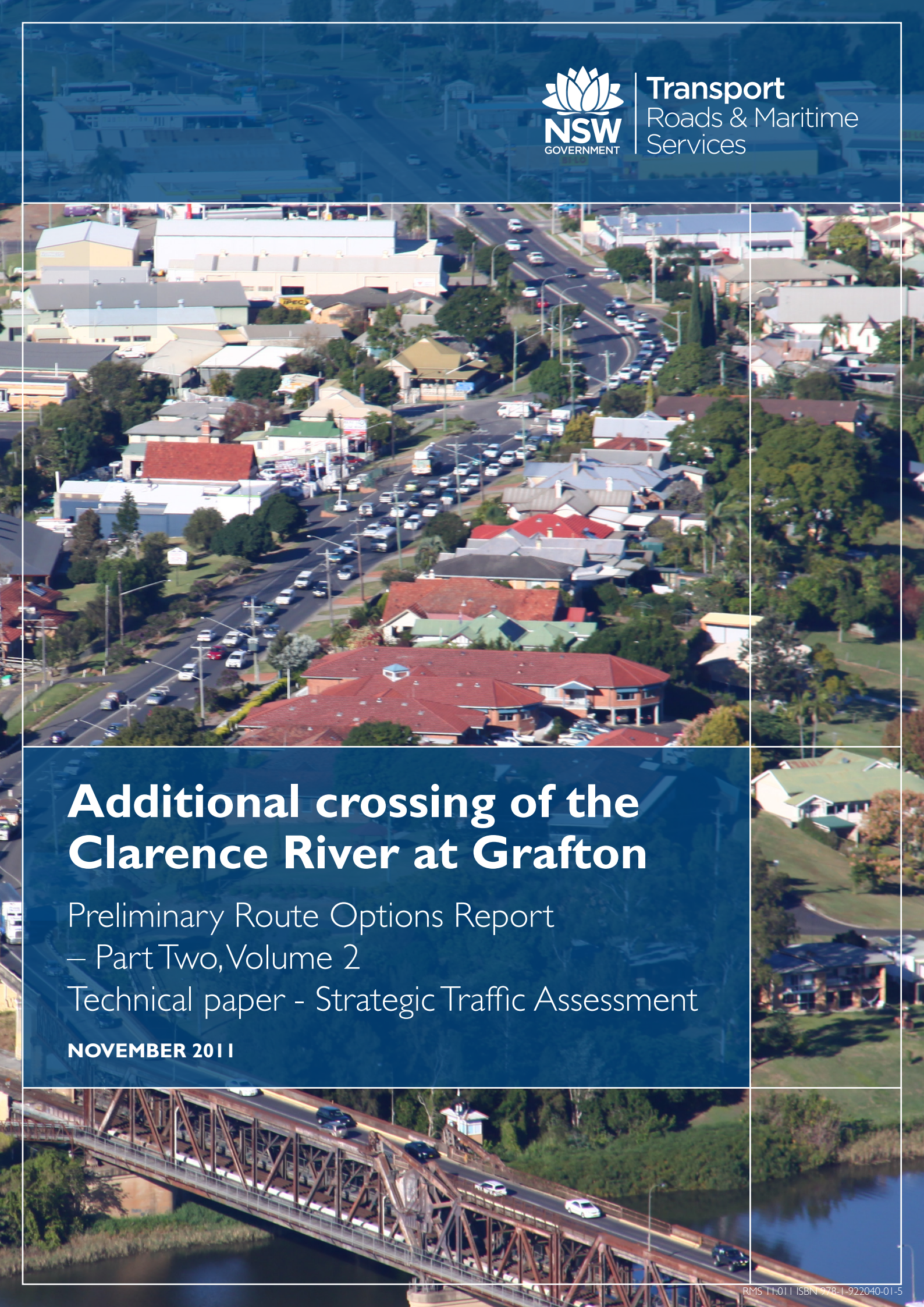

NSW GOVERNMENT
Transport
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Additional crossing of the Clarence River at Grafton

Preliminary Route Options Report – Part Two, Volume 2 Technical paper - Strategic Traffic Assessment

NOVEMBER 2011

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Main Road 83 Summerland Way

Additional Crossing of the Clarence River, Grafton

Strategic Traffic Assessment

transportation planning, design and delivery

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GTAconsultants

Executive Summary

Strategic transport modelling of Grafton and its surrounds has been 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.

Origin and destination (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 and surrounds.

Modelling a "do minimum" scenario (refer Section 5), 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 unacceptable 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. It would appear from the traffic count data that bridge users have timed their trip 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 have been 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.

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1. Introduction

1.1 Background

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

Strategic transport modelling of Grafton and South Grafton has been undertaken on 25 preliminary route options that were identified in the RMS June 2011 Feasibility Assessment Report and Community Update. The modelling was completed using Cube-TRIPS and was developed using a range of inputs to assess the existing and future travel patterns in and around Grafton and South Grafton.

This report sets out the strategic transport modelling undertaken for the project and provides the outcomes of the modelling for each of the 25 preliminary options.

1.2 Study Objectives

The objectives of the study are as follows:

- Obtain an understanding of the following items (both within Grafton and South Grafton and at a wider regional level):
  - existing transport demand
  - existing travel patterns
  - existing traffic flow
  - existing traffic constraints.
- Forecast future year travel demands, taking into consideration future regional and local growth.
- Undertake a strategic modelling assessment to identify the impacts on the overall road network of the 'do minimum' case and the 25 preliminary route options.

The outcomes of this report will be used to advise the project team on the relative performance of the options within each of the five corridors from a traffic and transport perspective as an input into the selection of a short list of options for further detailed investigation.

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 with 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 indicates 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 has been undertaken to develop an understanding of the existing and future traffic demands and patterns within Grafton. In particular, future demands across the river have been estimated for a range of 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 indicate that 53% of trips using the Grafton Bridge travel between external destinations and Grafton, 45% of trips are internal whilst only 2% of trips are those travelling directly through Grafton and South Grafton.

Existing conditions (do nothing) 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 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 aims 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 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 show that approximately 97% of vehicles crossing the bridge have an origin and / or destination within Grafton or South Grafton, and 3% of vehicles are through trips that do 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 a proportion of 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.

2. Approach to Preliminary Route Assessment

2.1 Introduction

The traffic assessment of the preliminary route options was informed by a strategic transport model. The strategic transport model was developed from observed travel and traffic count data. Future year population forecasts were used to estimate future year travel behaviour and how certain trips would respond to the each of the preliminary route options.

2.2 Purpose of the Strategic Model

Transport models are tools for forecasting the implications of proposed transport infrastructure improvements. Strategic traffic models such as this are typically used to inform planning decisions and not necessarily to determine the specific impacts on individual links. The purpose of the strategic traffic model is to:

- Provide an understanding of travel patterns through the study area for existing and future conditions, including the network-wide origins and destinations of traffic using key routes within and through the study area.
- Estimate changes to travel within Grafton and South Grafton for each of the 25 preliminary route options for the forecast years (2019, 2029, 2039 and 2049).
- Provide model outputs for use in route option assessment.
- Provide input to more detailed modelling assessment as part of the assessment of shortlisted route options at the next stage of the overall study.

The strategic model was developed to assess the relative performance of the route options within each of the five corridors. The model determines the network performance of each option for comparative purposes rather than providing detailed assessment of every individual component of the network. The detailed analysis will be undertaken on the short list of options at the next stage of the project at which time a microsimulation model will be used for the traffic assessment.

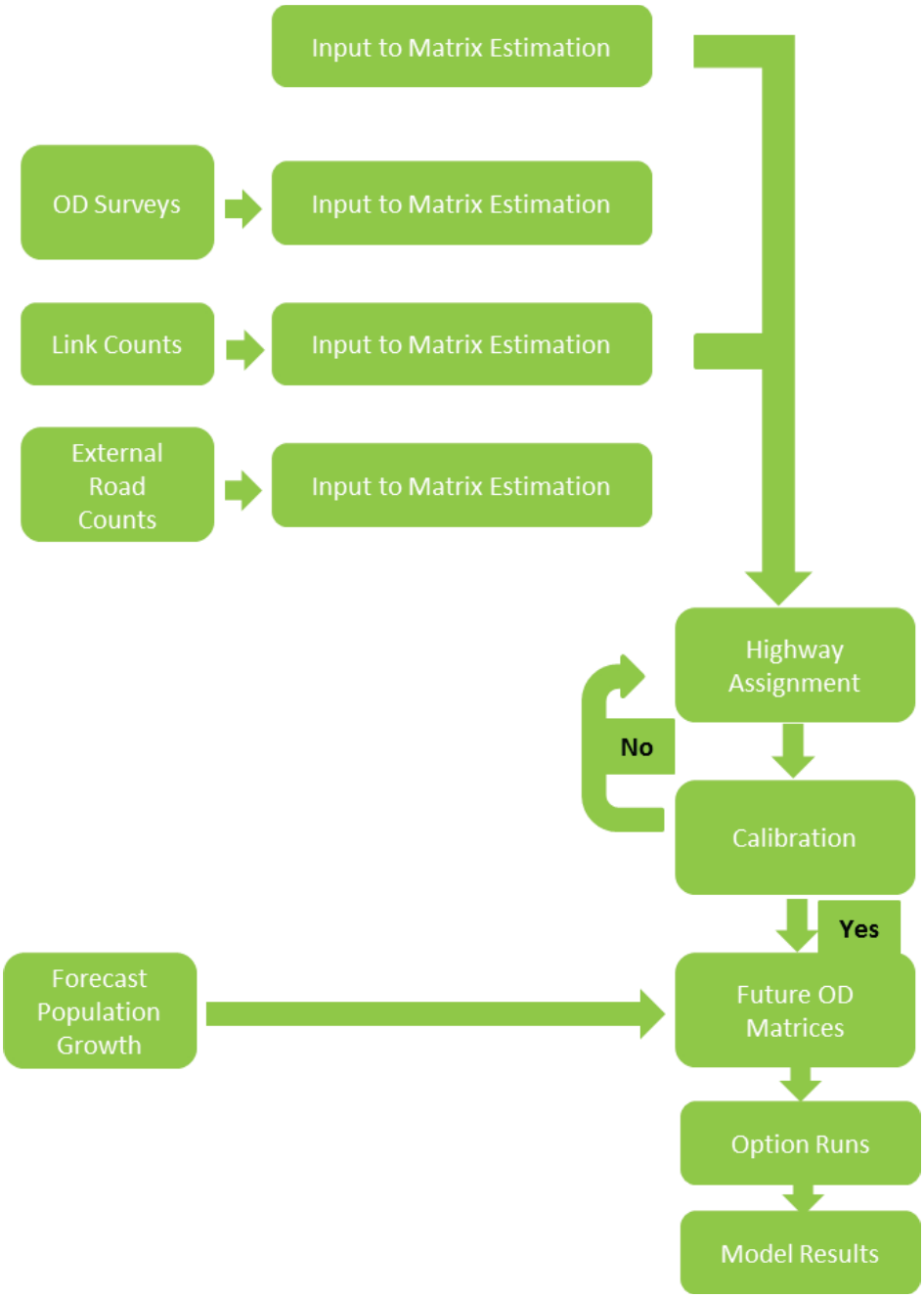
2.3 Strategic Model Methodology

The modelling methodology was designed to be flexible and iterative to ensure that the best modelling outcomes are achieved. Figure 2.1 describes the process adopted for the strategic traffic model development.

The strategic traffic modelling was developed with the Cube-TRIPS software. A 2011 base year was adopted with the model developed to suitably reflect existing conditions. Future year changes in demands resulting from land use and road network changes are able to be adequately assessed.

Further detail on the development of the strategic model is provided in Section 3.

Figure 2.1: Strategic Model Methodology

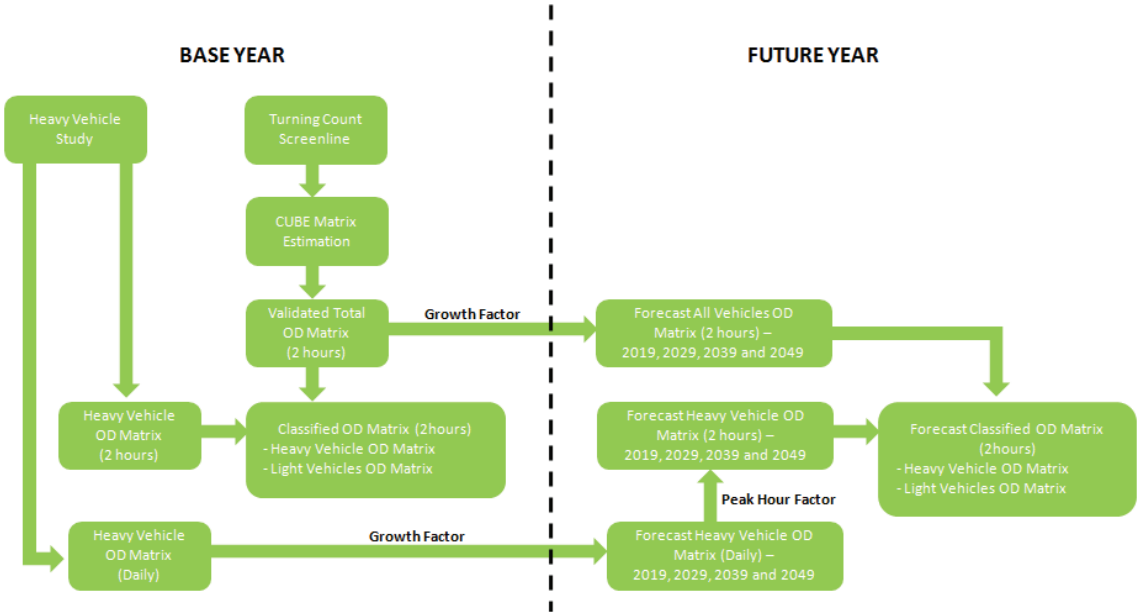


2.4 Heavy Vehicle Matrix Development

Separate matrices were developed for heavy vehicles (Austroads classes 3 to 12) and light vehicles (Austroads classes 1 and 2). An AM peak ban currently exists on the bridge for heavy vehicles (B-doubles) and assuming that all route options allow the movement of heavy vehicles, a method of estimating the heavy vehicle movements from the daily movements has been developed.

The existing pattern or movement of daily trips across the network has been used to develop the proportions of heavy vehicle movements in the future years. Figure 2.2 presents the methodology used to develop the heavy and commercial vehicle future year OD matrices.

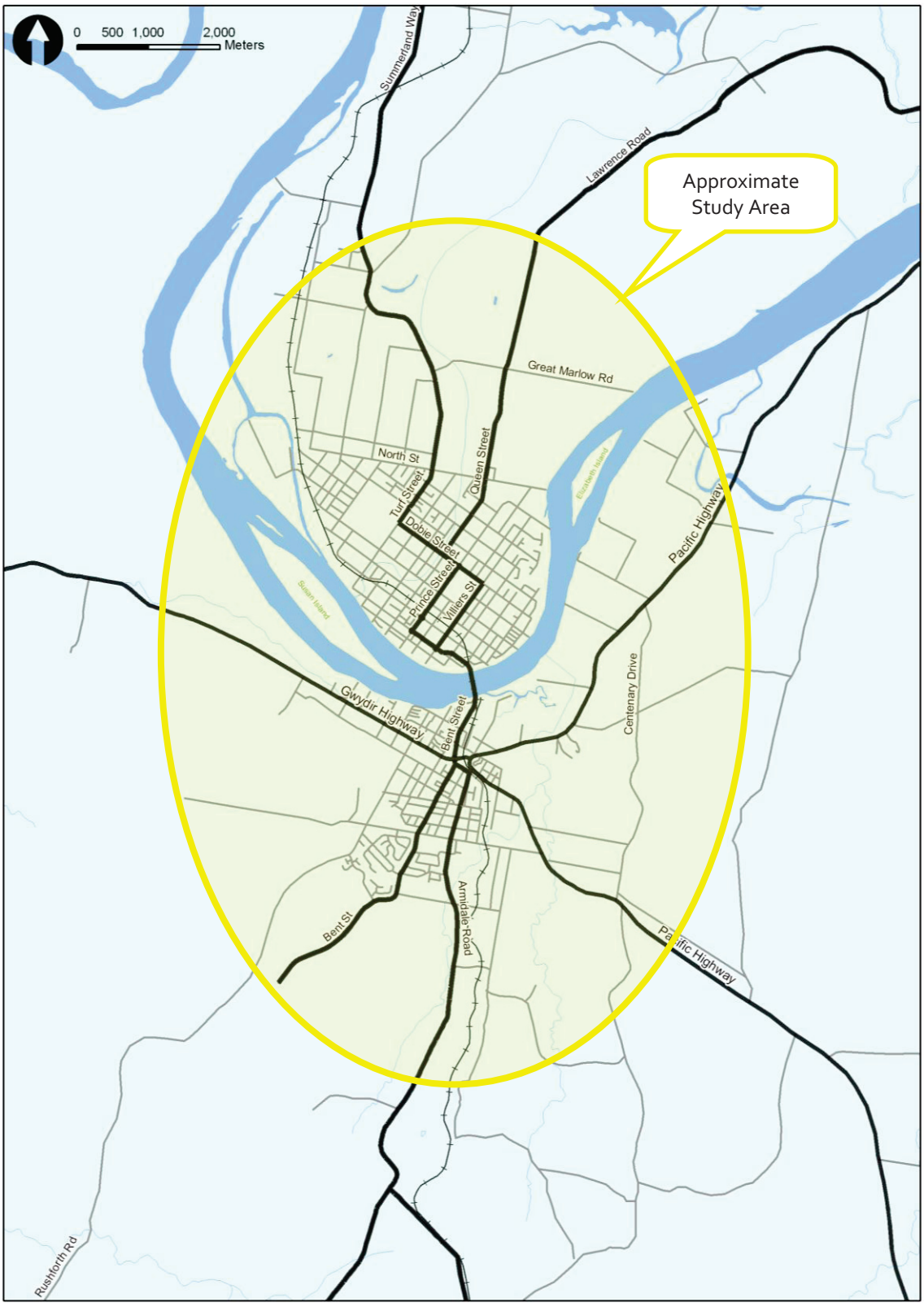
Figure 2.2: Future Year OD Matrix Development Methodology



2.5 Strategic Transport Model Extents

The study area used for the strategic transport for this assessment includes Grafton and South Grafton. The study area includes the existing Clarence River bridge connecting Grafton and South Grafton as well as the areas of Junction Hill, Carrs Creek, Grafton Great Marlow, Clarenza, Waterview and South Grafton. The extent of the study area is shown approximately in Figure 2.3. The strategic model considers traffic movements within these areas and includes traffic movements to and from the Pacific Highway north and south, the Summerland Way, the Gwydir Highway and Armidale Road.

Figure 2.3: Main Road 83 Summerland Way – Study Area



2.6 Traffic Data

Traffic information for the study was obtained from numerous sources including the RMS, Clarence Valley Council, previous reports and studies and surveys undertaken as part of this study. The data was sourced to 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 up to 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. Details of the traffic information used for this study are set out in the following sections and summarised 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.	2011

All traffic data used as part of this modelling has been reviewed and validated to ensure its appropriateness for use in this assessment. Further discussion on the data and its use is discussed in the following sections.

2.6.1 Traffic Count Locations

The locations of the traffic counts for the abovementioned surveys are presented graphically in Figure 2.4, showing the locations of the historical (pre 2008), 2008 and 2009 traffic data, whilst Figure 2.5 shows the locations of the more recent 2010 and 2011 traffic data.

