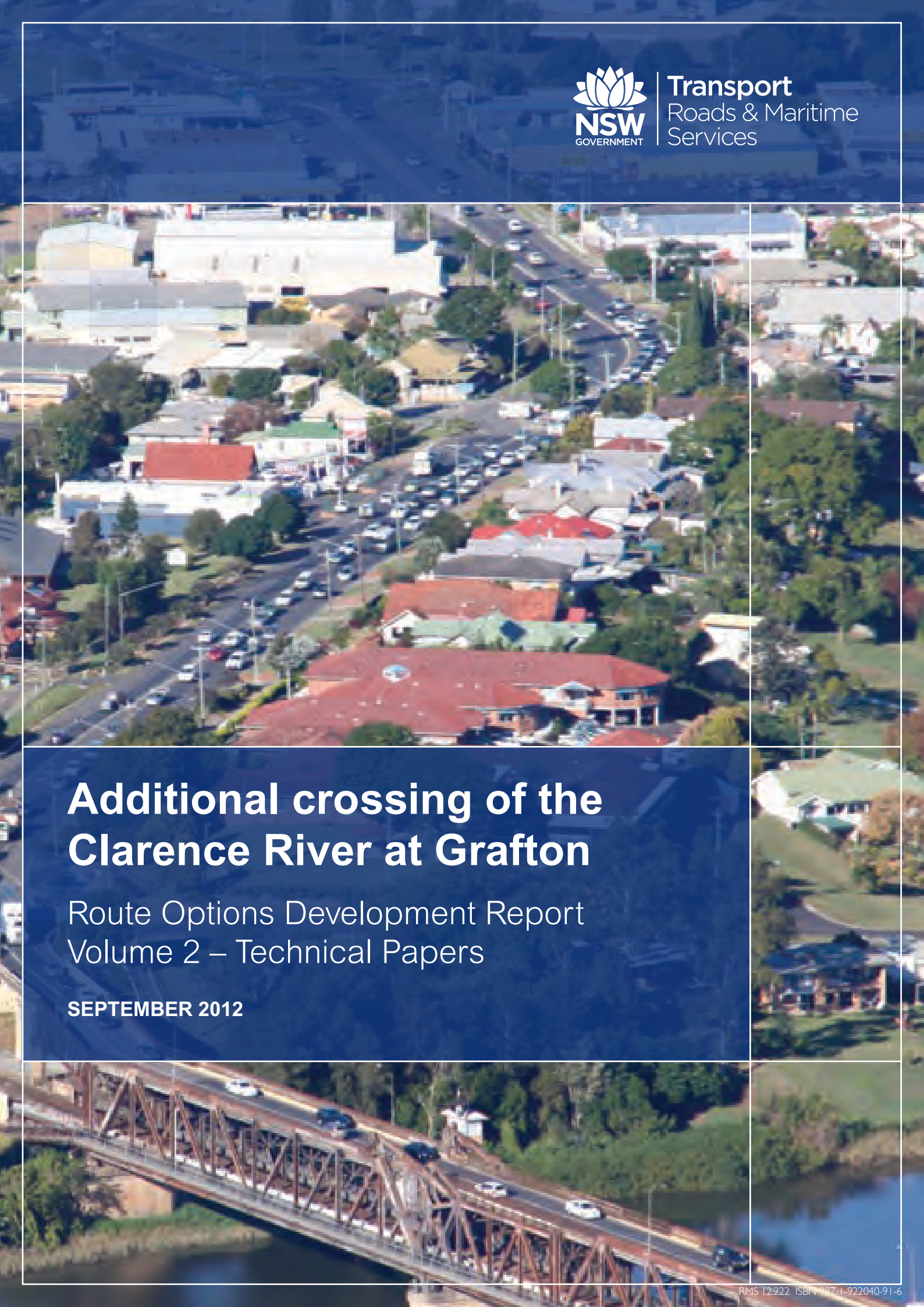

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Additional crossing of the Clarence River at Grafton

Route Options Development Report
Volume 2 – Technical Papers

SEPTEMBER 2012

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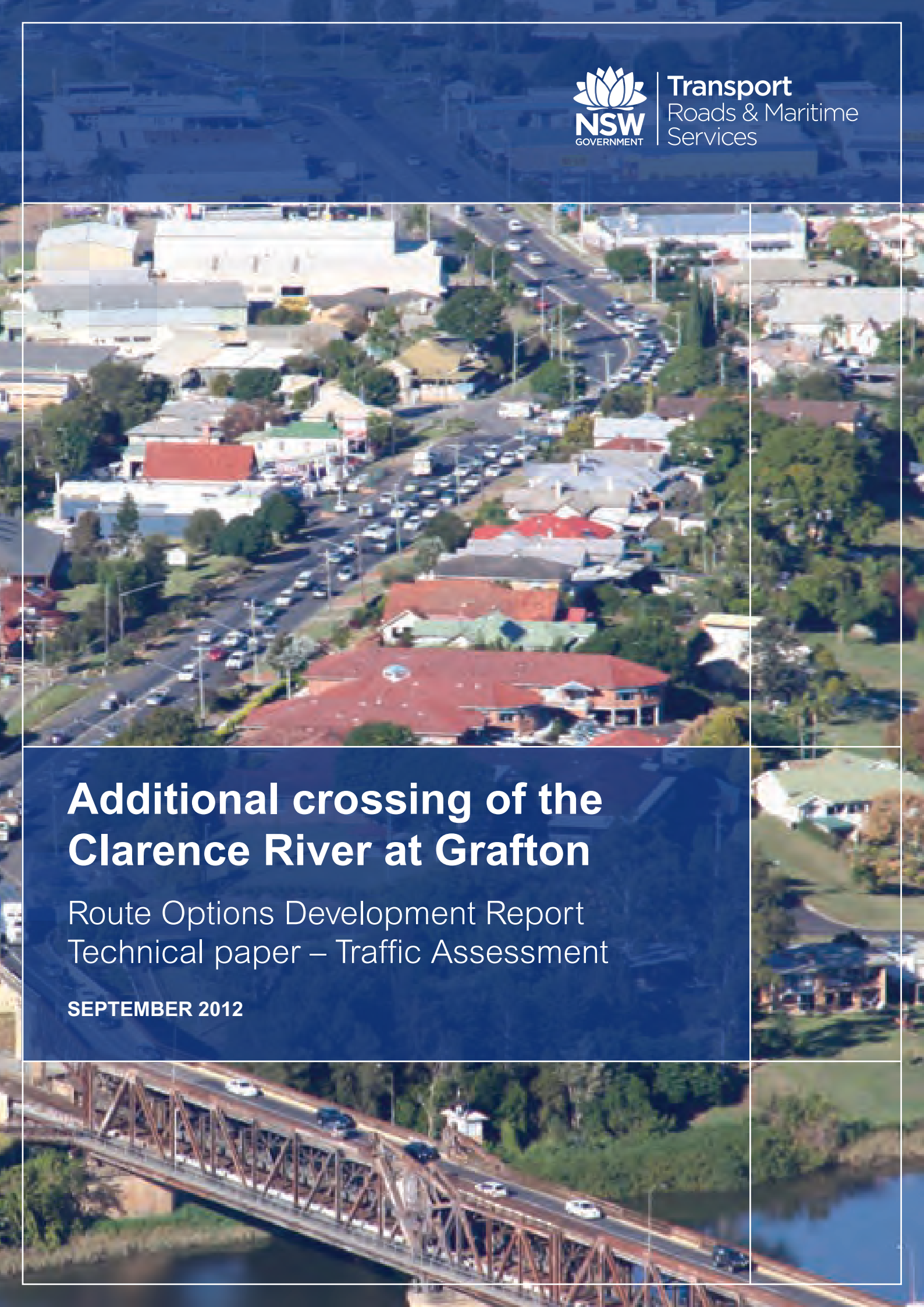

NSW GOVERNMENT
Transport
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Additional crossing of the Clarence River at Grafton

Route Options Development Report
Technical paper – Traffic Assessment

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Main Road 83, Summerland Way
Additional Crossing of the Clarence River, Grafton
Route Options Development Report
Technical Paper: Traffic Assessment

transportation planning, design and delivery

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GTAconsultants

Executive Summary

Microsimulation modelling has been used to predict the existing and future traffic conditions in Grafton and its surrounds to inform investigations into the identification of a preferred location for an additional crossing of the Clarence River. The modelling assessed the six options short-listed from the 25 preliminary route options that were assessed as part of the Preliminary Route Options Report.

The microsimulation model covers the Grafton and South Grafton areas. It enables a realistic representation of driver behaviour such as overtaking and lane changing and can also illustrate network performance. As such, microsimulation modelling enables a more detailed investigation of traffic conditions than strategic transport modelling.

This report sets out the details of the microsimulation modelling undertaken and details the modelling results for the six options in the design years of 2019, 2029, 2039 and 2049.

The objectives of this study are to undertake an assessment of the six short-listed route options and understand their performance in terms of operation of the road network. The microsimulation modelling will help assess the performance of the options on initial opening as well as their ability to cater for future traffic growth.

The unique features of the Grafton Bridge required that the selected software, in this case Q-Paramics, was able to analyse the movement of traffic over the Grafton Bridge and through the adjacent road network and assess its operation from both a localised intersection and network perspective.

An existing conditions model was developed to accurately reflect the current operating conditions of the network. This model was calibrated and validated to industry standard guidelines that compare modelled and observed traffic data as well as by a visual assessment of operating conditions, including vehicle queues.

Future year growth was adopted from the strategic modelling assessment which was developed in consultation with Clarence Valley Council and the Department of Planning and Infrastructure.

A "do minimum" model was established to consider the future year operating conditions and included a number of network improvements necessary for the model to operate reasonably in the future. However, even with these improvements, the existing bridge and road network approaches are unable to cater for the estimated future traffic demand and the system is forecast to become heavily congested in the 2029 peak periods and beyond. As such the "do minimum" modelling revealed an inability for the road network to cater for the expected growth to 2029, even with these improvements.

In order to accurately define the likely future traffic conditions for each option, the method of 'Equilibrium Assignment' was used. This approach assumes that drivers choose their travel routes based on their previous experience travelling through the network, hence drivers will have decided when they commence their journey, as to whether or not they will travel via the new or existing bridge.

The modelling results showed that at the time of the assumed year of opening (2019), all six options perform similarly. However, as traffic demands increase in the later years (2039 and 2049), the options that are in close proximity to the existing bridge (Options E, A and C) perform better than those further downstream (Options 11, 14 and 15), in terms of average speed, number of stops and total distance travelled.

The results also indicate:

- The "do minimum" results show that if the assumptions of growth are realised by 2029 the demands across the river will significantly reduce the performance of the network potentially causing grid lock during the peak periods.
- The network performance in Options 14 and 15 deteriorates in future years with average speeds in the AM peak up to 40% less than the other options by 2049.
- By 2049 the number of stops recorded in both the AM and PM peaks for Options 14 and 15 are substantially higher than for Options E, A, C and 11. This is a result of the majority of motorists still wanting to use the existing bridge with those options.
- From 2029 and beyond, point to point travel times indicate that Options E and C provide the shortest travel times between South Grafton and Grafton, and that Options 14 and 15 provide the best travel times between Butterfactory Lane and the Pacific Highway.
- In 2049 Option A provides the best average speed during the AM peak, however during the PM peak, the average speed of Option A is 20% lower than the best options for the PM peak (Options E and C).
- All options with a new bridge in close proximity to the existing bridge (i.e. Options E, A and C) experience a greater drop in volumes on the existing bridge when compared to those downstream (Options 11, 14 and 15).

The modelling presented in this report indicates that each of the options improved the operation of the network with the options close to the existing bridge (Options E, A and C) performing better than the downstream options.

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1. Introduction

1.1 Background

GTA Consultants (GTA) have been engaged by Arup, on behalf of Roads and Maritime Services (RMS), to provide traffic and transport input for Main Road 83 Summerland Way, Additional Crossing of the Clarence River at Grafton.

GTA has recently undertaken strategic transport modelling of Grafton and South Grafton on 25 preliminary route options that were identified by the RMS in GTA's report *Main Road 83 Summerland Way, Additional Crossing of the Clarence River, Grafton – Strategic Traffic Assessment* dated 11 November 2011 (henceforth referred to as GTA's 2011 Strategic Traffic Assessment). The strategic transport modelling was completed using Cube-TRIPS and used a range of inputs to assess the existing and future travel patterns in and around Grafton and South Grafton.

In January 2012, six route options were short-listed to be investigated further as part of the process to identify a location for a new crossing. The short-listed options were identified in the *Preliminary Route Options Report – Final (RMS, January 2012)* which also provided details of the technical investigation undertaken on the 25 preliminary options and the process that selected the short-listed options.

This Route Options Development Report (RODR) – Technical Paper: Traffic Assessment sets out the details of the microsimulation modelling undertaken for the six options and details the results for the design years of 2019, 2029, 2039 and 2049.

1.2 Study Objectives

This study follows on from previous studies (as described in the following section) undertaken to assess the existing and future traffic conditions in the Grafton area and to inform investigations into the identification of a preferred location for an additional crossing of the Clarence River.

The objectives of this study are to undertake an assessment of the six short-listed route options and understand their performance in terms of the operation of the road network. The microsimulation modelling will help assess the performance of the options on initial opening as well as their ability to cater for future traffic growth.

The outputs of this report allow a comparison of the traffic efficiency and performance of the road layouts of each option, from the assumed year of opening in 2019 through to 30 years after opening in 2049.

1.3 Background Traffic and Transport Studies

A range of background reports and data have been reviewed as part of this package of work as they provide relevant and useful information into the development of the modelling. This section sets out a brief summary of the reports and their relevance.

'Additional Crossing of the Clarence River', RTA NSW, February 2003

This report notes that the need for an additional link over the Clarence River, to improve connectivity between Grafton and South Grafton, has been discussed for many years. The existing bridge was opened to vehicular traffic in 1932 and correspondence in relation to a second crossing dates back to 1960.

As part of the study, a community questionnaire was conducted with some 1,900 responses received. The responses included 73% of persons having experienced delays on the bridge either daily (37%) or weekly (36%).

In conclusion the study suggests the most feasible location for an additional river crossing would be in the vicinity of the existing bridge.

'South Grafton Traffic Study', GTA Consultants, February 2009

The report sets out an assessment of the existing conditions for the South Grafton area and assessed expected future traffic conditions. It was concluded that the Grafton Bridge is the 'bottle neck' resulting in congested conditions within South Grafton, especially during the AM peak period. If no changes were to be introduced to the existing road network, travel times and queuing would progressively increase and the network would become more vulnerable to blockages or grid lock caused by the additional traffic demand.

A number of options were assessed (including increased Bridge capacity) and the results of the microsimulation modelling indicated that those options would provide marginal benefits to the operating performance of the network, predominantly due to the constraints experienced at the Grafton Bridge.

'Existing Conditions Report', GTA Consultants, December 2009

This report sets out the results of the modelling and analysis assuming the current road network and shows the likely traffic outcomes if no additional river crossing capacity is provided.

Regional and microsimulation modelling of Grafton and its surrounds was undertaken to develop an understanding of the existing and future traffic demands and patterns within Grafton. In particular, future demands across the river were estimated for a range of land uses.

The strategic modelling was undertaken to understand the existing travel behaviour in Grafton and to determine future year growth rates for Grafton and South Grafton. A limiting feature of the strategic model was the lack of detailed land use planning and information which resulted in marginal changes to the travel patterns as a result of a new bridge.

As a consequence of the limited land use planning information, a growth rate of 1.9% per annum was adopted for testing purposes to the year 2039, along with strategic model sensitivity testing for various other growth rates.

Origin destination surveys completed by GTA indicated that 53% of trips using the Grafton Bridge travel between external destinations and Grafton, 45% of trips are internal whilst only 2% of trips were those travelling directly through Grafton and South Grafton.

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

- An additional bridge crossing in the vicinity of the existing bridge should be considered.
- 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.

'Preliminary Road Corridor Options Report', GTA Consultants, February 2010

Four preliminary corridor options and their approaches to an additional river crossing in the vicinity of the existing bridge were tested using microsimulation to determine the impact that each option would have on traffic movement in and around Grafton and South Grafton.

The results of the modelling indicated:

- Traffic demands across the Grafton River are anticipated to more than double over the life of a new bridge.
- The Yellow and Blue Options (RTA Options A and B) would increase bridge capacity but are constrained by the existing intersection capacity on the approaches to the bridge.
- The Yellow and Blue Options (RTA Options A and B) would have minimal impact on the travel patterns within Grafton and South Grafton.
- The Yellow and Blue Options (RTA 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.
- The Green and Red Options (RTA Options C and D) would create alternative routes between South Grafton and Grafton and provide opportunity for traffic to distribute across the network.
- The Green and Red Options (RTA Options C and D) would provide good connectivity between Grafton and South Grafton, reducing the reliance on key intersections approaching the existing river crossing.

The modelling showed that 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 would be a number of effects. Peak period traffic volumes would immediately increase, as people revert to their preferred travel behaviour and activity patterns. In the medium term, there would be changes in land use, as the city would be able to function more as a single unit, and traffic across the river would probably grow at a higher than average rate for several years. In the longer term, growth in population, employment and traffic would revert to a more normal rate.

'Additional Crossing of the Clarence River – Heavy Vehicle Study', GTA Consultants, February 2011

The RTA commissioned GTA to undertake a study of heavy vehicle movements in Grafton, South Grafton and adjacent areas on the arterial road network, including the Grafton Bridge and Summerland Way. The study aimed to provide a comprehensive understanding of the heavy vehicle travel patterns in Grafton to inform the route selection of the additional crossing of the Clarence River at Grafton.

The study methodology was designed in consultation with the RTA project team and consisted of three survey types:

i a detailed origin and destination (OD) survey to capture vehicle movements crossing the Grafton Bridge and within Grafton and South Grafton
ii automated classified tube count surveys at key locations in Grafton and South Grafton to obtain a summary of traffic volumes, directions, daily profiles and vehicle class proportions
iii questionnaire surveys of bridge users and businesses in the local area.

The surveys were designed to provide a summary of the travel behaviour of heavy vehicle movements in Grafton and South Grafton. Table 1.1 shows a breakdown of heavy vehicle movements that crossed the Grafton Bridge on Thursday the 19th of August 2010 between 5am and 7pm.

Table 1.1: Heavy Vehicles* Crossing the Grafton Bridge on 19th August 2010 (5am to 7pm)

Trip Type	Matched Heavy Vehicles	Percentage of Total (%)
External to External (through trips)	163	12%
External to Grafton / South Grafton	567	41%
Internal - Grafton to / from South Grafton	658	47%
Total	**1,388**	**100%**

*Heavy Vehicles includes buses and are for Austroads classes 3 – 12

The OD results showed that approximately 88% of heavy vehicles crossing the Grafton Bridge have an origin and / or destination within Grafton or South Grafton, and 12% of heavy vehicles are considered through trips that do not have an origin or destination within Grafton or South Grafton.

The proportion of external to external heavy vehicles is higher than that of all vehicles types crossing the Grafton Bridge which is summarised in Table 1.2.

Table 1.2: All Vehicle Trip Types Crossing Grafton Bridge on 19th August 2010 (5am to 7pm)

Trip Type	Matched Vehicles	Percentage of total (%)
External to External (through trips)	728	3%
External to Grafton / South Grafton	10,360	39%
Internal - Grafton to/from South Grafton	15,466	58%
Total	**26,554**	**100%**

The results showed that approximately 97% of vehicles crossing the bridge had an origin and / or destination within Grafton or South Grafton, and 3% of vehicles made through trips that did not have an origin and destination within Grafton or South Grafton. This is comparable to the previous study in March 2009 which indicated 2% of traffic using the bridge was through traffic.

Other key findings of the OD surveys were:

- Approximately 63% of northbound vehicles crossing the Clarence River have an origin in South Grafton and 92% of northbound vehicles crossing the Clarence River travel to a destination in Grafton south of Butterfactory Lane.
- Approximately 90% of southbound vehicles crossing the Clarence River have an origin in Grafton, south of Butterfactory Lane and 65% of southbound vehicles crossing the Clarence River travel to a destination in South Grafton.
- Approximately 62% of heavy vehicles travelling northbound across the Clarence River have an origin in South Grafton and 80% of heavy vehicles travelling northbound across the Clarence River travel to a destination in Grafton, south of Butterfactory Lane.

- Approximately 72% of heavy vehicles travelling southbound across the Clarence River have an origin in Grafton, south of Butterfactory Lane and 56% of heavy vehicles travelling southbound across the Clarence River travel to a destination in South Grafton.

Tube counters were placed at strategic locations in Grafton and South Grafton to supplement the OD information. The surveys indicated that:

- The Grafton Bridge carries approximately 27,580 vehicles per week day.
- 5% of vehicles crossing the Grafton Bridge were heavy vehicles (both directions).
- During the AM peak period, traffic flow is 61%/39% in favour of the northbound into Grafton, whilst during the PM peak period traffic flow is 53%/47% in favour of the southbound.
- Weekday trips between 7am and 10pm represent approximately 94% of all trips crossing the bridge.
- 91% of heavy vehicles cross the Clarence River between 7am and 10pm.
- Villiers Street north of Oliver Street carries 10% heavy vehicles (783 per day), which is 60% more than Prince Street north of Oliver Street which carries 4% heavy vehicles (301 vehicles per day).
- The Pacific Highway carries approximately 2,250 heavy vehicles per day (22% of Pacific Highway Traffic) and is significantly higher than the Summerland Way north of Butterfactory Lane which carries 609 heavy vehicles per day (9%), the Gwydir Highway which carries 443 heavy vehicles per day (9%) and Lawrence Road which carries 94 heavy vehicles per day (9%).

The businesses and bus companies surveyed as part of this study indicated that:

- It was common for most companies to establish routes to avoid peak hour traffic congestion.
- Some companies have arranged business times so that deliveries are made outside of the peak periods, although at times this was noted to be unavoidable.
- The most prominent issue raised was the bridge curfew during morning and afternoon peak periods and the effect it has on business operations (e.g. scheduling).
- Late running of services was noted due to bridge congestion which led to incurring of extra cost in the operation of catch up and head off services.
- Perceptions of incidents on the bridge were a concern due to a lack of access to and from each side of the bridge in emergency situations for ambulances and the like.

'Additional Crossing of the Clarence River, Grafton – Strategic Traffic Assessment', GTA Consultants, November 2011

Strategic transport modelling of Grafton and its surrounds was undertaken to develop a detailed understanding of the existing and future traffic demands and patterns for the Grafton and South Grafton areas and surrounds. The modelling involved reviewing population and land use forecasts, as well as traffic volumes in Grafton and South Grafton. It was developed in consultation with Clarence Valley Council and the Department of Planning and Infrastructure to assess the traffic impacts of existing and likely future development and to estimate future demands across the River up to 2049.

OD data indicates that a high proportion of bridge users have destinations in either Grafton or South Grafton, and three per cent of bridge traffic use the bridge as a 'through' route. Future changes in travel patterns have been based on forecast population growth data and planned development patterns in Grafton, South Grafton, surrounds and nearby areas.

Modelling a "do minimum" scenario, which involves modelling existing conditions with only upgrading of the Pacific Highway to cater for planned future development at Clarenza, determined that as traffic demand across the river increases, additional capacity would be required. Doing nothing would therefore lead to deteriorating road network operating conditions due to prolonged periods of congestion on the existing bridge and significantly increased travel times.

The traffic demand across the river currently exceeds the capacity of the existing bridge at peak times. Traffic delays in peak periods are changing people's travel behaviour and daily activity patterns, and as a result may be constraining development. Traffic count data suggests that many bridge users time their trips to avoid the peak period traffic congestion. Grafton and South Grafton are to some extent operating as separate towns.

25 preliminary route options in five strategic corridors for an additional river crossing of the Clarence River were tested using the strategic transport model. The options were tested to determine the impact each option would have on traffic movement in and around Grafton and South Grafton from a network perspective. The results of the modelling indicated:

- Information provided by Clarence Valley Council and the Department of Planning and Infrastructure indicates that population growth is expected to occur at an average rate of 1.6 per cent per annum between 2011 and 2049.
- The strategic transport modelling indicates that traffic demands across the river would increase by 108 per cent over the next 30 years.
- Additional river crossing capacity would be required in future to accommodate the additional demand as a result of growth, primarily at Junction Hill, South Grafton and Clarenza.
- Doing nothing would lead to unacceptable road network operating conditions.
- Traffic utilisation of the existing bridge is subject to the location of the new bridge. Generally, the further a new bridge is located away from the existing bridge, the greater the volume of traffic that will continue to utilise the existing bridge.
- For Corridors 1, 2, 3 and 4, modelling results indicate that the options within a corridor perform in a similar manner.
- Modelling results also indicate that there are some significant differences in performance between the options in Corridor 5.

If additional traffic capacity is provided across the river, there would be a number of effects. Peak period traffic volumes would immediately increase, as people revert to their preferred travel behaviour and activity patterns. In the medium term, there are likely to be changes in land use, as the city would be able to function more as a single unit, and traffic across the river could grow at a slightly higher than average rate for several years. In the longer term, growth in population, employment and traffic is expected to revert to previously mentioned rates of growth.

2. Approach to Traffic Assessment

2.1 Introduction

Following the completion of the strategic transport model assessment set out in GTA's 2011 Strategic Traffic Assessment, six route options were short-listed to undergo further detailed assessment. The six options have been assessed using microsimulation modelling, as set out in this report.

The new bridge connections to the existing road network for each of the route options and any other relevant road network upgrades within the study area discussed in Section 5.2.2 and Section 6 were determined by the project team and are reflected in the microsimulation model. Future year traffic predictions determined from the strategic transport model (discussed in Section 4) have also been applied to the microsimulation models to represent the future year demands of 2019, 2029, 2039 and 2049.

2.2 Purpose of Microsimulation Model

Microsimulation models are generally prepared in cases where an existing network is already over-saturated or a proposed scheme 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 (stop, give way or signal control) can be modified to make sure that effective strategies can be designed and tested.

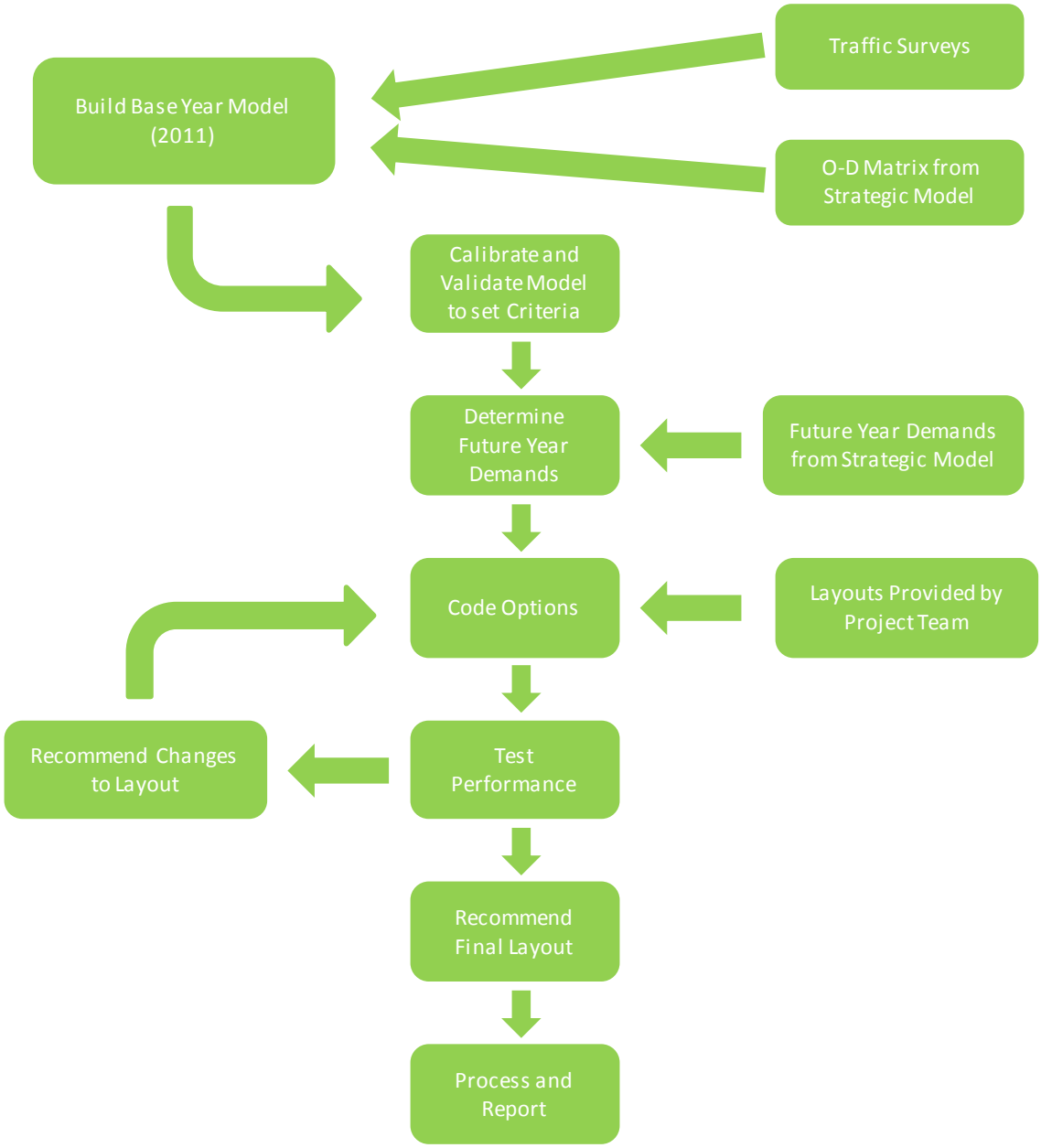
The unique features of the Grafton Bridge (in terms of its alignment, traffic conditions and connectivity) required that the selected software, in this case Q-Paramics, was able to analyse the movement of traffic over the Grafton Bridge and through the adjacent road network and assess operation from both a localised intersection and network perspective.

2.3 Study Methodology

Detailed microsimulation modelling using Q- Paramics focussed on assessment of the road network in order to provide key indicators for each option such as link flows, intersection turning movements, delays and travel times.

Figure 2.1 provides a flow chart setting out the overall study methodology (including the strategic transport modelling).

Figure 2.1: Study Methodology



The study methodology is designed to be flexible and iterative to ensure that the best modelling outcomes are achieved.

2.4 Study Area

The study area used for the microsimulation model includes Grafton and South Grafton. The study area includes the existing Clarence River Bridge connecting Grafton and South Grafton and the extent of the study area is shown approximately in Figure 2.2. The microsimulation model considers traffic movements within Grafton and South Grafton, and includes traffic movements to and from the Pacific Highway north and south, the Summerland Way, the Gwydir Highway and Armidale Road.

Figure 2.2: Main Road 83 Summerland Way – Study Area

2.5 Traffic Data

Traffic information for the study was obtained from numerous sources including RMS, Clarence Valley Council, previous reports, studies and surveys undertaken as part of this study. The data was sourced to primarily capture the peak periods within the study area and includes the following:

- traffic movement counts
- origin-destination (OD) surveys
- automated traffic counts.

The surveys captured at least one week's worth of data to provide an accurate representation of the existing typical weekly traffic movements and day to day variations in traffic flows and profiles. A summary of the traffic data used for this study is set out in Table 2.1.

Table 2.1: Sources of Traffic Data

Source	Type of Count Data	Date
Surveys undertaken by AusTraffic on behalf of GTA as part of the South Grafton Paramics model, 2007 / 2008	Turning Movement Data and OD Data	2007
Traffic Volume data supplied by Clarence Valley Council (numerous sites)	Two-way daily traffic volume counts at numerous sites across the study area. Data also includes limited average speed data	2006-2009
Surveys undertaken by AusTraffic on behalf of GTA as part of the Additional Crossing of the Clarence River, Grafton – Heavy Vehicle Study, February 2011	OD Surveys for a duration of one week.	2010
Surveys undertaken by TTM Group on behalf of GTA as part of the Additional Crossing of the Clarence River, Grafton – Heavy Vehicle Study, February 2011	Automatic tube count data at numerous sites across the study area for a duration of two weeks.	2010
Surveys undertaken by AusTraffic on behalf of GTA for this assessment	Automatic tube count data at numerous sites across the study area for a duration of two weeks in June and July 2011. Queue length surveys on the southern side of the bridge during the AM peak period on Bent Street and Fitzroy Street during the PM peak.	2011
Travel Time surveys undertaken by GTA	Travel time surveys between Gwydir Hwy and Villiers Street.	2011
Travel Time surveys undertaken by RMS	Travel time surveys were conducted by RMS on additional routes throughout Grafton	2012

All traffic data used as part of this modelling has been reviewed and validated to ensure its appropriateness for use in this assessment.

The AM and PM peak period volumes are shown in the calibration and validation report located in Appendix A.

3. Microsimulation Model Development

3.1 Introduction

Q-Paramics microsimulation modelling is a computer software package that has the ability to individually model each vehicle, including heavy vehicles within a road system. 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 road networks where the resulting vehicle queuing impacts on upstream intersections. It also allows testing of how the method of control and signal timings, where applicable can be modified to ensure that more effective traffic management strategies can be designed and tested.

3.2 Model Build Methodology

3.2.1 Model Periods and Years

The model covers AM and PM peak hour periods augmented by warm up and cool down periods as follows:

AM Peak Period

- 6:30am to 7:00am (AM warm up period)
- 7:00am to 8:00am (first AM peak hour)
- 8:00am to 9:00am (second AM peak hour)
- 9:00am to 10:00am (third AM peak hour)
- 10:00am to 10:30am (AM cool down period)

PM Peak Period

- 2:30pm to 3:00pm (PM warm up period)
- 3:00pm to 4:00pm (first PM peak hour)
- 4:00pm to 5:00pm (second PM peak hour)
- 5:00pm to 6:00pm (third PM peak hour)
- 6:00pm to 7:00pm (PM cool down period)

Thirty minute warm up periods were considered appropriate to pre-load the network before the peak hours.

The model has a base year of 2011 and forecast years 2019, 2029, 2039 and 2049.

3.2.2 Model Extents

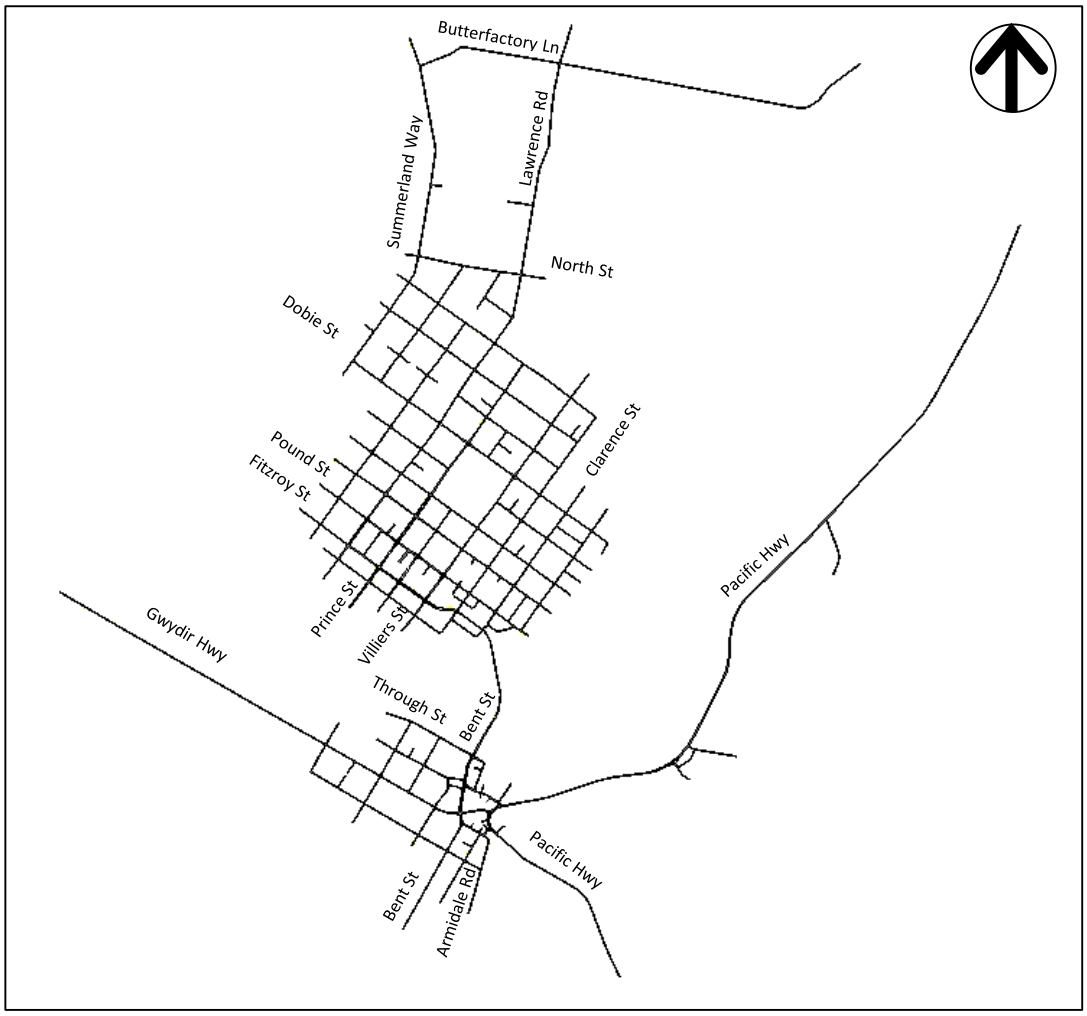
The study area includes the major roads of Summerland Way, Lawrence Road, Fitzroy Street, Prince Street, Villiers Street, Dobie Street, Bent Street, Gwydir Highway Armidale Road and the Pacific Highway and includes (but not limited to) the following key intersections:

- Fitzroy Street / Prince Street
- Prince Street / Pound Street
- Fitzroy Street / Villiers Street

- Pound Street / Villiers Street
- Bent Street / Through Street
- Bent Street / Ryan Street (Gwydir Highway)
- Pacific Highway / Gwydir Highway
- Pacific Highway / Iolanthe Street / Spring Street
- Villiers Street / Dobie Street
- Prince Street / Dobie Street
- Dobie Street / Turf Street
- Queen Street / Dobie Street
- Summerland Way / Butterfactory Lane

The Q-Paramics model includes all intersecting roads within the area and is shown in Figure 3.1.

Figure 3.1: Microsimulation Model Extents



The model extents were selected to adequately deal with existing and future year testing in terms of vehicle queuing and blocking back.

Other model features included into the model were:

- Network layout and geometric data

- Traffic composition
- Traffic Demand
- Zone structure
- Public Transport

Each of the features is discussed in detail in the model calibration and validation report which is located in Appendix A.

3.3 Calibration and Validation

Prior to using models for the purposes of testing, they must be calibrated and validated before they can provide meaningful results. The model outputs are compared to a series of observed and recorded data sets that, when considered holistically, determine its suitability for further use. This section provides a summary of the calibration and validation process.

3.3.1 Calibration and Validation Guidelines

The calibration and validation process was carried out in accordance with the criteria set out in the 'UK Design Manual for Roads and Bridges (Vol 12, Section 2, Part 1 – Traffic Appraisal in Urban Areas)'. These guidelines and criteria are internationally accepted best practice.

The guidelines provide criteria to compare modelled and observed flows for items such as turn counts, link flows, vehicle travel times and a visual assessment of operating conditions including vehicle queues. The targets set out in the guidelines are shown in Table 3.1.

Table 3.1: Microsimulation Modelling Calibration and Validation Criteria

Criteria and Measurements	Calibration Acceptable Targets
Hourly Flows, Modelled Versus Observed	
Individual Link Flows	
Within 15%, for 700 veh/h < Flow < 2700 veh/h	> 85% of cases
Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases
Sum of All Link Flows	Within 5% of sum of all link counts
GEH[1] Statistic < 5 for Individual Link Flows	> 85% of cases
Travel Times, Model Versus Observed	
Journey Times Within 15% (or 1 min, if higher)	> 85% of cases
Visual Audits	
Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Visually Acceptable Queuing	To analyst's satisfaction

[1] The GEH statistic is a standard measure of the 'goodness of fit' between observed and modelled flows. For further detail refer to Appendix A of this report.

3.3.2 Seed Runs

In order to test the robustness of the model, five seeds were tested and the average results of the five seed runs were reported. A 'seed' is a random number that within the software creates a different modelled outcome and is intended to reflect day to day traffic variation. Best practice has established that five seed runs are adequate. The seed run numbers utilised in the analysis are 28, 560, 2849, 7771

and 86524 and have been applied consistently throughout the existing and future year models. These numbers are consistent with RMS guidelines.

3.3.3 Calibration and Validation Results

Hourly Flows, Modelled Versus Observed

A summary of the comparison of modelled and observed flows is provided in Table 3.2.

Table 3.2: Calibration Summary

Criteria UK Design Manual for Roads and Bridges	Within 15% for 700 veh/h < Flow < 2700 veh/h	Within 100 veh/h, for Flow < 700 veh/h	GEH[1] less than 5	Sum of all link flows
Target	**>85%**	**>85%**	**>85%**	**within 5%**
AM (8:00 – 9:00)	100%	98%	86%	Yes (0.0%)
PM (4:00 – 5:00)	100%	97%	87%	Yes (0.8%)

[1] The GEH statistic is a standard measure of the 'goodness of fit' between observed and modelled flows. For further detail refer to Appendix A of this report.

Table 3.2 indicates that there is a high correlation between modelled and observed traffic counts with all criteria specified in Table 3.1 being met or exceeded.

Travel Times

The observed and modelled northbound and southbound travel times between the Gwydir Highway at Bent Street and Villiers Street have been compared in Table 3.3 and Table 3.4.

Table 3.3: AM Travel Time Summary

Direction	AM Peak Hour (8:00am to 9:00am)					
	Minimum Observed (sec)	Maximum Observed (sec)	Average Observed (sec)	Modelled Average (sec)	Difference (sec)	% Difference
Northbound (Gwydir Hwy to Villiers St)	221	405	355	397	42	12%
Southbound (Villiers St to Gwydir Hwy)	147	172	160	174	14	9%

Table 3.4: PM Travel Time Summary

Direction	PM Peak Hour (4:00pm to 5:00pm)					
	Minimum Observed (sec)	Maximum Observed (sec)	Average Observed (sec)	Modelled Average (sec)	Difference (sec)	% Difference
Northbound (Gwydir Hwy to Villiers St)	171	220	204	182	-22	-11%
Southbound (Prince St to Through St)	211	394	303	289	-14	-5%

Table 3.3 and Table 3.4 indicate that during the AM and PM peak, average modelled travel times are generally consistent with average observed travel times and are within acceptable limits specified in the calibration and validation criteria (Table 3.1).

The average modelled travel times are within the minimum and maximum observed travel times during both peak hours, except for the AM southbound which is 2 seconds above the maximum observed time.

Queue Lengths

Queue lengths on the bridge and approaches to the bridge were observed during site observations in order to ensure that the model is consistent with existing patterns.

Northbound queue lengths were recorded on Bent Street from the bridge to Gwydir Highway. The southbound queue lengths were recorded on Fitzroy Street and Prince Street. The graphs presented in Figure 3.2 and Figure 3.3 show the comparison of observed and modelled queue lengths on the north and south approaches to the bridge during the AM and PM peak periods respectively.

Figure 3.2: AM Peak Queue Length Comparison

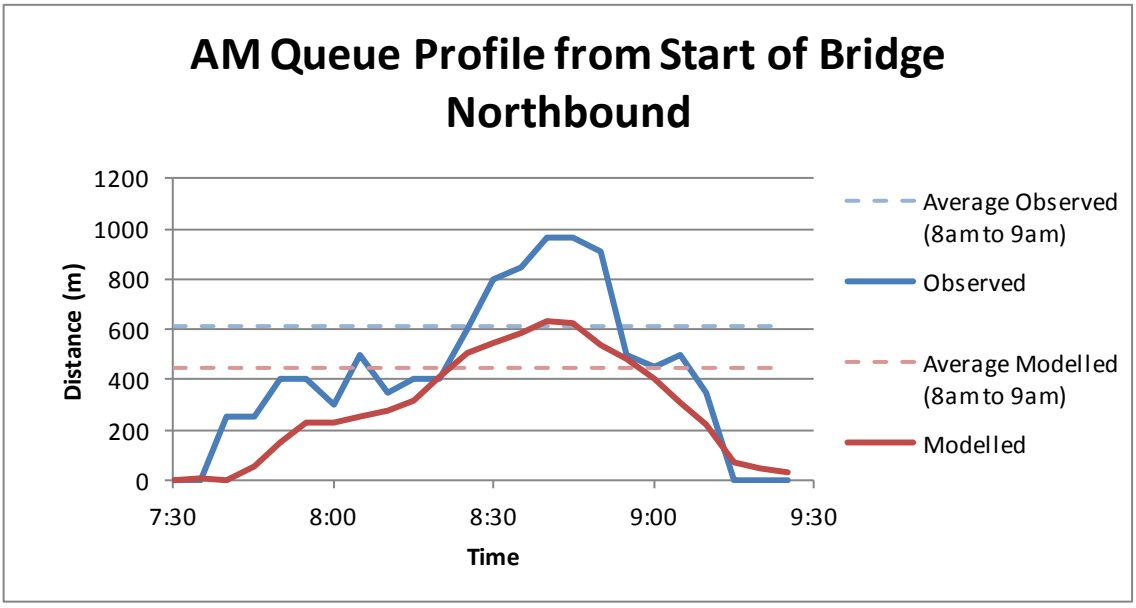


Figure 3.3: PM Peak Queue Length Comparison

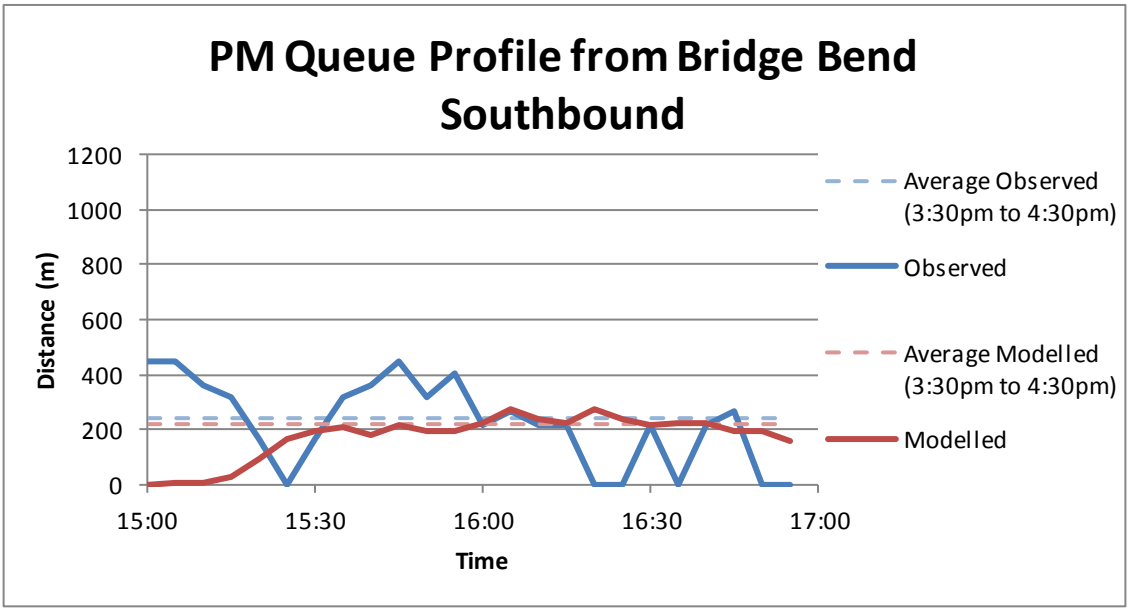


Figure 3.2 and Figure 3.3 indicate a general correlation or fit between the observed and modelled queue lengths, in particular their average queue lengths. Furthermore, visual observations of the model suggest that queuing conditions within the model extents generally reflect the observed conditions.

It is noted that during the PM peak, there is an oscillating queue length on the north approach. This was observed as being the results of a specific incident such as a truck stopping on the bridge. The graphs indicate that localised incidents easily result in extended queue lengths.

Summary

A summary of the calibration and validation results is as follows:

- Modelled turning movement counts achieved a high level of correlation to observed counts.
- Modelled travel times also reflected observed travel times and are within the nominated guidelines.
- Queue lengths on the critical approaches to the bridge over the Clarence River reflect the observed conditions.

The quality of input data, model building and calibration has produced a sound model, validated by travel time and queue length data. GTA considers that the model is 'fit for purpose'.

Full details of the calibration and validation process and results are presented in the Microsimulation Model Calibration and Validation Report located in Appendix A.

3.4 Base Year Model Results (2011)

3.4.1 General Network Statistics

The results of the network performance parameters include the following:

- number of completed vehicle trips per reported simulation period
- number of incompleted vehicle trips per reported simulation period which are those trips that start within the modelled period but do not arrive at their destination prior to the end of the modelled period. Their details are logged and reported with the completed trip results
- number of unreleased vehicles are those unable to be released into the network due to congested network conditions
- average kilometres per completed vehicle per reported simulation period
- average travel time per completed vehicle per reported simulation period
- average speed of all completed and incompleted vehicles per reported simulation period
- number of stops of all completed and incompleted vehicles per reported simulation period
  A stop is recorded when a vehicle travels below 5km/h
- vehicle-kilometres travelled (VKT) of all completed and incompleted vehicles per reported simulation period
- vehicle hours travelled (VHT) of all completed and incompleted vehicles per reported simulation period.

Table 3.5 is a summary of the modelling of the existing network performance for the AM and PM peak hours. The one hour periods from 8-9AM and 4-5PM have been reported as these are considered the critical hours in the morning and afternoon peak periods.

Table 3.5: Modelled AM and PM Peak Hour Network Performance (2011)

Statistic	AM Peak (8am to 9am)	PM Peak (4pm to 5pm)
Number of Completed Trips	7315	7,384
Number of Incompleted Trips	496	463
Number of Unreleased Vehicles	0	0
Average Km per vehicle (km/veh)	3.0	3.0
Average Travel Time per vehicle (min/veh)	4.2	4.3
Average Speed (km/h)	42.2	41.5
Number of Stops	21,999	20,144
Vehicle-Kilometres Travelled (VKT)	23,199	22,984
Vehicle Hours Travelled (VHT)	550	554

The results have been reported for all completed trips during the relevant time periods and are useful for comparison of future year concept options.

