Additional crossing of Clarence River Grafton

Summerland Way

VOLUME 1 - ENVIRONMENTAL OVERVIEW

January 2004

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1 Introduction and Methodology

1.1 Introduction

This Environmental Overview summarises any likely environmental constraints and/or potential issues that would need to be considered as part of the investigations for an additional crossing of the Clarence River at Grafton.

The purpose of the Environmental Overview is to:

- Identify environmental constraints for the Proposal;
- Identify the impacts of these constraints on each of the crossing localities; and
- Identify potential issues that may require additional investigations, specialist studies, or design considerations for route selection.

This Environmental Overview would be used as a basis for making a decision on which crossing localities should be further investigated in the route selection stage. The route selection would be based on the constraints identified from the results of investigations summarised in this report. This report does not recommend a specific site for an additional crossing.

This Environmental Overview has been prepared by Environmental Technology (RTA Operations Directorate) on behalf of RTA Technical Services at Grafton, RTA Northern Region, and would be made available to the community. Technical information relating to this report is contained in the Appendices (Volume II). A Glossary of Terms is provided in the rear of this document to describe the technical terms used throughout this document.

1.2 Methodology

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

1. A start up Project Management Workshop was held on 28 July 2003 to discuss the Proposal and identify potential issues;

2. Desktop database searches were conducted on the following databases to identify any potential issues:
   Australian Heritage Commission Register of the National Estate;
   NSW Heritage Office State Heritage Register/Inventory;
   RTA Heritage and Conservation Register;
   State Rail Authority Section 170 Register;
   Council Heritage Listings;
   DEC Aboriginal Heritage & Information Management System (AHIMS);
   DEC Wildlife Atlas of Threatened Flora and Fauna Records;
   Environment Australia (EPBC Act) Database;
   NSW Fisheries Fishfiles Database;
   DEC Contaminated Land Register; and
   National Pollutant Inventory (NPI).

3. Specialist Sub-Consultants were commissioned to undertake specialist studies for:
   Ecology;
   Water Quality;
   Air Quality;
   Noise;
   Indigenous and Non-Indigenous Heritage;
   Hydrology/Hydraulics;
   Planning;
   Land Use;
   Socio-Economics; and
   Traffic.

4. A literature review and review of documentation was undertaken to determine issues relating to:
   Geology, soils and landforms;
   Local heritage;
   Local Environmental Plans;
   Regional Environmental Plans;
   State Environmental Planning Policies; and
   State of Environment Reports.

1.3 Background

Approval was given in 1915 for the design and construction of a bridge over the Clarence River, at Grafton (with a moveable span for river navigation clearance) to carry a railway and a footway. In 1922, when design was well advanced, the Minister for Works requested that the design include vehicular traffic in addition to the railway and pedestrian traffic. The new bridge was opened to traffic in 1932.

Grafton City Council initiated correspondence to the Department of Main Roads (DMR) regarding a second bridge in 1960 with investigations commencing in the early 1970's. In 1977, the DMR advised that a new bridge location had been adopted linking Fitzroy Street, Grafton, to Bent Street, South Grafton. Survey and geotechnical investigations were then undertaken. In 1985, the DMR advised that the new bridge was a long-range Proposal.

In 1999, the RTA examined a number of upgrading options for the existing bridge. They were:

- Do Nothing;
- Minor alterations to the kerbs at the 'kinks';
- Remove the 'kinks';
- Construct one lane on the existing rail bridge on the lower deck;
- Provide two additional travel lanes at the existing rail or road bridge;
- Upgrade the southern approach lanes from the Through Street roundabout; and
- Upgrade the northern approach lanes from the Villiers Street roundabout.

Construction on the northern and southern approaches to the existing bridge was undertaken in 2000 and 2001. This was a cost-effective short term solution to improve the road capacity at the approaches and reduce the queuing at Villiers Street and Through Street roundabouts.

In 2001, a group of business people formed a committee to campaign for a new bridge at Grafton. In May 2002, the community campaign for an additional crossing of the Clarence River at Grafton commenced. A public meeting held in May 2002 lead the State Government to commission the RTA to undertake a Feasibility Study and determine strategic options for the location of an additional

crossing to service Grafton and the surrounding communities. Following the completion of the Feasibility Study in February 2003 a project team was formed to proceed with a Route Selection Study. The Route Selection Study would identify route options and assess the best value for money alignment for the additional crossing to improve road safety, reduce traffic delays and provide improved access for the local and state road network between the north and south of the Clarence River.

1.4 Description of the Study Area

Grafton is situated on the northern coastal plain of NSW, approximately 670km north of Sydney and 350km south of Brisbane. Grafton City and its surrounds has an area of approximately 82km^2 and is divided into north and south by the Clarence River. The older part of North and South Grafton are situated on the floodplain of the river, while newer development in South Grafton extends into pasturelands with expansive views across to the Clarence River.

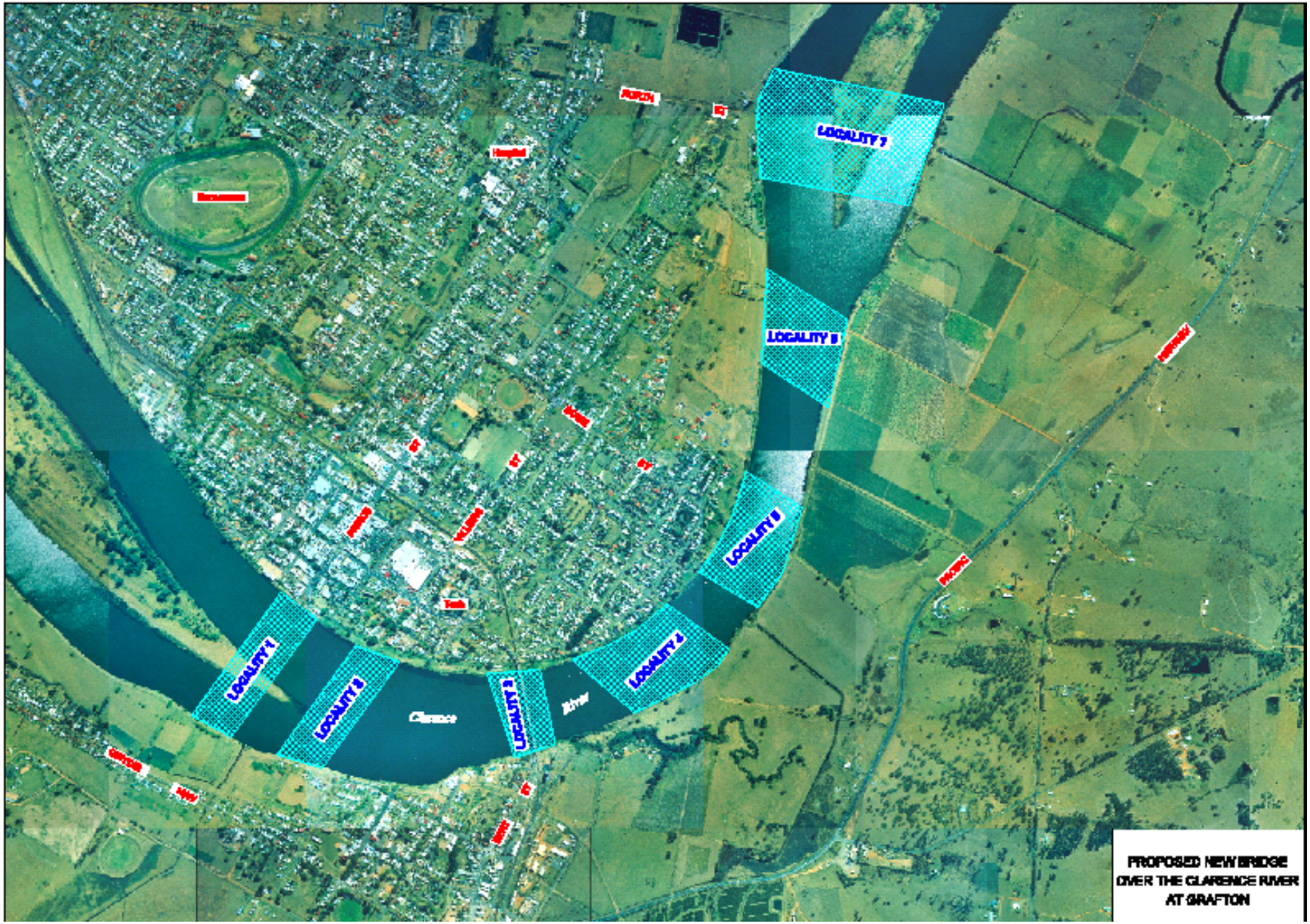
The "study area" for the purposes of the Proposal encompasses an area between Susan Island and Elizabeth Island, and extending into the township of Grafton and South Grafton as far south as the Pacific Highway.

Within the study area, seven broad localities have been identified for investigation in preparation of the route selection study. A description of each option's locality is provided in Table 1.1 below. An aerial photograph of the study area showing the location of the proposed options is also provided in Figure 1.1 on the following page.

Table 1.1: A description of the proposed locality options.

Locality	Origin	Destination
1	From the Gwydir Highway to the Clarence River via rural land, and crossing the river via Susan Island.	Directly onto Prince Street, crossing Victoria Street, and meeting with Fitzroy Street.
2	From the Gwydir Highway along Abbot Street.	Direct onto Villiers Street (school and convent on either side of road) crossing Victoria Street and meeting with Fitzroy Street.
3	Merge with existing route on Bent Street access.	Merge with existing Craig Street access.
4	From the Pacific Highway to the Clarence River via rural land.	Crossing in the vicinity of Bacon Street and meeting at Villiers Street.
5	From the Pacific Highway to the Clarence River via rural land.	Crossing in the vicinity of Dobie Street and meeting at Villiers Street.
6	From the Pacific Highway to the Clarence River via rural land.	Crossing within the vicinity of Arthur Street and meeting at Turf Street (Summerland Way).
7	From the Pacific Highway in the vicinity of Centenary Drive to the Clarence River via rural land, and crossing the river via Elizabeth Island.	Within the vicinity of North Street and meeting at Turf Street (Summerland Way).

Figure 1.1: Aerial photograph of the study area with proposed locality options.



2 Proposal Description

The Proposal is to provide an additional crossing of the Clarence River at Grafton between Susan Island and Elizabeth Island in order to improve road safety, reduce traffic delays and provide improved access for the local and State road network between Grafton and South Grafton.

For potential crossings directly adjacent to the existing bridge, a pedestrian cycleway would not be provided, as one has already been provided on the existing bridge. The existing and new crossings would consist of two lanes with a one-way flow. Consequently, the 'kinks' on the existing bridge would be modified to allow the free flow of one lane traffic. For potential crossings downstream or upstream of the existing bridge, a pedestrian cycleway would be considered, with traffic flow on the existing and new crossing two lanes being two-way flow. However, these crossings would not include the modification of the "kinks" on the existing bridge. All crossings would provide two x 3.5m travel lanes with two x 1.0m shoulders.

The Proposal would involve bridge works and road approach works which would connect to the existing road network. Intersection works may be required at these connections. Bridge works associated within an additional crossing would include the construction of road approaches, embankments, bridge abutments, piers, decking etc. It is important to note that this project is at the commencement of the route selection phase; therefore, any information concerning the details of the Proposal is susceptible to change.

The following objectives are considered essential outcomes for the Proposal:

- Significantly improve traffic efficiency;
- Significantly reduce the potential for road accidents and injuries;
- Be socially acceptable to the regional and local community;
- Support economic development;
- Be managed in accordance with Ecologically Sustainable Development (ESD) principles; and
- Achieve maximum effectiveness of expenditure.

3 Statutory Planning

Statutory planning considerations are important for determining the planning approval regime for the project. In some cases, the approval of more than one organisation may be required for a Proposal. It is therefore important to identify at an early stage the planning processes applicable.

3.1 Local Environmental Plan (LEP)

The Proposal is located within the Grafton Local Government Area. Grafton City Council regulate land use in their LGA through the Grafton City Council Local Environment Plan (LEP) 1988. Within the study area the Proposal is likely to pass through one or more of the 15 land use zonings within the LGA. Land use zonings applicable to the study area include:

1. Rural (a), (b), (c), (d), (e)
2. Living Area (a)
3. Business (a), (b)
4. Industrial (a)
5. Special Uses (a), (b)
6. Open Space (a), (b)
8. National Parks and Nature Reserves (a)
9. Reservations (a)

Within each of the land use zonings in the Grafton City Council LEP 1988, development consent from Council is required for "roads". In addition, consent would be required where the Proposal would be located over the Clarence River (Clause 20 of the LEP) and where works may affect heritage items, places or conservation areas as described in Clause 28 and 29 of the LEP. In relation to zoning 8 (a), any development would require authorisation by or under the *National Parks and Wildlife Act 1974*.

However, the application of the EP&A Model Provisions and SEPP 4 to the Proposal, may remove the need for consent as detailed below and in Section 3.3 of this report.

Environmental Planning and Assessment Model Provisions 1980

The LEP adopts, in part, the EP&A Model Provisions 1980, including "savings" provisions of Clause 35.

Clause 35 states:

Nothing in the local environmental plan shall be construed as restricting or prohibiting or enabling the consent authority (i.e. Council) to restrict or prohibit.

a) the carrying out of development of any description specified in Schedule 1;

Schedule 1 includes:

The carrying out of any development required in connection with the construction, reconstruction, improvement, maintenance or repair of any road except widening, realignment or relocation of such road.

Therefore, where applicable, Clause 35 of the EP&A Model Provisions 1980 potentially allows the Proposal to proceed without the need to obtain development consent. It should be acknowledge that there is some uncertainty surrounding the application of Clause 35(a) of the Model

Provisions and that whilst its application is arguable in this case, the conservative approach would be to lodge a development application where development consent is required at first instance.

3.2 Regional Environmental Plans (REPs)

The following REP applies to the Proposal.

North Coast Regional Environmental Plan, 1988 - Provides local government with state and regional policy guidelines for the preparation of local environmental plans and for certain types of development. The plan sets the framework for new urban and rural development. The emphasis is on progress coupled with careful management. Amendments to the policy deal with heritage items, the NSW Coastal Policy and concurrence and consultation requirements in the REP.

The REP applies to the Proposal where the proposed activities may require the alteration or demolition of a heritage item, or where activities are undertaken within Conservation Areas such as the Grafton Urban Conservation Area. It also applies to any development within or adjacent to major waterways, wetlands or fishery habitats. It is anticipated that further assessment of the REP and how it applies to the Proposal, would be undertaken prior to the decision on a preferred route.

3.3 State Environmental Planning Policies (SEPPs)

The following SEPP applies to the Proposal.

State Environmental Planning Policy No. 4 (SEPP 4) *– Development Without Consent and Miscellaneous Complying Development* "*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 therefor, that development may be carried out without that consent"*.

For the purposes of the application of SEPP 4, it is assumed that any land or existing roads used in connection with the new crossing would be gazetted as Main Road 83 (Summerland Way) (i.e. a classified road within the meaning of the *Roads Act 1993*).

However, these provisions of SEPP 4 do not apply in cases involving the following:

Clause 4 (2): Except as provided by Clauses 11A, 11E and 13, this Policy does not apply to:

(a) land which is reserved under an environmental planning instrument for use exclusively for a purpose referred to in Section 26 (c) of the Act,

(b) land, other than land referred to in paragraph (a), which is reserved under an environmental planning instrument for use exclusively for any purpose or thing for which a site could have been reserved under section 342G (3) (e), (f), (g), (h), or (j) of the Local Government Act 1919, as in force immediately before 1 September 1980, or

(c) land, other than land referred to in paragraph (a) or (b), which a public authority may, under an environmental planning instrument, be required to acquire by the owner of the land.

Clause 10 (3):

(a) to development carried out on land, or in relation to a building or work, described in an environmental planning instrument as a heritage item, an item of environmental heritage or a potential historical archaeological site, or

(b) to development carried out on land, or in relation to a building or work on land, described in an environmental planning instrument as comprising or being within a conservation area or a heritage conservation area, or

(c) to development carried out on land, or in relation to a building or work on land, described in an environmental planning instrument as comprising or being within a foreshore scenic protection area, a harbour foreshore preservation area or a beach front scenic protection area, or

(d) to land, or a building or work on land, a part of which land is used:

(i) as a means of entrance to, or exit from, the land, or

(ii) for the loading, unloading, manoeuvring or parking of vehicles, or

(iii) for landscaping required to be carried out or maintained by reason of a condition imposed under the Act, if the development would prevent or restrict that use of the part of the land, or

(e) to development authorised by Clause 9, or

(f) to land to which State Environmental Planning Policy No. 14 Coastal Wetlands applies.

However, in summary, SEPP 4 is likely to remove consent requirements only for certain sections of the Proposal. Where the above Clauses are triggered Clause 11C of SEPP 4 would not apply. For example, SEPP 4 would not apply where the Proposal would travel through a conservation area such as the Grafton Urban Conservation Area or affect a heritage item described in the Grafton City Council LEP 1988. As an alternative, and already mentioned, Clause 35 of the EP&A Model Provisions may override the need for consent.

A further assessment of SEPP 4 and how it applies to the Proposal would be undertaken prior to the selection of a preferred route.

3.4 Confirmation of Part 4 / Part 5 Assessment

The determination of whether Part 4 or Part 5 of the EP&A Act applies to the Proposal is dependent upon the zones the preferred route would encroach and the development constraints associated with Clauses within the LEP and REP.

At this stage of planning, it is considered that Part 5 of the EP&A Act would apply to most of the Proposal. However, should the preferred route pass through zones 6(a), 6(b) or 8, or involve the alteration or demolition of heritage items, then Part 4 of the EP&A Act may come into effect for that particular section, where Part 5 of the act would continue to apply to the remainder of the Proposal.

In those cases where consent is required, the application of the EP&A Model Provisions may remove the that consent.

Following the selection of a preferred route, it is anticipated that a request would be made to amend Grafton LEP 1988 to rezone the preferred route as Main Road 83 (Summerland Way).

3.5 State Legislation

State legislation that is likely to be relevant to the Proposal includes:

- Crown Lands Act, 1989
- Environmental Planning and Assessments Act, 1979
- Fisheries Management Act 1994 and Fisheries Management Amendment Act, 2000
- Roads Act, 1993
- National Parks and Wildlife Act 1994 and National Parks and Wildlife Amendment Act, 2001
- Noxious Weeds Act, 1993
- NSW Heritage Act, 1977
- Land Acquisition (Just Terms Compensation) Act, 1991
- Local Government Act, 1993
- Protection of the Operations Act, 1997
- Threatened Species Conservation Act, 1997
- Waste Avoidance and Resource Recovery Act, 2001
- Water Act, 1912

3.6 Commonwealth Legislation

Commonwealth legislation that is likely to be relevant to the Proposal includes:

- Aboriginal and Torres Strait Islander Heritage Protection Act, 1984
- Australian Heritage Commission Act, 1975
- Environment Protection and Biodiversity Conservation Act, 1999

4 Community Consultation

4.1 Introduction

This section of the report discusses and identifies the community participation activities undertaken to date and the participation issues identified.

In summary, the RTA has involved a broad range of stakeholders in its formal participation processes including government agencies (Grafton City, Pristine Waters and Copmanhurst Shire Councils), community organisations, businesses, resident and landholder representatives. Additionally, the RTA Project Manager has made himself available to speak with individuals or groups who require additional information or wish to make personal representation.

To manage and guide the community consultation processes, the RTA prepared a Community Participation Plan (CPP) (Appendix B). The RTA's Northern Region Media Liaison Unit has also been involved in the process.

4.2 Route Selection Process and Community Participation Activities

The CPP indicates that five steps need to be undertaken for the route selection process and identifies the community participation activities to be conducted at each step. To date step 1 (Feasibility Study) & step 2 (Inform the Community about Process & Provide Information) have been completed and step 3 (Develop Route Options) has commenced with the public display of options to occur in March 2004.

To date all activities identified in the CPP have been completed within the expected timeframe.

4.2.1 Government Agency Workshop

The consultation process commenced with a Government Agency Workshop on 29 July 2003. The purpose of the meeting was for the RTA to provide details regarding the delivery of the project and for agencies to highlight major issues relating to the project.

4.2.2 Media

Advertisements and media releases were undertaken at relevant points in the process with reports in the Daily Examiner (Grafton) and Coffs Harbour Advocate Newspapers, and local and regional radio.

The initial media release in August 2003 encouraged people and organisations to nominate for the Community Focus Group (CFG) and Community Workshops and promoted the free-call hotline. An advertisement was also placed in the Daily Examiner on 30 August and 3 September 2003.

The RTA's Northern Regional Manager was interviewed on both the local Grafton commercial radio and regional ABC radio. The interviews explained the site selection process and encouraged people to nominate for the CFG and Workshops.

Subsequent releases in December 2003 promoted the short listed localities, the role of the CFG and encouraged interested people to attend the Community Workshops. The NSW Government Duty MLC for Clarence was interviewed on regional ABC radio and encouraged people to attend the Workshops.

Community consultation was also undertaken at the 'feasibility' stage of the project, and details of that are contained in the Feasibility Report (RTA, March 2003).

4.2.3 Letter to Residents in the Study Area

A letter to residents inviting nomination to the CFG or Community Workshops was posted in late August 2003 to approximately 2,650 households & businesses in the Grafton and South Grafton study areas. Nomination forms for the CFG and Community Workshops were attached to the letter. A similar letter was used to forward nomination forms to members of the community who made telephone enquiries and to key community organisations and local government.

A database of landowners in critical localities in the study area was searched for non-residential owners and a letter sent to their residential address or PO Box. This ensured that local land owners who do not live in the Grafton area were also made aware of the route selection project.

Anecdotal feedback indicated that some residents did not receive the letter so a random number of key residents were phoned to ensure that the letter distribution occurred satisfactorily. A substantial number had received the letter or been contacted by neighbours about it. Additional letters were forwarded to those who indicated they required a copy.

4.2.4 Community Update Newsletter No. 4

The Community Update Newsletters Numbers 1 to 3 were circulated during the Feasibility Study. The Community Update No 4 newsletter was circulated in September 2003 via a letterbox drop to all households in Grafton, South Grafton, Waterview Heights & Clarenza. The aim of the letter was to inform the community about the route selection process and the methods by which the community was to be involved.

4.2.5 Free-call Hotline

The Free-call Hotline was established in July 2003. Fifteen calls were received in response to media coverage regarding the establishment of the CFG and the Community Workshops. Twenty-one calls were received in response to the media coverage of the short listed localities. The majority of calls were immediately responded to or within 24 hours.

4.2.6 Community Focus Group (CFG)

The role and establishment of a CFG was widely promoted in the media and via direct mail. The role of CFG members is to convey project information to and from their group of interest and to participate in the process to develop the recommendation of the preferred route to the RTA. Nominations to the CFG could be made by organisations, an informal group of residents from a particular area, or by individuals. Nominations closed on 17 September 2003.

