Additional crossing of the Clarence River at Grafton

Traffic study for preliminary options

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Grafton Bridge

Traffic Study for Preliminary Road Corridor Options – February 2010

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Executive Summary

Regional and microsimulation traffic modelling of Grafton and its surrounds has been undertaken to develop a detailed understanding of the existing and future traffic demands and patterns within Grafton. In particular, future demands across the River have been estimated for a range of future land uses.

Existing conditions (do nothing) modelling determined that as traffic demand across the river increases an additional river crossing capacity will be required and that doing nothing will lead to severely degraded and unacceptable road network operating conditions. This concluded the following:

- An additional bridge crossing in the vicinity of the existing bridge should be considered, and
- Road approach options to determine the optimum location and impact on the movement of traffic in and around Grafton and South Grafton should be assessed

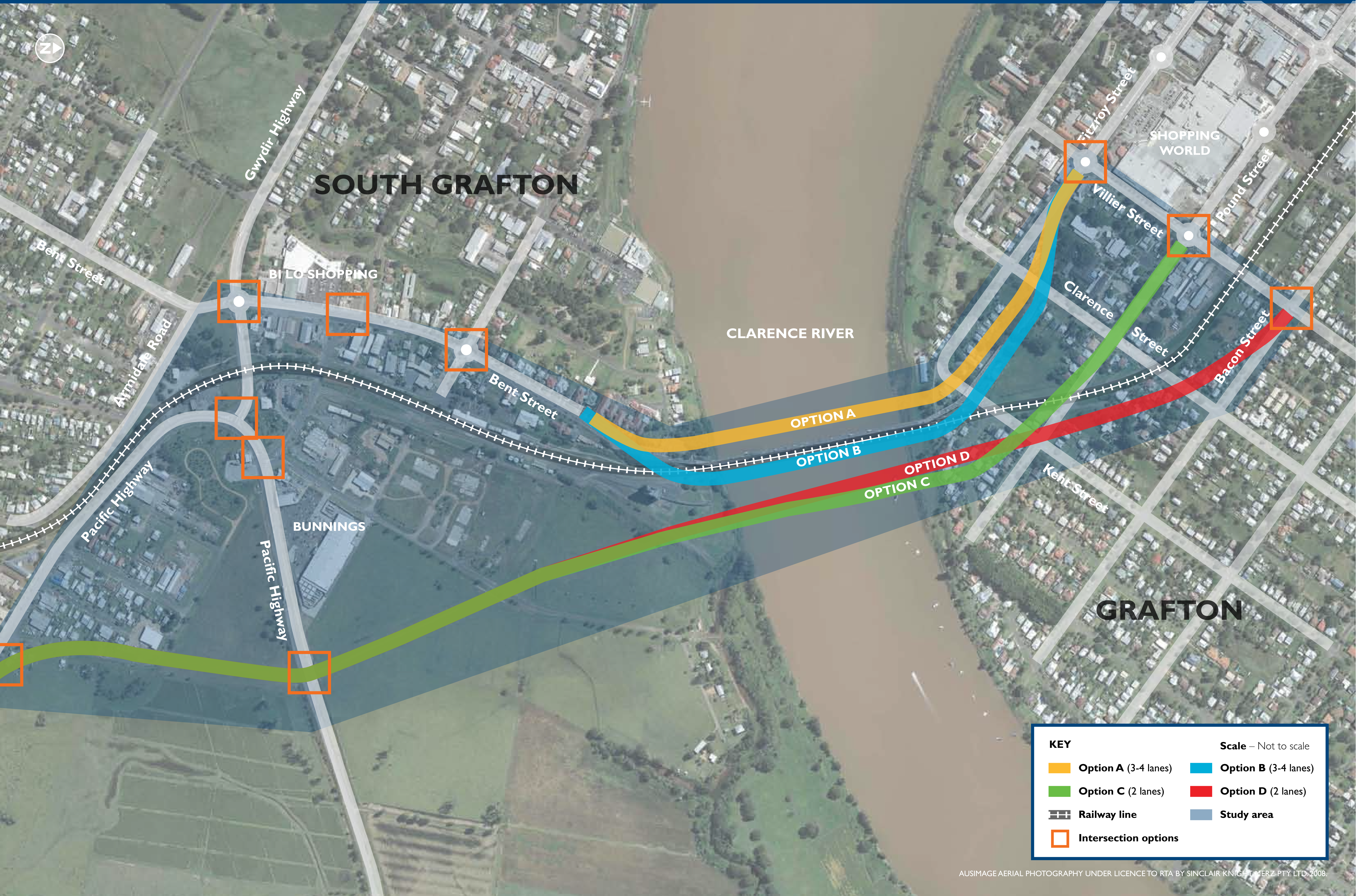
Four preliminary corridor options and their approaches to an additional river crossing in the vicinity of the existing bridge have been prepared by the RTA. The options were tested to determine the impact that each option would have on traffic movement in and around Grafton and South Grafton. The approximate location for the preliminary options for the additional river crossing are shown on the following page.

The results of the modelling are described in Section 6 and 7 of this report which indicated:

- Traffic demands across the Grafton River are anticipated to increase to more than double over the life of a new bridge.
- Options A and B would increase bridge capacity but are constrained by the existing intersection capacity on the approaches to the bridge
- Options A and B would have minimal impact on the travel patterns within Grafton and South Grafton
- Options A and B would experience increased network congestion after 2019, and by 2039 the network would not be able to handle the additional traffic and would reach grid lock
- Options C and D, would create alternative routes between South Grafton and Grafton and provide opportunity for traffic to distribute across the network, and
- Option C and D would provide good connectivity between Grafton and South Grafton, reducing the reliance on key intersections approaching the existing river crossing.

Option D east of the existing bridge, consisting of two lanes in each direction between the Pacific Highway and Villiers Street, provides the best traffic operating outcomes of the four options modelled, in terms of completed trips, number of stops, average speeds and vehicle hours travelled for all design periods.

Additional Clarence River crossing – preliminary options



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1. Introduction

1.1 Background

Grafton is located within Clarence Valley Council area in New South Wales, has a population of approximately 17,500 people and is located on Pacific Highway between Sydney and Brisbane. Grafton functions as a sub-regional centre providing a focus for services to the Clarence Valley community.

The existing river crossing in Grafton was first opened to vehicular traffic in 1932. With the continuing increase in traffic demands and resulting levels of traffic congestion, Grafton City Council began investigation of a second river crossing in 1960 with the Department of Main Roads (DMR) advising that the new bridge location would be adopted linking Fitzroy Street to Bent Street.

The approaches to the bridge are generally four lane carriageways (two lanes in each direction) which narrow to one lane in each direction over the Clarence River. The single lane and other geometric constraints result in large queues and delays on the approach to the bridge during both the morning and afternoon peak periods.

GTA Consultants has been commissioned by the Roads and Traffic Authority (Northern Region) to undertake further regional and microsimulation modelling of Grafton and its surrounds to develop a comprehensive traffic management scheme for a series of proposed bridge options and configurations.

