



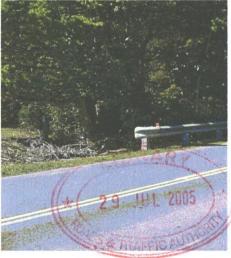
Upgrade of Cudgera Creek Road

Review of Environmental Factors

July 2003



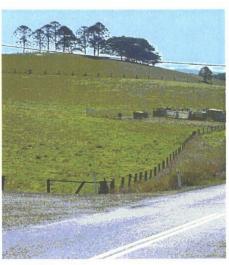
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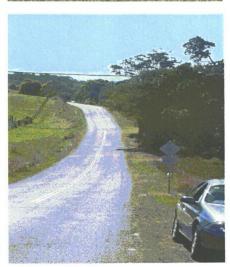












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I Proposal Identification

Name of Proposed Activity

Review of Environmental Factors for the upgrade and rehabilitation of Cudgera Creek Road, Cudgera.

Local Government Area

Tweed Shire Council.

RTA Region

Northern Region.

2 Introduction and Background

2.1 Introduction

The NSW Roads and Traffic Authority (RTA) propose to upgrade and rehabilitate Cudgera Creek Road at Cudgera Creek.

This Proforma 2 Review of Environmental Factors (REF) has been prepared by Environmental Technology Branch (RTA Operations Directorate) on behalf of the RTA Northern Region (RTA Client Services).

For the purpose of these works, the RTA is the proponent and determining authority under Part 5 of the *Environmental Planning and Assessment* (EP&A) *Act 1979*.

The purpose of this REF is to describe the Proposal, to identify and assess the likely impacts of the Proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed works and the associated environmental impacts have been undertaken in the context of Clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Threatened Species Conservation* (TSC) *Act 1995*, the *Fisheries Management (FM)* Act 1994, and the (Commonwealth) *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*. In doing so, the REF helps fulfil the requirements of Section III of the EP&A Act that the RTA examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

This REF has been prepared in accordance with the RTA's Proforma 2 REF as presented in the RTA's *Environmental Impact Assessment Policy, Guidelines and Procedures, Version 4* (RTA, April 2001).

The findings of the REF will be considered when assessing:

 whether the Proposal is likely to have a significant impact on the environment and therefore the necessity for an Environmental Impact Statement (EIS) under Section I12 of the EP&A Act;

- the significance of any impact on threatened species as defined by the TSC Act, in Section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement (SIS); and
- the potential for the Proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Commonwealth Environment Minister in accordance with the EPBC Act.

2.2 Background

The upgrading of the Pacific Highway between Yelgun to Chinderah arose directly from a land use and transport strategy study undertaken in 1996 by the Department of Urban Affairs and Planning (DUAP) and the RTA. That study identified the need for upgrading the highway between the Brunswick River and Yelgun, and identified an investigation corridor for the section between Yelgun and Chinderah.

As part of the concept design for the Yelgun to Chinderah project, traffic investigations were undertaken for the project, which identified three locations where interchanges were required to link with the existing road network. These were at Cudgera Creek Road, Clothiers Creek Road and Oak Avenue.

The interchanges were to create the priority links to the coastal hamlets to the east of the Yelgun to Chinderah project. As such Cudgera Creek road was to become the main route by which access would be gained to Pottsville. Given the expected immediate increase in usage and additional increase in line with expected residential growth in the Pottsville area a need was identified for Cudgera Creek Road to be upgraded as a direct result of the Yelgun to Chinderah Project.

The requirement for RTA to undertake the current Proposal has arisen from the Conditions of Approval for the Yelgun to Chinderah Project provided by the then Minister for Planning in February 1999.

Condition 31 states:

"The proponent (RTA) shall in consultation with Tweed Council, ensure commencement of the upgrade of Cudgera Creek Road between the Proposal (Freeway) and Mooball-Pottsville Road no later than 5 years after the commissioning of the Proposal. The Proponent shall undertake all necessary environmental assessment under the EP&A Act and other relevant legislation prior to commencement of any upgrade works."

2.2.1 Consideration of Options

Abigroup undertook a Route Options Identification and Assessment on behalf of the RTA on 21st February 2002. Five (5) possible routes or options were identified and assessed. The preferred route was selected based on the consideration of environmental impact, hydrological impact, noise impact, social impact and transport efficiency. The organisations represented were:

- Roads & Traffic Authority
- Professional Engineering Services
- National Parks & Wildlife Service
- NSW Fisheries

- Abigroup
- Dept Land & Water Conservation
- Tweed Shire Council
- Geolink

The study identified 5 possible route options as detailed below (refer to Figure A-3 in **Appendix A**):

Option I: Route A - Do nothing.

This option is not feasible given Condition of Approval No 31 for the Yelgun to Chinderah Project. Therefore this option was not considered further.

Option 2: Route B - 10m north of existing bridge and through existing hill.

This option would involve a bridge length of at least 80m with at least 2 sets of piers in the waterway. Rare and threatened plants would be impacted and surplus fill material would be created. One dwelling and four landholders would be affected.

Option 3: Route C – 10m south of existing bridge and through existing hill.

This option would involve a bridge length of at least 24m. Riparian vegetation would be affected and at least one threatened species would be directly impacted. Isolation of grazing land would occur to the east of the existing bridge. This option would result in the creation of surplus fill material. Two dwellings and three landholders would be affected.

Option 4: Route D – Northern alignment with large curves.

This option departs the existing road to the west of the bridge cutting through the toe of the existing hill on the bend to the north. This option would involve a bridge of at least 24m, no piers in the stream and no direct impacts upon threatened species. This option would also create surplus fill. Two dwellings (one unoccupied) and four landholders would be affected. This option provides the opportunity to revegetate between the existing road and Route D.

Option 5: Route E – Construct new bridge over existing bridge and straight alignment.

Threatened species would be directly impacted due to complex construction processes that would be required over the existing bridge. Isolation of grazing land would occur to the east of the existing bridge. This option would result in the creation of surplus fill material. There would be an increased cost of construction associated with keeping the existing bridge open to traffic during construction. No dwellings and a minimum of two landholders would be affected.

A preferred route option was selected following a review of the technical and non-technical information collated during the investigation stages of the Proposal by Abigroup. The review was aimed at selecting a route that achieved a balance between meeting the needs of the community and road users while minimising environmental impacts. In choosing a preferred route option the following evaluation criteria were considered:

- Safety during construction;
- Operational safety;
- Ecological impact;
- Hydrological impact;
- Noise impact;
- Social impact;
- · Efficiency of expenditure; and

• Transport efficiency.

AbiGroup, (2002) in consultation with stakeholders, determined that route D (option 4 above) was preferred as it would result in the least impact on the environment, a safe road for motorists and residents, and has minimal impact on the community overall. Route D delivered the best outcome as it achieved the following:

- Meets the project design objectives;
- Minimises noise impacts;
- Meets the hydrology requirements;
- Minimises the impact on rare and threatened species;
- Minimises cost:
- Meets safety requirements;
- Minimises social impacts; and
- Minimises agricultural impacts.

Subsequent to the identification of the preferred route preliminary comments were sought from key stakeholders including relevant government agencies regarding issues relevant to the preferred route chosen.

2.3 Methodology

The method in which this document has been prepared is as follows:

- I. A start-up workshop was held on Wednesday 18th September 2002 including a project familiarisation meeting, a risk management workshop and a site inspection. Attendees included:
 - Jim Campbell (Client);
 - Peter Black (Project Manager);
 - Dave Purdy (Project Management);
 - Richard Dunnicliff (REF Project Manager);
 - Greg Collins (Regional Environmental Advisor (REA) Northern Region)
 - David Warren-Gash (Geotech Drilling);
 - John Taylor (Geotech);
 - David Anderson (Survey);
 - Chris Sutherland (Bridge Design);
 - Bob Davis (Road Design);
 - Sally Benham (WBM Oceanics Hydrology Modelling); and
 - Donna Martin.
- 2. Consultation was undertaken with the following agencies and RTA personnel:
 - Tweed Shire Council;
 - NSW Agriculture;
 - NSW Fisheries;
 - NSW Department of Land and Water Conservation;
 - NSW National Parks and Wildlife Service;
 - NSW EPA:
 - Greg Collins Environmental Adviser, RTA Northern Region; and

- Mary-Lou Buck Aboriginal Programs Consultant, RTA Northern Region.
- 4. A search was conducted on the following databases to identify any potential issues:
 - Australian Heritage Commission Register of the National Estate;
 - NSW Heritage Office State Heritage Register;
 - RTA Heritage and Conservation Register (s170);
 - Council Heritage Listings (LEP);
 - NPWS Aboriginal Heritage Information Management System (AHIMS);
 - National Native Title Claims Search;
 - Atlas of NSW Wildlife threatened flora records;
 - Atlas of NSW Wildlife threatened fauna records; and
 - Environment Australia (EPBC Act) Databases.

The results of the database searches are included at **Appendix D** of this REF.

- 5. As part of the environmental assessment undertaken for this REF, a series of specialist studies were undertaken to identify Proposal constraints and to provide environmental impact mitigative measures. Details and findings from the relevant investigations are further discussed in this REF and a copy of each specialist study is included in the appendices of this REF. Specialist investigation leading up to and during the REF development phase focussed on:
 - Biodiversity;
 - Acid Sulphate Soils;
 - Hydrology/Hydraulics;
 - Water Quality; and
 - Noise.
- 6. A literature review and review of documentation was undertaken to determine issues relating to:
 - Landform, geology and soils and Potential Acid Sulphate Soils;
 - Local Environment Plan (zoning);
 - State Environmental Planning Policies; and
 - Regional Environmental Plans.
- 7. Assessment was undertaken in line with the RTAs *Environmental Impact Assessment Policy Guidelines Procedures, 2001* and current RTA policies

3.1 Location

The Proposal is located on Cudgera Creek Road approximately 25km south of Tweed Heads, 15km southeast of Murwillumbah and approximately 40km north of Byron Bay. Refer to Figure 1 below for site location.

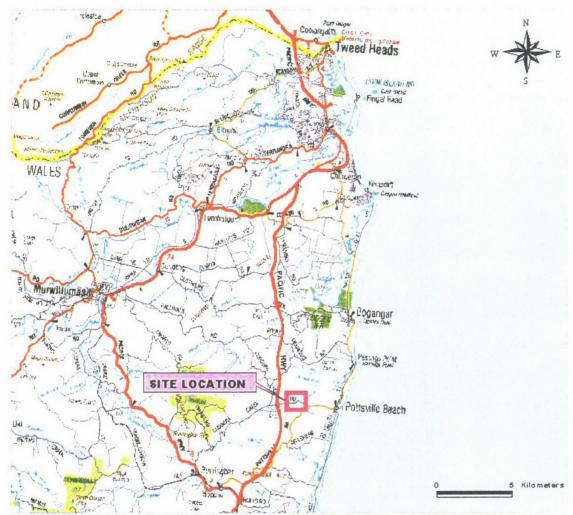


Figure 1: Location Map showing the Proposal and Study Area (Not to Scale). Data under licence from Pacific Access, 2002.

3.2 Description of Site and Surroundings

The study area is located approximately 2.5km west of Pottsville Beach. The study area extends from the location of the Cudgera Creek road interchange on the Yelgun to Chinderah section of the Pacific Highway upgrade (refer to photo I in **Appendix A**), to 200m east of the junction of Cudgera Creek Road and Pottsville/Mooball Road (refer to photo 2 in **Appendix A**), a distance of approximately 2 kilometres. The investigation includes lands within 20 metres either side of the existing road verge as well as areas between the existing alignment and the proposed alignment. The large majority of the study area comprises grassland and crop land habitats.

The existing road is a two lane single carriageway rural road, with unformed shoulders and a variable clear zone. The speed limit along Cudgera Creek Road is 100km/h, however the safe travel speed is as low as 50 km/hr in the vicinity of Cudgera Creek bridge. The road crosses Cudgera Creek approximately 1km to the east of the Cudgera Interchange. A Lowland Rainforest on Floodplain community is located within the study area along the banks of Cudgera Creek. Adjacent land uses are predominantly agriculture-based, although a quarry is located on the southern side of the road opposite the existing bridge.

Nine dwellings gain access to Cudgera Creek Road within the study area, two of which are located within 40m. One of the houses is to be removed as part of the Proposal. A further derelict dwelling is also to be removed for the new alignment (refer to photo 3 in **Appendix A**). Cudgera Creek Road traverses relatively low-lying floodplain lands associated with Cudgera Creek. The large majority of the land has been historically cleared for agricultural purposes, and is currently used for sugar cane production (crop land) and as grazing land (pasture grasses). Regrowth and weed infested areas occur alongside roadside verges. A narrow linear strip of vegetation has been retained along the banks of Cudgera Creek. This comprises remnant and regrowth Lowland Rainforest on Floodplain of relatively high quality in terms of plant species diversity and protection of aquatic habitats associated with Cudgera Creek.

The 'Lowland Rainforest on Floodplain' community is categorised as a threatened ecological community under the TSC Act. The remaining rainforest habitat is a remnant of the original vegetation of the locality. A portion of the total study area contains habitat attributes important to local fauna species, including dense cover, tree hollows, freshwater, foraging and breeding areas, refuge and movement opportunities. Of particular importance is the presence of a diversity of fruiting tree and shrub species. These provide seasonal food resources to a wide range of frugivorous fauna species, including several threatened bird species.

Cudgera Creek (refer to photos 4 & 5 in **Appendix A**) provides a specific habitat for aquatic fauna, in particular stream dwelling frogs, fish and crustaceans. The creek is a permanent watercourse, with occasional deep pools and riffles and areas of dense sedge and rush vegetation. The creek has a natural low flow, which is still in dry times and has submerged logs and debris providing shelter and breeding sites for fish and aquatic fauna.

3.3 Description of the Proposal

3.3.1 General Description of the Proposal

The Proposal involves the upgrading and realignment of Cudgera Creek Road from the eastern limits of the Cudgera Creek Road Interchange with the Pacific Highway to approximately 200 metres east of the junction with Mooball-Pottsville Road, a length of approximately I.8km (refer to Design Plan in **Appendix B**).

The realignment would include a new bridge crossing approximately 80m to the north of the existing bridge. The bridge would be 28 metres in length and would span the entire width of the creek at this location. No piers would be located within the banks or the streambed. The existing concrete bridge, which has no timber components, would be removed with that area being rehabilitated with species indicative of the 'Lowland Rainforest on Floodplain' community.

The Proposal would also involve rehabilitation of the existing road and realignment in the vicinity of Cudgera Creek (refer to photo 3 in **Appendix A**), including widening of the

existing cutting to the east of the proposed new bridge crossing. The alignment would be improved to a safe standard for travel at 80 km/hr along the entire length.

Currently the section of Cudgera Creek to which this Proposal applies is closed during a 1 in 2 year average rainfall interval flood event. The pavement would be raised to provide protection from a 1 in 5 year average rainfall interval flood event.

The existing pavement would be restored to a 20 year design life. Two 3.5 m travel lanes with minimum 2m shoulders would be provided along the entire length of the Proposal. The Proposal would also involve the redesign of the intersection of Cudgera Creek Road with Mooball-Pottsville Road so that Cudgera Creek Road becomes the priority road.

The proposed works also involves replanting, rehabilitation and landscaping works, property acquisition, utility adjustments, clearing, earthworks, stockpiling and spoiling material, drainage works, bridge construction, existing bridge removal, pavement works, wearing surface and rehabilitation works.

3.3.2 Cost and Source of Funds

The Proposal is estimated to cost \$8 million based on the preferred concept design discussed in this REF.

3.3.3 Timing

The works are anticipated to begin in late 2004 and take approximately 12 months to complete.

4 Statutory Requirements

4.1 Local Environmental Plan

The Proposal is located within the Tweed Shire Council Local Government Area (LGA) therefore the Proposal is subject to the Tweed Shire Local Environmental Plan (LEP) 2000. Under the LEP the following zonings applies to the study area:

- The road reserve is unzoned;
- I (a) Rural; and
- I (b)2 Agricultural Protection.

Under the Tweed Shire LEP 2000 the following clause applies to the development of unzoned land:

"A person must not carry out development (other than development for the purpose of an outdoor eating area on a footpath within a road reserve or development listed in Schedule 5) on unzoned land except with consent."

The primary objectives of the Rural I(a) zone are to enable the ecologically sustainable development of land that is suitable primarily for agricultural or natural resource utilisation purposes and associated development and to protect the rural character and amenity of the land.

The primary objectives of the Agricultural Protection 1(b)2 zoning is to protect identified prime agricultural land from fragmentation and the economic pressure of competing land uses

Activities including drainage, roads and utility installations undertaken within unzoned land and within land zoned Rural and Agricultural Protection would ordinarily require development consent. However, as the works are for the purposes of a classified road, clause IIC of SEPP 4 operates to remove these consent requirements. For further information regarding SEPP 4, please refer to section 4.3 of this REF.

4.2 Regional Environmental Plan

The North Coast Regional Environmental Plan 1988 applies to the Tweed Shire Local Government Area. This REP does not impose EP&A Act consent requirements in relation to the Proposal. Regardless the Proposal is not considered to be inconsistent with the aims and objectives of the plan. Aims and objectives of this plan relevant to the Proposal are:

I. Agricultural resources

- (a) to conserve the productive potential of agricultural land;
- (b) to provide for new forms of agricultural development and changing patterns of existing agricultural development;
- (c) to ensure that commercial agriculture is not affected adversely by incompatible uses which impair its long term sustainability; and
- (d) to ensure that industries and services that support agriculture are not disrupted.

The Proposal would affect only 400m² of agricultural land and wold assist in in the continuation of agricultural pursuits by providing a better quality road.

2. The objectives of this plan in relation to fisheries and catchment management are to preserve and enhance fishery habitats and associated catchments, and to promote the sustainable use of natural resources.

No threatened fish species were found during survey.

3. The natural environment

- (a) to protect areas of natural vegetation and wildlife from destruction and to provide corridors between significant areas;
- (b) to protect the scenic quality of the region, including natural areas, attractive rural areas and areas adjacent to waterbodies, headlands, skylines and escarpments; and
- (c) to protect water quality, particularly within water catchment areas.

The Flora, Fauna and Aquatic Assessment undertaken by SKM concluded that the Proposal would not result in a significant impact on locally occurring flora and fauna.

4. The objective of this plan in relation to environmental hazards is to *locate urban and tourism development on land that is free from flooding, land instability, coastal erosion, bush fire risks, aircraft noise pollution and other environmental hazards.*

Whilst the development is not located on land that is free from flooding it is an existing road that currently experiences these problems. A major objective of the Proposal is to improve the alignment to alleviate existing flooding issues.

4.3 State Environmental Planning Policies

State Environmental Planning Policy 4 (SEPP 4) - Development without Consent and Miscellaneous Complying Development

Clause IIC(2) of SEPP 4 states "where, in the absence of this clause, development for the purposes of a classified road or toll work, or a proposed classified road or toll work, may be carried out only with development consent being obtained therefore, that development may be carried out without that consent".

SEPP 4 applies to the Proposal, as the proposed works are for the purposes of a classified road as defined by the *NSW Roads Act 1993*. Therefore the RTA would not require consent from Tweed Shire Council prior to undertaking the proposed works. This activity has therefore been assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

State Environmental Planning Policy 44 - Koala Habitat Protection

The Tweed Shire Council Area is identified in Schedule I of SEPP 44 as a Local Government Area to which the Policy generally applies, however, as the Proposal is not the subject of a development application the development control provisions in Part 2 of the Policy are not

applicable. Notwithstanding, it is the RTA's practice to consider SEPP 44 matters in its EIA process in particular the presence of:

- 1. core koala habitat being an area with a resident population of koalas
- 2. potential koala habitat being an area of native vegetation containing the requisite percentage of feed trees (see Clause 4 and Schedule 2 of SEPP 44)"

Ecological survey undertaken by SKM (refer to Ecological Assessment Report in **Appendix E**) found that no Koala food tree species listed on Schedule 2 of the SEPP occurred within the study area and no records were found of koalas occurring within the Lowland Rainforest on Floodplain habitat associated with the site. Therefore, it was concluded that the area does not constitute potential or core koala habitat and no further provisions of the policy apply to the Proposal.

4.4 Confirmation of Part 4 or Part 5 Position

All relevant statutory planning instruments have been examined for the Proposal. SEPP 4 operates to remove development consent requirements thereby permitting appropriate assessment of the Proposal under Part 5 of the *Environmental Planning and Assessment Act*, 1979.

4.5 Protection of the Environment Operations Act 1997

The Proposal is not a scheduled activity under the Protection of the Environment Operations (POEO) Act 1997 and as such, no environmental protection license would be required for the Proposal.

Under the POEO Act, the RTA may apply for an Environmental Protection License to carry out activities, which may result in water pollution.

4.6 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

A database search within a 10km radius of the Proposal site was conducted on 20 November 2002. Search results indicate that no threatened ecological communities, 51 threatened species, 20 migratory species and 51 marine protected species have the potential to occur within 5km of the Proposal site.

Further information regarding Matters of National Environmental Significance can be found in Sections 9.18 and 11.2 of this REF.

4.7 Licences and Approvals

- A license or permit under the Water Management Act 2000 would be required should the creek be realigned;
- Should water for roadworks need to be drawn locally from natural waterways, a
 permit would be required from the Department of Land and Water Conservation;
 and

•	Under the POEO Act, the RTA may apply for an Environmental Protection to carry out activities, which may result in water pollution.	License

5 Specialist Studies and Consultation

5.1 Specialist Studies

Due to the sensitive nature of the terrestrial and aquatic communities located within the study area an Ecological Assessment was commenced by Sinclair Knight Mertz (SKM) in September 2002. A summary of that study is given in Section 9.5 of this REF. The entire ecological report is included at **Appendix E**.

Due to the known presence of Acid Sulfate Soils in the Tweed Shire LGA an Acid Sulfate Soils Assessment was undertaken by Environmental Technology's Monitoring section. A summary of that study is given in Section 9.1 of this REF. The entire report is included as **Appendix F**.

Due to the potential for impact on water quality a Water Quality Assessment was also undertaken by Environmental Technology. A summary of that study is given in Section 9.4 of this REF. The entire report is included as **Appendix G**.

A Noise and Vibration Assessment was undertaken by Environmental Technology. A summary of that study is given in Section 9.10 of this REF. The entire report is included as **Appendix H**.

A Hydrology Assessment was undertaken by WBM Oceanics Pty Ltd. A summary of that study is given in Section 9.4 of this REF. The entire report is included as **Appendix I**.

5.2 Consultation

A number of key stakeholders were consulted in the Route Options Identification and Assessment process. Subsequent to choosing the preferred option the stakeholders including NSW Agriculture, NSW Fisheries, NSW Department of Land and Water Conservation (DLWC), NSW National Parks and Wildlife Service (NPWS), and NSW Environment Protection Authority (EPA) made comments regarding the environmental assessment. The issues raised, and the location of where these issues are addressed in the REF is outlined in Table 5.1 below. A complete copy of all correspondence is provided in **Appendix C** of this REF.

Table 5.2.1: Summary of issues raised and RTAs response.

Government Agency Comments	Where in REF	
Tweed Shire Council		
In their reply letter TSC raised no issues.	N/A	
NSW Agriculture		
The REF should aim to quantify the agricultural, financial and other impacts associated with the preferred option.	Section 9.6	
A former cattle dip site is located in the vicinity of the Proposal and this should be considered in the REF.	Section 9.11	

NSW Fisheries	
The bridge should be at least 24m long and should span Cudgera Creek.	Section 9.5 and 10.5
No piers should be located within the 24m span.	Section 9.5 and 10.5
The bridge should be a maximum width of 15m.	Section 9.5 and 10.5
The bridge abutments should be located at least 2m back from the uppermost bench of the river channel.	Section 9.5 and 10.5
Works should not commence until written approval of the bridge and road design has been received from NSW Fisheries.	Section 9.5 and 10.5
Areas of riparian vegetation should be fenced with protective fencing during construction.	Section 9.5 and 10.5
The opportunity to comment on the proposed method of removal of existing bridge should be given to NSW Fisheries.	Section 9.5 and 10.5
NSW Department of Land and Water Conservation (DLWC)	
A license under the <i>Water Act 1912</i> would be required should the creek be realigned.	Section 4.7
A permit to extract water would be required if water is needed from the creek.	Section 4.7
Testing should be undertaken for the presence of Acid Sulphate Soils (ASS) and an ASS management plan compiled if testing is positive.	Section 9.1
An erosion and sedimentation control plan should be compiled for the site.	Section 9.1 and 10.1
No license or permits are required under the <i>Native Vegetation</i> Conservation Act 1997 or the Rivers and Foreshores Improvements Act 1948.	Section 4.7
NSW National Parks and Wildlife Service (NPWS)	
The bridge should be at least 24m long and should span Cudgera Creek from top of bank to top of bank;	Section 9.5 and 10.5
No piers should be located within the 24m span;	Section 9.5 and 10.5
The bridge should be a maximum width of 15m;	Section 9.5 and 10.5
The southern edge of the bridge should be no closer than Im from the Randia moorei individual; and	Section 9.5 and 10.5
Works should not commence until written approval of the bridge and road design has been received from NPWS.	Section 9.5 and 10.5
NSW Environment Protection Authority (EPA)	
The REF should assess the presence of Acid Sulfate Soils (ASS) and the potential impacts on the environment associated with the disturbance of	Section 9.1

any ASS present;	
The REF should identify any potentially contaminated sites associated with past or current land use in the study area and should identify impacts and mitigation measures should these sites be affected by the Proposal;	Section 9.11 and 10.10
Operational noise associated with the proposed upgrade should be assessed using the criteria for the "Redevelopment of existing local roads" contained in Table I of the EPA's Guideline – Environmental Criteria for Road Traffic Noise (ECRTN); and	Section 9.10 and 10.9
An Environment Protection license would not be required by the EPA for the project.	Noted

6 Strategic Stage

6.1 General

The upgrading of the Pacific Highway between Yelgun to Chinderah arose directly from a land use and transport strategy study undertaken in 1996 by the Department of Urban Affairs and Planning (DUAP) and the RTA. That study identified the need for upgrading the highway between the Brunswick River and Yelgun, and identified an investigation corridor for the section between Yelgun and Chinderah.

As part of the concept design for the Yelgun to Chinderah Project, traffic investigations were undertaken for the project, which identified three locations where interchanges were required to link with the existing road network. These were at Cudgera Creek Road, Clothiers Creek Road and Oak Avenue.

The requirement for the current Proposal has arisen from the Conditions of Approval for the Yelgun to Chinderah Project provided by the Minister for Planning in February 1999.

The Yelgun to Chinderah Project Proposal was developed as a result of the North Coast Road Strategy (1993). It was conceived to improve the road transport system between Yelgun and Chinderah to cater for past and future population growth within the Tweed Shire LGA. The upgrade of Cudgera Creek Road would further improve access and travel times to the coastal towns of Pottsville, Hastings Point and Bogangar.

6.2 Justification and Need for the Proposal

As one of only three interchanges along the Yelgun to Chinderah Project, Cudgera Creek Road provides an important link to the coastal towns to the east of the Project. The Cudgera Creek interchange incorporates an off-ramp and local road connection to the coastal villages of Pottsville and Hastings point. It was estimated, in the EIS, that traffic levels along the section of Cudgera Creek Road between the interchange and Pottsville-Mooball Road would increase by 1,400 vehicles per day once the Yelgun to Chinderah Project became operational.

This section of Cudgera Creek Road is narrow and considered to have a lower level of service due to a sharp bend in the road approximately half way between Pottsville-Mooball Road and the Pacific highway. The existing 80m and 100m radius curves located to the east of the bridge on Cudgera Creek Road can currently only accommodate traffic speed of 50km/h and 60km/h respectively.

The existing flood immunity in this section is a 1 in 2 year flood event with the bridge being at least 300mm below the current 1 in 5 year flood level. Upgrading the road to meet the desired design criteria would require elevating the roadway by a minimum of 300mm on the straight at the western end of the project and widening the carriageway to 2/3.5m travel lanes with min 2m shoulders.

The current Cudgera Creek Road joins the Pottsville–Mooball Road with prioritisation given to Pottsville–Mooball traffic. A change to the prioritisation is considered warranted given the expected increase in traffic volumes for Cudgera Creek Road.

Several members of the local community have expressed concern about the current alignment and condition of the road as well as the safety of residents and road users. The consequence of not undertaking the upgrade is that motorists using the Pacific Highway at the Cudgera Creek interchange would be required to travel on a road which is not designed for the increased traffic volumes or safety risks. The proposed redesign would result in an increased level of safety to motorists and local residents.

7 Concept Stage

7.1 Proposal Objectives

The primary objective of the Proposal is to upgrade this section of Cudgera Creek Road to a safe standard of up to 80km/h design speed and to provide protection from a 1 in 5 year flood event. The objective flood levels arose from recommendations made in the Pacific Highway Upgrade Yelgun to Chinderah Representations Report. In conjunction with the primary objectives, the completion of this Proposal would achieve the following secondary objectives:

- · Improve travelling conditions;
- Reprioritise the intersection of Cudgera Creek Road and Pottsville-Mooball Road;
- To provide suitable amelioration measures to minimise environmental impacts and improve environmental outcomes
- Provide an acceptable positive to the local community;
- Provide a road network that would promote economic development;
- Build a road pavement that would minimise maintenance costs;
- · Achieve an acceptable return on assets; and
- Transfer road to Tweed Shire Council.

7.2 Constraints

The Proposal has the following constraints:

- Property acquisition required to complete the Proposal;
- Statutory environmental obligations;
- Flooding issues;
- Development and pre-construction activities to be completed within the approved schedule; and
- Eight (8) flora species, constituting 89 individual plants, listed as either vulnerable or threatened, under the TSC Act, found within the study area.

8 Design Considerations

8.1 Existing and Forecast Traffic

Prior to the opening of the Yelgun to Chinderah Project, traffic volume data Annual Average Daily Traffic (AADT) for Cudgera Creek Road was not collected. Temporary traffic counters were established on Cudgera Creek Road and Pottsville-Mooball Road from August to October 2002. The counters recorded traffic volume and classification data for a 35-day period.

The counter data indicated:

a Year I AADT (2003) of
a commercial vehicle volume of
8.9%.

8.2 Design Parameters

The following design parameters have been used to formulate the design for the proposed works:

- To provide protection from a 1 in 5 flood event;
- Upgrade to a safe standard of up to 80 km/hr
- Reprioritisation of the intersection of Cudgera Creek Road and Mooball-Pottsville Road;
- Restore existing pavement to a 20 year design life;
- Minimise construction costs;
- Minimise environmental impact on flora, fauna, waterways and adjacent areas;
- Provide 2 x 3.5 m travel lanes with minimum 2m shoulders, including the proposed bridge, and consideration of bus bays; and
- Bridge design that incorporates no piers in the creekline.

8.3 Design Constraints

Design constraints for this Proposal would include the following:

- Design speed for alignment up to 80km/h;
- The bridge would be at least 24m long and would span Cudgera Creek;
- No piers would be located within the 24m span of the bridge;
- The bridge would be a maximum width of 15m;
- The bridge abutments would be located at least 2m back from the uppermost bench of the river channel;
- The entire alignment is to be above the level of a 1 in 5 year ARI flood event;
- Cudgera Creek Road would become the priority road at the intersection with Pottsville-Mooball Road;
- Optical fibre cable along the project;
- · Endangered flora in Cudgera Creek; and
- Dip site at the eastern section.

8.4 Urban and Regional Design

The Proposal would be designed to blend into the surrounding landscape, which includes a pocket of Lowland Rainforest on Floodplain. The existing bridge location (refer to photo 6 in **Appendix A**) would be rehabilitated post demolition with locally occurring native plant species, to re-establish the rainforest corridor in this location. This would provide a gateway to the entrance to the village of Pottsville.

Signposting would be designed in consultation with Tweed Shire Council. Signage would be designed to meet urban design requirements without compromising the existing visual landscape of the area.

8.5 Earthworks

The earthworks for the project are as follows;

- Cut 61,000 m3
- Fill 47,000 m3
- Spoil 14,000 m3

The vertical alignment is governed by several constraints. In particular the raising of levels at the bridge site to avoid any excavation within 2 metres of the bank of the stream and the need to provide for a nominal overlay where the Proposal follows the existing alignment. The height of fill on the western approach to the proposed bridge would be minimised to reduce the potential settlement that may occur. Therefore, it is not possible to gain a balance of earthworks. A proportion of the excess material would be used for the batter slopes, which are a maximum of 4 to 1 where achievable.

Cut batters are generally 2 to 1. In the large cutting to the east of Cudgera Creek the batters may be steepened to 1.5 to 1 for a vertical distance of 7 metres and treated with an approved cellular confinement system to hold the topsoil in place and slow the water down across the slope. This would reduce the quantity of spoil and would be considered in the detailed design. Benching would be provided above the 1.5 to 1 batter followed by a 2 to 1 batter slope.

The excess material would as a priority re-used on nearby RTA projects or provided for reuse by Tweed Shire Council or local businesses. Should this not be feasible then the material would be disposed of to an appropriately licensed waste facility. In the short-term the excess material would be spoiled at the locations detailed in Section 8.7 of this REF.

8.6 Additional Truck Movements

The supply of materials required for the Proposal would require up to 10,000 bogey drive tip truck movements spread over the duration of the construction period, that is 85 to 150 truck movements per day during the earthworks and pavement operations. This may be reduced as it is likely that larger trucks may be used by the construction contractor thereby reducing the number of movements.

This compares to a daily volume of approximately 2,341 vehicles including 208 heavy vehicles on Cudgera Creek Road (based on 8.9% heavy vehicles). Therefore it is likely that the

number of heavy vehicles per day on Cudgera Creek Road during construction would be approximately 358. It is expected that the increase in volume of heavy vehicles would be accepted due to the nature of the works and the benefits that the Proposal would bring to the local residents.

Trucks would approach the site either from the newly upgraded Pacific Highway (Yelgun to Chinderah Project) or via Pottsville-Mooball Road. The upgraded Pacific Highway is a State Highway that has been upgraded to cater for future increases in traffic along the route including heavy vehicles. Pottsville-Mooball Road is a local road providing access to the growing coastal suburb of Pottsville. This road currently experiences a higher level of heavy vehicle traffic than Cudgera Creek Road. Much of this traffic is due to expanding residential development along the coastline. Pottsville-Mooball Road is considered to be in good condition and is unlikely to experience impacts on the pavement surface as a result of the short-term increases in heavy vehicle traffic. Cudgera Creek Road is currently in good condition to the east of the existing bridge. The condition of Cudgera Creek Road deteriorates to the west of the existing bridge. This section of Cudgera Creek Road is unlikely to experience major impacts to the pavement from heavy vehicles as it is programmed to be upgraded in the initial stages of the Proposal.

8.7 Stockpile and Compound Sites

Three potential compound/stockpile sites were identified within the study area (refer to Figure A-I in **Appendix A**):

- the RTA land on the southeastern side of the Cudgera Creek Road Interchange with the Pacific Highway. The guardrail would need to be opened and an access provided at this location (currently zoned 1(b)2);
- 2. a triangular piece of residual land where the nearest house to the existing bridge is to be removed (currently zoned 1(b)2); and
- 3. the existing unlicensed gravel pit east of the existing bridge (currently zoned I(b)2).

All three potential sites:

- · are located on flat ground;
- are located at least 40m away from Cudgera Creek; and
- do not require removal of trees or native vegetation.

All three sites have been included in the environmental assessment process for this REF. Should the compound or stockpile site be located at an alternative site the Regional Environmental Adviser would be consulted regarding the need for further environmental assessment. Excess earthworks would be stockpiled at either of the three sites or other approved stockpile sites.

8.8 Bridge Design

The proposed bridge over Cudgera Creek consists of a single span of approximately 29 metres incorporating two traffic lanes (refer to photos 7 and 8 for proposed alignment). The width between the inside faces of the traffic barriers is 11.0m. The horizontal alignment consists of a 300m radius curve and the vertical alignment consists of a 2.67% grade heading upwards in an easterly direction.

The proposed bridge foundations would consist of spill-through abutments supported on driven concrete piles. The superstructure would consist of Super-T girders 1.2m deep with a 200mm thick cast-in-place reinforced concrete deck. The concrete deck is overlaid with a 75mm thick Asphaltic Concrete (AC) wearing surface. The bridge incorporates cast-in-place reinforced concrete Type F traffic barriers.

The location at which the proposed bridge crosses Cudgera Creek is governed by two major factors:

- The proposed bridge is required to clear the endangered flora species that occur in the area; and
- To the north of the proposed bridge location Cudgera Creek bends sharply towards the east thereby requiring a significantly longer span to cross the creek and still keep the abutments a minimum of 2.5 metres clear of the banks to satisfy the 2.0m clearance required by the NSW Fisheries and NPWS and at the same time provide a 0.5m working area in front of the abutments.

The proposed bridge location provides the required clearances to the endangered flora species whilst maintaining a reasonable span length with the abutments being located a minimum of 2.5 metres back from the creek banks.

The proposed bridge incorporates octagonal prestressed concrete driven piles. This foundation type was selected on the basis of the findings of the geotechnical investigation undertaken at the proposed bridge site. The borehole samples taken at each abutment location indicate a lack of substantial bedrock at a suitable depth on which to found cast-in-place concrete piles, therefore driven piles are proposed as the most appropriate solution.

The proposed bridge incorporates spill-through abutments at each end. This selection of abutment type is based on the following factors:

- On the eastern bank of Cudgera Creek the proposed soffit level of the deck is less than 1 metre above the natural ground level and therefore requires minimal fill in front of the abutment thereby enabling the spill-through abutment to be virtually as close to the river bank as would be achievable with a more expensive walled abutment;
- On the western bank the quantity of fill in front of the proposed spill-through abutment is relatively small and only requires the abutment to be shifted back approximately 2 metres from where an alternative, more expensive, walled abutment would be located.

The calculated level of the 1:100 year flood event is less than 500mm above the existing ground level on the western bank. This combined with a relatively slow flood velocity (calculated at 1.0m/s) for this flood event enables the use of spill-through abutments with minimal batter protection whilst still maintaining adequate scour protection for the foundations.

The impact of the abutment type on the corresponding span length is minimal. Providing spill-through abutments as compared with walled abutments increases the span by approximately 2m, which does not require an increase in superstructure depth of the bridge.

The proposed bridge superstructure consists of 6 prestressed concrete Super-T girders with a 200mm thick cast-in-place reinforced concrete deck. This superstructure type is considered to be the most cost effective for the given span.

The proposed bridge girder soffit level is well above the calculated 1:100 flood event. The girder soffit is also above the calculated 1:2000 year flood event and is therefore not susceptible to submergence under ultimate limit state conditions. Since the bridge girders would not be subject to submergence under ultimate limit state conditions the proposed use of closed cell Super-T girders is acceptable for this particular bridge site.

8.9 Pavement Design

A gravel pavement would be used for both construction of new pavements (deviations) and widening and strengthening of old pavements along the existing alignment. Along the areas of existing alignment the subgrade is generally not adequately covered. The road design involves raising the levels over the majority of the existing pavement surface hence a flexible overlay is a logical design option. Treatment for the existing pavement involves removing the seal and re-compacting the existing pavement gravels, followed by overlay with a minimum of I50mm of sub-base quality granular material and I50mm of base quality granular material. Where the levels are required to be raised greater than 300mm, the additional gravel would consist of select quality material (minimum CBR I5), down to the existing surface level.

For areas of existing pavement that require widening, excavation of the shoulders to 600mm below design surface level would be undertaken, followed by backfilling with 150mm general fill (CBR 5), 150mm of select quality material (CBR 15), 150mm of sub-base quality gravel, and 150mm base quality gravel. The investigation indicated that the pavement formation is quite narrow. Excavation for widening would commence no further than 3m left and right of the existing centreline. The widened areas would be keyed in to the existing alignment to prevent stability problems.

For areas of new construction along the proposed deviations the pavement design is the same as that for the widened areas. This would comprise a minimum of 150mm of general fill (CBR 5), 150mm of select quality material (CBR 15), 150mm of sub-base and 150mm of base quality gravel. The seal would be a sprayed seal and the aggregate size would be determined in discussions with Tweed Shire Council and in consideration of the noise assessment.

8.10 Design Outcomes

The outcomes for this Proposal would be:

- Improved driving conditions from pavement widening and curve improvements.
- Improved safety from improved pavement, shoulder and bridge widths;
- Meet current design standards for width and travel speed;
- Pavement designed for a 20 year life; and
- Reduction in maintenance costs.

8.11 Construction Activities

The works would be undertaken by a Contractor selected after a competitive tendering process, and would include the following activities:

- · Site establishment and compounds;
- Construction of fencing;
- Erosion and sedimentation controls;
- Stripping of topsoil;
- Earthworks;
- Spoiling of surplus material;
- Bridge construction;
- · Drainage works;
- Pavement construction;
- Wearing surface;
- Signposting and linemarking;
- · Revegetation;
- · Removal of existing bridge and rehabilitation; and
- Rehabilitation of surrounding areas.

8.12 Plant and equipment

It is anticipated that equipment used during construction of the Proposal would include: Tractors, loaders, excavators, trucks, graders, rollers, a water cart and hand held plant.

The requirement for plant and equipment would depend on the stage of construction and not all plant listed would be on site at any given time.

8.13 Source of Material

Fill material would be obtained from cut activities onsite wherever possible to minimise the creation of excess material as a result of the Proposal. However, material of particular quality would be required for road base and pavement construction. Quantities of base and sub-base chert required are 4,500m³ of select and 3,750m³ of pavement. Preliminary investigations have revealed that the materials would be available from a combination of the following list of quarries:

- Mudges Quarry (Billinudgel);
- Taggarts Pit (Tweed Coast);
- O'Keeffe Quarry (Tweed Valley); and
- Bartletts Quarry (Tweed Valley).

8.14 Signposting, Linemarking and Guideposting

Signposting, linemarking and guideposts would be developed in consultation with Tweed Shire Council, detailed on the construction plans and be implemented in accordance with RTA Specifications R141 and R143.

8.15 Workforce and Working Hours

The workforce would comprise approximately 15 personnel.

Construction works would be restricted to the following times:

Standard working hours:

Monday-Friday

7.00am to 6.00pm

Saturday

8.00am to 1.00pm

Sunday and Public Holidays

No work

Work may extend to 4 pm on a Saturday. Should work be required outside of the standard working hours, the procedure contained in the *RTA Noise Management Manual, "Practice Note vii – Roadworks Outside of Normal Working Hours"* shall be followed. If any complaints are received from residents during the extended period on Saturday, working hours would revert to normal working hours ie.1:00 pm Saturday.

9 Environmental Assessment

9.1 Geology, Soils and Landforms

Existing Environment

Reference to the I:250 000 Geological Series Sheet for Tweed Heads (D.T. Morand 1996) shows the route to be underlain by the rocks of the Neranleigh-Fernvale Group. These comprise greywacke, slate, phyllite and quartzite. Geotechnical investigations encountered metamorphosed sediments and phyllites, which are compatible with the Geological Sheet.

Geological conditions have direct implications on the suitability of bridge design and construction processes, batter slope, and suitability for use of excavated material as fill. There is also potential for erosion and or landslips where surfaces are exposed due to excavation activities.

The study area encompasses two soil landscapes:

- Cobaki soil landscape (located to the west of the proposed bridge crossing) comprises deep (>200cm), poorly drained Humic Gleys on the plain, deep (>300cm) poorly drained Humic Gleys and acid peats on very low-lying areas, and podzols and sands overlying Humic Gleys in inter barrier stream alluvial plains.
- Billinudgel soil landscapes (located to the east of the proposed bridge crossing) comprise deep (>100cm), moderately well-drained Red Podzolic Soils on crests; moderately deep (70-100cm), moderately well-drained Yellow Earths and Yellow Podzolic Soils on slopes; better drained areas; moderately deep (50-150cm), moderately well-drained Prairie Soils on bib; deep (200cm), moderately well-drained Red Podzolic Soils within contact metamorphised zone.

The area surrounding the Proposal has been mapped by DLWC as having a low probability of Acid Sulfate Soils (ASS). Should ASS and/or Potential Acid Sulfate Soils (PASS) be present the disturbance of these soils could adversely impact upon water quality in the immediate vicinity and downstream of the study area.

Because of the sensitive nature of the water catchment, an assessment of ASS and any predicted impact to water quality was undertaken (refer to **Appendix F**). Sites along the proposed new alignment were chosen and test pits dug in association with geotechnical investigations using a backhoe.

Selected samples were taken from the test pits excavated within the marine plains at Ch 860, Ch 970 and Ch 1690, and tested for the potential and/or presence of ASS. Samples were initially tested with hydrogen peroxide in the field. The samples of soil suspected of potentially containing pyritic material were sealed in air tight plastic bags and forwarded directly to the Centre for Coastal Management at Southern Cross University, Lismore for analysis.

Field tests were undertaken by oxidising a sample of soil with $30\%~H_2O_2$. Initial reactions indicated the possibility of low levels of PASS, however the potential for a false positive existed because the samples contained organic matter, which was also oxidised during the reaction.

A summary of the results obtained from the laboratory analysis, along with calculations of neutralisation rates are given in Table 9.1.1 below.

Table 9.1.1: Summary of soil sample laboratory results

Sample	Depth	Reduced Inorganic Sulfur % Cr reducible S (Scr)	TAA pH	TAA kg/mol e	Neutralisation Calculation kg/mole (based on Scr)
CC4a	0.8 – 1.0	0.011	3.98	0.040	0.4
CC5a	0.2 – 0.4	0.007	4.19	0.024	0.3
CC10a	0.2 – 0.4	0.005	4.15	0.046	0.2
CC10b	0.8 – 1.0	0.022	4.22	0.004	0.8

ASS generally refers to inorganic acidity from sources such as pyrite, but a natural pH < 4.0 may sometimes be caused by organic acidity which is generally less hazardous. Organic matter can also contain significant amounts of sulfur. Chromium Reducible Sulfur (SCR) analysis distinguishes between pyrite and organic sulfur sources. Where Chromium Reducible Sulfur levels are found to be below 0.03% soils are not considered to be ASS. Therefore the assessment concluded that ASS are not present within the study area and that any minor sources of acidity would be as a result of the presence of organic sulfur.

Geotechnical investigation of the cutting between chainages 1080m to 1320m was undertaken to determine the preferred option for widening at this location. This included inspection of the existing cut batter, the drilling of two boreholes, and the excavation of six test pits.

The existing cut batter is angled at approximately 40-60 degrees at the western end, within high to very high strength chert. This chert bed appears to be dipping at an angle of 35-45 degrees to the north-west. The geology changes to an extremely low to low strength phyllite mid-way around the cutting, with a corresponding reduction in batter angle to approximately 20-40 degrees. There is evidence of previous failures within this material, with slumping as the dominant mode of failure. The batter face towards the eastern end of the cutting is sparsely vegetated in places and has been subject to scour erosion.

Evidence of chert outcrop on the hill above the existing cutting, along the proposed realignment, was only found along the ridgeline. Test pit at Ch 1120 and borehole at Ch 1130 were targeted at these areas of outcrop. Borehole at Ch 1130 encountered a high to very high strength chert layer from approximately Im to 4m depth, below this extremely low to low strength meta-siltstone and phyllite was encountered to a depth of 14m (below the base of the proposed cutting).

Extremely low, to low strength phyllite was encountered in a further four test pits excavated on top of the cutting. This material was easily excavated to test pit depths up to 5.0m. The borehole at Ch 1150 was drilled at the highest point of the cutting and encountered approximately 0.5m of very high strength chert (1.5-2.0m depth), with the remainder of the hole (16m) comprised of extremely low, to low strength phyllite and meta-siltstone.

The test pit at Ch 1120 indicated that there is a distinct boundary between the very high strength chert and the extremely low strength phyllite. It should be noted that excavation of the high strength chert would potentially lead to increased wear on the ripping equipment. This combined with low productivity rates may result in the need to revert to

alternative techniques, including the possibility of blasting. The material logged as extremely low to low strength phyllite within the cutting should be easily excavated.

Potential Impacts

- Damage or displacement of foundations due to the settlement process;
- Scour and erosion as a result of steep batters; and
- Impacts upon water quality should Acid Sulfate Soils exist.

Proposed Safeguards

- A Soil and Water Management Plan (SWMP) would be prepared as part of the Contractors Environmental Management Plan (CEMP). The plan would be prepared in accordance with the requirements of the NSW Department of Housing publication "Managing Urban Stormwater - Soils and Construction" (the Blue Book);
- The SWMP would address the management measures detailed in Section 6.5.1 (Erosion and Sedimentation Control), 6.5.2 (Stockpile management), 6.5.3 (Water Quality) and 6.5.4 (Water Extraction) of the RTA's *Environmental Protection* (Management Plan) QA Specification G36;
- Progressive Erosion and Sedimentation Control Plans would be prepared for each stage of the works as part of the SWMP;
- All batters other than the cutting to the east of the proposed bridge crossing would be 2:I horizontal to vertical;
- All batters would be progressively revegetated;
- In the large cutting to the east of the proposed bridge crossing the batters may be steepened to 1.5 to 1 for a vertical distance of 7 metres. Should this option be chosen this section of the slope would be treated with an approved cellular confinement system to stabilise the slope and aid in longer term revegetation of the slope. Benching would be provided above the 1.5 to 1 batter followed by a 2 to 1 batter slope for the remaining height;
- Minor settlement may occur at the western approach to the proposed bridge and surcharging of these approach embankments may be required;
- Regular inspection of the work site would be undertaken during construction to ensure that the SWMP was properly implemented and maintained; and
- Exposed areas would be revegetated progressively and restored as work is completed for each section. A cover crop of non-invasive sterile species and locally occurring native vegetation species would be used. This would be detailed in a Landscape Revegetation Plan (LRP) mentioned further in Section 9.5 Ecology.

9.2 Climate

Existing Environment

The closest weather station to the Proposal is located at Murwillumbah, approximately 15km west of the Proposal. The climate of the region is characterised by hot summers and mild to warm winters. The average maximum summer temperature is approximately 28.6°C and the average maximum winter temperature is approximately 21.4°C. Highest rainfall is during the month of February (http://www.bom.gov.au/).

Potential Impacts

- There is no risk of the Proposal affecting the climate of the region. The lack of any substantial clearing of vegetation, and the linear nature of the existing vegetation would also limit the potential risks to microclimates within stands of trees along the roadside;
- The construction of a new bridge would alter the shadowing regime of the creek.
 However since the canopy is currently quite closed this impact is considered to be
 minor. Removal of the existing bridge would result in increased sun intrusion
 however rehabilitation of this area would result in a minimal net impact; and
- Works during rainfall events would result in erosion and sedimentation of Cudgera Creek.

Proposed Safeguards

- Issues relevant to climate are covered in the sections on Geology, Soils and Landform and Water Quality, Hydrology and Drainage (Sections 9.1 and 9.4);
- · Works would not be undertaken during periods of heavy rainfall; and
- In the event of heavy fog, works would be delayed until such time as the fog has satisfactorily dissipated.

9.3 Air Quality

Existing Environment

Air quality in the locality would be expected to be very good, given the rural nature of the region and the lack of any polluting industries or cities in the region.

Potential Impacts

- The Proposal has the potential to locally reduce air quality during the construction phase from increased dust levels and exhaust from machinery. However, these impacts would be highly localised and short in duration, and can be adequately ameliorated with appropriate controls;
- Pollutants would include dust and emissions from vehicles during the construction phase, however this short term impact would be mitigated with safeguards below and would likely to be accepted by the community given the short period of duration of the works; and
- Works during periods of high wind would result in impacts on air quality.

Proposed Safeguards

- Air quality controls would be managed in accordance with the specifications set out in Section 6.6 of the RTA's Environmental Protection (Management Plan) - QA Specification G36;
- Trucks and all fuel powered equipment would be maintained in good working condition to minimise potential emissions;
- Stockpiles would be protected from wind erosion through dampening or covering;
- Unsealed access roads, compound areas and other areas with traffic would be regularly dampened using water sprays;
- When winds reach a velocity of 2.5 metres per second, the frequency of watering would be increased appropriately. Where possible, dust generating activities would be re-programmed to avoid periods of high wind velocity;
- Truck loads would be wet down or covered to suppress dust generation;

- Cleaning of debris from the road surface would be undertaken as soon as practicable;
- Tailgates would be secured during operation of trucks and utes;
- · There would be no burning of timber; and
- If winds are high and works are creating high levels of dust that are likely to cause discomfort to local residents or a safety hazard to traffic or work personnel, the works would be modified or stopped until the dust hazard is eliminated or has reduced to an acceptable level.

9.4 Water Quality, Hydrology and Drainage

Existing Environment

Cudgera Creek has a catchment of approximately 33km², which includes two tributaries, Christies Creek and an unnamed Creek, and is bounded by the Burringbar Range to the west. The catchment is heavily forested in the upper parts and the lower slopes have been heavily cleared as a result of agricultural activities.

The dominant feature of this creek system is that the floodplain on the northern side of Cudgera Creek Road is considerably lower than that associated with the southern side of the road and adjacent to Cudgera Creek. Hence, Cudgera Creek Road is a major control for the break-out of floodwaters from Cudgera Creek to the floodplain to the north and north east. WBM undertook a Hydrology/Hydraulics Assessment completed in April 2003 (refer to Appendix I of this REF).

The study area is located on floodplain land. Average rainfall levels are high in the region and the area experiences flooding on a regular basis. In recent years a levee has been constructed upstream of Cudgera Creek Road on the eastern bank of Cudgera Creek. Other recent development within the floodplain has been the Pacific Highway upgrade, which alters flood flow around the Pacific Highway/Cudgera Creek Road interchange. Previously, flood flows crossed Cudgera Creek Road generally at the location of the interchange. The existing flow path for this area is now directed through a series of culverts (refer to Figure I in **Appendix I**). The net effect of the interchange has been that discharge is concentrated into three locations compared to the previous even distribution in this area.

The WBM assessment concluded that the proposed vertical alignment of Cudgera Creek Road was sufficiently high to ensure that the road surface would not be inundated during a 20% Annual Exceedence Probability (AEP) flood event (or I in 5 year ARI). The assessment also concluded that adverse impact on surrounding properties would not be experienced if the following recommended waterway openings were incorporated into the design:

Table 9.4.1: WBM recommended waterway openings

Chainage (m)	Number of Barrels and Size of Culverts			
	Existing	Proposed		
135	I x 1700W x 550H RCBC	2 x 1800W x 600H RCBC		
280		I x 450 RCP		
385		I x 1200W x 900H RCBC		
545	I × 300 RCP	I x 450 RCP		
860		3 x 1200W x 900H RCBC		

Further information regarding the hydrologic and hydraulic characteristics of the Proposal and the study area and surrounds can be found in the WBM Hydrology/Hydraulics Working Paper in **Appendix I**.

Cudgera Creek has been classified as a class one watercourse by NSW Fisheries. Due to the sensitive nature of the watercourse a Water Quality Assessment (refer to **Appendix G**) was undertaken as part of the REF. Water quality monitoring consisted of data being collected from 2 monitoring sites within the study area, one upstream and one downstream of the proposed new bridge. Monitoring was undertaken on three separate occasions through in situ monitoring and through laboratory analysis of grab samples taken offsite (see tables below). Conditions for Cudgera Creek during monitoring were good with low levels of turbidity.

Table 9.4.2: Summary of In Situ water quality results.

Site	Clarity	Depth m	Temp °C	D.O. % Sat	рН	Turbidity NTU
In-Situ W	ater Quality	Measuremen	ts - Dry Episo	de (02/09/02)		
CCI	Clear	0.8	17.0	63	7.2	6
CC2	Clear	0.8	17.0	72	7.3	14
In-Situ W	ater Quality	Measuremen	ts - Wet Episc	de (28/10/02)		
CCI	Turbid	0.3	18.0	32	6.8	27
CC2	Clear	0.3	18.0	33	6.7	13
In-Situ W	ater Quality	Measuremen	ts - Dry Episo	de (04/11/02)		
CCI	Clear	0.4	21.4	53	6.7	8
CC2	Clear	0.4	21.4	78	6.8	6
ANZECC Guidelines			+ 2°C	80 - 90	6.5 - 9.0	+10%

Table 9.4.3: Summary of Laboratory water quality results.

Site	рН	TDS	TSS	Total P	Total N	Al	Fe
CCI	6.55	123	0.5	0.06	0.73	0.102	0.448
CC2	6.36	124	<0.5	0.01	0.39	0.087	0.418
	ANZE	CC Guideline	es	10 - 100	100 - 750	5	1000

The road design levels on the western straight have been designed to be above the I in 5 year flood immunity. This involves removing the very old culverts and replacement with new box culverts. The design has considered the adjacent land owners requirements to ensure that the size of the new culverts does not exceed the capacity of the downstream cane drains and therefore eliminating the potential of erosion.

Potential Impacts

- During construction the Proposal would have the potential, through runoff and fuel spillages, to locally reduce water quality;
- Increase in turbidity and / or a decrease in pH levels.
- Sediment runoff into Cudgera Creek from exposed surfaces associated with earthworks, clearing activities, bridge construction and demolition works and would also be possible;
- Stormwater runoff from road surfaces could carry nutrients, heavy metals, grease and other pollutants into Cudgera Creek; and

• The Proposal, which includes raising of the pavement to above the 1 in 5 year flood immunity, could result in changes to the hydrological behaviour of the area including adverse flooding impacts.

Proposed Safeguards

- Hydrology and water quality would be managed in accordance with the specifications set out in Section 6.5.3 (Water Quality), 6.5.4 (Water Extraction) and 6.13 (Spillage Prevention and Contamination Management) of the RTA's QA Specification G36;
- Erosion and sedimentation safeguards are provided in Section 9.1 of this REF;
- All drainage infrastructure would be designed and implemented in accordance with the NSW Fisheries Policy and Guidelines for bridges, roads, causeways, culverts and similar structures (1999);
- Stormwater from the bridge surface would be diverted through some form of treatment, such as a grassed swale drain, prior to being dispersed towards Cudgera Creek via overland flow:
- A practical and effective water quality monitoring program would be undertaken in consultation with the REA, the EPA, and the Pacific Highway Office (PHO) during construction and the first six months of operation. The monitoring program would be designed so that upstream and downstream samples are collected at each sampling event and therefore an assessment of the impact from the works on the receiving water at any one time can be made;
- A check of any drainage works would be undertaken promptly during and after heavy rain events following completion of the works;
- Mud and dirt would be removed from the wheels and bodies of haulage equipment before they enters public roads or other sealed pavements;
- Should any spillages occur during the construction activity the Environmental Adviser, Northern Region, would be contacted immediately, and contaminants would be immediately contained, removed, treated (if necessary) and disposed of to the satisfaction of the EPA;
- Culvert sizing would be undertaken in accordance with mitigations measures recommended by WBM Oceanics Pty Ltd. Refer to the following table:

Table 9.4.4: WBM recommended waterway openings

Chainage	Number of Barrels and Size of Culverts			
(m)	Existing	Proposed		
135	I × 1700W × 550H RCBC	2 x 1800W x 600H RCBC		
280		I x 450 RCP		
385		I x I200W x 900H RCBC		
545	I x 300 RCP	I x 450 RCP		
860		3 x 1200W x 900H RCBC		

- The existing bridge over Cudgera Creek would be removed; and
- Scour protection would be designed to include flow velocities not exceeding 1.5m/s upon exiting the culvert and bridge.

9.5 Ecology

Existing Environment

Thirty-one (31) threatened flora species have been previously recorded within 10km of the study area (SKM 2002). Forty-seven (47) threatened fauna species have been recorded in the study locality, which includes species listed in the Atlas of NSW Wildlife (NPWS) as well as species with known distributions in the upper North Coast region and nationally listed threatened species. Three (3) threatened fish species and one threatened aquatic invertebrate species, as scheduled in the *Fisheries Management Act 1994*, have distributional ranges that incorporate the study area (NSW Fisheries 1998; Allen *et al* 2002).

Lowland Rainforest on Floodplain is listed as an Endangered Ecological Community on the Schedules of the TSC Act from the NSW North Coast bioregion. Rainforest classed as this vegetation community type occurs in a patchy distribution throughout the north coast region, with some areas occurring in relative proximity to the study area and known from Cudgera Creek.

Due to the sensitive nature of the Rainforest community located within the study area an Ecological Impact Assessment was undertaken by Sinclair Knight Mertz. NPWS was involved in the review process of the Ecological Impact Assessment. The full report is contained in **Appendix E**.

The flora survey involved traverses on foot of all vegetation types present within the study area. Identification of the floristics and structure of the vegetation, and the type and distribution of plant communities was undertaken.

Fauna field surveys involved a range of techniques aimed at identifying species from all fauna groups and included specific techniques to survey for the presence of threatened fauna species deemed potential subject species. In general, the following field survey techniques were undertaken: spotlighting, bat census (ultrasonic call detection and spotlighting), searches for indirect evidence (tracks, scats, nests, diggings, bones and other traces), herpetofauna surveys, diurnal bird census, and call playback (nocturnal birds).

Twelve aquatic bait traps were set during the two-day sampling period (ie. Ist and 2nd October 2002) (Table 4-2). Eight traps were set upstream of the existing Cudgera Creek Road Bridge (southern side) and left for a period of two and a half hours. The traps were baited with dog biscuits and raw meat. Samples were later retrieved and their contents recorded. Traps I and 3 were reset on the Ist October and left overnight with the remaining six traps removed. Four traps were then set downstream (northern side) of the bridge and left overnight. The six traps were retrieved on the 2nd October and information on species and number of individuals was recorded.

The results of the surveys included:

a) Floral species diversity was noted to be relatively high considering the small area of remnant vegetation present and the extent of past clearing for agriculture. A total of one hundred and fifty-three (153) flora species from seventy-seven (77) families were identified and recorded within the study area. The area of Lowland Rainforest on Floodplain identified from the study area is characteristic of the community type scheduled as an Endangered Ecological Community in the TSC Act.

A total of eight (8) threatened flora species currently listed on the TSC Act were recorded within the study area (Table 4-I). Of the eight threatened species recorded, six (6) are also listed as nationally threatened species on the Schedules of the EPBC Act. The eight (8) threatened species were represented on the site by eighty-nine (89) individual plants. In addition to the identified threatened species, one (I) ROTAP species (ie. Rare or Threatened Australian Plant, classified by Briggs & Leigh 1996) and one regionally significant species was also identified in the study area.

As all threatened flora species identified in the study area occur within the Lowland Rainforest on Floodplain, a single 8-part test was applied. The 8-part test concluded that the Proposal would not significantly impact on local populations of threatened flora species identified at the Cudgera Creek study area. The conclusion is based on the currently proposed road and bridge location, which has been specifically designed to traverse through a narrow disturbed part of the creek and would involve minimal disturbance to the vegetation at the site.

b) The results of the assessment indicated that habitat for terrestrial fauna was limited as a result of past vegetation clearing (isolation and fragmentation of the site habitat), timber removal and general simplification of the habitat. A total of fifty-five (55) terrestrial fauna species were recorded within the study area during the field surveys. This list comprised five (5) mammal species (three native), five (5) frog species, ten (10) reptile species and thirty-five (35) species of birds.

One threatened fauna species (TSC Act) was positively identified on the site during field surveys. This was the Black Flying-fox (*Pteropus alecto*). Several Black Flying-foxes were observed flying over at dusk and some were recorded feeding on native figs (*Ficus* spp) which occur within the Lowland Rainforest on Floodplain habitat associated with Cudgera Creek. Individuals of this species would regularly utilise the available foraging resources within the study area, although such resources are not solely restricted to the Cudgera Creek area and are well represented throughout the north coast of NSW.

An additional nine threatened fauna species have been recorded in similar habitats to that identified at Cudgera Creek and may potentially be impacted by the Proposal. An 8-part test was applied for each of these species and due to similarities in lifecycles and habitat, some species were assessed via combined 8-part tests.

Eight-part tests were documented for Megabats (Black Flying-fox and Grey-headed Flying-fox), Microbats (Northern Long-eared Bat and Southern Myotis), Frugivorous birds (Wompoo Fruit-Dove, Superb Fruit-Dove, rose-crowned Fruit-Dove and Barred Cuckoo-shrike), the Giant Barred Frog and the Three-toed Snake-tooth Skink. The conclusion of the 8-part tests indicates that this Proposal would not significantly impact on local populations of threatened terrestrial fauna species identified at the Cudgera Creek study area or considered to potentially occur. The conclusion is based on the currently proposed road and bridge location, which has been specifically designed to traverse through a narrow disturbed part of the creek and would involve minimal disturbance to the vegetation at the site.

c) The results of the fish survey revealed a total of four (4) native fish species, three (3) crustaceans and one (1) eel species.

No threatened fish species as listed on the FM Act, were recorded from the Cudgera Creek study site. The creek does not experience continuous flow and exists as shallow ephemeral pools, with numerous snags and silted beds. The habitat is not suited to the three threatened fish species known from the area and no threatened fish species are expected to occur within the upper reaches of Cudgera Creek.

Potential Impacts

- The Proposal has the potential to impact upon one Endangered Ecological Community, 8 threatened flora species, and I threatened fauna species listed on Schedules of the TSC and/or EPBC Acts. The current Proposal has been chosen to minimise direct impacts upon the threatened species. Further construction management protocols would be implemented to ensure that biota within the study area are not adversely impacted by the Proposal, particularly that located near to the proposed bridge footprint;
- Construction of the bridge and approaches would require removal of approximately 500m² of native vegetation presently situated along the bank of Cudgera Creek within the bridge footprint area. This vegetation has been identified as Lowland Rainforest on Floodplain, which is classified as an Endangered Ecological Community scheduled in the TSC Act;
- The proposed bridge and approaches could result in severance of a corridor in the form of a barrier to fauna movement;
- The introduction of the bridge could result in the proliferation of invasive weeds at the interface of the road corridor and the ecological community;
- Indirect impacts on threatened plants could result from insensitive construction methods and would be considered in the construction specifications;
- The proposed road may involve removal of a small area of Coast Cypress Pine (*Callitris columellaris*) on the hill and existing road cutting to the east of the bridge. This species is not threatened although is also considered locally significant; and
- One threatened fauna species (TSC Act) was directly observed within the study site, the Black Flying-fox (*Pteropus alecto*). Several additional threatened species could potentially utilise the small areas of habitat present at the site. This usage would be also be associated with the Lowland Rainforest on Floodplain, as several frugivorous feeding species, such as Fruit-Doves, and Fruit Bats are expected to visit the site. Removal of feed trees may impact upon these species.

Proposed Safeguards

- Flora controls would be undertaken in accordance with the specifications set out in Sections 6.9 and 6.10 of RTA's Environmental Protection (Management Plan) - QA Specification G36. In addition, the following site specific mitigative measures would also be required as part of the Proposal;
- The limits of the proposed bridge and road approach area would be identified in the field within the densely vegetated areas either side of Cudgera Creek and construction of the road would be limited to this footprint. The limits of the footprint are shown in Figure 7.1 and Figure 7.2 of the Ecological Assessment Report (Refer to **Appendix E**). Disturbance would be limited to a:
 - Maximum of two (2) metres upstream and downstream from the sides of the proposed bridge. This limit would be clearly defined onsite so that workers are aware of it at all times. This could be achieved by flagging of vegetation along the identified boundary or by the placement of some clearly identifiable stringline;

- Minimum two (2) metres back from the uppermost bench of the river channel of Cudgera Creek (eg. The bridge abutments would be located at least 2m back from the top of the bank). This limit would be clearly identified onsite via the provision of protective fencing 2m back from the top of the bank; and
- Maximum of three (3) metres from the toe of fills on the approach works that are adjacent to the rehabilitation area.
- Protective fencing is to be placed around the Randia moorei and Syzygium moorei (Threatened Species) individuals identified in proximity to the proposed bridge location prior to starting work in the construction area. This would be undertaken by a qualified ecologist;
- Areas of native vegetation in proximity to construction areas would be fenced with protective fencing prior to work commencing in the area;
- Contractors would be instructed on the limits of clearing and not allowed to
 encroach into areas outside the identified road construction limits defined in Figure
 7.1 and behind the protective fencing. This includes preventing any materials or
 construction equipment from entering into protected areas;
- Within the banks of the creek there would be no complete removal of vegetation.
 Instead there would be trimming of vegetation no further than Im below the
 girders. This trimming would be undertaken using a cherry picker with trimmed
 vegetation lifted out by a crane;
- The southern edge of the bridge should be no closer than Im from the *Randia moorei* individual;
- Appropriate erosion and siltation mitigation measures would be used in proximity to the creek and rainforest vegetation;
- All construction work would be undertaken from outside of the 2 metre creek buffer areas:
- As compensation for the small loss of 'Lowland Rainforest on Floodplain' associated with the Proposal an area of 2100m² between the existing Cudgera creek road and the newly proposed road (including the abandoned house and associated cleared areas) would be rehabilitated and revegetated with rainforest plant species as shown in Figure 7.3 of the Ecological Assessment Report (Appendix E). The weeds in the hatched area up to 5 cm diameter would be cut down or poisoned using an appropriate herbicide;
- The bridge would be at least 24m long and would span Cudgera Creek;
- No piers would be located within the 24m span;
- The bridge would be a maximum width of 15m;
- Works would not commence until the bridge and road design has been reviewed by NSW Fisheries and any recommendations are incorporated.;
- Works would not commence until the bridge and road design has been reviewed by NPWS and any recommendations are incorporated.
- The opportunity to comment on the proposed method of removal of existing bridge would be given to NSW Fisheries;
- Following the removal of the existing bridge, the area surrounding the bridge would be rehabilitated and revegetated with locally indigenous rainforest species using locally collected seed stock. This would require the preparation of a Landscape Rehabilitation Plan to be carried out in liaison with National Parks and Wildlife Service (NPWS). The preparation of the Landscape Rehabilitation Plan would be managed by the RTA and prepared by a suitably qualified contractor satisfying the NPWS criteria. Close consultation would be required between NPWS, RTA and the contractor during preparation of the Landscape Rehabilitation Plan;
- Plant species selection would complement existing rainforest areas, with species selection corresponding to the species listed in the Flora and Fauna Report

- (Appendix E). Species that are most suitable for regeneration would be included in the Landscape Rehabilitation Plan. Consideration would be given to the successional approach to planting such species and collection and use of local seed;
- Any Coast Cypress Pine individuals near the works area would be identified and tagged prior to work commencing;
- Where Coast Cypress Pine individuals would be removed, suitable management of the species would include the collection of seed and propagation for future replanting back into the study area. Consideration should be given to translocating the individual trees if possible which should be done according the accepted guidelines for translocation of threatened plants in Australia (Australian Network for Plant Conservation 1997);
- The revegetated area shall be maintained for a period of 2 years after completion of the roadworks;
- Suppression of weeds by poisoning in the 'weed removal area' shown in Figure 7.1
 of the Flora and Fauna Report would continue for two years after completion of
 the roadworks. The poisoning would be undertaken using some form of water safe
 green herbicide; and
- The RTA would carry out a follow-up control program for foxes and feral cats at the site over the two-year maintenance period subject to program being approved by relevant bodies.

9.6 Socio-economic Considerations

Existing Environment

The predominant land use in the study area is for agricultural purposes in particular sugar cane. A private quarry is located approximately 100m to the east of the existing bridge. Nine houses gain access to the existing road within the length of the Proposal.

On the northern side of Cudgera Creek Road in the vicinity of the new bridge crossing cattle currently gain access to the creek for drinking water from two properties. In both cases this access would be affected.

Potential Impacts

- In the construction phase the Proposal would delay through traffic during working hours, although appropriate traffic control measures would minimise the delays experienced along the road;
- The Proposal has the potential to affect access to private properties during construction;
- The Proposal would result in an additional 85 to 150 truck movements per day during earthworks and pavement construction;
- The Proposal would result in the severance of approximately 400m² area of agricultural land. The land currently appears to be intermittently used for grazing cattle. The region is generally used for cane farming in preference to cattle grazing, and given the flood prone nature of the area, is a more suitable land use. The area is minor in relation to the amount of agricultural land in the Tweed Shire and since the severed piece of land would be located adjacent to the Lowland Rainforest on Floodplain community it may provide a longer term opportunity for further rehabilitation of the rainforest corridor; and
- An existing cattle access to water (Cudgera Creek) would be severed as a result of the realignment on the western side of the new bridge. This issue would be resolved concurrently with property acquisition. Options to be resolved in

consultation with landowners would be to provide a bore, a pump system or to provide an access for each property to a second existing cattle access.

Proposed Safeguards

- Traffic management would be undertaken in accordance with the specifications set out in RTA QA Specification G10 Control of Traffic and Section 6.4 "Access and Traffic Management" of the RTA's Environmental Protection (Management Plan) -QA Specification G36;
- The proposed works would be undertaken under traffic;
- Access would be maintained to private residences at all times during construction;
- Access to water would be maintained through property rearrangements or alternatively through provision of a bore or pump on the affected properties. Consultation would be undertaken between the affected property owners and the project manager. This would be resolved prior to commencement of works;
- Should the option of a bore be chosen to solve the access to water issue consultation would be undertaken with the Department of Land and Water Conservation regarding water access rights; and
- Should access to a new location be provided then:
 - Fencing would be erected to prevent cattle from straying onto neighbouring properties, the road or into the rainforest community;
 - Fencing would be erected to the waters edge to prevent cattle impacting on banks previously not affected by cattle access and riparian vegetation; and
 - Aggregate material or road base would be provided if the access area is potentially boggy;

9.7 Indigenous Heritage

Existing Environment

Much of the study area has been cleared or disturbed in the past for the purposes of agriculture. However a pocket of Lowland Rainforest on Floodplain does remain on the banks of Cudgera Creek at the location of the proposed bridge.

A search of the NSW NPWS Aboriginal Heritage Information Management System (AHIMS) identified four (4) Aboriginal sites as occurring within 10km of the study area (refer to **Appendix C**). A ceremonial site is the closest, approximately 1.7km to the east of the study area.

RTA's Northern Region Environmental Adviser Greg Collins met, on behalf of RTA's Aboriginal Programs Consultant Mary-Lou Buck, with a representative of the Tweed/Byron Local Aboriginal Land Council (TBLALC) on the 29th November 2002 to inspect the study area and discuss the Proposal. Verbal concurrence for the Proposal was obtained from the LALC representative onsite.

Written correspondence from the TBLALC was received on the 18^{th} March 2003 (refer to **Appendix C**). It was confirmed that the results of the inspection were:

- No trees mature enough to carry scars as a result of past cultural activities were found;
- · No middens were found;
- No campsites were present.

It was also requested that an LALC officer be present onsite during topsoil removal outside of the existing pavement alignment. This would include but not be limited to where the proposed route diverges away from the existing route to the west of the proposed new crossing until it rejoins the existing alignment further to the west.

Potential Impacts

The Proposal is not expected to impact upon items of indigenous heritage due to the majority of works involving filling activities.

Proposed Safeguards

- Indigenous Heritage would be managed in accordance with the specifications set out in Section 6.14 of RTA's Environmental Protection (Management Plan) - QA Specification G36;
- Tweed/Byron LALC would be notified 5 days prior to removal of topsoil outside of the existing pavement alignment;
- An officer representing the Tweed/Byron LALC would be present onsite during removal of any topsoil (to a depth of 500mm) outside of the existing pavement alignment;
- In the event that any indigenous artefacts or items are located during the works, all
 work would cease in the vicinity of the find, and the RTA's Environmental Adviser,
 Northern Region, Aboriginal Programs Consultant and NSW NPWS would be
 contacted; and
- The RTA, as the Proponent, is aware of its statutory responsibility for protecting sites and places of cultural significance. This knowledge and responsibility would be transferred to the contractors undertaking the works. All staff contracted to work on the project would be made aware of the process required when remains are uncovered.

9.8 Non-indigenous Heritage

Existing Environment

A desktop review of non-indigenous heritage has been carried out for this Proposal. As part of this investigation, searches were undertaken on a number of databases to assess the cultural heritage of the study area. Searches were undertaken of the NSW Heritage Office State Heritage Register, RTA s.170 Heritage Conservation Register, Tweed Shire Council LEP and the Australian Heritage Commission Register of the National Estate Database. No recorded sites were shown to exist within or near the study area.

Advice from Tweed Shire Council indicates that the existing Cudgera Creek Bridge was constructed in the 1960's. The bridge is not currently or proposed to be included on a council heritage register. The bridge is a concrete structure consisting of concrete planks with concrete abutments.

Potential Impacts

Due to the lack of any heritage-listed items in the vicinity of the study area, and the type of activity proposed (i.e. filling), it is not anticipated that the proposed works would impact on any item of non-indigenous cultural heritage in the vicinity of the Proposal.

Proposed Safeguards

- Non-Indigenous Heritage Controls would be managed in accordance with the specifications set out in Section 6.15 of RTA's Environmental Protection (Management Plan) - QA Specification G36;
- In the event that any non-indigenous items are located during the works, all work
 would cease in the vicinity of the find and the RTA's Environmental Advisor,
 Northern Region and a suitably qualified archaeologist would be contacted; and
- The RTA, as the Proponent, is aware of its statutory responsibility for protecting sites of heritage significance. This knowledge and responsibility would be transferred to contractors undertaking the works. All staff contracted to work on the project would be made aware of the process required when items are uncovered.

9.9 Visual/Landscape

Existing Environment

The visual amenity of the area is characterised by a rural landscape, with a thin corridor of Lowland Rainforest on Floodplain framing Cudgera Creek. Visual amenity would be medium to high given the rural setting and the presence of the Rainforest community.

Between the Pacific Highway and the existing bridge the views are extensive to the north and west due to the flat topography. During the growing season the views would be obscured by mature crop sugar cane fields that make up the majority of the land use in the area. To the east and south the views are characterised by the riparian vegetation that frames Cudgera Creek.

Very little of the components of the existing bridge are above the road pavement level. As such it is difficult to observe the bridge from more than 50 metres. To the west of the existing bridge a 12 metre high cutting is located on the southern side of Cudgera Creek Road as the road winds north and then back to the east following the line of Cudgera Creek. The topography to the east of the existing bridge is undulating. Views to the south are of grassy slopes. To the north and east views are characterised by the riparian vegetation that frames Cudgera Creek while to the east views extend along Pottsville Road and adjacent agricultural properties as Cudgera Creek diverts its course to the northeast.

Potential Impacts

- Filling activities to raise the road pavement along the entire alignment would have a minor impact upon the visual scope of Cudgera Creek Road;
- The cutting proposed to the east of the proposed new bridge is unlikely to result in a major visual impact. There is an existing cutting in this location and the works propose to extend this cutting. Views are obscured from the west north and east by the riparian corridor that frames Cudgera Creek. Some minimal view may be obtained of the cutting through the new bridge corridor. However, this would be minimal and revegetation strategies for the improved slope of the cutting would minimise this impact;
- The proposed new bridge crossing would involve the removal of approximately 400m² of riparian vegetation approximately 150m north of the existing bridge. The new crossing would create a severance of the existing vegetation corridor to views from the west as far away as the Pacific Highway;
- The new bridge structure may be more visible from a distance as a result of the new location, a higher deck level and a wider deck. However, the bridge would

- have minimal components above the deck level, and the angle of the bridge and corridor would minimise the visual impact to sections of Cudgera Creek Road and just the interchange zone of the Pacific Highway; and
- The Proposal also has the potential to increase the roadscape visual amenity of the existing road through the provision of standard pavement types and colours across the length of the Proposal and rehabilitation of the existing bridge site.

Proposed Safeguards

- The Landscape Rehabilitation Plan (LRP) would incorporate revegetation strategies for all exposed surfaces created during the Proposal including fill batters along the road verge and revegetation of the cutting;
- The LRP would also consider visual impacts and attempt to address this issue in conjunction with other objectives of revegetation;
- Tweed Shire Council would be consulted in regards to the LRP as responsibility for Cudgera Creek Road would be transferred back to Council upon completion of the works;
- Visual impacts of the bridge would be minimised by maintaining a low structure with only those components necessary for the integrity of the structure and to address safety issues to be incorporated into the design; and
- Signage design would be undertaken in consultation with Tweed Shire Council.

9.10 Noise and Vibration

Existing Environment

The existing road environment is that of a rural road with relatively low ambient noise levels. With the opening of the Yelgun to Chinderah Project the daily traffic volumes on Cudgera Creek Road are up to 2,800 vehicles per day.

Due to the identified potential for noise impacts as a result of the Proposal, Environmental Technology undertook a 'Noise and Vibration Impact Assessment'. The assessment report identified that there are approximately 4 residences that would currently experience road traffic noise that is in excess of the Environmental Criteria for Road Traffic Noise (ECRTN). These properties are located approximately 20m from the roadway.

9.10.1 Construction Noise

The period of construction of the Proposal is estimated to be 12 months, however, due to the progressive nature of the construction works over the 1.8 km length of the Proposal it is unlikely that construction noise impacts would be experienced at the identified receivers for the full duration of work. Therefore, it was deemed more appropriate to assess the predicted construction noise against the 4 - 26 weeks EPA Construction Noise criteria, (ie., the measured background noise plus 10 dB).

Table 9.10.1 summarises the measured background noise level and the EPA daytime working hours construction noise goal for the estimated construction duration in the study area.

Table 9.10.1: Measured Background Noise Level and EPA Construction Noise Goal

Site	Background Noise Level Day LA ₉₀ (7am – 6pm)	EPA Construction Noise Goal ¹ LA ₁₀ (7am – 6pm)
999 Cudgera Ck Rd	41	51
Hardy Residence	35	45
1050 Cudgera Ck Rd	39	49

I: L_{90} + 5 dB for receivers where work is likely to be > 26 weeks duration.

Table 9.10.2 lists typical sound power levels of the type of construction plant items provided in the proposed schedule of works for the construction. **Appendix D** details calculations determined for the study area.

Table 9.10.2: Typical sound power levels of construction plant items (AS 2436, 1981 Table D2)

ltem	Sound Power Level dBA	
Batch Plant	107 - 121	
Excavator	108 - 118	
Rock Hammer	110 - 119	
Compressor	98 - 100	
Vibratory Roller	100 - 104	
20t Truck	103 - 108	
Grader	114 - 120	

Table 9.10.3: Construction Noise Level Objectives and Predicted Levels

Site	EPA Construction Noise Goal LA ₁₀ (0700 - 1800)	Predicted Construction Noise LA ₁₀ (0700 - 1800)	Exceedance of EPA Goals dB	Existing LA ₁₀ Exceedances and (Means) (0700 – 1800)
999 Cudgera Ck Rd	51	79	28	4 – 27 (19.8)
Hardy Residence	45	79	34	12.2 - 48.3 (26.9)
1050 Cudgera Ck Rd	49	73	24	7 - 25 (11.4)

While daytime construction activities are predicted to exceed the current EPA Criteria by up to 34 dB, it is not expected that these levels would cause adverse comment. From Table 9.10.3 it can be seen that ambient L_{10} noise levels are already well in excess of the target levels at times being up to 48 dB over the L_{90} for the measured interval. It is often recognised that the daytime construction noise goals are very stringent and are sometimes unachievable, particularly where noise sensitive receptors are located in close proximity to construction works and background noise levels are relatively low. Where daytime goals are likely to be exceeded, a performance approach would be followed that allows the implementation of best management practice in reducing construction noise levels towards the goals. Close consultation with the affected community is essential where it is expected that construction works would exceed EPA criteria, with consultation protocols (*RTA Community Involvement Practice Notes and Resource Manual, 1998*) being followed.

 L_{90} + 10 dB for receivers where work is likely to be 4 - 26 weeks duration.

 L_{90} + 20 dB for receivers where work is likely to be < 4 weeks duration.

9.10.2 Construction Vibration

From experience it may be expected that the residences located 20m from heavy road construction work would experience vibration levels up to 3 mm/sec when vibratory rolling is being undertaken at the closest point to the residence. This level would be well below that which may cause architectural damage. Therefore it was concluded that the proposed works would not result in vibration levels that would cause adverse comment at any sites. No mitigation measures were proposed.

9.10.3 Operational Noise

While no noise monitoring results for Cudgera Creek Road were available for the period prior to the opening of the Yelgun to Chinderah Project, based upon traffic volumes at that time it is reasonable to assume that levels of road traffic noise were at, or below the current criteria as estimated in Table 9.10.4. It is therefore concluded that since the opening of the Yelgun to Chinderah Project, residences that are located in close proximity to Cudgera Creek Road are now being exposed to levels of road traffic noise that require reasonable and feasible methods of attenuation to be implemented (i.e. as outlined in EPA's Environmental Criteria for Road Traffic Noise – Criteria for "Redevelopment of existing local roads")

Pre-construction noise monitoring was undertaken at two residences fronting Cudgera Creek Road.

Table 9.10.4: Tenth Percentile Noise Levels Leq(Ihr) dBA

Location	LA _{eq(Ihr)} 7am – I0pm	LA _{eq(Ihr)} 10pm - 7am
Site A - Lot 999 Cudgera Ck Rd	67.4	60.0
Site B - Hardy Residence Cudgera Ck Rd	66.3	58.9
EPA Objectives	55	50

Data collected during the daytime monitoring period shows that residences located close to Cudgera Creek Road are experiencing $L_{\rm eq}$ (1hr) noise levels that are up to 12 dB above the relevant EPA Criteria. Under the "Do Nothing Option" it is predicted that road traffic noise would rise by a further 1.3 dB by 2013 based on an annual traffic growth of 3%. The Proposal to upgrade the road would result in minimal change in alignment for most of the properties that would be retained, except for the Hardy residence which would have its setback increased by 15 – 20m. Due to the current deteriorated state of the pavement, there may be reductions achieved in road traffic noise due to improved wearing surface, however, these are likely to be less than 2 dB.

Data collected during the night-time period was not considered to be representative of road traffic noise because it did not exhibit the normal characteristics of road generated noise. The data was possibly contaminated by insect noise such as that created by crickets or cicadas. Because of the low traffic volumes experienced at night it was considered that road traffic noise would not be dominating the noise catchment during this period and that the criteria would be unlikely to be regularly exceeded for this period as a result of road traffic noise only.

The assessment concluded that the proposed work would not significantly change the current levels of road traffic noise, although there is an expectation that the improved wearing surface and pavement alignment may improve the current levels of road traffic noise at some receiver locations due to improvements in pavement surfacing and alignment, therefore it may be appropriate to undertake further monitoring prior to the

implementation of any mitigation measures to reassess the levels of road traffic noise following the construction of the new pavement.

It was suggested that additional monitoring may also be used to confirm the night-time level of road traffic noise exposure against a background that is not impacted by extraneous noise sources. It is recommended that any additional monitoring be conducted during a time when it is unlikely that there would be any influence by extraneous noise sources.

Potential Impacts

- Operational Noise levels are likely to exceed levels experienced prior to the opening of the Yelgun to Chinderah Bypass Development. The relevant EPA criteria placed on this Proposal are also likely to be exceeded since they are already exceeded in the current situation;
- Impacts could also be experienced as a result of construction noise (refer to section 9.10.1 above); and
- Both noise and vibration impacts may be experienced should blasting be required in the major cutting to the east of the existing road bridge.