Twenty-three people were selected to join the CFG. Interest groups represented included:

- Local government;
- Land owners within the study area;
- Business representatives;
- Environmental groups;
- Road transport sector;
- River users;
- Residents Association; and
- Local Aboriginal Land Council.

To date two CFG meetings have been held on 14 October and 10 December 2003.

4.2.7 Community Workshops

Community Workshops were held the day following the CFG meeting, namely 15 October and 11 December 2003. The role of the Community Workshops was to provide an opportunity for members of the public to access information about the project and to contribute opinion.

A total of twenty-eight people attended the October workshops and twenty-five people attended the December workshops including twelve who attended both.

4.2.8 Access

The meeting venue was fully accessible for people with a disability and near public transport.

4.2.9 Meetings with Stakeholders

The RTA Project Manager initiated informal meetings with residents who are located in key positions within the study area and has made himself available to meet with residents who make contact.

4.2.10 Consultation with the Aboriginal Community

The consultant engaged to undertake the Indigenous Heritage Assessment has met with representatives of the Ngerrie Aboriginal Land Council and a letter from the RTA inviting submissions was forwarded. A position was made available on the CFG for a Land Council representative.

4.2.11 Short Listing of Localities Workshop

A Workshop independently facilitated by the Australian Centre for Value Management was held on 28 November 2003 with the objective of reviewing and assessing preliminary localities investigated for the project in order to shortlist those worthy of more detailed investigation.

The attendees were the RTA Project Team and staff representatives from Grafton City, Copmanhurst Shire and Pristine Waters Councils.

The results of the Workshop were presented to the CFG and Community Workshops in December 2003.

4.2.12 Written Submissions

Fourteen written submissions from seven people have been received by the RTA Project Team to date. All have been acknowledged and responded to by the RTA.

4.2.13 Evaluation of Community Focus Group and Community Workshop Meetings

Evaluation forms were provided at each CFG and Workshop. A summary of the responses is contained in the full Community Participation Report provided in Appendix B of this report.

4.3 Social Impact Assessment Interviews

During October and November 2003 interviews with randomly selected businesses and residents in Grafton and South Grafton, were undertaken by the consultant conducting the Social and Economic Impacts Report (refer to Appendix E). A total of 9 residents and 12 businesses were interviewed.

4.3.1 Community Participation Issues and the Next Step

Ensuring a community is aware of community participation initiatives for a project is a difficult task and can consume large amounts of resources for a small return. As detailed in this report the RTA undertook numerous activities to inform the community about the CFG and Community Workshops and to invite nominations. To date all activities and timelines of the CPP have been delivered. The effectiveness of the activities in achieving the CPP objectives is discussed below.

There was an adequate response to establish a widely representative CFG however the number of people attending the Community Workshops was a less than expected. As the largest percentage of people attending the Workshops may be directly affected by one of the bridge localities, it may be that the rest of the Grafton community is not sufficiently affected to actively participate at this stage of the project process. The feedback from the CFG and Workshops (see section 2.12 of Appendix B) indicates that the majority of participants agree with the community participation process to date.

The following issues have been raised by a number of people:

a) Feedback from the newspaper short listing article (including that from affected residents) indicated a dislike for the Villiers St/Abbott St locality due to the impact on the heritage area, social impact, road traffic noise, visual impact, restriction of river use and maintenance of all traffic through the CBD.
b) The short listing of only 2 localities neither of which address the issue of removing heavy vehicles from the CBD. An option should be considered that effectively removes heavy vehicles from the CBD.
c) The RTA should consider an option at the Turf Street locality. (Note: The RTA subsequently agreed to investigate this locality and present its findings at the Community Workshops in February 2004).
d) Concern over the validity of traffic counts and the assumptions used in the traffic model.
e) The CFG and Community Workshops need to be longer to allow time for participants to digest and discuss information.
f) All information to be discussed at the CFG & Workshops should be sent out beforehand to allow time for participants to consider it. Note: This was partially undertaken for the second CFG with a background paper provided beforehand. However, the report from the Short Listing Workshop was unavailable for distribution prior to the CFG.
g) Perception that the RTA already has a preferred site and the community participation is just a "smoke screen."
h) Perception that the short listing workshop that resulted in only 2 localities going forward supported the view above.

The RTA would present a public display of route options within the short listed localities and distribute Community Update No 4 in March 2004. Following the display period and receipt of submissions a 2 day, Option Evaluation Workshop would be held in which community representatives would be involved. These activities would provide additional opportunities for the community to gain information and to provide opinion to assist in the recommendation of a preferred site.

5 Traffic Investigations

5.1 Introduction

In general, this section of the report provides a summary of the findings of the traffic study that examines the distribution of traffic associated with providing an additional crossing at the seven localities.

The traffic study provides an assessment of potential bridge crossing sites of the Clarence River to improve the quality of access to Grafton and in particular reduce traffic congestion problems on the existing Clarence River Bridge. The analysis has been carried out with consideration of area wide traffic flows for existing and future conditions. It should be noted that the recent traffic study undertaken contains a more detailed analysis than the study prepared for the *Additional Crossing of the Clarence River Feasibility Study Report 2002*, however, has still been conducted at a network level for the purposes of the route selection stage.

The main tasks preformed as part of the traffic investigation include:

- Consideration of urban growth in the Grafton locality and in nearby centres;
- Consideration of traffic issues raised by the community during the consultation process;
- Consideration of future traffic growth and needs up to 30 years;
- A review of existing data and collection of additional traffic data;
- Traffic modelling and analysis; and
- A benefit cost analysis based on traffic modelling outputs and project cost estimates.

Further details of the methodologies of the investigation are provided in Appendix C.

5.2 Results of Traffic Analysis

The results of the traffic investigations are detailed below. For the purposes of this report the following vehicle description is used:

Light Vehicles: Cars, vans, wagons, 4 wheel drive, motorcycles, cars towing trailers, caravans and boats.

Heavy vehicles comprising the following:

- **Light Commercial**: Austroads Class 3 to 5 (i.e., two to four axle rigid trucks such as buses, panteks and dump trucks).

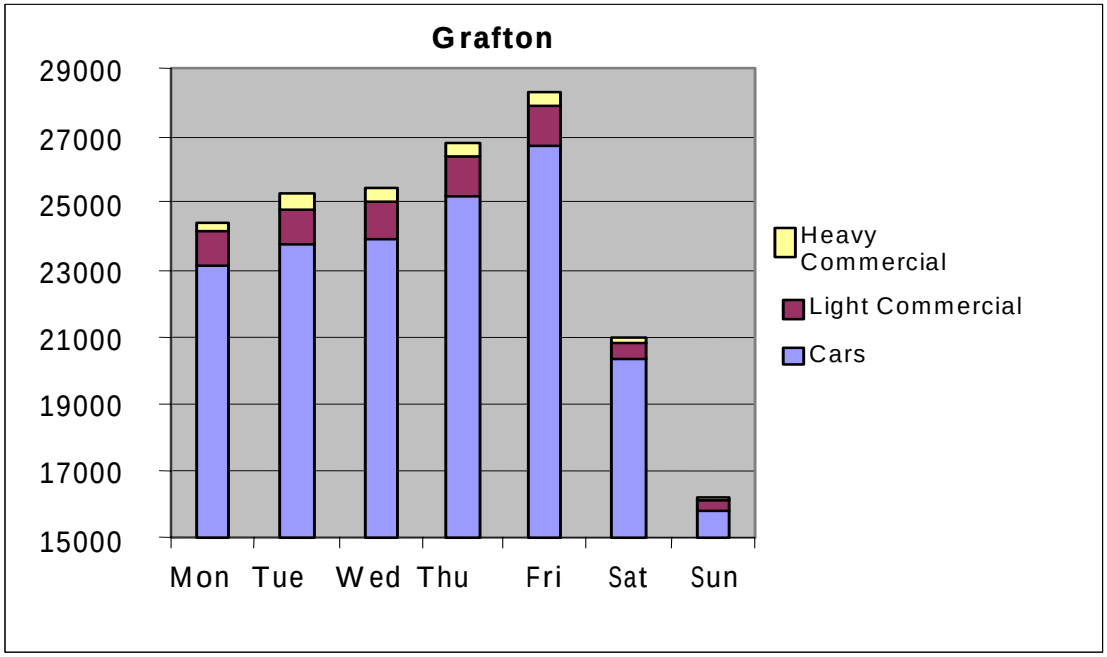
- **Heavy Commercial**: Austroads Class 6 to 12 (i.e., articulated vehicles such as semi trailers and B-Doubles).

Vehicle Classification Counts

Vehicle classification counts determine the types of light and heavy vehicles that use the road. Vehicle classification counts were conducted for the week ending Sunday 21 September 2003 in various locations on the Summerland Way and residential streets in Grafton. Daily traffic volumes along with vehicle classification recorded for the Clarence River Bridge and Summerland

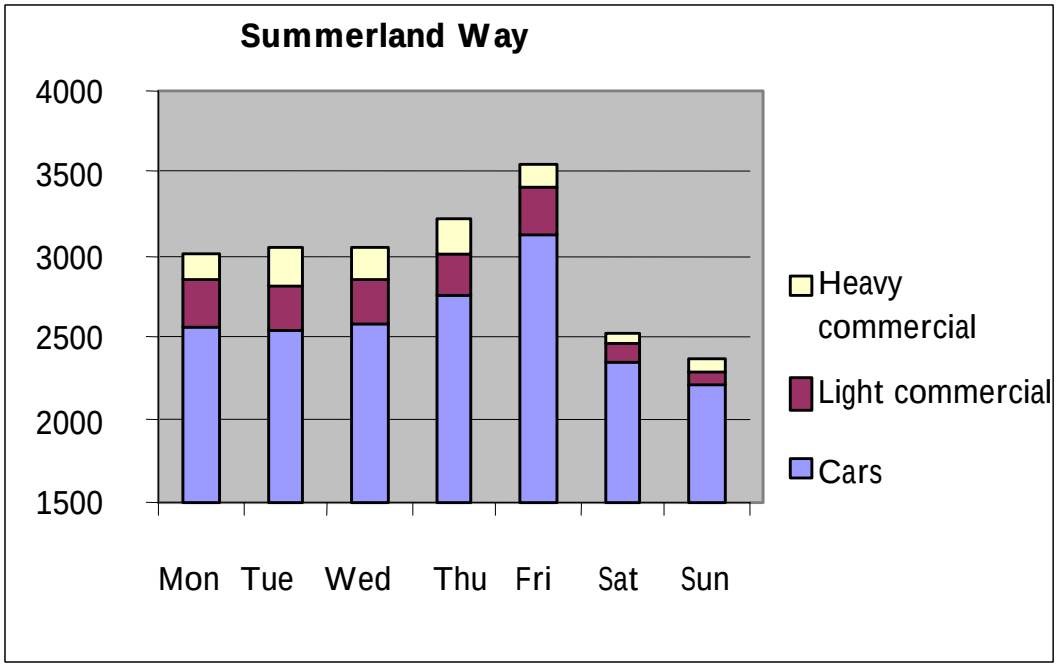
Way / Junction Hill are detailed in Figure 5.1. It should be noted that buses are included in the light commercial category.

Figure 5.1: Daily traffic flows and vehicle composition at Clarence River Bridge.



Daily volumes during the survey week progressively increased from 24,000 on Monday to 28,000 on Friday whilst weekend volumes were considerably lower. The figure of 26,000 vehicles per day on the bridge has been used for analysis purposes as it reflects typical weekday traffic flows.

Figure 5.2: Daily traffic flows with vehicle composition for Summerland Way at Junction Hill.



The traffic volumes recorded for Junction Hill are considerably lower than those at the Clarence River Bridge and give an indication that the majority of traffic that use the existing bridge is local traffic rather than through traffic using the Summerland Way. However, the trend is similar to traffic at the existing bridge where the highest traffic volumes are during the weekday period with Friday receiving the highest levels of traffic.

Origin and Destination Survey

To determine where traffic was travelling to and from, an Origin and Destination Survey was conducted over a 12 hour period between 7am and 7pm during Thursday 18 September 2003. During the survey, vehicle classification counters were installed at eight specified locations (see Appendix C). The number plates of all heavy commercial vehicles (i.e., articulated vehicles Austroads Class 6 and above), and all "red" cars were recorded to track heavy commercial vehicles and the proportion of cars that turned off the Pacific Highway and travelled north through Grafton to Summerland Way. Results of the survey are presented in Table 5.1 below.

Table 5.1: Origin and destination survey results.

24 hour Trips	Vehicle Type	Northbound	Southbound	Comment
All vehicles at Junction Hill on survey day.	Car	1380	1369	Obtained from classification counters.
	Bus	14	14	
	L. Commercial	95	143	
	H. Commercial	110	98	
	Total	**1599**	**1624**	
Vehicles using Clarence River Bridge and passing through Junction Hill on survey day.	Car	395	395	Includes vehicles doing repeat trips and no limit on trip times.
	Bus	9	9	
	L. Commercial	46	46	
	H. Commercial	50	50	
	Total	**500**	**500**	
Through traffic vehicles using Clarence River Bridges and Junction Hill on survey day.	Car	156	155	Excludes vehicles doing repeat trips. Travel time <25mins from bridge and 45mins from Pacific Highway.
	Bus	2	2	
	L. Commercial	34	33	
	H. Commercial	14	15	
	Total	**206**	**206**	

Source: RoadNet, 2003.
Note: 'L' denotes Light, 'H' denotes Heavy.

The daily volumes recorded on that day at the Clarence River Bridge were:

13, 440 northbound and 13,335 southbound **Total 26, 755**

Of the 26,755 vehicles that used the bridge on the survey day, 1000 (3.7%) of those vehicles also travelled through Junction Hill. Of these 1000 trips approximately 100 were to/from the Pacific Highway (north) and 220 to/from the Pacific Highway (south). Only 9 to/from the Pacific Highway (north) and 14 to/from the Pacific Highway (south) were heavy commercial vehicles. The rest either originated in South Grafton or came from the west along the Gwydir Highway.

Approximately half of these 1000 trips were 'through traffic' that did not stop or were (local trips) vehicles that showed up more than once in the survey period. Only 70 of the 400 heavy commercial vehicles using the bridge on the survey day were 'through traffic'. It is estimated that approximately 10% of 'through traffic' are heavy commercial vehicles after allowing for some additional through heavy commercial vehicles at night.

Results of the origin and destination survey therefore indicate that the main traffic flows across the Clarence River Bridge are to and from Grafton. A very small percentage is through, or bypass, traffic.

Peak hour flow comprises 8.4% of the daily flow. This figure is unusually low. Peak hour volumes are commonly around 10% of daily flow. This indicates a level of unmet demand where some motorists defer trips until peak hour congestion clears.

Heavy Vehicles

The number of heavy vehicles on a road has an impact on lane capacity. This is particularly important on the Clarence River Bridge in peak hours due to the "kinks" where opposing drivers hesitate to allow heavy vehicles to negotiate the "kinks". This behaviour causes a shock wave to occur in the traffic stream and reduces road capacity.

Previous surveys show that total heavy vehicles accounted for between 4% and 6% on the bridge depending upon time of day. A survey in 2001 showed that total heavy vehicles accounted for 6% of total traffic during peak hour. The 2003 survey showed that total heavy vehicles accounted for 5% of total traffic during peak hour traffic.

Table 5.2 represents heavy commercial vehicles at various sites for morning and afternoon period hour traffic on the survey day Thursday 18 September 2003.

Table 5.2: Heavy commercial vehicle survey during peak hour traffic.

	Day time 7am to 7pm		Night time 7pm to 7am	
Direction	Northbound	Southbound	Northbound	Southbound
Junction Hill	75	65	35	33
Dobie Street west of Prince St	81	81	24	16
Villiers Street	90	73	22	9
Clarence River Bridge	162	141	53	47

These are total heavy commercial vehicles volumes at specific locations and do not specifically reflect travel paths.

Heavy Vehicle Routes

Prince Street is Main Road No 83. It passes through Grafton's commercial precinct. A number of alternative routes have been signposted to remove unnecessary traffic from Prince Street the 'main street'. Villiers Street is a signposted alternative route to Prince Street to destinations north. Heavy commercial vehicles commonly use Villiers Street to travel in a north/south direction except for high loads, which use Duke Street. Duke Street runs parallel to Villiers Street and Prince Street and is used (signposted) as a high vehicle detour.

Vertical Clearance

The railway viaduct creates a barrier to high vehicles where 4.3m is the maximum legal vehicle height although this can be increased to 4.6m with a permit. A vertical clearance of 4.0m is currently available in Villiers and Prince Streets. Duke Street has a 5.0m clearance and as such has been signposted as a High Vehicle Detour. Viaduct crossings to the west of Prince Street have signposted height restrictions except for Mary Street, which has no restriction.

Constraints to Heavy Vehicle Usage

The suitability of each crossing locality for heavy commercial vehicles (including B-Doubles) is influenced by:

- Vertical clearance;
- "Kinks" on existing bridge, tight turns at roundabouts and congestion in town;
- The Duke Street High Vehicle Detour passes a major shopping centre and has additional turning movements for trucks;
- The Villiers Street town centre bypass is along a residential street;
- Some localities would put additional heavy commercial vehicle traffic in residential streets and past sensitive land uses eg schools;
- Congestion on the existing bridge creates an impediment to business activities. Some light commercial vehicle movements involving local business deliveries are deferred if possible until after peak hours; and
- The CBD and town centre is a destination in itself for heavy commercial deliveries and access is required for these heavy commercial vehicles.

Through heavy commercial vehicle traffic is very low and consideration of this alone would not justify the provision of a second crossing.

Road Capacity

The capacity of the road is determined by factors including the volume of opposing flow, the number of large vehicles, lane width, adjacent development, and vertical and horizontal alignment. The road / bridge is at capacity when two way volumes reach 2400 vehicles per hour, or for shorter periods (approximately 15 minutes), when volumes reach 600 vehicles for that period.

An examination of traffic volumes over 15 minute intervals during the day provides an insight into traffic distribution. Previous traffic counts indicate that during 2001 the peak traffic period is 2.5 hours per day, typically comprising 45 minutes in the morning (8:15–9:00am) and 1 hour 45 minutes in the afternoon (3:30–5:15pm). These periods have 15 minute two way volumes of traffic between 500 and 600 vehicles. The capacity of the bridge is 600 vehicles per 15 minutes under ideal conditions, which is equivalent to 2,400 vph.

Recent traffic counts indicate that pm-peak hour traffic is busier than am-peak hour traffic however; the arrival of traffic during am peak hour is more concentrated with the intensity peaking around 8:20am and continuing to 9:15am. Similar, pm-peak hour traffic occurs on the bridge between 4:30-5:30pm but the arrival rate is less intense and queuing is not as extensive as the morning period. Nevertheless, more traffic arrives in the afternoon period than can be accommodated by the bridge and approaches, which results in traffic congestion.

Further analysis of traffic growth shows that traffic periods change throughout the day as traffic increases. The peak periods become longer as maximum flow conditions are extended to accommodate the increased flow. It is anticipated, the peak period would extend to 3 hours by 2011 and the delays currently experienced in the morning peak leading up to 9:00am would be common for the whole period, morning and afternoon. By 2011, traffic flows for the whole period (3 hours) would approach that of the current 15 minutes peak periods. This would mean a higher probability of collapse of flow equilibrium with the resultant long traffic delays.

By 2021, the peak period would extend to 4 hours 30 minutes and to 9 hours by year 2031. These peak periods are calculated on the basis of maximum flow conditions (600vp15 minutes). In reality, there would be operational problems well before the commencement of peak hour traffic because of start times for school, work and business activities. There is more flexibility in

travel decisions in the afternoon period but that too would incur longer delays. It has been necessary to extend the peak period in this way in the analysis to allow the modelling of daily traffic flows.

With the type of delays that currently occur on the bridge there is likely to be a latent demand that would readily take up any minor improvements to traffic capacity on the bridge. The result would be the same level of peak hour delays would continue to occur.

Intersection Capacity

For the purposes of the traffic study, it was assumed that existing intersections have adequate spare capacity to accommodate reassigned traffic associated with each locality. This assumption is based on previous traffic analysis and the assessment that there is scope to enhance these sites as part of any bridge option to obtain an acceptable level of service.

Previous traffic investigations conducted by SKM 1999 identified that capacity would occur at the Villiers Street/Fitzroy Street and Through Street/Bent Street roundabouts at a Degree of Saturation of about 0.85 at which point queuing would occur. Results of the previous investigation concluded that these sites would continue to operate satisfactorily if the existing bridge were to be duplicated. Traffic modelling indicated that these intersections would be able to accommodate an increase in traffic of up to 30%, which is the predicted growth for the next 30 years.

The Villiers and Fitzroy Street roundabout would reach practical capacity in about 30 years for locality 3. The two roundabouts in Bent Street on the southern side of the river would function satisfactorily for the 30 year period but may require traffic management for other reasons eg pedestrians, turning paths for trucks, and unexpected increased turning volumes for certain movements.

Pedestrians

Pedestrians are well catered for on the existing bridge with a footpath on both sides at rail level. No additional pedestrian facilities would be provided on an additional crossing adjacent to the existing. A pedestrian/cycleway would be considered for localities away from the existing crossing.

Pedestrian safety on the approach roads for localities away from the existing crossing would need to be considered in detail at the concept design stage. Issues such as travel speeds and the ability to safely cross the new routes in view of increased traffic flows would be important considerations.

Vehicle Occupancy

A vehicle occupancy survey was carried out on the bridge for the morning and afternoon peak periods in July 2002 as part of the previous Feasibility Study. This survey counted for all vehicles and identified occupancy as well as estimating occupancy of buses. Table 5.3 shows the average car occupancy.

Table 5.3: Average car occupancy.

Period/Direction	Average occupancy per vehicle	Percentage of cars with drivers only
AM peak northbound	1.46	67%
AM peak southbound	1.34	74%
PM peak northbound	1.61	60%
PM peak southbound	1.56	61%
Combines	1.53	63%

Travel Times

Table 5.4 shows travel times recorded for various traffic periods of the day for the section of Bent Street between the Gwydir Highway and Villiers Street, a distance of 1.9km.

Table 5.4: Travel times.

Period	Northbound	Southbound
AM peak	7 min 30 secs (average)	3 min 00 secs
AM peak 8:30 to 9:00	Variable up to 9min 50 secs max	3 min 00 secs
PM peak	2 min 55 secs	5 min 00 secs
Business	2 min 50 secs	2 min 50 secs
Offpeak	2 min 30 secs	2 min 30 secs
Night	2 min 15 secs	2 min 15 secs

Future Traffic Volumes and Associated Impacts

Traffic data collected from the vehicle classification counts and the origin and destination survey has been used to predict future volumes on various crossing localities being considered. Refer to Table 5.5.

