 5-9**.

Table 5-9 Areas of archaeological sensitivity within the study area

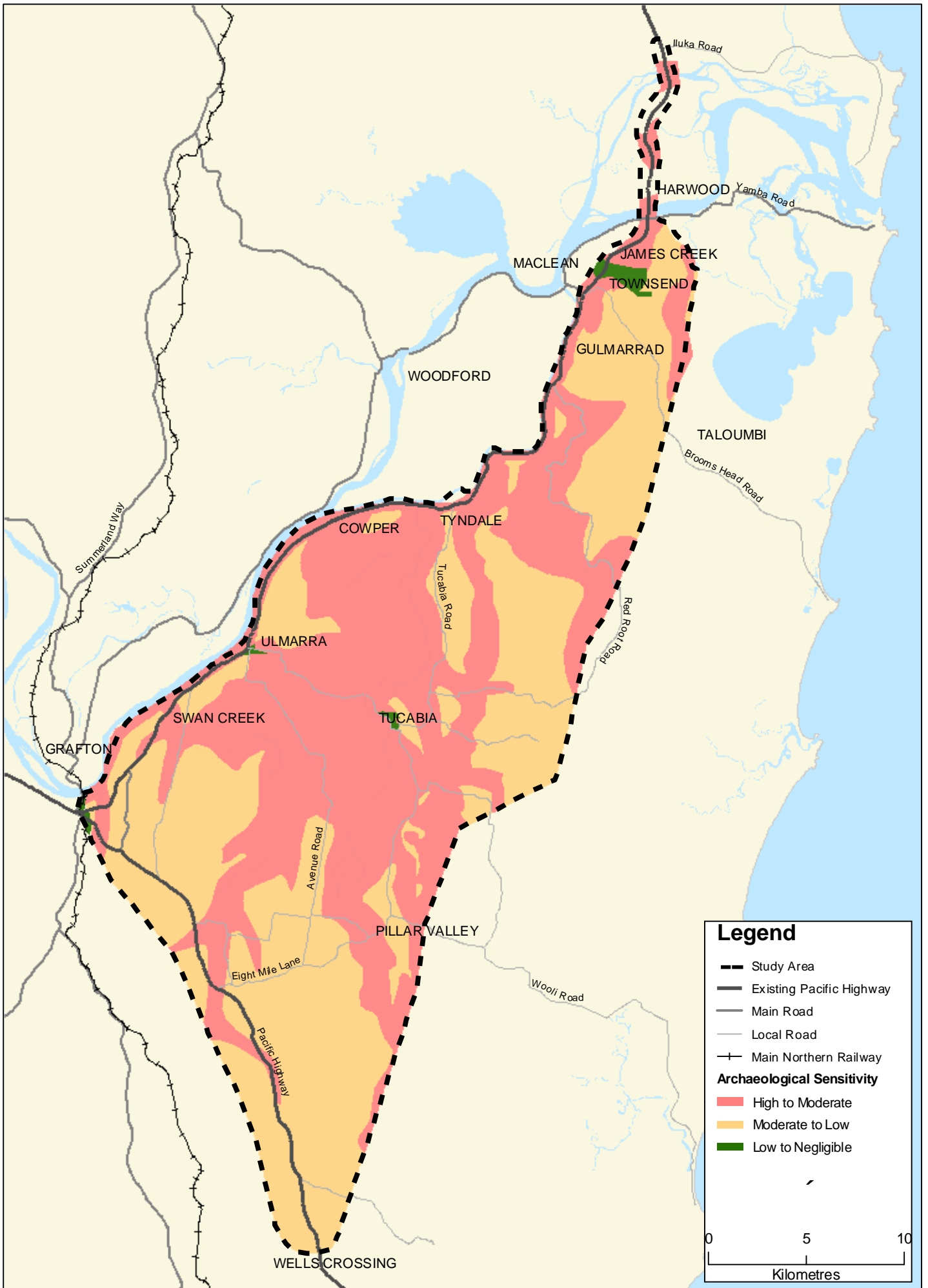
Sensitivity Classification	Broad Scale landforms
High to moderate archaeological sensitivity	<ul style="list-style-type: none"> ▪ Valley floor topography associated with the margin of the Clarence River, major creeks and wetland basins. ▪ Locally elevated topography on the valley floor. ▪ Lowland ranges - low ranges adjacent to and bordering the valley floor. ▪ Sandstone exposures within the Escarpment Ranges. ▪ Locally elevated valley floor topographies in the narrow valleys which transect the escarpment ranges. ▪ Glenugie Peak.
Moderate to low archaeological sensitivity.	<ul style="list-style-type: none"> ▪ Upper and mid-valley ranges. ▪ Lesser riparian zones. ▪ Valley floor and lowland range topographies associated with intermittent or lesser water sources. ▪ Relatively level crest topographies in the escarpment ranges.