Proposed Safeguards

- Controls associated with Noise Control and Vibration would be undertaken in accordance with the specifications set out in Sections 6.7 and 6.8 of RTA's Environmental Protection (Management Plan) QA Specification G36;
- The RTAs Environmental Noise Management Manual would be consulted prior to the development of any noise management strategies. It is recommended that advice be sought on any proposed methods to determine what internal noise reduction would be achieved, as the construction of the residence at lot 999 Cudgera Creek Road would not be receptive to architectural treatments;
- Further monitoring would be undertaken prior to the implementation of any mitigation measures to reassess the levels of road traffic noise following the construction of the new pavement;
- Should blasting be required for widening of the existing cutting to the east of the proposed bridge crossing then this activity would be undertaken in accordance with Section 6.8 of the RTA's *Environmental Protection (Management Plan) QA Specification G36.* Noise monitoring would be undertaken at residences within 200m during blasting activities; and
- The EMP would include a strategy for but not be limited to utilising best practice technology and means to achieve noise mitigation by use of:

A. Source controls

- Time constraints Limit work to daylight hours;
- Scheduling Perform noisy work during less sensitive time periods;
- Equipment restrictions Select low-noise plant and equipment. Ensure equipment has quality mufflers installed;
- Emission restrictions Establish stringent noise emission limits for specified plant and equipment. Implement noise monitoring audit program to ensure equipment remains within specified limits;
- Substitute methods quieter and less vibration emitting construction methods where possible.
- Limit equipment on site Only have necessary equipment on site;
- Limit activity duration Where possible, concentrate noisy activities at one location and move to another as quickly as possible;

- Site access Vehicle movements outside construction hours, including loading and unloading operations, should be minimised and avoided where possible;
- Equipment maintenance Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the design specifications;
- Reduced equipment power Use only necessary size and power.
- Quieter work practices For example, implement work-site induction training, educating staff on noise sensitive issues and the need to make as little noise as possible; and
- Reversing alarms Consider alternatives, such as manually adjustable or ambient noise sensitive types ("smart" reversing alarms). Alternative site management strategies can be developed, in accordance with the Occupational Health and Safety Plan, with the concurrence of the Occupational Health and Safety Officer.

B. Path Controls

- Noise barriers Locate equipment to take advantage of the noise barriers provided by existing site features and structures, such as embankments and storage sheds;
- Enclosures Install noise-control kits for noisy mobile equipment and shrouds around stationary plant, as necessary;
- Increased distance Locate noisy plant as far away from noise-sensitive receptors as possible; and
- Site access Select and locate site access roads as far away as possible from noise-sensitive areas.

C. Receptor Controls

- Architectural treatment Upgrade the glazing or window shutters of affected bedrooms:
- Consultation Community consultation, information, participation and complaint responses are essential aspects of all construction noise management programs. They typically involve:
 - ✓ A community information program before construction and/or high risk activities are commenced. This usually involves a leaflet distribution and direct discussions and negotiations with affected residents, explaining the type, time and duration of expected noise emissions:
 - ✓ The involvement of affected residents in the development of acceptable noise management strategies;
 - ✓ A nominated community liaison officer with a contact telephone number;
 - ✓ A complaints hotline; and
 - ✓ Timely responses to complaints, providing information on planned actions and progress towards the resolution of concerns.

9.11 Contaminated Land

Existing Situation

The Lower Cudgera Cattle Tick Dip Site is located in the vicinity of the Proposal. The dip site is located on the southern side of Cudgera Creek Road approximately 200 metres west of the intersection with Pottsville-Mooball Road. The dip site has been decommissioned

which means that all standing structures have been removed and the bath emptied of fluid and concrete capped. No data is available on when the dip was last operational.

Topsoil would be removed to a depth of I50mm within 40m of the Lower Cudgera Cattle Tick Dip Site.

Potential Impacts

- Research data indicates that contamination of the soil with DDT and/or arsenic may
 exist up to 40 metres from the bath. Disturbance of contaminated soils could have
 several implications. Exposure of the soils could result in erosion and subsequent
 transport of the contamination to Cudgera Creek;
- Further disposal of contaminated spoil or reuse for filling activities could also have implications, including the requirement for EPA licensing; and
- Potential for impacts would only arise if excavation works are required in the vicinity of the dip site. The concept indicates that works in the vicinity of the dip site involve filling only.

Proposed Safeguards

- Controls associated with contaminated land would be undertaken in accordance with the specifications set out in Sections 6.5, 6.13 & 6.16 of RTA's *Environmental Protection (Management Plan) QA Specification G36*;
- Soil testing would be undertaken prior to commencement of works to determine
 the presence of any contaminants. Adequate soil testing would be undertaken to
 determine if the works would create contaminated spoil as a result of the
 excavation proposed within 40m of the tick dip site;
- Should the investigation reveal that contaminants exist above guideline criteria for
 the intended land use, then a contaminated land management plan (CLMP) would be
 prepared as part of the CEMP for the Proposal. Any remediation works that are
 required would be completed under the conditions of a remedial action plan (RAP)
 that would be prepared by a qualified consultant. Any planning approvals or licenses
 required for remediation works would be identified in the RAP and sought prior to
 remediation works commencing; and
- The CLMP and/or RAP would detail environmental controls and incident management procedures for any works in contaminated areas.

9.12 Waste Minimisation and Management

The existing unlicensed and disused quarry to the east of the existing bridge is being considered as a potential stockpile site. There is an opportunity to rehabilitate the quarry site by filling the site with the excess fill material generated by the Proposal. The fill material could be reshaped back to the original shape of the land and revegetated accordingly. The viability of this option is subject to further negotiations with the current landowner.

Potential Impacts

Potential wastes streams generated from the Proposal would include:

- Bitumen, concrete and asphalt as a result of removal of existing pavement;
- Cleared vegetation and topsoil potentially contaminated by weeds;
- Waste oils and liquids from maintenance of construction plant and equipment;
- Concrete from the removal of the existing bridge;
- · Garbage and sewage from site compounds; and

• Excess spoil material.

The RTA is committed to ensuring the responsible environmental management of waste that cannot be avoided and to providing opportunities for promoting the re-use of these wastes through appropriate measures. In undertaking this commitment the RTA follows the resource management hierarchy principles embodied in the *Waste Avoidance and Resource Recovery Act* 2001 (WARR Act).

The resource management hierarchy principles of the WARR Act are as follows:

- Avoid unnecessary resource consumption as a priority.
- Avoidance is followed by resource recovery (including re-use of materials, reprocessing, recycling and energy recovery).
- Disposal is undertaken as a last resort.

Proposed Safeguards

The following mitigation measures would be put in place to ensure that the management of waste is carried out efficiently and effectively:

- The management of waste would be undertaken in accordance with Section 6.17 (Waste Management) of the RTAs QA Specification G36;
- Unnecessary resource consumption would be avoided as a priority;
- Where waste is created resource recovery would be employed (including re-use of materials, reprocessing, recycling and energy recovery). Examples for this project include:
 - recycling of waste road surface materials such as bitumen and asphalt;
 - reusing excavated material from the cutting as fill material to raise the level of Cudgera Creek Road;
 - reuse of native branches and logs by placing them in nearby areas of vegetation to provide habitat for native species; and
 - > processing and reuse either within the Proposal or through sale or supply to Council or local businesses:
- Disposal would be undertaken as a last resort when the previous two options have been exhausted and where re-use is not acceptable. For example exotic species would be disposed of to a licensed landfill to prevent the spread of seeds. A suitable Council operated waste management centre is located at Stotts Island near the Pacific Highway approximately 20km south of Tweed Heads (about 20km from Cudgera Creek);
- As a priority Tweed Shire Council and local businesses would be contacted to determine if they would be able to utilise the excess material created by the Proposal; and
- Should fill be permanently disposed of in the unlicensed quarry to the east of the existing bridge (refer to Figure I-A in Appendix A) approval must be obtained from the REA for the method of disposal proposed. The REA would need to consider the suitability of the site for filling activities, the nature and volume of the fill to be disposed of, and the proposed methods of compaction and stabilisation of this site.

9.13 Associated Infrastructure and Activities

Existing Situation

Overhead powerlines cross Cudgera Creek Road at a number of locations along the length of the Proposal. Underground Telstra fibre optic cabling is located parallel to the southern side of Cudgera Creek Road. Additionally Tweed Shire Council are proposing to install a water main along the western side of Mooball-Pottsville Road. These works would be considered during the detailed design of the Proposal, in order to avoid interference with the main.

Potential Impacts

- The utilities affected by the Proposal are;
 - Country Energy power lines;
 - > Telstra optical fibre; and
 - > Telstra local cables.
- The affect on powerlines is minimal with the relocation of stay poles. Telstra local cables on the northern side, at the western end of the Proposal, would need to be relocated. The Telstra installation at Ch 1640 would require relocation including two pits at the reprioritised intersection with Pottsville/Mooball Road. The Telstra Optic fibre between Ch 1440 and 1520 would require relocation.

Proposed Safeguards

- The road alignment has been moved to the north at the western straight to avoid any impact on the optical fibre on the southern side of the road;
- All public utilities would be relocated prior to works commencing;
- The "dial before you dig" hotline would be contacted prior to construction to confirm that no utility infrastructure would be affected by the earthworks; and
- The Landscape Revegetation Plan would consider maintenance issues to public utilities.

9.14 Demand on Resources

The demand on resources is not expected have a major impact as a result of the Proposal. Fill material required for the Proposal would be obtained from cut activities involved in this Proposal. The balance of cut material would be either re-used on another RTA project in the area or disposed of to licensed landfill. No materials currently in short supply would be required for the Proposal. Road base and pavement materials would be sourced locally wherever possible. Bridge construction materials would be sourced from within Australia and would not amount to a large volume of material.

The Proposal would result in the loss of a small area of Lowland Rainforest on Floodplain (<500m²), which is listed as a threatened ecological community under the TSC Act 1995. The impacts of this loss would be mitigated with the safeguards proposed in Section 9.5 of this REF.

9.15 Cumulative Environmental Effects

The Proposal is closely linked to the Yelgun to Chinderah Project. The majority of cumulative impacts would be associated with this development:

Flooding

No significant flood events have occurred in the Tweed area since the Pacific Highway Upgrade was completed in August, 2002. Therefore there has been no experience or evidence of the altered hydrological behaviour in the area as a result of the Pacific Highway project. If no significant events occur before construction of the Cudgera Creek Road upgrade, the gross effect of the two projects combined would be experienced during the next flood event and the impact attributable to each individual project would not be easily determined.

Residents are generally aware that the flow regime has been altered by the Pacific Highway project and would be altered by the Cudgera Creek Proposal and that the individual impacts of either would not be easily determined. Further, SKM have recommended several waterway openings to allow water to cross Cudgera Creek Road. It is stated in the WBM report that no adverse impacts would be experienced by adjoining properties if the recommended culvert sizings and locations are adopted in the detailed design of the Proposal.

Noise

The Pacific Highway Upgrade from Yelgun to Chinderah completed in 2002 has resulted in a substantial increase in traffic volumes using Cudgera Creek Road. Monitoring of road traffic noise has shown that daytime noise levels are currently up to 12 dB above what would be considered appropriate for a local rural road. This Proposal would not provide for design increases in traffic carrying capacity and therefore would not be expected to result in noise increases for sensitive receivers based on the current measured noise levels. The Proposal is in fact expected to improve the current levels of road traffic noise at some receiver locations due to improvements in pavement surfacing and alignment.

Therefore the cumulative impact of the two Proposals would involve an increase in noise along Cudgera Creek Road that is less than that currently experienced by residents. Further attempts to mitigate the net noise impacts of the two projects would be undertaken at the completion of the upgrade works. Architectural treatments would be likely to be the most acceptable mitigation measure in a rural environment. However close consultation would be undertaken with the affected residents, and involving expert noise advice, to achieve a practical solution acceptable to both the RTA and the residents.

Ecology

The Proposal involves the removal of approximately 400m² of native vegetation. The cumulative effect of land clearing within the region has resulted in Lowland Rainforest on Floodplain being listed as an Endangered Ecological Community (EEC) on the TSC Act. It is proposed to rehabilitate a nominated area of land bordering the community. The area of the land proposed to be rehabilitated equates to more than 1000 m²

9.16 Operational Hazards and Risks

Operational hazards and risks could include the following:

- Degradation of the surrounding environment due to littering, in particular near or on the bridge, which could result in the proliferation of invasive weed species in the Lowland Rainforest on Floodplain community;
- Potential degradation of the Lowland Rainforest on Floodplain community as a result of increased human intrusion near the proposed bridge crossing;
- Increased speed and volume of traffic; and
- An accident causing a spill into the waterway.

9.17 Principles of Ecologically Sustainable Development

The National Strategy for Ecologically Sustainable Development (NSESD) has been formulated to ensure that ESD is accounted for in all Proposals. There are three core objectives:

- 1. to enhance individuals' and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- 2. to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and lifesupport systems.

These objectives are complemented with a number of guiding principles that are considered below in Table 9.17.1 in terms of the Proposal.

Table 9.17.1: Principles of ESD Applied to the Proposal

Principle	Application to the Proposal		
Precautionary Principle	The majority of the Proposal would be located on the existing road reserve, however some land acquisition would be required from adjacent landholders. Design aspects of the Proposal have considered potential hazards and risks resulting from both construction and operation of the Proposal. No issues have been identified that would cause any serious or irreversible environmental damage as a result of the Proposal at this location. The introduction of mitigative measures as outlined in Chapter 10 of this REF would ameliorate potential environmental impacts.		
Intergenerational Equity	The Proposal would improve the level of supporting infrastructure required on the Yelgun to Chinderah Project to make provision for a more safe and efficient transport system for use by future generations. Concurrently, the Proposal considers and minimises impacts to the local environment through the introduction of mitigative measures to ensure the integrity of natural and social values of the environment for future generations.		
Conservation of Biological Diversity & Ecological Integrity	The Proposal has undergone a rigorous process to determine an alignment / option that minimises impacts to the local environment. Thorough assessment of the local ecology, along with extensive consultation with stakeholders, has been		

Principle	Application to the Proposal			
	undertaken to identify and manage any potential environmental hazards or risks associated with the Proposal. Ameliorative measures outlined in Chapter 10 of this REF would ensure that the Proposal does not compromise biological diversity or ecological integrity.			
Improved Valuation & Pricing of Environmental Resources	It is often difficult to place a monetary value on environmental resources. An indirect indication of the value of such resources is the cost of the proposed mitigation measures. These costs were considered in a comparison of options in the Route Options Identification and Assessment Report undertaken by Abigroup.			

9.18 Matters of National Environmental Significance (NES) and Commonwealth Land

The *Commonwealth Environment Protection and Biodiversity Act 1999* (EPBC Act) requires that the following factors must be considered:

Matters of National Environmental Significance

- World Heritage properties: None Found within 10km of the study area.
- Ramsar Wetlands of international significance: Nine Ramsar wetlands are listed for New South Wales (Towra Point NR, Kooragang NR, Macquarie Marshes NR, Little Llangothlin NR, Blue Lake, Lake Pinaroo, Gwydir Wetland, Myall Lakes, Narran Lakes NR). None of these occur in, near or downstream of the study area. There would be no impact on listed Ramsar wetlands because of the proposed works.
- There are no Threatened Ecological Communities: There are no Threatened Ecological Communities and 51 listed threatened species potentially occurring within 10km of the proposed works. Of the 51 species listed as potentially occurring within 10km of the study area six (6) were recorded during the flora and fauna surveys that are listed on the schedules of the EPBC Act (Refer to Table 5.1 of the Ecological Assessment Report in **Appendix E** of this REF).

The preferred option has the least direct impact upon threatened species. No threatened individuals are to be removed as part of the Proposal. Other mitigation measures such as minimising the construction footprint and rehabilitating the area of the existing bridge would result in overall minimal impact upon threatened species.

Six of these species were identified during survey work undertaken by SKM. They were:

- Ochrosia moorei;
- > Randia moorei;
- Hicksbeachia pinnatifolia;
- Syzygium moorei;
- > Syzygium hodgkinsoniae; and
- Macadamia tetraphylla.

Also potential habitat exists for the Grey-headed Flying-fox. Coxen's Fig Parrot is considered to be locally extinct and is unlikely to occur in the study area.

The guidelines within the EPBC Act were reviewed in terms of assessing the potential impacts on these nationally threatened species. The assessment considers whether the action is likely to have a significant impact on a threatened species if it is likely to:

I. Lead to a long-term decrease in the size of an important population of a species.

The results of the survey indicate that six nationally threatened flora species have been identified at the study site. The Proposal would not involve removal

of any of these individual plants nor would it lead to the long-term decrease in a population of these species as the disturbance would be temporary only.

2. Reduce the area of occupancy of an important population

Whilst a small area of vegetation would be removed for the proposed bridge and road approaches, this would not result in the loss of an area currently occupied by a nationally threatened species.

3. Fragment an existing important population into two or more populations

The proposed bridge and road through the lowland rainforest would dissect the vegetation to a small degree, however this is not considered a significant fragmentation of the community. The small area of vegetation removal is considered unlikely to significantly disrupt future seed dispersal and recruitment of rainforest species to the north and south of the bridge. Additionally the community is currently fragmented by an existing bridge that would be decommissioned. This area would be revegetated and rehabilitated so that the net effect of fragmentation would be minimal.

4. Adversely affect habitat critical to the survival of a species

There is a register of critical habitat in the EPBC Act and only three locations are listed, none of which relate to the study area.

5. Disrupt the breeding cycle of an important population

It is likely that seed dispersal is via flowing water along the creek as well as birds and bats feeding on fruits of rainforest trees. The bridge would not imped water flow in any way as the piers are to be constructed two metres back from the top of the banks of Cudgera Creek. The Proposal would not create an impediment to birds or bats therefore seed dispersal would remain relatively unaffected. It is not considered that there would be any significant impacts on the breeding cycle of the population, however, the protective measures identified would ensure that any potential impacts are prevented. The Proposal would not impact on a roosting colony of the Grey-headed Flying-fox nor remove potential foraging habitat for this species.

6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed road alignment avoids the nationally threatened flora species identified from the study. As part of the road upgrade it is proposed to rehabilitate formerly cleared areas thereby actually increasing the availability of habitat, which more than compensates for the small area to be cleared. The Proposal would not involve significant declines in populations of threatened plants recorded at the site.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the threatened species habitat

Some impacts of invasive weed species are likely to be experienced as a result of the crossing at a new location. This impact would be minimised partly by the lopping rather than removal of vegetation under the bridge and by the minimisation of the construction footprint. This would minimise the opportunity for invasive species to colonise.

The existing bridge location and eastern approach currently experiences the edge effects of invasive weeds. Camphor Laurel is a significant invasive species that currently occurs in the lowland rainforest habitat at the site. The Proposal would provide the opportunity to remove much of the existing invasive species and replace with species indicative of Lowland Rainforest on Floodplain.

8. Interferes substantially with the recovery of the species

Currently there are no species recovery plans produced for the species found during the survey, however it is considered that the proposed safeguards outlined under previous criteria would ensure that the populations are protected, such that no interference with the recovery of the species occurs as a result of the Proposal.

• Commonwealth Listed Migratory Species: There are 20 migratory species potentially occurring within 10km of the study area. Marine species were not considered relevant to the Proposal given the distance to the ocean and in particular the distance to the ocean via Cudgera Creek. There are 9 migratory species potentially occurring within the study area.

The terrestrial species covered by migratory provisions of the EPBC Act are:

- Coxen's Fig-Parrot (Cyclopsitta diophthalma coxeni)
- White-bellied Sea-Eagle (Haliaeetus leucogaster)
- White-throated Needletail (Hirundapus caudacutus)
- > Black-faced Monarch (Monarcha melanopsis)
- > Spectacled Monarch (Monarcha trivirgatus)
- > Satin Flycatcher (Myiagra cyanoleuca)
- Rufous Fantail (*Rhipidura rufifrons*)

The wetland species covered by the migratory provisions of the Act are:

- Latham's Snipe (Gallinago hardwickii)
- Painted Snipe (Rostratula benghalensis)

The Proposal is not likely to create any direct or indirect impacts on migratory species. No direct impacts on estuarine or inter-tidal habitats are envisaged as a result of the proposed works, especially as appropriate control measures would be adopted to minimise loss of riparian and aquatic habitats and preserve water quality. Furthermore, the Proposal is not likely to affect the prey base of migratory species in the locality and the current population size and visitation rates of migratory species in the locality are likely to be maintained.

- Nuclear Actions: The Proposal would not involve a nuclear action.
- Commonwealth Marine Areas: None Found within 10km of the study area.

9.19 Assistance to Assessing Officer

9.19.1 Summary of Key Issues

 Presence of eight (8) threatened species, listed on the TSC Act, within the study area;

- Potential for noise impacts on nearby residents due to increased traffic;
- · Potential for water pollution via drainage lines; and
- Potential for erosion and sedimentation of creeklines.

9.19.2 Summary of Beneficial Effects

The beneficial effects resulting from the construction of the Proposal include:

- Encouraging road safety and assisting in the realisation of strategic framework goals as presented in Action for Transport 2010 – an Intergraded Transport Plan for NSW (DoT 1998);
- The Proposal meets the requirements of the Conditions of Approval for the Pacific Highway Upgrade Yelgun to Chinderah EIS;
- The Proposal would result in an overall net increase in Lowland Rainforest on Floodplain in the study area;
- Improved access for residents during flooding events;
- · Increased design speed for Cudgera Creek Road; and
- Improved travel times for residents and visitors to the coastal villages of Pottsville and Hastings Point.

9.19.3 Summary of Adverse Effects

The Proposal would result in some adverse effects, which would include:

- Potential reduction in habitat and foraging areas for threatened species;
- Increased potential for sedimentation of local waterways as a result of construction activities;
- Short and long term increase in noise levels;
- Short term disruption to traffic flow along Cudgera Creek Road;
- Increased potential for short-term water pollution episodes as a result of construction activities;
- Removal of native vegetation including a small area of Lowland Rainforest on Floodplain (<500m²); and
- Severance of habitat corridor along with increased potential for the introduction of invasive weeds into the native rainforest habitat.

10.1 Environmental Management Plans

Should approval be given for the Proposal to proceed, then detailed specifications and two environmental management plans specific to the Proposal would be prepared, as follows:

- A Project Environmental Management Plan (PEMP) would be used as a working document to effectively plan, monitor and record the project environmental responsibilities of the Project Manager and his/her representatives.
- A Contractor's Environmental Management Plan (CEMP) would be developed in accordance with the specifications set out in the RTA's *Environmental Protection* (Management Plan) QA Specification G36. In addition the CEMP would incorporate additional site specific requirements, outlined in section 10.2 below, which are not covered by G36. The CEMP would be reviewed and certified by the RTA Environmental Adviser, Northern Region, prior to the commencement of any site works.

These documents would be continually updated to respond to specific project requirements and as works proceed through the various stages of the Proposal.

10.1.1 The Project Environmental Management Plan (PEMP)

The PEMP would be developed for the project concurrently with RTA Specification G36, including environmental safeguards identified within this REF and any conditions of approval. The PEMP would be completed as the project progresses through the REF, approval, contract preparation and implementation phases. The aims of the PEMP would be to:

- Assist the Project Manager to control the environmental management of the Proposal;
- Identify the processes required for the environmental evaluation of this Proposal;
- Identify environmental risks which may impact on the Proposal and its stakeholders;
- Identify those environmental risks which must be managed by the RTA and ensure that relevant risks would be managed by the Contractor;
- Document the requirements for review and/or approval of environmental documents such as REF, Environmental Specifications (G36) and the Contractor's Environmental Management Plan (CEMP); and
- Document project requirements for auditing the implementation of the CEMP.

10.1.2 Contractor's Environmental Management Plan (CEMP)

Contractors seeking to work on this project would be required to have a corporate environmental management system (EMS) accredited by the RTA. Such Contractors would operate in accordance with their accredited EMS and would be required to prepare their own CEMP that specifically addresses the environmental issues raised in this REF, any conditions of approval, and the RTA's PEMP. The CEMP would provide the main 'onsite' instrument used to control and minimise environmental impacts during the Cudgera Creek Road Upgrade works.

The Contractor's EMP would include the following:

- a) Assignment of responsibility for planning, approving, implementing, maintaining, assessing and monitoring of environmental controls;
- b) Copies of approvals, licences and permits to meet statutory requirements;

- c) Details of the potential environmental effects and the operational control measures which are to be implemented to comply with statutory requirements and provide environmental protection in accordance with the requirements of the contract;
- d) Details of how environmental protection would be maintained for each of the subcontractor's activities including full details in accordance with (b) and (c) above;
- e) Environmental monitoring program and report forms for recording all monitoring activities, including periodic inspections and inspections essential for monitoring high risk events, the adequacy of operational controls together with measurements for aspects where compliance limits have been specified;
- f) Locations of environmental controls and environmentally sensitive areas, with particular reference as to how the effectiveness of such controls would be ensured in any environmentally sensitive areas;
- g) Supplementary plans for environmental protection and operational control (including Erosion and Sedimentation Control Plan, Soil and Water Management Plan, Noise Management Plan, Waste Management Plan, Vegetation Management Plan, Vibration and Air Blast Management Plan, Contaminated Land Management Plan and a Landscape Rehabilitation Plan);
- h) How nonconformance control, corrective and preventive actions would be implemented and closed out;
- i) Communication procedures;
- j) Emergency response procedures for containing environmental damage and procedures for planning restoration activities;
- k) Environmental training program;
- Authorised personnel and procedure for changing and issuing the CEMP;
- m) Details of how the changes to the environmental management documentation and data are to be identified and communicated to relevant project personnel;
- n) Mechanism for regular evaluation of environmental performance; and
- o) Environmental auditing program.

The CEMP would particularly address the following environmental protection requirements (where relevant):

- Legislation;
- Approvals, licences and permits;
- Access and traffic management;
- Soil and water management;
- Air quality;
- Noise control;
- Ground vibration and air blast:
- Vegetation;
- Fauna;
- Fire precautions;
- Herbicides and other contaminants;
- Spillage prevention and containment;
- Indigenous heritage;
- Non-indigenous heritage;
- Contaminated ground;
- · Waste management; and
- Restoration of site.

10.2 Summary of Proposed Safeguards

As outlined above the following safeguards which are not covered by G36 would be incorporated into the CEMP.

A. Geology, Soils and Landform

- A Soil and Water Management Plan (SWMP) shall be prepared as part of the Contractors Environmental Management Plan (CEMP). The plan shall be prepared in accordance with the requirements of the NSW Department of Housing publication "Managing Urban Stormwater Soils and Construction" (the Blue Book);
- Progressive Erosion and Sedimentation Control Plans shall be prepared for each stage of the works as part of the SWMP;
- Regular inspection of the work site shall be undertaken during construction to ensure that the SWMP was properly implemented and maintained;
- The cutting to the east of the proposed crossing may be constructed no steeper than 1.5:1 horizontal to vertical for the first 7 metres of vertical height. The 1.5:1 cut shall be protected with an approved cellular confinement system to hold the topsoil in place and prevent erosion of the slope. Above 7 metres the cutting shall be no steeper than 2:1;
- All other batter slopes shall be constructed no steeper than
 2:I horizontal to vertical. These batters shall then be covered in topsoil and grassed;
- The western approach embankment shall be constructed and allowed to settle before the bridge foundations are constructed; and
- Exposed areas shall be revegetated progressively and restored as work is completed for each section. A cover crop of non-invasive sterile species and locally occurring native vegetation species shall be used (Refer to Appendix A of Ecological Assessment Report for flora species list).

B. Climate

- Works shall not be undertaken during periods of heavy rainfall; and
- In the event of heavy fog, works shall be delayed until such time as the fog has satisfactorily dissipated.

C. Air Quality

- Trucks and all fuel powered equipment would be maintained in good working condition to minimise potential emissions;
- Stockpiles shall be protected from wind erosion through dampening or covering;
- Unsealed access roads, compound areas and other areas with traffic shall be regularly dampened using water sprays;
- When winds reach a velocity of 2.5 metres per second, the frequency of watering shall be increased appropriately.

- Where possible, dust generating activities shall be reprogrammed to avoid periods of high wind velocity;
- Truck loads shall be wet down or covered to suppress dust generation;
- Cleaning of debris from the road surface shall be undertaken on a regular basis;
- Tailgates shall be secured during operation of trucks and utes;
- · There shall be no burning of timber;
- Work that would potentially create dust shall cease during periods of high wind; and
- If winds are high and works are creating high levels of dust that are likely to cause discomfort to local residents or a safety hazard to traffic or work personnel, the works shall be modified or stopped until the dust hazard is eliminated or has reduced to an acceptable level.

D. Water Quality and Hydrology

- All drainage infrastructure shall be designed and implemented in accordance with the NSW Fisheries Policy and Guidelines for bridges, roads, causeways, culverts and similar structures (1999);
- Stormwater from the bridge surface shall be treated prior to being directed towards Cudgera Creek through overland flow (refer to section 9.4 proposed safeguards);
- A water quality monitoring program shall be undertaken in consultation with the REA, the EPA, and the Pacific Highway Office (PHO) during construction and the first six months of operation (refer to section 9.4 proposed safeguards);
- A check of any drainage works shall be undertaken promptly during and after heavy rain events following completion of the works;
- Should any spillages occur during the construction activity the Environmental Adviser, Northern Region, shall be contacted immediately, and contaminants shall be immediately contained, removed, treated (if necessary) and disposed of to the satisfaction of the EPA;
- Mud and dirt shall be removed from the wheels and bodies of haulage equipment before it enters public roads or other sealed pavements;
- Culvert sizing shall be undertaken in accordance with mitigations measures recommended by WBM Oceanics Pty Ltd. Refer to the following table:

Table 10.2.1: WBM recommended waterway openings

Chainage	Number of Barrels and Size of Culverts			
(m)	Existing	Proposed		
135	I x 1700W x 550H RCBC	2 x 1800W x 600H RCBC		
280		I x 450 RCP		
385		I x I200W x 900H RCBC		
545	I x 300 RCP	I x 450 RCP		
860		3 x 1200W x 900H RCBC		

- The existing bridge over Cudgera Creek shall be removed;
 and
- Scour protection shall be designed to include flow velocities not exceeding 1.5m/s upon exiting culvert and bridge.

E. Ecology

- The limits of the proposed bridge and road approach area shall be identified in the field within the densely vegetated areas either side of Cudgera Creek and construction of the road shall be limited to this footprint (refer to Figure 7.1 and Figure 7.2 of the Flora and Fauna Report Appendix E);
- The limits of the proposed bridge and road approach area shall be identified in the field within the densely vegetated areas either side of Cudgera Creek and construction of the road shall be limited to this footprint. The limits of the footprint are shown in Figure 7.1 and Figure 7.2 of the Ecological Assessment Report (Refer to **Appendix E**). Disturbance shall be limited to a:
 - Maximum of two (2) metres upstream and downstream from the sides of the proposed bridge. This limit shall be clearly defined onsite so that workers are aware of it at all times. This could be achieved by flagging of vegetation along the identified boundary or by the placement of some clearly identifiable stringline;
 - Minimum two (2) metres back from the uppermost bench of the river channel of Cudgera Creek (eg. The bridge abutments shall be located at least 2m back from the top of the bank). This limit shall be clearly identified onsite via the provision of protective fencing 2m back from the top of the bank; and
 - Maximum of three (3) metres from the toe of fills on the approach works that are adjacent to the rehabilitation area.
- Protective fencing shall be placed around the Randia moorei and Syzygium moorei (Threatened Species) identified in proximity to the proposed bridge location prior to starting work in the construction area;
- Areas of native vegetation in proximity to construction areas shall be fenced with protective fencing prior to work commencing in the area;

- Contractors shall be instructed on the limits of clearing and not allowed to encroach into areas outside the identified road construction limits defined in Figure 7.1 and behind the protective fencing. This includes preventing any materials or construction equipment from entering into protected areas;
- Within the banks of the creek there shall be no complete removal of vegetation. Instead there shall be trimming of vegetation no further than Im below the deck level. This trimming shall be undertaken using a cherry picker with trimmed vegetation lifted out by a crane;
- The southern edge of the bridge shall be no closer than Im from the Randia moorei individual;
- Appropriate erosion and siltation mitigation measures shall be used in proximity to the creek and rainforest vegetation;
- All construction work shall be undertaken outside the 2 metre creek buffer areas as defined above:
- The area between the existing Cudgera creek road and the newly proposed road (including the abandoned house and associated cleared areas) shall be rehabilitated and revegetated with rainforest plant species as shown in Figure 7.3 of the Ecological Assessment Report (Appendix E). The weeds in the hatched area up to 5 cm diameter shall be cut down or poisoned using an appropriate herbicide;
- The bridge shall be at least 24m long and shall span Cudgera Creek:
- No piers shall be located within the 24m span;
- The bridge shall be a maximum width of 15m;
- Works shall not commence until the bridge and road design has been reviewed by NSW Fisheries and recommendations are incorporated;
- Works shall not commence until the bridge and road design has been reviewed by NPWS and recommendations are incorporated.
- The opportunity to comment on the proposed method of removal of existing bridge shall be given to NSW Fisheries;
- A Landscape Rehabilitation Plan (LRP) shall be prepared for the Proposal by a suitably qualified contractor satisfying NPWS criteria. RTA shall manage the preparation of the LRP.
- Close consultation shall be maintained between NPWS, RTA and the contractor during preparation of the Rehabilitation Plan:
- The LRP shall detail revegetation strategies for disturbed areas, planting regimes for the rehabilitation of the existing bridge and approaches and for the area to be rehabilitated as

per Figure 7.3 of the Flora & Fauna Report (Appendix E);

- Plant species selection shall complement existing rainforest areas, with species selection corresponding to the species listed in the Flora and Fauna Report (Appendix E). Species that are most suitable for regeneration shall be included in the Rehabilitation Plan. Consideration shall be given to the successional approach to planting such species and collection and use of local seed
- The LRP shall also incorporate the extent and proposed method of weed removal for the Proposal;
- Plant species selection shall complement existing rainforest areas, with species selection corresponding to the species listed in the Flora and Fauna Report (Appendix E) report. Species that are most suitable for regeneration shall be included in the LRP. Consideration shall be given to the successional approach to planting such species and collection and use of local seed;
- Any Coast Cypress Pine individuals near the works area shall be identified and tagged prior to work commencing;
- Where Coast Cypress Pine individuals are removed suitable management of the species shall include translocation the individual trees where possible which should be done according the accepted guidelines for translocation of threatened plants in Australia (Australian Network for Plant Conservation 1997). Where translocation is unlikely to be successful the collection of seed and propagation for future replanting back into the study area shall be undertaken at a rate of at least 10:1;
- The revegetated area shall be maintained for a period of 2 years after completion of the roadworks;
- Suppression of weeds by poisoning in the Weed Removal Area shown in Figure 7.1 of the Flora and Fauna Report (Appendix E) shall continue for two years after completion of the roadworks;
- The RTA shall carry out a follow-up control program for foxes and feral cats at the site. The program shall involve limited trapping and poisoning of foxes and feral cats every six months over the 2-year maintenance period.

F. Socio-Economic Considerations

- The proposed works shall be undertaken under traffic;
- Access shall be maintained to private residences at all times during construction; and
- Access to water shall be maintained through property rearrangements or alternatively through provision of a bore on the property. Consultation shall be undertaken between the affected property owners, the regional environmental advisor and the project manager. This shall be resolved

prior to commencement of works;

- Should the option of a bore be chosen to solve the access to water issue consultation would be undertaken with the Department of Land and Water Conservation regarding water access rights;
- Should access to a new location be provided then:
 - Fencing shall be erected to prevent cattle from straying onto neighbouring properties, Cudgera Creek Road or into the rainforest community;
 - Fencing shall be erected to the waters edge to prevent cattle impacting on banks previously not affected by cattle access and riparian vegetation;
 - Aggregate material or road base shall be provided if the access area is potentially boggy;

G. Indigenous Heritage

- Tweed/Byron LALC shall be notified 5 days prior to removal of topsoil outside of the existing pavement alignment;
- An officer representing the Tweed/Byron LALC shall be present onsite during removal of any topsoil (to a depth of 500mm) outside of the existing pavement alignment;
- In the event that any indigenous artefacts or items are located during the works, all work shall cease in the vicinity of the find, and the RTA's Environmental Adviser, Northern Region, Northern Region Aboriginal Programs Consultant and NSW NPWS shall be contacted: and
- The RTA, as the Proponent shall be aware of its statutory responsibility for protecting sites and places of cultural significance, and shall transfer this knowledge and responsibility to contractors undertaking the works. All staff contracted to work on the project shall be made aware of the procedure required should remains be uncovered.

H. Non -Indigenous Heritage

- In the event that any non-indigenous items are located during the works, all work shall cease in the vicinity of the find and the RTA's Environmental Advisor, Northern Region and a suitably qualified archaeologist shall be contacted; and
- The RTA as the Proponent is aware of its statutory responsibility for protecting sites of heritage significance. This knowledge and responsibility shall be transferred to contractors undertaking the works. All staff contracted to work on the project shall be made aware of the process required when items are uncovered.

I. Visual/ Landscape

- All areas affected or exposed during works shall be revegetated and landscaped after the completion of construction works using locally occurring native species;
- The Landscape Rehabilitation Plan (LRP) shall incorporate revegetation strategies for all exposed surfaces created during the Proposal including fill batters along the road verge

and revegetation of the cutting;

- The LRP shall consider visual impacts and attempt to address this issue in conjunction with other objectives of revegetation;
- Tweed Shire Council shall be consulted in regards to the LRP as responsibility for Cudgera Creek Road would be transferred back to Council upon completion of the works;
- Visual impacts of the bridge shall be minimised by maintaining a low structure with only those components necessary for the integrity of the structure and to address safety issues to be incorporated into the design; and
- Signage design shall be undertaken in consultation with Tweed Shire Council.

J. Noise and Vibration

- The RTAs Environmental Noise Management Manual shall be consulted prior to the development of any noise management strategies. Expert advice shall be sought on any proposed methods to determine what internal noise reduction would be achieved, as the construction of the residence at lot 999 Cudgera Creek Road would not be receptive to architectural treatments;
- Post construction noise monitoring shall be undertaken prior to the implementation of any mitigation measures to reassess the levels of road traffic noise following the construction of the new pavement;
- The CEMP shall include a strategy for utilising best practice technology to achieve noise mitigation incorporating a combination of the most appropriate source control, path control and receptor control measures from those recommended in Section 9.10 of this REF.

K. Contaminated Land

- Adequate soil testing shall be undertaken prior to the commencement of works to determine if the works would create contaminated spoil as a result of the excavation proposed within 40m of the tick dip site;
- In the event that the investigation reveals that contaminants exist above guideline criteria for the intended land use then:
 - a Contaminated Land Management Plan (CLMP) shall be prepared as part of the CEMP for the Proposal;
 - any remediation works that are required shall be completed under the conditions of a Remedial Action Plan (RAP) that shall be prepared by a qualified consultant;
 - any planning approvals or licenses required for remediation works shall be identified in the RAP and obtained prior to the commencement of remediation; and
- The CLMP and/or RAP shall detail environmental controls

and incident management procedures for any works in contaminated areas.

L. Waste Minimisation and Management

- Unnecessary resource consumption shall be avoided as a priority;
- Where waste is created resource recovery shall be employed (including re-use of materials, reprocessing, recycling and energy recovery). Examples for this project include;:
- Recycling of waste road surface materials such as bitumen and asphalt;
- Reusing excavated material from the cutting as fill material to raise the level of Cudgera Creek Road;
- Reuse of native branches and logs by placing them in nearby areas of vegetation to provide habitat for native species; and
- Processing and reuse either within the Proposal or through sale or supply to Council or local businesses;
- Disposal shall be undertaken as a last resort when the previous two options have been exhausted and where re-use is not acceptable. For example exotic species shall be disposed of to a licensed landfill to prevent the spread of seed. A suitable Council operated waste management centre is located at Stotts Island near the Pacific Highway approximately 20km south of Tweed Heads (about 20km from Cudgera Creek);
- As a priority Tweed Shire Council and local businesses shall be contacted to determine if they would be able to utilise the excess material created by the Proposal;
- Should fill be permanently disposed of in the unlicensed quarry to the east of the existing bridge (refer to Figure I-A Design Plan in Appendix A) approval must be obtained from the REA for the method of disposal proposed. The REA would need to consider the RTA's preference for The REA would need to consider the suitability of the site for filling activities, the nature and volume of the fill to be disposed of, and the proposed methods of compaction and stabilisation of this site.

M. Associated Infrastructure and Activities

The "dial before you dig" hotline shall be contacted prior to construction to confirm that no utility infrastructure would be affected by the earthworks.

II Consideration of Environmental Factors

11.1 Clause 228 Checklist (NSW Legislation)

The fifteen factors listed in Clause 228(2) of the EP&A Regulation 2000 have been addressed below to ensure that the likely impacts of the Proposal on the natural and built environment are fully considered.

Factor	Impact
a) Any environmental impact on a community?	
Comments:	
There would be some increase in traffic as a result of the Proposal causing some noise impacts, which would be mitigated. In the long term, the community would be provided with better access during flooding events.	Short term -ve; Long term +ve
b) Any transformation of a locality?	
Comments:	
The change in the road alignment would result in a slight change in the locality. The new road alignment would result in the removal of two dwellings from the area.	-ve
c) Any environmental impact on the ecosystems of the locality?	
Comments:	
The Proposal would sever the rainforest community approximately 150m north of the existing bridge. The community is relatively undisturbed in this area. However the existing bridge is to be removed and the	Short term –ve;
surrounding area rehabilitated resulting in a net zero change in the ecosystem.	Long term nil
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	
Comments:	
There would be a short term negative impact on the aesthetic and environmental quality of the locality as some vegetation would be removed. The Proposal would have long term positive impacts on the	Short term -ve;
aesthetic, recreational and scientific values of the site due to the rehabilitation of native vegetation in combination with landscaping of the site.	Long term nil
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?	
Comments:	
The Proposal is not anticipated to have any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.	Nil

Factor	Impact
f) Any impact on the habitat of any protected or endangered fauna (within the meaning of the National Parks and Wildlife Act 1974?	
Comments:	
A small area of Lowland Rainforest on Floodplain (approximately 500m²) would be removed as part of this Proposal. This would result in some minor short-term impact upon species that use or inhabit this rainforest community. However rehabilitation of adjacent areas would maen that no long term adverse impacts would be experienced by protected or endangered fauna.	Short-term -ve
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?	
Comments:	
Several threatened species have been located in the study area however no species would be endangered by the Proposal. Mitigative measures outlined in Chapter 10 of this REF would minimise any impacts.	Nil
h) Any long-term effects on the environment?	
Comments:	
No long term effects on the environment are predicted upon completion of rehabilitation measures proposed in chapter 10 of this report.	Nil
i) Any degradation of the quality of the environment?	
Comments:	
There would be a short-term negative impact on the local environment as vegetation would be removed and disturbed. However, the local environment would be improved through weed removal and the use of native plants for regeneration, thereby resulting in a long term nil impact.	Short term -ve; Long term nil
j) Any risk to the safety of the environment?	
Comments:	Short term
There is a risk of waterway pollution during construction. However mitigative measures outlined in Chapter 10 of this REF would minimise these impacts.	-ve; Long term Nil
k) Any reduction in the range of beneficial uses of the environment?	
Comments:	
The Proposal would result in the severance of a small amount of agricultural land. The amount of land is considered to be insignificant and is compensated by the benefits of a safer road with a higher design speed.	Long term +ve
l) Any pollution of the environment?	
Comments:	
The Proposal has the potential to pollute waterways, the soil, the air and a Lowland Rainforest on Floodplain community. The mitigation measures	Short term -ve

Factor	Impact
outlined in this REF would reduce or eliminate those impacts.	
m) Any environmental problems associated with the disposal of waste?	
Comments:	
Some contaminated waste may be produced as a result of excavation within 40m of the Lower Cudgera Cattle Tick Dip Site. Soil testing shall be undertaken prior to the commencement of excavation works to confirm this. Should testing reveal that contaminants do exist then a license would be obtained from the EPA for disposal of the contaminated material and a Contaminated Land Management Plan (CLMP) would be prepared as part of the CEMP for the Proposal. The CLMP would outline how the works would be undertaken in accordance with the license conditions.	Nil
n) Any increased demands on resources, natural or otherwise which are, or are likely to become in short supply?	
Comments:	
The Proposal would not increase demands on resources, natural or otherwise, that are or are likely to become in short supply.	Nil
o) Any cumulative environmental effect with other existing or likely future activities?	
Comments:	
Increased traffic associated with the Yelgun to Chinderah Project.	Net +ve
Improved safety and more efficient road network in association with the Yelgun to Chinderah Project.	

11.2 EPBC Act 1999 (Commonwealth Legislation)

The EPBC Act requires that the following matters of National Environmental Significance (NES) be considered:

Factor	Impact
a) Any environmental impact on a World Heritage property?	•
Comments:	
There are no world heritage properties within the vicinity of the Proposal.	Nil
b) Any environmental impact on wetlands of international importance?	
Comments:	
There are no wetlands of international importance located within 5km of the Proposal.	Nil
c) Any environmental impact on Commonwealth listed threatened species or ecological communities? Comments:	
There are no Threatened Ecological Communities and 51 listed threatened species potentially occurring within 10km of the proposed works. With the introduction of safeguards as outlined in Section 10.5 of this REF, it is not anticipated that there would be any negative impact on a Commonwealth listed threatened species or ecological communities.	Nil
d) Any environmental impact on Commonwealth listed migratory species?	
Comments:	
Twenty (20) migratory species have been recorded within 10km of the study area. However, given the minimal vegetation removal involved it is not anticipated that migratory species would be affected by the proposed works.	Nil
e) Does any part of the Proposal involve a nuclear action?	
Comments:	
The Proposal would not involve a nuclear action.	Nil
f) Any environmental impact on a Commonwealth marine area?	
Comments:	
No Commonwealth marine areas are located within 10km of the Proposal. Providing the safeguards recommended in Section 9.5 of this REF are implemented it is considered unlikely that any commonwealth Marine areas would be impacted.	Nil
In addition, any impact on Commonwealth Land?	
Comments:	
No Commonwealth Land is located within 10km of the study area.	Nil

12 Certification

This Review of Environmental Factors provides a true and fair review of the Proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the Proposal.

Richard Dunnicliff Environmental Officer

RTA Environmental Technology

Date: 21.5.03

I have examined this Review of Environmental Factors and the certification by Richard Dunnicliff and accept the Review of Environmental Factors on behalf of the RTA.

Peter Black
Project Manager

Date: 11 JUN 2003

13 References

- Department of Transport (1998), Action for Transport 2010. An integrated transport plan for NSW;
- NSW Fisheries (1999), *Update, Policy and Guidelines. Aquatic Habitat Management and Fish Conservation*;
- NSW Fisheries (1999), Policy and Guidelines for Bridges, Causeways, Culverts and Similar Structures 1999;
- NSW RTA, (2001) RTA Environmental Impact Assessment Policy, Guidelines and Procedures;
- D.T. Morand (1996), Soil Landscapes of the Murwillumbah-Tweed Heads 1:100 000 Sheet,
- Acid Sulfate Soils Management Advisory Committee, (1998). Acid Sulfate Soils Manual. NSW Agriculture, Wollongbar;
- Abigroup (2002), Upgrade and Rehabilitation of Cudgera Creek Road Route Options Identification and Assessment Report;
- Sinclair Knight Merz (1998); Pacific Highway Upgrade Yelgun to Chinderah EIS, and
- Sinclair Knight Merz (2003), Cudgera Creek Road Upgrade Ecological Assessment, and
- New South Wales Consolidated Regulations website: (http://www.austlii.edu.au/au/legis/nsw/consol_reg/tlep1996333/);

Appendix A

Aerial Photo and Photos of the Site



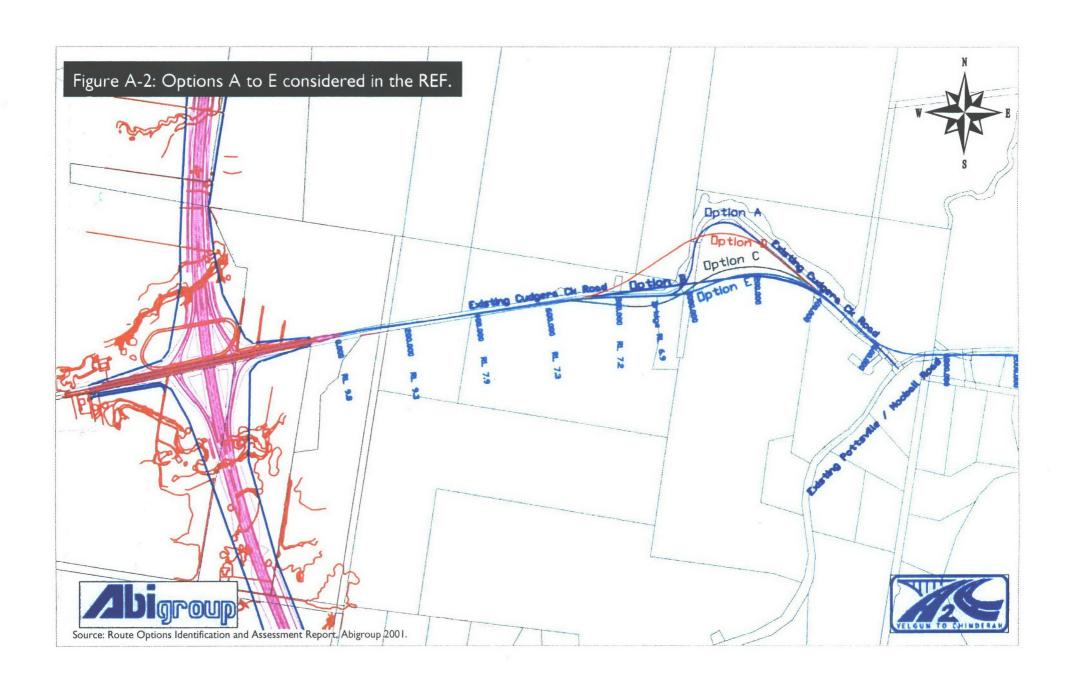


Photo I: View site from western limit of proposed works.



Photo 2: View site from eastern limit of proposed works.



Photo 3: Proposed alignment, derelict house looking northeast.



Photo 4: Cudgera Creek looking north from existing bridge.



Photo 5: Cudgera Creek looking south from existing bridge.





Photo 7: Eastern side of proposed new bridge crossing from top of existing cutting.

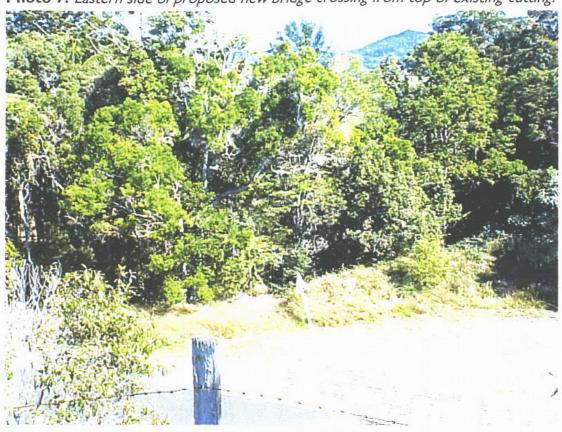
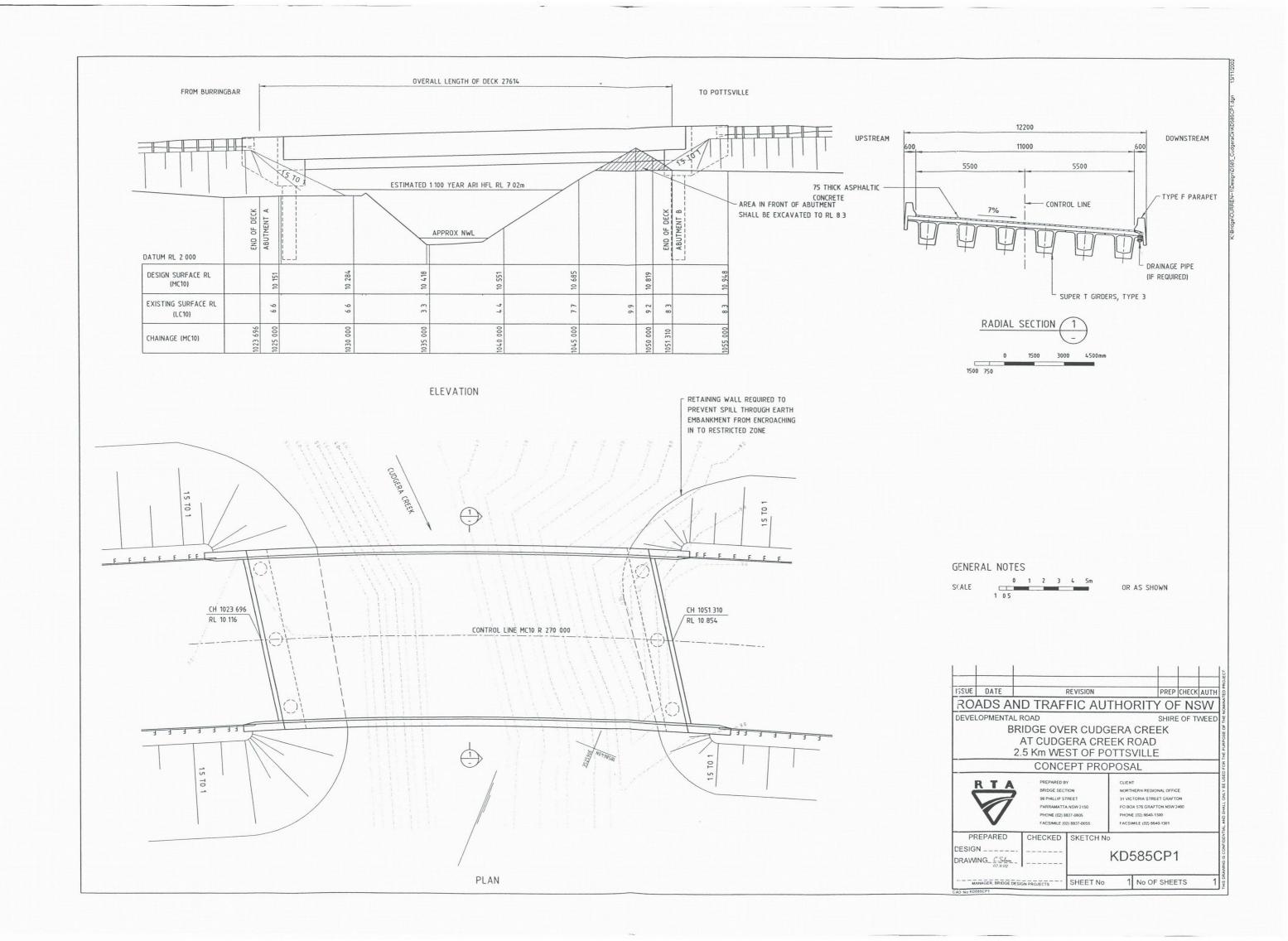


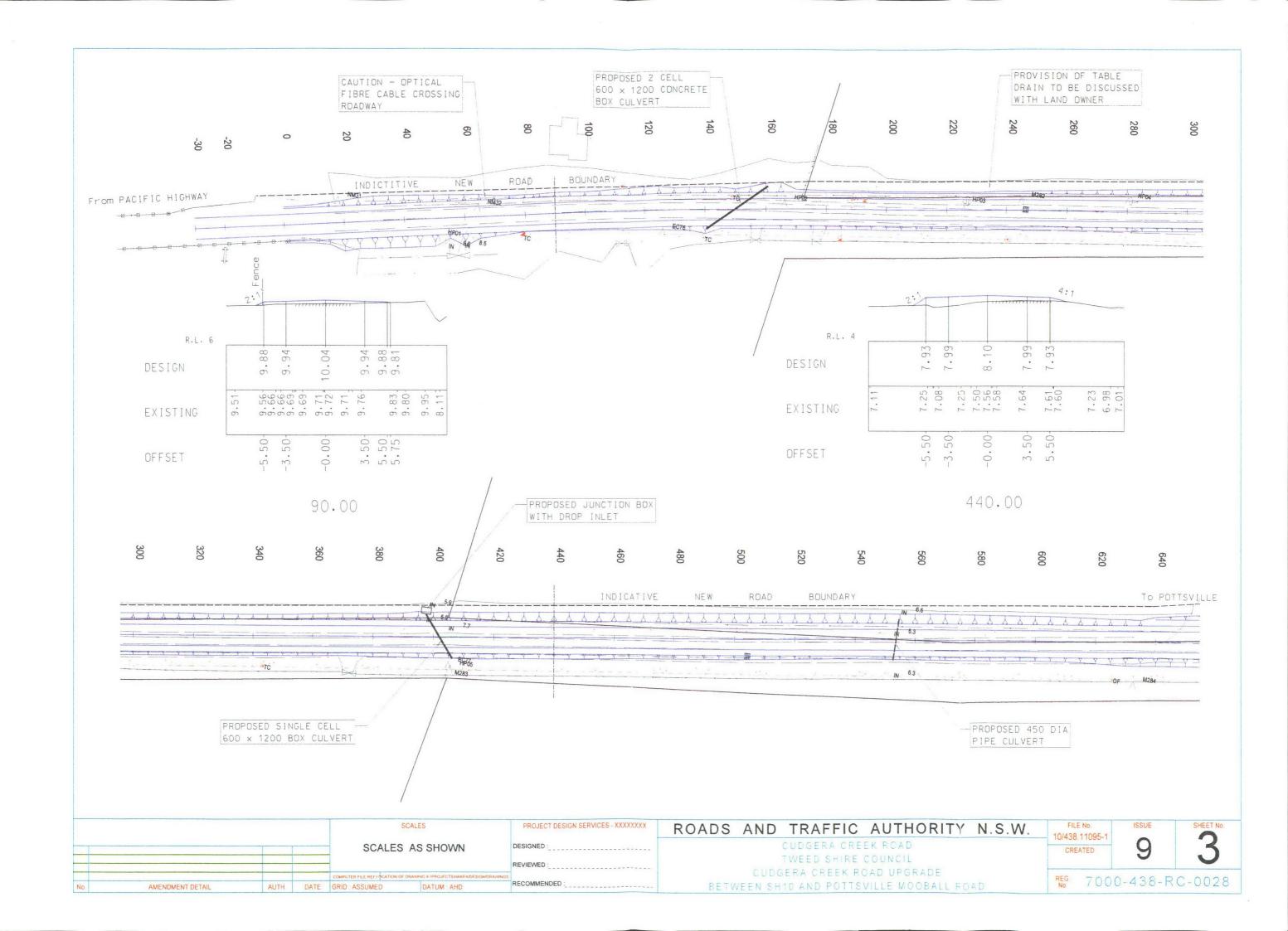
Photo 8: Eastern side of proposed new bridge crossing.

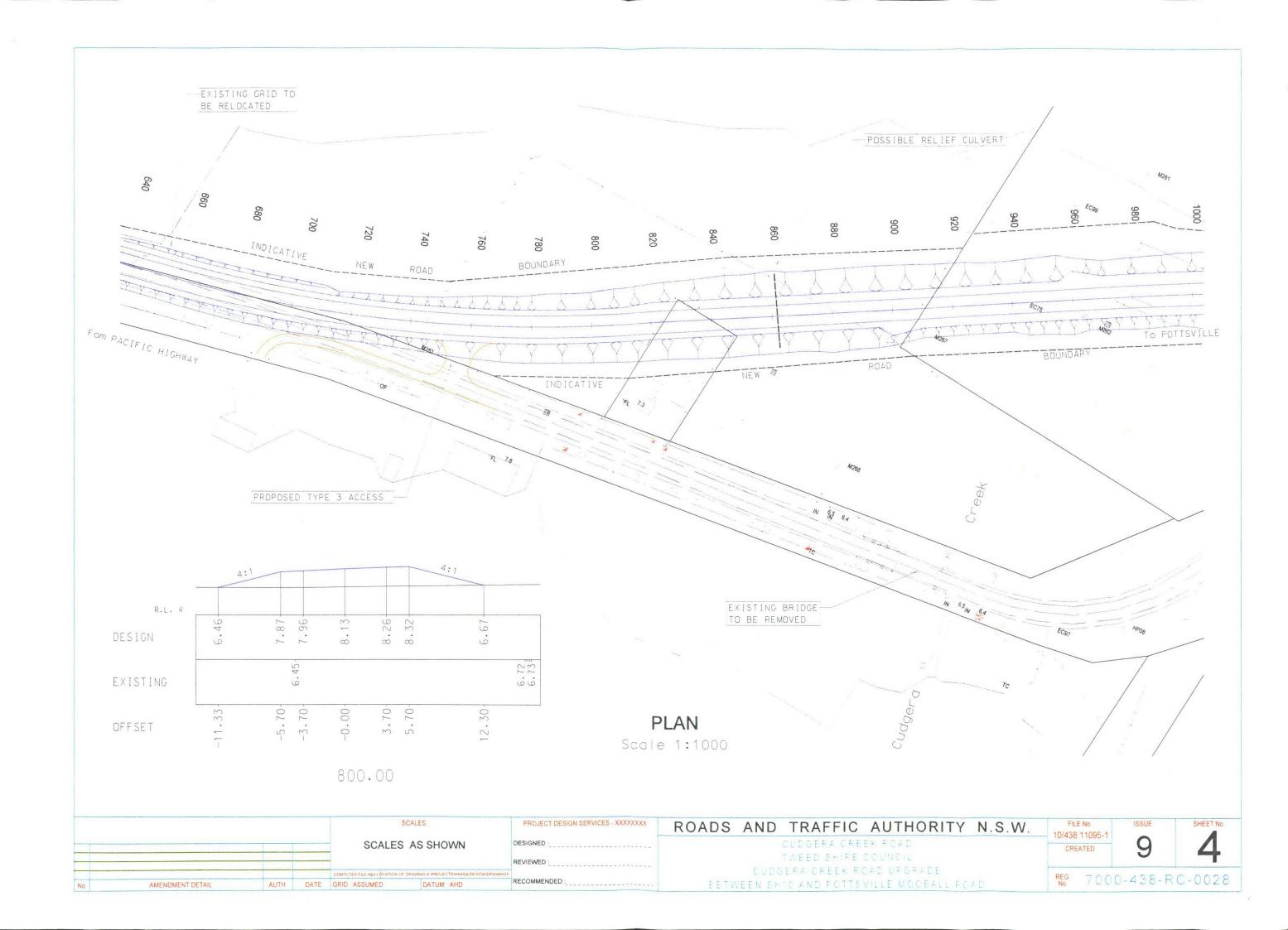


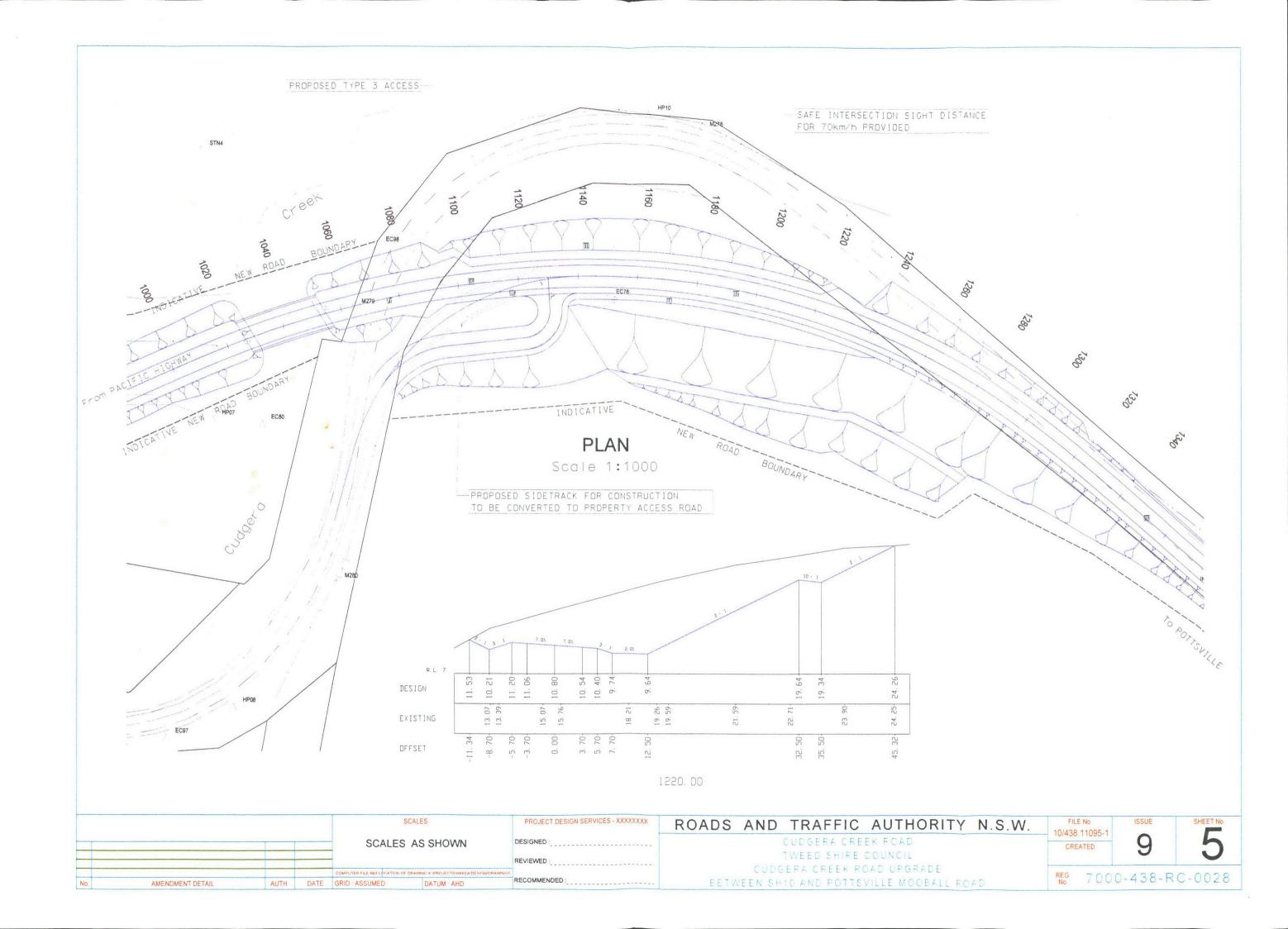
Appendix B

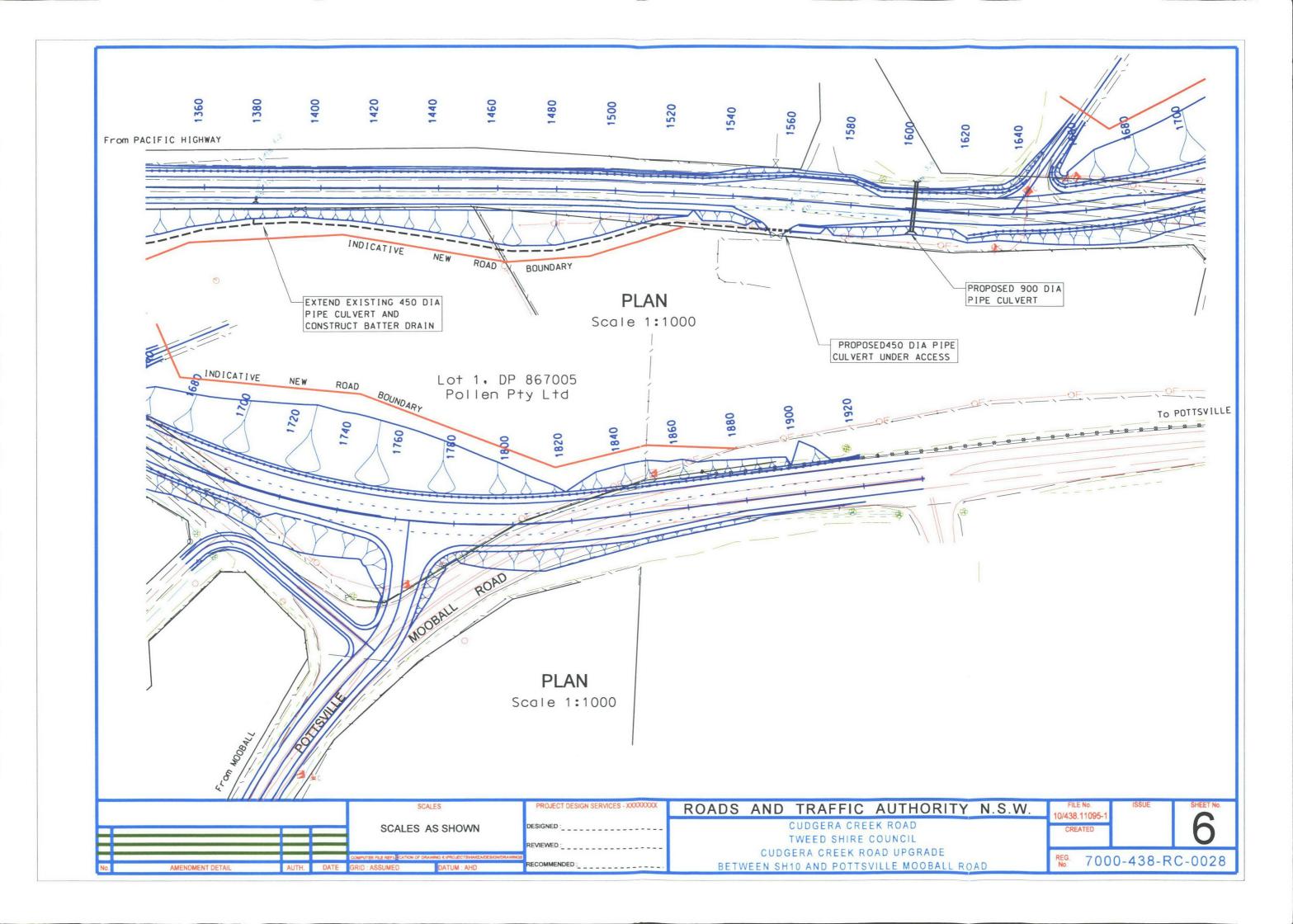
Concept Design

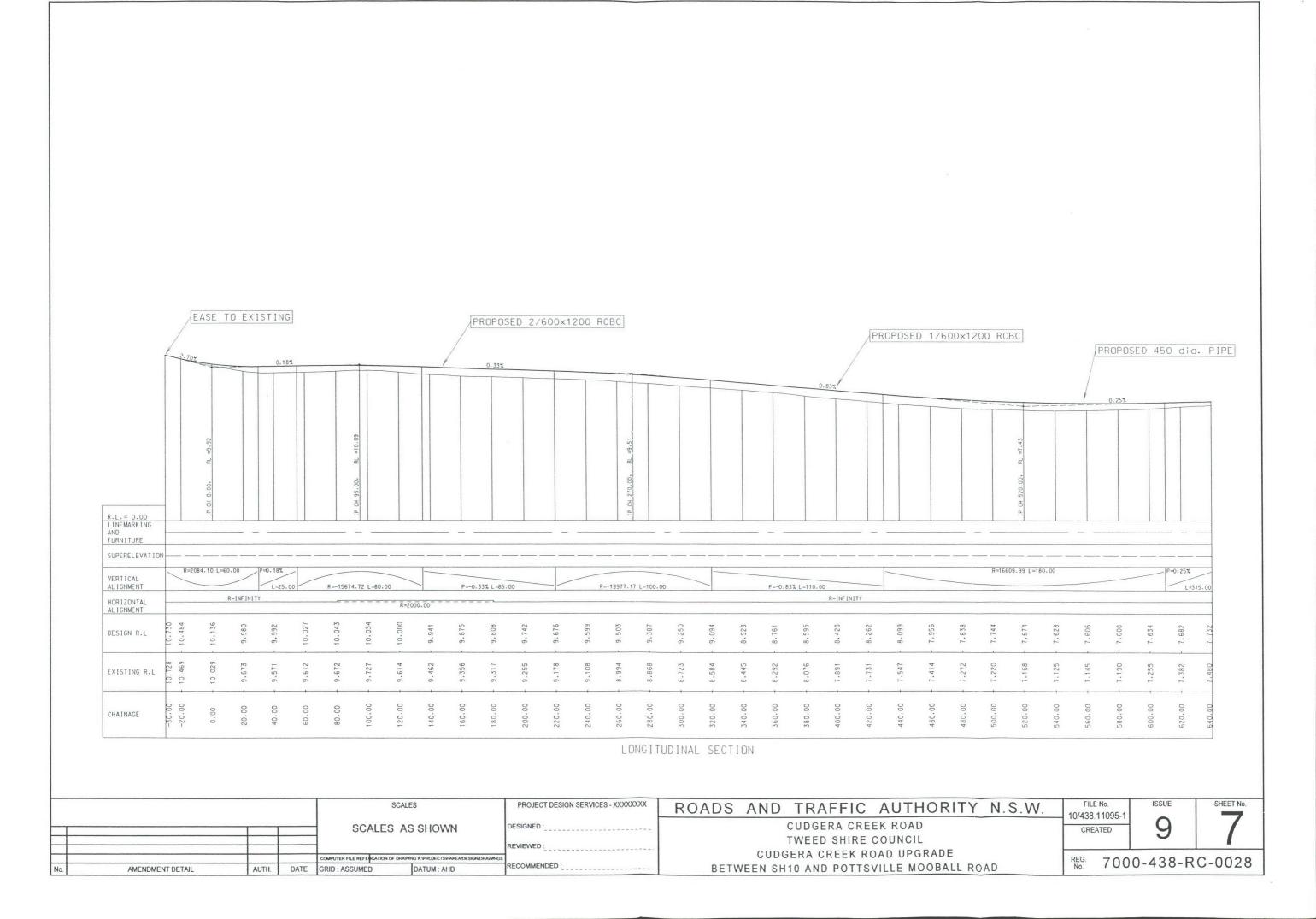


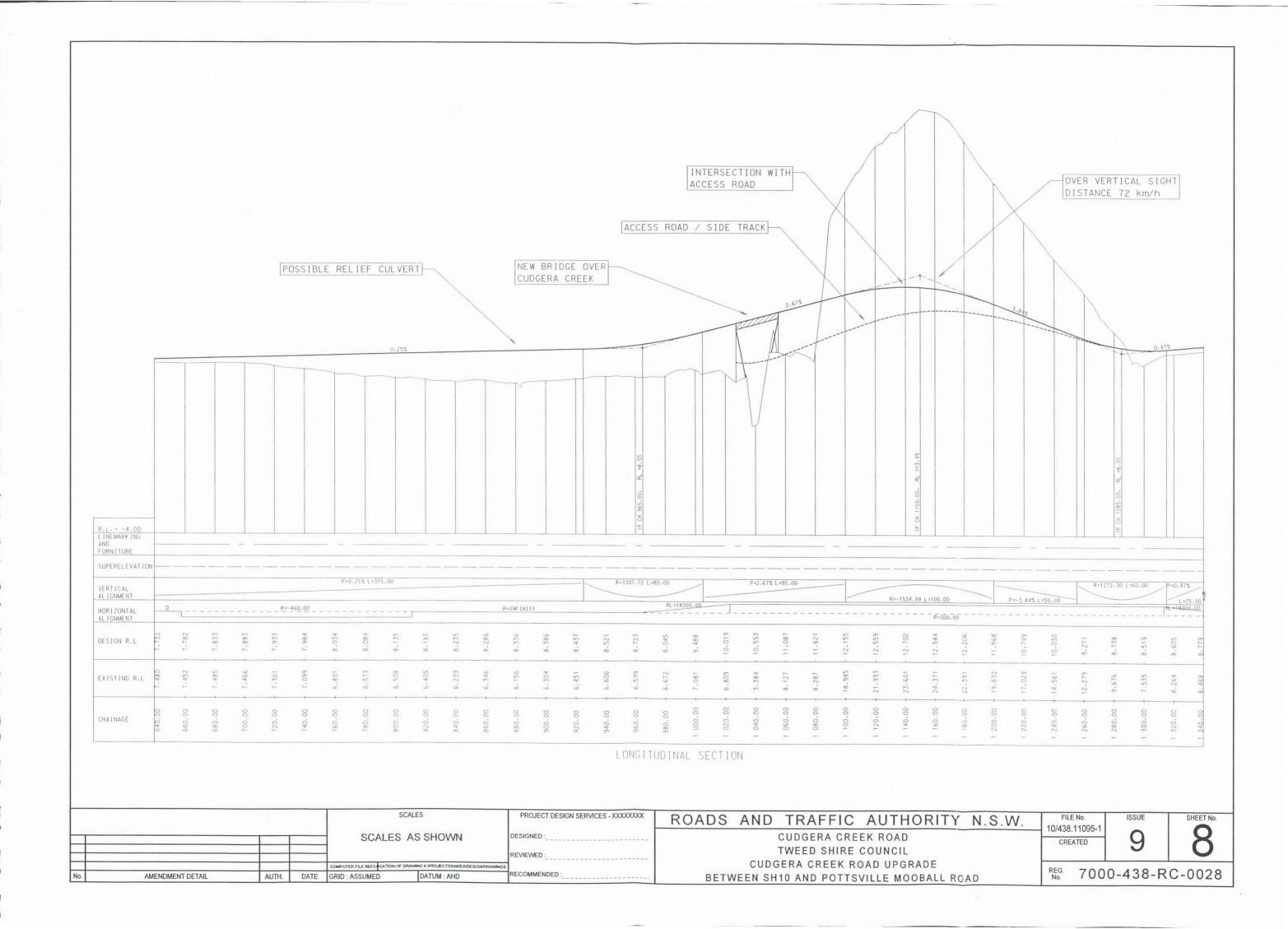


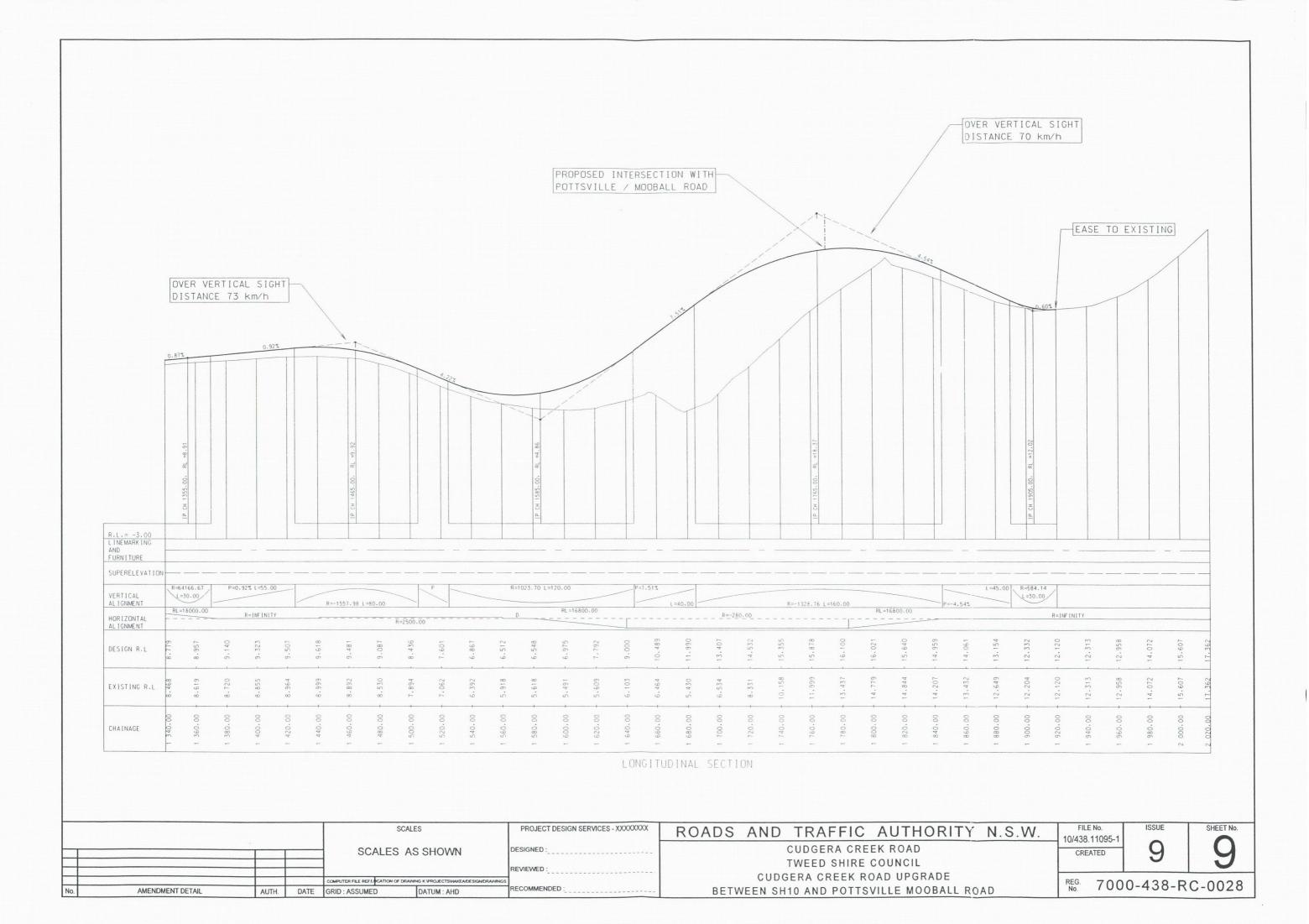












Appendix C

Consultation



Please Quote Council Ref:

R1470 Pt2 DW: 718843

[dltr]

Your Ref No:

For Enquiries Please Contact:

Garry Smith

Telephone Direct

(02) 6670 2450

103a03.doc

3 February 2003

Mr R Dunnicliff RTA Operations PO Box 3035 PARRAMATTA NSW 2124

Fax 8837 0053

Dear Sir

Cudgera Creek Road Upgrade

I refer to your fax of 29 January 2003 regarding the above proposed road upgrade that sets out your views in relation to the appropriate approval process under the Environmental Planning and Assessment Act, 1979.

If it is your view that the provision of Clause 11c of SEPP4 applies in this instance then Part V of the Environmental Planning and Assessment Act applies. I note from your fax that you are aware of the provisions of Tweed Local Environmental Plan 2000.

As the assessment of the potential impacts of the road upgrade will be carried out by the RTA then a decision on how this assessment will be carried out will finally rest with you.

Yours faithfully

Garry Smith

Manager Development Assessment



RDA Unit

5/64

Our Ref: RW/PI/RTA&RD/Cudgera Ck Rd REF Your Ref: David Purdy

NSW Agriculture

25 March 2002

Mr David Purdy RTA Project Engineer PO Box 86 OCEAN SHORES NSW 2483

Dear David

Wollongbar Agricultural Institute Bruxner Highway WOLLONGBAR NSW 2477 Australia

Telephone (02) 6626 1200 Facsimile (02) 6628 1744 http://www.agric.nsw.gov.au

UPGRADE OF CUDGERA CREEK ROAD

Thank you for your letter of 28 February 2002 in which you indicate the preferred route option is option "D". As previously advised in our letter of 18 February 2002,

"...option D may have the greatest impacts on agriculture given it fragments a number of properties and is a substantial deviation from the present alignment. This route may also alienate some land from cane production. The cane industry is a major industry in the Tweed. Details on the extent to which option D will impact on future agricultural production would be appreciated and would allow further more informed comment. Option D does appear however to traverse lower quality agricultural lands (based on our shire wide mapping). Therefore, the impact of this route on future agricultural production and opportunities may not be significant".

The REF and subsequent planning process should aim to quantify the agricultural, financial and other impacts associated with option D. Measures and strategies that assist to reduce the impact of the route and upgrade on agriculture, particularly individual enterprises need to be developed and assessed. These measures should be discussed and negotiated with the landholders affected. In accordance with our previous advice, the impacts that may require negotiation and mitigation include alienation of agricultural lands, access and underpasses, use of the existing route by farm machinery and local traffic, access to water resources, new fencing and boundaries, restructuring of farms and/or paddocks, loss of farm income, weed and soil management (eg. noxious weeds and Panama disease).

The Lower Cudgera Cattle Tick Dip located on Lot 199 DP 654821 near the intersection of Cudgera Creek Road and the road leading north towards Hastings Point may also require attention in the REF if it is to be affected by the proposal.

Please contact me on (02) 6626 1349 should you require further advice or wish to discuss this matter.

Yours faithfully

Rik Whitehead

Agricultural Environmental Officer

NORTH COAST

Directors Unit

Our Ref: RW/PI/RTA&RD/Cudgers Ck
Rd Upgrade
Your Ref: David Purdy / File 1378/9.27

NSW Agriculture

18 February 2002

Mr David Purdy Professional Engineering Service Pty Ltd Sleepy Hollow Project Office PO Box 86 OCEAN SHORES NSW 2483 Wollongbar Agricultural Institute Bruxner Highway WOLLONGBAR NSW 2477 Australia

Telephone (02) 6626 1200 Facsimile (02) 6628 1744 http://www.agric.nsw.gov.au

Dear Mr Purdy

UPGRADE OF CUDGERA CREEK ROAD

Thank you for providing a copy of the Upgrade and Rehabilitation of Cudgera Creek Road – Route Options Identification and Assessment report prepared by Abigroup Contractors Pty Ltd for the RTA (Feb. 2002).

I appreciate the difficult task of finding an optimal route given all constraints and requirements. On first glance, it would appear that the preferred option D may have the greatest impacts on agriculture given it fragments a number of properties and is a substantial deviation from the present alignment. This route may also alienate some land from cane production. The cane industry is a major industry in the Tweed. Details on the extent to which option D will impact on future agricultural production would be appreciated and would allow further more informed comment. Option D does appear however to traverse lower quality agricultural lands (based on our shire wide mapping). Therefore, the impact of this route on future agricultural production and opportunities may not be significant.

Should option D continue to appear to be the most favourable option, we would encourage measures and strategies that assist to reduce the impact of the route and upgrade on agriculture, particularly individual enterprises. These measures should be discussed and negotiated with the landholders affected. The impacts that may require negotiation and mitigation include alienation of agricultural lands, access and underpasses, use of the existing route by farm machinery and local traffic, access to water resources, new fencing and boundaries, restructuring of farms and/or paddocks, loss of farm income, weed and soil management (eg. noxious weeds and Panama disease).

Our records indicate that there is a former cattle tick dip site near the current and proposed road alignment. Lower Cudgera dip is located on Lot 199 DP 654821 near the intersection of Cudgera Creek Road and road leading north towards Hastings Point. The cattle tick program at the Wollongbar Agricultural Institute can provide further advice regarding this dip if required.

@ 021

Please contact me on (02) 6626 1349 should you require further advice or wish to discuss this matter.