1.2 Study objectives

The objectives of the study are as follows:

i Obtain an understanding of the following existing items as they apply to a crossing of the Clarence River at Grafton:

- transport demand
- travel patterns
- traffic flow
- traffic constraints.

ii Forecast future year travel demands, taking into consideration future developments and network growth.

iii Undertake preliminary assessment of whether alternative bridge connection options provide traffic flow benefits.

iv Identify any recommendation for improvements in the operation of the road network.

Items (i) and (ii) have been assessed in the "Existing Conditions" report prepared by GTA Consultants dated 17 December 2009, whilst this report deals with items (iii) and (iv). This report is the result of the planning investigation including a comparison of the tested options and the degree to which they achieve the study objectives in terms both quantitative and qualitative measures.

2. Existing Conditions Modelling (Do Nothing)

2.1 Introduction

The Grafton Bridge Traffic Study Report, prepared by GTA Consultants on the 17 December 2009, set out the results of modelling and analysis of the existing road network and the likely outcomes if an additional river crossing is not provided.

Regional and microsimulation modelling of Grafton and its surrounds was undertaken to develop a detailed understanding of the existing and future traffic demands and patterns within Grafton.

Full details of the modelling extents, summary and conclusions are located in the report dated 17 December 2009.

2.2 Methodology

The adopted study approach was designed to address both strategic and local operational issues.

Strategic modelling using Cube TRIPS focused on future demands and how the demands are expected to change as a result of land use and economic development, both within Grafton and the broader region of Clarence. These demand changes were then used to arrive at a range of future demands across the river and to define broad traffic pattern changes.

Detailed microsimulation modelling using Q- Paramics was concerned with the road network assessment in order to provide key indicators for each option such as link flows, intersection operation, congestion levels and travel times.

3. Future Year Traffic Demands

3.1 Future Year Growth

Future year traffic growth is a function of population and employment growth and typically increases at a higher rate than that of population growth. Population growth has been sourced from the NSW Department of Planning *Mid North Coast Regional Strategy* dated March 2009.

Table 3.1 is a land use summary for the Mid North Coast region between the years 2009 and 2039 which is based on information obtained from various planning reports. Growth rate forecasts are provided for both population and employment changes.

Table 3.1: Regional Land Use Annual Growth Rate Forecast Summary

Land Use	Year 2009-2019	Year 2019-2029	Year 2029-2039	Year 2009-2039
Population	1.0%	0.9%	1.1%	1.0%
Employment	1.7%	1.5%	1.5%	1.6%

(source: various recent planning reports)

This review indicates that the region of Grafton will experience long term regional traffic growth rates of between 1% and 2% per annum. This typically covers trips between regional centres as opposed to traffic flows within the centres themselves.

The growth rate in traffic is typically higher than that of underlying population and/or employment growth reflecting economic growth amongst other things. As a result an annual growth rate of 2% has been adopted for external trips, which is broadly consistent with historical growth rates observed in the past 10 to 15 years on roads into and out of Grafton as described earlier.

The remaining trips represent the majority of travel demands across the river. A common future year growth rate for both trips to/from and within Grafton has been adopted. In the absence of detailed and agreed land use forecasts, and so as to provide a robust basis on which to plan for major transport infrastructure investment, a range of growth rates has been assessed being 1.5%, 2.5% and 3.5%. When these are combined with the 2% growth rate for external trips the resulting traffic growth crossing the river becomes 0.9%, 1.9% and 2.9% per annum.

The key model input assumptions utilised for the future year growth are:

- Historical traffic growth rates in recent times across the River have been in the order of 1%pa for AADT.
- A 2% growth rate has been adopted for external (through) traffic based on regional planning studies and long term expected regional population and employment growth rates.
- Official detailed land use forecasts for Grafton are not available and as such a range of growth rates between 1.5% and 3.5% have been tested for internal traffic flows to provide a robust basis on which to consider the study outcomes.
- The resulting overall growth rates tested are 0.9%, 1.9% and 2.9%.

A transport growth rate of 1.9%p.a. is recommended as the most likely outcome and therefore it forms the basis of model testing.

The likelihood of 1.9%p.a. being achieved is considered realistic given source material underpinning the growth rates utilised. The Federal Department of Infrastructure, Transport, Regional Development and Local Government Australia Bureau of Infrastructure, Transport and Regional Economics prepared a report titled National Road Network Intercity Traffic Projections to 2030 Working Paper 75 earlier in 2009. The report provides long-term passenger and freight vehicle traffic projections for intercity corridors of the National Land Transport Network (NLTN) between the years 2005 and 2030. It sets out an annual growth rate of 2.1% for all vehicles on the Sydney to Brisbane Pacific Hwy corridor (Figure 3.5 page 62) using ABS 2006 regional population projections and state based population based projections. The 1.9% adopted growth rate in the Grafton study area is therefore in line with these wider area forecasts.

The report then compares the latest projections with earlier BTRE (2006a) projections for the period 1999 to 2025 which resulted in an annual growth rate of 3.0% on the same corridor (Table 3.30 page 124). The report states that these rates are designed for long term trend growth in longer distance interregional movements between major population centres and should be considered against the availability of small area local level influences such as local movements likely in Grafton. This is why a higher 2.9% growth rate has been selected as a sensitivity test to reflect the local traffic changes due to localised population and employment growth.

A further reference is the RTA Pacific Highway Upgrade Program Wells Crossing to Iluka Road Upgrade Project which set out historical growth rates of 2.2% pa for the period 1978 to 2001 and a proposed rate of 1.7%pa for local traffic and 3.3% for through traffic over the period 2001 to 2021.

In overall terms the rate of 1.9% pa is supported as a reasonable long term growth rate for the purposes of bridge planning. Further, the 2.9%pa rate can be supported as a rate deserving of careful thought given the lack of any formal local land use forecasts for the next 30 years. The growth rate of 0.9%p.a. completed the range of growth rates for which testing was completed.

The additional volumes are significant and warrant construction of additional capacity to maintain acceptable operating conditions on the road network. The increases are also such that they are likely to adversely affect the level of amenity of the commercial and retail centres on both sides of the river.

Traffic demand across the river already exceeds the capacity of the existing bridge at peak times. The traffic delays in peak periods are forcing changes in people's travel behaviour and daily activity patterns, and as a result are constraining development. Grafton and South Grafton are to some extent being forced to operate as separate towns. If additional traffic capacity is provided across the river, there will be a number of effects. Peak period traffic volumes will immediately increase, as people revert to their preferred travel behaviour and activity patterns. In the medium term, there will be changes in land use, as the city is now able to function more as a single unit, and traffic across the river will probably grow at a fairly high rate for several years. In the longer term, growth in population, employment and traffic will revert to a more normal sort of rate.

The growth rates adopted for testing provide a guide in determining the operating performance of the network. These growth rates are considered conservative for the purposes of transport planning. A growth rate less than what is indicated in this report will result in the anticipated traffic forecasts achieved at a time beyond the modelled periods (i.e. beyond 30 years).

To simplify the initial modelling, overall growth rates have been applied, and a range of different rates tested. It would be desirable to investigate the land use and traffic impacts of the options in more detail, in consultation with Council, Chamber of Commerce, and other stakeholders.