Field surveys were undertaken over a period of five days in April 2005 across the study area to sample a range of topographies such as hills and ridges, floodplains, river and creek margins and associated terraces. The ability to obtain representative sampling across the entire study area was somewhat constrained by property access issues.

The survey concentrated on areas of high visibility, such as vehicle and stock tracks, contour banks, areas of erosion and ploughed or denuded ground. Previously recorded sites were also inspected by archaeologists to confirm their location and status. The field survey identified 17 sites within the study area, in addition to the nine sites already recorded on the AHIMS register.

In addition, a further four sites have been identified in the study area from previous studies. However, these are not recorded on the AHIMS database as they are finds from property owners that were brought forward to archaeologists, and their location cannot be accurately determined. These items are artefact scatters and PADs.

The majority of sites are recorded from the lower lying floodplain sections of the study area, although some sites have also been identified in the foothills and hill slopes.



WC_Ro_017

Wells Crossing to Iluka Road
Upgrading the Pacific Highway

**Figure 5-11 Predictive model for indigenous heritage sites
in the study area**

For reasons of sensitivity to the local Aboriginal community, indigenous heritage sites are not publicly reported. However, they have been reported to the DEC for inclusion in the AHIMS register.

Consultation with local Aboriginal groups was undertaken as part of the route options heritage investigations. These consultations indicated the presence of locations and features in and around the study area that have cultural significance to the Aboriginal people of the area. These include:

- Glenugie Peak.
- Clarence Peak.
- The Pillar Valley area.
- Camp sites at Wells Crossing, Bom Bom and Ulmarra.
- Ceremonial sites located to the east of the study area, south of Maclean, and walking routes to these sites that pass through the study area.

The potential for indigenous heritage sites within the study area may well be higher than indicated by the results of investigations. The history of Aboriginal occupation of the study area is well documented, and the findings of some studies suggest that the limited records from the study area are more a result of lack of investigations than a low concentration of sites. Particularly in high sensitivity areas such as major river margins, ridge and spurline crests and other locally elevated areas, the potential for indigenous heritage items is significant. In addition, local Aboriginal community representatives have advised of areas of cultural significance within or near the study area. As such, despite the relatively low number of records for the study area, it is considered to have high archaeological potential. At a broad scale, the floodplain areas in the west of the study area are considered to have greater potential than the forested coastal ranges and slopes of the eastern study area.

5.4.5 Non-Indigenous heritage

Historical overview

References to the Clarence River are made as early as 1799 by Flinders, who anchored his sloop in the river estuary and described Aboriginal huts on the riverbank (Flinders 1799:6).

The first official exploration by settlers was in 1839. The Clarence River district was eventually opened up by the cedar cutters exploiting the timbers along the river. By 1845 much of the lower reaches of the river had been taken over by the cedar trade (Rich 1990). Shortly after the first cedar getters settled in the region a village grew in the area of the city of Grafton.

Timber-getters were soon followed by pastoralists and station properties were established in the Grafton area in the 1840s. The gold rushes in the latter 1800s and the Robertson Land Acts from

1861 brought a dramatic increase in the white population. The large leasehold pastoral runs were replaced by the closer settlement of small selectors, their holdings eventually impacting on even marginal country in the upper tributary valleys.

Ulmarra town prospered with the introduction of the dairy industry after the collapse of the sugar mill. Ulmarra wharf was a major pick-up point for steam and sailing vessels serving the Sydney markets. The town thrived until improved roads and technology ended its role as a major river port.