Locality 1: Would attract a reasonable volume of traffic (10,000 vpd leaving 16,000 on the existing bridge). Traffic would disperse at Fitzroy Street but there would be increased volumes in Prince Street that would otherwise use Villiers Street. Comparison of traffic flows at the Villiers Street roundabout shows that approximately twice as much traffic comes to / from the Prince Street precinct from the bridge than to/from the Villiers Street area.

The crossing would not attract significant Pacific Highway traffic due to distance, possible delays associated with parking in the CBD and viaduct height restrictions. However, it would attract a proportion of South Grafton traffic and the majority of the Gwydir Highway traffic.

A second crossing at this locality would encourage traffic onto the main street (Prince Street) and this raises safety and amenity issues. It is likely that traffic management measures would be necessary to ensure that the Prince Street shopping environment remains compatible with business activities.

Measures such as diverting trucks via Duke Street may need to be considered. This would possibly result in trucks continuing to use the existing bridge.

Locality 2: Would attract considerable traffic (11,000 vpd) off the existing bridge, due to its proximity to the existing bridge and the Pacific Highway. Much of the South Grafton traffic and the majority of the Gwydir Highway traffic would be attracted to the locality.

For the purposes of the analysis it is assumed that the road connection in this locality is via Villiers Street.

Some traffic would use Victoria Street to disperse prior to entering the Villiers Street / Fitzroy Street roundabout. This would have some benefits for the intersection but the additional traffic in Victoria Street would have impacts on parking and safety.

Traffic volumes in Villiers Street to the north of Fitzroy Street would not necessarily increase to any significant degree.
Locality 2 would need the Villiers Street southern approach widened to 2 entry lanes into the roundabout at Fitzroy St to achieve a LOS 'C' in 30 years. The left turn lane from Clarence Street onto the bridge would need to be retained or queuing would develop in Villiers Street in the afternoon.

There would be less traffic entering the Fitzroy St roundabout compared to locality 3 because some traffic would use Victoria Street. This would mean slightly less congestion at the roundabout in the long term.

Locality 3: A second bridge located adjacent to the existing bridge provides the highest traffic benefits of the crossings considered due to two travel lanes being available in one direction on the existing and additional crossing. All other localities would have a single lane flow in each direction on the existing and additional crossing. The differences are shown in the level of service calculations where a 2 lane, one way facility provides better travel conditions – freedom to manoeuvre, ability to pass slower vehicles, extra capacity. However, the impact on existing intersections is greater because locality 3 centralises traffic flows. Other localities distribute traffic more widely.

Traffic modelling shows that the Villiers Street / Fitzroy Street intersection would operate up to a LOS 'C' under its current configuration within the 30 year period. Additional lanes or a change to traffic signals may ultimately be necessary depending upon traffic growth and operational issues at the intersection.

Retention of the Clarence Street access onto the bridge would be necessary to help relieve traffic congestion in the long term at the Villiers Street / Fitzroy Street intersection. With two lanes in each direction on the bridge, the impact of traffic 'pushing in' to travel south in the afternoon would be minor. The left turn lane from Clarence Street onto the bridge needs to be retained or the LOS at the Villiers Street roundabout would drop to 'F' in the afternoon peak with queuing in Villiers Street.

Intersections on the southern approach, Bent Street at Through Street and at Ryan Street, are shown to function satisfactorily but may also require traffic management within 30 years. Again, the replacement of the roundabouts with traffic signals would be a long term option.

Localities 4 to 7: Downstream crossings have some traffic management appeal as they provide a direct connection to the north of Grafton and the Summerland Way from the Pacific Highway. Localities 4 and 5 provide a direct connection to the future development area of Clarenza where three schools are located. These crossing locations may attract a percentage of school buses off the existing bridge. Currently 270 buses use the bridge each day.

The attractiveness for traffic of downstream localities diminishes as the distance for a second crossing increases from the existing bridge. This is due to the majority of traffic being local traffic

with very little bypass traffic. The volumes that would be taken off the existing bridge ranges from 6,000vpd at locality 4 reducing to 3,000vpd at locality 7, Elizabeth Island. Downstream localities would attract traffic at a higher rate over time due to development at Clarenza and to the north.

Localities 4 to 7 would generate additional travel on the Pacific Highway even though there would be some reduction in travel distance for traffic to and from the Pacific Highway (north). The safety implications of additional local travel on the Highway and an additional intersection on the Highway are important. It would be desirable to minimise the mix of local and through traffic movements on the Highway.

Traffic volumes would increase on local road connections for the downstream localities giving rise to road safety and amenity impacts. These localities would increase traffic flow past residences and sensitive developments such as nursing homes and Grafton Hospital. For the purposes of the analysis existing traffic volumes have been estimated up to 3000 vehicles per day on potentially affected local roads where counts are unavailable. As a guide Oliver Street west of Prince Street carries almost 2000 vehicles per day.

Table 5.5: Predicted changes in traffic flow.

Criteria		Do Nothing	1	2	3	4	5	6	7
Volumes on crossings	**2003**								
New Bridge		-	10000	11000	13000	6000	5000	4500	3000
Existing Bridge		2600	16000	15000	13000	20000	21000	21500	23000
Volumes on crossings	**2033**								
New Bridge		-	12000	13000	17000	10000	9000	8000	6000
Existing Bridge		3400	22000	21000	17000	24000 **	25000 **	26000 **	28000
** Traffic on the existing bridge may not exceed 24,000 because it may transfer to other routes to avoid peak hour delays.									
Level of Service year peak	**2033**								
New Bridge			D	D	C	C	C	C	B
Existing Bridge		F	E	E	C	E	E	E	E/F
Based on Florida DOT model for Urban Conditions with 8.4% peak hour flows and 63% tidal flow. Los A = very good, Los F = Very Poor, Los C is the project objective.									
Average weekday traffic in streets forming possible connection to localities.			Sth of Fitzroy	Sth of Fitzroy		East of Villiers	East of Villiers	East of Villiers	East of Villiers
Existing traffic volumes	**(2003)**	-	5000	3000	26000	3000	3000	3000	3000
Volumes with Do nothing	**(2033)**	-	6500	3000	34000	3000	3000	3000	3000
Volumes with new bridge	**(2033)**	-	18500	16000	34000	13000	12000	11000	9000
Total Heavy Commercial	**2033**								
New Bridge		-	130	270	250	260	260	240	190
Existing Bridge		500	370	150	250	240	240	260	310
Light trucks and buses excluded.									

Accident Analysis

All crossings would be designed in a way to maximise safety. However, it is difficult to accurately predict accident savings due to the high number of variables. As an indication of the safety performance of each locality an estimation of future traffic flows on existing and possible future major roads has been made across the network within the Grafton area. Existing accident rates have been calculated and applied to the change in traffic flow over the main routes. Estimated accident savings for a 5 year period are shown in the Table 5.6. For example, an accident saving of –5.0 means that 1 accident per year would be saved.

Those localities that involve an increase in accidents results from additional traffic being allocated to sections of road with higher accident numbers, i.e. Pacific Highway between the Gwydir Highway and Duncans Lane and parts of the Gwydir Highway. The accidents included in the analysis are the more serious accidents that involve injury or tow away. Minor collisions are not represented in the RTA database. Table 5.6 relates to the safety performance of each locality.

Table 5.6: Difference in safety performance across all major routes.

Criteria	Do Nothing	1	2	3	4	5	6	7
5 Year Accident Savings **								
2003	-	-6	-8	-12	+2	+4	+1	-3
2013	-	-7	-9	-13	+3	+5	+1	-4
2023	-	-7	-9	-14	+3	+5	+1	-5
2033	-	-8	-10	-15	+4	+6	+2	-6

**: The change in accident savings is shown every 10 years and relates to a 5 year period.

6 Background Investigations

6.1 Background Database Searches

The following results were obtained from desktop database searches conducted for the study area and as part of the specialist studies undertaken for the route selection stage and for preparation of this report. The information below provides a summary of the database search results within the study area.

Register of the National Estate
A search of the Register of the National Estate database was conducted for listings within the City of Grafton. Results of the search indicate that 18 items are located within Grafton. Of the 18 items, 5 items of national significance are located within the study area. A further description of items of national significance within the study area is provided in Section 7.9 of this report.

NSW Heritage Office State Heritage Register / Inventory
Records of the NSW Heritage Office State Heritage Register indicate that eight items of State Heritage significance are located within the City of Grafton. Of the eight items, only four heritage items are located within the study area. Records of the NSW Heritage Office State Heritage Inventory indicate 75 heritage items are located within Grafton LGA. Of the 75 items, only 11 heritage items are located within the study area. A further description of heritage items of local, regional and state significance within the study area is provided in Section 7.9 of this report.

Section 170 of the Heritage Act, 1977
A search of the RTA Heritage and Conservation register and State Rail Authority Heritage Register was undertaken for listings within the study area. The Clarence River Bridge is the only item affected in the study area that is listed on both of these registers.

The National Shipwreck Database and NSW Maritime Heritage Online
A search of the National Shipwreck Database and NSW Maritime Heritage Database was undertaken to identify any maritime heritage within the study area. Results of the search indicate that one item known, as the 'Induna' is located along the riverbank of the Clarence River approximately 200m upstream of the existing bridge.

North Coast Regional Environmental Plan
The North Coast Regional Environmental Plan includes a heritage Schedule that consists of three Schedules including conservation areas, heritage items of state and regional environmental significance and heritage items of regional environmental significance. Following a review of the REP, results indicate that there are nine heritage items and one conservation areas listed on the REP that are located within the study area. A further description of items and conservation areas listed on the REP is provided in Section 7.9 of this report.

Grafton Local Environmental Plan, 1988
The Grafton Local Environmental Plan 1988, includes a Schedule of 'Items of Environmental Heritage'. Some of the items listed within the Schedule are items listed individually or areas listed as conservation areas. Following a review of the LEP, results indicate that there are seven items listed on the LEP and two conservation areas within the study area. A further description of items listed on the LEP and conservation areas within the LEP is provided in Section 7.9 of this report.

National Native Title Tribunal

A search of the Native Title Tribunal register was conducted for the Grafton LGA on 9 December 2003. Results indicated that at the time of the search, there were no relevant entries in the Native Title Claims Register and the Register of Indigenous Land Use Agreements.

NSW DEC Aboriginal Heritage Information Management System (AHIMS)

A search of the AHIMS was conducted for listings within an area of 5-6km of the study area. Results of the database search indicate that five sites are listed on the database within the search area. Of the five sites, four sites are located within the study area. A further discussion of Indigenous sites and potential archaeological deposits (PADs) recorded within the study area is provided in Section 7.10 of this report.

NSW DEC Atlas of Wildlife – Flora and Fauna Records

A search of the NSW DEC Wildlife Atlas for threatened flora and fauna was undertaken as part of the ecological assessment to determine the known occurrence of threatened species listed under the TSC Act within a 10km radius of the study area.

Results of the database search indicate that three threatened plant species and 33 threatened fauna species are known to occur within 10km of the study area. A further discussion of threatened flora and fauna species and endangered ecological communities listed under the TSC Act is provided in Section 7.8 of this report.

Environment Protection and Biodiversity Conservation Act, 1999

A search of the EPBC Act Online Database was conducted as part of the ecological assessment for records of listed Matters of National Environmental Significance (NES) within a 10km radius of the study area. Eight plant species, 33 fauna species and 13 migratory species listed under the provisions of the EPBC Act have the potential to occur within a 10km radius of the study area. A further discussion of threatened flora and fauna species listed under the EPBC Act is provided in Section 7.8 of this report.

NSW DEC Contaminated Land Register

A search of the DEC's Contaminated Land Register was undertaken to determine known occurrences of contaminated sites within the vicinity of the locality options. Results of the database search indicate that there are 18 licensed premises on the register located within, or nearby, the study area. In addition, there are 21 premises currently operating under environment protection notices, including premises on the Pacific Highway, Turf and Irene Streets, Fitzroy Street, Swallow Road, Tyson Street, Arthur Street, Kirchner Street, Clarenza Road, Armidale Road, Heber Street, Old Glen Innes Road, Bruce Street, Minden Street and Bent Street.

NSW Fisheries Fishfiles Database

A search of the NSW Fisheries Fishfiles Database was conducted as part of the ecological assessment, for records of threatened aquatic species listed under the *NSW Fisheries Management Act 1994* (FM Act). Results of the database search indicate that only two species could potentially occur in the study area, these being the: Eastern Cod (*Maccullochella ikei*) and Green Sawfish (*Pristis zijsron*). A further discussion of the likely occurrences of these species within the study area is provided in Section 7.8.3 of this report.

7 Environmental Constraints

7.1 Introduction

This section of the report provides a summary of the findings of the specialist investigations that have been undertaken (see Appendices) and the potential constraints and risks the Proposal may have at each of the locality options in terms of land use and visual/landscape effects.

7.2 Land Use

In general, the various land uses in Grafton are the same as any other major rural city, in which local factors determine the location of each type of land use in any particular town. In general, Grafton has the following land uses:

- Business Areas
- Residential
- Open Space / Recreation
- Industrial
- Special Uses
- Rural

Business Area

The main business area is centred on Fitzroy and Prince Streets, from the bridge or eastern end of Fitzroy Street to a point north of the railway along Prince Street. Prince Street consists of the "shopping strip" with most businesses maintaining conventional shopfronts to the street, although some are also located within arcades.

Just east of Prince Street is a "hardtop" centre with Woolworths and Big W as its anchor tenants and just west of Prince Street is a smaller "hardtop" which hosts Coles as its main tenant. In Fitzroy Street, between the bridge and Prince Street, there is a typical main road orientated development strip with motels, service stations and businesses. There is a similar area to the north in Prince Street around the railway underpass.

The government precinct in Victoria Street complements the adjoining business area. Grafton has historically been the location of a large number of regionally orientated government offices with several of these established in Victoria Street. The post office, courthouse, police station and sheriff's office are also in Victoria Street. Associated with the "government" area is a riverbank precinct containing church and school developments.

At South Grafton, Bent Street (the Summerland Way), from the southern end of the bridge to the roundabout, consists of a classic fringe business area with car-orientated businesses. The only "retail" business is the new "BiLo" supermarket and its associated small shops. Another fringe business area at South Grafton includes areas around Spring and Skinner Streets.

Residential Areas

A large proportion of land use within the city of Grafton is residential development. Residential properties are generally in the form of single houses on large residential lots with only a small number of flats and units. Many houses are of the "high-set" form, giving the dual benefits of protection from flooding and provision of cooling in summer. The majority of streets are wide, with wide grass verges and gently graded drainage swales. The southern section of Grafton

generally consists of older style houses, whilst northwestern and northeastern areas of the city consist of more recent residential developments.

At South Grafton, there are two very discrete residential areas, one along and west of Bent Street and the other west of the business area and extending as a long ribbon westwards along the Gwydir Highway.

Recreation Land and Open Space

In general, the majority of the riverbank consists of open space and passive recreation areas. There are four main parks north of the river including See Park, Westward Park, Fisher Park and Corcoran Park. See Park and Westward Park are considered to be urban open spaces whilst Corcoran Park is an extensive riverside park with picnic and boating facilities.

Within the Clarence River itself, there are two islands, Elizabeth Island and Susan Island. The northwestern section of Susan Island is a nature reserve administered by the Department of Environment and Conservation (DEC). The remainder of Susan Island and Elizabeth Island are open space land administered by a trust.

Special Uses

Special Uses land generally includes areas designated for public purposes and land utilised by the provisions of railway services. The North Coast Railway that passes through Grafton is a major component of the land use within the study area. Areas occupied by the railway and its embankments are generally 30-40m wide, in addition to stations, sidings and railway related land uses such as the viaducts.

Other special uses include schools, churches, hospitals, the Grafton Gaol, and other community facilities.

Rural Areas

The most substantial rural land in the study area is east of the river in the locality of Clarenza, in which areas are used for cattle grazing and sugar cane cultivation. Rural areas are also present west of South Grafton along the Gwydir Highway between large residential lots and the Clarence River. Land uses in these areas also include grazing and cultivation.

Industrial Areas

The railway line, to the east of Bent Street, sets the industrial character of development in the locality. South Grafton train station is now the main passenger station, supplanting the less-accessible station at Grafton. State Rail's own repair and refuelling areas are located here, with industries, some railway oriented, and others less so. The railway development and the industrial development around Iolanthe Street would be a considerable obstacle to any road/bridge alteration at this point. There is an industrial zone in Cowan Street, west of the South Grafton shopping centre. This is probably historical, in recognition of some riverbank industry. The last occupant appears to have been a joinery works, but the buildings are now derelict.

Typical land uses within each of the localities, including both North and South Grafton are summarised in Table 7.1 below.

Table 7.1: Summary of land uses within each of the locality options.

Locality	Typical Land Uses
1	Open space and nature reserve (Susan Island), business, minimal commercial areas, rural (grazing and cultivation) and rural residential.
2	Open space, business and commercial areas, special uses, residential and industrial.
3	Open space, minimal commercial, residential, special uses, community facilities and infrastructure.
4	Open space, urban residential, rural (grazing and cropping) and rural residential.
5	Open space, residential, minimal commercial, rural residential, recreation and rural (agriculture).
6	Open space, residential, rural, rural residential and special uses.
7	Open space (Elizabeth Island), infrastructure, commercial, residential, rural residential, rural and special uses.

Potential Land Use Risks

Duplication of the existing bridge would have the least impact on land use, as it would reinforce existing development patterns and provide certainty for future land use decisions.

Locality options located away from the existing bridge would create pressure for changes to the existing land use. New intersections with the Pacific Highway for localities 4 to 7 would see development pressure for Highway associated activities similar to those located near the Gwydir Highway turnoff. Connection to locality 4 and 5 within the vicinity of Bacon and Dobie Streets would become similar to the existing Villiers Street connection which may potentially induce pressure for a change to commercial activities.

Locality 1 within the vicinity of Prince Street would see the roadside development in north Grafton change from civic recreational uses to main road commercial uses. Localities within the vicinity of Villiers Street may affect current educational and business uses and may not remain compatible with the predicted increased traffic flows. On the southern side of the river, there is the potential for a change in commercial development to take advantage of passing trade.

The NSW DEC are currently considering both Susan and Elizabeth Islands for gazettal as Nature Reserves. This would impact upon localities 1 (Susan Island) and 7 (Elizabeth Island).

7.3 Visual and Landscaping

The study area falls within the Clarence River catchment/floodplain character type comprising three broad landscaping settings. These include the Clarence River, urban landscape and rural/agriculture setting. A description of each of the landscapes is detailed below.

The Clarence River

This setting is identified by Elizabeth Island and Susan Island and the small stands of remnant rainforest, isolated trees and riparian vegetation present along the Clarence River and its tributaries of Carrs Creek, Alumy Creek and Alipou Creek. The Lowland Floodplain Rainforest is a predominant feature on the western end of Susan Island. The existing bridge crosses the Clarence River at the narrowest section of the river in the study area and is a significant local

land mark. There are flood levee walls on the northern and southern banks which protect Grafton and South Grafton.

There are a number of sailing boats moored on the downstream side of the existing bridge. No yachts are moored on the upstream side of the bridge due to the navigational clearance at the existing bridge. There are a number of recreational areas along the river on the Grafton side. These include the river end of Prince Street where there is a jetty, boat ramp, rowing club and Memorial Park. At Fitzroy Street, directly upstream of the existing bridge, there are sailing club sheds and picnic tables. Further downstream of the existing bridge there are residential properties which front the river. This frontage also includes a number of facilities including the Fry Street boat ramp, a park at the end of Dobie Street and Corcoran Park at the end of Kirchner Street.

On the south side there is a wharf opposite Skinner Street, which is the main street of South Grafton. The South Grafton Bowling Club and South Grafton Ex-Servicemen's Club have direct frontage to the Clarence River upstream of the existing bridge. The riverbank downstream of the existing bridge fronts the agricultural setting.

The Urban Landscape

The urban setting is the most dominant feature of the study area taking in the areas of Grafton and South Grafton. The historic nature of the urban environment is prominent in this area with specific areas identified as Urban Conservation Areas and has many buildings of heritage value or heritage listing. The Clarence River separates the Grafton and South Grafton areas which are protected from flooding by the levee walls along the river banks. A significant portion of the urban setting is comprised of residential development which extends right up to the levee wall. Flooding characteristics within the study area restricts future urban development.

The Agricultural/Rural Landscape

A predominant setting within the downstream locality of the study area is an agricultural landscape comprising cleared private and public land used for agriculture and grazing activities along the floodplain. This is predominantly on the South Grafton side of the river with some rural activities on the Grafton side near Elizabeth Island. Within this setting, there are areas that have been intensively cultivated and are devoid of remnant vegetation. Other areas within the agricultural landscape are have been cleared to a lesser extent and there are isolated stands of remnant rainforest trees.

Any proposal for an additional crossing of the Clarence River has the potential to visually impact on the landscape and its inherent visual qualities. The extent of this impact and whether it is a negative or positive impact is dependant on the ability for the development to fit into the existing environment. There is a significant degree of subjectivity in assessing the visual qualities of a landscape scene. Whether a landscape scene is considered to have a high or low value depends on the preference of the viewer and the response or reaction to a landscape scene can vary substantially.

Potential Visual Risks

The visual impact of an additional crossing is an important issue for the community. Aspects that would need to be considered for any proposed additional crossing would include:

- Destruction or obscuring of existing views for residents and motorists;

- Creation of unattractive additions to the landscape that detract from the existing aesthetic quality or scenic character. In particular, consideration would need to be given to maintaining the character of the area associated with the existing bridge; and
- Alignment and design features, including details such as materials to be used.

An additional crossing at all localities would have an impact on the Clarence River setting. A crossing at localities 1 and 2 would have a high impact on the visual quality from the recreation areas such as the sailing club and rowing club. It would be difficult to 'absorb' the new crossing into the existing landscape.

A crossing at locality 3 would provide the opportunity for the bridge to 'blend in' with the existing structure. The design would need to consider a duplication of the design of the existing structure or provide a modern slim line design that blends in with the existing bridge. The piers would need to match the existing piers to obtain a sense of symmetry. However, the impact on visual quality would still be high particularly from the existing residences and the recreation areas.

Localities 4 to 7 would impact on the agricultural/rural setting particularly for the residential areas on the Grafton approach. The visual impact on the agricultural/rural setting would generally be less critical as there would be opportunities for extensive and effective landscape works in areas of low scenic/visual quality. Elevated views from the approach roadways would provide the traveller with more expansive views across the floodplain landscape.

7.4 Socio-Economics

As part of the route selection stage, assessments of potential social and economic impacts were investigated for the study area. The assessment was based on 2001 census data, inspections of the study area and input from the community including feedback from Community Focus Meetings and three community liaison meetings held in Grafton during October and December 2003. Face to face discussions were also held with a sample of residents and businesses randomly selected in the overall study area during late 2003.