4. Future Year Growth

4.1 Future Year Growth

Future year growth for Grafton and its surrounds in the microsimulation model is consistent with that used in GTA's 2011 Strategic Traffic Assessment. The growth assumptions are briefly discussed in Section 1.3. The strategic model and microsimulation model zones have been matched, where possible, to ensure a level of consistency between the growth rates applied for each respective zone. The increase was determined as a rate per annum.

The growth rates (increase per annum) for the relevant design years were applied to the calibrated and validated 2011 matrix as follows:

i Traffic productions and attractions for each zone have been assumed to have the same growth (for example all trips to and from zone 1 adopted the same growth rate).

ii Where two zones have different forecast growth rates for the origin or destination, the greater growth rate has been adopted (for example trips to and from zone 2 may have a greater forecasted increase than trips to and from zone 1, as such the growth rate for zone 2 trips corresponding with zone 1 has been adopted).

iii Each origin and destination pair within the overall matrix has been checked and the growth rate assigned.

iv The future year demand matrices were developed for the design years in 2019, 2029, 2039 and 2049.

v For growth between 2011 and 2019, trips were distributed across the network so that the theoretical capacity of the bridge is not exceeded in the peak direction. This approach is considered representative of expected operating conditions prior to the introduction of additional capacity and a resumption of "normal" travel patterns in Grafton after the introduction of additional capacity.

Based on the above, a summary of the overall growth rates for trips within the microsimulation model is set out in Table 4.1 for both the AM and PM peak periods.

Table 4.1: Summary of Traffic Growth for each Design Year

Year	AM Peak (7am to 9am)		PM Peak (3pm to 5pm)	
	Total Trips (vehicles)	Traffic Growth Rate per annum (%)	Total Trips (vehicles)	Traffic Growth Rate per annum (%)
2011	12,456	-	14,641	-
2019	14,040	1.5%	15,963	1.1%
2029	18,130	2.6%	20,554	2.6%
2039	21,232	1.6%	23,833	1.5%
2049	23,047	0.8%	25,577	0.7%

4.2 Pacific Highway Bypass

For the purposes of this assessment, it has been assumed that the upgrade of the Pacific Highway to bypass South Grafton would be completed by 2019.

4.3 Bridge Demands

Table 4.2 shows the resultant demands for cross river traffic for the relevant time periods and design years.

Table 4.2: Summary of Bridge Demands

Year	AM Peak (7am to 9am)		PM Peak (3pm to 5pm)	
	Northbound	Southbound	Northbound	Southbound
2011	2,287	1,496	2,042	2,561
2019	2,562	1,723	2,475	3,073
2029	3,643	2,487	3,357	4,150
2039	4,276	2,876	3,828	4,798
2049	4,829	3,270	4,157	5,387

The resultant bridge demands have been compared against those presented as part of the strategic modelling assessment (which is only a 2 hour AM peak model). Table 4.3 summarises the strategic and microsimulation bridge demands.

Table 4.3: AM Peak Cross River Demands, Strategic versus Microsimulation (2 hour)

Year	Strategic		Microsimulation		% Difference	
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
2011	2,306	1,573	2,287	1,496	1%	5%
2019	2,763	1,884	2,562	1,723	7%	9%
2029	3,760	2,516	3,643	2,487	3%	1%
2039	4,260	2,852	4,276	2,876	0%	-1%
2049	4,834	3,229	4,829	3,270	0%	-1%

Table 4.3 shows that the cross river demands for the AM microsimulation model are within five percent of the strategic model demands for all demand years excluding 2019 which is within nine percent. For 2039 and 2049 the cross river demands for the microsimulation model are very similar to those of the strategic model.

5. "Do Minimum" Model Results

5.1 Purpose

There are several reasons for the development of "do minimum" models. They are:

- to establish that the model will perform as expected in the future years and that the results are logical and sensible
- to establish a justification for road network options by estimating the road network conditions in the future without the options
- to be used as a baseline input to the cost benefit analysis.

The model calibration and validation confirms that the model replicates existing behaviour. It is also important to establish that the model will be capable of making realistic estimates of travel behaviour in the future years. The "do minimum" modelling is used to confirm that the model is performing adequately. This revealed that the assignment technique which determines travel paths needed to be adjusted in order for the model to cater for the demand. This is discussed in Section 7.

The need for an additional bridge has to be established, which is achieved by considering the traffic conditions if a solution is not provided. This is considered a "no build" or "do minimum" situation. A "do minimum" model includes future road works that are committed or funded and expected to be built whether or not a second river crossing goes ahead. The proposed Pacific Highway bypass of Grafton is such an example. The Grafton road system is assessed to show how the traffic system will operate without a second river crossing. In the case of Grafton, the "do minimum" modelling revealed an inability for the road network to cater for the expected growth detailed in Section 4.

The final reason for modelling a "do minimum" is that the benefits of building the option as opposed to not building the option need to be estimated for the purposes of undertaking cost benefit analysis.

5.2 Approach

The approach to developing the "do minimum" model is as follows:

- Identify road network improvements, including those projects with firm commitments or that are required irrespective of whether the second crossing is built.
- Estimate travel demand for the future years based on the population growth detailed in Section 4.1.
- Assign the future demand to the "do minimum" network and assess future year network performance.

5.2.1 Modelled Forecast Years

Traditionally "do minimum" models would be prepared for all forecast years, in this case (2019, 2029, 2039 and 2049). The project team has investigated the future year options and concluded that a "do minimum" option cannot be achieved for all design years without a second bridge being built. The existing bridge and road network approaches are unable to cater for the estimated future traffic demand and the system becomes over congested. The future year bridge demands, as detailed in Section 4.2, exceed the capacity of a single bridge by 2029 and beyond. Only a 2019 "do minimum"

model was established. Microsimulation models are vehicular based and as such physically prevent vehicles from passing through a congested network resulting in grid lock in over-congested conditions.

The approach to the economic appraisal has been adjusted to reflect the inability to establish future year models for all periods. The method for estimating future year benefits is discussed in *Technical Paper: Economic Evaluation.*

Further discussion on this is provided in Section 5.4.

5.2.2 Future Year "Do Minimum" Networks

There are no committed road network upgrades currently planned, except for the upgrade of the Pacific Highway to bypass South Grafton. The "do minimum" model needs to reasonably cater for expected demand and it is likely that some additional roadworks would be necessary to address localised congestion and capacity constraints (constrained situation) as they arise. Four localised network upgrades were considered necessary for the model to operate reasonably in the future. The "do minimum" model road network assumed:

- upgrading of Pound Street to two traffic lanes in each direction between Villiers Street and Prince Street
- upgrading of Gwydir Highway to two traffic lanes in each direction between Pacific Highway and Bent Street
- upgrading of the Villiers Street/ Dobie Street roundabout to improve turning movements for heavy vehicles
- upgrading of the Gwydir Highway/ Skinner Street roundabout from a single roundabout to a two lane roundabout.

These were the only assumed changes from the 2011 base year road network.

5.3 Network Results ("Do Minimum")

The following outputs were obtained from the modelling in order to develop an understanding of the operation of the network for each of the future years:

- number of completed vehicle trips per reported simulation period
- number of incompleted vehicle trips per reported simulation period which are those trips that start within the modelled period but do not arrive at their destination prior to the end of the modelled period. Their details are logged and reported with the completed trip results
- number of unreleased vehicles are those unable to be released into the network due to congested network conditions
- average kilometres per completed vehicle per reported simulation period
- average travel time per completed vehicle per reported simulation period
- average speed of all completed and incompleted vehicles per reported simulation period
- number of stops of all completed and incompleted vehicles per reported simulation period
- vehicle-kilometres travelled (VKT) of all completed and incompleted vehicles per reported simulation period
- vehicle hours travelled (VHT) of all completed and incompleted vehicles per reported simulation period.

Table 5.1 and Table 5.2 summarises the "do minimum" network performance results for the AM and PM peak hours, respectively, for 2011 and 2019. The network performance measures are aggregated across the entire modelled area or are averaged for all trips within the model. One hour periods have been reported, corresponding to the critical hours in the morning and afternoon peak periods.

Table 5.1: Modelled AM Peak Hour (8am to 9am) Network Performance

Statistic	Base Year (2011)	"Do Minimum" (2019)
Number of Completed Trips	7315	8,023
Number of Incompleted Trips	496	653
Number of Unreleased Vehicles	0	2
Average Km per vehicle (km/veh)	3.0	3.1
Average Travel Time per vehicle (min/veh)	4.2	4.7
Average Speed (km/h)	42.2	38.4
Number of Stops	21,999	30,764
Vehicle-Kilometres Travelled (VKT)	23,199	26,390
Vehicle Hours Travelled (VHT)	550	686

Table 5.2: Modelled PM Peak Hour (4pm to 5pm) Network Performance

Statistic	Base Year (2011)	"Do Minimum" (2019)
Number of Completed Trips	7,384	7,496
Number of Incompleted Trips	463	863
Number of Unreleased Vehicles	0	128
Average Km per vehicle (km/veh)	3.0	2.9
Average Travel Time per vehicle (min/veh)	4.3	5.5
Average Speed (km/h)	41.5	27.5
Number of Stops	20,144	39,019
Vehicle-Kilometres Travelled (VKT)	22,984	22,837
Vehicle Hours Travelled (VHT)	554	829

The modelling results indicate total trips in 2019 for the AM peak and PM peak hour increase by 10% and 2% respectively. The smaller increase in the PM peak indicates that the road network in the PM peak hour is operating close to capacity and opportunity for growth is limited. This is reflected in "number of stops", the average speed and average travel time per vehicle measures. The "number of stops" is estimated to increase by approximately 94% between 2011 and 2019 for the PM peak. This reflects the likely stop/ start nature of the future congestion network. The average speed, which is an average of all completed trips across the modelled area in the PM peak hour, has declined by 51% from 41.5 km/h to 27.5 km/h. Similarly the average travel time per vehicle, which is an average for all completed trips across the modelled area in the PM peak hour, has increased by 28% from 4.3 minutes to 5.5 minutes.

Figure 5.1 and Figure 5.2 have been prepared to graphically show the increase in total number of completed trips and the expected reduction in average speed. It is not unusual for microsimulation models to have unreleased vehicles if a traffic system is congested. These represent a small fraction of the total demand and the results are considered acceptable.

Figure 5.1: Total Number of Completed Trips (Vehicles) and Average Speed (km/h) Year 2011 to 2019 (AM Peak Hour – 8am to 9am)

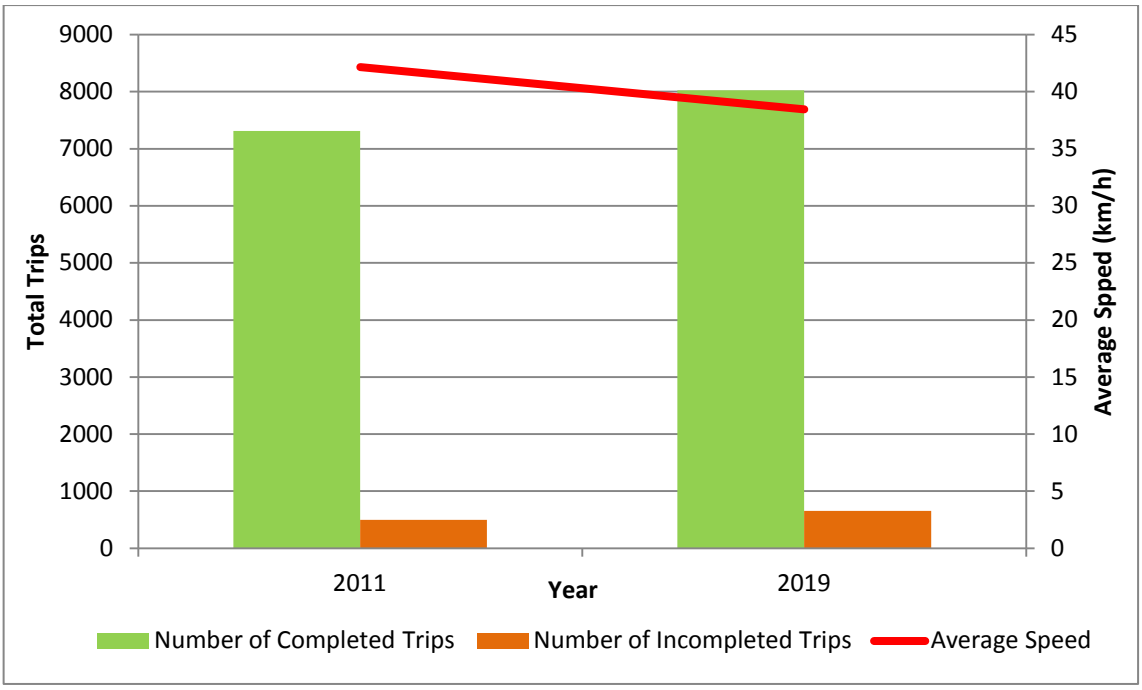
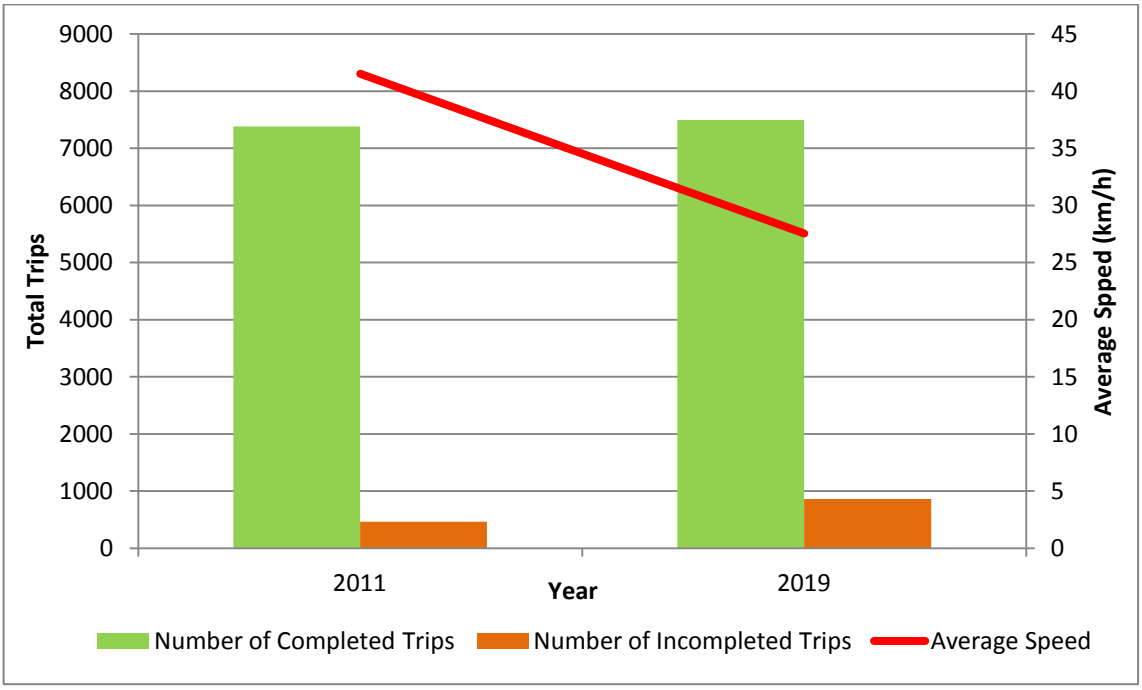


Figure 5.2: Total Number of Completed Trips (Vehicles) and Average Speed (km/h) Year 2011 to 2019 (PM Peak Hour – 4pm to 5pm)



The model results indicate the average speed for the network is expected to decrease from 2011 to 2019. This is reflective of an increase in trips on the wider network and the capacity of parts of the road network to cater for the additional demand.

5.4 Approach to "Do Minimum" Economic Appraisal

For the purposes of this assessment, an alternative approach to estimating the future year economic benefits has been adopted. It was agreed with RMS that these benefits would be estimated by generating an indicative "do minimum" case for the future years of 2029 and beyond. Establishment of this indicative "do minimum" case acknowledges the reality that the existing road network would continue to function beyond 2019 even without an additional bridge. It also conservatively assumes that motorists would accept higher levels of future congestion because of the absence of an alternative route and also adapt to increasing congestion in the middle of the peak periods including (but not limited to):

- rescheduling their trip to less congested periods throughout the day
- changing the number of trips undertaken by choosing alternate modes
- changing their route and/or origin and destination.

Development of the indicative "do minimum" case is intended to replicate the increase in delays and congestion that would occur over time without an additional bridge. It has been established by taking the 2019 "do minimum" model and factoring up the annual VKT and VHT parameters at similar rates to the increases recorded in Options 14 and 15. Options 14 and 15 are considered to more closely represent the anticipated "do minimum" conditions due to the greater distance of the proposed bridge from the new bridge and the town centres of Grafton and South Grafton, resulting in the majority of traffic still attracted to continue using the existing bridge.

This would be considered a conservative approach, especially for travel time (VHT) growth, because without the additional bridge it is likely that VHT growth for the "do minimum" case would be higher than Options 14 and 15 as they have spare capacity on the new bridge, albeit with longer travel times.

The results of the indicative "do minimum" case for the future years of 2029 to 2049 are presented in Table 5.3.

Table 5.3: Indicative "Do Minimum" Results for 2029 to 2049

Option	AM Peak (8am to 9am)		PM Peak (4pm to 5pm)	
	Vehicle-Kilometres Travelled (VKT)	Vehicle Hours Travelled (VHT)	Vehicle-Kilometres Travelled (VKT)	Vehicle Hours Travelled (VHT)
"Do Minimum" 2029	34,945	999	30,244	1,206
"Do Minimum" 2039	40,901	1,201	35,398	1,450
"Do Minimum" 2049	44,479	1,363	38,494	1,647

Annualised results for the "do minimum" case are reported in Appendix G, using the approach to daily and year expansion factors as described in Section 7.3.

6. Route Option Description

6.1 Introduction

The strategic transport modelling assessment assessed 25 preliminary route options within five corridors. In January 2012, six route options to be investigated further as part of the process to identify a location for the crossing were announced. The short-listed options were identified in the Preliminary Route Options Report – Final (January 2012) which also provided details of the technical investigation undertaken on the 25 preliminary options and the process to select the short-listed options.

A summary of the short-listed route options is provided in Table 6.1, whilst each of the short-listed route options are illustrated in Appendix B.

Table 6.1: Summary of Route Options

Option	New Connection	Underpass/Overpass (no direct connection to bridge approach)	Road Closures	Signalised Intersections	Roundabouts	Priority Junctions	Left-in/Left-out only from side road
E	Between Gwydir Highway/Cowan Street in South Grafton and Villiers Street in Grafton	None	Kennedy Street	Villiers Street/ Fitzroy Street Villiers Street/ Pound Street	Gwydir Highway/Bent Street Gwydir Highway/Skinner Street Gwydir Highway/Cowan Street Cowan Street/Spring Street Pound Street/Duke Street Craig Street/Clarence Street Villiers Street/Dobie Street	Pacific Highway/Gwydir Highway Gwydir Highway/Bligh St Pacific Highway/Iolanthe street Pound Street/Clarence Street	Wharf Street New Street Victoria Street
A	Between Bent St in South Grafton and Fitzroy Street in Grafton, with new bridge just upstream of existing bridge	Bridge Lane Fitzroy Street east/Kent Street	Fitzroy Street east	Bent Street/ Spring Street east {partial} Bent Street/Through Street Fitzroy Street/Villiers Street Villiers Street/Pound Street	Pacific Highway/Gwydir Highway Gwydir Highway/Bent Street/Ryan Street Gwydir Highway/Skinner Street Pound Street/Duke Street Villiers Street/Dobie Street	Pacific Highway/Iolanthe street Pound Street/Clarence Street Clarence Street/Fitzroy Street east	New Street Spring Street west Riverside Drive (left turn from Riverside Drive onto new bridge not permitted) Clarence Street
C	Between Pacific Highway/Gwydir Highway in South Grafton and Clarence Street/Pound Street in Grafton, with new bridge just downstream of existing bridge	Greaves Street	Kent Street Fitzroy Street east Pound Street east	Pound Street/ Clarence Street Pound Street/Villiers Street	Realigned Pacific Highway/Iolanthe Street/bridge approach Pacific Highway/Gwydir Highway Ryan Street/Viaduct Road Gwydir Highway/Skinner Street Craig Street/Clarence Street Pound Street/Duke Street Villiers Street/Dobie Street	Realigned Iolanthe Street/new bridge approach Clarence Street/Fitzroy Street east	Spring Street west Old Pacific Highway Clarence Street north
11	Between Pacific Highway north of McClaers Lane South in Grafton and Fry Street in Grafton	None	McHugh Street Weiley Avenue	No new signalised intersections	Pacific Highway/bridge approach Gwydir Highway/Bent Street Gwydir Highway/Skinner Street Fry Street/Clarence Street Fry Street/Villiers Street Villiers Street/Dobie Street	Pacific Highway/Gwydir Highway Pacific Highway/Iolanthe Street Fry Street/Breimba Street	New Street Kent Street
14	Between Pacific Highway/Centenary Drive in South Grafton and North Street in Grafton	Eggins Lane	Villiers Street south Duke Street Morrison Street Crown Street west Hoof Street east Powell Street west	No new signalised intersections	Pacific Highway/Centenary Drive/bridge approach Gwydir Highway/Bent Street Gwydir Highway/Skinner Street Kirchner Street/Prince Street North Street/Queen Street North Street/Turf Street Villiers Street/Dobie Street	Pacific Highway/Gwydir Highway Pacific Highway/Iolanthe Street Kirchner Street/ Villiers Street north New link road/North Street east North Street east/Duke Street north North Street/Challinor Street North Street/Mary Street North Street/ Alice Street North Street/ Davey Avenue west Prince Street/ Arthur Street Prince Street/ Hoof Street west Prince Street/Powell Street east	New Street North Street/ Davey Avenue east
15	Between Pacific Highway /Centenary Drive near Clarenza and the Summerland Way just north of Grafton	Eggins Lane	Villiers Street south Duke Street Crown Street west Hoof Street east Powell Street west	No new signalised intersections	Pacific Highway/Centenary Drive/bridge approach Gwydir Highway/Bent Street Gwydir Highway/Skinner Street Kirchner Street/Prince Street New link road/Grafton-Lawrence Road New link road/Summerland Way Villiers Street/ Dobie Street	Pacific Highway/Gwydir Highway Pacific Highway/Iolanthe Street Kirchner Street/Villiers Street north New link road/North Street North Street east/Duke Street north Prince Street/ Arthur Street Prince Street/ Hoof Street west Prince Street/ Powell Street east	New Street

The microsimulation model results and assessment of these options are set out in Section 7.

It should be noted that the option layouts that have been assessed indentify the works required to achieve sufficient capacity for the option to function adequately in 2049, 30 years after the assumed opening date. In practice, construction of the road network upgrades would be staged over time following construction of the new bridge, as traffic demand increases.

7. Results of the Modelling of the Route Options

7.1 Approach to Future Year Modelling (Equilibrium Assignment Method)

The method of 'Equilibrium Assignment' was used to model all future year options. This approach assumes that drivers choose their travel routes based on their previous experience travelling through the network, hence drivers will have decided when they commence their journey as to whether they will travel via the new or existing bridge.

To simulate the knowledge which would be obtained by a driver's real life experience, an iterative modelling process was undertaken in which each model was simulated repetitively with drivers choosing routes based on the delays experienced for each turning movement of the previous simulation. This process was undertaken until 'convergence' was reached. For the purpose of this study, convergence was determined to be a point at which two-way traffic volumes for both the existing and new bridge were showing little variation between subsequent simulation runs.

A copy of the two-way bridge volumes obtained in determining the convergence point for all options can be found in Appendix C.

7.2 Truck Movements on Existing Bridge

Each of the options has been designed to accommodate heavy vehicles and as such, it has been assumed that large heavy vehicles (semi-trailers and B-doubles) would be banned from using the existing bridge (with the exception of Option A where movements on the existing bridge are restricted to one southbound lane only).

Traffic counts undertaken of the area indicate that there are currently a small number of articulated vehicles that utilise the bridge during both the AM and PM peak hours, despite the ban on heavy vehicles during these time periods. For this reason heavy vehicles were not banned on the bridge for the existing conditions. For all options excluding Option A, all articulated vehicles (Austroads User Class 6 to 12) have been banned from the existing bridge.

It is important to recognise that the removal of heavy vehicles from the existing bridge provides some benefit to the approaches and crossing volumes of the existing bridge. These are noted in Section 7.6.

7.3 Daily and Yearly Expansion Factors

The expansion of the peak hour results to daily and yearly values was undertaken to assist in the development of the economic assessment.

In undertaking this assessment, consideration was provided to the likely travel patterns for vehicles during off peak periods for a typical day (midnight to 7am, 9am to 3pm and 5pm to midnight). For example, during the AM peak hours in 2049, vehicles are likely to use routes that may not necessarily be the shortest in distance but will be shorter in travel time, however during the off peak or less

congested periods, vehicles are more than likely to travel the shortest distance between destinations. This distance will also more than likely be the quickest in travel time during the off peak periods.

As such, each of the six options were modelled with off peak travel demands to determine the travel distances and travel times. Using the available existing daily traffic count data, the results from the off peak models were then apportioned accordingly over a typical weekday to determine the off peak results.

The daily results were then obtained by adding the peak hours results for 7-9am and 4-6pm to the off peak results.

Annual results were obtained by using a daily to yearly factor of 335. This number has been determined from the available count data and is the ratio of the annual average daily traffic (AADT) to the weekday average daily traffic.

The following annual results for each option and design year are presented in Appendix G, including a breakdown of the AM peak, PM peak and off peak results:

- vehicle-kilometres travelled (VKT)
- vehicle hours travelled (VHT)
- number of stops
- average speed (km/h)

The results presented in Appendix G includes all recorded trips (i.e. completed and incompleted trips).

7.4 General Network Statistics

As with the "do minimum" results the general network statistics were extracted from the models and include the following:

- number of completed vehicle trips per reported simulation period
- number of incompleted vehicle trips per reported simulation period which are those trips that start within the modelled period but do not arrive at their destination prior to the end of the modelled period. Their details are logged and reported with the completed trip results
- number of unreleased vehicles are those unable to be released into the network due to congested network conditions
- average kilometres per completed (vehicle trip) per reported simulation period
- average travel time per completed (vehicle trip) per reported simulation period
- average speed of all completed and incompleted (vehicle trips) per reported simulation period
- number of stops of all completed and incompleted (vehicle trips) per reported simulation period
- vehicle-kilometres travelled (VKT) of all completed and incompleted (vehicle trips) per reported simulation period
- vehicle hours travelled (VHT) of all completed and incompleted (vehicle trips) per reported simulation period.

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.

7.5 Model Results

A summary of the network statistics for all six route options has been prepared for the AM and PM peak hours respectively and are presented in Table 7.1 to Table 7.12. The network performance measures are aggregated across the entire modelled area or are average for all trips within the model.

Table 7.1: Option E Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,863	9,959	11,575	12,381
Number of Incompleted Trips[2]	496	425	582	818	1,032
Number of Unreleased Vehicles[3]	0	0	0	0	0
Average Km per vehicle (km/veh)	3.0	3.0	3.2	3.3	3.3
Average Travel Time per vehicle (min/veh)	4.2	3.6	3.9	4.0	4.5
Average Speed (km/h)	42.2	51.2	49.8	48.7	43.7
Number of Stops	21,999	14,806	23,711	30,458	45,830
Vehicle-Kilometres Travelled (VKT)	23,199	24,840	33,507	39,365	43,685
Vehicle Hours Travelled (VHT)	550	485	673	814	1,000

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.2: Option E Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,764	10,182	11,765	12,669
Number of Incompleted Trips[2]	463	456	615	770	854
Number of Unreleased Vehicles[3]	0	0	0	0	0
Average Km per vehicle (km/veh)	3.0	2.8	3.0	3.0	3.1
Average Travel Time per vehicle (min/veh)	4.3	3.5	3.8	3.9	4.2
Average Speed (km/h)	41.5	48.6	47.6	46.3	44.5
Number of Stops	20,144	15,507	25,773	34,283	45,278
Vehicle-Kilometres Travelled (VKT)	22,984	22,930	31,780	37,090	41,366
Vehicle Hours Travelled (VHT)	554	471	668	801	929

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.3: Option A Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,870	9,914	11,632	12,485
Number of Incompleted Trips[2]	496	420	609	849	954
Number of Unreleased Vehicles[3]	0	0	0	0	0
Average Km per vehicle (km/veh)	3.0	3.1	3.3	3.3	3.4
Average Travel Time per vehicle (min/veh)	4.2	3.6	4.0	4.1	4.5
Average Speed (km/h)	42.2	50.9	49.5	47.9	45.3
Number of Stops	21,999	14,174	21,935	30,891	40,311
Vehicle-Kilometres Travelled (VKT)	23,199	24,914	33,817	40,336	44,909
Vehicle Hours Travelled (VHT)	550	489	683	842	992

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.4: Option A Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,882	10,169	11,690	12,677
Number of Incompleted Trips[2]	463	449	627	784	972
Number of Unreleased Vehicles[3]	0	0	0	0	69
Average Km per vehicle (km/veh)	3.0	2.8	3.0	3.1	3.2
Average Travel Time per vehicle (min/veh)	4.3	3.5	3.8	4.1	5.1
Average Speed (km/h)	41.5	48.1	47.2	44.7	37.2
Number of Stops	20,144	15,666	24,801	35,972	56,972
Vehicle-Kilometres Travelled (VKT)	22,984	23,034	31,760	37,430	42,111
Vehicle Hours Travelled (VHT)	554	479	673	838	1133

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.5: Option C Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,872	9,870	11,546	12,422
Number of Incompleted Trips[2]	496	432	603	888	1,094
Number of Unreleased Vehicles[3]	0	0	0	4	48
Average Km per vehicle (km/veh)	3.0	3.1	3.3	3.3	3.4
Average Travel Time per vehicle (min/veh)	4.2	3.6	3.9	4.1	4.8
Average Speed (km/h)	42.2	51.8	50.7	47.6	42.5
Number of Stops	21,999	12,742	19,739	28,082	43,761
Vehicle-Kilometres Travelled (VKT)	23,199	25,143	33,764	40,180	44,732
Vehicle Hours Travelled (VHT)	550	486	666	844	1,053

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.6: Option C Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,792	10,168	11,720	12,523
Number of Incompleted Trips[2]	463	438	616	751	817
Number of Unreleased Vehicles[3]	0	0	0	0	0
Average Km per vehicle (km/veh)	3.0	2.8	3.0	3.1	3.2
Average Travel Time per vehicle (min/veh)	4.3	3.5	3.7	3.9	4.0
Average Speed (km/h)	41.5	49.2	48.5	48.0	47.6
Number of Stops	20,144	12,777	20,810	27,555	32,890
Vehicle-Kilometres Travelled (VKT)	22,984	22,969	32,087	37,708	41,692
Vehicle Hours Travelled (VHT)	554	467	661	786	875

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.7: Option 11 Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,835	9,937	11,502	12,320
Number of Incompleted Trips[2]	496	402	601	903	1,141
Number of Unreleased Vehicles[3]	0	0	0	25	0
Average Km per vehicle (km/veh)	3.0	3.1	3.3	3.4	3.4
Average Travel Time per vehicle (min/veh)	4.2	3.5	3.7	4.2	4.6
Average Speed (km/h)	42.2	53.3	49.9	47.5	43.8
Number of Stops	21,999	9,959	20,337	31,768	42,866
Vehicle-Kilometres Travelled (VKT)	23,199	24,929	34,052	40,614	44,543
Vehicle Hours Travelled (VHT)	550	468	683	855	1017

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.8: Option 11 Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,857	10,102	11,588	12,353
Number of Incompleted Trips[2]	463	428	763	1,032	1,182
Number of Unreleased Vehicles[3]	0	0	52	20	110
Average Km per vehicle (km/veh)	3.0	2.8	3.1	3.2	3.3
Average Travel Time per vehicle (min/veh)	4.3	3.4	4.6	5.4	5.7
Average Speed (km/h)	41.5	50.3	39.5	34.4	33.6
Number of Stops	20,144	10,755	39,736	65,273	72,971
Vehicle-Kilometres Travelled (VKT)	22,984	23,187	32,425	38,666	42,648
Vehicle Hours Travelled (VHT)	554	461	821	1,125	1,271

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.9: Option 14 Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,836	9,834	11,161	11,723
Number of Incompleted Trips[2]	496	420	743	1,323	1,462
Number of Unreleased Vehicles[3]	0	0	0	47	358
Average Km per vehicle (km/veh)	3.0	3.1	3.3	3.3	3.4
Average Travel Time per vehicle (min/veh)	4.2	3.6	4.4	4.6	5.6
Average Speed (km/h)	42.2	51.7	43.7	38.1	31.8
Number of Stops	21,999	9,665	29,180	38,240	50,315
Vehicle-Kilometres Travelled (VKT)	23,199	25,272	33,886	39,349	42,422
Vehicle Hours Travelled (VHT)	550	489	776	1,033	1,335

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.10: Option 14 Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,826	10,218	11,335	12,081
Number of Incompleted Trips[2]	463	434	926	1,334	1,555
Number of Unreleased Vehicles[3]	0	0	49	251	568
Average Km per vehicle (km/veh)	3.0	2.9	3.1	3.3	3.4
Average Travel Time per vehicle (min/veh)	4.3	3.4	5.9	6.8	7.5
Average Speed (km/h)	41.5	49.9	30.7	26.8	25.7
Number of Stops	20,144	10,697	54,796	74,466	83,356
Vehicle-Kilometres Travelled (VKT)	22,984	23,220	33,651	39,168	43,979
Vehicle Hours Travelled (VHT)	554	466	1,095	1,460	1,711

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.11: Option 15 Network Performance (AM Peak: 8am to 9am)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7315	7,919	9,705	11,134	11,535
Number of Incompleted Trips[2]	496	405	771	1,293	1,555
Number of Unreleased Vehicles[3]	0	0	0	8	496
Average Km per vehicle (km/veh)	3.0	3.1	3.3	3.3	3.4
Average Travel Time per vehicle (min/veh)	4.2	3.5	4.4	4.7	5.5
Average Speed (km/h)	42.2	52.3	42.9	38.6	29.4
Number of Stops	21,999	9,965	29,704	38,690	48,987
Vehicle-Kilometres Travelled (VKT)	23,199	25,307	33,415	39,050	41,174
Vehicle Hours Travelled (VHT)	550	484	779	1,011	1,401

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

Table 7.12: Option 15 Network Performance (PM Peak: 4pm to 5pm)

Statistic	Design Year				
	2011 [1]	2019	2029	2039	2049
Number of Completed Trips	7,384	7,848	10,168	11,522	12,324
Number of Incompleted Trips[2]	463	441	950	1,198	1,379
Number of Unreleased Vehicles[3]	0	0	111	166	255
Average Km per vehicle (km/veh)	3.0	2.9	3.2	3.3	3.5
Average Travel Time per vehicle (min/veh)	4.3	3.4	6.2	6.5	6.9
Average Speed (km/h)	41.5	49.9	29.7	29.0	28.8
Number of Stops	20,144	11,101	58,964	68,629	77,690
Vehicle-Kilometres Travelled (VKT)	22,984	23,351	33,911	39,937	45,011
Vehicle Hours Travelled (VHT)	554	468	1,141	1,377	1,564

[1] 2011 base year model
[2] Number of incompleted trips are those trips that start within the model period but do not arrive at their destination prior to the end of the model period.
[3] Unreleased vehicles are those unable to be released into the network due to congested network conditions

7.6 Peak Period Results Comparison

The volumes on the existing and new bridges during the AM and PM peak periods are presented in Figure 7.1 and Figure 7.2.

Figure 7.1: Bridge Utilisation (AM Peak)

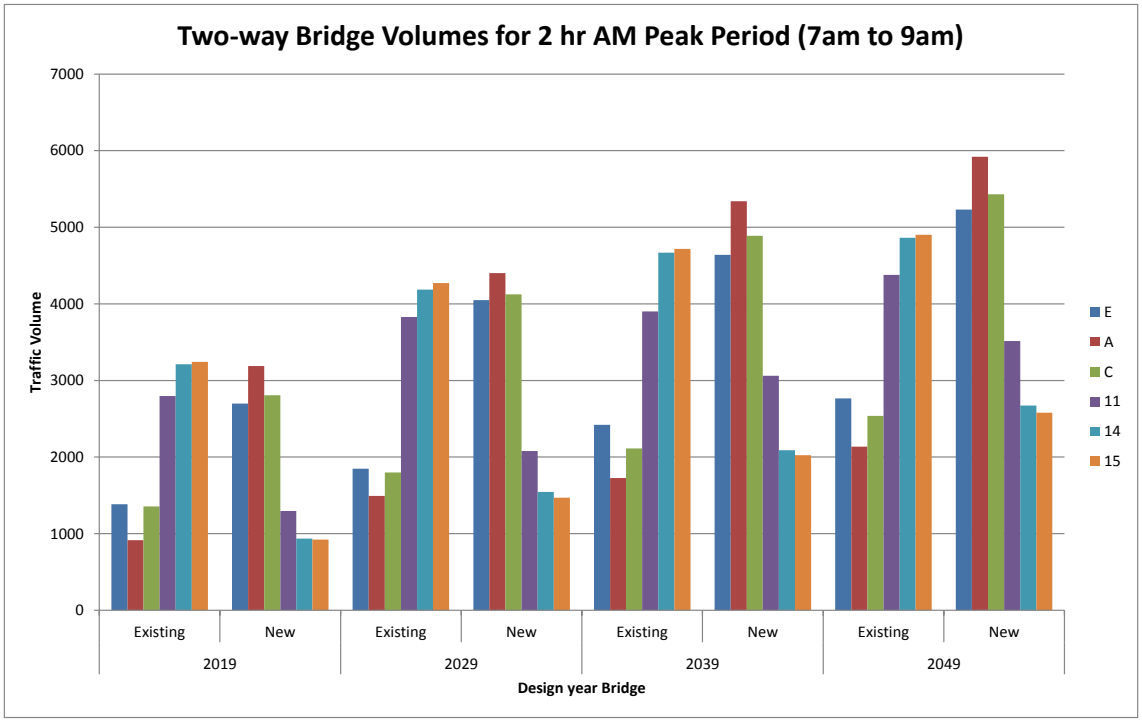


Figure 7.2: Bridge Utilisation (PM Peak)

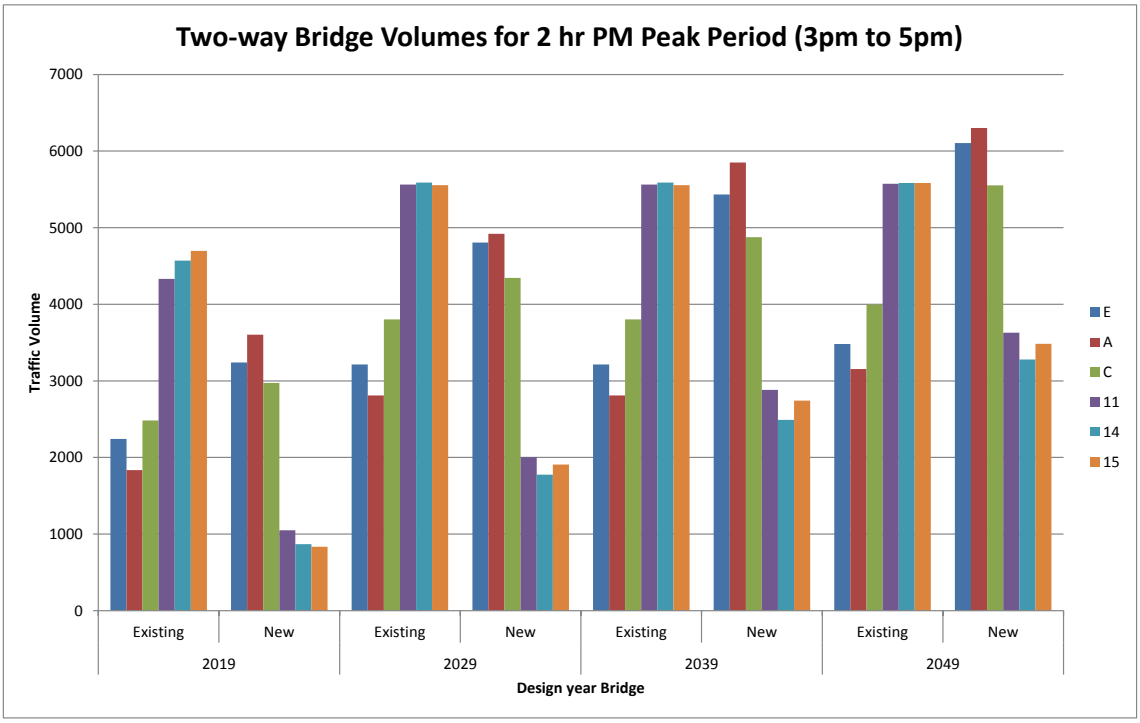


Figure 7.1 and Figure 7.2 show that, during peak periods, traffic would use the new bridge in the upstream options (Options E, A and C) in preference to the existing bridge. However for the options that are further downstream (Options 11, 14 and 15) there is still a tendency for motorists to choose the existing bridge. This is most likely a result of the trip origins and destinations along with the delays experienced throughout the network. A high proportion of motorists are choosing to use the existing bridge as it is a more attractive route than the new bridge downstream which requires a longer travel distance. A full summary of the bridge volumes is provided in Appendix F.

In addition, a comparison of the average speeds, number of completed trips, vehicle-kilometres travelled (VKT) and total number of stops are shown graphically in Figure 7.3 to Figure 7.10.

Figure 7.3: Average Vehicle Speed (AM Peak) - All Vehicles

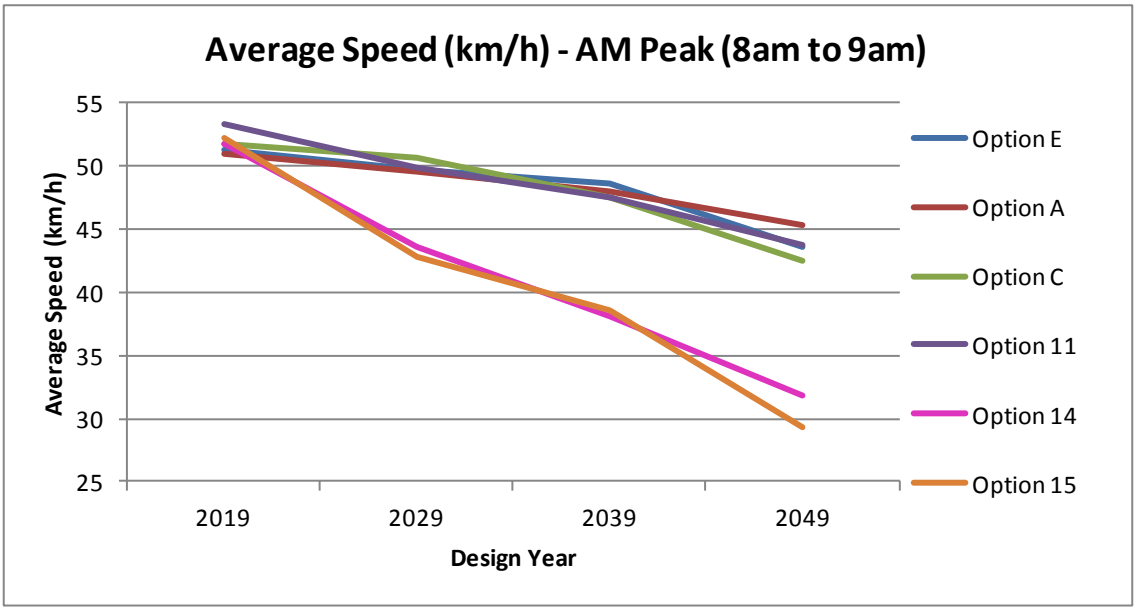


Figure 7.4: Average Vehicle Speed (PM Peak) – All Vehicles

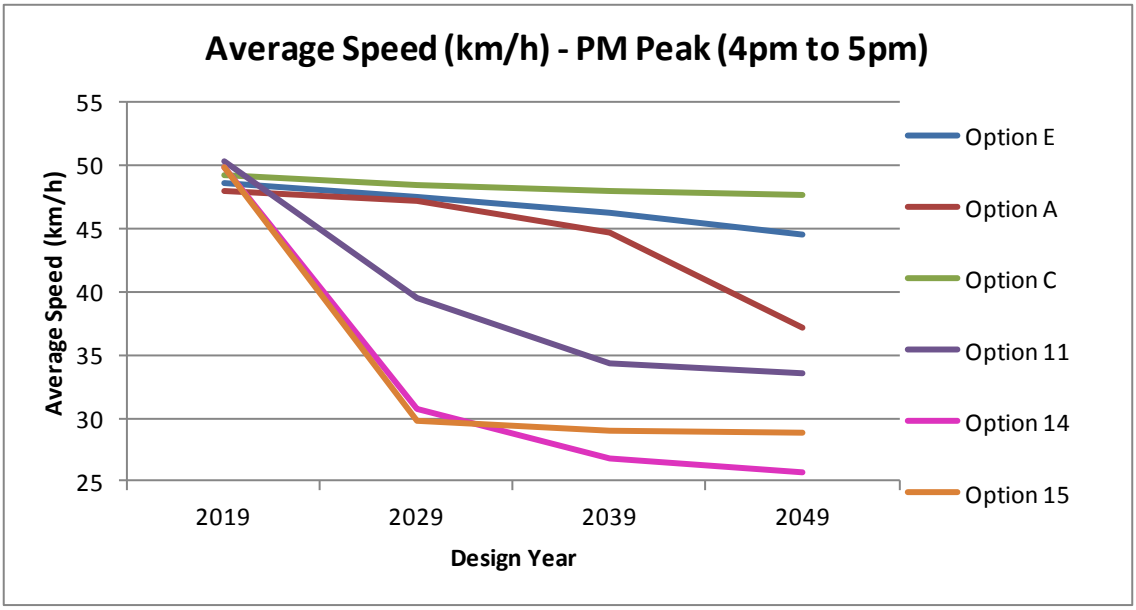


Figure 7.5: Number of Completed Trips (AM Peak) – All Vehicles

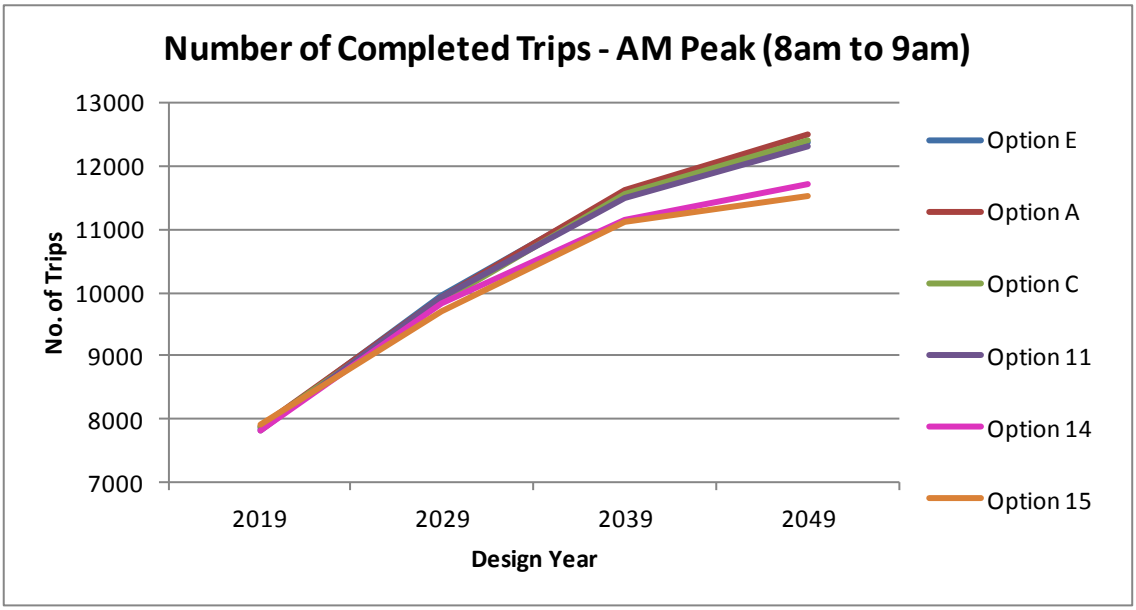
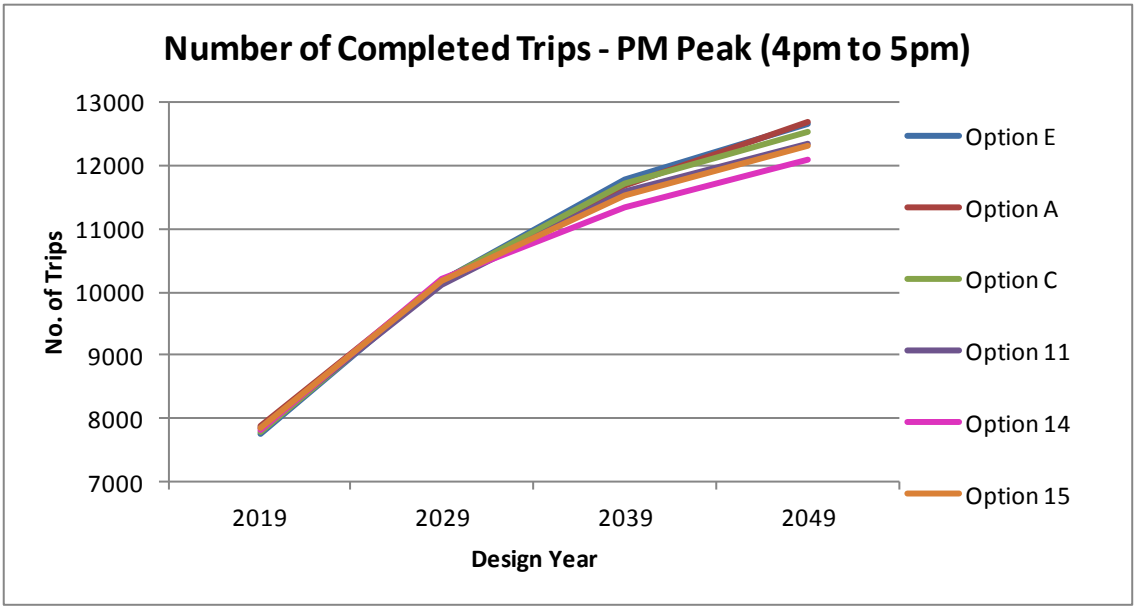


Figure 7.6: Number of Completed Trips (PM Peak) – All Vehicles



The results presented in Figure 7.3 to Figure 7.6 show that in 2019 all options operate at a similar level of performance in terms of average speed and the number of completed trips. As the design years approach 2049, the upstream options perform better than the downstream options in terms of both average speed and the number of completed trips. This is most notable during the PM peak, where Option 14 and Option 15 experience drops in average speed of up to 40% compared with their performance in 2019. Options A and 11 perform better than 14 and 15; however the best options in terms of average speeds are E and C.