4. Options Tested

4.1 Description of Preliminary Corridor Options

A total of four preliminary corridor options have been modelled during the AM and PM peak periods. Table 4.1 provides detail and rationale for each of the Options, whilst a detailed description is provided in Section 4.1.1 - 4.1.4.

These options have been developed solely for the purposes of testing whether alternative connections of a new bridge can provide long term relief from the congestion that would develop on Grafton and South Grafton streets if either options A or B were adopted. In determining the preferred route options for the new bridge and its connections, the assumptions and options that follow are likely to change with community input, further planning and investigation.

Table 4.1: Grafton Bridge Traffic Study – Description of Options

Option No.	Description	Details	Rationale
A	One lane on existing bridge and a new three lane bridge (upstream, west)	Existing bridge to be retained with a single lane and a new bridge constructed immediately west of the existing bridge. The new bridge will consists of 3 traffic lanes – two northbound and one southbound. Connection via Bent Street and Fitzroy Street similar to existing conditions	Test impact of increased bridge capacity.
B	One lane on existing bridge and a new three lane bridge (downstream, east)	Existing bridge retained with a new bridge constructed immediately east of the existing bridge. The new bridge to consist of two southbound and one northbound traffic lanes. Connection via Bent Street and Fitzroy Street similar to existing conditions	Test impact of increased bridge capacity.
C	Existing bridge maintained and a new bridge downstream with two lanes	A new bridge to be constructed east of the existing bridge. The bridge will consist of 2 lanes connecting the Pacific Highway into Grafton at the Pound Street/Clarence Street intersection. The existing bridge will be for passenger vehicles only (No trucks).	Test significance of new bridge crossing and major road network changes.
D	Existing bridge maintained and a new bridge downstream with two lanes	A new bridge to be constructed east of the existing bridge. The bridge will consist of 2 lanes connecting the Pacific Highway into Grafton at a new roundabout on Villiers Street north of the railway. The existing bridge will be for passenger vehicles only (No trucks).	Test significance of new bridge crossing and major road network changes.

4.1.1 Option A

Option A provides a new bridge structure constructed immediately adjacent to the existing bridge (upstream). The new bridge would be three lanes comprising of two northbound lanes and one southbound lane. Option A retains the existing bridge. However, this would be reduced to one trafficable lane (southbound). Approaches to the new bridge from Fitzroy Street and Bent Street would be two lanes in each direction.

4.1.2 Option B

Option B is similar to A except the new bridge structure would be constructed immediately downstream of the existing bridge. The new bridge would be three lanes comprising of two southbound lanes and one northbound lane. This option would retain the existing bridge but reduce to one trafficable lane (northbound). Approaches to the new bridge from Fitzroy Street and Bent Street would be two lanes in each direction.

This option requires two crossings of the railway.

4.1.3 Option C

Option C would retain the existing bridge and introduce an additional river crossing, east of the existing bridge. The new bridge would consist of a single lane in each direction with the southern approach providing a direct link to the Pacific Highway via new intersections at the levee bank and at Heber Street . The northern approach would link the new bridge with Pound Street. Heavy and articulated vehicles would not be permitted on the existing bridge.

For the traffic assessment purposes, Option would C include the following features:

- realignment of the Pacific Highway to bypass South Grafton
- new roundabout or controlled intersection on Pacific Highway
- grade separation of Greaves Street and the railway line on the north approach to the bridge
- closure of Kent Street either side of the new bridge
- new connection into Pound Street.

4.1.4 Option D

Option D would retain the existing bridge and introduce an additional river crossing, east of the existing bridge. The new bridge would consist of a single lane in each direction with the southern approach providing a direct link to the Pacific Highway via new intersections at the levee bank and at Heber Street. The northern approach links the new bridge with Bacon Street and Villiers Street. Heavy and articulated vehicles will not be permitted on the existing bridge.

For the traffic assessment purposes, Option D would include the following features:

- realignment of the Pacific Highway to Bypass South Grafton
- new roundabout controlled intersection on the Pacific Highway in South Grafton
- grade separation of Greaves Street. Kent Street & Pound Street for the northern approach to the new bridge in the Grafton Township
- new roundabout controlled intersection on Villiers Street at Bacon Street.

Other options may be considered after community and stakeholder input.

5. Strategic Model Results

5.1 Introduction

The CUBE-TRIPS platform has been used for strategic modelling purposes in this study. It is a link-based travel demand network model.

Separate models have been prepared for 2009 to represent existing conditions and 2019 and 2039 to represent future conditions for the purposes of testing likely travel behaviour.

The network contains all major highways, arterial roads and other significant local roads covering North and South Grafton and the roads into and out of town. There are 39 transport zones (including 10 external zones) in the model which are based on Census Collector Districts (CCD) and disaggregated where necessary. The model zones have been selected to reflect road, geographical and land use boundaries and to be consistent where required with the microsimulation modelling to enable integration of inputs and outputs.

Details of the model purpose and methodology are located in the report dated 17 December 2009.

5.2 Existing Conditions Model

The strategic model network was produced based on the road network, which extends approximately 15km from the centre of Grafton and includes South Grafton, Junction Hill and Clarenza, closely reflecting actual road characteristics (speed and capacity), road alignment and orientation.

The Traffic Study Report of 17 December prepared by GTA Consultants details the following:

- model establishment
- zone structure
- land uses
- matrix estimation process
- the model calibration and validation
- future year growth.

5.3 Model Options

The future year Grafton strategic model has been tested using four options:

- Option A: Additional 2 lanes is provided adjacent to the existing Grafton Bridge upstream
- Option B: Additional 2 lanes is provided adjacent to the existing Grafton Bridge downstream
- Option C: New bridge downstream connecting between Pound Street and Pacific Highway
- Option D: new Bridge downstream connecting between Villiers Street and Pacific Highway.

For the purposes of the network model, there is no network difference between Option A and B, therefore Option A and B have been modelled as the same option.

Further detail on each of the options is located in Section 4 of this report.

5.4 Growth Rate

A range of growth rates were considered as part of this study, which are detailed in Section 3 of this report. For the purposes of assessing the options, a growth rate of 1.9%p.a. has been adopted, which has been applied to future year option models.

5.5 Model Results

Grafton Bridge Volumes

The future year option models have been analysed using daily volumes. Table 5.1 shows the daily modelled volumes across the River for the years 2009 and 2039.

Table 5.1: Grafton Bridge Traffic Study – Daily Modelled Traffic Flows Across the River for 2009 & 2039

Year	Trip Type	Vpd*	Percent (%)
2009	External trips	214	1%
	Trips to and from Grafton	8,234	28%
	Trips within Grafton	21,075	71%
	Total	**29,523**	**100%**
2039	External trips	295	1%
	Trips to and from Grafton	13,195	18%
	Trips within Grafton	43,724	81%
	Total	**57,214**	**100%**

* Daily flows calculated by multiplying AM peak period (2 hour) flows by 7.57 based on survey data

Table 5.1 indicates that a Growth Rate of 1.9% yields a bridge crossing demand in 2039 that is approximately double that of the 2009 model. External trips are insignificant in comparison with the remaining demand of the Grafton Bridge.