Yours faithfully

Rik Whitehead

Agricultural Environmental Officer

NORTH COAST

12/3

5/64

Office of Conservation PORT STEPHENS FISHERIES CENTRE Ph: (02) 4916 3967

Fax: (02) 4982 1107

NSW FISHERIES

4/3/02

Upgrade and Rehabilitation of Cudgera Creek Road - Preferred Route Option

To whom it may concern,

NSW Fisheries attended a meeting and site visit to discuss route options for Cudgera Creek Road on 21 February, during which the RTA identified Route D as their preferred option.

As you are aware the preferred route would result in a new bridge being constructed over Cudgera Creek, and the removal of the existing crossing. This proposal would also require disturbance to an area of high quality riparian vegetation along the bank of Cudgera Creek, which has been identified by the Ecology Lab as one of the most biodiverse watercourses in the local region with regard to fish fauna.

NSW Fisheries is prepared to support Option D provided that the following conditions are met.

Design and Construction of the road and bridge

- (1) The bridge will be at least 24m long and will span Cudgera Creek.
- (2) No piers will be located within the 24m span.
- (3) The bridge will be a maximum width of 15m.
- (4) The abutments of the bridge will be located at least 2 metres back from the uppermost bench of the river channel.
- (5) Works will not commence until written approval of the bridge and road design have been received from NSW Fisheries.

Protection of existing native vegetation

- 1. Areas of riparian vegetation in the vicinity of the construction area will be fenced with protective fencing (as per figure 1, supplied in correspondence from NPWS).
- 2. All construction work will be undertaken from outside this protected buffer zone. For example tree lopping will be undertaken by a 'cherry picker' reaching out over the creek. Trees will be lopped to just below bridge height. Roots and stumps of removed vegetation will be retained in place to ensure the bank is stabilised. All contractors working in the area will be informed of the above conditions relating to protection of the riparian zone and creek area. Each contractor will sign a proforma indicating that they understand and will abide by these conditions. This proforma must be approved by the NSW Fisheries.

Removal of old bridge

NSW Fisheries requests the opportunity to review and comment on the proposed method statement for removal of the existing bridge. Such works should incorporate:

- (1) Adequate erosion/sedimentation controls
- (2) Removal of existing piers, abutments and scour protection beneath the existing bridge
- (3) Use of extensive vegetative scour protection in place of existing concrete/rock.

No works shall be conducted from within the streambed.

Rehabilitation

Vegetative rehabilitation measures will be undertaken in accordance with advice from NPWS.

Yours faithfully

Bi

Matt Barwick

Senior Conservation Manager, Pacific Highway Upgrade NSW Fisheries

rec'd 12/3

LAND & WATER CONSERVATION

Contact: David Thompson
Phone: (02)6640 2125
Fax: (02) 6640 2088
e-mail:
dthompso @ dlwc.nsw.gov.au

Our Ref: 6122912

[G:NAPALY/ECOMGT/VEGMGT/RT A/TWEED/Coudgera Creek Realignment DLWC Requirements.doc]

Your Ref: ABN 64 480 155 255

5 March 2002

Mr David Purdy RTA Project Engineer Roads and Traffic Authority P.O. Box 576 GRAFTON NSW 2460

Dear David,

Re: Upgrade of Cudgera Creek Road, Pacific Highway Upgrade Yelgun to Chinderah Project

In reference to your letter of the 28th February 2002 concerning the Cudgera Creek Road realignment the Department of Land and Water Conservation has the following comments:

Water Licence

A licence under the Water Act 1912 will be required only if the creek needs to be realigned.

A permit to extract water will be required if water is needed from the creek.

Acid Sulfate Soils

Testing for the presence should be carried out and an ASS management plan compiled if testing is positive.

Erosion and Sediment Control

An erosion and sediment control plan should be compiled for the site.

Native Vegetation and Rivers and Foreshores Improvement Act

No licence is required under the Native Vegetation Conservation Act 1997, for works carried out within the road reserve and no permit is required under the Rivers and Foreshores Improvement Act

For further information please contact myself on (02)66402125

Yours sincerely

David Thompson

Landscape Planning Officer

NSW Department of Land and Water Conservation

2 April 2002

Mr David Purdy
RTA Project Engineer
Yelgun to Chinderah
PO Box 86
OCEAN SHORES NSW 2483.

3057/2

Our Reference: Your reference:

Dear Mr Purdy

Upgrade and Rehabilitation of Cudgera Creek Road – Preferred Route Option

Thank you for your letter of 28 February 2002 and the attached Route Options Identification and Assessment Report for the upgrade and rehabilitation of Cudgera Creek Road.

I refer to the Value Management Study (VMS) meeting and site visit held on 21 February 2002 to discuss a preferred route option for the upgrade of Cudgera Creek Road. The Roads and Traffic Authority (RTA), Professional Engineering Services (PES), Abigroup and the relevant government agencies including the National Parks and Wildlife Service (NPWS) attended this meeting.

Prior to the VMS, the RTA identified five possible route options that were based on the mapping of key features and constraints. These five route options were discussed at length during the VMS meeting and the preferred route option was subsequently identified as Option D.

The NPWS notes that Option D was identified as the route that would deliver the best outcome from an environmental, engineering and community perspective. The NPWS notes, however, that Option D would result in a new corridor of cleared vegetation through the area of riparian rainforest which has been identified as an endangered ecological community (lowland subtropical rainforest on floodplain) and is also known habitat for a number of flora species of conservation significance.

It is understood that the RTA proposes to undertake further detailed studies along the Option D route, including fauna and Aboriginal heritage studies. Pending the outcome of these studies, the NPWS will only support Option D provided adequate ameliorative and compensatory measures are included and subsequently met in the Environmental Impact Assessment (EIA) documentation prepared by the RTA.



NSW NATIONAL PARKS AND WILDLIFE SERVICE

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Head Office 43 Bridge Street P.O. Box 1967 Hurstville NSW 2220 Australia

Fax: (02) 6651 6187

Tel: (02) 9585 6444 Fax: (02) 9585 6555 www.npws.nsw.gov.au These conditions and measures should ensure that the road and bridge are designed and constructed in a manner that will minimise impacts on the endangered ecological community and threatened species habitat, including the Spiny Gardenia (*Randia moorei*) and its habitat.

Appropriate rehabilitation and replanting works should be undertaken to ensure that potential impacts on the endangered ecological community such as fragmentation, increased weed invasion will be mitigated and the area of the community will be expanded to increase the chances of its long-term viability. Steps must also be included to re-establish a Coast Cypress Pine (Callitris columellaris) community at the site.

The NPWS proposes the following conditions:

Design and Construction of the road and bridge

- (1) The bridge will be at least 24m long and will span Cudgera Creek from top of bank to top of bank.
- (2) No piers will be located within the 24m span.
- (3) The bridge will be a maximum width of 15m.
- (4) The southern bridge edge will be located no closer than 1m from the Spiny Gardenia individual (as indicated in Figure 1).
- (5) No works will commence until written approval of the bridge and road design has been received from the NPWS.

Protection of existing native vegetation

- (1) Areas of the rainforest remnant that are in proximity to the construction area will be fenced with protective fencing, as indicated in Figure 1.
 - (2) A large pile of earth is currently situated near the top of the eastern bank adjacent to the proposed creek crossing. This earth mound will be removed prior to installing the protective fencing.
- (3) No persons shall enter the rainforest remnant area without prior written approval from the NPWS.
- \(\chi \) No objects shall be dropped or felled into the rainforest remnant area
 prior to or during construction. The NPWS will be consulted if such an
 incident occurs and ameliorative action will be undertaken under the
 direction of the NPWS.
- (5) The protective fencing will be located no closer than 2m from the top of the eastern and western creek banks respectively, at the site of the new creek crossing, as shown in Figure 1.
- ★(6) Protective fencing will be erected around the Spiny Gardenia.
- (7) All construction work will be undertaken from outside the delineated creek buffer. For example tree lopping will be undertaken by a 'cherry picker' reaching out over the creek. Trees will be lopped to just below bridge substructure height. Tree tops will be secured prior to cutting and the tops lifted from the base and out of the creek area. The stump and roots will remain in situ to ensure the bank is stabilised. A NPWS representative must be on site during any vegetation removal. If material from the tree falls into the creek area (eg. branches) the NPWS representative will advise on the appropriate course of action.

contractors working in the area will be informed of the above ditions relating to protection of the endangered ecological munity, threatened species and threatened species habitat. Each tractor will sign a form indicating that they understand and will le by the conditions. The NPWS will assist with the format of the 1. The form must be approved by the NPWS.

er via a subsurface drain shall be directed to an area at the top of creek bank to water the Slender Gardenia, but must not cause

sion.

al of old bridge

removal of the existing bridge will be undertaken in accordance advice obtained from the NPWS, the Department of Land and ter Conservation (DLWC) and NSW Fisheries. The area adjacent ne old bridge (Area 1) will be rehabilitated as indicated in Figure 2. tection and shall be established no more than 1m from the edge ne old bridge deck. No entry shall be permitted beyond this area, apt following approval from the NPWS.

litation

nabilitation including replanting must occur in the areas (Area 1,2,3 4) indicated in Figure 2. Further discussion must be undertaken the NPWS during the preparation of the Rehabilitation Plan on the ential rehabilitation of Areas 5 and 6.

seed and other propagation material will be collected from the nant or other rainforest areas within 5km of the Cudgera Creek

Please note that collection from an endangered ecological Immunity will require a Section 91 licence from the NPWS.

proposed road is likely to result in the removal of a small area of

ist Cypress Pine on the hill to the east of the bridge.

seed will be collected from the Coast Cypress Pine on site or within of the ite.

immature Coast Cypress Pine on site will be translocated into the abilitation area between the new road and the old road.

restocation must be undertaken by a person with demonstrated ertise in successful translocation. The person must meet the

VS approval.

lehabilitation Plan must be prepared by a person or persons with nonstrated expertise in the preparation of rehabilitation plans for forest communities in north-east NSW. This plan must be pared and incorporated into the EIA documentation, which will be d for approval. The contents of the plan must be in accordance the NPWS direction and will include such things as, species to be sed, weed removal, planting and maintenance strategies. The labilitation Plan must meet the approval of the NPWS, NSW leries and DLWC prior to inclusion into the EIA documentation. NPWS will assist wherever possible in the preparation of the plan. rehal lation and replantings must be undertaken by a person or sons when demonstrated specialist expertise in the rehabilitation of

Bea, Need tender docs for this. Get some prices etc. lowland floodplain rainforest or another local rainforest community (eg littoral rainforest) in north-eastern NSW. The successful applicant must be able to provide at least one example of an area that they have successfully rehabilitated that meets the NPWS approval.

(9) Weed removal will be undertaken throughout the existing community to alleviate the effects of opening the rainforest canopy for the proposal, as shown in Figure 2. Weed removal will be undertaken either by or under the direct supervision of the person undertaking the rehabilitation of the remnant.

(10) The remnant will be expanded by supplementary plantings that will reduce the edge/core ratio of the remnant and increase the likelihood of its long-term viability (see Figure 2). As a general rule, the density and ratios of these plantings must be greater than the surrounding vegetation.

Please be aware that the Cudgera Creek rainforest remnant is well known to local botanists and conservationists and has been studied extensively in the past, hence the NPWS recommends that during rehabilitation works signs be erected on the roadside drawing attention to the works being undertaken.

Should you wish to discuss this matter or should you require further information please contact Kim Forsyth at this office on (02) 6659 8238.

Yours faithfully

GARY DAVEY

Manager

Conservation Programs & Planning Division

Northern Directorate

for Director-General



Please Quote Council Ref:

DW655113

Your Ref No:

For Enquiries Please Contact:

Mr Paul Morgan

Telephone Direct

(02) 6670 2473

[eltr]

125f16.doc

27 February 2002

Professional Engineering Service Pty Ltd PO Box 86 OCEAN SHORES NSW 2483

Attention: Mr D C Purdy - Project Engineer

Dear Sir

Upgrade and Rehabilitation - Cudgera Creek Road

I refer to your letter dated 13 February 2002 regarding the above subject and the meeting held on the 21 February 2002 at which the Options Identification Report was discussed. I advise that Option D is satisfactory to Council as set out in the Route Evaluation Report for Cudgera Creek Road dated January 2002.

In regard to property acquisition, Council's Property Officer is fully committed to other projects at the current time and it is Council's preference for the RTA to pursue the acquisitions required in accordance with appropriate legislation.

If you require any further information regarding this matter, please contact Mr P Morgan on the above number.

Yours faithfully

Don McAllister

Manager

PLANNING & DESIGN





Please Quote Council

R1470

Your Ref No:

tsc-S-TW-0129

For Enquiries Please Contact:

Mr Stephen Enders

Telephone Direct

(02) 6670 2456

Y2C STH - 4 JAN 2002

117nw06

RECEIVED

21 December 2001

Abigroup P.O. Box 195 PYMBLE NSW 2073

Attention: Sam Turnbull

Dear Sir

Upgrade of Cudgera Creek Road

I refer to your letter dated 12 November 2001 and apologise for the delay in responding.

It is understood that as a requirement of the approval for the Yelgun to Chinderah freeway, the upgrade of a 3km section of Cudgera Creek Road between the Cudgera Creek Interchange and Mooball-Pottsville Road must be commenced no later than five (5) years after the commissioning of the proposal.

Key planning issues which should be considered as part of the planning process are as follows:

Management of Acid Sulphate Soils

A part of the upgrade would pass through an area identified as containing Class 3 Acid Sulphate Soils by Acid Sulphate Soils Risk Maps produced by the Department of Land and Water Conservation. Any works which may affect these soils would need to be managed appropriately and would trigger the need for development consent to be obtained.

Impact on Agricultural Land

The existing road alignment adjoins or traverses land zoned 1(b) Agricultural Protection under Tweed Local Environmental Plan 2000. The required upgrade should aim at minimising the impact and loss of agricultural land through fragmentation.

The area to be upgraded is relatively low and the upgrade should be designed to provide flood free access from the motorway to Pottsville during major flooding events.

Should the upgrade require works outside the existing road reserve development consent would be required, otherwise an Environmental Assessment under Part V of the Environmental Planning and Assessment Act 1979 would need to be carried out (Development consent required if Acid Sulphate Soils affected).

e). Road Alignment

> At the time route options are being considered it is requested that Council's Director Engineering Services be consulted regarding Council's preferred option.

I hope the above is of assistance and should you have any questions please contact Stephen Enders on the above number.

Yours faithfully

a Smith

Garry Smith Jorg Manager Development Assessment

ic. T.W

CIVIC AND CULTURAL CENTRE, MURWILLUMBAH PO BOX 816, MURWILLUMBAH, N.S.W. 2484 TELEPHONE (02) 6670 2400 FAX (02) 6670 2429

PLEASE ADDRESS ALL COMMUNICATIONS TO THE GENERAL MANAGER ABN 90 178 732 496 www.tweed nsw.gov.au

NSW FISHERIES

Office of Conservation

PORT STEPHENS FISHERIES CENTRE

Ph: (02) 4916 3967 Fax: (02) 4982 1107

3 December 2001

Mr Turnbull Project Manager Abigroup Contractors Pty Ltd PO Box 195 Pymble NSW 2073

RE: Upgrade of Cudgera Ck. Rd., Pacific Highway Upgrade, Yelgun to Chinderah Project.

Thankyou for the opportunity to comment on the proposed works cited above. NSW Fisheries has reviewed the information provided, and requests that during initial planning and route selection process, the following issues be considered:

- From the map provided, the main watercourse which may be impacted by the proposed works is Cudgera Creek. Studies conducted by the Ecology Lab indicate this system is one of the most biodiverse in the local region with regard to fish fauna. In addition, riparian vegetation along this watercourse is of a high quality. Consequently all measures should be employed to mitigate the effects of the proposed works on this system, and its associated habitats. Watercourse crossings of both Cudgera Creek, and other watercourses should be avoided where possible, however if necessary, planning, construction and maintenance of crossings should be conducted in accordance with NSW Fisheries (1999) Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures.
- Examination of acid sulphate maps indicate the proposed works may pass through potential
 acid sulphate soil (PASS) areas. It would be desirable to ensure the proposed route avoids
 these areas, to minimise disturbance and mobilisation of acid sulphate drainage.

NSW Fisheries requests the opportunity for further review of the proposal once a route is selected, to identify issues which may be specific to the selected path. The department is also interested in reviewing environmental assessments relating to the proposed works.

If you have any further enquires regarding this matter please do not hesitate to contact me.

Regards.

("/-)

Matt Barwick

Senior Conservation Manager (Pacific Highway Upgrade)

Ph: (02) 49163967 Mob: 0407 936646 Fax: (02) 49821107

CC. File(CCR)

RTA GFTN RTA

LAND & WATER CONSERVATION

Mr Sam Turnball
Project Manager
AbiGroup Contractors Pty Ltd
P.O. Box 195
PYMBLE NSW 2073

Contact: David Thompson
Phone: (02)6640 2125
Fax: (02) 6640 2088
e-mail;
dthompso@dlwc.nsw.gov.au

Our Ref: 6122912
[G:\RAPLVECOMGTIVEGMGTNT
A\TWEED\AbiGroup Upgrade
Cudgera Creek Road.doc]
Your Ref: DLW-S-TW-0006

22 November 2001

Dear Sam,

Re: Pacific Highway Upgrade Yelgun to Chinderah - Upgrade of Cudgera Creek Road

In reference to your letter of the 2nd November 2001 concerning the Upgrade of the Cudgera Creek Road, the Department of Land and Water Conservation (DLWC) has the following comments:

Surface Water/Flooding

- ☐ The impact of the upgraded road on water flows/hydrolgy and flooding need to be assessed and minimised.
- All drainage/ culverts under the road should be designed to minimise flood impacts such as aflux
- Any change in the route of a defined watercourse will require a licence under Part 2 of the Water Act 1912.

Erosion and Sediment Control

Normal Erosion and Sediment Control works should be implemented prior to and during construction

Rehabilitation

It is important that appropriate rehabilitation works are carried out a soon as possible after work is completed. Batters should be left in rough condition and be topsoiled with approximately 25mm of topsoil prior to reseeding, to aid revegetation.

Acid Sulfate Soils

Detailed information of the extent and possible impacts of ASS needs to be determined prior to construction commencing.

RTA GFTN RTA

☐ The ASS Management Plan as adopted for the Highway Upgrade should be implemented for this upgrade.

Riparian Zone

No permit is required under the Rivers and Foreshores Improvement Act 1948 for excavation works carried out within 40m of the high bank of a defined watercourse (nb Cudgera Creek) within the road reserve. Works outside the road reserve will however require a permit.

Care should be taken to minimise any disturbance/impacts in the riparian zone of Cudgera Creek.

For further information please contact David Thompson on (02) 66402125.

Yours sincerely

David Thompson

Environmental Projects Officer

NSW Department of Land and Water Conservation

26 November 2001

Mr Sam Turnbull Project Manager Abigroup Contractors Pty Ltd PO Box 195 PYMBLE NSW 2073

01/1364 File 3057/2

Dear Mr Turnbull,

Our Reference:

Your reference:

Upgrade of Cudgera Creek Road, Pacific Highway Upgrade, Yelgun to Chinderah Project.

Thank you for your letter, dated 2 November 2001, inviting comments on the proposed upgrade of Cudgera Creek Road. The National Parks and Wildlife Service (NPWS) has reviewed the information presented and offers the following advice.

During the initial planning of the above proposal, the NPWS recommends that consideration be given to the following issues:

• Identification, mapping, protection of vegetation which is of conservation significance. Particular reference should be given to the value of the habitat for threatened species, populations and ecological communities as listed under the *Threatened Species Conservation Act* 1995 (TSC Act), Rare or Threatened Australian Plants (ROTAP) (Briggs and Leigh, 1996) and regionally significant species (Sheringham and Westaway, 1997).

Particular consideration should be given to the occurrence of the following threatened species - Davidsonia jerseyana, Ochrosia moorei, Randia moorei and Syzygium moorei and the following ROTAP species - Rhodamnia maideniana, Endiandra globosa and Acacia bakeri. These species have been recorded within close proximity to the Cudgera Creek Road.

Your attention is also drawn to the occurrence of Lowland Rainforest on Floodplain within the area, especially along sections of the road and fringing Cudgera Creek. This vegetation community has been classified under the TSC Act as an Endangered Ecological Community.

• Identification, mapping, and protection of areas of potential significance for native fauna. Particular reference should be given to the value of the habitat for threatened species, populations or ecological communities, ROTAP or



NSW NATIONAL PARKS AND WILDLIFE SERVICE

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Head Office 43 Bridge Street P.O. Box 1967 Hurstville NSW 2220 Australia

Tel: (02) 9585 6444 Fax: (02) 9585 6555 www.npws.nsw.gov.au regionally significant species. Consideration should also be given to bird species listed under international agreements such as Japan Australia Migratory Birds Agreement and China Australia Migratory Birds Agreement.

- Consideration to Key Threatening Processes, as listed under the TSC Act. Please be aware that there have been recent additions to this list.
- Areas of archaeological potential and Aboriginal heritage value as identified by the Aboriginal community and sites registered on the Aboriginal Heritage Information Management System (formally known as the Aboriginal Site Register). Consideration should also be given to Aboriginal Land Claims and Native Title Claims.
- Commonwealth legislation, such as the Environment Protection and Biodiversity Conservation Act 2000 and State legislation such as TSC Act, the National Parks and Wildlife Act 1974 and the National Parks and Wildlife (Adjustment of Areas) Act 2001.
- Possible mitigation measures for potential impacts on cultural and natural heritage values.

The NPWS is interested in reviewing the proposed route options and providing further input into the identification of a preferred option. Following this, the NPWS is also interested in reviewing any of the environmental assessments.

Please contact Ms Kim Forsyth, on (02) 6659 8218, should you require further information on the above matters.

Yours faithfully

GARY DAVEY

Manager Conservation Programs and Planning Division

for DIRECTOR-GENERAL

References:

Briggs, J, D. and Leigh, J. H., 1996, Rare or Threatened Australian Plants. CSIRO, Collingwood, VIC.

Sheringham, P. & Westaway, J. 1997. Significant Vascular Plants of Upper North East New South Wales. Revised edition. A Report by the NSW National Parks and Wildlife Service for the Natural Resources Audit Council. NSW NPWS, Sydney.



cc.TW file/

Directors Unit

NSW Agriculture

Wollongbar Agricultural Institute Bruxner Highway WOLLONGBAR NSW 2477 Australia

Telephone (02) 6626 1200 Facsimile (02) 6628 1744 http://www.agric.nsw.gov.au

Our Ref: PI/RTA&RD/Road-AbiGrp-CudgerCk Your Ref: DOA-S-TW-0001

21 November 2001

Mr Sam Turnbull Abigroup Contractors Pty Ltd PO Box 195 PYMBLE NSW 2073

Dear Mr Turnbull

PROPOSED UPGRADE OF CUDGERA CREEK ROAD (PACIFIC HIGHWAY UPGRADE YELGUN TO CHINDERAH)

I refer to your letter of 2 November 2001 advising of the above proposal and requesting the identification of any issues relevant to the work to be undertaken.

The main agricultural issues with regard such projects are typically:

- Minimising adverse impacts on present and future agriculture via appropriate route alignment and compensatory measures to offset adverse impacts;
- Directing the route towards the lower quality and less productive agricultural lands,
- Minimising adverse impacts on individual properties/enterprises,
- Assessment route options based on the quality and use of the subject and adjoining lands,
- Appropriate notification of affected landholders as to any proposed works or closures,
- Management of soil erosion so as to minimise soil loss and impacts on downstream water quality,
- Appropriate provision of any new farm access roads that may be required,
- Appropriate site remediation and weed control.

Furthermore, inconvenience to landholders, such as via damage or changes to fencing, temporary interruption of access, problems with stock or machinery movement, etc. should be minimised, considered and managed. It is desirable that any upgrade work not lead to the creation of small isolated lots unless such lots are consolidated with adjoining lands.

Please contact me on (02) 6626 1349 should you require further information or advice. Mr Jim Hindmarsh of this office can also be contacted on (02) 6626 1200 should you require additional information on the agricultural classes of land in this locality as mapped by the Department.

Thank you for the opportunity to comment on this proposal.

Yours faithfully

Rik Whitehead

Agricultural Environmental Officer

NORTH COAST

RTA GFTN RTA

Your Reference: EPA-S-TW-0110
Our Reference: GRF6011 - 257224A1/12
Contact: Irwin Perring, 66402509

ec. T.W file /



Mr Sam Turnbull
Project Manager
Cudgera Creek Road Project
ABIGroup Pty Limited
PO Box 1616
KINGSCLIFF NSW 2487

Northern Regions

11 1 1 132

Dear Sam

CUDGERA CREEK ROAD UPGRADE PROJECT - SITE INVESTIGATION:

I refer to your letter of 1 November 2001 requesting advice from the Environment Protection Authority (EPA) on issues to be addressed during the preliminary site investigations and subsequent preparation of the Review of Environmental Factors (REF) for the above project. I also refer to the discussions regarding the Project between yourself, Ms Tracey Wallbridge and the EPA's Mr Irwin Perring.

We understand from discussions that ABIGroup have been asked first to investigate the route options for the upgrade and then initiate a more rigorous environmental assessment of the chosen route for the upgrade. We therefore consider it appropriate to provide you with the following comprehensive response to your request to assist you in both the investigation and assessment processes for the proposed Cudgera Creek Road Upgrade project.

GENERAL COMMENTS:

The investigation should be carried out, and the REF prepared, with reference to the Department of Urban Affairs and Planning (DUaP) EIS Guideline "Roads and Related Facilities – Specific requirements for an EIS" (September 1996). The resulting REF should identify the range of potential short and long term environmental impacts associated with the construction and operation of this road upgrade project as well as provide details of proposed measures to address those potential environmental impacts. To this end we have prepared several tables to supplement the DUaP guideline that may assist you in your investigations and ultimately preparing the REF to meet specific requirements of the EPA. A copy of those tables is attached for your convenience as "Appendix: A – Environmental Goals / Targets and Assessment Criteria for Road Construction Projects" and "Appendix: B - Additional EPA Issues / Requirements when preparing an REF for Road Construction".

We note that some of the documents referred to in the DUaP guideline have been superseded and therefore provide you with a revised list of relevant documents to assist you in the preparation of the REF. A copy of the revised list is attached for your convenience as "Appendix: C – List of Relevant REF Guidance Documents."

Page 2

SPECIFIC PROJECT ISSUES:

The following specific information and issues are provided for your consideration in the investigation of the proposed upgrade project and the preparation of the REF.

(a) Acid Sulphate Soils:

The study area identified for the proposed upgrade Project lies within an area identified in various previous studies as having a moderate to high risk of Potential Acid Sulphate Soils (PASS) and Acid Sulphate Soils (ASS). We suggest that the investigation of the proposed route include a comprehensive assessment of the presence of these type of soils.

The REF should identify potential impacts on the environment associated with the disturbance of these soils during construction and include details of management strategies and procedures that will be adopted to prevent adverse impacts on the environment from these soils.

(b) Contaminated sites:

We suggest that the investigation include measures to identify any potentially contaminated sites associated with past or current landuse in the study area. This includes identifying the location of any current or disused cattle tick dip sites or disused landfills.

The REF should identify the potential impacts associated with disturbing these sites and provide details of strategies and procedures to be implemented to prevent those impacts.

(c) Operational Noise:

We advise that the operational noise associated with the proposed upgrade should be assessed using the criteria for the "Redevelopment of existing local roads" contained in Table 1 of the EPA's Guideline - Environmental Criteria for Road Traffic Noise (ECRTN). That is:

Day (7 am – 10 pm)

L_{Aeq(1hr)} 55 dB(A); and

Night (10 pm – 7 am)

L_{Aeq(1hr)} 50 dB(A).

(d) Environment Protection Licence:

The information provided during preliminary discussions suggests the project is not scheduled as "Freeway or Tollway construction" and therefore an Environment Protection Licence (EPL) will not be issued by the EPA for the Project. Therefore all construction activities on the Project site must comply with the relevant provisions of the Protection of the Environment Operations Act, 1995 (POEO Act).

However, individual items of equipment used during construction may be scheduled will and if so will need to be operated under an EPL. These items could include mobile concrete batching plants, crushing and screening equipment and mobile bitumen batching plants.

The EPA will be the "Appropriate Regulatory Authority" (ARA) for the Project and we suggest that ABIGroup, RTA and Council continue to liaise with the EPA's North Coast Regional Office throughout the development and construction of the Project.

Page 3

Thank you for the opportunity to assist you in the preparation of the REF for this project. Please contact Mr Irwin Perring on 02 66402509 should you have any further inquiries.

Yours sincerely

GRAEME BUDD Head Programs Unit NORTH COAST

cc: Jon Keats (EPA) e-mail

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APPENDIX: A - Environmental Goals / Targets and Assessment Criteria for Road Construction Projects:

The following table provide the proponent with the goals / targets the EPA expect to be adopted for the relevant environmental issues when planning the Project.

• Additional EPA issues / requirements when preparing the REF using DUaP's EIS Guideline - Roads and Related Facilities.

Table: 1 - Environmental Goals / Targets and Assessment Criteria

Issue	Goals / Targets / Assessment criterla
Noise and Vibration	All practical measures be taken to ensure that the existing noise levels do not increase and where it is practicable to achieve lower noise levels, we consider that this should occur.
	The target noise level of "background + 10 dB(A)" contained in Chapter 171 Construction Site Noise of the EPA's Environmental Noise Control Manual should generally be adopted as target / goals for construction noise. All reasonable endeavours should be made to reduce the level of noise impacts in circumstances where it is identified that the guideline level will not be achieved.
	The limits contained in the "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure & Ground Vibration" (ANZECC) should be adopted when assessing impacts from blasting activities.
	The environmental guideline "Environmental Noise Management: Environmental Criteria for Road Traffic Noise" should be used when assessing road traffic noise associated with the Project. This document provides specific guidance on the minimum information required by the EPA in any assessment of road traffic noise.
Air Quality	 All construction plant, equipment, vehicles and machinery must be maintained to meet the requirements of the Protection of the Environment Operations Act, 1997 and associated Regulations.
	The generation of particulate on site during construction should be controlled to the greatest extent practicable.
	Particulate generated by the project should be contained within the construction site area to the maximum extent practicable.
	Construction activities should be managed to minimise adverse effects on the amenity of local residents and sensitive land uses.
Waste Management	 EPA goal is based on a waste management hierarchy of waste avoidance, followed by reuse and recycling/ reprocessing with disposal as a last resort.
Soils	The assessment of the project site for Potential Acid Sulphate Soils (PASS) and Acid Sulphate Soils (ASS) should be carried out with reference to the ASSMAC Manual (ASSMAC, 1998).

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Table: 1 -	Environmental	Goals /	Targets and	Assessment	Criteria	(Cont'd)
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Issue	Goals / Targets / Assessment criteria
Soils (Cont'd)	Management strategies and procedures adopted for PASS and ASS should be consistent with those described in the ASSMAC Manual.
	The temporary erosion and sediment controls proposed for the Project must be designed (stability, location, type and size), constructed, operated and maintained in accordance with the guideline "Managing Urban Stormwater – Soils and Construction, 3rd edition, 1998" produced by the NSW Department of Housing unless otherwise agreed to in writing by the EPA.
	A 'design particle' of 0.02 mm and a 'design flow' of one-quarter of the 1 year ARI flow must be adopted when designing the sediment basin(s) if the soil type in the catchment of any temporary sediment basin(s) is confirmed as 'Type C' soils.
	The relevant 80 th percentile Rainfall Depth (mm) value obtained in the "Table 6.5 – 5 Day Rainfall Events for Sites in NSW contained in the guideline "Managing Urban Stormwater – Soils and Construction, 3 rd edition, 1998" must be adopted when designing the sediment basin(s) if the soil type in the catchment of the sediment basin(s) is confirmed as 'Type P' or 'Type D' soils.
Water Quality	 Waters can include permanent and ephemeral watercourses, wetlands, canals and dams and groundwater. Reference should be made to the definition of "waters" and "pollution" contained in the POEO Act 1997 when preparing the REF for the Project.
	All practical measures should be used to control and treat water leaving construction sites to ensure discharges from the site will not degrade receiving waters.
	Additional waterway pollution control measures such as retention basins and gross pollutant traps should be installed in strategic locations to minimise the effects of road spills on waterways. These mitigation measures should be incorporated into the road design, particularly in sensitive receiver environments and areas of higher runoff.

APPENDIX: B - ADDITIONAL EPA ISSUES / REQUIREMENTS WHEN PREPARING AN REF FOR ROAD CONSTRUCTION

The following table provide the proponent with additional EPA issues / requirements that should be addressed when preparing the REF for the Project using DUaP's EIS Guideline - Roads and Related Facilities.

Table: 1 Additional EPA issues / requirements

DUaP Reference	Issue	EPA Requirement
C.1. (c)	Location	The diagrams and mapping should include the location of environmentally sensitive areas such as wetlands (SEPP 14 included), watercourses and water supplies.
C.2. (a)	Rainfall	Discussion of the potential for the rainfall intensity, frequency, duration and seasonal distribution to impact on the timing / staging of works and the potential to increase risks of off site impacts.
E.4. (a)	Existing acoustic environment	The existing acoustic environment should be assessed and reported with reference to the relevant Sections of the EPA's Environmental Noise Management Guidelines, "NSW Industrial Noise Policy" and "Environmental Criteria for Road Traffic Noise".
E.4. (a)	High noise level sources	The location of sources of high noise levels such as depots, CBP, BBP, wood chippers, crushers, etc should be clearly identified on any diagrams provided with the noise assessment report.
E.4. (a)	Sensitive receivers	The location of sensitive noise receivers such as schools, residences, hospitals, etc should be clearly identified on any diagrams provided with the noise assessment report (NAR).
E.4. (b)	Sensitive receivers	The predicted noise and vibration levels at all potentially affected sensitive receivers should be included in the NAR.
E.4. (b)	Impact Assessment	The assessment of the noise, vibration and blasting impacts NAR should include any impacts associated with the frequency and duration of intermittent noise on sensitive receivers.
E.4. (b)	Assessment Criteria	The criteria used to develop the proposed mitigation measures to control noise, vibration and blasting impacts caused by construction activities and associated traffic should be included in the NAR.
E.4. (b)	Mitigation Measures	The NAR should include noise and vibration mitigation measures proposed for construction <u>and</u> blasting activities. This includes installation of noise barriers, attenuation treatment of noisy equipment (eg. Piling hammers, concrete saws, tunnel ventilation systems) and programming noisy construction activities to minimise impact on receivers;

Table: 1 - Additional EPA issues / requirements (Cont'd)

DUaP Reference	Issue	EPA Requirement
E.4. (b)	Mitigation measures	The NAR should identify the maintenance requirements for any mitigation and control measures proposed.
E.5. (b)	Sensitive receptors	The REF should identify the location of sensitive receptors likely to be impacted by particulate and other air emissions from the Project site (eg: Schools, residents, etc);
E.5. (b)	Mitigation measures	The REF should identify the maintenance requirements for any mitigation and control measures proposed.
E.6. (b)	Soil constraints	The dispersibility of the soil must also be considered when describing and assessing the potential direct and indirect effects of soils on the project.
E.6. (b)	Soil constraints	The assessment of the soils should include the potential environmental constraints / impacts associated with the soils during construction.
E.6. (c)	ESCP	The Erosion and Sediment Control Plan (ESCP) prepared for the temporary control measures must be consistent with "the Blue Book".
E.7. (a)	Potentially affected waters	The description of the potentially affected waters should include the classification (if applicable) and current use of the waters. The REF should include the details of the water Quality Monitoring Program (WQMP) carried out to prepare the description.
E.7. (b)	Water Quality	The assessment of water quality impacts should reference the ANZECC guidelines and interim water quality objectives to assist in the description.
E.7. (b)	WQMP	The REF should include an outline of the proposed construction WQMP to be implemented to monitor discharges from the Project site and construction impacts on potentially affected waters.

Table: 1 - Additional EPA issues / requirements (Cont'd)

DUaP Reference	Issue	EPA Requirement
	Waste Management	The REF should: Identify waste streams associated with the construction and operation of the Project in accordance with the EPA document, Environmental Guideline: Assessment, Classification and Management of Liquid and Non-Liquid Wastes (1999). Detail the proposed waste minimisation and management strategies and procedures that will be adopted for each stream identified; Identify the potential to use recycled construction materials; and Discuss the cut / fill earth works balance for the Project.
G.	ECPs	Along with the outline of the EMP the REF should include an outline of the individual Environmental Control Plans (ECPs) proposed for the Project such as: Soil and Water Management Plan (S&WMP) Including a site rehabilitation / revegetation plan. Erosion and Sediment Control Plan (ESCP) (including dust suppression initiatives) Noise and Vibration Management Plan (NVMP) Waste Management Plan Water Quality Monitoring Program (for surface and ground water) Pollution incident management procedures
G.	Method Statements / procedures	Method statements and procedures are an important tool that can be used to assist in managing environmental issues that can arise when carrying out high risk construction activities in sensitive environments (eg: piling in watercourses, constructing temporary watercourse crossings, concrete paving and sawcutting, etc). The REF should provide details of any proposed method statements / procedures that will be included in the EMP and ECPs for the project.

APPENDIX: C - List of Relevant REF / REF Guidance Documents

The following documents / maps / manuals should be used (where appropriate):

- · To obtain relevant assessment criteria,
- As references for appropriate techniques and processors to be used when collecting and analysing data and modelling potential environmental impacts;
- · When preparing proposed ameliorative measures to minimise those impacts; and
- · As references when discussing exceedances of the assessment criteria.

The following (and other) relevant EPA publications may be referenced on the EPA's web site at www.epa.nsw.gov.au, with copies available by telephoning the EPA's Pollution Line on 131555.

Table: 1 - List of Guidance documents

SOIL & WATER	Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000 "In Publication")
	Water Quality and River Flow Interim Environmental Objectives: Guidelines for River, Groundwater and Water Management Committees (EPA, 1999)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA, 1998)
	Managing Urban Stormwater: Soils and Construction (Dept of Housing, August 1998) ("The Blue Book")
	Soil Landscape Maps (Dept Land & Water Conservation)
	· Construction Sites (EPA Manual for Authorised Officers, 1995)
,	The Utilisation of Treated Effluent by Irrigation (EPA, Draft, August, 2000)
	· Wetlands for Treating Wastewater (EPA Manual for Authorised Officers ,1995)
	Environment Matters Series: Using Herbicides Near Water (EPA's Draft, April, 2000)
ACID SULFATE	Acid Sulphate Soils Manual (Acid Sulphate Soil Management & Advisory Committee, 1998)
SOILS	Acid Sulfate Soils Risk Maps (Soil Conservation Service of NSW, 1995)

Table:	1	- List	of	Guidance	documents	(Cont'd)	
AID					1.1.1			_

	idance documents (Cont'd)	
AIR	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA, 2000)	
NOISE	Environmental Noise Management: Environmental Criteria for Road Traffic Noise (EPA, 1999)	
	NSW Industrial Noise Policy (EPA, 2000)	
	Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure & Ground Vibration (ANZECC)	
	Environmental Noise Control Manual (EPA,1994)	
FUEL & CHEMICAL STORAGE	Bunding and Spill Management (EPA Manual for Authorised Officers, 1997)	
WASTE AND LITTER	Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes" (EPA, 1999)	
	· Concrete Wastes (EPA Manual for Authorised Officers, 1995)	
	Not Too Hard: Minimising Waste. An information and training package for construction workers (EPA, The Aust. Centre for Construction Innovation, Uni. Of NSW)	
CONTAMINATED SITES	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC, 1992)	
31123	Guidelines for Consultants Reporting on Contaminated Sites (EPA, 1997)	
	Guidelines for the NSW Site Auditor Scheme (EPA, 1998)	
	Contaminated Sites - Sampling Design Guidelines (EPA 1995)	
	Contaminated Agricultural Land (EPA Manual for Authorised Officers, 1995)	
	Service Station Site: Assessment and Remediation (EPA Manual for Authorised Officers, 1995)	
LICENSING	Guide to Licensing Under the protection of the Environment Operations Act 1997 – Parts A and B (EPA, 1999)	

Table: Numbers of Threatened and Rare Plant Species recorded in sections A to F of the Cudgera Creek rainforest remnant and near the Pottsville Rd. - Cudgera Creek Rd. junction (N)

		A	В	C	D	E	F	N
THREATENED SPECIES	COMMON NAME							
Endangered				-				
Davidsonia jerseyana	Davidson's Plum		2					
Endiandra floydii	Crystal Creek Walnut			2				
Ochrosia moorei	Southern Ochrosia			1	1			
Randia moorei	Spiny Gardenia		1	2	6	11		
Vulnerable								
Acacia bakeri	Marblewood		1	4	4	15	2	
Archidendron hendersonii	White Laceflower							
Hickesbeachia pinnatifolia	Red Bopple Nut					9		
Macadamia tetraphylla	Bush Nut	1	17*					
Syzygium hodgkinsoniae	Red Lilly Pilly				1		1	
Syzygium moorei	Coolamon Tree	18*	1	5	6	4	2	1
ROTAP AND REGIONALLY SIGNIFICANT								
Archidendron muellerianum	Veiny Laceflower	1						1
Cupaniopsis newmanii	Long-leaved Tuckeroo		1					
Endiandra globosa	Black Walnut	5	2		1	3	1	
Medicosma cunninghamii	Medicosma			2	3	1	2	
Mucuna gigantea	Burny Bean	4	1	1			2	1
Rhodamnia maideniana	Smooth Rhodannia	1		1	1	2		

^{*} mostly juvenile saplings



TWEED/BYRON LOCAL ABORIGINAL LAND COUNCIL

P.O. Box 1410 Kingscliff, NSW 2487 Telephone: (02) 6674 3600

Fax: (02) 6674 3603 E-mail: tblalc@better.net.au

Greg Collins RTA-Grafton Zone 31 Victoria Street Grafton NSW 2460

Attention: Greg Collins

Subject: Cudgera Creek Road

Dear Greg

Tweed Byron Local Aboriginal Land Council's sites representative Cyril Scott, completed a search on a site located on the above property at Cudgera Creek Road.

The site contains low-lying plains with extensive marshy and boggy areas. The terrain is mostly semi-cleared grazing land with small crops and low to medium grassy areas.

The western part of the study area is low lying and prone to flooding.

Surface visibility is 80 to 100%

The inspection was to find as many sites as possible. Foot and vehicle navigated the site search.

The following is the result of the search:

- No Trees mature enough to carry scars as a result of the past cultural activities
- No middens found at this time
- No campsites present

I would consider it likely that this property contains sites of a permanent nature.

Recommendations:

The Tweed/Byron LALC recommends monitoring be on site of all sub-surface disturbance. A five (5) day notice prior to excavation would be appreciated.

Regards,

Clarence Phillips
Tweed/Byron local Aboriginal Land Council

Thank you

Clarence Phillips

Appendix D

Database Searches

Environment Protection and Biodiversity Conservation Act Online Database

Report created on: Tuesday, Mar 18 2003

Report on: threatened ecological communities, threatened species, marine protected species,

migratory species and , Ramsar sites, Commonwealth areas, World Heritage Areas

Search type: point

Approx buffer: 10 km (minimum buffer is approx 1km)

Coordinates used:

Longitude Latitude

153.537 -28.38



view map

Threatened ecological communities

0 communities

Threatened species

51 species

Migratory species

20 species

Marine protected species

51 species

World Heritage Areas [dataset information]

None found

Ramsar sites [dataset information]

None found

Commonwealth areas

Note: The database on Commonwealth areas is incomplete and includes only Commonwealth

marine areas and Commonwealth reserves

12nm limit

Extra Information

Conservation reserves [dataset information]

Cudgen Nature Reserve

Mooball National Park

Wooyung Nature Reserve

Billinudgel Nature Reserve

Regional Forest Agreements

Note: all RFA areas including those still under consideration have been included [dataset

information]

Upper North East NSW RFA

Species and Community Report

This report provides a general indication of the species and threatened communities that may occur in your nominated area

Threatened species

	Scientific Name	Common Name	Type of Presence	Status
Amphibia	Litoria olongburensis (1821)	Wallum Sedge Frog	Species or species habitat likely to occur within area	Vulnerable
Amphibia	Mixophyes iteratus (1944)	Southern Barred Frog	Species or species habitat likely to occur within area	Endangered
Aves	Cyclopsitta diophthalma coxeni (59714)	Coxen's Fig-Parrot	Species or species habitat likely to occur within area	Endangered
Aves	Diomedea dabbenena (66471)	Tristan Albatross	Foraging recorded within area - Derived from a general distribution map > 1 degree	Endangered
Aves	Lathamus discolor (744)	Swift Parrot	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Endangered
Aves	Macronectes giganteus (1060)	Southern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Endangered
Aves	Macronectes halli (1061)	Northern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Aves	Poephila cincta cincta (64447)	Black-throated Finch (southern)	Species or species habitat likely to occur within area	Vulnerable
Aves	Pterodroma neglecta neglecta (64450)	Kermadec Petrel (western)	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable

	Thalassarche impavida (64459)		Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
	Turnix melanogaster (923)	Black-breasted Button-quail	Species or species habitat likely to occur within area	Vulnerable
	Carcharias taurus (east coast population) (68751)	Grey Nurse Shark (east coast population)	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Critically Endangered
Chondrichthyes	Carcharodon carcharias (64470)	Great White Shark	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Chondrichthyes	Rhincodon typus (66680)	Whale Shark	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Insecta	Phyllodes imperialis (southern subsp ANIC 3333) (67453)	a moth	Species or species habitat likely to occur within area	Endangered
Mammalia	Balaenoptera musculus (36)	Blue Whale	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Endangered
Mammalia	Chalinolobus dwyeri (183)	Large-eared Pied Bat, Large Pied Bat	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Mammalia	Dasyurus maculatus maculatus (s. lat.) (64476)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (south-east mainland and Tasmanian subspecies)	Species or species habitat likely to occur within area	Vulnerable
Mammalia	Eubalaena australis (40)	Southern Right Whale	Species or species habitat likely to occur within area - Derived from a general	Endangered

			distribution map > 1 degree	
Mammalia	Megaptera novaeangliae (38)	Humpback Whale	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Mammalia	Potorous tridactylus tridactylus (66645)	Long-nosed Potoroo (SE mainland)	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Mammalia	Pteropus poliocephalus (186)	Grey-headed Flying- fox	Species or species habitat likely to occur within area	Vulnerable
Plant	Acronychia littoralis (8582)	Scented Acronychia	Species or species habitat likely to occur within area	Endangered
Plant	Austromyrtus <u>fragrantissima</u> (15716)	Scale Myrtle, Sweet Myrtle	Species or species habitat likely to occur within area	Endangered
Plant	Baloghia marmorata (8463)	Marbled Balogia, Jointed Baloghia	Species or species habitat likely to occur within area	Vulnerable
Plant	Bosistoa selwynii (13702)	Heart-leaved Bosistoa	Species or species habitat likely to occur within area	Vulnerable
Plant	Bosistoa transversa (16091)	Three-leaved Bosistoa	Species or species habitat likely to occur within area	Vulnerable
Plant	Bulbophyllum globuliforme (6649)	Miniature Moss-orchid	Species or species habitat likely to occur within area	Vulnerable
Plant	Corokia whiteana (17820)		Species or species habitat likely to occur within area	Vulnerable
Plant	Cryptocarya foetida (11976)	Stinking Cryptocarya	Species or species habitat likely to occur within area	Vulnerable
Plant	Davidsonia pruriens var. jerseyana (8795)	Davidson's Plum, Ooray	Species or species habitat likely to occur within area	Endangered
Plant	Davidsonia sp. Mullumbimby- Currumbin Ck (A.G.Floyd 1595) (64667)		Species or species habitat likely to occur within area	Endangered
Plant	Desmodium acanthocladum	Thorny Pea	Species or species habitat likely to occur	Vulnerable

	(17972)		within area	
Plant	Diospyros mabacea (18548)	Red-fruited Ebony	Species or species habitat likely to occur within area	Endangered
Plant	<u>Diploglottis</u> campbellii (21484)	Small-leaved Tamarind	Species or species habitat likely to occur within area	Endangered
Plant	Elaeocarpus williamsianus (8956)	Hairy Quandong	Species or species habitat likely to occur within area	Endangered
Plant	Endiandra floydii (52955)	Floyd's Walnut	Species or species habitat likely to occur within area	Endangered
Plant	Endiandra hayesii (13866)	Rusty Rose Walnut; Velvet Laurel	Species or species habitat likely to occur within area	Vulnerable
Plant	Floydia praealta (15762)	Ball Nut, Possum Nut, Big Nut	Species or species habitat likely to occur within area	Vulnerable
Plant	Fontainea australis (24037)		Species or species habitat likely to occur within area	Vulnerable
Plant	Hicksbeachia pinnatifolia (21189)	Monkey Nut, Bopple Nut, Red Bopple, Red Bopple Nut, Red Nut, Beef Nut, Red Apple Nut	Species or species habitat likely to occur within area	Vulnerable
Plant	Macadamia tetraphylla (6581)	Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough- leaved Queensland Nut	Species or species habitat likely to occur within area	Vulnerable
Plant	Marsdenia longiloba (2794)	Clear Milkvine	Species or species habitat likely to occur within area	Vulnerable
Plant	Ochrosia moorei (11350)	Southern Ochrosia	Species or species habitat likely to occur within area	Endangered
Plant	Randia moorei (10577)	Spiny Gardenia	Species or species habitat likely to occur within area	Endangered
Plant	Syzygium hodgkinsoniae (3539)	Smooth-bark Rose Apple, Red Lilly Pilly	Species or species habitat likely to occur within area	Vulnerable
Plant	Syzygium moorei (12284)	Rose Apple, Coolamon, Robby, Durobby, Watermelon Tree, Coolamon Rose Apple	Species or species habitat likely to occur within area	Vulnerable
Plant	Tinospora tinosporoides	Arrow-head Vine	Species or species habitat likely to occur	Vulnerable

Reptilia	(5128) Chelonia mydas (1765)	Green Turtle	within area Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Reptilia	Coeranoscincus reticulatus (59628)	Three-toed Snake-tooth Skink	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable
Reptilia	Dermochelys coriacea (1768)	Leathery Turtle, Leatherback Turtle, Luth	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Vulnerable

Marine birds covered	by migratory pr	rovisions of the EPBC Act, 1999
Scientific Name	Common Name	e Type of Presence
Aves Diomedea dabbenena (66471)	Tristan Albatross	Foraging recorded within area - Derived from a general distribution map > 1 degree
Aves Macronectes giganteus (1060)	Southern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Aves Macronectes halli (1061)	Northern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Aves Thalassarche impavida (64459)	Campbell Albatross	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree

Marine specie		ratory provisions of th Common Name	e EPBC Act, 1999 Type of Presence
	Scientific Ivallie	Common Name	Type of Fresence
Chondrichthye	es Rhincodon typus	s Whale Shark	Species or species habitat likely to occur within area - Derived from a general
	(66680)		distribution map > 1 degree
Mammalia	Balaenoptera musculus (36)	Blue Whale	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Mammalia	Dugong dugon (28)	Dugong	Species or species habitat likely to occur within area
Mammalia	Eubalaena australis (40)	Southern Right Whale	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree

Mammalia	Megaptera novaeangliae (38)	Humpback Whale	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Reptilia	Chelonia mydas (1765)	Green Turtle	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Reptilia	Dermochelys coriacea (1768)	Leathery Turtle, Leatherback Turtle, Luth	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree

Terrestrial species covere	ed by migratory p	provisions of the EPBC Act, 1999
Scientific Name	Common Name	Type of Presence
Aves <u>Cyclopsitta</u> diophthalma coxeni (59714)	Coxen's Fig- Parrot	Species or species habitat likely to occur within area
Aves <u>Haliaeetus</u> <u>leucogaster</u> (943)	White-bellied Sea-Eagle	Species or species habitat likely to occur within area
Aves Hirundapus caudacutus (682)	White-throated Needletail	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Aves Monarcha melanopsis (609)	Black-faced Monarch	Breeding or breeding habitat likely to occur within area - Derived from a general distribution map > 1 degree
Aves Monarcha trivirgatus (610)	Spectacled Monarch	Breeding or breeding habitat likely to occur within area
Aves Myiagra cyanoleuca (612)	Satin Flycatcher	Breeding or breeding habitat likely to occur within area
Aves Rhipidura rufifrons (592)	Rufous Fantail	Breeding or breeding habitat likely to occur within area - Derived from a general distribution map > 1 degree

Wetland species covered	l by migratory pro	visions of the EPBC Act, 1999
Scientific Name	Common Name	Type of Presence
Aves <u>Gallinago</u> <u>hardwickii</u> (863)	Latham's Snipe, Japanese Snipe	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree
Aves Rostratula benghalensis s. lat. (889)	Painted Snipe	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree

Species covered by marine provisions of the EPBC Act, 1999

Scientific Name Common Name Type of Presence Status

Actinopterygii	Acentronura tentaculata (66187)	Hairy Pygmy Pipehorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Campichthys tryoni (66193)	Tryon's Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Corythoichthys amplexus (66199)	Fijian Banded Pipefish, Brown- banded Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Corythoichthys ocellatus (66203)	Orange-spotted Pipefish, Ocellated Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Festucalex cinctus (66214)	Girdled Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Filicampus tigris (66217)	Tiger Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Halicampus grayi (66221)	Mud Pipefish, Gray's Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippichthys cyanospilos (66228)	Blue-speckled Pipefish, Blue- spotted Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippichthys heptagonus (66229)	Madura Pipefish, Reticulated Freshwater Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippichthys penicillus (66231)	Beady Pipefish, Steep-nosed Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippocampus kelloggi (66723)	Kellogg's Seahorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippocampus kuda (66237)	Spotted Seahorse, Yellow Seahorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Hippocampus planifrons (66238)	Flat-face Seahorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed

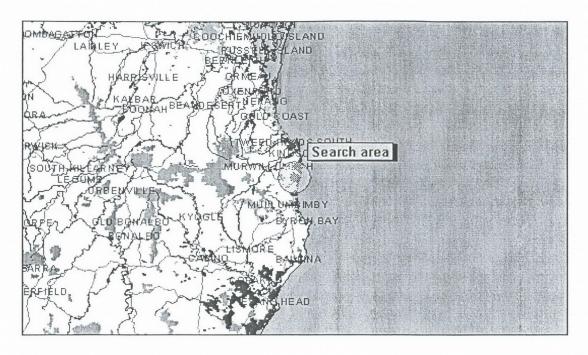
Actinopterygii	Hippocampus whitei (66240)	White's Seahorse, Crowned Seahorse, Sydney Seahorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Lissocampus runa (66251)	Javelin Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Maroubra perserrata (66252)	Sawtooth Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Micrognathus andersonii (66253)	Anderson's Pipefish, Shortnose Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Micrognathus brevirostris (66254)	Thorn-tailed Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Microphis manadensis (66258)	Manado River Pipefish, Manado Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Solegnathus dunckeri (66271)	Duncker's Pipehorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Solegnathus hardwickii (66272)	Pipehorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Solegnathus spinosissimus (66275)	Spiny Pipehorse, Australian Spiny Pipehorse	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Solenostomus cyanopterus (66183)	Blue-finned Ghost Pipefish, Robust Ghost Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Solenostomus paradoxus (66184)	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Stigmatopora nigra (66277)	Wide-bodied Pipefish, Black Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygii	Syngnathoides biaculeatus (66279)	Double-ended Pipehorse, Alligator Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed

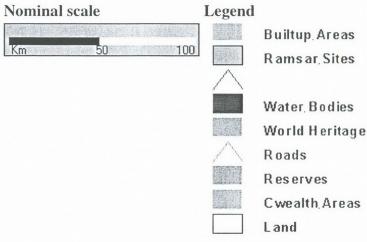
Actinopterygi	i Trachyrhamphus bicoarctatus (66280)	Bend Stick Pipefish, Short-tailed Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygi	i <u>Urocampus</u> <u>carinirostris</u> (66282)	Hairy Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Actinopterygi	i <u>Vanacampus</u> margaritifer (66283)	Mother-of-pearl Pipefish	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Aves	Anseranas semipalmata (978)	Magpie Goose	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Catharacta skua (59472)	Great Skua	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Aves	Diomedea dabbenena (66471)	Tristan Albatross	Foraging recorded within area - Derived from a general distribution map > 1 degree	Listed
Aves	Gallinago hardwickii (863)	Latham's Snipe, Japanese Snipe	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Haliaeetus leucogaster (943)	White-bellied Sea- Eagle	Species or species habitat likely to occur within area	Listed
Aves	Hirundapus caudacutus (682)	White-throated Needletail	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Lathamus discolor (744)	Swift Parrot	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Macronectes giganteus (1060)	Southern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Aves	Macronectes halli (1061)	Northern Giant-Petrel	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Aves	Monarcha melanopsis (609)	Black-faced Monarch	Breeding or breeding habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Monarcha trivirgatus	Spectacled Monarch	Breeding or breeding habitat likely to occur within area	Overfly marine

	(610)			area
Aves	Myiagra cyanoleuca (612)	Satin Flycatcher	Breeding or breeding habitat likely to occur within area	Overfly marine area
Aves	Rhipidura rufifrons (592)	Rufous Fantail	Breeding or breeding habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Rostratula benghalensis s. lat. (889)	Painted Snipe	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Overfly marine area
Aves	Thalassarche chlororhynchos (66481)	Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Aves	Thalassarche impavida (64459)	Campbell Albatross	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Mammalia	Dugong dugon (28)	Dugong	Species or species habitat likely to occur within area	Listed
Reptilia	Astrotia stokesii (1122)	Stokes' Seasnake	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Reptilia	Chelonia mydas (1765)	Green Turtle	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Reptilia	Dermochelys coriacea (1768)	Leathery Turtle, Leatherback Turtle, Luth	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Reptilia	Hydrophis elegans (1104)	Elegant Seasnake	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed
Reptilia	Pelamis platurus (1091)	Yellow-bellied Seasnake	Species or species habitat likely to occur within area - Derived from a general distribution map > 1 degree	Listed

Species with a ** in the status field are predominantly non-marine, however they are known to overfly or occasionaly visit the Commonwealth marine area.

Map of area defined including buffer





Aknowledgements

This database has been compiled from a range of data sources. Environment Australia acknowledges the following custodians who have contributed valuable data and advice:

- o New South Wales National Parks and Wildlife Service
- o Department of Natural Resources and Environment, Victoria (Secretary)
- o Department of Primary Industries, Water and Environment, Tasmania
- o Department of Environment and Heritage, South Australia Planning SA
- o Parks and Wildlife Commission of the Northern Territory
- Queensland Environment Protection Agency
- o Birds Australia
- o Australian Bird and Bat Banding Scheme
- o Australian National Wildlife Collection
- o Natural history museums of Australia
- o Queensland Herbarium
- o Royal Botanic Gardens and National Herbarium of NSW

- o Royal Botanic Gardens and National Herbarium of Victoria
- o Tasmanian Herbarium
- o State Herbarium of South Australia
- o Northern Territory Herbarium
- o Western Australian Herbarium
- o Australian National Herbarium, Atherton and Canberra
- o University of New England
- o Other groups and individuals

ANUCLIM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

See log of system/dataset changes

For further information see http://www.environment.gov.au/epbc



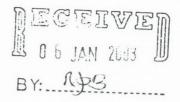
Your Ref: Our Ref: AHIMS #7006

RTA Environment Technology LvI 5 POD D 99 Phillip st Parramatta NSW 2150

Tuesday, 17 December 2002

Attention: Richard Dunnicliff

Dear Sir or Madam:





NSW NATIONAL PARKS AND WILDLIFE SERVICE

ABN 30 841 387 271

Re: AHIMS Search for the following area at Cudge creek area Zone 56 Eastings: 549000-555000 Northings: 6857500-6861500

I am writing in response to your recent inquiry in respect to Aboriginal objects and Aboriginal places registered with the NSW National Parks and Wildlife Service (NPWS) at the above location.

A search of the NPWS Aboriginal Heritage Information Management System (AHIMS) has shown that 4 Aboriginal objects and Aboriginal places are recorded in or near the above location. Please refer to the attached report for details.

The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not to be made available to the public.

The following qualifications apply to an AHIMS search:

- AHIMS only includes information on Aboriginal objects and Aboriginal places that have been provided to NPWS;
- Large areas of New South Wales have not been the subject of systematic survey or recording of Aboriginal history. These areas may contain Aboriginal objects and other heritage values which are not recorded on AHIMS;
- Recordings are provided from a variety of sources and may be variable in their accuracy. When an AHIMS search identifies Aboriginal objects in or near the area it is recommended that the exact location of the Aboriginal object be determined by re-location on the ground; and
- The criteria used to search AHIMS are derived from the information provided by the client and NPWS assumes that this information is accurate.

All Aboriginal places and Aboriginal objects are protected under the *National Parks* and *Wildlife Act 1974* (NPW Act) and it is an offence to destroy, damage or deface them without the prior consent of the NPWS Director-General. An Aboriginal object is considered to be known if:

- It is registered on AHIMS;
- It is known to the Aboriginal community; or
- It is located during an investigation of the area conducted for a development application.

Head Office 43 Bridge Street PO Box 1967

Hurstville NSW 2220 Australia Tel: (02) 9585 6444 Fax: (02) 9585 6555

www.npws.nsw.gov.au

If you are considering undertaking a development activity in the area subject to the AHIMS search, NPWS would recommend that an Aboriginal Heritage Assessment be undertaken. You should consult with the relevant consent authority to determine the necessary assessment to accompany your development application.

Yours Sincerely

Vanessa Atkins

Aboriginal Information Officer Information Systems Unit Cultural Heritage Division

Phone: (02) 9585 6345 Fax: (02) 9585 6325



Weather: National | Victoria | NSW | ACT | Queensland | South Aus | Western Aus | Nthn. Territory | Tasmania

What is the weather usually like?

- Climate Averages for Australian Sites -

Averages for MURWILLUMBAH (BRAY PARK)

Make sure you understand what the Climate Averages are all about before you make use of the following information. A comma separated text file of these averages is also available for download which can be graphed in software such as a spreadsheet

058158 MURWILLUMBAH (BRAY PARK) Latitude:-28.3408 S Longitude: 153.3784 E				Commenced: 1972 Last reco Elevation: 18.0 m State:				
JAN FEB	MAR APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Mean Daily Max T	emp (deg C) 28.2 26.2	23.5	21.2	20.9	22.3	24.9	26.0	27.6
Mean no. Days, M	(ax >= 40.0 deg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean no. Days, M			0.0	0.0	0.0	0.1	0.1	0.8
Mean no. Days, M	lax >= 30.0 deg	g C						
12.6 9.3 Highest Max Temp	7.5 2.3 (deg C)	0.1	0.0	0.0	0.1	1.9	3.5	7.4
41.2 36.7	36.5 35.4	30.8	27.7	28.3	30.8	36.0	35.2	38.7
Mean Daily Min 7 19.4 19.4 Mean no. Days, M	18.1 15.2		9.5	8.6	8.7	11.1	13.8	16.3
0.0 0.0 Mean no. Days, N	0.0 0.0	0.0	0.3	1.0	0.4	0.0	0.0	0.0
0.0 0.0	0.0 0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Lowest Min Temp 13.7 13.8	(deg C) 11.5 6.6	2.7	-0.3	0.2	0.9	3.2	5.2	6.6
Mean 9am Air Ten 23.8 22.9 Mean 9am Wet-bul	22.7 20.5 b Temp (deg C)	14.4	13.5	15.0	18.5	21.1	21.8
21.4 21.1 Mean 9am Dew Poi		C)	12.5	11.5	12.5	14.9	17.2	18.8
20.1 20.0 Mean 9am Relativ	19.1 16.6 re Humidity (%		10.6	9.4	10.0	11.9	14.3	16.6
80 84	81 79	82	79	77	73	66	66	73
Mean 9am Wind Sp 7.4 7.6		9.2	9.6	9.2	8.5	8.8	8.8	7.4
Mean 3pm Air Ter 28.0 27.5 Mean 3pm Wet-bul	26.5 24.3		19.8	19.6	20.7	23.0	23.7	25.8
22.9 22.7 Mean 3pm Dew Pos	21.8 19.5	17.4	15.0	14.2	14.8	16.6	18.3	20.3
20.3 20.2	19.1 16.3	14.2	10.7	9.3	9.4	11.5	14.5	16.9
Mean 3pm Relative 63 65	65 62		58	53	50	50	57	59
Mean 3pm Wind Sp	peed (km/hr)							

16.7 15.5 14.8 13.2 11.3 11.2 12.4 14.0 17	.4 17.6 16.4
Mean Rainfall (mm)	
	.5 86.0 130.1
Median (Decile 5) Rainfall (mm)	
165.4 168.4 212.8 109.0 105.6 54.8 48.6 34.9 22	.4 77.0 127.2
Decile 9 Rainfall (mm)	
310.0 521.2 457.2 451.9 492.7 245.7 161.1 124.4 100	.2 163.8 218.8
Decile 1 Rainfall (mm)	
_ 64.0 86.7 46.8 40.2 26.1 10.0 8.9 2.5 1	.7 26.8 25.6
Mean no. of Raindays	
15.5 17.0 17.2 15.2 14.3 10.5 9.4 8.3 8	1.2 11.1 13.5
Highest Monthly Rainfall (mm)	
820.4 645.6 764.4 752.4 543.0 421.7 430.4 255.0 153	.9 205.4 353.2
Lowest Monthly Rainfall (mm)	
51.6 40.6 29.6 14.2 9.4 9.4 0.4 0.2 0	1.0 17.0 20.6
Highest Recorded Daily Rain (mm)	
231.8 275.0 321.0 261.4 203.4 154.4 154.9 93.1 93	.2 244.3 101.2
Mean no. of Clear Days	
	8.4 8.1 6.7
Mean no. of Cloudy Days	
13.0 13.0 11.4 9.5 12.0 8.8 8.0 6.4 5	5.9 10.9 12.4

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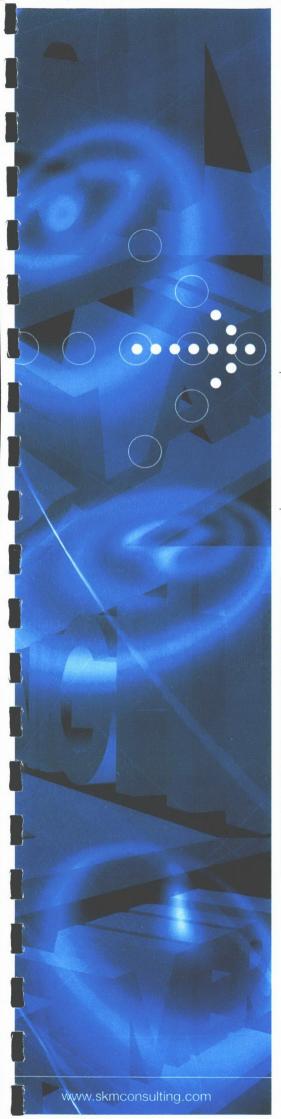
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Appendix E

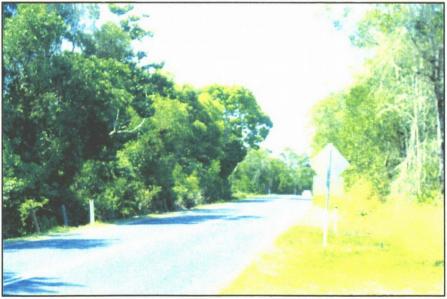
SKM Ecological Assessment Report



Cudgera Creek Road Upgrade Ecological Assessment

Report to the Roads and Traffic Authority

March 2003



Cudgera Creek Road Upgrade Ecological Assessment

Report to the Roads and Traffic Authority March 2003



Sinclair Knight Merz Pty Limited ACN 001 024 095 ABN 37 001 024 095 **Tonella Commercial Centre** 125 Bull Street Newcastle West NSW Australia 2302

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1. Introduction

1.1 Background

This report investigates the ecological attributes associated with the proposed Cudgera Creek Road Upgrade between the Pottsville/ Mooball Road and the Yelgun to Chinderah Pacific Highway interchange. The report follows on from the Route Options Identification and Assessment prepared by Abigroup (2002) which assessed five route options and identifying Option D as the preferred route. This report presents an assessment of ecological considerations relevant to the preferred route option (Option D).

The report has utilised field investigations, aerial photograph interpretation and review of available data to assess the potential impacts of the proposed works in relation to relevant legislation. For this report, the:

- □ *Study corridor* consisted of the proposed Cudgera Creek Road and proposed upgrade areas.
- Study area is defined as the study corridor as well as proximal and adjacent lands that are potentially affected by the proposed construction. The study area is shown in **Figure 1-1**.
- □ Study locality refers to the area within a 10-kilometre radius of the study area.
- □ Study region is the NSW North Coast bioregion as described by the Interim Bioregionalisation of Australia (IBRA) of Thackway & Cresswell (1995).

The study corridor extends from the location of the Cudgera Creek road interchange on the Yelgun to Chinderah section of the Pacific Highway upgrade, to the location of the proposed intersection of the Cudgera Creek Road and Pottsville/Mooball Road, a distance of approximately 1.9 kilometres. The investigation includes lands within 20 metres either side of the existing road verge as well as areas between the existing alignment and the proposed alignment.

1.2 Description of the Proposal

The Proposal involves the upgrading and realignment of Cudgera Creek Road from the eastern limits of the Cudgera Creek Road Interchange to approximately 200 metres east of the junction with Mooball-Pottsville Road, a length of approximately 1.8 km. The Proposal would involve rehabilitation of the existing road and realignment in the vicinity of Cudgera Creek. The Proposal would also involve the redesign of the intersection of Cudgera Creek Road with Mooball-Pottsville Road. The redesign would make Cudgera Creek Road the priority road.

The works would include property acquisition, utility adjustments, clearing, earthworks and drainage works, bridge construction, existing bridge removal, pavement works, wearing surface and rehabilitation works.

The recommended flora and fauna mitigation measures are detailed in Section 7 of this report.

1.3 Scope of the Investigation

This study investigates the terrestrial and aquatic flora and fauna within the study corridor and has been conducted in a number of stages:

- The first stage was a review of existing information on protected and threatened flora and fauna species, populations and ecological communities and their habitats (as listed in the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999, NSW Threatened Species Conservation Act 1995 and the NSW National Parks and Wildlife Act, 1974) within the study area;
- A detailed evaluation of the terrestrial and aquatic floral and faunal habitats of the study area, drawing from the results of previous investigations as well as specific ground-truthing and assessment. This aimed to delineate the separate structural habitats of the study area and compile information on the type and availability of habitat features;
- The third stage comprised an analysis of those threatened flora and fauna species deemed potential inhabitants of the study area (ie. potential subject species). This analysis utilised the listings of threatened species in the locality and wider subregion, the nature of the preferred habitats of these threatened species and the results of the habitat delineation and evaluation program in the study area. It culminated with the listing of potential threatened species within the study area;
- The design and implementation of floral and faunal field surveys (terrestrial and aquatic) within the study area to describe and map the extent of vegetation communities, compile lists of biological species diversity (flora and fauna) and adequately target the potential presence of threatened flora and fauna species deemed potential subject species;
- The final stage was the assessment of the Proposal under the provisions of the relevant legislation to determine whether there is likely to be a significant impact from the Proposal on threatened species, populations, ecological communities or their habitats. Assessment under the provisions of other relevant State and Commonwealth legislation was also documented;
- ☐ Identify and describe the inherent ecological constraints and opportunities;
- Undertake the 8-part test (EP&A Act) to assess the potential significance of impacts on threatened species and assess the need for a Species Impact Statement; and
- Devise and formulate protective and mitigatory measures that may be applied to minimise potential ecological impacts. This included considerations pertaining to wildlife corridors and vegetation management.

1.4 Summary of Relevant Legislation

The following environmental legislation has been referenced in this report:

- □ Environmental Planning and Assessment Act 1979- Part V (EP&A Act);
- ☐ Threatened Species Conservation Act 1995 (TSC Act);
- □ Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);
- □ Fisheries Management Act, 1994 (FM Act);
- □ National Parks and Wildlife Act 1974 (NPW Act);
- □ State Environmental Planning Policy No. 14 Coastal Wetlands (SEPP 14);

- □ State Environmental Planning Policy No. 26 Littoral Rainforests (SEPP 26); and
- □ State Environmental Planning Policy No. 44 Koala Habitat Protection (SEPP 44).

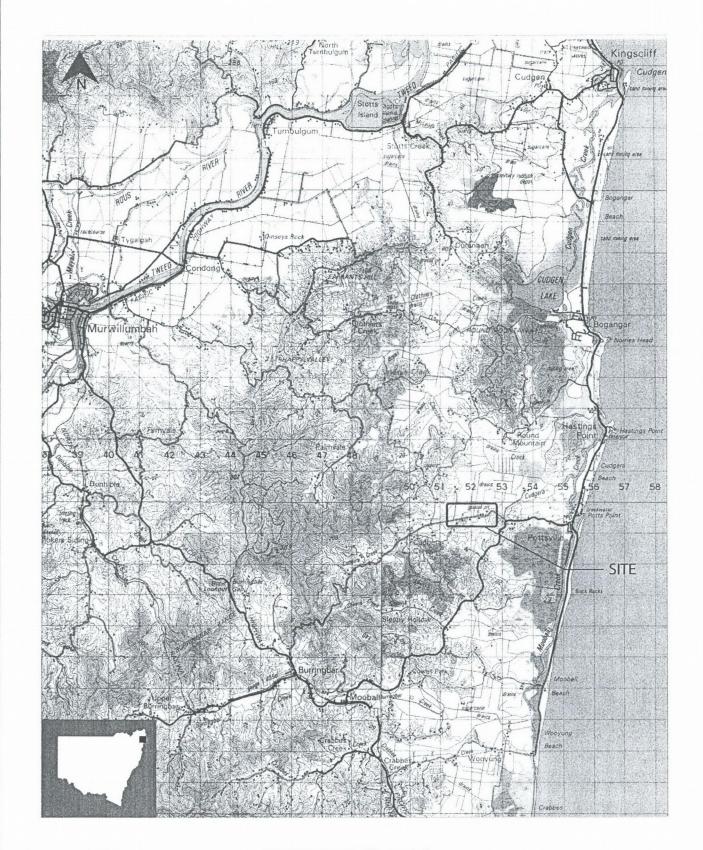


Figure 1.1

Site Locality

2. Review of Existing Knowledge

2.1 Previous Investigations

A detailed route option identification and assessment for the Cudgera Creek Road upgrade was prepared by Abigroup (2002). As part of the assessment a comprehensive flora survey of lands covering five broad route options was carried out. The survey covered an area of land more extensive then the current investigation and identified from this area a total of ten threatened flora species and six ROTAP (Rare or Threatened Australian Plants) and regionally significant species (see list below). The results of the Abigroup (2002) investigation were used to select a preferred route option, the location of which is the focus of this investigation.

Threatened Species	Common Name	
Endangered		
Davidsonia jerseyana	Davidson's Plum	
Endiandra floydii	Crystals Creek Walnut	
Ochrosia moorei	Southern Ochrosia	
Randia moorei	Spiny Gardenia	***************************************
Vulnerable		
Acacia bakeri	Marblewood	
Archidendron hendersonii	White Laceflower	
Hickesbeachia pinnatifolia	Red Bopple Nut	
Macadamia tetraphylla	Bush Nut	
Syzygium hodgkinsoniae	Red Lilly Pilly	
Syzygium moorei	Coolamon Tree	
ROTAP and Regionally Significant	Species	
Archidendron muellerianum	Veiny Laceflower	***************************************
Cupaniopsis newmanii	Long-leaved Tuckeroo	
Endiandra globosa	Black Walnut	
Medicosma cunninghamii	Medicosma	
Mucuna gigantea	Burny Bean	
Rhodamnia maideniana	Smooth Rhodamnia	

Source: Abigroup (2002)

Each of the threatened species presented in Abigroup (2002) and listed above were considered as potentially occurring in study corridor and subsequently targeted during field surveys.

Woodward-Clyde (1998) conducted investigations and reported on terrestrial flora and fauna issues pertaining to the proposed Yelgun to Chinderah Pacific Highway Upgrade EIS. The surveys concentrated on a long linear study area, which included, although was not limited to the land in proximity to Cudgera Creek. This included lands in proximity to and connected to the area investigated for this study, however the EIS covered a broader range of habitat types and a considerably larger area then the surveys for this assessment.

Studies of the freshwater aquatic fauna associated with the EIS investigation were reported by The Ecology Lab (1998). The methods and results of these investigations are summarised below.

Surveys for terrestrial flora and fauna for the EIS were undertaken during August and September 1997 with supplementary surveys in April 1998 (Woodward-Clyde 1998). Comprehensive flora and fauna surveys were designed to sample vegetation and habitats to be disturbed within the study area associated with the highway

construction. Notes were taken on the structure and floristic composition of vegetation communities within the investigation area.

Vegetation Assemblages

Six (6) vegetation communities including twenty-two (22) associations were mapped and identified in the report.

Vegetation Community	Community Association
	Warm sub-tropical rainforest
1. Rainforest	Hoop pine +/- rainforest
1. Rainiorest	Rainforest with exotic species
	Rainforest regrowth
	Brush Box +/- Hoop Pine, Eucalypt and rainforest
2. Brush Box Forest	Brush Box +/- emergent Eucalypt
2. Brush box r orest	Brush Box regrowth (with rainforest, Acacia and exotic species)
	Mixed Eucalypt
	Blackbutt
2 Mat Calarash II Farrat	Grey Ironbark-Pink Bloodwood
Wet Sclerophyll Forest	Tallowwood
	Flooded Gum
	Wet sclerophyll regrowth
	Forest Red Gum
1 Day of Maint Coloranhyll	Cypress Pine
Dry or Moist Sclerophyll Forest	Brush Ironbark Wattle
Tolest	Black Wattle
	Forest Oak /Swamp Oak
5. Mixed Regrowth	Brush Box-Wet Sclerophyll-Rainforest-Wattle-Camphor
Communities	regrowth
6. Camphor Laurel Dominated Forest	
	Paperbark
7. Swamp Sclerophyll Forest	Swamp Oak

Source: Landmark Ecological Services in (Woodward-Clyde 1998)

Woodward-Clyde (1998) identified the presence of five (5) endangered species and six (6) vulnerable species (as scheduled under the TSC Act) and six (6) species listed as a Rare or Threatened Australian Plant (ROTAP) by Briggs and Leigh (1996) within proximity to the footprint for the Yelgun to Chinderah roadworks. These species are listed below.

Species		Status	
,	TSC Act	EPBC Act	ROTAF
Davidsonia pruriens var. jerseyana	Е	-	2ECi
Endiandra floydii	Ε	V	2VC-
Endiandra muelleri subsp. bracteata	Ε		-
Marsdenia longiloba	E	Е	3RC
Randia moorei	Е	Е	3ECi
Cryptocarya foetida	V	V	3VCi
Endiandra hayesii	V	V	3VC-
Hicksbeachia pinnatifolia	V	V	3RC-
Macadamia tetraphylla	V	V	2VC-
Syzygium hodgkinsoniae	V	V	3VC-
Syzygium moorei	V	V	2Vci
Archidendron muellerianum	-	-	3RCa
Cassia brewsteri var. marksiana	-	-	2RCi
Cupaniopsis newmannii	-	-	2RC-
Endiandra globosa	-	-	2RC-
Millettia australis	-	-	3RC-
Rhodamnia maideniana	-	•	2RC-

E - endangered species

V - vulnerable species

ROTAP category

2 geographical range < 100km

3 geographical range > 100km

E endangered, species at serious risk of disappearing from the wild

V vulnerable, species not presently endangered but at risk of disappearing from the wild

R rare, species considered rare in Australia

c a population known to be represented within a conservation reserve

a population considered adequately reserve (>1000 plants in a reserve)

i population considered inadequately reserved with a total population

- size of the conserved population no known

Faunal Assemblages

A considerable amount of information is available in relation to the vertebrate fauna of the coastal shires of Byron and the Tweed, the more predominate sources including Milledge (1991), RACAC (1994), Mount King Ecological Surveys (1994), and Landmark Ecological Services *et al* (1999). Information presented in Mount King Ecological Surveys (1994) summarises several previous surveys carried out in the broader Tweed Shire area, indicating a high faunal diversity comprising:

29 Amphibians (1 introduced species);

51 Reptiles;

219 Birds (4 introduced); and

67 Mammals (29 bat species, 7 introduced species).

Surveys undertaken specifically for the Yelgun to Chinderah EIS (Woodward-Clyde 1998) concentrated on the actual road footprint and immediately adjacent habitats potentially impacted by the proposal, including parts of Cudgera Creek upstream from the current investigation area. The surveys investigated fewer habitat types and topographic variation then what occurs in the wider north coast region as discussed in Mount King Ecological Surveys (1994). As a result the faunal diversity recorded during the EIS represents a percentage of the total species diversity from the Upper North Coast region. The results of the field surveys reported by Woodward-Clyde (1998) revealed a total of:

17 Amphibians 8 Reptiles 128 Birds (2 introduced species) 26 Mammals (4 introduced)

Of the species identified in the Yelgun to Chinderah EIS (Woodward-Clyde 1998), fourteen (14) are listed as threatened in the TSC Act (see list below). This includes one species scheduled as vulnerable since completion of the EIS, namely the Greyheaded Flying-fox (*Pteropus poliocephalus*). An unconfirmed record of the Grass Owl (*Tyto capensis*) was also reported although the species was not positively identified (Woodward-Clyde 1998). Several other threatened species were considered to potentially occur. Further discussion on potential subject species is provided later in the report.

Species	Status		
	TSC Act	EPBC Act	
Osprey (Pandion haliaetus)	V	-	
Square-tailed Kite (Lophoictinia isura)	V	-	
Bush Hen (Amaurornis olivaceus)	V	-	
Rose-crowned Fruit-Dove (Ptilinopus regina)	V	-	

Species	Sta	tus
Glossy Black Cockatoo (Calyptorhynchus lathami)	V	_
Masked Owl (Tyto novaehollandiae)	V	•
White-eared Monarch (Monarcha leucotis)	V	-
Grass Owl (unconfirmed) (Tyto capensis)	V	-
Koala (Phascolarctos cinereus)	V	-
Little Bentwing-bat (Miniopterus australis)	V	-
Common Bentwing-bat (Miniopterus schreibersii)	V	-
Large-footed Myotis (Myotis macropus)	V	-
Northern Long-eared Bat (Nyctophilus bifax)	V	-
Grey-headed Flying-fox (Pteropus poliocephalus)	V	V
Black Flying-fox (Pteropus alecto)	V	-

No aquatic surveys (fish fauna) were undertaken for the Yelgun to Chinderah Pacific Highway EIS. However, a review of threatened fish from the area was undertaken by The Ecology Lab (1998). This review indicated two threatened species (FM Act) which could potentially occur in the study area, including the Oxleyan Pygmy Perch (Nannoperca oxleyana) and the Honey Blue-eye (Pseudomugil mellis).

2.2 Wildlife Databases

A review of ecological literature pertaining to the study locality was undertaken as the first stage of this investigation. The documented locations of threatened flora and fauna species, including fish within the study locality was reviewed and compiled. The data sources used in this review included but was not limited to the following:

- □ NPWS Atlas of NSW Wildlife Database for the Tweed Heads (9641) and Murwillumbah (9541) obtained mid September 2002;
- Results of Terrestrial and Aquatic Flora and Fauna Investigations carried out for the Yelgun to Chinderah Pacific Highway Upgrade Environmental Impact Statement (EIS) (Woodward-Clyde 1998; The Ecology Lab 1998)
- □ NPWS (1999) Threatened Species Management Guidelines;
- ☐ Records published in scientific journals, reports and general flora and fauna distribution texts;
- Results of local environmental studies, including studies prepared by consultants, government authorities, biological organisations, universities and other sources, including (Landmark Ecological Services *et al* 1999);
- Other relevant databases including the National Herbarium, Environment Australia (nationally threatened species, EPBC Act), records published in the Birds Australia and CANRI database, NSW Fisheries and Fish Files database;
- Discussions with personnel from the National Parks and Wildlife Service (NPWS), NSW Fisheries, PlanningNSW and Environment Australia (EA); and
- Anecdotal reports from authorities and local naturalists.

All of the threatened flora and fauna species, endangered populations and ecological communities known to occur within the study locality have been tabulated in Section 2.2 of the report. This information will be utilised in the preparation of lists of threatened species deemed potential inhabitants of the study corridor (ie. potential subject species).

2.2.1 Threatened Flora

Thirty-one (31) threatened flora species have been previously recorded in the study locality:

■ Table 2-1 Flora species recorded within 10 km of the study area (Atlas of NSW Wildlife)

Species		tus	Year	Location	WC
	NSW	Nat.			report
Acacia bakeri	V		1997	Upper Cudgera Creek	V
			1997	Palmvale	
			1991	Round Mountain	
			1991	Sleepy Hollow	
Acalypha eremorum	E1		1997	Upper Cudgera Creek	
Acronychia littoralis	E1		2001	Cudgera Creek	
torony orna miorano			2001	Cudgen Lake	
			2001	Wooyung	
Angiopteris evecta	E1		1997	Upper Cudgera Creek	

Archidendron hendersonii	V		1987	Cudgen Lake	
Bosistoa transversa	V		1991	Upper Blindmouth Creek	
Cassia brewsteri var. marksiana	E1		1997	Upper Cudgera Creek	✓
			1996	Sleepy Hollow	
			1991	Reserve Creek	
Corokia whiteana	V	V	1991	Crabbes Creek Beach	
Cryptocarya foetida	V	V	1998	Southeast Cudgera Creek	✓
oryprodury a roomaa			1997	Upper Cudgera Creek	
			1994	Upper Lacks Creek	
0 :/ :			1993	Cudgen Lake	
Davidsonia pruriens var. ierseyana	E1	Е	2000	Sheens Creek	
			1998	Cowell Park	
			1997	Crabbes Creek	
			1995	Mooball north	
Davidsonia johnsonii	E1		2001	Cudgera Creek	
			2001	Burringbar Gap	
			2001	Upper Blindmouth Creek	
Dendrocnide moroides	E1		1997	Upper Cudgera Creek	
Dendrochide moroides			1987	Cudgen Lake	
Diagrams maiss absent	Ε4				
Diospyros major var. ebenus forma australiensis	E1		2000	Inner Pocket	
Diploglottis campbellii	E1	E	1991	Clothiers Creek west	
Drynaria rigidula	E1		1997	Southwest Cudgen Lake	
Elaeocarpus williamsianus	E1		1997	Burringbar Gap east	
			1993	Upper Lacks Creek	
Endiandra floydii	E1		2000	Cudgera Creek	✓
Endianara noyan			1999	Sheens Creek	
			1998	Cudgera Creek west	
			1997	Burringbar Gap east	
Endiandra hayesii	V		1998	Mooball	1
			1998	Christies Creek Catchment	
				(middle)	
			1997	Palmvale	
			1997	Upper Cudgera Creek	
Endiandra muelleri subsp. bracteata	E1		2000	Cudgera Creek	✓
			2000	Sleepy Hollow	
			1997	North Burringbar Range	
Fontainea australis	V		1997	Burringbar Gap east	
Geodorum densiflorum	E1		2000	Norries Head	,
Hicksbeachia pinnatifolia	٧.	V	1998	Wooyung	✓
			1997	Cowell Park north	
			1997	Upper Blindmouth Creek	
			1997	Upper Cudgera Creek	
Isoglossa eranthemoides	E1		1999	Upper Lacks Creek	
Macadamia tetraphylla	V	V	1997	Cudgera Creek west	✓
madadama tetrapriyila	V	V			
			1995	Sleepy Hollow	
			1994	Upper Lacks Creek	
Marsdenia longiloba	E1	V	2000	Cudgera Creek east	✓
Ochrosia moorei	E1	E	1996	Tweed River near Dinseys	
				Rock	
				ROCK	

	Sta	tus			
			1991	Cudgera Creek east	
Oldenlandia galioides	E1		1998	Hastings Point	
Randia moorei	E1	E	2000	Sleepy Hollow north	✓
			1999	Sleepy Hollow	
			1992	Upper Burringbar	
			1991	Mooball	
Syzygium hodgkinsoniae	V	V	1998	Cowell Park	✓
, , ,			1998	Christies Creek Catchment	
				(middle)	
			1997	Burringbar Range (Mooball	
				State Forest)	
			1997	Upper Cudgera Creek	
Syzygium moorei	V	V	2000	Cudgera Creek	✓
			1998	Christies Creek Catchment	
				(middle)	
			1997	Crabbes Creek	
			1997	Upper Blindmouth Creek	
Tinospora tinosporoides	V	V	2002	Environment Aust. Database	
				records this species in the	
				distributional area	

^{* &#}x27;WC report' indicates whether the species was recorded in the surveys undertaken by Woodward-Clyde for the Yelgun-Chinderah Pacific Highway Upgrade EIS and SIS prepared in 1998.