Social and Economic Overview

Grafton is defined as the sub-regional centre for the Clarence Valley and as such is the major centre for the focus of services to the sub-region of Grafton, Copmanhurst, Maclean, Nymboida and Ulmarra. It has the higher order services of a hospital, TAFE facility, Community Health Centre and high schools.

The natural catchment / flow of population is from the valleys into Grafton. People residing in the adjoining local government areas of Copmanhurst (Junction Hill) and Pristine Waters travel to work in Grafton City and most of the services they use are located in Grafton. In the past the (then) NSW Department of Urban Affairs and Planning classified Grafton and the surrounding urban and rural areas as "greater Grafton" as the catchment areas crossed several local government boundaries. Residents of Grafton City also use recreational and sporting facilities located in rural areas outside of Grafton City (Clarence Valley Draft Social Plan 2000).

Grafton is the transport hub of the Clarence Valley, with road links to Sydney, Brisbane, Armidale, Casino and Glen Innes, and the North Coast Railway all converging there. The location of this convergence is right within the study area. Rail, air and river do not provide any significant intra-valley transport function and hence, the Valley is strongly reliant on road transport. The dispersed nature of the settlement patterns and the size of the Valley means that transport is very much dependant upon the private car (Clarence Valley Draft Social Plan 2000). This has implications for accessibility to services via the Clarence River Bridge Bridge.

A demographic analysis using 2001 Census data was conducted to determine the social and economic structure of the population in the study area. Results of the analysis indicate a 1% growth rate within Grafton. Council's population projections based on the census data and planning proposals also indicates a growth rate of 1% over the next ten years. In the last 12 months, there has been a building boom in the Mid North Coast area, which is also reflected in the Grafton City area. However, much of the building growth appears to be as much from investment housing and reducing family sizes and occupancy rates, as from population increases. Council is satisfied that the adopted 1% is still a reliable estimate of population projections over time.

In addition, historical traffic growth since 1970 contained in the RTA's Traffic Volumes publication (2001) shows a trend line of 1%. Therefore, a 1% growth figure has been adopted for the Social and Economic Impacts Report (Appendix E).

As of 2001, the total population within Grafton LGA is 16704. It is considered that areas upstream of the existing bridge contain 9.6% of the Grafton population and 16% of the study area population. The South Grafton area upstream of the bridge contains 11% of the overall Grafton population and 18.6% of the study area population. The area of Grafton downstream of the bridge within the vicinity of localities 4 and 5 contains 16.7% of the overall Grafton population and 28% of the study area population. The area of Grafton further downstream (in the vicinity of localities 6 and 7 contains 22% of the Grafton population, and over 37% of the population of the study area.

The median age for Grafton residents is 38, and for the study area is between 34 and 43 (with the exception of areas in the north, which contains nursing homes). The population is spread relatively evenly across the age groups, with there being slightly higher numbers of residents aged 5-19 and 35-49 than other age groups. This indicates that the study area, as well as Grafton as a whole, has a high percentage of households in the early to mid stages of family formation. This is typical of a town in the Mid North Coast area.

The overall unemployment rate within Grafton City is approximately 12.1%, with the highest area of unemployment within the study area being at South Grafton, with an average of 21.4%. The lowest area of unemployment in the study area is that part of the city located in the vicinity of localities 6 and 7. It is considered that the retail trade employs the largest proportion of the population (18.6%) with the health and community service employing the second largest proportion (11.8%).

Cost Benefit Analysis

An economic evaluation is designed to quantify the social and community benefits and costs of a Proposal in order to assess the overall net social benefits of a project. Traditional project evaluation for transport infrastructure develops a benefit assessment by quantifying user benefits such as time savings, reduction in the number of accidents and vehicle operating cost savings. For the purposes of this Proposal, these quantitative costs have been derived from improvement in travel time, reduction in travel distance, savings in terms of fuel, wear and tear etc and from reduced accidents determined in the traffic study. Both construction costs and accrued benefits were discounted to current day dollars to provide a benefit cost ratio. The first year rate of return shows the percentage return on investment (cost of the project) in the first year of operation after completion. A summary of the economic evaluation for each locality is provided in Table 7.2 below.

Table 7.2: Summary of economic analysis.

Economics Return on investment	Do Nothing	1	2	3	4	5	6	7
Project Cost (Strategic Est.)	-	$45m	$45m	$40m	$45m	$40m	$50m	$55m
Benefit cost ratio @7%	-	1.49	1.44	2.02	1.06	0.94	0.57	0.14
First year rate of return 7%	-	9.7%	9.2%	12.9%	5.6%	5.1%	2.4%	0.0%

Potential Social Risks

Recent investigations undertaken have revealed that there are a number of concerns in the general community about the existing bridge. The community seems generally in agreement that a new crossing is necessary. Key reasons cited are the traffic delays currently experienced at peak hours on weekdays, the need for emergency services to be able to cross the bridge at all times without delays, and safety issues associated with trucks and buses using the bridge.

The Clarence River Bridge is currently operating at capacity during weekday peak periods. The 'do nothing' option would only further exacerbate existing traffic delays. Delays and congestion would reach a level (9 hours of peak hour per day in 30 years time) where they would have serious social and economic impacts. Restricted access across the river would progressively add to business costs and seriously impact on the future economic development of Grafton. In reality, the duration of peak traffic periods would be limited to several hours in the morning and afternoon. The nine-hour estimate is based on how long it would take to move the required traffic volumes in 2033. However, people need to get to work and school at these times. Accordingly, business decisions would be made on accessibility for workers and movement of goods and services. Should there be no improvement to the current situation Grafton City cannot continue to grow at even 1% for any extended period.

The lack of access for emergency services to / from the south side of the river is also a critical issue and would remain that way until an additional crossing is provided. Safety concerns would also increase as the periods of congestion extend. The restrictions caused by the bridge, whether real or perceived, would further lead to social isolation for those motorists that currently avoid using the bridge.

The issue of a heavy vehicle bypass of Grafton City has also been consistently raised by sections of the community. Removal of unnecessary heavy vehicles from road approaches to the localities under consideration would be a desirable outcome. However, the origin and destination study contained in the Traffic Study (Appendix C) indicated that only a small number of heavy commercial vehicles use the bridge and proceed along the Summerland Way. This means that the destination for most heavy commercial vehicles using the bridge is within the study area, including Grafton CBD. Further investigation is needed to better define truck destinations and this is being undertaken in the ongoing investigations.

Significant positive social impacts with the construction of an additional crossing of the Clarence River at Grafton may include:

- Ability to cross safely at any desired time of the day;
- Perceived decrease in accidents;
- Ease of movements for delivery vehicles;
- Quicker travel times to work, school, shopping and other activities, as well as quicker delivery times for products;

- Rapid response times for emergency services to South Grafton and other destinations south of the river;
- Flow on effects of reduced congestion, reduced emissions in urban areas, and reduced noise; and
- Removal of a major constraint to future urban development and economic growth.

Negative social impacts resulting from the construction of an additional crossing of the Clarence River at Grafton may include:

- Uncertainty about impacts and development possibilities, which may manifest in individual community members through increased stress, anxiety or apathy about the future;
- Changes to personal economic situations through changes to property values;
- Perceptions that individual property owners and residents will suffer because of decisions made for the benefit of the wider community;
- Concerns over reduction in amenity values for residential areas likely to be affected, where attributes such as wide streets, older stately tree plantings, impacts on stately homes and a peaceful and quiet environment strongly contribute to personal and community well being in areas that may be impacted by the proposed crossing and increased traffic flows;
- Alterations to the way people undertake trips to their daily activities;
- Perceived impacts to significant environmental and heritage areas including Susan and Elizabeth Islands;
- Perception of changes in existing levels of community cohesion and integration; and
- Concerns over the heritage value of the existing bridge, and how any additional crossing may affect its amenity.

A summary of potential social impacts for each locality is detailed in the Social and Economic Impacts Report in Appendix E of this report.

Potential Economic Risks

Results of discussions held to date with members of the business community in the study area reflect the findings of the previous Roads and Traffic Authority Feasibility Study of February 2003, that the business and employment sector of the community seems generally in agreement that a new crossing is necessary. Businesses in Grafton cite difficulties of deliveries into the city centre and the fact that the perceived problems with the existing bridge may alter shopping preferences for customers. Many businesses appear to alter their business operations (in terms of trips and/or timing) because of the present level of congestion associated with the existing bridge.

The general consensus from the business sector of the community is that whilst a new bridge is needed, consideration needs to be given to the location of that bridge in terms of ease of access for delivery vehicles into the city centre and whether it would reduce travel times. There appears to be general agreement that regardless of the location of the additional crossing, if it will reduce travel times and delays without significantly increasing numbers of kilometres travelled, that businesses would happily utilise any new crossing. Some businesses have even suggested that if the new crossing is in a satisfactory location, heavy vehicles could be banned from crossing at the existing bridge.

It would appear that delivery trucks to the city come equally out of Sydney and Brisbane, with only a minor amount using the Gwydir Highway and the Summerland Way. Discussions with trucking companies have revealed foodstuffs and produce seem to come mainly from Brisbane via

the Pacific Highway (70%), while whitegoods and building supplies seem to come mainly from Sydney via the Pacific Highway (70%).

State Forests has advised that major forest based processing industries are located to the north and south of the Clarence River, and that a crossing of the Clarence River continues to be important to these industries as forest products are hauled in both directions to supply these industries. Usage of a crossing by heavy vehicles associated with the forest and timber industry is likely to continue in the future.

The Business Enterprise Centre has provided an estimate of employment opportunities within the city. It is estimated that 60% of businesses are located in the city CBD, 10% of businesses are located in the South Grafton CBD, 15% in the South Grafton industrial area, and 15% in the Junction Hill business and industrial locality. Of those businesses in the Grafton CBD, it is further estimated that 70-75% are located in the main street and surrounding areas (92 retailers are located in Prince Street) and 25-30% in Grafton Shopping World (estimated at 30 retailers).

Of information available to date, the Department of Education and Training employs the largest number of staff (being 360 teaching and non-teaching school staff, and 200 TAFE staff). This is closely followed by Grafton Base Hospital which employs 502 staff.

Feedback from the overall community received to date indicates that significant positive economic impacts associated with the construction of an additional crossing of the Clarence River at Grafton may include:

- A potential increase in the number of customers and tourists into the city centre because of perceived Increase in travel safety over bridge;
- Quicker travel times for trips to work and making deliveries;
- Increased access to regional areas, with flow-on economic benefits;
- Ease of access for delivery trucks;
- Buses would better able to meet timetables;
- Flow on effects of reduced congestion, reduced emissions in urban areas, and reduced noise; and
- Facilitation of urban growth and economic development within Grafton City.

More specifically, the identified negative economic impacts resulting from the construction of an additional crossing of the Clarence River at Grafton may include:

- Disruption to businesses located at or near the proposed additional crossing;
- Changes to economic situations and business profitability through changes to traffic volumes past the business;
- The creation of business and industry development nodes along any new route location, potentially; and
- The reduction of custom from existing businesses and industry.

A summary of potential economic impacts for each locality is detailed in the Social and Economic Impacts Report in Appendix E of this report.

7.5 Landforms, Geology, Soils and Erosion

Topography

The topography of the study area generally consists of the Clarence River floodplain, which is a relatively flat alluvial plain, only a few metres above sea level. The eastern bank of the Clarence River to the north of the existing bridge is higher than the land back from the river, sloping away from the river at less than a 1 degree slope. The Pacific Highway to the north of Alipou Creek is on higher ground as it skirts along the edge of the hills bordering the floodplain.

The only part of the study area that is not part of the alluvial plain is the southern approach to the existing bridge which is along a ridge of soil and rock of the Grafton Formation, forming an island in the floodplain.

The study area contains a number of artificial deep drainage channels as well as natural watercourses. The main constructed drainage channels are north of Eggins Lane (locality 7), north of McLares Lane (locality 5) and the Ardent Street drain (locality 1 and 2).

Geology and Soils

The study area is underlain by the Grafton Formation [1:250 000 Geological Series Sheet (SH56-6)] that is known to consist of Sandstone, Siltstone, Claystone and Minor Coal. The Clarence River floodplain stretches to a maximum width of approximately 7km within the study area. The deep layered alluvial soils vary in texture with distance from the river. Close to the bank, brown-black silty loams overlay dark brown acid silty soils. On the old ridges and terraces associated with the migrating river channel, silty clay loams overlay silty organic clay of medium to low plasticity. On the flat floodplains low plasticity clays, (with fine sand) overlay heavy plastic clays. The Grafton Formation exposed at South Grafton is a weathered clayey siltstone. These red-brown heavy inorganic clays have a moderate to very high plasticity and the potential for mass movement. Historical logs show that the riverbed consists of horizontally bedded, fine grained, hard, grey sandstone of the Grafton Formation overlain by alluvial deposits of sand, gravel and sandy clay. Dunlop's 1981 report identifies that floodplain alluvial soils have problems related to settlement, providing a poor subgrade for construction, as well as necessitating the haulage of higher class materials from outside of Grafton.

The Grafton Area Urban Capability Study, 1976 indicates that the floodplain of the Clarence River is the least eroded landform unit in the area with no appreciable erosion identified at the locality options. Only minor sheeting has been recorded in areas of alluvial terraces where slopes of up to five per cent occur (Grafton City Council SOE, 1999/2000).

The concern of erosion susceptibility within the study area is considered to be relatively low due to the alluvial soil landscape. As this alluvial landscape occurs across each locality option the relative potential for erosion and sedimentation impacts would be directly related to the area of soil disturbed during construction, the slope of disturbed area and the number of pylons required.

Acid Sulphate Soils

Reference to the 1:25 000 Acid Sulphate Soil Map for Grafton indicates that the investigation area contains areas of both low and high probability of occurrence of acid sulphate soil materials. The areas of high probability are predominantly to the northeast of Grafton.

The urban areas of Grafton and South Grafton are located within areas of low probability of occurrence, although thin strips of land surrounding creeks in the area as well as Susan Island are

reported to be high probability areas. The bottom sediments of the Clarence River from west of Susan Island to the eastern extent of the study area also carry a high probability of occurrence. Other areas of high probability occur predominantly to the northeast of Grafton with additional occurrences flanking Cowans Creek, Alumy Creek, Swan Creek and parts of Musk Valley and Carrs Creek. Of these creeks, two have the potential to be affected by three of the locality options. These include, Cowans Creek, potentially affected by locality options 1 and 2 and Alumy Creek, potentially affected by locality option 4. An Acid Sulphate Soil Risk Map is provided in Appendix F.

Increased occurrences of potential acid forming soils are also associated with Susan Island and along the bed of the Clarence River within the Grafton area. The relative potential risk to water quality of the Clarence River from oxidation of acid sulphate soils is directly related to the extent of potential disturbance to these soils during construction activities.

The highest potential for acid sulphate soild occurs in the downstream section of the study area. Hence, soil samples collected from localities 6 and 4 were tested for acid sulphate soils. The results indicated that the sample from locality 6 did not show actual or potential acid sulphate soils, but the sample from locality 4 showed actual acid sulphate soils, having a pH of 4.2.

Contaminated Sites

Within Grafton City LGA, the 2002/2003 SOE report indicates that there are five identified cattle tick dip sites, nine closed landfill sites, eight sites under investigation and five unhealthy building sites. Known contaminated sites within the vicinity of the locality options include:

- The Vere Street Tip;
- Disused South Grafton Saleyard dip site on Abbott Street;
- Old dip site on the corner of Villiers Street and Kirchener Street; and
- Old landfill site at Cororan Park.

Of the sites listed above, only locality 2 has the potential to encounter any of the known contaminated sites. It is anticipated that further consultation with Grafton City Council would be undertaken to determine any contaminated land within the alignment of a preferred route.

A review of EPA's contaminated register indicates that there are 18 licensed premises on the register located within, or nearby, the study area. In addition, there are 21 premises currently operating under environment protection notices, including premises on the Pacific Highway, Turf and Irene Streets, Fitzroy Street, Swallow Road, Tyson Street, Arthur Street, Kirchner Street, Clarenza Road, Armidale Road, Heber Street, Old Glen Innes Road, Bruce Street, Minden Street and Bent Street.

Dryland Salinity

The Department of Infrastructure, Planning and Natural Resources (DIPNR) have provided data on known sites of salinity within the City of Grafton to Grafton City Council. Figure 1.1 of the Grafton City Council SOE Report 2002/2003, indicates small areas of dryland salinity occurring at approximately four areas around Southampton. Areas affected or at risk of dryland salinity have not been identified within the study area.

Potential Risks

The geotechnical constraints associated with a second crossing of the Clarence River are expected to be those typically encountered during design and construction processes including batter slope and suitability for use of excavated material as fill. There may be the potential for soft soils at depth, particularly on the eastern side of the study area. This is not expected to be a major constraint, but may add time to construction and/or increase costs.

Recent geotechnical investigations indicate that locality 3 would have the least geotechnical constraints as it would have the shortest road approaches and it is likely to have greater stability and a shallower depth to the bedrock on the bridge approaches in comparison to localities 1, 2, 4, 5, 6 and 7. The southern approach is also above the floodplain on weather rock, rather than alluvial soils.

Localities 1, 2, 4, 5, 6, and 7 are also very similar in terms of subsurface conditions, with few geological constraints identified that would have an impact on any of the routes. The strata of the alluvial plain is quite variable over short distances, and detailed drilling would be necessary to evaluate possible foundation problems, such as the presence of substantial depths of boulders. Likewise, the areas of soft soils, which would lead to greater settlement are limited in extent and would need to be examined in a detailed investigation once a preferred locality option has been adopted. Soft soils can be overcome through geotechnical design.

Other risks associated with the Proposal include soil erosion and scouring as a result of soil exposure, flooding, excavation activities, general soil disturbance, piling, and the erosion of stockpiles and aggregates. It is anticipated that those areas with a greater slope gradient along the riverbank such as the levee bank on the northern bank of localities 1 to 7 and the southern bank of localities 1 to 3, would have a greater risk of erosion. Localities with areas of soft soils along creek lines (locality 4) and that are likely to disturb larger areas of soil (localities 6 and 7) also have a greater risk of soil erosion.

Overall, there is a potential risk of disturbing potential acid sulphate soils within each of the localities, although some localities may have a higher risk than others. Based on information provided in the Acid Sulphate Soils Risk Map (DLWC 1997), it is anticipated that localities 6 and 7 would have a greater risk than localities 3 and 4 however, results of geotechnical investigations indicate that actual acid sulphate soils were found within the vicinity of locality 4.

As there are no known occurrences of dryland salinity within the study area, it is not anticipated that the Proposal would further enhance salinity levels. In addition, the likelihood of disturbing contaminated land is minimal.

7.6 Hydrology

Flooding in the Clarence River is a common event given the size of the catchment and frequent storms and rainfall that occur in the region. Levee banks have been constructed along both banks of the river for flood protection of the town, using various combinations of concrete, soil and rock walls. North Grafton is protected from floods reaching no higher than 8.25m. In South Grafton only the embankment from the Arden Street drain to the existing bridge is protected for levels up to 7.62m. West of the Arden Street drain the levee bank protects against levels to 6.09m and downstream of the bridge at Clarenza, the levee provides protection to 5.49m.

The levee bank on the northern side of the river has been designed to withstand a 1 in 100 year flood. However, recent floods have shown that the grade of the levee crest and the structural integrity of the levee system downstream of the existing bridge may not be adequate to provide the expected level of protection.

Most of South Grafton is more frequently inundated by flooding with the exception of the area approaching locality 3, which is one of the few places in South Grafton high enough to be out of range of most of the common flood levels. Downstream of Grafton, land use is predominantly rural. Seven residences and six machinery sheds have the potential to be impacted upon by flooding, and hence may be significantly affected if affluxes are significant.

With the objective of maintaining the current level of flood protection experienced by Grafton, each locality was evaluated from the perspective of potential flood impacts. In order to standardise the comparison, the following design standards were adopted:

- Afflux in the 1 in 100 year flood would not exceed 100mm upstream and 50mm downstream;
- Afflux created at the road design level would not exceed 200mm; and
- Road shoulder level would be set at design flood level plus allowance for 200mm afflux.

A preliminary assessment was undertaken of flood levels within the Clarence River channel, for bridges constructed at design flood level. Localities 1 and 2 record the smallest affluxes, of approximately 50mm. Localities 7 and 3, record intermediate expected affluxes of approximately 60mm and 75mm, respectively. Localities 4 to 6 record high values of afflux, ranging between 87mm and 99mm. It is suspected that the high affluxes at localities 4 to 6 are a result of sedimentation of the river cross section, creating predictions of high velocity flows. An adjusted afflux estimate of approximately 60mm is considered to be a more accurate prediction.

Localities 1 to 3 represent bridges that span the entire flood width, whereas the southern approach to localities 4 to 7 would also be required to meet design flood levels and flows. To protect the approach embankments of localities 4 to 7 from scour, waterway openings would also be required. To determine the number of openings and spans required at each locality, the approach embankment was set to withstand the 1 in 10 year flood, but overtop during 1 in 100 year flood events. The spans and openings selected therefore create a maximum afflux of 200mm, during the 1 in 10 year flood and an afflux of 190mm during the 1 in 100 year flood.

Potential Risks

Based on the above predictions, an assessment and ranking of the localities, from the perspective of potential flooding impacts, is provided in Table 7.3.

Table 7.3: A summary of potential flooding impacts.

Locality	Potential Flooding Impacts	Ranking
1	The likely afflux is small, given the river section is wide and there would not be significant flows on the small section of floodplain on the southern bank.	2
2	Little afflux and limited effect is expected because the existing levee systems are effectively at the top of bank on both sides of the Clarence River.	2
3	Little impact is anticipated as the northern abutment is protected by the Grafton levee and the southern abutment is on flood free ground. The levee is generally accessible and could be "topped-up" to account for afflux created by the bridge crossing.	1
4 & 5	Major affluxes on the southern floodplain are expected and smaller affluxes may extend to the river channel itself. There are 2 houses potentially affected by the proposed road.	4

Locality	Potential Flooding Impacts	Ranking
	Thus, the Proposal has the potential to affect the Grafton levee system at a location where the crest levels are low and some structural inadequacies are evident. Further, access to the levee is difficult thus, levee works would require a significant cost provision.	
6 & 7	A major impact on flood levels on the southern floodplain is anticipated. Three residences may be affected. The potential impact on the Grafton levee system is not as severe, as the levee is newer in this location and without the demonstrated problems of further upstream.	3

Source: Paterson Consultants, 2004.

From the perspective of potential flood impacts, locality 3 is considered to be the best option. The existing abutment on the northern bank and the topography of the southern bank would simultaneously protect bridge embankments from scour and minimise afflux. Localities 1 and 2 are also expected to result in minimal afflux, with the advantage of spanning the entire flood width of the Clarence River. Localities 4 to 6 do not span the entire flood width of the river, and are expected to produce major affluxes on the southern floodplain. In particular, localities 4 and 5 are likely to threaten the integrity of the Grafton levee system and therefore likely to prove a costly option.