A daily model has not been developed and daily volumes are not produced directly from the strategic model. In order to produce daily results, the AM peak results are factored on the basis of existing traffic counts by a factor of 7.57.

Screenline Flows

Screenlines are imaginary lines crossing sections of the model that are used to obtain an understanding of the changes in travel patterns for each option. Seven screenline locations have been selected for this project, and the locations are shown in Figure 5.1.

Figure 5.1: Grafton Bridge Traffic Study - Screenline Location

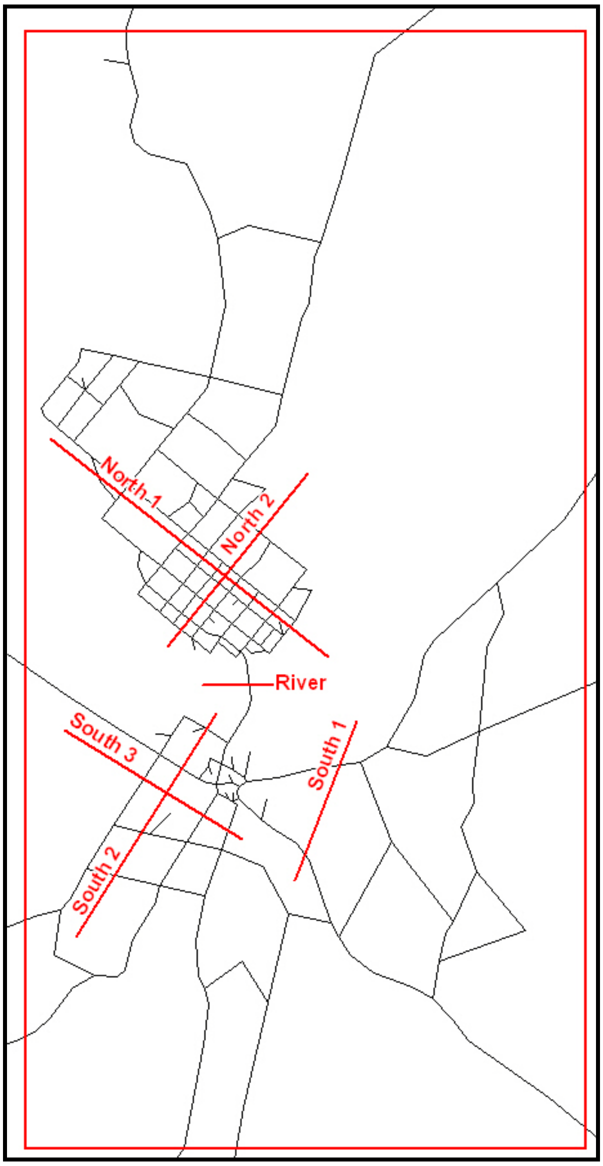


Table 5.2 summarises volumes across screenlines for all future year options.

Table 5.2: Grafton Bridge Traffic Study – Modelled Traffic Volumes Existing and Future (Daily)

Location Description	Year 2009	Year 2019			Year 2029			Year 2039		
	Volume	Volume	Growth	%	Volume	Growth	%	Volume	Growth	%
River Crossing	**29,523**	**36,843**	**7,320**	**25%**	**45,859**	**16,336**	**55%**	**57,214**	**27,691**	**94%**
North 1										
Option A/B	32,400	41,105	8,706	27%	51,574	19,175	59%	64,648	32,248	100%
Option C	-	41,105	8,706	27%	51,574	19,175	59%	66,283	33,883	105%
Option D	-	41,105	8,706	27%	51,574	19,175	59%	65,662	33,263	103%
North 2										
Option A/B	39,637	49,712	10,076	25%	62,339	22,702	57%	78,198	38,562	97%
Option C	-	49,705	10,068	25%	62,331	22,695	57%	78,198	38,562	97%
Option D	-	49,712	10,076	25%	62,339	22,702	57%	78,198	38,562	97%
South 1										
Option A/B	14,837	17,638	2,801	19%	20,893	6,056	41%	26,593	11,756	79%
Option C	-	18,774	3,936	27%	22,566	7,729	52%	29,167	14,330	97%
Option D	-	18,895	4,058	27%	22,702	7,865	53%	29,447	14,610	98%
South 2										
Option A/B	25,753	31,817	6,064	24%	39,303	13,550	53%	48,743	22,990	89%
Option C	-	31,802	6,048	23%	39,288	13,535	53%	48,849	23,096	90%
Option D	-	31,832	6,079	24%	39,296	13,543	53%	48,932	23,179	90%
South 3										
Option A/B	23,512	29,182	5,670	24%	36,268	12,755	54%	44,368	20,855	89%
Option C	-	28,289	4,777	20%	34852	11,340	48%	42,536	19,023	81%
Option D	-	28,183	4,671	20%	34,739	11,226	48%	40,999	17,487	74%
External Screenlines *										
Option A/B	32,755	38,365	5,609	17%	44,693	11,938	36%	52,528	19,773	60%
Option C	-	38,365	5,609	17%	44,693	11,938	36%	52,528	19,773	60%
Option D	-	38,365	5,609	17%	44,693	11,938	36%	52,528	19,773	60%

* For external screenlines location relates to the red box shown in Figure 5.1

Table 5.2 indicates that there is minor variation in travel patterns within the network, except for the South 1 and South 3 screenlines. Screenline South 1 indicates that Option C and D will experience more traffic than A and B east of Bent Street, whilst screenline south 3 indicates that C and D will experience less traffic than A and B south of the Gwydir Highway. .

5.6 Strategic Model Summary

Model outputs presented in Table 5.2 indicate there are minor differences between the modelled options at the strategic level. However, all future year volumes are governed by future year growth rates as trip matrices (based on land use and observed flows) determine the overall travel demand in the network model. This analysis involves using a growth rate of 1.9% (refer to Section 3 of this report) and in turn provides an input into the micro-simulation analysis presented in Section 6.

The following comments are provided in relation to the modelling results presented in this report:

- Traffic demands across the Grafton River are anticipated to double over the next 30 years.
- Irrespective of the growth rate assumed, Options A and B will allow additional traffic to cross the river into the Grafton and South Grafton Townships, impacting on the road infrastructure.
- Options A and B will provide little changes to the travel patterns within Grafton and South Grafton.
- Options C and D, which create alternative routes between South Grafton and Grafton provide more flexibility for traffic to distribute amongst the network within South Grafton and Grafton.

6. Microsimulation Model Results

6.1 Introduction

Q-Paramics microsimulation modelling has been utilised to assess the operation of the network at a vehicle by vehicle level. Q-Paramics microsimulation is a computer software package that has the ability to individually model each vehicle, including buses, taxis, trains, trams, etc. within a road network. It enables a realistic representation of driver behaviour such as overtaking and lane changing and can also illustrate network performance. Q-Paramics is a particularly useful tool in modelling congested road networks where over-saturation and resulting vehicle queuing impacts on upstream intersections.