Status: NSW as scheduled in the NSW Threatened Species Conservation Act, 1995

2.2.2 Threatened Terrestrial Fauna

Forty-seven (47) threatened fauna species have been recorded in the study locality, which includes species listed in the Atlas of NSW Wildlife (NPWS) as well as species with known distributions in the upper North Coast region and nationally listed threatened species. Several other threatened marine and estuarine dependent threatened species have also been recorded from the wider study area, although these species have not been assessed in the report, given the terrestrial study area.

Table 2-2 Fauna species recorded within 10 km of the study area

Species	Status		Year	Location	WC
	NSW	Nat			report
Bush Hen (Amaurornis olivaceus)	V		1998	Sheens Creek	1
			1990	Upper Lacks Creek	
Magpie Goose	V	***************************************	1990	Cudgen Lake	
(Anseranas semipalmata)					
			1990	Bogangar	
Pouched Frog (Assa darlingtoni)	V		1994	Upper Christies Creek	
				(Mooball State Forest)	
Bush Stone Curlew (Burhinus grallarius)	E1		2000	Pottsville north	
Red-tailed Black-Cockatoo	V		1992	Bogangar north	
(Calyptorhynchus banksii)					
Glossy Black-Cockatoo	V		2002	Black Rocks	✓
(Calyptorhynchus lathami)			2002	Norries Head	
			1996	Inner Pocket	
			1987	North Burringbar Range	
Barred Cuckoo-Shrike	V		1987	Reserve Creek	
(Coracina lineata)					
Three-toed Snake-tooth Skink	V		-	Known from the upper	
(Coeranoscincus reticulatus)				north coast	
Wallum Froglet (Crinia tinnula)	V		1994	Bogangar Beach	
			1994	Bogangar west	
Black-necked Stork	E1		1995	Burringbar	
(Ephippiorhynchus asiaticus)			1995	Mooball Creek (middle)	
			1992	Bogangar	
Red Goshawk (Erythrotriorchis radiatus)	E1	V	1993	Bobs Lookout	
			1987	Cudgera Creek	
			1985	Burringbar Gap	
Black Bittern (Ixobrychus flavicollis)	V		1989	Lower Clothiers Creek	

Nat: nationally threatened species as scheduled in the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999.

	Sta	tus			
Coxen's Fig Parrot (Cyclopsitta diophthalma coxeni)		E	-	Historical range includes the upper north coast	
Swift Parrot (Lathamus discolor)	V	Е	-	Distributional range	
,				includes the upper north	
				coast	
Black-throated Finch (Poephila cincta)	Е	V	-	Distributional range	
				includes the upper north	
				coast	
Black-breasted Button-quail	Ε	Е	-	Distributional range	
(Turnix melanogaster)				includes the upper north	
				coast	
Olongburra Frog (<i>Litoria olongburensis</i>)	V		1988	Bogangar west	
Albert's Lyrebird (<i>Menura alberti</i>)	V		1990	Upper Lacks Creek	
Little Bentwing-bat	V		2001	Bogangar	✓
(Miniopterus australis)					
			1997	Yelgun	
Large Bentwing-bat	V		1997	Cudgera Creek	✓
(Miniopterus schreibersii)			1997	Duranbah	
Giant Barred Frog (Mixophyes iteratus)	E1		1987	Palmvale	
White-eared Monarch	V		1998	Cudgera Creek	✓
Monarcha leucotis)				3	
,			1990	Yelgun	
			1990	Upper Lacks Creek	
Southern Myotis (Myotis macropus)	V		2000	Pottsville north	✓
			1997	Cudgera Creek	
				southeast	
Eastern Long-eared Bat	V		1997	Duranbah	/
(Nyctophilus bifax)	•		1997	Christies Creek (middle)	
(Ty otoprimus briax)			1996	Inner Pocket	
Golden-tipped Bat	V		-	Distributional range	
(Kerivoula papuensis)	V			includes the upper north	
(Nerwould papaerisis)				coast	
Large Pied Bat (Chalinolobus dwyeri)	V	V	_	Distributional range	
Large Fred Bat (Orialinolobus dwyen)	V	V	7.	includes the upper north	
				coast	
Greater Broad-nosed Bat	V		_	Distributional range	
(Scoteanax rueppellii)	V		-	includes the upper north	
(Geoleanax rueppellir)				coast	
East Coast Freetail Bat	V			Distributional range	
(Mormopterus norfolkensis)	V		-	includes the upper north	
(Mornopterus nonoikensis)				coast	
Eastern False Pipistrelle	V				
(Falsistrellus tasmaniensis)	V		-		
(i aisistielius tasilialilelisis)				includes the upper north coast	
0	\ /		2002		
Osprey	V		2002	Mooball Beach south	
(Pandion haliaetus)			4007	D. H. 21.	
			1997	Pottsville southwest	
0	\/		1995	Tweed River	
Squirrel Glider (Petaurus norfolcensis)	V		1992	Cudgera Creek west	***************************************
Brush-tailed Phascogale	V		1975	Burringbar	
(Phascogale tapoatafa)			666-		
Koala (Phascolarctos cinereus)	V		2002	Round Mountain	V
			0001	southeast	
			2001	Bogangar	
			1990	Upper Lacks Creek	
0 5 176			1986	Clothiers Creek	
Common Planigale (Planigale maculata)	V		1994	Pottsville north	
			1994	Lower Christies Creek	
Spotted-tailed Quoll	V	V	2002	Distributional range	
(Dasyurus maculatus)				includes the upper north	
	*************************	***************************************		coast	
Marbled Frogmouth	V		1990	Upper Lacks Creek	
(Podargus ocellatus)					
Long-nosed Potoroo	V	V	1989	Upper Cudgen Creek	
(Potorous tridactylus)					
(Potorous tridactylus) Black Flying-fox (Pteropus alecto)	V	***************************************	2001	Duranbah	1

	Sta	itus			
Grey-headed Flying-fox	V	V	2001	Bogangar west	
(Pteropus poliocephalus)			2001	Bogangar	
Wompoo Fruit-Dove	V		2000	Cudgen Lake	
(Ptilinopus magnificus)			1996	Inner Pocket	
			1990	Upper Lacks Creek	
Rose-crowned Fruit-Dove	V		2002	Mooball Beach south	✓
(Ptilinopus regina)			1998	Yelgun	
			1990	Upper Lacks Creek	
Superb Fruit-Dove (Ptilinopus superbus)	V		1990	Upper Lacks Creek	
Common Blossom Bat	V		1994	Round Mountain	
(Syconycteris australis)			1994	Pottsville north	
Collared Kingfisher	V		1981	Hastings Point	
(Todiramphus chloris)					
Grass Owl (Tyto capensis)	V		1998	Clothiers Creek (middle)	?
			1993	Mooball Creek (middle)	
Masked Owl (Tyto novaehollandiae)	V		1998	Cudgera Creek	1
			1997	Crabbes Creek	
				southeast	
Sooty Owl (Tyto tenebricosa)	V		1990	Upper Lacks Creek	
			1990	Burringbar Gap north	

^{* &#}x27;WC report' indicates whether the species was recorded in the surveys undertaken by Woodward-Clyde for the Yelgun-Chinderah Pacific Highway Upgrade EIS and SIS prepared in 1998.

Several additional threatened fauna species not recorded within 10 kilometres of the study site have distributional ranges, which include the study area. These species could potentially occur and include the Greater Broad-nosed Bat (*Scoteanax rueppellii*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Eastern Freetail Bat (*Mormopterus norfolcensis*) and Green-thighed Frog (*Litoria brevipalmata*). The potential presence of these species has also been considered in the report.

2.2.3 Threatened Aquatic Fauna

Three (3) threatened aquatic species and one (1) threatened aquatic invertebrate species as scheduled in the *FM Act* have distributional ranges that include the current study area (NSW Fisheries 1998; Allen *et al* 2002) and have been addressed as part of this assessment.

Table 2-3 Aquatic fauna species potentially occurring in the study area.

Scientific Name	Common Name	Status (FM Act)
Nannoperca oxleyana	Oxleyan Pygmy Perch	Vulnerable
Pseudomugil mellis	Honey Blue-eye	Vulnerable
Maccullochella ikei	Eastern Cod	Endangered
Archaeophya adamsi	Adam's Emerald Dragonfly	Vulnerable

2.2.4 Endangered Populations and Ecological Communities

Lowland Rainforest on Floodplain from the NSW North Coast bioregion is listed as an endangered ecological community on Schedule 1 part 3 of the *TSC Act*. Remnant rainforest classed as this vegetation community type occurs in a patchy distribution throughout the north coast region, with some areas occurring within proximity to the study area and known from Cudgera Creek (Abigroup 2002).

One endangered fauna population has been listed on the *TSC Act* for the NSW North Coast Bioregion, namely the Emu *Dromaius novaehollandiae* population. The Emu occurs in a diversity of habitat types although these are predominantly associated with low open vegetation, such as arid inland plains, tropical woodlands, heathlands and

Status: NSW as scheduled in the *Threatened Species Conservation Act*, 1995, Nat. nationally threatened species as listed in the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999.

[?] Identification unconfirmed

coastal dunes. Individuals from this population are likely to occur in the open heathlands along the coastal areas north and south of Pottsville although are unlikely to frequent the sugar cane farms or densely forested riparian forest types, which are represented at Cudgera Creek. The proposed works would not affect the endangered Emu population and no further assessment is required.

No endangered populations as listed in the FM Act relate to the Cudgera Creek study area.

3. Preliminary Assessment

3.1 Habitat Assessment

The results of a preliminary habitat assessment have been documented as the first stage of the ecological investigations of the study area. From the habitat assessment, it was possible to:

- identify the parts of the study area that contain potentially significant habitats for threatened species and local biodiversity;
- determine if any parts of the study area are heavily constrained in relation to ecological issues or important for threatened and significant species; and
- generate a list of threatened subject species regarded as potential inhabitants.

3.1.1 Vegetation Communities

Aerial photograph interpretation was used to examine the distribution of natural vegetation types in the study area. It is evident that Cudgera Creek Road traverses relatively low-lying floodplain lands associated with the lower catchment of Cudgera Creek. The large majority of the land has been historically cleared for agricultural purposes, and is currently used for sugar cane production (crop land) and as grazing land (pasture grasses). Regrowth and weed infested areas occur alongside roadside verges. In the study corridor a narrow linear strip of vegetation has been retained along the banks of Cudgera Creek. This comprises remnant and regrowth lowland rainforest of relatively high quality in terms of plant species diversity and protection of aquatic habitats associated with Cudgera Creek.

3.1.2 Terrestrial and Aquatic Fauna Habitat

Three general fauna habitats are present within proximity to Cudgera Creek Road and surrounds, including;

- 1. Rainforest habitat:
- 2. Freshwater aquatic habitat; and
- 3. Grassland habitat.

The rainforest habitat comprises a remnant of the original vegetation of the locality, and specific portions within the study area, contain attributes of significance to local fauna species, including dense cover, tree hollows, freshwater, foraging and breeding areas, refuge and movement opportunities. Of particular importance is the presence of a diversity of fruiting tree and shrub species. These provide seasonal food resources to a wide range of frugivorous fauna species, including several threatened bird species.

Cudgera Creek provides a specific habitat for aquatic fauna, in particular stream dwelling frogs, fish and crustaceans. The creek is a permanent watercourse, with occasional deep pools and riffles and areas of dense sedge and rush vegetation. The creek has a natural low flow, which is still in dry times and has submerged logs and debris providing shelter and breeding sites for fish. The creek also provides a specific habitat for a large diversity of invertebrate species, in turn providing a significant prey base for dependent fauna such as fish, shrimps, eels as well as insectivorous bats a several bird and mammal species.

The large majority of the area comprises grassland and cropland habitats. Whilst these habitats are modified and degraded in condition they provide a specific habitat type

and are utilised by a diversity of species from all faunal groups. Occasional isolated paddock trees are scattered throughout the landscape and these are considered important fauna habitat in an otherwise modified landscape.

Therefore, it is evident that the study area comprises a diversity of both modified and natural habitats for fauna, resulting from previous land management practices. However, within a heavily cleared and modified landscape, the creek areas and remnant rainforest habitats contain value as habitat for indigenous native fauna species. It is likely that a range of native fauna, including threatened species occupy or occasionally utilise the habitats of the study area for foraging and breeding as well as other life cycle purposes.

3.2 Determination of Potential Subject Species

Through an analysis of the known habitat requirements of locally recorded threatened flora and fauna species, in relation to the diversity of habitats present within the study site, a list of potential subject species has been compiled. Potential subject species are defined as those threatened species considered likely to occur in the habitats present within the study area (NPWS 1996). The majority of these species have been specifically addressed by field surveys within the study site (described later in the text). Discussion on the potential impacts on these species as a result of the proposal are provided in Section 5 of the report.

3.2.1 Threatened Flora

A discussion of the likelihood of threatened flora species recorded from the wider study locality occurring at the Cudgera Creek study site is presented below:

■ Table 3-1. Assessment of threatened flora species to occur within the habitats present at the Cudgera Creek site

Species	Preferred Habitat	Likelihood of Occurrence
Acacia bakeri	Lowland sub-tropical rainforest and adjacent wet sclerophyll forest from Mullumbimby to Maryborough (Qld)	Suitable habitat present
Acalypha eremorum	Dry rainforest near Lismore	Marginal habitat, moderate chance of occurring
Acronychia littoralis	Grows in littoral rainforest on sand.	Not expected in lowland rainforest on alluvium
Angiopteris evecta	Wet places, usually beside streams, up to 720 m elevation, mainly in NE QLD	Not expected in lowland rainforest
Archidendron hendersonii	Moist lowland rainforest in coastal areas	Suitable habitat present
Bosistoa transversa	Grows in rainforest to an altitude of 300 m, north of Tweed River District	Outside of known distribution, low chance of occurring
Cassia brewsteri var. marksiana	Littoral, riverine or lowland rainforest from the Brunswick River to Beenleigh (Qld)	Not present within the lowland subtropical rainforest assemblage, more likely in riparian rainforest.
Corokia whiteana	Grows in warm-temperate rainforest on poorer soils, only known from the Nightcap Ranges	Outside known distribution, ie. Nightcap volcanics. Not expected within the study area
Cryptocarya foetida	Littoral rainforest	Not expected in lowland rainforest on alluvium

Species	Preferred Habitat	Likelihood of Occurrence
Davidsonia pruriens var. jerseyana	Riverine rainforest of the Brunswick and Tweed Valleys on the NSW far north coast.	Suitable habitat is present
Davidsonia johnsonii	Only found in weed-threatened regrowth of subtropical rainforest.	Not expected on lowland rainforest on alluvium
Dendrocnide moroides	Moist rainforest habitat, usually low altitudes, commonly beside tracks in disturbed areas.	Marginal habitat moderate chance of occurring
Diospyros major var. ebenus forma australiensis	Lowland subtropical rainforest in Tweed Valley	Moderate chance of occurring
Diploglottis campbellii	Riverine rainforest in NE NSW and SE QLD	Suitable habitat is present
Drynaria rigidula	Rainforest	Moderate chance of occurring
Elaeocarpus williamsianus	Disturbed rainforest in Burringbar Range	Marginal habitat, moderate chance of occurring
Endiandra floydii	Found in warm temperate and subtropical rainforests within the Tweed district.	Suitable habitat present
Endiandra hayesii	Grows in lowland sub-tropical rainforest on sedimentary soils and alluvium in cool, moist, sheltered valleys, north from the Clarence River.	Suitable habitat present
Endiandra muelleri subsp. bracteata	Subtropical rainforest mainly at lower altitudes	Moderate chance of occurring
Fontainea australis	Rainforest	Moderate chance of occurring
Geodorum densiflorum	Dry sclerophyll forest often on coastal sand at lower altitudes	Not expected in lowland rainforest on alluvium
Hicksbeachia pinnatifolia	Grows in subtropical rainforest north from the Nambucca Valley.	Suitable habitat present
Isoglossa eranthemoides	Subtropical rainforest	Marginal habitat, moderate chance of occurring
Macadamia tetraphylla	Grows in subtropical rainforest in coastal areas north of the Clarence River.	Suitable habitat present
Marsdenia longiloba	Rainforest	Moderate chance of occurring
Ochrosia moorei	Sub-tropical rainforest in the Tweed and Richmond River valleys	Suitable habitat present
Oldenlandia galioides	Recorded only from Gunderbooka Mtns south of Bourke	Not expected
Randia moorei	Grows in sub-tropical rainforest north from Lismore	Suitable habitat present
Syzygium hodgkinsoniae	Riverine rainforest between the Richmond River (NSW) and Gympie (Qld)	Suitable habitat present
Syzygium moorei	Rainforest from the Richmond, Brunswick and Tweed River valleys to Tallebudgera (Qld)	Suitable habitat present
Tinospora tinosporoides	Grows in wetter sub-tropical rainforest, north from the Richmond River	Suitable habitat present

3.2.2 Threatened Terrestrial Fauna

Forty-seven (47) threatened fauna species have been recorded in the study locality or have distributional ranges that include the study area. A discussion of the likelihood of these species occurring in the habitats represented for the Cudgera Creek study area is presented below.

■ Table 3-2. Assessment of the potential for threatened fauna species to occur at the Cudgera Creek site

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Terrestrial Mammals		***************************************
Brush-tailed Phascogale (Phascogale tapoatafa)	Open woodland and forest, with open grassy or heath understorey. Requires tree hollows.	The rainforest and open grassland habitats are not suitable for this species.
Common Planigale (<i>Planigale maculata</i>)	Large variety of habitat types including open forest, woodland, heath, grassland and rainforest. Usually prefers sandy soils.	The species is unlikely to occur in the immediate study site, whilst a small area of suitable habitat occurs this is too small and fragmented and probably no longer suitable to sustain populations of this species. The soil type at the study site is not sandy, and more favourable sandy substrates occur to the east within fragmented vegetation along Cudgera Creek.
Koala (Phascolarctos cinereus)	Open forests and woodlands with preferred feed trees (ie. Forest Red Gum, Swamp Mahogany, etc).	The forested habitat in the study area is rainforest. Only one individual eucalypt was noted. Important koala feed tree species do not occur and the koala is not considered a potential subject species.
Squirrel Glider (<i>Petaurus norfolcensis</i>)	Open forest, woodland, swamp forest, rainforest edges with hollows. Prefers habitats with good eucalypt diversity or abundance of Acacia or Banksia in the understorey	The habitat lacks critical features for this species such as hollows, eucalypt diversity, and preferred food resources. Also the degree of isolation of the vegetation and small size suggests that this species would not occur.
Spotted-tailed Quoll (Dasyurus maculatus)	Open forest, woodland, closed forests, swamp forests and adjacent grasslands. Favours large expansive connected forests, and mature forest types with low fire frequency. Often dens in large hollowed logs, shallow caves.	The habitat lacks critical features for this species such as large expansive and connected forest types with large hollow logs. Also the degree of isolation of the vegetation and small size suggests that this species would not occur.
Long-nosed Potoroo (Potorous tridactylus)	Inhabits coastal heath and dry and wet sclerophyll forest, particularly with thick ground cover and in light and sandy soils.	The species is unlikely to occur in the study area, the habitat is marginal and is too small and fragmented and probably no longer suitable to sustain populations of this species

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Insectivorous Bats (Micros	chiroptera)	
Eastern Long-eared Bat (<i>Nyctophilus bifax</i>)	Roosts in tree hollows, amongst vegetation and under bark and forages in forest and woodlands. Prefers moist habitats, including swamps and rainforest. Apparently restricted to rainforest in northern NSW (Churchill 1998).	The habitat of the site is marginal for this species by virtue of its small size in comparison to larger rainforest habitats in the locality. However some roosting opportunities occur and as the habitat has some marginal value, the Northern Long-eared Bat may potentially occur.
Large Bentwing-bat (Miniopterus schreibersii) Little Bentwing-bat (Miniopterus australis)	Roost in caves, mines or tunnels and forages in large variety of structural habitat types including forest, urban bushland and grassland.	Roosts are absent. The wide- ranging nature of these species and their general habitat requirements suggest that individuals may forage throughout the study area. However, such usage is likely to
Southern Myotis (Myotis macropus)	Roosts in caves, bridges or tunnels and forages over water and adjacent open forest types.	continue post-construction. A search under the bridge at the site indicates no potential roost sites occur, although some moderate quality foraging habitat occurs and the species may potentially occur.
Large Pied Bat (Chalinolobus dwyeri)	Roosts in shallow overhangs and caves, favours sandstone and steep escarpment areas. Forages in open and closed forests.	Roosting habitat is not present within the site or in proximity to the study area and the species is unlikely to occur.
Eastern False Pipistrelle (Falsistrellus tasmaniensis)	Inhabits sclerophyll forests with tree hollows for roosting	The habitat is unsuitable for this species
East Coast Freetail Bat (Mormopterus norfolkensis)	Dry eucalypt forests and woodlands with tree hollows	The habitat is unsuitable for this species
Golden-tipped Bat (Kerivoula papuensis)	Rainforest or along rainforest gullies in wet sclerophyll forest	The habitat is too small and fragmented to support populations of this species. It is not a potential subject species.
Greater Broad-nosed Bat (Scoteanax rueppellii)	Roosts in tree hollows and forages in forest and woodlands and adjacent open lands.	Suitable foraging habitat is widespread and not limited to the study site. Roosting habitat is very limited on site. The current potential for the species to forage in the area is considered to remain post-construction. Rainforest habitat is unlikely to be frequented by this species
Fruit Bats (Megachiroptera Common Blossom Bat (Syconycteris australis)	Roosts in rainforests and forages in nearby coastal heaths. The species requires both habitat types to be in close proximity to satisfy life-cycle requirements.	Potential roosting habitat occurs, although the site is too far from any potential foraging habitat (coastal heaths), and the species is unlikely to occur
Grey-headed Flying-fox (Pteropus poliocephalus) Black Flying-fox (Pteropus alecto)	Forages in a wide diversity of habitat types, including open and closed forest, rainforest, woodland, urban bushland, orchards and isolated street trees. Adapted to foraging in cleared and urban lands.	A number of roosting colonies are known from the Richmond River and Tweed catchments some in relative proximity to Cudgera Creek, and the presence of figs and other suitable fruit-bearing trees suggests that individuals would forage in the area. Considered to potentially occur.

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Wetland Birds		
Black-necked Stork (<i>Ephippiorhynchus</i> <i>asiaticus</i>) Magpie Goose (<i>Anseranas semipalmata</i>)	Vegetated wetlands, wet grasslands, swamps and floodplains.	Habitat for these species does not occur in the study area.
Terrestrial Birds Osprey (Pandion haliaetus)	Forages for fish in near-shore seas, estuaries and rivers. Nests in tall, exposed often dead trees within 2km of water.	Habitat for this species does not occur in the study area.
Red Goshawk (Erythrotriorchis radiatus)	Very large stands of open woodlands and forests, especially near watercourses	The habitat is too small and degraded to support regular use by this species. It is not a potential subject species.
Bush Hen (Amaurornis olivaceus)	Moist stands of deep rank grass with pockets of dense shrubbery along the banks of permanent running streams, often on the edge of rainforest.	The habitat is only very marginal for this species. Records from the Sheens Creek area (Woodward-Clyde 1998) occur in more suitable habitat types, with low-lying wet grasslands and flowing creeks. The species has a low chance of occurring at Cudgera Creek.
Albert's Lyrebird (Menura alberti)	Restricted to rainforests around old volcanic craters in the Nightcap Range and Mistake ranges of the NSW-Qld border.	The habitat is not suitable and lies outside the distributional range of this species.
Glossy Black Cockatoo (Calyptorhynchus lathami)	Open forests and woodlands with large hollows and abundant She- oak resources.	She-oaks are minimal or absent and no large tree hollows occur. This species is not deemed a potential study area inhabitant.
Red-tailed Black Cockatoo (Calyptorhynchus banksii)	Coastal forests and woodlands with suitable foraging species, including a variety of eucalypts. Nest in large tree hollows	The habitat is not suitable for this species, lacking foraging and nesting resources
Black-breasted Button- quail (<i>Turnix melanogaster</i>)	Inhabits dry rainforest edges, and small grassy clearings or in tangled vines with thick overhead cover supplied, in some instances with introduced lantana.	The habitat is marginal for this species, although isolate and small in size. There are no records within 10km of the site and the species has a low chance of occurring.
Black-throated Finch (<i>Poephila cincta</i>)	Inhabits open timbered grasslands with continuous and often deep sward and sparse but often tall overstorey of eucalypts and paperbarks.	The dense rainforest and open grassland pastures are not suited to this species.
Swift Parrot (<i>Lathamus discolor</i>)	Populations over-winter on the Australian mainland, migrating from Tasmania. Only low number s reach the north coast in favourable flowering times. Requires an abundance of winter-flowering eucalypts for foraging requirements.	No winter-flowering eucalypts occur in the study area, this species is unlikely to utilise the habitat present.

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Coxen's Fig Parrot (Cyclopsitta diophthalma)	The southern population of this species is very rarely recorded (NSW and southern Qld), where it I possibly locally extinct. Forages on the fruits of rainforest species, in particular large figs as well as Camphor Laurel in lowland rainforest.	Low numbers of suitable fruiting plants occur, however the species has not been recorded within 10km of the site and the habitat present is probably too small and limited to attract individuals to the site to form part of a territory. Very low chance of occurring.
Grass Owl (<i>Tyto capensis</i>)	Dense rank grassland, cane, wet heath and reeds particularly if seasonally inundated.	Rank grasslands, wet heath and reed habitats are absent, however, the presence of tall introduced grasslands and abundant areas of sugar cane suggest that some moderate quality habitat occurs in the surrounding landscape. A tentative record of the species was recorded for the Yelgun to Chinderah Pacific Highway EIS. The species could potentially occur although no potential habitat would be removed as part of the project and no increased impacts are envisaged.
Masked Owl (Tyto novaehollandiae)	Frequents forests and woodlands, and adjacent open lands, and grasslands. Roosts and nests in large tree hollows, which generally influences the distribution of the species.	Habitat for this species is absent or of poor quality in the study area. Some occasional foraging use may occur, however the current potential to forage in the study area is expected to remain following construction.
Sooty Owl (<i>Tyto tenebricosa</i>)	Inhabits gully rainforests, tall moist forests with densely vegetated gullies, and suitable large tree hollows for roosting and nesting sites. Requires large territories of up to 800 hectares.	The habitat at Cudgera Creek is too small in size and fragmented to attract and sustain individuals and the Sooty Owl is unlikely to occur.
Barred Cuckoo-shrike (<i>Coracina lineata</i>)	A frugivorous bird requiring fruit- bearing trees and shrubs in rainforest, open forest and swamps	A diversity of fruit bearing trees and shrubs occur within the lowland rainforest habitat at the site, and this species may potentially utilise this habitat.
White-eared Monarch	Inhabits rainforest and nearby	Habitat for this species is absent or
(Monarcha leucotis) Collared Kingfisher (Todiramphus chloris)	mangrove fringes, wetlands. Mangroves and coastal habitats	of poor quality in the study area. The habitat is not suitable for this species.
Marbled Frogmouth (Podargus ocellatus)	Restricted to subtropical rainforests with palms. Individuals are sedentary and occupy the same territory year round	Whilst rainforest habitat occurs along Cudgera Creek, this habitat is isolated and fragmented and does not for part of a larger tract of forest. Opportunities for dispersal and movement to the habitat of the study area are absent and the habitat is probably too small and marginal for this species.
Bush Stone-curlew (<i>Burhinus grallarius</i>)	Open woodlands adjacent cleared grasslands.	There is no suitable habitat for this species in the study area.
Black Bittern (Ixobrychus flavicollis)	Shallow densely vegetated swamps and stream through forested land	Habitat for this species is absent or of poor quality in the study area.

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Frugivorous Pigeons Wompoo Fruit-dove (Ptilinopus magnificus) Superb Fruit-Dove (Ptilinopus superbus) Rose-crowned Fruit-Dove (Ptilinopus regina)	Rainforests and open forests with fruit bearing plants. Also forages on introduced Camphor Laurel.	A diversity of fruit bearing trees and shrubs occur within the lowland rainforest habitat at the site, and these nomadic wide-ranging species may potentially utilise this habitat.
Amphibians Olongburra Frog (<i>Litoria olongburensis</i>)	Inhabits creeks in marshy or swampy lowland coastal habitats, particularly with emergent vegetation of reeds and rushes. Has a small restricted distribution.	The habitat is not suitable for this species
Green-thighed Frog (Litoria brevipalmata)	Rainforest and moist forest streams, with low flow and densely vegetated, adjacent flooded paperbark swamps, with seasonally inundated depressions	The habitat within Cudgera Creek is too marginal for this species, which requires adjacent flooded low-lying swamps for breeding and refuge.
Wallum Froglet (<i>Crinia tinnula</i>)	Acid paperbarks swamps, low-lying seasonally inundated paperbark forest and adjacent sedgeland habitats	There is no suitable habitat for this species in the study area.
Pouched Frog (Assa darlingtoni)	Restricted to higher elevated subtropical rainforest and antarctic beech forests.	The habitat at Cudgera Creek is not suitable for this species
Giant Barred Frog (<i>Mixophyes iteratus</i>)	Occurs in upland and lowland rainforest and wet sclerophyll forests, including retained riparian vegetation in farmland (Ingram & McDonald 1993).	The habitat at Cudgera Creek is not optimal although individuals could potentially occur and have been recorded in similar disturbed habitat types.
Great Barred Frog (<i>Mixophyes fleay</i> i)	Associated with montane rainforest and open forest adjoining rainforest. Favours permanent flowing streams and does not occur in ponds or ephemeral pools.	The lowland rainforest habitat along Cudgera Creek is not suitable for this rare species, the creek is too ephemeral and disturbed in nature.
Reptiles Three-toed Snake-tooth Skink (Coeranoscincus reticulatus)	Inhabits rainforest and adjacent wet sclerophyll forests, where it is usually found in rotting logs or in soil under fallen timber	Reman riparian rainforest along Cudgera Creek could potentially support small populations of this species.

3.2.3 Threatened Aquatic Fauna

Three (3) threatened fish species have been recorded from coastal north-eastern New South Wales and one (1) threatened aquatic invertebrate species has potential to occur in the area, although there are no local records. The potential for these species to occur has been addressed below.

■ Table 3-3. Assessment of the potential for threatened fish species to occur at the Cudgera Creek site

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Fish		
Oxleyan Pygmy Perch (Nannoperca oxleyana)	Inhabits swamps with prolific sedge growth, gently flowing streams and dune lakes in areas of coastal heathland (wallum country) (Allen et al 2002).	The rainforest stream habitats of upper Cudgera Creek are not suitable for this species.

Common Name	Habitat Requirements	Likelihood of Occurrence in the Study Area
Honey Blue-eye (Pseudomugil mellis)	Found in slow flowing, tannin- stained creeks and coastal dune lakes in sandy country (wallum country) (Allen et al 2002)	The rainforest stream habitats of upper Cudgera Creek are not suitable for this species
Eastern Cod (<i>Maccullochella ikei</i>)	Pristine sections of clear, flowing, rocky streams strewn with logs and other woody debris	The rainforest stream habitats of upper Cudgera Creek are not suitable for this species
Adam's Emerald Dragonfly (Archaeophya adamsi)	Specimens of this species are extremely rare being found only in small streams.	There are only four currently known locations of Adam's Emerald Dragonfly from near Gosford (Somersby Falls and Floods Creek in Brisbane Waters NP), the lower Blue Mountains and Wollemi National Park (Hungry Way Creek). The species is not expected in Cudgera Creek.

3.2.4 Endangered Populations and Ecological Communities

One (1) endangered fauna population has been listed on the *TSC Act* for the NSW North Coast Bioregion, namely the Emu *Dromaius novaehollandiae* population.

One (1) endangered ecological community has been listed on the *TSC Act* for the NSW North Coast Bioregion, namely Lowland Rainforest on Floodplain. Remnant Lowland Rainforest has defined under the *TSC Act* has been mapped and documented along Cudgera Creek (Landmark Ecological Services *et al* 1999). Further discussion on the distribution of this community in the study area is provided in Section 4.0 and 5.0 of the report.

3.2.5 Summary of Potential Subject Species and Communities

The information presented in the previous sections addresses each of the threatened terrestrial and aquatic flora and fauna species, endangered populations and ecological communities previously recorded from the study locality and assesses the potential for these to occur in the study corridor. For individual species, the assessment is based on the habitat types present in the study corridor and the known habitat requirements of these species. Species considered to potentially occur in the study corridor are defined as potential subject species and are shown below.

Threatened Flora	Terrestrial Fauna	Aquatic Fauna	Ecological Communities	Endangered Populations
Ochrosia moorei Davidsonia pruriens Acacia bakeri Acalypha eremorum Endiandra haysesii Endiandra floydii Endiandra muelleri subsp. bracteata Fontainea australis Isoglossa eranthemoides Syzygium hodgkinsoniae Syzygium moorei Randia moorei Macadamia tetraphylla Hicksbeachia pinnatifolia Tinospora tinosporoides	Eastern Long-eared Bat Southern Myotis Grey-headed Flying-fox Black Flying-fox Wompoo Fruit-Dove Superb Fruit-Dove Rose-crowned Fruit-Dove Barred Cuckoo-Shrike Giant Barred Frog Three-toed Snake-tooth Skink	none	Lowland Rainforest in the NSW North Coast Bioregion	none

3.3 Critical life-cycle stages of potentially affected fauna

The assessment documented above provides a list of threatened fauna species considered to potentially occur at the Cudgera Creek site based on the presence of suitable habitat and the known habitat preferences of these species. A further investigation has been carried out to identify specific critical life-cycle stages of these species to assess potential impacts from the Proposal and determine any appropriate times to undertake construction such that impacts on life-cycle stages can be avoided. Table 3-3 provides information on the critical life-cycle stages of potential threatened fauna subject species.

■ Table 3-4 Critical life cycle stages of threatened fauna species considered likely to occur in the study area

Species	Breeding season	Migratory presence	Hibernation / torpor	Comments
Amphibians Giant Barred Frog	No data available, breeding response expected after favourable summer rains and extended wet periods during the warmer months of the year	Not a migratory species	-	Sedentary species occupying same area year round. No restrictions on construction works, however appropriate work methods should be adopted to avoid potential impacts (see Section 6).
Reptiles Three-toed Snake-tooth Skink	No data available, impacts more likely from indiscriminate removal of sheltering resources (fallen timber, logs etc)	Not a migratory species		No restrictions on construction works, however appropriate work methods should be adopted to avoid potential impacts (see Section 7)
Frugivorous Birds Rose-crowned Fruit-Dove	November-April	Mostly Spring (September- October)	-	These species are nomadic and could visit the site at
Superb Fruit-Dove Wompoo Fruit- Dove	June-February August-October	Autumn- winter. More likely over the summer when native figs are fruiting.		any time because of the irregular fruiting cycles of many trees (food resources). The proposal would not require removal of fig trees or significant fruiting trees and as such there are no restrictions on construction times. Appropriate work
Barred Cuckoo Shrike	October-January	More common in northern NSW in summer months.	-	methods to avoid impacts on nesting activities are detailed in recommendations section (Section 7)
Fruit-Bats (Megaci Black Flying-fox	<i>hiroptera)</i> March-December.	Not migratory		Both species are more likely
Grey-headed Flying-fox	Newborn have been seen from August until the end of November.	Not migratory species, however they will move large distances locally in response to fruiting and flowering		to utilise the site habitat through Spring and Summer when figs are fruiting. As the proposal would not involve clearing of figs or significant fruiting trees there are no restrictions on construction times

Species	Breeding season	Migratory presence	Hibernation / torpor	Comments		
		trees				
Insectivorous Ba Eastern Long- eared Bat	ts (Microchiroptera) May-January		Unknown	There are no optimal times for construction. Peak activity periods, including		
ared Bat Southern Myotis Breeding o	Breeding occurs in early summer		Winter	activity periods, including breeding are likely to be during the warmer months of the year (ie. September to March). Little is known about torpor and this could occur at any time of the year, and is triggered by times of inactivity rather then strict seasonal trends. Torpor car occur daily in some species and during cold periods. Periods of hibernation are likely to be during winter months.		
				No hollow bearing trees (potential roost sites) were found to occur in the road footprint area and there are no restrictions on construction times		

3.3.1 Optimum Survey Period

Species dependent on fruit resources such as the frugivorous bats and birds are nomadic and could visit the site at any time because of the irregular fruiting cycles of many trees. Optimal times for field surveys are probably during spring and summer, particularly during the fruiting season of resident figs (*Ficus* spp). For insectivorous bats the peak activity periods, including breeding events are also likely to be during the warmer months of the year (ie. spring and summer). Field surveys for this investigation were carried out in October 2002, following discussions with NPWS and were specially timed to coincide with periods of optimum detectability for the majority of fauna species targeted.

3.3.2 Preferred Construction Period

The information presented on critical life-cycle stages of potentially affected threatened fauna (Table 3-4), suggests that whilst some periods of peak activity or conversely hibernation by species can be identified, the nature of the vegetation within the proposed works area and the limited extent of habitat disturbance required negates any restrictions for an optimum construction period.

As discussed above, the spring-summer period presents the peak fruiting season for many local flora species in the study locality and consequently the likely period for potential activity by seasonally nomadic frugivorous species. However, the proposal and would not require removal of fig trees or significant fruiting trees and as such there are no restrictions on construction times. Appropriate work methods to avoid impacts on potential nest sites of threatened bird species are detailed in Section 7 of the report.

For insectivorous bats the peak activity periods are also spring and summer. Little is known about torpor activity of particular species and hibernation could occur at any time of the year, and is triggered by times of inactivity rather then strict seasonal

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trends. Torpor can occur daily in some species and during cold periods. Periods of hibernation are likely to be during winter months. However, no hollow bearing trees or potential roost sites were found to occur in the road footprint area and bats are unlikely to be roosting in the actual construction area. Therefore there are no restrictions on construction times, however appropriate work methods should be adopted to avoid any potential impacts (see Section 7).

4. Field Studies

Field surveys for this project were carried out by Chris Thomson (BAppSc), David Endersby (BEnvSc) and Michelle Paton (BSc) of Sinclair Knight Merz. Field surveys were undertaken under appropriate NPWS (Scientific Investigation Licence A2372 and NPWS A1765 and Licence to Pick Threatened Species TS0051) as well as Department of Agriculture licensing (AW2000/049, NSW Agriculture ACEC AW94/056) and NSW Fisheries Scientific Research Permit (T02/073).

4.1 Flora Survey

4.1.1 Methodology

Comprehensive flora field surveys were undertaken over the entire area proposed for the Cudgera Creek Road upgrade (ie. the study area). The survey concentrated on the area 20 metres either side of the proposed road alignment of Cudgera Creek Road as well as areas between the existing alignment and the proposed alignment.

The flora survey involved traverses on foot of all vegetation types present within the study area. Identification of the floristics and structure of the vegetation, and the type and distribution of plant communities was undertaken. Specific transects for all identified vegetation communities were then completed. Identification of plant communities was undertaken including an assessment of the presence of endangered ecological communities as listed in the TSC Act. The overall condition of the site vegetation was noted, including the extent of modification and weed invasion. A search was made for any threatened flora species (TSC Act) deemed a potential subject species and any additional rare or significant plant species. Cropper (1993) suggests that a general traverse is a suitable method for detecting the presence of rare species during flora surveys

Any unknown plant species were obtained for further examination and identification. If definite identifications could not be made, the specimen was sent to the National Herbarium in Sydney for confirmation.

4.1.2 Results

4.1.2.1 Floristic Diversity

Floral species diversity was relatively high considering the small area of remnant vegetation present and the extent of past clearing for agriculture. A total of one hundred and fifty-three (153) flora species from seventy-seven (77) families were identified and recorded within the study area. This total comprised one (1) species of club moss, twelve (12) species of fern, three (3) species of conifer, one hundred and twelve (112) species of monocotyledons and twenty-five (25) species of dicotyledons.

A total of eight (8) threatened flora species currently scheduled on the *TSC Act* were recorded within the study area in addition to one (1) ROTAP species (ie. Rare or Threatened Australian Plant, classified by Briggs & Leigh 1996) and one regionally significant species. Further discussion on these species is provided in Section 4.1.2.3.

Of the total species found, fifty-one (51) species of introduced flora were identified, representing approximately 33% of the total species. Three (3) of the introduced species, Camphor Laurel (*Cinnamomum camphora*), Groundsel Bush (*Bacchris halimifolia*) and Mistflower (*Agertina riparia*) are currently listed as a noxious plants within the Tweed Shire Council area.

A comprehensive list of the flora species present within the study area has been included as **Appendix A**.

4.1.2.2 Vegetation Communities

As stated previously, the large majority of the study area has been historically cleared for agriculture resulting in a mixture of modified plant communities including cropland, pasture and modified regrowth vegetation. Remnant and regenerating vegetation has been retained in a narrow linear strip along Cudgera Creek. Riparian vegetation along the creek occurs as two natural vegetation communities, namely lowland rainforest and regenerating rainforest. A description of the floristics and dominant species from each of the vegetation communities is presented below.

Community Name	Description	Dominant Species		
Lowland Rainforest Suballiance No. 3 (Tweed) (Endangered Ecological	Diverse medium to tall canopy, consisting of fewer species than true subtropical rainforest (35 rather than 70). Large number of epiphytes and woody lianas with a dominant cover of Phoenix Palm in mid-stratum. Forest type	Whip Vine Steelwood Cudgerie Lilly Pilly Two-veined Hickory Giant Water Vine		
Community – TSC Act)	restricted to small rises in topography on an otherwise flat flood plain, composed of well-drained, basalt enriched alluvium soil.	Bangalow Palm		
Regenerating Rainforest	Early successional stage of regeneration following the past clearing of vegetation. Mainly occurs in and adjacent to Cudgera Creek on the eastern side of the Bridge.	Red Ash Brush Kurrajong Foambark Tree Lantana		
Crop Land	Sugar Cane fields were present in the wider study area. Fields largely maintained monocultures of Sugar Cane.			
Pasture Pasture areas were present in and around an abandoned farmhouse. Grasslands currently present composed of some native, but mainly introduced pasture and weed species.		Kikuyu		
Modified vegetation	Weed and grass species resulting from the periodical slashing of roadside areas along the existing Cudgera Creek. Some exotic tree and garden species have been established in this area, largely occurring on either side of the road west of the Bridge, but including property immediately adjacent to Cudgera Creek Road.	Black-berry Nightshade Whiskey Grass Kikuyu		

The area of Lowland Rainforest identified from the study area is characteristic of the community type scheduled as an Endangered Ecological Community in the *TSC Act*. Within the study area, lowland rainforest was not restricted to the area investigated, with additional areas also associated with Cudgera Creek, extending east and west along the creek away from the Cudgera Creek Road area.

Several areas of Lowland Rainforest of similar quality and size areas occur within the study area investigated for the Yelgun to Chinderah Pacific Highway Upgrade

(Sinclair Knight Merz 1998). However Landmark *et al* (1999) indicate that only small remnants of rainforest remain on the coastal ranges and plains of north east NSW. Particularly on the fertile flood plains, the large majority of rainforest has been cleared for timber and agriculture. Small remnants retained for creek bank protection such as at Cudgera Creek represent significant vegetation worth of conservation, hence the status as an endangered ecological community.

4.1.2.3 Threatened Flora (TSC Act)

A total of eight (8) threatened flora species currently scheduled on the *TSC Act* were recorded within the study area (Table 4-1). This list includes three (3) species listed as Endangered on Schedule 1 and five (5) species listed as Vulnerable on Schedule 2 of the *TSC Act*. Of the eight threatened species recorded, six (6) are listed as nationally threatened species within the *EPBC Act*. The eight (8) threatened species were represented on the site by eighty-nine (89) individual plants. All individual threatened plants were recorded within the Lowland Rainforest community associated with Cudgera Creek. No threatened species were recorded in cropland, pasture, or modified areas.

In addition to the identified threatened species, one (1) ROTAP species (ie. Rare or Threatened Australian Plant, classified by Briggs & Leigh 1996) and one regionally significant species was also identified in the study area (Table 4-1). Additionally, a number of large Hoop Pine (*Araucaria cunninghamii*) occur in proximity to the proposed route and the locations of these have been indicated to assist final design planning issues. Given their size these trees would be considered locally significant.

Table 4-1. Field Records of Threatened and Significant Flora Species

Ref	Species	No.	AMG	AMG	Diam	Ht	Status	
No.		ind.	Easting	Northing	(cm)	(m)	NSW	Nat
1	Syzygium moorei	1	552565	6859747	15	20	V	V
2	Syzygium moorei	2	552643	6859782	4	2		
3	Syzygium moorei	3	552644	6859793	20	12		
4	Syzygium moorei	4	552645	6859792	25	16		
5	Syzygium moorei	5	552643	6859788	33	15		
6	Syzygium moorei	6	552642	6859783	15	11		
7	Syzygium moorei	7	552664	6859928	100	2.5		
8	Syzygium moorei	8	552653	6859829	2	3		
9	Syzygium moorei	9	552648	6859823	2	3		
10	Syzygium moorei	10	552662	6859876	20	15		
11	Syzygium moorei	11	552584	6859810	5	5		
12	Syzygium moorei	12	552608	6859816	1	0.5		
13	Syzygium moorei	13	552601	6859793	1.5	1.2		
14	Syzygium moorei	14	552597	6859784	60	27		
15	Syzygium moorei	15	552620	6859786	4	3		
16	Ochrosia moorei	1	552642	6859783	3	1.5	Е	Е
17	Ochrosia moorei	2	552580	6859787	4	4		
18	Randia moorei	1	552645	6859788	2	2	E	E
19	Randia moorei	2	552645	6859793	2	1		
20	Randia moorei	3	552681	6859891	2	2.8		
21	Randia moorei	4	552657	6859845	2	2		
22	Randia moorei	5	552657	6859847	5	4		
23	Randia moorei	6	552659	6859545	2	3		
24	Randia moorei	7	552649	6859827	2	2		
25	Randia moorei	8	552648	6859830	4	6		
26	Randia moorei	9	552648	6859820	4	3		
27	Randia moorei	10	552644	6859819	1	1.5		
28	Randia moorei	11	552639	6859814	1.5	1.5		

							Statu	IS
	andia moorei	12	552643	6859810	3	3		
	andia moorei	13	552636	6859806	4	4		
31 Ra	andia moorei	14	552618	6859797	1.5	1.2		
32 Ra	andia moorei	15	552620	6859813	1	1.5		
33 Ra	andia moorei	16	552625	6859810	1	2.5		***************************************
34 R	andia moorei	17	552626	6859811	1	0.5	***************************************	
	andia moorei	18	552678	6859811	3	2		
	andia moorei	19	552631	6859815	5	2.5		
	andia moorei	20	552631	6859831	1	1.4		
	andia moorei	21	552631	6859832	2	1		
***************************************	······································	************************	******************					
	andia moorei	22	552683	6859777	10	4		
***************************************	andia moorei	23	552582	6859803	1.5	2		
	andia moorei	24	552583	6859804	1.5	2		
	andia moorei	25	552584	6859805	1.5	3		
43 R	andia moorei	26	552593	6859809	1	0.8		
	cacia bakeri	1	552643	6859795	12	7	V	
45 Ac	cacia bakeri	2	552652	6859810	4	4		
46 Ac	cacia bakeri	3	552635	6859944	7	7		
47 Ac	cacia bakeri	4	552653	6859844	10	13		
48 Ac	cacia bakeri	5	552657	6859844	7	5		
	cacia bakeri	6	552657	6859845	7	8		
	cacia bakeri	7	552657	6859846	10	10		
	cacia bakeri	8	552655	6859835	10	7		
	cacia bakeri						***************************************	
		9	552644	6859821	7	8		
	cacia bakeri	10	552644	6859822	7	9		
	cacia bakeri	11	552644	6859823	8	10		
	cacia bakeri	12	552638	6859815	3	1.5		
	cacia bakeri	13	552645	6859813	10	12		
57 Ac	cacia bakeri	14	552647	6859811	13	15		
58 Ac	cacia bakeri	15	552632	6859795	4	7		
59 Ac	cacia bakeri	16	552629	6859791	10	7		
60 Ac	cacia bakeri	17	552618	6859786	5	2		
	cacia bakeri	18	552619	6859786	9	8		
	cacia bakeri	19	522622	6859790	6	5	***************************************	
	cacia bakeri	20	552620	6859804	9	7		
	cacia bakeri	21	552620		6	5		
				6859805				
	cacia bakeri · , , ·	22	552620	6859814	5	5		
	cacia bakeri	23	552626	6859812	6	6		
	cacia bakeri	24	552626	6859813	6	5		
	cacia bakeri	25	552634	6859822	5	4		
69 Ac	cacia bakeri	26	552583	6859778	12	4		
70 Ac	acia bakeri	27	552584	6859781	13	6		
71 Ac	cacia bakeri	28	552584	6859785	15	18		
	cacia bakeri	29	552580	6859795	14	5		
							***************************************	************
73 Er	ndiandra floydii	1	552642	6859796	7	6	Е	
74 14			FF0070	0050010		0.5	\ /	
	acadamia tetraphylla	1	552672	6859916	2	2.5	V	
	acadamia tetraphylla	2	552667	6859922	12	6		
	acadamia tetraphylla	3	552669	6859936	5	3		
	acadamia tetraphylla	4	552672	6859932	1	2		
	acadamia tetraphylla	5	552673	6859931	1.5	3.5		
79 M	acadamia tetraphylla	6	552671	6859935	1	1		
ر80 S	vzygium hodgkinsoniae	1	552635	6859940	8	10	V	\
04 11	-lhl': ' ''		EE0.050	0050055				
	cksbeachia pinnatifolia	1	552656	6859855	4	5	V	
	cksbeachia pinnatifolia	2	552656	6859856	2	2		
	cksbeachia pinnatifolia	3	552656	6859857	2	2		
	cksbeachia pinnatifolia	4	552656	6859858	2	1.5		
85 Hi	cksbeachia pinnatifolia	5	552656	6859860	7	8		
86 Hi	cksbeachia pinnatifolia	6	552659	6859544	3	2		
	cksbeachia pinnatifolia	7	552659	6859547	4	3.5		
	cksbeachia pinnatifolia		552659	6859845				
		8			8	10		
89 Hi	cksbeachia pinnatifolia	9	552652	6859846	2	0.8		

							Status
1	Medicosma cunninghamii	1	552645	6859794	1	2	Regionally significant
2	Medicosma cunninghamii	2	552585	6859780	1.5	1.6	P
3	Medicosma cunninghamii	3	552587	6859781	2	2.1	
4	Medicosma cunninghamii	4	552578	6859790	7	4.5	
5	Medicosma cunninghamii	5	552594	6859809	4	2.5	
6	Endiandra globosa	1	552591	6859807	3	2.5	ROTAP (2RC-)
7	Araucaria cunninghamii	1	552644	6859857	100	30	Locally significant
8	Araucaria cunninghamii	2	552648	6859847	130	30	
9	Araucaria cunninghamii	3	552645	6859848	40	22	
10	Araucaria cunninghamii	4	552635	6859859	40	20	

AMG (easting, northing) indicates Australian Map Grid reference for the Tweed Heads (9641) 1:100 000 mapsheet. Status (E) Endangered and (V) Vulnerable Species according to the TSCAct 1995 (NSW) and EPBC Act (Nat.). Locally significant = large specimen or poorly represented on the site. ROTAP = Rare or Threatened Australian Plant (2RC-) 2 = restricted range <100km, R = a rare species, C = at least one population within a national park; and - = reserved population size not accurately known.

The proposed road may involve removal of a small area of Coast Cypress Pine (Callitris columellaris) on the hill and existing road cutting to the east of the bridge. This species is also considered locally significant and any individuals near the works area should be identified and tagged prior to work commencing. Considering should be given to translocating the individual trees if possible and / or replanting of Coast Cypress Pine from locally collected seed. This is further discussed in Section 7.0 of the report.

4.2 Terrestrial Fauna Survey

Comprehensive seasonal fauna surveys were carried out for the Yelgun to Chinderah Pacific Highway Upgrade EIS (Woodward-Clyde 1998) which included the Cudgera Creek study area. The results of the previous investigation are provided in Appendix B, and provide an indication of the diversity of fauna from all groups that occur in the study area.

Preliminary habitat assessments carried out in the study area for this investigation indicated that the terrestrial faunal diversity would be low. This applies mostly to species that are restricted to relatively small home range areas and dependent on habitat connectivity for dispersal and genetic transfer such as non-flying small and medium-sized mammals.

Large-scale clearing in the study area has resulting in a mosaic of fragmented and relatively small patches of vegetation with limited or no connectivity, such as the Cudgera Creek study corridor. Furthermore, natural vegetation in the study corridor is limited to a narrow linear strip of rainforest along Cudgera Creek, where only one individual eucalypt tree was found to occur and tree hollow abundance is very low, suggesting that important foraging and sheltering resources for arboreal mammals are scarce. These factors reduce the capability of the study corridor habitats to support significant mammal populations. As a result of the expected low mammal diversity (ie. non-flying species), no live-trapping or hair collection techniques for terrestrial mammals were used and species considered to potentially occur were based on previous surveys in the area and precautionary principals.

Surveys for non-flying mammals included spotlighting, searches for tracks, scats and other evidence and habitat assessment. In general, the following field survey

techniques were undertaken: spotlighting, bat census (ultrasonic call detection and spotlighting), searches for indirect evidence (tracks, scats, nests, diggings, bones and other traces), herpetofauna surveys, diurnal bird census, and call playback (nocturnal birds). In addition, all opportunistic sightings of fauna were recorded and local residents from Cudgera Creek were interviewed when encountered.

Field surveys for fauna generally aimed to assess the faunal diversity of the entire study area, and investigate the fauna habitats present and the potential for local threatened fauna species to occur within these habitats. These involved a range of techniques aimed at identifying species from all fauna groups and included specific techniques to survey for the presence of threatened fauna species deemed potential subject species.

Potential Subject Species	Specific Field Survey Details
Northern Long-eared Bat	Bat call detection
Southern Myotis	Bat call detection
Grey-headed Flying-fox	Spotlighting
Black Flying-fox	Spotlighting
Wompoo Fruit-Dove	Diurnal bird census
Superb Fruit-Dove	Diurnal bird census
Rose-crowned Fruit-Dove	Diurnal bird census
Barred Cuckoo-Shrike	Diurnal bird census
Giant Barred Frog	Call playback, spotlighting, targeted searches
Three-toed Snake-tooth Skink	Targeted searches

Note for Fruit-Doves that targeted surveys are difficult, due to the seasonal fluctuations in food resources for these species. Detailed habitat assessment, and opportunistic searches were also used.

A full description of the specific methodologies used during the terrestrial fauna field surveys has been provided in the text below.

4.2.1 Weather Conditions

Weather conditions play an important role in faunal activity, and hence survey success. Air temperatures, wind velocity, cloud cover and the phase of the moon may affect bat and other mammal activity and prey availability, as well as behaviour.

The fauna field surveys were carried out over two days (ie. 1st and 2nd October 2002), during favourable warm spring seasonal weather. The prevailing conditions during the survey were warm with maximum daily temperatures at 27^oC and the minimum nightly temperature (1/10/02) 13^oC, with slight southeasterly winds. These conditions were considered optimal for detection of a range of fauna species active during this period.

4.2.2 Methodology

Diurnal Birds

Formal bird census was undertaken on two occasions during the survey period, on the 1st and 2nd October 2002. This involved point counts along a 100m transect sampling each vegetation community in the study area. A standard 20-minute census was carried out during dusk on the 1st October and an early morning session on the 2nd October along each transect where birds were identified on the basis of visual identification and characteristic call.

In addition, all opportunistic observations of bird species was also recorded whilst undertaking general survey activities on the site. A total of approximately three person hours were accrued during the diurnal bird census.

Nocturnal Birds

Nocturnal birds were surveyed using the playback of pre-recorded calls of threatened owl species. Calls of the target species (ie. Powerful Owl, Masked Owl, Barking Owl and Grass Owl) were played during the nocturnal survey on the 1st October. The survey involved initial listening periods at dusk for 30 minutes, followed by playing the species recorded call for five minutes duration. Each call was followed by a ten minute listening period for an audible response before commencing with the next species call. The end of the last call was followed by a five-minute listening period for any audible response, then spotlighting for approximately 10-minutes. The pre-recorded calls were played through a portable compact disk player cassette and broadcast via a loudhailer (Toa megaphone). The playback site was at the ecotonal edge between the rainforest and open pastureland.

Mammals (Spotlighting Surveys)

Spotlighting was undertaken for all medium and large-sized terrestrial and arboreal mammals, as well as nocturnal birds, within the study area. Due to the extensive clearing of vegetation resulting in open pasture areas with easy accessibility to the creek, it was possible to traverse all areas of the study area by foot. Spotlighting surveys were concentrated in the well-vegetated areas and adjoining cleared paddocks as well as around the proposed disturbance zones of the proposed road upgrade area.

Call playback for the koala and squirrel glider was not used as a result of the lack of potential habitat for these species

Spotlighting was carried out by two observers using Lightforce 50Watt hand-held spotlights powered by 12-volt batteries, totalling approximately 4 person hours. Additional searches of creek areas were carried out using head torches. The locations of sightings of fauna species were recorded during the spotlighting surveys.

Mammals (Insectivorous Bat Survey: Bat Detector)

Insectivorous bats were surveyed through the use of a hand-held bat detector (Titley Electronics). As a result of the open density of the surrounding site vegetation and the lack of suitable narrowed flyways, bat trapping (harp traps) was not undertaken. The bat detector was carried in the hand during the spotlighting survey. Any calls detected were recorded onto an audiotape, with bat identification being undertaken later via computer frequency analysis.

Ultrasonic call detectors have proved useful for recording species, which are difficult to capture. The use of bat detectors has greatly enhanced the success of bat surveys, particularly when used in open forest habitats and for recording species that frequent the upper tree canopy.

Herpetofauna Census

Reptiles and amphibians were surveyed by hand-searches in suitable habitat, and spotlighting for nocturnal species. Diurnal hand-searches for herpetofauna species were conducted on the 1st and 2nd October 2002. Suitable habitat includes any rocks or rocky areas, logs, timber and other debris including building refuse and discarded sheet metal, which provides good cover for herpetofauna. Any individuals detected

were caught where appropriate, identified and immediately released. All opportunistic sightings of active herpetofauna were noted. A nocturnal search was conducted around the creekline, and in small adjacent wet areas to survey for active frogs. Frogs were identified on the basis of their characteristic call as well as by direct observation. A total of approximately 4 person hours were surveyed for reptiles and amphibians.

Given the potential presence of the Giant Barred Frog (*Mixophyes iteratus*) in Cudgera Creek, broadcasts of recorded calls of this species were also used during the survey.

Searches for Evidence of Species Presence

Faecal pellets (scats) of predatory and non-predatory species were collected and identified to species level. The search concentrated on the ground beneath trees as well as around hollow logs where encountered logs, and tracks.

Searches were made for other characteristic signs of fauna species presence including tracks, bones, hair, shed skins and animal remains, as well as nests, diggings, chew marks, scratchings, chewed She-oak cones (indicative of Glossy Black Cockatoos), chewed fruits and pellets (indicative of birds of prey).

4.2.2.1 Terrestrial Faunal Diversity

A total of fifty-five (55) terrestrial fauna species were recorded within the study area during the field surveys. This list comprised five (5) mammal species (three native), five (5) frog species, ten (10) reptile species and thirty-five (35) species of birds. Appendix B lists the species recorded within proximity to Cudgera Creek Road during the field surveys in addition to species recorded within the broad study area incorporating the Yelgun to Chinderah Pacific Highway Upgrade (Sinclair Knight Merz 1998).

Birds

A total of thirty-five (35) bird species were recorded during the field surveys. This comprised one (1) species of waterbird, three (3) diurnal raptors and one (1) nocturnal species. The remainder comprised diurnal terrestrial species. In general the study area lacks a diversity of habitat types to attract a wide variety of bird species. Whilst a number of species which favour rainforest habitats and open grasslands were recorded, the lack of open forest and eucalypt tree cover limits the diversity of birds likely to occur. Although a number of additional bird species are likely to utilise the study, at least on occasion. Knowledge on the avian assemblage would increase with further studies.

There was no response to the broadcasting of threatened owl calls within the subject site. No threatened bird species were recorded during the study, although the habitats of the subject site allow for potential visitation by a number of threatened species that are discussed later in the text.

Mammals

Five (5) mammal species were identified on the site, comprising three native terrestrial species and two introduced species. No arboreal mammal species were recorded, although the study area lacks good habitat for these species, by virtue of its relative isolation, lack of eucalypts and tree hollow resources.

Spotlighting Results

Several Black Flying-fox (*Pteropus alecto*) were observed after dusk feeding on the fruits of a large fig (*Ficus* spp) occurring close to Cudgera Creek. The Black Flying-fox is listed as a vulnerable species in NSW (*TSC Act*). Given the presence of several fruiting tree species, Flying-fox are considered to regularly visit the study area during peak seasonal times.

Insectivorous Bats

The audible call of the White-striped Freetail Bat (*Nyctinomus australis*) was also heard during the spotlighting surveys. Despite the use of bat call detectors and warm favourable conditions, no other insectivorous bat species were recorded during the survey. This may be a reflection of the lack of tree hollows within the rainforest habitat and subsequent lack of roosting opportunities. Several species of insectivorous bat are expected to occur in the study area and could potentially forage over the site.

Searches for Evidence

Several predator scats attributed to the introduced Fox (*Vulpes vulpes*) were observed within the study area, mostly from the cleared pasture areas. Based on evidence observed in the area, reasonably large fox populations are likely to occur. These predators would be placing considerable pressure of native mammals. Scats of the introduced rabbit (*Oryctolagus cuniculus*) were recorded at the site.

The distinctive scats of Red-necked Wallabies (*Macropus rufogriseus*) were also observed throughout the rainforest and adjacent open grassland areas. The species would be limited to the more densely vegetated areas of the study area.

Reptiles and Amphibians

Ten (10) reptile species and five (5) frog species were recorded from the study area during this investigation. These species are listed below. A number of species were identified through discussions with local residents. Of the ten reptile species, this includes three snakes (Family: Elapidae), two dragons (Agamidae), three skinks (Scincidae), one monitor (Varanidae) and one turtle (Chelidae).

Reptiles

Eastern Snake-necked Turtle
Eastern Water Dragon
Bearded Dragon
Lace Monitor
Eastern Water Skink
Dark-flecked Garden Sunskink
Eastern Blue-tongued Lizard
Dwarf Crowned Snake
Red-bellied Black Snake
Eastern Brown Snake

Frogs

Dusky Toadlet Red-eyed Tree Frog Eastern Dwarf Tree Frog Peron's Tree Frog Cane Toad

Overall the study area contains good quality habitat for reptiles, in the form of a diversity of sheltering resources as well a mix of forested and open habitats including dense grass thickets as well as freshwater habitats.

The frog fauna identified during the survey was considered relatively low, although dry conditions were experienced leading up to the survey period which may have influenced presence and abundance of frogs. Indeed good quality frog habitat occurs in Cudgera Creek itself although this is best suited to stream dwelling frogs and not species adapted to low-lying swamp habitats. The remainder of the pasture and crop

areas provide only limited resources for frogs. The introduced Cane Toad (*Bufo marinus*) represented the most abundant species at the site.

4.2.2.2 Threatened Terrestrial Fauna

The Black Flying-fox (*Pteropus alecto*) was positively identified on the site during the field surveys. This is a vulnerable species in NSW scheduled in the *TSC Act*. Several Black Flying-fox were observed flying over at dusk and some were recorded feeding on native figs (*Ficus* spp) which occur within the lowland rainforest habitat associated with Cudgera Creek. Individuals of this species would regularly utilise the available foraging resources within the study area, although such resources are not solely restricted to the Cudgera Creek area and are well represented throughout the north coast of NSW.

No other threatened terrestrial fauna species as scheduled in the *TSC Act* or *EPBC Act* were recorded in the study area during the current surveys.

4.2.2.3 Review of Previous Fauna Field Investigations

A fauna survey of the proposed Yelgun to Chinderah Pacific Highway Upgrade area was undertaken by Woodward-Clyde (1998). The current study area lies centrally within this study area and adjoins the highway at the Cudgera Creek Road intersection. The survey looked at similar lowland rainforest and open pasture / crop areas although also surveyed a much wider diversity of forest types, including open and closed eucalypt forests and woodlands and swamps and grasslands. The proximity of the site in relation to the present study area suggests that the results can contribute to the knowledge of the faunal assemblage of the proposed Cudgera Creek Road upgrade area. Consequently, the results of the 1998 surveys have been reviewed for this report.

The 1998 survey identified the presence of twenty-six (26) mammal species, eight (8) reptile species, seventeen (17) frog species and one-hundred and twenty-eight (128) bird species. The list of species recorded during the study are presented in Appendix B of this report for comparison. The 1998 survey revealed fourteen (14) threatened species, as discussed in Section 2.0 of this report.

Caution should be applied to assessing the potential presence of fauna species recorded for the EIS at the present Cudgera Creek Road site. This is because a considerably larger area and greater diversity of habitat types was surveyed for the EIS. Certainly not all species recorded from the wider study area would be expected to utilise the habitats present at the Cudgera Creek Road site, although some additional species would be expected to occur. Species recorded during the EIS (Woodward-Clyde 1998) are shown in Appendix B alongside species recorded for the current assessment.

Several additional bird species are likely to be present within the Cudgera Creek Road area during different seasons, at least on occasion, and especially during the peak flowering and fruiting period of the dominant trees. This includes several frugivorous specialist species such as the Fruit-Doves and Barred Cuckoo-Shrike. However the majority of the bird species expected would be common and widespread birds of forest remnants within agricultural environments.

4.3 Aquatic Fauna Survey

4.3.1 Methodology

The nature of the waterway at Cudgera Creek restricted the type of sampling techniques that could be used to survey for fish and other aquatic vertebrates. Indeed the steep profile of the banks, shallow waters and abundance of snags ruled out the possibility of seine netting and the setting of fyke nets. Therefore bait traps and dip netting were the foundation of sampling efforts.

Twelve bait traps were set during the two-day sampling period (ie. 1st and 2nd October 2002) (Table 4-2). Eight traps were set upstream of the existing Cudgera Creek Road Bridge (southern side) and left for a period of two and a half hours. The traps were baited with dog biscuits and raw meat. Samples were later retrieved and their contents recorded. Traps 1 and 3 were reset on the 1st October and left overnight with the remaining six traps removed. Four traps were then set downstream (northern side) of the bridge and left overnight. The six traps were retrieved on the 2nd October and information on species and number of individuals were recorded

Eighteen dip net samples were also taken during the two-day sampling event, which included nine samples on the 1st October 2002, and nine samples taken on the 2nd October 2002 (Table 4-3). A total of six sites were sampled with each site sampled in three different locations including in and around snags, the centre of the creek and around the edges. Location, time and environmental conditions were recorded and are presented below.

Table 4-2. Details of fish bait trap survey

Trap	Date	Tir	ne	Loca	tion	Depth	Environment
#		In	Out	In relation to Road	In Creek		
1	1/10	12:30pm	3:00pm	40m upstream of existing Bridge	Centre of creek, under/near fallen	60cm	Cloudy water, shady
	1/10	3:05pm	8:30am	existing bridge	tree and debris		Snauy
	2/10						
2	1/10	12:35pm	3:10pm	Upstream of existing bridge, just before first bend	1m out from left bank	40cm	Clearer water mottled sunlight
3	1/10	12:40pm	3:15pm	Upstream of existing bridge. Top of first	Centre of creek	1m	Sunny, Reeds on right bank
	1/10 - 2/10	3:16pm	9:10am	bend			
4		10.50	2.20	11	4	1 2	NA-441J
4	1/10	12:50pm	3:20pm	Upstream of existing bridge. Middle of first property(west) 10m from horse watering hole	1m out from left bank	1.3m	Mottled sunlight, deep hole, steep banks
5	1/10	1:00pm	3:30pm	Upstream of existing bridge, 20m south of windmill	1m out from left bank	40cm	Shady
6	1/10	1:05pm	3:35pm	Upstream of existing bridge, approximately 15m downstream of farmers crossing – 3 rd property west	Centre of creek, in the middle of a snag	80cm	Shady
7	1/10	1:15pm	3:40pm	Upstream of existing bridge- west- bend closest to road	Centre of creek opposite lily like cover	1m	Shady

Trap	Date	Tir	me	Loca	tion	Depth	Environment
#		In	Out	In relation to Road	In Creek		
8	1/10	1:25pm	3:45pm	Upstream of existing bridge, opposite freshly ploughed field	1m from right bank – palms lined left bank	30cm	Wider section of the creek, mottled sunlight
9	1/10 - 2/10	4:15pm	9:40am	Downstream of existing bridge, creek bends back towards road- upstream from top of bend	1m out from left bank	1.5m	Very steep, very high banks, mottled sunlight
10	1/10 - 2/10	4:20pm		Downstream of existing bridge, creek bends back towards road-downstream from top of bend	1m out from the left bank	30cm	Stagnant looking water
11	1/10 - 2/10	4:25pm		Downstream of existing bridge, approximately 100m downstream of site 10, behind abandon house	Centre of creek downstream of fallen tree(log)	40cm	Mottled sunlight, clear water
12	1/10 - 2/10	4:30pm		Downstream of existing bridge, 50m downstream of trap 11 where creek forks	1m out from the left bank	1m	Mottled sunlight, wider section of the creek.

■ Table 4-3. Details of dip net surveys

Site	Date	Time	Depth	Substrate	Location		
#					Along Creek	Creek	
1	1/10/02	2:05pm	20cm	Muddy, Leafy and rocky	5m downstream of existing bridge	In and around snags Edge Middle	
2	1/10/10	2:15pm	30cm	Sandy	Downstream of existing bridge, creek bends back towards road- downstream from top of bend (same location as trap 10)	In and around snags Edge Middle	
3	1/10/02	2:30pm	40cm	Sandy – leaf litter around edges	Downstream of existing bridge, approximately 100m downstream of site 10, behind abandon house	In and around snags Edge Middle	
4	2/10/02	8:55am	60cm	Sandy – leaf litter around edges	40m upstream from existing bridge (same location as trap 1)	In and around snags Edge Middle	
5	2/10/02	9:15am	1m	Decaying Matter	Upstream of bridge. Top of first bend	In and around snags Edge Middle	
6	2/10/02	9:25am	1m	Decaying Matter	Upstream of existing bridge. Middle of first property(west) horse watering hole	In and around snags Edge Middle	

4.3.2 Results

The results of the fish survey revealed a total of four (4) native fish species, three (3) crustaceans and one (1) eel species. The results of the trapping survey are presented below. Species recorded at the site are presented in Appendix B. An opportunistic observation of a Marbled Eel (*Anguilla reinhardtii*) was recorded.

■ Table 4-4. Results of the fish trapping survey

Trap No.	Common Name	Scientific Name	Number
1	Firetail Gudgeon	Hypseleotris galii	1
	Ornate Rainbow Fish	Rhadinocentrus ornatus	4
2	Nil	-	-
3	Nil	•	-
	Nil		-
4	Nil	-	•
5	Nil	-	-
6	Empire Gudgeon	Hypseleotris compressus	2
	Ornate Rainbow Fish	Rhadinocentrus ornatus	2
7	Nil	-	Nil
8	Ornate Rainbow Fish	Rhadinocentrus ornatus	17
	Atyid Shrimp	Paratya australiensis	2
9	Long-armed Prawn	Macrobrachium australiense	5
	Striped Gudgeon	Gobiomorphus australis	1
10	Long-armed Prawn	Macrobrachium australiense	2
	Ornate Rainbow Fish	Rhadinocentrus ornatus	5
	Empire Gudgeon	Hypseleotris compressus	1
	Mayfly Larvae	-	1
11	Long-armed Prawn	Macrobrachium australiense	2
	Riffle Shrimp	Australatya striolata	1
	Striped Gudgeon	Gobiomorphus australis	2
	Ornate Rainbow Fish	Rhadinocentrus ornatus	1
12	Nil	-	Nil

■ Table 4-5. Results of the dip net surveys

Site No.	Common Name	Scientific Name	Number
1	Atyid Shrimp	Paratya australiensis	1
'	Blood Worm	-	1
2	Atyid Shrimp	Paratya australiensis	2
	Spider	-	1
	Atyid Shrimp	Paratya australiensis	2
	Atyid Shrimp	Paratya australiensis	2
2	Atyid Shrimp	Paratya australiensis	2
3	Mayfly larvae	-	1
	Atyid Shrimp	Paratya australiensis	2
4	Atyid Shrimp	Paratya australiensis	7
5	Atyid Shrimp	Paratya australiensis	3
5	Mosquito larvae	-	1
	Atyid Shrimp	Paratya australiensis	1
	Blood worm		1
6	Atyid Shrimp	Paratya australiensis	1
O	Blood worm	_	5

4.3.3 Threatened Aquatic Fauna

No threatened fish species as listed in the *Fisheries Management Act* 1994, were recorded from the Cudgera Creek study site. The creek does not experience continuous flow and exists as shallow ephemeral pools, with numerous snags and silted beds. The habitat is not suited to the three threatened fish species known from the area and no threatened fish species are expected to occur within the upper reaches of Cudgera Creek.

5. Impact Assessment

5.1 Potential Impacts Associated with the Proposal

The proposed upgrade of Cudgera Creek Road involves a deviation from the existing road to form a new crossing over Cudgera Creek. A two-lane bridge is required and a short section of deviation to accommodate the bridge. The remainder of the construction will upgrade the existing road and involve minimal disturbance to a few small areas of regrowth vegetation.

Construction of the bridge and approach from the east and west will involve removal of native vegetation presently situated along the bank of Cudgera Creek within the bridge footprint area of a maximum width of 15 metres. This vegetation has been identified as Lowland Rainforest, which is classified as an endangered ecological community scheduled in the *TSC Act*.

The proposal involves disturbance to a small area of rainforest within the bridge footprint itself and would not completely remove this vegetation type from the study area, which is well represented outside the construction area.

A total of 8 threatened flora species consisting of 89 individual plants have been identified within a narrow linear strip of rainforest along Cudgera Creek. Planning of the bridge and road deviation has been designed to avoid all identified threatened species and would involve only minimal vegetation removal and tree lopping works. Therefore the Proposal would not directly impact on threatened plant species identified in the report. The location of the threatened plants relative to the proposed alignment of the Cudgera Creek Road deviation and bridge is presented in **Figure 5-1**.

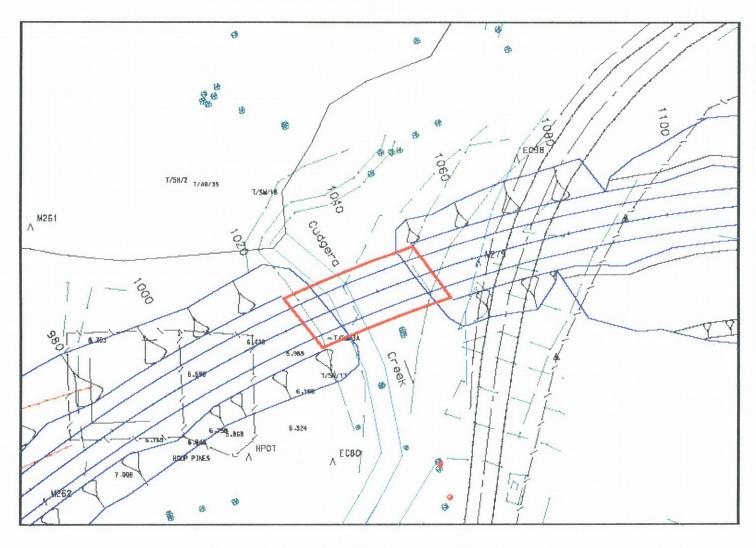
However, indirect impacts on threatened plants may result from insensitive construction methods and should be considered in the construction specifications. Two individual threatened plants occur in close proximity to the western side of the proposed bridge alignment, namely a *Randia moorei* and a *Syzygium moorei*. Both species are relatively well represented in the study area outside the road footprint and a total of twenty-six (26) *Randia moorei* and fifteen (15) *Syzygium moorei* specimens were identified in the study area. Under the present design the road works would avoid these two plants however they should be identified and flagged prior to commencement of construction works.

Indirect impacts may also result from 'edge effects' associated with the clearing of the bridge footprint through an area of existing vegetation. The removal of vegetation increases the chance of degradatory processes effecting plant species retained on the edge of the clearing. Such potential effects may include increased exposure to light and wind as well as dust and air pollution from traffic. Increased light and disturbance may also present favourable conditions for weed species growth and competition. It is important that the potential impacts from edge effects are addressed in any rehabilitation plan prepared for the site.

One threatened fauna species (TSC Act) was directly observed within the study site, the Black Flying-fox (Pteropus alecto). Several additional threatened species could potentially utilise the small areas of habitat present at the site. This usage would be also be associated with the Lowland Rainforest, as several frugivorous feeding

species, such as Fruit-Doves, and Fruit Bats are expected to visit the site. The assessment of impact on threatened fauna considers the removal of fruit-bearing trees and shrubs.

No threatened fish species (FM Act) were identified from the site or are expected to occur. As part of the development, the existing Cudgera Creek Road bridge would be decommissioned and the area rehabilitated.



■ Figure 5-1.
Proposed Cudgera
Creek Road
deviation and bridge
showing the
locations of
threatened plants

• Threatened Flora Species

5.2 Environmental Planning and Assessment Act 1979

The EP&A Act aims to control development in the context of environmental protection and is of the highest priority in New South Wales planning legislation. It ensures that consent authorities duly consider environmental concerns in the decision-making processes. The Act aims to encourage:

- ☐ The proper management, development and conservation of natural and man-made resources, including natural areas, for the purpose of promoting the social and economic welfare of the community and a better environment
- ☐ The promotion and coordination of the orderly and economic use and development of land
- □ The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.

Section 5A ('8 part test') of the EP&A Act 1979 was amended by the Threatened Species Conservation Act 1995 (TSC Act). Section 5A aims to improve the standard of consideration and protection afforded to threatened species, populations and communities, and their habitats in the planning process. The outcome of any threatened species assessment should be that development is undertaken in an manner that is sensitive to the natural environment and that appropriate measures are undertaken to minimise adverse effects on the environment, threatened species and threatened species habitats.

Determining authorities have an obligation under the *EP&A Act* to consider whether a proposal is likely to significantly affect threatened species, populations or ecological communities, or their habitats. In this regard, the determining authority must take into account the '8 part test.'

5.2.1 Endangered Ecological Communities

The area of Lowland Rainforest which has been retained along the banks of Cudgera Creek is classified as an endangered ecological community as scheduled in the *TSC Act* (Lowland Rainforest on Floodplain in the NSW north coast bioregion). Much of the surrounding areas would have historically been lowland rainforest although have been cleared and replaced by agriculture. Therefore any remaining remnant patches represent significant vegetation, hence the listing of this community on the north coast as an endangered community. The proposed new Cudgera Creek Road deviation involves constructing a two-lane bridge over a small section of the creek. This construction would involve minimal clearing and tree lopping within a narrow area of rainforest vegetation to accommodate the road corridor. This would represent the removal of a small area of the threatened ecological community 'Lowland Rainforest' as part of the proposal. The road alignment has been specifically chosen to traverse a narrow section of the rainforest vegetation.

An assessment of impact of the proposal on the area of Lowland Rainforest identified in the report has been carried out (8-part test).

5.2.2 Threatened Flora

A total of 8 threatened plant species have been identified within the study site consisting of 89 individual plants. The species include Acacia bakeri, Endiandra

floydii, Hicksbeachia pinnatifolia, Macadamia tetraphylla, Ochrosia moorei, Randia moorei, Syzygium hodgkinsoniae, and Syzygium moorei.

All plants have been identified from the Lowland Rainforest (endangered ecological community) and all occur within a restricted area encompassing up to 300m north and south of the proposed new bridge. As mentioned previously, no individual threatened plants would be directly removed to accommodate the road and bridge construction, although indirect impacts may potentially occur and have been addressed in the following assessment.

Species with similar habitat requirements have been assessed via a single 8-part test as referred to in NPWS (1996). As all threatened flora species identified in the study area occur within the Lowland Rainforest, a single 8-part test has been applied for this endangered community which provides the habitat requirements of all threatened flora species recorded at the site.

8-part Test (Section 5a of the EP&A Act)

Lowland Rainforest on Floodplain and associated threatened species.

Acacia bakeri, Endiandra floydii, Hicksbeachia pinnatifolia, Macadamia tetraphylla,
Ochrosia moorei, Randia moorei, Syzygium hodgkinsoniae and Syzygium moorei

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

This 8-part test covers an area of specified Lowland Rainforest on Floodplain in the north coast bioregion (as per Schedule 1 of the Threatened Species Conservation Act, 1995). A narrow linear remnant of lowland rainforest has been retained along the banks of Cudgera Creek continuing north and south of the existing Cudgera Creek Road Bridge. A survey of this community at the study area has identified 8 threatened plant species consisting of 89 individual plants. The species include:

- Acacia bakeri
- □ Endiandra floydii
- Hicksbeachia pinnatifolia
- □ Macadamia tetraphylla
- □ Ochrosia moorei
- □ Randia moorei
- □ Syzygium hodgkinsoniae
- □ Syzygium moorei

As part of this study the location of all individual threatened plant species identified from the survey was documented (see Table 4-1) and plotted onto a plan overlayed with the proposed road deviation and bridge (see Figure 5-1). From this survey it is evident that no individual threatened species would be directly removed to accommodate the road deviation and bridge structure. However two individuals occur within close proximity to the southern side of the bridge, this includes a *Randia moorei* and *Syzygium moorei*.

These two individuals may potentially be impacted through indirect impacts, such as indiscriminate clearing or trampling. Specific mitigation measures relevant to the protection of these individuals are presented in Section 7.0 of this report. Of the two species potentially affected a total of 26 *Randia moorei* and 15 individual *Syzygium moorei* were identified at the site, this would represent the local population for both species. If carried out with the appropriate sensitive work methods the proposal is unlikely to impact on the two individual threatened plants identified. Furthermore, given the extent and location of the local population of these species, the proposal is unlikely to result in significant impacts on a viable local population of a threatened species at the site.

No other identified threatened plants would require removal and the road deviation and bridge have been deliberately placed to avoid concentrations of threatened plants identified within the Lowland Rainforest.

Indeed the location of the bridge would potentially remove a narrow footprint through a currently disturbed portion of the rainforest and if this construction is carried out with appropriate work methods and follow-up rehabilitation, this would not compromise the future integrity of the vegetation community. It is proposed to lop trees rather then completely removing then thereby assisting in the maintenance of the creek bank stability.

A detailed survey of all individual plants potentially removed as a result of the bridge construction was carried out. The number and type of species have been documented below.

No.	Species	Diam (cm)	Ht (m)
1.	Hoop Pine (Araucaria cunninghamii) (Regionally significant species)	50	40
2.	Camphor Laurel (introduced invasive species)	25	30
3.	Hoop Pine (Regionally significant species)	35	25
4.	Silver Aspen (Acronychia wilcoxiana)	10	5
5.	Hoop Pine (Regionally significant species)	10	4
6.	Camphor Laurel (introduced invasive species)	12	5
7.	Camphor Laurel (introduced invasive species)	30	8
8.	Bennent's Ash (Flindersia bennettiana)	11	6.5
9.	Silver Aspen	8	3
10.	Silver Aspen	4	3
11.	Foambark Tree (Jagera pseudorhus)	45	15
12.	Tamarind (Diploglottis australis)	14	10
13.	Silver Aspen	40	14
14.	Camphor Laurel (introduced invasive species)	20	8
15.	Bangalow Palm (up to 6 individual palms)	Small	
16.	Brush Kurrajong (Commersonia fraseri)	25	13

All individual plants to be lopped are relatively immature specimens (less than 50cm diameter at breast height) and the introduced Camphor Laurel, which will be poisoned when lopped, represents 25% of the species is be lopped. Three Hoop Pine would potentially be lopped. This species is considered locally significant, however is well represented at the site outside of the proposed construction areas and would not be completely removed from the site. Where possible there may be scope to relocate the smallest Hoop Pine and also utilise this species in the planned revegetation works at the site.

The proposed road may involve removal of a small area of Coast Cypress Pine (Callitris columellaris) on the hill and existing road cutting to the east of the

bridge. This species is not threatened although is also considered locally significant and any individuals near the works area should be identified and tagged prior to work commencing. In the event that tree removal is required suitable management of the species would include the collection of seed and propagation for future replanting back into the study area. Consideration should be given to translocating the individual trees if possible which should be done according the accepted guidelines for translocation of threatened plants in Australia (Australian Network for Plant Conservation 1997).