7.7 Water Quality

The Clarence River catchment is the largest catchment in southeastern Australia in terms of catchment size and river flows. It has a catchment area of approximately 22,700km^2. The mouth of the river is located between the towns of Yamba and Iluka, with its estuarine reaches extending upstream past Grafton to Copmanhurst.

Land use within the catchment is dominated by agricultural activities, including large areas of grazing in the upper sections, crop growing in the middle sections and sugar cane and tea tree growing on the coastal floodplains. The Clarence River has significant environmental values and is a valuable socio-economic resource. There is little in the way of aquaculture at Grafton, however, further downstream the Clarence River hosts some aquaculture activities including prawn fishing. At Grafton, the Clarence River is used for recreational activities, including annual events such as the Bridge-to-Bridge Ski Race, the Sailing Classic and numerous rowing regattas.

Surface water quality data obtained from Grafton City Council's 2002/03 monitoring program indicates that the water quality of the Clarence River at Grafton is slightly to moderate saline with a mean pH of approximately neutral (7). Water temperature generally falls within the relevant ANZECC and ARMCANZ (2000) guideline range whilst minimum pH levels in some areas are slightly acidic and fall below the aquatic ecosystem guideline range. Mean dissolved oxygen levels are above the desirable minimum of 6mg/L (ANZECC 1992), while turbidity levels typically exceed the aquatic ecosystem guideline range. Results of the water quality monitoring also indicate that concentrations of faecal coliforms and enterococci coliforms exceed the ANZECC and ARMCANZ recreational primary contact guidelines. Complete details of the data are provided in Table 2.1 of Appendix H.

Based on data provided from irrigation ponds within the Grafton region and current geotechnical data, it is estimated that the groundwater can be reached at 0m-5m below ground level with water quality pH of >6 and a relatively low conductivity.

Potential Risks

The potential impacts on water quality within the study area may include increased levels of turbidity, sedimentation, localised contamination, algal blooms and potential changes in chemical (pH, nutrients, dissolved oxygen and inorganic and organic contaminants) and physical (light penetration, salinity & temperature) parameters. Key pollutants associated with the operation of the Proposal would include stormwater-related contaminants such as suspended sediment from roadway surfaces and embankments, and from vehicle pollutants including hydrocarbons and combustion derivatives, lubricating oil, petroleum spillage, rubber and heavy metals. Accidental spillages also have the potential to adversely affect water quality and local and downstream aquatic ecosystems. In addition, the Proposal has the potential to increase surface runoff from an increased impervious surface area.

Impacts on water quality during construction have the potential to occur as a result of sediment laden water and contaminated water entering water bodies during pile driving and excavation activities, and as a result of spills from fuels, hydraulic fluids, cement, pavement materials and chemicals. In addition, the oxidisation of acid sulphate soils can contaminate local waterways causing a decrease in dissolved oxygen and lowering of the waters' pH, algal blooms, aluminium toxicity, and subsequently smother benthic organisms (sediment dwelling) and cause fish diseases and kills. The consequences of these potential risks may also result in socio-economic effects on the community and on aquaculture industries downstream of Grafton.

Groundwater quality may also be potentially affected through the infiltration of polluted runoff, acid water and increased salinity through increased surface runoff and rising watertables.

To determine the potential risks in terms of water quality for each of the proposed localities, a qualitative assessment was undertaken (December 2003) considering each of the locality options in terms of greatest potential impact to sensitive and surrounding environments. Further detail of this assessment is provided in Appendix H.

The assessment included the consideration of four primary water quality issues (erosion, acid sulphate soils, pollutants and groundwater contamination) associated with the construction and operation of the Proposal. Locality options were ranked low, medium or high according to the potential risk to water quality at each locality option. An overall ranking was then applied where the greater the numerical number, the greater the risk. A summary of the results is provided in Table 7.4 on the following page.

Locality	Erosion	Acid Sulphate Soils	Pollutants	Groundwater	Explanation	Overall Ranking
1	Low	Med	Med	Low	Erosion: low extent of disturbance, flat slopes, and moderate bridge length. Acid Sulphate Soils: moderate disturbance of potential acid sulphate soils. Pollutants: moderate bridge length, moderate traffic volumes. Groundwater: relatively small area of compaction.	2
2	Low	Low	Med	Low	Erosion: low extent of disturbance, flat slope, and moderate bridge length. Acid Sulphate Soils: low disturbance of potential acid sulphate soils. Pollutants: moderate bridge length, moderate traffic volumes. Groundwater: relatively small area of compaction.	1
3	Low	Low	High	Low	Erosion: low extent of disturbance, flat and some steep slopes, and short bridge length. Acid Sulphate Soils: low disturbance of potential acid sulphate soils. Pollutants: low bridge length, high traffic volumes. Groundwater: relatively small area of compaction.	3
4	Med	Med	Med	Med	Erosion: moderate extent of disturbance, flat slopes, and moderate bridge length. Acid Sulphate Soils: moderate disturbance of potential acid sulphate soils. Pollutants: moderate bridge length, moderate traffic volumes. Groundwater: moderate area of compaction.	4
5	Med	Med	Med	Med	Erosion: moderate extent of disturbance, flat slopes, and moderate bridge length. Acid Sulphate Soils: moderate disturbance of potential acid sulphate soils. Pollutants: moderate bridge length, moderate traffic volumes. Groundwater: moderate area of compaction.	4
6	High	High	Med	High	Erosion: high extent of disturbance, flat slopes, and long bridge length. Acid Sulphate Soils: high disturbance of potential acid sulphate soils. Pollutants: long bridge length, low traffic volumes. Groundwater: high area of compaction.	5
7	High	High	Med	High	Erosion: high extent of disturbance, flat slopes, and long bridge length. Acid Sulphate Soils: high disturbance of potential acid sulphate soils. Pollutants: long bridge length, low traffic volumes. Groundwater: high area of compaction.	5

Table 7.4: Potential water quality risks at each locality option.

Based upon the information provided in Table 7.4, it is considered that localities 6 and 7 would have the greatest potential impacts upon water quality with a high risk of localised changes to groundwater levels due to shallow groundwater levels in the vicinity and impacts on hydraulic conductivities from embankments. Localities 6 and 7 are also located within areas of high potential occurrence of acid sulphate soils within the bed sediments of the river and on the adjacent floodplain. In addition, due to the relatively long length of the crossing required at these locations (6 and 7), it is anticipated that a greater ratio of area would be disturbed with greater risks to soil erosion and therefore potentially high levels of sedimentation entering waterways from excavation activities and associated bridge works.

Localities 4 and 5 pose moderate risks associated with all four water quality aspects as the area of disturbance and therefore soil erosion and sedimentation would be relatively moderate as would the percentage of pollutants likely to be generated. Potential impacts on groundwater and risks associated with acid sulphate soils are also considered to be moderate, as the risk of disturbing acid sulphate soils is not as high as localities 6 and 7 and the anticipated area of compaction would be also be less than localities 6 and 7.

Potential risks associated with localities 1, 2 and 3 are likely to be minimal. The area of compaction would be relatively low as the area of disturbance is smaller and the crossing shorter. Risks associated with acid sulphate soils within localities 2 and 3 are low, however locality 1 has a greater risk of potential acid sulphate soils associated with Susan Island. The likely level of pollutants generated as a result of the crossing within localities 1 and 2 would be low, while locality 3 has the potential to generate greater levels of pollutants associated with greater traffic volumes and a greater risk of accidental spills from traffic accidents.

Overall, locality 2 has the lowest risk on water quality due to low risks of potentially occurring acid sulphate soils, a smaller area of compaction and risk of impacting upon local groundwater, minimal extent of soil erosion and sedimentation and moderate levels of pollutants associated with the length of the crossing and moderate traffic levels.

In conclusion, it is considered, that the upstream and existing localities pose a relatively lower risk compared to downstream locality options.

7.8 Biodiversity

Kendall and Kendall Ecological Consultants were engaged to conduct an ecological survey (October 2003) of the study area and of the locality options. As part of the ecological assessment, a desktop review of threatened species databases was undertaken. In addition, a review of existing literature and aerial photography and field surveys. No systematic terrestrial or aquatic fauna surveys were conducted however opportunistic records of terrestrial fauna species and aquatic habitats observed were recorded. Further details of the survey methodologies and results are provided in Appendix I of this report.

7.8.1 Flora

Existing Flora

Existing vegetation within the study area consists mainly of open woodlands and grasslands that have been previously modified as a result of clearing activities, grazing and urban development. Small stands of remnant rainforest isolated trees and riparian vegetation are present within the study area. It is considered that all native vegetation within the study area has local significance as the vast majority of the study area has been cleared and only remnant trees or small patches of disturbed communities remain. It is considered that much of the study area would have been covered by a mosaic of:

- Wet open forest (Forest Red Gum – *Eucalyptus tereticornis*);
- Paperbark swamp sclerophyll forest (*Melaleuca spp.*);
- Lowland Floodplain Rainforest;
- Sedgelands and open wetlands; and
- Riparian vegetation.

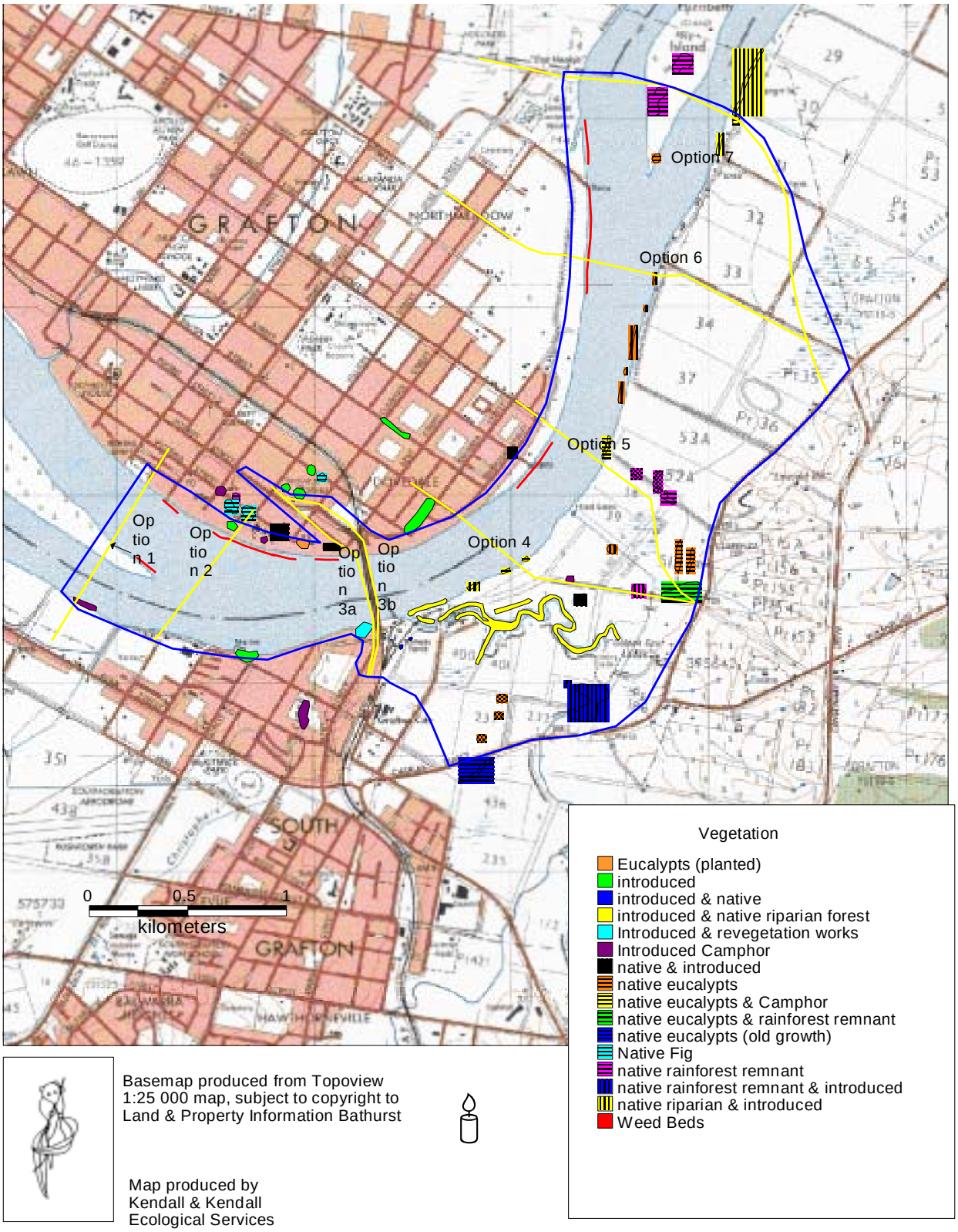
Riparian vegetation can be found within the vicinity of localities 4 and 7 along the southern riverbank with weed beds throughout the riverbed and riverbanks in localities 1, 2, 5, and 6. Riparian zones of intermittent creeks within the rural areas of South Grafton and Clarenza are often dominated by Swamp Oak (*Casuarina glauca*) and occasional specimens of Forest Red Gum (*Eucalyptus tereticornis*) and Broad-leaved Apple (*Angophora subvelutina*).

Lowland Floodplain Rainforest is an endangered ecological community under the TSC Act that occurs within proximity to, but outside of the study area, at the western end of Susan Island (locality 1). The community is listed as an endangered ecological community under Part 3 of Schedule 1 of the TSC Act and comprises the majority of the forested area that occurs on the northwest section of Susan Island. That section of Susan Island forms a Nature Reserve under the reserve system of the DEC (former National Parks and Wildlife Service) estate. The Susan and Elizabeth Island Trust manage the remainder of the island, although the remainder of Susan Island and all of Elizabeth Island is currently being considered for incorporation into the Nature Reserve (Jefferies, A. NPWS pers.comm.).

Isolated rainforest trees have also been identified in other locations of the study area that may have been part of a larger stand of Lowland Floodplain Rainforest. Isolated stands of remnant rainforest trees were surveyed within localities 2, 4, 5 and 7. A rainforest tree species was identified along the Alipou Creek Travelling Stock Route (TSR) (locality 4) during the field survey. The species identified was a Broad-leaved Brush Wilga (*Geijera latifolia*), which is considered to be very uncommon to rare, locally.

Introduced plant species were recorded throughout the majority of the study area with introduced *Camphor spp.*, sited at localities 1, 2, and 4 and other introduced species recorded at locality 3. There are 39 different declared noxious weed species in the Grafton City Council under Order No. 17 of the *Noxious Weeds Act 1993* (Grafton City Council SOE, 2002/2003).

Figure 7.1: Vegetation types within the study area.



Threatened Flora

No threatened plant species listed under the Schedules of the EPBC Act or TSC Act have been recorded within the immediate study area or were detected during the field assessment. However, a desktop review of the EPBC Act database identified that habitat for eight threatened flora species may occur within a 10km radius of the study area. DEC's wildlife atlas also lists three flora species under the Schedules of the TSC Act, as occurring within a 10km radius of the study area. Of the three threatened plant species recorded only *Amorphospermum whitei* is situated within the City of Grafton but is outside of the study area.

Table 7.5: Threatened flora species/habitat listed under the Schedules of the TSC and EPBC Acts potentially occurring within 10km of the study area.

Scientific Name	Habitat	Legal Status (EPBC/TSC)	Likelihood of occurrence
*Angophora robur**	Dry sclerophyll forest on sandy or skeletal soils	V	Nil
*Arthraxon hispidus**	Edges of rainforest in wet sclerophyll forest	V	Unlikely
*Cryptostylis hunteriana**	Coastal heath on sand	V	Nil
*Eucalyptus tetapleura**	Dry sclerophyll forest	V	Nil
*Marsdenia longiloba**	Rainforest & wet sclerophyll forest	V	Unlikely
*Melichrus hirsutus**	Dry eucalypt forest on sandy infertile soils with rocky outcrops	E	Nil
*Triplarina imbricata**	Along water courses in low open forest with Water Gum	E	Nil
*Tylophora woollsii**	Rainforest & Wet sclerophyll forest	E	Unlikely
Cryptandra longistaminea	Red gum open forest near watercourse	E	Unlikely
Amorphospermum whitei	Rainforest and adjoining moist open forest	V	Unlikely
Eucalyptus tetrapleura	Dry sclerophyll forest	V	Nil

* Denotes EPBC Act listed species with modelled habitat within 10km of the study area.

Based on habitat requirements, the likelihood of these threatened plant species or populations occurring within the study area are regarded as unlikely, as the vegetation of the study area has been subjected to a long period of disturbance resulting in severe floristic and structural modification. In addition, the study area has previously been well surveyed with no identification of any threatened flora or populations. A further discussion on the habitat requirements for each species recorded and the likelihood of occurrence is detailed in the ecological assessment, Appendix I of this report.

As previously discussed in this section, the endangered ecological community "Lowland Floodplain Rainforest" under Part 3 of Schedule 1 of the TSC Act occurs on the western section of Susan Island, outside of the study area.

Potential Risks

Potential impacts as a result of an additional crossing would include the removal of native vegetation, loss of vegetation structure and riparian vegetation, the spread of noxious weeds and new weed propagules to the area. It is anticipated that the level of impact would be minimal in areas that have previously been disturbed and cleared and consist mainly of rural agricultural pastures or built environments (localities 2, 3, and 6). However, riparian vegetation, remnant rainforest stands and native Eucalypt spp., have the potential to be affected by an additional crossing within localities 4, 5 and 7. Although locality 1 would not directly impact upon the endangered Lowland Floodplain Rainforest, the Proposal has the potential to impact indirectly through the provision of increasing access, the spread of weeds and intrusion during the construction of a crossing within this locality. In addition, the clearing of remnant native vegetation within any of the localities could be considered a 'Key Threatening Process' under the Schedules of the EPBC Act and TSC Act.

Table 7.6: A summary of vegetation/habitat potentially affected by an additional crossing for each of the localities.

Locality	Description of possible vegetation/habitat affects
Locality 1	Indirect effects upon the endangered Lowland Floodplain Rainforest.
Locality 2	The removal of a large fig in Villiers Street - part of the Grafton Conservation Area (National Estate Register) and riverweed bed habitat.
Locality 3	Possible removal of riparian and revegetated areas.
Locality 4	Possible removal of native rainforest remnants and native eucalypts.
Locality 5	Possible removal of riverweed bed habitat and part of native eucalypt and rainforest remnants.
Locality 6	Possible removal of riverweed bed habitat.
Locality 7	Possible removal of native rainforest remnants.

Source: Kendall & Kendall, 2003.

In addition to the information provided in Table 7.6, the Proposal also has the potential to impact upon landscape trees located within each of the localities, through widening potential works associated with the Proposal. These trees mainly include species within the genera of *Brachychiton, Ficus or Jacaranda* that are located throughout the streets of the City of Grafton and are of local heritage significance.

7.8.2 Fauna

Fauna Habitat

Birds, reptiles, amphibians and mammals are the four main fauna groups recorded within the City of Grafton. For the year 2002/03, a total of 215 fauna species were listed in the DEC's Atlas for Grafton. Birds have been the most commonly identified fauna species within the area, including numerous migratory species in addition to those listed under the provisions of the EPBC Act.

The terrestrial fauna habitat within the study area has been severely compromised by clearing, drainage and other disturbances associated with rural and urban development. Fauna habitat is mainly restricted to isolated trees and remnant patches of vegetation, although timber bridges are known to provide sheltering, nesting and roosting habitat features for animals, in particular, microchiropteran bat species.

Although, it is considered that the most important habitat types within the study area include:

- The Lowland Rainforest on Floodplain on the western end of Susan Island just outside of the study area and other small stands of rainforest in the study area; and
- The tree hollows of the senescent Forest Red Gum (*Eucalyptus tereticornis*) trees. A small stand of old growth Eucalypt spp. occurs to the south of the study area, within the vicinity of locality 5 between the Pacific Highway and the Clarence River.

Isolated stands of Forest Red Gums (*Eucalyptus tereticornis*) and Figs also provide foraging habitat and food resources for threatened fauna species. Susan Island, in particular, provides an important habitat for a permanent colony of the threatened TSC Act listed Grey-headed Flying Fox (*Pteropus poliocephalus*).

In addition, remnant vegetation and isolated trees also provide connectivity for mobile wildlife species capable of moving between isolated habitat resources. The closest identified regional wildlife corridors to the study area include:

- Picnic Creek Regional Corridor, approximately 5km to the west of the study area between Eldon Creek and Orara River; and
- Bushy Park Regional Corridor, approximately 6km to the south of the study area between Shannon Creek and the north coast railway (see Appendix I).

Threatened Fauna

No threatened or migratory fauna species listed under the Schedules of the TSC Act or EPBC Act were recorded during the field survey. However, a desktop review of the EPBC database and DEC's Wildlife Atlas indicates that there are 27 threatened and migratory fauna species that have previously been recorded within 10km of the study area or that may utilise habitat of the study area. These include eighteen (18) birds, eight (8) mammals and one (1) reptile species. Table 7.6 lists those threatened and migratory fauna species that are known or likely to occur (under the Schedules of the TSC Act and EPBC Act) that may utilise the habitat of the study area. It is anticipated that these species would be subject to further assessment once a preferred route has been identified. A more detailed discussion of species habitat requirements and likelihood of occurrence are detailed in Appendix D and Map 4 of the ecological report (see Appendix I).

Table 7.7: Threatened fauna and migratory species listed under the provisions of EPBC and TSC Act with predicted habitat within 10km of the study area.