Figure 7.7: Vehicle-Kilometres Travelled (AM Peak) – All Vehicles

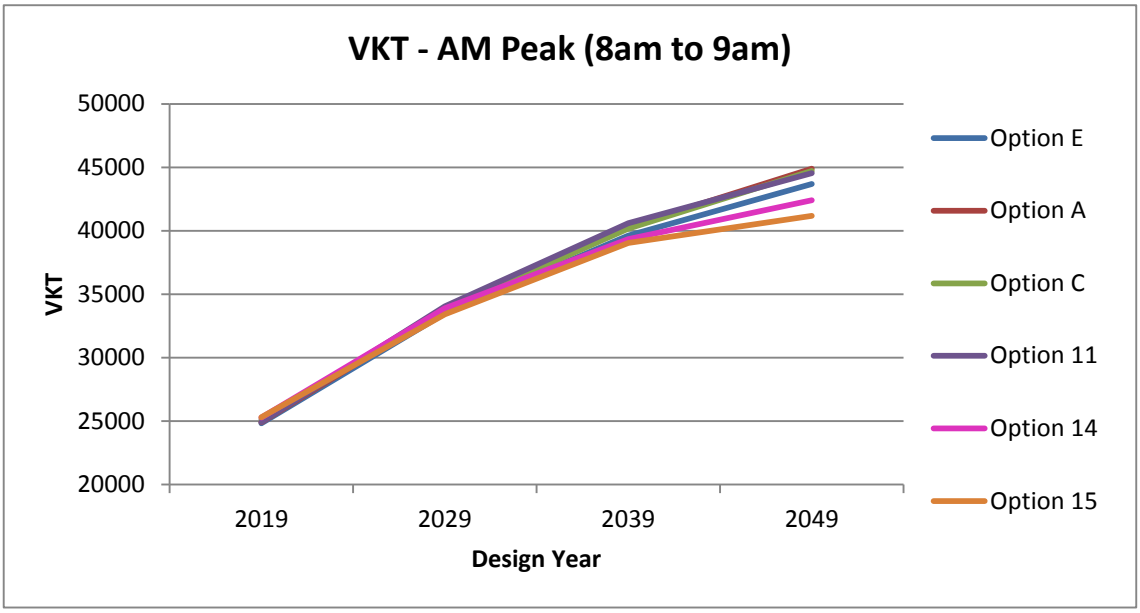
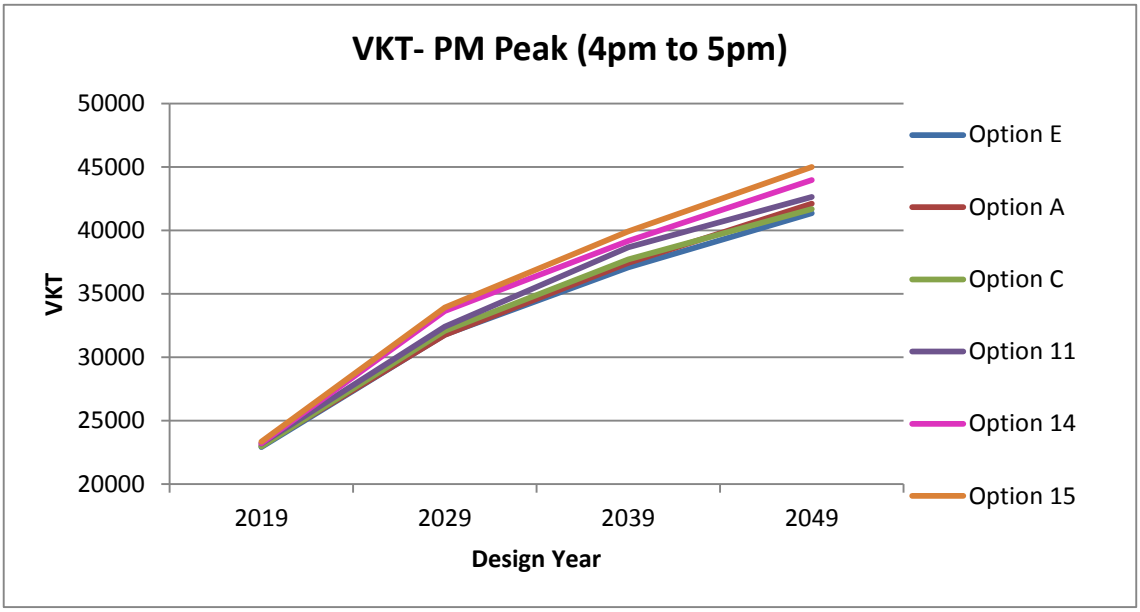


Figure 7.8: Vehicle-Kilometres Travelled (PM Peak) – All Vehicles



The vehicle-kilometres travelled (VKT) represents the total distance travelled by all vehicles within the simulated period. The PM peak results for Options 14 and 15 show higher VKTs than Option 11, which in turn are higher than Options C, A and E, as motorists travel further to use the new downstream bridge to avoid congestion in the vicinity of the existing bridge. During the AM peak period however, VKTs are lower for options 14 and 15 than the other options at 2049. This shows that for these options even though congestion increases in 2049, motorists still prefer to utilise the existing bridge.

The differences between the performance of Options 14 and 15 in 2049 in terms of VKT, between the AM and PM peak period is likely a result of less congestion (see bridge volumes and number of stops) in the AM when compared to the PM.

Figure 7.9: Total Number of Stops (AM Peak) – All Vehicles

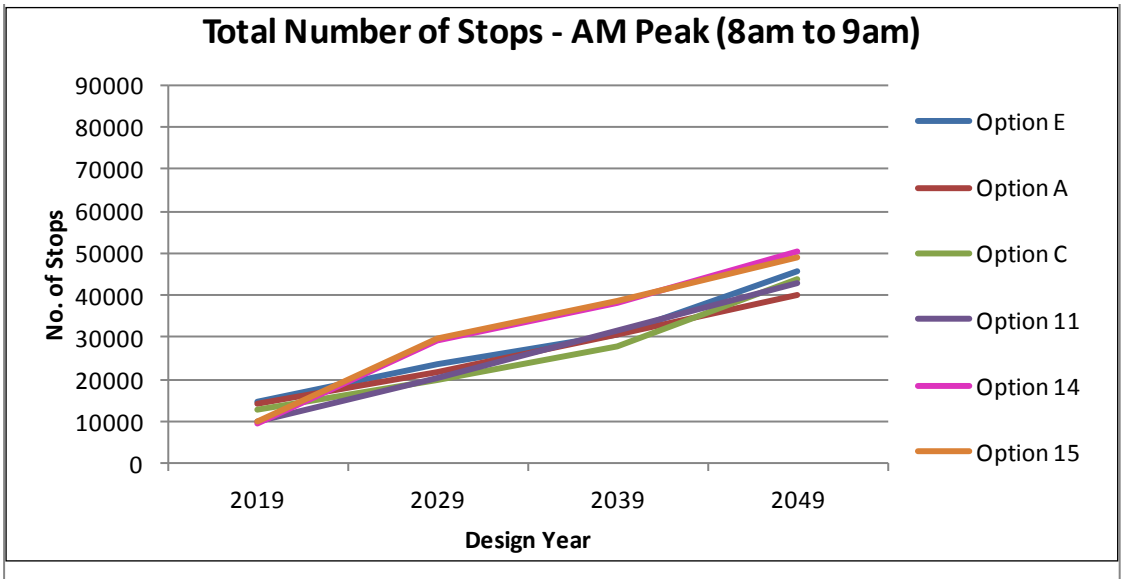
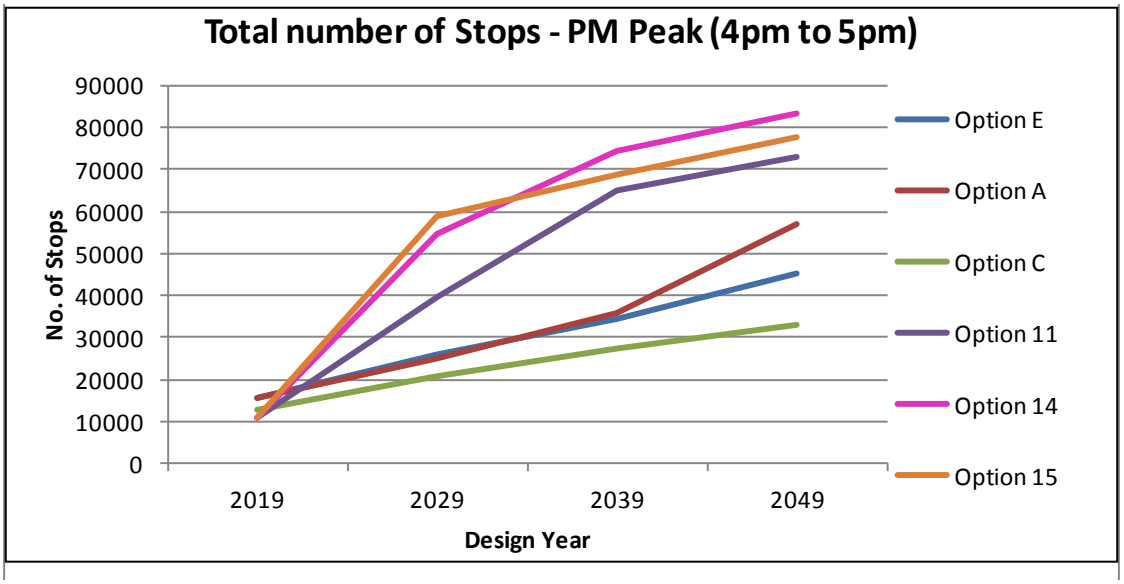


Figure 7.10: Total Number of Stops (PM Peak) – All Vehicles



The number of stops records when a vehicle travels from above 15 km/h to below 5 km/h, and is a good representation of the level of congestion across the network. It is clear that options 14 and 15 experience the highest levels of congestion on the network especially in later years as traffic volumes increase. The increasing number of stops for all options is representative of the increasing volume of traffic crossing the existing and new bridges during the simulation period.

7.7 Point to Point Travel Times

The point to point travel times for four bi-directional routes were recorded between the following locations:

- Pacific Highway / Tyson Street to Pound Street / Prince Street via the existing bridge
- Pacific Highway / Tyson Street to Summerland Way / Butterfactory Lane via proposed bridge
- Pacific Highway / Centenary Drive (North) to Pound Street / Prince Street via the existing bridge.
- Pound Street / Prince Street to Summerland Way / Butterfactory Lane

The route maps for the routes are provided in Appendix E.

A summary of the corresponding results for point to point travel times for the first two routes are presented graphically in Figures 7.11 to 7.18. Travel times for all routes are provided in Appendix E.

Figure 7.11: Pacific Highway / Tyson Street to Pound Street / Prince Street via Existing Bridge (AM Peak Northbound)

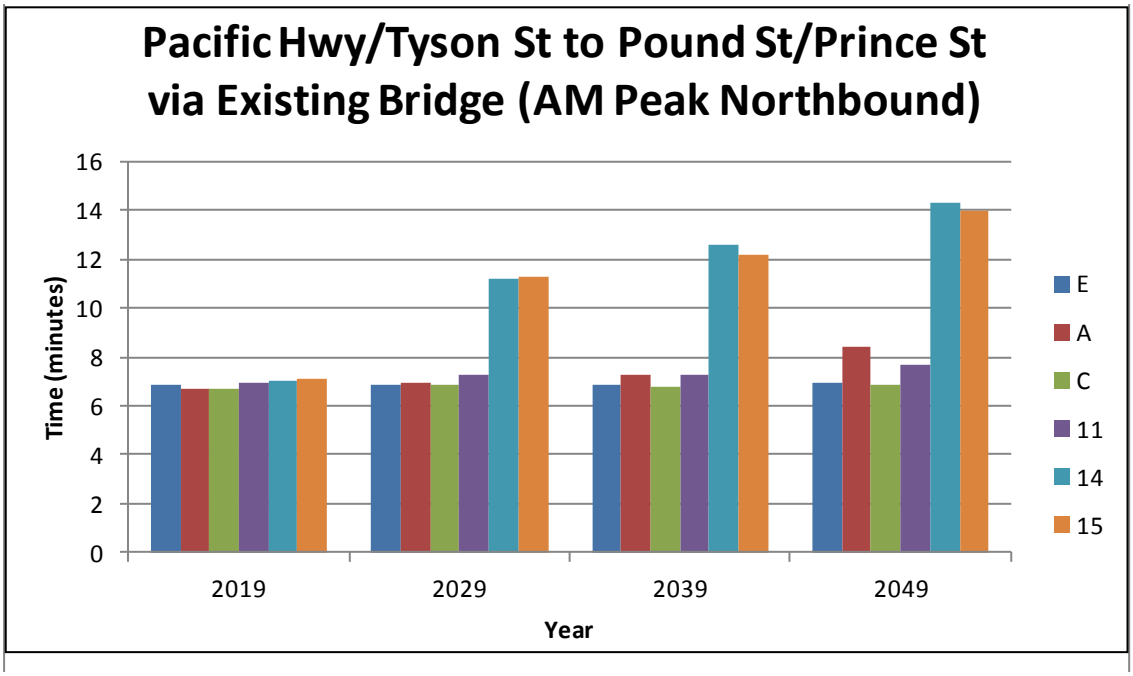
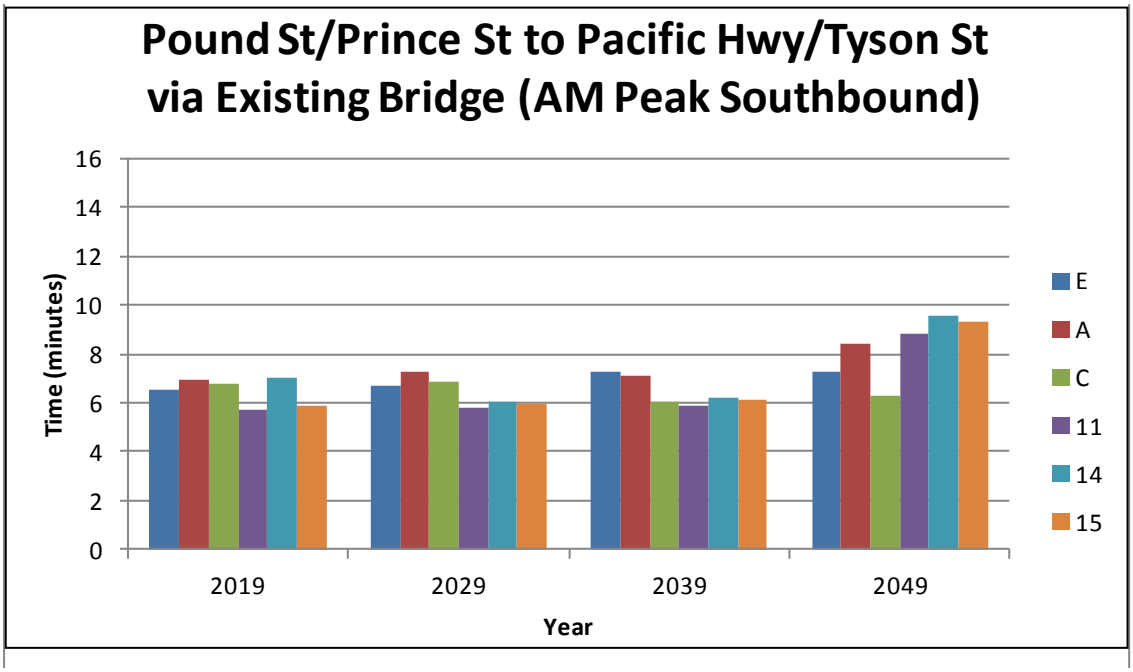


Figure 7.12: Pound Street / Prince Street to Pacific Highway / Tyson Street via Existing Bridge (AM Peak Southbound)



The travel times show that during the AM peak by 2049, Options 14 and 15 experience the highest travel times in both directions, particularly noticeable in the northbound direction which is more than double the options in the vicinity of the existing bridge. This is a clear indication that even though

network congestion occurs around the existing bridge, the new bridges are too far away to attract additional traffic.

Figure 7.13: Pacific Highway / Tyson Street to Pound Street / Prince Street via Existing Bridge (PM Peak Northbound)

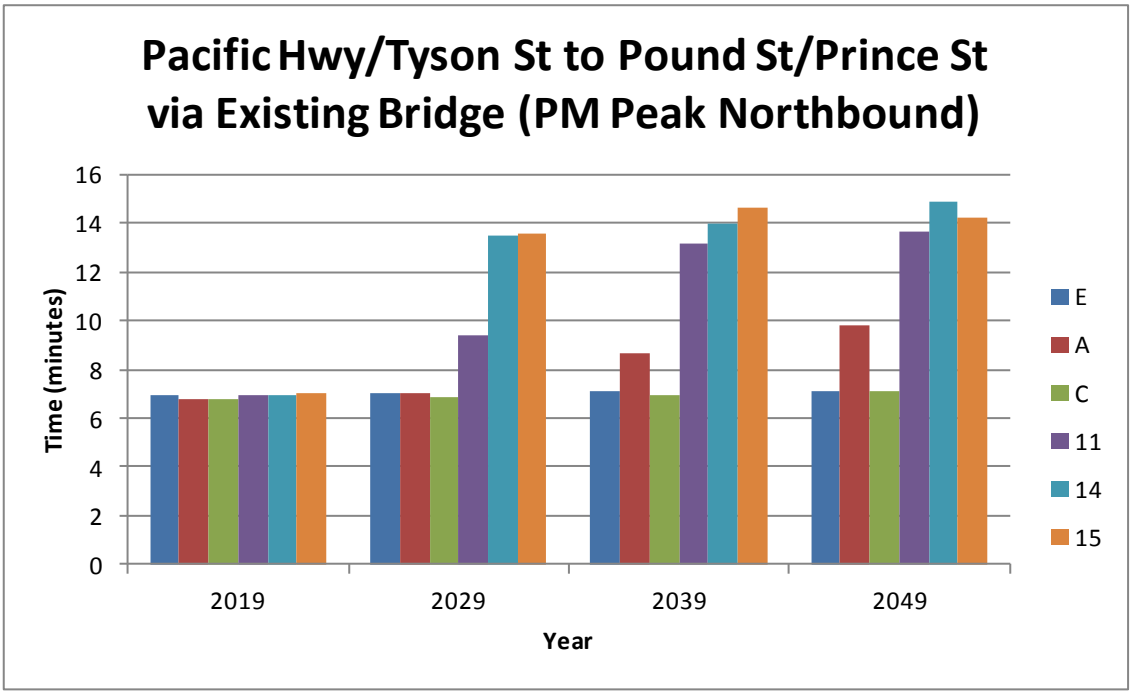
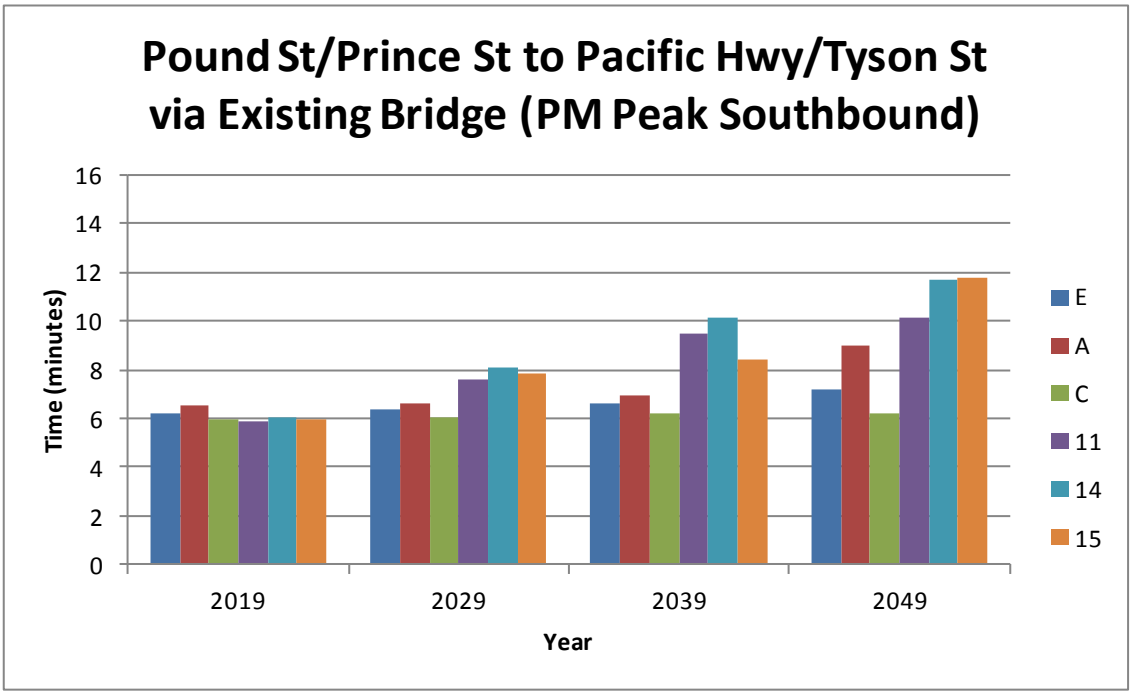


Figure 7.14: Pound Street / Prince Street to Pacific Highway / Tyson Street via Existing Bridge (PM Peak Southbound)



As with the AM peak, the PM peak travel times indicate that, by 2049 Options 14 and 15 experience the greatest travel times when compared to all other options. The travel times are significantly higher in the PM as a result of the constrained road network in both Grafton and South Grafton on the approach

to the existing bridge. As the congested conditions occur, the alternatives for re-routing reduce and longer queues form resulting in the higher travel times.

The PM peak travel times increase in later years more than the AM peak which is likely a result of the PM peak network having greater volumes and congestion.

Figure 7.15: Pacific Highway / Tyson Street to Summerland Way / Butterfactory Lane via Proposed Bridge (AM Peak Northbound)

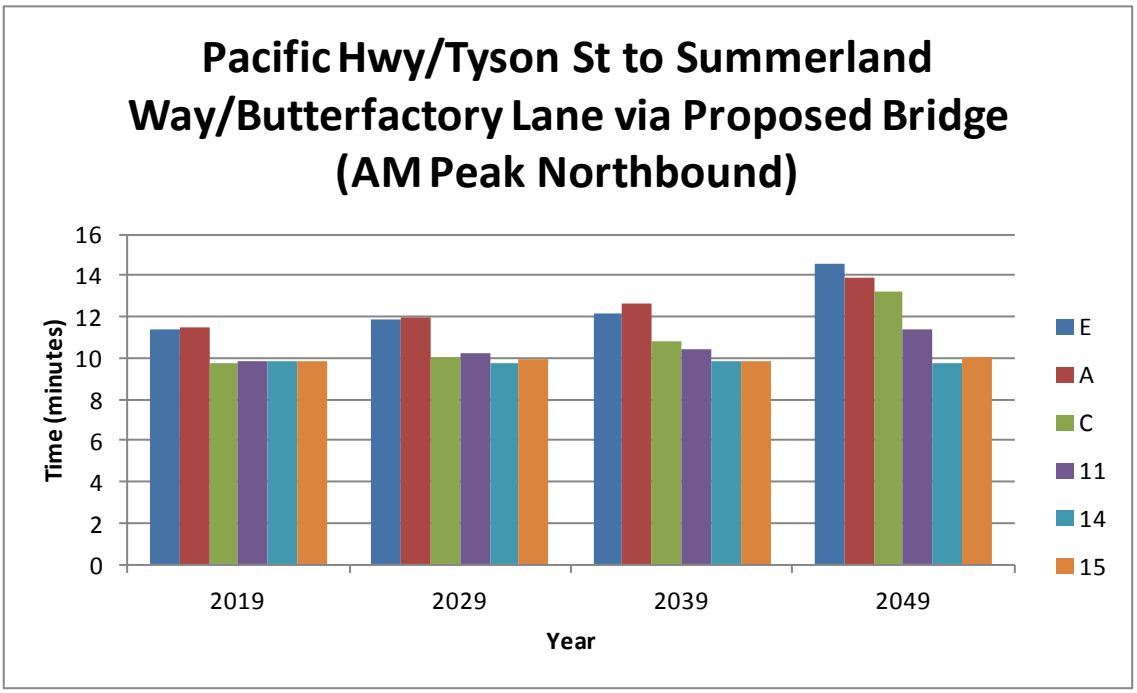


Figure 7.16: Summerland Way / Butterfactory Lane to Pacific Highway / Tyson Street via Proposed Bridge (AM Peak Southbound)

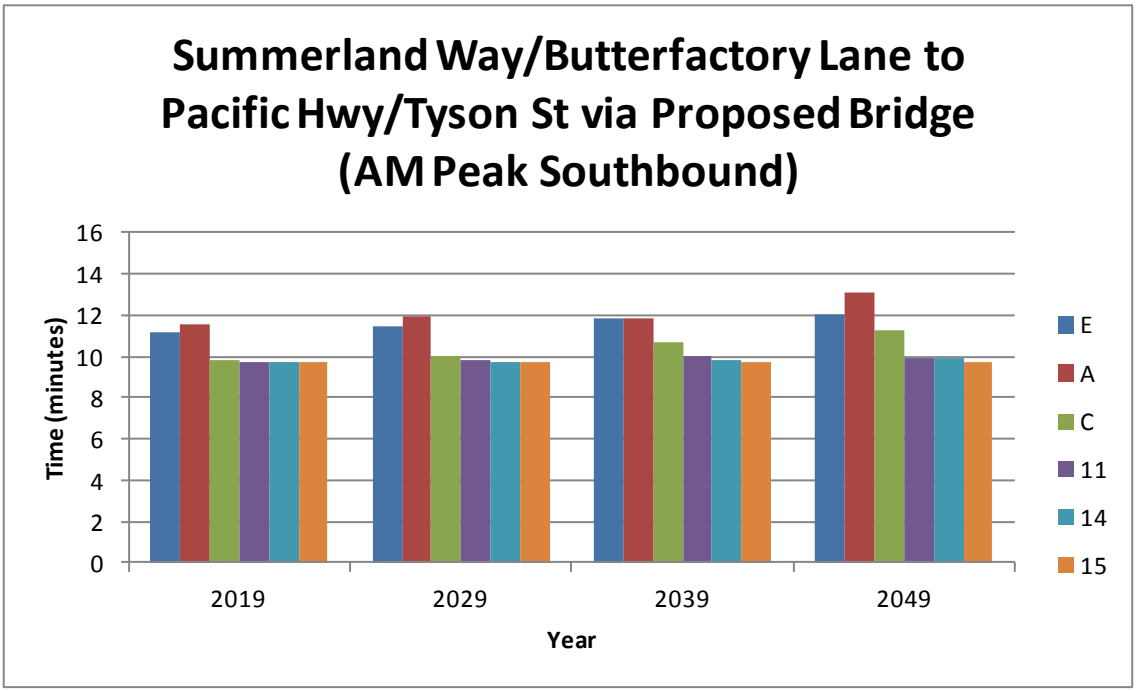


Figure 7.17: Pacific Highway / Tyson Street to Summerland Way / Butterfactory Lane via Proposed Bridge (PM Peak Northbound)

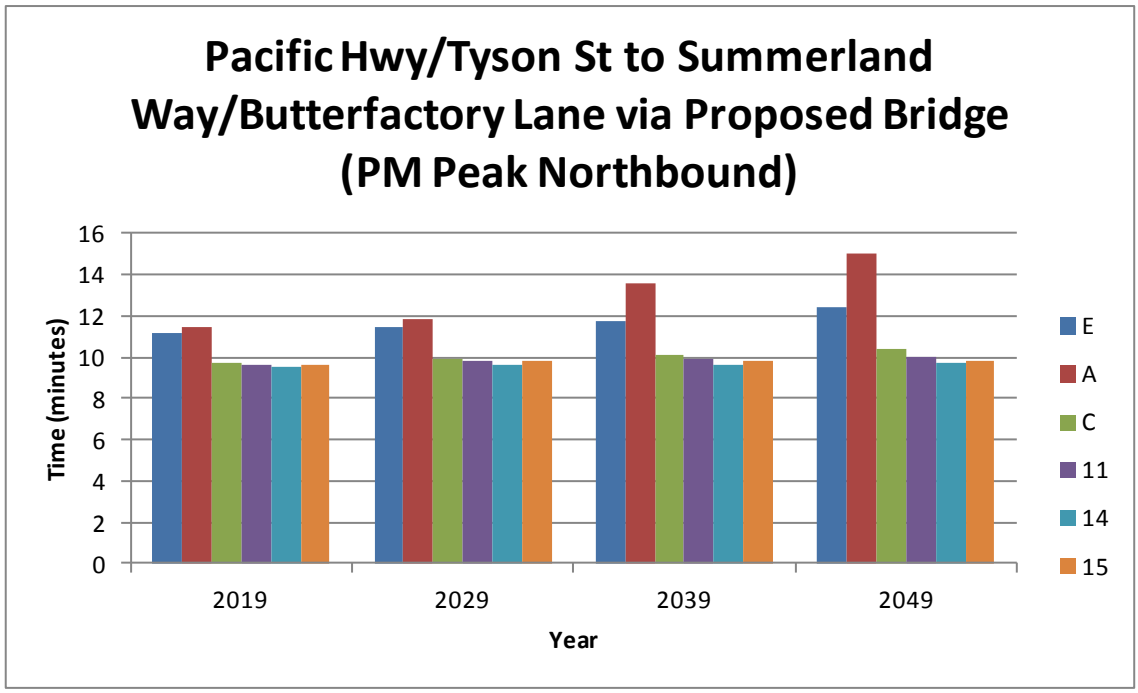
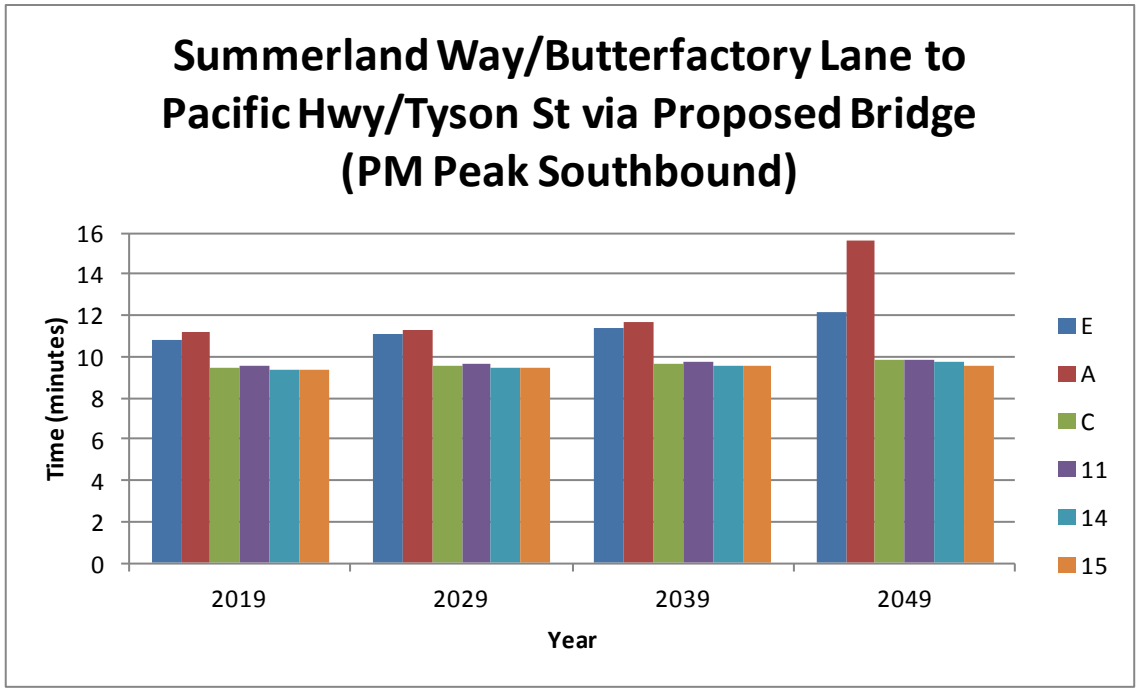


Figure 7.18: Summerland Way / Butterfactory Lane to Pacific Highway / Tyson Street via Proposed Bridge (PM Peak Southbound)



The travel times on the new bridges show that during both peak periods, the downstream options (Options 11, 14 and 15) experience the lowest travel times when compared to the options in the vicinity of the existing bridge. These are indicative of the congestion levels on the bridges, with the downstream options less congested. The bridges downstream are effectively operating as a bypass of Grafton.

The results also show that Option C also performs well, particularly in the PM peak.

8. Assessment of Route Options

8.1 Introduction

This chapter presents an assessment of the route options against a number of traffic indicators determined by the project team, which are summarised in Table 8.1. The information used to compare each option in the indicators has been obtained from the microsimulation model outputs. Each of the indicators and their outputs described in Table 8.1 are summarised in the following sub-sections.

Table 8.1: Traffic Indicators for the Assessment of the Route Options

Project objective	Supporting objective	Indicator	Unit
Improve traffic efficiency between and within Grafton and South Grafton	Provide efficient access for a second crossing of the Clarence River and for the State road network	Total time travelled by all vehicles across the modelled road network at the year of opening (2019) and at 20 years after opening (2039)	Million hours per year
		Total distance travelled by all vehicles across the modelled road network at the year of opening (2019) and at 20 years after opening (2039)	Million km per year
		Total time travelled by heavy vehicles across the modelled road network at the year of opening (2019) and at 20 years after opening (2039)	Million hours per year
		Total distance travelled by heavy vehicles across the modelled road network at the year of opening (2019) and at 20 years after opening (2039)	Million km per year
	Provide a traffic management network which reduces delays between Grafton and South Grafton in peak periods to an acceptable level of service for 30 years after opening	Average travel time between Grafton and South Grafton using the existing bridge, 30 years after opening (2049)	minutes
Support regional and local economic development	Provide for commercial transport including B-Doubles where required	Average travel time between the Pacific Highway and the Summerland Way using the new bridge, 30 years after opening (2049)	minutes
Minimise impact on the environment	Minimise the impact on residential amenity, including noise, vibration and air quality etc.	Estimated fuel consumption in urban areas during peak hours at 10 years after opening (2029). (Note that fuel consumption will be estimated in the RODR using data supplied in this report.)	Peak hour vehicle-kilometres travelled and peak hour vehicle-hours travelled (For peak hour fuel consumption estimates)

8.2 Indicator: Total Time Travelled By All Vehicles across the Road Network

8.2.1 Indicator Description

This indicator compares the total time travelled by all vehicles across the modelled road network for each of the route options. It is the time spent travelling by all vehicles measured in vehicle hours travelled (VHT). The VHT is a measure of the estimated total number of hours spent travelling by all

vehicles within the modelled network of Grafton and South Grafton. It includes all classes of light, medium and heavy vehicles.

The time spent travelling (VHT) for this indicator has been derived from the microsimulation traffic model for the years 2019 and 2039, representing the assumed year of opening and 20 years after opening.

The time spent travelling is the annual travel time for 2019 and 2039 across the modelled network.

Comparatively, options with a lower time travelled (VHT) indicate less time spent travelling on average and a more efficient road network. Benefits of a lower VHT include less congestion and commuting time, and improved accessibility to work and services.

8.2.2 Indicator Results

The results of the annual VHT for 2019 and 2039 are shown in Table 8.2.

Table 8.2: Total Time Travelled by All Vehicles across the Road Network (VHT)

Indicator		Option						
		"Do Minimum"	E	A	C	11	14	15
Time travelled by all vehicles across the road network	At the year of opening (2019) – million hours per year	2.37	1.91	1.97	1.89	1.85	1.89	1.88
	20 years after opening (2039) – million hours per year	# 4.15	2.99	3.12	2.96	3.07	3.32	3.27

Indicative "do minimum" case – refer to Section 5.4 for details.

The addition of a second river crossing creates additional road network capacity substantially reducing peak period delay in the network at 2019.

Total annual hours of travel for Options E, C, 11, 14 and 15 are within three per cent of each other in 2019. Option 11 has the lowest total travel time with the next best performing being Option 15. Option A has the highest total travel time, as all cross river traffic travels within the Bent Street/Craig Street/Fitzroy Street corridor. This extra traffic in the corridor creates the additional delay and therefore higher total travel time. Option 11 performs best as the option provides a convenient route to Grafton for traffic from Clarenza and the north, while attracting enough traffic away from the Bent Street corridor to improve overall network performance.

Traffic demand from the major new development areas of Clarenza and Waterview Heights become more pronounced on the network at 2039 and the relative performance of each option alters compared to 2019.

At 2039 Option C is the best performing option followed by Option E. Both Option E and Option C perform better than Option A at reducing traffic in the Bent Street/Craig Street/Fitzroy Street corridor, reducing delays and total travel times. One reason is that Options E and C provide the most direct routes for traffic from Waterview Heights and Clarenza respectively to connect to the central area of Grafton, attracting traffic away from the existing bridge. By 2039, Option 11 is no longer the best performing option. Traffic demand on the existing bridge corridor is higher for Option 11 than for Option C or Option E, resulting in lower network performance.

Options 14 and 15 have the highest total travel times and do not perform as well. The options do not attract enough traffic to the new bridge during either the peak hours or off peak hours and are less effective at reducing delay in the Bent Street/Craig Street/Fitzroy Street corridor. The result is higher overall travel times.

8.3 Indicator: Total Distance Travelled By All Vehicles across the Road Network

8.3.1 Indicator Description

This indicator compares the total distance travelled by all vehicles across the modelled road network for each of the route options. It is the distance travelled by all vehicles measured in vehicle-kilometres travelled (VKT). The VKT is a measure of the estimated total number of kilometres travelled by all vehicles within the modelled network of Grafton and South Grafton. It includes all classes of light, medium and heavy vehicles.

The distance travelled is derived from the microsimulation traffic model for the years 2019 and 2039, representing the assumed year of opening and 20 years after opening.

The distances travelled are annual distances travelled for 2019 and 2039 across the modelled network.

Comparatively, options with a lower distance travelled (VKT) indicate less distance travelled on average and a more efficient road network.

8.3.2 Indicator Results

The results for the annual VKT are shown in Table 8.3.

Table 8.3: Total Distance Travelled by All Vehicles across the Road Network (VKT)

Indicator		Option						
		"Do Minimum	E	A	C	11	14	15
Distance travelled by all vehicles across the road network	At the year of opening (2019) – million km per year	95.56"	94.63	95.75	95.14	95.14	96.18	95.95
	20 years after opening (2039) – million km per year	# 148.13	145.85	148.32	146.88	147.56	148.91	148.89

Indicative "do minimum" case – refer to Section 5.4 for details.

Option E performs the best as it offers the shortest route between South Grafton and Grafton in both 2019 and 2039.

Options C and 11 are the next best options at 2019 with total distance travelled being equal. By 2039, Option C is performing slightly better than Option 11. Option C has better road network capacity on the Grafton side, particularly along the Pound Street corridor, whereas traffic in Option 11 must use less direct routes to access the central area of Grafton. Option 11 does not reduce traffic on the existing bridge to the same extent as Option C. The delay associated with the Bent Street/Craig Street/Fitzroy Street corridor is higher for Option 11 which encourages some drivers to choose to travel further, using the new bridge, to avoid this delay.

Option 14 has the highest total distance travelled in 2019 and in 2039, marginally more than Option 15. Both options are least effective in reducing traffic on the existing bridge. These options are not effective at reducing delay in the Bent Street/Craig Street/Fitzroy Street corridor. The delay associated with the existing bridge and the 100 km/h posted speed limit on the Pacific Highway encourages some traffic to make the longer journey over the new bridge. As a result total travel distance is higher for Options 14 and 15 than for the other options.

8.4 Indicator: Total Time Travelled by Heavy Vehicles across the Road Network

8.4.1 Indicator Description

This indicator compares the total time travelled by heavy vehicles across the modelled road network for each of the route options. It is the time spent travelling by heavy vehicles measured in vehicle hours travelled (VHT). The VHT is a measure of the estimated total number of hours spent travelling by heavy vehicles within the modelled network of Grafton and South Grafton. It includes all buses, trucks, articulated vehicles and B-Doubles but excludes light commercial vehicles.

The time spent travelling (VHT) for this indicator has been derived from the microsimulation traffic model for the years 2019 and 2039, representing the assumed year of opening and 20 years after opening.

The time spent travelling is the annual travel time for 2019 and 2039 across the modelled network.

Comparatively, options with a lower time travelled (VHT) indicate less time spent travelling on average and a more efficient road network for heavy vehicles. Benefits of a lower VHT would include less congestion, which would be expected to result in lower transport costs and improved accessibility for deliveries.

8.4.2 Indicator Results

The results for the heavy vehicle travel times are shown in Table 8.4.

Table 8.4: Total Time Travelled by Heavy Vehicles across the Road Network (VHT)

Indicator		Option						
		"Do Minimum"	E	A	C	11	14	15
Time travelled by heavy vehicles across the road network	At the year of opening (2019) – million hours per year	0.040	0.035	0.034	0.033	0.032	0.035	0.033
	20 years after opening (2039) – million hours per year	# 0.070	0.053	0.052	0.050	0.049	0.055	0.053

Indicative "do minimum" case – refer to Section 5.4 for details.

The addition of a second river crossing creates additional road network capacity substantially reducing peak period delay for heavy vehicles in the network at 2019. However the performance of the options for heavy vehicles differs to that of all vehicles because the larger heavy vehicles are obliged to use the new bridge.

In 2019 the total annual hours of heavy vehicle travel would be lowest for Option 11 which provides good overall access for heavy vehicles at this time. Options A, C and 15 are the next best performing in 2019, with Options E and 14 the worst performing.

By 2039 the relativities change as traffic grows. Option 11 is still the best performing option but is closely followed by Option C. Options E , A and 15 are a little worse, with Option 14 having the highest heavy vehicle travel time. For Option 14, increasing congestion around the central areas of Grafton and South Grafton is increasing the travel time for heavy vehicles accessing these areas.

8.5 Indicator: Total Distance Travelled by Heavy Vehicles across the Road Network

8.5.1 Indicator Description

This indicator compares the total distance travelled by heavy vehicles across the modelled road network for each of the route options. It is the distance travelled by heavy vehicles measured in vehicle-kilometres travelled (VKT). The VKT is a measure of the estimated total number of kilometres travelled by heavy vehicles within the modelled network of Grafton and South Grafton. It includes all buses, trucks, articulated vehicles and B-Doubles but excludes light commercial vehicles.

The distance travelled is derived from the microsimulation traffic model for the years 2019 and 2039, representing the assumed year of opening and 20 years after opening.

The distances travelled are annual distances travelled for 2019 and 2039 across the modelled network.

Comparatively, options with a lower distance travelled (VKT) indicate less distance travelled on average by heavy vehicles resulting in a more efficient road network and lower transport costs.

8.5.2 Indicator Results

The results for the heavy vehicle travel distance are shown in Table 8.5.

Table 8.5: Total Distance Travelled by Heavy Vehicles across the Road Network (VKT)

Indicator		Option						
		"Do Minimum"	E	A	C	11	14	15
Distance travelled by heavy vehicles across the road network	At the year of opening (2019) – million km per year	1.86	1.83	1.79	1.77	1.73	1.92	1.82
	20 years after opening (2039) – million km per year	# 2.89	2.73	2.71	2.62	2.61	2.87	2.75

Indicative "do minimum" case – refer to Section 5.4 for details.

In terms of distance travelled by heavy vehicles, rather than distance travelled by all vehicles, Option E is no longer the most efficient network. Option 11 provides the most efficient network in 2019, followed by Options C and A. Options E and 15 are the next best with Option 14 having appreciably greater heavy vehicle travel distances. By 2039, Option 11 still has the lowest heavy vehicle travel distances, closely followed by Option C. Options A, E and 15 are the next best, with Option 14 again having the highest heavy vehicle travel distance.

8.6 Indicator: Average Travel Time between Grafton and South Grafton Using the Existing Bridge

8.6.1 Indicator Description

This indicator compares the average travel time between Grafton and South Grafton using the existing bridge for each of the route options. The average travel time between Grafton and South Grafton using the existing Grafton Bridge has been estimated for each option in the year 2049 as an indicator of the reduction in delays for vehicles using the existing bridge.

The travel times are measured between the intersection of Pacific Highway / Tyson Street in South Grafton, and the intersection of Prince Street / Pound Street (clock tower) in Grafton, using the existing bridge. The times have been derived from the microsimulation traffic model for the morning (AM) peak period (8-9am) in the northbound direction and the afternoon (PM) peak period (4-5pm) in the southbound direction in 2049.

The average travel time is reported in minutes.

Comparatively, the higher the travel time, the greater the congestion experienced on the existing bridge, for that option.

8.6.2 Indicator Results

The results for the travel times in 2049 are shown in Table 8.6.

Table 8.6: Average Travel Time between Grafton and South Grafton using the Existing Bridge

Indicator		Option					
		E	A	C	11	14	15
Average travel time between Grafton (Prince St / Pound St) and South Grafton (Pacific Hwy / Tyson St) using the existing bridge, 30 years after opening	Morning (AM) peak period (minutes) – Northbound	7	8	7	8	14	14
	Afternoon (PM) peak period (minutes) - Southbound	7	9	6	10	12	12

Options E and C would result in the shortest travel times in 2049 during the morning 8-9am (northbound) and afternoon 4-5pm (southbound) peaks between the intersection of Pacific Highway / Tyson Street in South Grafton and the intersection of Prince Street / Pound Street (clock tower) in Grafton. They are the best performing options as they provide convenient alternative routes between South Grafton and Grafton. They attract more traffic away from the existing bridge and allow higher travel speeds in the Bent Street / Craig Street / Fitzroy Street corridor. Option C performs a little better than Option E in the afternoon peak because it separates traffic at both the southern and northern ends of the bridge reducing the conflicts between various movements and reducing the overall delay, particularly at the Fitzroy Street / Villiers Street intersection.

Option 14 and Option 15 perform in a similar manner and are least successful in reducing delay in the Bent Street / Craig Street / Fitzroy Street corridor as the options attract less traffic away from the existing bridge.

8.7 Indicator: Average Travel Time between the Pacific Highway and the Summerland Way

8.7.1 Indicator Description

This indicator compares the average travel time for heavy vehicles between the Pacific Highway and the Summerland Way for each of the route options.

The travel times are between the intersection of the Pacific Highway and Tyson Street, South Grafton, and the intersection of Summerland Way and Butterfactory Lane, Grafton using the new bridge in 2049. The times have been derived from the microsimulation traffic model for the morning (AM) peak period (8-9am) in the northbound direction and the afternoon (PM) peak period (4-5pm) in the southbound direction in 2049.

The average travel time is reported in minutes.

Comparatively, the higher the travel times the less efficient the route option is considered to be for heavy vehicles travelling through Grafton.

8.7.2 Indicator Results

The results of the travel times in 2049 are shown in Table 8.7.

Table 8.7: Average travel time between the Pacific Highway and the Summerland Way via New Bridge

Indicator		Option					
		E	A	C	11	14	15
Average travel time between the Pacific Highway and the Summerland Way, 30 years after opening (2049)	Morning (AM) peak period (minutes) – Northbound	15	14	13	11	10	10
	Afternoon (PM) peak period (minutes) - Southbound	12	16	10	10	10	10

Options 14 and 15 would result in the shortest travel times in 2049 during the morning 8-9am (northbound) and afternoon 4-5pm (southbound) peaks between the intersection of the Pacific Highway / Tyson Street in South Grafton and the intersection of Summerland Way / Butterfactory Lane in Grafton. The lower traffic levels and higher speed limits on the Pacific Highway assist in reducing the travel times for Options 14 and 15. Option E is has the highest travel time in the AM peak and Option A in the PM peak. Both options require through traffic to travel through central area key intersections where the delays are higher and add to the time required to complete the trip.

8.8 Indicator: Estimated Fuel Consumption at 10 years After Opening (for year 2029)

8.8.1 Indicator Description

This is an indicator of the impact on the air quality in Grafton urban areas.

Fuel consumption during peak hours will be estimated in the RODR as an indicator of the impact of each option on the air quality of Grafton urban areas. The indicator focuses on sections of the road that are urbanised (i.e. developed) only, as these are the areas where air quality sensitive receivers are located (eg houses, schools, hospitals, child care centres, aged care centres, etc).

The modelling results from this report will be used to derive the average speed in urban areas achieved by each of the route options during the AM and PM peak periods at year 2029, and these speeds together with the distances travelled by the different classes of vehicles in the peak hours will then be used in the RODR to estimate the total fuel usage for each option.

The amount of fuel consumed per option is proportional to the amount of contaminants emitted by vehicles to the atmosphere and therefore is considered a good indicator for air quality impacts.

The greater the amount of fuel consumed, the greater the air quality impact of the route option on urban areas.

8.8.2 Indicator Results

The results of the distances and time travelled in urban areas in 2029 are shown in Table 8.8.

Table 8.8: Results of the Indicator for Calculation of Peak Hour Fuel Usage

Indicator		Option					
		E	A	C	11	14	15
Travel by all vehicles in urban areas in the in 2029 (10 years after opening	Distance travelled by all vehicles in urban areas in the AM and PM peak periods (km travelled)	46,700	46,990	46,590	46,430	44,600	43,400
	Time travelled by all vehicles in urban areas in the AM and PM peak periods (hours of travel)	1,040	1,050	1,020	1,160	1,440	1,460

Total travel times and distances travelled in urban areas during the 8-9am morning and 4-5pm afternoon peak hours have been estimated as an indicator of likely fuel consumption and hence relative air quality impacts. Options with higher fuel consumption are likely to have poorer relative air quality.

Options C, E and A reduce road network delay better than the downstream options and have comparatively low total travel times in urban areas during peak hours. These options would be likely to have the lowest fuel consumption in urban areas.

Options 14 and 15 would be likely to have the highest fuel consumption. These options do not reduce delays in the Bent Street / Craig Street / Fitzroy Street corridor to the same extent as the other options, resulting in lower speeds, higher total travel times and higher fuel consumption in urban areas.

Fuel consumption estimates for all options are reported in the RODR.

Appendix A

Calibration and Validation Report

Main Road 83 Summerland Way

Additional Crossing of the Clarence River, Grafton

Route Options Design Report

Microsimulation Calibration and Validation Report

transportation planning, design and delivery

IS11352 26/07/12

GTAconsultants

Main Road 83 Summerland Way

Additional Crossing of the Clarence River, Grafton, Route Options Design Report

Microsimulation Calibration and Validation Report

Issue: D 26/07/12

Client: Roads and Maritime Services, NSW
Reference: IS11352
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By
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D	26/07/12	Final	Bryan Li / Matthew Petherick	Reece Humphreys	

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1. Introduction

1.1 Background

GTA Consultants (GTA) was commissioned by ARUP on behalf of the Roads and Maritime Services, NSW (RMS) for the development of a Q-Paramics model of Grafton and South Grafton, in Northern NSW. As part of the project the existing road network was constructed with an aim of representing the existing traffic conditions.