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No endangered populations were identified in the study area, nor are expected to occur

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The existing Cudgera Creek Road traverses largely disturbed and modified agricultural land, albeit for a crossing of Cudgera Creek which is comprises narrow linear strip of lowland rainforest. Much of the surrounding study area would have originally been floodplain rainforest, although has been cleared and replaced by agricultural land. A narrow linear strip has been retained along Cudgera Creek which is considered a significant area of known habitat, however this community is not restricted to Cudgera Creek and also occurs in the wider locality being associated with several other creeks along the Pacific Highway (Woodward-Clyde 1998) and throughout the region (Floyd 1990a; 1990b; Landmark Ecological Consultants *et al* 1999).

It is evident that vegetation removal for the road deviation would not significantly compromise the area of lowland rainforest present in the study area. The subject area of rainforest currently exists as a fragmented patch of vegetation surrounded by cleared lands and is already dissected by the existing Cudgera Creek Road. The best quality areas within the study site, occur outside the road footprint and will not be impacted by the proposal.

This conclusion is reinforced by the proposal to decommission the existing bridge and rehabilitate this area. However increased diligence and proactive management is required to preserve and improve the lowland rainforest habitat within the study area.

The road design has been planned to avoid the dense areas of rainforest vegetation and would cross the creek at a very narrow section only a few metres width from the banks of the creek. By restricting the works to the currently proposed road footprint, this would not result in a significant regional loss of habitat for this community.

The lowland rainforest community at the site was found to comprise 8 threatened plant species, which represents a moderately high diversity and this vegetation

would be considered a significant area of known habitat for these threatened species. Habitat suitable to these species (ie. lowland and subtropical rainforest) has been extensively cleared from the North Coast Bioregion and only a fraction of this vegetation type remains. The habitat of these species has been reduced although not completely removed from the region. However this factor has minimal influence on the current proposal as the road construction will not directly remove any threatened plant species from the site and would involve minimal modification or removal to a significant area of known habitat for these threatened species.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

The area of lowland rainforest occurring at the Cudgera Creek Road area is currently isolated from other connecting vegetation in the study area. The vegetation exists as a narrow linear strip which continues along the creek to the south as far as the newly constructed Pacific Highway and to the north about 300-400m from the proposed new bridge, where it is replaced by cleared agricultural lands, and small areas of regrowth rainforest with occasional isolated rainforest trees. The proposal includes a narrow bridge through a disturbed area of rainforest and includes revegetation of currently cleared areas. The bridge would separate an area of interconnecting vegetation, however this narrow interruption to the continuity of the vegetation is unlikely to significantly impact on the area of vegetation as a whole. The proposal would not permanently interrupt water flow under the bridge, thereby affecting seed dispersal. Seed dispersal would also be instigated by birds not affected by the road construction.

The proposal includes decommission of the existing Cudgera Creek Road bridge and revegetating the formerly disturbed area, effectively resulting in no net loss of vegetation and no change to the current fragmentation of the corridor.

(e) Whether critical habitat will be affected

No assessment under this Part is required. No areas of critical habitat relate to the study area.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

Floyd (1990a) suggests that only 35ha of this specific lowland rainforest (Suballiance No. 3: Tweed Variant) are known to remain. A few small and isolated remnants are conserved in the region, including but not limited to Tyagarah Nature Reserve, Victoria Park Nature Reserve and Boat Harbour Nature Reserve. The extent of this community has been considerably reduced from the region and this community is poorly conserved.

Similarly, it was be possible to suggest that threatened plant species dependent on the lowland rainforest community and occurring in the region would also be inadequately conserved. This would be the case for the eight species addressed in this assessment. (g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The main key threats to this rainforest community and the threatened species identified in this assessment are clearing of native vegetation, including modification of habitat and possibly alteration to natural streams. Clearing, in particular fragmentation has been discussed in the Final Determination for Lowland Rainforest. Only minimal vegetation removal and tree lopping is proposed and water flow within the creek should not be impacted in the long-term if constructed appropriately. The proposal would not involve removal of any threatened species from the study area and has been designed to avoid significant plants. Furthermore the proposed location of the bridge has been placed to traverse a particularly narrow section of riparian vegetation, further minimising vegetation loss.

One issue to consider is assessing the loss of vegetation associated with this proposal, is the proposed revegetation of land between the existing road and the proposed road. This would effectively increase the area of vegetation within the study area.

An additional key threat, which has been preliminarily determined has also been considered for this assessment, this includes 'The Removal of Dead Wood, Dead Trees and Logs'. This does not represent a significant threat as the road traverses largely cleared land and minimal removal of dead wood would occur.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

Lowland Rainforest is not at its limit of distribution in the immediate study area, although the endangered community is restricted to the North Coast bioregion. Similarly the threatened plant species assessed are limited by the distribution of lowland rainforest, however as stated, this community is not restricted to the study area.

Conclusion

The conclusion of this 8-part test indicates that this proposal would not significantly impact on local populations of threatened plant species or the area of Lowland Rainforest identified at the Cudgera Creek study area. The conclusion is based on the currently proposed road footprint, which has been designed to avoid threatened plants and traverse through a narrow disturbed part of the creekline vegetation.

5.2.3 Threatened Terrestrial Fauna

One threatened fauna species was positively identified at the Cudgera Creek site during the current investigation this species is the Black Flying-fox (*Pteropus alecto*). An 8-part test has been undertaken for this species and is combined with the closely related Grey-headed Flying-fox (*Pteropus poliocephalus*) which is also considered to potentially occur.

An additional nine threatened fauna species have been recorded in similar habitats to that identified at Cudgera Creek and may potentially be impacted by the proposal. An

8-part test has been applied for each of these species and due to similarities in lifecycles and habitat, some species have been assessed via combined 8-part tests.

Eight-part tests have been documented for Megachiropterans (Black Flying-fox and Grey-headed Flying-fox), Microchiropterans (Northern Long-eared Bat and Southern Myotis), Frugivorous birds (Wompoo Fruit-Dove, Superb Fruit-Dove, rose-crowned Fruit-Dove and Barred Cuckoo-shrike), the Giant Barred Frog and the Three-toed Snake-tooth Skink.

Megachiropterans (Black Flying-fox and Grey-headed Flying-fox)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Several Black Flying-fox were observed flying over the study area and feeding in a large Moreton Bay Fig located to the north of the proposed road-footprint. No roosting colonies of this species or the Grey-headed Flying-fox occur along this area of Cudgera Creek investigated although both species may frequent the site during the peak fruiting times of the dominant trees, particularly the figs.

Flying-foxes forage on the nectar and pollen on native trees, and within the study area native figs (Ficus spp) and several other rainforest tree species are expected to provide a food resource capable of attracting individuals to the area. The species is threatened primarily by two main factors, the destruction of habitat by clearing for urban development and agriculture and disturbance at roost sites. Other threats include unregulated shooting, electrocution on power lines, human persecution and competition and hybridisation between both species (NPWS 1996).

The proposed Cudgera Creek Road upgrade would involve removal of a small percentage of native tree species from the study area, as discussed previously in the report. No Figs or other fruiting tree species will be removed and these food resources would be retained at the site post-construction. Therefore the current potential for this species to forage in the study is considered to remain following the road upgrade works. No roost sites of these species occur within the study site. Several roost sites are known from the Richmond and Tweed districts although no roost areas will be disturbed as part of the proposal.

The proposed road upgrade work is considered unlikely to significantly disrupt the life-cycle of the Black Flying-fox and Grey-headed Flying-fox such that any viable local population would be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No consideration under this part of the assessment is required.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

For the purposes of this assessment and the '8-part test' the 'region' referred to in part (c) is the entire North Coast Biogeographic Region. Both species of Flying-fox exhibit a broad distributional range which encompass large areas of the Bioregion including the study area. Indeed the area of habitat addressed within this assessment (ie. the study area) constitutes only a fraction of the area of known habitat for these species within this 'region'. Furthermore, whilst the study area is expected to provide important habitat resources and assist in lifecycle events for these Flying-fox species, thus contributing as an area of known habitat, such resources are not solely restricted to the study area and are well replicated throughout the locality and 'region'. Therefore the study area is not considered to be a significant area of known habitat in relation to the regional distribution of habitat for these species.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

The area of lowland rainforest occurring at the Cudgera Creek Road site is currently isolated from other connecting vegetation in the study area. The vegetation exists as a narrow linear strip which continues along the creek to the south as far as the newly constructed Pacific Highway and to the north about 300-400m from the proposed new bridge, where it is replaced by cleared agricultural lands, and small areas of regrowth rainforest with occasional isolated rainforest trees. The proposal includes a narrow bridge through a disturbed area of rainforest and includes revegetation of currently cleared areas. The bridge would separate an area of interconnecting vegetation, however this narrow interruption to the continuity of the vegetation is unlikely to significantly impact on these highly mobile Flying-fox species, particularly as they are known to travel large distances between patches of remnant forest in search of food, seasonally available fruit and nectar resources.

(e) Whether critical habitat will be affected

No assessment under this part is required.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

For the purposes of this assessment and the '8-part test' the 'region' referred to in part (f) is the entire North Coast Biogeographic Region. It is reasonable to suggest that to a degree suitable sites for roosting camps are inadequately represented in conservation reserves in the 'region'. Conversely given the diverse foraging habits of these species, suitable foraging habitat is probably adequately reserved in the region.

However, these factors are unlikely to reflect a significant concern in relation to the Proposal as the habitats which are represented do not constitute a significant area of known habitat for the Black Flying-fox and Grey-headed flying-fox and indeed extensive areas of comparable habitat occur throughout the surrounding area, which would not be impacted by the proposal.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Of the key threatening processes listed in the TSC Act, the clearing of native vegetation probably has the most potential impact on these flying-fox species, particularly where this involves removal of important food resources. As stated previously, the proposal would not remove any large figs or other significant food resources for these species from the study area.

One further issue to consider relating to this proposal and in assessing the impact on threatened species associated with land clearance, is the proposal for revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road. This proposal may effectively increase future food resources for frugivorous species such as the megabats.

In conclusion, the proposed road upgrade is not expected to significantly increase the incidence of designated threatening processes listed on Schedule 3 of the *TSC Act*.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Grey-headed Flying Fox occurs in a narrow broad strip along coastal eastern Australia from Rockhampton (Qld) in the north to western Victoria. The species is not at the limit of its distribution in the NSW North Coast.

The Black Flying-fox occurs along northern Australia down the east coast to northern NSW and approaches its southern limit of distribution in the study area.

Microchiropterans (Eastern Long-eared Bat and Southern Myotis)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Neither species was recorded during the survey, however potential habitat is present at the site and associated with the rainforest and creek habitat at Cudgera Creek. The Eastern Long-eared Bat is restricted to rainforest and moist forest in the NSW north coast area and roosts in tree hollows. The Southern Myotis roosts in caves, tunnels, underground drains and other man-made structures such as buildings and under bridges. A search was carried out for potential roost sites under the existing Cudgera Creek Road Bridge, however no such features occur.

The Eastern Long-eared Bat is threatened primarily by clearing of suitable habitat. Being restricted to rainforest and moist habitats, the loss of much of the

natural rainforests of north-east NSW would have severely reduced available habitat. It may also be threatened by selective tree removal that reduces the incidence of hollows and roosting cavities. There may be some predation from cats and foxes. The Southern Myotis forages low over water for aquatic insects, and apart from modification to roost sites, the species may also be impacted by draining of waterways affected prey species.

Important aspects of the lifecycles include foraging, shelter, breeding and movement/ dispersal. The potential effects/ impacts of the proposal for these lifecycle aspects are discussed below:

Foraging

The habitat of highest potential importance to these species in the study area is the lowland rainforest and associated waterway of Cudgera Creek. The Proposal would remove only a narrow band through the rainforest and would not significantly impact on the foraging habitat of either species. Potential foraging habitat will remain post construction.

Roosting/ Breeding

The Eastern Long-eared Bat roosts under peeling bark, among epiphytes, in tree hollows, in the roots of strangler figs, amongst dead fronds of tree ferns and in foliage (Churchill 1997). There are numerous roosting opportunities within the rainforest areas outside of the proposed development area. Indeed, the Proposal would not remove any hollow-bearing trees and roosting habitat is very limited within the construction area.

Whilst the Southern Myotis is know to occasionally roost under bridges over water, wooden bridges are preferred over concrete ones such as Cudgera Creek Road and there are no roosting opportunities under Cudgera Creek Road Bridge.

The Proposal would not result in the removal of significant roosting habitat.

Movement

The Proposal would not isolate habitat nor would it separate any areas deemed potential movement corridors for these species. These bats are highly mobile and capable of flying through open areas to access roosts or foraging areas.

This assessment has concluded that through the preservation of the rainforest habitats surrounding the road deviation and the appropriate management or protection of mature trees, a significant impact is not envisaged.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No consideration under this part of the assessment is required.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Eastern Long-eared Bat occurs within the north of the NSW North Coast region, but is subject to relatively few records. There has never been a detailed survey of the extent of regional habitat of this species. Within the region, the species inhabits rainforest, which is widely distributed and not restricted to the Cudgera Creek study site.

The Southern Myotis occurs throughout the entire North Coast Bioregion, and is found in a variety of habitat types where water is a feature. This includes mangroves, paperbark swamps, rainforest, wet and dry sclerophyll forest, and open woodland. The small area of potential foraging habitat at the Cudgera Creek site is not expected to constitute a significant area of known habitat for this species with the regional distribution.

The available habitat at the study area is not likely to comprise regionally significant habitat for these species. It is a relatively small and isolated patch of habitat. Better quality habitat occurs in the larger rainforest remnants of the north coast. The minimal vegetation removal and tree lopping required is unlikely to cause a regionally significant loss of habitat for these species. Foraging habitat will be retained on the site post-construction.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

Both species are highly mobile and would use a relatively large foraging area. They are also capable of moving between roosting sites. The Proposal is unlikely to affect the movement dynamics of these species.

(e) Whether critical habitat will be affected

No assessment under this part is required.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

The conservation status of these bat species is poorly known. However, large areas of suitable habitat have been cleared for agriculture and settlement and records are infrequent. The species cannot be considered adequately conserved at present based on the available data.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Of the key threatening processes listed in the TSC Act, the clearing of native vegetation probably has the most potential impact on these species, particularly where this involves removal of potential roost sites. The Proposal would not involve the removal of hollow-bearing trees considered the potentially provide roosting opportunities for these species.

One further issue to consider relating to this proposal and in assessing the impact on threatened species associated with land clearance, is the proposal for revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road. If carried out effectively, the proposal would more then compensate for the minimal loss of vegetation and would in fact increase the current area of rainforest at the site.

In conclusion, the proposed road upgrade is not expected to significantly increase the incidence of designated threatening processes listed on Schedule 3 of the *TSC Act*.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Eastern Long-eared Bat occurs through tropical northern Australia, extending down the east coast to the north coast of NSW. The species approaches its southern limit of distribution in the area.

The Southern Myotis extends across northern Australia down the east coast to Victoria and South Australia. The species is not at the limit of its distribution in the study area.

Frugivorous Birds (Wompoo Fruit-Dove, Rose-crowned Fruit-Dove, Superb Fruit-Dove and Barred Cuckoo-Shrike)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

None of these threatened frugivorous bird species were recorded in the study area during the survey, although based on the presence of lowland rainforest and a diversity of fruiting tree species individuals may potentially occur. All species are wide-ranging and locally nomadic, capable of moving large distances between remnant vegetation is response to the sporadic availability of food resources.

These bird species forage on fruits from native rainforest trees and shrubs as well as the introduced Camphor Laurel. Therefore, these species are threatened primarily by the destruction of habitat by clearing for urban development and agriculture.

The proposed Cudgera Creek Road upgrade would involve removal of a small percentage of native tree species from the study area, as discussed previously in the report. No Figs or other fruiting tree species would be removed and these food resources would be retained at the site post-construction. Therefore the current potential for this species to forage in the study is considered to remain following the road upgrade works.

The proposed road upgrade work is considered unlikely to significantly disrupt the life-cycle of these frugivorous birds such that any viable local population would be placed at risk of extinction. (b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No consideration under this part of the assessment is required.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

For the purposes of this assessment and the '8-part test' the 'region' referred to in part (c) is the entire North Coast Biogeographic Region. These species exhibit broad distributional ranges, which encompass large areas of the Bioregion including the study area. Indeed the area of habitat addressed within this assessment (ie. the study area) constitutes only a fraction of the area of known habitat for these species within this 'region'. Furthermore, whilst the study area is expected to provide important habitat resources and assist in life-cycle events for these species, thus contributing as an area of potential habitat, such resources are not solely restricted to the study area and are well replicated throughout the locality and 'region'. Therefore the study area is not considered to be a significant area of known habitat in relation to the regional distribution of habitat for these species.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

The area of lowland rainforest occurring at the Cudgera Creek Road site is currently isolated from other connecting vegetation in the study area. The vegetation exists as a narrow linear strip which continues along the creek to the south as far as the newly constructed Pacific Highway and to the north about 300-400m from the proposed new bridge, where it is replaced by cleared agricultural lands, and small areas of regrowth rainforest with occasional isolated rainforest trees. The Proposal includes a narrow bridge through a disturbed area of rainforest and includes revegetation of currently cleared areas. The bridge would separate an area of interconnecting vegetation, however this narrow interruption to the continuity of the vegetation is unlikely to significantly impact on the movements of these highly mobile bird species, particularly as they are known to travel large distances between patches of remnant forest in search of seasonally available food resources.

The proposal includes decommission of the existing Cudgera Creek Road bridge and revegetating the formerly disturbed area, effectively resulting in no net loss of vegetation and no change to the current fragmentation of the corridor.

(e) Whether critical habitat will be affected

No assessment under this part is required.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

For the purposes of this assessment and the '8-part test' the 'region' referred to in part (f) is the entire North Coast Biogeographic Region. Considering the extensive amount of lowland and subtropical rainforest, which has been historically cleared from the region, it is reasonable to suggest that to a degree the habitat of these species is inadequately represented in conservation reserves in the 'region'.

However, these factors are unlikely to reflect a significant concern in relation to the proposal, as the habitats that are represented do not constitute a significant area of known habitat for these species.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Of the key threatening processes listed in the TSC Act, the clearing of native vegetation probably has the most potential impact on these birds, particularly where this involves removal of important food resources. The Proposal has been designed to avoid extensive vegetation removal and is unlikely to reduce food resources for these species from the study area.

One further issue to consider relating to this proposal and in assessing the impact on threatened species associated with land clearance, is the proposal for revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road. If carried out effectively, this proposal would more then compensate for the minimal loss of vegetation and would in fact increase the current area of rainforest at the site.

In conclusion, the proposed road upgrade is not expected to significantly increase the incidence of designated threatening processes listed on Schedule 3 of the *TSC Act*.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

None of these wide-ranging frugivorous bird species is at the limit of their distribution in the study area. Although being rainforest specialists the distribution of these species is dictated by the distribution of lowland and in particular sub-tropical rainforest. All four species approach the southern limit or their stronghold areas around the north coast of NSW, however sporadic occurrences have been documented as far south as Sydney.

Giant Barred Frog (Mixophyes iteratus)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The species was not recorded during the survey, however potential habitat is present at the site and associated with the creek habitat along Cudgera Creek. However whilst this area represents potential habitat, the presence of a viable local population of the species is doubtful considering the small size of the remnant and the complete isolation of the vegetation and lack of records from the study area.

The potential impacts on this species would be associated with removal of vegetation and construction of the new bridge. The construction would only temporarily modify a small section of the creek and potential habitat would remain outside the construction area. The proposal is unlikely to disrupt the lifecycle of this species such that a viable local population would be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No consideration under this part of the assessment is required.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The study area does not constitute an area of regional significance for this species. Recent surveys in the north coast region identified the species from only three locations with the largest populations occurring in Mebbin State Forest (Goldingay *et al* 1999). It is evident that better quality habitat occurs in the larger rainforest remnants of the north coast. Minimal vegetation removal and tree lopping is unlikely to cause a regionally significant loss of habitat for this species.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

The area of lowland rainforest occurring at the Cudgera Creek Road area is currently isolated from other connecting vegetation in the study area. The vegetation exists as a narrow linear strip which continues along the creek to the south as far as the newly constructed Pacific Highway and to the north about 300-400m from the proposed new bridge, where it is replaced by cleared agricultural lands, and small areas of regrowth rainforest with occasional isolated rainforest trees. The proposal includes a narrow bridge through a disturbed area of rainforest and includes revegetation of currently cleared areas. The bridge will separate an area of interconnecting vegetation, however this narrow interruption to the continuity of the vegetation is unlikely to significantly impact on the

movements of this species as it would not permanently modify or disrupt the natural stream flow within the potential habitat of the species.

The proposal includes decommission of the existing Cudgera Creek Road bridge and revegetating the formerly disturbed area, effectively resulting in no net loss of vegetation and no change to the current fragmentation of the corridor.

(e) Whether critical habitat will be affected

No assessment under this part is required.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

The conservation status of this species is poorly known. A population is currently contained in Mebbin State Forest (Goldingay *et al* 1999). However, large areas of suitable habitat have been cleared for agriculture and settlement and records are infrequent. The species cannot be considered adequately conserved at present based on the available data.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Of the key threatening processes listed in the TSC Act, the clearing of native vegetation and alteration to the natural flow of streams probably has the most potential impact on this species. The Proposal has been specifically designed to avoid vegetation clearance and the proposed bridge structure would not permanently modify or disrupt the natural flow regime of the creek.

One further consideration relating to this proposal and in assessing the impact on threatened species associated with land clearance, is the proposal for revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road. If carried out effectively, this proposal would more then compensate for the minimal loss of vegetation and would in fact increase the current area of rainforest at the site.

In conclusion, the proposed road upgrade is not expected to significantly increase the incidence of designated threatening processes listed on Schedule 3 of the *TSC Act*.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Giant Barred Frog is distributed on the coast and ranges from south-eastern Qld to the Hawkesbury River in NSW and is not at its distributional limit in the north coast of NSW.

Three-toed Snake-tooth Skink (Coeranoscincus reticulatus)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The species was not recorded during the survey, however potential habitat is present at the site and associated with the lowland rainforest along Cudgera Creek. However whilst this area represents potential habitat, the presence of a viable local population of the species is doubtful considering the small size of the remnant and the complete isolation of the vegetation and lack of records from the study area.

The potential impacts on this species would be associated with removal of vegetation including logs and fallen timber that provide sheltering resources. The construction would only temporarily modify a small section of the creek and potential habitat will remain outside the construction area. The proposal is unlikely to disrupt the life-cycle of this species such that a viable local population would be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

No consideration under this part of the assessment is required.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The study area does not constitute an area of regional significance for this species. The distribution of the species includes rainforest and wet sclerophyll forest in the northern rivers area and south-eastern Queensland area. There are no recent records from the Cudgera Creek area, and given the very small and isolated area of lowland rainforest at the site, this habitat is unlikely to be regionally significant.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas for a threatened species, population or ecological community

The area of lowland rainforest occurring at the Cudgera Creek Road area is currently isolated from other connecting vegetation in the study area. The vegetation exists as a narrow linear strip which continues along the creek to the south as far as the newly constructed Pacific Highway and to the north about 300-400m from the proposed new bridge, where it is replaced by cleared agricultural lands, and small areas of regrowth rainforest with occasional isolated rainforest trees. The proposal includes a narrow bridge through a disturbed area of rainforest and includes revegetation of currently cleared areas. The bridge will sever an area of interconnecting vegetation, however this narrow interruption to the continuity of the vegetation is unlikely to significantly impact on this species.

The proposal includes decommission of the existing Cudgera Creek Bridge and revegetating the formerly disturbed area, effectively resulting in no net loss of vegetation and no change to the current fragmentation of the corridor.

(e) Whether critical habitat will be affected

No assessment under this part is required.

(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or other similar protected areas) in the region

The conservation status of this species is poorly known. However, large areas of suitable habitat have been cleared for agriculture and settlement and records are infrequent. The species cannot be considered adequately conserved at present based on the available data.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Of the key threatening processes listed in the TSC Act, the clearing of native vegetation probably has the most potential impact on this species. Additionally the removal of dead wood, logs and dead trees may also significantly threaten local populations of this species. The proposal has been specifically designed to minimise vegetation removal and only minimal disturbance to fallen timber would result. Microhabitat features potentially used by this species are well represented outside the construction areas.

One further consideration relating to this proposal and in assessing the impact on threatened species associated with land clearance, is the proposal for revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road. If carried out effectively, this proposal would more then compensate for the minimal loss of vegetation and would in fact increase the current area of rainforest at the site.

In conclusion, the proposed road upgrade is not expected to significantly increase the incidence of designated threatening processes listed on Schedule 3 of the *TSC Act*.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Three-toed Snake-tooth Skink has a restricted distribution that includes the forest areas of the coast and adjacent ranges of the northern rivers district, northeastern NSW and south-eastern Qld (Cogger 1996). The study area is within this restricted area, although no recent records are noted.

Conclusion

The conclusion of this 8-part test indicates that this Proposal would not significantly impact on local populations of threatened terrestrial fauna species identified at the Cudgera Creek study area or considered to potentially occur. The conclusion is based on the currently proposed road and bridge location, which has been specifically designed to traverse through a narrow disturbed part of the creek and would involve minimal disturbance to the vegetation at the site.

5.3 Environment Protection and Biodiversity Conservation Act, 1999

Actions that have the potential to significantly impact matters of national environmental significance (NES) need to be subject to rigorous assessment and approval under the provisions of this Act. The matters of NES identified in the Act that trigger the Commonwealth assessment and approval regime are listed as follows:

- □ World Heritage Properties;
- □ Ramsar wetlands;
- □ Nationally threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- □ Nuclear actions (including uranium mining).

To determine whether the proposal is likely to require assessment under the provisions of the *EPBC Act*, this investigation used the following methods:

- 1) Determination as to whether the action is likely to have a significant impact on a matter of NES or the environment of Commonwealth land
- 2) Using the information compiled on the above triggers, a conclusion has been drawn regarding the potential impacts of the proposal on matters of national environmental significance or Commonwealth land.

The study area is not Commonwealth land and no areas of Commonwealth land occur in proximal or inter-connecting habitats.

Discussion of the Matters of NES in relation to the proposal is presented in **Table 5-1**.

■ Table 5-1 Assessment of Matters of National Environmental Significance with regard to the proposal

Matter of National Environmental Significance	Comments relevant to the Proposal		
World Heritage Properties	The study area is not located near any World Heritage Property. Three World Heritage Properties are listed for New South Wales (Willandra Lakes, Central Eastern Rainforest Reserves and Greater Blue Mountains Area). These are all located considerable distances from the study area. No direct or indirect impacts on World Heritage Properties would result from the proposed works		
Ramsar wetlands	Nine Ramsar wetlands are listed for New South Wales (Towra Point NR, Kooragang NR, Macquarie Marshes NR, Little Llangothlin NR, Blue Lake, Lake Pinaroo, Gwydir Wetland, Myall Lakes, Narran Lakes NR). None of these occur in, near or downstream of the study area. There would be no impact on listed Ramsar wetlands because of the proposed works		
Nationally threatened species and ecological communities	The results of the search indicate that there are 20 nationally threatened species potentially occurring within the study area. These are:		

Matter of National Comments relevant to the Proposal **Environmental Significance** Coxen's Fig Parrot (Cyclopsitta diophthalma coxeni) Swift Parrot (Lathamus discolor) Black-throated Finch (Poephila cincta cincta) П ☐ Black-breasted Button-quail (*Turnix melanogaster*) Large Pied Bat (Chalinolobus dwyeri) ☐ Spotted-tail Quoll (Dasyurus maculatus maculatus) ☐ Long-nosed Potoroo (Potorous tridactylus tridactylus) Grey-headed Flying Fox (Pteropus poliocephalus) Corokia whiteana ☐ Stinking Cryptocarya (Cryptocarya foetida) Davidson's Plum (Davidsonia pruriens var. jerseyana) ☐ Davidsonia sp. Small-leaved Tamarind (Diploglottis campbellii) ☐ Bopple Nut (Hicksbeachia pinnatifolia) ☐ Macadamia Nut (Macadamia tetraphylla) ☐ Southern Ochrosia (Ochrosia moorei) Spiny Gardenia (Randia moorei) ☐ Red Lilly Pilly (Syzygium hodgkinsoniae) ☐ Coolamon (Syzygium moorei) ☐ Arrow-head Vine (*Tinospora tinosporoides*) Several of these species were identified at the Cudgera Creek study site including, Ochrosia moorei, Randia moorei, Hicksbeachia

Several of these species were identified at the Cudgera Creek study site including, Ochrosia moorei, Randia moorei, Hicksbeachia pinnatifolia, Syzygium moorei, Syzygium hodgkinsoniae, and Macadamia tetraphylla. Also potential habitat exists for the Greyheaded Flying-fox. Coxen's Fig Parrot is considered to be locally extinct and is unlikely to occur in the study area.

The guidelines within the EPBC Act were reviewed in terms of assessing the potential impacts on these nationally threatened species. The assessment considers whether the action is likely to have a significant impact on a threatened species if it is likely to:

 Lead to a long-term decrease in the size of an important population of a species.

The results of the survey indicate that six nationally threatened flora species have been identified at the study site. The proposal would not involve removal of any of these individual plants nor would it lead to the long-term decrease in a population of these species as the disturbance would be temporary only.

2. Reduce the area of occupancy of an important population

Whilst a small area of vegetation would be removed for the proposed bridge and road approaches, this would not result in the loss of an area currently occupied by a nationally threatened species.

Fragment an existing important population into two or more populations

The proposed bridge and road through the lowland rainforest would dissect the vegetation to a small degree, however this is not considered a significant fragmentation of the community. This is based on the fact that the community is currently fragmented by an existing bridge that will be decommissioned and the area revegetated and the fact that the small area of vegetation removal is unlikely to significantly disrupt future seed dispersal and recruitment of rainforest species to the north and south of the bridge.

4. Adversely affect habitat critical to the survival of a species

There is a register of critical habitat in the EPBC Act and only three locations are listed, none of which relate to the study area.

5. Disrupt the breeding cycle of an important population

It is likely that seed dispersal is via flowing water along the creek as well as birds and bats feeding on fruits of rainforest trees. Therefore, it

Matter of National Environmental Significance

Comments relevant to the Proposal

would be necessary to ensure that flow within the creek is not impeded by the proposed bridge construction and this is recommended. As the vegetation would not be isolated or severed, pollinators would still have access to the population. It is not considered that there would be any significant impacts on the breeding cycle of the population, however, the protective measures identified would ensure that any potential impacts are prevented. The proposal would not impact on a roosting colony of the Grey-headed Flying-fox nor remove potential foraging habitat for this species.

 Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed road alignment avoids the nationally threatened flora species identified from the study. As part of the road upgrade it is proposed to rehabilitate formerly cleared areas thereby actually increasing the availability of habitat which more then compensates for the small area to be cleared. The proposal would not involve significant declines in populations of threatened plants recorded at the site.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the threatened species habitat

Camphor Laurel is a significant invasive species that currently occurs in the lowland rainforest habitat at the site. It is recommended that future rehabilitation areas consider the removal and future invasion of this species. As the proposal involves only minimal vegetation removal and tree lopping to accommodate the bridge and road approaches, this are is not expected to be threatened by weed invasion. Furthermore, the proposed revegetation of the site post-construction may assist in reducing the potential future colonisation of Camphor Laurel.

8. Interferes substantially with the recovery of the species

Currently there are no species recovery plans produced for these species, however it is considered that the proposed safeguards outlined under previous criteria would ensure that the populations are protected, such that no interference with the recovery of the species occurs as a result of the proposal.

The proposal is not likely to result in any impacts on nationally threatened species and no further provisions of this Act apply to the proposal in relation to threatened species.

No nationally threatened ecological communities exist within 1 km of the study area.

Migratory species

There are 9 migratory species potentially occurring within the study area.

The terrestrial species covered by migratory provisions of the EPBC Act are:

- ☐ Coxen's Fig-Parrot (Cyclopsitta diophthalma coxeni)
- ☐ White-bellied Sea-Eagle (Haliaeetus leucogaster)
- ☐ White-throated Needletail (*Hirundapus caudacutus*)☐ Black-faced Monarch (*Monarcha melanopsis*)
- ☐ Spectacled Monarch (Monarcha trivirgatus)
- ☐ Satin Flycatcher (Myiagra cyanoleuca)
- ☐ Rufous Fantail (Rhipidura rufifrons)

The wetland species covered by the migratory provisions of the Act are:

- ☐ Latham's Snipe (Gallinago hardwickii)
- ☐ Painted Snipe (Rostratula benghalensis)

The proposal is not likely to create any direct or indirect impacts on migratory species. No direct impacts on estuarine or inter-tidal habitats are envisaged as a result of the proposed works, especially as appropriate control measures would be adopted to minimise loss of riparian and aquatic habitats and preserve water quality. Furthermore,

Matter of National Environmental Significance	Comments relevant to the Proposal		
	the proposal is not likely to affect the prey base of migratory species in the locality and the current population size and visitation rates of migratory species in the locality are likely to be maintained.		
Commonwealth marine areas	The proposal would not result in the modification or disruption of any Commonwealth marine areas		
Nuclear actions	The proposal is not a nuclear action.		

The Administrative Guidelines for determining whether an action has, will have, or is likely to have a significant impact on a matter of national environmental significance under the EPBC Act 1999, was consulted and reviewed in relation to the findings of this study. This has enabled determination as to whether the project requires a referral to the Environment Minister.

The guidelines indicate that in determining the nature and magnitude of an action's impact, it is important to consider matters such as:

- □ All on-site and off-site impacts;
- □ All direct and indirect impacts;
- ☐ The frequency and duration of the action;
- The total impact which can be attributed to that action over the entire geographic area affected and over time;
- The sensitivity of the receiving environment; and
- ☐ The degree of confidence with which the impacts of the action are known and understood.

This assessment indicates that listed matters of NES would not be significantly modified, disrupted or affected as a result of the proposed works. Consequently, the proposed action is not likely to have a significant impact on a matter of NES or the environment of Commonwealth land. Recommendations presented in the following section of the report are considered appropriate in protecting and enhancing the Lowland Rainforest identified at the study area which provides an area of core habitat for several nationally threatened plant species identified during this survey.

5.3.1 Key Threatening Processes

Of the key threatening processes listed in the EPBC Act, those relevant to the proposal include land clearance, predation by feral cats and predation by the European Red Fox.

The issue of land clearance was addressed in the 8-part test assessments for threatened species (section 5.2). It was concluded that the percentage of land clearance required would be minimal and not significant to the overall value of the vegetation on site. Furthermore, the proposed revegetation and rehabilitation of the site around the existing bridge and between the existing road and the proposed new road would more then compensate for the minimal loss of vegetation and would in fact increase the current area of rainforest at the site.

Predation by feral animals is expected to currently occur at a relatively high rate, given the history of the land and the extent of disturbance including the presence of the existing Cudgera Creek Road. The proposal is not expected to increase the rates of predation to levels higher than currently exist. Nonetheless, the RTA have proposed some follow-up control programs for foxes and feral cats at the site; and these are discussed in Section 7 of the report.

5.4 Fisheries Management Act, 1994

Section 5.4 addresses information required to satisfy an assessment of impact under the *Fisheries Management Act 1994*, the *Fisheries Management Amendment Act 1997*, the Fish Habitat Protection Plan No.1 and the document *Policy and Guidelines – Aquatic Habitat Management and Fish Conservation* (NSW Fisheries 1998).

The aims of the aquatic habitat assessment were to:

- Describe the type and nature of the watercourse:
- □ Evaluate the presence of fish habitat within Cudgera Creek; and
- Devise a list of threatened aquatic species regarded as potential subject species.

An assessment of the habitat value of Cudgera Creek is presented below.

Watercourse	Cudgera Creek			
Geomorphology	Shallow, permanent watercourse, with some moderately deep pools. Low flow at the time of the survey.			
Water quality	Moderate, no obvious pollutants			
Land use	Surrounding sugar cane and pasture grasses. Small pockets of remnant lowland rainforest retained along the creek			
Riparian vegetation Moderately dense; narrow and linear Lowland Rainforest with a perc Camphor Laurel				
Instream wetlands	None near the study area			
Nearby wetlands	The lower reaches of Cudgera Creek to the east of the site comprise shallow well-vegetated wetlands.			
Sub-stratum	Alluvial (silt and mud)			
Refuge areas	Moderate: relatively deep sections with aquatic vegetation providing refuge small fish and aquatic vertebrates. Submerged logs and steep banks			
Spawning areas	Limited areas: some aquatic vegetation			
Barriers	Silted and weed encroached areas provide natural barriers. Also several large logs and snags provide barriers.			
Native Fish Species	Four native fish species and one eel species were identified in the creek, including the Ornate Rainbow Fish, Striped Gudgeon, Firetail Gudgeon, Empire Gudgeon and Short-finned Eel. Three crustacean species were also recorded. Aquatic faunal diversity is reasonably well development, considering impacts to the creek.			
Critical habitat/ Threatened fish	No critical habitat has been declared for fish habitat within NSW. The upper reaches of Cudgera Creek are unlikely to provide habitat for threatened fish species known from the area, although is of value to locally common fish species. Suitable habitat for threatened fish may occur in lower reaches to the east of the site and close to the coast.			
Classification	Class 1 – Major Fish Habitat			

5.4.1 Threatened Aquatic Fauna

No threatened fish species as scheduled in the FM Act were identified from the Cudgera Creek study site. Based on the documented distribution of all of the freshwater fish species (NSW Fisheries 1998; Allen *et al* 2002) and on the documented habitat requirements of these species, it is considered that none of the listed fish species are likely to occur in the upper reaches of Cudgera Creek.

Considering that the type of development proposed will not impede or impact on the known or potential habitat of a threatened species or ecological community as listed in the *Fisheries Management Act* 1994, no '8-part test' assessment of impact is required under Schedules 4 and 5 of the Act. Further, the study area does not contain 'critical habitat' as listed in the *Threatened Species Conservation Act*, 1995.

5.4.2 Key Threatening Processes

Schedule 6 of the *Fisheries Management Act*, relates to Key Threatening Processes and lists three of these being:

- 1. The introduction of fish to fresh waters within a river catchment outside their natural range
- 2. The removal of large woody debris
- 3. The degradation of native riparian vegetation along New South Wales water courses

Of these processes, points 1 and 2 do not relate to the proposed Cudgera Creek Road Upgrade. The proposal would not involve removal of large woody debris or the introduction of fish to the creek.

In relation to point 3, the proposal includes a bridge construction across Cudgera Creek. Some disturbance to riparian vegetation at the crossing site is likely, however the proposal would not involve permanent modification or disruption to the natural flow regime within the creek. The proposed road alignment as been specifically designed to traverse a narrow disturbed section of riparian vegetation which would involve minimal removal of riparian vegetation.

5.4.3 Policy and Guidelines for Aquatic Habitat Management and Fish Conservation

The legislative requirements of the *Fisheries Management Act* provide a series of policies and guidelines designed to mitigate the impacts of certain activities and developments on aquatic habitat (NSW Fisheries 1999). These guidelines are relevant to construction of the proposed Cudgera Creek Road upgrade and associated bridge construction. Therefore the implications for development and the need to adhere to these guidelines are discussed below.

Despite the absence of threatened fish species from the habitats within Cudgera Creek, this habitat is considered to be an important coastal habitat for native fish, other aquatic vertebrates and invertebrates and semi aquatic bird species. The water quality and habitats of the creek are currently in a moderate to good condition and are likely to be higher quality downstream in low-lying coastal areas. If carried out indiscriminately, the proposed road and bridge construction has potential to impact on the fish habitats within the creek and it is considered imperative that the proposed construction considers the sensitivity of this environment.

Stream Classification

Cudgera Creek has been classified as a Class 1 waterway (NSW Fisheries 1999), providing major fish habitat. This classification is based on the characteristics of the creek, and known presence of freshwater aquatic vegetation and native fish.

The proposed Cudgera Creek Road deviation and bridge has been specifically designed to minimise the area of riparian vegetation requiring removal. Further provisions have been made to stabilise the banks near the construction and rehabilitate disturbed areas, including decommission and revegetation of the current bridge and road alignment.

Policies and Guidelines

The following information outlines the background and NSW Fisheries legislation, policies and guidelines to mitigate the impacts of roads, causeways, culverts and similar structures on aquatic habitats. NSW Fisheries must be informed under Part 7 (3, 4, 5 and 8) of the *Fisheries Management Act* about the construction of any bridges, roads, causeways, culverts, pipelines, cables and similar structures that impinge upon or are adjacent to (within 50m) aquatic habitats. This policy relates to the proposed Cudgera Creek Road upgrade project.

Section 5.4.3 of the Aquatic Habitat Management document (NSW Fisheries 1999) details the <u>Policies</u> for bridges, roads, causeways, culverts and similar structures, which states that:

- Roads and bridges must be constructed to minimise habitat loss, changes in sediment transport and stream siltation, and to maintain natural tidal exchange or river flow.
- A bridge is preferred over a causeway or culvert to cross a stream or tidal creek
- Where a culvert structure is constructed, large box culverts are preferred to round pipes
- There should be no drop, or 'waterfall', at the end of a structure. The water levels above and below the crossing should be the same.

Section 5.4.4 of the Aquatic Habitat Management document (NSW Fisheries 1999) details the <u>Guidelines</u> for bridges, roads, causeways and similar structures, which states that:

- ☐ The cross-sectional area of the box culverts should equal or exceed the cross-sectional area of the stream, to avoid funnelling the flow and creating any difference in hydraulic head across the structure (ie. use three or four sets of culverts placed side by side rather than one).
- The structures should be as wide across the stream and narrow along the length of the stream as possible to maximise water flow and to minimise discontinuities. Maximum length should be 10 metres so that fish are not required to swim through dark passages.
- The culvert should be placed as level as possible to ensure that the water flow velocities through the culvert do not exceed 0.25 metres per second during low flows or that natural flows are maintained.
- □ The base of the culvert should be set into (rather than on) the stream bed so that natural sediments (mud, sand, gravel, etc.) can cover the bottom, providing a less alien habitat. The impacts can be further minimised by adding a few large rocks to the base of the culvert.
- ☐ A tunnel may be a viable alternative to a bridge, road or pipeline crossing of a waterway

It is proposed to construct a two lane bridge 27.614 metres in length and a minimum 11 metres wide between kerbs. The bridge would not involve disturbance to the creek substrate and no alterations to natural water flow.

The design parameters in general satisfy the policies and guidelines as are set out and documented above. A number of factors concerning the proposed bridge construction suggest that minimal disturbance to the stream passage will occur and that the impacts on aquatic vertebrate species and riparian vegetation will also be minimal. These factors are:

☐ The road deviation and bridge has been designed to minimise habitat loss, changes in sediment transport and stream siltation, and to maintain natural water flow.

Fish Habitat Protection Plan No.1

To assist in the protection of key fish habitats, the *Fisheries Management Act* enables to formation of fish habitat protection plans. The first of these plans, the Fish Habitat Protection Plan No.1 applies to the following developments, works or activities, each of which can impact on fish habitat (NSW Fisheries 1998):

- dredging or reclamation
- □ impeding fish passage;
- damaging marine vegetation; and
- desnagging

The proposed Cudgera Creek Road upgrade would not involve any of these activities and would not compromise the integrity of the habitat for resident native fish species, other aquatic vertebrates and invertebrates.

Conclusion

The proposed Cudgera Creek Road upgrade and bridge construction has been specifically designed to minimise the severity of impacts on the aquatic habitats and riparian habitat associated with Cudgera Creek. The condition of the habitat and vegetation is considered moderate to good condition with some impacts from surrounding agriculture and weed invasion evident.

The quality of the habitat for native fish and amphibian species is considered good and the stream has been classified as Class 1 providing major fish habitat. However, the area is not declared critical habitat or indeed is considered to provide potential habitat for threatened fish or aquatic invertebrate species as listed in the *Fisheries Management Act* 1994.

The assessment addresses relevant design parameters for the road and bridge construction and assesses the potential impacts of the construction on the existing aquatic habitat with particular reference to standard sediment and nutrient runoff controls. The road deviation and bridge have been designed to minimise habitat loss, changes in sediment transport and stream siltation, and to maintain natural water flow.

5.5 National Parks and Wildlife Act, 1974

Schedule 13 generally relates to the prohibition of taking of listed plants for commercial or private purposes. It generally lists species that are known to have commercial values but which are not regarded as threatened. No Schedule 13 plants have been listed as occurring in the study area and the degraded nature of the vegetation would generally limit the potential occurrence of these species. There is unlikely to be any significant loss of Schedule 13 plants and no specific management regime is required for Schedule 13 plants.

5.6 SEPP 14 - Coastal Wetlands

The proposed development would not directly affect any listed SEPP 14 Wetland and no further provisions of the policy apply.

5.7 SEPP 26 - Littoral Rainforests

No designated SEPP 26 littoral rainforests occur within the study area or surrounds. There would be no disruption of listed Littoral Rainforests and no further provisions of this policy apply to the development proposal.

5.8 SEPP 44 - Koala Habitat Protection

The proposal is Part V matter under the *EP&A Act* and there is no legislative requirement for assessment under SEPP 44 - Koala Habitat Protection. However, Koalas and their habitats are a significant ecological issue in the north coast area and an assessment under the provisions of this policy has been undertaken.

An assessment as to whether the study area constitutes Potential Koala Habitat (PKH) forms the first stage of the Koala Habitat Assessment. PKH is defined as 'areas of native vegetation where the trees of types listed in Schedule 2 (of SEPP 44) constitute at least 15% of the total number of trees in the upper and lower strata of the tree component' (SEPP No. 44).

No Koala food tree species listed on Schedule 2 occur within the investigation area and no records of koalas occur within the lowland rainforest habitat associated with the site. Therefore the area does not constitute potential or core koala habitat and no further provisions to the policy apply.

In conclusion, no impacts on Koalas are envisaged as a consequence of the proposed works.

6. Summary

The ecological assessment report presents the results of a literature review and field survey to identify the intrinsic biodiversity of the upper reaches of Cudgera Creek and surrounding study area. The information has been used to assess the significance of impacts on threatened species and endangered ecological communities associated with the proposed upgrade of the existing Cudgera Creek Road.

The study area has a broad history of occupation from clearing for dairy farming and grazing practices to more recently sugar cane production. The large majority of the proposed works area traverses cleared and productive farming land with little native vegetation. A narrow linear strip of vegetation has been retained along Cudgera Creek, which comprises Lowland Rainforest.

The survey identified a high floral species diversity despite the small area of remnant vegetation present and the extent of past clearing. A total of one hundred and fifty-three (153) flora species from seventy-seven (77) families were identified from the study area.

A total of fifty-one (51) terrestrial fauna species were identified at the site comprising five (5) mammal species, five (5) frog species, ten (10) reptile species and thirty-six (36) bird species. The results of the fish survey revealed a total of four (4) native fish species, three (3) crustaceans and one (1) eel species.

Overall, the floral and faunal species diversity and abundance was found to be well developed. This exists despite the obvious historical impacts from extensive clearing of lowland rainforest to establish agriculture, in addition to the high level of disturbance experienced by weed invasion and the presence of introduced domestic and/or feral animals.

The area of Lowland Rainforest associated with Cudgera Creek is classified as an Endangered Ecological Community as scheduled in the *Threatened Species Conservation Act*. At the site, this community extends along Cudgera Creek to the south as far as the newly constructed Pacific Highway and to the north for approximately 300-400 metres from Cudgera Creek Road where it is replaced by cleared grassland with occasional remnant rainforest trees.

Lowland Rainforest is not limited to the Cudgera Creek study area and indeed comparable rainforest habitats occur in several locations within the broader study area as identified in the EIS for the Yelgun to Chinderah Pacific Highway Upgrade (Sinclair Knight Merz 1998). Landmark *et al* (1999) suggests that only small remnants of rainforest remain on the coastal ranges and plains of northeast NSW. Particularly on the fertile flood plains, the large majority of rainforest has been cleared for timber and agriculture. Small remnants retained for creek bank protection such as at Cudgera Creek represent significant vegetation worthy of conservation, hence the status as an endangered ecological community.

The lowland rainforest supports eight threatened flora species and one threatened terrestrial fauna species as scheduled in the *Threatened Species Conservation Act 1995*. Six of the eight flora species are also listed a nationally threatened species under the provisions of the *Environment Protection and Biodiversity Conservation Act*,

1999. An additional eight threatened fauna species are considered to potentially occur at the site. No threatened fish species as scheduled in the *Fisheries Management Act* 1994 were identified at the site or would be expected to occur, based on the absence of suitable habitat. No threatened species were recorded in cropland, pasture, or modified areas.

This report provides a flora and fauna inventory and ecological assessment under the provisions of the relevant New South Wales and Commonwealth legislation. The assessment discusses and illustrates the distribution on site of those threatened species recorded during field surveys. The conclusion of this assessment indicates that this proposal would not significantly impact on local populations of threatened flora and fauna species or the area of Lowland Rainforest identified at the Cudgera Creek study area. The conclusion is based on the currently proposed road footprint, which has been designed to avoid threatened plants and traverse through a narrow disturbed part of the creekline vegetation and the construction specifications which would avoid disruption to the natural flow regimes with Cudgera Creek.

Whilst no significant impacts on the local biodiversity of Cudgera Creek are envisaged, given the significance of the vegetation at the site, consideration should be given to avoiding any on-site and downstream impacts. Several protective measures have been proposed in the following section of the report which if implemented in the design and construction of the road upgrade project should assist in avoiding impacts.

The proposal includes decommission of the existing Cudgera Creek Road bridge and revegetating the formerly disturbed area, effectively resulting in no net loss of vegetation and no change to the current fragmentation of the corridor.

7. Recommended Mitigation Measures

The nature of this proposal and prior planning for the locations of the road deviation suggests that it is unlikely to impose an adverse impact on the overall biodiversity of the site or individual flora and fauna populations found to be present. However particular care and consideration should be given during the construction works in order to further minimise threats and conserve areas of specific value to threatened species and the endangered ecological community (lowland rainforest).

1. Protection of Existing Vegetation

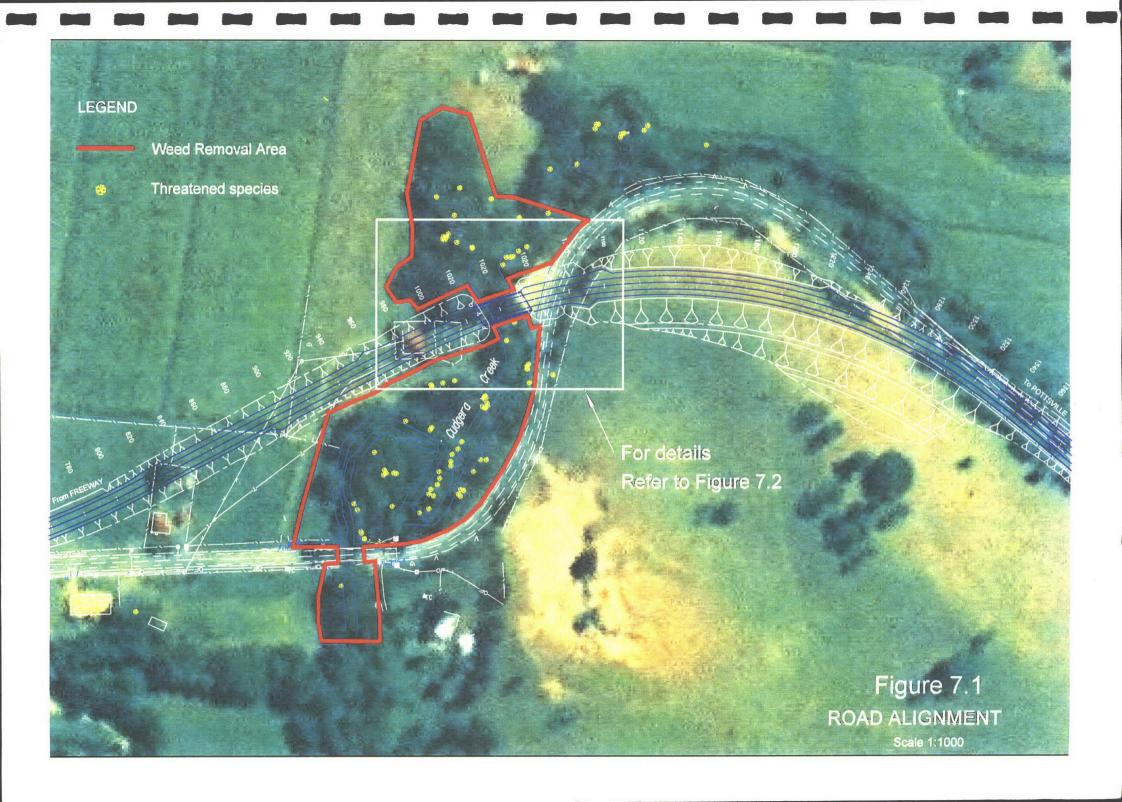
Following are recommendations in regard to protection of the existing native vegetation in the proposed development area during the construction phase:

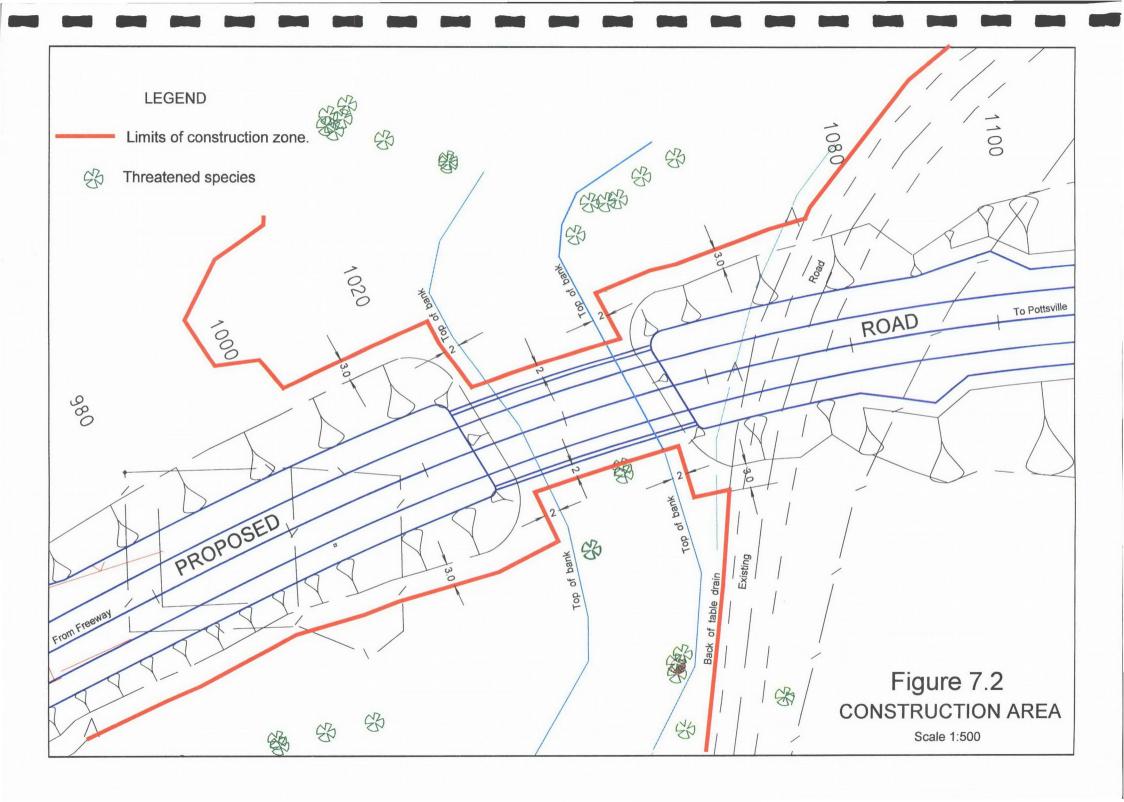
- a. The limits of the proposed bridge and road approach area should be identified in the field within the densely vegetated areas either side of Cudgera Creek and construction of the road should be limited to this footprint. The limits are shown in **Figure 7.1 and 7.2** and are:
 - ☐ Maximum two (2) metres from the southern and northern parapets of the proposed bridge
 - ☐ Minimum two (2) metres from the top of the banks of Cudgera Creek;
 - ☐ Maximum of three (3) metres from the toe of fills on the approach works that are adjacent to the rehabilitation area.
- b. Areas of native vegetation in proximity to construction areas should be fenced with protective fencing prior to work commencing in the area;
- c. Contractors should be instructed on the limits of clearing and not allowed to encroach into areas outside the identified road construction limits defined in **Figure 7.1** and behind the protective fencing. This includes preventing any materials or construction equipment from entering into protected areas;
- d. Protective fencing is to be placed around the *Randia moorei* and *Syzygium moorei* (Threatened Species) identified in proximity to the proposed bridge location prior to starting work in the construction area. The location of these plants is discussed in Table 4-1 of the report;
- e. Appropriate erosion and siltation mitigation measures are to be used in proximity to the creek and rainforest vegetation;
- f. All construction work is to be undertaken outside the 2 metre creek buffer areas defined in 1 a. above;

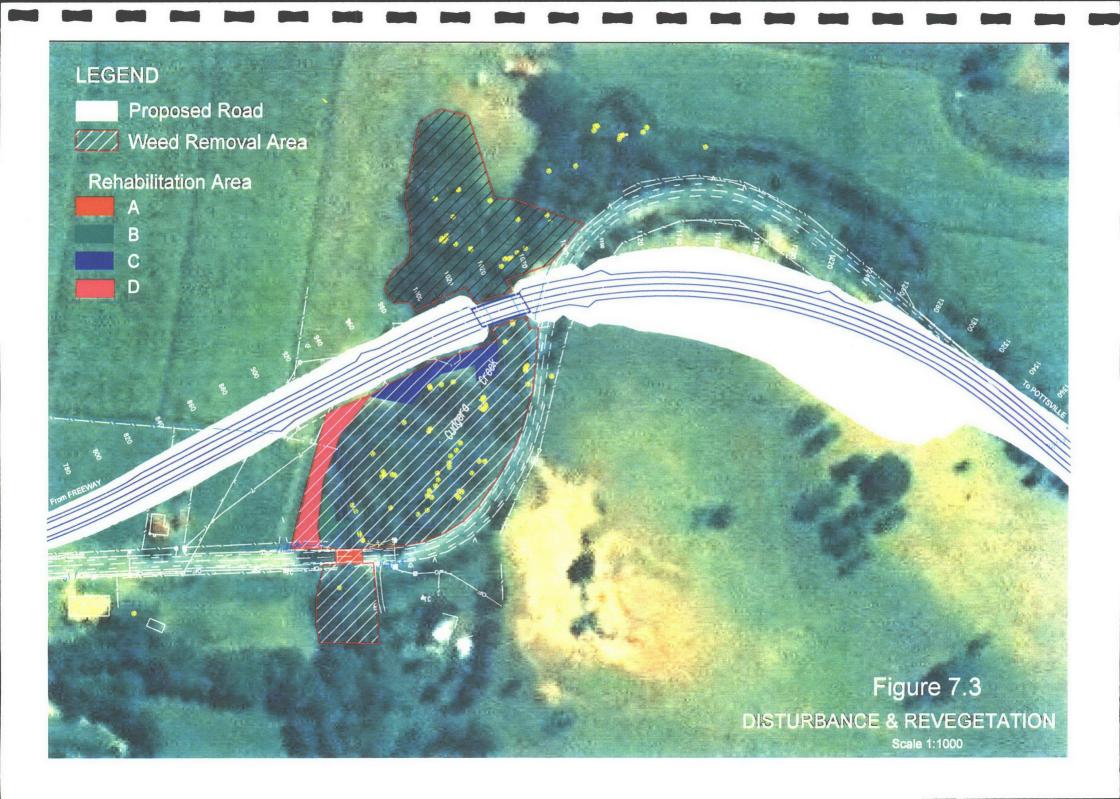
2. Post Construction Rehabilitation

a. As compensation for the small loss of rainforest associated with the proposal, and considering the importance of the community, the area between the existing Cudgera Creek Road and the newly proposed road (including the abandoned house and associated cleared areas) should be rehabilitated and revegetated with rainforest plant species as shown in **Figure 7.3**. The weeds in the hatched area up to 5 cm are to be cut down or poisoned using an appropriate herbicide. It is noted that some of the areas for weeding will be on private property, which is additional to the minimum area required for weeding. If agreement is not reached with the landowners no alternative areas will be considered for weeding;

- b. It is further recommended that following the removal of the existing bridge, then the area surrounding the bridge be rehabilitated and revegetated with locally indigenous rainforest species. This will require the preparation of a Rehabilitation Plan to be carried out in liaison with NPWS and NSWF. The preparation of the Rehabilitation Plan will be managed by the RTA and prepared by a suitably qualified contractor satisfying the NPWS and NSWF criteria. Close consultation will be required between NPWS, NSWF, RTA and the contractor during preparation of the Rehabilitation Plan.
- c. Plant species selection should complement existing rainforest areas, with species selection corresponding to the species listed in this report. Species that are most suitable for regeneration are to be included in the Rehabilitation Plan. Consideration should be given to the successional approach to planting such species and collection and use of local seed.
- d. The proposed road may involve removal of a small area of Coast Cypress Pine on the hill and existing road cutting to the east of the bridge. The Pines are to be identified and tagged prior to translocation. Appropriate methods should be employed to translocate this species if possible and / or replanting of Coast Cypress Pine from locally collected seed. The method for translocation is to be detailed in the Rehabilitation Plan.
- e. The revegetated area shall be maintained for a period of 2 years after completion of the roadworks.
- f. Suppression of weeds by poisoning in the Weed Removal Area shown in Figure
 7.1 shall continue for two years, at agreed intervals, after completion of the roadworks.
- g. The RTA has indicated their intention to carry out a follow-up control program for foxes and feral cats at the site. The program would involve limited trapping and poisoning of foxes and feral cats every six months over the 2-year maintenance period.







8. Concluding Remarks

This assessment has used the field survey results of Sinclair Knight Merz (1998) in addition to a follow-up field survey specific to the Cudgera Creek Road alignment to assess the impacts of the proposed upgrade of Cudgera Creek Road in terms of the relevant State and Commonwealth environmental legislation. It has concluded the following:

- Significant impacts on threatened species, ecological communities, populations and their habitats would be avoided. The planned location of the bridge crossing over Cudgera Creek will avoid the large majority of threatened plants identified on the site and will traverse a predominantly cleared and narrow section of the creek.
- 2. A narrow and linear strip of vegetation was identified along Cudgera Creek, whilst the remainder of the study area was found to comprise cleared, degraded and modified agricultural land of reduced significance to local biodiversity. The vegetation present along Cudgera Creek was identified as Lowland Rainforest on Floodplain (ie. classified as an Endangered Ecological Community under the provisions of the TSC Act). The proposed road deviation has been specifically designed to traverse a narrow section of the rainforest community and would not significantly modify or impact on the future integrity of this community. This is further reinforced by the proposal to decommission the existing bridge and rehabilitate the disturbed area and adjoining degraded areas.
- 3. A total of 8 different threatened plant species comprising a total of 89 individual plants were identified in the Lowland Rainforest Community along the small area of Cudgera Creek. The proposed road deviation has been specifically designed to avoid removal of any individual threatened plants identified from the survey and no threatened plant species will need to be directly removed.
- 4. One threatened terrestrial fauna species was identified from the Lowland Rainforest and a further nine threatened terrestrial fauna species were deemed potential study area inhabitants and 8-part tests were prepared for these. These assessments conclude that the proposed works are not likely to create significant impacts and a Species Impact Statement is not required. Several protective measures were devised that would further minimise and avoid potential ecological impacts. These are detailed in Section 7 of the report.
- 5. No threatened aquatic species (FM Act) were identified at Cudgera Creek and no threatened species are expected to occur.
- 6. Impacts on matters of National Environmental Significance as listed on the EPBC Act would be avoided
- 7. There are no constraints to the proposed works under the provisions of the Fisheries Management Act, National Parks and Wildlife Act, SEPP 14, SEPP 26 or SEPP 44.

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Appendix A Flora Species List

The following flora species list is provided to give an indication of the dominant species present within and adjacent to the study area and should not be seen to be fully comprehensive.

	NOTES ON SYMBOLS USED IN THE TABLE	
E	Indicates species listed as Endangered under the TSC Act 1995 (NSW)	
V	Indicates species listed as Vulnerable under the TSC Act 1995 (NSW)	
¥	Indicates species listed under the Commonwealth's EPBC Act 1999.	
k	Indicates introduced species.	

Indicates species listed as Noxious.

(*) Indicates non-indigenous native species.

Indicates species identification not confirmed.

N/L Indicates species is at or near northern limit of distribution.

Common Names other than Harden.

Botanical Nomenclature follows Harden (2002, 2000, 1993 and 1992) and subsequent recent revisions.

Species Name	Common Name	
CLASS LYCOPSIDA (Club Mosses)		
LYCOPODIACEAE		
Lycopodium deuterodensum	Bushy Club Moss	
CLASS FILICOPSIDA (Ferns)		
ADIANTACEAE		
Adiantum hispidulum	Rough Maidenhair Fern	
ASPLENIACEAE		
Asplenium attenuatum	Simple Spleenwort	
Asplenium australasicum	Bird's Nest Fern	
, topiomam auditarasioam	Bild 3 NOSCI CITI	
DENNSTAEDTIACEAE		
Pteridium esculentum	Bracken	
DRYOPTERIDACEAE		
Lastreopsis microsora	Creeping Shield Fern	
GLEICHENIACEAE		
Gleichenia dicarpa	A Coral Fern	
Sticherus lobatus	Spreading Shield Fern	
LINDSAEACEAE		
Lindsaea microphylla	Lacy Wedge Fern	
POLYPODACEAE		
Platycerium bifurcatum	Elkhorn	
SCHIZAEACEAE		
Lycgodium microphyllum		
SINOPTERIDACEAE		
Cheilanthes sieberi subsp. sieberi		
THELYPTERIDACEAE		
Christella dentata		
CLASS CONIFEROPSIDA (Conifers)		
ARAUCARIA		
Araucaria cunninghamii	Hoop Pine	
CUPRESSACEAE		
Callitris columellaris	Coast Cypress Pine	
PODOCARPACEAE		
Podocarpus elatus	Plum Pine	

Species Name	Common Name
CLASS MAGNOLIOPSIDA (Flowering Plants) Subclass Magnoliidae (Dicotyledons) ACANTHACEAE	
Thunbergia alata*	Black-eyed Susan
AMYGDALACEAE Prunus persica*	Peach
ANACARDIACEAE Mangifera indica*	Mango
APIACEAE Foeniculum vulgare*	Fennel
APOCYNACEAE	
Ochrosia moorei (E) ¥ Parsonsia straminea	Southern Ochrosia Common Silkpod
ARALIACEAE Schefflera actinophylla(*)	Umbrella Tree
ASCLEPIADACEAE	
Asclepias curassavica* Gomphocarpus fruiticosus*	Blood Flower Narrow-leaved Cotton Bush
ASTERACEAE	
Ageratina riparia* #W3 Ageratum conyzoides*	Mistflower Goatweed
Ambrosia confertiflora*	Burr Ragweed
Baccharis halimifolia* #W2	Groundsel Bush
Bidens pilosa*	Farmers Friends
Cirsium vulgare *	Spear Thistle
Conyza sp.*	Fleabane
Crassocephalum crepidioides*	Thickheads
Gnaphalium americanum* Hypochaeris radicata*	A Cudweed Flatweed
Senecio madagascariensis*	Fireweed
Sonchus oleraceus*	Common Sowthistle
BIGNONIACEAE	
Jacaranda mimosifolia*	Jacaranda
CASUARINACEAE	
Allocasuarina littoralis	{Black Forest Oak}
CRASSULACEAE Bryophyllum pinnatum*	Resurrection Plant
CUNONIACEAE Caldcluvia paniculosa	Soft Corkwood
DILLENIACEAE	
Hibbertia scandens	Climbing Guinea Flower
EBENACEAE Diospyros pentamera	Grey Ebony
ELAEOCARPACEAE	
Elaeocarpus obovatus	Hard Quandong
Sloanea australis	Maiden's Blush
ELATINACEAE Elatine gratioloides	Waterwort
ESCALLONIACEAE Polyosma cunninghamii	Featherwood
EUPHORBIACEAE	
Euphorbia peplus*	Sun Spurge

Species Name	Common Name	
Macaranga tanarius	•	
FABACEAE - Caesalpinioideae		
Caesalpinia subtropica	Corky Prickle-vine	
Senna pendula var. glabrata*	Cassia	
Senna septemtrioalis	{Rainforest Cassia}	
Seriia septemuloalis	{Namiorest Cassia}	
FABACEAE – Faboideae		
Callerya megasperma	Native Wisteria	
Castanospermum austral	Black Bean	
Desmodium nemorosum		
Erythrina X sykesii*	Coral Tree	
Neonotonia wightii*	Perennial Soybean	
Trifolium repens *	White Clover	
FABACEAE - Mimosoideae		
Acacia bakeri (V)	{Marblewood}	
Acacia binervata	Two-veined Hickory	
Acacia implexa	Hickory Wattle	
Acacia melanoxylon	Blackwood	
LAURACEAE		
Cinnamomum camphora* #W4d	Camphor Laurel	
Cryptocarya laevigata	Red-fruited Laurel	
Cryptocarya rigida	Forest Maple	
Cryptocarya triplinervis var. pubens	Three-veined Cryptocarya	
Endiandra globosa	Black Walnut	
Endiandra floydii (E1)	11-1	
Endiandra pubens	Hairy Walnut	
Litsea australis Neolitsea dealbata	Brown Bolly Gum White Bolly Gum	
rveomsea dealbata	Write Bolly Guill	
LORANTHACEAE		
Amyema congener subsp. congener	A Mistletoe	
Amyema conspicuum subsp. conspicuum	A Mistletoe	
MALACEAE		
Eriobotrya japonica*	Loquat	
144174.0545		
MALVACEAE	Dadddalarana	
Sida rhombifolia*	Paddy's Lucerne	
MELIACEAE		
Synoum glandulosum subsp. glandulosum	Scentless Rosewood	
MONIMIACEAE		
Wilkiea austroqueenslandica	Smooth Wilkiea	
MORACEAE		
Ficus coronata	Sandpaper Fig	
Ficus macrophylla	Morton Bay Fig	
Maclura cochinchinensis	Cockspur Thorn	
MYRSINACEAE		
Rapanea subsessilis	Red Muttonwood	
MYRTACEAE		
Acmena smithii	Lilly Pilly	
Corymbia henryi	Large-leaved Spotted Gum	
Lophostemon confertus	Brush Box	
Syzygium corynanthum	Sour Cherry	
Syzygium hodgkinsoniae (V)	Red Lilly Pilly	
Syzygium moorei (V)	Coolamon	
NYCTAGINACEAE		
Bougainvillea buttiana*	Bougainvillea	
OCHNACEAE		
Ochna serrulata*	Ochna	

Species Name	Common Name	
OXALIDACEAE		
Oxalis purpurea*		
PASSIFLORACEAE		
Passiflora aurantia var. aurantia	Blunt-leaved Passionfruit	
Passiflora edulis*	Common Passionfruit	
PHYTOLACCACEAE		
Phytolacca octandra*	Inkweed	
1 Trytoracca octanora	likweed	
PITTOSPORACEAE		
Citriobatus pauciflorus	Orange Thorn	
	orange mem	
POLYGONACEAE		
Persicaria strigosa	{Spotted Knotweed}	
Rumex crispus *	Curled Dock	
PRIMULACEAE		
Anagallis arvensis*	Scarlet Pimpernel	
PROTEACEAE		
Hicksbeachia pinnatifolia (V)	Red Bopple Nut	
Macadamia tetraphylla (V) ¥	{Queensland Nut}	
Stenocarpus sinuatus	Firewheel Tree	
oteriocarpus sinuatus	Thewheel Tree	
ROSACEAE		
Rubus moluccanus var. trilobus	Native Bramble	
RUBIACEAE		
Randia moorei (E)	Spiny Gardenia	
BUTLOSIS		
RUTACEAE	0.11	
Acronychia wilcoxiana	Silver Aspen	
Flindersia schottiana	Cudgerie	
Medicosma cunninghamii Melicope vitiflora	Pinkheart	
Sarcomelicope simplicifolia subsp. simplicifolia		
Сагостоповре отприснова завор. этприснова		
SAPINDACEAE		
Cupaniopsis anacardioides	Tuckeroo	
Diploglottis australis	Native Tamarind	
Jagera pseudorhus	Foambark Tree	
Mischocarpus adodontus		
Mischocarpus pyriformis	Yellow Pear Fruit	
Sarcopteryx stipata	Steelwood	
Toechima dasyrrhache		
SOLANACEAE		
SOLANACEAE Solanum aviculare	Vangaraa Annia	
Solanum aviculare Solanum capsicoides*	Kangaroo Apple	
Solanum mauritianum*	Devil's Apple Wild Tobacco Bush	
Solanum nigrum*	Black-berry Nightshade	
Solanum pseudocapsicum*	Jerusalem Cherry	
Solanum rostratum*	Pincushion Nightshade	
	J. 10.100	
STERCULIACEAE		
Commersonia fraseri	Brush Kurrajong	
ULMACEAE		
Aphananthe philippinensis	Rough-leaved Elm	
VERBENACEAE		
Gmelin leichhardtii	White Beach	
Lantana camara*	Lantana	
Lantana montevidensis*	Creeping Lantana	
Editional montevidensis	ordeping Lantana	
VIOLACEAE		
Viola hederacea	Ivy-leaved Violet	

Species Name	Common Name
VITACEAE	
Cissus antarctica	Water Vine
Cissus hypoglauca	Giant Water Vine
CLASS MAGNOLIOPSIDA (Flowering Plants)	
Subclass Liliidae (Monocotyledons)	
AGAVACEAE	
Furcraea foetida*	{Century Plant}
ALLIACEAE	
Agapanthus orientalis*	Agapanthus
ARACEAE	
Colocasia esculenta*	Taro
Pothos longipes	-
ARECACEAE	
Archontophoenix cunninghamiana	Bangalow Palm
Calamus muelleri	Lawyer Vine
ASTELIACEAE	
Cordyline stricta	Narrow-leaved Palm Lily
COMMELINIACEAE	
COMMELINACEAE Tradescantia albiflora*	Mandarina law
Tradescantia aibinora	Wandering Jew
FLAGELLARIACEAE	
Flagellaria indica	Whip Vine
JUNCACEAE	
Juncus usitatus	
LOMANDRACEAE	
Lomandra hystrix	
LUZURIAGACEAE	
Geitonoplesium cymosum	Scrambling Lily
Generalian sympsom	Octambing Lify
ORCHIDACEAE	Cinnaman Palla
Gastrodia sesamoides	Cinnamon Bells
PHORMIACEAE	
Dianella revoluta var. revoluta	{Mauve Flax Lily}
POACEAE	
Andropogon virginicus*	Whisky Grass
Bromus cartharticus*	Prairie Grass
Chloris truncata	Windmill Grass
Entolasia stricta	Wiry Panic
Imperata cylindrica	Blady Grass
Pennisetum clandestinum*	Kikuyu
Phalaris aquatica *	Canary Grass
Poa annua	Winter Grass
Saccharum officinarum*	Sugarcane
Urochloa mutica*	Para Grass
SMILACACEAE	
Smilax australis	Wait-a-while

Appendix B Fauna Species List

NOTES ON SYMBOLS USED IN THE TABLE

Nomenclature follows Stanger et al (1997)

Source

- 1. species identified along the Cudgera Creek Road upgrade area during the current assessment
- 2. species identified in the wider study area of for the Yelgun to Chinderah EIS (Sinclair Knight Merz 1998)
- (E) Schedule 1 endangered species (TSC Act)
- (V) Schedule 2 vulnerable species (TSC Act)
- M migratory species listed in the EPBC Act
- O identified by observation
- T species trapped
- AC identified by audible call
- S identified by scats (dung)
- BC identified by bat call analysis
- L species identification confirmed by discussions with Local residents
- * introduced species

Scientific Name	Common Name	Source	
		1	2
MAMMALIA			
TACHYGLOSSIDAE			
Tachyglossus aculeatus	Short-beaked Echidna		✓
DASYURIDAE			
Antechinus stuartii	Brown Antechinus		✓
PERAMELIDAE			
Perameles nasuta	Long-nosed Bandicoot		1
Isoodon macrourus	Northern Brown Bandicoot		✓
PHASCOLARCTIDAE			
Phascolarctos cinereus	Koala		✓
PETAURIDAE			
Petaurus breviceps	Sugar Glider		✓
PSEUDOCHEIRIDAE			
Pseudocheirus peregrinus	Common Ringtail Possum		✓
PHALANGERIDAE			
Trichosurus caninus	Mountain Brushtail Possum		✓
Trichosurus vulpecula	Common Brushtail Possum		1
MACROPODIDAE			
Macropus rufogriseus	Red-necked Wallaby	S, O	,
Wallabia bicolor	Swamp Wallaby		✓
PTEROPODIDAE			
Pteropus alecto	Black Flying-fox (V)	O, AC	1
Pteropus poliocephalus	Grey-headed Flying-fox (V)		1
MOLLOSIDAE			
Nyctinomus australis	White-striped Freetail-bat	AC	✓
Mormopterus sp. 1	A Freetail Bat		✓
VESPERTILIONIDAE			
Myotis adversus	Large-footed Myotis		✓
Miniopterus australis	Little Bentwing-bat (V)		✓
Miniopterus schreibersii	Common Bentwing-bat (V)		✓
Nyctophilus bifax	Northern Long-eared Bat		✓
Vespadelus regulus	Forest Bat		✓

		Source	
MURIDAE			
MURIDAE Mus musculus *	House Mouse		✓
			/
Rattus fuscipes	Bush Rat		*
Rattus lutreolus	Swamp Rat		/
Rattus rattus *	Black Rat		_
Melomys cervinipes	Fawn-footed Melomys		V
CANIDAE	F	6	,
Vulpes vulpes *	Fox	S	~
LEPORIDAE			
Lepus capensis *	Brown Hare		✓
Oryctolagus cuniculus *	Rabbit	O, S	
REPTILIA			
CHELIDAE			
Chelodina longicollis	Eastern Snake-necked Turtle	L	
AGAMIDAE			
Physignathus lesueurii	Eastern Water Dragon	0	0
Pogona barbata	Bearded Dragon		0
VARANIDAE			
Varanus varius	Lace Monitor	0	0
SCINCIDAE			
Cryptoblepharus virgatus	Cream-striped Shinning-skink		0
Ctenotus robustus	Robust Ctenotus		0
Ctenotus taeniolatus	Copper-tailed Skink		
Eulamprus quoyii	Eastern Water Skink	0	
Lampropholis delicata	Dark-flecked Garden Sunskink	0	0
Tiliqua scincoides	Eastern Blue-tongued Lizard	L	O
	Lasterii bide-torigued Lizard	L	
COLUBRIDAE Dendrelaphis punctulata	Common Tree Snake	L	0
	Sommon free offance	_	0
ELAPIDAE	B (0		
Cacophis krefftii	Dwarf Crowned Snake	0	
Pseudechis porphyriacus	Red-bellied Black Snake	L	
Pseudonaja textilis	Eastern Brown Snake	L	
AMPHIBIA			
MYOBATRACHIDAE			
Adelotus brevis	Tusked Frog		AC
Crinia parasignifera	Eastern Sign-bearing Froglet		AC
Crinia signifera	Common Eastern Froglet		AC
Limnodynastes peroni	Brown-striped Frog		0
Limnodynastes tasmaniensis	Spotted Grass Frog		AC
Limnodynastes salmini	Salmon-striped Frog		AC
Mixophyes fasciolatus	A Barred Frog		0
Pseudophryne bibronii	Brown Toadlet		AC
Pseudophryne coriacea	Red-backed Toadlet		AC
Uperoleia fusca	Dusky Toadlet	AC	
HYLIDAE			
Litoria caerulea	Green Tree Frog		0
Litoria chloris	Red-eyed Tree Frog	AC	
Litoria fallax	Eastern Dwarf Tree Frog	AC	O, AC
Litoria gracilenta	Dainty Green Tree Frog		AC
Litoria nasuta	Rocket Frog		0
Litoria peroni	Peron's Tree Frog	AC	AC
Litoria tyleri	Tyler's Tree Frog	70	AC
Litoria verreauxii	Verreauxii's Frog		AC
BUFONIDAE			
Bufo marinus *	Cane Toad	0	0
Salo mainas	Jano Toda	0	O

		Source	
AVES			
MEGAPODIIDAE			
Alectura lathami	Australian Brush Turkey		✓
PHASIANIDAE			
Coturnix australis	Brown Quail		✓
ANATIDAE			
Anas superciliosa	Pacific Black Duck (M)	0	/
Aythya australis	Hardhead		1
Chenonetta jubata	Australian Wood Duck		/
Dendrocygna arctuata	Wandering Whistling Duck		/
sonarooygna arotaata	Walldeling Willsting Duck		
PHALACROCORACIDAE			
Phalacrocorax melanoleucos	Little Pied Cormorant		✓
Phalacrocorax sulcirostris	Little Black Cormorant		,
			*
Phalacrocorax carbo	Great Cormorant		~
ARDEIDAE			
Ardea alba	Great Egret		✓
Ardea ibis	Cattle Egret		✓
Ardea intermedia	Intermediate Egret		✓
Ardea pacifica	White-necked Heron		✓
Egretta novaehollandiae	White-faced Heron	0	1
		O	
THRESKIORNITHIDAE			
	Payal Speephill		,
Platalea regia	Royal Spoonbill		1
Threskiornis molucca	Australian White Ibis		✓
Threskiornis spinicollis	Straw-necked Ibis		~
ACCIPITRIDAE			
Circus approximans	Swamp Harrier		✓
Elanus axillaris	Black-shouldered Kite	0	1
Haliastur indus	Brahminy Kite	•	✓
		0	1
Haliastur sphenurus	Whistling Kite	0	
Haliatus leucogaster	White-bellied Sea-eagle		✓
Hieraaetus morphnoides	Little Eagle		✓
Aquila audax	Wedge-tailed Eagle		✓
Aviceda subcristata	Pacific Baza		✓
Accipter fasciatus	Brown Goshawk		✓
Accipter novaehollandiae	Grey Goshawk	0	✓
FALCONIDAE			
Falco perigrinus	Peregrine Falcon		/
Falco longipennis	Australian Hobby		1
alco longiperinis	Australian Hobby		•
RALLIDAE			
	D #1 - 1 1 D 1		,
Gallirallus philippensis	Buff-banded Rail		√
Rallus pectoralis	Lewin's Rail		✓
Amaurornis olivaceus	Bush Hen		✓
Porphyrio porphyrio	Purple Swamphen		✓
Gallinula tenebrosa	Dusky Moorhen		✓
CHARADRIIDAE			
Vanellus miles	Masked Lapwing (m)	AC	✓
		,	
COLUMBIDAE			
Macropygia amboinensis	Brown Cuckoo-Dove		1
Geopelia humeralis			V
	Bar-shouldered Dove		
Ocyphaps lophotes	Crested Pigeon		✓
Columba leucomela	White-headed Pigeon		✓
Streptopelia chinensis*	Spotted Turtle Dove		✓ ✓
Chalcophaps indica	Emerald Dove		✓
Leucosarcia melanoleuca	Wonga Pigeon		/
Ptilinopus regina	Rose-crowned Fruit-dove		/
Lopholaimus antarcticus	Topknot Pigeon		./
-opriorainius antareticus	TOPKHOLF IGEOR		•
CACATUDAE			
CACATUIDAE	OL - DI LO L		,
Calyptorhynchus lathami	Glossy Black Cockatoo		√
Calyptorhynchus funereus	Yellow-tailed Black Cockatoo	O, AC	

0	0.1.1	Sou	
Cacatua roseicapilla	Galah	0	1
Cacatua galerita	Sulphur-crested Cockatoo		1
Cacatua sanguinea	Little Corella		√
PSITTACIDAE			
Trichoglossus haematodus	Rainbow Lorikeet	O. AC	1
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	0, 40	1
			1
Alisterus scapularis	Australian King Parrot Eastern Rosella		,
Platycercus eximius	Eastern Rosella		٧
CUCULIDAE			
Cacomantis flabelliformis	Fan-tailed Cuckoo		/
Scythrops novaehollandiae	Channel-billed Cuckoo	AC	
01101111011			
CUCULIDAE	5 1 1 10 1		1
Cuculus flabelliformis	Fan-tailed Cuckoo		V
CENTROPODIDAE			
Centropus phasianinus	Pheasant Coucal		✓
oom opus priasiariiras	r Hoddain Goddai		
STRIGIDAE			
Ninox novaeseelandiae	Southern Boobook		✓
TYTONIDAE			
ΓΥΤΟΝΙDΑΕ Tyto alba	Barn Owl		✓
Tyto alba Tyto novaehollandiae	Masked Owl (V)		/
Tyto novacnomanaiae	Masked OWI (V)		
PODARGIDAE			
Podargus strigoides	Tawny Frogmouth	0	✓
ALCEDINIDAE		4.0	,
Dacelo novaeguineae	Laughing Kookaburra	AC	*
Alcedo azurea	Azure Kingfisher		1
Todiramphus sanctus	Sacred Kingfisher		✓
Todiramphus macleayii	Forest Kingfisher		1
Merops ornatus	Rainbow Bee-eater		1
Eurystomus orientalis	Dollarbird		V
MEROPIDAE			
Merops ornatus	Rainbow Bee-eater		✓
CORACIIDAE	5	0.10	
Eurystomus orientalis	Dollarbird	O, AC	✓
PITTIDAE			
Pitta versicolor	Noisy Pitta	0	1
ATRICHORNITHIDAE			
Atrichornis rufescens	Rufous Scrub-bird	O, AC	
MALURIDAE			
	Cuparh Plus Fairman		,
Malurus cyaneus	Superb Blue Fairy-wren		1
Malurus lamberti	Variegated Fairy-wren		· /
Malurus melanocephalus	Red-backed Fairy-wren		V
PARDALOTIDAE			
Pardalotus punctatus	Spotted Pardalote		✓
Pardalotus striatus	Striated Pardalote		✓
Sericornis frontalis	White-browed Scrub-wren	O, AC	✓
Sericornis magnirostris	Large-billed Scrub-wren	5,710	1
Gerygone olivacea	White-throated Gerygone		1
canthiza pusilla	Brown Thornbill		✓
canthiza lineata	Striated Thornbill	AC	1
MELIPHAGIDAE			
nthochaera chrysoptera	Little Wattlebird		/
hilemon corniculatus	Noisy Friarbird		~
ntomyzon cyanotis	Blue-faced Honeyeater		1
lanorina melanocephala	Noisy Miner	O, AC	~
1eliphaga lewinii	Lewin's Honeyeater	O, AC	✓

		Sour	ce
Lichenostomus chrysops	Yellow-faced Honeyeater		✓
Melithreptus albogularis	White-throated Honeyeater		✓
Lichmera indistincta	Brown Honeyeater		✓
Acanthorhynchus tenuirostris	Eastern Spinebill		~
Myzomela sanguinolenta	Scarlet Honeyeater	AC	✓
PETROICIDAE			
Petroica multicolor	Scarlet Robin	O	
Eopsaltria australis	Eastern Yellow Robin		\checkmark
ORTHONYCHIDAE			
Orthonyx temminckii	Logrunner		✓
PSOPHODIDAE			
Psophodes olivaceus	Eastern Whipbird	AC	\checkmark
PACHYCEPHALIDAE			
Falcunculus frontatus	Crested Shrike-tit		✓
Pachycephala pectoralis	Golden Whistler		✓
Pachycephala rufiventris	Rufous Whistler	0	✓
Colluricincla harmonica	Grey Shrike-thrush	0	1
Colluricincla megarhyncha	Little Shrike-thrush		✓
DICRURIDAE			
Monarcha trivirgatus	Speckled Monarch	O	1
Monarcha melanopsis	Black-faced Monarch		✓
Monarcha leucotis	White-faced Monarch		✓
Myiagra inquieta	Restless Flycatcher		1
Myiagra rubecula	Leaden Flycatcher		✓
Grallina cyanoleuca	Magpie-lark	O, AC	1
Rhipidura rufifrons	Rufous Fantail		✓
Rhipidura fuliginosa	Grey Fantail	O, AC	✓
Rhipidura leucophrys	Willie Wagtail		1
Dicrurus hottentottus	Spangled Drongo		✓
CAMPEPHAGIDAE			
Coracina novaehollandiae	Black-faced Cuckoo-shrike	AC	✓
Lalage leucomela	Varied Triller		1
Coracina tenuirostris	Cicadabird		✓
ORIOLIDAE			
Oriolus flavocinctus	Olive-backed Oriole	O, AC	✓
Sphecotheres viridis	Figbird	O, AC	✓
ARTAMIDAE			
Artamus leucorynchus	White-breasted Woodswallow		✓
Cracticus torquatus	Grey Butcherbird		✓
Cracticus nigrogularis	Pied Butcherbird		1
Gymnorhina tibicen	Australian Magpie	0	✓
Strepera graculina	Pied Currawong	0	✓
CORVIDAE			
Corvus coronoides	Australian Raven	O, AC	
Corvus orru	Torresian Crow		✓
PTILONORHYNCHIDAE			
Ptilonorhynchus violaceus	Satin Bowerbird	0	1
Ailuroedus crassirostris	Green Catbird		✓
MOTACILLIDAE			
Anthus novaeseelandiae	Richard's Pipit		✓
PASSERIDAE			
Neochmia temporalis	Red-browed Finch		✓
DICAEIDAE			
Dicaeum hirundinaceum	Mistletoebird	O, AC	✓
HIRUNDINIDAE			
Hirundo neoxena	Welcome Swallow		✓

		Source	
Hirundo nigricans	Tree Martin		√
Hirundo ariel	Fairy Martin		✓
SYLVIIDAE			
Megalurus timoriensis	Tawny Grassbird		✓
Cisticola exilis	Golden-headed Cisticola		✓
Acrocephalus stentoreus	Clamorous Reed-Warbler		✓
ZOSTEROPIDAE			
Zosterops lateralis	Silvereye		✓
STURNIDAE			
Sturnus vulgaris	Common Starling		✓
FISH / EELS			
ANGUILLIDAE			
Anguilla reinhardtii	Marbled Eel	О	
ELEOTRIDAE			
Hypseleotris galii	Firetail Gudgeon	Т	
Hypseleotris compressus	Empire Gudgeon	Т	
Gobiomorphus australis	Striped Gudgeon	Т	
MELANOTAENIIDAE			
Rhadinocentrus ornatus	Ornate Rainbowfish	Т	
CRUSTACEANS			
Paratya australiensis	Atyid Shrimp	Т	
Macrobrachium australiense	Long-armed Prawn	Ť	
Australatya striolata	Riffle Shrimp	Ť	

Appendix C Project Personnel

Field surveys for this project were carried out by Chris Thomson, David Endersby and Michelle Paton of Sinclair Knight Merz. Field surveys were undertaken under appropriate NPWS (Scientific Investigation Licence A2372 and NPWS A1765 and Licence to Pick Threatened Species TS0051) as well as Department of Agriculture licensing (AW2000/049, NSW Agriculture AW94/056) and NSW Fisheries Scientific Research Permit (T02/073).