Heritage records for the study area

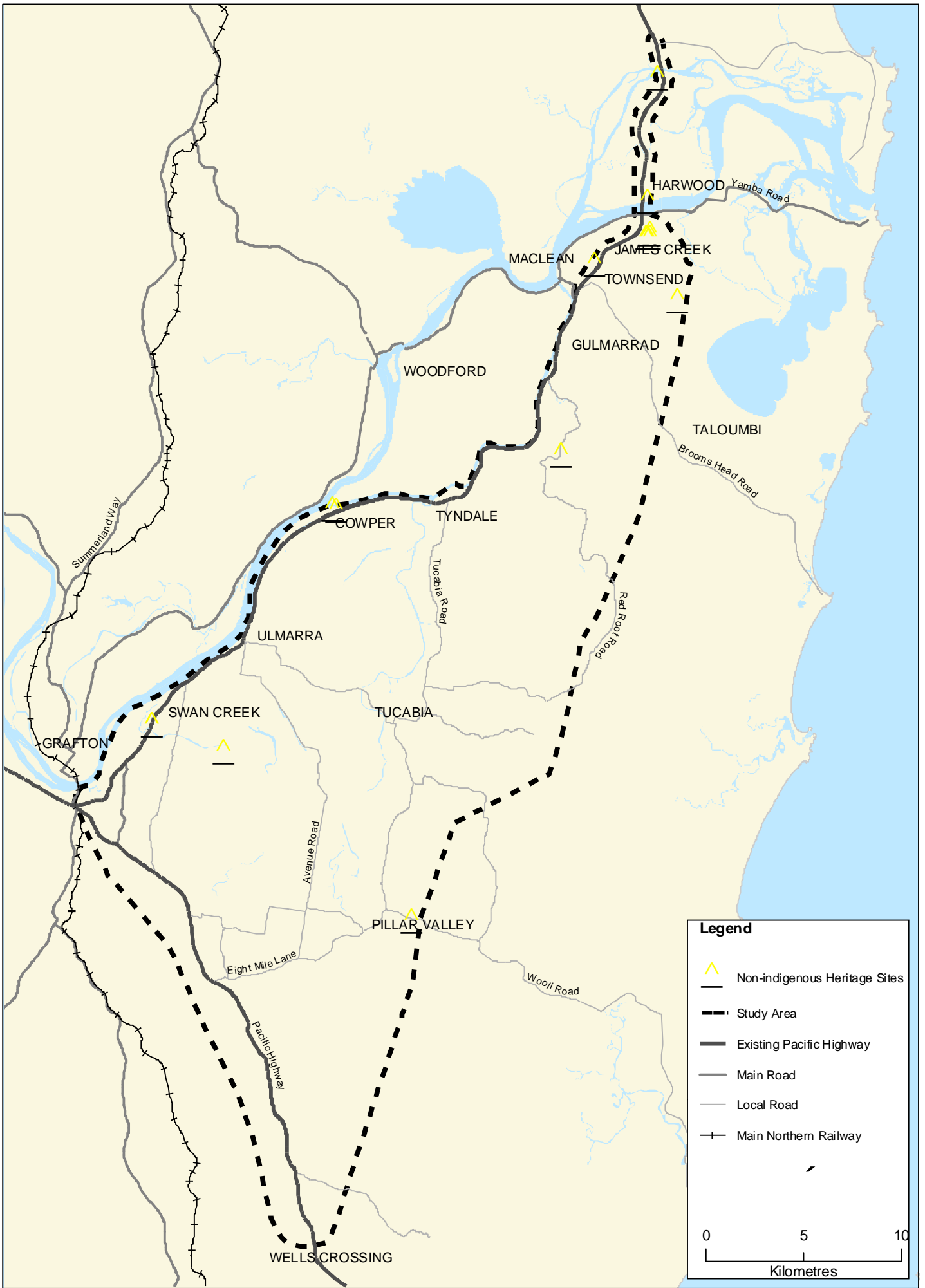
There are 14 heritage listed sites within, or immediately adjacent to, the study area, as illustrated at **Figure 5-12**. Of these, one is listed on the Register of the National Estate, two are listed on the State Heritage Register, one is shown on the register of the National Trust of Australia (NSW), eight are listed on the Maclean LEP 2001, two are listed on the RTA Heritage and Conservation Register, and one is listed on the Ulmarra LEP 1992.