6.2 Purpose

Microsimulation models are generally prepared in cases where an existing network is already over-saturated or a proposed scheme or future year is likely to over-saturate the study network. In such cases what is of interest is the impact of over-saturation on upstream intersections and how their method of control and timing plans can be modified to make sure that effective strategies can be designed and tested.

The modelling has been prepared for each of the options to assess their effectiveness in terms of vehicle by vehicle and network operating statistics.

6.3 Options Testing

This section of the report sets out the operating conditions for each of the tested options in terms of overall network performance. The results of the network performance include the following:

- number of completed vehicle trips per simulation period
- average kilometres per vehicle
- average travel time per vehicle
- average speed
- number of stops
- vehicle kilometres travelled (VKT)
- vehicle hours travelled (VHT)

For the purpose of obtaining results that represent a typical week data sample, five runs with different seed numbers were performed for each option. Applying different seed numbers changes the profile of the traffic arrival and therefore represents more reliable replication of real life variation in day-to-day traffic conditions.

6.4 Future Year Traffic Forecast

For the purposes of testing the ability of the road network to cater for the future demands, a growth rate of 1.9%p.a. was adopted. The future year traffic forecast rates discussed in Section 4 have been utilised in assessing the road network operation in the design years of 2019, 2029 and 2039. The growth rate of 2.5% p.a. was adopted for the majority of internal zones and trips within Grafton and South Grafton, whilst a lower rate of 1.9% p.a. was used for trips travelling over the Grafton Bridge (i.e. between Grafton and South Grafton).

Smaller zones that are unlikely to generate increased demands such as petrol stations, and established residential zones, have not been applied growth.

Table 6.1 is a summary of the growth factor used in determining future year traffic demands.

Table 6.1: Grafton Bridge Study AM Peak Network Performance

Trip Type	Design Year			
	2009	2019	2029	2039
External Trips	1.0	1.21	1.46	1.76
Internal Trips	1.0	1.28	1.64	2.10

Table 6.1 shows that the traffic demands in Grafton are likely to increase by between 20% and 30% within 10 years and double within 30 years. The impact of the increased growth on the existing road network has been assessed using the microsimulation model and is set out in the following sections.

6.5 Results

A summary of the network statistics for all four preliminary corridor options has been prepared for the AM and PM peak hours respectively and are presented in Tables 7.2 to 7.9. The network results are calculated for the number of completed trips for each design year.

Table 6.2: Grafton Bridge Traffic Study – Option A Network Performance (AM Peak 8-9am)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5718	6756	8298	3257
No. Uncompleted Trips	69	80	163	603
No. Unreleased Vehicles1	0	0	0	4665
Average Km per vehicle (km/veh)	1.9	1.8	1.8	1.6
Average Travel Time per vehicle (min/veh)	2.4	2.5	3.0	3.1
Average Speed (km/hr)	45.4	43.9	35.7	13.8
No. of Stops	10034	14747	35029	19114
Vehicle Kilometres Travelled (VKT)	1077	12669	15246	6274
Vehicle Hours Travelled (VHT)	237	288	432	453

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.3: Grafton Bridge Traffic Study – Option A Network Performance (PM Peak 4-5pm)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5817	6935	506	2
No. Uncompleted Trips	70	82	693	776
No. Unreleased Vehicles 1	0	0	6536	14315
Average Km per vehicle (km/veh)	1.8	1.7	0.9	0.5
Average Travel Time per vehicle (min/veh)	2.4	2.4	135	14.2
1Average Speed (km/hr)	44.6	43.4	5.4	1.3
No. of Stops	10246	14591	1301	15
Vehicle Kilometres Travelled (VKT)	10393	12274	753	7
Vehicle Hours Travelled (VHT)	233	286	140	5

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.4: Grafton Bridge Traffic Study – Option B Network Performance (AM Peak 8-9am)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5772	6708	8329	3469
No. Uncompleted Trips	65	81	115	545
No. Unreleased Vehicles 1	0	0	0	4521
Average Km per vehicle (km/veh)	1.9	1.8	1.8	1.7
Average Travel Time per vehicle (min/veh)	2.5	2.5	3.0	3.4
Average Speed (km/hr)	45.0	43.9	36.6	14.7
No. of Stops	10523	14559	31410	20931
Vehicle Kilometres Travelled (VKT)	10946	12544	15359	6830
Vehicle Hours Travelled (VHT)	243	285	421	484

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.5: Grafton Bridge Traffic Study – Option B Network Performance (PM Peak 4-5pm)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5795	6913	2697	6
No. Uncompleted Trips	72	85	665	811
No. Unreleased Vehicles 1	0	0	4169	14472
Average Km per vehicle (km/veh)	1.8	1.8	1.2	0.3
Average Travel Time per vehicle (min/veh)	2.4	2.4	2.5	14.6
Average Speed (km/hr)	44.8	44.0	14.7	5.2
No. of Stops	10203	14024	12556	0
Vehicle Kilometres Travelled (VKT)	10497	12315	4928.8	2.7
Vehicle Hours Travelled (VHT)	234	281	333.9	0.5

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.6: Grafton Bridge Traffic Study – Option C Network Performance (AM Peak 8-9am)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5689	6753	8389	9259
No. Uncompleted Trips	49	58	80	271
No. Unreleased Vehicles 1	0	0	0	380
Average Km per vehicle (km/veh)	1.8	1.8	1.8	1.8
Average Travel Time per vehicle (min/veh)	2.4	2.4	2.5	3.6
Average Speed (km/hr)	45.1	45.1	42.0	27.9
No. of Stops	8401	11530	19497	45832
Vehicle Kilometres Travelled (VKT)	10487	12314	15025	16857
Vehicle Hours Travelled (VHT)	229	273	360	628

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.7: Grafton Bridge Traffic Study – Option C Network Performance (PM Peak 4-5pm)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5799	6908	8404	9602
No. Uncompleted Trips	48	58	77	219
No. Unreleased Vehicles 1	0	0	0	1018
Average Km per vehicle (km/veh)	1.8	1.8	1.7	1.7
Average Travel Time per vehicle (min/veh)	2.3	2.4	2.8	5.5
Average Speed (km/hr)	45.1	44.2	37.9	19.2
No. of Stops	9375	13190	22272	64221
Vehicle Kilometres Travelled (VKT)	10381	12226	14752	17024
Vehicle Hours Travelled (VHT)	230	285	393	930

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.8: Grafton Bridge Traffic Study – Option D Network Performance (AM Peak 8-9am)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5715	6726	8400	9666
No. Uncompleted Trips	48	55	71	218
No. Unreleased Vehicles 1	0	0	0	119
Average Km per vehicle (km/veh)	1.8	1.8	1.8	1.8
Average Travel Time per vehicle (min/veh)	2.3	2.4	2.4	3.2
Average Speed (km/hr)	47.6	47.1	45.4	32.6
No. of Stops	7795	10832	17772	402331
Vehicle Kilometres Travelled (VKT)	10560	12330	15069	17970
Vehicle Hours Travelled (VHT)	226	269	345	551

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 6.9: Grafton Bridge Traffic Study – Option D Network Performance (PM Peak 4-5pm)

Statistic	Design Year			
	2009	2019	2029	2039[2]
No. Completed Trips	5621	6893	8301	9556
No. Uncompleted Trips	43	58	79	100
No. Unreleased Vehicles 1	0	0	64	754
Average Km per vehicle (km/veh)	1.8	1.8	1.7	1.7
Average Travel Time per vehicle (min/veh)	2.3	2.3	3.0	3.3
Average Speed (km/hr)	47.2	46.4	35.0	24.5
No. of Stops	7844	12021	21780	30353
Vehicle Kilometres Travelled (VKT)	10268	12213	14649	16713
Vehicle Hours Travelled (VHT)	220	270	422	536

1 Unreleased vehicles are those unable to be released into the network due to congested network conditions

The average speeds and number of completed trips are also shown graphically in Figures 6.1 to 6.6.