Project management and report writing was undertaken by Chris Thomson, with additional report writing assistance from Heidi Bischof and Michelle Paton of Sinclair Knight Merz.

Appendix F

Acid Sulfate Soils Assessment Report



Acid Sulfate Soil Assessment

Proposed Upgrade of Cudgera Creek Road between Pacific Highway Freeway and Pottsville-Mooball Road



Prepared for:

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February 2003

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Business Unit	Environmental Moni	itoring
Project No.	H/38387/C	ASS Cudgera Creek
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Approving Manager	Jeff Parnell	10/4/03

Person managing this document	Person writing this document		
Jeff Parnell	Jeff Parnell		

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ACID SULFATE SOIL ASSESSMENT

for

Proposed Upgrade of Cudgera Creek Road between Pacific Highway Freeway and Pottsville-Mooball Road

February, 2003

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Appendices

- A. Site Photographs and Maps
- B. Acid Sulfate Soil Risk Maps
- C. Laboratory Results

Glossary of Terms

AHD Australian Height Datum

ASS Acid Sulfate Soil

ASSMAC Acid Sulfate Soil Management Committee

DLWC Department of Land and Water Conservation

EPA NSW Environment Protection Authority

PASS Potential Acid Sulfate Soil

REF Review of Environmental Factors

RTA NSW Roads and Traffic Authority

%Scr % Sulfur determined by Chromium Reducible Method

TAA Total Actual Acidity

1 Introduction

The RTA's Road Services, Northern Region has been contracted to upgrade a section of the Cudgera Creek Road west of Pottsville. The work will include the construction of a new bridge and a realignment of the existing road. The works are directly related to the Yelgun to Chindera Freeway development, which is located immediately to the west of the Proposal. Upgrading of Cudgera Creek Road within 5 years of the commencement of works was a condition of consent imposed on the Yelgun to Chindera Freeway development by the Minister of Urban Affairs and Planning.

Cudgera Creek has a small catchment of approximately 33km² which includes two tributaries. Christies Creek and an unnamed Creek. The dominant feature of this creek system is that the floodplain on the northern side of Cudgera Creek Road is considerably lower than that associated with the southern side of the road and adjacent to Cudgera Creek. In recent years a levee has been constructed upstream of Cudgera Road on the eastern bank of Cudgera Creek. The predominant land uses in the catchment include cane farming and other agricultural uses such as banana plantations.

The area surrounding the Proposal is known to have a low occurrence of Acid Sulfate Soils, the disturbance of which could adversely impact upon water quality in the immediate vicinity. Because of the sensitive nature of the water catchment, an assessment of the Acid Sulfate Soils and any predicted impact to water quality is required. Mapping and identification of these soils will to allow mitigation measures to be developed if necessary.

1.1 Scope and Objectives

This report has been prepared to assist in the environmental assessment of the proposed roadworks by meeting the following objectives:

- By reference to DLWC ASS Risk Maps, assess the potential occurrence of ASS in the study area;
- By undertaking a geotechnical investigation, identify the presence of any Acid Sulfate Soils or Potential Acid Sulfate Soils in the soil horizon and quantify the acid generating potential;
- Predict the environmental impacts that would occur by the disturbance of any PASS and recommend methods of management and mitigation.

2 Study Area & Proposed Works

The study area is defined as the section of Cudgera Creek Road in the immediate vicinity of the existing Bridge over Cudgera Creek, approximately 1 km east of the recently completed Yelgun – Chinderah Freeway Upgrade. The location of the study area is shown in **Figure 2.1**. An aerial photograph of the study area showing the location of the proposed works is attached in Appendix A.



Figure 2.1 - Locality map of the location of proposed roadworks on Cudgera Creek Road

2.1 Scope of Works

The proposed upgrade of Cudgera Creek Road involves relocation of the bridge and approaches, some curve widening, horizontal realignment and vertical realignment so that the pavement is above the I in 5 year flood level. The new bridge would cross Cudgera Creek approximately 200m north of the existing bridge. The positioning of the new bridge was driven by the environmental constraints of the area of remnant rainforest bordering Cudgera Creek at this location. The location was chosen to minimise impacts upon threatened species located within the rainforest community.

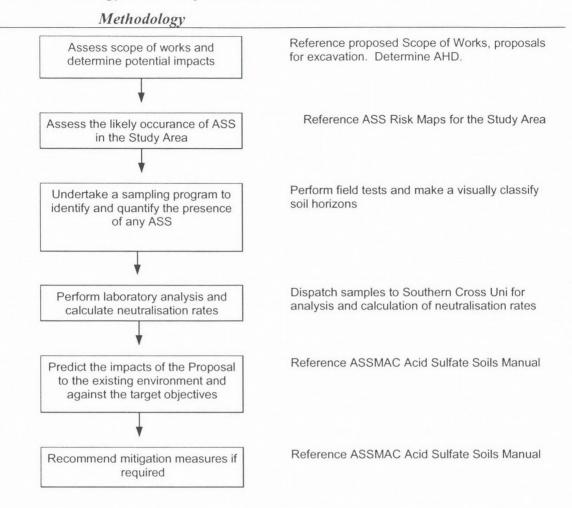
It would be expected that construction equipment for the Proposal would include:

- Piling equipment
- Chainsaws
- Bulldozers
- Backhoes
- Excavators
- · Front end loaders
- Grader
- Vibrating rollers
- Static rollers

- Paving machines
- Jackhammers
- Heavy transport
- · Concrete agitator trucks
- Water tanker
- · Road sweeper
- Linemarking vehicles
- Truck delivery of construction materials
- · Light commercial and passenger vehicles.

3 Methodology

The methodology of the study can be summarised as follows:



4 Site Selection

Sites along the proposed new alignment were chosen and test pits dug in association with geotechnical investigations using a backhoe. Three sites selected were located on the floodplain where the potential to encounter ASS would be the highest. A pedalogical log of the soil horizons at all test pit excavations was made and has been included in the Geotechnical Report undertaken by Grafton Technical Services. Sample numbering in this Report is consistent with the log recorded in the Geotechnical Report. Location of sites sampled for ASS are shown on the aerial photograph in Appendix A.

5 Assessment Criteria

The most appropriate document to reference when assessing ASS in Australia is the Acid Sulfate Soil Management Committee (ASSMAC) Acid Sulfate Soil Manual.

6 Sampling

Field tests were undertaken by oxidising a sample of soil with $30\%~H_2O_2$. Initial reactions indicated the possibility of low levels of PASS, however the potential for a false positive existed because the samples contained organic matter, which was also oxidised during the reaction.

Samples of soil suspected of potentially containing pyritic material were sealed in air tight plastic bags and forwarded directly to the Centre for Coastal Management at Southern Cross University, Lismore for analysis.

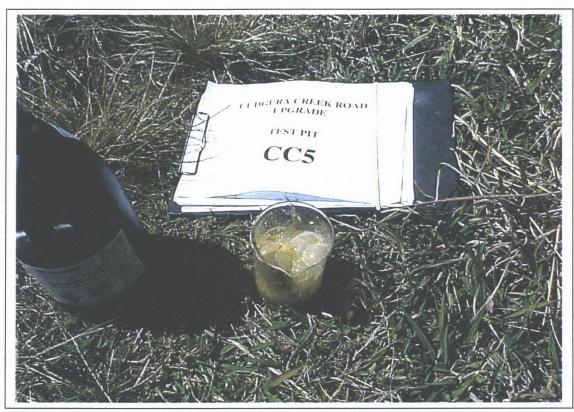


Photo 1. Showing the reaction of a soil sample from Site CC 5 with H₂O₂

7 Results

A summary of the results obtained from the laboratory analysis along with calculations of neutralisation rates are given in Table 7.1 below. The complete set of results in given in Appendix C.

Table 7.1 Summary of Laboratory Results

Sample	Depth	Reduced Inorganic Sulfur % Cr reducible S (Scr)	TAA pH	TAA kg/mole	Neutralisation Calculation kg/mole (based on Scr)
CC4a	0.8 - 1.0	0.011	3.98	0.040	0.4
CC5a	0.2 - 0.4	0.007	4.19	0.024	0.3
CC10a	0.2 - 0.4	0.005	4.15	0.046	0.2
CC10b	0.8 - 1.0	0.022	4.22	0.004	0.8

From the results it can be seen that analysis of chromium reducible sulfur indicates that there is only a minor presence of pyritic material within the soil matrix.

8 Conclusion

Acid Sulfate Soil Risk Maps for the study area revealed that the area was classified as having a low occurrence of ASS. Further confirmation of this classification was established by excavation of test pits, which failed to reveal any visible signs of jarosite or any other pyrite containing soil horizons.

Laboratory analysis of 4 samples indicated minor amounts of chromium reducible sulfur, which would not result in the soils being considered as ASS nor would these levels trigger any further risk assessment.

It is therefore concluded that construction of the Proposal would not result in the release of any acidic leachate into the nearby waterways nor is it required to prepare an Acid Sulfate Soil Management Plan for the proposed works.

9 References

- Acid Sulfate Soils Management Advisory Committee, (1998). *Acid Sulfate Soils Manual*. NSW Agriculture, Wollongbar.
- Roads and Traffic Authority, (1998b). *Environmental Impact Statement: Pacific Highway Upgrade. Yelgun Chinderah.* Prepared by Sinclair Knight Mertz.
- White, I., and Melville, M.D., (1993). Treatment and containment of potential acid sulphate soils: Formation, properties and management of potential acid sulphate soils. Technical Report T53, CSIRO, Canberra, Australia.

Appendix A

Site Photographs and Maps



Photo 1. Showing the site of CC4 which is located on a floodplain



Photo 2. Showing the excavation at CC4

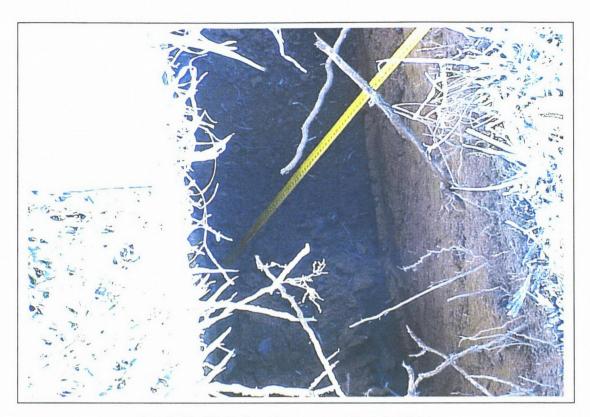


Photo 3. Showing the excavation at CC5

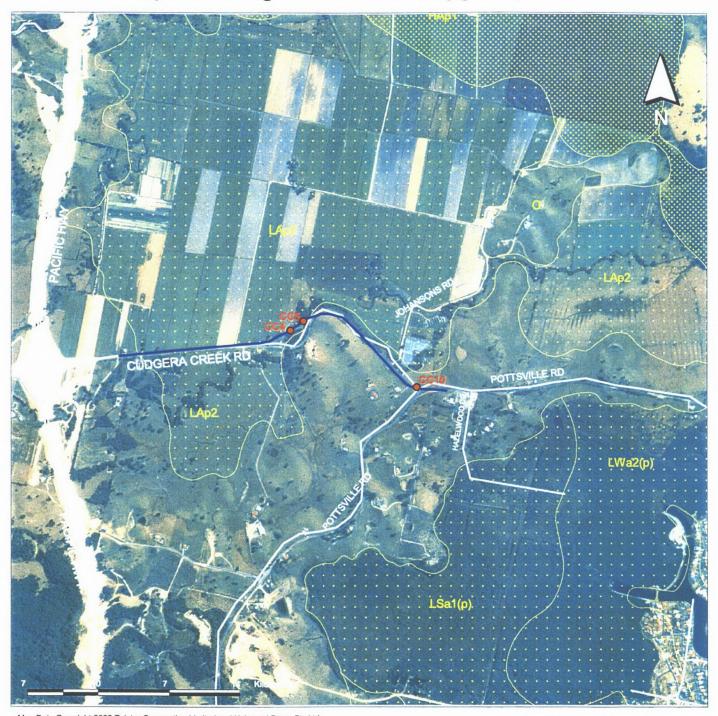


Photo 4. Looking over Cudgera Creek from hill to the east

Appendix B

Acid Sulfate Soil Risk Map

Acid Sulfate Soil Risk Map, Proposed Cudgera Creek Road Upgrade, Pottsville.



Map Data Copyright 2002 Telstra Corporation Limited and Universal Press Pty Ltd Department of Land & Water Conservation NSW, August 2002. ecwp://tmcweb/ecw_files/lambertsrta94/lr94sh10bt1m.ecw

LEGEND

Proposed upgrade Cudgera Creek Road
Roads

ASS Sampling locations

Acid Sulfate Soil

High occurence Low occurence

Oxbow

Please refer to Landform Code Table for description of land form codes.

LANDFORM CODES USED ON THE ACID SULFATE SOIL RISK MAPS*

Landform Process Class	Code	Landform Element	Code
Aeolian	W	Backplain	b
Alluvial	A	Backswamp	k
Beach	В	Bottom Sediments	m
Estuarine	Е	Channel	n
Lacustrine	L	Dune	d
Swamp	S	Interbarrier Swamp	r
Disturbed Terrain	X	Intertidal Flat	i
		Lagoon	g
		Levee	1
		Levee Toe	t
		Ox-bow	0
		Plain	p
		Sandplain	a
		Swamp	S
		Splay	у
		Supratidal Flat	u
		Swale	w
		Tidal Creek	С
Elevation (AHD)	Code	Additional Descriptive Codes	Code
0-1m	0	Pleistocene	(p)
1-2m	1	Acidic Scald	(s)
2-4m	2		
>4m	4	TRIAM Description of the 18 West Comment	

^{*}abstract from Guidelines for the Use of Acid Sulfate Soil Risk Map, Department of Land & Water Conservation, 1998.

Appendix C

Laboratory Results



Environmental Analysis Laboratory Centre for Coastal Management

PO BOX 5125, EAST LIEMORE NSW 2480 AUSTRALIA TELEPHONE: (02) 6620 3678 FACSIMILE: (02) 6620 3957

Job Number	J9307
Sample Accession No.	Samples 1 - 4
Sample Type	SOIL
No. of samples	4
Date supplied	3rd September, 2002

FROM-WCS ASSESSMENT PROJECT



6th September, 2002

Att/ Jeff Parnell Roads & Traffic Authority Level 3, 55 Rothschild Ave **ROSEBERRY NSW 2018**

Dear Jeff.

Herewith are the results of the examination of 4 soil samples supplied on 3rd September, 2002.

From the analysis conducted the samples supplied would NOT be classified as actual or potential acid sulphate material. No acid sulphate management is required.

Please contact the laboratory if you have any further matters you wish to discuss.

Yours faithfully,

Graham Lancaster Laboratory Manager

Results refer to samples as received at the laboratory. This report is not to be reproduced except in full,

Analysis performed according to "Standard Methods for the Examination of water & Wastewater", 19th Edition 1995, APHA, except where stated otherwise.

RESULTS OF ACID SULPHATE SOIL ANALYSIS (Page 1 of 1)

4 samples supplied by Roads & Traffic Authority on 3rd September, 2002 - Lab. Job No. J9307 Analysis requested by Jeff Parnell - Your Project: Cudgera Creek Reatignment

Sample Sile	Depth (m)	Texture (note 9)	Reduced inorganic Sulphur (% chromium reducible S) (%Scr) (note 2)	TAA pH	Total Actual Acidity (TAA) mole / Kg	Lab. Bulk Density tonne DW/m³.	Neutralising Calculation Kg Lime/m³ (based on %Scr)	Neuvalising Calculation Kg Ume/m ³ (based on TAA)	Neutralising of Actual and Potential ASS Kg Lime/m ² (see note 10)
CC4A	0.8-1.0	Fine	0.011	3.98	0.040	1.23	0.4	2,4	not required
CC5A	0.2-0.4	Fina	0.007	4.19	0.024	1.22	0.3	1.4	not required
CC10A	0.2-0.4	Fine	0.005	4.15	0.046	1.15	0.2	2.6	not required
CC10B	0.8-1.0	Fine	0.022	4.22	0.004	1.13	0.8	0.2	not required
							Relar Note 3 & 7	Refer Note 6 & 7	Refer Note 6, 7 & 10

NOTE:

Environmental Analysis

- 1 All analysis is Dry Weight (DW) samples dried and ground immediately upon arrival (unless supplied dried and ground)
- 2 Samples analysed by POCAS method (le Peroxide Oxidation Complined Acidity and Sulphate Method 21) and 'Chromium Raduciple Sulphur' technique (Scr. Method 22B)
- 3 Melhods from Stone, Y. Ahern CR, and Blunden B (1998). Acid Sulphate Soil Manual 1998, ASSMAC, Wollongbar, NSW.
- 4 Total carbon and total sulphur determined using a LECO CNS 2000 analyse:
- 5 Bulk density was celermined immediately on arrival to laboratory (Insite bulk density is preferred)
- 6 Nautrallaing Requirement (based on NAGP chromium reducible sulphur or total author) = 40 H2SO2/tonne x bulk density
- 7 The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)
- 8 Conductivity 1 dS/m = 1 mS/cm = 1000 uS/cm
- 9 For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; line = medium to heavy clays and slity days
- 10 Neutralisation Calculation for neutralisation of actual and potential acidity (ie. sum of calculation based on Crs and TAA)
- 11 ANC= Add Neutralising Capacity of the Soll (Detection limit of 0.05% CaCO₃ Equivalent)
- 12 NAGP= Net Acid Generating Potential= (31.3*%5_{ox})-(10'%ANC) (From Mulvey, 1993)

(Classification of potential acid sulphate material if: coarse Scr≥0.03%S; medium Scr≥0.06%S; fine Scr≥0.1%S) (equivalent conversions - 0.03%S = 0.019 mole/ Kg; 0.06%S = 0.037 mole/ Kg; 0.1%S = 0.062 mole/ Kg)

* Projects that disturb >1000 topings of ASS sites with ≥0.03% S, a detailed management plan may be required.

Appendix G

Water Quality
Assessment Report



Water Quality Assessment

Proposed Upgrade of Cudgera Creek Road between Pacific Highway (Yelgun to Chindera Freeway) and Pottsville-Mooball Road.



Prepared for: RTA Operations Environmental Technology Branch Environmental Assessments Section

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March 2003

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Project No.	H/38387/c	WQM Cudgera	Creek					
Document description	Proposed Upgrade of Cudgera Creek Road between Pacific							
	Highway Freeway and Pottsville-Mooball Road							
	Name	Signed	(1	Date				
Approving Manager	Jeff Parnell	Add		11/04/03				
Person managing this	document	Person writin	g this do	cument				

Person managing this document	Person writing this document
Jeff Parnell	Jeff Parnell / Richard Dunnicliff

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Upgrade\Reports\REF\Appendices\Appendix G Water Report Final 11.04.03.doc	

Client Reference	Status	Date
	Final	II April 2003



RTA Operations Directorate AS/NZS ISO 9001 QEC 7443 Standards Australia

© Roads and Traffic Authority Environmental Technology Branch

WATER QUALITY ASSESSMENT

Proposed Upgrade of Cudgera Creek Road between Pacific Highway (Yelgun to Chindera Freeway) and Pottsville-Mooball Road. March, 2003

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APPENDICES

- A. Water Monitoring Sites
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- C. Laboratory Results

Glossary of Terms

AHD Australian Height Datum

ASS Acid Sulfate Soil

EPA NSW Environment Protection Authority

PASS Potential Acid Sulfate Soil

REF Review of Environmental Factors
RTA NSW Roads and Traffic Authority

%Scr % Sulfur determined by Chromium Reducible Method

TAA Total Actual Acidity

I Introduction

The RTA's Road Services, Northern Region has been contracted to upgrade a section of the Cudgera Creek Road west of Pottsville. The work would include the construction of a new bridge and a realignment of the existing road. The works are directly related to the Yelgun to Chindera Freeway development, which is located immediately to the west of the Proposal. Upgrading of Cudgera Creek Road within 5 years of the commencement of works was a condition of consent imposed on the Yelgun to Chindera Freeway development by the Minister of Urban Affairs and Planning.

Cudgera Creek has a catchment of approximately 33km². The dominant feature of this creek system is that the floodplain on the northern side of Cudgera Creek Road is considerably lower than that associated with the southern side of the road and adjacent to Cudgera Creek. Hence, Cudgera Creek Road is a major control for the breakout of floodwaters from Cudgera Creek to the floodplain to the north and north-east. In recent years a levee has been constructed upstream of Cudgera Creek Road on the eastern bank of Cudgera Creek. Flood flow patterns outlined in the EIS show that the dominant flow direction is in a north-easterly direction away from Cudgera Creek towards the lower portions of the Cudgera/Christies Creek floodplain.

The area surrounding the Proposal has been mapped by the Department of Land and Water Conservation (DLWC) as having a low known occurrence of Acid Sulfate Soils (ASS). Disturbance of ASS's could adversely impact upon water quality in the immediate vicinity. An Acid Sulfate Soils Assessment was undertaken as a result to determine if actual or potential acid sulfate soils are present within the study area. It was determined that the acidic levels in the soil were not high enough for them to be considered as Acid Sulfate Soils.

1.1 Scope and Objectives

This report has been prepared to assist in the environmental assessment of the proposed roadworks by meeting the following objectives:

- By reference to existing water quality data, assess the condition of waterways in the study area;
- By undertaking a water monitoring program, assess ambient water quality conditions in Cudgera Creek;
- Predict the environmental impacts if any, that may occur to water quality in the study area and if necessary recommend methods of management and impact mitigation.

2 Study Area & Proposed Works

The study area is a section of Cudgera Creek Road in the immediate vicinity of existing bridge over Cudgera Creek, approximately 2 km east of the recently completed Yelgun – Chinderah Upgrade. A locality map is given in Figure 2.1. An aerial photograph of the study area showing the location of the proposed works is attached in Appendix A.

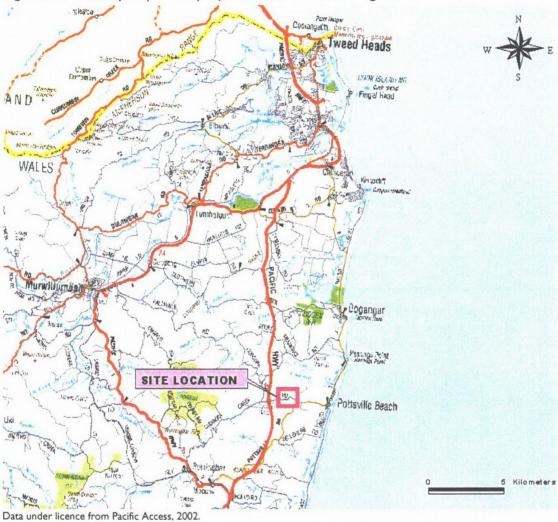


Figure 2.1 – Locality map of the proposed roadworks on Cudgera Creek Road

2.1 Scope of Works

The Proposal would involve the upgrading and realignment of Cudgera Creek road from the eastern limits of the Cudgera Creek Road Interchange to approximately 200 metres east of the junction with Mooball-Pottsville Road, a length of approximately 1.8km. The Proposal would involve rehabilitation of the existing road and realignment in the vicinity of Cudgera Creek. The Proposal would also involve the redesign of the intersection of Cudgera Creek Road with Mooball-Pottsville Road. The redesign would make Cudgera Creek Road the priority road.

The proposed works would include property acquisition, utility adjustments, clearing, earthworks and drainage works, bridge construction, existing bridge removal, pavement works, wearing surface and rehabilitation works.

It would be expected that construction equipment for the Proposal would include:

- Piling equipment
- Chainsaws
- Bulldozers
- Backhoes
- Excavators
- Front end loaders
- Grader
- Vibrating rollers
- Static rollers

- Paving machines
- lackhammers
- Heavy transport
- · Concrete agitator trucks
- Water tanker
- · Road sweeper
- Linemarking vehicles
- · Truck delivery of construction materials
- · Light commercial and passenger vehicles.

2.2 Traffic Data

Temporary traffic counters were established on Cudgera Creek Road and Pottsville-Mooball Road from August to October 2002. The counters recorded traffic volume and classification data for a 35-day period. This data indicated a Year I AADT (2003) of 2,341 and a commercial vehicle volume of 8.9%. It was predicted in the Yelgun to Chindera Pacific Highway Upgrade EIS that traffic volumes on Cudgera Creek Road east of the freeway would more than double as a result of that Proposal.

The methodology of the study can be summarised as follows:

Methodology

Assess scope of works and determine potential impacts

Undertake a sampling program to identify and quantify the current ambient water quality

Perform laboratory analysis

Predict the impacts of the Proposal to the existing environment and against the target objectives

Recommend mitigation measures if required

Notes

Reference proposed Scope of Works, proposals for excavation. Reference existing water quality and meteorological data for the catchment.

Perform field testing of physical parameters, collect grab samples and record details of catchment topography and riparian vegetation

Dispatch grab samples to Southern Cross Uni for analysis

Reference ANZECC Australian Water Quality Guidelines

Reference ANZECC Australian Water Quality Guidelines

4 Site Selection / Sampling locations

Prior to undertaking pre-construction monitoring, a field inspection of the proposed route was undertaken to select the sampling sites. Two water monitoring sites along Cudgera Creek were chosen, one being upstream and the other downstream of the proposed new alignment. Monitoring Site Map is attached in Appendix A.



Site I: Is located upstream of the proposed bridge alignment underneath the existing bridge. The site comprised pooled water approximately 0.5m deep with slow flow rate. Banks under the bridge are stabilised by rock and shotcrete.



Site 2: Is located downstream of the proposed new bridge alignment. The creek is in a more natural state in this location. Banks are vegetated with native rainforest ferns. The flow rate of the stream was noticeably faster in this area.

5 Existing Water Quality Data

Prior to the commencement of construction on the Yelgun – Chinderah Upgrade, Environmental Technology undertook a program of water quality monitoring to establish ambient conditions of 15 watercourses that were being crossed by the Yelgun – Chinderah Upgrade. This monitoring program included Cudgera Creek. Monitoring was undertaken both upstream and downstream of what is now the upgraded Pacific Highway. The monitoring sites were located adjacent to Cudgera Creek Road approximately 2 km west (upstream) of the current proposal. During construction, the contractor was responsible for undertaking water quality monitoring and undertook data collection at similar locations to that undertaken during the pre-construction period.

Results of monitoring undertaken in both the pre-construction and construction stages of the Yelgun to Chindera development is considered useful for establishing the current and past condition of water quality in Cudgera Creek. The relevant data is summarised in Appendix C.

The EIS described the water quality in Cudgera Creek as follows:

"The water quality in the unnamed creek and Cudgera Creek both indicated low dissolved oxygen conditions. The pH of the upper catchment is very low (ie very acidic), which is supported by the slightly acidic nature of the waters measured."

"Water clarity appears to be high in the upper and lower sections of the creek, with middle sections having moderate clarity. Nitrogen concentrations appear to be elevated on some occasions in the creek, although phosphorus concentrations tend to be within the recommended range. Secondary contact (eg boating) criteria would be met in all areas of the creek. Primary contact (eg swimming) criteria, however, mat not be met in the middle sections of the creek."

6 Assessment Criteria

The most appropriate document to reference when assessing water quality in Australia is the ANZECC Australian Water Quality Guidelines.

7 Sampling and Testing

Water quality determinations were undertaken both by insitu monitoring and through laboratory analysis of grab samples.

7.1 In Situ Sampling

7.1.1 Procedure

Testing was undertaken using a pre calibrated Yeo-Kal water sonde in accordance with manufacturers recommendations. Where possible the sonde is submersed to a depth of 0.25m. At least two measurements are made at each site and the average is reported. A summary of results is given in Section 8. Grab samples were collected in clean sterile bottles supplied by Southern Cross University.

7.1.2 Sampling Parameters

For in-situ surface water sampling, parameters measured include:

- Temperature
- Depth
- pH
- Dissolved Oxygen
- Conductivity
- Salinity
- Turbidity

7.2 Laboratory Analysis

7.2.1 Grab samples

Grab samples were collected in clean and sterile bottles and preserved and chilled in ice according to the methods of Australian Standards AS5667.1-1997, prior to their delivery to Southern Cross Laboratory in Lismore a NATA accredited laboratory. Full was undertaken of metals, nutrients, oil and grease.

7.2.2 Sampling Parameters

- Total Nitrogen
- Total Phosphorus
- Chloride
- Turbidity
- pH
- Salinity in Water
- Suspended Solids (SS)
- Total Dissolved Solids
- Total Aluminium
- Total Iron
- Total Copper
- Total Zinc
- Total Cadmium

7.3 Frequency

7.3.1 Surface Water

Determinations of ambient water quality was made on 3 occasions during the 3 months prior to the commencement of the construction period: The following criteria was applied.

- A dry episode was defined as one where less than 10mm of rain had fallen in the previous seven days;
- A wet episode was defined as that following a fall of greater than 10mm in the previous 24 hours. The objective was to catch the first flush after an extended dry episode; and

Monitoring during extended wet periods was not undertaken, as results would only
indicate the composition of rainwater. To date it has not been possible to monitor
any representative first flushes.

8 Results

Water quality testing was undertaken on three separate occasions between September and November 2002. A summary of the in situ data obtained for Cudgera Creek is provided in Table 8.1 below:

Table 8.1: Summary of In Situ water quality results.

Site	Clarity	Depth m	Temp °C	D.O. % Sat	рН	Turbidity NTU
In-Situ W	ater Quality	Measuremen	ts - Dry Episod	de (02/09/02)		
CCI	Clear	0.8	17.0	63	7.2	6
CC2	Clear 0.8		17.0 72		7.3	14
In-Situ W	ater Quality	Measuremen	ts - Wet Episo	de (28/10/02)		
CCI	Turbid	0.3	18.0	32	6.8	27
CC2	2 Clear 0.3 18.0		33	6.7	13	
In-Situ W	ater Quality	Measuremen	ts - Dry Episod	de (04/11/02)		
CCI	Clear	0.4	21.4	53	6.7	8
CC2	2 Clear 0.4		21.4	78	6.8	6
AN	ZECC Guid	elines	+ 2°C	80 - 90	6.5 - 9.0	+10%

Samples were also forwarded to Southern Cross University's Environmental Analysis Laboratory for detailed analysis. A summary of the results of this testing is included in Table 8.2 below and the full results are included in Appendix D.

Table 8.2: Summary of Laboratory water quality results.

Site	pН	TDS	TSS	Total P	Total N	Al	Fe
CCI	6.55	123	0.5	0.06	0.73	0.102	0.448
CC2	6.36	124	<0.5	0.01	0.39	0.087	0.418
	ANZE	CC Guideline	S	10 - 100	100 - 750	5	1000

9 Conclusion

This report presents water quality data collected on three separate occasions. The data was collected from 2 monitoring sites within the study area, one upstream and one downstream of the proposed new bridge. During the first collection grab samples were taken from both monitoring sites and extensive laboratory analysis was carried out on these samples.

An increase in Turbidity and / or a decrease in pH levels are considered as the most likely impacts on water quality as a result of the proposed construction. Measured pH levels ranged between 6.7 and 7.3. These levels are within the ANZECC guidelines for Water Quality. Turbidity levels were found to be very low with values ranging from 6 to a maximum 27 NTU.

The results obtained during the monitoring period and other previous data presented in this report represent snapshots of the ambient conditions of water quality in the study area. It is believed that implementation of best practice sediment control measures would ensure that there would be nil or minimal impact upon water quality in Cudgera Creek as a result of the Proposal. It is recommended that monitoring of water quality be undertaken during the construction and then post construction.

10 References

Acid Sulfate Soils Management Advisory Committee, (1998). Acid Sulfate Soils Manual. NSW Agriculture, Wollongbar.

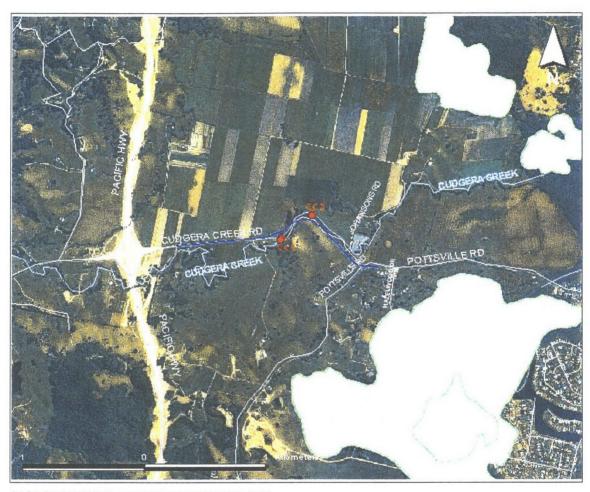
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Appendix A

Water Monitoring Sites

Water Quality Monitoring Sites, Proposed work on Cudgera Creek Road, Pottsville



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Appendix B

Insitu Water Quality Results

Table A.I Stream Conditions and In-Situ Water Quality Measurements - Dry Episode (02/09/02)

Site	Clarity	Flow m/min	Time	Depth m	Temp °C	Conductivity uS/cm	Salinity ppt	D.O. % Sat	рН	ORP	Turbidity NTU
CCI	Clear	3	15:05	0.8	17.0	122	0.1	63	7.2	310	6
CC2	Clear	3	14:30	0.8	17.0	128	0.1	72	7.3	415	14
	ANZE	CC Guidel	ines		+ 2°C	~1500	1.0	80 - 90	6.5 - 9.0	NA	+10%

Table A.2 Stream Conditions and In-Situ Water Quality Measurements - Wet Episode (28/10/02)

Site	Clarity	Flow m/min	Time	Depth m	Temp °C	Conductivity uS/cm	Salinity ppt	D.O. % Sat	pH	ORP	Turbidity NTU
CCI	Turbid	5	13:44	0.3	18.0	166	0.07	32	6.8	514	27
CC2	Clear	5	14:00	0.3	18.0	159	0.07	33	6.7	446	13
	ANZE	CC Guidel	lines		+ 2°C	~1500	1.0	80 - 90	6.5 - 9.0	NA	+10%

Table A.3 Stream Conditions and In-Situ-Water Quality Measurements - Dry Episode (04/11/02)

Site	Clarity	Flow m/min	Time	Depth m	Temp °C	Conductivity uS/cm	Salinity ppt	D.O. % Sat	рН	ORP	Turbidity NTU
CCI	Clear	3	1/3:2/3	0.4	21.4	166	0.06	53	6.7	422	8
CC2	Clear	3 /	13:32	0.4	21.4	154	0.06	78	6.8	367	6
	ANZE	CC Guide	lines		+ 2°C	~1500	1.0	80 - 90	6.5 - 9.0	NA	+10%

Appendix C

Laboratory Results

RESULTS OF WATER ANALYSIS (Page 1 of 1)

2 samples supplied by RTA on the 3rd September, 2002 - Lab. Job No. J9308

Analysis requested by Jeff Parrell.

		SAMPLE 1	SAMPLE 2
PARAMETER	METHODS REFERENCE	CC1	
	Job Na.	J9308/1	J9303/2
Н	арна 4500-H°	6.55	6.36
CONDUCTIVITY (EC) (dS/m)	APHA 2510-B	0.18	0.18
OTAL DISSOLVED SALTS (mg/L)	calculation using EC x 680	123	124
OTAL SUSPENDED SOLIDS (mg/L)	APHA 2540-D	0.5	<0.5
OTAL OILS AND GREASE (mg/L)	APHA 5520-D (hexane extractable)	<2.0	<2 0
TOTAL PHOSPHORUS (mg/L P)	APHA 4500 P-H	0.06	0.01
OTAL NITROGEN (mg/L N)	APHA 4500 N-C	0.73	0.39
CHLORIDE (mg/L)	APHA 4500-Cf	35	34
ULPHATE (mg/L SO,2)	APHA 3120 ICPOES THOUSE	15	1.7
CHLORIDE/ SULPHATE RATIO	Calculation	2.3	2.3
LUMINIUM (mg/L)	APHA 3120 ICPMS/OES ^{'holi 142}	0.102	0.037
:HROMIUM (mg/L)	APHA 3120 ICPMS Table 152	0.001	< 0.001
COPPER (mg/L)	APHA 9120 ICPMS*note 112	0.001	0.031
ROM (mg/L)	APHA 3120 ICPNS/OES Tols 1 k2	0.448	0.418
MANGANESE (mg/L)	APHA 3120 ICPNS/OES Tall 182	0.079	0.072
.EAO (mg/L)	APHA 3120 ICPMS note 152	<0.001	< 0.001
ZINC (mg/L)	APHA 3120 ICPMS Tools 182	0.003	0.003

Notes:

ta. Total Available metals - samples additied with nitric add and then filtered through 0.45µm cellulose acetate

- 2. Metals analysed be ICP-MS (Inductively Coupled Plasma Mass Spectrometry) or ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry)
- 3. 1 mg/L (milligram per litre) = 1 ppm (part per million) = 1000 µg/L (micrograms per litre)= 1000 ppb (part per billion)
- 4. For conductivity 1 dS/m = 1 mS/cm = 1000 μ S/cm
- 5. Analysis performed according to APHA, 1998, "Standard Methods for the Examination of Water & Wastewater", 20th Edition, except where stated otherwise.

checked:

Appendix H

Noise and Vibration Assessment Report



Noise and Vibration Assessment

Proposed Upgrade of Cudgera Creek Road between Pacific Highway Freeway and Pottsville-Mooball Road



Prepared for:

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Business Unit	Environmental Mon	Environmental Monitoring				
Project No.	H/38387/D/03/01	NM Cudgera Creek				
Document description	Proposed Upgrade of Cudgera Creek Road between Pacific Highway Freeway and Pottsville-Mooball Road					
	Name	Signed	Date			
Approving Manager	Jeff Parnell	411	112/5/03			
	-	Th	//			

Person managing this document	Rorson writing this document
Jeff Parnell	Jeff Parnell

Location	CARMS File	
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Client Reference	Status	Date
	Final	12 May 2003



NOISE AND VIBRATION ASSESSMENT

Proposed Upgrade of Cudgera Creek Road between Pacific Highway Freeway and Pottsville-Mooball Road April, 2003

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Appendices

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- **D.** Operational Noise Calculations
- E. Background Noise Level Calculations
- F. Construction Noise Level Predictions

Glossary of Terms

DUAP Former name of Planning NSW

ECRTN EPA's Environmental Criteria for Road Traffic Noise

EPA NSW Environment Protection Authority

REF Review of Environmental Factors

RTA NSW Roads and Traffic Authority

dB The is the abbreviation used for decibel which is the measure of sound

pressure level

dBA The "A" denotes that the sound pressure level has been A weighted so

that the scale approximates the response of the human ear. The ear is less sensitive to high and low frequency sounds than it is to sounds in the midrange. Most community noise is measured in "A" weighted decibels.

Lmax dBA This is the highest noise level in dBA measured during the specified time

period.

 L_{10} dBA This is the noise level in dBA exceeded for 10% of a specified time

period. For a 1 hour period the level would be exceeded for 6 minutes but would be less for the remaining 54 minutes. This is sometimes

written as L_{A10}

L₉₀ dBA This is the noise level in dBA exceeded for 90% of a specified time

period. For a 1 hour period the level would be exceeded for 54 minutes but would be less for the remaining 6 minutes. This approximates the average minimum noise level and is often referred to as the background

noise level and is sometimes written as L_{A90}

 L_{eq} The Leq represents the average noise energy during the measurement

period. When the energy level is A weighted it may be written as L_{Aeq}

 L_{Aeq} (9 hr) The logarithmic average of the hourly L_{Aeq} measurements recorded

between 10 pm and 7 am. (Current NSW EPA night-time objective)

 L_{Aeq} (15 hr) The logarithmic average of the hourly L_{Aeq} measurements recorded

between 7 am and 10 pm. (Current NSW EPA daytime objective)

 L_{Aeq} (1 hr) Night The highest 10th percentile L_{Aeq} one hour measurement recorded between

10 pm and 7 am.

 L_{Aeq} (1 hr) Day The highest 10th percentile L_{Aeq} one hour measurement recorded between

7 am and 10 pm.

Tenth Percentile Background Noise Level

This is the background L₉₀ noise level calculated according to the 10th

percentile method described in the NSW EPA Industrial Noise Policy

(2000) for the proposed construction hours.

1 Introduction

The RTA's Road Services, Northern Region has been contracted to upgrade a section of the Cudgera Creek Road west of Pottsville. The work will include the construction of a new bridge and a realignment of the existing road. The works are directly related to the Yelgun to Chinderah Project, which is located immediately to the west of the Proposal. Upgrading of Cudgera Creek Road within 5 years of the commencement of works was a condition of consent provided for the Yelgun to Chinderah Project by the then Minister of Urban Affairs and Planning.

The existing road is a two lane single carriageway with a posted speed of 100 km/hr. Lane width is generally narrow and there are no formed shoulders. The pavement is deformed in several sections resulting in a high roughness index. Replacement of the existing bridge would improve the alignment and reduce the impedance to water flow during times of flood.

1.1 Scope and Objectives

This report assists in the environmental assessment of the proposed upgrade of Cudgera Creek Road by meeting the following objectives:

- Determination of the current road traffic noise levels and assessment of ambient noise conditions in the study area;
- Estimation of the level of road traffic noise exposure in the study area prior to the opening of the Yelgun to Chinderah Project;
- Prediction of the environmental impacts of construction noise and vibration and operational noise levels that would result from the Proposal;
- Prediction of road traffic noise levels 10 years after the opening of the Yelgun to Chinderah Project;
- Identification of the relevant assessment criteria for the scope of the proposed work.

2 Study Area & Proposed Works

The study area is a 1.8 km section of the Cudgera Creek Road, from immediately east of the bridge over the Pacific Highway, to the Pottsville – Mooball Road intersection. The surrounding land use is predominantly rural with a disused quarry near Cudgera Creek. The noise catchment area is therefore dominated by road traffic with few other contributing noise sources.

2.1 Scope of Works

The Proposal would involve the upgrading and realignment of Cudgera Creek Road from the eastern limits of the Cudgera Creek Road Interchange, to approximately 200 metres east of the junction with Mooball-Pottsville Road, a length of approximately 1.8km. The Proposal would involve rehabilitation and realignment of the existing road in the vicinity of Cudgera Creek. The Proposal would also involve the redesign of the intersection of Cudgera Creek Road with the Mooball-Pottsville Road.

Page 1

The proposed works would include property acquisition, utility adjustments, clearing, earthworks, drainage works, bridge construction and removal of the existing bridge, paving and rehabilitation works.

It would be expected that construction equipment for the Proposal would include:

- Piling equipment
- Chainsaws
- Bulldozers
- Backhoes
- Excavators
- Front end loaders
- Grader
- Vibrating rollers
- Static rollers

- Paving machines
- Jackhammers
- Heavy transport
- · Concrete agitator trucks
- Water tanker
- · Road sweeper
- Linemarking vehicles
- Truck delivery of construction materials
- Light commercial and passenger vehicles.



Figure 2.1 – Locality map of the proposed roadworks on Cudgera Creek Road Map Data Copyright 2002 Telstra Corporation Limited and Universal Press Pty Ltd

An aerial photograph of the area showing the location of the proposed works is attached in Appendix A.

2.2 Traffic Data

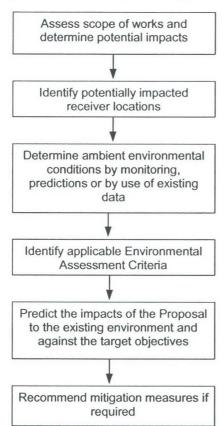
Temporary traffic counters were established on Cudgera Creek Road and Pottsville-Mooball Road from August to October 2002. The counters recorded traffic volume and classification data for a 35-day period. This data indicated a Year 1 AADT (2003) of 2,341 and a commercial vehicle volume of 8.9%.

It is understood that prior to the opening of the Yelgun to Chinderah Project the traffic volumes were less than 500 vehicles per day.

3 Methodology

The methodology of the study can be summarised as follow:

Methodology



- · Identified in locality map and site inspection
- LA_{eq} (15 hours) day time
- LA_{eq} (1 hour) day time
- LA_{eq} (1 hour) night-time
- LA_{eq} (9 hours) night-time
- LA₉₀ background noise level
- References from EPA's ECRTN, RTA's Environmental Noise Management Manual, relevant Standards and guidelines and Planning NSW Conditions of Approval
- LA₁₀ for construction noise assessment
- Post Construction LA_{eq} (day time 1 & 15 hours and night-time 1 & 9 hours)
- Construction vibration levels

3.1 Identification of Potentially Impacted Receivers

Residential properties are located on both sides of Cudgera Creek Road, two of which would be acquired as part of the Proposal. There are up to four additional properties which are located 15 - 40 m from the roadway that have been identified as being likely to have been impacted upon as a result of the opening of the Yelgun to Chinderah Project. These properties are located along the section of Cudgera Creek Road between the Pacific Highway and the bridge over Cudgera Creek. Data was collected from two sites that were in close proximity to Cudgera Creek Road and was used to supplement indicative data that had previously been collected at another site along the route of the proposed work.

Table 3.1 – Data Collected from Potentially Impacted Receivers

Location	Receiver Type	Distance from Road/Work (m)	Potential Impact Source
A	Residence ¹	15	Construction/ Operation
В	Residence ¹	15	Construction/ Operation
С	Residence ²	40	Construction/ Operation

Long term monitoring was undertaken at these sites

4 Assessment Criteria

Environmental criteria applicable to road proposals generally falls into two categories, being:

- that which is a result of construction activities, and;
- that which is generated from operational use of the final product.

Discussion of the criteria applicable to these two categories within the terms of reference of this report are given in Sections 4.1 to 4.3.

4.1 Construction Noise

The NSW Environment Protection Authority (EPA) *Environmental Noise Control Manual* (ENCM), Chapter 171, sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. The EPA guidelines for construction noise are summarised in Table 4.1.

Table 4.1 - Construction Site Noise Control Guidelines

Total Construction Period	Acceptable LA ₁₀ Noise Level ¹
4 weeks and under	Background LA ₉₀ plus 20 dBA
4 weeks to 26 weeks	Background LA ₉₀ plus 10 dBA
Greater than 26 weeks	Background LA ₉₀ plus 5 dBA

¹ Applicable to normal working hours between the hours of 7.00am and 6.00pm Monday to Friday, and 7.00am to 1.00pm Saturdays. For all other times construction noise must be inaudible at the receiver. No construction work is to take place on Sundays or Public Holidays.

Exceedance of the above goals is only permitted after all feasible and reasonable noise mitigation measures have been exhausted. Close consultation with the affected community is essential where construction works are proposed outside normal working hours. In addition, where noise goal exceedances are likely and all feasible and reasonable noise mitigation measures have been exhausted.

4.2 Construction Vibration

German Standard DIN 4150 (1986) which sets conservative vibration levels for structural damage at 5mm/second is generally recognised as setting the most appropriate criteria for architectural assessment. A lower level of 2mm/second is often adopted for heritage structures. These levels would rarely be exceeded by roadworks, however human perception and comfort levels are usually reached at a much lower level. In this regard the British Standard BS6472 provides the most authoritative criteria for assessment of the impacts of construction vibration on the community as given in Tables 4.2 and 4.3.

² Short term monitoring was undertaken at this site.

Table 4.2 - Vertical Vibration Levels and Human Perception

Approximate Vibration Level	Degree of Perception
0.10 mm/s	Not Felt
0.15 mm/s	Threshold of Perception
0.35 mm/s	Barely Noticeable
1.0 mm/s	Noticeable
2.2 mm/s	Easily Noticeable
6 mm/s	Strongly Noticeable
14 mm/s	Very Strongly Noticeable

Note: These approximate vibration levels (in floors of buildings) are for vibration having a frequency content in the range of 8Hz to 80Hz.

Table 4.3 - Vibration Dose Values (mm/s^{1.75}) Versus Degrees of Adverse Comment Expected in Residential Buildings

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night	0.13	0.26	0.51

4.3 Operational Noise

The NSW Government's "Environmental Criteria for Road Traffic Noise" (ECRTN) (May 1999) provides the assessment criteria for road traffic noise in NSW. Tables 1 and 2 of these Criteria contain various classifications for road construction.

While the proposed works on Cudgera Creek Road will not provide for design increases in traffic carrying capacity, there has, as a result of the Yelgun to Chinderah Project been a significant increase in traffic volumes. It has therefore been deemed that the appropriate category is "Redevelopment of existing local roads". This interpretation is confirmed by reference to the flow chart for selecting criteria given in Practice Note 1, (page 82) of the RTAs Environmental Noise Management Manual and in correspondence from the NSW EPA (reference GRF6011 – 257224A1/12).

Under this classification recommended levels are:

Residences:

 L_{Aeq} 1hr (7am-10pm) 55dB L_{Aeq} 1hr (10pm-7am) 50dB

Calculations performed in Appendix D and reported in Section 6 allow comparison of the appropriate criteria with existing levels (2003) and for 10 years after opening of the Yelgun to Chinderah Project in 2013. An estimation of levels that existed prior to the opening of the Yelgun to Chinderah Project are also given in Section 6.

5 Instrumentation

Two Acoustic Research Laboratories Environmental Noise Loggers were used during the monitoring period. These instruments satisfy the requirements of Australian Standard AS1259-1990 for Type 1 instrumentation and were operated using the A-weighted setting and RMS detector time set to "fast". Data was collected in 15 minutes intervals and reported in 1hr intervals. These instruments were field calibrated before and after measurements with a Bruel & Kjaer Type 4231

acoustic calibrator (Serial No. 992411). The field calibration levels were within the acceptable limit of variation of \pm 0.5 dBA. The noise loggers and the acoustic calibrator used for field calibration had current NATA calibration. The reference pressure for all sound pressure level measurements is 20 μ Pa.

6 Results

Noise monitoring was conducted at two sites over a period of up to 12 days from 17 February 2003 to 3 March 2003 inclusive. Noise measurements were obtained by placing the noise logger 1 m from the closest facade of the residence facing Cudgera Creek Road (refer to site data sheet in Appendix B).

Table 6.1 - Instrument Location

Site	Location	Noise Logger Number
A	Lot 999 Cudgera Creek Road, Cudgera	16-498-413
В	Hardy Residence, Cudgera Creek Road, Cudgera	16-302-486

Where possible data from a short term monitoring study undertaken at 1050 Cudgera Creek Road during September 2002 is also referenced in this report as Site C.

A extract of noise measurements for the two sites is presented in Table 6.2 and 6.3 below with calculated arithmetic means in a format $\{L_{Aeq}(9hr) \text{ and } L_{Aeq}(15hr)\}$ that allow comparison to more developed roads that the RTA usually undertakes work upon. The complete hourly measurement results can be found graphically represented in Appendix C.

Table 6.2 – Measured Noise Levels at Site A: 999 Cudgera Creek Road, Cudgera

Days	Date	L _{Aeq} (9hr) dBA	L _{Aeq} (15hr) dBA
Tuesday	18/2/2003	57	66
Wednesday	19/2/2003	57	66
Thursday	20/2/2003	60	64
Friday	21/2/2003	62	64
Saturday	22/2/2003	58	64
Sunday	23/2/2003	55	64
Monday	24/2/2003	55	63
Tuesday	25/2/2003	55	64
Wednesday	26/2/2003	55	68
Thursday	27/2/2003	57	62
Me	ans	57	65

Table 6.3 – Measured Noise Levels at Site B: Hardy Residence Cudgera Creek Road, Cudgera

Days	Date	L _{Aeq} (9hr) dBA	L _{Aeq} (15hr) dBA
Thursday	20/2/2003	56	63
Friday	21/2/2003	56	63
Saturday	22/2/2003	55	66
Sunday	23/2/2003	54	71
Monday	24/2/2003	58	64
Tuesday	25/2/2003	55	63
Wednesday	26/2/2003	55	63
Thursday	27/2/2003	56	65
Friday	28/2/2003	55	68
Friday	03/01/2003	54	63
Monday	03/02/2003	54	65
Thursday	20/2/2003	56	65
Mo	eans	57	65

To allow comparison with the appropriate criteria as discussed in Section 4, the $L_{Aeq}(1hr)$ for the day and night periods has been calculated according to the method described in section C4 of the EPA *Environmental Noise Control Manual* and is presented in Table 6.5. The criteria requires comparison against the highest tenth percentile hourly L_{Aeq} noise levels recorded during the respective noise monitoring periods.

For the purposes of comparison, estimation of the $L_{Aeq}(1hr)$ levels that would have existed prior to the opening of the Yelgun to Chinderah Project have been made in Table 6.4. These estimations are based on previous experience of low volume rural roads and by discounting the recorded levels to account for the reduced traffic volumes that occurred prior to the opening of the Yelgun to Chinderah Project.

Table 6.4 – Estimated¹ Tenth Percentile Noise Levels Leq(1hr) dBA
Prior to Opening of Yelgun to Chinderah Project

Location	LA _{eq(1hr)} 7am – 10pm	LA _{eq(1hr)} 10pm – 7am
Site A Lot 999 Cudgera Ck Rd	55	48
Site B Hardy Residence Cudgera Ck Rd	55	48
Site C Lot 1050 Cudgera Ck Rd	50	45
EPA Objectives	55	50

1 estimated on the basis of previous experience and reduction for reduced traffic volumes

Table 6.5 - Current Tenth Percentile Noise Levels Leq(1hr) dBA

Location	$LA_{eq(1hr)}$ $7am - 10pm$	$\begin{array}{c} LA_{eq(1hr)} \\ 10pm - 7am \end{array}$
Site A Lot 999 Cudgera Ck Rd	67.4	60.0
Site B Hardy Residence Cudgera Ck Rd	66.3	58.9
Site C ² Lot 1050 Cudgera Ck Rd	60.5	55.8
EPA Objectives	55	50

² data from previous short term study

The background L₉₀ noise level was also recorded for each 15 minutes interval during the monitoring period for determination of construction noise levels. Background noise level for the monitored sites were calculated by following the "tenth percentile method" described in Appendix B of the NSW Governments *Industrial Noise Policy 2000*. Background noise level results are presented in Table 6.6. Detailed calculations of background noise level are attached in Appendix D.

Table 6.6 - Current Tenth Percentile Background Noise Levels L₉₀ dBA

Location	L90 7am – 6pm
Site A Lot 999 Cudgera Ck Rd	41
Site B Hardy Residence Cudgera Ck Rd	35
Site C ¹ Lot 1050 Cudgera Ck Rd	37

Given the relatively low traffic volumes on Cudgera Creek Road at night there is concern that the results recorded during the night-time monitoring period may not be solely as a result of road generated noise. This is further discussed in Section 9.

As discussed in Section 4 it is required to estimate road traffic noise levels 10 years after opening (opening of the Yelgun to Chinderah Project). Calculations undertaken in Appendix D indicate that based on a 3% per annum growth in traffic there would be a 1.3 dB increase in road traffic noise by 2013. Table 6.7 gives predictions of the noise levels that would be experienced at the monitored locations in 10 years. Because of doubts over the validity of the night-time data and the contribution of vehicles, the predictions have only been undertaken for the daytime period.

Table 6.7 – Predicted Tenth Percentile Noise Levels Leq(1hr) dBA for Ten Years After Opening (2013)

Location	LA _{eq(1hr)} 7am – 10pm
Site A Lot 999 Cudgera Ck Rd	68.7
Site B Hardy Residence Cudgera Ck Rd	67.6
Site C ¹ Lot 1050 Cudgera Ck Rd	61.8
EPA Objectives	55

¹ data from previous short term study

7 Construction Noise

The period of construction of the Proposal is estimated to be 12 months, however, due to the progressive nature of the construction works over the 1.8 km length it is unlikely that construction equipment would be used in front of the identified receivers for the full duration of work. Therefore, it is more appropriate to assess the predicted construction noise against the 4 - 26 weeks EPA Construction Noise criteria, ie., the measured background noise plus 10 dB. Table 7.1 summarises the measured background noise level and the EPA daytime working hours construction noise goal for the estimated construction duration in the study area.

Table 7.1 – Measured Background Noise Level and EPA Construction Noise Goal

Site	Background Noise Level Day LA ₉₀ (7am – 6pm)	EPA Construction Noise Goal ¹ LA ₁₀ (7am – 6pm)
999 Cudgera Ck Rd	41	51
Hardy Residence	35	45
1050 Cudgera Ck Rd	39	49

^{1:} $L_{90} + 5$ dB for receivers where work is likely to be > 26 weeks duration.

It is often recognised that the daytime construction noise goals are very stringent and are sometimes unachievable, particularly where noise sensitive receptors are located in close proximity to construction works and background noise levels are relatively low. Where daytime goals are likely to be exceeded, a performance approach should be followed that allows the implementation of best management practice in reducing construction noise levels towards the goals. Close consultation with the affected community is essential where it is expected that construction works will exceed EPA criteria, with consultation protocols (RTA Community Involvement Practice Notes and Resource Manual, 1998) being followed.

7.1 Construction Noise Predictions

Table 7.2 lists typical sound power levels of the type of construction plant items provided in the proposed schedule of works for the construction. Appendix D details calculations determined for the study area.

Table 7.2 - Typical sound power levels of construction plant items (AS 2436 – 1981, Table D2)

Item	Sound Power Level dBA
Batch Plant	107 - 121
Excavator	108 - 118
Rock Hammer	110 - 119
Compressor	98 - 100
Vibratory Roller	100 - 104
20t Truck	103 - 108
Grader	114 - 120

Calculations performed in Appendix D used mean values from Table 7.2 for a range of assumed construction equipment to predict the sound pressure level at the monitoring site as identified in Table 6.1. Experience shows that the L_{10} is generally between 5 and 12 dB less than the sound pressure level predicted from sound power levels and this can be discounted by a further 2 dB because all equipment will not be

 L_{90} + 10 dB for receivers where work is likely to be 4 - 26 weeks duration.

 $L_{90} + 20$ dB for receivers where work is likely to be < 4 weeks duration.

working at the same time. Table 7.3 shows the predicted L_{10} that has been conservatively discounted by a total of 7 dB and compares against calculated guideline and reasonable criteria for the identified receiver.

Table 7.3 – Construction Noise Level Objectives and Predicted Levels at Identified Receivers

Site	EPA Construction Noise Goal LA ₁₀ (0700 – 1800)	Predicted Construction Noise LA ₁₀ (0700 – 1800)	Exceedance of EPA Goals dB	Existing LA ₁₀ Exceedances and (Means) (0700 – 1800)
999 Cudgera Ck Rd	51	79	28	4 – 27 (19.8)
Hardy Residence	45	79	34	12.2 - 48.3 (26.9)
1050 Cudgera Ck Rd	49	73	24	7 - 25 (11.4)

Due to conservative estimating, the error range is likely to be $\pm 2/-9$ dB for predictions of noise levels from the Construction Site for the assumed equipment use.

7.2 Construction Noise Impact

While daytime construction activities are predicted to exceed the current EPA Criteria by up to 34 dB, it is not expected that these levels would cause adverse comment. From Table 7.3 it can be seen that ambient L_{10} nose level are already well in excess of the target levels at times being up to 48 dB over the L_{90} for the measured interval. From Appendix E it can also be seen that these ambient L_{10} levels are comparable to those predicted for when construction equipment is being used. It is however, recommended that best practice work methods be adopted to ensure that potential impacts would be minimised. A procedure for dealing with complaints should also be developed. Section 7.3 references techniques for controlling construction noise which may be included in an Environmental Management Plan.

7.3 Construction Noise Management

While the following list of noise management options is not exhaustive, it will assist in reducing impacts. These and any other available options should be considered when planning works, and should be implemented where practical and cost-effective. The RTAs *Environmental Noise Management Manual* should be consulted prior to the development of any noise management strategies.

Source controls

- Time constraints
 - Limit work to daylight hours.
- Scheduling
 - Perform noisy work during less sensitive time periods.
- Equipment restrictions
 - Select low-noise plant and equipment.
 - Ensure equipment has quality mufflers installed.
- Emission restrictions

Establish stringent noise emission limits for specified plant and equipment. Implement noise monitoring audit program to ensure equipment remains within specified limits.

Substitute methods

Use quieter and less vibration emitting construction methods where possible. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration reduction benefits.

• Limit equipment on site

Only have necessary equipment on site.

Limit activity duration

Where possible, concentrate noisy activities at one location and move to another as quickly as possible.

Site access

Vehicle movements outside construction hours, including loading and unloading operations, should be minimised and avoided where possible.

• Equipment maintenance

Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the design specifications.

Reduced equipment

• **Power** Use only necessary size and power.

Quieter work practices For example, implement work-site induction training, educating staff on noise sensitive issues and the need to make as little noise as possible.

Reversing alarms

Consider alternatives, such as manually adjustable or ambient noise sensitive types ("smart" reversing alarms). Alternative site management strategies can be developed, in accordance with the *Occupational Health and Safety Plan*, with the concurrence of the Occupational Health and Safety Officer.

Path controls

Noise barriers

Consider installing temporary construction noise barriers.

Install any permanent noise barriers required to minimise road traffic noise as early as possible in the construction process.

Locate equipment to take advantage of the noise barriers provided by existing site features and structures, such as embankments and storage sheds.

Enclosures

Install noise-control kits for noisy mobile equipment and shrouds around stationary plant, as necessary.

• Increased distance

Locate noisy plant as far away from noise-sensitive receptors as possible.

Site access

Select and locate site access roads as far away as possible from noise-sensitive areas.

Receptor controls

Architectural treatment

Upgrade the glazing or window shutters of affected bedrooms.

Consultation

Community consultation, information, participation and complaint responses are essential aspects of all construction noise management programs.

They typically involve:

- A community information program before construction and/or high risk activities are commenced. This usually involves a leaflet distribution and direct discussions and negotiations with affected residents, explaining the type, time and duration of expected noise emissions.
- The involvement of affected residents in the development of acceptable noise management strategies.
- A nominated community liaison officer with a contact telephone number.
- A complaints hotline.
- Timely responses to complaints, providing information on planned actions and progress towards the resolution of concerns

It is recommended that:

- Best management practice should be applied in development of a noise and vibration management plan (NVMP).
- Where work is conducted outside normal working hours and noise goal exceedances are predicted, all feasible and reasonable noise mitigation measures should be evaluated and included in the NVMP. If after the application of all feasible and reasonable noise mitigation measures, it is still predicted that there will be noise goals exceedances, the RTA's out of normal hours construction programming and consultation protocols should be followed.

8 Construction Vibration

From experience it may be expected that the residences located 20 m from heavy road construction work would experience vibration levels up to 3 mm/sec when vibratory rolling is being undertaken at the closest point to the residence. This level would be well below that which may cause architectural damage. It is not expected that the minor scope of proposed works would result in vibration levels that would cause adverse comment at any sites. It is not expected that mitigation measures would be required.

9 Operational Noise

For the purpose of these type of studies, it is generally assumed that road traffic noise dominates the noise catchment of the study area. Samuels and Huybregts (1998) found that where road traffic noise is the dominant noise source, a linear relationship exists which approximates to $L_{10} = L_{eq} + 3$ dB. Inspection of the collected data using this relationship shows that for both monitored locations although this rule appears to hold true during the daytime, the L_{10} is consistently less than the L_{eq} during the night-time hours. Because the L_{90} is also higher than normally expected for a rural environment, yet still well below the L_{eq} the data is indicating that there is a consistent extraneous background noise level during the night that lasts for between 10 and 90% of the time. Infrequent peak noise level events may then be responsible for further increasing the average energy levels (L_{eq}) above the L_{10} . This type of extraneous noise may commonly occur in rural environments during summer months as a result

Page 12

of insects such as crickets or cicadas. Previous experience has shown that crickets may increase a background noise level from less than 30 dBA to a level of 50 dBA, and be able to maintain this for greater than 10 minutes per hour. This theory of why there are high L_{eq} levels at night is further confirmed by the strong correlation between the L_1 and the L_{eq} which indicates a small number of peak noise level events are influencing the overall noise energy levels. This would be consistent with the low traffic volumes being experienced during the night.

It is therefore concluded that extraneous noise sources have significantly affected data collected during the monitoring period from approximately 7pm until 7am. There is no evidence that data collected during the daytime was affected by extraneous noise.

Traffic volumes are too low during the night-time period to accurately model the contribution of road traffic noise to the noise catchment, however experience would indicate an expected L_{eq} (1hr) range of 52-55 dBA would be expected at the closest residence during the night-time period.

Data collected during the daytime monitoring period shows that residences located close to Cudgera Creek Road are experiencing L_{eq} (1hr) noise levels that are up to 12 dB above the relevant EPA Criteria. Under the "Do Nothing Option" it is predicted that road traffic noise would rise by a further 1.3 dB by 2013 based on an annual traffic growth of 3%. The Proposal to upgrade the road would result in minimal change in alignment for most of the properties that would be retained, except for the Hardy residence which would have its setback increased by 15-20m. Due to the current deteriorated state of the pavement, there may be reductions achieved in road traffic noise due to improved wearing surface, however, these are likely to be less than 2 dB.

10 Conclusion

This study has been prepared using all available information and is based on an assumed scope of works. The parameters of Construction Noise, Construction Vibration and Operational Noise and are summarised separately below.

10.1 Construction Noise

Current NSW EPA Criteria for Construction Noise does not provide a satisfactory basis for determining workable limits in a rural environment due to the low ambient background L₉₀ noise levels that generally prevail. While it is likely that construction activities would exceed EPA daytime objectives, given that these criteria are currently being exceeded by up to 44 dB, it is not expected that construction noise levels would cause any level of discomfort or result in adverse comment from identified residences.

It is recommended that best practice work methods be adopted to ensure that potential impacts would be minimised. A procedure for dealing with complaints should also be developed.

The EMP may include strategies for, but not limited to:

- Utilising best practical technology and means to achieve noise mitigation by use of
 - Source controls

- Path Controls
- Receptor Controls
- Planning of noisy activities for parts of the day when they will have the least impact.
- Provision of a line of communication between the Community and Project Management.

10.2 Construction Vibration

Because the scope of works is minor and does not require prolonged use of heavy construction equipment, it is not expected that construction activities would cause adverse comment. While it is not considered necessary for mitigation strategies to be developed, best management practices that are consistent with those described in the RTAs Environmental Noise Management Manual should be adopted.

10.3 Operational Noise

The proposed work will not significantly change the current levels of road traffic noise, although there is an expectation that the improved wearing surface and pavement alignment will reduce vehicle passby noise levels and in particular those of unladen trucks. The Conditions of Approval provided for the Yelgun to Chinderah Project by the Minister of Planning NSW (formally Urban Affairs and Planning) do however require that the upgrading of Cudgera Creek Road be commenced within 5 years.

It is also required that the proposed works be assessed against conditions that prevailed prior to the opening of the Yelgun to Chinderah Project and that for the purposes of assigning criteria, the works be classified as "Redevelopment of existing local roads" according to the EPAs Environmental Criteria for Road Traffic Noise.

While there has been a significant increase in traffic volumes on the Cudgera Creek Road, these levels are still not considered high for a rural road. Monitoring of road traffic noise has shown, however, that daytime noise levels are currently up to 12 dB above what would be considered appropriate for a local rural road. Data collected during the night-time period is not considered to be representative of road traffic noise because it does not exhibit the normal characteristics of road generated noise. Because of the low traffic volumes experienced at night it is considered that road traffic noise would not be dominating the noise catchment during this period and that the criteria would unlikely to be regularly exceeded for this period as a result of road traffic noise only.

While no noise monitoring results for Cudgera Creek Road were available for the period prior to the opening of the Yelgun to Chinderah Project, based upon traffic volumes at that time it is reasonable to assume that levels of road traffic noise were at, or below the current criteria as estimated in Table 6.4. It is therefore concluded that since the opening of the Yelgun to Chinderah Project, residences that are located in close proximity to Cudgera Creek Road are now being exposed to levels of road traffic noise that require reasonable and feasible methods of attenuation to be implemented.

The RTAs Environmental Noise Management Manual should be consulted prior to the development of any noise management strategies. Although architectural treatments

are likely to be the most acceptable mitigation measure in a rural environment, consultation should be undertaken with the affected residents. It is recommended that advice be sought on any proposed methods of mitigation to determine what internal noise reduction would be achieved, as the construction of the residence at lot 999 Cudgera Creek Road would not be receptive to architectural treatments.

The Proposal may improve the current levels of road traffic noise at some receiver locations due to improvements in pavement surfacing and alignment, therefore, it may be appropriate to undertake further monitoring prior to the implementation of any mitigation measures to reassess the levels of road traffic noise following the construction of the new pavement.

Additional monitoring may also be used to confirm the night-time level of road traffic noise exposure against a background that is not impacted by extraneous noise sources. It is recommended that any additional monitoring be conducted during a time when it is unlikely that there would be any influence by extraneous noise sources.

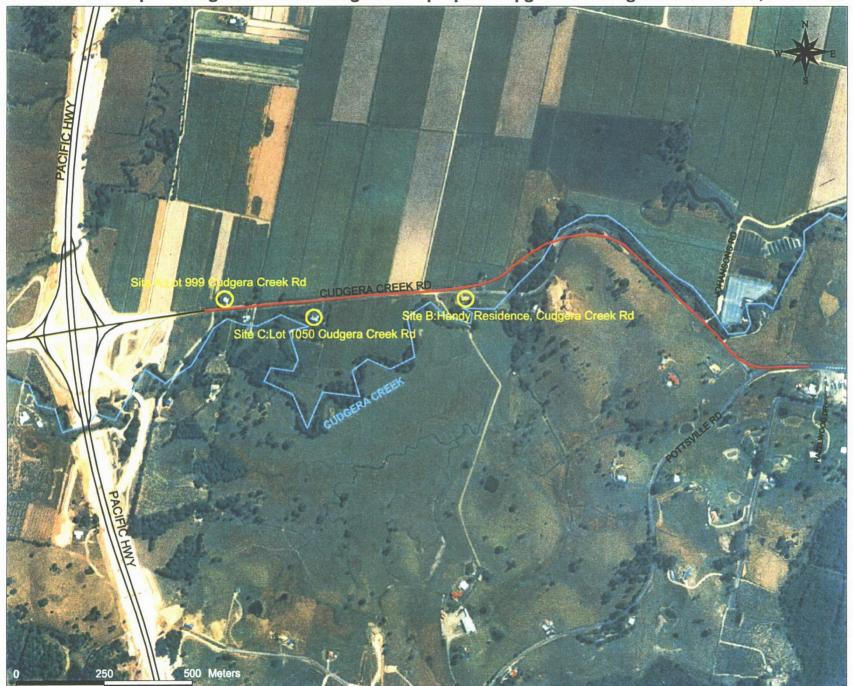
11 References

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Appendix A

Site Photographs and Maps

Aerial Photo Map showing Noise Monitoring Sites of proposed upgrade of Cudgera Creek Road, Pottsville.