Figure 2.4: Traffic Count Locations – 2006 to 2009

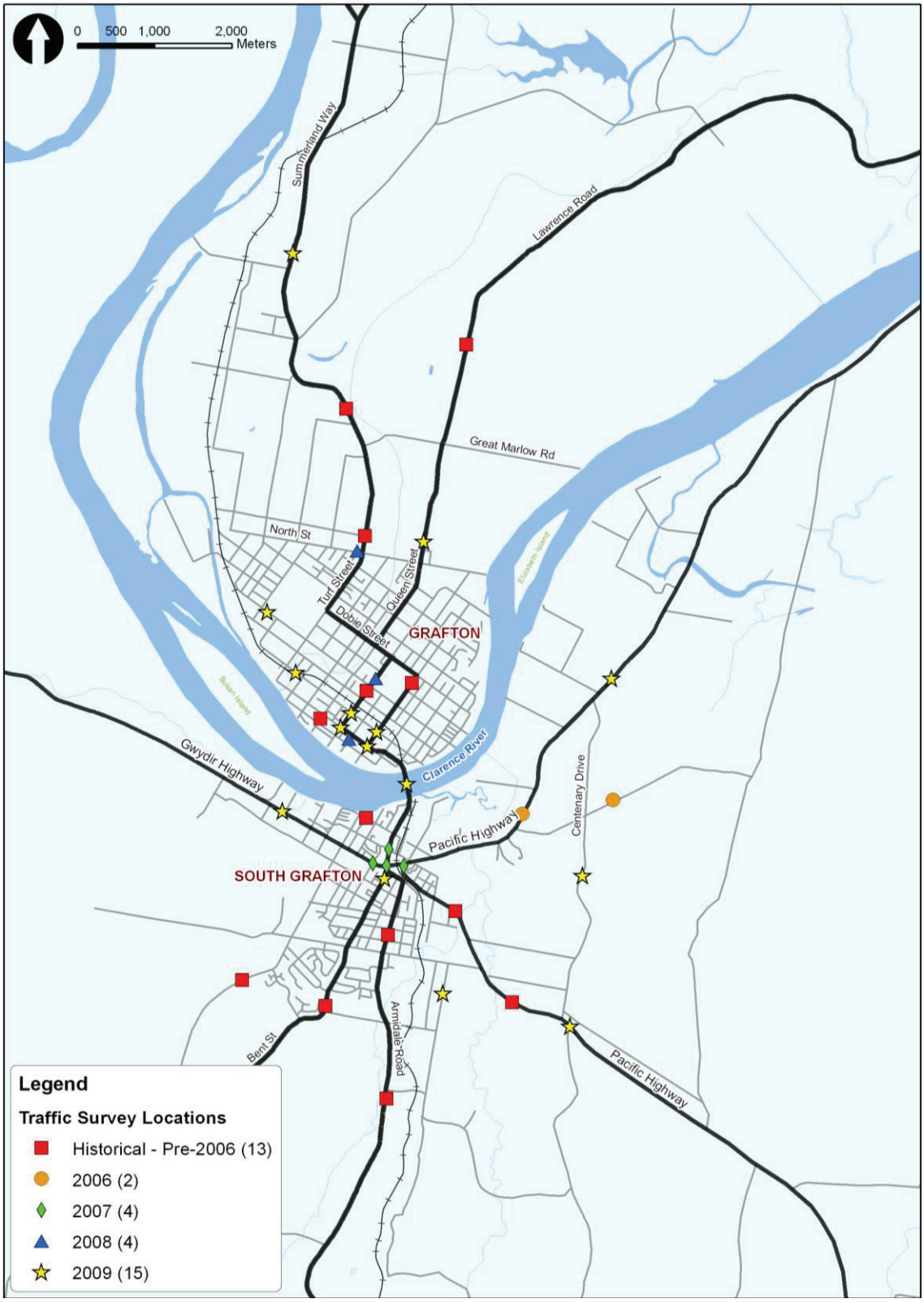
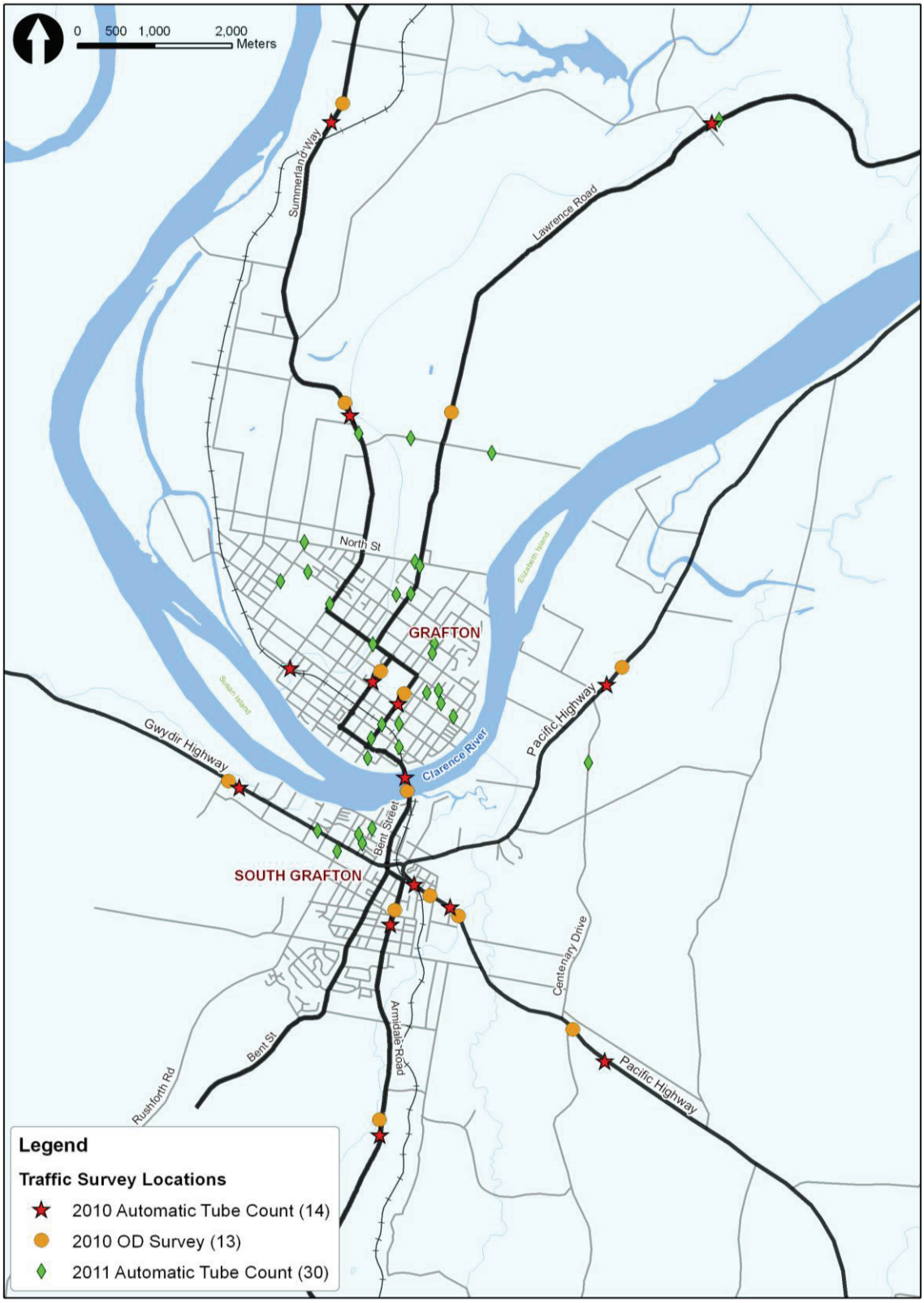


Figure 2.5: Traffic Count Locations – 2010 and 2011



The traffic count locations and OD sites provide suitable coverage of the study area and capture traffic volumes at key locations on all key routes into and from Grafton and South Grafton.

2.6.2 Summary of Traffic Count Data

The traffic count data has been classified in three categories which accord to the Austroads vehicle classification system as described in Table 2.2. A breakdown of the Austroads vehicle classes has been provided in Appendix A.

Table 2.2: Vehicle Classification Descriptions

Vehicle Description	Austroads Vehicle Classification
Light Vehicles	Austroads classes 1 and 2
Commercial Vehicles	Austroads classes 3 to 5
Heavy Vehicles	Austroads classes 6 to 12

Figure 2.6 and Figure 2.7 provide an overview of the range of data for historical (pre 2008), 2008 and 2009 traffic count data, whilst Figure 2.8 and Figure 2.9 provide an overview of the 2010 and 2011 traffic count data.

Figure 2.6: Traffic Count Data (Light and Commercial Vehicles) – 2006 to 2009

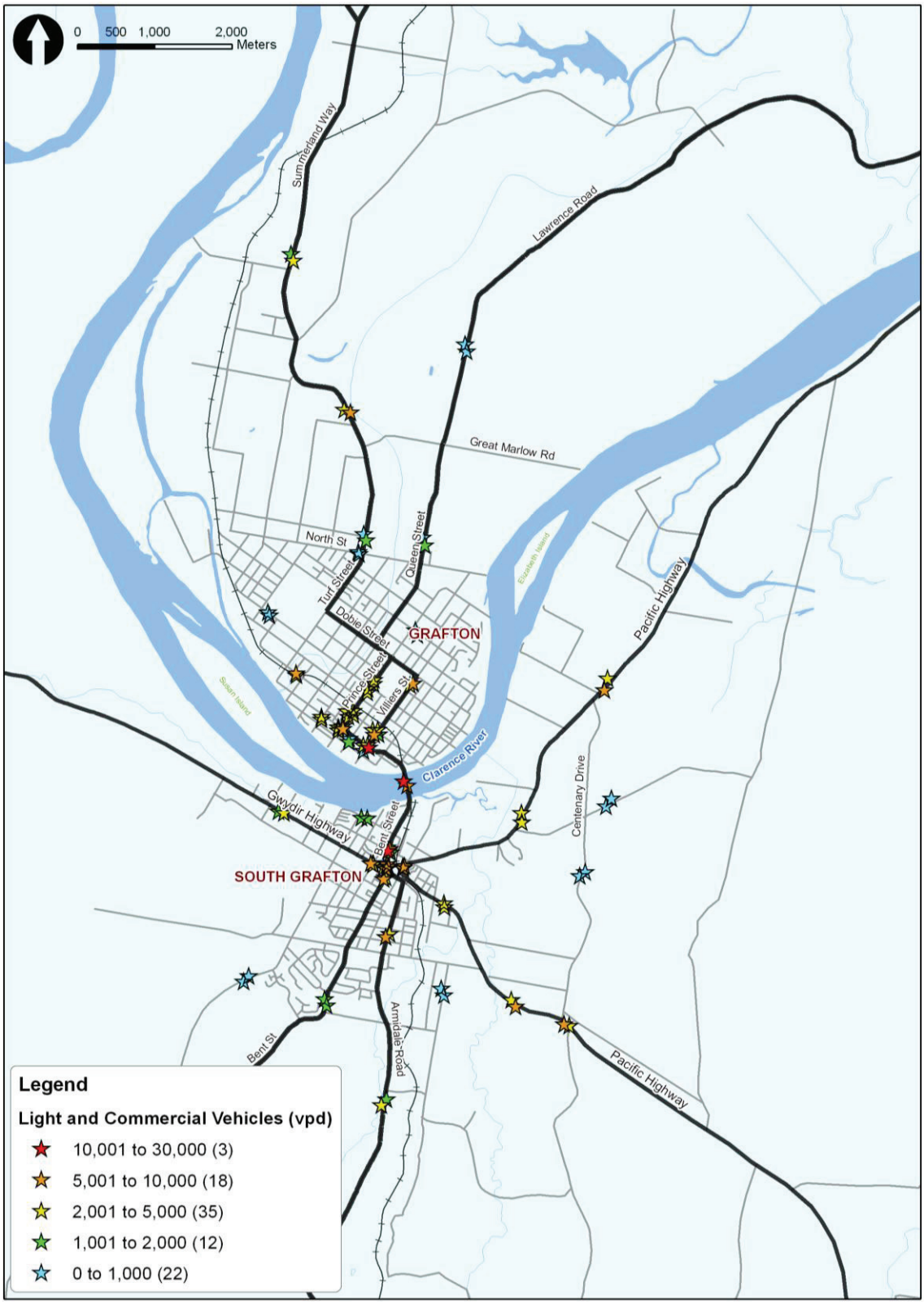


Figure 2.7: Traffic Count Data (Heavy Vehicles) – 2006 to 2009

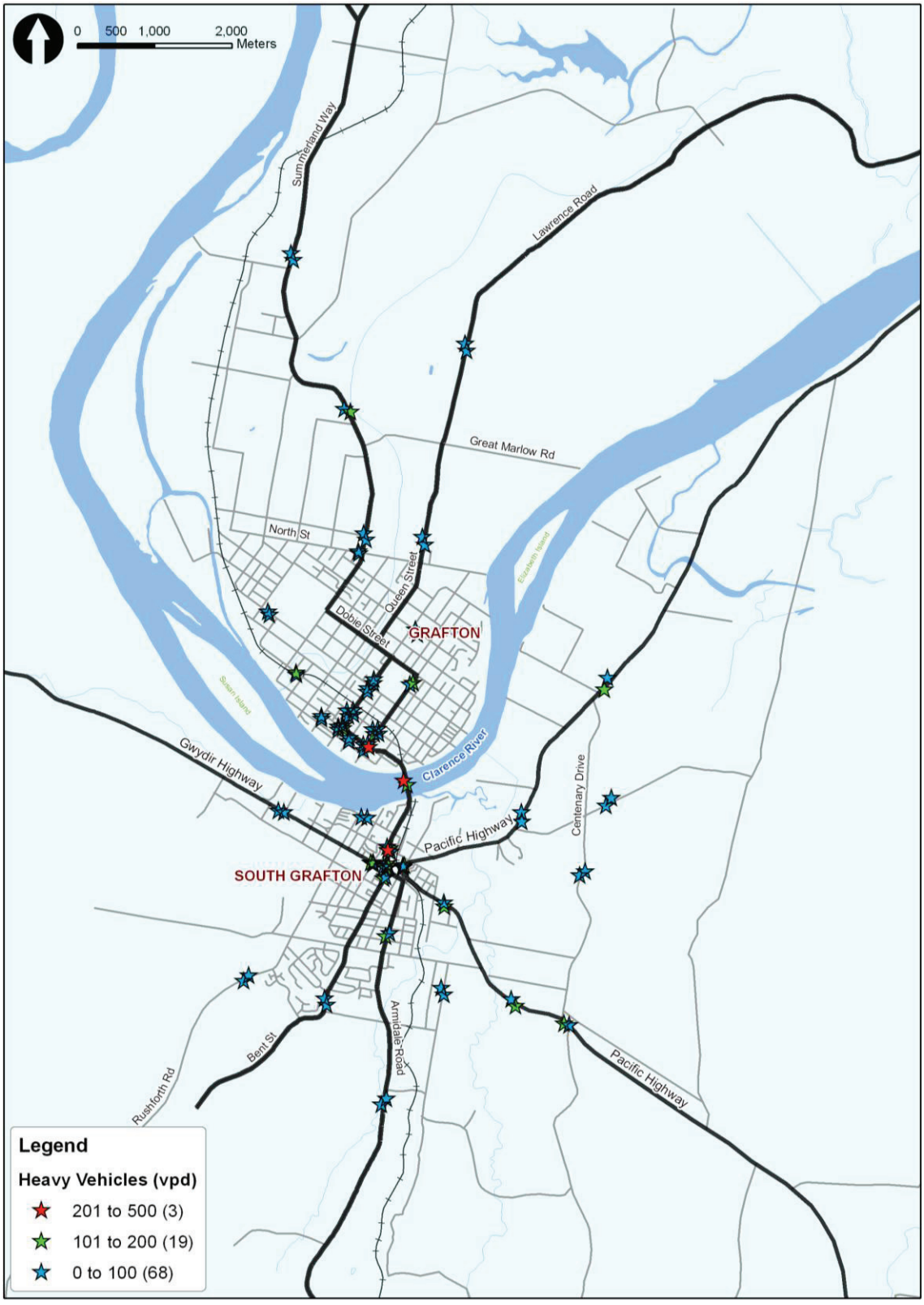


Figure 2.8: Traffic Count Data (Light and Commercial Vehicles) – 2010 and 2011

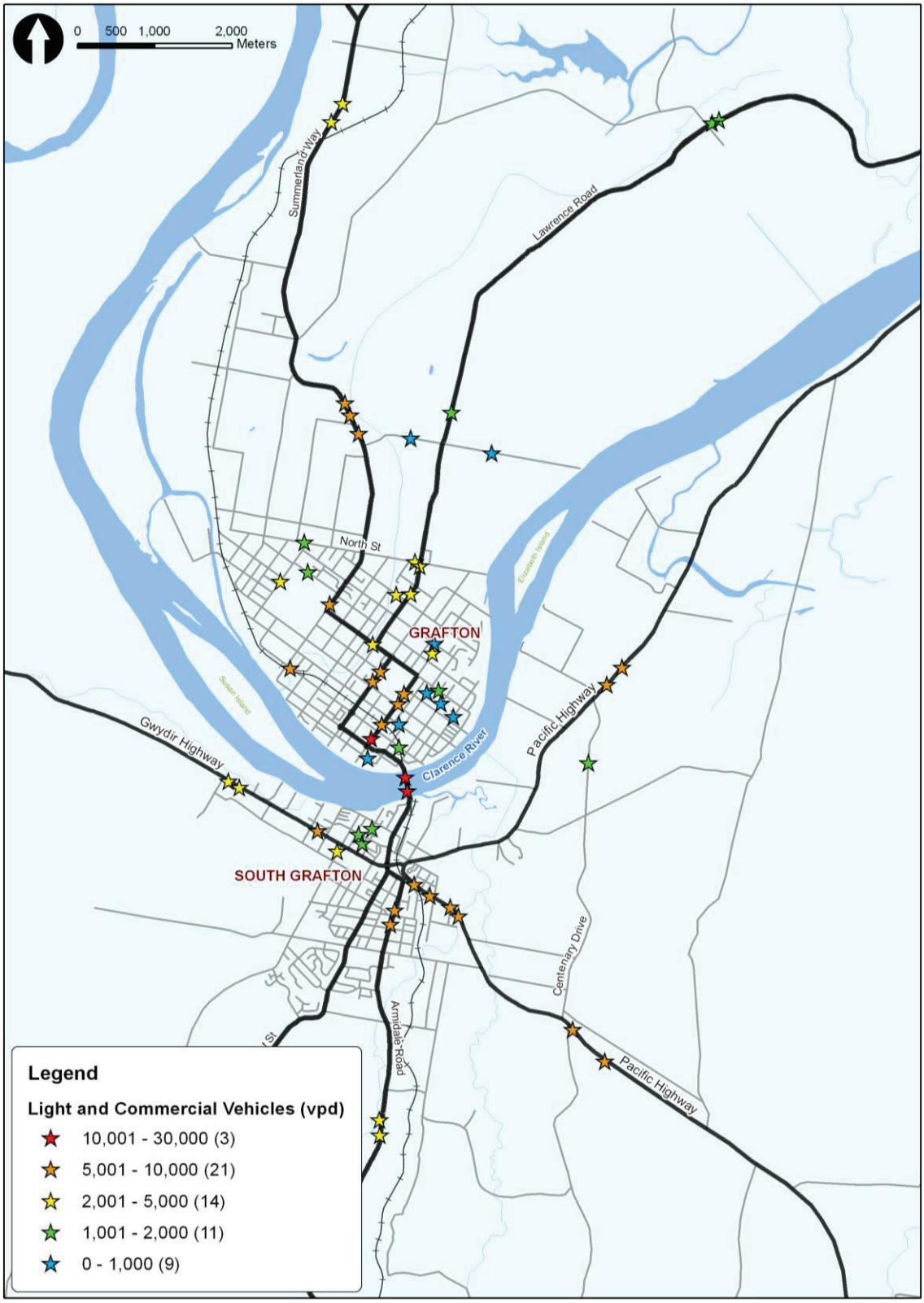
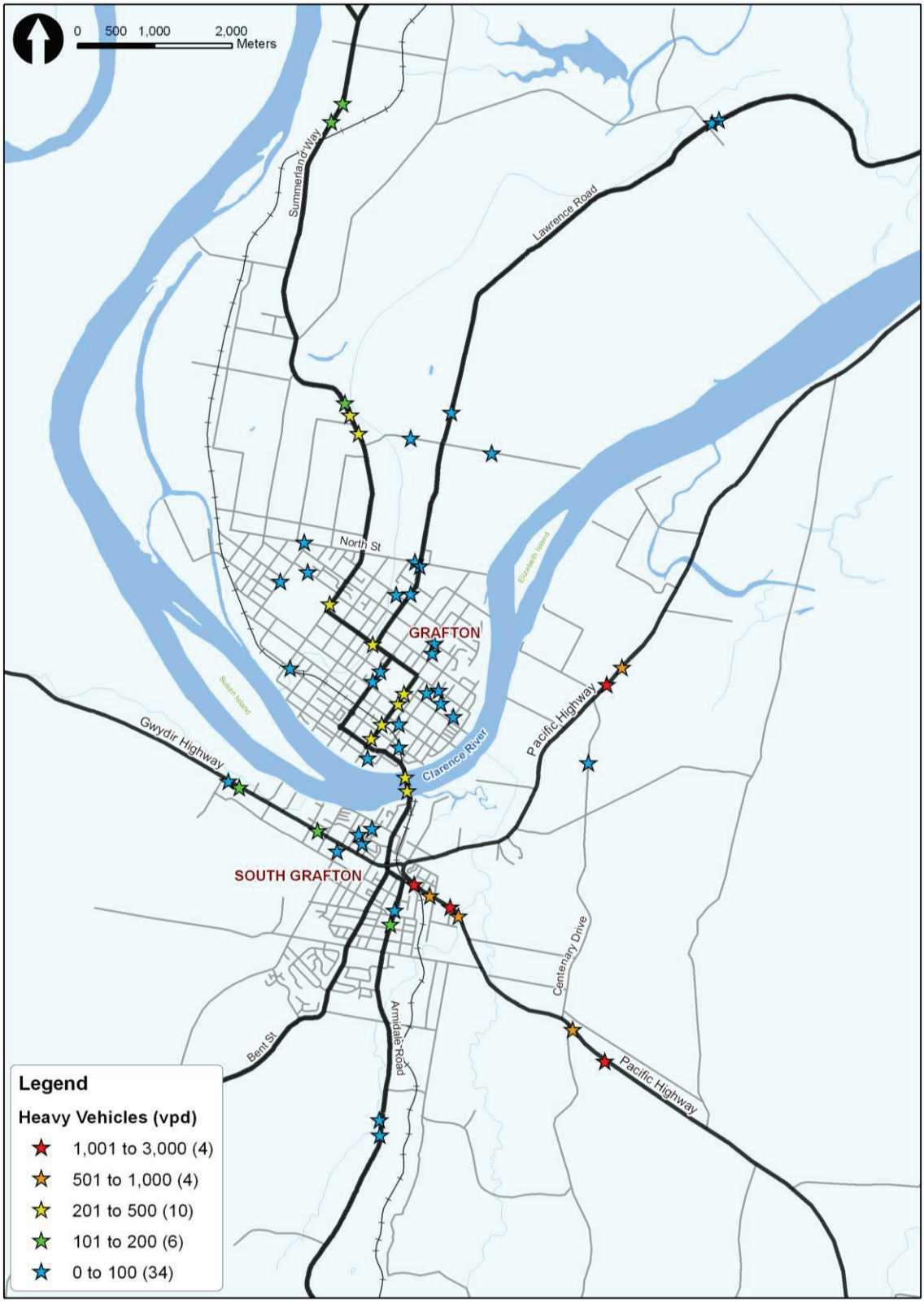


Figure 2.9: Traffic Count Data (Heavy Vehicles) – 2010 and 2011



2.6.3 2011 Automated Counts

Automatic tube counters were placed at 30 locations in Grafton and South Grafton between Monday 20 June and Monday 4th July 2011. The data is able to provide a summary of the weekday AM and daily average across the network.

The counts were undertaken to supplement the range of data obtained from other sources to ensure that a robust model was developed. A summary of the 2011 count data is provided in Table 2.3.