The report discusses the calibration and validation of the Q-Paramics model, to confirm its 'fitness for purpose' as a basis for future options testing to be undertaken as part of this assignment.

1.2 Study Area

The model area is located within Grafton in northern New South Wales and includes the town centres of Grafton and South Grafton and the existing bridge crossing of the Clarence River. The study area includes the major roads of Summerland Way, Fitzroy Street, Prince Street, Villiers Street, Dobie Street, Bent Street, Gwydir Highway and the Pacific Highway and includes the following key intersections:

- Fitzroy Street / Prince Street
- Prince Street / Pound Street
- Fitzroy Street / Villiers Street
- Pound Street / Villiers Street
- Bent Street / Through Street
- Bent Street / Ryan Street (Gwydir Highway)
- Pacific Highway / Gwydir Highway.

The Q-Paramics model includes all intersecting roads within the area and is shown in Figure 1.1 below.

Figure 1.1: Microsimulation Model Extents

The model was constructed with the use of aerial photography enabling the physical road geometry, lane and line-marking, to be matched to the existing layout.

Existing conditions information and traffic volume data was based on comprehensive surveys and site observations undertaken throughout the study area and supplemented with additional data sourced from RMS and previous studies. The manual turning movements, automatic tube counts and origin-destination surveys were undertaken at key locations and intersections for matrix estimation process.

The model has been calibrated and validated in accordance with the criteria set out in the 'UK Design Manual for Roads and Bridges (Vol 12, Section 2, Part 1 – Traffic Appraisal in Urban Areas)'.

The purpose of the modelling is to represent the existing operation of the network. This will then provide an accurate base for which to test the impact of various scenarios.

2. Model Specification

2.1 Software

The model was built using version 6.7.2 of Q-Paramics. To supplement the Q-Paramics core, the Lane Choice and Route Choice Azalient plug-ins were used.

2.2 Network Coverage

The brief was to build a model of Grafton in northern New South Wales which includes the town centres of Grafton and South Grafton and the existing bridge crossing of the Clarence River. The modelled area includes Summerland Way, Fitzroy Street, Prince Street, Villiers Street, Dobie Street, Bent Street, Gwydir Highway and the Pacific Highway.

2.3 Temporal Coverage

The base model covers AM and PM peak hour periods augmented by warm up and cool down periods as follows:

AM Peak Period

- 6:30am to 7:00am (AM warm up period)
- 7:00am to 8:00am (first AM peak hour)
- 8:00am to 9:00am (second AM peak hour)
- 9:00am to 10:00am (third AM peak hour)
- 10:00am to 10:30am (AM cool down period)

PM Peak Period

- 2:30pm to 3:00pm (PM warm up period)
- 3:00pm to 4:00pm (first PM peak hour)
- 4:00pm to 5:00pm (second PM peak hour)
- 5:00pm to 6:00pm (third PM peak hour)
- 6:00pm to 7:00pm (PM cool down period)

Thirty minute warm up periods were considered appropriate to pre-load the network before the peak hours.

3. Network Build

3.1 Overlay

The aerial photograph overlay was imported into the Q-Paramics model as a starting point at 94 Lambert projection. This base aerial photo, representing the whole modelled area, was under low scale and the road geometry, lane and line-marking were not clearly visible. Therefore, a series of smaller scaled aerial photographs were imported in the model and scaled to the base aerial photograph and checked to ensure all the scales were correct.

3.2 Configuration

The RMS standard configuration file was used. No changes were made to the RMS standard. The RMS's standard five seeds were also used to generate model outputs for validation.

3.3 Nodes

Nodes were input into the model at all key intersections and geometric locations.

Zone connectors were coded at model entry points where it is appropriate the vehicles enter the network at speed.

3.4 Links

Link geometry, lanes and restrictions were coded on the basis of the aerial photograph.

Link speeds were coded to sign-posted speed limits and link categories defined using the RMS standard categories file.

3.5 Kerbs and Stoplines

The aerial photograph overlay was used as the basis for the positioning of kerbs and stoplines. Adjustments were made to ensure realistic progression of vehicles between links.

3.6 Junctions

There are a number of priority junctions in the network. Priority junctions within the network were coded using the default Q-Paramics priority – 'minor', 'medium' and 'major' hierarchy. All U-turns in the model were barred.

3.7 Nextlane Rules

Nextlanes were applied in various locations throughout the network to achieve appropriate lane changing behaviour.

3.8 Lane Choice Rules

The lane choice plug-in was used throughout the network as a supplement to the limited functionality of signposting in the Q-Paramics core.

3.9 Route Choice Rules

The route choice plug-in was used specifically at roundabouts to control which routes vehicles use by specifying which exit vehicles must use when approaching an intersection.

4. Modelling Details and Assumptions

The following assumptions were made with regard to the development and calibration of the model.

- The speed on the southbound and northbound approaches to the bridge has been reduced in the model to reflect the road geometry and existing conditions at these locations.
- Speeds at the approaches to the roundabouts within the study area were marginally decreased to more realistically represent observed traffic conditions.
- A number of route choices were applied to reflect the results of traffic surveys and site observations.
- Heavy Goods Vehicles (HGV) and B-Double vehicles were restricted from travelling on residential streets. In addition, B-doubles were only permitted to travel on Pacific Highway, Bent Street, Fitzroy Street and Villiers Street.
- Lower end speed factors were applied on links with unsignalised pedestrian crossings in the town centre.
- Zone release percentages were applied to zones representing major activity centres reflecting traffic surveys and site observations.
- A number of bus routes currently operate within the study area and were included in the base model. The locations of all bus stops were input into the models and the arrival and departure times were based on the current bus time table.

5. Model Stability

A full summary of the turn counts and link counts are provided in Attachment A of this report.

Seed values of 28, 560, 2849, 7771 and 86524 were used to test the stability and sensitivity of the model. The following graph shows a comparison of the network vehicles within the model for each seed run. The following graphs show an acceptable range of sensitivity with similar peaks over the time period indicating that the model is robust in both the AM and PM Peak periods.

5.1 Seed Run Comparison for Network Vehicles (NV)

Figure 5.1: Comparison of Seed Runs for Network Vehicles (NV) - AM Peak

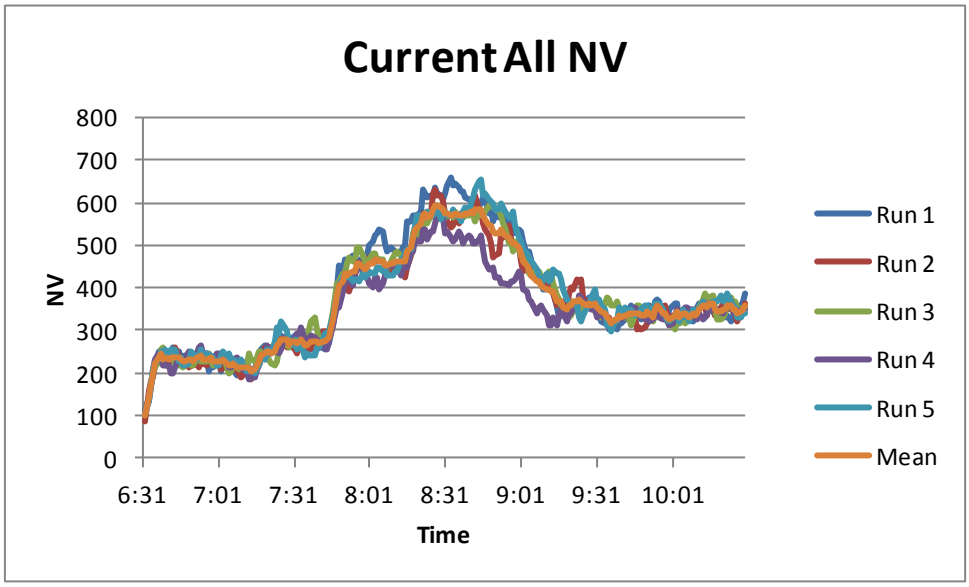
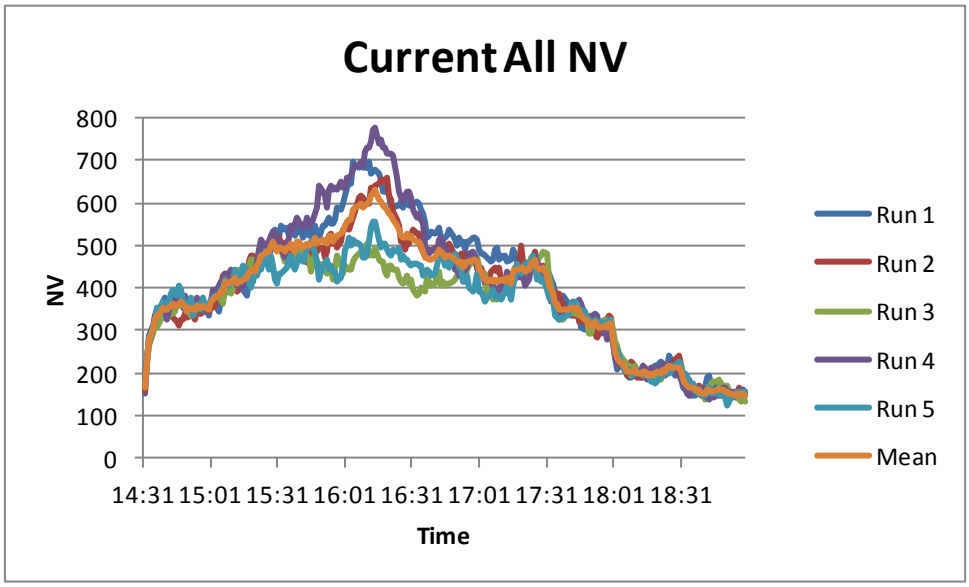


Figure 5.2: Comparison of Seed Runs for Network Vehicles (NV) - PM Peak



5.2 Vehicle Kilometres Travelled (VKT)

Figure 5.3: Vehicles Kilometres Travelled (VKT) - AM Peak

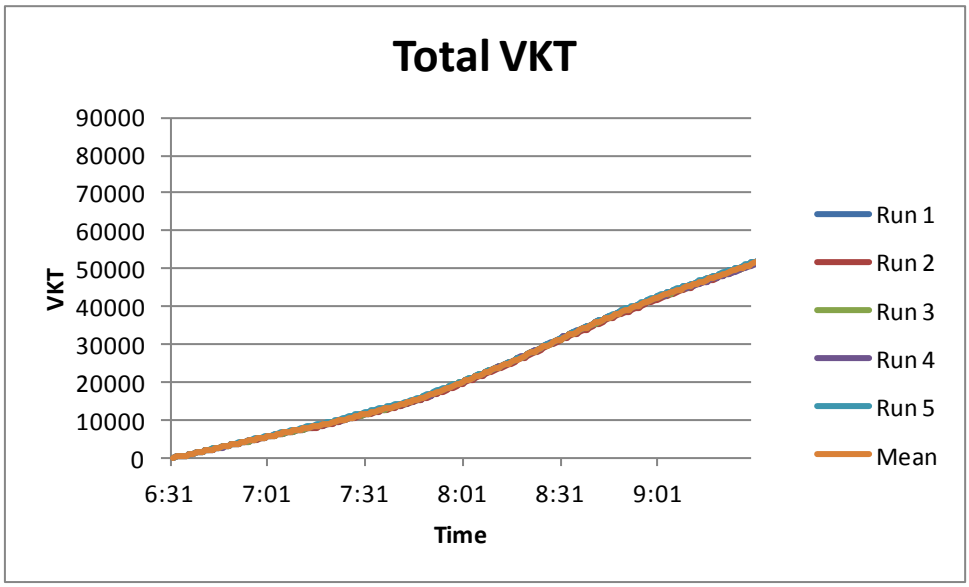
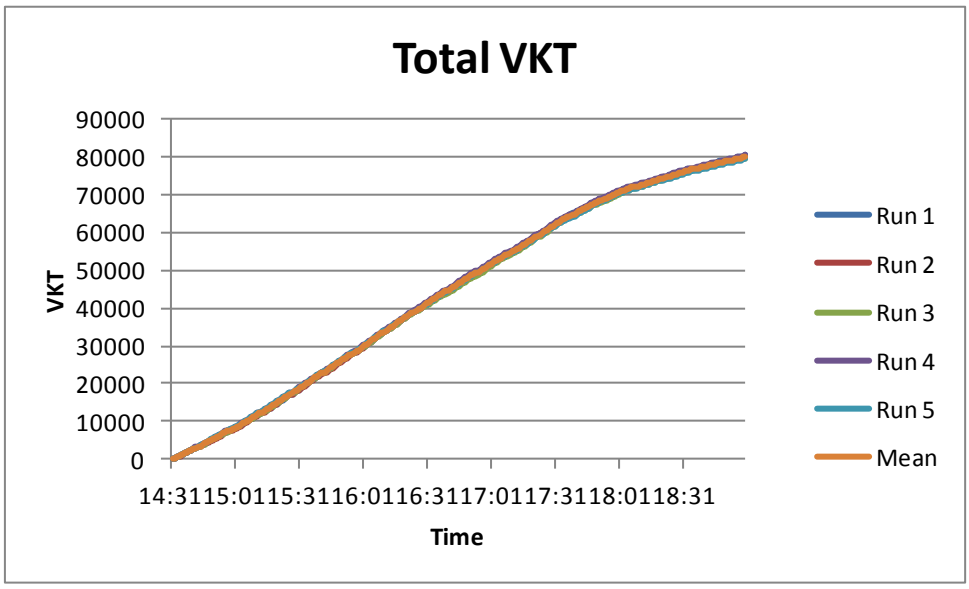


Figure 5.4: Vehicles Kilometres Travelled (VKT) - PM Peak



5.3 Vehicles Hours Travelled (VHT)

Figure 5.5: Vehicles Hours Travelled (VHT) - AM Peak

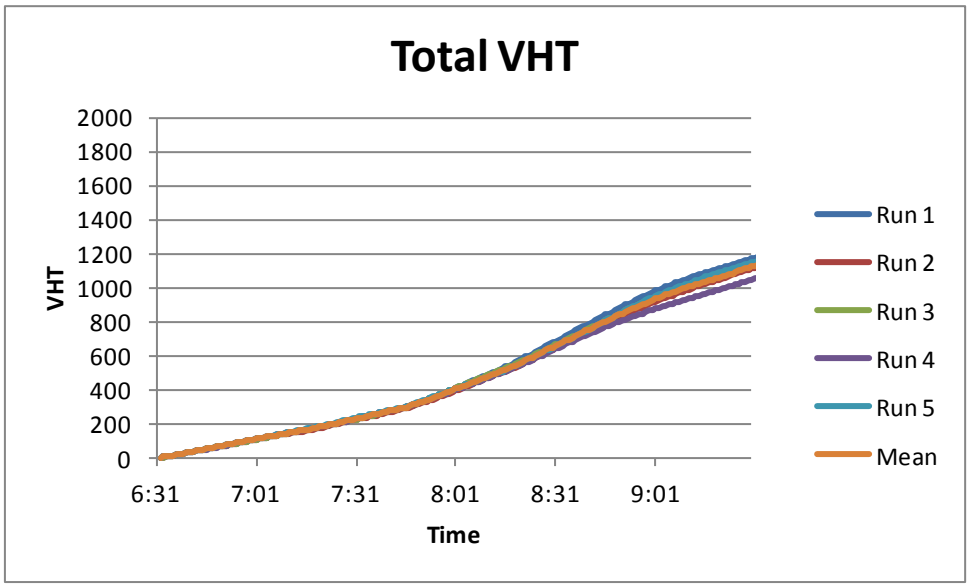
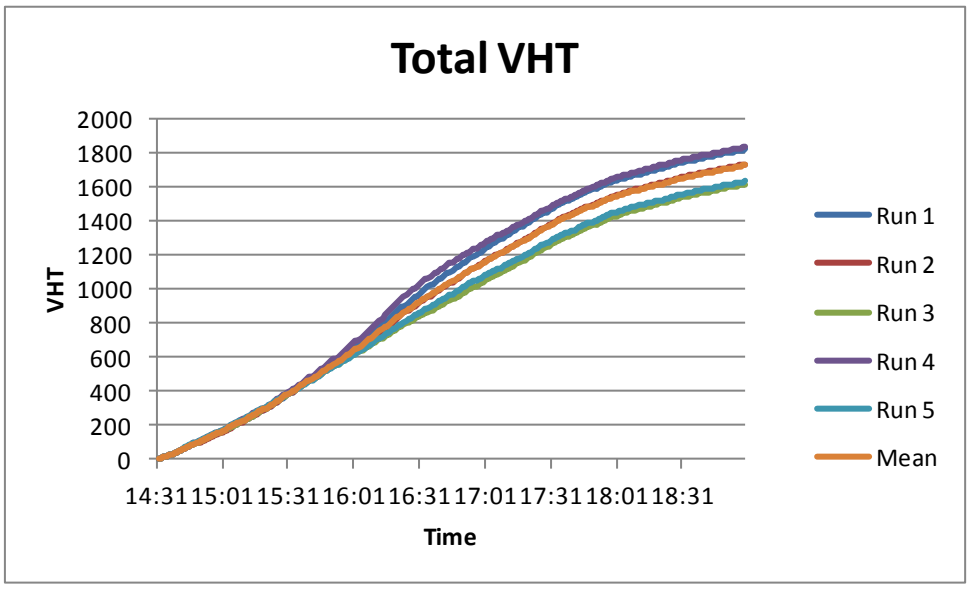


Figure 5.6: Vehicles Hours Travelled (VHT) - PM Peak



6. Calibration and Validation

6.1 Calibration and Validation Guidelines

The aim of the microsimulation models is to obtain the best possible match between the model results and the field measurements. The calibration and validation process was carried out in accordance with the criteria set out in the *'UK Design Manual for Roads and Bridges (Vol 12, Section 2, Part 1 – Traffic Appraisal in Urban Areas)'*.

The targets set out in the guidelines are shown in Table 6.1.

Table 6.1: Microsimulation Modelling Calibration and Validation Criteria

Criteria and Measurements	Calibration Acceptable Targets
Hourly Flows, Modelled Versus Observed	
Individual Link Flows	
Within 15%, for 700 veh/h < Flow < 2700 veh/h	> 85% of cases
Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases
Sum of All Link Flows	Within 5% of sum of all link counts
GEH Statistic < 5 for Individual Link Flows	> 85% of cases
Travel Times, Model Versus Observed	
Journey Times Within 15% (or 1 min, if higher)	> 85% of cases
Visual Audits	
Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Visually Acceptable Queuing	To analyst's satisfaction

Source: 'UK Design Manual for Roads and Bridges (Vol 12, Section 2, Part 1 – Traffic Appraisal in Urban Areas)'

The hourly flow criteria set out in Table 6.1 were utilised to calibrate the model, whilst queuing and visual audits were used to validate the model.

6.2 Turning Movements Calibration Results

Tables 6.2 and 6.3 show the results obtained from the comparison of turn flows for both the AM and PM peak periods in relation to GEH Requirement.

The GEH statistic is a standard measure of the 'goodness of fit' between observed and modelled flows. Unlike comparing percentage difference the GEH statistic places more emphasis on larger flows rather than on small flows.

The GEH statistic is defined as follows:

$$GEH = \sqrt{\frac{(M-C)^2}{(M+C)/2}}$$

where M and C are the modelled and observed flows respectively.

A smaller GEH value illustrates better fit and the Q-Paramics model of the existing situation will aim for all GEH values less than 5.

The GEH statistic is designed to measure one hour flows and as such, it is applied to hourly flows within the model. A GEH greater than 10 indicates no correlation between the observed and modelled data. A GEH between 5 and 10 indicates an acceptable match for modelling purposes, and a GEH below 5 indicates a good correlation. Tables 6.2 and 6.3 summarise the AM and PM calibration results.

Table 6.2: AM Peak Period Calibration Summary

Criteria UK Design Manual for Roads and Bridges	Within 15% for 700 veh/h < Flow < 2700 veh/h	Within 100 veh/h, for Flow < 700 veh/h	GEH less than 5	Sum of all link flows
Target	>85%	>85%	>85%	within 5%
7:00 – 8:00	100%	97%	88%	No (10%)
8:00 – 9:00	100%	99%	88%	Yes (0%)
Total Average	**100%**	**98%**	**88%**	**Yes (5%)**

Table 6.3: PM Peak Period Calibration Summary

Criteria UK Design Manual for Roads and Bridges	Within 15% for 700 veh/h < Flow < 2700 veh/h	Within 100 veh/h, for Flow < 700 veh/h	GEH less than 5	Sum of all link flows
Target	>85%	>85%	>85%	within 5%
3:00 – 4:00	100%	96%	85%	Yes (3%)
4:00 – 5:00	100%	97%	87%	Yes (1%)
Total Average	**100%**	**97%**	**86%**	**Yes (2%)**

Table 6.2 and Table 6.3 indicate that the AM and PM models generally meet the UK Design Manual for Roads and Bridges (Vol 12, Section 2, Part 1 – Traffic Appraisal in Urban Areas) and GEH turning movement criterion.

It is noted that there are minor discrepancies in the calibration results, such as the average sum of all link flows not within the required 5% bracket during the AM peak hour of 7am to 8am. Review of the results indicate that the actual modelled sum of link flows is higher than the observed, which means that the model has more traffic than what has been observed. However, whilst this discrepancy is outside the respective requirements, it is considered to have little or no impact on the model outcome.

In addition, the AM peak hour of 8am to 9am, which meets all model requirements, is considered to be more critical than 7am to 8am during the AM peak and will be used for reporting and analysis throughout this study.

Full details of the turn flows comparisons are included in Attachment A.

6.3 Travel Time Validation Results

Travel times along the route were recorded for each of the AM and PM peak periods and compared with data extracted from the model. 85% of the Q-Paramics values should be within 15% of the observed values. Because the travel times vary greatly in the real world, a sufficient number of on-site observations were made and average travel times were calculated for the main sections within the study area. For the purposes of the study, the following travel time routes were recorded:

AM Peak

- Northbound – between Gwydir Highway / Bent Street roundabout and Fitzroy Street / Villiers Street roundabout vi Bent Street and Fitzroy Street

- Southbound – between Fitzroy Street / Villiers Street roundabout and Gwydir Highway / Bent St roundabout via Fitzroy Street and Bent Street.

PM Peak

- Northbound – between Gwydir Highway / Bent Street roundabout and Fitzroy Street / Villiers Street roundabout. Via Bent Street and Fitzroy Street
- Southbound – between Fitzroy Street / Prince Street roundabout and Bent Street / Through Street roundabout via Fitzroy Street and Bent Street.

Tables 6.4 and 6.5 summarise the observed and modelled average travel time for both northbound and southbound traffic during the AM and PM peak periods.

Table 6.4: AM Travel Time Summary

Direction	AM Peak Hour (8:00am to 9:00am)			
	Average Observed (s)	Modelled Average (s)	Difference (seconds)	% Difference
Northbound (Gwydir Hwy to Villiers St)	355	397	42	12%
Southbound (Villiers St to Gwydir Hwy)	172	174	14	9%

Table 6.5: PM Travel Time Summary

Direction	PM Peak Hour (4:00pm to 5:00pm)			
	Average Observed (s)	Modelled Average (s)	Difference (seconds)	% Difference
Northbound (Gwydir Hwy to Villiers St)[1]	204	182	-22	-11%
Southbound (Prince St to Through St)[2]	303	289	-14	-5%

[1] 2011 travel time data was not observed on the northbound route in the PM peak and as such 2008 travel time data has been used to validate the route in the PM peak.

[2] Due to minimal travel time data recorded for the southbound route in the PM peak, a combination of the 2008 and 2011 travel time data has been used to determine the average observed travel time.

The results presented in Table 6.4 and 6.5 indicate that the travel times generally meet the requirements set out in the validation criteria, with travel times within the 15% threshold during both the AM and PM peak hours.

6.4 Queue Length Validation Results

Whilst not a specific requirement of calibration it is noted that during peak periods, traffic congestion on the bridge over the Clarence River increases. As such, queue lengths on the bridge and approaches to the bridge were observed during site observations in order to replicate this behaviour in the Q-Paramics model.

For this assessment, northbound queue lengths were recorded on Bent Street from the bridge to Gwydir Highway. The southbound queue lengths were recorded on Fitzroy Street to Pound Street. The graphs presented in Figures 6.1 and 6.2 show the comparison of observed and modelled queue lengths on the north and south approaches to the bridge during the AM and PM peak periods respectively.

Figure 6.1: AM Peak Queue Length Comparison

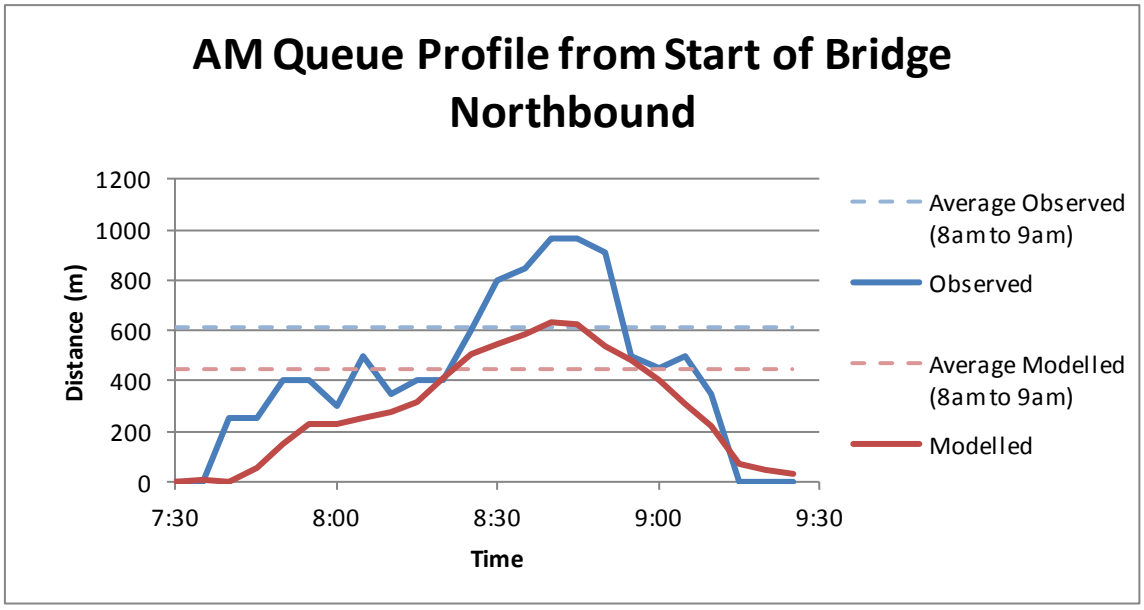
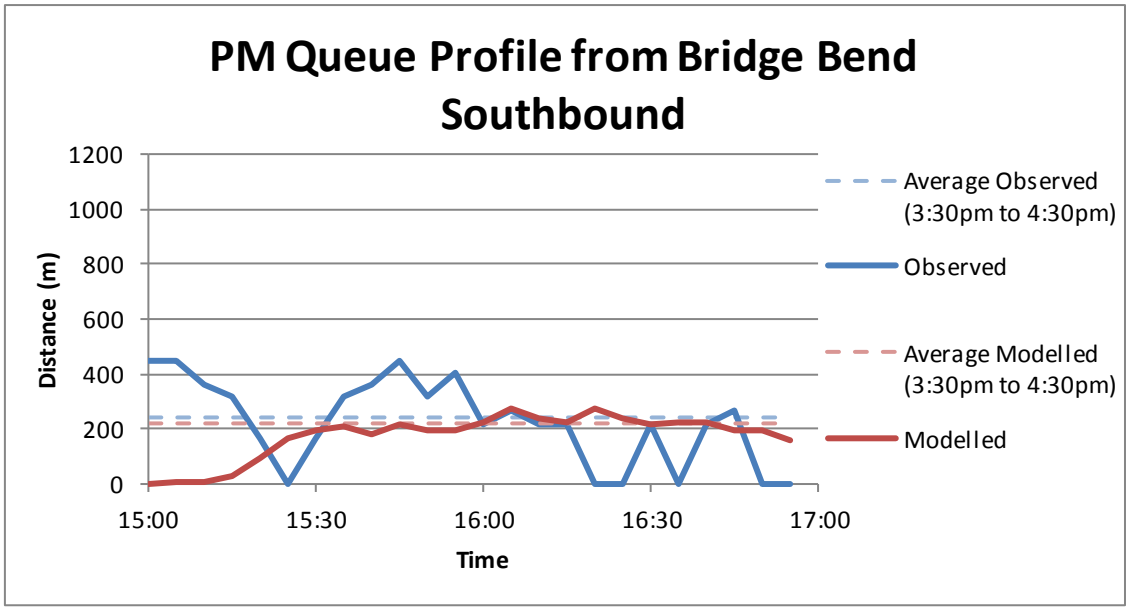


Figure 6.2: PM Peak Queue Length Comparison



Figures 6.1 and 6.2 indicate a general correlation or fit between the observed and modelled queue lengths. Furthermore, visual observations of the model suggest that queuing conditions within the model extents generally reflect the observed conditions.

It is noted that during the PM peak, there is an oscillating queue length on the south approach. This was observed on site as being the result of the constrained nature of the existing bridge where in some instances, a truck was required to stop or slow down on the bridge bend to give way to oncoming traffic, resulting in a stop of traffic.

7. Conclusion

The existing model has been built and calibrated using sound modelling practice, as outlined in this report. The data used to build the model was thoroughly analysed to ensure the quality of model inputs.

Modelled turning movement counts achieved a high level of correlation to observed counts. Modelled travel times also reflected observed travel times to an anticipated statistical confidence. Queue lengths on the critical approaches to the bridge over the Clarence River generally reflect the observed conditions.

The quality of input data, model building and calibration has produced a sound model, validated by travel time data. GTA considers that the model is 'fit for purpose'.

Attachment A

Turn Flow Comparison Results

7am to 8am Intersection	Approach	Movement	AVERAGE MODELLED	Observed	Diff	%	GEH	GEH <5	Within 15%, for 700veh/h<Flow<2700veh/h	Within 100veh/h, for Flow <700veh/h
3. Dobie Street and Turf Street	North	Through	170	182	-12	-0.1	0.90	0	FALSE	12
	North	Left	150	113	36.6	0.32	3.23	0	FALSE	36.6
	East	Right	102	101	1.4	0.01	0.10	0	FALSE	1.4
	East	Left	21	5	16	3.2	4.44	0	FALSE	16
	South	Right	18	4	14	3.5	4.22	0	FALSE	14
	South	Through	68	90	-22.2	-0.2	2.48	0	FALSE	22.2
Bent / Spring	South	Left	8	12	-4.2	-0.4	1.26	0	FALSE	4.2
	South	Through	697	629	68.4	0.11	2.64	0	FALSE	68.4
	East	Left	93	37	56.4	1.52	6.95	1	FALSE	56.4
	North	Left	66	88	-22.2	-0.3	2.51	0	FALSE	22.2
	North	Through	447	329	117.8	0.36	5.99	1	FALSE	117.8
	West	Left	22	21	1	0.05	0.22	0	FALSE	1
Gwydir / Bligh	South	Left	17	11	6	0.55	1.60	0	FALSE	6
	South	Through	3	8	-4.8	-0.6	2.13	0	FALSE	4.8
	South	Right	28	4	23.6	5.9	6.00	1	FALSE	23.6
	East	Left	20	8	12	1.5	3.21	0	FALSE	12
	East	Through	178	119	59	0.5	4.84	0	FALSE	59
	East	Right	7	10	-3.4	-0.3	1.03	0	FALSE	3.4
	North	Left	10	23	-12.6	-0.5	3.20	0	FALSE	12.6
	North	Through	13	12	1	0.08	0.28	0	FALSE	1
	North	Right	4	13	-8.8	-0.7	3.09	0	FALSE	8.8
	West	Left	18	14	3.8	0.27	1.00	0	FALSE	3.8
	West	Through	206	224	-18.2	-0.1	1.23	0	FALSE	18.2
	West	Right	22	13	8.8	0.68	2.15	0	FALSE	8.8
Ryan St / Pac Hwy Connection	East	Through	164	221	-57.4	-0.3	4.11	0	FALSE	57.4
		Right	43	65	-22.4	-0.3	2.99	0	FALSE	22.4
	North	Left	37	46	-8.8	-0.2	1.40	0	FALSE	8.8
		Right	49	16	32.8	2.05	5.79	1	FALSE	32.8
	Weest	Left	38	29	9.2	0.32	1.55	0	FALSE	9.2
		Through	147	178	-31.4	-0.2	2.43	0	FALSE	31.4
Pac Hwy / connection to Ryan Street	South	Left	48	24	24.2	1.01	4.00	0	FALSE	24.2
		Right	45	55	-9.8	-0.2	1.41	0	FALSE	9.8
	East	Left	38	31	7.2	0.23	1.19	0	FALSE	7.2
		Through	332	299	33.4	0.11	1.86	0	FALSE	33.4
	North	Through	157	185	-27.8	-0.2	2.14	0	FALSE	27.8
		Right	69	42	26.8	0.64	3.62	0	FALSE	26.8
Pacific Hwy / Spring Street	East	Through	136	159	-23.4	-0.1	1.89	0	FALSE	23.4
		Right	99	141	-41.8	-0.3	3.83	0	FALSE	41.8
	North	Left	64	96	-31.6	-0.3	3.58	0	FALSE	31.6
		Right	52	33	19.4	0.59	2.91	0	FALSE	19.4
	West	Left	130	118	12	0.1	1.08	0	FALSE	12
		Through	199	159	40.4	0.25	2.99	0	FALSE	40.4
Pacific Hwy / Gwydir	South	Left	221	173	48.2	0.28	3.42	0	FALSE	48.2
		Through	176	189	-12.8	-0.1	0.96	0	FALSE	12.8
	North	Through	93	128	-35.4	-0.3	3.33	0	FALSE	35.4
		Right	95	82	13	0.16	1.38	0	FALSE	13
	West	Left	152	97	55.4	0.57	4.93	0	FALSE	55.4
		Right	135	98	36.8	0.38	3.43	0	FALSE	36.8
Gwydir-Bent	East	Left	7	25	-17.8	-0.7	4.50	0	FALSE	17.8
		Through	53	46	6.8	0.15	0.99	0	FALSE	6.8
		Right	253	171	82.2	0.48	5.63	1	FALSE	82.2
	South	Left	51	27	24	0.89	3.84	0	FALSE	24
		Through	338	363	-24.8	-0.1	1.34	0	FALSE	24.8
		Right	12	27	-15	-0.6	3.40	0	FALSE	15
	West	Left	139	139	-0.2	-0	0.00	0	FALSE	0.2
		Through	76	75	0.6	0.01	0.12	0	FALSE	0.6
		Right	29	61	-31.6	-0.5	4.77	0	FALSE	31.6
	North	Left	199	79	119.6	1.51	10.18	1	FALSE	119.6
		Through	163	227	-63.6	-0.3	4.58	0	FALSE	63.6
		Right	102	63	39.4	0.63	4.29	0	FALSE	39.4
	East	Left	67	74	-6.8	-0.1	0.83	0	FALSE	6.8
Fitzroy-Villers		Through	426	389	36.8	0.09	1.83	0	FALSE	36.8
		Right	414	403	10.8	0.03	0.54	0	FALSE	10.8
	South	Left	9	3	5.6	1.87	2.45	0	FALSE	5.6
		Through	9	5	3.8	0.76	1.51	0	FALSE	3.8
		Right	12	2	9.8	4.9	3.78	0	FALSE	9.8
	West	Left	45	18	27.2	1.51	4.81	0	FALSE	27.2
		Through	256	219	37.4	0.17	2.40	0	FALSE	37.4
		Right	4	10	-6.4	-0.6	2.27	0	FALSE	6.4
	North	Left	298	179	118.8	0.66	7.71	1	FALSE	118.8
		Through	12	15	-2.8	-0.2	0.82	0	FALSE	2.8
		Right	26	13	12.6	0.97	2.94	0	FALSE	12.6
Villers-Pound	East	Left	27	9	17.6	1.96	4.24	0	FALSE	17.6
		Through	21	43	-21.8	-0.5	3.89	0	FALSE	21.8
		Right	27	8	19.4	2.43	4.54	0	FALSE	19.4
	South	Left	153	108	44.6	0.41	3.94	0	FALSE	44.6
		Through	216	294	-78.4	-0.3	4.88	0	FALSE	78.4
		Right	97	36	60.8	1.69	7.48	1	FALSE	60.8
	West	Left	3	4	-1	-0.3	0.53	0	FALSE	1
		Through	24	24	-0.4	-0	0.00	0	FALSE	0.4
		Right	85	17	68	4	9.52	1	FALSE	68
	North	Left	54	30	24.4	0.81	3.70	0	FALSE	24.4
		Through	223	109	114.4	1.05	8.85	1	FALSE	114.4
		Right	4	9	-4.8	-0.5	1.96	0	FALSE	4.8
Fitzroy-Prince	East	Left	119	52	66.6	1.28	7.25	1	FALSE	66.6
		Through	170	158	11.6	0.07	0.94	0	FALSE	11.6
		Right	58	100	-41.8	-0.4	4.73	0	FALSE	41.8
	South	Left	48	37	11	0.3	1.69	0	FALSE	11
		Through	36	43	-6.6	-0.2	1.11	0	FALSE	6.6
		Right	38	29	9.2	0.32	1.55	0	FALSE	9.2
	West	Left	37	8	29	3.63	6.11	1	FALSE	29
		Through	162	104	58.2	0.56	5.03	1	FALSE	58.2
		Right	31	29	1.6	0.06	0.37	0	FALSE	1.6
	North	Left	163	114	49	0.43	4.16	0	FALSE	49
		Through	69	79	-10.2	-0.1	1.16	0	FALSE	10.2

		Right	4	34	-30	-0.9	6.88	1		FALSE	30
Prince-Pound	East	Left	8	37	-29	-0.8	6.11	1		FALSE	29
		Through	84	79	4.8	0.06	0.55	0		FALSE	4.8
		Right	31	29	1.6	0.06	0.37	0		FALSE	1.6
	South	Left	28	20	8.2	0.41	1.63	0		FALSE	8.2
		Through	74	117	-43	-0.4	4.40	0		FALSE	43
		Right	29	7	22.2	3.17	5.19	1		FALSE	22.2
	West	Left	38	15	23.2	1.55	4.47	0		FALSE	23.2
		Through	99	81	18	0.22	1.90	0		FALSE	18
		Right	72	90	-18	-0.2	2.00	0		FALSE	18
	North	Left	43	32	11.2	0.35	1.80	0		FALSE	11.2
		Through	158	130	28	0.22	2.33	0		FALSE	28
		Right	28	28	0	0	0.00	0		FALSE	0
Prince-Dobie	South	Left	57	58	-1	-0	0.13	0		FALSE	1
		Through	48	45	3.4	0.08	0.44	0		FALSE	3.4
		Right	42	22	20.2	0.92	3.54	0		FALSE	20.2
	West	Left	2	2	-0.2	-0.1	0.00	0		FALSE	0.2
		Through	112	113	-0.8	-0	0.09	0		FALSE	0.8
		Right	92	47	44.6	0.95	5.40	1		FALSE	44.6
	North	Left	22	8	14	1.75	3.61	0		FALSE	14
		Through	47	81	-34	-0.4	4.25	0		FALSE	34
		Right	1	6	-5.2	-0.9	2.67	0		FALSE	5.2
	East	Left	25	37	-11.6	-0.3	2.16	0		FALSE	11.6
		Through	103	110	-7.4	-0.1	0.68	0		FALSE	7.4
		Right	36	2	33.8	16.9	7.80	1		FALSE	33.8
Queen-Dobie	East	Left	1	15	-14.2	-0.9	4.95	0		FALSE	14.2
		Through	121	111	9.6	0.09	0.93	0		FALSE	9.6
		Right	39	48	-9.4	-0.2	1.36	0		FALSE	9.4
	South	Left	9	10	-1	-0.1	0.32	0		FALSE	1
		Through	67	41	25.6	0.62	3.54	0		FALSE	25.6
		Right	0	12	-12	-1	4.90	0		FALSE	12
	West	Left	5	3	2.4	0.8	1.00	0		FALSE	2.4
		Through	173	118	54.6	0.46	4.56	0		FALSE	54.6
		Right	40	17	22.8	1.34	4.31	0		FALSE	22.8
	North	Left	47	29	18.2	0.63	2.92	0		FALSE	18.2
		Through	94	62	32	0.52	3.62	0		FALSE	32
		Right	0	2	-1.6	-0.8	2.00	0		FALSE	1.6
Bent-Through	East	Left	2	4	-1.8	-0.5	1.15	0		FALSE	1.8
		Through	1	9	-7.6	-0.8	3.58	0		FALSE	7.6
		Right	174	149	25.4	0.17	1.97	0		FALSE	25.4
	South	Left	9	13	-4	-0.3	1.21	0		FALSE	4
		Through	677	714	-37.2	-0.1	1.40	0		5.21%	FALSE
		Right	18	7	10.6	1.51	3.11	0		FALSE	10.6
	West	Left	116	93	23.4	0.25	2.25	0		FALSE	23.4
		Through	2	3	-0.6	-0.2	0.63	0		FALSE	0.6
		Right	2	4	-1.6	-0.4	1.15	0		FALSE	1.6
	North	Left	44	71	-27.2	-0.4	3.56	0		FALSE	27.2
		Through	498	472	25.6	0.05	1.18	0		FALSE	25.6
		Right	77	80	-2.6	-0	0.34	0		FALSE	2.6
			13471	12128				88%		0	4
				90%							

Conforming sites	126	1	139
Non Conforming Sites	18	0	4
Total Sites	144	1	143
	88%	**100%**	**97%**

8am to 9am Intersection	Approach	Movement	AVERAGE MODELLED	Observed	Diff	%	GEH	GEH <5	Within 15%, for 700veh/h<Flow<2700veh/h	Within 100veh/h, for Flow <700veh/h
3. Dobie Street and Turf Street	North	Through	363	373	-10	-0	0.52	0	FALSE	10
	North	Left	200	184	16.2	0.09	1.15	0	FALSE	16.2
	East	Right	155	158	-3.4	-0	0.24	0	FALSE	3.4
	East	Left	19	16	3.4	0.21	0.72	0	FALSE	3.4
	South	Right	22	10	12.2	1.22	3.00	0	FALSE	12.2
	South	Through	151	167	-16.2	-0.1	1.27	0	FALSE	16.2
Bent / Spring	South	Left	19	24	-5.2	-0.2	1.08	0	FALSE	5.2
	South	Through	1084	1181	-96.8	-0.1	2.88	0	8.20%	FALSE
	East	Left	158	90	68.4	0.76	6.11	1	FALSE	68.4
	North	Left	83	105	-21.6	-0.2	2.27	0	FALSE	21.6
	North	Through	606	506	100	0.2	4.24	0	FALSE	100
	West	Left	64	48	15.6	0.33	2.14	0	FALSE	15.6
Gwydir / Bligh	South	Left	74	45	29.4	0.65	3.76	0	FALSE	29.4
	South	Through	5	20	-14.8	-0.7	4.24	0	FALSE	14.8
	South	Right	43	19	24.2	1.27	4.31	0	FALSE	24.2
	East	Left	22	11	11.4	1.04	2.71	0	FALSE	11.4
	East	Through	254	233	20.6	0.09	1.35	0	FALSE	20.6
	East	Right	37	32	5.2	0.16	0.85	0	FALSE	5.2
	North	Left	24	42	-18.2	-0.4	3.13	0	FALSE	18.2
	North	Through	24	25	-0.8	-0	0.20	0	FALSE	0.8
	North	Right	3	11	-7.6	-0.7	3.02	0	FALSE	7.6
	West	Left	38	39	-1.2	-0	0.16	0	FALSE	1.2
	West	Through	257	329	-71.8	-0.2	4.21	0	FALSE	71.8
	West	Right	35	26	9.4	0.36	1.63	0	FALSE	9.4
Ryan St / Pac Hwy Connection	East	Through	172	264	-91.8	-0.3	6.23	1	FALSE	91.8
		Right	69	100	-30.6	-0.3	3.37	0	FALSE	30.6
	North	Left	81	75	5.8	0.08	0.68	0	FALSE	5.8
		Right	86	45	41.2	0.92	5.07	1	FALSE	41.2
	Weest	Left	43	59	-16.4	-0.3	2.24	0	FALSE	16.4
		Through	242	220	22	0.1	1.45	0	FALSE	22
Pac Hwy / connection to Ryan Street	South	Left	61	52	8.8	0.17	1.20	0	FALSE	8.8
		Right	66	95	-28.8	-0.3	3.23	0	FALSE	28.8
	East	Left	62	42	19.6	0.47	2.77	0	FALSE	19.6
		Through	404	332	72.4	0.22	3.75	0	FALSE	72.4
	North	Through	175	246	-71.2	-0.3	4.89	0	FALSE	71.2
		Right	118	83	34.6	0.42	3.49	0	FALSE	34.6
Pacific Hwy / Spring Street	East	Through	401	433	-32	-0.1	1.57	0	FALSE	32
		Right	91	108	-16.8	-0.2	1.70	0	FALSE	16.8
	North	Left	129	171	-42.4	-0.2	3.43	0	FALSE	42.4
		Right	76	70	6	0.09	0.70	0	FALSE	6
	West	Left	156	146	9.6	0.07	0.81	0	FALSE	9.6
		Through	278	227	51.2	0.23	3.21	0	FALSE	51.2
Pacific Hwy / Gwydir	South	Left	260	223	36.6	0.16	2.38	0	FALSE	36.6
		Through	234	229	5	0.02	0.33	0	FALSE	5
	North	Through	176	213	-36.6	-0.2	2.65	0	FALSE	36.6
		Right	301	302	-1	-0	0.06	0	FALSE	1
	West	Left	201	152	48.8	0.32	3.69	0	FALSE	48.8
		Right	114	113	1.2	0.01	0.09	0	FALSE	1.2
Gwydir-Bent	East	Left	50	22	28.2	1.28	4.67	0	FALSE	28.2
		Through	98	39	58.6	1.5	7.13	1	FALSE	58.6
		Right	409	385	24	0.06	1.20	0	FALSE	24
	South	Left	74	61	13.2	0.22	1.58	0	FALSE	13.2
		Through	432	392	39.8	0.1	1.97	0	FALSE	39.8
		Right	19	18	0.8	0.04	0.23	0	FALSE	0.8
	West	Left	201	165	35.8	0.22	2.66	0	FALSE	35.8
		Through	62	91	-29	-0.3	3.32	0	FALSE	29
		Right	61	57	4.4	0.08	0.52	0	FALSE	4.4
	North	Left	234	72	161.8	2.25	13.10	1	FALSE	161.8
		Through	290	367	-77	-0.2	4.25	0	FALSE	77
		Right	140	144	-4.2	-0	0.34	0	FALSE	4.2
	East	Left	117	149	-32.2	-0.2	2.77	0	FALSE	32.2
Fitzroy-Villers		Through	658	722	-64.4	-0.1	2.44	0	8.92%	FALSE
		Right	504	608	-104	-0.2	4.41	0	FALSE	104
	South	Left	26	15	11.4	0.76	2.43	0	FALSE	11.4
		Through	30	17	13.2	0.78	2.68	0	FALSE	13.2
		Right	24	25	-1.4	-0.1	0.20	0	FALSE	1.4
	West	Left	62	40	22.4	0.56	3.08	0	FALSE	22.4
		Through	361	275	85.8	0.31	4.82	0	FALSE	85.8
		Right	7	9	-1.8	-0.2	0.71	0	FALSE	1.8
	North	Left	374	282	91.8	0.33	5.08	1	FALSE	91.8
		Through	27	37	-9.8	-0.3	1.77	0	FALSE	9.8
		Right	50	40	10	0.25	1.49	0	FALSE	10
Villers-Pound	East	Left	52	17	35.4	2.08	5.96	1	FALSE	35.4
		Through	58	71	-12.8	-0.2	1.62	0	FALSE	12.8
		Right	37	9	28	3.11	5.84	1	FALSE	28
	South	Left	215	268	-53.4	-0.2	3.41	0	FALSE	53.4
		Through	259	279	-19.6	-0.1	1.22	0	FALSE	19.6
		Right	122	64	57.6	0.9	6.01	1	FALSE	57.6
	West	Left	6	16	-10	-0.6	3.02	0	FALSE	10
		Through	33	85	-51.8	-0.6	6.77	1	FALSE	51.8
		Right	126	87	39.4	0.45	3.78	0	FALSE	39.4
	North	Left	33	63	-30.4	-0.5	4.33	0	FALSE	30.4
		Through	271	287	-16	-0.1	0.96	0	FALSE	16
		Right	23	44	-21	-0.5	3.63	0	FALSE	21
Fitzroy-Prince	East	Left	148	93	55.4	0.6	5.01	1	FALSE	55.4
		Through	315	323	-7.8	-0	0.45	0	FALSE	7.8
		Right	114	123	-9	-0.1	0.83	0	FALSE	9
	South	Left	66	70	-4	-0.1	0.49	0	FALSE	4
		Through	58	91	-33.2	-0.4	3.82	0	FALSE	33.2
		Right	47	29	18.2	0.63	2.92	0	FALSE	18.2
	West	Left	27	24	3	0.13	0.59	0	FALSE	3
		Through	213	177	35.6	0.2	2.58	0	FALSE	35.6
		Right	51	80	-29.2	-0.4	3.58	0	FALSE	29.2
	North	Left	185	127	58	0.46	4.64	0	FALSE	58
		Through	154	137	16.6	0.12	1.41	0	FALSE	16.6