Common Name	Scientific Name	Habitat	Likelihood of Occurrence	*Status
White-bellied Sea-eagle	Haliaeetus leucogaster	Maritime habitats and terrestrial wetlands and large rivers (Marchant & Higgins 1993)	Known	5
Swift Parrot	Lathamus discolor	Dry eucalypt forest (Higgins 1999)	Possible	1
White-throated Needle tail	Hirundapus caudacutus	Aerial over variety of vegetation types	Known	5
Rufous Fantail	Rhipidura rufifrons	Wet sclerophyll forest/rainforest	Known	5
Satin Flycatcher	Myiagra cyanoleuca	Tall & medium open forests (Simpson & Day 1993)	Possible	5
Black-faced Monarch	Monarcha melanopsis	Wet sclerophyll forest/rainforest	Known (Susan Island)	5
Spectacled Monarch	Monarcha trivirgatus	Wet sclerophyll forest/rainforest	Known (Susan Island)	5
Regent Honeyeater	Xanthomyza phrygia	Terrestrial wetlands usually west of the Great Dividing Range	Possible	1, 3 & 5
Spotted-tailed Quoll	Dasyurus maculatus	Variety of forest types	Known (Sth Grafton)	2
Grey-headed Flying-fox	Pteropus poliocephalus	Roost in camps in rainforest & swamp forest, known to roost on Susan Island and feed in a variety of forest types (NPWS 2002b)	Known	4
Black Flying-fox	Pteropus alecto	Roost in camps in rainforest & swamp forest, known to roost on Susan Island and feed in a variety of forest types (NPWS 2002b)	Known	4
Large Pied Bat	Chalinolobus dwyeri	Variety of forest types (Parnaby & Gilmore 1994)	Possible	2
Common Bentwing-bat	Miniopterus schreibersii	Variety of forest types (Parnaby & Gilmore 1994)	Possible	4
Little Bentwing-bat	Miniopterus australis	Variety of forest types, generally roost in caves, tunnels etc (NPWS 2002b) but recorded roosting in tree hollows.	Possible	4
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	Variety of forest types, nests in hollows (NPWS 2002b)	Possible	4
Hoary Wattled Bat	Chalinolobus nigrogriseus	Dry eucalypt forest (NPWS 2002b)	Possible	4
Three-toed Snake-tooth Skink	Coeranoscincus reticulatus	Rainforest and occasionally moist sclerophyll forest on sandy soils (NPWS 2002b)	Known (Susan Island)	2 & 4

Common Name	Scientific Name	Habitat	Likelihood of Occurrence	*Status
Pied Oystercatcher	Haematopus longirostris	Open beaches, intertidal flats, sand banks & occasionally headlands (NPWS 2002b)	Possible (occasional)	4
Latham's Snipe	Gallinago hardwickii	Open freshwater permanent & temporary wetlands also fresh meadows and edges of rivers (Higgins & Davies 1996)	Known	6
Painted Snipe	Rostratula benghalensis	Shallow freshwater and occasionally brackish wetlands (Marchant & Higgins 1993)	Possible	6
Australian Painted Snipe	Rostratula australis	Wetlands	Possible	2
Black-necked Stork	Ephippiorhynchus asiaticus	Swamps, mangroves, mudflats, dry floodplains & irrigated land (NPWS 2002b)	Likely	3
Magpie Goose	Anseranas semipalmata	Shallow wetlands (NPWS 2002b)	Possible	4
Freckled Duck	Stictonetta naevosa	Terrestial wetlands usually west of the Great Dividing Range but seeks drought relief on coasts (Marchant & Higgins 1990)	Possible	4
Square-tailed Kite	Lophoictinia isura	Dry woodland and open forest (NPWS 2002b)	Likely	4
Osprey	Pandion haliaetus	Forages for fish in rivers lakes and estuaries (NPWS 2002b)	Known, nests on Susan Island	4
Masked Owl	Tyto novaehollandiae	Variety of forest types (Gilmore & Parnaby 1994)	Possible	4

Source: Kendall & Kendall, 2003.

*Status: 1= species listed as endangered under the provisions of the EPBC Act 1999
2= species listed as vulnerable under the provisions of the EPBC Act 1999
3= species listed as endangered under the Schedules of the TSC Act 1995
4= species listed as vulnerable under the Schedules of the TSC Act 1995
5= terrestrial species listed under the migratory provisions of the EPBC Act 1999
6= wetland species listed under the migratory provisions of the EPBC Act 1999

Those species known to occur within the study area include the Osprey (*Pandion haliaetus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*). A local population of Grey-headed Flying-fox occur on Susan Island to the west of the study area, which have been observed camped in the rainforest throughout most of the year. However, numbers tend to decrease to a few hundred or even to zero during the winter months. Small numbers forage over most of the island in blossoming and fruiting trees when these are available, but mostly animals disperse from Susan Island in the direction of available food, which is mostly nectar and pollen of eucalypts and other tree species. The Grey-headed Flying-fox population on Susan Island is one of the largest in NSW although numbers are variable with peak numbers occurring in summer (Mark Williams DEC pers comm.). The maternity colony on Susan Island is regarded as an important maternity camp with numbers reaching 200,000 at certain times of the year (Jeff Thomas DEC pers comm.). As it is estimated that there are only approximately 400,000 Grey-headed Flying Foxes remaining in Australia, Grafton is sometimes host to half of the entire country's population of this species (Grafton City Council SOE, 2000/01).

Little Red Flying-foxes (*Pteropus scapulatus*) and threatened Black Flying-foxes (*Pteropus alecto*) have also been observed occasionally stopping over on Susan Island (Grafton City Council SOE, 2000/01).

Potential Risks

Potential impacts as a result of an additional crossing of the Clarence River at Grafton would include habitat removal, habitat modification and degradation, fragmentation, disruption to local habitat linkages, barrier formation, and road strike mortality. In addition, the clearing of remnant vegetation within any of the localities could be considered a 'Key Threatening Process' under the Schedules of the TSC and EPBC Acts. A summary of these potential impacts within each of the localities is detailed in Table 7.8 below.

Table 7.8: Summary of potential impacts upon fauna/fauna habitat for each locality.

Locality	Habitat Fragmentation	Habitat Modification	Potential Road Strike	Comments
1	Nil	Nil	Yes	Potential impact on the movement of Grey-headed Flying-foxes.
2	Nil	Nil	Yes	Potential impact on the movement of Grey-headed Flying-foxes although less impact than locality 1.
3	Nil	Nil	No	This option confines any potential impact to the same locality as the impact created by the existing bridge.
4	Yes	Edge effects	Yes	Potential impact on local corridors between areas of remnant vegetation.
5	Yes	Edge effects	Yes	Potential impact on local corridors between areas of remnant vegetation.
6	Nil	Shading	Yes	Limited impact on wildlife movement.

Locality	Habitat Fragmentation	Habitat Modification	Potential Road Strike	Comments
7	Yes	Edge effects	Yes	Potential impact on movement of wildlife between native rainforest remnants on Elizabeth Island.

Source: Kendall & Kendall, 2003.

The construction of an additional crossing within localities 4, 5 and 7 has the potential to directly impact upon fauna habitat through the potential removal of remnant rainforest patches and the potential to modify the existing value of remaining habitat as a result of edge effects such as a change in solar regime and increased exposure to wind and noise. The removal of these remnant patches would also be likely to cause further fragmentation and to some degree impact on wildlife movement.

Localities 1 and 2, being elevated and on or near Susan Island, have the potential to create a barrier to the movement of Grey-headed Flying-foxes as they leave and return to their camp on Susan Island and in addition, have the potential to create road strike mortality on aerial animals including threatened bat and bird species. The potential for road strike upon all groups of fauna also has the potential to occur within localities 4, 5, 6, and 7. It is anticipated that locality 3 would have the least impact as this locality does not lie close to any remnant vegetation and would be confined to an existing area of wildlife movement obstruction and potential road strike. However, there is the potential that the existing bridge may provide habitat and shelter for micro-chiropteran bat species and some bird species.

It is also considered that a crossing within localities 1 and 7 would increase access to the Islands and as a result increase the risk of introducing feral animals to the area.

In conclusion, it is considered that localities 3 and 6 would have the least impacts, whilst locality 1 would have the greatest impacts due to its potential impacts upon Susan Island and associated flora and fauna. Locality 2 has the potential to affect a large fig tree that is likely habitat for bat species while localities 4 and 5 may impact upon remnants of Lowland Floodplain Rainforest and fauna movement.

7.8.3 Aquatic Ecology

Aquatic Habitat

The aquatic environment in Grafton is dominated by the Clarence River, which divides the City into North and South. At its widest point within the study area, the river is approximately 650m wide and at its narrowest point is approximately 300m wide. At Grafton the Clarence River flows around a large U bend. On the inside curve (north bank) the banks are not steep and sandy substrate slopes gently into the river. On the outer edge of the bend, (south bank) the banks are steep and the substrate is rockier, and slopes more sharply into the river. A local resident and fisher reported that the river depth on the southern side is approximately 6m deep near the bank.

The Clarence River at Grafton lies in the upper part of the estuary where the freshwater current from upstream usually overrides the tidal saltwater from the lower sections of the estuary, although the influence of the tide still occur within the study area. At Grafton, the river is usually predominantly freshwater overlying a prism of salt water, which allows aquatic vegetation more typical of freshwater rivers to occur. Hence, the predominance of freshwater in the study area

has restricted the establishment of communities typical of tidal estuaries such as mangroves, salt marshes and seagrass beds. During the field inspection, no weed beds were located in areas where they had been previously mapped from aerial photography. There have also been recent sightings of sharks and dolphins in the river at Grafton (Nigel Blake pers. comm.).

Freshwater weed beds that are usually present in the Clarence River at Grafton within the study area would provide shelter for fish fingerlings and usually consist of ribbon weed (*Vallisneria gigantea*) in the shallow areas and dense waterweed (*Egeria densa*) in deeper locations. Weed beds are more vigorous in open unshaded areas and do not occur under the existing bridge (Nigel Blake, wetlands officer, DIPNR pers. comm.).

Overall, the Clarence River can be classified as a Class 1 habitat under the *NSW Fisheries Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures, 1999*, which constitutes a major fish habitat.

Aquatic Fauna

No surveys of macro-invertebrates were undertaken as part of the assessment, although it is expected that a range of macro-invertebrates would be present and include classes such as crustaceans, molluscs, insects, annelids and arachnids. A search of the "Fish files" on the CANRI website did not list any macro-invertebrates as occurring in the Clarence River near Grafton, and either the river does not contain suitable habitat or is not in the distribution range of threatened macro-invertebrate species listed on the Schedules of the *Fisheries Management Act 1994* (FM Act).

Fish species occurring in the Clarence River at Grafton are usually estuarine species as the water is generally too salty for freshwater fish, although fish such as bass and estuary perch are found during their annual migrations (Nigel Blake pers comm.). A local fisher also reported catching jewfish, mullet, bream, catfish and eels within the study area. A search of the NSW Fisheries "Fish Files" on the CANRI website indicated numerous freshwater fish as occurring in the Clarence River catchment with Grafton as the closest town, however, all of these except the Long-finned Eel were recorded in the Orara River well upstream from the study area.

Threatened Species

The NSW Fisheries website provides a description of the habitat and distribution of species listed as threatened under the FM Act. It is considered that only two species have remotely possible occurrences within the study area, these being:

- Eastern Cod (*Maccullochella ikei*); and
- Green Sawfish (*Pristis zijsron*).

The Eastern Cod was once distributed throughout the freshwater areas of the Clarence River but has retracted to pristine areas of the upper catchment. Its decline is attributed to over fishing and water quality deterioration. These disturbance factors make the occurrence of the Eastern Cod unlikely in the study area. The Eastern Cod is also listed as a nationally threatened species.

The Green Sawfish is rarely recorded; its habitat includes the upper reaches of estuaries in NSW. Due to its rarity, it is considered an unlikely occurrence in the study area. Therefore, it is not anticipated that the Proposal would impact upon any known threatened aquatic species listed under the Schedules of the FM Act and EPBC Act.

Potential Risks

The construction of bridges has the potential to cause primary and secondary impacts. During construction, the Proposal may cause primary impacts such as loss of riparian and sub tidal fish habitat due to disturbance of the foreshore, shading, bed scouring, and accelerated sedimentation. The operation of the Proposal may result in secondary impacts such as long term barriers to fish movements, changes to habitat in particular aquatic plant communities, increased pollution, and alter the frequency of flooding by altering bank heights. Floodplains provide important food sources and spawning grounds for fish during floods and allow fish to move between rivers, creeks and wetlands (NSW Fisheries, 1999).

The likelihood and severity of potential primary and secondary impacts for each locality would vary depending upon the design of the bridge and its location. The design of the crossing is not known at this stage, however based upon the existing environment, it is anticipated that localities 2, 5 and 6 would have a greater impact upon fish habitat than localities 1, 3, 4, and 7 due to the potential disturbance to existing weed beds. Locality 4 would have a greater potential flooding impact, which in turn has the potential to degrade aquatic food sources and habitat. An additional crossing within locality 4 may require a crossing across Alipou Creek which may require the removal of riparian habitat and involve bed and bank disturbance from the construction and placement of bridge abutments and piers. In addition, localities 4, 5, 6 and 7 would have a greater risk of habitat modification due to a larger ratio of shading as a result of longer bridge spans and approaches.

It is considered that locality 3 would have the least potential impact due to the lack of habitat, minimal impact on flooding and shading impacts and minimal impact on fish movements. The positioning of bridge piers for locality 3 is likely to be similar to the existing bridge and require less number of piers than localities 1, 2, 4, 5, 6 and 7, due to distance and immediate landform. However, locality 1 is likely to have the least number of piers in the water due to the option of utilising Susan Island. The level of impact upon aquatic biodiversity from pollution is associated with potential water quality impacts, which is discussed in Section 7.7 of this report.

Due to the locality of the study area, the Proposal has the potential to encounter acid sulphate soils within the Clarence River at Grafton and adjacent floodplains, creeks, drainage lines, islands and riparian zones. The release of acid water from acid sulphate soils also has the potential to cause localised contamination, fish kills and fish diseases, and impacts upon frog populations and waterfowl habitat. Acidic water destroys food resources, displaces biota to other areas, precipitates iron that smothers vegetation and microhabitat and alters the chemical and physical properties of the water. The acid not only affects general habitat but also many spawning and nursery grounds. As the likely occurrence of acid sulphate soils in the bottom sediments of the Clarence River is high, it is considered that each locality has a high risk, although localities 2 and 3 have been identified as having potentially a low risk occurrence than localities 1, 4, 5, 6 and 7. Locality 7 is likely to have a greater risk due to a larger ratio of adjacent floodplain that has been identified as a high risk area.

In addition, the Proposal has the potential to be considered as contributing to "key threatening processes" listed under the FM Act, these being:

- The removal of large woody debris. Although no large woody debris was observed during the field inspection there may be submerged large woody debris;
- The degradation of native riparian vegetation along NSW water courses; and
- The installation and operation of instream structures and other mechanisms that alter the natural flow regimes of rivers and streams.

It is anticipated that further aquatic studies would be undertaken to determine the level of impacts associated with the preferred route and to identify mitigation measures that would be required to ameliorate potential impacts.

7.9 Non-Indigenous Heritage

BIOSIS Research undertook an assessment of non-Indigenous heritage within the study area during October - December 2003. The assessment included a review of literature and historical themes, field inspections and consultation with Grafton City Council and the Clarence River Historical Society Inc. In addition, a desktop database search was conducted on the following registers for listings within each of the localities and surrounds: NSW State Heritage Register/Inventory, Register of the National Estate, RTA's and SRA's Heritage and Conservation Register, the NSW Maritime Heritage and National Shipwreck Databases and Heritage Schedules listed under the Grafton LEP 1998, and North Coast REP. Results of the findings are summarised below in Table 7.8. Further details of the findings are provided in Appendix J of this report.

Seventeen known statutory listed heritage items including two conservation areas and three known non-statutory items are located within the study area. Statutory listed items include those items listed on statutory registers such as the State Heritage Register/Inventory, Grafton LEP, North Coast REP and Register of the National Estate, while non-statutory items include items listed on Grafton City Council's heritage inventory and study, the National Shipwreck Database and NSW Maritime Heritage Database. Although the shipwreck databases are not statutory registers, shipwrecks are however, protected by the NSW *Heritage Act 1977* if the item is over 50 years of age and located in NSW.

Table 7.8 provides a complete list of statutory and non-statutory listed heritage items identified within each of the proposed localities. Results in Table 7.9 indicate that non-Indigenous heritage items, including REP and LEP Conservation Areas, are present within each of the proposed localities.

Within the study area, there are two items of State Heritage Significance within the proximity of locality 3 (Grafton City Railway Station and the Grafton Rail and Road Bridge) and 1 item within locality 1 (Saraton Theatre) and locality 6 (Grafton Gaol). Items of regional significance include four items within locality 3, three items within locality 1 and one item within localities 5 and 6. Localities 1, 2 and 3 fall within the Grafton REP Urban Conservation Area, with localities 1 and 2 also situated within the Grafton LEP Civic Precinct Conservation Area.

One of the heritage items identified within locality 3 includes the S.S *Induna.* The Induna was a rail ferry which sank at mooring on the south bank of the river in 1932. The wreckage is located at South Grafton, 200m upstream from the Clarence River Bridge. The hulk is visible from the bridge or the river.

The REP Grafton Urban Conservation Area encompasses two broad regions 1 to the north and 1 to the south of the Clarence River, consisting of land bounded by Turf Street and the railway line to the river at Grafton, and Minden and Ryan Streets and Christopher Creek in South Grafton. The LEP Conservation Area includes the Grafton Civic Precinct Conservation Area that encompasses areas within Victoria Street and Duke Street (locality 1 and 2). Many items within the Conservation Areas are not necessarily listed individually, but the existence of the conservation area entails further assessment.

Tree plantings within the City of Grafton are also considered a significant element of Grafton's city character and fabric. Tree species within the genera of *Brachychiton, Ficus* or *Jacaranda* located in any road reserve and being more than 3m in height are listed as a heritage item on

Councils' LEP. Tree species within the genera of *Brachychiton, Ficus* or *Jacaranda* can be found in each of the proposed localities. The Susan Island Nature Reserve on Susan Island (locality 1) is also a heritage item listed on the RNE and is the sole representative remnant of the formerly extensive cedar brushes of the Clarence Valley.

Potential Risks

In summary, localities 1 and 3 consist of five or more listed heritage items while localities 2, 4, 5, 6, and 7 consist of one to three listed heritage items that may be potentially affected by the Proposal and associated road improvements, through vibration effects, earthworks, direct removal, property acquisition and aesthetics. It is anticipated that the level of impact would be greater within localities 1, 2 and 3 than localities 4, 5, 6 and 7.

Potential impacts upon the State Heritage listed Clarence River Bridge (locality 3) would include impacts on the aesthetics of the existing bridge and impacts associated with proposed modifications to the existing 'kinks' should an additional crossing within this locality occur. To determine the level of impact for this locality it is anticipated that a Statement of Heritage Impact (SoHI) would be required for the Proposal including the Proposal to modify the existing 'kinks' in addition to the requirements for submitting an application to the NSW Heritage Office under Section 60 of the *NSW Heritage Act, 1977*.

Potential impacts within localities 4, 5, 6 and 7 would generally include affects upon non-statutory heritage items and tree species of the genera *Brachychiton, Ficus or Jacaranda*, as a result of associated road works.

It is anticipated that heritage items within the study area would be subject to further assessment once a preferred route has been adopted for the Proposal.

Table 7.9: Non-Indigenous Heritage items identified within each of the locality options.

Heritage Item	Address	Locality	SHR	SHI	LEP Item	LEP Area	REP Item	REP Area	S170	RNE	NSD	GCHI
Grafton Gaol	Arthur Street	6	x	x	x		x			x		
Saraton Theatre	101 Prince Street	1	x					x		x		
Northern Rivers County Council Building	17 Prince Street	1		x	x			x				
Pullens Store and Warehouse Group	7-9 Prince Street	1					x	x				
National Australia Bank	39 Prince Street	1		x	x		x	x		x		
Grafton Post Office	57 Victoria Street	1		x		x	x	x		x		
Induna	River Bank 200m upstream of bridge (south bank)	Adjacent 3					x				x	
Bow Memorial (Earle Page Park)	Bent Street	3					x					
Showground Barn (TJ Ford Pavillion)	Prince Street	5		x	x		x					
Grafton City Railway Station	Railway Lands	3	x	x			x		SRA/RTA			
Clock Tower	Corner Prince and Pound Streets	1		x	x							
Grafton Rail and Road Bridge	Bent/Fitzroy Streets across Clarence River	3	x	x	x		x		SRA/RTA			
Brachychiton, Ficus or Jacaranda Trees	Various	All			x							
Rail Viaducts	Various	Various		x				x	SRA/RTA			
Conservation Areas North Coast REP	See Figure 2a of Appendix J	1, 2 & 3		x				x				
Conservation Areas Grafton LEP	See Figure 2b of Appendix J	1 & 2		x		x						
Susan Island	Clarence River	1								x		
Albion Hotel	Arthur Street	6										x
Tooheys Brewery	170 North Street	7										x

Source: Biosis Research 2003.
Notes: SHR: State Heritage Register; SHI: State Heritage Inventory; RNE: Register of National Estate; NSD: National Shipwreck Database; GHI: Grafton Council Heritage Inventory.

7.10 Indigenous Heritage

A broad investigation of Indigenous heritage was undertaken by BIOSIS Research during October - December 2003 to identify known Indigenous sites and areas of potential cultural heritage. The assessment involved reviews of previous archaeological assessments, a search DEC's Aboriginal Heritage Information Management System (AHIMS), fieldwork and consultation with Grafton Ngerrie Local Aboriginal Land Council (LALC). Further details of methodologies and results of the survey are provided in Appendix K of this report

Indigenous sites can generally be divided into two types. The first type are sites with tangible evidence of past Aboriginal occupation: these include occupation sites (containing material such as stone artefacts, charcoal or shell), modified trees, grinding grooves, burial sites and art sites. The second category is those sites relating to less tangible cultural elements such as ceremonial or dreaming sites. Some ceremonial sites, such as bora rings, may have tangible elements but many are natural landscape features that take on cultural significance through ceremonial or religious association. Tangible, ceremonial, and dreaming sites have been identified in the Grafton region and within the study area.

DEC's AHIMS (for an area of 5-6km including the study area) identified five Indigenous sites as previously recorded. Of the five sites, four sites are located within the study area. Table 7.10 below provides a summary of the known sites registered on the AHIMS within the study area.

Table 7.10: A summary of AHIMS registered Indigenous heritage sites.

Site Name	Site Type	Location
Grafton Marriage Trees	TRE	Locality 4 (Alipou Creek)
Goorie Park	TRE	Nil locality (Fisher Park)
Susan Island	CMR	Locality 1 (Susan Island)
Clarence River Golden Eel	ACD	Locality 3 (Downstream of existing bridge, southern river bank)
Elizabeth Island Woman's Place	ACD	Locality 7 (Elizabeth Island)

Source: BIOSIS Research 2003. Notes: TRE: Modified Tree (Carved or Scarred); ACD: Aboriginal Ceremony and Dreaming; CMR: Ceremonial Ring (Stone or Earth);

Both Susan and Elizabeth islands and downstream of the existing bridge (localities 1, 3, and 7) have been identified as areas associated with ceremonial practices or dreaming and have been recorded as significant sites to the Indigenous local community. Many ceremonial and dreaming sites may still hold significance regardless of disturbance since non-Indigenous settlement. In general, the Indigenous community has recorded all of the study area as significant for a variety of reasons.

Carved or scarred trees are also present within North and South Grafton. Grafton Marriage Trees are located in close proximity to locality 4 along Alipou Creek. A carved or scared tree is also located within Fisher Park that has tangible evidence and is associated with a non-Indigenous constructed dam. Due to extensive vegetation clearing in the past, the potential for other scarred trees to occur within the study area is generally low. It is considered that scarred trees are likely to be an uncommon site type within the region.