Table 2.3: Automated Tube Counts Summary

Road Name	Location	Direction	Weekday AM Average Volume (7am-9am)	Weekday Daily Average Volume
North Road	between Mary Street and Queen Street	Eastbound	154	1040
		Westbound	154	968
Queen Street	between Ford Street and North Street	Northbound	206	1868
		Southbound	359	1832
Queen Street	between Arthurs Street and Crown	Northbound	293	2439
		Southbound	448	2441
Arthur Street	between Queen Street and Mary Street	Eastbound	254	1409
		Westbound	169	1420
Hoof Street	between Villiers Street and Chapman Street	Eastbound	41	292
		Westbound	47	273
Villiers Street	between Powell Street and Hoof Street	Northbound	298	2174
		Southbound	379	2253
Dobie Street	between Kent Street and Clarence Street	Eastbound	58	636
		Westbound	129	723
Clarence Street	between Fry Street and Dobie Street	Northbound	27	277
		Southbound	90	533
Kent Street	between Fry Street and Dobie Street	Northbound	28	226
		Southbound	22	182
Breimba Street	between Fry Street and Dobie Street	Northbound	31	287
		Southbound	41	240
Bacon Street	between Woodward Street and Clarence Street	Eastbound	30	320
		Westbound	43	287
Pound Street	between Clarence Street and Kent Street	Eastbound	51	542
		Westbound	151	834
Victoria Street	between Villiers Street and Clarence Street	Eastbound	33	347
		Westbound	85	454
Butterfactory Lane	between Richmond Road and Lawrence Road	Eastbound	16	99
		Westbound	19	138
	between Lawrence Road and Great Marlow Road	Eastbound	5	64
		Westbound	16	69
Wharf Street	between Through Street and Spring Street	Northbound	97	618
		Southbound	77	1123
	between Spring Street and Lawrence Lane	Northbound	77	422
		Southbound	39	589
Spring Street	between Wharf Street and New Street	Eastbound	106	992
		Westbound	87	829
Gwydir Highway	between Cowan Street and Abbot Street	Eastbound	672	3198
		Westbound	241	3126

Road Name	Location	Direction	Weekday AM Average Volume (7am-9am)	Weekday Daily Average Volume
Lawrence Road	between North of Experimental Farm Lane	Northbound	54	719
		Southbound	194	723
Centenary Avenue	between Pacific Highway and Pacific Highway	Northbound	56	614
		Southbound	83	698
Skinner Street	south of Gwydir Highway	Northbound	310	1816
		Southbound	201	1711
Villiers Street	between Pound Street and Bacon Street	Northbound	567	4601
		Southbound	666	4319
	between Fitzroy Street and Pound Street	Northbound	955	6455
		Southbound	634	5062
Summerland Way	north of Butterfactory Lane	Northbound	285	3189
		Southbound	629	3098
Turf Street	between Dobie Street and Powell Street	Northbound	446	4572
		Southbound	708	4410
Dobie Street	between Queen Street and Bowtell Avenue	Eastbound	369	2490
		Westbound	309	2839
Powell Street	between Turf Street and Cranworth Street	Eastbound	80	588
		Westbound	68	667
North Street	between Cranworth Street and Milton Street	Eastbound	136	649
		Westbound	65	598
Cranworth Street	between Dobie Street and Fry Street	Northbound	124	1107
		Southbound	252	1226

The data collected during the count periods was reviewed to ensure it was appropriate and suitable for use in the model development.

Pacific Highway Closure

The Pacific Highway had the following closures before and after the survey period:

- From Tuesday 14 June to about 5.30pm on Sunday 19 June the highway was closed near Kempsey due to flooding, with traffic diverted to travel along the New England Highway.
- The Highway was also closed due to flooding in Grafton between Musk Valley Creek and Alipou Creek from about 7.30am to 10am on 14 June. Traffic was diverted via Centenary Drive and into Grafton via South Grafton.
- On Friday 1 July, due to an incident near Tyndale, traffic was diverted off the highway from about 4am to 10am

All of the closures occurred outside of the survey period except for the incident near Tyndale on 1 July 2011, which occurred on the last day of the survey. The count data was checked during this period and no unusual variations to the data was observed. The data is considered valid for inclusion in the model.

3. Strategic Model Development

3.1 Introduction

Development of the Grafton strategic traffic model was undertaken based on the methodology discussed in Section 2.3 and assumptions outlined below. The key steps in developing the model were:

- define traffic zones
- define highway network
- identify highway link characteristics
- assign starting demand to the network and assess weaknesses
- refine the road network and
- refine the demand matrices.

The steps outlined above are discussed in more detail in subsequent sections of the report.

The strategic traffic model was implemented within the Cube-TRIPS platform as a link-based travel demand network model. That is, intersection effects were not explicitly modelled. Intersection effects will be specifically included in the detailed analysis of the shortlisted options.

3.2 Zone Structure

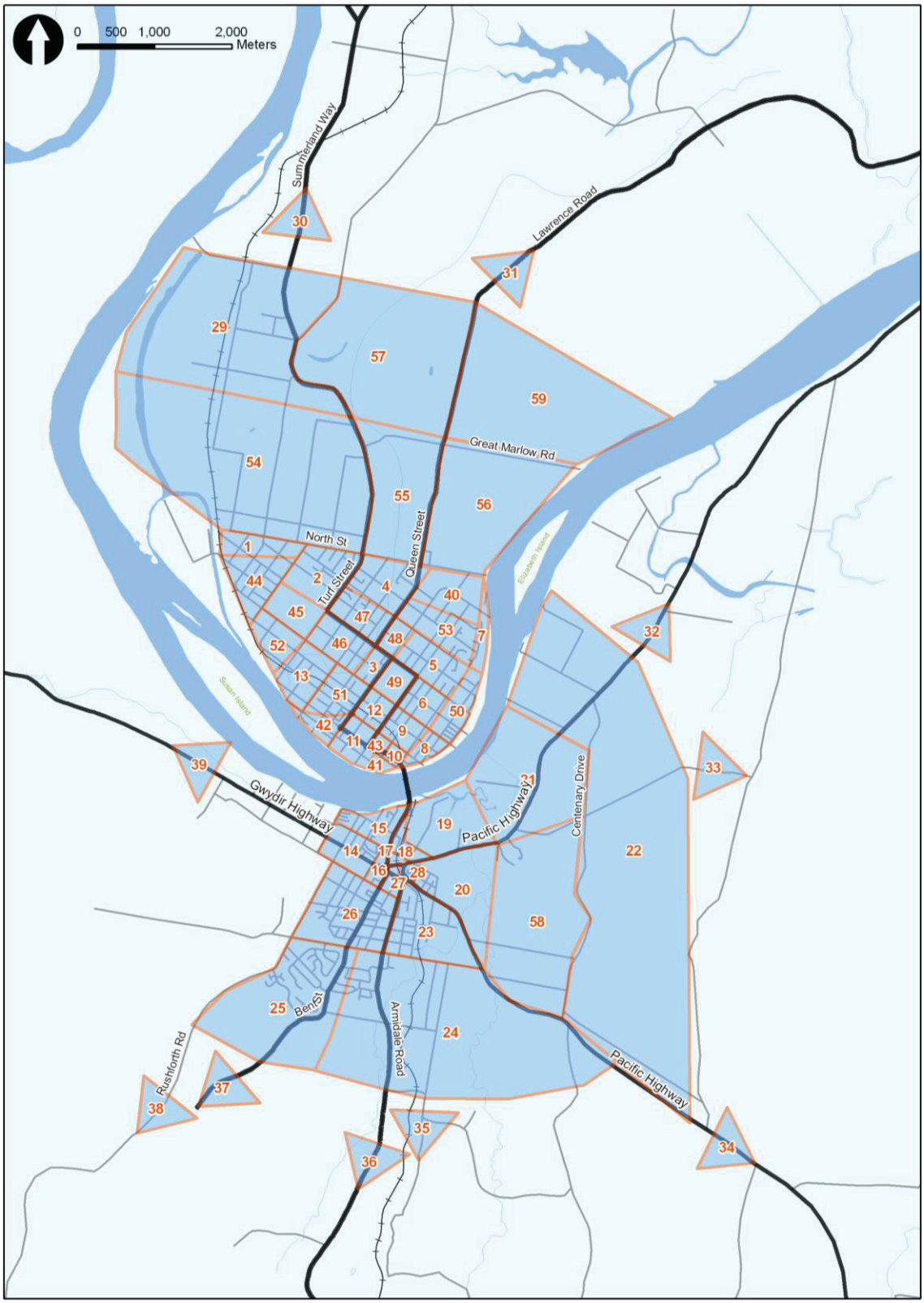
The study area was divided into smaller areas, referred to as transport zones. The zones were developed to provide the following:

- Sufficient detail to realistically enable the loading of traffic on to the road network to allow for testing of options.
- Consistency with the available demographic data (population and employment).
- Appropriate size to minimise intra-zonal motorised trips.
- Consistency with the Australian Bureau of Statistics Census Collection Districts (CCDs). Whilst the CCDs are of adequate resolution for the base year land use and road network, sub-division of a number of CCDs was undertaken, particularly in South Grafton, to account for future residential and industrial developments.
- Reflect road, geographical and land use boundaries.

The model has 59 transport zones set out in Figure 3.1 comprising 49 internal zones and 10 external zones. The external zones are:

- Summerland Way (at North Coast Railway Crossing)
- Grafton - Lawrence Road (at Alumy Creek)
- Pacific Highway North (at Swan Creek)
- Washpool Road (west of Four Mile Lane)
- Pacific Highway South (south of Four Mile Lane)
- Swallow Road (north of Lillypool Road)
- Armidale Road (south of Brickworks Lane)
- Bent Street (south of Fairway Drive)
- Rushford Road (south of Watters Road)
- Gwydir Highway (west of Hay Street)

Figure 3.1: Strategic Model Transport Zones

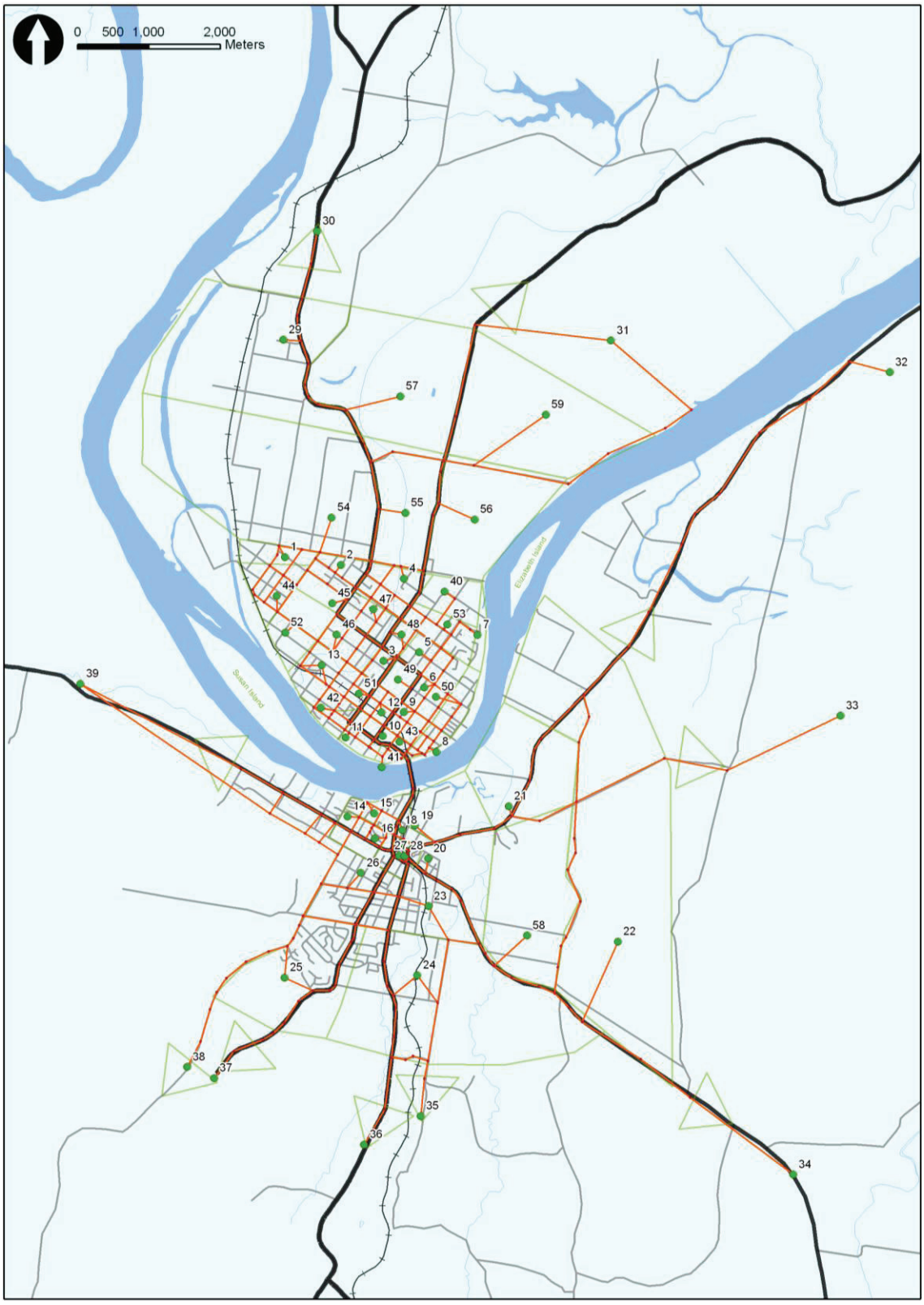


3.3 Road Network (Links and Nodes)

The road network adopted for the strategic model comprises all roads with a posted speed limit of 50km/h and above. In addition, roads with speed limit less than 50km/h that had daily two-way counts greater than 1,000 vehicles and roads which are important connecting routes were also included. The network contains all major highways, arterial roads and other significant local roads within Grafton and South Grafton and the roads into and out of town. The base year model road network is shown in Figure 3.2.

Road network features such as existing speed limits, link capacities and turn bans were confirmed through on-site observations along with general network operating conditions in terms of travel times, vehicle delays and queue lengths. Particular attention was paid to the Grafton Bridge and its approaches during peak periods.

Figure 3.2: Strategic Model Road Network



3.4 Model Period and Years

The model is an AM Peak model which is a two hour model representing typical travel for the 7am to 9am period. The AM Peak period was considered representative of the travel patterns in and around Grafton due to the tidal nature of travel patterns across Grafton Bridge during both peak periods. The model is designed to forecast the changes in travel patterns and the AM peak model outputs can be used to determine the PM peak demands.

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

3.5 Matrix Estimation

The base year demand matrix was developed using matrix estimation. Matrix estimation is a well established technique used to calibrate a trip matrix using observed OD data and traffic counts as inputs.

Matrix estimation was undertaken using the matrix estimator tool within TRIPS and was based on the available traffic count data outlined in Section 2.6. A prior, or starting matrix, was developed from the origin and destination data obtained from the Heavy Vehicle Study dated February 2011.

The volume of traffic crossing the boundary of the study area (referred to as external zones) was determined directly from traffic counts and OD surveys at the external cordon points.

The TRIPS matrix estimator was run taking the prior matrix road network and link counts to calibrate the 2011 base year matrix. The resultant base year matrix was assigned to the model road network and the modelled link traffic volumes compared to the observed traffic count volumes. The steps were repeated until an acceptable fit between modelled and actual volumes was achieved. When the fit between modelled and observed traffic volumes is considered acceptable, the demand matrix is calibrated. More detail on the demand matrix calibration is provided in the following section.

3.6 Calibration and Validation

3.6.1 Introduction

Initially, an existing conditions model is run and compared against existing traffic data such as traffic counts. When the model results match the existing traffic flows within the specified range, the model is validated and therefore suitable for use as the base to prepare models for future conditions. Strategic network models are generally calibrated to reflect existing traffic counts across a wide corridor or regional area. Strategic network models are not expected to accurately match traffic counts at individual locations; instead model validation/calibration is measured by comparing counts across a number of screen lines and across the entire modelled area. All future model run results can then be interpreted against the calibrated existing conditions model.

3.6.2 Calibration & Validation

For this study the 2011 base year model validation was measured by the GEH[1], per cent Root Mean Square Error (%RMSE) statistic and Coefficient of Determination (R^2) statistics. The model is considered validated when the following targets are achieved.

- GEH greater than 85%
- Flows (modelled versus observed) greater than 85%
- Coefficient of determination (R^2)of greater than 0.90
- Root Mean Square Error of less than 30%.

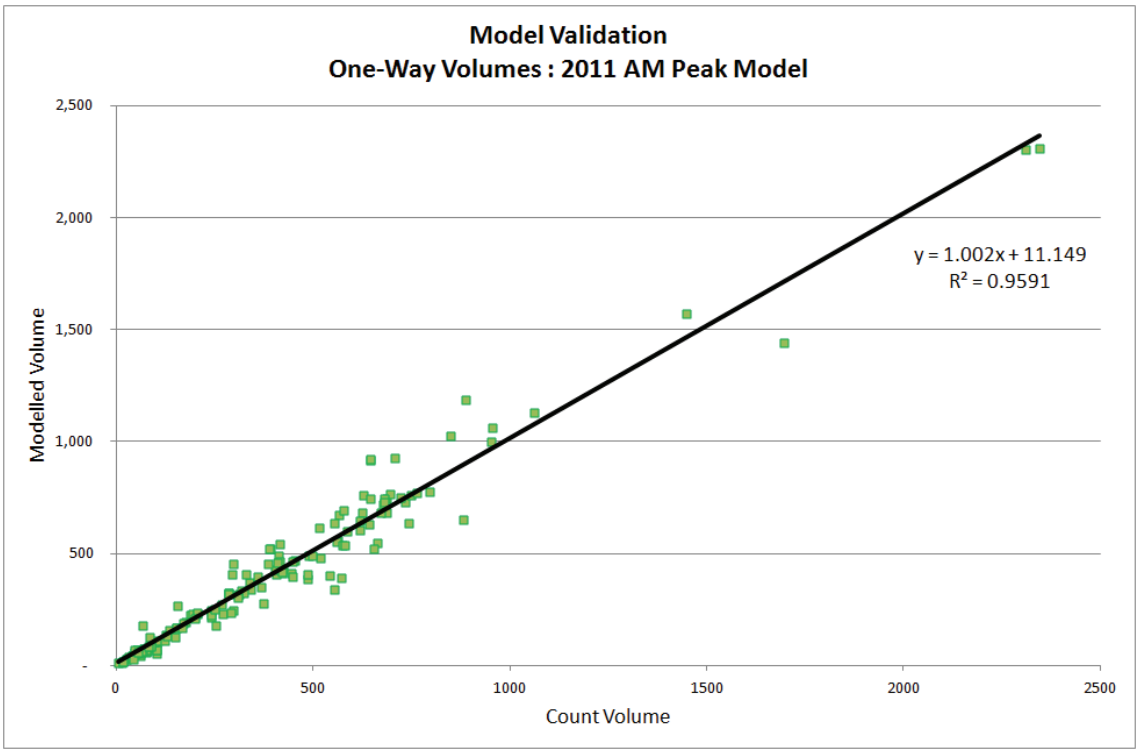
A total of 154 counts have been used to calibrate and validate the model.

3.6.3 Calibration & Validation Results

The full model calibration and validation results are provided in Appendix B.

Figure 3.3 is a plot depicting modelled volumes versus observed volumes and a coefficient of determination (R^2) result of 0.96, which is greater than the required 0.90. This represents a good fit between modelled and observed data.

Figure 3.3: Modelled versus Count Volumes for Links



[1] GEH is a well established measure used in traffic modelling and measures the agreement between two sets of numbers, normally modelled and observed traffic volume. The GEH statistic accounts for the scale of the numbers and places more weight on larger volumes than smaller numbers. The GEH statistic is calculated as follows:

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

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

A summary of the calibration criteria is set out in Table 3.1.

Table 3.1: Calibration Criteria Summary

Criteria	Value	Requirement
GEH	88%	>85%
Flows	86%	>85%
R^2	0.96	>0.9
%RMSE	18.08	<30

The results set out in Figure 3.3 and Table 3.1 confirm that the model meets the calibration and validation targets. As such, the 2011 existing conditions model run is considered suitable for use in future year modelling.

A summary of the modelled versus count (survey) locations for various areas within the model is set out in Table 3.2, which shows that the modelled flows provide good correlation between observed flows with an average of 2.86% difference

A list of modelled versus count locations is contained in Appendix B.

Table 3.2: Modelled versus Count Volumes (AM Peak 2 Hour Period)

Model Area or Location	Count	Modelled Volume	Abs Difference	% Difference
Cordon points (external zones)	26223	25120	1103.4	4.21%
North Grafton	27913	27451	462.2	1.66%
South Grafton	2619	2576	43.5	1.66%
Bridge Northbound	2306	2309	2.8	0.12%
Bridge Southbound	1573	1448	125.0	7.95%
All points	**60634**	**58903**	**1731.3**	**2.86%**

The information presented in Table 3.2 indicates that the modelled and observed volumes provide good correlation across the network, and more specifically, the bridge volumes are within 0.12% for the northbound direction and 7.95% for the southbound direction.

3.7 Peak to Daily Factor

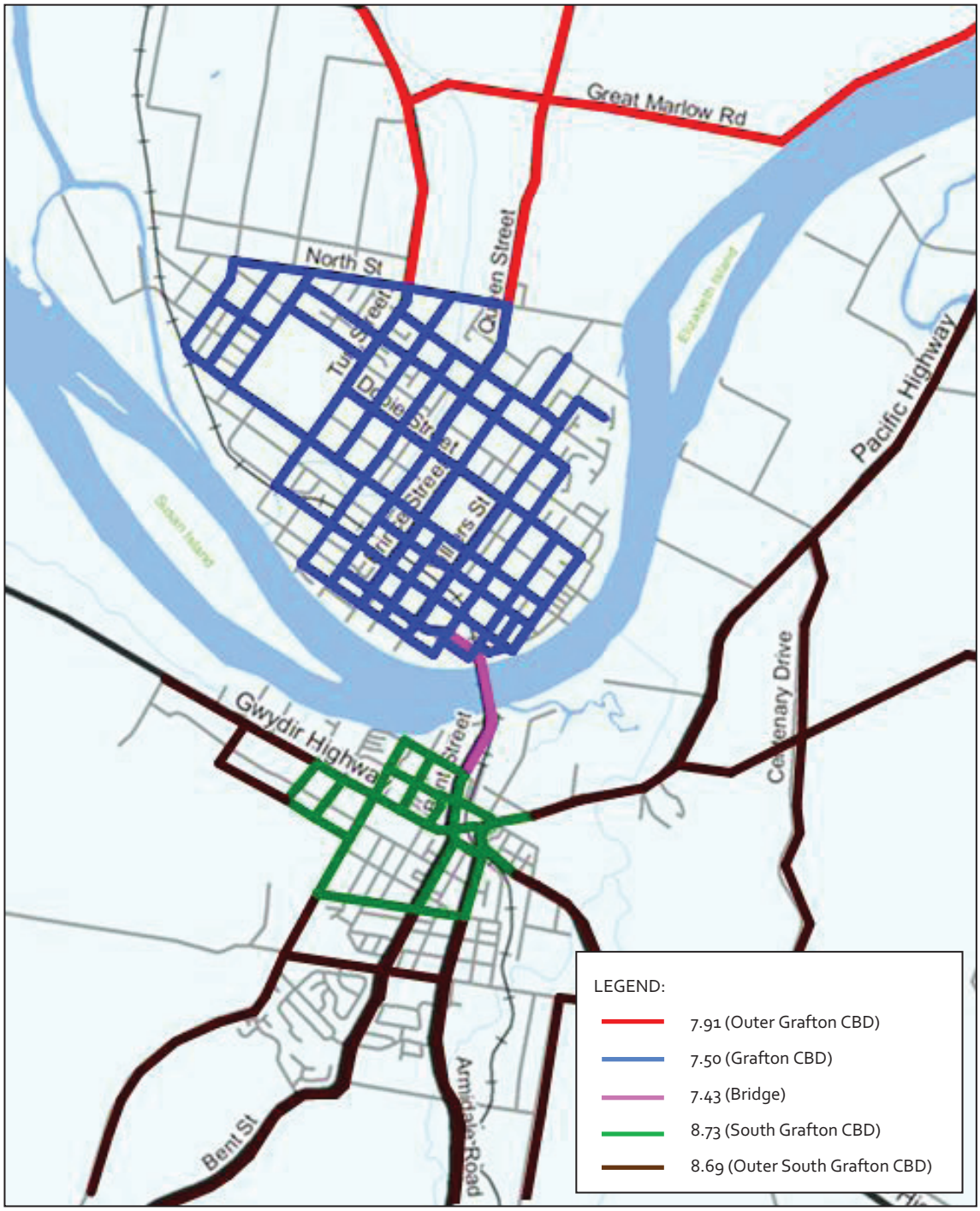
As the strategic model is an AM peak period model, it is necessary to estimate the daily traffic volume on particular links in the model. For this purpose a series of factors were developed that factor the AM peak period volumes to daily volumes. The factors were derived from the traffic count data and account for the hourly variations across the day.