		Right	52	69	-16.6	-0.2	2.19	0		FALSE	16.6
Prince-Pound	East	Left	9	74	-65.2	-0.9	10.09	1		FALSE	65.2
		Through	169	211	-42	-0.2	3.05	0		FALSE	42
		Right	89	56	33	0.59	3.88	0		FALSE	33
	South	Left	73	60	12.8	0.21	1.59	0		FALSE	12.8
		Through	111	162	-51.2	-0.3	4.37	0		FALSE	51.2
		Right	16	27	-11	-0.4	2.37	0		FALSE	11
	West	Left	66	53	13	0.25	1.69	0		FALSE	13
		Through	142	207	-64.6	-0.3	4.92	0		FALSE	64.6
		Right	149	117	32.2	0.28	2.77	0		FALSE	32.2
	North	Left	69	85	-16.2	-0.2	1.82	0		FALSE	16.2
		Through	233	201	32.2	0.16	2.17	0		FALSE	32.2
		Right	90	67	23	0.34	2.60	0		FALSE	23
Prince-Dobie	South	Left	77	92	-14.8	-0.2	1.63	0		FALSE	14.8
		Through	87	65	21.8	0.34	2.52	0		FALSE	21.8
		Right	43	23	20.4	0.89	3.48	0		FALSE	20.4
	West	Left	3	7	-4.4	-0.6	1.79	0		FALSE	4.4
		Through	120	147	-26.8	-0.2	2.34	0		FALSE	26.8
		Right	128	144	-16.2	-0.1	1.37	0		FALSE	16.2
	North	Left	16	10	6.4	0.64	1.66	0		FALSE	6.4
		Through	132	153	-21	-0.1	1.76	0		FALSE	21
		Right	2	6	-4.4	-0.7	2.00	0		FALSE	4.4
	East	Left	61	56	5.2	0.09	0.65	0		FALSE	5.2
		Through	151	161	-9.8	-0.1	0.80	0		FALSE	9.8
		Right	54	5	49	9.8	9.02	1		FALSE	49
Queen-Dobie	East	Left	3	14	-11.2	-0.8	3.77	0		FALSE	11.2
		Through	163	186	-23.4	-0.1	1.74	0		FALSE	23.4
		Right	65	54	10.8	0.2	1.43	0		FALSE	10.8
	South	Left	28	17	10.8	0.64	2.32	0		FALSE	10.8
		Through	91	68	23.4	0.34	2.58	0		FALSE	23.4
		Right	0	11	-10.6	-1	4.69	0		FALSE	10.6
	West	Left	5	11	-6.2	-0.6	2.12	0		FALSE	6.2
		Through	203	237	-33.6	-0.1	2.29	0		FALSE	33.6
		Right	77	25	51.6	2.06	7.28	1		FALSE	51.6
	North	Left	64	43	20.8	0.48	2.87	0		FALSE	20.8
		Through	147	137	9.6	0.07	0.84	0		FALSE	9.6
		Right	2	20	-17.8	-0.9	5.43	1		FALSE	17.8
Bent-Through	East	Left	3	16	-12.8	-0.8	4.22	0		FALSE	12.8
		Through	2	7	-4.8	-0.7	2.36	0		FALSE	4.8
		Right	103	52	50.8	0.98	5.79	1		FALSE	50.8
	South	Left	7	17	-10.4	-0.6	2.89	0		FALSE	10.4
		Through	1086	1176	-90.4	-0.1	2.68	0		7.69%	FALSE
		Right	18	9	9	1	2.45	0		FALSE	9
	West	Left	97	195	-97.8	-0.5	8.11	1		FALSE	97.8
		Through	3	6	-3.4	-0.6	1.41	0		FALSE	3.4
		Right	1	7	-6.4	-0.9	3.00	0		FALSE	6.4
	North	Left	43	111	-68.2	-0.6	7.75	1		FALSE	68.2
		Through	676	702	-25.6	-0	0.99	0		3.65%	FALSE
		Right	117	158	-40.8	-0.3	3.50	0		FALSE	40.8
			19805	**19827**				**88%**		0	**2**
				100%							

Conforming sites	126	4	138
Non Conforming Sites	18	0	2
Total Sites	144	4	140
	88%	**100%**	**99%**

3pm to 4pm Intersection	Approach	Movement	AVERAGE MODELLED	Observed		Diff	%		GEH	GEH <5		Within 15%, for 700veh/h<Flow<2700veh/h	Within 100veh/h, for Flow <700veh/h
3. Dobie Street and Turf Street	North	Through	214	240		-25.8	-0.1		1.73	0		FALSE	25.8
	North	Left	162	180		-18	-0.1		1.38	0		FALSE	18
	East	Right	186	209		-23	-0.1		1.64	0		FALSE	23
	East	Left	28	24		4.2	0.18		0.78	0		FALSE	4.2
	South	Right	18	13		4.8	0.37		1.27	0		FALSE	4.8
	South	Through	298	290		8.2	0.03		0.47	0		FALSE	8.2
Bent / Spring	South	Left	37	37		-0.2	-0		0.00	0		FALSE	0.2
	South	Through	784	724		59.6	0.08		2.19	0		8.23%	FALSE
	East	Left	99	120		-21.2	-0.2		2.01	0		FALSE	21.2
	North	Left	100	115		-14.6	-0.1		1.45	0		FALSE	14.6
	North	Through	937	942		-5.2	-0		0.16	0		0.55%	FALSE
	West	Left	28	47		-19.2	-0.4		3.10	0		FALSE	19.2
Gwydir / Bligh	South	Left	43	22		20.8	0.95		3.68	0		FALSE	20.8
	South	Through	3	8		-5	-0.6		2.13	0		FALSE	5
	South	Right	14	9		5.2	0.58		1.47	0		FALSE	5.2
	East	Left	34	20		14.4	0.72		2.69	0		FALSE	14.4
	East	Through	333	361		-28.4	-0.1		1.50	0		FALSE	28.4
	East	Right	8	19		-11.4	-0.6		2.99	0		FALSE	11.4
	North	Left	50	89		-39.2	-0.4		4.68	0		FALSE	39.2
	North	Through	43	32		10.8	0.34		1.80	0		FALSE	10.8
	North	Right	24	43		-19.2	-0.4		3.28	0		FALSE	19.2
	West	Left	20	26		-5.8	-0.2		1.25	0		FALSE	5.8
	West	Through	269	278		-9	-0		0.54	0		FALSE	9
	West	Right	31	18		13.4	0.74		2.63	0		FALSE	13.4
Ryan St / Pac Hwy Connection	East	Through	177	284		-107.2	-0.4		7.05	1		FALSE	107.2
		Right	84	85		-1.4	-0		0.11	0		FALSE	1.4
	North	Left	42	61		-18.8	-0.3		2.65	0		FALSE	18.8
		Right	64	28		35.6	1.27		5.31	1		FALSE	35.6
	Weest	Left	47	47		0	0		0.00	0		FALSE	0
		Through	254	369		-115.2	-0.3		6.52	1		FALSE	115.2
Pac Hwy / connection to Ryan Street	South	Left	26	39		-12.6	-0.3		2.28	0		FALSE	12.6
		Right	76	75		0.6	0.01		0.12	0		FALSE	0.6
	East	Left	64	47		16.8	0.36		2.28	0		FALSE	16.8
		Through	372	309		63.4	0.21		3.41	0		FALSE	63.4
	North	Through	398	411		-12.8	-0		0.65	0		FALSE	12.8
		Right	54	53		0.8	0.02		0.14	0		FALSE	0.8
Pacific Hwy / Spring Street	East	Through	233	237		-3.8	-0		0.26	0		FALSE	3.8
		Right	44	88		-44	-0.5		5.42	1		FALSE	44
	North	Left	129	169		-40	-0.2		3.28	0		FALSE	40
		Right	114	89		24.6	0.28		2.48	0		FALSE	24.6
	West	Left	112	124		-12	-0.1		1.10	0		FALSE	12
		Through	256	248		8	0.03		0.50	0		FALSE	8
Pacific Hwy / Gwydir	South	Left	223	164		59.2	0.36		4.24	0		FALSE	59.2
		Through	215	231		-15.8	-0.1		1.07	0		FALSE	15.8
	North	Through	230	254		-24.2	-0.1		1.54	0		FALSE	24.2
		Right	117	80		37	0.46		3.73	0		FALSE	37
	West	Left	152	130		22.4	0.17		1.85	0		FALSE	22.4
		Right	222	202		20	0.1		1.37	0		FALSE	20
Prince-Dobie	South	Left	91	166		-75	-0.5		6.62	1		FALSE	75
		Through	175	129		46	0.36		3.73	0		FALSE	46
		Right	19	39		-19.6	-0.5		3.71	0		FALSE	19.6
	West	Left	0	5		-4.8	-1		3.16	0		FALSE	4.8
		Through	222	173		48.6	0.28		3.49	0		FALSE	48.6
		Right	110	95		15.4	0.16		1.48	0		FALSE	15.4
	North	Left	23	14		9.2	0.66		2.09	0		FALSE	9.2
		Through	117	116		1	0.01		0.09	0		FALSE	1
		Right	4	9		-5.2	-0.6		1.96	0		FALSE	5.2
	East	Left	32	41		-9	-0.2		1.49	0		FALSE	9
		Through	190	137		53	0.39		4.14	0		FALSE	53
		Right	24	18		5.6	0.31		1.31	0		FALSE	5.6
Queen-Dobie	East	Left	7	21		-14.4	-0.7		3.74	0		FALSE	14.4
		Through	202	224		-21.8	-0.1		1.51	0		FALSE	21.8
		Right	76	65		11	0.17		1.31	0		FALSE	11
	South	Left	38	24		14.4	0.6		2.51	0		FALSE	14.4
		Through	63	90		-27	-0.3		3.09	0		FALSE	27
		Right	3	23		-19.6	-0.9		5.55	1		FALSE	19.6
	West	Left	8	13		-5.2	-0.4		1.54	0		FALSE	5.2
		Through	200	212		-11.6	-0.1		0.84	0		FALSE	11.6
		Right	27	14		12.8	0.91		2.87	0		FALSE	12.8
	North	Left	129	46		83	1.8		8.87	1		FALSE	83
		Through	81	111		-29.8	-0.3		3.06	0		FALSE	29.8
		Right	7	13		-6	-0.5		1.90	0		FALSE	6
Bent-Through	East	Left	22	18		3.8	0.21		0.89	0		FALSE	3.8
		Through	26	14		12.2	0.87		2.68	0		FALSE	12.2
		Right	131	205		-74.2	-0.4		5.71	1		FALSE	74.2
	South	Left	14	44		-29.6	-0.7		5.57	1		FALSE	29.6
		Through	784	829		-45.2	-0.1		1.58	0		5.45%	FALSE
		Right	11	33		-22.4	-0.7		4.69	0		FALSE	22.4
	West	Left	131	139		-8	-0.1		0.69	0		FALSE	8
		Through	3	11		-8.2	-0.7		3.02	0		FALSE	8.2
		Right	14	10		4	0.4		1.15	0		FALSE	4
	North	Left	114	163		-49.4	-0.3		4.16	0		FALSE	49.4
		Through	998	881		116.6	0.13		3.82	0		13.23%	FALSE
		Right	121	255		-134.4	-0.5		9.77	1		FALSE	134.4
Gwydir-Bent	East	Left	28	37		-8.6	-0.2		1.58	0		FALSE	8.6
		Through	62	81		-18.6	-0.2		2.25	0		FALSE	18.6
		Right	249	176		73.4	0.42		5.01	1		FALSE	73.4
	South	Left	63	68		-4.8	-0.1		0.62	0		FALSE	4.8
		Through	461	463		-2	-0		0.09	0		FALSE	2
		Right	13	37		-24.4	-0.7		4.80	0		FALSE	24.4
	West	Left	91	133		-42	-0.3		3.97	0		FALSE	42
		Through	116	115		1	0.01		0.09	0		FALSE	1
		Right	127	124		2.6	0.02		0.27	0		FALSE	2.6
	North	Left	246	150		96	0.64		6.82	1		FALSE	96
		Through	470	559		-89	-0.2		3.92	0		FALSE	89
		Right	250	255		-4.8	-0		0.31	0		FALSE	4.8

	East	Left	70	93		-22.8	-0.2	2.55	0		FALSE	22.8
Fitzroy-Villers		Through	551	584		-32.6	-0.1	1.39	0		FALSE	32.6
		Right	407	535		-128.4	-0.2	5.90	1		FALSE	128.4
	South	Left	4	16		-12	-0.8	3.79	0		FALSE	12
		Through	8	23		-15.4	-0.7	3.81	0		FALSE	15.4
		Right	74	52		22.2	0.43	2.77	0		FALSE	22.2
	West	Left	89	65		23.8	0.37	2.74	0		FALSE	23.8
		Through	559	517		41.6	0.08	1.81	0		FALSE	41.6
		Right	12	17		-4.6	-0.3	1.31	0		FALSE	4.6
	North	Left	528	362		165.8	0.46	7.87	1		FALSE	165.8
		Through	25	33		-8	-0.2	1.49	0		FALSE	8
		Right	15	23		-7.6	-0.3	1.84	0		FALSE	7.6
Villers-Pound	East	Left	53	22		31	1.41	5.06	1		FALSE	31
		Through	117	63		54.4	0.86	5.69	1		FALSE	54.4
		Right	33	10		23	2.3	4.96	0		FALSE	23
	South	Left	186	243		-57.4	-0.2	3.89	0		FALSE	57.4
		Through	225	293		-68	-0.2	4.23	0		FALSE	68
		Right	89	31		58	1.87	7.49	1		FALSE	58
	West	Left	40	57		-17.4	-0.3	2.44	0		FALSE	17.4
		Through	194	143		50.6	0.35	3.93	0		FALSE	50.6
		Right	155	161		-6.4	-0	0.48	0		FALSE	6.4
	North	Left	51	88		-36.8	-0.4	4.44	0		FALSE	36.8
		Through	372	251		121.2	0.48	6.86	1		FALSE	121.2
		Right	10	47		-36.6	-0.8	6.93	1		FALSE	36.6
Fitzroy-Prince	East	Left	84	92		-7.8	-0.1	0.85	0		FALSE	7.8
		Through	253	252		1.2	0	0.06	0		FALSE	1.2
		Right	131	145		-14.4	-0.1	1.19	0		FALSE	14.4
	South	Left	51	76		-25.4	-0.3	3.14	0		FALSE	25.4
		Through	107	123		-16.4	-0.1	1.49	0		FALSE	16.4
		Right	106	100		5.6	0.06	0.59	0		FALSE	5.6
	West	Left	25	41		-16	-0.4	2.79	0		FALSE	16
		Through	249	228		21.2	0.09	1.36	0		FALSE	21.2
		Right	32	36		-4.2	-0.1	0.69	0		FALSE	4.2
	North	Left	139	165		-26	-0.2	2.11	0		FALSE	26
		Through	111	72		38.8	0.54	4.08	0		FALSE	38.8
		Right	34	32		1.6	0.05	0.35	0		FALSE	1.6
Prince-Pound	East	Left	21	98		-77.4	-0.8	9.98	1		FALSE	77.4
		Through	226	190		36.4	0.19	2.50	0		FALSE	36.4
		Right	61	112		-51.2	-0.5	5.48	1		FALSE	51.2
	South	Left	94	91		2.6	0.03	0.31	0		FALSE	2.6
		Through	158	203		-44.8	-0.2	3.35	0		FALSE	44.8
		Right	7	25		-17.8	-0.7	4.50	0		FALSE	17.8
	West	Left	83	106		-23	-0.2	2.37	0		FALSE	23
		Through	250	234		15.6	0.07	1.03	0		FALSE	15.6
		Right	87	101		-14.4	-0.1	1.44	0		FALSE	14.4
	North	Left	82	127		-45.4	-0.4	4.40	0		FALSE	45.4
		Through	174	202		-28.2	-0.1	2.04	0		FALSE	28.2
		Right	24	44		-20.2	-0.5	3.43	0		FALSE	20.2
			20317	20912					85%		0	6
				103%								

Conforming sites	123	4	138
Non Conforming Sites	21	0	6
Total Sites	144	4	144
	85%	**100%**	**96%**

4pm to 5pm Intersection	Approach	Movement	AVERAGE MODELLED	Observed		Diff	%	GEH	GEH <5	Within 15%, for 700veh/h<Flow<2700veh/h	Within 100veh/h, for Flow <700veh/h
3. Dobie Street and Turf Street	North	Through	206	191		14.6	0.08	1.06	0	FALSE	14.6
	North	Left	172	154		17.8	0.12	1.41	0	FALSE	17.8
	East	Right	167	187		-19.8	-0.1	1.50	0	FALSE	19.8
	East	Left	26	15		11.2	0.75	2.43	0	FALSE	11.2
	South	Right	17	19		-1.8	-0.1	0.47	0	FALSE	1.8
	South	Through	311	282		29.2	0.1	1.68	0	FALSE	29.2
Bent / Spring	South	Left	30	37		-6.8	-0.2	1.21	0	FALSE	6.8
	South	Through	754	724		30.2	0.04	1.10	0	4.17%	FALSE
	East	Left	99	120		-21	-0.2	2.01	0	FALSE	21
	North	Left	115	115		-0.4	-0	0.00	0	FALSE	0.4
	North	Through	968	942		26.4	0.03	0.84	0	2.80%	FALSE
	West	Left	24	47		-22.6	-0.5	3.86	0	FALSE	22.6
Gwydir / Bligh	South	Left	39	22		16.8	0.76	3.08	0	FALSE	16.8
	South	Through	3	8		-5	-0.6	2.13	0	FALSE	5
	South	Right	18	9		9.2	1.02	2.45	0	FALSE	9.2
	East	Left	39	20		19.2	0.96	3.50	0	FALSE	19.2
	East	Through	356	361		-5.2	-0	0.26	0	FALSE	5.2
	East	Right	6	19		-13	-0.7	3.68	0	FALSE	13
	North	Left	52	89		-37.2	-0.4	4.41	0	FALSE	37.2
	North	Through	48	32		16.4	0.51	2.53	0	FALSE	16.4
	North	Right	19	43		-24.4	-0.6	4.31	0	FALSE	24.4
	West	Left	17	26		-8.8	-0.3	1.94	0	FALSE	8.8
	West	Through	257	278		-20.8	-0.1	1.28	0	FALSE	20.8
	West	Right	33	18		14.6	0.81	2.97	0	FALSE	14.6
Ryan St / Pac Hwy Connection	East	Through	185	284		-99	-0.3	6.46	1	FALSE	99
		Right	74	85		-11.2	-0.1	1.23	0	FALSE	11.2
	North	Left	41	61		-20.2	-0.3	2.80	0	FALSE	20.2
		Right	62	28		33.8	1.21	5.07	1	FALSE	33.8
	Weest	Left	45	47		-1.6	-0	0.29	0	FALSE	1.6
		Through	260	369		-108.6	-0.3	6.15	1	FALSE	108.6
Pac Hwy / connection to Ryan Street	South	Left	43	39		4	0.1	0.62	0	FALSE	4
		Right	65	75		-10	-0.1	1.20	0	FALSE	10
	East	Left	61	47		14.2	0.3	1.91	0	FALSE	14.2
		Through	398	309		88.6	0.29	4.73	0	FALSE	88.6
	North	Through	443	411		32.4	0.08	1.55	0	FALSE	32.4
		Right	52	53		-1.4	-0	0.14	0	FALSE	1.4
Pacific Hwy / Spring Street	East	Through	265	237		27.8	0.12	1.77	0	FALSE	27.8
		Right	57	88		-31	-0.4	3.64	0	FALSE	31
	North	Left	137	169		-32.2	-0.2	2.59	0	FALSE	32.2
		Right	117	89		27.6	0.31	2.76	0	FALSE	27.6
	West	Left	122	124		-1.6	-0	0.18	0	FALSE	1.6
		Through	291	248		43.4	0.18	2.62	0	FALSE	43.4
Pacific Hwy / Gwydir	South	Left	228	164		64.2	0.39	4.57	0	FALSE	64.2
		Through	254	231		23	0.1	1.48	0	FALSE	23
	North	Through	268	254		13.6	0.05	0.87	0	FALSE	13.6
		Right	113	80		32.6	0.41	3.36	0	FALSE	32.6
	West	Left	161	130		30.8	0.24	2.57	0	FALSE	30.8
		Right	227	202		25	0.12	1.71	0	FALSE	25
	West	Left	91	147		-56	-0.4	5.13	1	FALSE	56
		Through	175	154		21	0.14	1.64	0	FALSE	21
		Right	19	47		-27.6	-0.6	4.87	0	FALSE	27.6
	North	Left	0	11		-10.8	-1	4.69	0	FALSE	10.8
		Through	222	154		67.6	0.44	4.96	0	FALSE	67.6
		Right	110	97		13.4	0.14	1.28	0	FALSE	13.4
	East	Left	23	11		12.2	1.11	2.91	0	FALSE	12.2
		Through	117	127		-10	-0.1	0.91	0	FALSE	10
		Right	4	6		-2.2	-0.4	0.89	0	FALSE	2.2
Queen-Dobie	East	Left	32	49		-17	-0.3	2.67	0	FALSE	17
		Through	190	124		66	0.53	5.27	1	FALSE	66
		Right	24	18		5.6	0.31	1.31	0	FALSE	5.6
	South	Left	7	12		-5.4	-0.5	1.62	0	FALSE	5.4
		Through	202	214		-11.8	-0.1	0.83	0	FALSE	11.8
		Right	76	53		23	0.43	2.86	0	FALSE	23
	West	Left	38	23		15.4	0.67	2.72	0	FALSE	15.4
		Through	63	90		-27	-0.3	3.09	0	FALSE	27
		Right	3	17		-13.6	-0.8	4.43	0	FALSE	13.6
	North	Left	8	12		-4.2	-0.4	1.26	0	FALSE	4.2
		Through	200	194		6.4	0.03	0.43	0	FALSE	6.4
		Right	27	15		11.8	0.79	2.62	0	FALSE	11.8
Bent-Through	East	Left	129	47		82	1.74	8.74	1	FALSE	82
		Through	81	99		-17.8	-0.2	1.90	0	FALSE	17.8
		Right	7	9		-2	-0.2	0.71	0	FALSE	2
	South	Left	22	16		5.8	0.36	1.38	0	FALSE	5.8
		Through	26	19		7.2	0.38	1.48	0	FALSE	7.2
		Right	131	144		-13.2	-0.1	1.11	0	FALSE	13.2
	West	Left	14	41		-26.6	-0.6	5.15	1	FALSE	26.6
		Through	784	687		96.8	0.14	3.58	0	FALSE	96.8
		Right	11	19		-8.4	-0.4	2.07	0	FALSE	8.4
	North	Left	131	145		-14	-0.1	1.19	0	FALSE	14
		Through	3	11		-8.2	-0.7	3.02	0	FALSE	8.2
		Right	14	22		-8	-0.4	1.89	0	FALSE	8
			114	176		-62.4	-0.4	5.15	1	FALSE	62.4
			998	971		26.6	0.03	0.86	0	2.74%	FALSE
Gwydir-Bent	East	Left	121	237		-116.4	-0.5	8.67	1	FALSE	116.4
	South	Left	27	37	37	-9.6	-0.3	1.77	0	FALSE	9.6
		Through	77	81	81	-4	-0	0.45	0	FALSE	4
		Right	237	176	176	61	0.35	4.24	0	FALSE	61
	West	Left	72	68	68	3.6	0.05	0.48	0	FALSE	3.6
		Through	439	463	463	-23.8	-0.1	1.13	0	FALSE	23.8
		Right	12	37	37	-24.8	-0.7	5.05	1	FALSE	24.8
	North	Left	84	133	133	-49	-0.4	4.70	0	FALSE	49
		Through	119	115	115	3.8	0.03	0.37	0	FALSE	3.8
		Right	124	124	124	0	0	0.00	0	FALSE	0
	East	Left	257	150	150	107	0.71	7.50	1	FALSE	107
Fitzroy-Villers		Through	490	559	559	-69.2	-0.1	3.01	0	FALSE	69.2
		Right	252	255	255	-3	-0	0.19	0	FALSE	3

	South	Left	62	77	77	-15.4	-0.2	1.80	0		FALSE	15.4
		Through	573	530	530	43.2	0.08	1.83	0		FALSE	43.2
		Right	366	403	403	-37	-0.1	1.89	0		FALSE	37
	West	Left	5	9	9	-3.8	-0.4	1.51	0		FALSE	3.8
		Through	6	23	23	-17	-0.7	4.46	0		FALSE	17
		Right	82	77	77	5	0.06	0.56	0		FALSE	5
	North	Left	87	52	52	35	0.67	4.20	0		FALSE	35
		Through	614	559	559	54.8	0.1	2.27	0		FALSE	54.8
		Right	13	21	21	-7.8	-0.4	1.94	0		FALSE	7.8
Villers-Pound	East	Left	497	367	367	129.6	0.35	6.25	1		FALSE	129.6
		Through	21	23	23	-1.6	-0.1	0.43	0		FALSE	1.6
		Right	22	26	26	-3.8	-0.1	0.82	0		FALSE	3.8
	South	Left	78	22	22	56	2.55	7.92	1		FALSE	56
		Through	100	81	81	19.2	0.24	2.00	0		FALSE	19.2
		Right	40	7	7	33.4	4.77	6.81	1		FALSE	33.4
	West	Left	162	153	153	9.2	0.06	0.72	0		FALSE	9.2
		Through	220	244	244	-23.8	-0.1	1.58	0		FALSE	23.8
		Right	74	33	33	41.4	1.25	5.61	1		FALSE	41.4
	North	Left	37	52	52	-14.6	-0.3	2.25	0		FALSE	14.6
		Through	170	171	171	-1	-0	0.08	0		FALSE	1
		Right	133	195	195	-61.6	-0.3	4.84	0		FALSE	61.6
Fitzroy-Prince	East	Left	56	76	76	-20.4	-0.3	2.46	0		FALSE	20.4
		Through	316	262	262	53.6	0.2	3.18	0		FALSE	53.6
		Right	12	53	53	-41	-0.8	7.19	1		FALSE	41
	South	Left	96	93	93	3	0.03	0.31	0		FALSE	3
		Through	264	216	216	48.2	0.22	3.10	0		FALSE	48.2
		Right	140	158	158	-18.2	-0.1	1.47	0		FALSE	18.2
	West	Left	41	74	74	-33	-0.4	4.35	0		FALSE	33
		Through	96	125	125	-28.8	-0.2	2.76	0		FALSE	28.8
		Right	104	67	67	36.6	0.55	4.00	0		FALSE	36.6
	North	Left	28	66	66	-37.6	-0.6	5.54	1		FALSE	37.6
		Through	246	246	246	0.2	0	0.00	0		FALSE	0.2
		Right	33	47	47	-13.8	-0.3	2.21	0		FALSE	13.8
Prince-Pound	East	Left	176	197	197	-21.4	-0.1	1.54	0		FALSE	21.4
		Through	117	109	109	8	0.07	0.75	0		FALSE	8
		Right	35	42	42	-7.2	-0.2	1.13	0		FALSE	7.2
	South	Left	25	72	72	-47	-0.7	6.75	1		FALSE	47
		Through	202	191	191	11.4	0.06	0.78	0		FALSE	11.4
		Right	63	93	93	-30.2	-0.3	3.40	0		FALSE	30.2
	West	Left	92	92	92	0.2	0	0.00	0		FALSE	0.2
		Through	165	218	218	-52.8	-0.2	3.83	0		FALSE	52.8
		Right	5	45	45	-39.6	-0.9	8.00	1		FALSE	39.6
	North	Left	100	84	84	16	0.19	1.67	0		FALSE	16
		Through	245	212	212	33.2	0.16	2.18	0		FALSE	33.2
		Right	108	102	102	6.2	0.06	0.59	0		FALSE	6.2
Princes-Pound North Left			71	109	109	-37.8	-0.3	4.01	0		FALSE	37.8
Princes-Pound North Through			189	184	184	5.4	0.03	0.37	0		FALSE	5.4
Princes-Pound North Right			32	44	44	-11.8	-0.3	1.95	0		FALSE	11.8
			20571	**20400**					**87%**		0	4
				99%								

Conforming sites	125	3	137
Non Conforming Sites	19	0	4
Total Sites	144	3	141
	87%	**100%**	**97%**

Attachment B

Travel Time Comparison Results

		Grafton Northbound								
		Average Modelled								
		28	560	2849	7771	86524	AVG	Observed	Diff	%
7:00-8:00	**Northbound Section 1-5 (Gwydir Hwy - Pound St)**	**340**	**317**	**332**	**320**	**316**	**324**			
	Northbound Section 1 (Gwydir - Through)	42	41	42	41	42	42			
	Northbound Section 2 (Through - Bridge bend)	60	44	62	43	55	53			
	Northbound Section 3 (Bridge bend - Villiers)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			
	Northbound Section 4 (Villiers - Prince)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			
	Northbound Section 5 (Fitzroy - Pound)	78	76	75	78	76	76			
8:00-9:00 (2008)	**Northbound Section 1-5 (Gwydir Hwy - Pound St)**	**612**	**489**	**531**	**400**	**515**	**502**	543	-41	**-7.6**
	Northbound Section 1 (Gwydir - Through)	201	123	140	44	144	129	197	-68	**-34.4**
	Northbound Section 2 (Through - Bridge bend)	208	182	205	141	191	185	158	28	**17.8**
	Northbound Section 3 (Bridge bend - Villiers)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	96	#N/A	**#N/A**
	Northbound Section 4 (Villiers - Prince)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	56	#N/A	**#N/A**
	Northbound Section 5 (Fitzroy - Pound)	79	77	76	78	78	77	37	41	**110.8**
8:00-9:00 (2011)	**Bent St (Gwydir to Vlilliers)**	**484**	**398**	**421**	**282**	**406**	**397**	355	42	**12.0**
	Northbound Section 1 (Gwydir - Through)	201	123	140	44	144	129	99	30	**30.6**
	Northbound Section 2 (Through - Bridge bend)	208	182	205	141	191	185	151	35	**23.1**
	Northbound Section 3 (Bridge bend - Villiers)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	105	#N/A	**#N/A**
	Northbound Section 4 (Villiers - Prince)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	55	#N/A	**#N/A**

		Grafton Southbound								
		Average Modelled								
		28	560	2849	7771	86524	AVG	Observed	Diff	%
7:00-8:00	**Southbound Section 5-1 (Pound St - Gwydir Hwy)**	**261**	**262**	**260**	**263**	**260**	**261**			
	Southbound Section 5 (Pound - Fitzroy)	36	39	36	39	36	37			
	Southbound Section 4 (Prince - Villiers)	44	44	44	44	43	44			
	Southbound Section 3 (Villiers - Bridge bend)	99	99	99	99	99	99			
	Southbound Section 2 (Bridge bend - Through)	99	99	99	99	99	99			
	Southbound Section 1 (Through - Gwydir)	42	42	42	43	42	42			
8:00-9:00 (2008)	**Southbound Section 5-1 (Pound St - Gwydir Hwy)**	**273**	**268**	**267**	**267**	**268**	**268**	284	-15	**-5.4**
	Southbound Section 5 (Pound - Fitzroy)	46	44	42	44	44	44	38	6	**15.4**
	Southbound Section 4 (Prince - Villiers)	44	44	44	44	43	44	64	-20	**-31.6**
	Southbound Section 3 (Villiers - Bridge bend)	100	100	100	100	100	100	92	8	**8.4**
	Southbound Section 2 (Bridge bend - Through)	38	38	38	38	38	38	43	-5	**-11.5**
	Southbound Section 1 (Through - Gwydir)	43	43	43	43	43	43	47	-4	**-8.7**
8:00-9:00 (2011)	**Bent St (Villiers to Gwydir)**	**174**	**173**	**174**	**173**	**174**	**174**	160	14	**8.8**

		Grafton Northbound Average Modelled								
		28	560	2849	7771	86524	AVG	Observed	Diff	%
15:00-16:00 (2008)	**Northbound Section 1-5 (Gwydir Hwy - Pound St)**	**314**	**316**	**320**	**325**	**312**	**318**	319	-1	**-0.4**
	Northbound Section 1 (Gwydir - Through)	42	42	42	42	42	42	59	-17	**-28.8**
	Northbound Section 2 (Through - Bridge bend)	41	42	44	42	42	42	59	-16	**-27.8**
	Northbound Section 3 (Bridge bend - Villiers)	98	97	97	101	96	98	101	-3	**-2.9**
	Northbound Section 4 (Villiers - Prince)	58	58	57	59	58	58	57	1	**1.9**
	Northbound Section 5 (Fitzroy - Pound)	77	79	79	78	77	78	44	34	**77.0**
16:00-17:00 (2008)	**Northbound Section 1-5 (Gwydir Hwy - Pound St)**	**332**	**323**	**315**	**330**	**315**	**325**	**291**	34	**11.6**
	Northbound Section 1 (Gwydir - Through)	42	42	42	42	42	42	54	-12	**-22.4**
	Northbound Section 2 (Through - Bridge bend)	41	41	40	43	42	41	60	-19	**-30.9**
	Northbound Section 3 (Bridge bend - Villiers)	103	98	96	103	95	99	90	9	**10.4**
	Northbound Section 4 (Villiers - Prince)	60	58	58	61	58	59	48	11	**22.3**
	Northbound Section 5 (Fitzroy - Pound)	82	78	78	78	78	79	39	40	**103.7**
17:00-18:00 (2008)	**Northbound Section 1-5 (Gwydir Hwy - Pound St)**	**320**	**312**	**316**	**313**	**313**	**315**	**291**	24	**8.2**
	Northbound Section 1 (Gwydir - Through)	42	42	42	42	42	42	54	-12	**-22.5**
	Northbound Section 2 (Through - Bridge bend)	39	38	39	38	38	38	60	-22	**-36.0**
	Northbound Section 3 (Bridge bend - Villiers)	98	96	96	96	96	96	90	6	**7.1**
	Northbound Section 4 (Villiers - Prince)	58	57	57	57	57	57	48	9	**18.9**
	Northbound Section 5 (Fitzroy - Pound)	81	78	82	80	79	80	39	41	**106.3**

		Grafton Southbound Average Modelled								
		28	560	2849	7771	86524	AVG	Observed	Diff	%
15:00-16:00 (2008)	**Southbound Section 5-1 (Pound St - Gwydir Hwy)**	**359**	**321**	**305**	**413**	**296**	**358**	295	64	**21.7**
	Southbound Section 5 (Pound - Fitzroy)	49	46	45	51	46	47	49	-2	**-3.2**
	Southbound Section 4 (Prince - Villiers)	45	43	43	52	43	46	66	-20	**-30.3**
	Southbound Section 3 (Villiers - Bridge bend)	180	166	130	198	124	161	99	63	**63.8**
	Southbound Section 2 (Bridge bend - Through)	38	38	38	38	38	38	40	-1	**-3.3**
	Southbound Section 1 (Through - Gwydir)	45	45	45	45	45	45	42	3	**7.5**
15:00-16:00 (2008)	Bent St (Prince/Villiers to Bent/Through) - 2011	262	248	212	288	206	245	204	42	**20.5**
15:00-16:00 (2011)	Bent St (Prince/Villiers to Bent/Through) - 2011	262	248	212	288	206	245	394	-149	**-37.8**
15:00-16:00 (Average 2008 & 2011)	Bent St (Prince/Villiers to Bent/Through) - 2011	262	248	212	288	206	245	299	-54	**-17.9**
16:00-17:00 (2008)	**Southbound Section 5-1 (Pound St - Gwydir Hwy)**	**443**	**390**	**287**	**426**	**323**	**415**	289	127	**43.8**
	Southbound Section 5 (Pound - Fitzroy)	60	50	45	57	45	53	33	20	**58.8**
	Southbound Section 4 (Prince - Villiers)	60	48	43	58	43	52	60	-9	**-14.2**
	Southbound Section 3 (Villiers - Bridge bend)	239	220	119	218	169	198	102	96	**94.1**
	Southbound Section 2 (Bridge bend - Through)	38	39	38	39	38	38	49	-10	**-20.8**
	Southbound Section 1 (Through - Gwydir)	45	45	45	45	45	45	44	1	**2.2**

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Appendix B

Route Options

PRINTED DATE 16/08/2012

MAIN PLAN

INSET 2

INSET 1

KEY PLAN
NOT TO SCALE

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

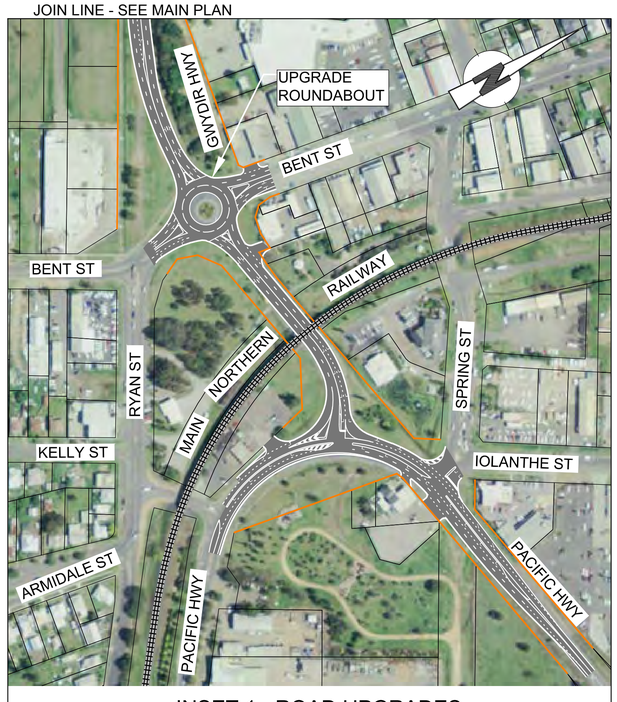
NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.

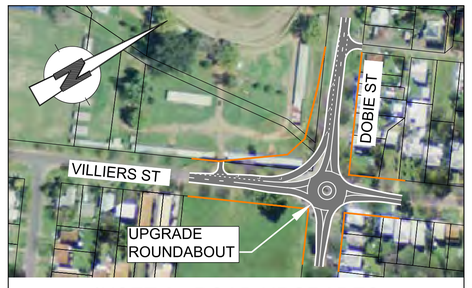
SUSAN ISLAND
CLARENCE RIVER
PRINCE ST
POUND ST
UPGRADE POUND ST TO FOUR LANES BETWEEN VILLIERS ST AND PRINCE ST
UPGRADE ROUNDABOUT
DUKE ST
SHOPPING WORLD
FITZROY ST
NO RIGHT TURN FROM NEW BRIDGE INTO FITZROY ST EAST
PROPOSED PIERS
PROPOSED BRIDGE - ONE LANE IN EACH DIRECTION
NEW LEFT IN/LEFT OUT
UPGRADE VILLIERS ST TO FOUR LANES (WITH TURNING LANES) BETWEEN PROPOSED BRIDGE AND POUND ST
VILLIERS ST TO BE LOWERED TO PROVIDE HIGH VEHICLE CLEARANCE (5.3m) BENEATH RAILWAY
ABBOTT ST
GWYDIR HWY
KENNEDY ST
VILLIERS ST
PROPOSED VIADUCT
NEW LEFT IN/LEFT OUT
VICTORIA ST
REPLACE ROUNDABOUTS WITH TRAFFIC SIGNALS
PROPOSED TAFE BUILDING WORKS
UPGRADE PARKING ON POUND ST
NORTHERN RAILWAY
PROPOSED NAVIGATION CHANNELS MINIMUM CLEARANCES: VERTICAL: 9.1m ABOVE MHWS HORIZONTAL: 2 x 35m
COWAN ST
NEW ROUNDABOUT
NEW ROUNDABOUT
MAIN
CLARENCE ST
UPGRADE PARKING ON CLARENCE ST
BACON ST
KENT ST
SKINNER ST
UPGRADE ROUNDABOUT
NEW LEFT IN/LEFT OUT
NEW ST
SPRING ST
UPGRADE RYAN ST (GWYDIR HWY) TO FOUR LANES FROM PACIFIC HWY TO COWAN ST
NEW LEFT IN/LEFT OUT
WHARF ST
BLIGH ST
JOIN LINE - SEE INSET 1

MAIN PLAN

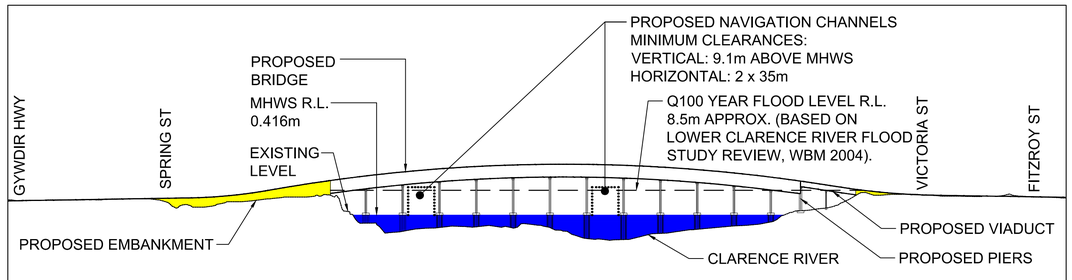
JOIN LINE - SEE MAIN PLAN



INSET 1 - ROAD UPGRADES
PACIFIC HWY/GWYDIR HWY



INSET 2 - ROAD UPGRADES
DOBIE ST/VILLIERS ST INTERSECTION



PROPOSED BRIDGE LONGITUDINAL SECTION
SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport for NSW Roads & Maritime Services

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3
UNLESS SHOWN OTHERWISE

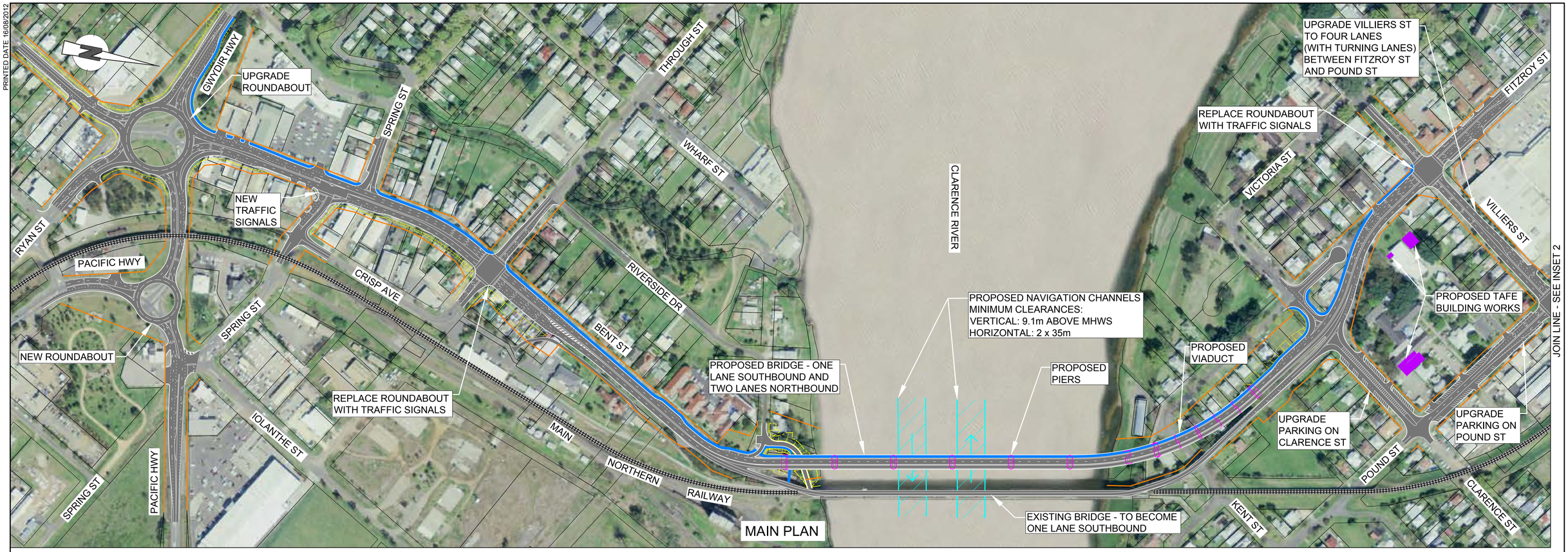
MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION E - PLAN AND LONGITUDINAL SECTION

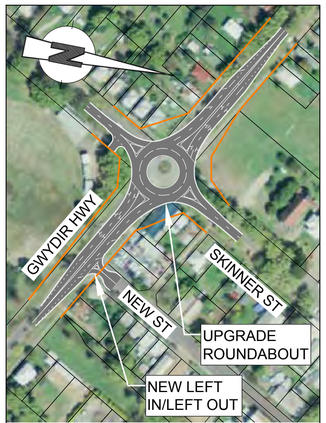
DRAWING 1

OPTION E

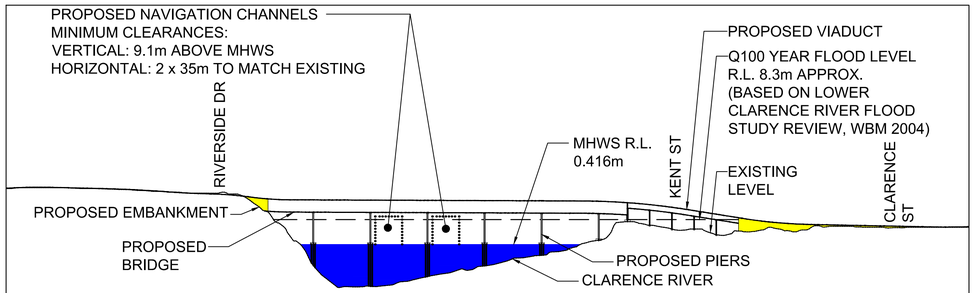
220422_SK9011.dwg

PRINTED DATE 16/08/2012

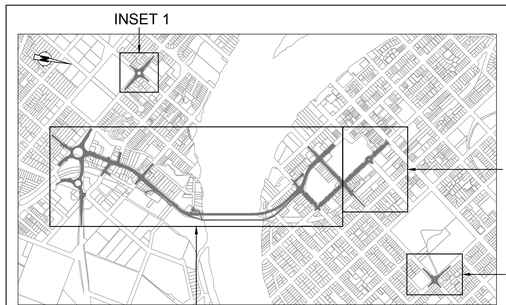




INSET 1 - ROAD UPGRADES
SKINNER ST/GWYDIR HWY
INTERSECTION



PROPOSED BRIDGE LONGITUDINAL SECTION
SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE



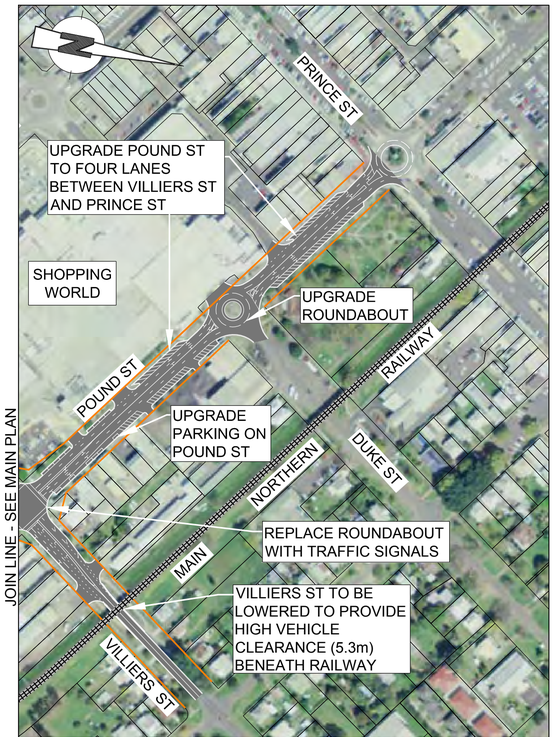
KEY PLAN
NOT TO SCALE

LEGEND:

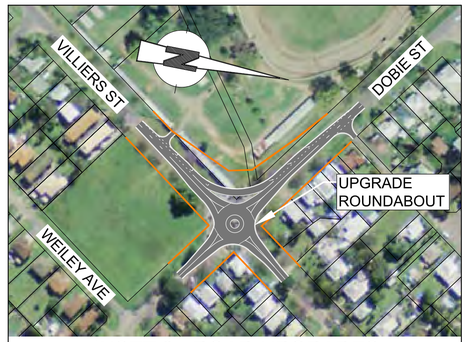
- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.



INSET 2 - ROAD UPGRADES
POUND ST/VILLIERS ST INTERSECTION



INSET 3 - ROAD UPGRADES
DOBIE ST/VILLIERS ST INTERSECTION

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3

ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION A - PLAN AND LONGITUDINAL SECTION

DRAWING 2

OPTION A

220422_SK9021.dwg

PRINTED DATE 13/07/2012

NEW ROUNDABOUT
KELLY ST
RYAN ST
GWYDIR HWY
SPRING ST
WHARF ST
PACIFIC HWY
CRISP AVE
THROUGH ST
RIVERSIDE DR
CLARENCE RIVER
VICTORIA ST
VILLIERS ST
FITZROY ST
UPGRADE VILLIERS ST TO FOUR LANES (WITH TURNING LANES) BETWEEN FITZROY ST AND POUND ST
NEW ROUNDABOUT
NEW LEFT IN/LEFT OUT
NEW LEFT IN/LEFT OUT
BENT ST
PROPOSED NAVIGATION CHANNELS MINIMUM CLEARANCES: VERTICAL: 9.1m ABOVE MHWS HORIZONTAL: 2 x 35m
PROPOSED TAFE BUILDING WORKS
NEW ROUNDABOUT
NEW CARPARK ACCESS
NEW ROUNDABOUT
MAIN
NORTHERN
RAILWAY
EXISTING BRIDGE - ONE LANE IN EACH DIRECTION
POUND ST
UPGRADE PARKING ON CLARENCE ST
UPGRADE INTERSECTION WITH TRAFFIC SIGNALS
PACIFIC HWY
PROPOSED VIADUCT
IOLANTHE ST
CLARENCE ST
BRIDGE ST
PROPOSED VIADUCT
PROPOSED PIERS
PROPOSED BRIDGE - ONE LANE IN EACH DIRECTION
GREAVES ST
GREAVES ST TO BE LOWERED TO PROVIDE 4.0m CLEARANCE BENEATH VIADUCT
POUND ST TO BE LOWERED TO PROVIDE HIGH VEHICLE CLEARANCE (5.3m) BENEATH RAILWAY
JOIN LINE - SEE INSET 3

MAIN PLAN

UPGRADE ROUNDABOUT
GWYDIR HWY
NEW LEFT IN/LEFT OUT
NEW ST
SKINNER ST

INSET 1 - ROAD UPGRADES SKINNER ST/GWYDIR HWY INTERSECTION

INSET 1
INSET 3
MAIN PLAN
KEY PLAN
NOT TO SCALE
INSET 2

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.