A further 16 historical sites, with potential heritage significance, were identified during field surveys by Navin Officer Heritage Consultants and are illustrated at **Figure 5-12**. These sites are believed to be in excess of 50 years old and if so are protected as relics under Section 139 of the *NSW Heritage Act 1977*. However, they are not currently recorded on any local, state or national heritage lists. Further assessment is required to determine their potential heritage significance in accordance with relevant heritage legislation, and would be undertaken at the preferred route stage for relevant sites.

5.4.6 Visual amenity

North of Grafton, the visual landscape of the study area is dominated by the Clarence River, its tributaries and the surrounding floodplain. These features provide an attractive landscape for residents in the study area and motorists travelling through. The relatively flat topography provides opportunities for uninterrupted views over the agricultural land to the Coast Range in the east. In the south and east of the study area, the visual landscape alters due to the presence of denser vegetation within the State Forests, State Conservation Areas and other bushland areas.

Water is a major landscape feature of the study area due to the dominance of the Clarence River in the local area, along with its tributaries, creeks and wetlands. These elements have all contributed substantially to the shaping of the landscape. In addition to these natural features the riverside towns of Ulmarra, Cowper and Maclean are also attractive cultural features. In a similar way the rural town of Tucabia has a more subtle charm that adds visual variety to the setting of the study corridor.



WC_Ro_023

Wells Crossing to Iluka Road
Upgrading the Pacific Highway

Figure 5-12 Non-indigenous heritage items within the study area

The majority of the study area is characterised by the floodplain. It is low, generally flat and has been subject to substantial alteration in terms of vegetation cover and clearing as a result of a long history of agricultural use. Defining features or landmarks are few in this area. Watercourses tend to provide the main source of variety in the visual landscape.

The south-eastern section of the study area contrasts with the low elevation floodplain areas of the west and north. It is more hilly, and includes several low coastal ranges with relatively steep topography. Remnant vegetation is better preserved in comparison to floodplain areas, where it has been largely cleared for agricultural development. The overall character of the south-east of the study area is more rugged, isolated and varied than the floodplain areas. It is less developed and retains more of the natural features that would have characterised the area prior to non-indigenous settlement.

Major landmarks within the study area are few, as a result of the generally low relief. Glenugie Peak, in the south of the study area, is a significant feature that is visible from much of the study area and beyond. Clarence Peak, to the east of the study area around Taloumbi, is a similarly striking feature that can be seen from significant distances.

5.4.7 Noise environment

The study area has a large number of residential dwellings, some of which are clustered together in developments, while others are more widely dispersed. The study area contains approximately 2,800 buildings that may potentially be residential dwellings⁹. The majority of these residences are located in Grafton and districts, Ulmarra, Pillar Valley, Townsend, Gulmarrad and James Creek. Other significant communities include Tucabia and residences along the existing highway. Smaller communities and individual properties are scattered throughout the investigation area. Dwellings are also concentrated along main roads.

It should be noted that actual numbers of affected residences, or other sensitive receivers such as schools, hospitals, etc, may be subject to change as the assessment of noise develops through the project. Exact numbers of structures may be subject to change due to counting errors. In some cases, potentially sensitive receivers may turn out to be sheds or other structures that are not considered noise sensitive. Further refinement of the noise assessment would be undertaken for the preferred route to provide an accurate assessment of noise impacts. This would include verification

⁹ Buildings were identified from aerial photography dated November 2004. Exact numbers of noise sensitive structures may be subject to change due to counting errors, buildings constructed since the aerial photography or incorrect interpretation e.g. large sheds counted as houses. Accordingly, a conservative approach has been adopted.

of the location and type of all noise sensitive receivers through further aerial photography interpretation and field inspections.

The majority of the study area is currently not subject to significant road traffic noise, or to noise from other sources. Areas adjacent to the existing Pacific Highway are subject to the highest levels of road traffic noise. Other areas, particularly in the east of the study area, are subject to only low volumes of traffic on local roads, and the existing noise environment is typical of relatively isolated rural areas.

Road noise goals

Road traffic noise goals are identified from the Department of Environment and Conservation’s (DEC) *Environmental Criteria for Road Traffic Noise* (ECRTN) guideline. The appropriate noise goals for the proposed upgrade of the Pacific Highway are listed in **Table 3.1** below. The assessment methodology and application of the noise criteria are taken from the RTA’s Environmental Noise Management Manual (ENMM).