Peak to daily volume comparisons across the network vary and as such a range of factors have been developed to estimate the daily volumes across the network. The following five areas have used factors to convert the AM two hour volumes to daily volumes:

i Outer Northern Grafton 7.91
ii Grafton Township and surrounds 7.50
iii Grafton Bridge and approaches 7.43
iv South Grafton township 8.73
v Outer South Grafton. 8.69

These factors have been developed to provide an indicative methodology for the prediction of daily volumes across the network and are used solely for planning reasons. As such, the effects of the boundaries or connections of these points have not been assessed. Each of the areas is shown graphically in Figure 3.4.

Figure 3.4: Peak to Daily Factors used in Grafton Strategic Model



4. Future Year Growth

4.1 Key Assumptions

A number of key assumptions were used in undertaking the strategic modelling assessment, in particular those for the future year model. A summary of the key assumptions used to determine the future year growth is as follows:

i The proposed inland port located in the vicinity of the NSW and Queensland borders has been discussed at high levels of government and is currently in its planning infancy. The proposed inland terminal would have several connections to the Pacific Highway north of Grafton. Consequently, future year traffic growth predictions for the Grafton are do not include any change in long distance heavy vehicle freight movements travelling to / from the port, in particular those travelling through Grafton and South Grafton.

ii A future industrial estate and freight hub has been planned for Casino (located approximately 100km north of Grafton). A traffic impact assessment of the freight hub concluded that a small reduction in heavy vehicle movements on the Summerland Way through Grafton would result. A conservative approach was to assume no change to heavy vehicle movements on the Summerland Way as a result of the freight hub. For the modelling no adjustments to the model resulting from the freight hub were assumed.

iii All future year modelling has assumed that the Pacific Highway Bypass of Grafton would be open by 2019.

iv The Australian Bureau of Statistics (ABS) suggests that the persons per household within Grafton and South Grafton are decreasing due to the ageing population and declining household size. It was assumed that infill development would offset the population reductions due to declining household size thereby maintain constant zonal population forecasts for the traditional areas of Grafton and South Grafton.

v The key residential growth areas were identified in discussions with Clarence Valley Council as Junction Hill, Waterview Heights, and Clarenza. It was assumed that development sequence would result in firstly construction of Junction Hill initially followed by Waterview Heights and finally Clarenza. These are located in Appendix F.

vi Growth in cross-river demand was constrained between 2011 and 2019 due to the capacity of the existing bridge and as such traffic was redistributed within Grafton and South Grafton in order to realistically capture anticipated growth.

The following section discusses how the assumptions have been applied in order to forecast traffic growth for the future years for input into the strategic model.

4.2 Future Year Growth

Future year population forecasts for Grafton and its surrounds was provided from Clarence Valley Council and the Department of Planning. These population growth forecasts were aligned to the respective model zones and the increase was determined as a rate per annum.

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

i Traffic production and attractions for each zone have been assumed to have the same growth (for example all trips to and from zone 1 will adopt 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 O-D pair within the overall matrix has been checked and a 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 capacity of the bridge is not exceeded in the peak direction. This approach is considered more representative of expected operating conditions prior to the introduction of additional capacity and a resumption of "normal" travel patterns in Grafton.

The estimated annual population growth forecasts by traffic zone for each of the forecast years are shown graphically in Figures 4.1 to 4.4, whilst full summary tables of the forecast growth are provided in Appendix C.

Figure 4.1: Growth Increase per Annum (2011 – 2019)

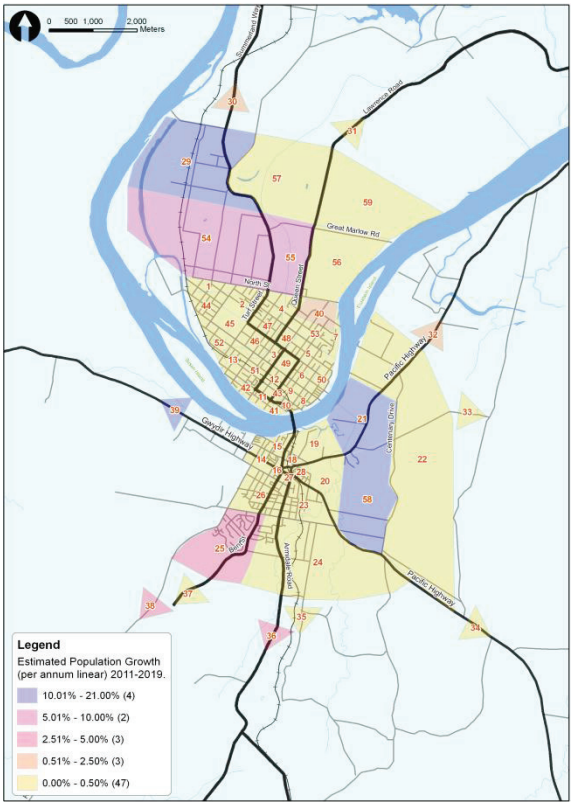


Figure 4.2: Growth Increase per Annum (2019 – 2029)

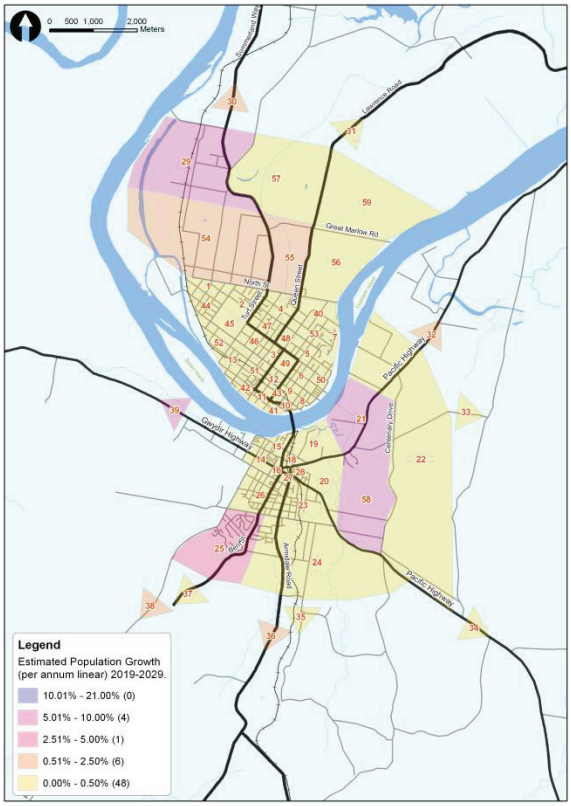


Figure 4.3: Growth Increase per Annum (2029 – 2039)

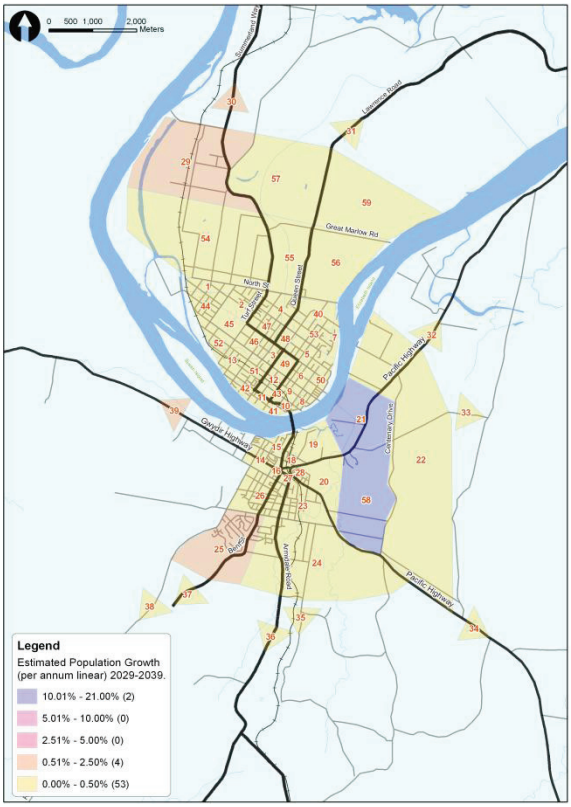
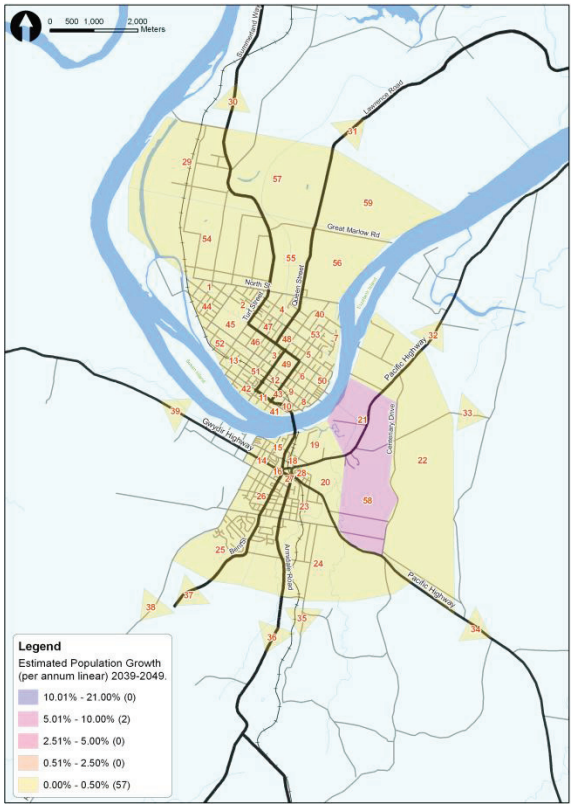


Figure 4.4: Growth Increase per Annum (2039 – 2049)



The above figures show that prior to 2039, the majority of growth is expected to occur at Junction Hill, Clarenza and South Grafton. After 2039 the growth is expected to occur mainly in Clarenza.

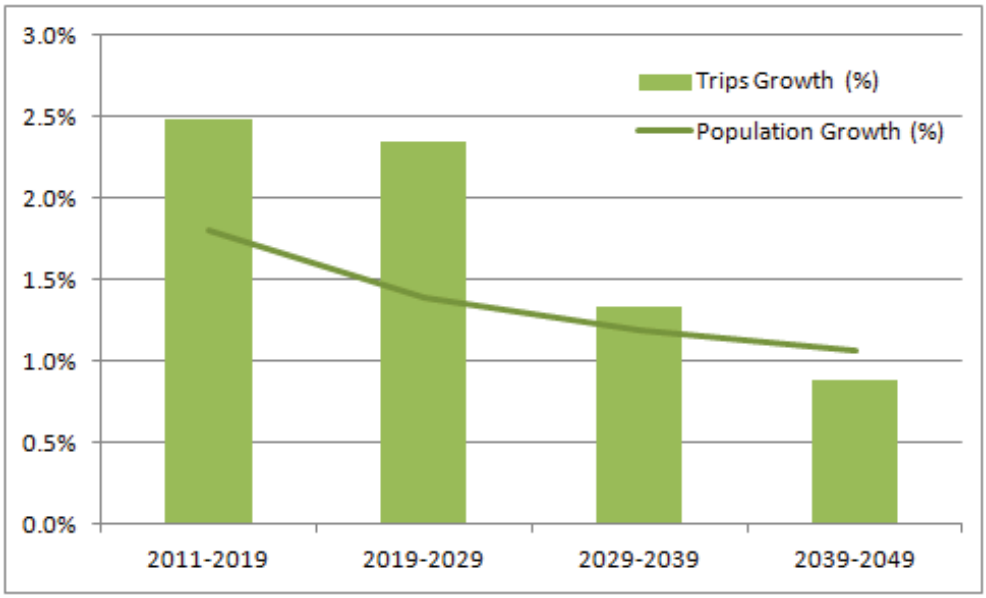
The estimated population and corresponding AM peak period trips in Grafton up to 2049 are summarised in Table 4.2.

Table 4.1: Grafton Forecast Population and Traffic Growth up to 2049

Year	Forecast Population	Population Growth Rate p.a. (%)	Total AM Peak Period Trips Completed	Traffic Growth Rate p.a. (%)
2011	18,803		20,942	
2019	21,519	1.8	25,107	2.5
2029	24,522	1.4	30,996	2.3
2039	27,426	1.2	35,145	1.3
2049	30,330	1.1	38,234	0.9

Table 4.2 indicates that the rate of population growth is expected to reduce over time with an average annual increase of 1.6% pa between 2011 and 2049. At the same time traffic growth is forecast to average 2.2% pa between 2011 and 2049. Figure 4.5 graphically shows the rate of growth for each ten year period for population and peak period trips.

Figure 4.5: Population and Trip Growth p.a. (10 years)



5. Do Minimum Model Results

5.1 Introduction

The Grafton strategic model results provided in this section are based on a 'do minimum' approach to infrastructure or road network upgrades and assume that all population growth forecasts are realised. These models act as a 'base case' in order to compare the results of the 25 route options discussed in Section 6 and 7. The 'do minimum' model road network assumed upgrading of the Pacific Highway to cater for the scale of the development in Clarenza. This was the only assumed change from the 2011 base year road network.

5.2 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:

- total number of AM peak period trips
- Vehicle Kilometres Travelled (VKT), which represents the total distance travelled by all trips within the network
- Vehicle Hours Travelled (VHT), which represents the total time travelled by all trips within the network
- average speed (km/h) of the modelled network.

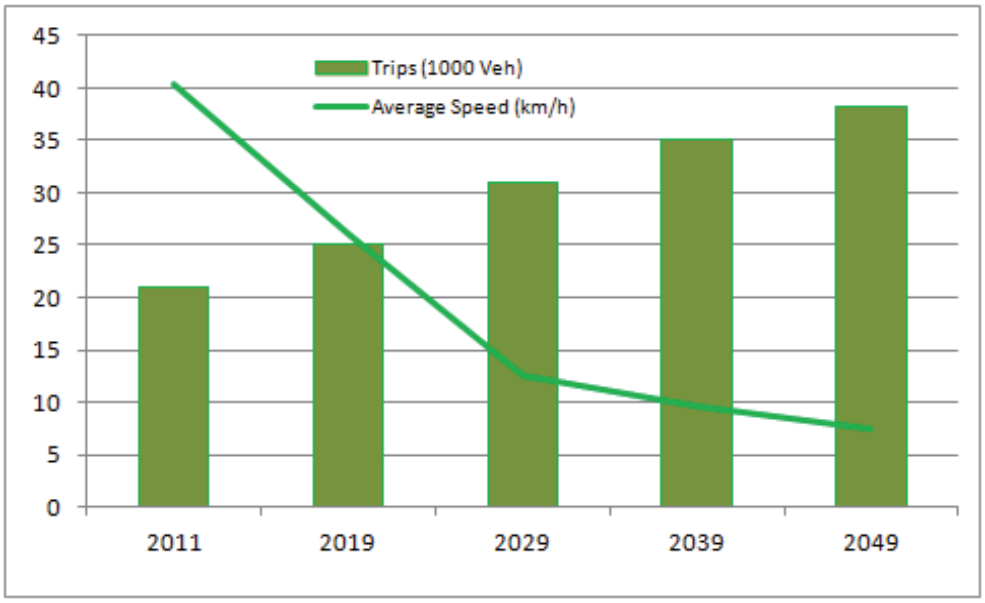
Key results of the two hour AM peak 'do minimum' models are shown in Table 5.1, which are aimed at giving a basic summary and comparison of the network operation with only the 'do minimum' infrastructure improvements in the relevant design years.

Table 5.1: 'Do Minimum' Model Network Results

Year	Total Trips	VKT	VHT	Average Speed (km/h)
2011 Existing Conditions	20,942	70,832	1,751	40.5
2019 Do minimum	25,107	86,240	3,298	26.1
2029 Do minimum	30,996	115,888	9,167	12.6
2039 Do minimum	35,145	136,816	14,067	9.7
2049 Do minimum	38,234	154,207	20,515	7.5

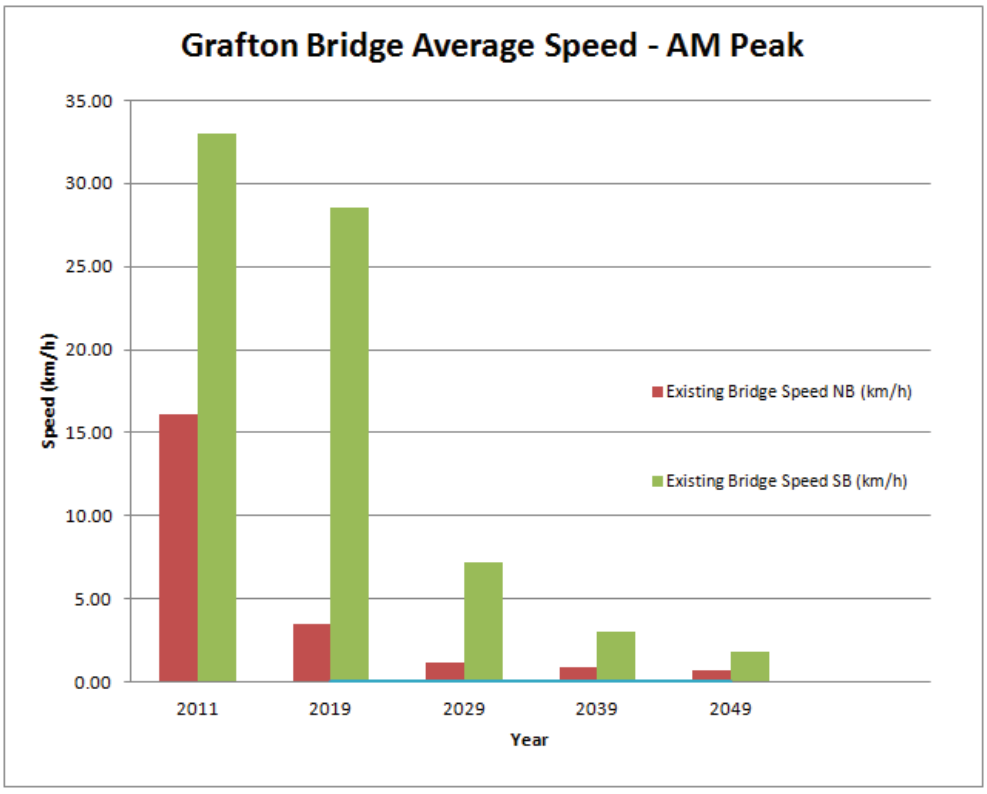
Figure 5.1 has been prepared to graphically show the increase in total trips and the expected reduction in average speed.

Figure 5.1: Total Trips (Veh) and Average Speed (km/h) Year 2011 to 2049



The model results indicate the average speed for the network is expected to decrease from 2011 to 2049. This is reflective of an increase in trips on the wider network. The average vehicle speed on the existing bridge is shown in Figure 5.2 and shows the substantial deterioration in travel speed in the future without any capacity enhancement.

Figure 5.2: Grafton Bridge Average Speed (km/h)



Note: NB = Northbound; SB = Southbound

In summary, the network conditions are expected to reduce as population increases.

6. Preliminary Route Options

6.1 Introduction

The project team and community have developed 25 preliminary route options located within five corridors. The options locations are shown in Figures 6.1 to 6.5 with a brief description of each option provided in Table 6.1 thereafter. Full details of each option have been provided in Appendix D.