Figure 6.1: Average Vehicle Speed (AM Peak)

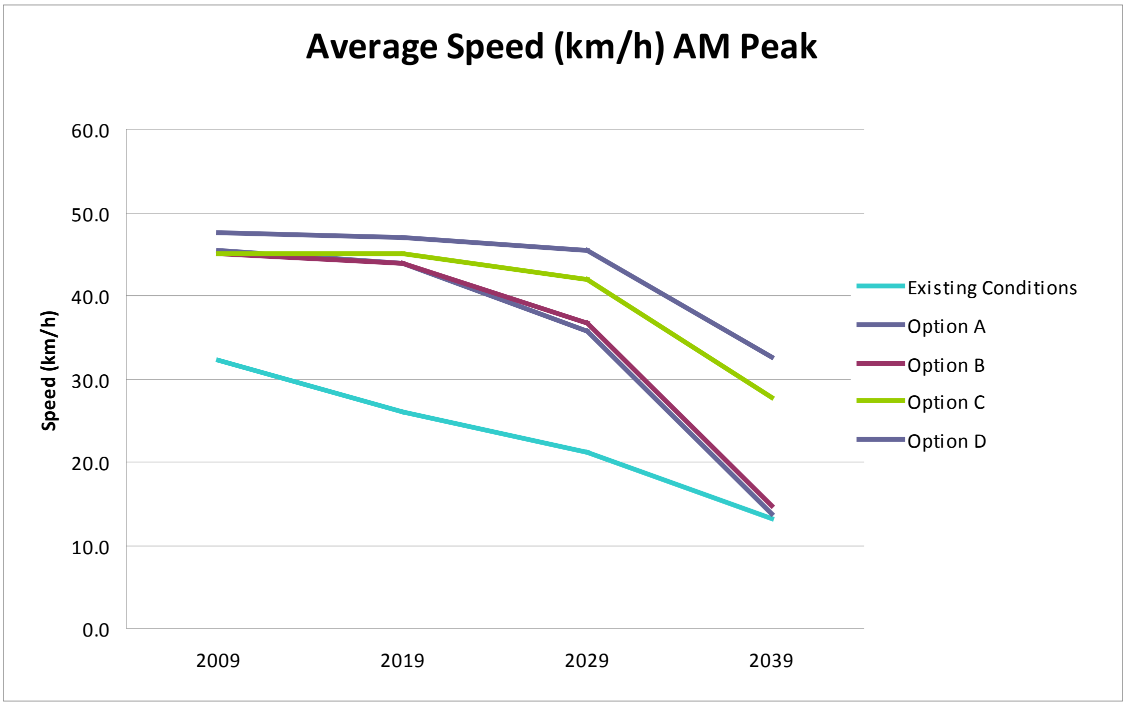


Figure 6.2: Average Vehicle Speed (PM Peak)

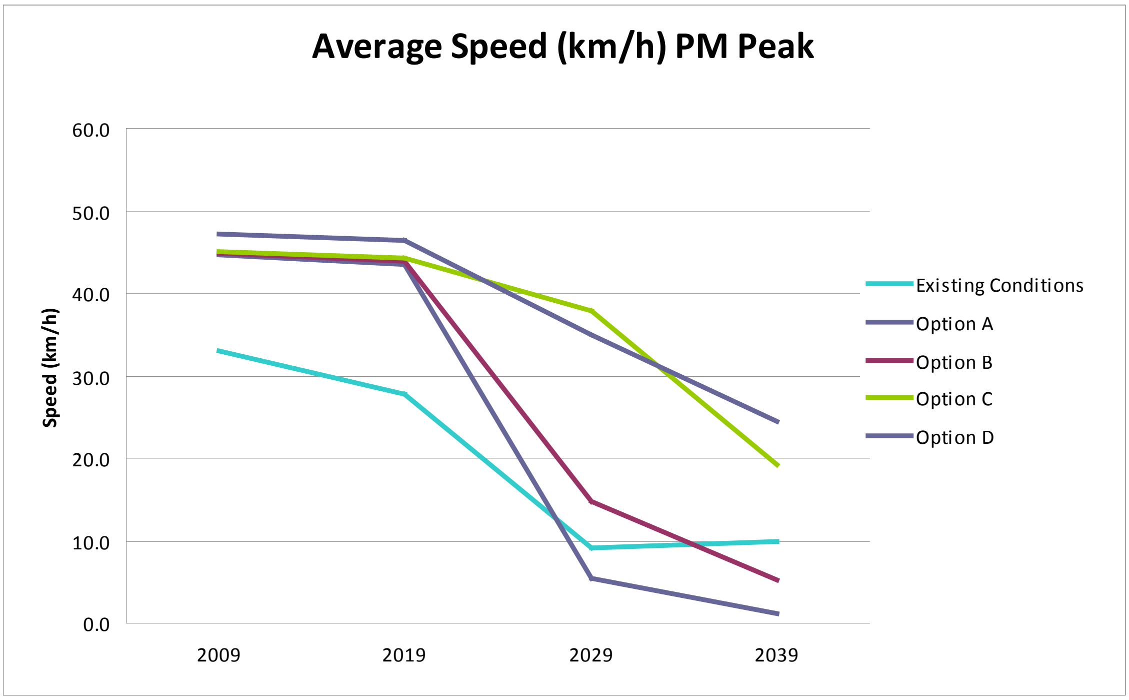


Figure 6.3: Number of Completed Trips (AM Peak)