During site inspections, no other Indigenous sites were identified, although areas adjacent to Alipou Creek (locality 4) were noted as an area of potential archaeological sensitivity, as the creek is likely to have been rich in resources. The potential for further Indigenous heritage within and surrounding localities 2, 5, and 6 and upstream of the existing bridge is generally low

as much of the riverbank and floodplain has been disturbed from flooding, levee construction, agriculture and landscaping associated with urban development. However, some sub surface material of a disturbed nature may still be present in these areas. In areas of aggrading soil landscapes, it is possible that deeply buried material could also be present.

During the Indigenous assessment, consultation was undertaken with representatives of Grafton Ngerrie LALC and DEC. During the course of discussions it was expressed by representatives that there was some difficulty in assessing the community concerns over such a wide area with no identified specific impacts. The most significant issue raised by representatives was the likely presence of further dreaming and ceremonial sites associated with the Clarence River.

Potential Risks

Risks associated with the construction and operation of the Proposal would include direct and indirect impacts through vegetation clearing, excavation works and modification of the landscape, and through vibration effects.

In conclusion of the assessment undertaken and background investigations, it is considered that based upon information received and known recorded Indigenous sites, localities 2, 5 and 6 would have the least potential for areas of archaeological sensitivity, whilst, localities 1 and 7 consist of areas of high Indigenous significance. Localities 3 and 4 also consist of areas of archaeological sensitivity and of recorded Indigenous sites.

It must however, be noted that consultation with the Grafton Ngerrie Local Aboriginal Land Council (LALC) was undertaken to identify Indigenous heritage constraints for the study area prior to short listing of the crossing localities and that information concerning Indigenous Heritage within the study area may not be comprehensively addressed in this report.

It is planned that further consultation with the Grafton Ngerrie LALC would be undertaken with further detailed assessments conducted following the short listing of the crossing localities.

7.11 Noise

Existing noise sources within each of the localities would vary depending on the immediate and surrounding land uses. It can be expected that existing noise levels at localities 1 to 3 would be greater than localities 4 to 7 due to a greater exposure to traffic volumes and commercial activities. Areas away from major road networks and within residential and urban areas are likely to experience minimal noise levels.

To determine the level of potential impacts for each of the localities and background noise levels at the existing bridge, a broad operational noise assessment was undertaken. Note that noise impacts associated with construction of an additional crossing would be assessed at a later stage, as construction noise would be influenced by the concept design and techniques likely to be adopted.

To determine the background noise levels at the existing bridge, two noise data loggers from the 15 to 23 September 2003 were placed at the closest residences on the northern and southern sides of the existing bridge (see Figure 2.1 of Appendix L). Traffic movements at this location were also recorded in conjunction with noise monitoring to ensure direct correlation between traffic noise and volume.

The assessment background level (ABL) for each day, evening and night period was determined by using the tenth percentile method. The ABL is the “L90 of the L90” over each day, evening

and night period. The rating background level (RBL), used to establish the local noise criteria, is defined as the median assessment background level over all days for each period. Table 7.11 below provides a summary of the RBL for daytime and night time in comparison with the appropriate DEC criteria, which in this case is an existing arterial road.

Table 7.11: Measured traffic noise against DEC operational noise criteria.

Residential Receptor	Measured Day dB(A)	Criteria Day dB(A)	Criteria Exceedance dB	Measured Night dB(A)	Criteria Night dB(A)	Criteria Exceedance dB
	$L_{Aeq,15hr}$	$L_{Aeq,15hr}$		$L_{Aeq,9hr}$	$L_{Aeq,9hr}$	
North	57.0	60.0	- 3.0	51.5	55.0	- 3.5
South	57.4	60.0	- 2.6	53.3	55.0	- 1.7

Note: $L_{Aeq,\ T(hr)}$ represents the continuous equivalent sound pressure level at a receiving location for the traffic volume between the 15-hour period from 7 am to 10 pm and the 9-hour period from 10 pm to 7 am.

Results presented in Table 7.11 shows that the $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$ traffic noise levels at both residential receptors fall within the relevant DEC criteria for the redevelopment of an existing freeway/arterial road, by approximately 2 to 3dB. As outlined above, the road traffic noise criteria for locality 3 is 60dB(A) during the day and 55dB(A) during the night time. In consideration of existing background noise levels recorded it can be concluded that the existing environment within locality 3 is relatively noisy.

The DEC *Environmental Criteria for Road Traffic Noise 1999*, is used as a recommended guide in assessing road traffic noise impacts and for determining the need for ameliorative measures. The criterion is applied to the relevant types of roads and land uses and recognises any extra noise sensitivities (i.e. schools and hospitals) in which standards that are more stringent are expected. Sensitive noise land uses within the study area include proposed school classrooms, existing schools, places of worship, areas of passive recreation and school playgrounds (locality 2) and the Grafton Hospital (locality 6). A list of the relevant criterion applicable to the road sections and noise sensitivities within each of the localities is detailed in Section 2.1 of the Noise Assessment report (see Appendix L). It should however, be noted that in consideration of the future category of road type, the criteria provided at this stage of the project may not necessarily be relevant in the future. Therefore it is anticipated that future investigations and consultation with DEC would be undertaken to determine the most appropriate road traffic noise criteria relevant to the preferred route selected.

Potential Risks

To determine the level of potential noise impacts associated with an additional crossing, a qualitative analysis was undertaken, where each of the proposed localities were ranked in order according to prevalence of noise impacts on residential receivers. A representative value to enable comparison between each locality was then determined by considering three basic parameters in conjunction with the likely effects of absolute traffic noise level and of changes in traffic noise levels on potential annoyance. The three basic parameters included:

- Number of residential properties potentially affected;
- Future absolute noise level at each residence; and
- Change in noise levels (both increases and decreases) from the existing situation at each residence.

The predicted change in noise levels from the existing situation was then reviewed against DEC's *Environmental Criteria for Road Traffic Noise 1999,* likely to be relevant to that locality. Further details of the methodology for which the noise assessment was prepared is provided in Appendix L of this report.

Results of the qualitative analysis in Table 7.12 indicate that the locality options with the lowest weighted value correspond to the route with the least impacts. Localities 1 and 3 have been identified as having the least potential impacts primarily because of the lower number of residents in comparison to localities 2, 4, 5, 6 and 7 and due to a likely minimal noise increase of between 0dB(A) and 3dB(A) in comparison to a noise increase of between 4dB(A) and 12dB(A). Although locality 3 receives the greatest percentage of traffic levels, the actual change in noise levels over the existing noise levels would be minimal, as traffic noise dispersed from two bridges would make little change.

The potential noise impacts associated with an additional crossing within locality 2 are anticipated to be similar to those impacts identified for localities 1 and 3, however a number of noise sensitive land uses have been identified within the area. As a result, the noise criterion applicable is lower and more stringent, resulting in a greater potential impact without ameliorative measures.

It is anticipated that localities 4, 5, 6 and 7 would generate the greatest potential impacts due to a larger number of residents being further away from the existing bridge and thereby being subjected to a greater change in absolute traffic noise levels. For example, residents that experience little or no traffic noise currently are likely to be more affected by traffic noise on a new road alignment than those residents that experience some road traffic noise where noise from traffic on a realigned or upgraded road may make little or no change. Hence, the weighted value for localities 4 to 7 is significantly higher than localities 1 to 3.

Overall, the Proposal has the potential to exceed the relevant *Environmental Criteria for Road Traffic Noise 1999*, for those residents closest to the road without appropriate ameliorative measures.

A further assessment of operational and construction noise and vibration effects including a review of ameliorative measures would be undertaken following the selection decision of a preferred route.

Table 7.12: Summary of the noise assessment rankings, in ascending order.

Locality	Comment	Results
1	Provides the least noise impact, primarily because the proposed locality would mainly effect commercial properties north of the Clarence River and a low number of residents on the southern side adjacent to the Gwydir Highway.	• Weighted comparison value = 88. • Traffic noise level increase over existing is in the order of 3dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
3	Provides minimal impact over the existing alignment, primarily because the existing traffic volume would be split equally over two bridges with total traffic noise generation being similar. However, some residents are likely to experience either an increase or decrease in received noise levels from being closer or further from traffic respectively.	• Weighted comparison value = 110. • Traffic noise level increase over existing is in the order of 0 to 3dB(A). • Some residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
2	This option impacts sensitive land use, that is a school and place of worship located either side of Villiers Street. Stringent DEC criteria for sensitive land use may significantly increase the difficulty for compliance.	• Weighted comparison value = 407. • Traffic noise level increase over existing is in the order of 4dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
7	This option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise.	• Weighted comparison value = 2520. • Traffic noise level increase over existing is in the order of 11dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
5	Locality 5 primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise.	• Weighted comparison value = 3767. • Traffic noise level increase over existing is in the order of 10dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
4	This option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise.	• Weighted comparison value = 4274. • Traffic noise level increase over existing is in the order of 11dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.
6	Locality 6 provides the greatest impact primarily because of a larger number of residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. This option also impacts sensitive land use, that is hospital wards located on Arthur Street.	• Weighted comparison value = 4441. • Traffic noise level increase over existing is in the order of 12dB(A). • Nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

Source: Environmental Resource Management Australia Pty Ltd, 2003.

7.12 Air Quality

Local air quality surrounding the study area is likely to be influenced by dominant land uses within the Grafton LGA, local topography and meteorological conditions. Dominant land uses associated with local air quality include rural agricultural activities, mining and quarrying, timber mills, reserves, urbanisation and infrastructure. As grazing and grasslands comprise the largest ratio of land use, it is considered that existing local air quality would consist of relatively low levels of pollution. Minimal levels of pollution that may occur within the Grafton LGA are likely to be associated with emissions from motor vehicles, bushfires, the burning of cane fields to the north of Grafton, backyard burning and incineration, (Grafton City Council SOE, 1999/2000), timber mills, concrete plants, brick works and the hospital (Grafton City Council SOE, 1999/2000). In addition, the National Pollutant Inventory (NPI) indicates six top indicative sources of emissions and a range of pollutants within the Grafton region, which are summarised in Figures 7.2 and 7.3 below.

Figure 7.2: Total emissions (%) of substances based on indicative sources within the Grafton Region.

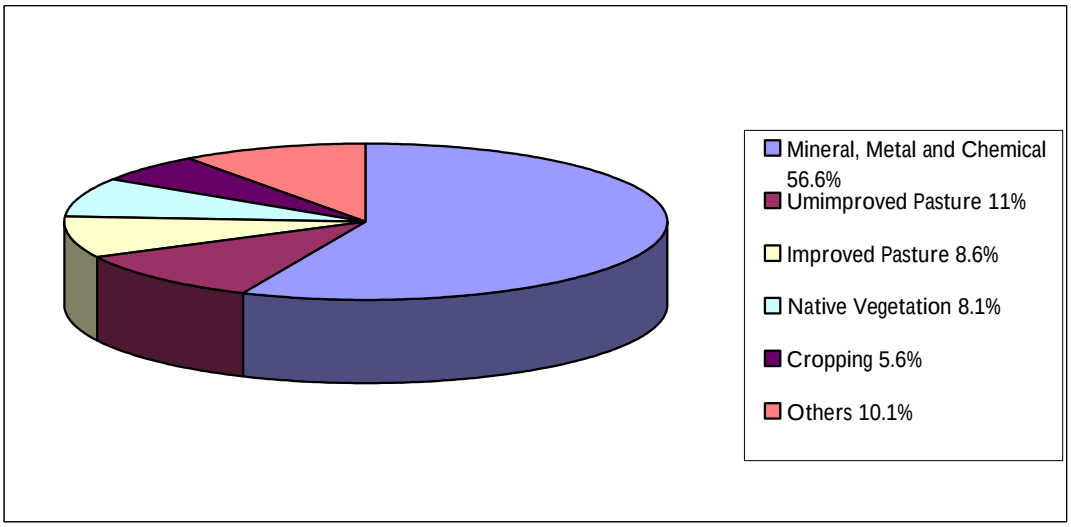
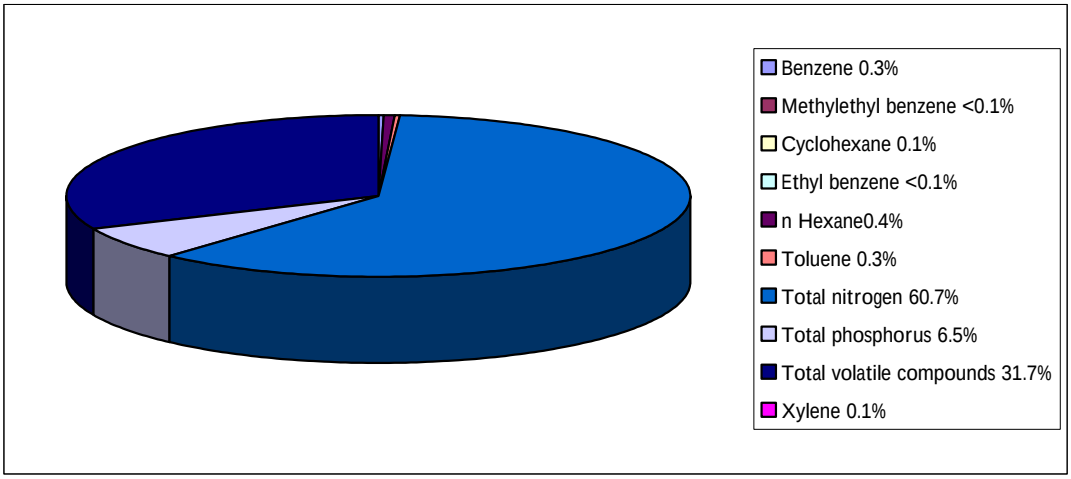


Figure 7.3: Total emissions (%) of substances emitted within the Grafton region.



Note: Methyl ethyl benzene, Cyclohexane, Ethyl benzene and Xylene proportions are too small to be represented in the pie chart.

Figure 7.3 indicates that the largest proportion of total emissions consists of total phosphorus, which is largely associated with unimproved pasture, improved pasture, native vegetation, and cropping and urban and residential sources. The second largest proportion of total emissions includes total volatile compounds that are associated with mineral, metal and chemical wholesaling and rail transport activities. Overall, the information provided in Figure 7.3 indicates that the level of industrial activity and concentration of pollutants within the Grafton region is relatively low. It is also considered that the prevailing winds from the west, which occur for most of the year would disseminate pollutants over Grafton city towards the east.

Potential Risks

The Proposal has the potential to emit polluting emissions during construction and long term during the operational phase of an additional crossing of the Clarence River. Emissions to the atmosphere during the construction phase would predominately be emitted from the exhaust of construction equipment and dust generated during earth works, stockpiling, the translocation of spoil and from exposed surface areas. The operation of the Proposal has the potential to alter existing air quality through changes in traffic volumes and travel behaviour. Emissions to the atmosphere during the operational phase would predominantly be emitted from the combustion of fuel used in vehicles. Typical emissions for both phases would include carbon monoxide, nitrogen dioxide, hydrocarbons, particulate matter and carbon dioxide.

To determine the level of potential impact for each of the proposed localities, a qualitative assessment was conducted by Environmental Resources Management Australia Pty Ltd (December 2003). The broad assessment involved the consideration of four 'air quality aspects' (position of sensitive or critical receptors, greenhouse gas implications, meteorological conditions & semi quantitative assessment) that were assigned a percentage according to the importance or potential severity of the aspect. The level of potential impact upon local air quality for each of the localities was then ranked (1–5) depending on the sensitivity of the immediate surrounding area. Therefore, the locality option with the highest numerical number would be the least desirable option in terms of potential effects upon local air quality. A summary of the findings for each locality for both the construction and operational phases is provided in Table 7.13 below. Further details of the assessment are detailed in Appendix M of this report.

Table 7.13: A summary of the assessment results for both construction and operational phases.

Air Quality Aspect – Summary		
Locality	Total for Construction	Total for Operation
1	20	20
2	20	20
3	22	22
4	33	33
5	33	33
6	16.5	16.5
7	18.5	18.5

Source: Environmental Resources Management Australia, 2003.

Results of the assessment indicate that the differences between each locality in terms of air quality is likely to be minimal during both phases with localities 6 and 7, likely to have the least potential impact upon sensitive receptors, while localities 4 and 5 are likely to have the greatest

potential impact. As expected, localities with the greater number of sensitive receptors ranked high for potential impacts for both the construction and operation phases.

When considering the potential air quality impacts relating to feasible localities, localities 6 and 7 would be the most feasible areas for minimising potential impacts. These two localities are located furthest away from central Grafton area and therefore have a limited number of nearby sensitive receptors. Localities 4 and 5 have a greater number of sensitive receptors, therefore ranking high and are considered to be less feasible localities which may require stringent mitigation measures.

Localities 1, 2 and 3 (upstream of the existing bridge) would probably require less stringent mitigation measures on the Grafton side as they already experience high volumes of traffic. However, on the South Grafton side, more stringent measures would be required due to the current lack of traffic. In addition, localities 4, 5, 6 and 7 would require more stringent measures, again due to a current lack of high traffic levels.

7.13 Climate

Grafton has a subtropical climate typical of the North Coast Region. Local variation occurs due to Grafton being approximately 50km inland, producing generally cooler winter nights, hotter summer days and different wind patterns than those experienced on the coast (Grafton City Council SOE, 2002/03).

Relevant climatic statistics are:

Temperature:	Average Annual Temperature	20.3^{o}C
	Average Summer Maximum	29.6^{o}C
	Average Winter Minimum	7.1^{o}C
Rainfall:	Annual Average Rainfall	1069.8mm
	The wettest months are December through to March/April, with a dry season extending from July to October.	

Over much of the year, prevailing winds occur from the west. The annual wind speed for the Grafton region is estimated to be 3 to 4m/s with calm wind frequency of approximately 10% of the time, indicating reasonably unstable conditions throughout the year.

Potential Risks

Rain and occasional fog would be high risk factors during construction, with heavy local and regional rainfall providing the risk of flood. Should torrential or heavy rainfalls occur they have the potential to amplify construction problems with water draining off pavement surfaces into working areas and then transporting high sediment loads into traversing drainage lines and the Clarence River. In addition, access to the site has the potential to be restricted during flood events.

7.14 Waste Minimisation and Management

The Grafton Regional Landfill commenced operations in September 1998 (Grafton City Council SOE, 2002/03). The landfill site is located at 704 Armidale Road, South Grafton. The site has a predicted life in excess of 50 years. Table 7.14 provides a summary of the percentage of solid waste received by the landfill each year from the various waste sources.

Table 7.14: Summary of solid waste received by the landfill during 1998 to 2003.

Year	Domestic %	Comm/Ind %	Build/Demol %	Transfer Stations %	Other %
98/99	55.0	23.0	5.0	8.0	9.0
99/00	62.8	20.6	3.0	9.0	4.6
00/01	59.3	23.7	1.8	9.3	5.9
01/02	52.5	25.0	2.6	10.1	9.8
02/03	36.0	30.0	7.0	13.0	14.0

Source: Grafton City Council SOE, 2002/03.

Statistics provided for 2002/03 represent a significant reduction in domestic waste due to the introduction of a new domestic waste collection service (Grafton City Council SOE, 2002/03).

Potential Risks

The construction and operation of the Proposal has the potential to generate liquid and non-liquid wastes. The key waste streams likely to be generated include:

- Cleared vegetation
- Excavated soil
- General waste construction
- Gross pollutants
- Putrescible waste
- Timber, including treated timber
- Fuels, liquids and chemicals
- Cemen
- Asphalt
- Potential contaminated waste

It is anticipated that the greatest source of waste generated from the Proposal would include spoil resulting from excavation works for bridge piers, abutments, embankments and approaches, asphalt, bitumen and concrete. Should a preferred route be identified within the vicinity of locality 3, wastes associated with the Proposal would additionally include the disposal of material from works associated with the modification of the existing "kinks". These would include steel and concrete.

The quantity of spoil generated would vary depending on the existing landforms surrounding each locality and the design of the bridge. Localities 4 to 7 are likely to generate larger qualities of spoil than localities 1 to 3 due to the need for longer approaches and greater bridge spans. It can also be expected that localities 4 to 7 would require the most vegetation removal due to the length of the approach connections to the Pacific Highway. Localities 1 and 2 would require less vegetation removal on the southern approach connection to the Gwydir Highway.

Other wastes associated with the Proposal would also include acid sulphate soils and potentially contaminated wastes. As previously discussed in Sections 8.4 and 8.6 of this report, all localities have the potential to generate acid forming soils. In particular from the bed sediments of the

Clarence River during piling activities and excavation works. It is anticipated that further investigations would be undertaken or an acid sulphate soil management plan would be prepared for the construction of the preferred route.

The principles of waste management are to minimise the amount of waste generated, recycle waste wherever possible and dispose of the remaining waste in a responsible manner in accordance with appropriate RTA policy. The RTA adopts the Resource Management Hierarchy principles embodied in the *Waste Avoidance & Resource Recovery Act 2001 (WARR Act).*

7.15 Ecologically Sustainable Development

The NSW Government is committed to the principles of ecologically sustainable development (ESD). The most relevant reference in terms of preparing a large-scale environmental impact assessment is found in Schedule 2 of the *Environmental Planning and Assessment* (EP&A) *Regulation 2000*. According to Schedule 2, ESD is based on the following four interrelated principles:

1. ***The Precautionary Principle***. Namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

2. ***Intergenerational Equity***. Namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

3. ***Conservation of Biological Diversity and Ecological Integrity***. This should be a fundamental consideration throughout all aspects of environmental impact assessment.

4. ***Improved Valuation, Pricing and Incentive Mechanisms***. Environmental factors should be included in the valuation of assets and services.

The RTA seeks to ensure that all road proposals are consistent with the principles of ESD and that environmental impact assessments provide sufficient and unambiguous scientific information to assess the performance of Proposals against ESD principles. Any consideration of a new crossing over the Clarence River would need to take into account the above principles.

8 Summary

In summary the major environmental constraints identified for the construction and operation of an addition crossing of the Clarence River at Grafton are:

Land Use and Visual Effects

- Duplication of the existing bridge would have the least impact on land use, as it would reinforce existing development patterns and provide certainty for future land use decisions.
- Locality options located away from the existing bridge would create pressure for changes to the existing land use.
- New intersections with the Pacific Highway for localities 4 to 7 would see development pressure for Highway associated activities similar to those located near the Gwydir Highway turnoff.
- Connection to locality 4 and 5 within the vicinity of Bacon and Dobie Streets would become similar to the existing Villiers Street connection which may potentially induce pressure for a change to commercial activities.
- Locality 1 within the vicinity of Prince Street would see the roadside development in north Grafton change from civic recreational uses to main road commercial uses.
- Localities within the vicinity of Villiers Street may affect current educational and business uses and may not remain compatible with the predicted increased traffic flows.
- On the southern side of the river, there is the potential for a change in commercial development to take advantage of passing trade.
- The NSW DEC are currently considering both Susan and Elizabeth Islands for gazettal as Nature Reserves. This would impact upon localities 1 (Susan Island) and 7 (Elizabeth Island).
- Localities 4 to 7 would impact on the agricultural/rural setting of the study area particularly for residential areas on the Grafton approach.
- An additional crossing at all localities would potentially reduce the visual amenity of the Clarence River.
- A crossing at locality 3 would provide the opportunity for the bridge to "blend in" with the existing structure.