Figure 6.1: Preliminary Route Options – Corridor 1

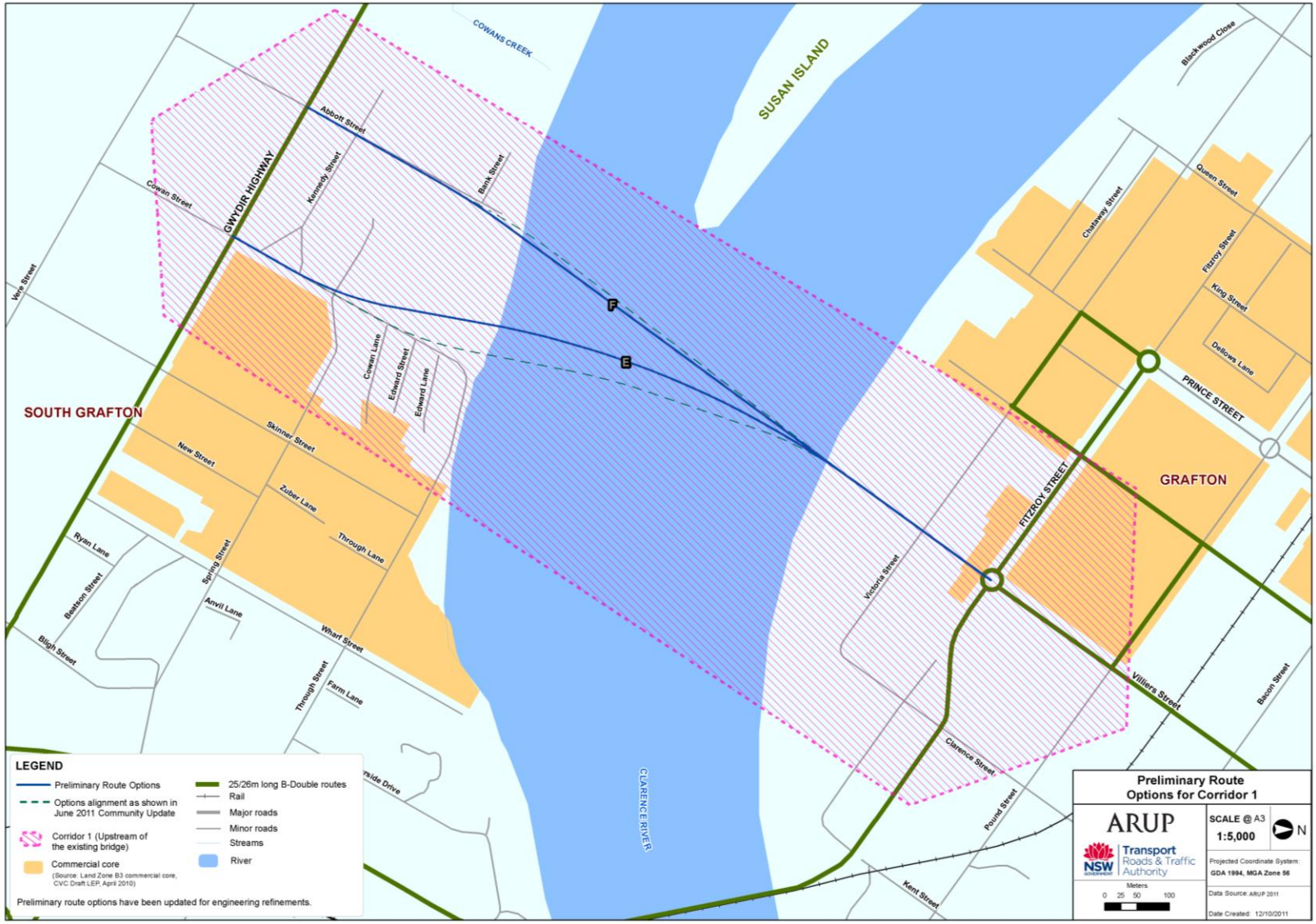


Figure 6.2: Preliminary Route Options – Corridor 2

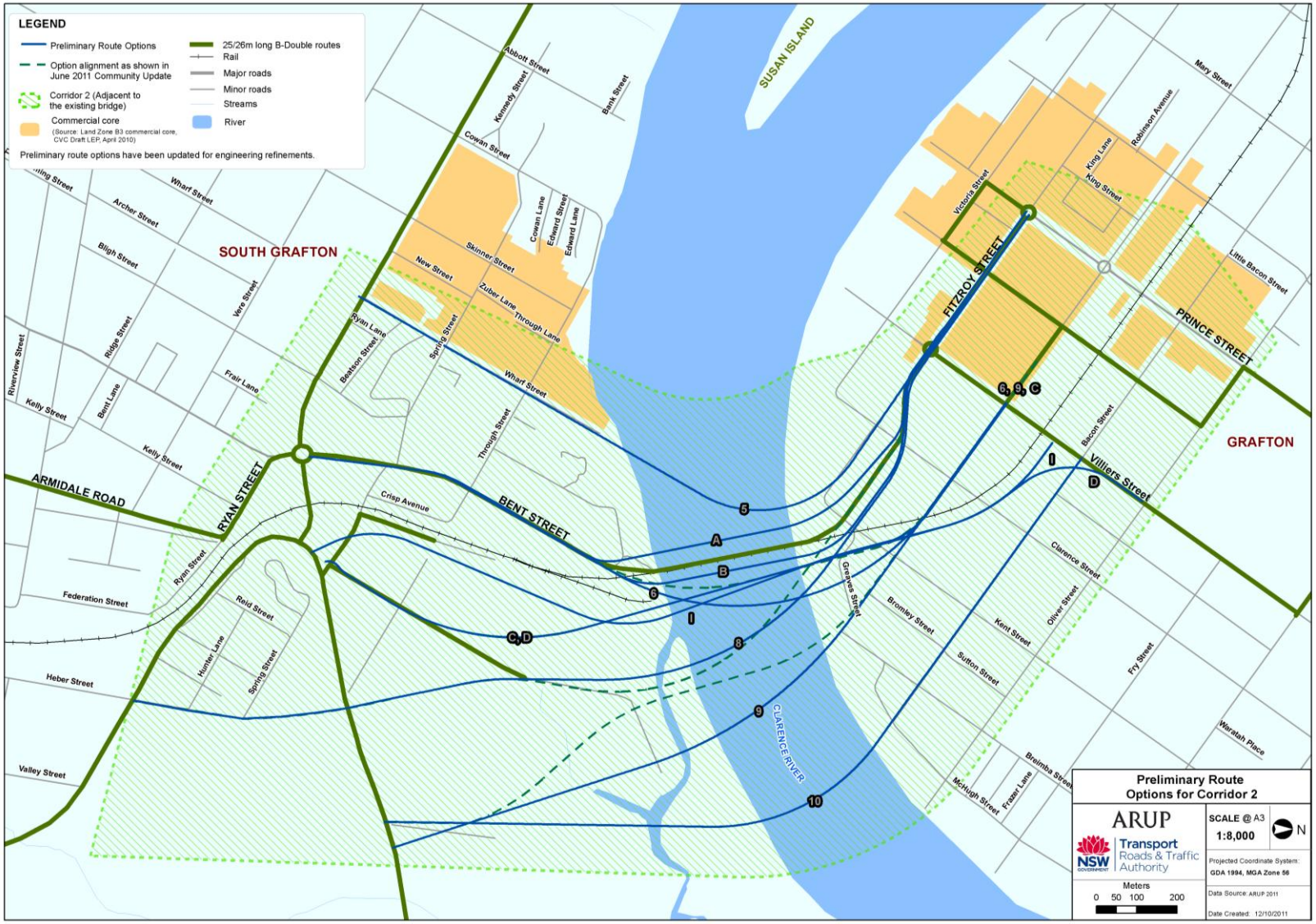


Figure 6.3: Preliminary Route Options – Corridor 3

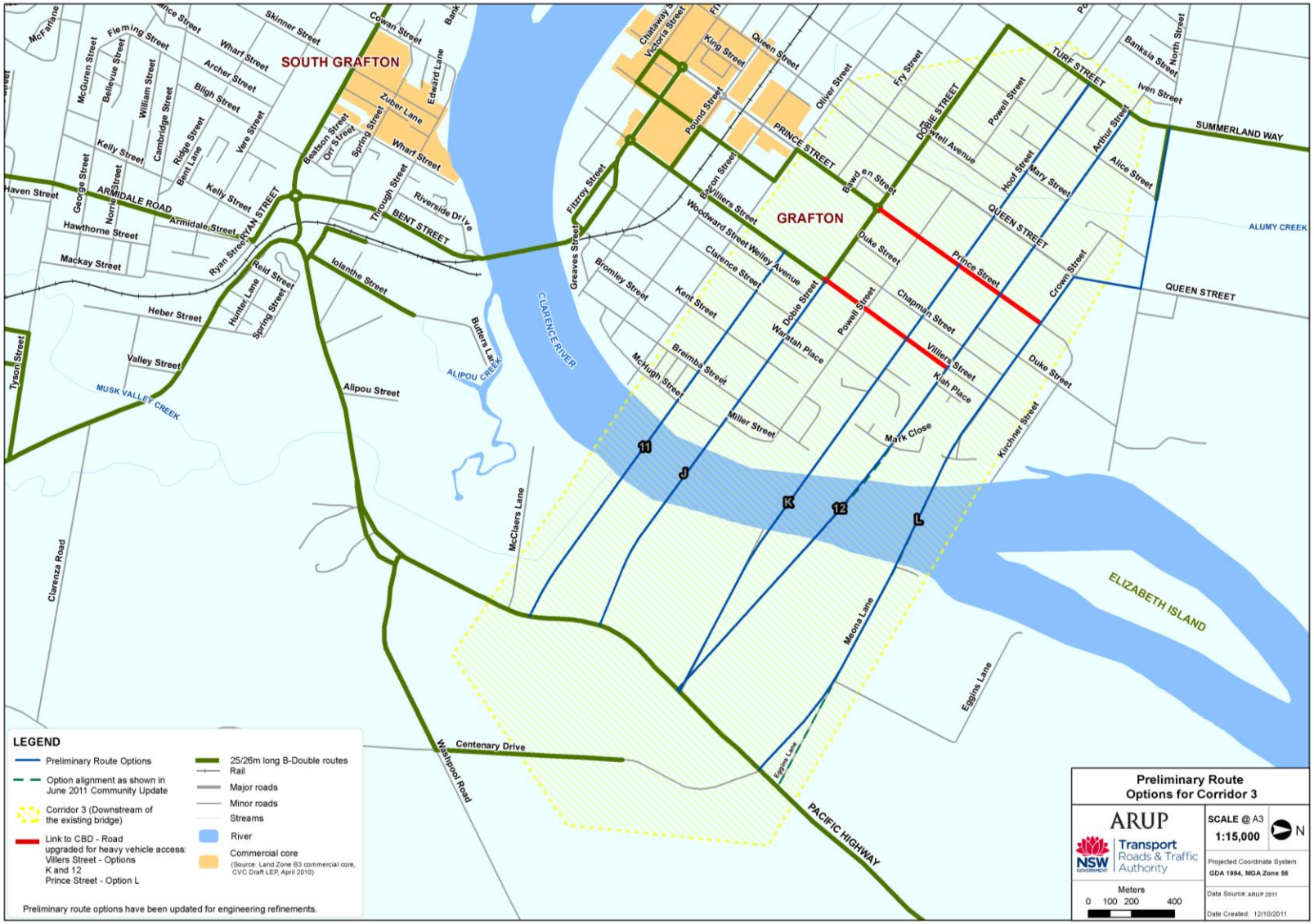


Figure 6.4: Preliminary Route Options – Corridor 4

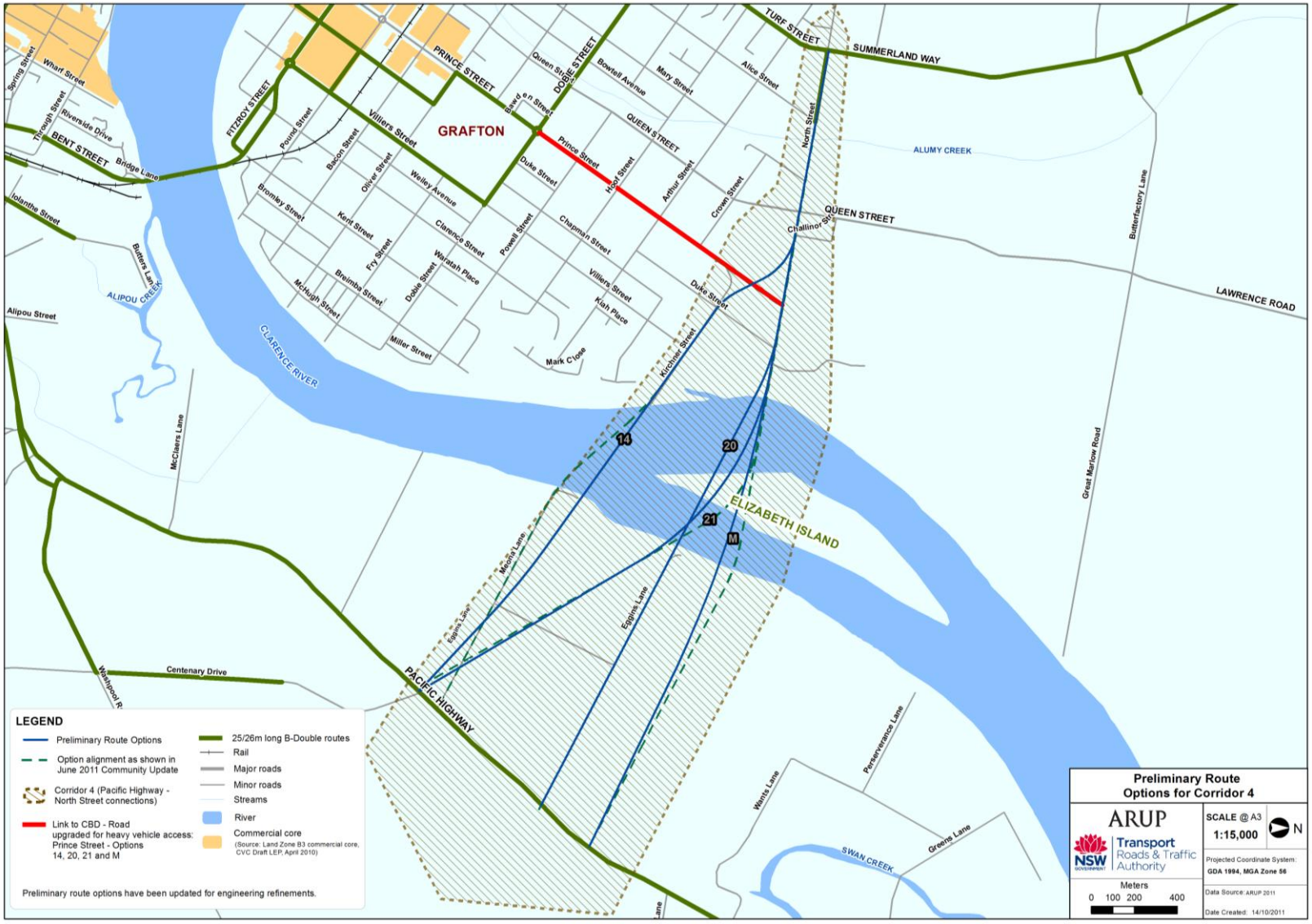


Figure 6.5: Preliminary Route Options – Corridor 5

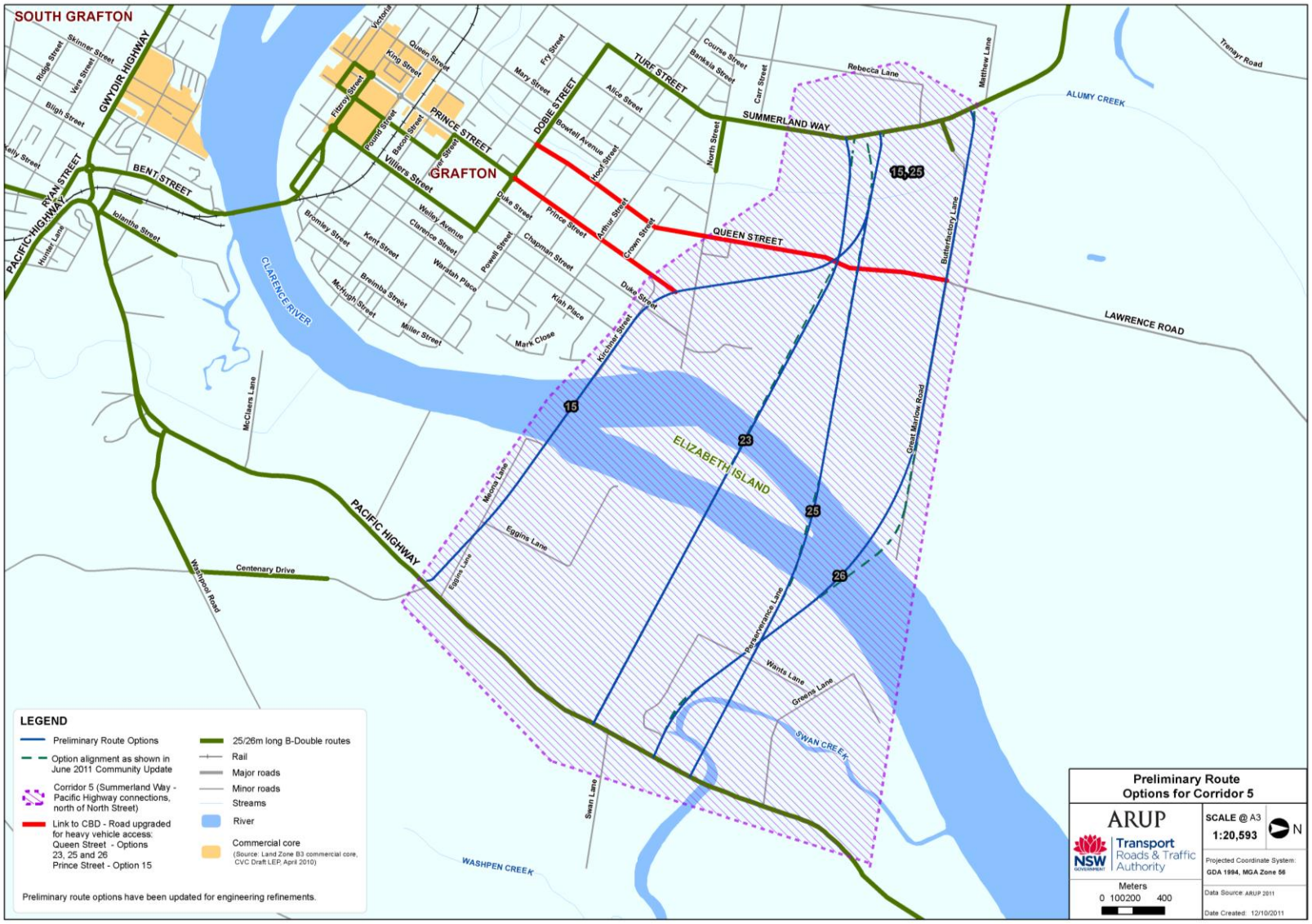


Table 6.1: Summary of Preliminary Route Options

Corridor	Option	New Bridge Connection	Road Closed	Underpass/Overpass
1	F	Gwydir Highway at Abbott Street in South Grafton and Villiers Street in Grafton	None	None
	E	Gwydir Highway at Cowan Street in South Grafton and Villiers Street in Grafton	Victoria Street, Spring Street, Cowan Lane, Edward Street, Edward Lane, Through Street, Kennedy Street	None
2	5	Gwydir Highway at Wharf Street South Grafton and Fitzroy Street in Grafton	Clarence Street South, Fitzroy Street north/Kent Street	None
	A	New bridge parallel existing bridge connect existing road network at Bent Street in South Grafton and Fitzroy Street in Grafton	Spring Street west, Clarence Street north	Fitzroy Street /Kent Street
	B	New bridge parallel existing bridge connect existing road network at Bent Street in South Grafton and Fitzroy Street in Grafton	Spring Street west, Clarence Street south, Clarence Street north (no left turn entry onto bridge)	Fitzroy Street east/Kent Street
	C	Pacific Highway – Spring Street in South Grafton and Clarence Street – Pound Street Grafton	Pound Street NE, Kent Street	Greaves Street
	D	Pacific Highway – Spring Street in South Grafton and Villiers Street – Oliver Street Grafton	Bacon Street	Greaves Street, Kent Street, Pound Street, Clarence Street
	I	Junction of Pacific Highway and Gwydir Highway South Grafton and Villiers Street North of Pound Street Grafton	Spring Street, Through Street	Greaves Street, Kent Street, Pound Street, Clarence Street
	6	Existing bridge and Pound Street – Clarence Street in Grafton	Spring Street west, Kent Street ,	Greaves Street
	8	Pacific Highway at Heber Street in South Grafton and Villiers Street in Grafton	Iolanthe Street (provide connection road from Pacific Highway on east side of bridge approach), Grieves Street , Clarence Street	Kent Street /Fitzroy Street east/Clarence Street south
	9	Pacific Highway in proximity to Alipou Street in South Grafton and Pound Street in Grafton	Greaves Street, Bromley Street	Alipou Street (diverted under viaduct), Iolanthe Street
	10	Pacific Highway in proximity to Alipou Street in South Grafton and Bacon Street in Grafton	McHugh St/Dovedale Street, Breimba Street	None
3	11	Pacific Highway North East of McClaers Lane South Grafton and Fry Street Grafton	McHugh Street, Welley Ave	None
	J	Pacific Highway North East of McClaers Lane South Grafton and Dobie Street Grafton	McHugh Street, Miller Street, Breimba Street	None
	K	Pacific Highway South West of Centenary Drive South Grafton and Hoof Street Grafton	Breimba Street, Kent Street, Duke Street (no road anyway)	None
	12	Pacific Highway South West of Centenary Drive South Grafton and Crown Street Grafton	Clarence St, Duke Street	None
	L	Pacific Highway - Centenary Drive South Grafton and Crown Street Grafton	Islandview Close, Duke Street	Eggins Lane (minor diversion beside viaduct)

Corridor	Option	New Bridge Connection	Road Closed	Underpass/Overpass
4	14	Pacific Highway - Centenary Drive South Grafton and North Street Grafton	Duke Street SW, North Street NE	Eggins Lane (minor diversion beside viaduct)
	20	Pacific Highway North East of Eggins Lane South Grafton and North Street Grafton	Duke Street	Eggins Lane
	21	Pacific Highway - Centenary Drive South Grafton and North Street Grafton	Duke Street	Eggins Lane
	M	Pacific Highway North East of Centenary Drive South Grafton and North Street Grafton	Duke Street	None
5	15	Pacific Highway - Centenary Drive South Grafton and North Street – Kirchner Street - Lawrence Road – Turf Street Grafton	Kirchner Street, Duke Street	Eggins Lane (minor diversion beside viaduct)
	23	Pacific Highway East of Centenary Drive South Grafton and Lawrence Road – Summerland Way South of Butterfactory Lane Grafton	None	None
	25	Pacific Highway – Perseverance Lane South Grafton and Lawrence Road – Summerland Way South of Butterfactory Lane Grafton	None	Wants Lane (Perseverance Lane diverted beside viaduct)
	26	Pacific Highway – Wants Lane South Grafton and Great Marlow Road – Butterfactory Lane – Summerland Way Grafton	None	Wants Lane, Perseverance Lane

The strategic model results and assessment of the options are set out in Sections 7.

6.2 Preliminary Route Option Assumptions

The following key assumptions were included in the preparation of each of the options for assessment at a strategic level:

- The capacity of each new link was assumed to be equal to 1600 vehicles per hour in each direction of travel.
- The posted speed limit for each link was assumed to be 60 kilometres per hour.
- For Options A, B and 6, the changes to the existing bridge operating arrangements (i.e. one lane on existing structure) are likely to enable a higher lane capacity and travel speed. The modelling has assumed for these three options that the speed and lane capacity would be the same as the new bridge.

In addition, the road closures and turning movement restrictions for the route options was included. A list of the banned turns is shown Table 6.2.

Table 6.2: Turn Ban Summary

Option	Preliminary Option Road Network Restrictions
Option A	No access from new bridge to old bridge
Option B	No access from new bridge to old bridge Bridge movement – Left in/Left out only at Clarence Street (no through traffic permitted)
Existing	Spring Street, Clarence Street - Left in/Left out only
Option 9	Spring Street, Clarence Street, Kent Street - Left in/Left out only
Option 10	Spring Street, Clarence Street, Bacon Street, Breimba Street - Left in/Left out only
Option 11	Spring Street, Clarence Street, Breimba Street - Left in/Left out only
Option 14	Spring Street, Clarence Street, Prince Street - Left in/Left out only

7. Results of the Preliminary Route Option Strategic Modelling

7.1 Network Results

The following results have been obtained from the strategic modelling in order to develop an understanding of the operation of each preliminary option:

- two way volumes across the existing bridge and additional crossing for the AM peak period
- total number of trips
- Vehicle Kilometres Travelled (VKT) which represents the total distance travelled by all trips within the network
- Vehicle Hours Travelled (VHT) which represents the total time travelled by all trips within the network
- average speed (km/h) of the modelled network.