VILLIERS ST
DOBIE ST
UPGRADE ROUNDABOUT

INSET 2 - ROAD UPGRADES DOBIE ST/VILLIERS ST INTERSECTION

POUND ST
PRINCE ST
UPGRADE POUND ST TO FOUR LANES (WITH TURNING LANES) BETWEEN CLARENCE ST AND VILLIERS ST
UPGRADE ROUNDABOUT
SHOPPING WORLD
RAILWAY
UPGRADE PARKING ON POUND ST
NORTHERN
MAIN
REPLACE ROUNDABOUT WITH TRAFFIC SIGNALS
DUKE ST
VILLIERS ST
VILLIERS ST TO BE LOWERED TO PROVIDE HIGH VEHICLE CLEARANCE (5.3m) BENEATH RAILWAY
JOIN LINE - SEE MAIN PLAN

INSET 3 - ROAD UPGRADES POUND ST/VILLIERS ST/PRINCE ST

PROPOSED NAVIGATION CHANNELS MINIMUM CLEARANCES: VERTICAL: 9.1m ABOVE MHWS HORIZONTAL: 2 x 35m TO MATCH EXISTING
Q100 YEAR FLOOD LEVEL R.L. 8.1m APPROX. (BASED ON LOWER CLARENCE RIVER FLOOD STUDY REVIEW, WBM 2004)
POUND ST TO BE LOWERED TO PROVIDE HIGH VEHICLE CLEARANCE (5.3m) BENEATH RAILWAY
GWYDIR HWY
PACIFIC HWY/ SPRING ST
THROUGH ST
PROPOSED BRIDGE
EXISTING LEVEL
MHWS R.L. 0.416m
GREAVES ST
CLARENCE ST
VILLIERS ST
PROPOSED EMBANKMENT
PROPOSED VIADUCT
PROPOSED PIERS
CLARENCE RIVER
PROPOSED VIADUCT
GREAVES ST TO BE LOWERED TO PROVIDE 4.0m CLEARANCE BENEATH VIADUCT
VILLIERS ST TO BE LOWERED TO PROVIDE HIGH VEHICLE CLEARANCE (5.3m) BENEATH RAILWAY

PROPOSED BRIDGE LONGITUDINAL SECTION SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

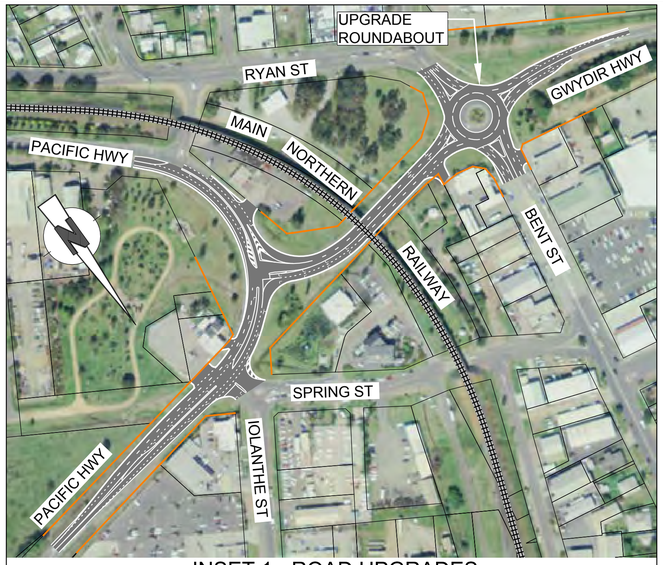
MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION C - PLAN AND LONGITUDINAL SECTION

DRAWING 3

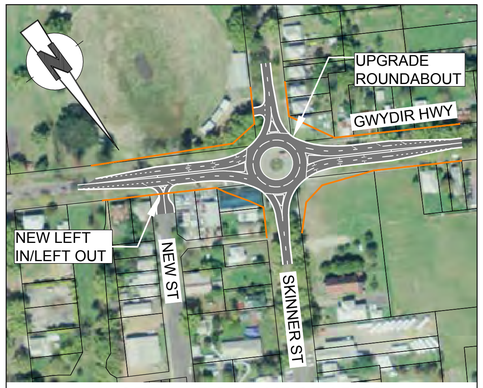
OPTION C

220422_SK9031.dwg

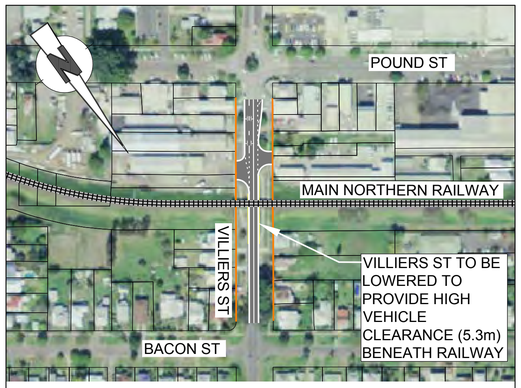
PRINTED DATE 13/07/2012



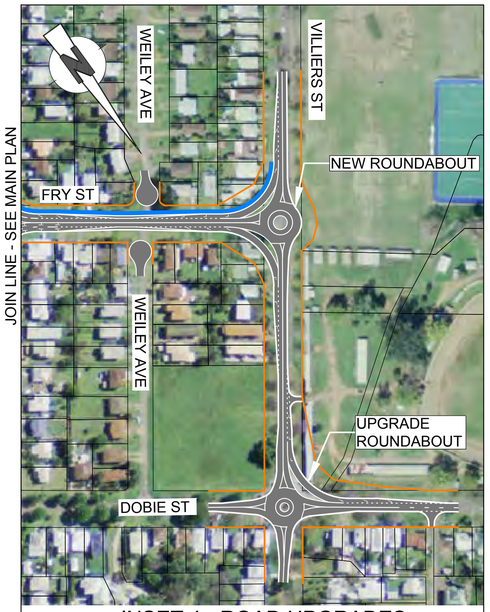
INSET 1 - ROAD UPGRADES
PACIFIC HWY/GWYDIR HWY



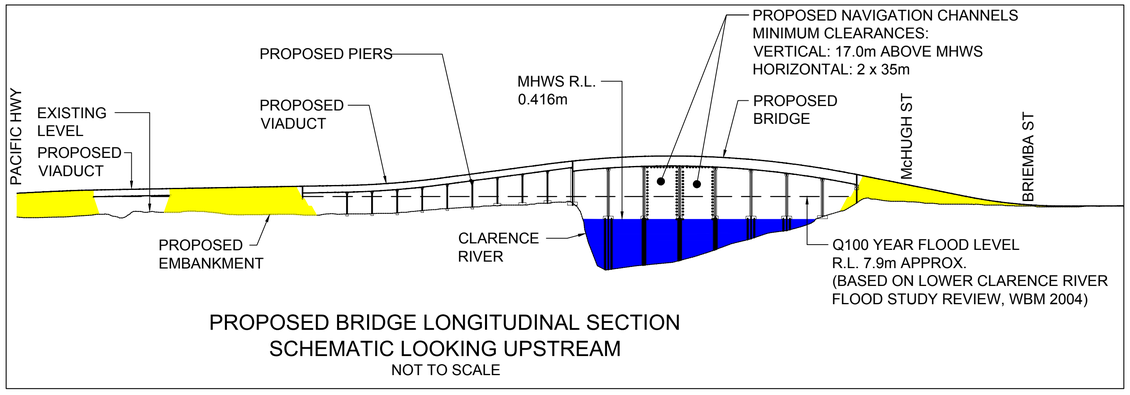
INSET 2 - ROAD UPGRADES
SKINNER ST/GWYDIR HWY INTERSECTION



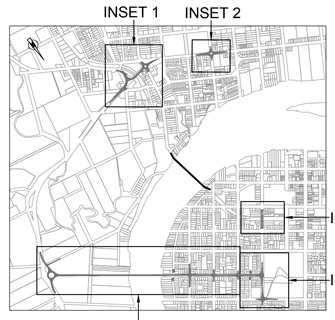
INSET 3 - ROAD UPGRADES
VILLIERS ST UNDERPASS



INSET 4 - ROAD UPGRADES
VILLIERS ST/DOBIE ST INTERSECTIONS



PROPOSED BRIDGE LONGITUDINAL SECTION
SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE



KEY PLAN
NOT TO SCALE

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

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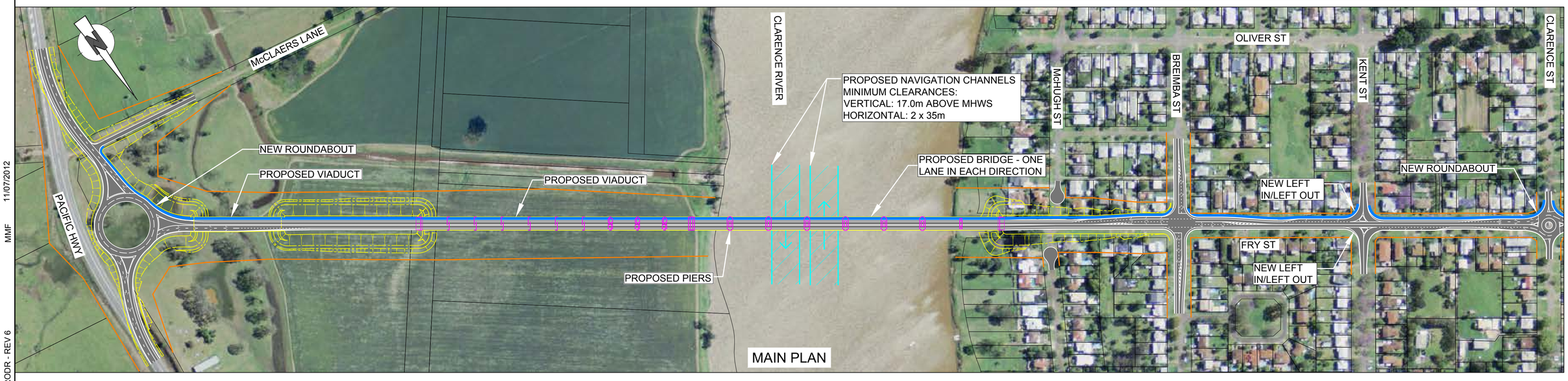


MAIN PLAN

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3

ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

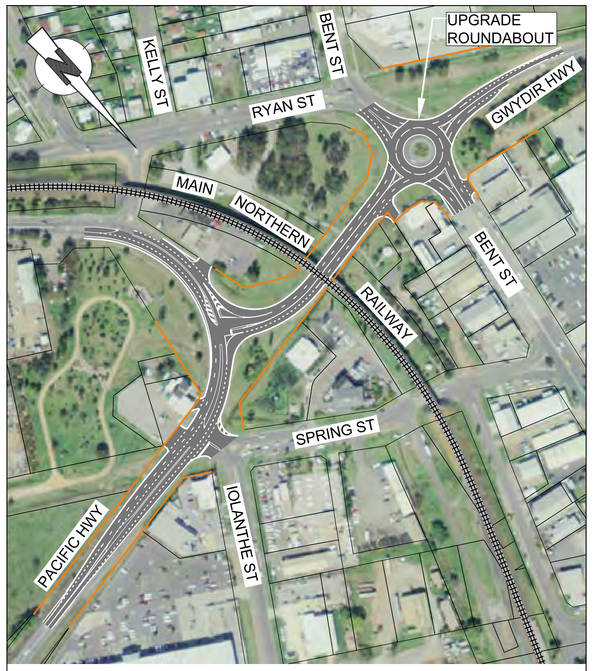
MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 11 - PLAN AND LONGITUDINAL SECTION

DRAWING 4

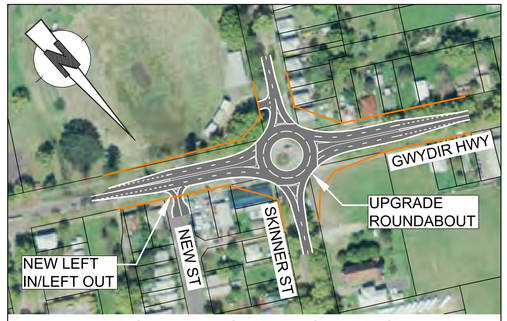
OPTION 11

220422_SK9041.dwg

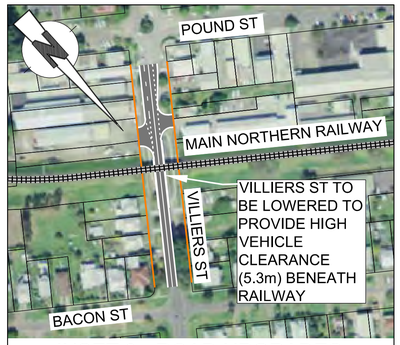
PRINTED DATE 13/07/2012



INSET 1 - ROAD UPGRADES
PACIFIC HWY/GWYDIR HWY



INSET 2 - ROAD UPGRADES
SKINNER ST/GWYDIR HWY INTERSECTION



INSET 3 - ROAD UPGRADES
VILLIERS ST UNDERPASS

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

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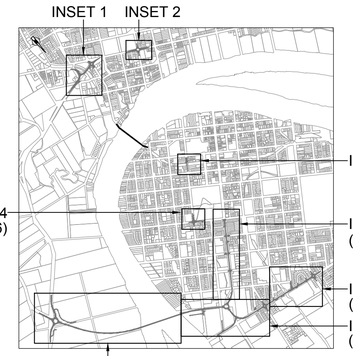
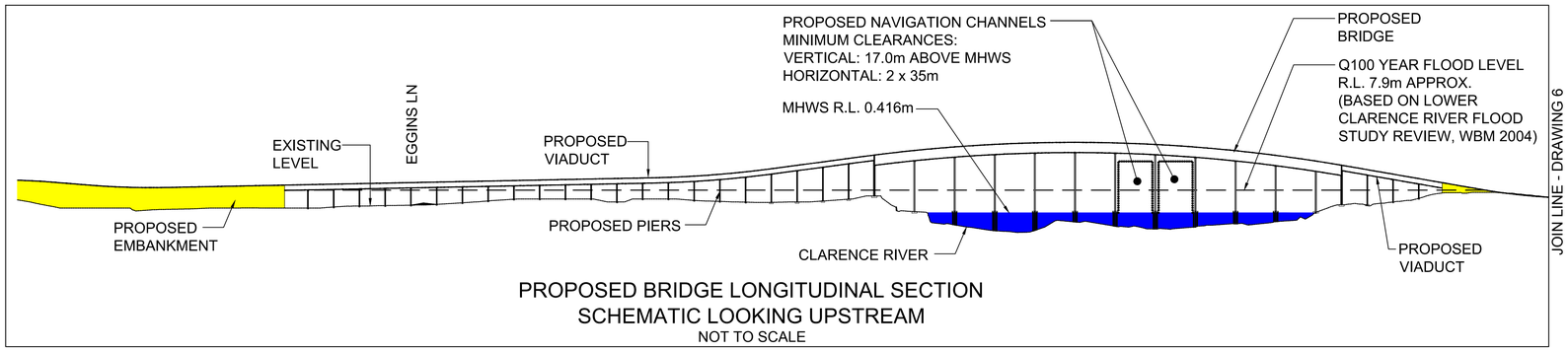
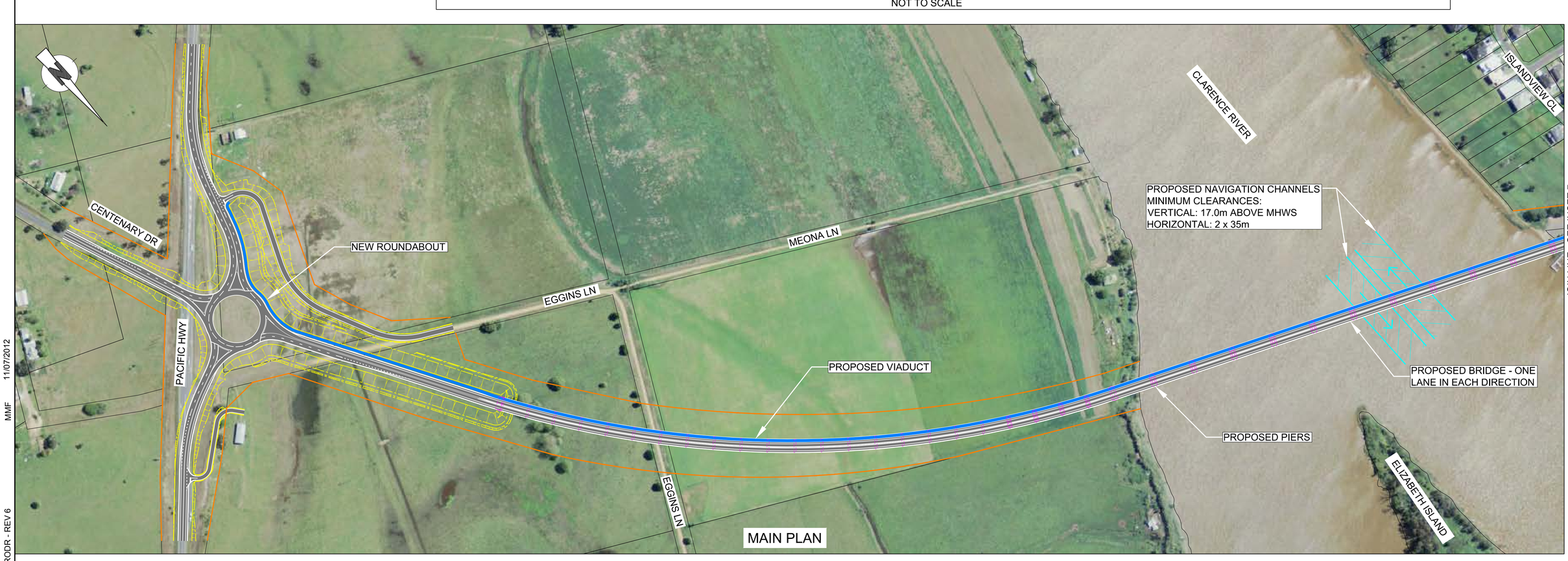


KEY PLAN
NOT TO SCALE



PROPOSED BRIDGE LONGITUDINAL SECTION
SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE



MAIN PLAN

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services
NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 14 - PLAN AND LONGITUDINAL SECTION 1 OF 2

DRAWING 5

OPTION 14

220422_SK9051.dwg

PRINTED DATE 13/07/2012

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

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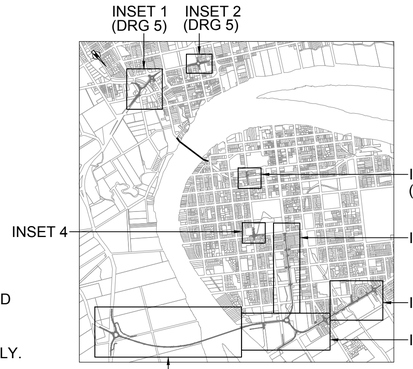
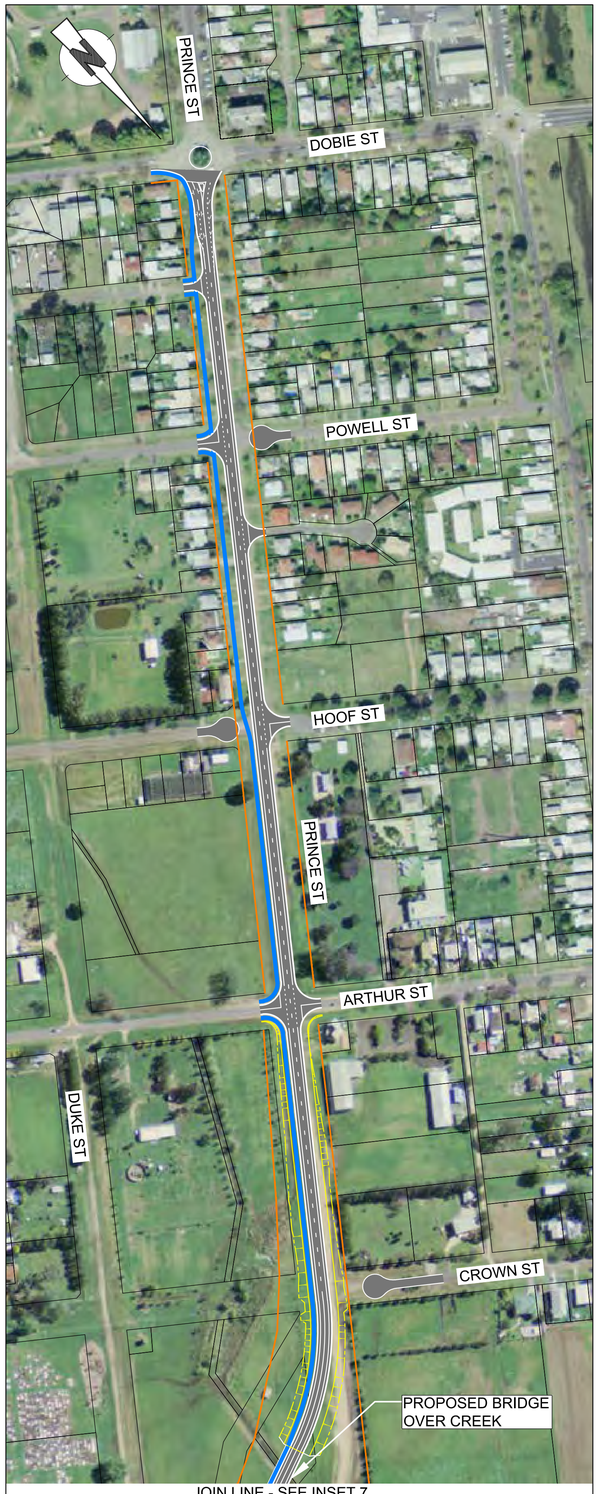
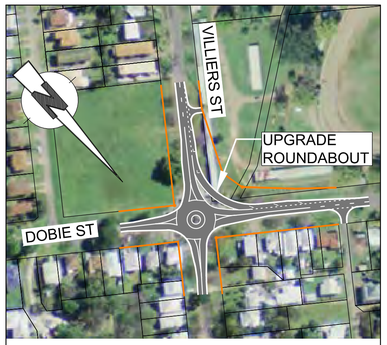
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.



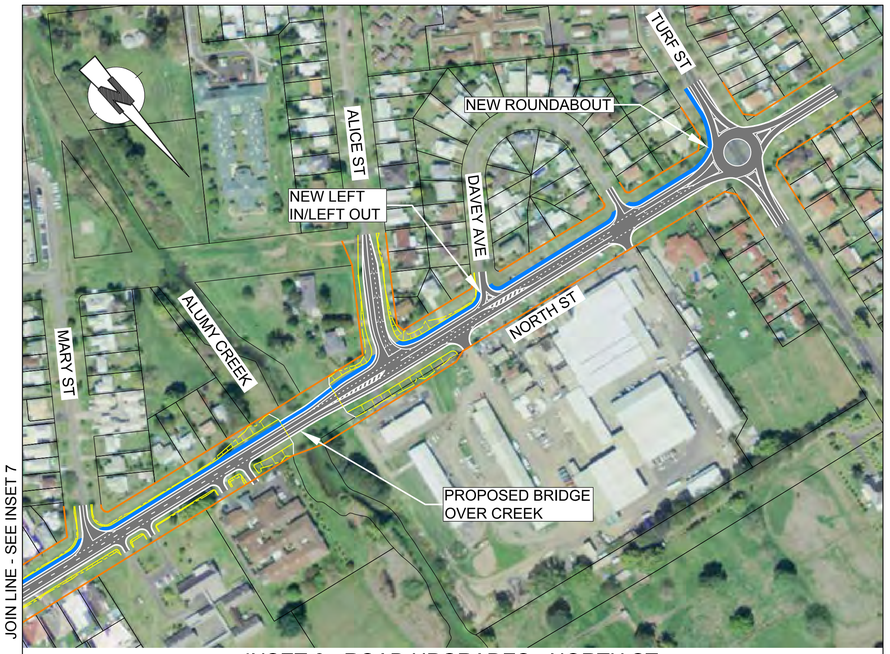
KEY PLAN
NOT TO SCALE



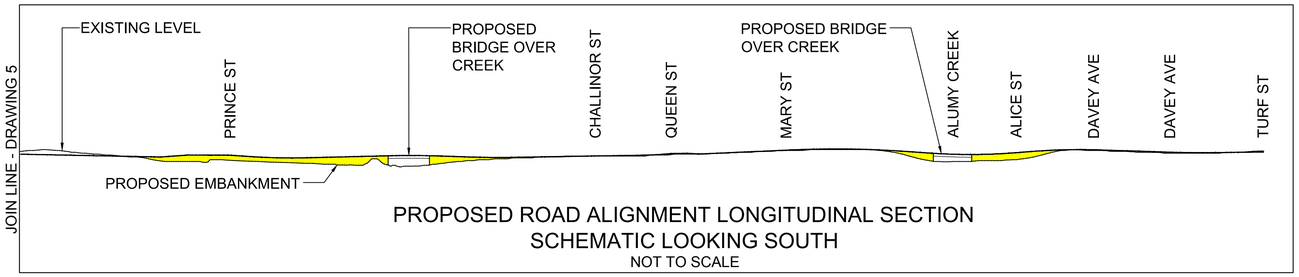
INSET 5 - ROAD UPGRADES
PRINCE ST LINK TO CBD



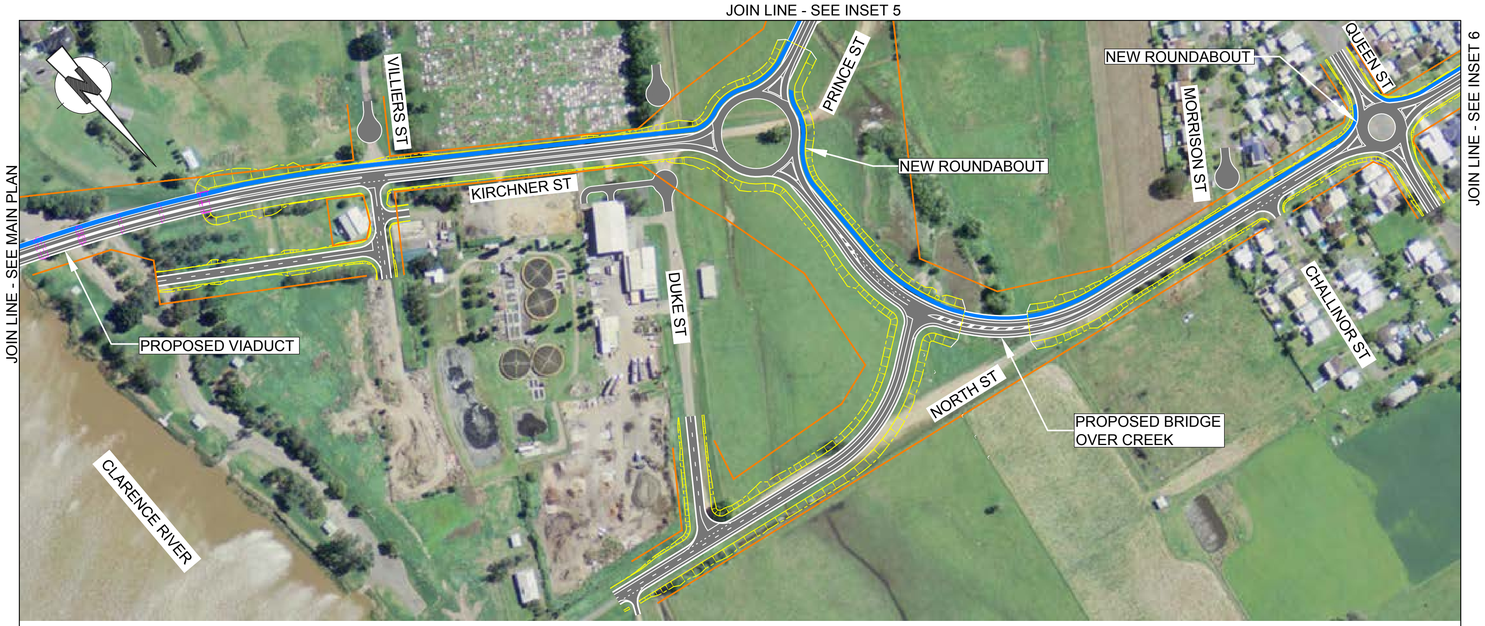
INSET 4 - ROAD UPGRADES
VILLIERS ST/DOBIE ST



INSET 6 - ROAD UPGRADES - NORTH ST



PROPOSED ROAD ALIGNMENT LONGITUDINAL SECTION
SCHEMATIC LOOKING SOUTH
NOT TO SCALE



INSET 7 - ROAD UPGRADES NORTH ST/PRINCE ST/KIRCHNER ST INTERSECTION AND LINK TO CBD ROAD UPGRADE

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport for NSW Roads & Maritime Services

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

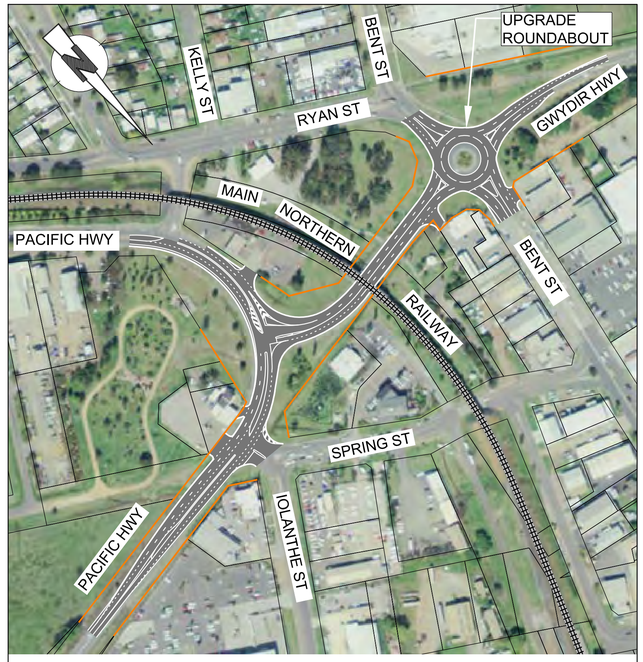
MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 14 - PLAN AND LONGITUDINAL SECTION 2 OF 2

DRAWING 6

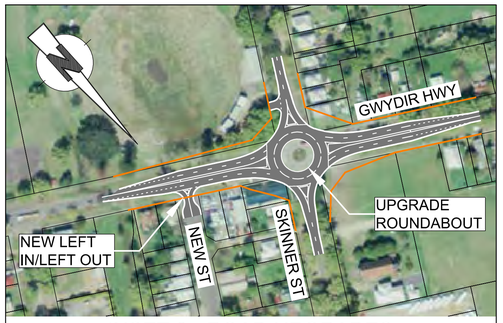
OPTION 14

220422_SK9052.dwg

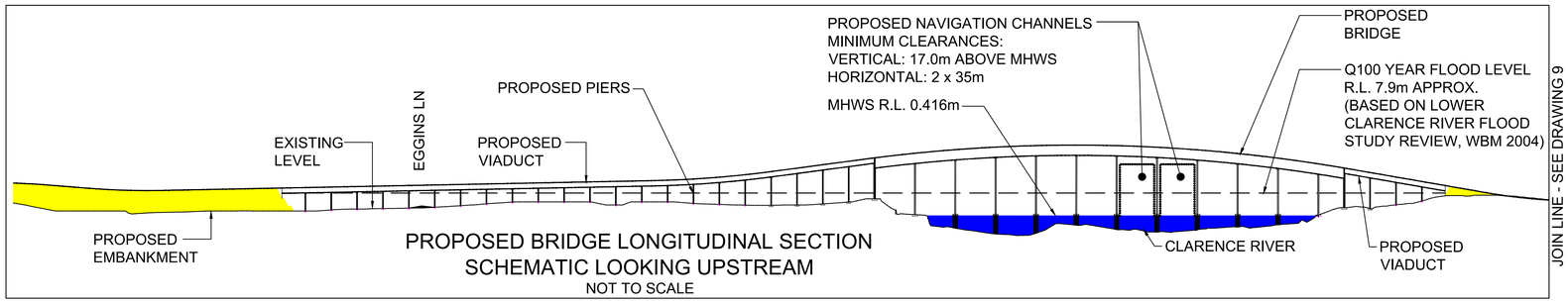
PRINTED DATE 13/07/2012



INSET 1 - ROAD UPGRADES
PACIFIC HWY/GWYDIR HWY



INSET 2 - ROAD UPGRADES
SKINNER ST/GWYDIR HWY
INTERSECTION



PROPOSED BRIDGE LONGITUDINAL SECTION
SCHEMATIC LOOKING UPSTREAM
NOT TO SCALE

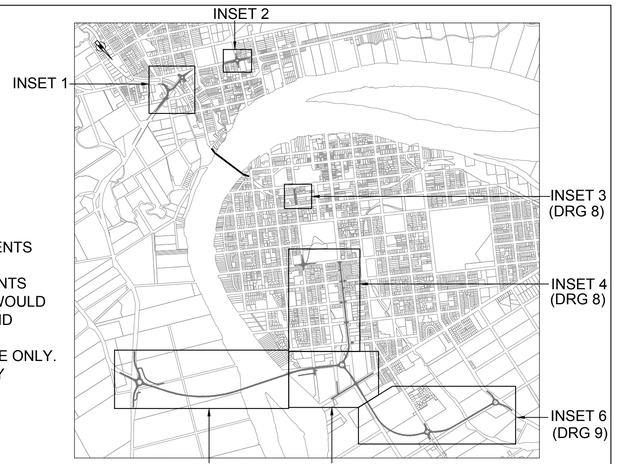
JOIN LINE - SEE DRAWING 9

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.



KEY PLAN
NOT TO SCALE

MAIN PLAN

JOIN LINE - SEE INSET 5

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3

ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 15 - PLAN AND LONGITUDINAL SECTION 1 OF 3

DRAWING 7

OPTION 15

220422_SK9061.dwg

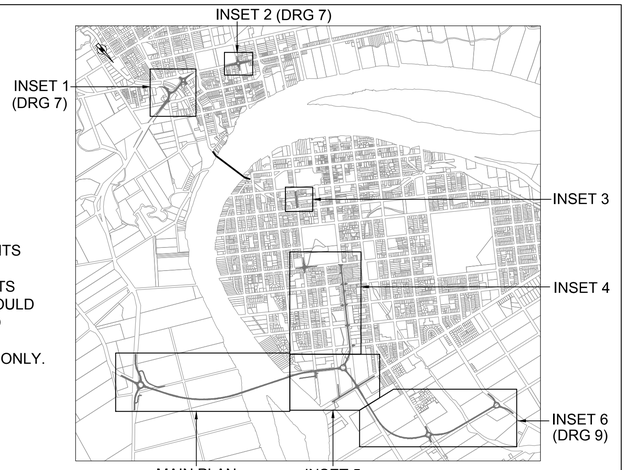
PRINTED DATE 13/07/2012

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.



KEY PLAN
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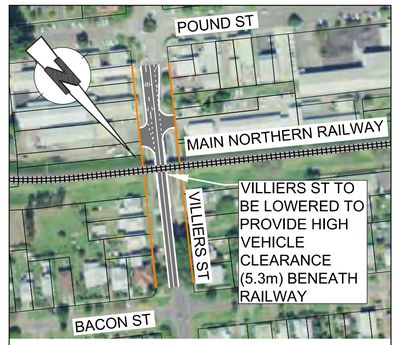


INSET 3 - ROAD UPGRADES
VILLIERS ST UNDERPASS

INSET 5 - ROAD UPGRADES NORTH ST/PRINCE ST/KIRCHNER ST AND LINK TO CBD

INSET 4 - ROAD UPGRADES DOBIE ST/VILLIERS ST AND LINK TO CBD

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 15 - PLAN AND LONGITUDINAL SECTION 2 OF 3

DRAWING 8

OPTION 15

220422_SK9062.dwg

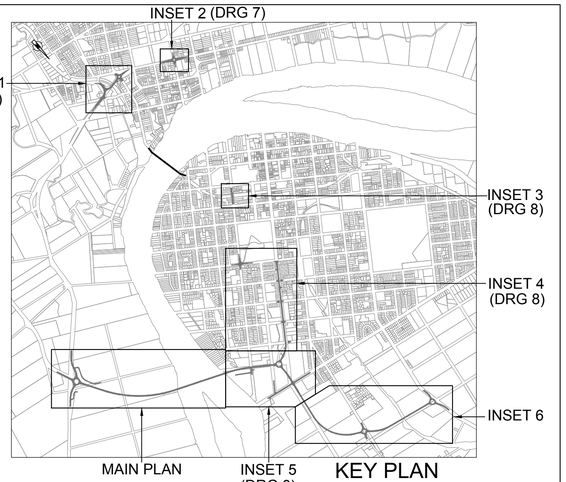
PRINTED DATE 13/07/2012

LEGEND:

- PROPOSED EMBANKMENT
- CADASTRAL BOUNDARY
- INDICATIVE ROAD BOUNDARY
- PROPOSED SHARED PATH
- PROPOSED PIERS AND ABUTMENT STRUCTURES

NOTES:

1. THE PLANS SHOW NETWORK IMPROVEMENTS REQUIRED FOR THE TRAFFIC VOLUMES MODELLED IN 2049. NOT ALL IMPROVEMENTS WOULD BE REQUIRED AT OPENING BUT WOULD BE ADDED IN STAGES AS TRAFFIC DEMAND GROWS.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY.
3. ACCESS SHOWN FOR MAJOR COMMUNITY FACILITIES AND BUSINESSES.



KEY PLAN
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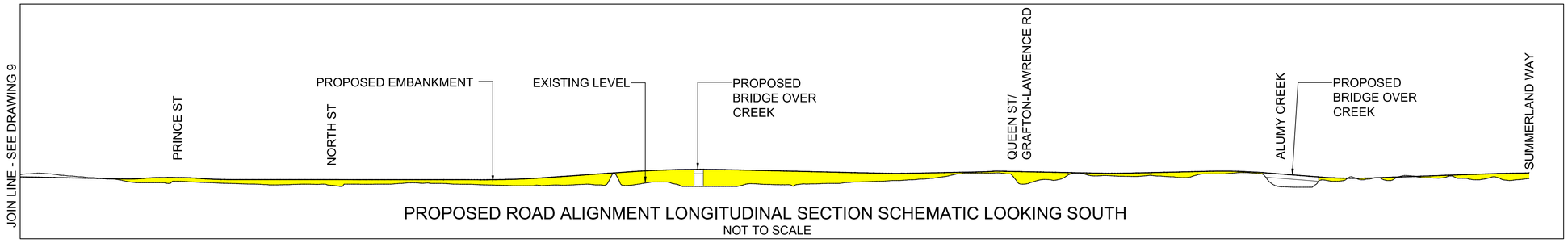


PROPOSED ROAD ALIGNMENT LONGITUDINAL SECTION SCHEMATIC LOOKING SOUTH
NOT TO SCALE

INSET 6 - NEW ROAD - NORTH ST/SUMMERLAND WAY CONNECTION

D DRAFT RODR - REV 6 MMF 11/07/2012

Transport Roads & Maritime Services NSW GOVERNMENT

ARUP
Arup Pty Ltd
ABN 18 000 966 165

0 50 100 150 200 250
SCALE 1:5000m SCALE @ A3
ALL PLANS SHOWN AT 1:5000 AT A3 UNLESS SHOWN OTHERWISE

MAIN ROAD 83 - SUMMERLAND WAY
ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON
OPTION 15 - PLAN AND LONGITUDINAL SECTION 3 OF 3

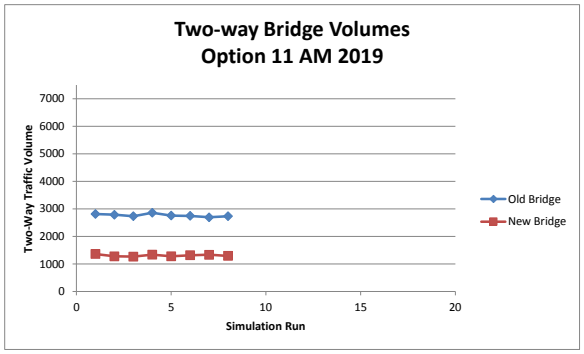
DRAWING 9

OPTION 15

220422_SK9063.dwg

Appendix C

Equilibrium Assignment Results


Two-way Bridge Volumes
Option 11 AM 2019
Two-Way Traffic Volume
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4000
3000
2000
1000
0
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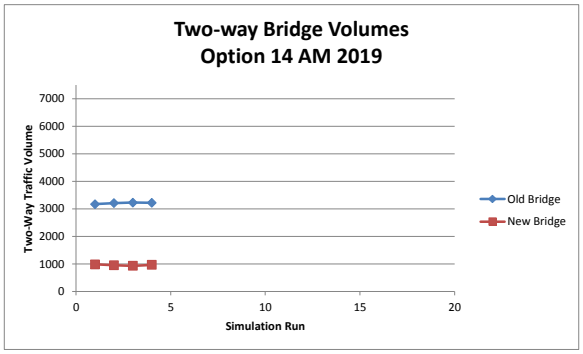
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option 14 AM 2019
Two-Way Traffic Volume
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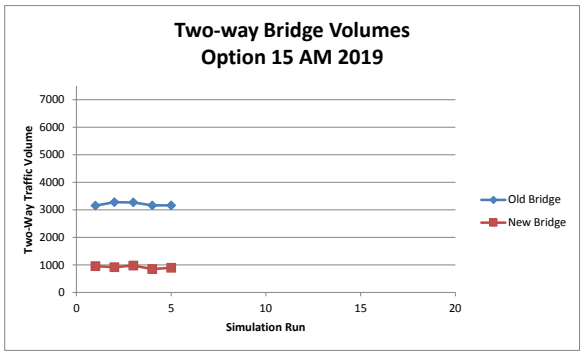
Simulation Run
Old Bridge
New Bridge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Two-Way Traffic Volume
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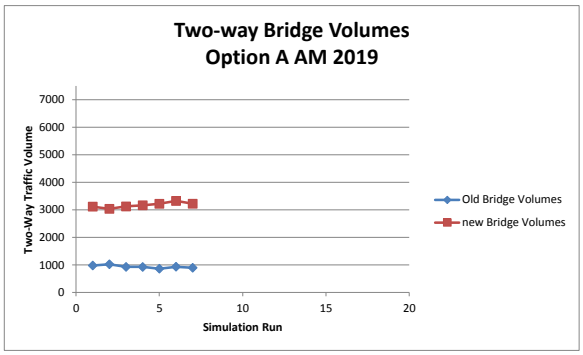
Simulation Run
Old Bridge
New Bridge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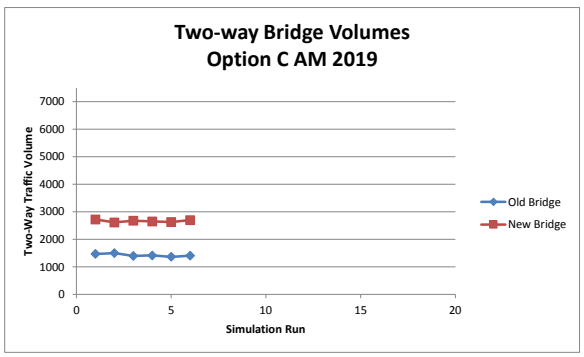
Simulation Run
Old Bridge Volumes
new Bridge Volumes


Two-way Bridge Volumes
Option C AM 2019
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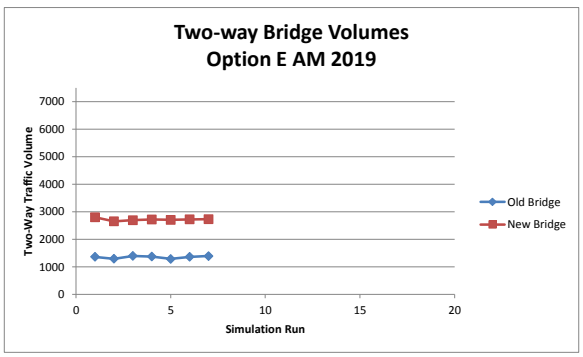
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option E AM 2019
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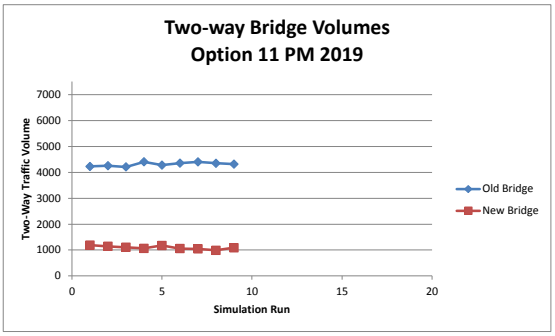
Simulation Run
Old Bridge
New Bridge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Simulation Run
Old Bridge
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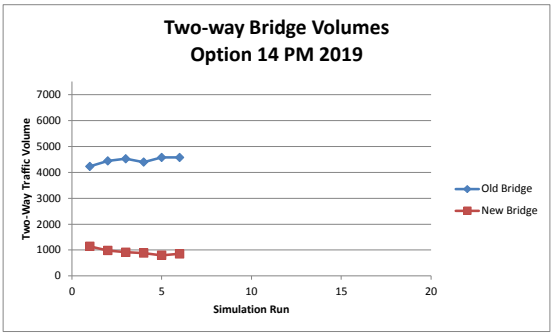
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Option 14 PM 2019
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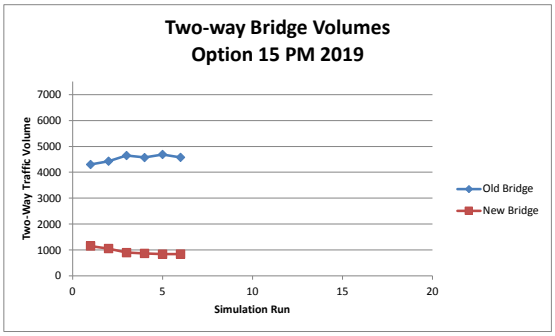
Simulation Run
Old Bridge
New Bridge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Option 15 PM 2019
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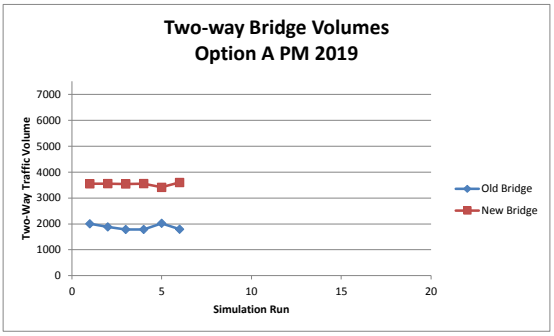
Simulation Run
Old Bridge
New Bridge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Simulation Run
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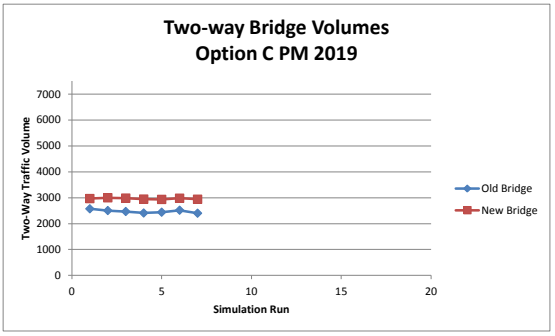
New Bridge


Two-way Bridge Volumes
Option C PM 2019
Two-Way Traffic Volume
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Simulation Run
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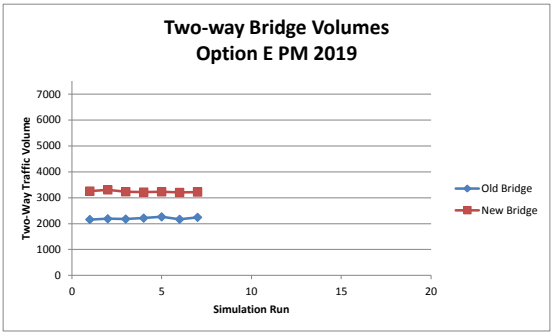
New Bridge


Two-way Bridge Volumes
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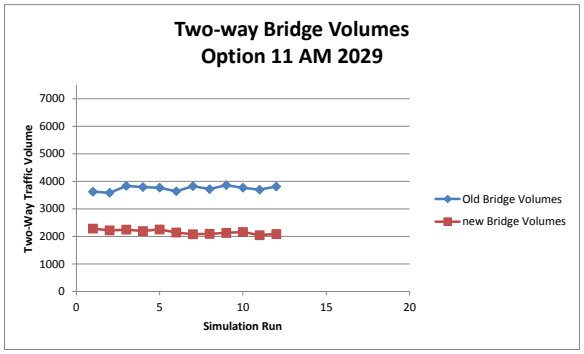
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
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Two-Way Traffic Volume
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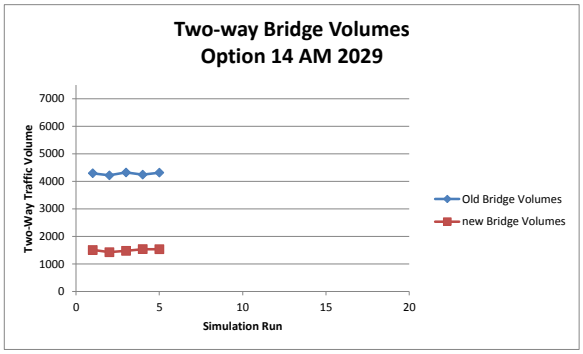
Simulation Run
Old Bridge Volumes
new Bridge Volumes


Two-way Bridge Volumes
Option 14 AM 2029
Two-Way Traffic Volume
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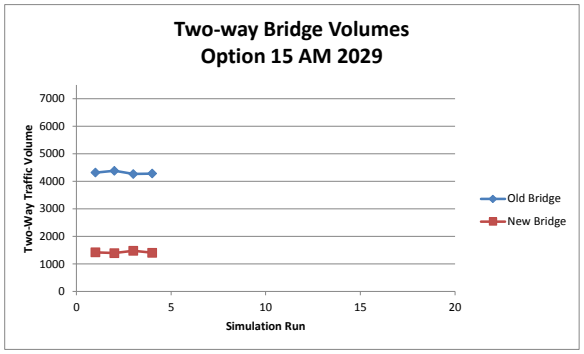
Simulation Run
Old Bridge Volumes
new Bridge Volumes