Table 5-10 Base criteria for road traffic noise

Road category	Daytime Levels	Night-time levels
New Freeway	L _{Aeq} (15hour) 55 dB (A)	L _{Aeq} (9hour) 50 dB (A)
Redevelopment of an existing freeway	L _{Aeq} (15hour) 60 dB (A)	L _{Aeq} (9hour) 55 dB (A)

The road category applicable for the majority of the route options is that of a new freeway. However, for parts of some options where the existing road is to be upgraded, the relevant criteria may be for redevelopment of an existing freeway, defined in the ECRTN as follows:

“Redevelop existing freeway/arterial refers to an existing freeway, arterial or sub-arterial corridor where it is proposed to increase traffic-carrying capacity, change the traffic mix or change the road alignment through design or engineering changes. Redevelopment does not cover minor road works designed to improve safety, such as straightening curves, installing traffic control devices or making minor road alignments.”

Other sensitive receivers not covered under the residential criteria such as schools hospitals and churches have separate internal noise level criteria under the ECRTN.

According to the ECRTN, new roads should be designed so as not to increase existing noise levels by more than 0.5 dB. For a road redevelopment, noise levels should not increase above the existing by more than 2 dB. In both cases the ECRTN states that noise levels should be reduced to meet the criteria. Measures for consideration to meet the criteria, where they cannot be met through alignment of the road, include:

- Maintenance of roads to identify and rectify potholes, to minimise vibration and airborne noise.
- Architectural acoustic treatment of existing buildings.
- Acoustic design in future developments, including imposition of conditions of consent by council on future development, and planning for future residential release areas.
- Road surface treatments, which can result in different noise emissions from roadways, particularly at higher traffic speeds.

The RTA's ENMM provides further detail on which strategies would be most appropriate, taking into account the factors affecting each sensitive receiver location.

5.5 Economic context

Grafton is located at the centre of the Clarence Valley and it provides retail outlets, services, entertainment and employment for many residents from the surrounding areas. Whilst Grafton has only 35 per cent of the Clarence Valley population, it has 60 per cent of the retail establishments within Clarence Valley and it provides 75 per cent of the employment in the retail field (Grafton City Council website). Maclean is also an important retail and service centre.

The economic base of the study area is largely agriculture, tourism and transport services, with all sectors having good potential for future development.

In the agricultural sector, the main crops grown are sugar cane, sub-tropical fruit and vegetables and cereals, while beef cattle raising is also an important activity. The land is prime agricultural land, being associated with the floodplains and alluvial levees of the Clarence and Coldstream river systems.

Grafton is a transport hub for the surrounding region, being served by three highways, the North Coast Railway and an airport. It is increasing in attractiveness as a location for the warehousing and distribution industry, partly because of improved road transport links and also because of factors such as proximity to the fast-growing south-east Queensland and mid-north coast of New South Wales and lower costs of land acquisition or building rental than Sydney or Brisbane locations.

Most manufacturing (other than sugar) is geared to production for local use, eg. food products, printing and local input requirements. This pattern is unlikely to change in the future, particularly as the general climate for business is possibly more favourable in south-east Queensland (through lower costs of doing business, other than land).

Growth opportunities in the study area will be led more by tourism and in-migration of households (both retirees and working-age) than by production. However, such growth is not expected to be as

strong as in the major centres of Coffs Harbour and Port Macquarie, with their better provision of health and education services, accommodation facilities and employment opportunities, or in coastal centres closer to Sydney or south-east Queensland (eg. Port Stephens, Great Lakes, Ballina, Tweed Heads). Grafton and surrounds also lack comprehensive air travel services and this may be a limiting factor in the growth of tourism, relative to other areas with more regular and larger capacity flights.

Tourism is, however, a major activity, with tourists attracted by the area's climate, beaches and waterways, heritage and cultural facilities, recreational and sporting activities, accommodation facilities and the village atmosphere of the town centres. There are large influxes of visitors to the coastal towns of Iluka, Yamba, Minnie Water and Wooli during holiday periods and to Grafton during major events such as the Racing Carnival, Bridge to Bridge Ski Race and Jacaranda Festival. Whilst these towns are outside the study area, visitors pass through the study area to reach these destinations.