Key results of the two hour AM Peak model are shown in Tables 7.1 to 7.4, which are aimed at giving a basic summary and comparison between options from a strategic point of view. Figures 7.1 to 7.10 present the VKT and VHT results graphically for the five corridors.

Table 7.1: 2011 and 2019 Strategic Modelling Results Summary

Corridor	Options	Bridge Volumes				Network Statistics			
		Existing Bridge		New Bridge		No. of Completed Trips	VKT (km)	VHT (hrs)	Speed (km/h)
		NB	SB	NB	SB				
2011		2,306	1,573	-	-	20,942	70,832	1,751	40.5
2019									
Base Model		2,763	1,884	-	-	25,107	86,240	3,298	26.1
1	F	1,723	955	1,040	929	25,107	86,176	1,996	43.2
	E	1,148	603	1,615	1,281	25,107	86,073	1,977	43.5
2	5	144	467	2,619	1,417	25,107	85,705	1,968	43.5
	A	-	951	2,763	933	25,107	86,112	1,953	44.1
	B	1,360	-	1,403	1,884	25,107	86,257	1,958	44.1
	C	1,484	749	1,279	1,135	25,107	86,442	1,986	43.5
	D	1,630	916	1,133	968	25,107	86,493	1,982	43.6
	I	1,485	919	1,278	965	25,107	86,615	1,987	43.6
	6	2,045	-	718	1,884	25,107	86,186	1,954	44.1
	8	1,645	1,208	1,118	676	25,107	86,630	1,992	43.5
	9	1,955	1,526	808	358	25,107	86,801	2,036	42.6
	10	2,054	1,592	709	292	25,107	86,862	2,051	42.3
3	11	2,347	1,846	416	38	25,107	86,747	2,137	40.6
	J	2,376	1,850	387	34	25,107	86,615	1,987	43.6
	K	2,419	1,858	344	26	25,107	86,949	2,195	39.6
	12	2,425	1,788	338	96	25,107	87,114	2,204	39.5
	L	2,451	1,820	312	64	25,107	87,112	2,278	38.2
4	14	2,494	1,789	269	95	25,107	87,401	2,414	36.2
	20	2,520	1,872	243	12	25,107	87,232	2,497	34.9
	21	2,501	1,825	262	59	25,107	87,249	2,437	35.8
	M	2,524	1,873	239	11	25,107	87,296	2,510	34.8
5	15	2,500	1,662	263	222	25,107	87,346	2,418	36.1
	23	2,548	1,831	215	53	25,107	87,498	2,583	33.9
	25	2,578	1,875	185	9	25,107	87,452	2,683	32.6
	26	2,588	1,871	175	13	25,107	87,421	2,714	32.2

Table 7.2: 2029 Strategic Modelling Results Summary

Corridor	Options	Bridge Volumes				Network Statistics			
		Existing Bridge		New Bridge		No. of Completed Trips	VKT (km)	VHT (hrs)	Speed (km/h)
		NB	SB	NB	SB				
Base Model		3,760	2,516	-	-	30,996	115,888	9,167	12.6
1	F	1,804	1,338	1,956	1,178	30,996	115,203	2,687	42.9
	E	1,320	954	2,440	1,562	30,996	115,045	2,670	43.1
2	5	870	686	2,890	1,830	30,996	114,884	2,677	42.9
	A	-	1,236	3,760	1,280	30,996	115,632	2,647	43.7
	B	1,858	-	1,902	2,516	30,996	116,933	2,667	43.5
	C	1,771	846	1,989	1,670	30,996	116,140	2,688	43.2
	D	1,801	1,068	1,959	1,448	30,996	116,235	2,676	43.4
	I	1,730	1,050	2,030	1,466	30,996	116,281	2,682	43.4
	6	2,379	-	1,381	2,516	30,996	115,649	2,646	43.7
	8	1,793	1,528	1,967	988	30,996	116,569	2,696	43.2
	9	2,064	1,874	1,696	642	30,996	116,759	2,764	42.2
	10	2,227	1,905	1,533	611	30,996	116,891	2,801	41.7
3	11	2,405	2,131	1,355	385	30,996	117,926	2,918	40.4
	J	2,444	2,160	1,316	356	30,996	118,299	3,029	39.1
	K	2,487	2,150	1,273	366	30,996	119,056	3,152	37.8
	12	2,492	2,077	1,268	439	30,996	119,349	3,158	37.8
	L	2,512	2,173	1,248	343	30,996	119,841	3,235	37.0
4	14	2,487	2,102	1,273	414	30,996	121,264	3,164	38.3
	20	2,519	2,231	1,241	285	30,996	121,785	3,308	36.8
	21	2,503	2,159	1,257	357	30,996	121,410	3,229	37.6
	M	2,518	2,277	1,242	239	30,996	122,273	3,327	36.8
5	15	2,495	2,098	1,265	418	30,996	120,713	3,171	38.1
	23	2,596	2,190	1,164	326	30,996	123,389	3,563	34.6
	25	2,626	2,249	1,134	267	30,996	124,342	3,700	33.6
	26	2,638	2,253	1,122	263	30,996	124,462	3,739	33.3

Table 7.3: 2039 Strategic Modelling Results Summary

Corridor	Options	Bridge Volumes				Network Statistics			
		Existing Bridge		New Bridge		No. of Completed Trips	VKT (km)	VHT (hrs)	Speed (km/h)
		NB	SB	NB	SB				
Base Model		4,260	2,852	-	-	35,145	136,81	14,067	9.7
1	F	1,833	1,534	2,427	1,318	35,145	135,79	3,177	42.7
	E	1,586	1,141	2,674	1,711	35,145	135,57	3,168	42.8
2	5	1,322	823	2,938	2,029	35,145	135,55	3,173	42.7
	A	-	1,401	4,260	1,451	35,145	136,47	3,135	43.5
	B	1,806	-	2,454	2,852	35,145	137,91	3,210	42.7
	C	1,895	922	2,365	1,930	35,145	136,99	3,192	42.9
	D	1,916	1,169	2,344	1,683	35,145	137,14	3,173	43.2
	I	1,854	1,146	2,406	1,706	35,145	137,20	3,180	43.2
	6	2,499	-	1,761	2,852	35,145	136,47	3,142	43.4
	8	1,865	1,641	2,395	1,211	35,145	137,54	3,193	43.1
	9	2,115	1,961	2,145	891	35,145	137,75	3,274	42.1
	10	2,241	1,961	2,019	891	35,145	138,09	3,302	41.8
3	11	2,432	2,136	1,828	716	35,145	139,79	3,474	40.2
	J	2,442	2,201	1,818	651	35,145	140,18	3,553	39.5
	K	2,464	2,236	1,796	616	35,145	141,44	3,616	39.1
	12	2,470	2,259	1,790	593	35,145	141,67	3,643	38.9
	L	2,486	2,290	1,774	562	35,145	142,23	3,706	38.4
4	14	2,516	2,324	1,744	528	35,145	143,95	3,851	37.4
	20	2,536	2,340	1,724	512	35,145	145,50	3,922	37.1
	21	2,538	2,320	1,722	532	35,145	144,49	3,923	36.8
	M	2,549	2,356	1,711	496	35,145	146,32	3,976	36.8
5	15	2,529	2,286	1,731	566	35,145	143,37	3,855	37.2
	23	2,601	2,388	1,659	464	35,145	148,00	4,205	35.2
	25	2,629	2,406	1,631	446	35,145	149,82	4,342	34.5
	26	2,638	2,409	1,622	443	35,145	150,10	4,373	34.3

Table 7.4: 2049 Strategic Modelling Results Summary

Corridor	Options	Bridge Volumes				Network Statistics			
		Existing Bridge		New Bridge		No. of Completed Trips	VKT (km)	VHT (hrs)	Speed (km/h)
		NB	SB	NB	SB				
Base Model		4,834	3,229	-	-	38,234	154,207	20,515	7.5
1	F	2,013	1,765	2,821	1,464	38,234	152,654	3,635	42.0
	E	1,905	1,465	2,929	1,764	38,234	152,388	3,626	42.0
2	5	1,788	991	3,046	2,238	38,234	152,605	3,630	42.0
	A	-	1,623	4,834	1,606	38,234	153,613	3,564	43.1
	B	2,323	-	2,511	3,229	38,234	154,343	3,641	42.4
	C	2,107	1,081	2,727	2,148	38,234	154,110	3,686	41.8
	D	2,128	1,276	2,706	1,953	38,234	154,293	3,653	42.2
	I	2,079	1,266	2,755	1,963	38,234	154,329	3,665	42.1
	6	2,536	-	2,296	3,229	38,234	153,619	3,582	42.9
	8	2,107	1,765	2,727	1,464	38,234	154,671	3,683	42.0
	9	2,182	1,996	2,652	1,233	38,234	155,105	3,774	41.1
	10	2,271	1,973	2,563	1,256	38,234	155,557	3,746	41.5
3	11	2,452	2,164	2,382	1,065	38,234	157,955	4,077	38.7
	J	2,495	2,233	2,339	996	38,234	158,481	4,247	37.3
	K	2,499	2,262	2,335	967	38,234	159,918	4,219	37.9
	12	2,477	2,323	2,357	906	38,234	160,790	4,163	38.6
	L	2,547	2,413	2,287	816	38,234	161,312	4,493	35.9
4	14	2,548	2,429	2,286	800	38,234	163,061	4,542	35.9
	20	2,577	2,447	2,257	782	38,234	165,794	4,658	35.6
	21	2,519	2,449	2,315	780	38,234	164,367	4,541	36.2
	M	2,527	2,458	2,307	771	38,234	167,694	4,561	36.8
5	15	2,519	2,432	2,315	797	38,234	162,729	4,464	36.5
	23	2,633	2,505	2,201	724	38,234	169,725	5,093	33.3
	25	2,692	2,516	2,142	713	38,234	172,555	5,400	32.0
	26	2,667	2,526	2,167	703	38,234	172,894	5,318	32.5