Two-way Bridge Volumes
Option 15 AM 2029
Two-Way Traffic Volume
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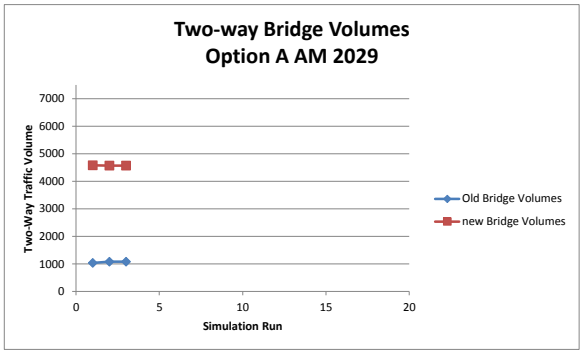
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option A AM 2029
Two-Way Traffic Volume
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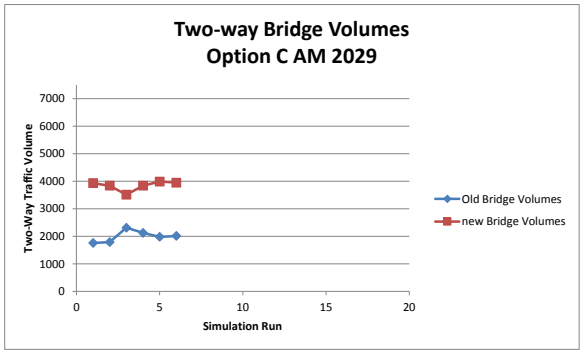
Simulation Run
Old Bridge Volumes
new Bridge Volumes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Two-Way Traffic Volume
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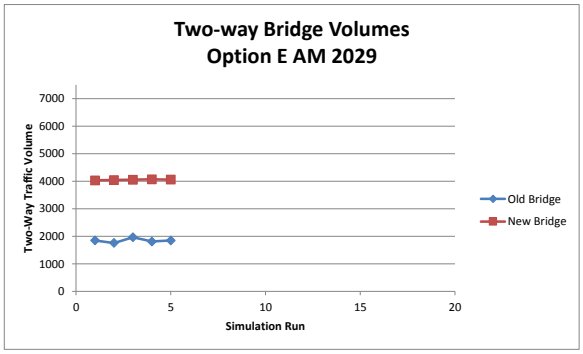
new Bridge Volumes


Two-way Bridge Volumes
Option E AM 2029
Two-Way Traffic Volume
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Simulation Run
Old Bridge
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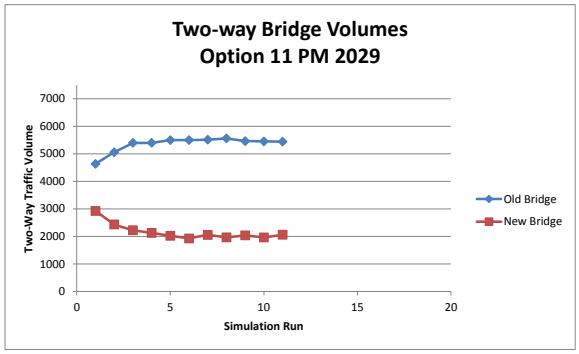
Two-way Bridge Volumes
Option 11 PM 2029
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Simulation Run
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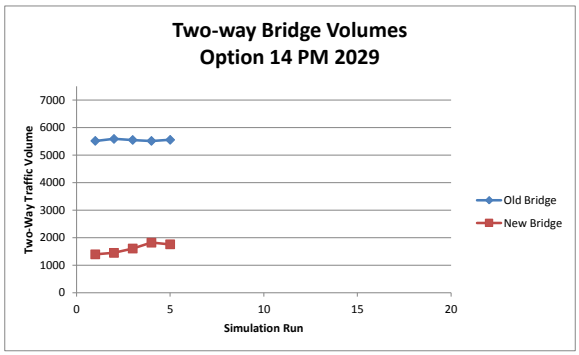
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Simulation Run
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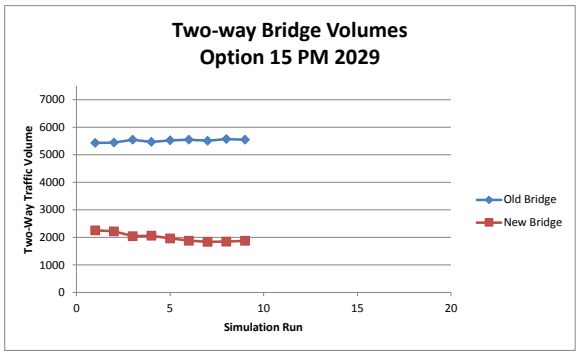
Two-way Bridge Volumes
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Simulation Run
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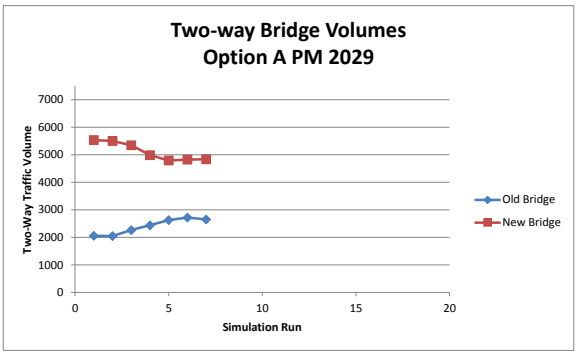
New Bridge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Two-Way Traffic Volume
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Simulation Run
Old Bridge
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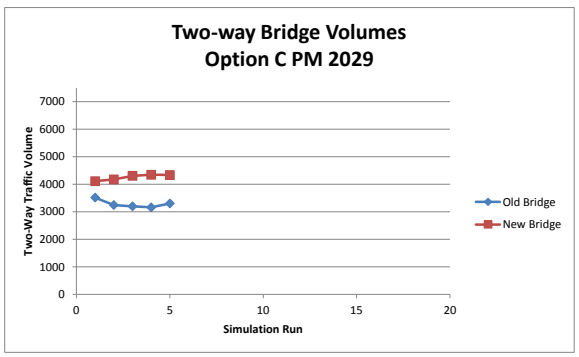
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Simulation Run
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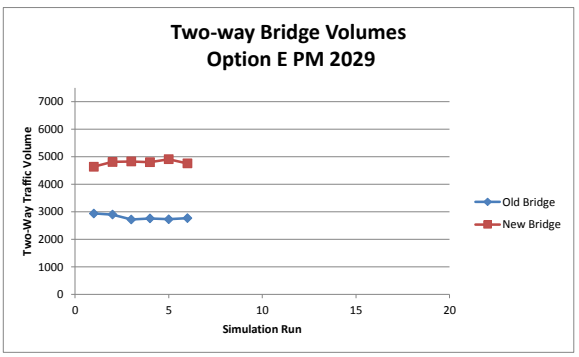
New Bridge


Two-way Bridge Volumes
Option E PM 2029
Two-Way Traffic Volume
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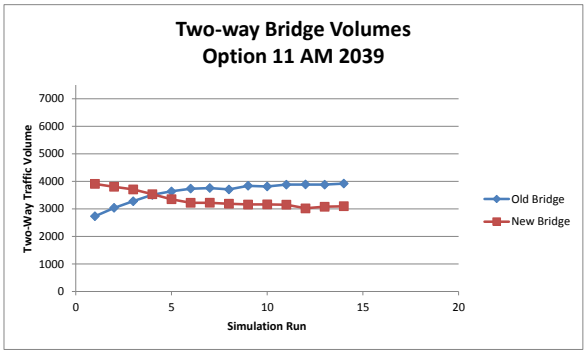
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option 11 AM 2039
Two-Way Traffic Volume
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Simulation Run
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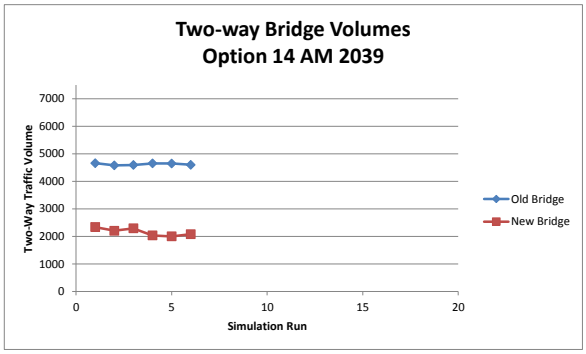
New Bridge


Two-way Bridge Volumes
Option 14 AM 2039
Two-Way Traffic Volume
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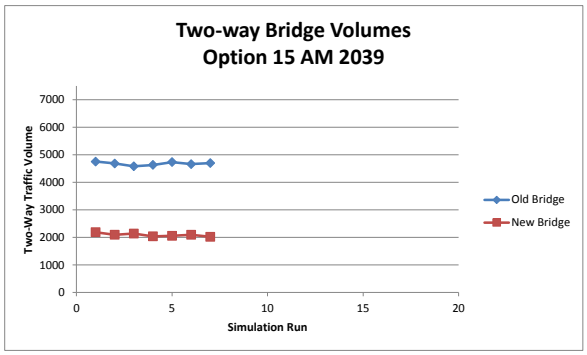
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Option 15 AM 2039
Two-Way Traffic Volume
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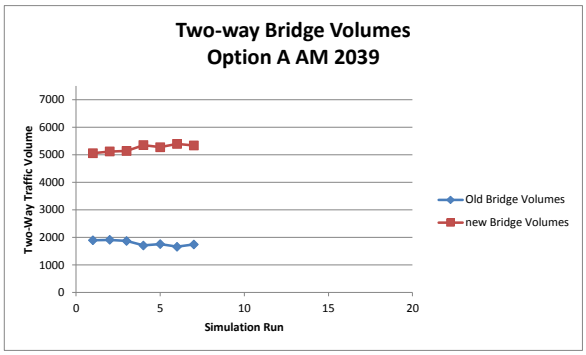
Simulation Run
Old Bridge
New Bridge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Option A AM 2039
Two-Way Traffic Volume
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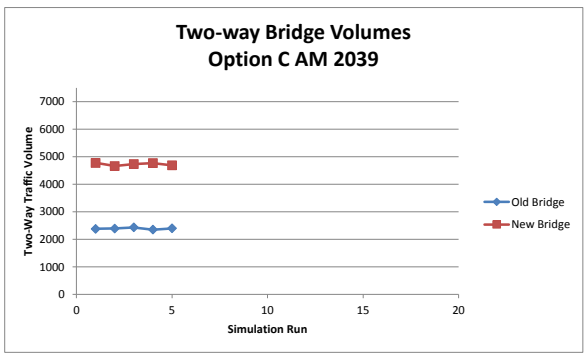
Simulation Run
Old Bridge Volumes
new Bridge Volumes


Two-way Bridge Volumes
Option C AM 2039
Two-Way Traffic Volume
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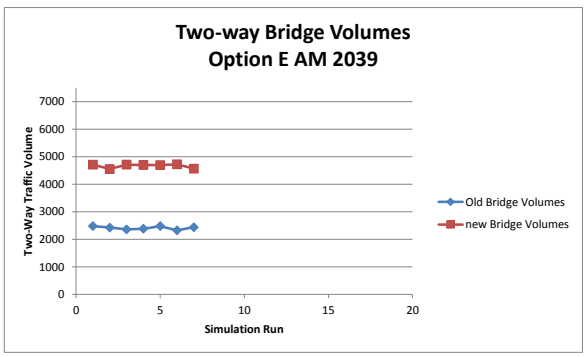
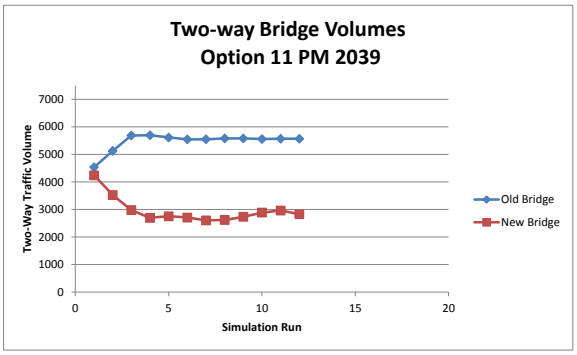
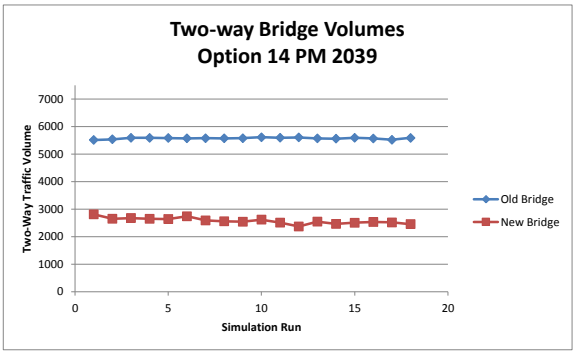
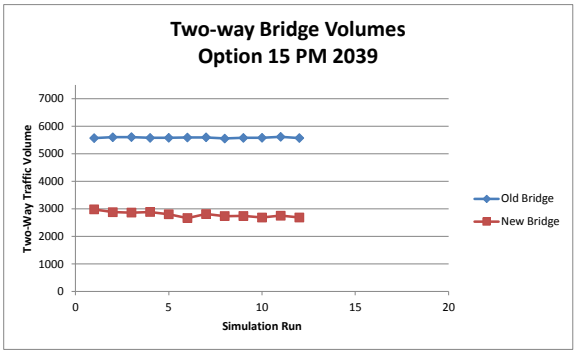
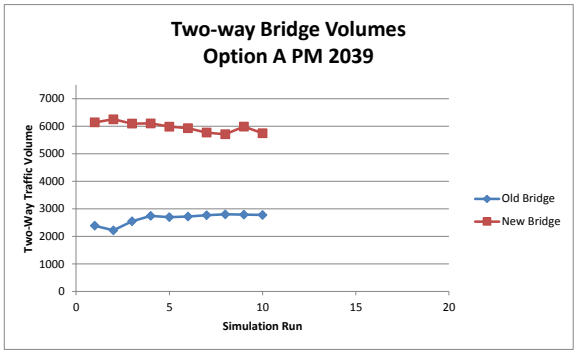
15
20
Simulation Run
Old Bridge
New Bridge

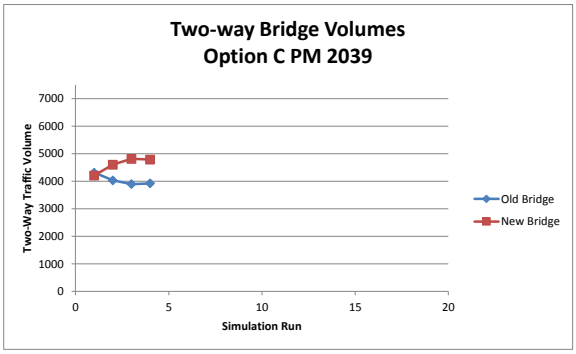

Two-way Bridge Volumes
Option E AM 2039
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge Volumes
new Bridge Volumes

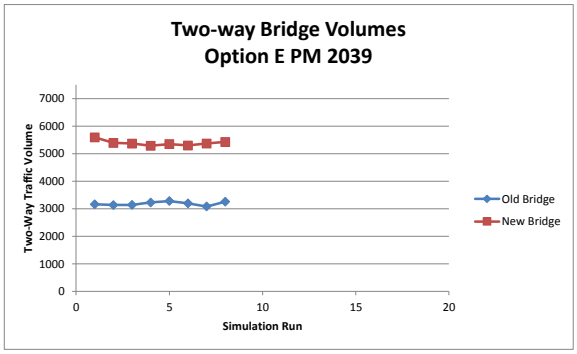

Two-way Bridge Volumes
Option 11 PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

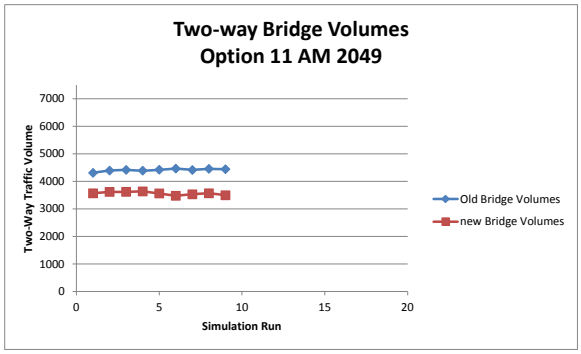

Two-way Bridge Volumes
Option 14 PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

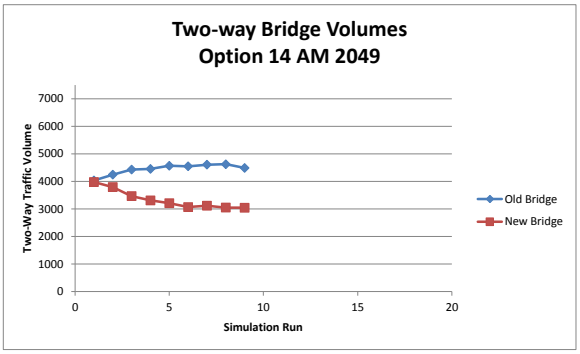

Two-way Bridge Volumes
Option 15 PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

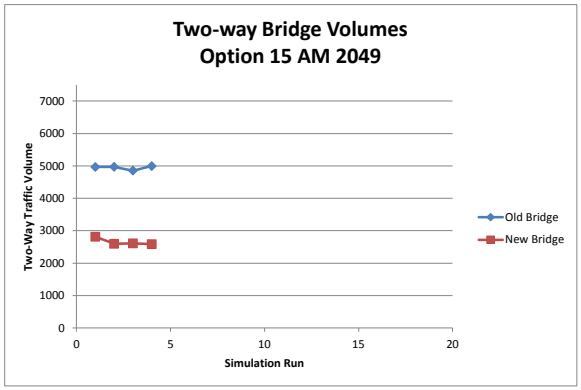

Two-way Bridge Volumes
Option A PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

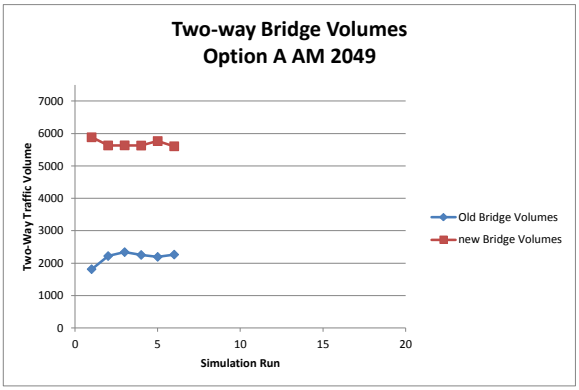

Two-way Bridge Volumes
Option C PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

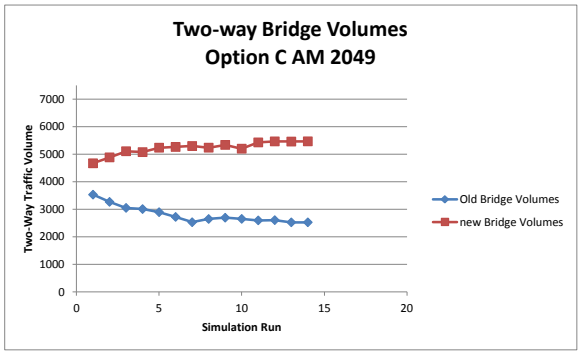

Two-way Bridge Volumes
Option E PM 2039
Two-Way Traffic Volume
Simulation Run
Old Bridge
New Bridge

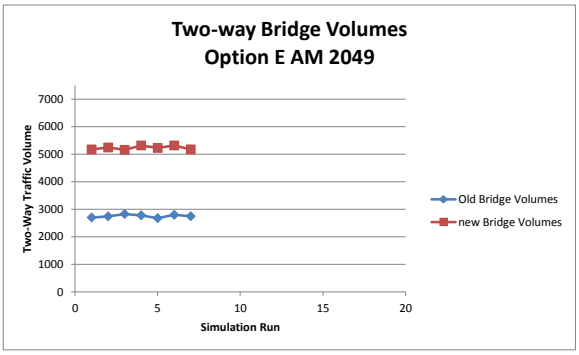

Two-way Bridge Volumes
Option 11 AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge Volumes
new Bridge Volumes

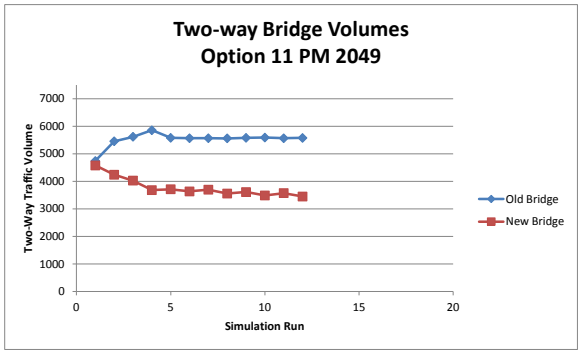

Two-way Bridge Volumes
Option 14 AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge

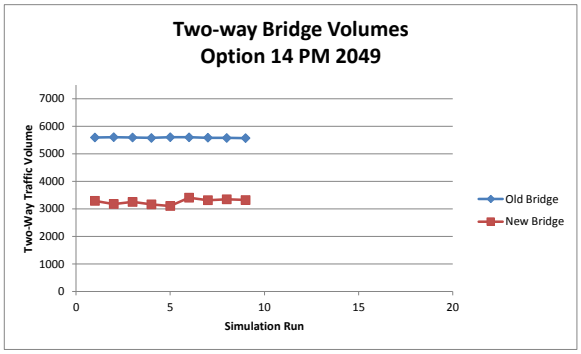

Two-way Bridge Volumes
Option 15 AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge

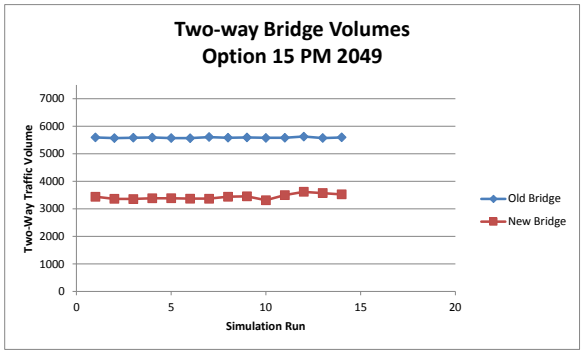

Two-way Bridge Volumes
Option A AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge Volumes
new Bridge Volumes

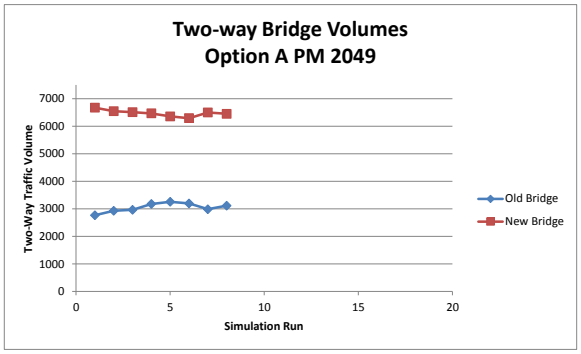

Two-way Bridge Volumes
Option C AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge Volumes
new Bridge Volumes

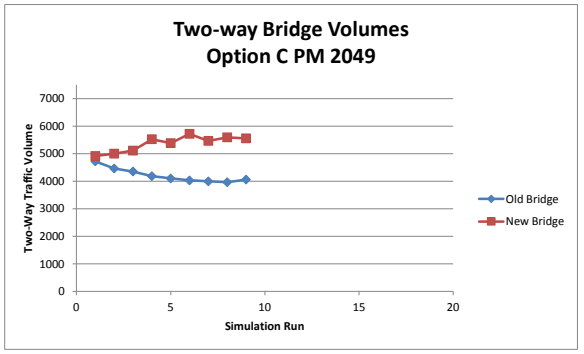

Two-way Bridge Volumes
Option E AM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge Volumes
new Bridge Volumes

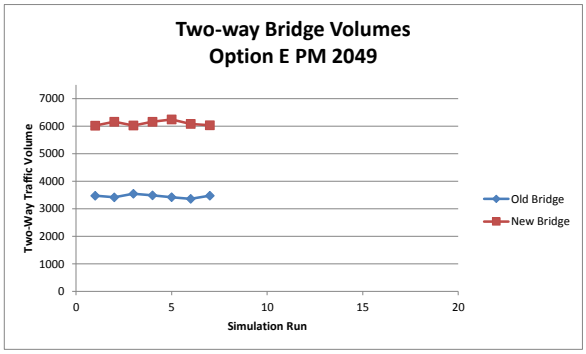

Two-way Bridge Volumes
Option 11 PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option 14 PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option 15 PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option A PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option C PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge


Two-way Bridge Volumes
Option E PM 2049
Two-Way Traffic Volume
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
Simulation Run
Old Bridge
New Bridge

Appendix D

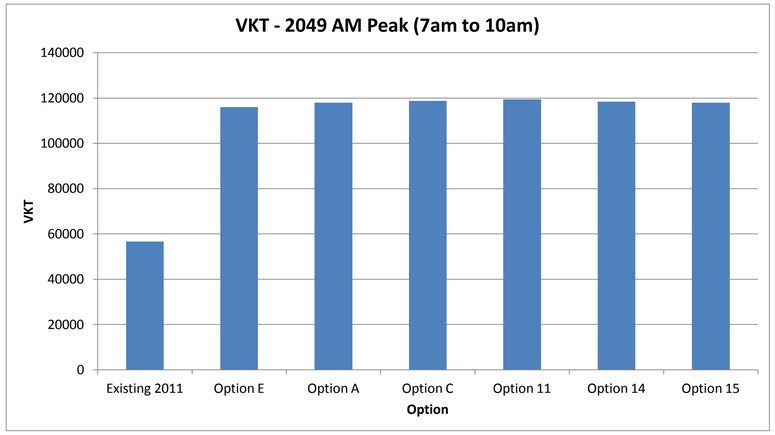
Full Network Results

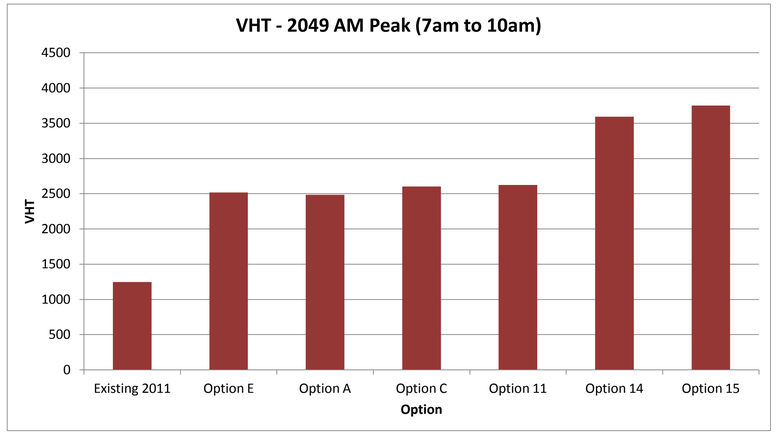
GTAconsultants

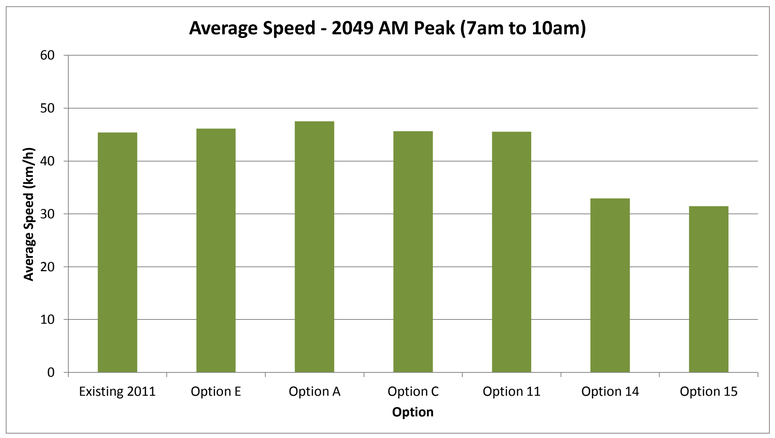
IS11352
Main Road 83 Summerland Way, Grafton - RODR

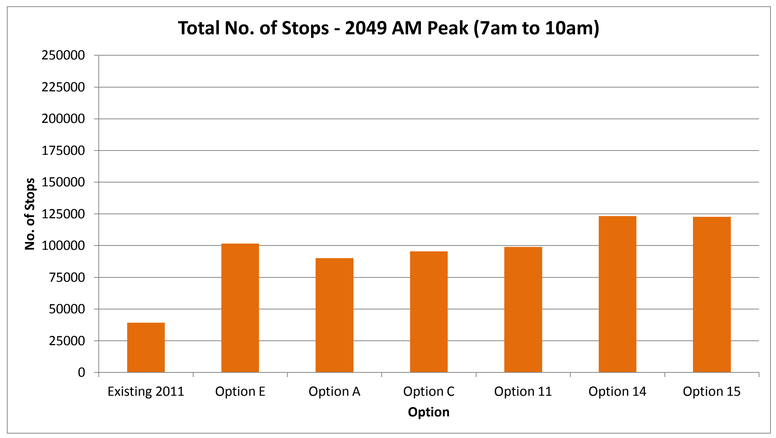
MICROSIMULATION MODELLING RESULTS (FINAL)
Network Statistics - AM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2049			Option E 2049			Option A 2049			Option C 2049			Option 11 2049			Option 14 2049			Option 15 2049		
	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
Total no. of incompleted trips (no. of vehicles)	448	496	324				721	1032	647	736	954	668	789	1094	656	720	1141	663	858	1462	1140	894	1555	1115
Total no. of completed trips (no. of vehicles)																			0	0	0	0	0	0
- Cars	4332	6645	5287				9086	11335	9334	9065	11403	9229	9015	11314	9401	9106	11229	9378	8883	10707	9348	8926	10544	9561
- Light	355	555	450				745	917	767	737	936	751	743	956	779	766	947	787	750	882	731	728	863	739
- Heavy	85	115	103				141	128	134	139	145	118	144	151	118	151	144	125	144	134	115	131	128	118
TOTAL	4772	7315	5840				9972	12381	10235	9940	12485	10098	9902	12422	10298	10023	12320	10290	9776	11723	10195	9785	11535	10418
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.1				3.4	3.3	3.4	3.5	3.4	3.5	3.5	3.4	3.5	3.6	3.4	3.5	3.7	3.4	3.5	3.6	3.4	3.6
Average travel time per vehicle (min/veh) per completed trip	3.5	4.2	3.9				4.2	4.5	4.4	4.3	4.5	4.3	4.3	4.8	4.5	4.2	4.6	4.9	4.5	5.6	7.5	4.5	5.5	7.7
Average speed (km/h)	49.1	42.2	47.2				48.3	43.7	47.2	49.2	45.3	48.8	48.4	42.5	47.2	51.1	43.8	43.0	47.4	31.8	26.1	46.6	29.4	25.4
Average delay per completed trip (sec)	0.1	39.6	16.9				27	52	36	27	49	30	27	60	37	13	45	61	26	107	210	27	100	220
Freeflow Time (hrs)	296.0	456.0	370.8				661	800	668	664	811	658	668	821	687	690	824	697	702	797	717	695	776	735
Total no. of Stops*																			0	0	0	0	0	0
- Cars	5605	19715	9763				24216	41852	26320	21957	36791	23313	21755	39610	25131	18789	39077	32194	22741	46028	44402	23407	44799	44591
- Light	480	1724	870				2055	3407	2188	1823	3002	1882	1866	3449	2117	1595	3221	2701	2000	3788	3067	1870	3759	3129
- Heavy	219	560	315				475	571	511	415	518	390	524	702	398	413	568	472	360	499	457	283	428	383
TOTAL	6304	21999	10948				26746	45830	29019	24195	40311	25585	24145	43761	27646	20797	42866	35367	25101	50315	47925	25560	48987	48103
Total Vehicle Kilometres Travelled (VKT)	14698.2	23198.8	18797.2				35805	43685	36566	36623	44909	36497	36415	44732	37589	37348	44543	37574	37762	42422	38222	37367	41174	39398
Total vehicle hours travelled (VHT)	299.4	550.2	398.6				741	1000	774	745	992	748	753	1053	797	732	1017	874	797	1335	1462	802	1401	1548
Unreleased Trips	0	0	0				0	0	0	0	0	0	0	48	0	0	0	0	0	358	304	0	496	320







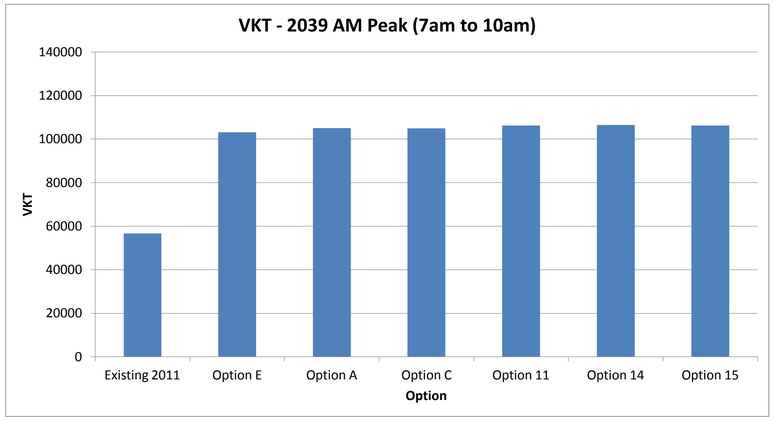


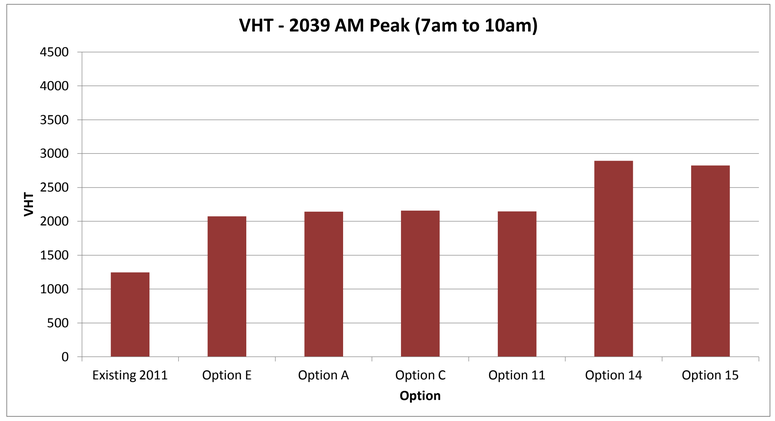
IS21352
Main Road 83 Summerland Way, Grafton - RODR

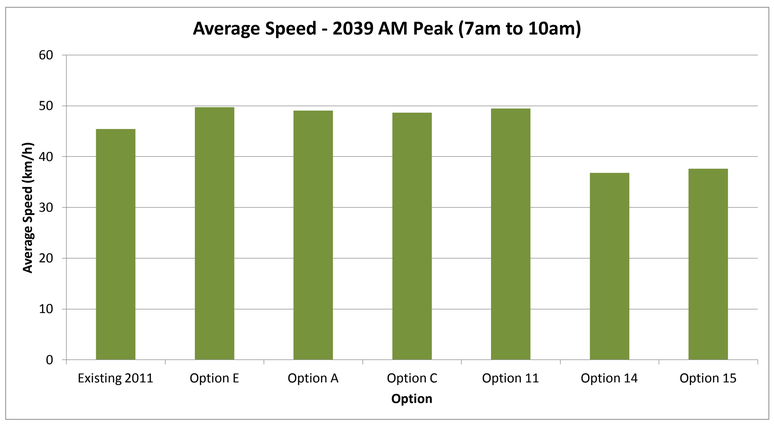
MICROSIMULATION MODELLING RESULTS (FINAL)

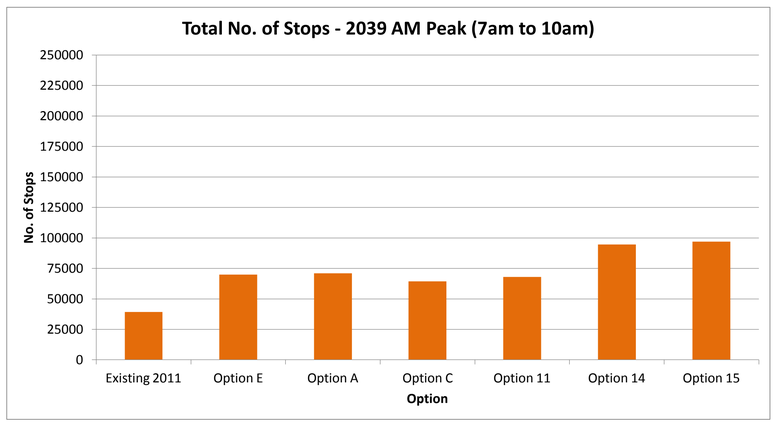
Network Statistics - AM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2039			Option E 2039			Option A 2039			Option C 2039			Option 11 2039			Option 14 2039			Option 15 2039		
	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
Total no. of incompleted trips (no. of vehicles)	448	496	324				601	818	599	630	849	558	603	888	567	613	903	558	634	1323	953	646	1293	829
Total no. of completed trips (no. of vehicles)																			0	0	0	0	0	0
- Cars	4332	6645	5287				8200	10576	8514	8192	10604	8579	8162	10551	8641	8168	10488	8569	8077	10165	8652	8128	10161	8773
- Light	355	555	450				686	867	716	686	890	720	688	857	716	686	878	706	691	856	700	672	846	726
- Heavy	85	115	103				138	132	120	143	138	122	138	139	118	142	136	111	151	140	120	146	126	113
TOTAL	4772	7315	5840				9024	11575	9350	9020	11632	9421	8987	11546	9475	8996	11502	9386	8919	11161	9472	8946	11134	9612
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.1				3.3	3.3	3.3	3.4	3.3	3.4	3.4	3.3	3.4	3.4	3.4	3.4	3.5	3.3	3.5	3.5	3.3	3.4
Average travel time per vehicle (min/veh) per completed trip	3.5	4.2	3.9				3.9	4.0	3.9	4.1	4.1	4.0	4.0	4.1	4.2	3.9	4.2	4.2	4.0	4.6	6.9	4.1	4.7	6.7
Average speed (km/h)	49.1	42.2	47.2				50.3	48.7	50.5	49.5	47.9	50.0	51.0	47.6	47.8	52.7	47.5	49.0	51.5	38.1	28.1	51.1	38.6	29.5
Average delay per completed trip (sec)	0.1	39.6	16.9				17	25	17	23	32	23	15	29	31	5	27	22	6	52	182	9	54	170
Freeflow Time (hrs)	296.0	456.0	370.8				575	727	593	578	730	596	581	736	608	602	752	618	610	742	652	610	737	657
Total no. of Stops*																			0	0	0	0	0	0
- Cars	5605	19715	9763				16964	27648	18562	17265	28035	19091	14851	25509	17975	12980	28910	19671	12256	34986	39166	13522	35386	39754
- Light	480	1724	870				1523	2327	1662	1425	2407	1676	1256	2125	1557	1159	2408	1702	1052	2802	3085	1153	2983	3193
- Heavy	219	560	315				426	483	398	368	450	345	360	449	351	332	450	314	247	452	488	215	321	423
TOTAL	6304	21999	10948				18913	30458	20622	19059	30891	21112	16467	28082	19882	14472	31768	21688	13554	38240	42739	14890	38690	43371
Total Vehicle Kilometres Travelled (VKT)	14698.2	23198.8	18797.2				31165	39635	32332	31730	40336	32975	31637	40180	33156	32439	40614	33159	32536	39349	34623	32483	39050	34770
Total vehicle hours travelled (VHT)	299.4	550.2	398.6				619	814	640	640	842	660	621	844	693	615	855	676	632	1033	1231	636	1011	1179
Unreleased Trips	0	0	0				0	0	0	0	0	0	0	4	0	0	25	0	0	47	6	0	8	9







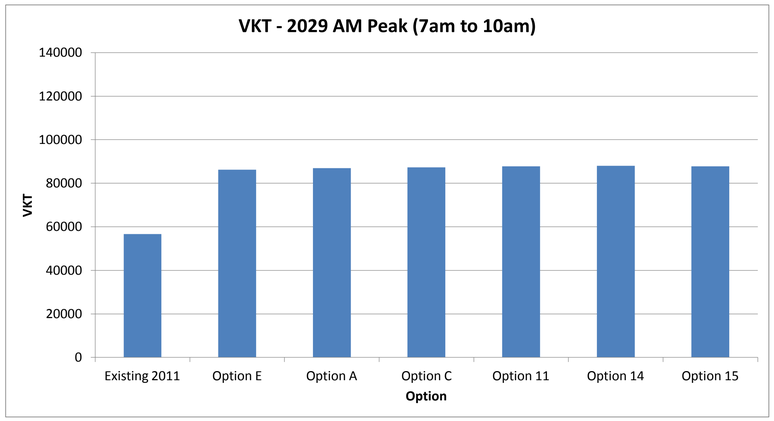


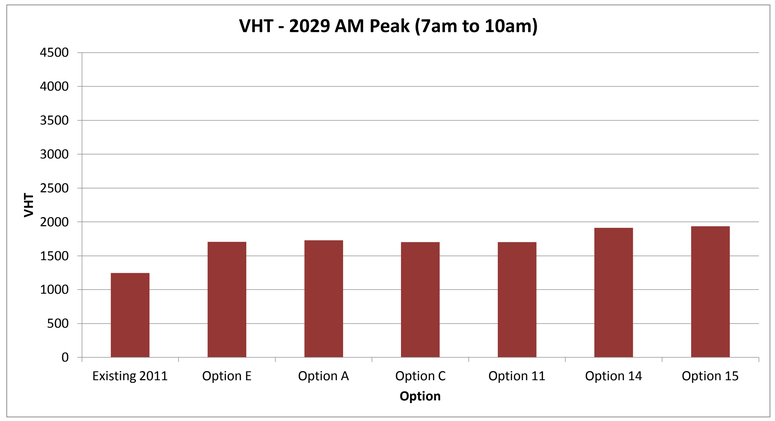
IS11352
Main Road 83 Summerland Way, Grafton - RODR

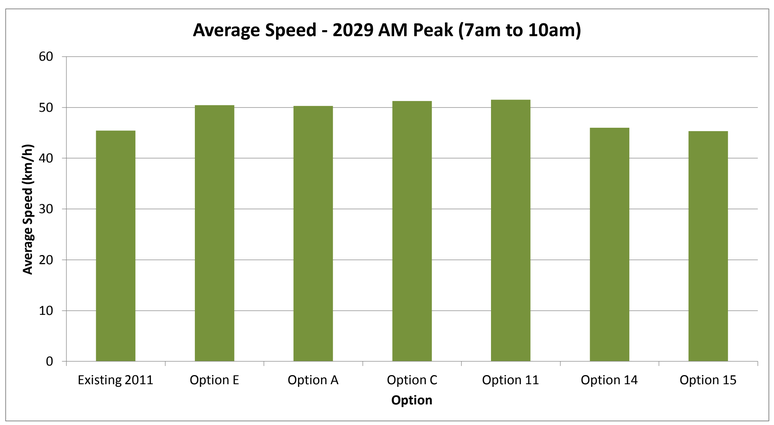
MICROSIMULATION MODELLING RESULTS (FINAL)

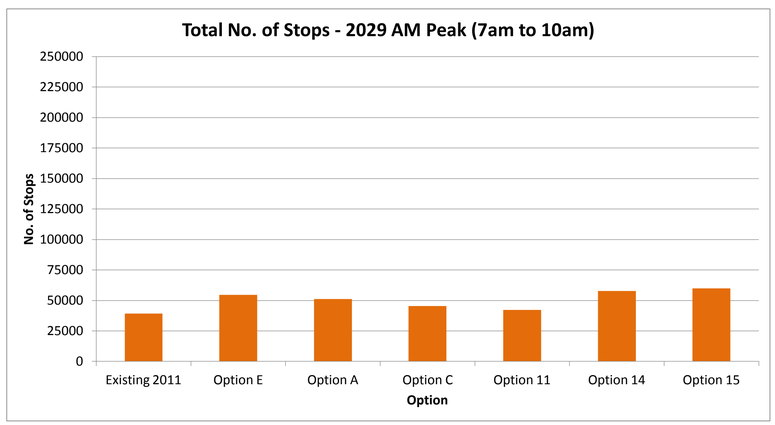
Network Statistics - AM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2029			Option E 2029			Option A 2029			Option C 2029			Option 11 2029			Option 14 2029			Option 15 2029		
	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
Total no. of incompleted trips (no. of vehicles)	448	496	324				566	582	483	553	609	495	558	603	488	583	601	475	636	743	485	605	771	491
Total no. of completed trips (no. of vehicles)																0	0	0	0	0	0	0	0	0
- Cars	4332	6645	5287				6981	9079	7133	6997	9024	7136	6949	9003	7127	6949	9050	7156	6894	8946	7252	6963	8850	7243
- Light	355	555	450				585	754	602	572	754	573	592	729	599	588	748	595	583	754	574	593	715	609
- Heavy	85	115	103				131	127	118	134	137	112	132	138	114	132	139	112	122	135	119	128	140	114
TOTAL	4772	7315	5840				7696	9959	7853	7703	9914	7822	7673	9870	7840	7669	9937	7862	7599	9834	7945	7684	9705	7966
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.1				3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Average travel time per vehicle (min/veh) per completed trip	3.5	4.2	3.9				3.8	3.9	3.8	3.9	4.0	3.8	3.8	3.9	3.8	3.8	3.9	3.7	3.9	4.4	4.4	3.9	4.4	4.5
Average speed (km/h)	49.1	42.2	47.2				50.4	49.8	51.4	50.3	49.5	51.2	51.3	50.7	52.0	52.3	49.9	52.9	50.8	43.7	44.8	50.4	42.9	44.1
Average delay per completed trip (sec)	0.1	39.6	16.9				15	21	14	19	25	17	12	16	11	3	15	2	6	38	35	7	42	44
Freeflow Time (hrs)	296.0	456.0	370.8				483	613	485	481	612	484	489	618	494	504	637	504	508	642	521	511	633	523
Total no. of Stops*																0	0	0	0	0	0	0	0	0
- Cars	5605	19715	9763				13797	21443	13915	13054	19890	13486	11256	17874	11780	9642	18419	9966	9999	26589	15995	10706	27127	16757
- Light	480	1724	870				1190	1825	1178	1112	1676	1116	1008	1518	1049	871	1682	884	878	2225	1201	933	2281	1422
- Heavy	219	560	315				376	433	361	320	369	253	287	347	255	285	335	222	202	366	268	189	296	233
TOTAL	6304	21999	10948				15363	23711	15454	14486	21935	14856	12551	19739	13083	10798	20337	11083	11079	29180	17464	11827	29704	18411
Total Vehicle Kilometres Travelled (VKT)	14698.2	23198.8	18797.2				26133	33507	26169	26407	33817	26780	26498	33764	26987	26797	34052	26897	26828	33886	27261	26840	33435	27483
Total vehicle hours travelled (VHT)	299.4	550.2	398.6				518	673	517	525	683	523	516	666	519	512	683	509	528	776	609	532	779	624
Unreleased Trips	0	0	0				0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0







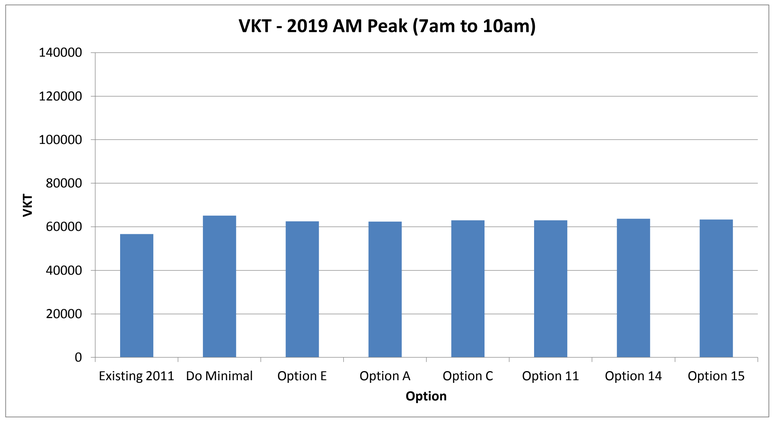


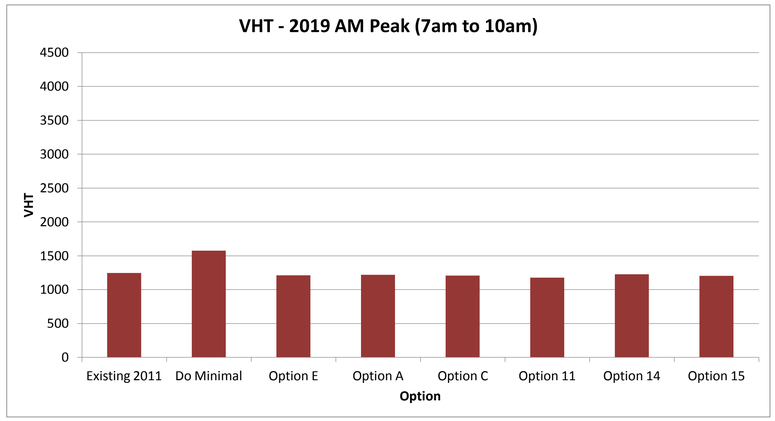
IS1352
Main Road 83 Summerland Way, Grafton - RODR

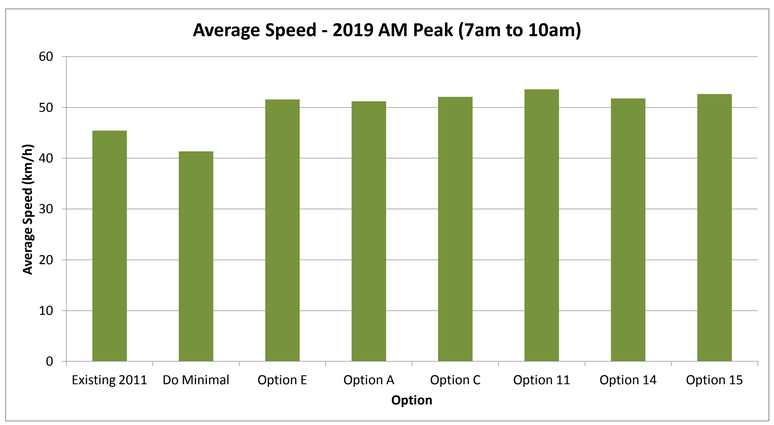
MICROSIMULATION MODELLING RESULTS (FINAL)