Socio-Economics

- Disruption to businesses located at or near the proposed additional crossing.
- Changes to economic situations and business profitability through changes to traffic volumes past the business.
- Creation of business and industry development nodes along any new route location, potentially.
- Reducing custom from existing businesses and industry.
- Uncertainty about impacts and development possibilities, which may manifest in individual community members through increased stress, anxiety or apathy about the future.
- Changes to personal economic situations through changes to property values;
- Perceptions that individual property owners and residents will suffer because of decisions made for the benefit of the wider community.

- Concerns over reduction in amenity values for residential areas likely to be affected, where attributes such as wide streets, older stately tree plantings, impacts on stately homes and a peaceful and quiet environment strongly contribute to personal and community well being in areas that may be impacted by the proposed crossing and increased traffic flows.
- Alterations to the way people undertake trips to their daily activities.
- Perceived impacts to significant environmental and heritage areas including Susan and Elizabeth Islands.
- Perception of changes in existing levels of community cohesion and integration.
- Concerns over the heritage value of the existing bridge, and how any additional crossing may affect its amenity.

Landforms, Geology, Soils and Erosion

- Minimal geological constraints were identified that would have a severe impact on any of the locality options.
- Locality 3 was identified as likely to provide the least geotechnical constraints as it would have the shortest road approaches, greater stability and shallower depth to the bedrock.
- The Proposal has the potential to cause soil erosion and bank scouring as a result of soil exposure, flooding, excavation activities and piling works.
- Localities with a greater slope gradient along the northern and southern river banks would have a greater risk to soil erosion.
- Localities with areas of soft-earthed soils along creek lines (locality 4) and that are likely to disturb larger areas of soil (localities 6 and 7) also have a greater risk to soil erosion.
- There is a risk of acid sulphate soils within all of the localities, although potentially greater risks within localities 1, 4, 6 and 7.
- Need to confirm the outcomes of the contaminated sites, following info from Council.

Hydrology

- Flooding in the Clarence River is a common event given the size of the catchment and frequent storms and rainfall that occur in the region.
- North Grafton is protected from floods reaching no higher than 8.25m. In South Grafton only the embankment from the Arden Street drain to the existing bridge is protected for levels up to 7.62m. West of the Arden Street drain the levee bank protects against levels to 6.09m and downstream of the bridge at Clarenza, the levee provides protection to 5.49m.
- The levee bank on the northern side of the river has been designed to withstand a 1 in 100 year flood. However, recent floods have shown that the grade of the levee crest and the structural integrity of the levee system downstream of the existing bridge may not be adequate to provide the expected level of protection.
- Most of South Grafton is more frequently inundated by flooding with the exception of the area approaching locality 3, which is one of the few places in South Grafton high enough to be out of range of most of the common flood levels.
- The likely afflux is small for locality 1, given the river section is wide and there would not be significant flows on the small section of floodplain on the southern bank.
- Little afflux and limited effect is expected for locality 2 because the existing levee systems are effectively at the top of bank on both sides of the Clarence.

- Little impact is expected for locality 3 as the northern abutment is protected by the Grafton levee and the southern abutment is on flood free ground. The levee is generally accessible and could be "topped-up" to account for afflux created by the bridge crossing.
- Major affluxes on the southern floodplain are expected for localities 4 and 5 and smaller affluxes may extend to the river channel itself. There are 2 houses potentially threatened by the proposed road. Thus, the proposal at these localities has the potential to threaten the Grafton levee system at a location where the crest levels are low and some structural inadequacies are evident. Further, access to the levee is difficult thus; levee works would require a significant cost provision.
- A major impact on flood levels on the southern floodplain is anticipated for localities 6 and 7. Three residences could be affected. The threat to the Grafton levee system is not as severe as for localities 4 and 5, as the levee is newer in this location and without the demonstrated problems of further upstream.
- From the perspective of potential flood impacts, locality 3 is considered to be the best option.

Water Quality

- The potential impacts on water quality associated with the construction and operation of the Proposal include increased levels of turbidity, sedimentation, localised contamination, algal blooms and potential changes in chemical (pH, nutrients, dissolved oxygen and inorganic and organic contaminants) and physical (light penetration, salinity & temperature) parameters. The Proposal also has the potential to generate pollutants, contaminate groundwater and alter localised groundwater levels.
- Localities 6 and 7 would have the greatest potential impacts on water quality with a high risk of localised changes to groundwater levels and impacts on hydraulic conductivities from embankments.
- There is a risk of acid sulphate soils within all of the localities, although potentially greater risks within localities 1, 4, 6 and 7.
- Localities 4 and 5 pose moderate risks associated with all four water quality aspects as the area of disturbance and therefore soil erosion and sedimentation would be relatively moderate as would the percentage of pollutants likely to be generated.
- Potential risks associated with localities 1, 2 and 3 would be minimal, although locality 3 has the potential to generate greater levels of pollutants associated with larger traffic volumes and thereby a greater risk of accidental spills.
- It is considered that the upstream and existing localities pose a relatively lower risk compared to downstream locality options.

Biodiversity

- Potential impacts as a result of the Proposal would include the removal of native vegetation, loss of vegetation structure and riparian vegetation and the spread of noxious weeds and introduction of new weed propagules to the area.
- In addition, habitat removal, habitat modification and degradation, fragmentation, disruption to local habitat linkages, barrier formation and road strike mortality would occur.
- The Proposal has the potential to impact on riparian and sub tidal fish habitat, aquatic plant communities and create barriers to fish movements.
- Riparian vegetation, remnant rainforest stands and native Eucalypt sp., have the potential to be affected by localities 4, 5 and 7. Localities 4, 5 and 7 also have the greatest risk of impact upon fauna habitat.

- The endangered ecological community Lowland Floodplain Rainforest has the potential to be indirectly affected by locality 1. In addition, a crossing within this vicinity and locality 2 would directly impact on threatened bat species.
- Riverweed bed habitat has the potential to be affected by a crossing within localities 2, 5 and 6.
- Landscape street trees have the potential to be affected by all of the locality options from potential road widening works associated with the Proposal.
- A crossing within localities 2 and 4 has the potential to impact on large fig trees that provide food resources and habitat for threatened fauna species.
- A crossing within locality 5 has the potential to impact on fauna habitat through the removal of remnant hollow bearing trees (*Eucalyptus tereticornis*).
- Localities 3 and 6 would have the least impacts upon biodiversity, whilst locality 1 would have the greatest impacts due to its potential impacts upon Susan Island and associated flora and fauna.
- Localities 2, 5 and 6 would have greater impacts on fish habitat than localities 1, 3, 4 and 7.
- Activities associated with the Proposal have the potential to be considered as Key Threatening Processes as listed under the EPBC, TSC and FM Acts.

Non-Indigenous Heritage

- 17 known statutory listed heritage items including two conservation areas and three known non-statutory items are located within the study area.
- Localities 1 and 3 consist of five or more listed heritage items while localities 2, 4, 5, 6 and 7 consist of one to three listed heritage items that may be potentially affected by the Proposal.
- The level of risk would be greater within localities 1, 2 and 3 than localities 4, 5, 6 and 7.
- Impacts on the State Heritage listed Clarence River Bridge would include the loss of aesthetics and (what – see Ian) associated with a crossing upstream or downstream from the existing bridge and the proposed modifications to the 'kinks'.
- Potential impacts within localities 4, 5, 6 and 7 would generally include potential affects upon non-statutory listed heritage items and tree species of the genera *Brachychiton, Ficus* or *Jacaranda*.

Indigenous Heritage

- Risks associated with the Proposal would include direct and indirect impacts through vegetation clearing, excavation works, modification of the landscape and vibration affects.
- Both Susan Island and Elizabeth Island and areas downstream of the existing bridge (localities 1, 3 and 7) have been identified as areas associated with ceremonial practices or dreaming and have been recorded as significant sites to the local Indigenous community.
- Carved or scarred trees are also present within North and South Grafton. Grafton Marriage Trees are located in close proximity to locality 4 along Alipou Creek.
- Areas adjacent to Alipou Creek (ocality 4) have the potential for archaeological deposits.
- Based upon information received regarding known recorded Indigenous sites, localities 2, 5 and 6 would have the least potential for areas of archaeological sensitivity.

Noise

- Existing noise levels at the existing bridge are approximately 2 to 3dB within DEC's *Environmental Criteria for Road Traffic Noise 1999*.
- Localities 1 and 3 would have the least potential noise impacts.
- Localities 1 and 3 would likely experience a minimal noise increase between 0dB(A) and 3dB(A).
- Residents that experience little or no traffic noise are likely to be more affected by traffic noise on a new road alignment than those residents that experience some road traffic noise where noise from traffic on a realigned or upgraded road may make little or no change.
- Localities 4, 5, 6 and 7 would generate the greatest potential impact due to affecting a larger number of residents and a greater change in absolute traffic noise levels.
- Traffic noise level increase over existing has the potential to be between 10dB(A) and 12dB(A) for localities 4 to 7.
- Localities 4 to 7 would also experience a greater percentage of heavy vehicles in relation to total assigned traffic volume, which would increase residential noise annoyance.
- The Proposal has the potential to impact upon sensitive land uses within localities 2 and 6.

Air Quality

- The Proposal has the potential to decrease local air quality in the short term during construction.
- The operation of the Proposal has the potential to alter existing air quality conditions through changes in traffic volumes and travel behaviour.
- The difference in potential effects in terms of air quality between each locality is likely to be minimal.
- A crossing within localities 6 and 7 is likely to have the least potential impacts upon sensitive receptors, whilst localities 4 and 5 are likely to have the greatest potential impacts.
- Impacts associated with localities 1, 2 and 3 are likely to be moderate as there are less sensitive receptors within the area than localities 4 and 5.

Waste Minimisation and Management

- The construction and operation of the Proposal has the potential to generate liquid and non-liquid wastes.
- It is anticipated that the greatest source of waste generated would be spoil from excavation works with the greatest quantities likely to be associated with a crossing within localities 4 to 7.
- Localities 4 to 7 are also likely to require the greatest ratio of vegetation removal.
- Acid forming soils have the potential to be generated within all of the localities, however a greater risk within locality 7.
- Contaminated soils have the potential to be exposed within locality 2.

9 Short listing of Locality Options

9.1 Introduction

This Environmental Overview summarises any likely environmental constraints and/or potential issues that would need to be considered as part of the investigations for an additional crossing of the Clarence River at Grafton.

The information gathered from the specialist studies and detailed in the Environmental Overview Report was used as a basis for decision making on which crossing localities should be further investigated in the route selection stage. As a result, seven localities were identified between Susan Island and Elizabeth Island as shown in Figure 1.1. The constraints identified within each locality are documented in this Environmental Overview Report.

In order to short list those localities worthy of further investigation a Localities Short Listing Workshop was held on 28 November 2003. The Australian Centre for Value Management (ACVM) was commissioned to facilitate and report on the short listing workshop. A copy of the workshop is in Appendix N.

The short listing of localities workshop was seen as the appropriate strategic tool to bring together some of the key stakeholders involved in the project, to review and assess the localities developed in order to shortlist those that most met the project objectives to proceed further for more detailed investigation. The participants included the RTA project team and representatives from Grafton City Council, Copmanhurst Council and Pristine Waters Council. Background papers comprising information gathered from the specialist studies within the study area were distributed to the participants prior to the workshop. The objective of the workshop was to *review and assess the preliminary localities investigated for the project in order to shortlist those worthy of more detailed investigation.*

9.2 Methodology

The broad objectives for the project, that were presented to the workshop include:

- Significantly improve traffic efficiency;
- Significantly reduce the potential for road accidents and injuries;
- Be socially acceptable to the regional and local community;
- Support economic development;
- Be managed in accordance with Ecologically Sustainable Development (ESD) Principles; and
- Achieve maximum effectiveness of expenditure.

There are a number of supporting objectives for the project that are more specific and measurable to ensure that the broad project objectives are achieved. A number of assessment criteria were developed from these supporting objectives, which would provide a variable response when undertaking comparisons of localities. The draft assessment criteria, and a description of the criteria used at the workshop are listed below.

a) Reduce delays at the existing Clarence River Bridge in peak hour to a Level of Service C in 30 years after opening

Assessment: Would the design meet a satisfactory level of service for road users by reducing the delays at the existing bridge?

b) Provide adequate vertical clearance for heavy transport on the Summerland Way

Assessment: Would the locality provide adequate vertical clearance for heavy transport on the Summerland Way?

c) Reduce the potential for road accidents and injuries for the approaches to the additional crossing, including the connecting intersections

Assessment: Would the locality reduce the potential for road accidents and injuries at the approaches and at the connecting intersections?

d) Reduce the volume of through traffic, including heavy vehicles, from the CBD

Assessment: Would the locality reduce the volume of through traffic, including heavy vehicles, from the Grafton and South Grafton business areas? A measure of effectiveness would be the volumes of through traffic that would be diverted away from the existing bridge.

e) Minimise flooding impacts caused by the project

Assessment: Would the locality have flooding potential by affecting upstream and downstream flood levels?

f) Minimise the impacts on the social environment

Assessment: What is the potential social impact of the locality? The following impacts are relevant to this assessment:

Impacts on local demographics, health problems, air quality, psychological stress, intrusion, community severance, changes to access patterns, changes to residential amenity and character, displacement and provision of safe pedestrian crossings, paths and cycleways.

g) Minimise the impacts on access for the community

Assessment: What is the potential impact on access of the locality? The following impacts are relevant to this assessment:

Impact on local access, including effects on local road access and access limitations to the new road; use of the road by cyclists and provision of safe pedestrian crossings and paths where necessary.

h) Provide improved opportunity for economic and tourist development for Grafton

Assessment: What is the potential for improved economic and tourist development? The following impacts are relevant to this assessment:

- Changes to industry and commerce, disruption or improvement to recreation and tourism, changes to access patterns;
- Impacts on settlement patterns and land use in the area; and
- Impacts on businesses/service facilities dependant on Summerland Way traffic.

i) Minimise impacts on the natural environment

Assessment: What are the potential impacts of the locality on flora and fauna? Assessment should consider the impact of the locality on critical habitat, threatened species, populations or ecological communities, or their habitats.

9.3 Assessment of Localities

The Feasibility Study stated, *"The most feasible location appears to be in the vicinity of the existing bridge"*. Therefore, as there is an expectation that options adjacent to the existing bridge (locality 3) would be further investigated, it was determined that this locality should be progressed to the next stage of investigation regardless of its merits or deficiencies.

It was also determined that the assessment would be undertaken as a comparison of localities 1, 2, 4, 5, 6 and 7 relative to locality 3 using the assessment criteria. This would determine which localities should move forward for further investigation.

The localities were judged on a qualitative basis by the workshop group in comparison to locality 3 against each criterion on the following scale:

Symbol	Explanation
✓	The locality option is better than locality 3 when compared against this criteria.
-	The locality option is the same as locality 3 when compared against this criteria.
X	The locality is worse than locality 3 when compared against this criteria.

For the purposes of the short listing the localities for further investigation, no weighting of the criteria was undertaken and that all criteria were considered equivalent in importance.

After the evaluation, the group considered which localities rated (on balance) so poorly or inferior to other localities in meeting the assessment criteria that they were not worthy of moving forward for further investigation and should be eliminated.

The assessment of the locality options against the criteria is represented in Table 9.1.

Table 9.1: Matrix assessment of localities in comparison to locality 3.

	Criteria/Locality	1	2	4	5	6	7
1.	**Significantly improve traffic efficiency**						
a)	Reduce delays at existing bridge	X	X	X	X	X	X
b)	Provide vertical clearance for heavy transport on Summerland Way	-	-	✓	✓	✓	✓
2.	**Significantly reduce accidents and injuries**						
a)	Reduce accidents and injuries at new approaches and intersections	-	-	-	-	-	-
b)	Reduce through traffic to CBD	X	-	✓	✓	✓	✓
3.	**Socially acceptable to regional and local community**						
a)	Minimise flooding impacts by project	-	-	X	X	X	X
b)	Minimise impact on the social environment	X	-	X	X	X	X
c)	Minimise impacts on access for the community	X	X	-	-	-	-

Criteria/Locality		1	2	4	5	6	7
4. Support Economic Development							
a)	Provide opportunity for economic and tourist development for Grafton and Clarence Valley Region	X	-	X	X	X	X
5.	**Managed within ESD Principles**						
a)	Minimise impacts on the natural environment	X	X	-	-	-	X
b)	Minimise impacts on heritage	X	X	✓	✓	✓	X
c)	Minimise impacts of traffic noise on existing sensitive development	X	X	X	X	X	X
6.	**Achieve maximum effectiveness of expenditure**						
a)	Provides BCR > 2	-	-	-	X	X	X

9.4 Eliminating Localities

As a result, of undertaking the qualitative assessment of localities, the workshop participants agreed to the following localities (on balance) to be eliminated from further investigations based upon the following reasons.

Locality 1

- Major precinct impacts and impacts on Memorial Park;
- Crown Hotel/river access impacts;
- Noise impacts;
- Traffic impacts within the CBD;
- Heritage issues (i.e. significant listed property impacts);
- Potentially significant ecological issues;
- Major impact on CBD (traffic movements, social, environmental impacts);
- Engineering issues;
- Noise impacts;
- Impact on Susan Island/environmental issues;
- Major precinct impacts and impacts on Memorial Park; and
- Crown Hotel/river access impacts.

Localities 4 and 5

- Effect on safety with increased traffic in residential streets which have low traffic;
- Major flooding effects which may not be overcome;
- Ramping effect of approach;
- Disruption to north – south local access movements;
- Community segregation;
- Major social issues;
- Doubling traffic noise;

- Direct access onto highway requiring additional length of travel;
- Does not significantly improve traffic efficiency on the existing bridge; and
- Very low Benefit Cost Ratio indicating poor value for money.

Locality 6

- Low traffic volumes would use the additional crossing;
- Poor connection to the road network;
- Approaches may travel through an approved residential development;
- Noise impacts on the hospital and other noise sensitive development;
- Social issues;
- Flooding impacts;
- Does not significantly improve traffic efficiency on the existing bridge (too remote); and
- Benefit Cost Ratio is less than one (indicating poor value for money).

Locality 7

- Low traffic volumes would use the additional crossing;
- Industrial heritage issues;
- Noise impacts;
- Social issues;
- Flooding impacts;
- Does not significantly improve traffic efficiency on the existing bridge (too remote); and
- Benefit Cost Ratio is less than 1 (indicating poor value for money).

9.5 Localities to be Further Investigated

Some of the issues raised for the localities to be further investigated include:

Locality 2

- Treatment of traffic at the intersection of Fitzroy and Villiers Streets needs to be addressed;
- Noise impacts on the schools and music academy in this precinct as well as addressing other noise sensitive building/receptors on the southern side;
- Connectivity and access to cross streets, relocation of traffic to other streets and associated road upgrades;
- Addressing the treatment of the impacted Figtree at the western end of Villiers Street (environmental and heritage values);
- Increased clearance considered at the Villiers Street viaduct;
- Heritage buildings and other heritage issues along the route;
- Economic analysis;
- Design heights to descend from the bridge deck down to Victoria and Villiers Street; and
- Other design constraints.

Locality 3

- Increased clearance to be considered at the Villiers Street viaduct;
- Design constraints;
- Connectivity and access to cross streets, relocation of traffic to other streets and associated road upgrades;
- Traffic noise;
- Heritage issues; and
- Removal of the "kinks".

9.6 Conclusions Drawn from the Evaluation of Localities

As a result, of the discussions during the evaluation process, the workshop group concluded that:

- Based on the qualitative assessment undertaken, locality 2 and locality 3 are more feasible than the other localities and should move forward for community input and further detailed investigation;
- The localities that were eliminated had significant issues (i.e. social, ecological, environmental, flooding, traffic efficiency, etc) and did not sufficiently meet the project objectives (from which the assessment criteria were taken);
- Social impacts, noise, community issues and heritage concerns would be the biggest issues to address (other than technical constraints) during the next stage of project development;
- There is a need to more fully articulate the issues associated with locality 3;
- The built environment in Grafton would have a big impact on where an additional crossing can be located;
- The further away that the additional crossing is from the existing bridge would impact on how well the project objectives can be met; and
- An additional crossing (away from the existing bridge) could place pressure on providing a third commercial node for Grafton which would segregate the community further (strategic view).

9.7 Where to From Here?

At the conclusion of the workshop, the project manager presented to the participants the next steps in the process to progress the project. These were recorded as:

- The recommendations from this workshop would be presented to the community workshops which would be undertaken on the 10 & 11 December 2003 for their input to this workshop's findings;
- There would an analysis of the community input to confirm/amend the recommendations of the workshop to determine the localities to move forward for further investigation;
- The localities to move forward would be investigated further with the results proceeding to public display of Route Options in March 2004;
- Community input to the Route Options display would be considered and feed into a Route Evaluation Workshop. This is likely to generate additional investigation and refinement; and
- The announcement of preferred route is scheduled for mid 2004, subject to completion of investigations.

10 References

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11 Glossary and Terms

Term or Abbreviation	Meaning
Acid Sulphate Soil	Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen, and may produce acidic leachate and runoff which can pollute receiving waters and liberate toxins
ANZECC & ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
Benthic Fauna	Bottom-dwelling aquatic animals
CANRI	Community Access to Natural Resource Information
CBD	Central Business District
CPP	Community Participation Plan
CFG	Community Focus Group
DEC	Department of Environment and Conservation
Degree of Saturation	A ratio of the number of vehicles entering an intersection in a specific period, to the number which could enter if all approaches were fully saturated during that period.
DIPNR	Department of Infrastructure, Planning and Natural Resources
EP&A 1979	Environmental Planning and Assessments Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FM Act	Fisheries Management Act 1994
LEP	Local Environmental Plan
LOS	Level of Service. Describes the performance of lengths of road and intersections. The LOS for lengths of road relates to freedom to move within the traffic stream. LOS at an intersection relates to the extent of delays.
MLC	Media Liaison Consultant
NES	(Matters of) National Environmental Significance
NPI	National Pollutant Inventory
One-in-50-year flood level	Refers to the flood, which occurs, on average once every 50 years
PAD	Potential Archaeological Deposit
pH	Acidity of alkalinity of water. Expressed in logarithmic units either side of 7 which is neutral, <7 = acid, >7 = alkaline.

REP	Regional Environmental Plan
RNE	Register of the National Estate
SRA	State Rail Authority
TSC Act	Threatened Species Conservation Act 1995
VPD	Vehicles per day
WARR Act	Waste Avoidance and Resource Recovery Act 2001