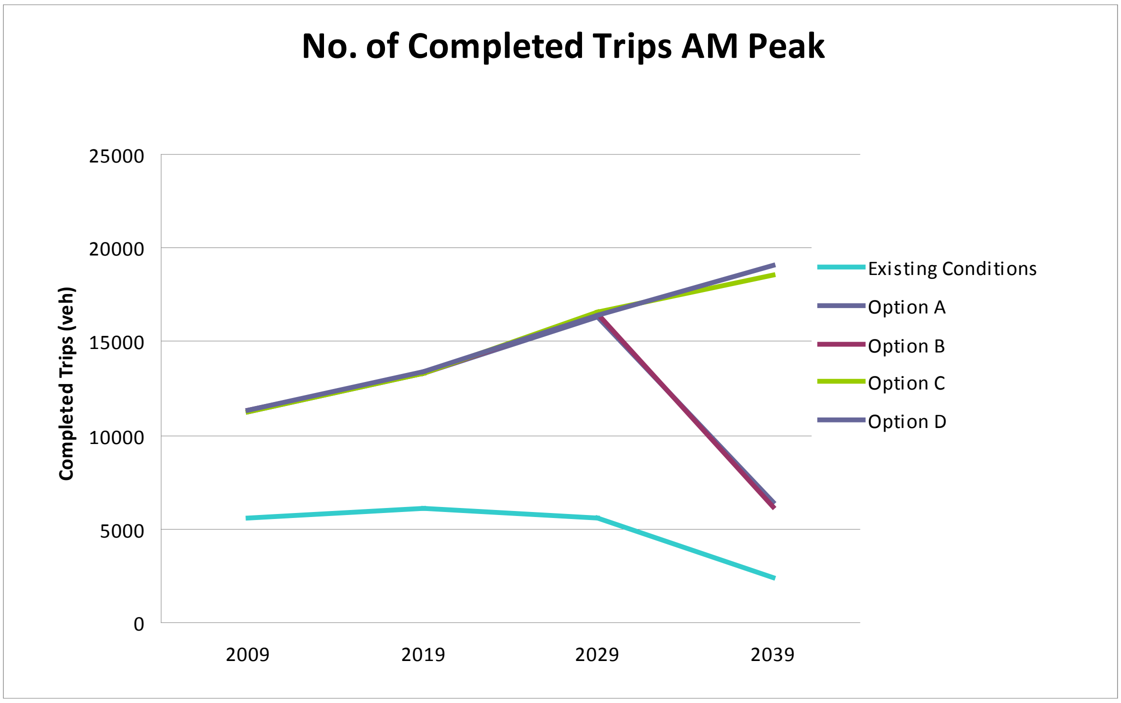
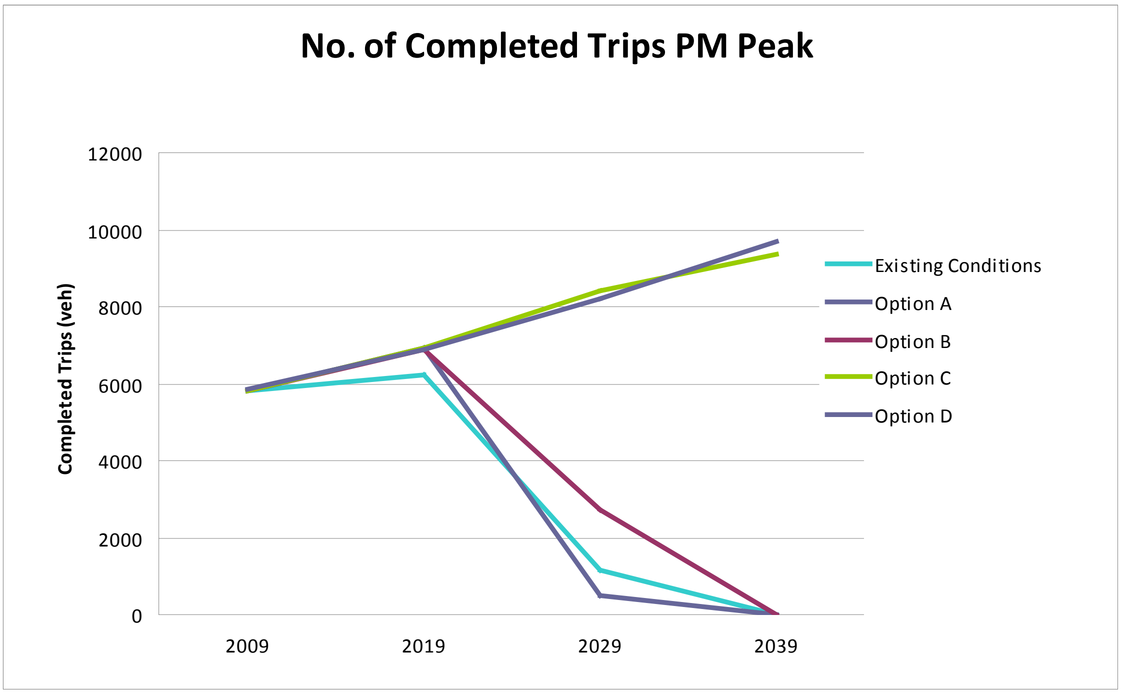


Figure 6.4: Number of Completed Trips (PM Peak)



Figures 6.1 to 6.4 indicate that Option A and B will provide immediate improvement in terms of average speed and the number of completed trips; however by 2039 the networks deteriorate. In contrast, Options C and D provide the best average speeds of all the options and by 2039 will operate at or above the existing operating conditions.

Point to Point Travel Times

In addition to the network results, vehicle travel times were recorded between the Pacific Highway (South Grafton) and Prince Street / Bacon Street intersection. In figures 6.5 and 6.6, the expected AM and PM peak travel times for all the options including the existing conditions are presented.

Figure 6.5: Point to Point Travel Time Northbound (AM Peak)