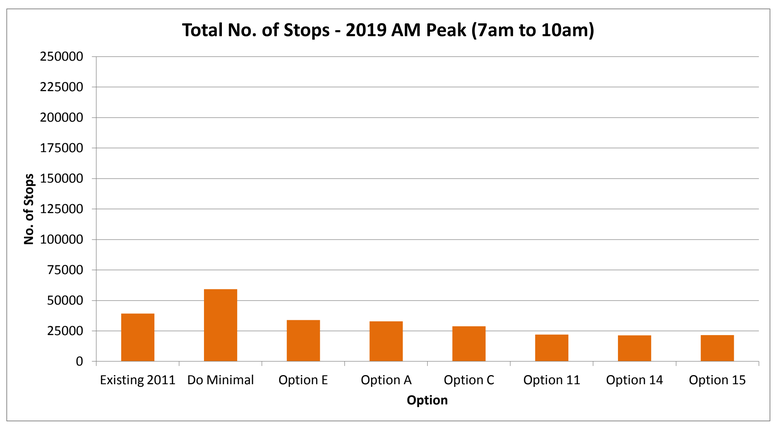
Network Statistics - AM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2019			Option E 2019			Option A 2019			Option C 2019			Option 11 2019			Option 14 2019			Option 15 2019		
	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
Total no. of incompleted trips (no. of vehicles)	448	496	324	569	653	397	506	425	350	532	420	359	521	432	354	511	402	331	537	420	355	521	405	340
Total no. of completed trips (no. of vehicles)																0	0	0	0	0	0	0	0	0
- Cars	4332	6645	5287	4950	7294	5878	5235	7147	5477	5279	7179	5460	5263	7166	5494	5301	7141	5472	5320	7129	5500	5272	7214	5481
- Light	355	555	450	405	621	479	438	606	452	423	584	448	422	591	458	439	590	448	426	588	449	429	595	440
- Heavy	85	115	103	82	107	94	80	110	93	79	108	85	78	116	91	81	105	93	74	119	87	83	111	91
TOTAL	4772	7315	5840	5437	8023	6451	5752	7863	6022	5781	7870	5993	5763	7872	6043	5820	7835	6013	5820	7836	6035	5785	7919	6012
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.1	3.0	3.1	3.2	3.0	3.0	3.1	3.0	3.1	3.0	3.0	3.1	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Average travel time per vehicle (min/veh) per completed trip	3.5	4.2	3.9	3.6	4.7	4.8	3.5	3.6	3.5	3.5	3.6	3.5	3.5	3.6	3.5	3.4	3.5	3.4	3.5	3.6	3.5	3.5	3.5	3.4
Average speed (km/h)	49.1	42.2	47.2	48.7	38.4	40.1	51.5	51.2	52.1	51.1	50.9	51.7	52.0	51.8	52.6	53.6	53.3	54.0	52.3	51.7	51.4	52.6	52.3	53.2
Average delay per completed trip (sec)	0.1	39.6	16.9	2	61	62	9	13	9	13	16	13	7	10	7	0	0	0	0	1	0	0	1	0
Freeflow Time (hrs)	296.0	456.0	370.8	345	517	424	341	456	352	339	451	343	346	462	352	358	468	358	364	481	369	363	482	364
Total no. of Stops*																0	0	0	0	0	0	0	0	0
- Cars	5605	19715	9763	7304	27679	18288	8325	13260	8881	8289	12865	8533	7144	11499	7438	5297	8952	5475	5220	8715	5320	5230	9052	5347
- Light	480	1724	870	665	2341	1512	741	1207	757	680	1054	728	591	1013	632	492	792	466	436	765	473	457	782	427
- Heavy	219	560	315	268	744	520	241	339	262	195	255	194	173	230	187	168	217	175	110	186	130	104	131	95
TOTAL	6304	21999	10948	8227	30764	20321	9307	14806	9900	9163	14174	9455	7909	12742	8257	5957	9959	6116	5765	9665	5924	5790	9965	5869
Total Vehicle Kilometres Travelled (VKT)	14698.2	23198.8	18797.2	17258	26390	21531	18416	24840	19218	18545	24914	18947	18700	25143	19174	19029	24929	19086	19003	25272	19388	18964	25307	19103
Total vehicle hours travelled (VHT)	299.4	550.2	398.6	354	686	537	358	485	369	363	489	367	359	486	365	355	468	353	363	489	377	361	484	359
Unreleased Trips	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0







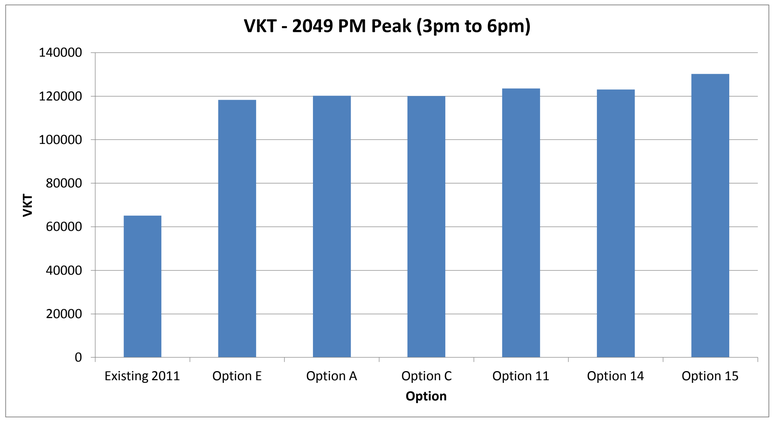


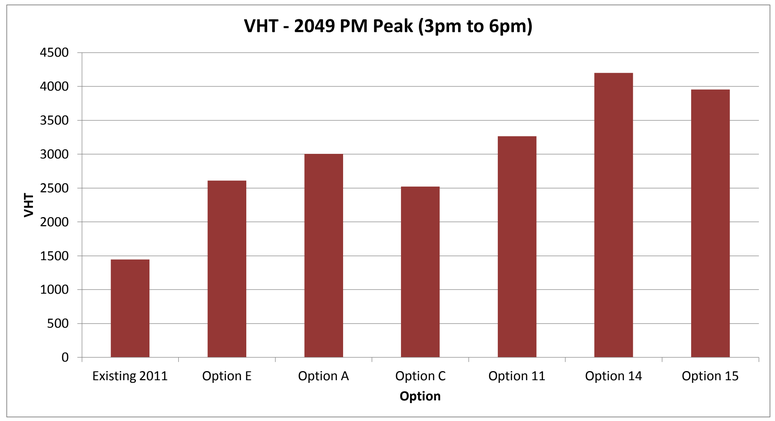
IS21352
Main Road 83 Summerland Way, Grafton - RODR

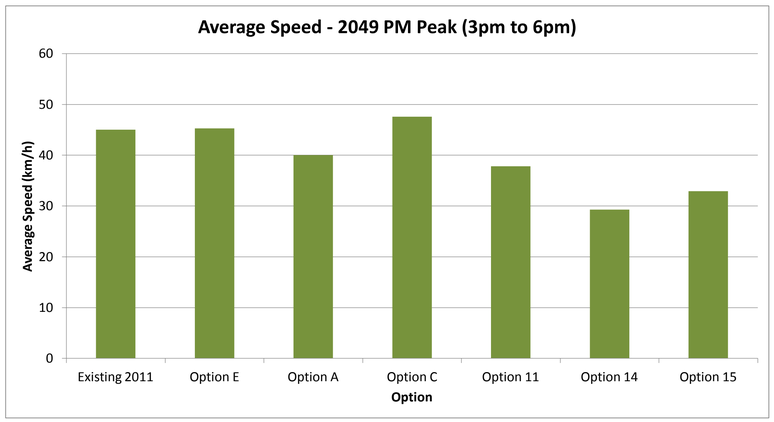
MICROSIMULATION MODELLING RESULTS (FINAL)

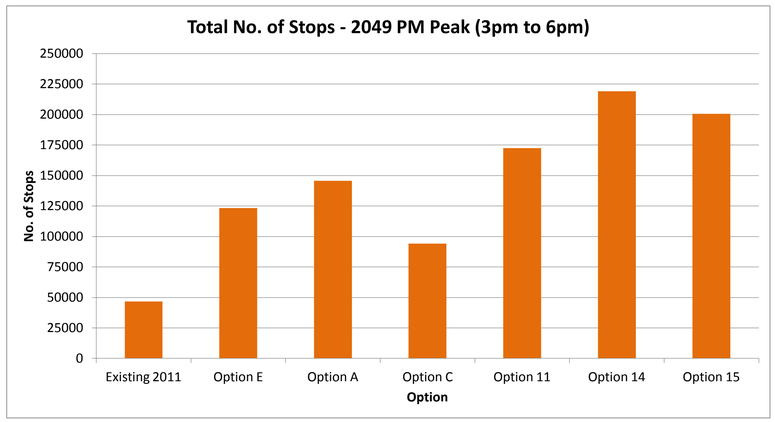
Network Statistics - PM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2049			Option E 2049			Option A 2049			Option C 2049			Option 11 2049			Option 14 2049			Option 15 2049		
	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm
Total no. of incompleted trips (no. of vehicles)	531	463	315				993	854	656	1182	972	692	920	817	660	1236	1182	693	1629	1555	1028	1482	1379	896
Total no. of completed trips (no. of vehicles)																								
- Cars	6511	6697	5545				11683	11614	9752	11609	11585	9837	11784	11491	9667	11510	11326	10038	15207	11088	10303	15479	11315	10138
- Light	550	553	446				983	958	772	944	986	798	999	939	796	944	926	822	1269	885	855	1267	907	852
- Heavy	129	134	115				133	97	77	134	106	80	123	93	79	124	101	85	165	108	86	170	102	87
TOTAL	7190	7384	6106				12799	12669	10601	12688	12677	10715	12907	12523	10542	12578	12353	10945	16641	12081	11244	16916	12324	11076
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.2				3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.5	3.4
Average travel time per vehicle (min/veh) per completed trip	3.8	4.3	3.9				4.3	4.2	3.9	4.7	5.1	4.3	4.1	4.0	3.9	4.6	5.7	5.0	4.8	7.5	7.3	4.7	6.9	6.3
Average speed (km/h)	45.8	41.5	48.8				44.1	44.5	47.8	39.8	37.2	44.3	46.5	47.6	49.0	41.7	33.6	39.3	36.0	25.7	27.0	41.2	28.8	32.5
Average delay per completed trip (sec)	15	44	7				40	39	22	68	93	45	28	23	15	48	116	75	56	233	205	48	176	139
Freeflow Time (hrs)	443	459	399				804	784	654	789	783	662	822	792	669	835	816	715	1116	836	760	1149	857	763
Total no. of Stops*																						0	0	0
- Cars	14040	18450	10350				44790	41610	26912	51143	52166	30317	34378	30204	21614	50014	66886	41410	60568	76685	63938	58122	71558	54452
- Light	1118	1509	809				3637	3390	2134	4161	4437	2486	2912	2438	1750	4014	5592	3435	5012	6044	5334	4742	5688	4462
- Heavy	168	185	116				415	308	224	407	370	229	351	248	200	397	494	287	571	627	373	499	444	328
TOTAL	15326	20144	11276				48842	45278	29271	55712	56972	33032	37641	32890	23564	54425	72971	45132	66151	83356	69646	63304	77690	59522
Total Vehicle Kilometres Travelled (VKT)	22042	22984	20064				42366	41366	34536	42477	42111	35609	43157	41692	35177	43775	42648	37130	39473	43979	39579	45493	45011	39697
Total vehicle hours travelled (VHT)	481	554	411				961	929	723	1068	1133	803	929	875	718	1049	1271	945	1026	1711	1466	1172	1564	1220
Unreleased Trips	0	0	0				0	0	0	45	69	8	0	0	0	5	110	0	101	568	189	46	255	26







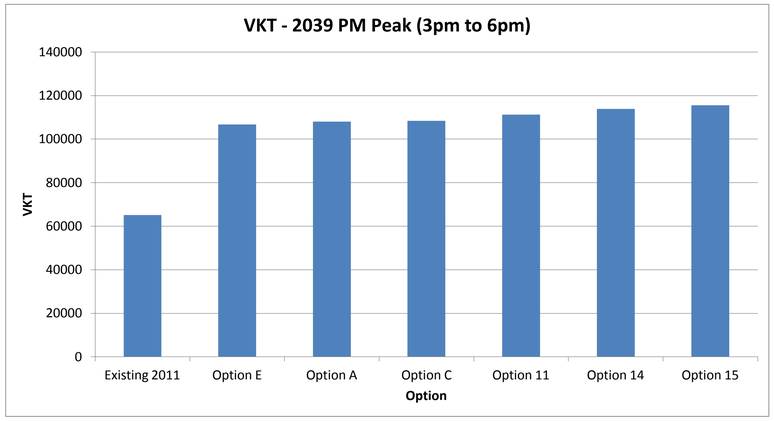


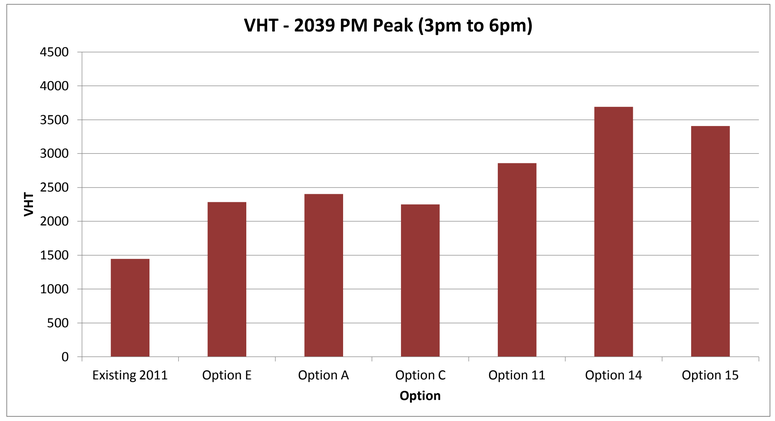
IS21352
Main Road 83 Summerland Way, Grafton - RODR

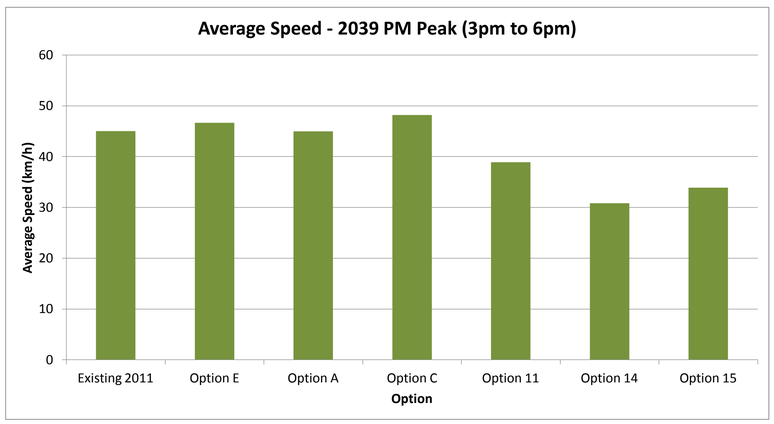
MICROSIMULATION MODELLING RESULTS (FINAL)

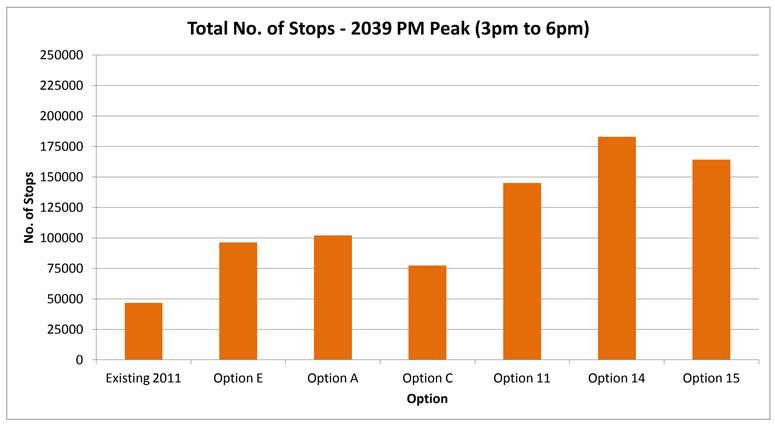
Network Statistics - PM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2039			Option E 2039			Option A 2039			Option C 2039			Option 11 2039			Option 14 2039			Option 15 2039		
	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm
Total no. of incompleted trips (no. of vehicles)	531	463	315				856	770	602	916	784	600	820	751	614	1083	1032	611	1359	1334	860	1316	1198	713
Total no. of completed trips (no. of vehicles)																								
- Cars	6511	6697	5545				10955	10790	9070	10999	10704	9069	11011	10725	8953	10741	10610	9283	10482	10385	9468	10480	10549	9464
- Light	559	553	446				924	871	756	911	884	747	926	892	751	896	878	753	852	848	808	858	864	792
- Heavy	129	134	115				127	104	84	128	102	89	123	102	84	119	99	83	116	102	87	123	109	88
TOTAL	7190	7384	6106				12006	11765	9911	12038	11690	9906	12060	11720	9786	11756	11588	10119	11451	11335	10363	11461	11522	10343
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.2				3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.3	3.3	3.2	3.3	3.3	3.3
Average travel time per vehicle (min/veh) per completed trip	3.8	4.3	3.9				4.0	3.9	3.8	4.2	4.1	3.9	3.9	3.9	3.8	4.4	5.4	4.6	4.7	6.8	6.6	4.6	6.5	5.7
Average speed (km/h)	45.8	41.5	48.8				45.8	46.3	48.2	43.6	44.7	47.2	47.6	48.0	49.1	41.9	34.4	41.8	38.5	26.8	29.2	40.1	29.0	34.4
Average delay per completed trip (sec)	15	44	7				29	27	19	46	40	28	20	18	13	44	105	53	58	184	167	50	165	115
Freeflow Time (hrs)	443	459	399				730	706	595	728	699	590	749	722	605	755	747	649	759	753	685	771	768	686
Total no. of Stops*																								
- Cars	14040	18450	10350				34448	31434	22220	38069	33006	22620	27421	25176	18042	41101	59846	32039	45043	68366	54366	41914	62848	45589
- Light	1118	1509	809				2836	2595	1923	3051	2704	1823	2288	2141	1522	3419	4990	2731	3690	5571	4798	3484	5309	3976
- Heavy	168	185	116				309	254	211	301	262	220	290	237	179	321	438	262	358	529	310	320	472	247
TOTAL	15326	20144	11276				37593	34283	24353	41421	35972	24663	29998	27555	19743	44841	65273	35032	49092	74466	59474	45717	68629	49812
Total Vehicle Kilometres Travelled (VKT)	22042	22984	20064				38327	37090	31277	38984	37430	31642	39100	37708	31585	39170	38666	33445	39474	39168	35233	40214	39937	35379
Total vehicle hours travelled (VHT)	481	554	411				836	801	649	895	838	671	821	786	644	935	1125	800	1025	1460	1207	1003	1377	1027
Unreleased Trips	0	0	0				0	0	0	0	0	0	0	0	0	8	20	0	17	251	129	10	166	25







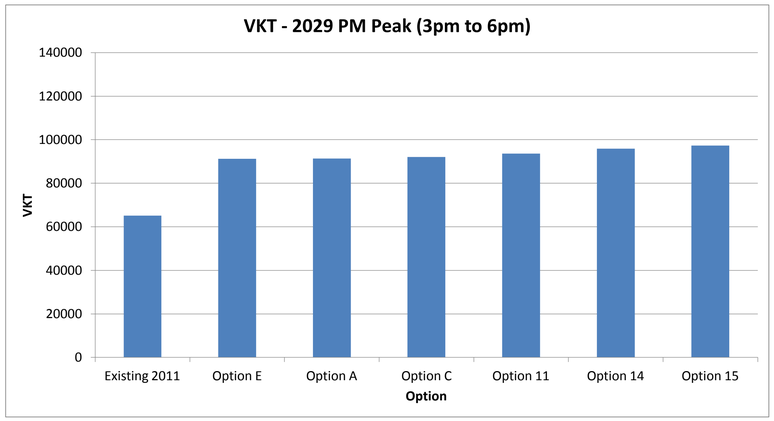


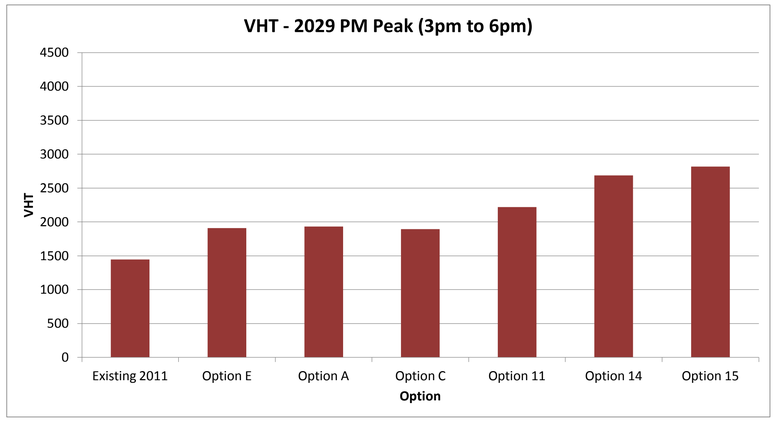
IS11352
Main Road 83 Summerland Way, Grafton - RODR

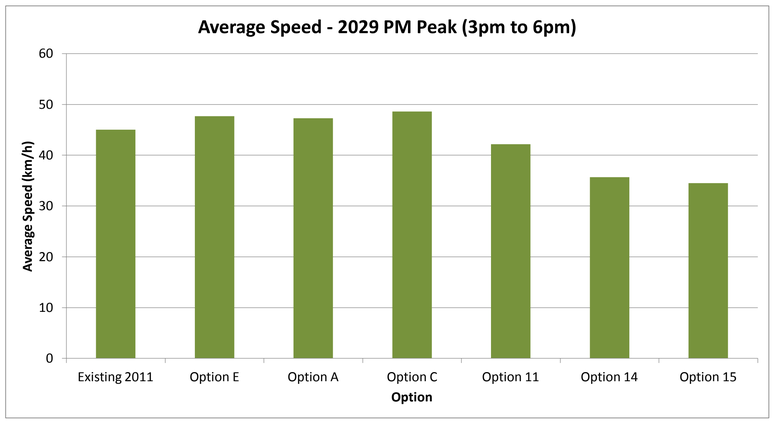
MICROSIMULATION MODELLING RESULTS (FINAL)

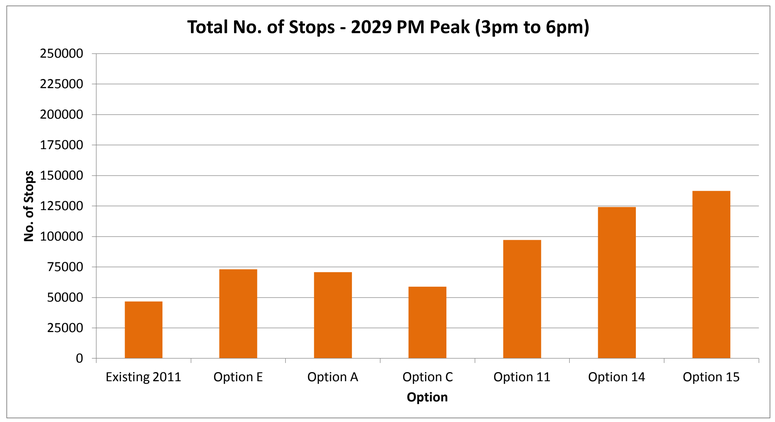
Network Statistics - PM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2029			Option E 2029			Option A 2029			Option C 2029			Option 11 2029			Option 14 2029			Option 15 2029		
	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm
Total no. of incompleted trips (no. of vehicles)	531	463	315				700	615	445	714	627	460	689	616	469	825	763	449	1031	926	475	1083	950	490
Total no. of completed trips (no. of vehicles)																								
- Cars	6511	6697	5545				9502	9305	7870	9556	9305	7874	9490	9328	7868	9391	9245	8022	9176	9359	8177	9196	9306	8233
- Light	550	553	446				799	783	651	793	773	655	794	745	653	766	761	650	776	766	670	765	759	685
- Heavy	129	134	115				118	95	82	114	91	78	123	95	77	118	96	77	118	93	77	115	103	81
TOTAL	7190	7384	6106				10419	10182	8604	10463	10169	8607	10408	10168	8598	10275	10102	8748	10069	10218	8923	10076	10168	8999
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.2				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2
Average travel time per vehicle (min/veh) per completed trip	3.8	4.3	3.9				3.8	3.8	3.7	3.9	3.8	3.7	3.7	3.7	3.7	4.1	4.6	4.4	4.3	5.9	5.1	4.4	6.2	5.5
Average speed (km/h)	45.8	41.5	48.8				47.1	47.6	48.6	46.7	47.2	48.1	48.2	48.5	49.2	45.0	39.5	42.4	41.4	30.7	36.7	40.4	29.7	35.2
Average delay per completed trip (sec)	15	44	7				22	21	16	29	26	22	16	15	12	26	59	45	38	134	86	45	151	102
Freeflow Time (hrs)	443	459	399				624	606	511	617	595	500	631	616	521	650	635	548	651	658	571	656	661	583
Total no. of Stops*																								
- Cars	14040	18450	10350				25629	23509	17631	25005	22712	16991	20332	19078	14265	27935	36614	24683	31144	50293	32407	33953	54186	37838
- Light	1118	1509	809				2125	2001	1412	2068	1895	1424	1724	1526	1233	2315	2840	2051	2507	4061	2746	2728	4415	3275
- Heavy	168	185	116				268	263	220	200	194	176	231	206	155	298	282	194	257	442	228	276	362	256
TOTAL	15326	20144	11276				28022	25773	19264	27273	24801	18591	22287	20810	15652	30568	39736	26928	33908	54796	35382	36957	58964	41369
Total Vehicle Kilometres Travelled (VKT)	22042	22984	20064				32642	31780	26762	32924	31760	26701	32851	32087	27167	33303	32425	27898	33376	33651	28882	33710	33911	29668
Total vehicle hours travelled (VHT)	481	554	411				693	668	551	705	673	555	681	661	552	741	821	658	805	1095	787	835	1141	842
Unreleased Trips	0	0	0				0	0	0	0	0	0	0	0	0	0	52	0	2	49	0	14	111	0







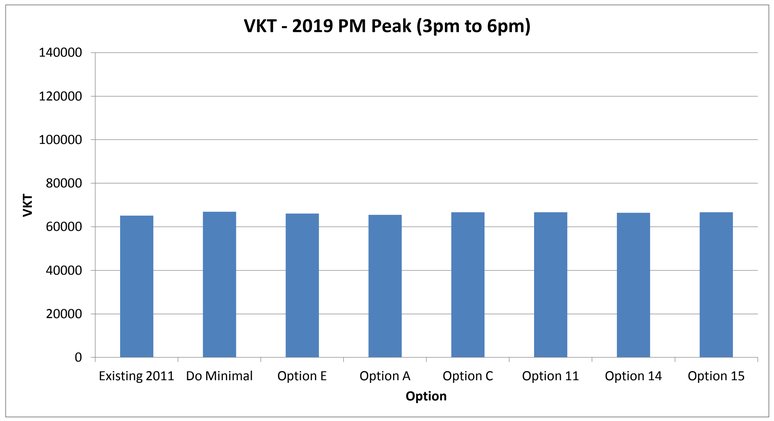


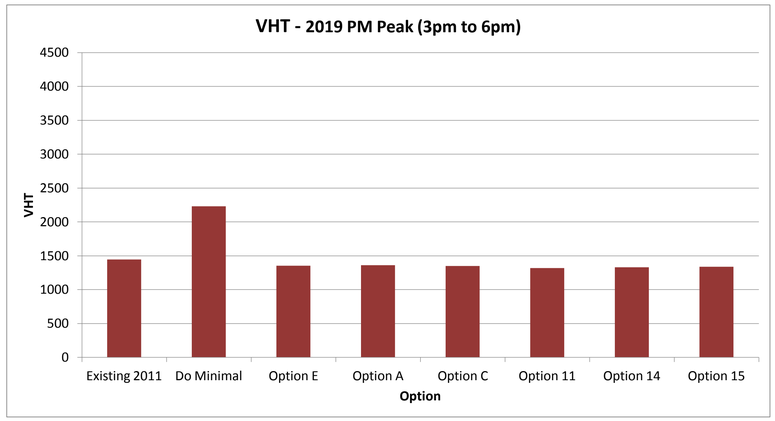
IS1352
Main Road 83 Summerland Way, Grafton - RODR

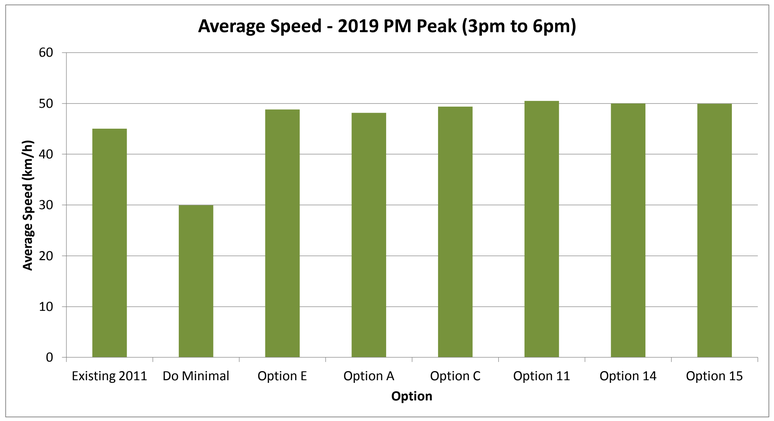
MICROSIMULATION MODELLING RESULTS (FINAL)

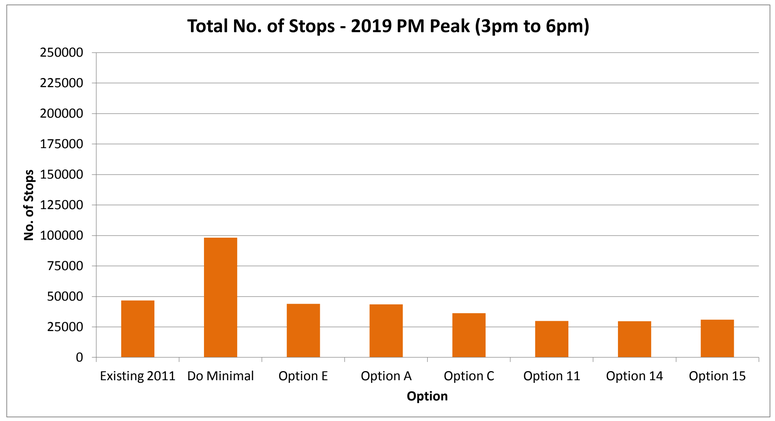
Network Statistics - PM Peak
Tuesday, 3 July 2012

Network Statistics	OPTION																							
	Existing Conditions 2011			Do Minimal 2019			Option E 2019			Option A 2019			Option C 2019			Option 11 2019			Option 14 2019			Option 15 2019		
	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm	3-4pm	4-5pm	5-6pm
Total no. of incompleted trips (no. of vehicles)	531	463	315	728	863	534	475	456	315	500	449	319	478	438	321	476	428	312	498	434	310	504	441	328
Total no. of completed trips (no. of vehicles)																						0	0	0
- Cars	6511	6697	5545	7100	6871	6154	7297	7111	6023	7261	7217	6007	7343	7130	6030	7317	7186	6032	7258	7178	5964	7266	7180	6000
- Light	550	553	446	591	563	508	623	581	497	598	594	495	610	589	484	603	597	490	589	573	509	602	596	494
- Heavy	129	134	115	74	62	70	77	72	63	81	70	63	91	73	59	83	74	60	80	75	66	78	71	66
TOTAL	7190	7384	6106	7765	7496	6731	7997	7764	6582	7941	7882	6565	8044	7792	6573	8003	7857	6582	7927	7826	6538	7946	7848	6560
Average vehicle KM travelled per vehicle (km/veh) per completed trip	2.9	3.0	3.2	2.8	2.9	2.9	2.8	2.8	2.9	2.8	2.8	2.8	2.9	2.8	2.9	2.9	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Average travel time per vehicle (min/veh) per completed trip	3.8	4.3	3.9	4.1	5.5	6.6	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.5	3.4	3.4	3.5	3.4	3.4
Average speed (km/h)	45.8	41.5	48.8	39.6	27.5	25.4	48.5	48.6	49.3	47.9	48.1	48.5	49.2	49.2	49.8	50.3	50.3	51.0	49.7	49.9	50.5	49.5	49.9	50.5
Average delay per completed trip (sec)	14.8	43.6	7.2	35	120	176	14	13	12	20	20	18	11	10	8	0	0	0	1	1	0	2	1	0
Freeflow Time (hrs)	442.9	459.3	398.7	483	473	429	455	441	372	439	433	360	465	443	376	475	461	386	475	464	389	476	466	392
Total no. of Stops*																						0	0	0
- Cars	14040	18450	10350	24024	35754	29991	15117	14177	10819	14639	14306	10830	12537	11696	8923	10318	9800	7067	10366	9804	6998	10791	10187	7431
- Light	1118	1509	809	2041	2939	2563	1296	1191	941	1225	1234	882	1073	976	698	888	844	616	820	780	598	910	830	633
- Heavy	168	185	116	183	325	327	136	139	128	125	126	117	149	105	86	120	110	97	105	114	87	90	84	66
TOTAL	15326	20144	11276	26249	39019	32881	16549	15507	11887	15988	15666	11829	13738	12777	9707	11326	10755	7780	11291	10697	7683	11792	11101	8129
Total Vehicle Kilometres Travelled (VKT)	22042.0	22983.6	20063.8	23438	22837	20601	23677	22930	19431	23304	23034	19186	24146	22969	19538	23955	23187	19482	23777	23220	19505	23762	23351	19611
Total vehicle hours travelled (VHT)	480.9	553.5	411.3	592	829	810	488	471	394	486	479	395	491	467	392	476	461	382	479	466	386	480	468	389
Unreleased Trips	0	0	0	4	128	190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0









Appendix E

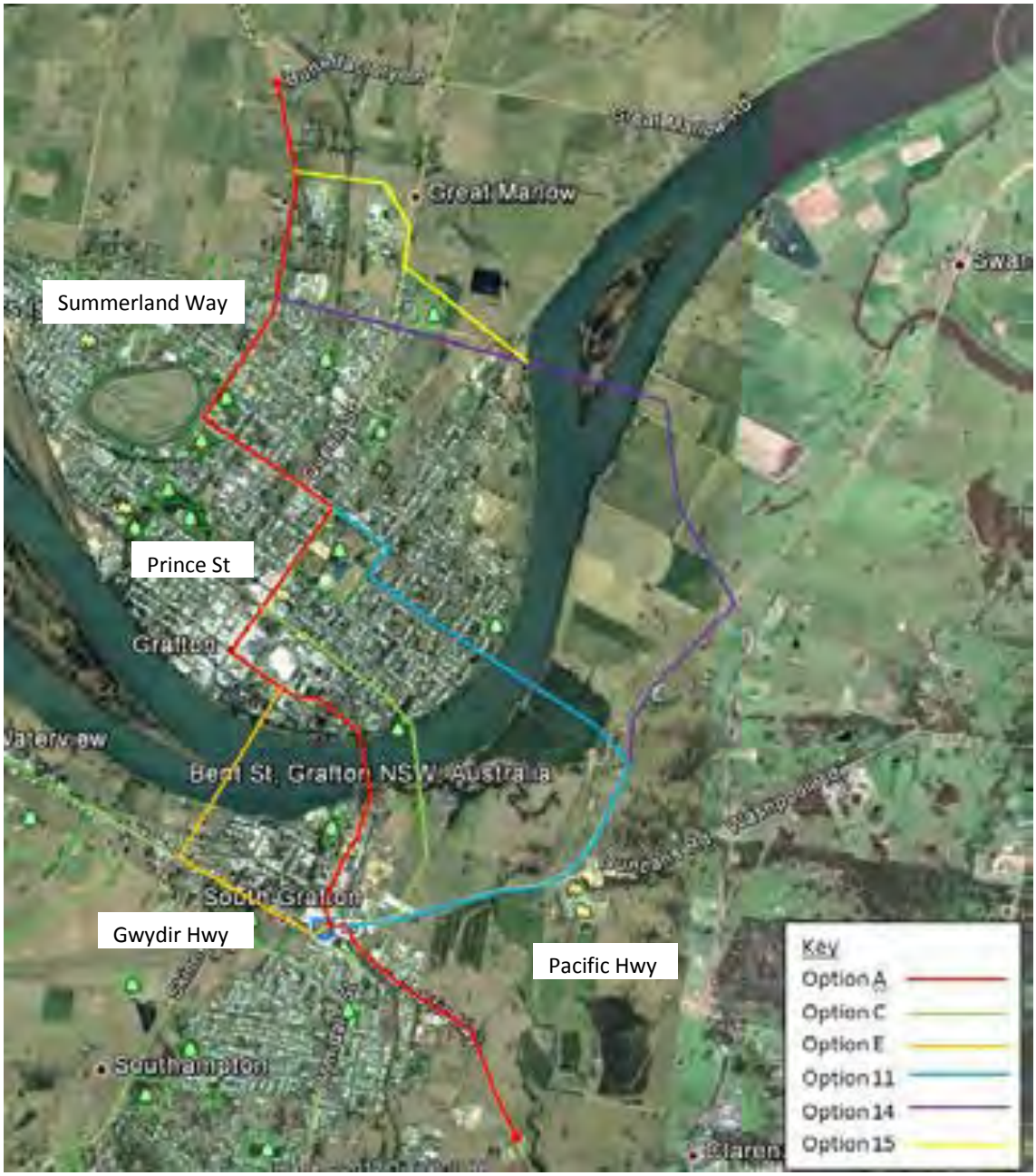
Point to Point Travel Time Results and Routes

Route 1, Tyson St to Pound St

Route 2, Centenary Dr to Pound St

Route 3, Pound St to Butterfactory Ln

Route 4, Tyson St to Butterfactory Ln via Propsed Bridge



Route 1, Point to Point Travel Times (seconds)

Design Year	Scenario	AM (8-9AM)		PM (4-5PM)	
		NB	SB	NB	SB
2011	Observed	572	379	416	502
	Base	621	346	450	464
2019	Do Minimal	792	724	628	1354
	E	411	392	416	373
	A	401	416	407	392
	C	404	407	404	359
	11	419	342	418	354
	14	423	421	416	360
	15	425	353	420	359
2029	E	412	403	412	383
	A	417	434	417	398
	C	410	411	410	363
	11	439	348	439	456
	14	671	362	671	486
	15	677	358	677	472
2039	E	411	436	424	395
	A	435	426	519	418
	C	408	365	418	371
	11	435	355	791	569
	14	756	374	841	606
	15	734	369	880	504
2049	E	414	435	428	429
	A	505	506	589	537
	C	414	376	428	371
	11	461	531	822	607
	14	861	576	894	701
	15	839	705	852	616

Route 2, Point to Point Travel Times (seconds)

Design Year	Scenario	AM (8-9AM)		PM (4-5PM)	
		WB	EB	WB	EB
2011	Observed	650	462	494	585
	Base	711	452	524	572
2019	Do Minimal	883	546	575	748
	E	498	486	503	472
	A	492	453	496	485
	C	511	521	511	473
	11	516	450	515	461
	14	516	527	510	464
	15	514	456	511	461
2029	E	503	489	510	480
	A	510	463	511	493
	C	521	528	517	479
	11	536	453	663	561
	14	766	466	903	585
	15	768	461	905	573
2039	E	505	498	514	486
	A	532	471	552	515
	C	524	486	527	488
	11	534	458	890	668
	14	853	476	939	704
	15	825	470	954	592
2049	E	515	498	522	510
	A	605	484	570	634
	C	538	592	531	490
	11	562	462	924	684
	14	957	495	988	750
	15	927	479	945	698

Route 3, Point to Point Travel Times (seconds)

Design Year	Scenario	AM (8-9AM)		PM (4-5PM)	
		NB	SB	NB	SB
2011	Observed	324	913	324	757
	Base	276	906	299	732
2019	Do Minimal	287	277	283	309
	E	287	281	281	281
	A	285	278	282	278
	C	287	278	282	278
	11	282	280	277	280
	14	286	284	280	283
	15	293	292	290	290
2029	E	299	283	291	283
	A	304	281	291	279
	C	299	281	289	280
	11	304	282	285	283
	14	297	289	286	284
	15	301	294	295	292
2039	E	311	285	296	284
	A	323	282	295	281
	C	323	282	298	281
	11	316	284	292	284
	14	309	293	292	286
	15	305	295	298	292
2049	E	348	286	309	284
	A	326	283	310	400
	C	335	285	304	282
	11	352	285	297	284
	14	324	298	311	289
	15	313	297	300	296

Route 4, Point to Point Travel Times (seconds)

Design Year	Scenario	AM (8-9AM)		PM (4-5PM)	
		NB	SB	NB	SB
2011	Observed*	913	703	757	826
	Base*	906	622	732	764
2019	Do Minimal	1080	1001	911	1664
	E	684	671	670	650
	A	687	693	688	670
	C	582	589	581	567
	11	589	585	576	571
	14	592	581	573	564
	15	589	580	578	564
2029	E	712	687	688	668
	A	720	715	710	677
	C	600	602	596	575
	11	611	590	587	575
	14	583	582	575	566
	15	598	580	589	569
2039	E	727	722	703	682
	A	758	708	814	699
	C	647	643	605	581
	11	625	598	595	585
	14	589	591	577	571
	15	593	582	590	573
2049	E	875	712	744	727
	A	831	786	899	937
	C	791	674	623	591
	11	683	595	601	590
	14	586	592	581	587
	15	600	586	589	574

* Observed and Base travel time results utilise the existing bridge.

Appendix F

Bridge Volumes

IS11352
Main Road 83 Summerland Way, Grafton - RODR

MICROSIMULATION MODELLING RESULTS
Bridge Crossing Volumes - AM Peak (7-9AM)

		AM Peak					
Year	Options	EXISTING BRIDGE			NEW BRIDGE		
		Northbound	Southbound	Total	Northbound	Southbound	Total
2011	Base Model 2011	2167	1450	3617	N/A	N/A	N/A
2019	Do Minimal	2314	1625	3939	N/A	N/A	N/A
	E	762	622	1384	1690	1007	2697
	A	N/A	915	915	2460	728	3188
	C	936	420	1356	1583	1226	2808
	11	1796	1000	2796	677	619	1296
	14	1982	1231	3212	508	428	936
	15	1993	1248	3241	505	417	921
2029	E	1058	791	1849	2491	1557	4048
	A	N/A	1492	1492	3552	850	4402
	C	1266	533	1798	2285	1839	4123
	11	2414	1413	3827	1123	955	2079
	14	2538	1648	4186	856	689	1545
	15	2560	1713	4273	840	629	1468
2039	E	1212	1209	2421	2997	1643	4640
	A	N/A	1725	1725	4250	1090	5340
	C	1360	753	2113	2846	2043	4889
	11	2498	1404	3902	1617	1444	3061
	14	2609	2060	4669	1261	830	2090
	15	2635	2083	4718	1235	788	2023
2049	E	1392	1372	2764	3397	1834	5231
	A	N/A	2137	2137	4852	1067	5919
	C	1641	897	2539	3164	2267	5431
	11	2607	1772	4379	2127	1388	3515
	14	2652	2212	4864	1714	960	2673
	15	2654	2248	4902	1664	915	2578

Bridge Crossing Volumes - PM Peak (3-5PM)

		PM Peak					
Year	Options	EXISTING BRIDGE			NEW BRIDGE		
		Northbound	Southbound	Total	Northbound	Southbound	Total
2011	Base Model 2011	2037	2544	4581	N/A	N/A	N/A
2019	Do Minimal	2422	2663	5086	N/A	N/A	N/A
	E	847	1395	2243	1604	1636	3240
	A	N/A	1835	1835	2463	1140	3603
	C	1207	1277	2483	1210	1762	2972
	11	2043	2287	4331	355	694	1049
	14	2170	2399	4570	253	616	869
	15	2220	2476	4696	238	596	835
2029	E	1075	1694	2769	2356	2451	4807
	A	N/A	2705	2705	3465	1454	4919
	C	1569	1680	3250	1908	2436	4343
	11	2569	2868	5437	837	1167	2004
	14	2654	2865	5519	648	1127	1775
	15	2658	2874	5531	726	1181	1906
2039	E	1229	1985	3214	2656	2776	5432
	A	N/A	2810	2810	3858	1992	5849
	C	1741	2061	3802	2150	2725	4875
	11	2652	2911	5563	1145	1738	2883
	14	2664	2924	5588	942	1549	2491
	15	2650	2906	5556	1023	1720	2743
2049	E	1282	2198	3480	2897	3208	6106
	A	N/A	3155	3155	4152	2151	6303
	C	1761	2235	3996	2456	3095	5551
	11	2653	2921	5574	1384	2245	3629
	14	2663	2919	5582	1149	2130	3279
	15	2663	2921	5585	1236	2248	3484

Appendix G

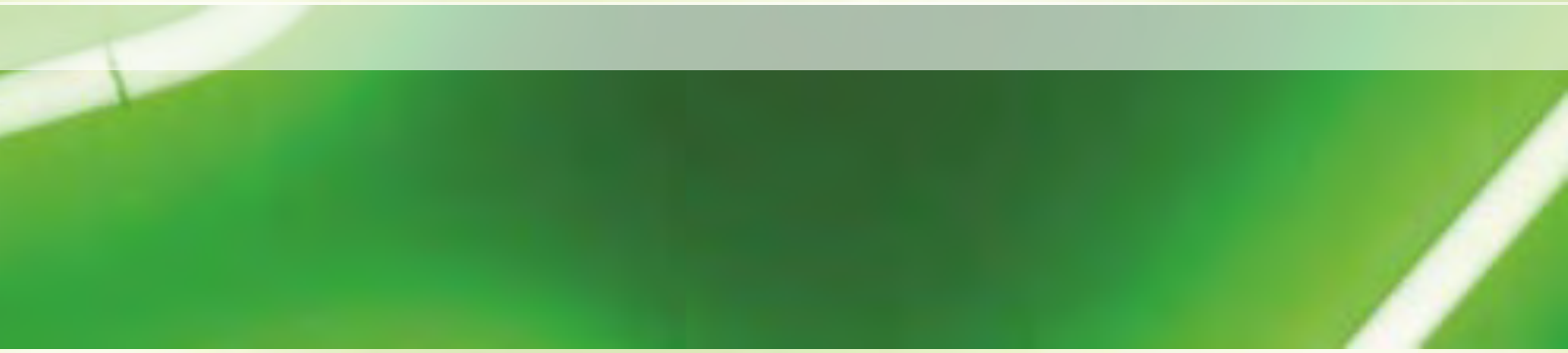
Annualised BCR Calculations for All Recorded Trips (Completed and Incompleted)

Appendix G: Annualised BCR Calculations for all recorded trips (completed and incompleted)

		Daily												Annual			
		AM Peak (7-9pm)				PM Peak (3-5pm)				Off Peak							
Year	Option	VKT (km)	VHT (Hrs)	Stops (No.)	Speed (km/h)	VKT (km)	VHT (Hrs)	Stops (No.)	Speed (km/h)	VKT (km)	VHT (Hrs)	Stops (No.)	Speed (km/h)	VKT (km)	VHT (Hrs)	Stops (No.)	Speed (km/h)
2011	Base Year	37893	849	28303	45.6	45023	1034	35470	43.7	175347	4143	159273	42.3	86517826	2018962	74720477	42.9
2019	"Do Minimum"	43644	1040	38997	43.6	46274	1420	65266	33.6	195348	4616	177441	42.3	95564127	2370626	94371007	40.3
	Option E	43257	843	24112	51.4	46602	959	32053	48.6	192629	3892	122693	49.5	94633246	1907556	59917287	49.6
	Option A	43456	852	23337	51.0	46335	966	31653	48.0	196025	4055	120221	48.3	95748511	1967231	58695713	48.7
	Option C	43842	845	20647	51.9	47112	957	26513	49.2	193060	3834	97691	50.4	95144428	1888285	48525092	50.4
	Option 11	43955	823	15915	53.4	47135	937	22079	50.3	192913	3755	74710	51.4	95141148	1847583	37755501	51.5
	Option 14	44271	852	15429	52.0	46990	944	21988	49.8	195840	3834	77705	51.1	96178946	1886012	38566134	51.0
	Option 15	44265	844	15753	52.4	47108	948	22895	49.7	195031	3813	77015	51.2	95945458	1877857	38747295	51.1
2029	Indicative "Do Minimum"	57798	1514	78729	39.7	61281	2067	131763	30.6	258701	6717	358230	38.5	126556225	3449786	190521894	36.7
	Option E	59642	1191	39070	50.1	64419	1361	53791	47.4	248642	5024	158370	49.5	124855709	2537977	84162623	49.2
	Option A	60227	1208	36421	49.9	64681	1378	52067	46.9	253026	5234	155180	48.3	126607796	2619554	81628675	48.3
	Option C	60263	1182	32287	51.0	64935	1342	43095	48.4	249199	4949	126098	50.4	125422909	2503605	67495598	50.1
	Option 11	60849	1195	31133	51.1	65726	1562	70303	42.2	249010	4847	96434	51.4	125820822	2547312	66286834	49.4
	Option 14	60714	1304	40260	47.2	67021	1900	88701	36.1	252788	4948	100301	51.1	127475380	2731232	76802758	46.7
	Option 15	59619	1299	41345	46.6	67612	1976	95923	35.0	251744	4922	99410	51.2	126956531	2745974	79287229	46.2
2039	Indicative "Do Minimum"	67649	1820	97297	38.6	71725	2485	162840	29.8	302793	8075	442719	37.5	148125859	4147441	235456826	35.7
	Option E	70802	1433	49369	49.5	75414	1636	71867	46.1	289155	5843	184174	49.5	145849162	2985692	102312367	48.8
	Option A	72074	1482	49952	48.7	76412	1732	77384	44.1	294253	6087	180464	48.3	148317407	3115785	103113066	47.6
	Option C	71822	1465	44550	49.3	76811	1606	57550	47.8	289802	5756	146644	50.4	146875734	2957063	83329271	49.7
	Option 11	73052	1470	46237	50.1	77835	2060	110118	38.1	289582	5637	112147	51.4	147557024	3070648	89948285	48.1
	Option 14	71882	1665	51797	44.8	78644	2486	123569	32.7	293976	5755	116643	51.1	148908431	3318230	97822927	44.9
	Option 15	71530	1647	53579	44.8	80146	2380	114357	34.6	292762	5723	115608	51.2	148886438	3266452	94987155	45.6
2049	Indicative "Do Minimum"	73566	2067	114022	37.0	77998	2822	190831	28.5	329276	9169	518819	35.9	161081441	4709324	275930006	34.2
	Option E	79495	1742	72582	46.0	83732	1889	94114	44.3	310235	6269	197601	49.5	158610103	3316573	122039425	47.8
	Option A	81538	1737	64507	47.2	84583	2202	112677	38.5	315704	6530	193620	48.3	161411313	3507153	124219289	46.0
	Option C	81151	1806	67898	45.4	84850	1804	70525	47.1	310929	6175	157335	50.4	159771573	3277872	99079062	48.7
	Option 11	81895	1749	63663	47.4	86421	2320	127404	37.7	310693	6048	120323	51.4	160468157	3388796	104315423	47.4
	Option 14	80186	2131	75413	39.6	87954	2934	142321	30.8	315408	6174	125147	51.1	161988536	3765130	114865374	43.0
	Option 15	78538	2203	74547	38.0	90499	2736	133041	33.8	314105	6141	124036	51.2	161852474	3711584	111093843	43.6

Notes: -Annual costs calculated using annualisation factor of 335.

-Indicative "Do Minimum" case for 2029 - 2049 obtained through estimation process as described in Ch 5.4 of GTA RODR Report.



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