Figure 7.1: VKT Results – Corridor 1

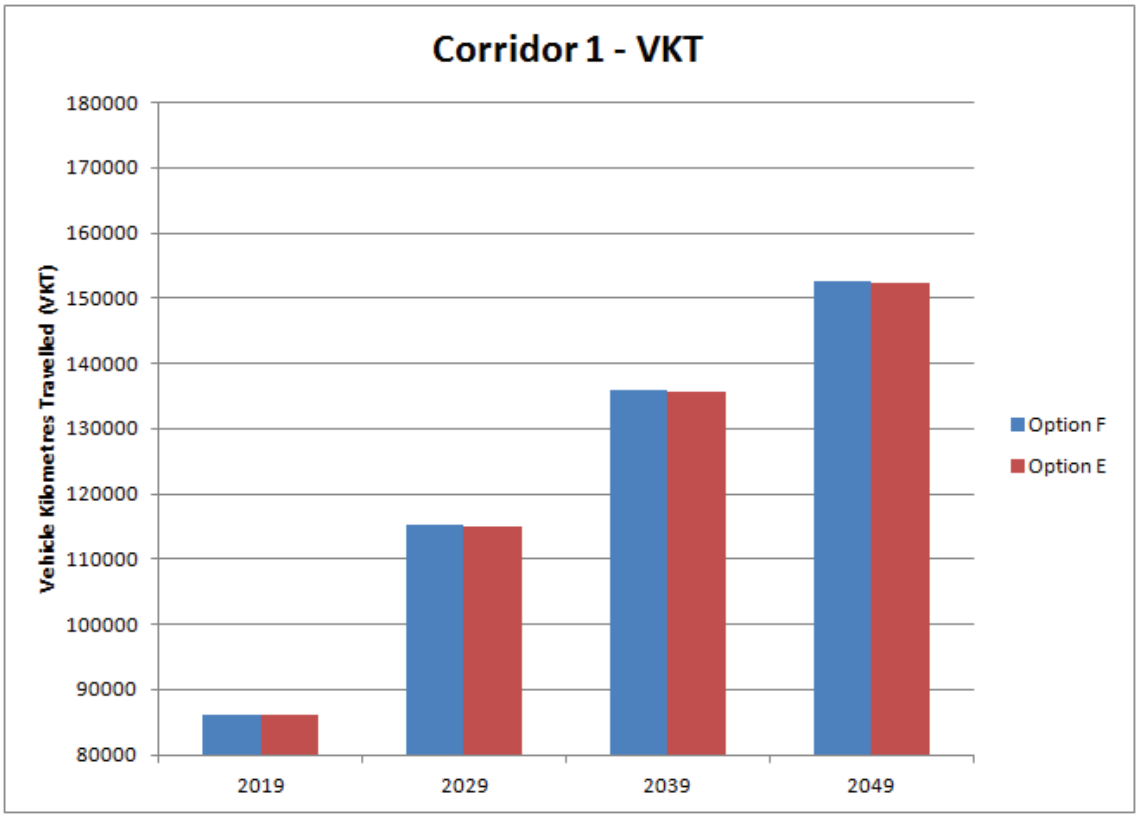


Figure 7.2: VHT Results – Corridor 1

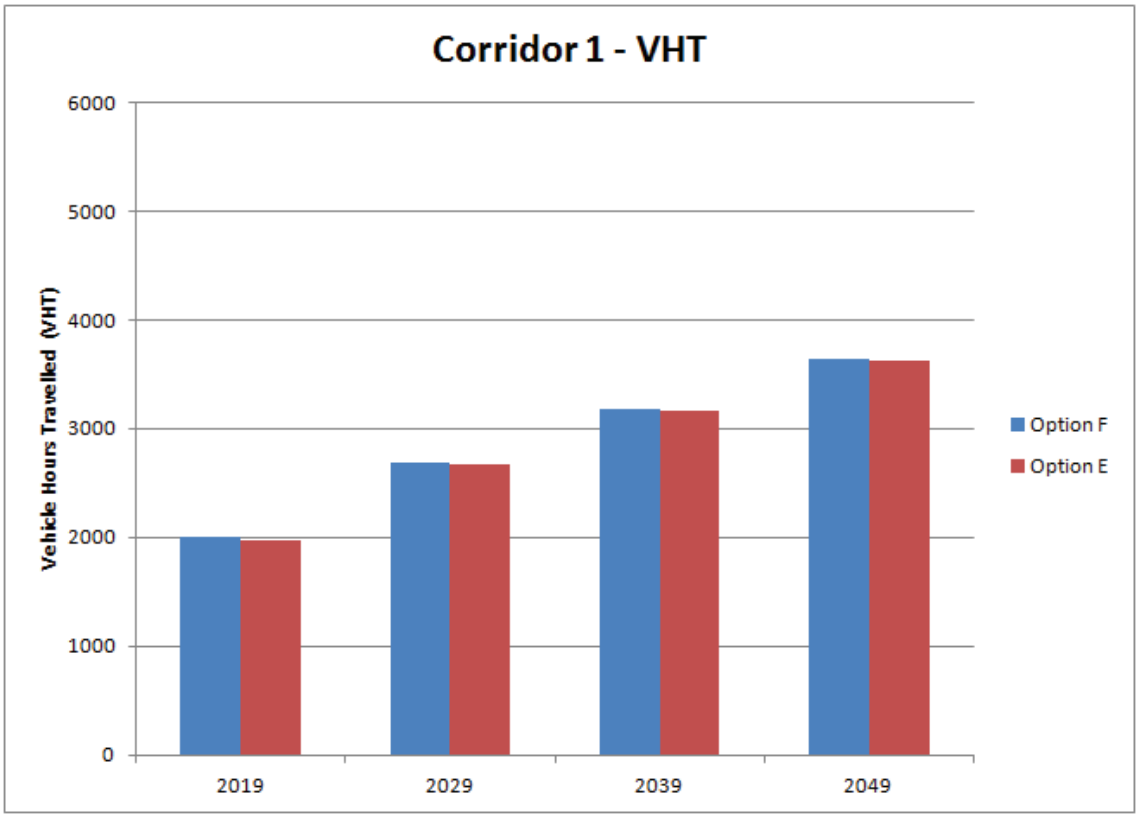


Figure 7.3: VKT Results – Corridor 2

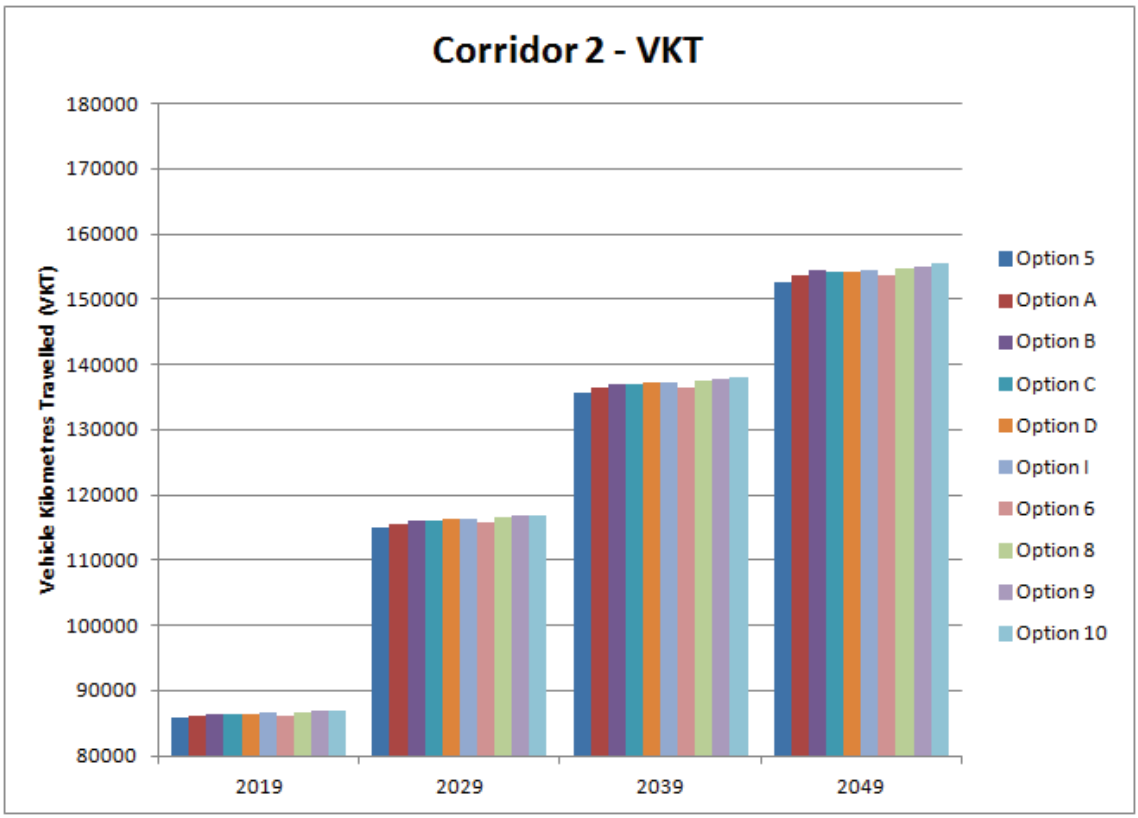


Figure 7.4: VHT Results – Corridor 2

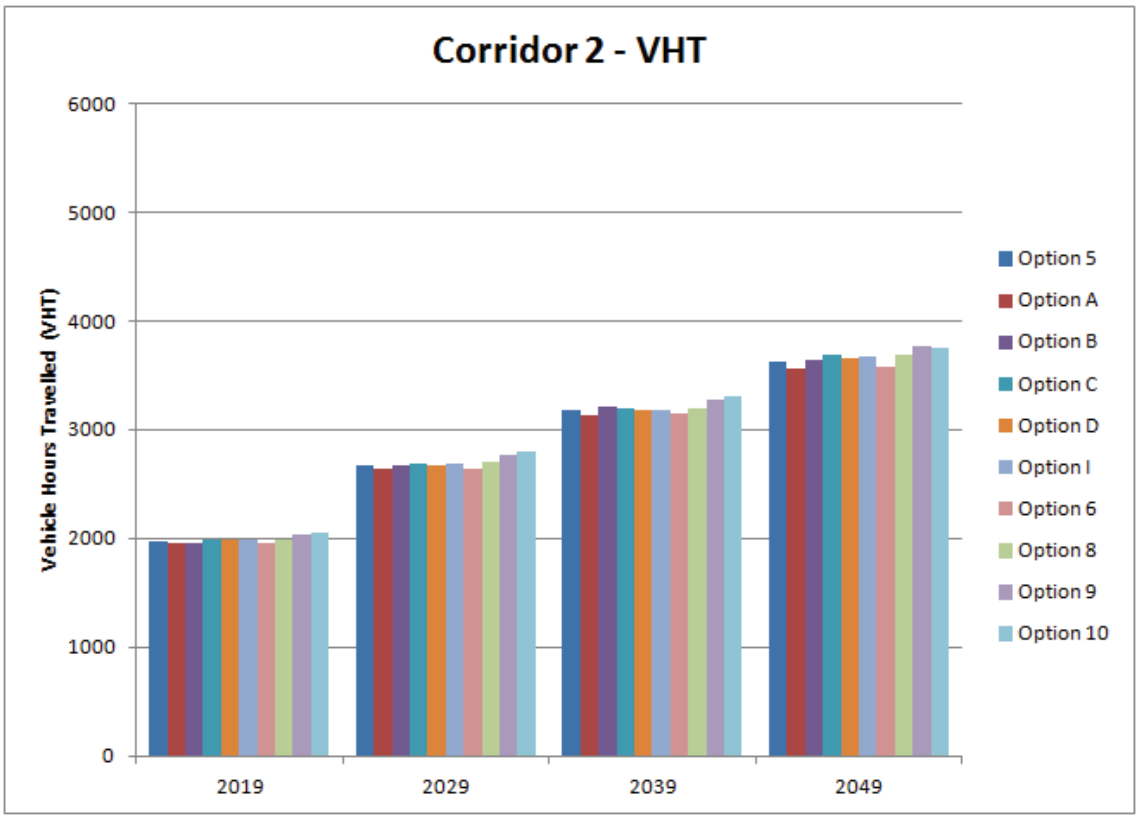


Figure 7.5: VKT Results – Corridor 3

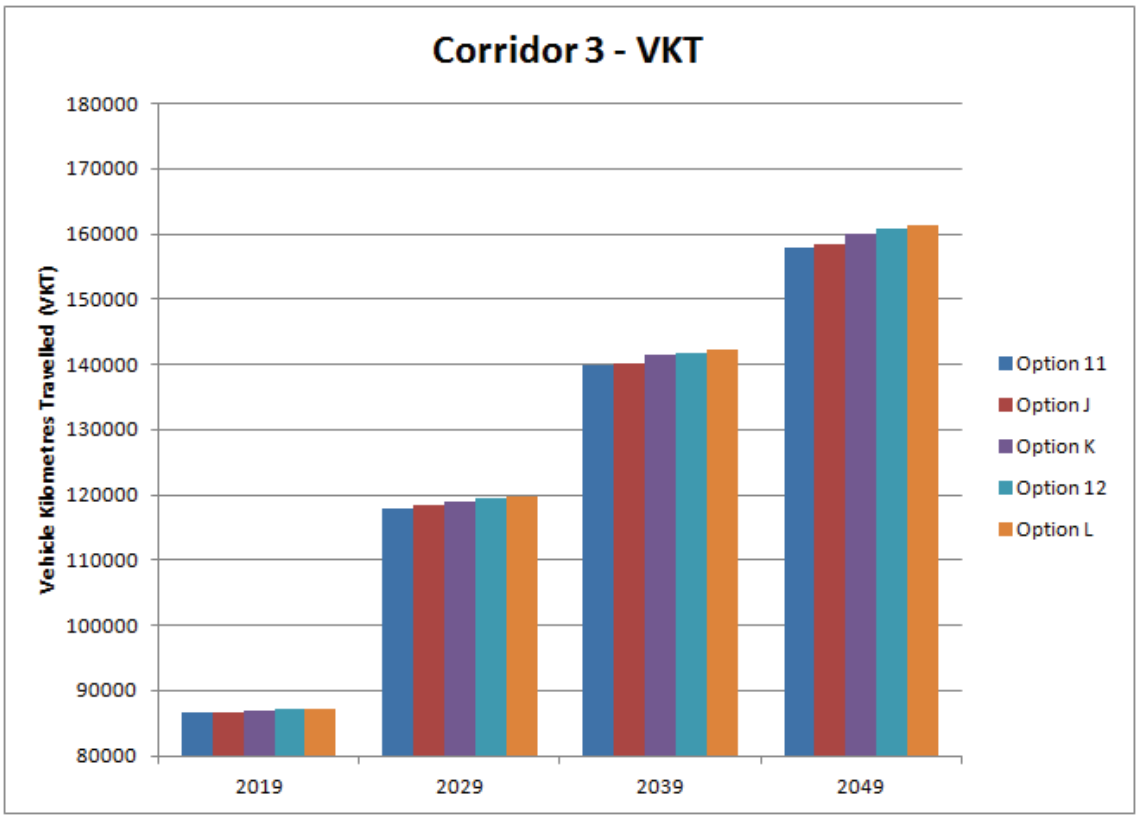


Figure 7.6: VHT Results – Corridor 3

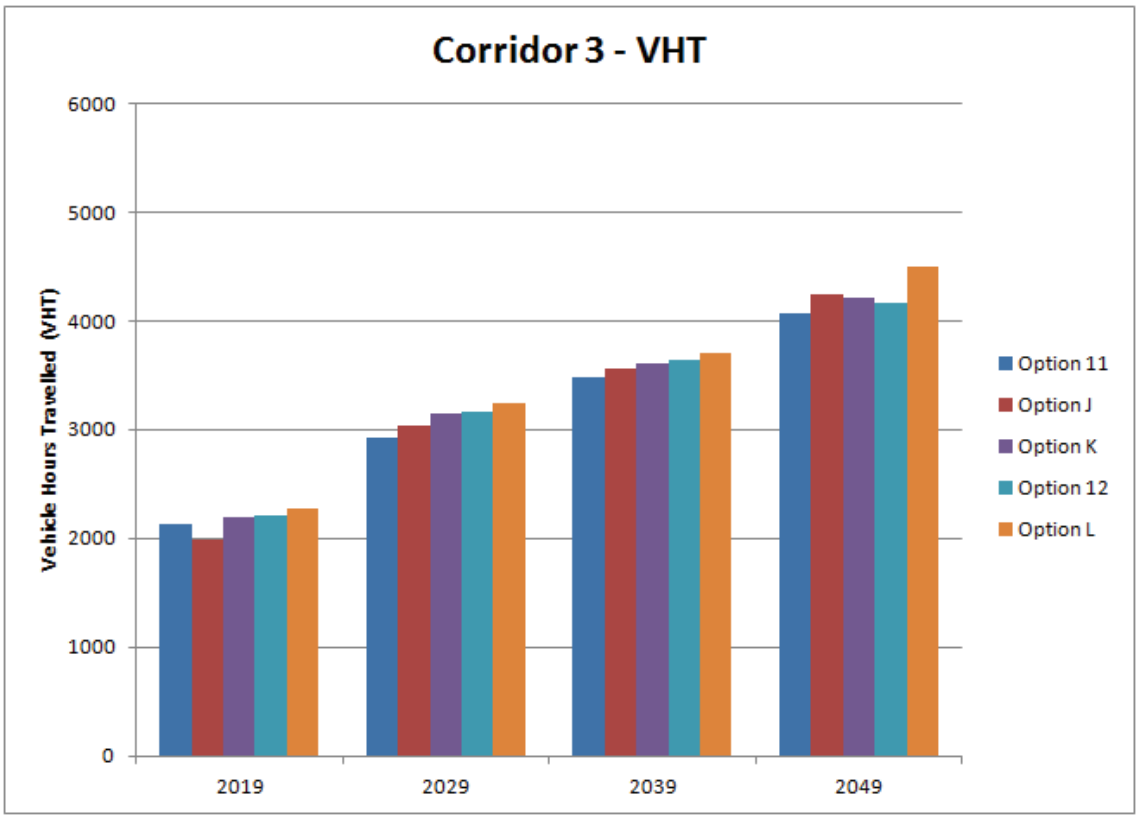


Figure 7.7: VKT Results – Corridor 4

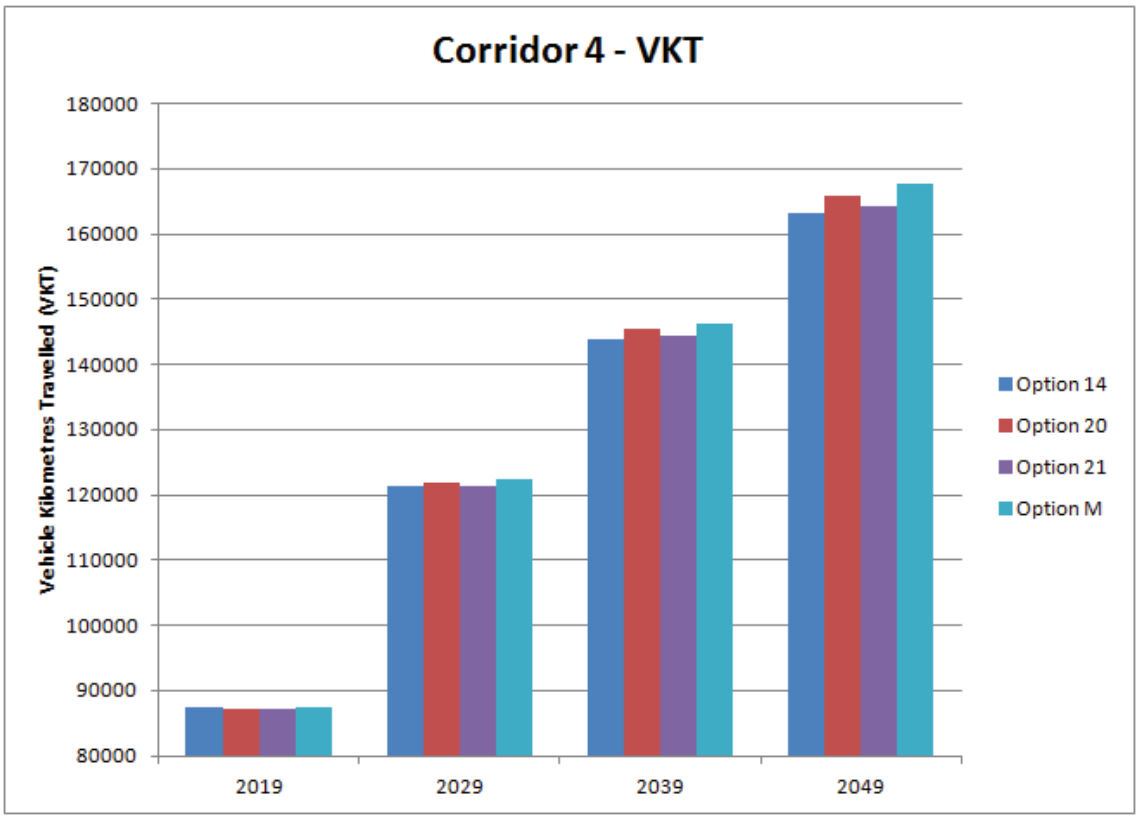


Figure 7.8: VHT Results – Corridor 4

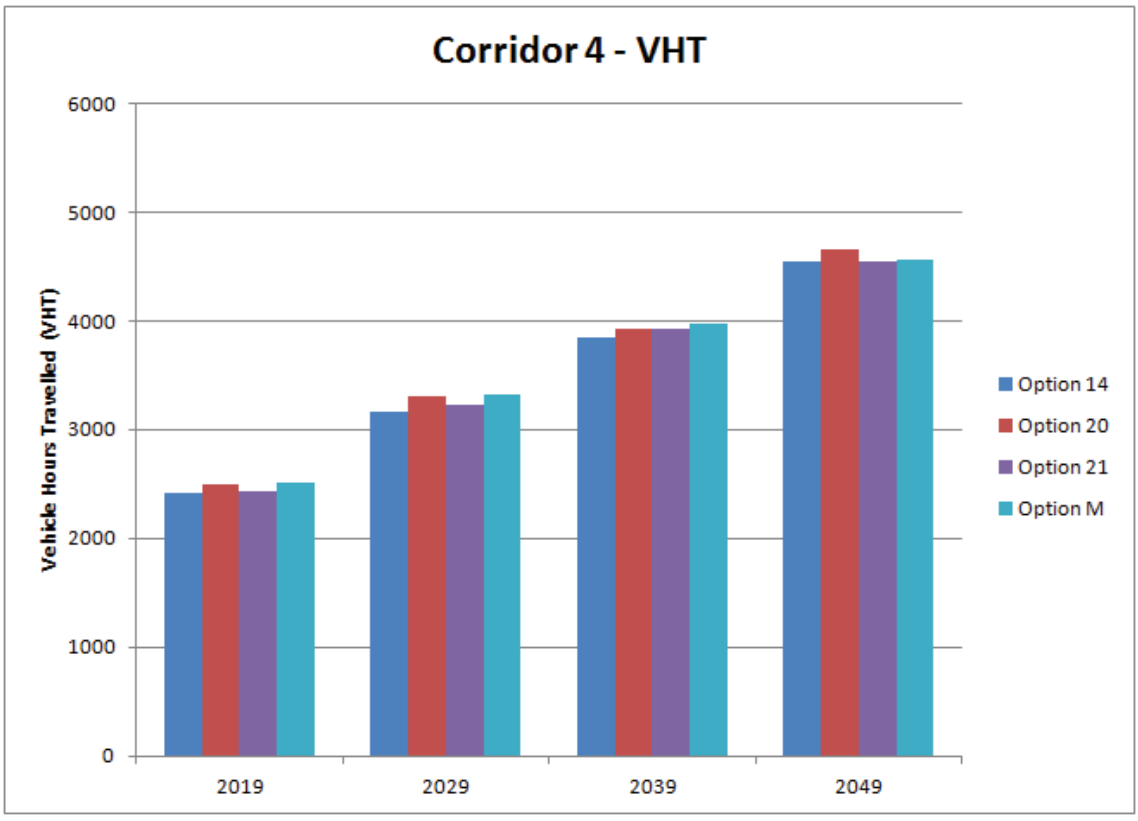


Figure 7.9: VKT Results – Corridor 5

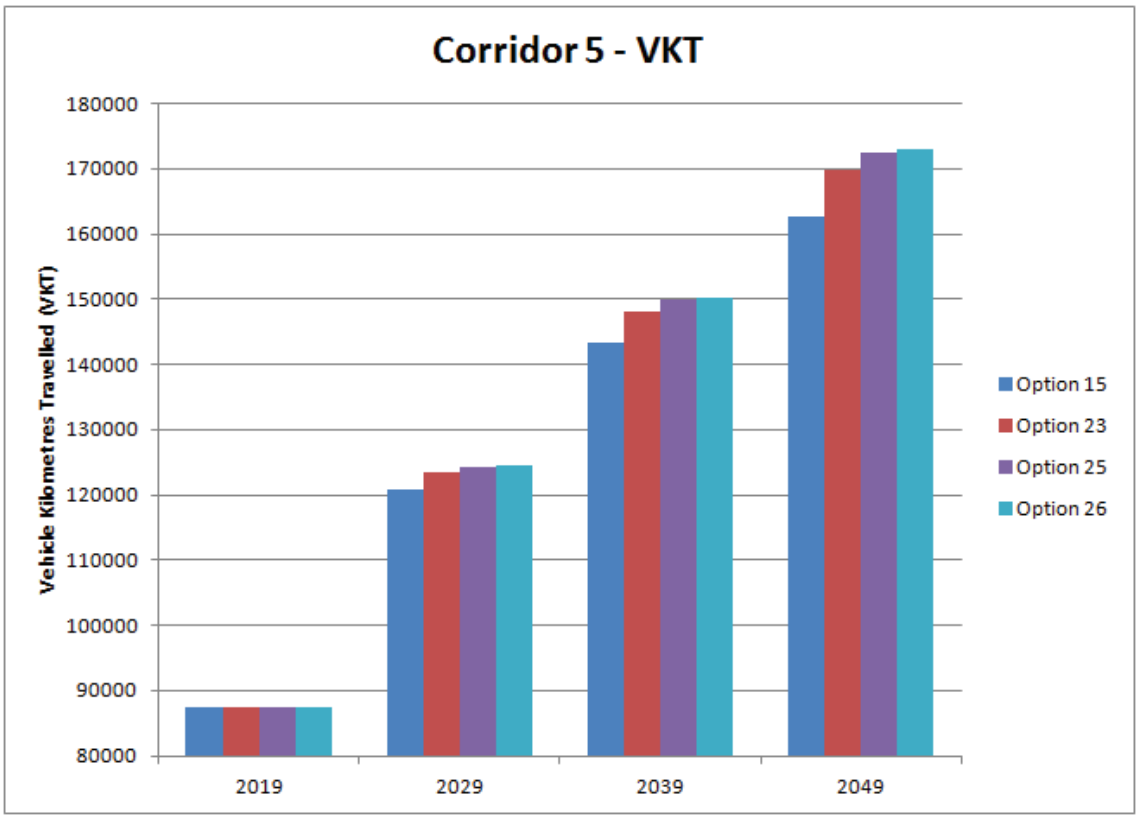
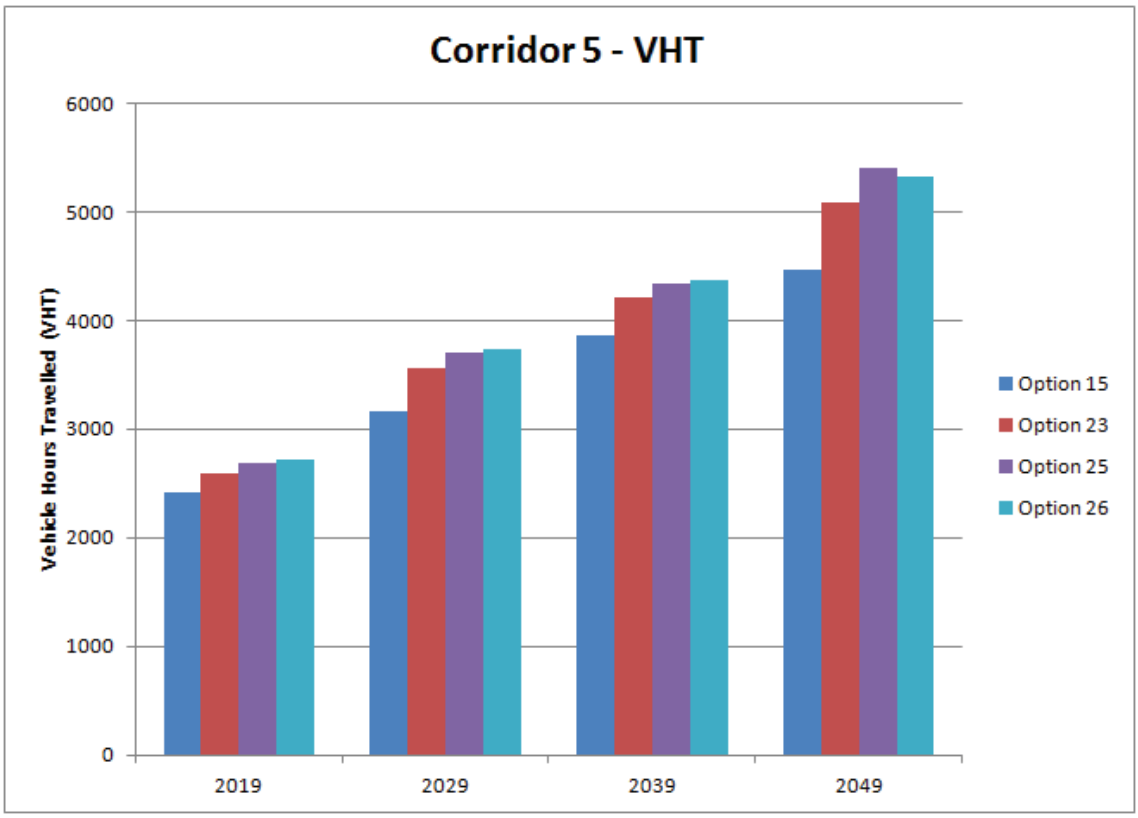


Figure 7.10: VHT Results – Corridor 5



The following provides a discussion of the comparative results for the options within each of the five corridors. It should be noted that the results and discussion provides a basis to compare options and their relative performance from a strategic perspective. They are not intended to provide a detailed comparison of the options against the full range of selection criteria.

Corridor 1

The network results for the options located in Corridor 1 (Options E and F) indicate that the difference in the operating performance between these options is marginal for all design years. From a strategic modelling perspective alone, these results suggest that they will operate similarly.

Corridor 2

The network results for Corridor 2 show marginal differences in the operating performance for all design years. Generally, the best performing options are those located in the vicinity of the existing bridge (Options A, B, D, I and 5). These options perform similarly from a strategic modelling perspective. Options 9 and 10 are located further away from the existing bridge and as such show a slight reduction in operating performance but again are similar when compared against one another.

Corridor 3

Option 11 generally provides the best operating performance in terms of VKT, VHT and average speed when compared to the other options. The other options show similar operating performance from a strategic perspective, with Options J and K producing network results marginally better than Options 12 and L.

Corridor 4

Option 14 has the best operating performance out of the Corridor 4 options up to 2039. For 2039 and 2049, Options 21 and M experience higher average speeds than Options 14 and 20. Nevertheless, these results show that there are marginal differences between the four options at a strategic modelling level.

Corridor 5

Of the options within Corridor 5, Option 15 provides the lowest travel distance and travel time, resulting in superior average speeds. The variation between options in this corridor are quite significant from a strategic modelling perspective.

8. Summary

Strategic transport modelling of Grafton and South Grafton has been undertaken to develop a detailed understanding of the existing and future traffic demands and patterns for an additional crossing of the Clarence River at Grafton. The modelling was used to estimate future traffic demands across the river for a 30 year period up to the year 2049 (assuming an opening date of a new bridge in 2019).

The strategic traffic model was developed to predict the traffic volumes and patterns that are likely to occur for each of the 25 preliminary route options that were identified in the RMS June 2011 Feasibility Assessment Report and June 2011 Community Update. To assess future traffic demand, a series of population growth forecasts identified by the NSW Department of Planning and Clarence Valley Council have been adopted. The population forecasts are based on current and future land capacity in Grafton, South Grafton and surrounding areas and indicate that population growth is expected to occur at an average rate of 1.6% p.a. between 2011 and 2049. As Clarence Valley Council data was only available to 2031, for modelling purposes, the 2031 data was extrapolated out to 2049.

Origin and destination data from previous traffic studies indicates that approximately 97 per cent of existing bridge users have an origin or destination in either Grafton or South Grafton, and only three per cent of existing bridge traffic is considered as 'through' traffic. Modelling of the existing conditions (i.e. the 'do minimum' case) determined that as future traffic demand across the river increases, additional road capacity will be required. The modelling shows that 'doing nothing' will lead to unacceptable road network operating conditions.

The traffic demand across the river currently exceeds the capacity of the existing bridge during peak periods. Traffic delays in peak periods are changing people's travel behaviour. It would appear from the traffic count data that bridge users have timed their trip to avoid the peak period traffic congestion. Travel time surveys undertaken in 2009 indicated that a trip between South Grafton and Grafton in the morning peak hour would take approximately nine minutes while the same trip in the southbound direction was considerably quicker at five minutes.

The 25 preliminary route options were tested to determine the impact that each option would have on traffic movement in and around Grafton and South Grafton from a network perspective. The results of the modelling indicate that:

- Based on the adopted forecast population growth figures, traffic demands across the river will increase by 108% over the next 30 years.
- Additional river crossing capacity will be required in future to accommodate the additional traffic demand as a result of forecast population growth.
- Do minimum will lead to unacceptable road network operating conditions.
- The year in which an additional river crossing is required is dependent on the increase in traffic growth in the coming years.
- The period over which an additional river crossing maintains acceptable operating conditions is also dependent on the increase in traffic growth rate in the coming years.
- 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.

- Network results indicate that the difference in operating performance between the options in Corridor 1 (Options E and F) would be marginal in all design years.
- Network results for Corridor 2 indicate marginal differences in operating performance between the options for all design years with the best performing options generally being located in the vicinity of the existing bridge (Options A, B, D, I and 5).
- Within Corridor 3, network results indicate that Option 11 provides the best operating performance with Options J and K performing marginally better than Options 12 and L.
- Network results for Corridor 4 indicate marginal differences between the four options at a strategic modelling level.
- From a strategic perspective, network results indicate differences in the performance of the options within Corridor 5 with Options 15 performing better than the other three options.