LEGEND

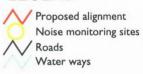




Photo 1 999 Cudgera Creek Road, Cudgera



Photo 2 Hardy Residence Cudgera Creek Road, Cudgera

Appendix B

Site Data Sheet

Project: Concons Crosil Ros Coansos

Location: HANDY PROPERTY

Logger No.	16-302-486	Calibrator No.	1795234
Reading Before	94.0	Reading After	93.8

No. of Lanes	7	7mm Flush Seal	
Grade	_	14mm Flush Seal	/
Speed	100	Dense Grade	
Volume		Open Grade	
% Heavy		Concrete	
Weather	Frue	Other	

Ground Cover

Paved		Technician	141
Gravel/C-pact Earth		Date	1/19/2/03
Lawn	15	Computer File	Coniona Z
Long Grass	-	Photo	
Other			

Measurements

A 1.0	B 1-5	C 18	D 15	E	F	
G	Н	I	J	K	L	
M	N	0	P	Q		

File No.
Sheet No.
Date Issued: April 99

Project: Corgons Caral Reso Cranas

Location: Los and Concern Crose Treas

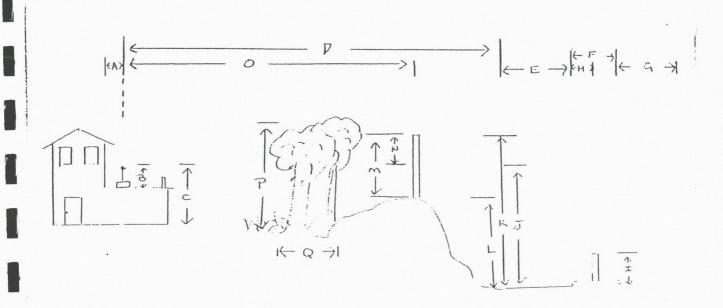
Logger No.	16. 498.413	Calibrator No.	1795234
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No. of Lanes	2	7mm Flush Seal	
Grade	-	14mm Flush Seal	
Speed	100	Dense Grade	
Volume		Open Grade	
% Heavy		Concrete	
Weather	FELE	Other	

Ground Cover

Paved		Technician	TAR .
Gravel/C-pact Earth		Date	17/2/03
Lawn	14	Computer File	Coperal
Long Grass		Photo	
Other			

Measurements C 2 F A В D G K L H I J M N P Q O



Appendix C

Hourly Measurement Results

Date: 20/2/2003

File Name: Cudgera2a_Sta.csv

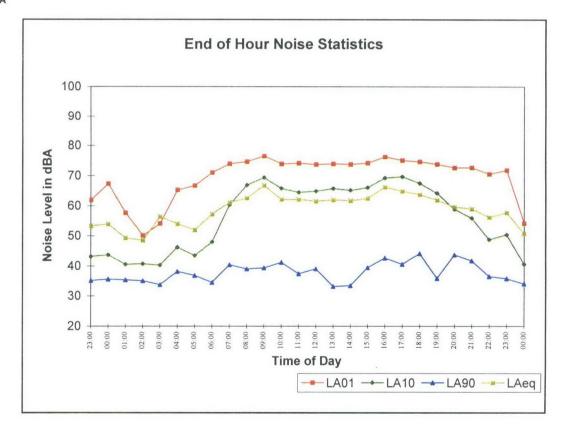
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	Lara	Lann	1
		L _{A10}	L _{A90}	L _{Aeq}
23:00	61.9	43.1	35.1	53.2
00:00	67.4	43.6	35.5	53.9
01:00	57.6	40.5	35.3	49.3
02:00	50.1	40.6	35.0	48.5
03:00	54.0	40.2	33.7	56.3
04:00	65.3	46.2	38.1	53.9
05:00	66.7	43.4	36.8	51.9
06:00	71.1	47.9	34.5	57.1
07:00	73.9	60.3	40.3	61.1
08:00	74.7	66.9	38.9	62.6
09:00	76.5	69.4	39.3	66.8
10:00	73.9	65.8	41.1	62.1
11:00	74.2	64.4	37.3	62.1
12:00	73.7	64.9	39.0	61.5
13:00	74.0	65.7	33.1	61.9
14:00	73.8	65.2	33.4	61.7
15:00	74.2	66.1	39.3	62.5
16:00	76.3	69.2	42.6	66.3
17:00	75.1	69.7	40.5	64.9
18:00	74.7	67.5	44.1	63.7
19:00	73.8	64.2	35.8	61.9
20:00	72.7	58.8	43.6	59.6
21:00	72.7	55.9	41.6	59.0
22:00	70.6	48.8	36.4	56.2
23:00	71.9	50.4	35.7	57.8
00:00	54.1	40.6	34.0	50.8

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	63.8	dBA
L _{A90} (Background)	07:00 - 18:00	39.0	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	55.6	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	62.9	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.4	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.9	dBA



Date: 21/2/2003

File Name: Cudgera2a_Sta.csv

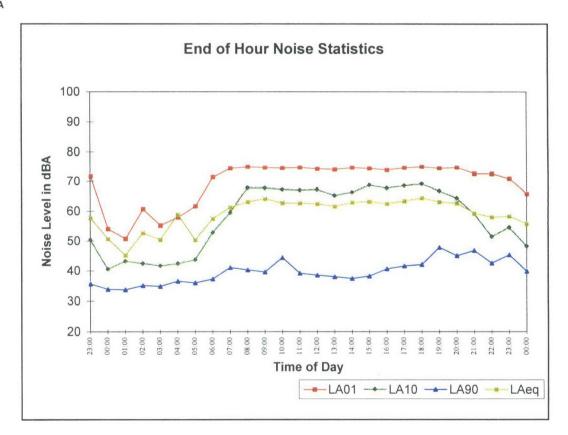
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
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01:00	50.9	43.2	33.8	45.2
02:00	60.8	42.4	35.2	52.7
03:00	55.3	41.7	35.0	50.5
04:00	58.0	42.4	36.6	58.9
05:00	61.7	43.7	36.1	50.4
06:00	71.6	52.8	37.3	57.5
07:00	74.4	59.5	41.2	61.4
08:00	75.0	67.9	40.4	63.2
09:00	74.7	67.8	39.7	64.2
10:00	74.5	67.4	44.5	62.8
11:00	74.8	67.1	39.3	62.8
12:00	74.3	67.3	38.6	62.5
13:00	74.1	65.2	38.1	61.7
14:00	74.7	66.3	37.5	63.0
15:00	74.4	68.7	38.3	63.3
16:00	73.9	67.8	40.7	62.6
17:00	74.7	68.6	41.7	63.4
18:00	75.1	69.2	42.2	64.4
19:00	74.5	66.8	47.9	63.2
20:00	74.8	64.3	45.2	62.8
21:00	72.7	59.2	46.9	59.3
22:00	72.6	51.5	42.6	58.1
23:00	71.1	54.6	45.5	58.4
00:00	65.9	48.3	40.0	55.9

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	64.0	dBA
L _{A90} (Background)	07:00 - 18:00	40.1	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	56.3	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	62.7	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.3	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	55.0	dBA



Date: 22/2/2003

File Name: Cudgera2a_Sta.csv

Weather: Fine

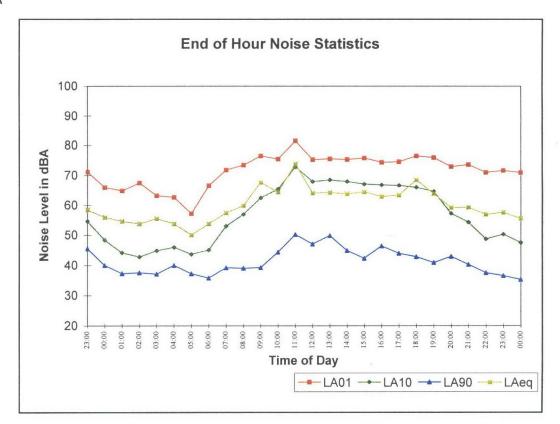
Logger Serial Number 16-302-486

Comments:

Weekend: YES (Saturday)

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01:00	64.8	44.1	37.2	54.6	
02:00	67.4	42.7	37.5	53.7	
03:00	63.1	44.8	37.1	55.4	
04:00	62.6	46.0	39.9	53.7	
05:00	57.1	43.6	37.2	50.0	
06:00	66.5	45.0	35.7	53.8	
07:00	71.7	53.0	39.1	57.4	
08:00	73.4	56.9	39.0	59.8	
09:00	76.4	62.5	39.2	67.6	
10:00	75.3	65.4	44.3	64.3	
11:00	81.4	72.8	50.2	73.8	
12:00	75.1	67.9	47.0	64.0	
13:00	75.4	68.4	49.8	64.2	
14:00	75.2	67.9	44.9	63.7	
15:00	75.6	67.0	42.3	64.4	
16:00	74.3	66.8	46.4	62.9	
17:00	74.4	66.6	43.9	63.3	
18:00	76.4	65.9	42.8	68.4	
19:00	75.8	64.6	40.9	63.8	
20:00	72.8	57.2	42.9	59.2	
21:00	73.5	54.3	40.2	59.3	
22:00	70.9	48.7	37.4	56.9	
23:00	71.5	50.2	36.5	57.6	
00:00	70.9	47.5	35.2	55.5	

Descriptor L _{dn}	Period 00:00 - 24:00	Noise 65.2	Level dBA
L _{A90} (Background)	07:00 - 18:00	44.5	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	55.3	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	65.9	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	64.1	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	55.0	dBA



Date: 23/2/2003

File Name: Cudgera2a_Sta.csv

Weather: Fine

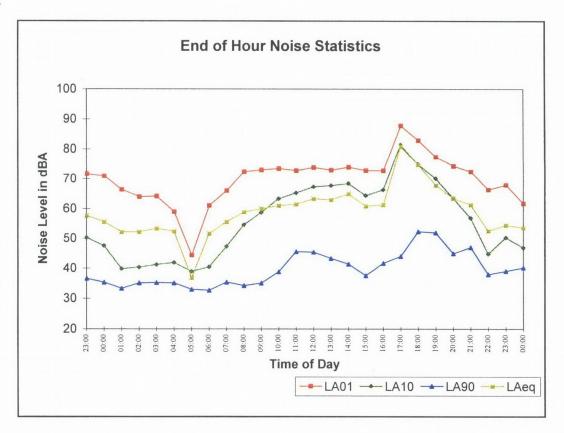
Logger Serial Number 16-302-486

Comments:

Weekend: YES (Sunday)

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01:00	66.3	39.8	33.2	52.1
02:00	63.9	40.3	35.0	52.2
03:00	64.1	41.2	35.1	53.3
04:00	58.9	41.9	35.0	52.3
05:00	44.3	38.9	32.9	36.7
06:00	60.9	40.4	32.6	51.6
07:00	66.0	47.3	35.3	55.5
08:00	72.3	54.5	34.1	58.8
09:00	72.9	58.6	35.0	59.9
10:00	73.3	63.3	38.7	60.9
11:00	72.7	65.2	45.5	61.4
12:00	73.7	67.3	45.3	63.3
13:00	72.8	67.7	43.2	62.9
14:00	73.8	68.4	41.3	64.9
15:00	72.7	64.3	37.5	60.8
16:00	72.7	66.3	41.6	61.2
17:00	87.8	81.4	43.9	80.8
18:00	82.8	74.8	52.2	74.6
19:00	77.4	70.1	51.8	67.8
20:00	74.2	63.5	44.8	63.4
21:00	72.4	56.8	46.9	61.2
22:00	66.3	44.7	37.8	52.5
23:00	67.9	50.2	38.9	54.4
00:00	61.6	46.9	40.1	53.5

Descriptor	Period	Noise Level
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L _{A90} (Background)	07:00 - 18:00	41.7 dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	53.8 dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	70.6 dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	68.6 dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.5 dBA



Date: 24/2/2003

File Name: Cudgera2a_Sta.csv

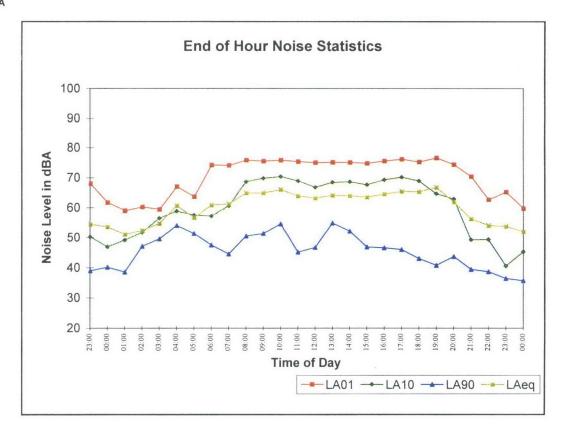
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	LA10	LA90	LAeq
23:00	67.9	50.2	38.9	54.4
00:00	61.6	46.9	40.1	53.5
01:00	58.9	49.1	38.5	51.0
02:00	60.1	51.7	47.0	52.3
03:00	59.3	56.4	49.5	54.6
04:00	67.0	58.7	54.0	60.6
05:00	63.6	57.5	51.3	56.6
06:00	74.1	57.2	47.5	60.8
07:00	74.0	60.5	44.5	61.2
08:00	75.8	68.6	50.5	64.9
09:00	75.5	69.7	51.3	64.9
10:00	75.8	70.3	54.5	66.0
11:00	75.3	68.9	45.1	63.9
12:00	75.0	66.8	46.7	63.2
13:00	75.1	68.4	54.8	64.2
14:00	75.0	68.6	52.1	64.0
15:00	74.7	67.6	46.8	63.5
16:00	75.5	69.3	46.5	64.6
17:00	76.1	70.1	46.0	65.4
18:00	75.2	68.9	43.0	65.3
19:00	76.5	64.6	40.7	66.7
20:00	74.3	62.9	43.7	61.8
21:00	70.3	49.2	39.4	56.2
22:00	62.7	49.3	38.7	54.0
23:00	65.2	40.5	36.4	53.7
00:00	59.7	45.3	35.7	51.9

Descriptor	Period	Noise Level
L _{dn}	00:00 - 24:00	65.5 dBA
L _{A90} (Background)	07:00 - 18:00	48.8 dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	57.6 dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	64.1 dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	62.6 dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	56.9 dBA
7.104		



Date: 25/2/2003

File Name: Cudgera2a_Sta.csv

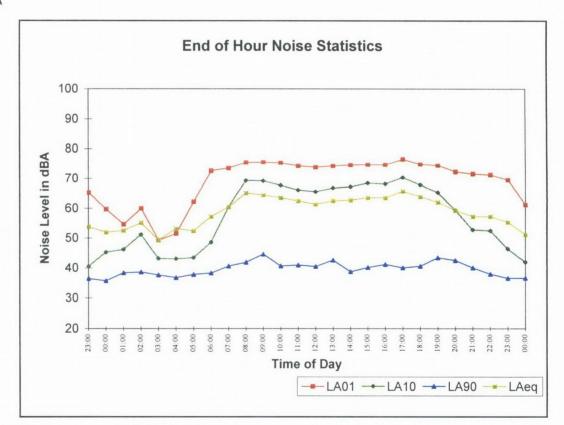
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	65.2	40.5	36.4	53.7
00:00	59.7	45.3	35.7	51.9
01:00	54.6	46.2	38.3	52.5
02:00	59.9	51.2	38.6	55.1
03:00	49.3	43.1	37.6	49.3
04:00	51.5	43.1	36.7	53.1
05:00	62.2	43.4	37.8	52.4
06:00	72.5	48.6	38.3	57.2
07:00	73.4	60.4	40.6	60.4
08:00	75.4	69.3	41.9	65.1
09:00	75.5	69.2	44.6	64.4
10:00	75.3	67.7	40.7	63.5
11:00	74.2	66.1	41.0	62.5
12:00	73.7	65.5	40.5	61.4
13:00	74.2	66.8	42.6	62.6
14:00	74.5	67.2	38.8	62.7
15:00	74.6	68.4	40.2	63.5
16:00	74.6	68.2	41.2	63.5
17:00	76.6	70.4	40.1	65.7
18:00	74.8	67.9	40.6	63.9
19:00	74.3	65.3	43.5	62.1
20:00	72.2	59.4	42.5	59.3
21:00	71.6	52.8	40.1	57.3
22:00	71.2	52.5	38.0	57.3
23:00	69.5	46.4	36.6	55.4
00:00	61.2	42.0	36.6	51.2

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	63.6	dBA
L _{A90} (Background)	07:00 - 18:00	41.1	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	55.2	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	62.9	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.3	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.7	dBA



Date: 26/2/2003

File Name: Cudgera2a_Sta.csv

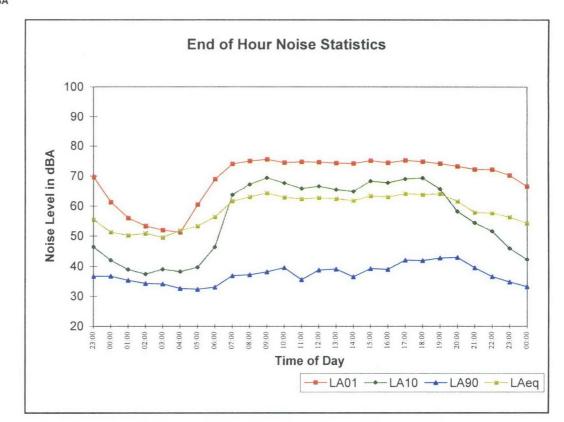
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}
23:00	69.5	46.4	36.6	55.4
00:00	61.2	42.0	36.6	51.2
01:00	55.9	38.9	35.3	50.2
02:00	53.2	37.4	34.2	50.8
03:00	51.9	38.9	34.0	49.5
04:00	51.1	38.2	32.5	51.8
05:00	60.4	39.6	32.3	53.2
06:00	68.9	46.3	32.9	56.4
07:00	73.9	63.7	36.8	61.6
08:00	74.9	67.2	37.1	63.0
09:00	75.4	69.4	38.1	64.3
10:00	74.4	67.6	39.5	62.9
11:00	74.7	65.8	35.5	62.4
12:00	74.6	66.5	38.7	62.7
13:00	74.2	65.4	39.0	62.4
14:00	74.1	64.8	36.4	61.8
15:00	75.0	68.2	39.1	63.3
16:00	74.3	67.7	38.9	63.0
17:00	75.1	69.0	42.0	64.1
18:00	74.7	69.3	41.8	63.8
19:00	74.0	65.6	42.7	64.1
20:00	73.1	58.2	42.9	61.5
21:00	72.1	54.4	39.4	57.8
22:00	72.1	51.6	36.5	57.7
23:00	70.2	45.9	34.7	56.3
00:00	66.4	42.2	33.1	54.2

Period	Noise	Level
00:00 - 24:00	63.5	dBA
07:00 - 18:00	38.7	dBA
22:00 - 07:00	55.3	dBA
07:00 - 22:00	62.7	dBA
00:00 - 24:00	61.1	dBA
22:00 - 06:00	53.0	dBA
	00:00 - 24:00 07:00 - 18:00 22:00 - 07:00 07:00 - 22:00 00:00 - 24:00	00:00 - 24:00 63.5 07:00 - 18:00 38.7 22:00 - 07:00 55.3 07:00 - 22:00 62.7 00:00 - 24:00 61.1



Date: 27/2/2003

File Name: Cudgera2a_Sta.csv

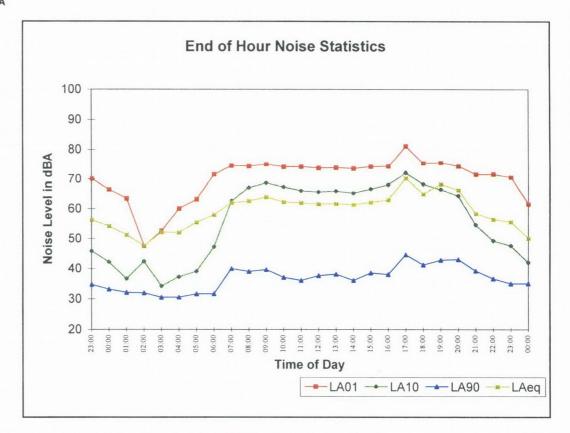
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	70.2	45.9	34.7	56.3
00:00	66.4	42.2	33.1	54.2
01:00	63.5	36.6	32.1	51.3
02:00	47.5	42.4	31.9	47.6
03:00	52.6	34.2	30.5	52.2
04:00	60.1	37.2	30.5	52.1
05:00	63.2	39.0	31.6	55.5
06:00	71.6	47.3	31.6	58.1
07:00	74.5	62.6	39.9	62.0
08:00	74.3	67.1	39.0	62.7
09:00	74.9	68.7	39.6	64.0
10:00	74.1	67.3	37.0	62.4
11:00	74.2	66.0	36.0	62.0
12:00	73.7	65.6	37.6	61.7
13:00	73.9	65.9	38.1	61.8
14:00	73.6	65.3	36.0	61.5
15:00	74.2	66.6	38.5	62.2
16:00	74.3	68.1	38.0	63.1
17:00	81.1	72.2	44.6	70.4
18:00	75.4	68.3	41.2	65.0
19:00	75.6	66.5	42.8	68.4
20:00	74.4	64.4	43.0	66.3
21:00	71.7	54.7	39.2	58.5
22:00	71.8	49.3	36.6	56.6
23:00	70.7	47.7	34.9	55.7
00:00	61.6	42.0	35.0	50.2

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	64.9	dBA
L _{A90} (Background)	07:00 - 18:00	38.7	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	56.2	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	64.5	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	62.8	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	54.4	dBA



Date: 28/2/2003

File Name: Cudgera2a_Sta.csv

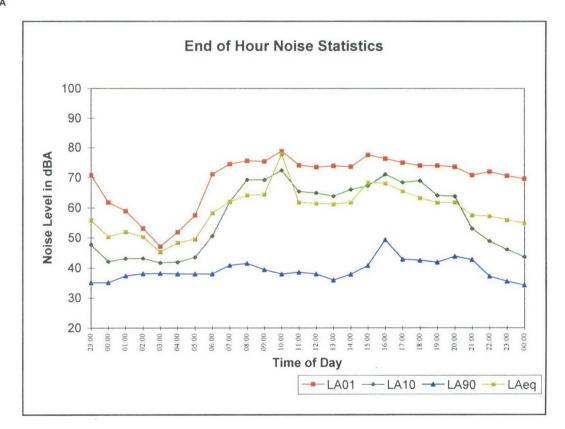
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}	
23:00	70.7	47.7	34.9	55.7	
00:00	61.6	42.0	35.0	50.2	
01:00	58.7	43.0	37.2	51.9	
02:00	53.0	43.0	37.9	50.2	
03:00	46.9	41.6	38.0	45.1	
04:00	51.7	41.8	37.9	48.3	
05:00	57.3	43.4	37.8	49.4	
06:00	71.0	50.5	37.9	58.1	
07:00	74.4	61.9	40.7	61.9	
08:00	75.4	69.2	41.3	64.1	
09:00	75.2	69.1	39.3	64.3	
10:00	78.7	72.3	37.8	77.7	
11:00	74.0	65.3	38.4	61.7	
12:00	73.4	64.8	37.8	61.3	
13:00	73.8	63.7	35.8	61.1	
14:00	73.5	66.0	37.7	61.7	
15:00	77.3	67.1	40.6	68.3	
16:00	76.1	71.0	49.2	68.0	
17:00	74.8	68.3	42.7	65.4	
18:00	73.9	68.8	42.3	63.2	
19:00	73.9	64.0	41.7	61.6	
20:00	73.4	63.7	43.6	61.7	
21:00	70.6	52.9	42.6	57.3	
22:00	71.8	48.8	37.1	57.1	
23:00	70.4	46.0	35.3	55.8	
00:00	69.4	43.5	34.1	54.8	

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	66.9	dBA
L _{A90} (Background)	07:00 - 18:00	40.3	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	55.4	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	67.9	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	66.0	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	52.9	dBA



Date: 3/1/2003

File Name: Cudgera2a_Sta.csv

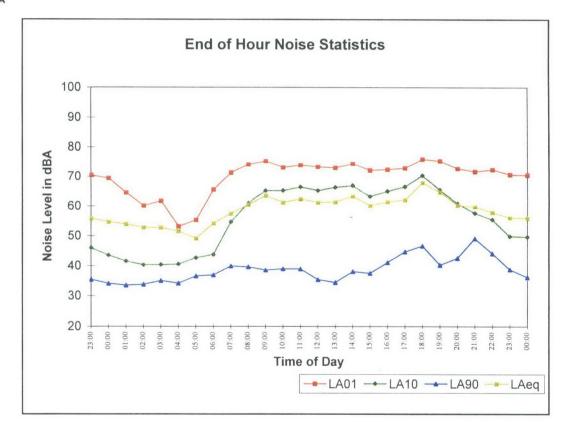
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	LA90	LAeq
23:00	70.4	46.0	35.3	55.8
00:00	69.4	43.5	34.1	54.8
01:00	64.6	41.5	33.5	53.9
02:00	60.1	40.3	33.8	52.8
03:00	61.7	40.4	35.0	52.8
04:00	53.2	40.5	34.1	51.6
05:00	55.3	42.6	36.5	49.2
06:00	65.6	43.7	36.9	54.2
07:00	71.3	54.6	39.9	57.5
08:00	74.1	61.1	39.6	60.5
09:00	75.3	65.3	38.6	63.6
10:00	73.1	65.3	39.0	61.3
11:00	73.8	66.5	38.9	62.4
12:00	73.3	65.3	35.4	61.3
13:00	72.9	66.4	34.4	61.5
14:00	74.4	67.0	38.1	63.4
15:00	72.1	63.3	37.5	60.3
16:00	72.4	65.1	41.1	61.5
17:00	72.8	66.6	44.7	62.2
18:00	76.0	70.4	46.6	68.0
19:00	75.4	65.5	40.3	64.8
20:00	72.7	60.9	42.5	60.3
21:00	71.7	57.7	49.2	59.8
22:00	72.3	55.5	44.1	57.9
23:00	70.7	49.9	38.8	56.2
00:00	70.5	49.7	36.2	56.1

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	62.7	dBA
L _{A90} (Background)	07:00 - 18:00	39.4	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	54.2	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	62.6	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.0	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.5	dBA



Date: 3/2/2003

File Name: Cudgera2a_Sta.csv

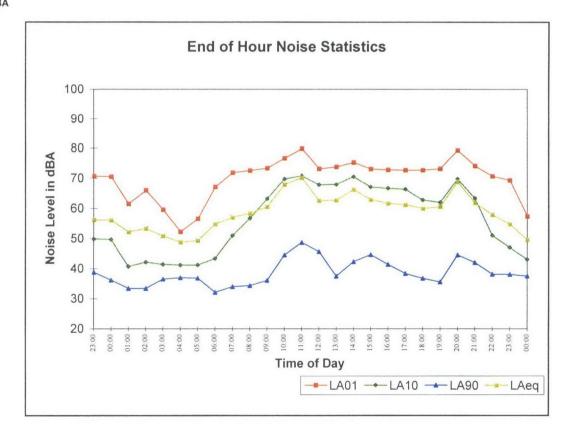
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}	
23:00	70.7	49.9	38.8	56.2	
00:00	70.5	49.7	36.2	56.1	
01:00	61.5	40.7	33.4	52.2	
02:00	66.0	42.1	33.4	53.3	
03:00	59.6	41.4	36.5	50.8	
04:00	52.2	41.2	37.0	48.8	
05:00	56.6	41.2	36.8	49.3	
06:00	67.1	43.3	32.1	54.8	
07:00	71.9	51.0	34.0	57.0	
08:00	72.6	56.7	34.3	58.4	
09:00	73.3	63.1	36.1	60.5	
10:00	76.6	69.8	44.5	67.9	
11:00	79.9	70.8	48.7	70.2	
12:00	73.1	67.8	45.6	62.6	
13:00	73.8	67.9	37.4	62.7	
14:00	75.2	70.5	42.3	66.3	
15:00	73.1	67.1	44.7	62.9	
16:00	72.8	66.6	41.4	61.7	
17:00	72.7	66.3	38.4	61.2	
18:00	72.7	62.7	36.7	60.0	
19:00	73.2	62.0	35.5	60.6	
20:00	79.3	69.8	44.5	68.8	
21:00	74.1	63.3	42.0	61.9	
22:00	70.7	51.0	38.1	57.9	
23:00	69.4	47.0	38.1	54.8	
00:00	57.4	43.0	37.5	49.6	

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	63.8	dBA
L _{A90} (Background)	07:00 - 18:00	40.9	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	54.1	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	64.6	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	62.7	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.5	dBA



Date: 3/3/2003

File Name: Cudgera2a_Sta.csv

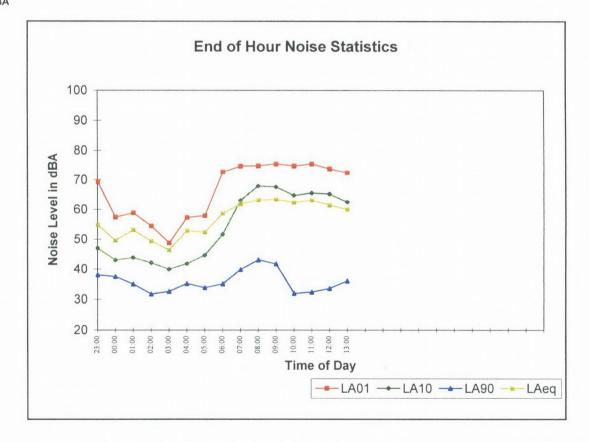
Weather: Fine

Logger Serial Number 16-302-486

Comments: Weekend:

Hour Ending	L _{A01}	LA10	LA90	LAeq
23:00	69.4	47.0	38.1	54.8
00:00	57.4	43.0	37.5	49.6
01:00	58.8	43.8	35.0	53.1
02:00	54.4	42.1	31.8	49.4
03:00	48.8	40.0	32.6	46.4
04:00	57.3	41.8	35.2	52.9
05:00	57.9	44.6	33.9	52.4
06:00	72.7	51.7	35.1	58.6
07:00	74.6	63.0	39.8	61.8
08:00	74.7	67.9	43.1	63.1
09:00	75.2	67.6	41.7	63.3
10:00	74.6	64.7	32.0	62.3
11:00	75.2	65.5	32.4	63.1
12:00	73.7	65.1	33.6	61.5
13:00	72.4	62.4	36.1	60.0

Period	Noise	Level
00:00 - 24:00	64.8	dBA
07:00 - 18:00	31.3	dBA
22:00 - 07:00	55.7	dBA
07:00 - 22:00	62.4	dBA
00:00 - 24:00	60.1	dBA
22:00 - 06:00	53.6	dBA
	07:00 - 18:00 22:00 - 07:00 07:00 - 22:00 00:00 - 24:00	00:00 - 24:00 64.8 07:00 - 18:00 31.3 22:00 - 07:00 55.7 07:00 - 22:00 62.4 00:00 - 24:00 60.1



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Location: Hardy Property Cudgera Ck Rd, Cudgera							
Logger Serial Number 16-302-486							1
 - 00			1				
						1	
		Day	Date	Leq(8hr)	Leq(9hr)	Leq(15hr)	Leq(24hr)
	Day No.1	Thursday	20/2/2003	54	56		
	Day No.2	Friday	21/2/2003	55	56	63	6
	Day No.3	Saturday	22/2/2003	55	55	66	6
	Day No.4	Sunday	23/2/2003	54	54	71	6
	Day No.5	Monday	24/2/2003	57	58	64	6
	Day No.6	Tuesday	25/2/2003	54	55	63	6
	Day No.7	Wednesday	26/2/2003	53	55	63	6
	Day No.8	Thursday	27/2/2003	54	56	65	6
	Day No.9	Friday	28/2/2003	53	55	68	6
	Day No.10		03/01/2003	54	54	63	
	Day No.11		03/02/2003	54	54	65	6
		means		54	55		

Date: 18/2/2003

File Name: Cudera1a.csv

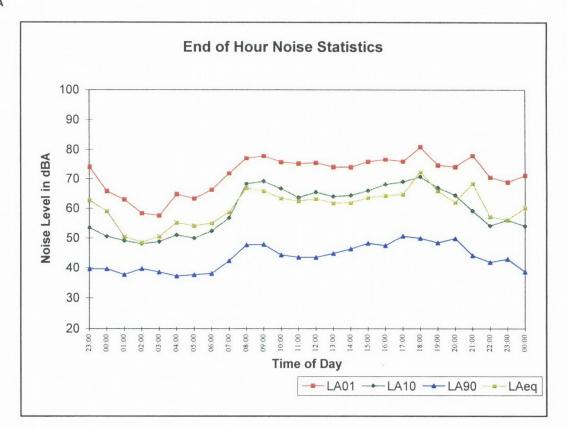
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}	
23:00	74.1	53.5	39.6	62.7	
00:00	65.8	50.6	39.6	59.1	
01:00	63.0	49.1	37.6	50.5	
02:00	58.3	48.1	39.6	48.6	
03:00	57.5	48.8	38.5	50.6	
04:00	64.8	51.0	37.2	55.2	
05:00	63.3	50.0	37.6	54.1	
06:00	66.3	52.4	38.0	55.0	
07:00	71.9	56.7	42.3	58.7	
08:00	77.0	68.4	47.7	66.9	
09:00	77.9	69.2	47.8	65.9	
10:00	75.6	66.7	44.3	63.4	
11:00	75.1	63.7	43.5	62.5	
12:00	75.4	65.5	43.5	63.3	
13:00	74.0	64.0	44.8	61.8	
14:00	73.9	64.4	46.3	61.9	
15:00	75.8	66.0	48.3	63.7	
16:00	76.6	68.2	47.5	64.4	
17:00	75.9	69.1	50.7	64.8	
18:00	80.9	70.7	49.9	72.4	
19:00	74.6	67.1	48.4	65.9	
20:00	74.1	64.5	49.9	62.1	
21:00	78.0	59.2	44.1	68.5	
22:00	70.5	54.2	41.9	57.2	
23:00	68.9	56.1	42.9	56.1	
00:00	71.2	54.1	38.6	60.2	

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	65.1	dBA
L _{A90} (Background)	07:00 - 18:00	46.7	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	57.1	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	65.8	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	64.0	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	56.9	dBA



Date: 19/2/2003 File Name: Cudera1a.csv

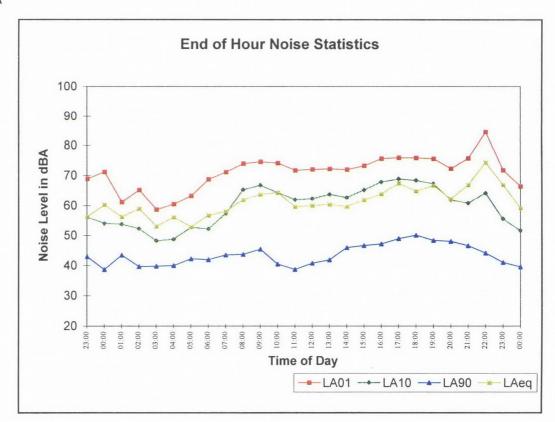
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}
23:00	68.9	56.1	42.9	56.1
00:00	71.2	54.1	38.6	60.2
01:00	61.1	53.8	43.4	56.2
02:00	65.1	52.2	39.6	58.9
03:00	58.6	48.2	39.7	53.1
04:00	60.4	48.7	39.9	56.1
05:00	63.2	52.8	42.2	52.9
06:00	68.7	52.2	41.9	56.7
07:00	71.1	57.3	43.4	58.1
08:00	73.9	65.2	43.7	61.9
09:00	74.5	66.7	45.4	63.7
10:00	74.1	64.3	40.4	64.4
11:00	71.7	61.9	38.7	59.6
12:00	72.0	62.3	40.8	60.0
13:00	72.2	63.7	41.9	60.4
14:00	72.0	62.7	45.9	59.7
15:00	73.3	65.2	46.6	61.9
16:00	75.6	67.9	47.1	63.9
17:00	75.9	68.9	48.9	67.4
18:00	75.8	68.4	50.0	64.8
19:00	75.5	67.3	48.3	66.7
20:00	72.3	61.9	48.0	62.2
21:00	75.7	60.8	46.5	66.9
22:00	84.5	64.2	44.1	74.4
23:00	71.8	55.6	41.0	66.9
00:00	66.4	51.7	39.5	59.2

Period	Noise	Level
00:00 - 24:00	66.1	dBA
07:00 - 18:00	44.5	dBA
22:00 - 07:00	57.1	dBA
07:00 - 22:00	66.1	dBA
00:00 - 24:00	64.7	dBA
22:00 - 06:00	56.9	dBA
	00:00 - 24:00 07:00 - 18:00 22:00 - 07:00 07:00 - 22:00 00:00 - 24:00	00:00 - 24:00 66.1 07:00 - 18:00 44.5 22:00 - 07:00 57.1 07:00 - 22:00 66.1 00:00 - 24:00 64.7



Date: 20/2/2003

File Name: Cudera1a.csv

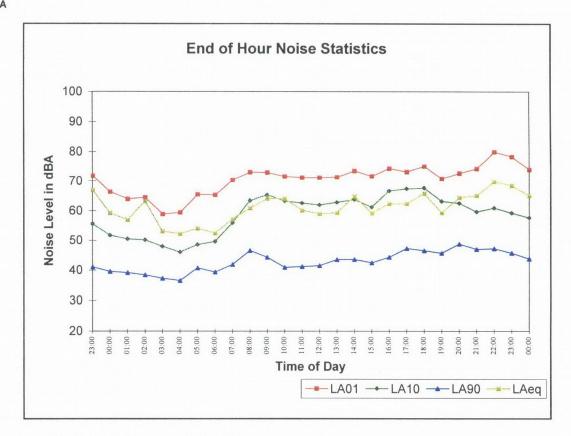
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	71.8	55.6	41.0	66.9
00:00	66.4	51.7	39.5	59.2
01:00	63.9	50.5	39.1	56.9
02:00	64.5	50.1	38.3	63.2
03:00	58.9	47.9	37.2	53.0
04:00	59.4	46.0	36.5	52.2
05:00	65.5	48.5	40.7	54.0
06:00	65.3	49.6	39.3	52.4
07:00	70.3	55.9	41.9	57.2
08:00	73.0	63.4	46.6	60.9
09:00	72.9	65.3	44.3	64.1
10:00	71.6	63.3	40.9	64.1
11:00	71.2	62.6	41.2	60.1
12:00	71.2	61.9	41.5	59.0
13:00	71.3	62.9	43.5	59.3
14:00	73.4	63.8	43.6	65.0
15:00	71.7	61.2	42.4	59.2
16:00	74.2	66.7	44.3	62.5
17:00	73.1	67.5	47.3	62.4
18:00	75.0	67.7	46.5	65.8
19:00	70.8	63.2	45.7	59.3
20:00	72.7	62.6	48.8	64.5
21:00	74.2	59.7	47.0	65.1
22:00	80.0	61.0	47.2	69.8
23:00	78.4	59.3	45.8	68.6
00:00	73.9	57.7	43.8	65.1

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	65.6	dBA
L _{A90} (Background)	07:00 - 18:00	43.8	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	60.3	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	63.9	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	63.3	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	60.6	dBA



Date: 21/2/2003 File Name: Cudera1a.csv

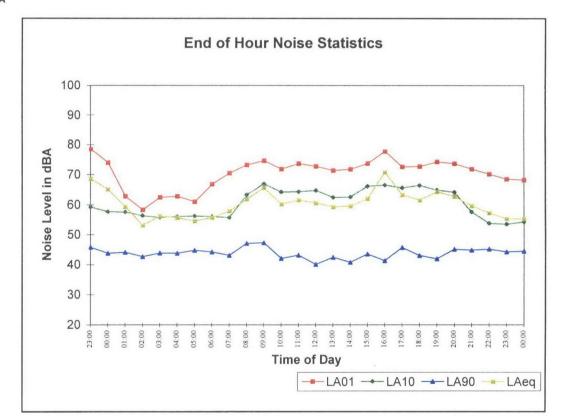
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}	
23:00	78.4	59.3	45.8	68.6	
00:00	73.9	57.7	43.8	65.1	
01:00	62.7	57.6	44.1	59.4	
02:00	58.3	56.4	42.7	53.2	
03:00	62.4	55.8	43.8	56.2	
04:00	62.7	56.1	43.8	55.7	
05:00	60.9	56.3	44.8	54.5	
06:00	66.8	56.1	44.2	55.7	
07:00	70.4	55.7	43.1	57.9	
00:80	73.2	63.3	47.1	61.9	
09:00	74.6	66.9	47.3	65.6	
10:00	71.8	64.2	42.1	60.2	
11:00	73.6	64.3	43.1	61.5	
12:00	72.7	64.7	40.1	60.6	
13:00	71.3	62.5	42.5	59.3	
14:00	71.7	62.5	40.8	59.6	
15:00	73.6	66.1	43.5	62.0	
16:00	77.6	66.5	41.3	70.8	
17:00	72.5	65.6	45.7	63.3	
18:00	72.6	66.4	43.0	61.5	
19:00	74.1	64.8	42.0	64.3	
20:00	73.6	64.2	45.1	62.7	
21:00	71.8	57.6	44.9	59.6	
22:00	70.1	53.8	45.2	57.2	
23:00	68.4	53.5	44.3	55.3	
00:00	68.2	54.3	44.5	55.3	

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	64.4	dBA
L _{A90} (Background)	07:00 - 18:00	43.3	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	61.8	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	63.5	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.9	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	62.1	dBA



Date: 22/2/2003

File Name: Cudera1a.csv

Weather: Fine

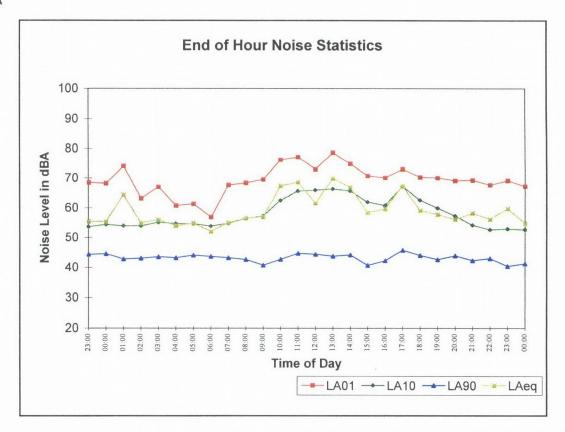
Logger Serial Number 16-498-413

Comments:

Weekend: YES (Saturday)

Hour Ending	L _{A01}	LA10	L _{A90}	LAeq
23:00	68.4	53.5	44.3	55.3
00:00	68.2	54.3	44.5	55.3
01:00	74.0	53.8	42.7	64.4
02:00	63.1	53.8	43.0	54.9
03:00	67.0	55.0	43.5	55.9
04:00	60.7	54.6	43.2	53.8
05:00	61.3	54.6	44.0	54.7
06:00	56.8	53.7	43.6	51.9
07:00	67.6	54.7	43.1	55.0
08:00	68.3	56.4	42.6	56.4
09:00	69.5	57.2	40.6	56.9
10:00	76.2	62.4	42.6	67.4
11:00	77.1	65.6	44.6	68.7
12:00	72.9	65.9	44.3	61.5
13:00	78.7	66.3	43.7	69.9
14:00	74.7	65.6	44.1	67.0
15:00	70.7	61.9	40.6	58.4
16:00	70.1	60.7	42.2	59.5
17:00	73.0	67.2	45.7	67.4
18:00	70.2	62.5	43.9	59.1
19:00	70.0	59.9	42.5	57.7
20:00	69.1	57.3	43.8	56.1
21:00	69.3	54.1	42.3	58.2
22:00	67.7	52.6	42.9	56.1
23:00	69.2	52.9	40.3	59.7
00:00	67.2	52.6	41.2	54.8

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	65.5	dBA
L _{A90} (Background)	07:00 - 18:00	43.2	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	57.6	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	64.2	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	62.8	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	57.8	dBA



Date: 23/2/2003

File Name: Cudera1a.csv

Weather: Fine

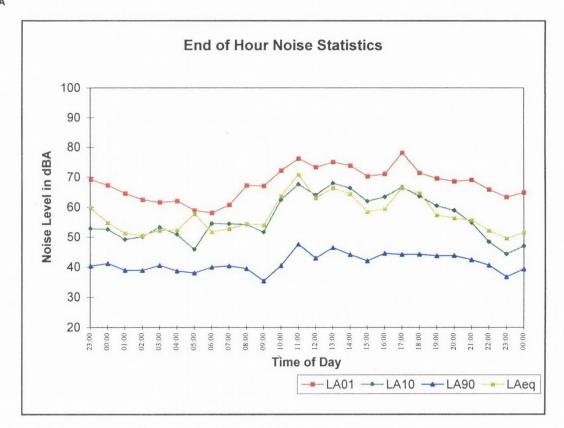
Logger Serial Number 16-498-413

Comments:

Weekend: YES (Sunday)

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}
23:00	69.2	52.9	40.3	59.7
00:00	67.2	52.6	41.2	54.8
01:00	64.5	49.2	38.9	51.2
02:00	62.4	50.1	38.9	50.5
03:00	61.5	53.3	40.5	52.2
04:00	62.0	50.9	38.7	52.4
05:00	58.8	45.8	38.0	57.7
06:00	58.0	54.6	40.0	51.7
07:00	60.7	54.4	40.4	52.7
08:00	67.2	54.2	39.5	54.4
09:00	67.0	51.7	35.4	54.0
10:00	72.2	62.5	40.5	63.7
11:00	76.1	67.6	47.6	70.8
12:00	73.2	64.1	42.9	63.0
13:00	74.9	68.0	46.5	66.3
14:00	73.8	66.3	44.1	64.3
15:00	70.2	62.0	42.0	58.4
16:00	71.0	63.4	44.5	59.4
17:00	78.1	66.7	44.2	66.3
18:00	71.3	63.7	44.2	64.7
19:00	69.5	60.4	43.7	57.4
20:00	68.6	58.9	43.8	56.4
21:00	69.1	54.9	42.4	55.7
22:00	65.8	48.4	40.6	52.1
23:00	63.3	44.3	36.8	49.6
00:00	64.8	47.0	39.3	51.4

Period	Noise	Level
00:00 - 24:00	63.2	dBA
07:00 - 18:00	42.8	dBA
22:00 - 07:00	54.8	dBA
07:00 - 22:00	63.6	dBA
00:00 - 24:00	61.8	dBA
22:00 - 06:00	55.0	dBA
	00:00 - 24:00 07:00 - 18:00 22:00 - 07:00 07:00 - 22:00 00:00 - 24:00	00:00 - 24:00 63.2 07:00 - 18:00 42.8 22:00 - 07:00 54.8 07:00 - 22:00 63.6 00:00 - 24:00 61.8



Date: 24/2/2003

File Name: Cudera1a.csv

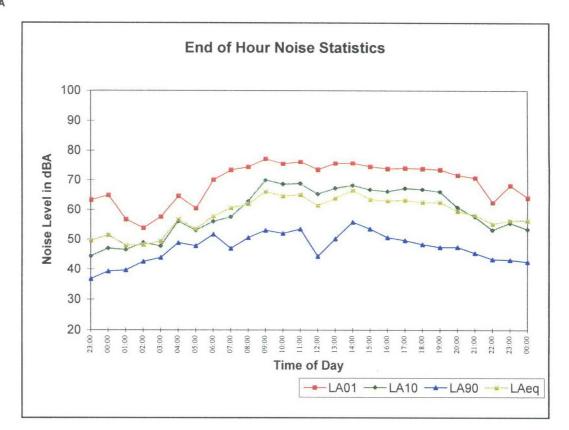
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	63.3	44.3	36.8	49.6
00:00	64.8	47.0	39.3	51.4
01:00	56.7	46.5	39.7	48.0
02:00	53.8	48.9	42.6	48.2
03:00	57.6	47.7	43.9	49.5
04:00	64.6	56.1	48.9	56.7
05:00	60.4	53.0	47.8	53.5
06:00	70.0	56.0	51.7	57.7
07:00	73.4	57.5	47.0	60.6
08:00	74.3	62.8	50.6	61.9
09:00	77.2	69.9	53.0	66.1
10:00	75.5	68.6	52.0	64.6
11:00	76.1	68.8	53.5	65.0
12:00	73.5	65.2	44.3	61.5
13:00	75.6	67.3	50.2	63.9
14:00	75.6	68.2	55.8	66.5
15:00	74.5	66.8	53.6	63.5
16:00	73.8	66.2	50.7	63.1
17:00	74.0	67.2	49.7	63.3
18:00	73.8	66.9	48.4	62.5
19:00	73.5	66.1	47.4	62.6
20:00	71.7	60.8	47.5	59.5
21:00	70.7	57.7	45.4	58.2
22:00	62.5	53.2	43.3	55.2
23:00	68.2	55.5	43.2	56.4
00:00	64.1	53.4	42.5	56.4

Descriptor	Period	Noise	Level
Ldn	00:00 - 24:00	63.9	dBA
L _{A90} (Background)	07:00 - 18:00	51.1	dBA
LAeq (9 Hours)	22:00 - 07:00	55.1	dBA
LAeq (15 Hours)	07:00 - 22:00	63.3	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	61.7	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	53.4	dBA



Date: 25/2/2003

File Name: Cudera1a.csv

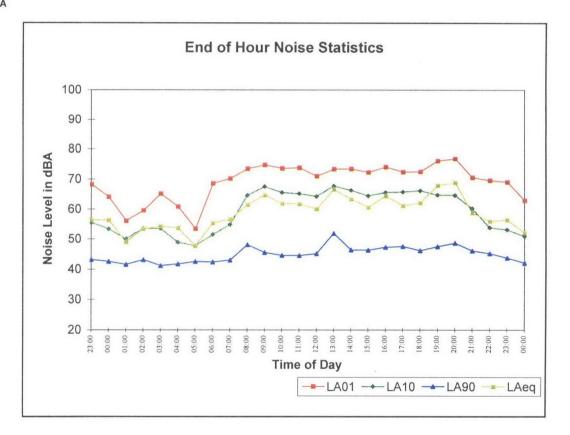
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}
23:00	68.2	55.5	43.2	56.4
00:00	64.1	53.4	42.5	56.4
01:00	56.1	50.1	41.5	49.0
02:00	59.5	53.5	43.1	53.4
03:00	65.1	53.5	41.2	54.3
04:00	60.8	48.9	41.7	53.7
05:00	53.4	47.8	42.5	47.7
06:00	68.6	51.5	42.4	55.4
07:00	70.2	54.8	43.0	56.6
08:00	73.4	64.6	48.1	61.5
09:00	74.7	67.5	45.5	64.7
10:00	73.5	65.5	44.6	61.9
11:00	73.8	65.2	44.5	61.8
12:00	71.0	64.2	45.2	60.1
13:00	73.3	67.7	51.9	66.6
14:00	73.4	66.3	46.4	63.4
15:00	72.3	64.5	46.3	60.7
16:00	74.0	65.6	47.3	64.5
17:00	72.4	65.8	47.6	61.2
18:00	72.5	66.2	46.2	62.2
19:00	76.0	64.7	47.5	67.9
20:00	76.8	64.7	48.7	68.9
21:00	70.6	60.2	46.1	58.8
22:00	69.6	53.8	45.2	56.0
23:00	69.1	53.2	43.7	56.5
00:00	62.9	51.0	42.1	52.2

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	63.6	dBA
L _{A90} (Background)	07:00 - 18:00	46.7	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	54.5	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	64.0	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	62.2	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	54.1	dBA



Date: 26/2/2003

File Name: Cudera1a.csv

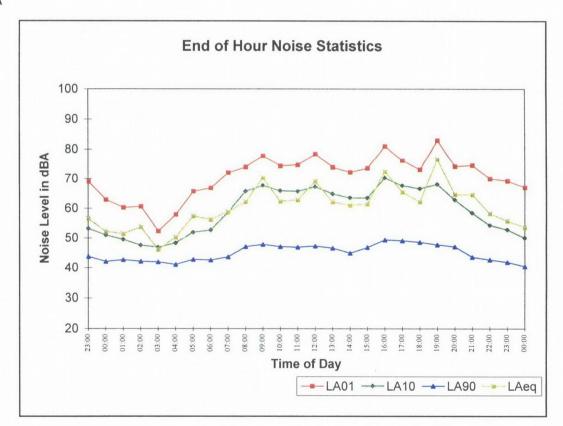
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	69.1	53.2	43.7	56.5
00:00	62.9	51.0	42.1	52.2
01:00	60.2	49.5	42.7	51.4
02:00	60.6	47.6	42.1	53.7
03:00	52.3	46.9	41.9	46.1
04:00	57.9	48.3	41.1	50.2
05:00	65.7	51.9	42.8	57.4
06:00	66.9	52.6	42.5	56.2
07:00	72.0	58.6	43.6	58.9
08:00	73.9	65.7	47.1	62.2
09:00	77.8	67.7	47.8	70.3
10:00	74.3	65.9	47.1	62.3
11:00	74.6	65.7	46.9	62.8
12:00	78.4	67.3	47.3	69.2
13:00	73.9	64.8	46.6	62.1
14:00	72.2	63.6	44.9	61.0
15:00	73.6	63.5	46.8	61.5
16:00	81.0	70.3	49.4	72.5
17:00	76.1	67.6	49.1	65.5
18:00	73.1	66.6	48.6	62.2
19:00	82.9	68.2	47.7	76.6
20:00	74.2	62.8	47.1	64.7
21:00	74.5	58.5	43.6	64.6
22:00	70.0	54.3	42.7	58.3
23:00	69.3	52.8	41.9	55.8
00:00	67.1	50.0	40.4	53.6

Danasistas	Desired.		
Descriptor	Period 00:00 - 24:00		Level
Ldn		67.3	dBA
L _{A90} (Background)	07:00 - 18:00	47.4	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	55.0	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	68.4	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	66.5	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	54.2	dBA



Date: 27/2/2003

File Name: Cudera1a.csv

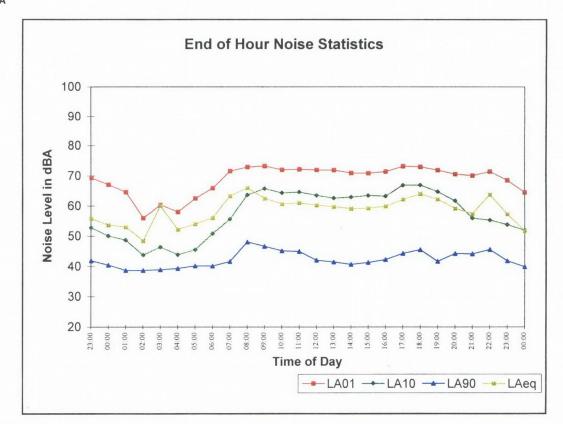
Weather: Fine

Logger Serial Number 16-498-413

Comments: Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	L _{Aeq}
23:00	69.3	52.8	41.9	55.8
00:00	67.1	50.0	40.4	53.6
01:00	64.6	48.7	38.7	53.0
02:00	55.9	43.7	38.7	48.4
03:00	60.3	46.4	38.9	60.0
04:00	57.9	43.9	39.3	52.2
05:00	62.5	45.5	40.2	54.0
06:00	65.9	50.8	40.1	56.0
07:00	71.6	55.5	41.6	63.3
08:00	72.9	63.6	48.0	66.0
09:00	73.2	65.8	46.6	62.5
10:00	72.0	64.3	45.1	60.6
11:00	72.1	64.6	44.9	61.0
12:00	71.9	63.5	42.0	60.2
13:00	71.9	62.6	41.4	59.7
14:00	70.9	62.9	40.6	59.1
15:00	70.9	63.4	41.3	59.2
16:00	71.4	63.3	42.2	59.8
17:00	73.1	66.9	44.3	62.2
18:00	73.0	66.9	45.5	64.0
19:00	71.9	64.7	41.6	62.2
20:00	70.5	61.7	44.2	59.1
21:00	70.1	55.9	44.1	57.4
22:00	71.4	55.2	45.6	63.8
23:00	68.5	53.7	41.8	57.2
00:00	64.4	51.9	39.9	51.7

Descriptor	Period	Noise	Level
Ldn	00:00 - 24:00	64.3	dBA
L _{A90} (Background)	07:00 - 18:00	43.8	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	57.3	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	61.7	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	60.5	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	55.2	dBA



Date: 28/2/2003

File Name: Cudera1a.csv

Weather: Fine

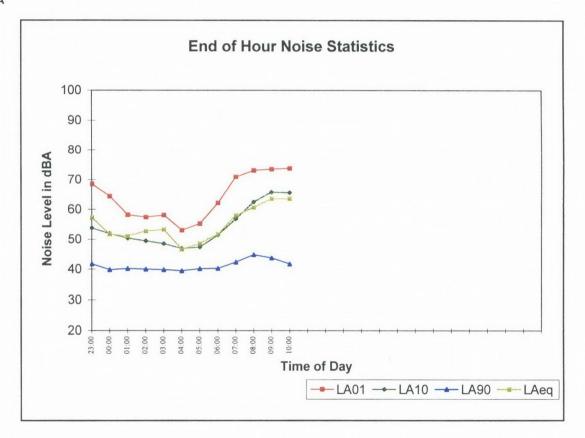
Logger Serial Number 16-498-413

Comments:

Weekend:

Hour Ending	L _{A01}	L _{A10}	L _{A90}	LAeq
23:00	68.5	53.7	41.8	57.2
00:00	64.4	51.9	39.9	51.7
01:00	58.2	50.3	40.2	51.1
02:00	57.4	49.4	40.0	52.7
03:00	58.1	48.5	39.9	53.2
04:00	53.1	46.9	39.5	46.6
05:00	55.2	47.4	40.2	48.6
06:00	62.2	51.4	40.3	51.8
07:00	70.9	56.8	42.4	58.0
08:00	73.1	62.5	44.8	60.6
09:00	73.5	65.7	43.7	63.6
10:00	73.7	65.6	41.8	63.6

Descriptor	Period	Noise	Level
L _{dn}	00:00 - 24:00	63.0	dBA
L _{A90} (Background)	07:00 - 18:00	32.6	dBA
L _{Aeq} (9 Hours)	22:00 - 07:00	53.7	dBA
L _{Aeq} (15 Hours)	07:00 - 22:00	62.8	dBA
L _{Aeq} (24 Hours)	00:00 - 24:00	58.6	dBA
L _{Aeq} (8 Hours)	22:00 - 06:00	52.7	dBA



		And the second s				-			
12.50		Location: Lot 999 Cudgera Ck Rd, Cudgera							
		Logger Serial Number 16-498-413							
12 10									
				Day	Date	Leq(8hr)	Leq(9hr)	Leq(15hr)	Leq(24hr)
			Day No.1	Tuesday	18/2/2003	57	57	66	64
	****		Day No.2	Wednesday	19/2/2003	57	57	66	65
			Day No.3	Thursday	20/2/2003	61	60	64	63
			Day No.4	Friday	21/2/2003	62	62	64	62
1000			Day No.5	Saturday	22/2/2003	58	58	64	63
W-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		The second secon	Day No.6	Sunday	23/2/2003	55	55	64	62
		* ** *** ** ** ** ** ** ** ** ** ** **	Day No.7	Monday	24/2/2003	53	55	63	62
			Day No.8	Tuesday	25/2/2003	54	55	64	62
		The state of the s	Day No.9	Wednesday	26/2/2003	54	55	68	67
			Day No.10	Thursday	27/2/2003	55	57	62	61
200				means		57	57	65	63

Appendix D

Operational Noise Level Calculations

Prediction of Increase in Road Traffic Noise as a Result of Traffic Growth

Using Increase in road traffic noise = $10 \log (1.0k^n)$

Where n = number of years to prediction date k = annual percentage growth in traffic

Assuming a growth of 3% it would be expected that the increase in 10 years would be given by:

$$= 10 \log (1.03^{10})$$

$$= 1.3 \text{ dB}$$

Appendix E

Background Noise Level Calculations

Method for Determining the Tenth Percentile Background Noise Level

The background L_{90} noise level was recorded for each 15 minutes interval during the monitoring period. The background noise level for the site in the daytime, evening and night-time periods were calculated by following the "tenth percentile method" described in Appendix B Table B1 of the NSW Industrial Noise Policy 2000.

Table B1. Method for determining the tenth percentile

Step 1	Sort the L _{A90,15 minute} data in each assessment period in ascending order.
Step 2	Work out the tenth per cent position of the number of samples in the assessment period. This can be calculated by multiplying the number of L _{ASO, 15 minute} values in the assessment period by 0.1.
Step 3	Determine the tenth percentile (essentially the lowest tenth per cent value):
	If the tenth per cent position (from Step 2) is an integer, then the tenth percentile is determined by taking the arithmetic average of the value of the L _{A20, 15 minute} at the tenth per cent position and the next highest value.
	If the tenth per cent position (from Step 2) is not an integer, then the tenth percentile is the next highest L _{ABO, 15 minute} value above the value at the tenth per cent position.
	Examples:
	 For a data set of size 40, the tenth per cent position is 4 (i.e. 0.1 x 40). As this is an integer, the tenth percentile is the average of the values at the 4th position and the 5th position, counting from the lowest value of the sorted data (from Step 1).
	 For a data set of size 44, the tenth per cent position is 4.4 (i.e. 0.1 x 44). As this value is not an integer, the tenth percentile is the value at the 5th position counting from the lowest value of the sorted data (from Step 1).

Lowest 10th Percentile Background Noise Calculations (7am - 6pm) Hardy Residence

Date	Time	L10	L90	L10 - L90
24/2/2003	9:45	71.5	58.1	13.4
28/2/2003	15:30	70.8	56.9	13.9
24/2/2003	8:15	71.3	56.7	14.6
24/2/2003	12:30	68.5	56.3	12.2
24/2/2003	13:00	68.8	55.7	13.1
24/2/2003	7:30	70	54.5	15.5
24/2/2003	12:45	69.3	54.3	15
24/2/2003	10:00	69.2	53.8	15.4
24/2/2003	13:45	67.5	53.5	14
28/2/2003	15:45	76.6	53.1	23.5
24/2/2003	9:30	71	53.1	17.9
24/2/2003	13:15	69.6	53	16.6
24/2/2003	12:15	66.9	53	13.9
24/2/2003	9:15	69.6	52.9	16.7
24/2/2003	13:30	69.2	52.5	16.7
21/2/2003	17:45	69.9	52.4	17.5
24/2/2003	9:00	68.2	52.4	16.1
24/2/2003			51.9	17.7
	10:15	69.6		
24/2/2003	8:00	68.7	50.5	18.2
24/2/2003	14:15	66.4	49.6	16.8
24/2/2003	12:00	68.7	49.6	19.1
24/2/2003	8:30	69.8	49.5	20.3
24/2/2003	14:00	67.9	49.4	18.5
24/2/2003	7:15	65.2	49.4	15.8
24/2/2003	11:30	64	49.3	14.7
24/2/2003	16:15	70	48.7	21.3
24/2/2003	16:00	69.5	48.5	21
24/2/2003	14:30	68.9	48.3	20.6
24/2/2003	10:30	67.7	48	19.7
24/2/2003	7:45	70.5	47.4	23.1
24/2/2003	11:45	67.6	47.3	20.3
27/2/2003	16:30	74.7	46.9	27.8
24/2/2003	8:45	69.6	46.9	22.7
24/2/2003	16:30	70.1	46.8	23.3
21/2/2003	10:00	68.3	46.4	21.9
24/2/2003	15:30	69.5	46.1	23.4
24/2/2003	15:15	68.8	45.9	22.9
26/2/2003	14:30	69	45.7	23.3
27/2/2003	16:45	73.2	45.6	27.6
24/2/2003	15:45	69.2	45.6	23.6
20/2/2003	17:15	70.3	45.5	24.8
24/2/2003	17:45	68.6	45.4	23.2
27/2/2003	17:00	70.6	45.3	25.3
24/2/2003	16:45	70.7	45.1	25.6
26/2/2003	16:30	70.1	45.1	25
3/3/2003	8:30	67.2	45	22.2
21/2/2003	9:30	67.3	44.9	22.4
20/2/2003	15:45	68.9	44.8	24.1
20/2/2003	15:00	68.7	44.8	23.9
24/2/2003	14:45	67.1	44.8	22.3
24/2/2003	15:00	68	44.6	23.4
20/2/2003	17:30	68	44.5	23.5
	,,,,,,			

20/2/2003	17:45	66.1	44.4	21.7
20/2/2003	16:00	71.2	44.2	27
28/2/2003	16:00	68.3	44.1	24.2
28/2/2003	15:00	72.4	43.8	28.6
20/2/2003	11:00	67.8	43.7	24.1
26/2/2003	18:00	69.3	43.6	25.7
21/2/2003	16:45	69.6	43.6	26
20/2/2003	11:15	66.2	43.6	22.6
21/2/2003	9:15	67.6	43.6	24
3/3/2003	8:00	69.2	43.6	25.6
24/2/2003	17:00	69.7	43.3	26.4
28/2/2003	16:15	68.2	43.3	24.9
21/2/2003	16:00	69.1	43.3	25.8
24/2/2003	17:30	69.7	43.2	26.5
3/3/2003	7:30	67.6	43.2	24.4
21/2/2003	9:45	66.2	43.1	23.1
21/2/2003	16:15	67.3	43	24.3
28/2/2003	7:45	70.3	43	27.3
3/3/2003	7:15	66.8	43	23.8
20/2/2003	14:45	66.9	42.9	24
28/2/2003	17:15	69.4	42.8	26.6
27/2/2003	18:00	66.1	42.6	23.5
28/2/2003	15:15	68.1	42.6	25.5
3/3/2003	7:45	67.9	42.6	25.3
26/2/2003	16:45	68.2	42.5	25.7
28/2/2003	16:30	67.1	42.5	24.6
24/2/2003	10:45	69.1	42.5	26.6
28/2/2003	17:30	69.2	42.4	26.8
28/2/2003	17:00	68.8	42.4	26.4
28/2/2003	16:45	69.1	42.4	26.7
27/2/2003	17:45	68.8	42.3	26.5
21/2/2003	16:30	68.2	42.3	25.9
28/2/2003	18:00	68.1	42.2	25.9
20/2/2003	16:30	69.9	42.2	27.7
21/2/2003	15:45	68.5	42.2	26.3
21/2/2003	15:00	68.7	42.2	26.5
21/2/2003	12:00	66.3	42.2	24.1
21/2/2003	10:15	65.7	42.2	23.5
26/2/2003	10:00	69	42.2	26.8
3/3/2003	8:45	67.5	42.2	25.3
26/2/2003	17:30	69.8	42.1	27.7
21/2/2003	7:30	67.7	42.1	25.6
28/2/2003	17:45	68.6	41.9	26.7
20/2/2003	9:45	68.2	41.9	26.3
20/2/2003	18:00	65.6	41.8	23.8
24/2/2003	17:15	70.4	41.8	28.6
21/2/2003	7:45	69.6	41.8	27.8
20/2/2003	10:00	64.4	41.6	22.8
28/2/2003	7:15	67.7	41.6	26.1
24/2/2003	18:00	66.7	41.5	25.2
26/2/2003	17:15	69.1	41.5	27.6
26/2/2003	9:45	66.7	41.4	25.3
20/2/2003	8:15	70.2	41.4	28.8
20/2/2003	9:30	63.7	41.4	22.4
3/3/2003				27
	8:15	68.3	41.3	
20/2/2003	15:15	68	41.1	26.9

28/2/2003	11:15	66.6	41.1	25.5
27/2/2003	17:30		41	29.1
		70.1		
26/2/2003	12:30	65.1	40.9	24.2
27/2/2003	16:15	70.3	40.7	29.6
27/2/2003	15:45	69.6	40.7	28.9
28/2/2003	9:15	89	40.7	48.3
26/2/2003	15:45	68	40.6	27.4
20/2/2001	8:30	71	40.6	30.4
20/2/2002	9:30	68.9	45.5	23.4
20/2/2003	16:45	69.8	40.5	29.3
27/2/2003	8:45	68.7	40.5	28.2
24/2/2003	11:15	66.7	40.4	26.3
28/2/2003	8:30	69.7	40.4	29.3
28/2/2003	8:00	70	40.4	29.6
21/2/2003	8:45	67.6	40.3	27.3
26/2/2003	16:15	67.2	40.2	27
28/2/2003	7:30	68.6	40.2	28.4
20/2/2003	15:30	68.8	40.1	28.7
26/2/2003	12:00	66	40.1	25.9
20/2/2003	11:30	63.4	40.1	23.3
21/2/2003	9:00	64.8	40.1	24.7
27/2/2003	7:45	68.8	40.1	28.7
26/2/2003	17:45	69	40	29
26/2/2003	17:00	70.4	40	30.4
26/2/2003	15:30	69.6	40	29.6
28/2/2003	14:00	64.6	40	24.6
27/2/2003	7:30	66.3	40	26.3
20/2/2003	16:15	69	39.9	29.1
28/2/2003	14:45	67.4	39.9	27.5
27/2/2003	8:30	68.3	39.9	28.4
21/2/2003	17:30	69.7	39.8	29.9
28/2/2003	8:45	69.6	39.8	29.8
20/2/2003	9:15	66.9	39.7	27.2
21/2/2003	10:30	67.2	39.6	27.6
26/2/2003	8:30	68.6	39.6	29
27/2/2003	14:45	67.1	39.5	27.6
20/2/2003	13:15	65.1	39.5	25.6
28/2/2003	10:45	66.6	39.5	27.1
26/2/2003	12:45	66.6	39.4	27.2
20/2/2003	17:00	70	39.3	30.7
28/2/2003	14:30	62.7	39.3	23.4
27/2/2003	14:15	66.4	39.3	27.1
26/2/2003	11:45	68.1	39.3	28.8
21/2/2003	8:15	69.6	39.3	30.3
27/2/2003	8:15	69.1	39.3	29.8
20/2/2003	7:45	68.5	39.3	29.2
21/2/2003	15:15	67.4	39.2	28.2
28/2/2003	14:15	66	39.2	26.8
21/2/2003	13:00	64.1	39.2	24.9
21/2/2003	18:00	68.8	39.1	29.7
28/2/2003	13:45	68.2	39	29.2
3/3/2003	12:30	62.2	39	23.2
21/2/2003	8:30	69.3	39	30.3
20/2/2003	8:00	66.4	39	27.4
27/2/2003	17:15	68.2	38.9	29.3
27/2/2003	8:00	67.4	38.9	28.5

26/2/2003	14:45	68.6	38.8	29.8
26/2/2003	13:45	64.9	38.8	26.1
27/2/2003	9:00	68.7	38.8	29.9
28/2/2003	9:00	67.3	38.8	28.5
21/2/2003				
	8:00	67.2	38.8	28.4
26/2/2003	16:00	68.4	38.7	29.7
26/2/2003	13:30	64	38.7	25.3
27/2/2003	12:45	67	38.7	28.3
26/2/2003	12:15	64	38.7	25.3
27/2/2003	12:15	65.4	38.7	26.7
26/2/2003	11:30	67.5	38.7	28.8
26/2/2003	8:45	69	38.7	30.3
20/2/2003	7:30	66.6	38.7	27.9
20/2/2003	7:15	65.9	38.7	27.2
21/2/2003	7:15	67	38.7	28.3
21/2/2003	14:00	67.1	38.5	28.6
27/2/2003	13:00	64.9	38.4	26.5
3/3/2003	9:00	67.2	38.4	28.8
27/2/2003	14:30	66.8	38.3	28.5
28/2/2003	10:30	63.6	38.3	25.3
21/2/2003	15:30	66.1	38.2	27.9
21/2/2003	13:45	68.6	38.2	30.4
27/2/2003	12:00	64.1	38.2	25.9
27/2/2003	10:15	66.1	38.1	28
28/2/2003	10:15	66.4	38.1	28.3
28/2/2003	9:30	66.7	38.1	28.6
20/2/2003	9:00	67.8	38.1	29.7
21/2/2003	12:30	64.7	38	26.7
21/2/2003				
	12:15	64.7	38	26.7
27/2/2003	11:30	67.4	38	29.4
24/2/2003	11:00	69.2	38	31.2
28/2/2003	8:15	69.8	38	31.8
21/2/2003	17:00	69.2	37.9	31.3
21/2/2003	14:30	69.2	37.9	31.3
20/2/2003	11:45	64.8	37.9	26.9
21/2/2003	11:30	67.6	37.9	29.7
28/2/2003	11:00	64.5	37.7	26.8
21/2/2003	10:45	66.6	37.7	28.9
27/2/2003	10:00	66.7	37.7	29
26/2/2003	8:00	69.3	37.7	31.6
20/2/2003	14:30	67	37.6	29.4
28/2/2003	12:15	63.7	37.6	26.1
26/2/2003	7:45	67.7	37.6	30.1
27/2/2003	15:15	66.2	37.5	28.7
27/2/2003	13:45	67.6	37.5	30.1
27/2/2003	13:15	65.4	37.5	27.9
21/2/2003	11:15	68.6	37.5	31.1
21/2/2003	11:00	68.8	37.5	31.3
27/2/2003	11:45	64.7	37.4	27.3
26/2/2003	9:15	67.7	37.4	30.3
21/2/2003	17:15	68.4	37.3	31.1
28/2/2003	11:30	66.9	37.3	29.6
27/2/2003	9:45	68.8	37.3	31.5
21/2/2003	13:15	63.6	37.2	26.4
21/2/2003	12:45	67.2	37.1	30.1
28/2/2003	9:45	66.2	37.1	29.1

26/2/2003	14:45	68.6	38.8	29.8
26/2/2003	13:45	64.9	38.8	26.1
27/2/2003	9:00	68.7	38.8	29.9
28/2/2003	9:00	67.3	38.8	28.5
21/2/2003	8:00	67.2	38.8	28.4
26/2/2003	16:00	68.4	38.7	29.7
26/2/2003	13:30	64	38.7	25.3
27/2/2003	12:45	67	38.7	28.3
26/2/2003	12:15	64	38.7	25.3
27/2/2003	12:15	65.4	38.7	26.7
26/2/2003	11:30	67.5	38.7	28.8
26/2/2003	8:45	69	38.7	30.3
20/2/2003	7:30	66.6	38.7	27.9
20/2/2003	7:15	65.9	38.7	27.2
21/2/2003	7:15	67	38.7	28.3
21/2/2003	14:00	67.1	38.5	28.6
27/2/2003	13:00	64.9	38.4	26.5
3/3/2003	9:00	67.2	38.4	28.8
27/2/2003	14:30	66.8	38.3	28.5
28/2/2003	10:30	63.6	38.3	25.3
21/2/2003	15:30	66.1	38.2	27.9
21/2/2003	13:45	68.6	38.2	30.4
27/2/2003	12:00	64.1	38.2	25.9
27/2/2003	10:15	66.1	38.1	28
28/2/2003	10:15	66.4	38.1	28.3
28/2/2003	9:30	66.7	38.1	28.6
20/2/2003	9:00	67.8	38.1	29.7
21/2/2003	12:30	64.7	38	26.7
21/2/2003	12:15	64.7	38	26.7
27/2/2003	11:30	67.4	38	29.4
24/2/2003	11:00	69.2	38	31.2
28/2/2003	8:15	69.8	38	31.8
21/2/2003	17:00	69.2	37.9	31.3
21/2/2003	14:30	69.2	37.9	31.3
20/2/2003	11:45	64.8	37.9	26.9
21/2/2003	11:30	67.6	37.9	29.7
28/2/2003	11:00	64.5	37.7	26.8
21/2/2003	10:45	66.6	37.7	28.9
27/2/2003	10:00	66.7	37.7	29
26/2/2003	8:00	69.3	37.7	31.6
20/2/2003		67		
	14:30		37.6	29.4
28/2/2003	12:15	63.7	37.6	26.1
26/2/2003	7:45	67.7	37.6	30.1
27/2/2003	15:15	66.2	37.5	28.7
27/2/2003	13:45	67.6	37.5	30.1
27/2/2003	13:15	65.4	37.5	27.9
21/2/2003	11:15	68.6	37.5	31.1
21/2/2003	11:00	68.8	37.5	31.3
27/2/2003	11:45	64.7	37.4	27.3
26/2/2003	9:15	67.7	37.4	30.3
21/2/2003	17:15	68.4	37.3	31.1
28/2/2003	11:30	66.9	37.3	29.6
27/2/2003	9:45	68.8	37.3	31.5
21/2/2003	13:15	63.6	37.2	26.4
21/2/2003	12:45	67.2	37.1	30.1
28/2/2003	9:45	66.2	37.1	29.1

20/2/2003	8:45	68.4	37.1	31.3	
26/2/2003	8:15	70.2	37.1	33.1	
28/2/2003	11:45	67.2	37	30.2	
27/2/2003	9:15	67.3	37	30.3	
27/2/2003	7:15	65.7	37	28.7	
27/2/2003	15:30	66.9	36.9	30	
26/2/2003	9:30	67	36.9	30.1	
26/2/2003	9:00	69.6	36.9	32.7	
26/2/2003	7:15	64	36.9	27.1	
27/2/2003	16:00	69.7	36.8	32.9	
27/2/2003	15:00	66.2	36.8	29.4	
28/2/2003	13:15	66.7			
			36.8	29.9	
26/2/2003	13:00	66	36.8	29.2	
21/2/2003	11:45	66.5	36.8	29.7	
27/2/2003	11:15	66.2	36.8	29.4	
21/2/2003	14:45	68.5	36.6	31.9	
27/2/2003	12:30	66.2	36.5	29.7	
26/2/2003	11:15	64.5	36.5	28	
21/2/2003	14:15	68.4	36.4	32	
3/3/2003	13:00	66.3	36.3	30	
26/2/2003	10:15	67.6	36.2	31.4	
26/2/2003	7:30	67.6	36.2	31.4	
26/2/2003	15:15	64.7	36.1	28.6	
26/2/2003	15:00	68.4	36.1	32.3	
27/2/2003	9:30	66.5	36.1	30.4	
21/2/2003	13:30	66	36	30	
27/2/2003	10:45	64	36	28	
26/2/2003	14:15	66.9	35.9	31	
28/2/2003	12:00	58.4	35.9	22.5	
20/2/2003	10:30	66.5	35.9	30.6	
20/2/2003	10:15	64.3	35.8	28.5	
28/2/2003	12:30	64	35.7	28.3	
3/3/2003	12:45	60.6	35.6	25	
26/2/2003	10:30	63.3	35.5	27.8	
28/2/2003		67.2			
	10:00		35.4	31.8	
27/2/2003	1100		050	00.4	
	14:00	64.7	35.3	29.4	
3/3/2003	13:24	64.7 62.9	35.3	27.6	
3/3/2003 26/2/2003		64.7			
	13:24	64.7 62.9	35.3	27.6	
26/2/2003	13:24 10:45 13:00	64.7 62.9 64.5 65.1	35.3 35.3 35.2	27.6 29.2 29.9	
26/2/2003 28/2/2003 28/2/2003	13:24 10:45 13:00 13:30	64.7 62.9 64.5 65.1 64.3	35.3 35.3 35.2 35	27.6 29.2 29.9 29.3	
26/2/2003 28/2/2003 28/2/2003 26/2/2003	13:24 10:45 13:00 13:30 13:15	64.7 62.9 64.5 65.1 64.3 64.9	35.3 35.3 35.2 35 35	27.6 29.2 29.9 29.3 29.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003	13:24 10:45 13:00 13:30 13:15 11:45	64.7 62.9 64.5 65.1 64.3 64.9	35.3 35.3 35.2 35 35 35	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66	35.3 35.3 35.2 35 35 35 35	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7	35.3 35.3 35.2 35 35 35 35 35 34.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8	35.3 35.3 35.2 35 35 35 35 35 34.8 34.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7	35.3 35.3 35.2 35 35 35 35 35 34.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8	35.3 35.3 35.2 35 35 35 35 35 34.8 34.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003 28/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3	35.3 35.2 35 35 35 35 35 34.8 34.8 34.5 34.4	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003 28/2/2003 20/2/2003 3/3/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3	35.3 35.2 35 35 35 35 35 34.8 34.8 34.8 34.4 34.4	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003 28/2/2003 20/2/2003 3/3/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 62.5	35.3 35.3 35.2 35 35 35 35 34.8 34.8 34.8 34.4 34.4	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 27/2/2003 28/2/2003 20/2/2003 3/3/2003 20/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 12:45 12:15 11:30 9:15 12:00	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 62.5 65.2	35.3 35.3 35.2 35 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 28/2/2003 20/2/2003 3/3/2003 3/3/2003 3/3/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 65.3 62.5 65.2	35.3 35.3 35.2 35 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.3 33.9	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.1	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 28/2/2003 20/2/2003 3/3/2003 3/3/2003 20/2/2003 3/3/2003 20/2/2003 20/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15 12:30	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 65.2 65.2 62.3 66.1	35.3 35.3 35.2 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.4 34.3 33.9 33.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.4 32.3	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 28/2/2003 20/2/2003 3/3/2003 3/3/2003 3/3/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 65.3 62.5 65.2	35.3 35.3 35.2 35 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.3 33.9	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.1	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 28/2/2003 20/2/2003 3/3/2003 3/3/2003 20/2/2003 3/3/2003 20/2/2003 20/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15 12:30	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 65.2 65.2 62.3 66.1	35.3 35.3 35.2 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.4 34.3 33.9 33.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.4 32.3	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 26/2/2003 27/2/2003 28/2/2003 3/3/2003 3/3/2003 20/2/2003 3/3/2003 20/2/2003 20/2/2003 20/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15 12:30 10:45 13:45	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 62.5 65.2 62.3 66.1 59.1 67.1	35.3 35.3 35.2 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.4 34.3 33.9 33.8 33.8 33.7	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.4 32.3 25.3 33.4	
26/2/2003 28/2/2003 28/2/2003 26/2/2003 3/3/2003 27/2/2003 27/2/2003 28/2/2003 20/2/2003 3/3/2003 20/2/2003 3/3/2003 20/2/2003 20/2/2003 20/2/2003 20/2/2003 20/2/2003	13:24 10:45 13:00 13:30 13:15 11:45 10:30 11:00 11:00 12:45 12:15 11:30 9:15 12:00 13:15 12:30 10:45	64.7 62.9 64.5 65.1 64.3 64.9 65.4 66 67.7 67.8 62.1 64.3 65.3 62.5 65.2 62.3 66.1 59.1	35.3 35.3 35.2 35 35 35 34.8 34.8 34.5 34.4 34.4 34.4 34.4 34.3 33.9 33.8 33.8	27.6 29.2 29.9 29.3 29.9 30.4 Lowest 10th % tile 31 32.9 33 27.6 29.9 30.9 28.1 30.9 28.4 32.3 25.3	

3/3/2003	12:15	60.6	33.3	27.3
3/3/2003	10:15	68.7	33.3	35.4
26/2/2003	14:00	65.4	33.2	32.2
3/3/2003	12:00	65.3	32.9	32.4
3/3/2003	9:30	65.3	32.7	32.6
20/2/2003	13:00	66.5	32.6	33.9
3/3/2003	11:15	64.5	32.1	32.4
20/2/2003	14:15	61.6	32	29.6
3/3/2003	10:45	63	31.9	31.1
20/2/2003	12:45	66	31.6	34.4
3/3/2003	10:30	63.2	31.1	32.1
3/3/2003	10:00	68.4	31	37.4
20/2/2003	14:00	64.4	30.5	33.9
20/2/2003	13:30	64	29.8	34.2
3/3/2003	9:45	62.5	29.8	32.7
	Average	67.4	40.5	26.9
	Max	89	58.1	48.3
	Min	58.4	29.8	12.2

Lowest 10th Percentile Background Noise Calculations (7am - 6pm) 999 Cudgera Ck Rd

	Time Lan			1.40 1.00
Date	Time L10		L90	L10 - L90
25/2/2003	12:15	73	69	4
18/2/2003	17:30	75	57.2	17.8
24/2/2003	10:15	69.1	56.9	12.2
24/2/2003	13:30	68.3	56.3	12
24/2/2003	13:45	70.6	56.3	14.3
24/2/2003	8:45	71	55.9	15.1
24/2/2003	13:15	67.9	55.6	12.3
24/2/2003	10:30	70.3	55.5	14.8
24/2/2003	14:00	66.1	55	11.1
24/2/2003	14:15	66.2	54.7	11.5
24/2/2003	14:30	68.2	54.2	14
24/2/2003	9:00	69.9	53.7	16.2
24/2/2003	10:00	68.4	53.5	14.9
24/2/2003	15:00	67.7	53.1	14.6
18/2/2003	17:15	69.8	53	16.8
18/2/2003	16:45	69.6	52.9	16.7
24/2/2003	9:45			
24/2/2003		68.8	52.2	16.6
	14:45	65	52.2	12.8
24/2/2003	8:15	71.8	52.1	19.7
24/2/2003	13:00	67.4	52.1	15.3
24/2/2003	10:45	67.3	51.8	15.5
25/2/2003	7:15	63.1	51.8	11.3
24/2/2003	12:45	69.7	51.5	18.2
26/2/2003	15:45	69.5	51.5	18
24/2/2003	9:15	70.6	51.2	19.4
24/2/2003	9:30	66.7	51.2	15.5
19/2/2003	16:45	70.6	51.1	19.5
24/2/2003	7:30	61.5	51.1	10.4
24/2/2003	7:15	62.5	51	11.5
24/2/2003	16:00	67.6	51	16.6
24/2/2003	15:15	65.5	50.9	14.6
19/2/2003	18:00	69.1	50.7	18.4
24/2/2003	7:45	61.1	50.7	10.4
21/2/2003	7:15	62.9	50.5	12.4
19/2/2003	17:45	68.4	50.4	18
24/2/2003	8:30	67	50.4	16.6
24/2/2003	15:30	66.9	50.4	16.5
24/2/2003	15:45	64.7	50.3	14.4
26/2/2003	7:15	65.7	50.3	15.4
26/2/2003	15:30	73.1	50.3	22.8
18/2/2003	8:00	69.6	50.1	19.5
18/2/2003	16:30	68.8	50.1	18.7
19/2/2003	17:30	68	50.1	17.9
24/2/2003				
	16:15	66.4	50.1	16.3
27/2/2003	7:45	62.3	50.1	12.2
18/2/2003	17:00	70.3	50	20.3
26/2/2003	8:45	68.3	50	18.3
18/2/2003	15:00	65.8	49.9	15.9
21/2/2003	8:30	67.9	49.9	18
21/2/2003	8:00	67.2	49.8	17.4
24/2/2003	11:00	68.6	49.7	18.9
24/2/2003	16:30	68	49.7	18.3

26/2/2003	16:30	67	49.7	17.3
18/2/2003	16:15			17.9
		67.5	49.6	
24/2/2003	17:00	68.8	49.6	19.2
26/2/2003	17:00	66.7	49.6	17.1
18/2/2003	8:15	70.2	49.5	20.7
24/2/2003	8:00	66.1	49.5	16.6
18/2/2003	14:00	65.5	49.4	16.1
18/2/2003	15:15	67.6	49.4	18.2
21/2/2003				17.1
	8:45	66.5	49.4	
24/2/2003	16:45	65.6	49.4	16.2
24/2/2003	12:15	67	49.3	17.7
24/2/2003	17:15	66.8	49.2	17.6
24/2/2003	17:30	67.1	49.2	17.9
26/2/2003	17:15	66.9	49.1	17.8
25/2/2003	7:45	65.4	49	16.4
26/2/2003	17:45	67.7	49	18.7
19/2/2003	15:45	68	48.9	19.1
19/2/2003	17:15	68.1	48.9	19.2
25/2/2003	16:45	65.4	48.9	16.5
26/2/2003	16:45	67.6	48.8	18.8
26/2/2003	15:15	69.6	48.7	20.9
20/2/2003	7:15	62.1	48.6	13.5
25/2/2003	13:15	65.6	48.6	17
26/2/2003	11:45	68.4	48.6	19.8
18/2/2003	16:00	68.2	48.5	19.7
19/2/2003	15:00	66.7	48.5	18.2
19/2/2003	16:30	69.3	48.4	20.9
26/2/2003	10:30	65.8	48.4	17.4
26/2/2003	18:00	66.3	48.4	17.9
18/2/2003	7:15	67.2	48.3	18.9
19/2/2003	16:00	66.5	48.3	18.2
26/2/2003	16:15	69.2	48.3	20.9
18/2/2003	14:30	63.9	48.2	15.7
19/2/2003	16:15	66.8	48.2	18.6
20/2/2003	7:30		48.2	17.1
		65.3		
27/2/2003	7:15	63.2	48.1	15.1
17/2/2003	17:45	70.3	48	22.3
19/2/2003	14:45	66.3	48	18.3
24/2/2003	12:30	65	48	17
25/2/2003	8:00	66	48	18
18/2/2003	14:45	68	47.9	20.1
20/2/2003	16:30	67.6	47.9	19.7
19/2/2003	17:00	68.8	47.8	21
20/2/2003	16:45	68.4	47.8	20.6
24/2/2003	17:45	67.7	47.8	19.9
18/2/2003	7:45	69.6	47.7	21.9
20/2/2003	17:30	68.7	47.7	21
25/2/2003	16:30	64.9	47.7	17.2
26/2/2003	17:30	65.5	47.7	17.8
25/2/2003	12:00	68.1	47.6	20.5
26/2/2003	9:30	65.1	47.6	17.5
26/2/2003				
	15:00	64.8	47.6	17.2
24/2/2003	12:00	64.1	47.5	16.6
25/2/2003	17:00	67.2	47.5	19.7
26/2/2003	8:15	69.2	47.5	21.7
26/2/2003	9:45	67.2	47.5	19.7

26/2/2003	10:45	66.2	47.5	18.7
18/2/2003	8:30	69.3	47.4	21.9
18/2/2003	15:45	67.9	47.4	20.5
20/2/2003	17:00	68	47.4	20.6
25/2/2003	15:30	68	47.4	20.6
25/2/2003	15:45	62	47.4	14.6
26/2/2003	14:15	65.8	47.4	18.4
18/2/2003	9:00	69.3	47.3	22
21/2/2003	16:15	66	47.3	18.7
25/2/2003	14:45	62.3	47.3	15
25/2/2003	16:00	66.1	47.3	18.8
25/2/2003	17:45	65.9	47.3	18.6
25/2/2003	18:00	64.9	47.3	17.6
26/2/2003	9:15	66.6	47.3	19.3
26/2/2003	12:30	65.6	47.3	18.3
19/2/2003	13:45	62.6	47.2	15.4
24/2/2003	18:00	65.8	47.2	18.6
26/2/2003	9:00	66.9	47.2	19.7
17/2/2003	18:00	68.6	47.1	21.5
19/2/2003	14:00	64.8	47.1	17.7
25/2/2003	15:15	66.2	47.1	19.1
26/2/2003	11:30	67.2	47.1	20.1
26/2/2003	14:30	62.4	47.1	15.3
27/2/2003	8:00	66.2	47.1	19.1
18/2/2003	8:45	68	47	21
18/2/2003	14:15	66.3	47	19.3
20/2/2003	17:15	68.4	47	21.4
21/2/2003	16:30	66.9	47	19.9
21/2/2003	17:15	66.4	47	19.4
26/2/2003	16:00	68.8	47	21.8
27/2/2003	9:00	65.5	47	18.5
25/2/2003	10:45	67.6	46.9	20.7
26/2/2003	11:15	69.8	46.9	22.9
27/2/2003	9:45	65.7	46.9	18.8
19/2/2003	8:45	66.9	46.8	20.1
25/2/2003	13:45	62.8	46.8	16
26/2/2003	12:45	64	46.8	17.2
26/2/2003	14:00	63.4	46.8	16.6
27/2/2003	7:30	62.7	46.8	15.9
27/2/2003	8:15	66.5	46.8	19.7
27/2/2003	8:30	63.8	46.8	17
27/2/2003	11:00	64.9	46.8	18.1
27/2/2003	17:15	67.7	46.8	20.9
21/2/2003	10:30	66.4	46.7	19.7
25/2/2003	8:15	68	46.7	21.3
25/2/2003	14:30	65.5	46.7	18.8
26/2/2003	12:15	66.9	46.7	20.2
20/2/2003	15:30	65.2	46.6	18.6
26/2/2003	8:30	66.3	46.6	19.7
26/2/2003	12:00	63.8	46.6	17.2
18/2/2003	17:45	70.4	46.5	23.9
24/2/2003	11:15	67	46.5	20.5
25/2/2003	13:00	64.9	46.5	18.4
27/2/2003	17:00	66.9	46.5	20.4
25/2/2003	8:45	67.8	46.4	21.4
26/2/2003	7:30	66.3	46.4	19.9

17/2/2003	17:15	68.9	46.3	22.6
26/2/2003	11:00	67.1	46.3	20.8
20/2/2003	17:45	67.5	46.2	21.3
25/2/2003	16:15	65.5	46.2	19.3
18/2/2003	12:45	64.8	46.1	18.7
18/2/2003	13:45	64.3	46.1	18.2
25/2/2003	12:30	69.2	46.1	23.1
26/2/2003	8:00	66.7	46.1	20.6
18/2/2003	9:15	68.8	46	22.8
19/2/2003	8:30	66.2	46	20.2
20/2/2003	8:45	66.6	46	20.6
20/2/2003	16:15	65.8	46	19.8
21/2/2003	16:45	64.3	46	18.3
25/2/2003	12:45	63.6	46	17.6
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28/2/2003	7:45	64.1	46	18.1
17/2/2003	17:00	72.3	45.9	26.4
18/2/2003	13:15	63	45.9	17.1
19/2/2003	13:30	62.9	45.9	17
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27/2/2003	10:30	64.9	45.8	19.1
21/2/2003	17:30	67	45.7	21.3
28/2/2003	7:15	58.9	45.7	13.2
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25/2/2003	17:30	67.5	45.6	21.9
19/2/2003	15:15	68	45.5	22.5
26/2/2003	10:15	63.5	45.5	18
26/2/2003	13:00	62.7	45.5	17.2
20/2/2003	8:00	65.2	45.4	19.8
26/2/2003	7:45	64	45.4	18.6
21/2/2003	12:45	62.1	45.3	16.8
25/2/2003	10:00	63.6	45.3	18.3
25/2/2003	14:15	63.9	45.3	18.6
18/2/2003	9:30	66.5	45.2	21.3
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19/2/2003	14:15	64.5	45.2	19.3
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25/2/2003	8:30	67.5	45.2	22.3
26/2/2003	14:45	61	45.2	15.8
27/2/2003	9:15	65.1	45.2	19.9
20/2/2003	15:15	66.4	45.1	21.3
25/2/2003	11:45	62.1	45.1	17
25/2/2003	11:30	63.5	45	18.5
28/2/2003	8:00	65.1	45	20.1
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27/2/2003	9:30	64.8	44.9	19.9
27/2/2003	17:45	66.5	44.9	21.6
28/2/2003	9:15	65.9	44.9	21
18/2/2003	13:00	61.4	44.8	16.6

27/2/2003 10:45 64.1 44.8 19.3 19/2/2003 16:00 69 44.7 18.6 21/2/2003 16:00 69 44.7 24.3 25/2/2003 9:15 67.2 44.7 22.5 25/2/2003 13:45 61.8 44.6 17.2 18/2/2003 7:30 67 44.5 22.5 18/2/2003 15:30 69 44.5 24.5 20/2/2003 15:30 69 44.5 24.5 20/2/2003 15:30 69 44.5 24.5 20/2/2003 14:30 67.5 44.5 21.9 26/2/2003 17:15 66.4 44.5 21.9 26/2/2003 13:15 64 44.5 19.5 20/2/2003 13:16 64 44.5 19.5 20/2/2003 14:00 63.3 44.4 20.6 20/2/2003 14:00 66.3 44.4 21.9 21/2/2003					
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25/2/2003	11:15	63.2	43	20.2
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18/2/2003	10:45	65.2	42.9	22.3
18/2/2003	18:00	67.6	42.9	24.7
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		65.7		
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21/2/2003	14:00	64.1	42.7	21.4
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28/2/2003	7:30	61.8		19.2
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19/2/2003	13:00	62	42.1	19.9
21/2/2003	11:30	64.9	42.1	22.8
27/2/2003	10:15	64.4	42.1	22.3
27/2/2003	12:00	64.1	42.1	22
27/2/2003	15:00	63.4	42.1	21.3
20/2/2003	13:30	63.9	42	21.9
21/2/2003	13:15	61.7	42	19.7
24/2/2003	11:45	65.5	42	23.5
27/2/2003	13:15	63.7	42	21.7
27/2/2003	12:30	63.2	41.9	21.3
28/2/2003	8:45	65.2	41.8	23.4
21/2/2003	10:45	63.4	41.7	21.7
27/2/2003	14:15	64.2	41.7	22.5
27/2/2003	12:15	62.8	41.6	21.2
27/2/2003	13:00	61.7	41.5	20.2
21/2/2003	12:15	64	41.3	22.7
24/2/2003	11:30	64.3	41.3	23
20/2/2003	11:30	63.3	41.2	22.1
20/2/2003	15:00	60.8	41.2	19.6
21/2/2003	15:45	64.5	41.2	23.3
27/2/2003	11:30	64.5	41.1	23.4
27/2/2003	14:45	62.8	41.1	21.7
27/2/2003	15:45	62.6	41.1	21.5
19/2/2003	9:30	63.5	40.9	22.6
20/2/2003	10:45	61.2	40.8	20.4

19/2/2003	11:15	61.2	40.7	20.5 Lowest 10th % tile
21/2/2003	15:00	66	40.7	25.3
27/2/2003	16:00	63.6	40.7	22.9
27/2/2003	12:45	62.6	40.6	22
20/2/2003	10:30	62.1	40.5	21.6
27/2/2003	11:45	62.3	40.5	21.8
19/2/2003	12:45	63.8	40.4	23.4
19/2/2003	11:00	63.4	40.3	23.1
27/2/2003	13:45	63.3	40.3	23
21/2/2003	11:00	63.9	40.2	23.7
21/2/2003	13:45	62	40.2	21.8
27/2/2003	14:30	63.3	40.2	23.1
28/2/2003	10:00	66.1	40.1	26
21/2/2003	9:45	62.8	39.9	22.9
19/2/2003	11:30	63.5	39.8	23.7
20/2/2003	11:15	60.2	39.8	20.4
20/2/2003	14:45	61.2	39.8	21.4
21/2/2003	13:00	61	39.8	21.2
21/2/2003	15:15	65.9	39.8	26.1
21/2/2003	17:45	66.4	39.8	26.6
21/2/2003	11:45	64.1	39.7	24.4
21/2/2003	11:15	64.6	39.5	25.1
21/2/2003	15:30	66.4	39.5	26.9
21/2/2003	18:00	65.7	39.5	26.2
20/2/2003	10:00	60.1	39.2	20.9
20/2/2003	10:15	63.9	39.1	24.8
21/2/2003	12:00	65.3	39.1	26.2
19/2/2003	9:45	63.5	38.9	24.6
28/2/2003	9:45	64.8	38.7	26.1
19/2/2003	10:45	56.8	38.6	18.2
19/2/2003	11:45	61.2	38.3	22.9
21/2/2003	13:30	62.3	38.3	24
28/2/2003	10:15	64.3	38.3	26
19/2/2003	10:15	64.8	38.2	26.6
19/2/2003	10:00	62.6	37.9	24.7
20/2/2003	9:45	62.2	37.9	24.3
27/2/2003	14:00	61.4	37.7	23.7
19/2/2003	10:30	62.7	37.6	25.1
Av		65.6	45.8	19.8
Ma		75	69	26.9
Mi	n	56.8	37.6	4,

Appendix F

Construction Noise Predictions

Acoustic Calculations

Noise Propagation from Construction Site

The calculations below follow procedures outlined in AS2436-1981. Assumptions made in the calculations include:

- No barrier attenuation
- No ground effect attenuation
- The number of machines on construction site
- Attenuation due to hemispherical spreading

Table E1

Construction Machine	Sound Power Level (dBA) ¹	Number of machines	Total Power Level (dBA) ²	Cumulative ³		
Grader	117	1	117	117		
Trucks	105	2	108	118		
Roller	102	2	105	118		

mean values from sound power levels (dBA) as suggested from Table D2 of AS2436-1981

Truck reversing alarms

PWL ~ 88 dB

+ 5 dB tonal penalty

+ 5 dB impulsive penalty

Therefore assume 98dB. As cumulative PWL used in calculations was 118, addition of 1 truck reversing alarm will have no additional influence on the predicted noise levels.