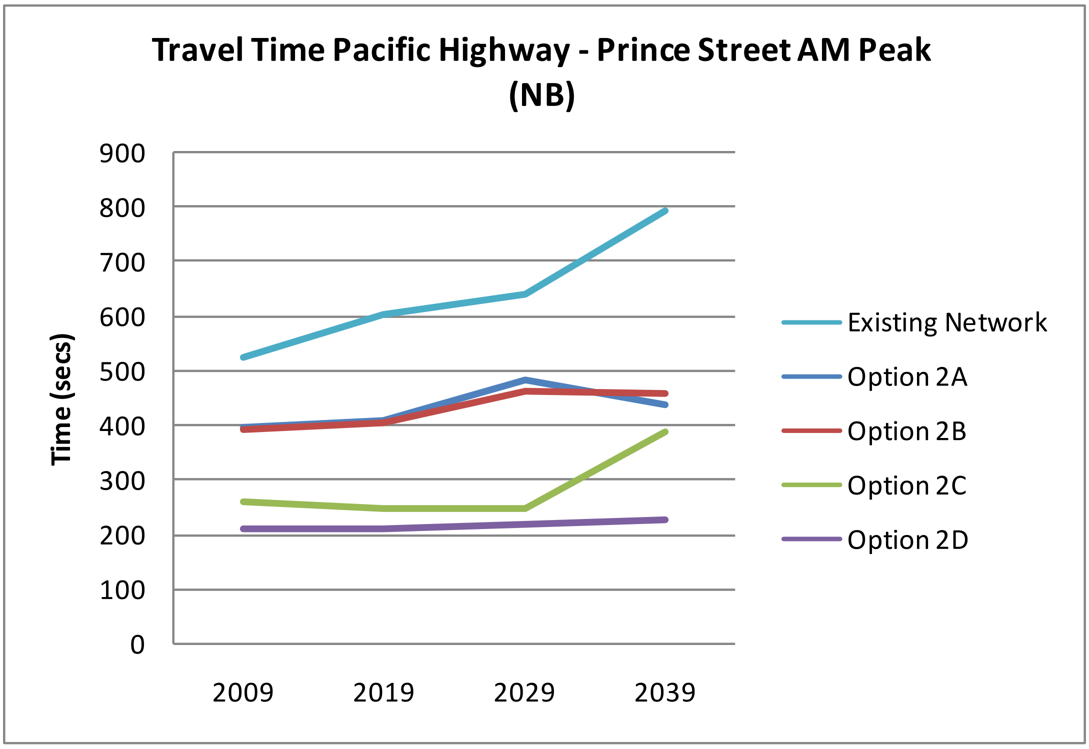
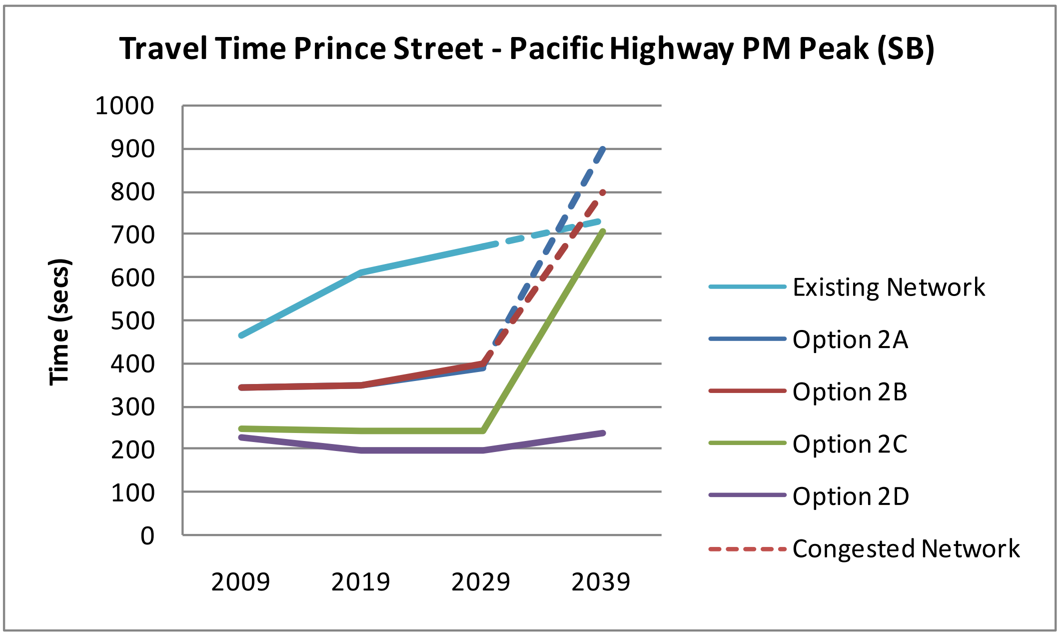


Figure 6.6: Point to Point Travel Time Southbound (PM Peak)



Figures 6.5 and 6.6 indicate that Option D will provide the best travel times in each of the design years.

6.6 Microsimulation Summary

Based on the model observations and the results presented in Tables 7.2-7.9, the following comments are provided in relation to **Options A and B**:

- Increased bridge capacity will provide immediate improvements to the operating conditions up to 2019.
- Traffic volumes on key roads including Clarence Street, Fitzroy Street, Prince Street and Bent Street will reach their capacities and would require works to improve their capacity.
- The intersection of Villiers Street and Fitzroy Street will reach its capacity by 2019 and beyond.
- Increased traffic volumes for the future year will result in longer delays for motorists on the approaches to Villiers Street / Fitzroy Street and Bent Street / Through Street intersections.
- The network will reach high congestion levels after 2019 and by 2039 the network will not be able to handle the additional traffic and will reach grid lock.

Based on the model observations and the results presented in Tables 7.2-7.9, the following comments are provided in relation to **Option C**:

- Provides an alternate connection between Grafton and South Grafton, reducing movement on the existing bridge and the reliance on the key intersection approaching the existing river crossing such as the Bent Street / Through Street and Fitzroy Street / Villiers Street intersections.
- Vehicle speeds across the network will remain above 40kph up to the year 2029.
- The number of unreleased vehicles in 2039 is low which indicates that the network is capable of handling the increased traffic demands.
- The removal of heavy vehicles from the existing bridge to the new bridge will improve traffic flow on the existing bridge .

Based on the model observations and the results presented in Tables 7.2-7.9, the following comments are provided in relation to **Option D**:

- Similar to Option C, Option D provides an alternate connection between Grafton and South Grafton, reduces the reliance on the existing bridge and distributes vehicular traffic across the network.
- Provides better operating conditions for the network in terms of completed trips, number of stops, average speeds and Vehicle Hours Travelled (VHT) for all design periods.
- The number of completed vehicles in 2039 is the highest of all options indicating that there is less congestion in the network and that it is capable of managing the increased traffic demands.
- The removal of heavy vehicles from the existing bridge to the new bridge will improve traffic flow on the existing bridge.
- The average travel time per vehicle is the lowest of all options.

7. Conclusions

This study has examined options aiming at improving current and future traffic conditions in Grafton and South Grafton. Based on the assumptions adopted for the options, the results of the traffic analysis demonstrate the following:

- A range of growth were considered for this assessment, with a growth rate of 1.9% is recommended as the most likely outcome. This formed the basis of model testing.
- Options A and B will have increased volumes on key roads such as Clarence Street, Fitzroy Street, Villers Street, Prince Street and Bent Street and will reach high congestion levels after 2019 and by 2039 the network will not be able to handle the additional traffic and will reach grid lock during the peak periods.
- Options C and D provide an alternate connection between Grafton and South Grafton, reducing the reliance on the key intersection approaching the existing river crossing such as the Bent Street / Through Street and Fitzroy Street / Villiers Street intersections.
- Microsimulation modelling results showed all options which involved bridge duplication yield positive results in terms of the overall network performance, however Options C and D will experience a longer life span than Options A and B.

Each option will also require a series of infrastructure items which would need to be addressed as part of any further planning for a bridge crossing.

These conclusions are based solely on traffic modelling of four preliminary corridor options for a new bridge connection to the local road network. The findings are based on a number of assumptions underpinning the analysis. They do not take into account the full range of issues to be considered in finally determining a preferred option.

Traffic demand across the river already exceeds the capacity of the existing bridge at peak times. The traffic delays in peak periods are forcing changes in people's travel behaviour and daily activity patterns, and as a result are constraining development. Grafton and South Grafton are to some extent being forced to operate as separate towns. If additional traffic capacity is provided across the river, there will be a number of effects. Peak period traffic volumes will immediately increase, as people revert to their preferred travel behaviour and activity patterns. In the medium term, there will be changes in land use, as the city is now able to function more as a single unit, and traffic across the river will probably grow at a fairly high rate for several years. In the longer term, growth in population, employment and traffic will revert to a more normal rate.

To simplify the modelling undertaken thus far, growth rates have been applied and a range of different rates tested. It would be desirable to investigate the land use and traffic impacts of the options in more detail, in consultation with Council, the NSW Chamber of Commerce, and other stakeholders.

Further options may be developed following community and stakeholder input. All options will need more detailed analysis to determine levels of service and congestion on the roads tying into the bridge approaches.

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