The sound level at a receiving position distant R from the geometric centre of a machine or process if sound is radiated uniformly in all directions over flat, open ground is given by the following formula (Appendix B3 of AS2436-1981):

PWL was found to be 118 dBA with the assumed number and types of construction equipment for the proposed works as shown in the above table.

The setback distances for the potentially impacted residences identified in this study is located between 15 m and 40 m from the Cudgera Creek Road, i.e. R = 15 m

Therefore, the sound pressure level at the monitoring site with the proposed construction is predicted to be:

SPL @
$$15m = 118 - 20 \log 15 - 8$$

= $86 dBA$

SPL @
$$40m = 118 - 20 \log 40 - 8$$

= 80 dBA

² The total power level from each machine type, calculated with reference to Table B2 of AS2436-1981

³ Cumulative sound power levels from different types of machines, calculated with reference to Table B2 of AS2436-1981

Experience shows that the L_{10} is generally between 5 and 12 dB less than the sound pressure level predicted from sound power levels and this can be discounted by a further 2 dB because all equipment will not be working at the same time. The L_{10} can be approximately calculated by deducting 7 dB from the sound pressure level.

Therefore, the L_{10} at the monitoring site is calculated to be:

At 15 m
$$L_{10} = 86 \text{ dB} - 7 \text{ dB}$$

=79 dB

At 40 m
$$L_{10} = 80 \text{ dB} - 7 \text{ dB}$$

=73 dB

Table E2 Predicted Noise Levels at Identified Locations

Site Tenth Percentile Background Noise Level L ₉₀ dBA (7am - 6pm)		$\begin{array}{c} \textbf{Construction Noise Goals} \\ \textbf{L}_{10} \ \textbf{dBA} \end{array}$	Predicted Construction Noise L ₁₀ dBA		
A	41	51	79		
В	35	45	79		
С	39	49	73		

Appendix I

WBM Hydrology Report

Cudgera Creek Road Upgrade Hydrology/Hydraulics Working Paper

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Client:

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Client Contact:

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Client Reference:

Synopsis:

Report on the hydraulic design requirements for upgrading Cudgera

quirements it

Creek Road.

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1 INTRODUCTION

1.1 Cudgera Creek Catchment

Cudgera Creek has a catchment of approximately 33km² and is bounded by the Burringbar Range to the west. Peak elevations of the catchment are in the order of 250m and mean catchment slopes are in the order of 25%. The catchment is heavily forested in the upper parts and the lower slopes have been somewhat cleared for agricultural pursuits.

The dominant feature of the Cudgera Creek system is that the floodplain on the northern side of Cudgera Creek Road is considerably lower on the southern side of the road and adjacent to Cudgera Creek. Hence, Cudgera Creek Road is a major control for the breakout of floodwaters from Cudgera Creek to the floodplain to the north and northeast.

The northern floodplain has a relatively steep flood gradient. At the south-western corner of the floodplain (taken to be the junction of Cudgera Creek Road and Cudgera Road) the ground level is approximately 12.5mAHD. Within the current study area, the ground level at the north-eastern corner of the junction of Cudgera Creek Road and the Pacific Highway is approximately 8.9mAHD. At the north-eastern corner of the floodplain, ground levels are in the order of 1.5mAHD.

The dominant flow direction is, therefore, in a north-easterly direction away from Cudgera Creek towards the lower portions of the Cudgera/Christies Creek floodplain.

1.2 Previous Studies

A 2D/1D flood model of the Cudgen and Cudgera Creek systems has been developed over time for studies culminating in the design and construction of the Yelgun to Chinderah Pacific Highway upgrade. This model was further upgraded during the provision of 5year ARI flood levels along Cudgera Creek Road on behalf of Abigroup.

This reports presents the detailed investigation in the hydraulic design requirements for upgrading Cudgera Creek Road to 5 year ARI flood immunity.

1.3 Recent Floodplain Development

Prior to the construction of the Pacific Highway upgrade, flood flows crossed Cudgera Creek Road generally at the location of the Pacific Highway/Cudgera Creek Road interchange. The hydraulic design of the upgrade segmented this flow path into two components. The first conveys flow northward under the western overpass embankment to the un-named creek approximately 520m north of the Cudgera Creek crossing. The remainder of the previous outbreak flow passes under the Highway at the crossing of Cudgera Creek, then breaks out to the north, through culverts in the eastern overpass embankment.

The net effect of the interchange is to concentrate discharge to three locations compared to the previous even distribution in this area.



No significant flood events have occurred in the area since the Pacific Highway upgrade. Therefore, there has been no experience of the altered flood behaviour. If no significant events occur before construction of the Cudgera Creek Road upgrade, the net effect of the two projects will be experienced and the impact attributed to each will not be easily determined.

Residents are generally aware that the flow regime will be altered due to each project and that the individual impact of either will not be easily determined.



2 EXISTING FLOOD BEHAVIOUR WITHIN THE PROJECT AREA

2.1 General Overview

Cudgera Creek and the flood flow behaviour discussed below are illustrated in Figure 2-1. This discussion is focussed on the detailed flood behaviour within the vicinity of Cudgera Creek Road between the Pacific Highway and the sharp bend to the north of the Cudgera Creek bridge at the eastern end of the straight. The flood behaviour is predicted by the hydraulic model and is guided by conversations with residents. As noted above, no significant flood events have occurred since the construction of the Pacific Highway upgrade, so the following has not been verified by experience.

Cudgera Creek is generally parallel to Cudgera Creek Road, although it is highly tortuous. One section of creek with a 1285m long flow path has a straight-line distance of 250m. This results in large head differences along the length of the road.

Drainage of the lower cane land floodplain to the north of Cudgera Creek Road is dominated by levelling in a 'saw-tooth' fashion, promoting an even distribution of flow north-east to cane drains that flow north to meet up with drains running east. This levelling has been undertaken to reduce flow and velocity concentrations on the erosion susceptible soils.

2.2 Detailed Flood Behavioural Features

As mentioned above, breakout from the northern bank of Cudgera Creek to the northern floodplain is controlled by Cudgera Creek Road. Floodwater crosses this road at the following locations:

- Through culverts in the interchange's eastern overpass embankment. These culverts are approximately 125m to the west of Chainage 0m of the current project. Flow through these culverts originates from breakout directly to the south of this location as discussed in Section 1.3, and from a breakout at Chainage 125m that follows the southern table drain west to the culverts.
- At Chainage 135m. Another breakout gully exists at this location, with water flowing north to the existing 1700x550mm box culvert at Ch 135m. Corrugated iron along the eastern side of this breakout gully deters flood flow from the residence to the east. The northern end of this culvert discharges into a substantial drain which at first is relatively unstructured for a length of 75m and is surrounded by trees and scrub. North of this, the drain is a trapezoidal channel approximately 5m wide and 1.2m deep. It conveys water northward through cane fields to join an easterly flowing drain approximately one kilometre north of Cudgera Creek Road.

When overtopped, this breakout gully discharges to a table drain on the southern side of the road. Water flows east to a culvert under the road at Ch 410m. Flow in excess of the 300mm circular culvert capacity ponds on the southern side of the road in farming land.

At higher water levels Cudgera Creek Road is overtopped at Ch 135m. Water flows east along the road to a 1200mm circular culvert north of the road and into a large cane drain at approx Ch 285m.

• At the eastern end of Cudgera Creek Road, immediately to the west of it's crossing of Cudgera Creek. Residents have noted that once the water level reaches the obvert of the existing bridge, it



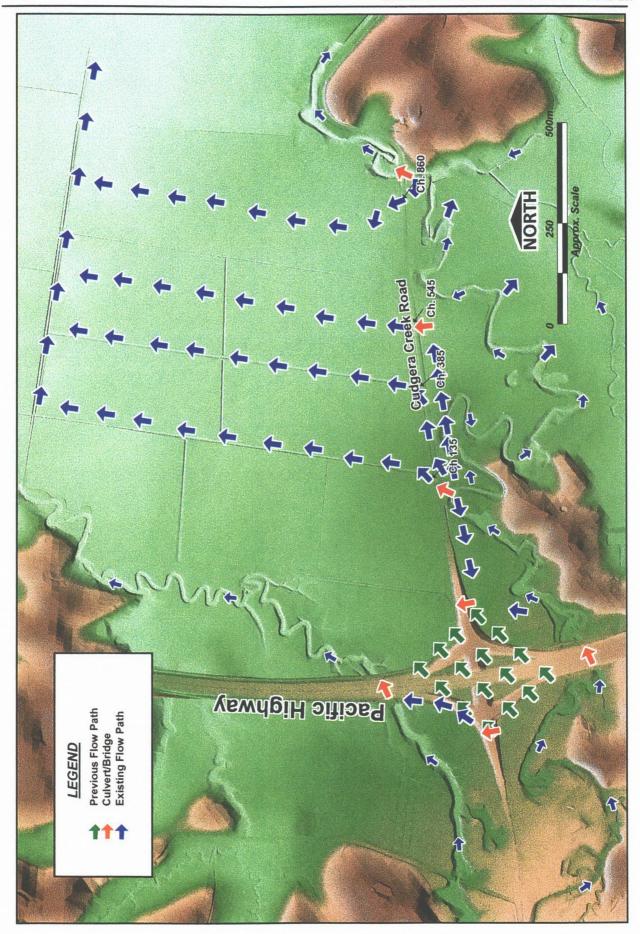
increases rapidly until overtopping the road immediately to the west of the creek crossing. Water then flows in a northwesterly direction into a drain at the rear of a residence, before flowing northward through a small cane drain.

A small, constructed levee close to the western creek bank downstream of the bridge prevents breakout at this location during the smaller flood events.

A large floodplain area dominates the area to the south of Cudgera Creek. The area is drained by several small, natural channels that combine before joining Cudgera Creek to the south of the bridge at the eastern end of the straight. Floodwater from Cudgera Creek backs up into this area from this confluence. A breakout channel has also been constructed from Cudgera Creek to the tributary near the confluence of the two, promoting this area for the storage of excess floodwater from Cudgera Creek.

During larger events, breakouts from the southern bank into the storage area occur at two additional locations where a meander in the creek turns to the north.





Existing Flood Behaviour

Figure 2-1



3 HYDRAULIC MODEL

3.1 TUFLOW Hydraulic Model

The two-dimensional (2D) hydraulic modelling software package TUFLOW calculates flood levels and flow patterns within the creek and over floodplains. The software also simulates the complex effects of backwater, overtopping of embankments, bridge constrictions, river confluences and other hydraulic behaviour.

The basis of a hydraulic model is the representation of topography. This may be a DEM for use in 2D modelling, or cross0sections for use in 1D modelling. From this base, the model is 'built' up to represent the conditions that are required to be modelled. Major structures such as bridges and large banks of culverts are added. Key model parameters are then defined. Parameters such as the hydraulic roughness (eg vegetation density), weir and culvert coefficients and specified. Finally, boundaries from the hydrologic model are established.

3.2 Development of the Digital Elevation Model

The Digital Elevation Model (DEM) produced for previous studies in the area was used as the topography base. Alterations to this DEM were made to incorporate additional ground survey undertaken since the previous work including:

- Detail of the existing Cudgera Creek Road;
- Detailed survey of the cane drain network within the floodplain to the north of Cudgera Creek Road:
- General floodplain levels to the south of Cudgera Creek Road and further south again of Cudgera Creek;
- Cudgera Creek bank elevation;
- Cross-sections of Cudgera Creek;
- Other topographical features eg minor embankments.

The resulting DEM is shown in Figure 3-1.

3.3 2D Model Extent

The 2D hydraulic model covers and area of 4 km² from Cudgera Road in the west to the location where the existing road turns sharply to the south east of its crossing of Cudgera Creek. The model is based on a 5m square grid, resulting in approximately 160,000 grid cells.

Each square grid element contains information on ground topography sampled from the DEM at 2.5m spacing, surface resistance to flow (Manning's 'n' value) and initial water level. Eight area of different land-use type based on aerial photography and site inspections were identified for setting Manning's 'n' values. The extent of the 2D model is shown in Figure 3-2.



3.4 Development of 2D/1D Model Components

A one-dimensional (1D) network was used to represent the smaller drainage elements within the floodplain. These include Cudgera Creek, the network of cane drains throughout the floodplain to the north of Cudgera Creek Road and culverts.

The 1D model also includes a linkage via Kanes Road to a full 1D model of the Cudgen Creek floodplain system (including Christies Creek, Reserve Creek and Clothiers Creek) which extends to the mouth of Cudgen Creek at Kinsgcliff.

The overall hydraulic model schematisation of Cudgera Creek floodplain for the existing case is shown in Figure 3-2.

3.5 Hydraulic Model Inflows

An XP-RAFTS hydrologic model was set up for the Cudgen and Cudgera Creek systems as part of previous studies (Yelgun to Chinderah Pacific Highway Upgrade EIS, 1998) with minor adjustments made as part of this study.

No calibration data (recorded rainfall and associated peak flood heights) was available within the catchment. A Rational Method check produced peak flow rates similar to those predicted by the hydrologic model.

Peak discharges from the Cudgera Creek catchment at the upstream or western end of the hydraulic model are presented in Table 3-1. These flows are for a duration of 12 hours which was found to be the critical duration (ie. producing the highest peak flood levels)

 Event (AEP)
 Peak Discharge (m³/s)

 20%
 52

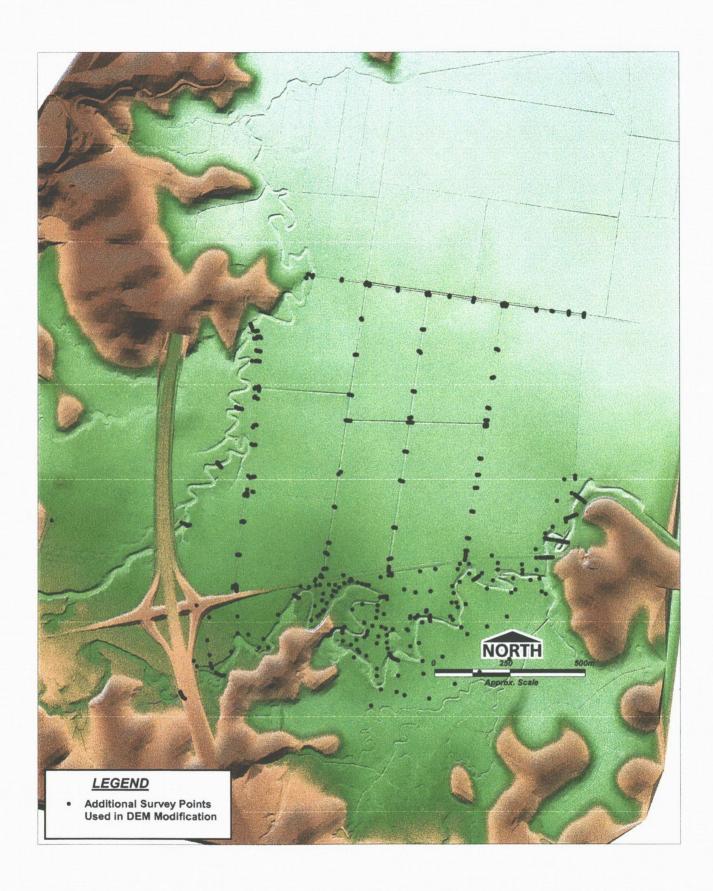
 5%
 90

 1%
 130

Table 3-1 Peak Discharges From The Hydrologic Model

3.6 Downstream Boundary Conditions

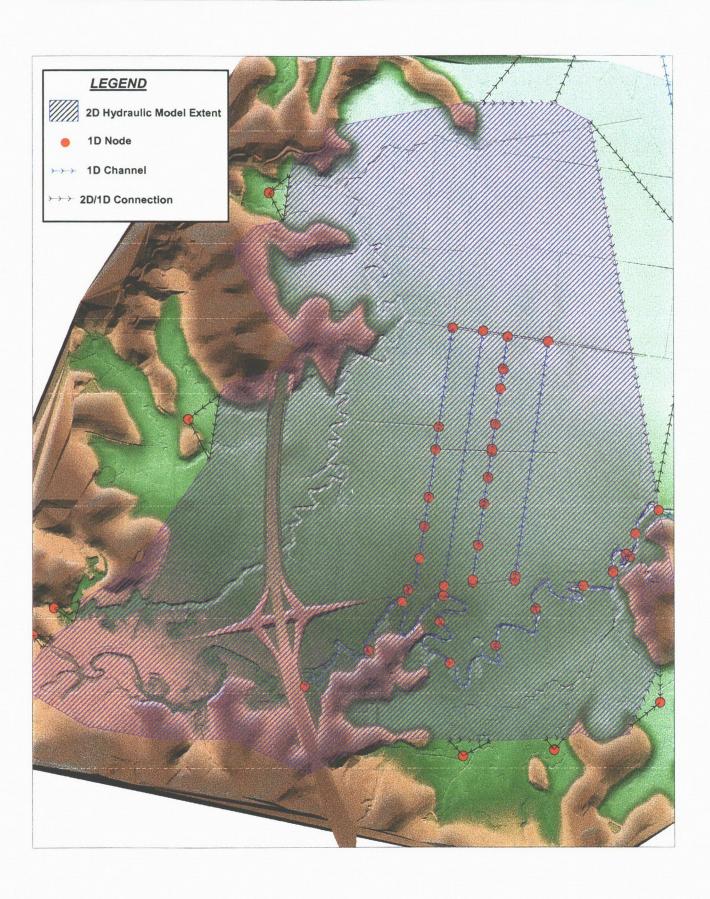
The downstream boundary was considered to be sufficiently removed from the study area as to not influence model results significantly. A tidal boundary condition at the ocean outlet of Cudgera Creek was, therefore, set to the 20% AEP storm surge for all events.



Digital Elevation Model

Figure 3-1





Hydraulic Model Layout

Figure 3-2



4 HYDRAULIC DESIGN CONSTRAINTS

A primary objective of the study is to develop a road that is not inundated in a 20% AEP flood event (note: the 20% AEP flood event is equivalent to the flood event with an average recurrence interval of 5 years, sometimes referred to as the "1 in 5 year flood").

For the purposes of defining required road levels, it was assumed that "not inundated" denotes that the edge of road surface is level with the 20% AEP flood level.

Possible impacts associated with the upgrade are detailed in Table 4-1, along with the management measures adopted.

Table 4-1 Possible Impacts and Associated Management Measures

Possible Impact	Criteria	Proposed Mitigation
Afflux at properties on the floodplain.	1% AEP: 100mm 5% AEP: 50mm 20% AEP: 10mm	Culvert sizing to be large enough to ensure these criteria are met. Remove existing bridge over Cudgera Creek Road.
Scour downstream of the upgraded Cudgera Creek Road	Culvert sizing to match capacity of cane drains for 20% AEP event. Velocities exiting culverts not to exceed 1.5m/s	Culvert design to meet criteria
Scour at upgraded bridge works	Minimise increase in creek velocities at bridge.	Bridge design to meet criteria

Therefore, the overall objective is to provide road flood immunity for the 20% AEP event, while ensuring sufficient conveyance underneath the road to reduce afflux, and restricting conveyance in the 20% AEP event to the capacity of the cane drains downstream of the road.

Should there be no workable solution to these two opposing constraints, property is to have priority over farming land and affluxes will be minimised.



5 PROPOSED ROADWAY DESIGN

5.1 Basic Elements of Roadway Design

The proposed roadway design received from the RTA is presented in Figure 5-1. The edge of surface level was set based on physical constraints and preliminary 20% AEP peak flood levels produced early in the study.

Features of the design that impacted on the hydraulic design constraints included the depth of roadway available for culverts while maintaining safety and cover requirements. The fixed width of roadway reserve also restricted the allowable size of table drain.

The bridge details over Cudgera Creek were fixed by factors including vertical alignment requirements to the east of the bridge and the NPWS constraint that no works should be undertaken within an exclusion zone 2m from the top of bank. This design was assessed for hydraulic impact and adjustments made as necessary.

Access to a property immediately to the east of the existing Cudgera Creek bridge was thought to possibly require retaining the existing bridge in the ultimate design case. This scenario was investigated to determine the hydraulic impact if it was to be required.

5.2 Recommended Minimum Road Level

The edge of surface level required to meet the design criteria is presented in Figure 5-2. This level was based on peak 20% AEP flood levels adjacent to the proposed road alignment.

5.3 Recommended Waterway Openings

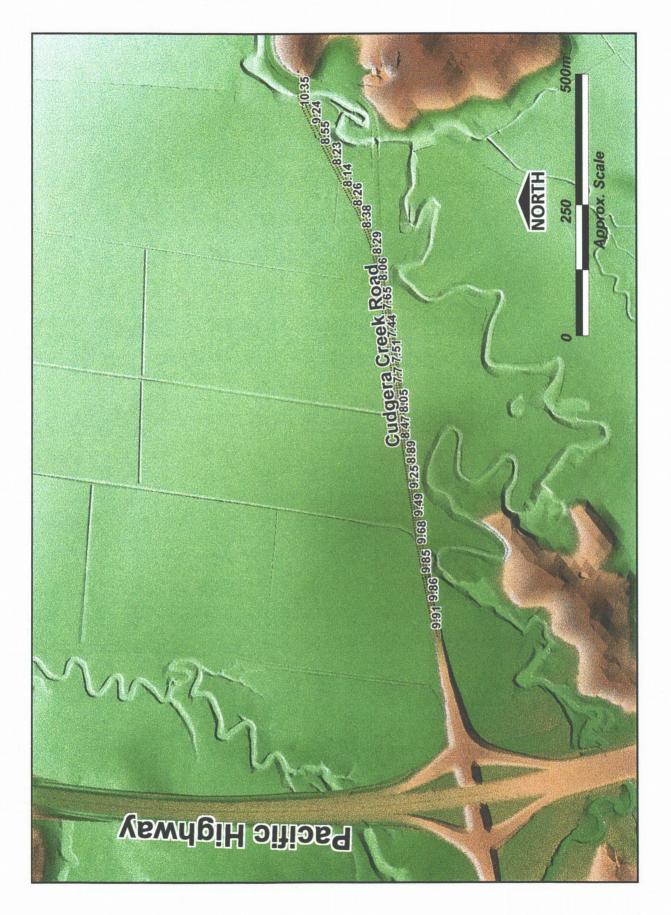
The recommended culvert sizes and locations are detailed in Table 5-1 and illustrated in Figure 5-2. Culvert sizes were chosen to conform to the constraints discussed above. In addition to road culverts, the proposed bridge was modelled as per the road design received from the RTA. It was found that alterations from the design were not required.

Table 5-1 Recommended Waterway Openings

Chainage	Number of Barrels and Size of Culverts		
(m)	Existing	Proposed	
135	1 x 1700W x 550H RCBC	2 x 1800W x 600H RCBC	
280		1 x 450 RCP	
385		1 x 1200W x 900H RCBC	
545	1 x 300 RCP	1 x 450 RCP	
860		3 x 1200W x 900H RCBC	

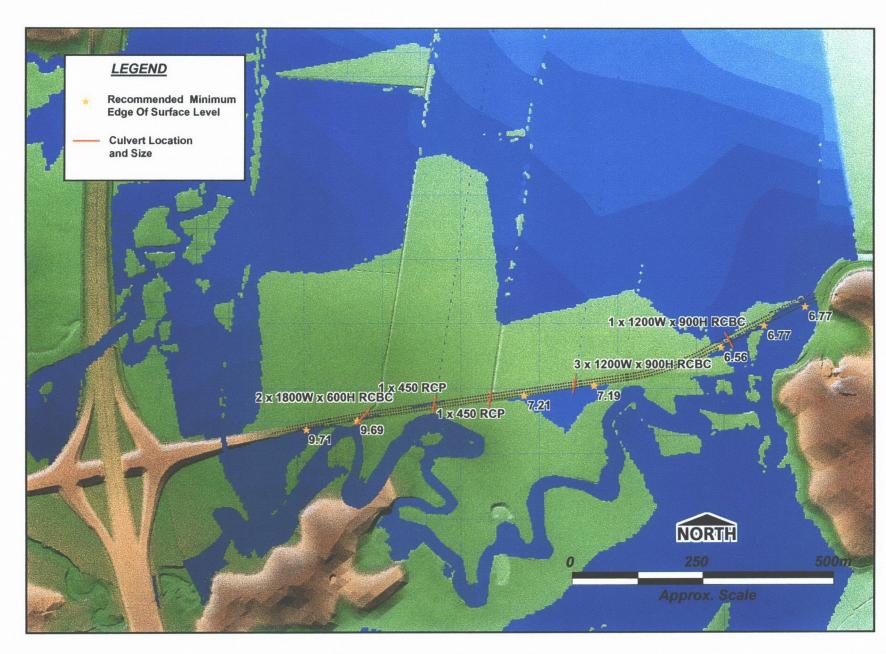
Note 1: RCBC = Reinforced Concrete Box Culvert
RCP = Reinforced Concrete Pipe





Proposed Base Road Design

Figure 5-1



6 HYDRAULIC MODELLING RESULTS

6.1 Crop Cover Scenarios

Over time, farming land of the Cudgera Creek floodplain may be completely fallow or under a 2m high crop, having substantial influence on the ability of flood flow to pass through this area. Land with no or emerging crop will provide little resistance to flow, resulting in high velocities and potential erosion. The converse is true for a cane crop ready for harvest, which retards flows significantly and can increase peak flood levels as a result.

As there were hydraulic constraints associated with both peak flood level and velocity, each of the crop scenarios was investigated. It is acknowledged that it is unlikely that the entire floodplain would, at any given time, be either completely under a mature cane crop or completely fallow. However, these situations present the worst-case scenario for each of potential erosion and afflux correspondingly, and were modelled as such.

The mature crop scenario was run for the 20%, 5% and 1% AEP events. The fallow land scenario was run for the 1% AEP event only to assess if impacts were within acceptable limits.

6.2 Flood Levels (with Mature Crop)

The existing peak flood levels for the 20%, 5% and 1% AEP events with a mature cane crop are presented in Figure 6-1 to Figure 6-3. These figures also illustrate the following:

- Residences that are currently affected by floodwaters;
- Residences that are likely to be affected by floodwaters as a result of the proposed road upgrade;
- Freeboard at residences not affected by floodwaters during the existing and proposed upgrade scenarios.

The afflux associated with the proposal is presented in Figure 6-4 to Figure 6-6. Note that some areas have affluxes greater than the tolerances given in Table 4-1. However, no buildings are located within these areas and so the criterion relating to affluxes is achieved.

It should also be noted that the cane drain at Chainage 545 will experience an increase in peak flood level as a result of the proposal, although this is unable to be mapped appropriately. This increase is due to the deliberate diversion of discharge from the breakout at Chainage 135 to the culvert under the road that is proposed to discharge into this drain. As discussed in Section 7, this discharge is within the capacity of the drain in a 20% AEP event.

6.3 Flood Depths (with Mature Crop)

The existing peak flood depths for the 20%, 5% and 1% AEP events with a mature cane crop are presented in Figure 6-7 to Figure 6-9. These figures also present the depths at buildings within the floodplain.



Changes to depths as a result of the proposed upgrade are identical to changes in absolute water level, which are presented in Figure 6-4 to Figure 6-6 as afflux results (ie. an increase in flood depth is the same as an increase in flood level).

6.4 Flood Velocities & Flow Distribution (Mature Crop)

The existing and proposed peak flood velocities for the 20%, 5% and 1% AEP events with a mature cane crop are presented in Figure 6-10 to Figure 6-15. The areas with floodplain velocities less than and greater than 0.3 m/s are shown as this velocity is considered to be the lower threshold for the initiation of velocity on highly erodible soils. This limit was derived from previous studies for the adjacent Burringbar Creek floodplain ("Proposed Motorway: Billinudgel to Chinderah Local Drainage Investigations" WBM, 1994).

These figures show that the area experiencing flood velocities greater than 0.3 m/s is not expected to increase to any significant degree as a result of the proposed upgrade. Hence, the potential for increased areas of erosion resulting form the redistribution of flows following the upgrade construction is expected to be low.

The existing and proposed flow distribution for the 20%, 5% and 1% AEP events with a mature cane crop are presented in Figure 6-16 to Figure 6-21.

6.5 Period of Inundation (with Mature Crop)

The existing periods of inundation for the 20% AEP flood event is compared with those of the proposal case in Figure 6-22 at three locations. The first location is in within Cudgera Creek south of the proposes upgrade. The graph demonstrates that the proposal case will result in marginally shorter periods of inundation. This is primarily due to the removal of the existing bridge resulting in amore efficient flowpath for the creek.

The second location is located mid-way along the cane drain at CH 135 north of the proposed upgrade. This graph also shows that the proposal case will result in marginally shorter periods of inundation.

The third location is mid-way along the cane drain at CH 410 north of the proposed upgrade. This graph shows that the proposal case will result in an increase in the period of inundation for this drain due to the concentration of flow within this drain. This increase is not expected to result in increased times of inundation for adjacent parts of the floodplain as the floodplain levels in this area are close to the peak flood levels in the drain (ie. 5.5 mAHD at this location).

6.6 Proposed Bridge (with Mature Crop)

6.6.1 Afflux with Proposed Bridge

As discussed previously, factors external to hydraulic requirements set the initial geometry of the proposed bridge. This geometry has been assessed for each of the 20%, 5% and 1% AEP events.

Table 6-1 presents the afflux immediately upstream of the bridge associated with its construction.



Table 6-1 Afflux Associated With The Proposed Cudgera Creek Bridge

Flood Event	Existing Upstream Peak Flood Level	Proposed Upstream Peak Flood Level	Afflux
(AEP)	(m)	(m)	(mm)
20%	6.74	6.76	20
5%	6.78	6.81	30
1%	6.80	6.88	80

Affluxes immediately upstream of the proposed bridge for the 5% and 1% AEP events are below the tolerances presented in Table 4-1. While afflux for the 20% AEP event is above the tolerance of 10mm, it is confined to the area downstream of the existing bridge and does not affect any buildings and only cane land.

6.6.2 Proposed Bridge Scour Potential

The predicted velocity under the proposed bridge is shown in Table 6-2. A minor increase in creek velocity is expected due to the proposed upgrade. This increase is primarily due to the minor increase in flows in the creek resulting from the removal of the existing bridge further upstream and associated flattening of the flood gradient.

This increase in flood velocities is not expected to result in any significant increase in the potential for creek bank scour.

Table 6-2 Increase in Creek Velocities Associated with Proposed Bridge

Flood Event (AEP)	Existing Peak Velocity (m/s)	Proposed Peak Velocity (m/s)	Increase (m/s)
(TICI)	(111/3)	(111/3)	(111/3)
20%	1.57	1.62	0.05 (3%)
5%	1.63	1.70	0.07 (4%)
1%	1.73	1.82	0.09 (5%)

6.6.3 Potential for Bridge Floatation

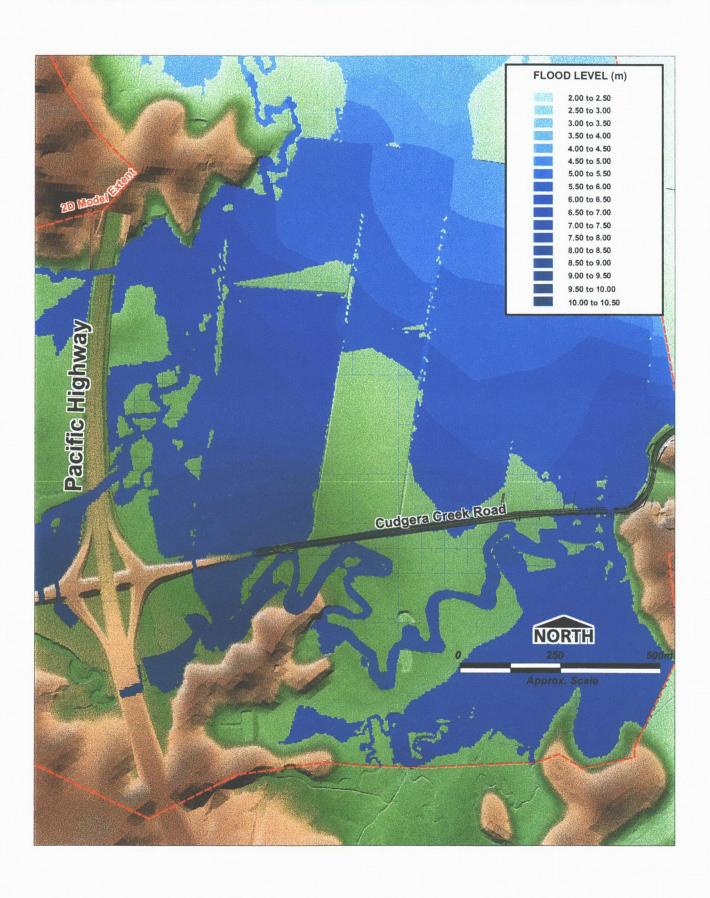
Bridge design specifies that a structure must be checked for potential floatation during a 0.05% AEP (ie. "1 in 2000 year") flood event. The obvert of the proposed bridge is approximately 8.0 mAHD, which is 1.1m above the predicted 1% AEP flood level. It was determined that given the large floodplain storage available, the increase in flood level from the 1% AEP flood event to the 0.05% AEP flood event is unlikely to increase flood levels by more than 1m. Hence, it is unlikely that the bridge obvert would be inundated in the 0.05% AEP flood event and the 0.05% AEP flood event was not simulated in detail.



6.7 Hydraulic Model Results (with Fallow Land)

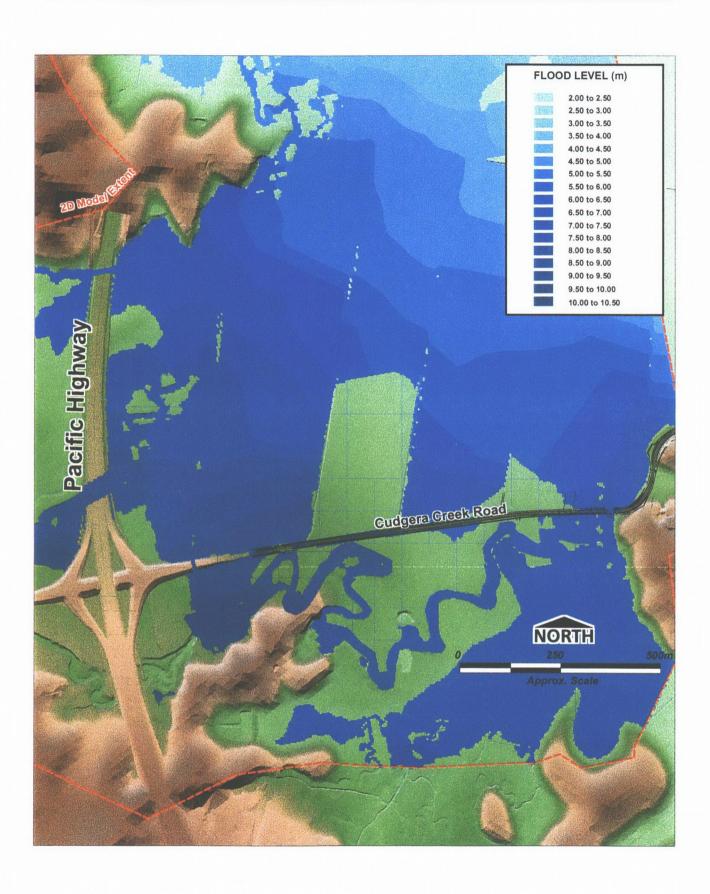
The impact of all cane land being fallow on peak flood levels for the 1% AEP event is presented in Figure 6-23. This figure demonstrates that the afflux is similar for that of the mature crop case.

The impact of all cane land being fallow on peak velocities for the 1% AEP event is presented in Figure 6-24 and Figure 6-25. These results show that, while there is a high potential for erosion in the event that all farming land to the north of the proposal is fallow, no significant increase in peak flood velocities is experienced due to the proposal. The risk of erosion is, therefore, not expected to be significantly greater due to construction of the proposed upgrade.



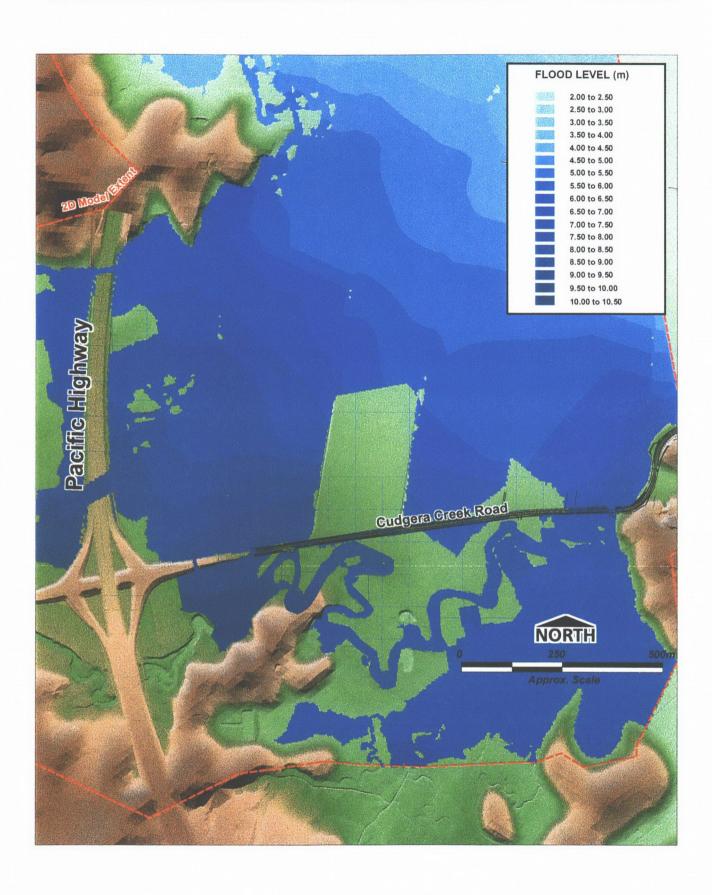
Existing Case (Mature Crop)
Peak Flood Levels: 20% AEP





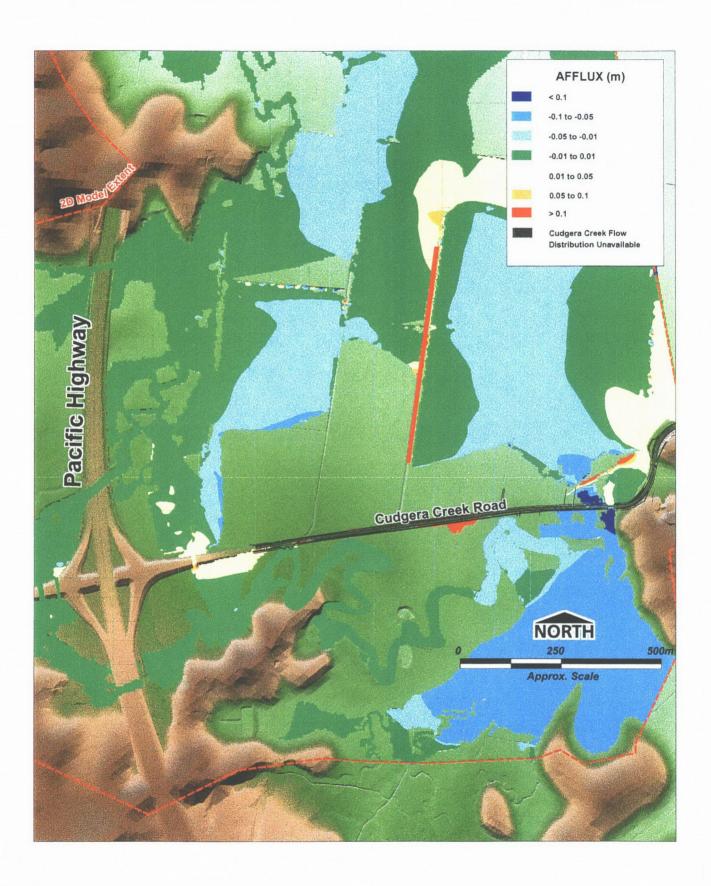
Existing Case (Mature Crop)
Peak Flood Levels: 5% AEP





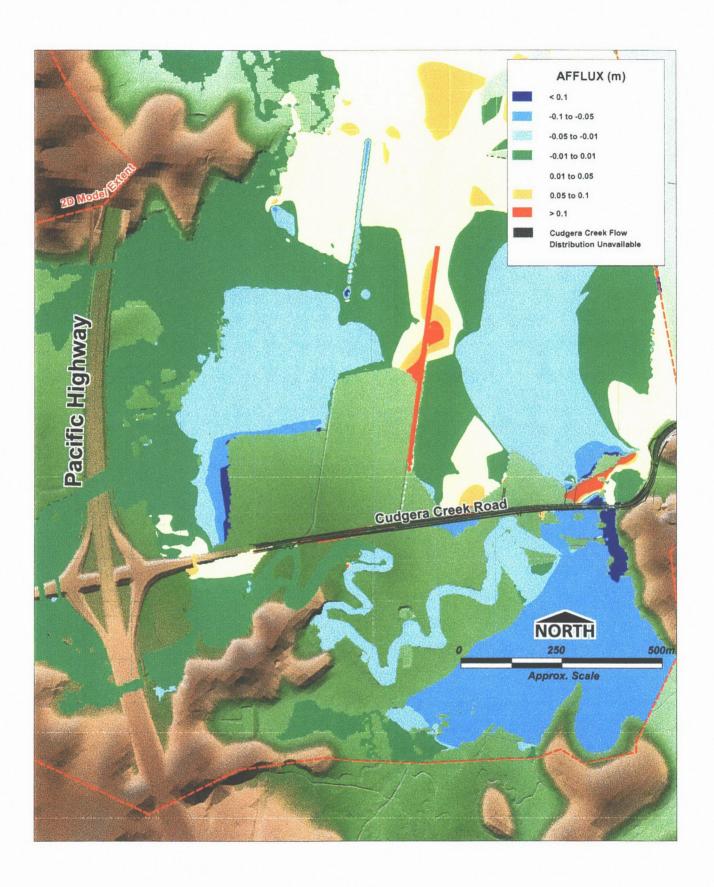
Existing Case (Mature Crop)
Peak Flood Levels: 1% AEP





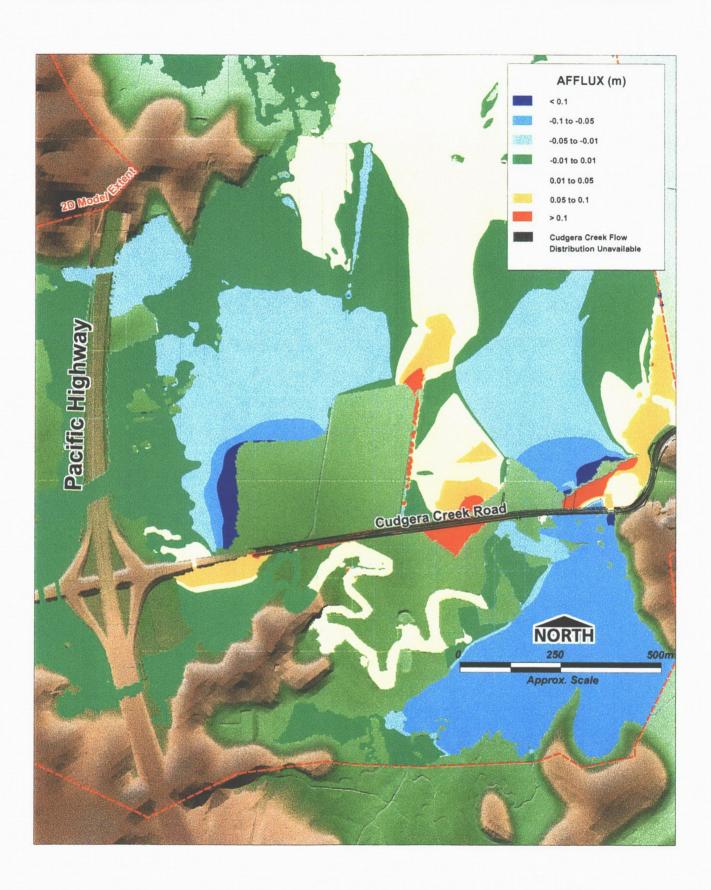
Afflux Associated With The Proposal (Mature Crop): 20% AEP





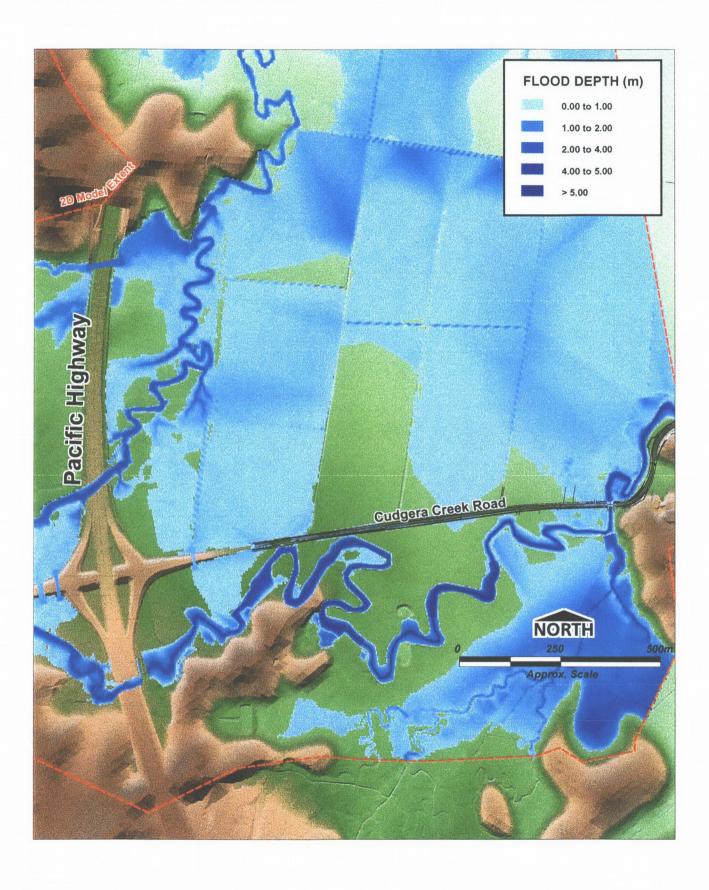
Afflux Associated With The Proposal (Mature Crop): 5% AEP





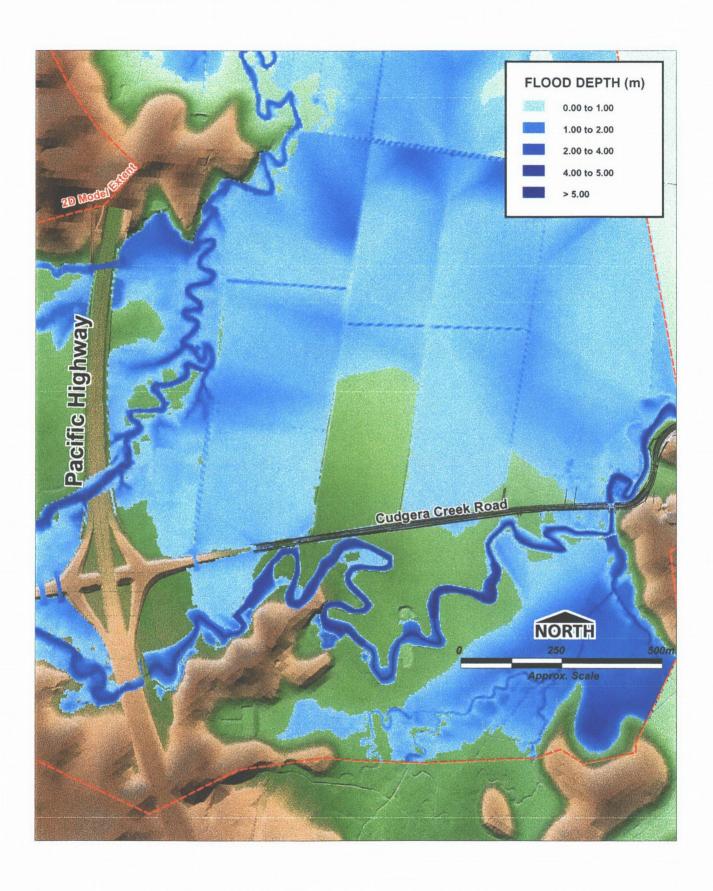
Afflux Associated With The Proposal (Mature Crop): 1% AEP





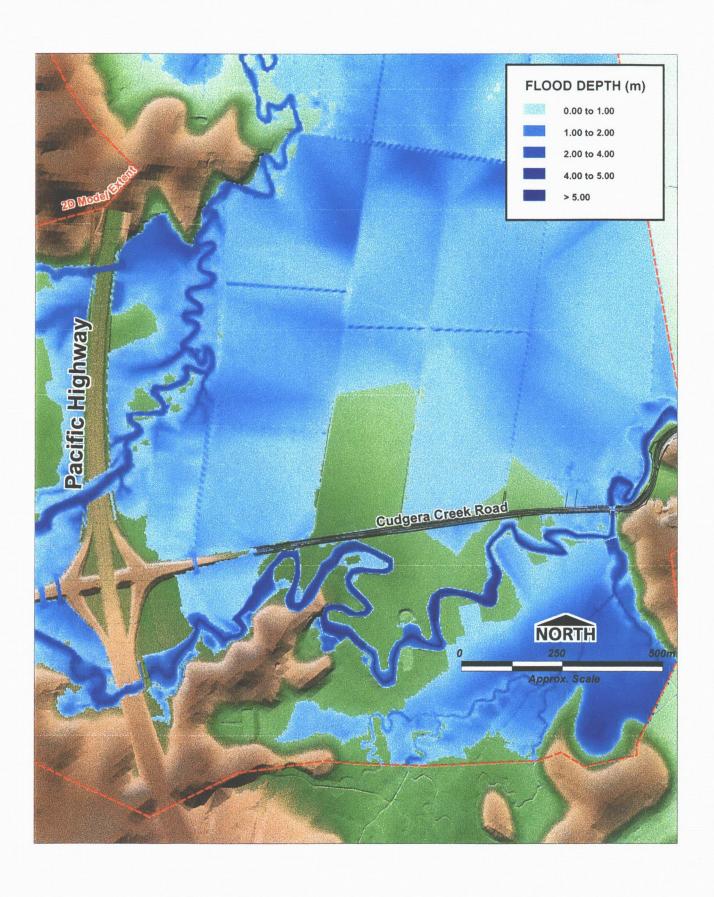
Existing Case (Mature Crop)
Peak Flood Depths: 20% AEP





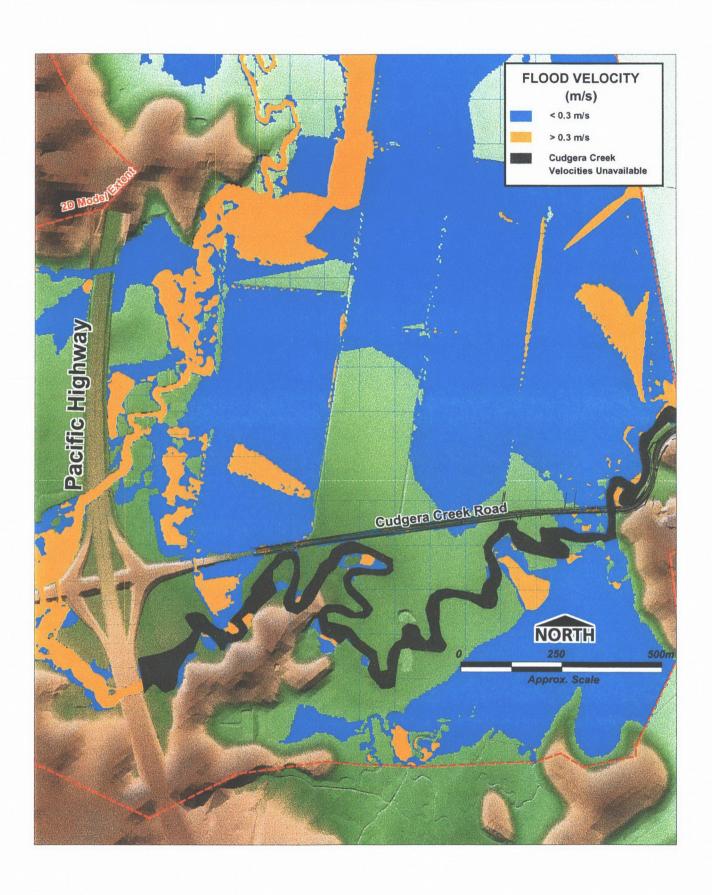
Existing Case (Mature Crop)
Peak Flood Depths: 5% AEP





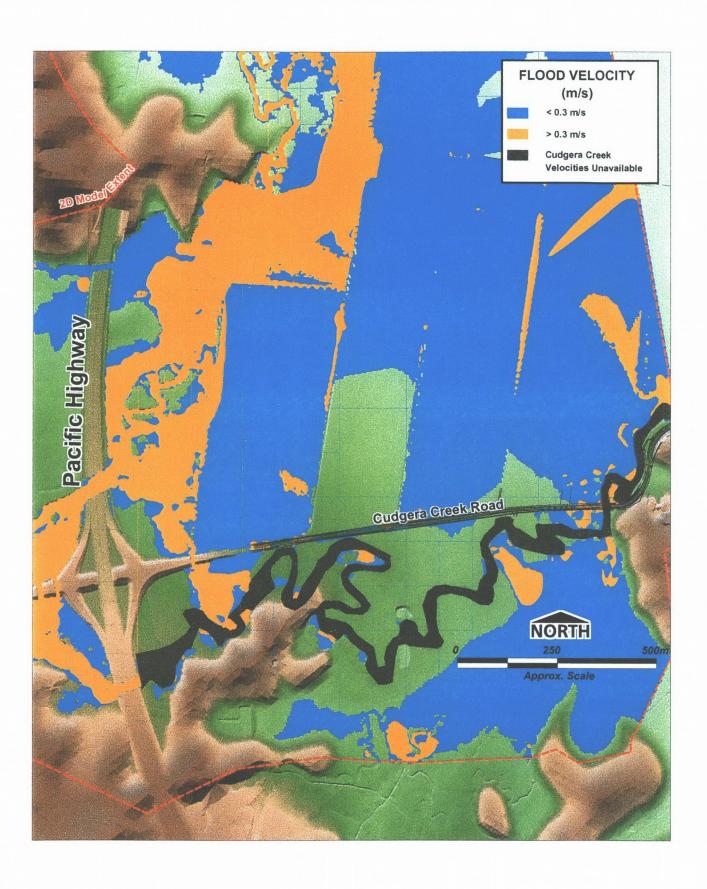
Existing Case (Mature Crop)
Peak Flood Depths: 1% AEP





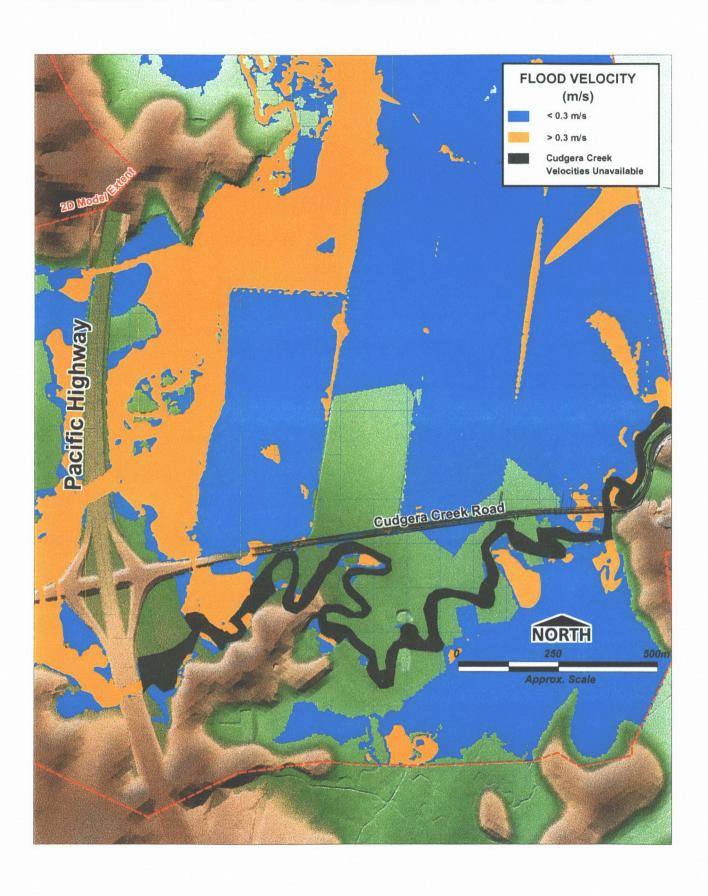
Existing Case (Mature Crop)
Peak Flood Velocities: 20% AEP





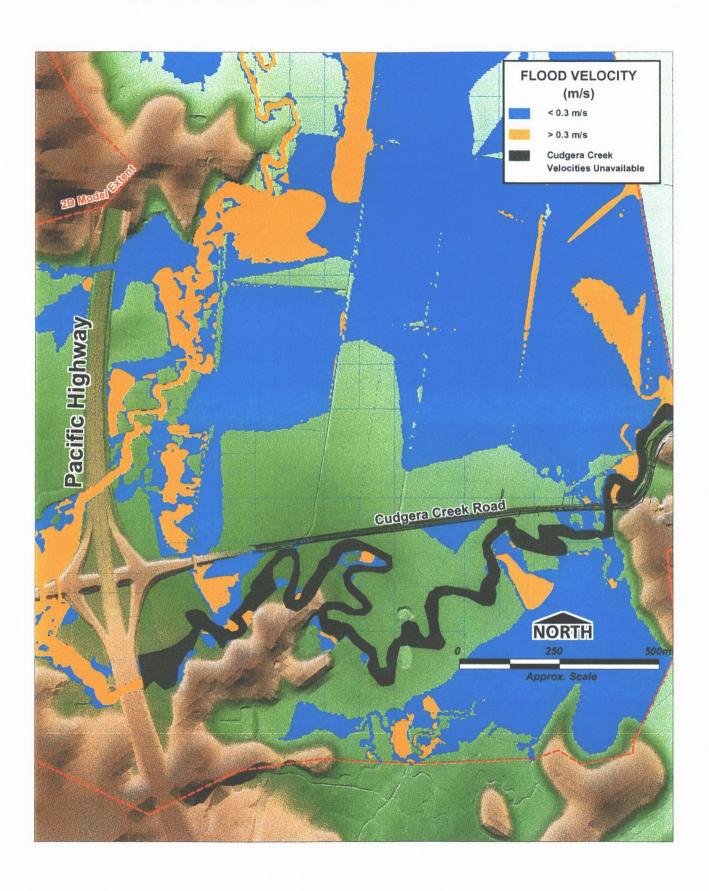
Existing Case (Mature Crop)
Peak Flood Velocities: 5% AEP





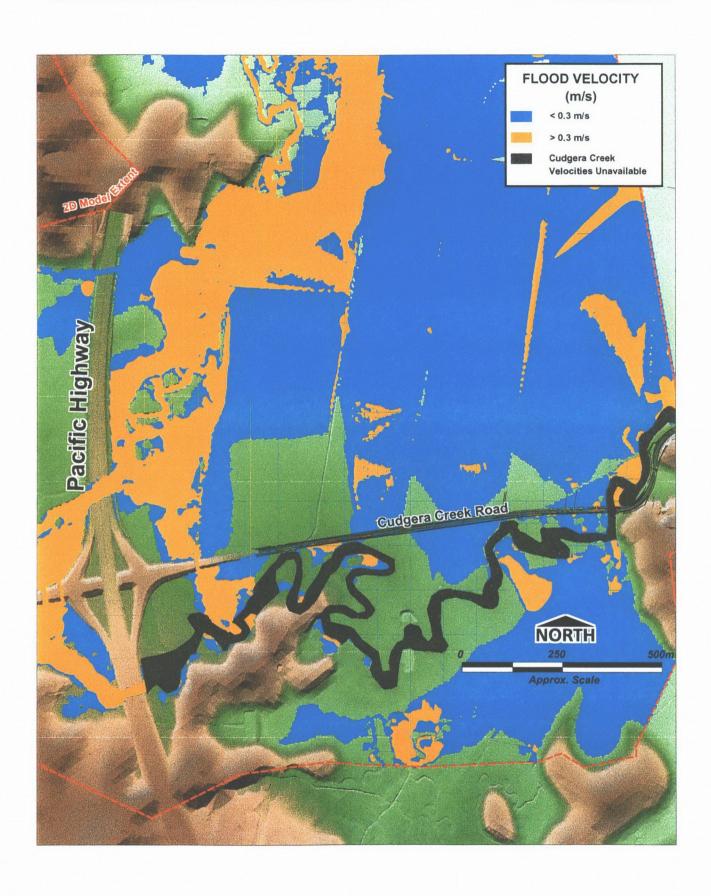
Existing Case (Mature Crop)
Peak Flood Velocities: 1% AEP





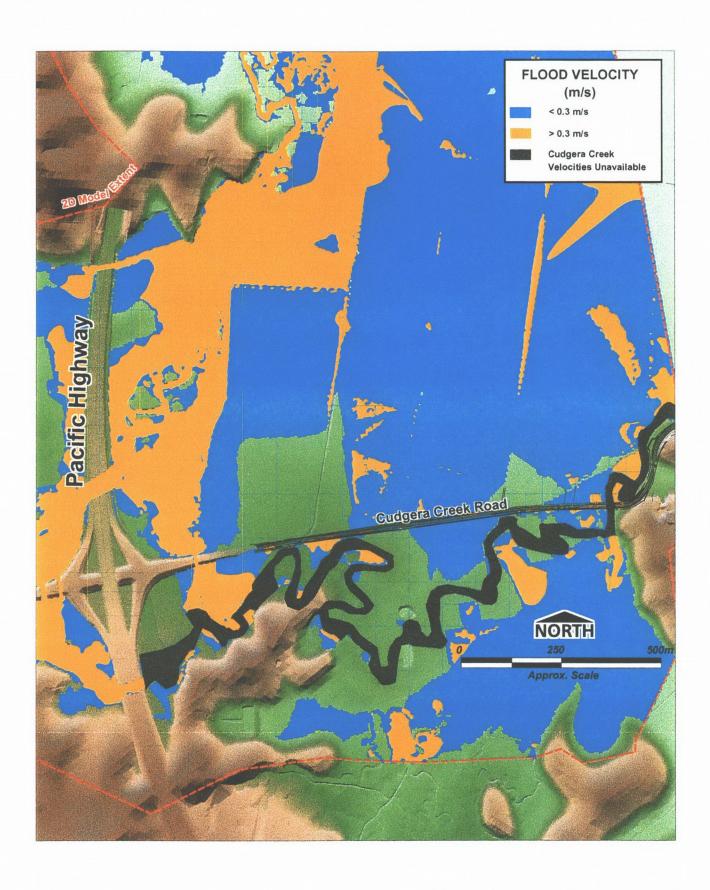
Proposal Case (Mature Crop)
Peak Flood Velocities: 20% AEP





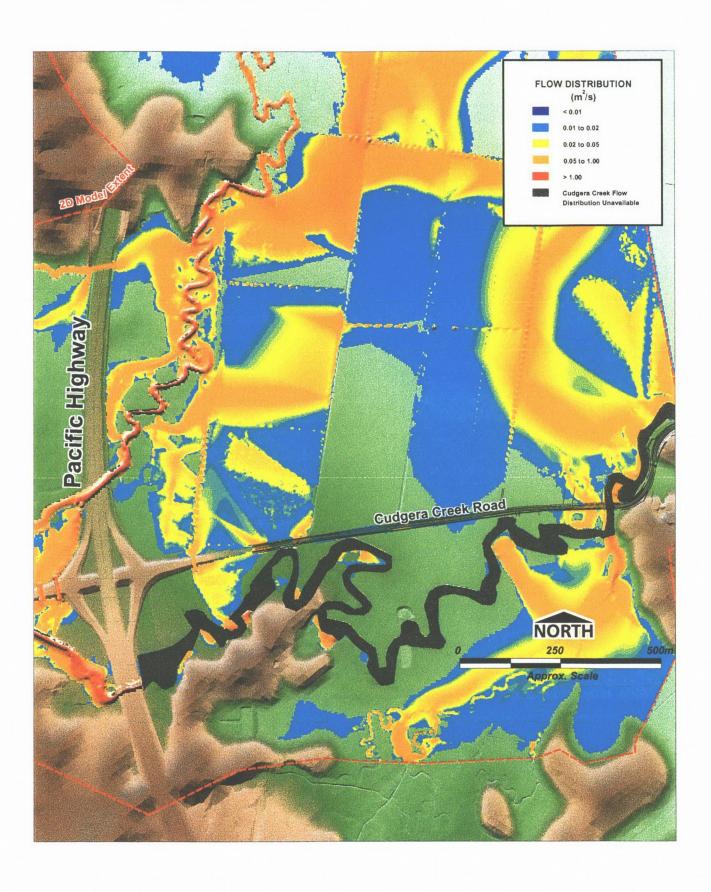
Proposal Case (Mature Crop)
Peak Flood Velocities: 5% AEP





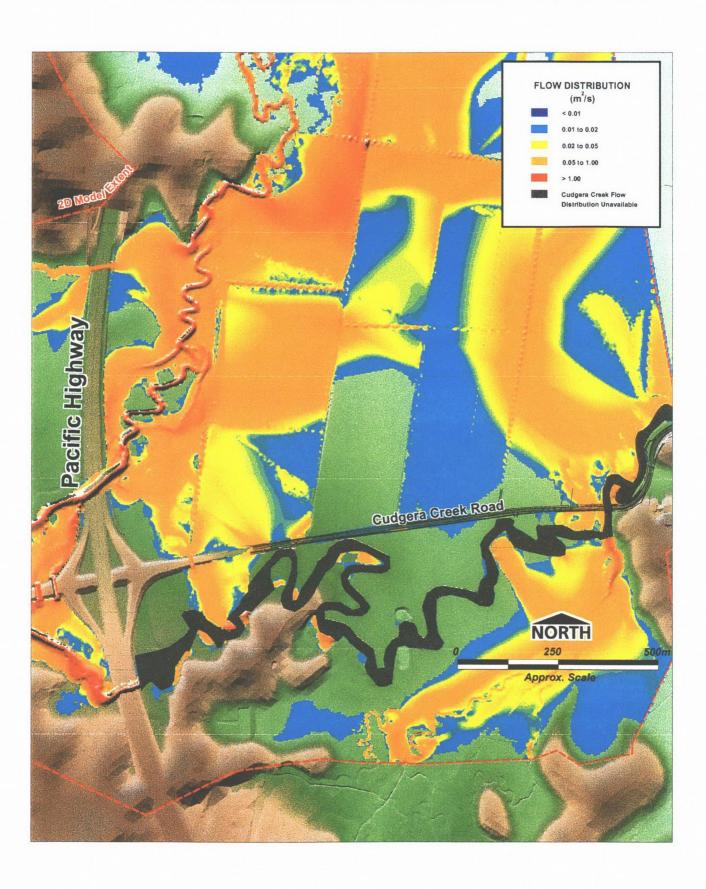
Proposal Case (Mature Crop)
Peak Flood Velocities: 1% AEP





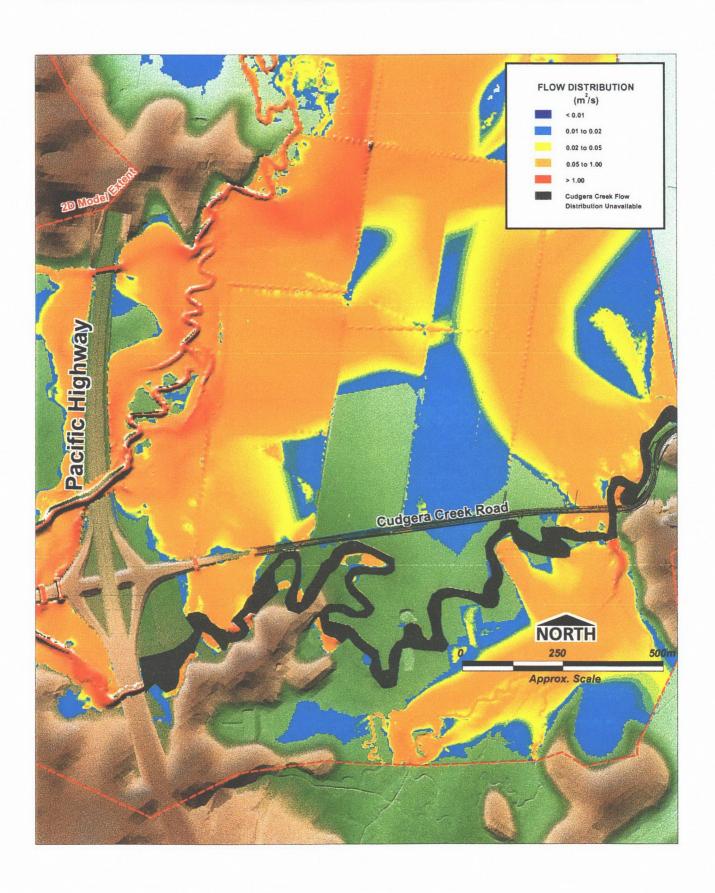
Existing Case (Mature Crop)
Peak Flow Distribution: 20% AEP





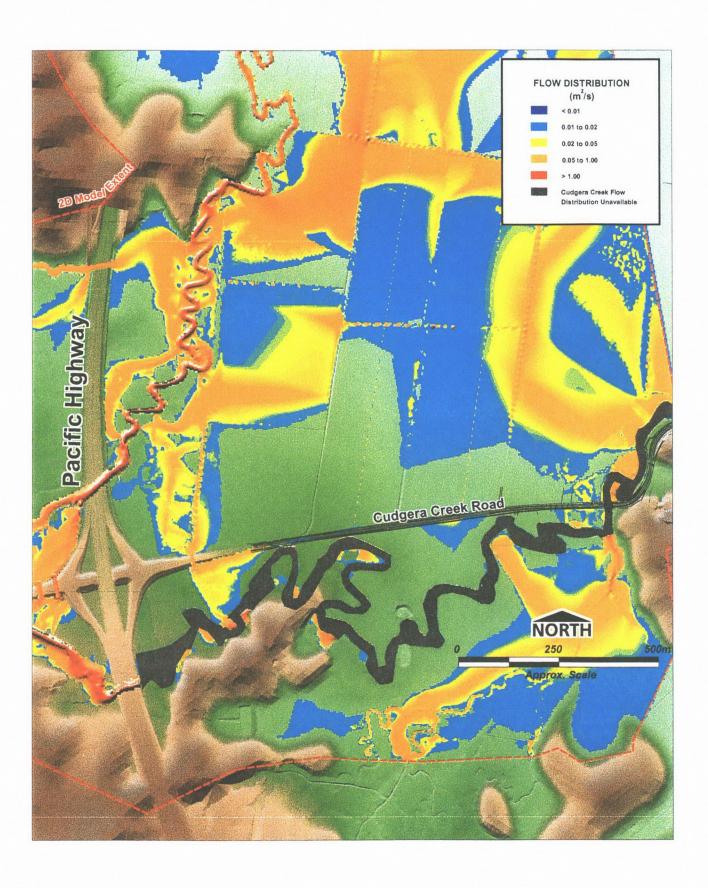
Existing Case (Mature Crop)
Peak Flow Distribution: 5% AEP





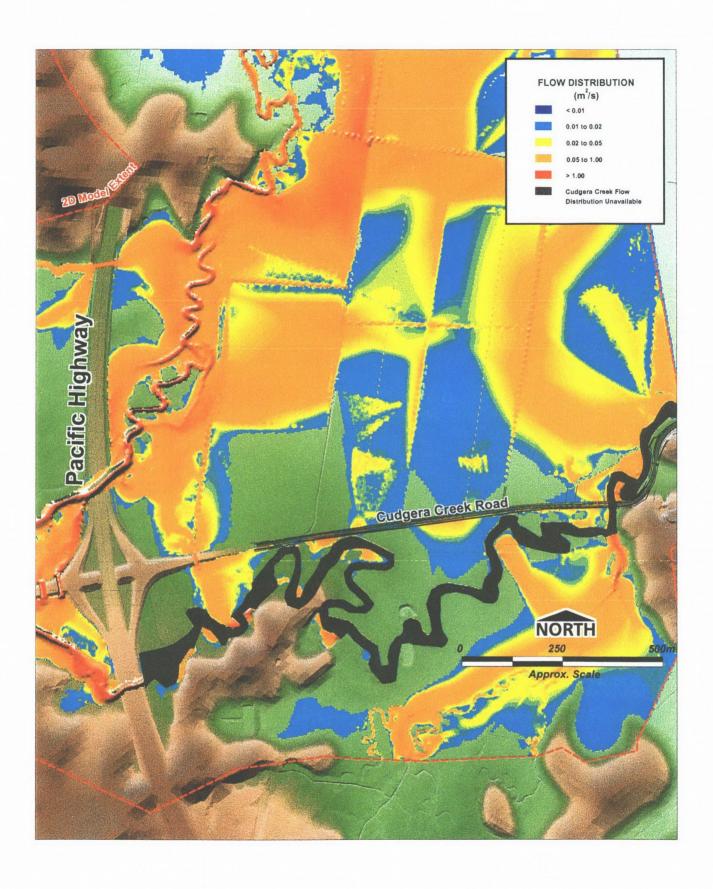
Existing Case (Mature Crop)
Peak Flow Distribution: 1% AEP





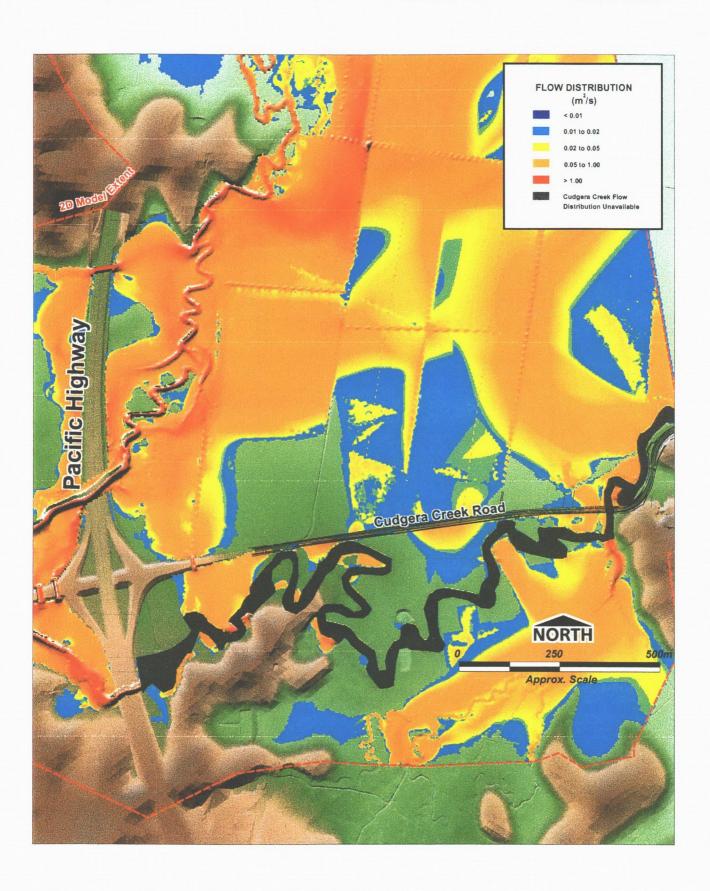
Proposal Case (Mature Crop)
Peak Flow Distribution: 20% AEP





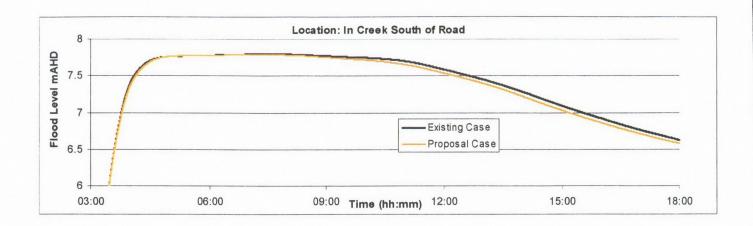
Proposal Case (Mature Crop)
Peak Flow Distribution: 5% AEP

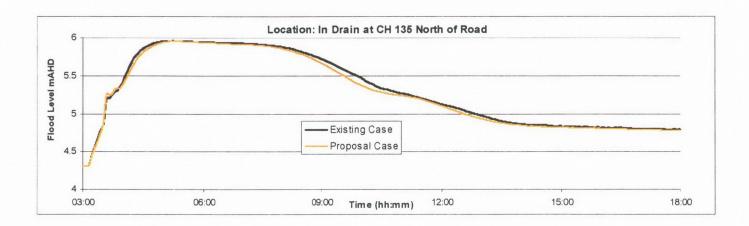




Proposal Case (Mature Crop)
Peak Flow Distribution: 1% AEP







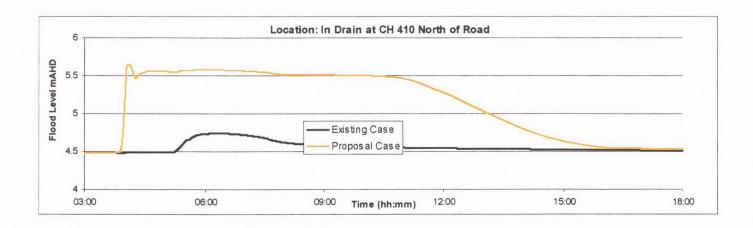
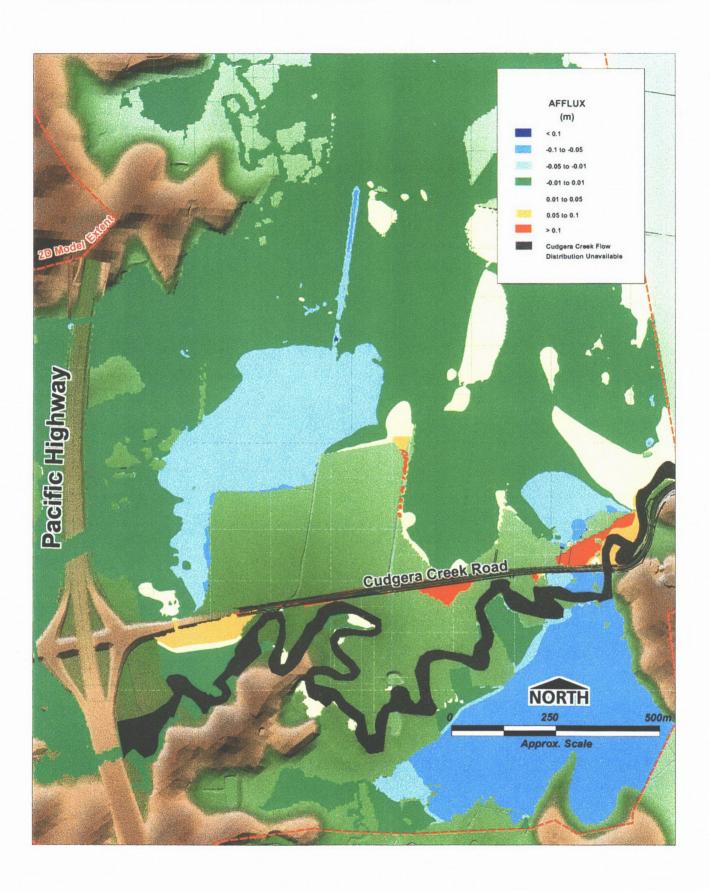
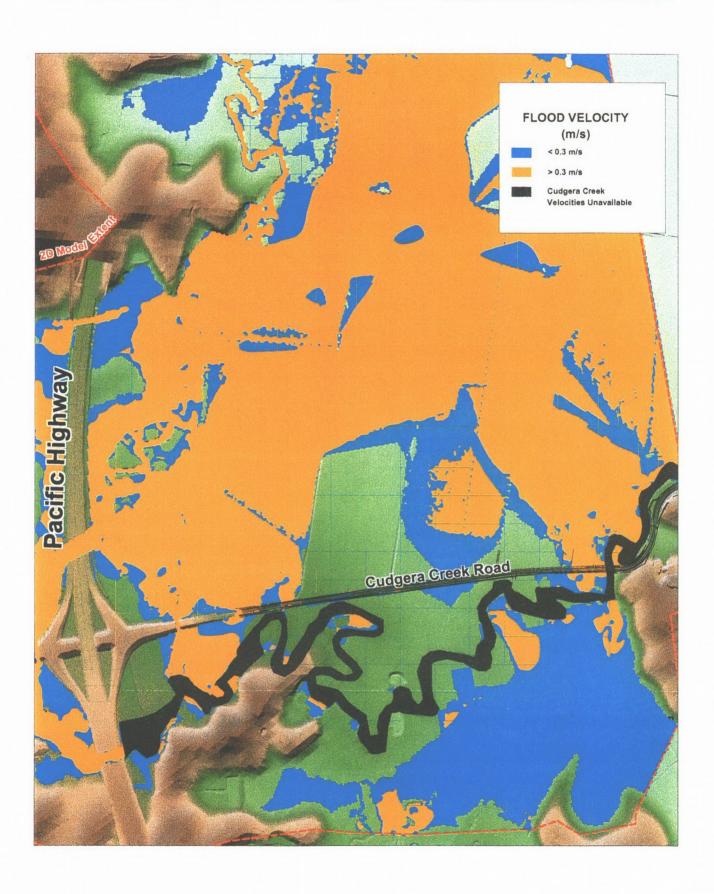


Figure 6-22 Comparisons of Period of Inundation (Mature Crop): 20% AEP



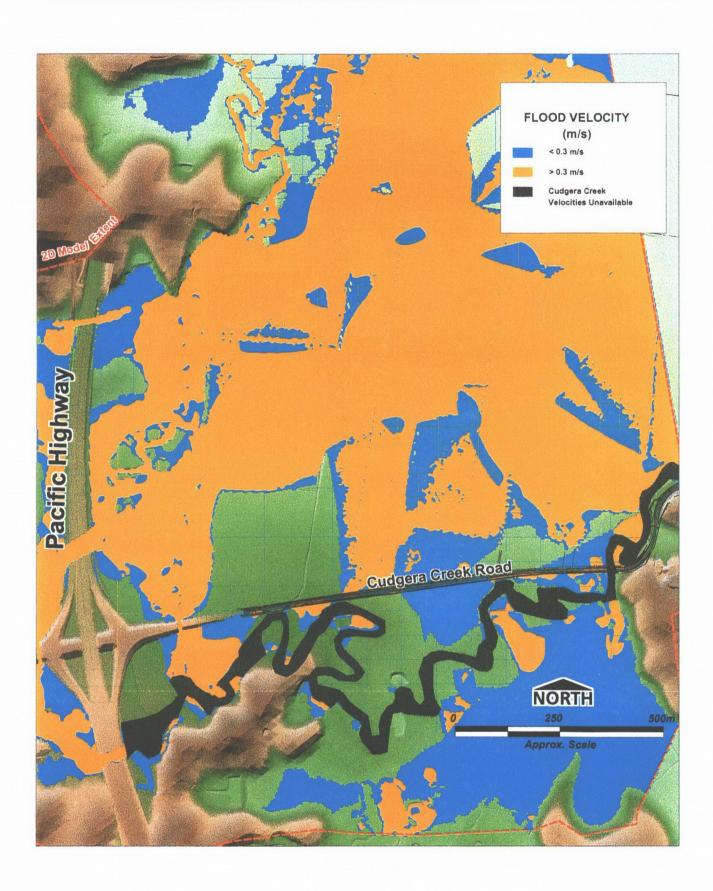
Afflux Associated With The Proposal (Fallow Land): 1% AEP





Existing Case (Fallow Land)
Peak FLood Velocities: 1% AEP





Proposal Case (Fallow Land)
Peak Flood Velocities: 1% AEP



7 CANE DRAIN DESIGN CHECKS

As discussed in Section 4, one of the design criteria was to match culvert sizing underneath the road upgrade with the capacity of downstream cane drains for the 20% AEP event so as not to increase the potential for scour on the floodplain. Culvert sizes were based on Manning's calculations of cane drain capacities. These capacities were then checked against the 20% AEP discharge in the drains as predicted by the hydraulic model. The results of this check are presented in Table 7-1. Manning's 'n' is assumed to be 0.03 for all of these calculations.

Table 7-1 Manning's Calculation Check of Cane Drain Capacity

Chainage of Culvert (m)	Assumed Cane Drain Dimensions	Manning's Calculation of Drain Capacity (m³/s)	Predicted 20% AEP Discharge (m³/s)
135	Base width = 1.0m Side slopes = 1:1 Depth = 1.0m	2.8	2.7
280	Base width = 0.2m Side slopes = 1:0.5 Depth = 0.9m	0.4	0.4
385	Base width = 1.0m Side slopes = 1:1 Depth = 1.0m	2.8	2.8
545	Base width = 0.2m Side slopes = 1:0.5 Depth = 0.9m	0.4	0.1

These results show that the culverts are conveying the 20% AEP discharge at the rate equivalent to the capacity of the receiving cane drain. Hence, the proposed upgrade and re-distribution of flows is not expected to result in the 20% AEP discharges exceeding the capacity of the cane drains.

8 CONCLUSIONS AND RECOMMENDATIONS

This assessment has found that the proposed vertical alignment of the Cudgera Creek Road upgrade is sufficiently high to ensure that the road surface will not be inundated during a 20% AEP flood event.

It has also been established that if the road is constructed with the waterway openings recommended in Table 5-1, the proposal will not adversely impact on surrounding property or potential erosion as prescribed in the hydraulic design criteria.

It is recommended that these waterway openings be adopted in the design for the proposal.