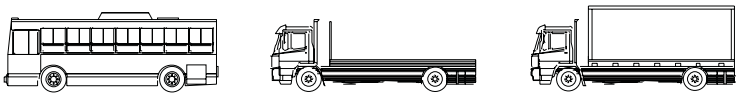
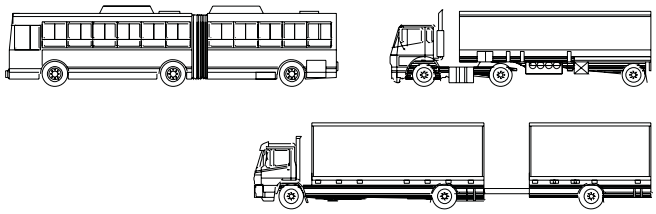
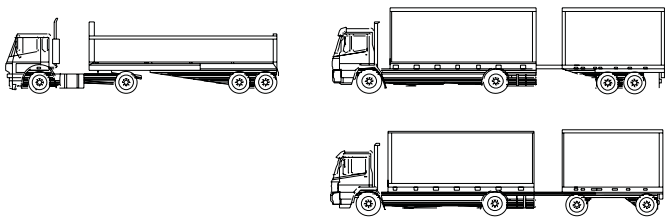
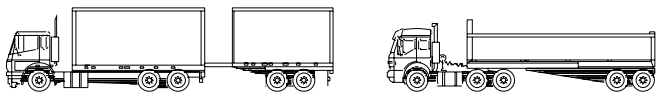
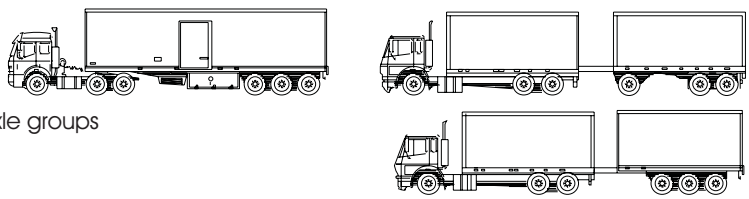
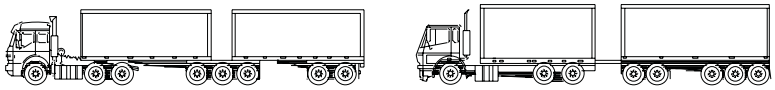
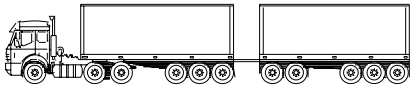
If additional traffic capacity is provided across the river, there would be a number of effects. Peak period traffic volumes would immediately increase, as people would revert to their preferred travel behaviour and activity patterns. In the medium term, there are likely to be changes in land use, as the city would be able to function more as a single unit, and traffic across the river would probably grow at a fairly high rate for several years.

Appendix A

Austroads Vehicle Classification System

VEHICLE CLASSIFICATION SYSTEM

AUSTROADS

CLASS	LIGHT VEHICLES
1	SHORT Car, Van, Wagon, 4WD, Utility, Bicycle, Motorcycle 
2	SHORT - TOWING Trailer, Caravan, Boat 
	HEAVY VEHICLES
3	TWO AXLE TRUCK OR BUS *2 axles 
4	THREE AXLE TRUCK OR BUS *3 axles, 2 axle groups 
5	FOUR (or FIVE) AXLE TRUCK *4 (5) axles, 2 axle groups 
6	THREE AXLE ARTICULATED *3 axles, 3 axle groups 
7	FOUR AXLE ARTICULATED *4 axles, 3 or 4 axle groups 
8	FIVE AXLE ARTICULATED *5 axles, 3+ axle groups 
9	SIX AXLE ARTICULATED *6 axles, 3+ axle groups or 7+ axles, 3 axle groups 
	LONG VEHICLES AND ROAD TRAINS
10	B DOUBLE or HEAVY TRUCK and TRAILER *7+ axles, 4 axle groups 
11	DOUBLE ROAD TRAIN *7+ axles, 5 or 6 axle groups 
12	TRIPLE ROAD TRAIN *7+ axles, 7+ axle groups 

Dwg No: 0293-009

Asset and Network Information - January 2002

Appendix B

Calibration and Validation Results

Appendix B

2011 Calibration AM Peak 2 Hour Period - TRIPS Model Results

Location	Count (Various)	Modelled Volumes	Modelled - Count	% Difference	(M-C)^2	GEH	Flow
Bridge, On Northern Approach	2309	2,306	- 3	-0.1%	8	0.06	1
Bridge, On Southern Approach	1448	1,573	125	8.6%	15,625	3.22	1
Pacific Hwy, South of Centenary Dr South NB	735	727	- 8	-1.1%	64	0.30	1
Pacific Hwy, South of Centenary Dr South SB	413	489	76	18.4%	5,776	3.58	1
Villier St East of Victoria St	67	177	110	164.2%	12,100	9.96	0
Fitzroy St/Villiers St	2345	2,307	- 38	-1.6%	1,444	0.79	1
Fitzroy St/Villiers St	566	671	105	18.6%	11,025	4.22	0
Fitzroy St/Villiers St	571	389	- 182	-31.9%	33,124	8.31	0
Prince St/Pound St	393	522	129	32.8%	16,641	6.03	0
Prince St/Pound St	486	387	- 99	-20.4%	9,801	4.74	1
Prince St East of Pound St	543	401	- 142	-26.2%	20,164	6.54	0
Prince St/Pound St	563	558	- 5	-0.9%	25	0.21	1
Fitzroy St/Prince St	299	246	- 53	-17.7%	2,809	3.21	1
Fitzroy St/Prince St	849	1,024	175	20.6%	30,625	5.72	0
Prince St West of Pound St	560	552	- 8	-1.4%	64	0.34	1
Fitzroy St/Prince St	422	411	- 11	-2.6%	121	0.54	1
Villiers St between Fitzroy St and Pound St NB	955	1,062	107	11.2%	11,385	3.36	1
Villiers St/Pound St	157	269	112	71.3%	12,544	7.67	0
Villiers St between Pound St and Bacon St NB	579	691	112	19.3%	12,544	4.44	0
Villiers St/Pound St	294	405	111	37.8%	12,321	5.94	0
Bent St/Spring St	1063	1,131	68	6.4%	4,624	2.05	1
Spring St WB	200	213	13	6.5%	169	0.90	1
Bent St/Spring St	1697	1,441	- 256	-15.1%	65,536	6.46	0
Bent St/Spring St	102	56	- 46	-45.1%	2,116	5.18	1
Bent St/Gwydir Hwy	952	998	46	4.8%	2,116	1.47	1
Bent St/Gwydir Hwy	688	744	56	8.1%	3,136	2.09	1
Ryan St NB	888	1,189	301	33.9%	90,601	9.34	0
Bent St/Gwydir Hwy	588	600	12	2.0%	144	0.49	1
Gwydir Hwy/Bligh St	102	102	-	0.0%	-	-	1
Gwydir Hwy/Bligh St	453	469	16	3.5%	256	0.75	1
Gwydir Hwy/Bligh St	696	767	71	10.2%	5,041	2.63	1
Pacific Hwy/Gwydir Hwy	680	746	66	9.7%	4,356	2.47	1
Pacific Hwy/Gwydir Hwy	883	650	- 233	-26.4%	54,289	8.42	0
Pacific Hwy/Gwydir Hwy	415	542	127	30.6%	16,129	5.81	0
Summerland Way, South of Clarence Way	137	141	4	2.7%	13	0.31	1
Summerland Way, South of Clarence Way	268	271	3	1.1%	8	0.17	1
Lawrence Rd	272	230	- 42	-15.4%	1,764	2.65	1
Lawrence Rd	104	68	- 36	-34.6%	1,296	3.88	1
Pacific Hwy	678	718	40	5.9%	1,600	1.51	1
Pacific Hwy	447	466	19	4.3%	361	0.89	1
Bent St	665	545	- 120	-18.0%	14,400	4.88	0
Bent St	339	372	33	9.7%	1,089	1.75	1
Gwydir Hwy, East of Hay Street	626	683	57	9.1%	3,249	2.23	1
Gwydir Hwy, East of Hay Street	189	224	35	18.6%	1,237	2.45	1
Queen St	407	407	-	0.0%	-	-	1
Queen St	342	341	- 1	-0.3%	1	0.05	1
Prince St	654	521	- 133	-20.3%	17,689	5.49	0
Prince St	576	538	- 38	-6.6%	1,444	1.61	1
Prince Street, North of Oliver Street	389	521	133	34.1%	17,556	6.21	0
Prince Street, North of Oliver Street	556	339	- 217	-39.0%	46,944	10.24	0
Rushforth Rd	46	58	12	26.1%	144	1.66	1
Rushforth Rd	46	48	2	4.3%	4	0.29	1
Bent St	242	217	- 25	-10.3%	625	1.65	1
Bent St	242	244	2	0.8%	4	0.13	1
Swallow Rd	72	72	-	0.0%	-	-	1
Swallow Rd	72	73	1	1.4%	1	0.12	1
Through St	285	326	41	14.4%	1,681	2.35	1
Bent St/Spring St	285	324	39	13.7%	1,521	2.23	1
Summerland Way north of Butterfactory Lane NB	285	317	32	11.2%	1,024	1.84	1
Summerland Way north of Butterfactory Lane SB	629	760	131	20.9%	17,266	4.99	0
Lawrence Rd between North of Experimental Farm Ln	54	68	14	26.9%	207	1.85	1
Lawrence Rd between North of Experimental Farm Ln	194	230	36	18.4%	1,274	2.45	1
Summerland Way	313	317	4	1.3%	16	0.23	1
Summerland Way	748	760	12	1.6%	144	0.44	1
Pacific Highway	686	682	- 4	-0.6%	16	0.15	1
Pacific Highway	426	433	7	1.6%	49	0.34	1
Armidale Road, South of Brickworks	489	490	1	0.3%	2	0.06	1
Armidale Road, South of Brickworks	177	193	16	8.8%	245	1.15	1
Pound Street, North of Alice Street	375	276	- 99	-26.3%	9,735	5.47	1
Pound Street, North of Alice Street	796	776	- 20	-2.5%	393	0.71	1
Villiers Street	518	478	- 40	-7.7%	1,600	1.79	1
Villiers Street	647	915	268	41.4%	71,824	9.59	0
Armidale Rd, North of Cambridge Stree NB	642	628	- 14	-2.2%	196	0.56	1
Armidale Rd, North of Cambridge Stree SB	404	429	25	6.2%	625	1.22	1
Pacific Hwy, East of Heber Street	620	648	28	4.5%	784	1.11	1
Pacific Hwy, East of Heber Street	415	462	47	11.3%	2,193	2.24	1
Centenary Drive NB	62	45	- 17	-27.4%	289	2.32	1
Centenary Drive SB	61	56	- 5	-8.2%	25	0.65	1
Hoof Street WB	52	68	16	30.8%	256	2.07	1
Hoof Street EB	40	42	2	5.0%	4	0.31	1
North Street A WB	57	57	-	0.0%	-	-	1
North Street A EB	100	91	- 9	-9.0%	81	0.92	1
Oliver Street B WB	85	85	-	0.0%	-	-	1
Oliver Street B EB	126	138	12	9.5%	144	1.04	1

Pacific Hwy NB	330	407	77	23.3%	5,929	4.01	1
Pacific Hwy SB	553	635	82	14.8%	6,724	3.36	1
Washpool Road WB	67	67	-	0.0%	-	-	1
Washpool Road EB	27	27	-	0.0%	-	-	1
Summerland Way, North of Butter Factory Lane	318	333	15	4.7%	220	0.82	1
Summerland Way, North of Butter Factory Lane	764	770	6	0.8%	38	0.22	1
Pacific Hwy, North of Centenary Drive	487	407	- 80	-16.4%	6,347	3.77	1
Pacific Hwy, North of Centenary Drive	743	635	- 108	-14.6%	11,700	4.12	1
Pacific Hwy, South of Lillypool Road	681	727	46	6.7%	2,101	1.73	1
Pacific Hwy, North of Four Mile Road	423	419	- 4	-0.9%	16	0.19	1
Villiers Street, North of Oliver Street	517	615	98	19.0%	9,604	4.12	1
Villiers Street, North of Oliver Street	647	921	274	42.4%	75,167	9.79	0
Pacific Hwy, East of Viaduct Road	723	751	28	3.9%	793	1.04	1
Pacific Hwy, East of Viaduct Road	325	325	0	0.1%	0	0.01	1
Armidale Road, South of Jubilee	620	603	- 17	-2.7%	272	0.67	1
Armidale Road, South of Jubilee	411	457	47	11.3%	2,162	2.23	1
Lawrence Rd, North of Butterfactory Lane SB	207	230	23	11.1%	529	1.56	1
Lawrence Rd, North of Butterfactory Lane NB	102	68	- 34	-33.3%	1,156	3.69	1
Armidale Rd, North of Brickworks Lane NB	497	490	- 7	-1.4%	49	0.32	1
Armidale Rd, North of Brickworks Lane SB	171	187	16	9.4%	256	1.20	1
North Rd between Mary St and Queen St EB	154	168	14	8.9%	190	1.09	1
Queen St between Ford St and North St NB	206	238	32	15.4%	1,011	2.13	1
Queen St betwwen Arthurs St and Crown St NB	293	238	- 55	-18.9%	3,058	3.39	1
Arthur St between Queen St and Mary St EB	254	178	- 76	-30.0%	5,806	5.18	1
Hoof St between Villiers St and Chapman St EB	41	42	1	3.2%	2	0.20	1
Villiers St between Powell St and Hoof St NB	298	454	156	52.1%	24,211	8.02	0
Dobie St between Kent St and Clarence St EB	58	65	7	11.7%	46	0.87	1
Clarence St between Fry St and Dobie St NB	27	27	- 0	-1.1%	0	0.06	1
Breimba St between Fry St and Dobie St NB	31	31	-	0.0%	-	-	1
Pound St between Clarence St and Kent St EB	51	53	2	4.5%	5	0.32	1
Victoria St between Villier St and Clarence St EB	33	38	5	15.2%	25	0.84	1
Butterfactory Ln between Richmond Rd and Lawrence Rd (2 ways)	16	10	- 6	-35.9%	31	1.57	1
Butterfactory Ln between Lawrence Rd and Great Marlow Rd EB	5	10	5	92.3%	23	1.74	1
Wharf St between Through St and Spring St NB	97	107	10	10.8%	108	1.03	1
Wharf St between Spring St and Lawrence Ln NB'	77	58	- 19	-24.7%	361	2.31	1
Spring St between Wharf St and New St EB	106	110	5	4.3%	20	0.43	1
Gwydir Hwy between Cowan St and Abbot St EB	672	683	11	1.6%	114	0.41	1
Skiner St South of Gwydir Highway NB	310	314	4	1.2%	14	0.22	1
Turf St between Dobie St and Powell St	446	411	- 35	-7.8%	1,225	1.69	1
Dobie St between Queen St and bowtell Ave EB	369	348	- 21	-5.6%	424	1.09	1
Powell St between Turf and Canworth EB	80	65	- 15	-18.4%	216	1.73	1
Norths St between Cranworth and Milton St EB	136	156	20	14.6%	396	1.65	1
Cranworth St between Dobie St and Fry St NB	124	112	- 12	-9.5%	137	1.08	1
North Rd between Mary St and Queen St WB	154	170	16	10.2%	246	1.23	1
Queen St between Ford St and North St SB	359	398	39	10.8%	1,505	1.99	1
Queen St betwwen Arthurs St and Crown St SB	448	398	- 50	-11.2%	2,520	2.44	1
Arthur St between Queen St and Mary St WB	169	169	0	0.1%	0	0.02	1
Hoof St between Villiers St and Chapman St WB	47	68	21	45.3%	449	2.80	1
Villiers St between Powell St and Hoof St SB	387	453	66	17.1%	4,356	3.22	1
Dobie St between Kent St and Clarence St WB	129	134	5	3.8%	24	0.43	1
Clarence St between Fry St and Dobie St SB	90	90	0	0.4%	0	0.04	1
Breimba St between Fry St and Dobie St SB	41	40	- 1	-2.7%	1	0.17	1
Bacon St between Woodward St and Clarence St WB	43	30	- 13	-30.6%	174	2.18	1
Pound St between Clarence St and Kent St WB	151	127	- 24	-15.8%	566	2.02	1
Victoria St between Villier St and Clarence St WB	85	125	40	47.6%	1,624	3.94	1
Butterfactory Ln between Richmond Rd and Lawrence Rd (2 ways)	19	16	- 3	-15.3%	8	0.69	1
Butterfactory Ln between Lawrence Rd and Great Marlow Rd WB	16	16	- 0	-0.6%	0	0.02	1
Wharf St between Through St and Spring St SB	77	69	- 8	-10.0%	59	0.90	1
Spring St between Wharf St and New St WB	87	87	0	0.1%	0	0.01	1
Gwydir Hwy between Cowan St and Abbot St WB	241	224	- 17	-6.9%	279	1.10	1
Skiner St South of Gwydir Highway SB	201	211	10	5.0%	100	0.70	1
Villiers St between Pound St and Bacon St SB	645	744	99	15.3%	9,801	3.76	1
Villiers St between Fitzroy St and Pound St SB	580	538	- 42	-7.2%	1,764	1.78	1
Turf St between Dobie St and Powell St	708	928	220	31.0%	48,312	7.68	0
Dobie St between Queen St and bowtell Ave WB	309	303	- 6	-1.9%	34	0.33	1
Powell St between Turf and Canworth WB	68	65	- 3	-4.3%	8	0.36	1
Norths St between Cranworth and Milton St WB	65	65	1	0.8%	0	0.06	1
Cranworth St between Dobie St and Fry St SB	252	253	1	0.4%	1	0.06	1
Centenarry Ave between Pacific Hwy and Pacific Hwy NB	56	59	4	6.3%	12	0.46	1
Centenarry Ave between Pacific Hwy and Pacific Hwy SB	83	83	0	0.4%	0	0.03	1
	58,903	**60,859**	**1,956**	**4.52%**	**910,086**	**133**	**132**
	154				0.91	154	154
					GEH>10	1	
		0					

Requirements			
RMSE	20.16420452	<30	18.08729978
RSQ	95.9%	>90%	0.966568917
GEH Existing Bridge	3.22	<5	3.216248882
GEH	86%	>85% of all cases	0.876623377
Flows	86%	>85% of all cases	0.857142857

Appendix C

Future Year Growth Summary

Appendix C

Future Year Growth Summary Table

Zone	2019	2029	2039	2049
1	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.00%	0.00%
12	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%
15	0.00%	0.00%	0.00%	0.00%
16	0.00%	0.00%	0.00%	0.00%
17	0.00%	0.00%	0.00%	0.00%
18	0.00%	0.00%	0.00%	0.00%
19	0.00%	0.00%	0.00%	0.00%
20	0.00%	0.00%	0.00%	0.00%
21	20.32%	9.30%	11.47%	5.60%
22	0.00%	0.00%	0.00%	0.00%
23	0.00%	0.00%	0.00%	0.00%
24	0.00%	0.00%	0.00%	0.00%
25	3.88%	3.13%	0.59%	0.00%
26	0.00%	0.00%	0.00%	0.00%
27	0.00%	0.00%	0.00%	0.00%
28	0.00%	0.00%	0.00%	0.00%
29	19.48%	9.05%	1.29%	0.00%
30	0.93%	0.93%	0.19%	0.00%
31	0.00%	0.00%	0.00%	0.00%
32	1.14%	1.13%	0.23%	0.00%
33	0.00%	0.00%	0.00%	0.00%
34	0.50%	0.50%	0.10%	0.00%
35	0.00%	0.00%	0.00%	0.00%
36	2.82%	2.28%	0.43%	0.00%
37	0.00%	0.00%	0.00%	0.00%
38	2.82%	2.28%	0.43%	0.00%
39	15.67%	7.90%	1.19%	0.00%
40	2.04%	0.41%	0.00%	0.00%
41	0.00%	0.00%	0.00%	0.00%
42	0.00%	0.00%	0.00%	0.00%
43	0.00%	0.00%	0.00%	0.00%
44	0.00%	0.00%	0.00%	0.00%
45	0.00%	0.00%	0.00%	0.00%
46	0.00%	0.00%	0.00%	0.00%
47	0.00%	0.00%	0.00%	0.00%
48	0.00%	0.00%	0.00%	0.00%
49	0.00%	0.00%	0.00%	0.00%
50	0.00%	0.00%	0.00%	0.00%
51	0.00%	0.00%	0.00%	0.00%
52	0.00%	0.00%	0.00%	0.00%
53	0.00%	0.00%	0.00%	0.00%
54	6.16%	1.23%	0.00%	0.00%
55	6.16%	1.23%	0.00%	0.00%
56	0.00%	0.00%	0.00%	0.00%
57	0.00%	0.00%	0.00%	0.00%
58	20.32%	9.30%	11.47%	5.60%
59	0.00%	0.00%	0.00%	0.00%

Appendix D

Option Description

Corridor	Option	Lane Configuration							Heavy vehicles		Local road connectivity		
		New bridge			Existing bridge		Total lanes across river						
		Northbound	Southbound	Cycle/Pedestrian lane	Northbound	Southbound	Northbound	Southbound	Truck bans on existing bridge?	Heavy Vehicle Route between Central Grafton and the north	Cross Roads connecting at grade	Roads Closed (no connection to bridge approach~~cross traffic~~)	Underpass / Overpass for cross traffic
Corridor 1	F	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Gwyder Hwy, Kennedy St, Bank St, Victoria St (LiLo), Fitzroy St.	None	None
	E	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Gwydir Hwy, Victoria St (LiLo), Fitzroy St.	Kennedy St, Spring St, Cowan Ln, Edward St, Edward Ln, Through St.	None
Corridor 2	5	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Gwyder Hwy, Spring St, Through St, Clarence St north, Villiers St.	Clarence St South, Fitzroy St north/Kent St.	None
	A	2	1	1	0	1	2	2	No truck bans required	Via Villers St	Gwyder Hwy/Pacific Hwy, Spring St, Through St, Clarence St south (LiLo), **Clarence St north (LiLo)**, Fitzroy St east, Villiers St.	Riverside Drive, Fitzroy St/Kent St.	None
	B	1	2	1	1	0	2	2	No truck bans required	Via Villers St	Gwyder Hwy/Pacific Hwy, Spring St, Through St, Clarence St north (left turn into Clarence St only), Villiers St.	Clarence St south, Clarence St north (no left turn entry onto bridge).	Fitzroy St east/Kent St.
	6	1	2	1	1	0	2	2	No truck bans required	Via Villers St	Gwyder Hwy/Pacific Hwy, Spring St, Through St, Clarence St, Villiers St.	Kent St, Pound St north-east.	Greaves St.
	C	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy/Gwydir Hwy/Spring St, Through St, Clarence St, Villers St.	Pound St north-east, Kent St.	Greaves St.
	D	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy/Gwydir Hwy/Spring St, Through St, Villers St.	Bacon St.	Greaves St, Kent St, Pound St, Clarence St.
	I	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy, Villiers St.	Spring St, Through St.	Greaves St, Kent St, Pound St, Clarence St.
	8	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy, Pacific Hwy, Villiers St.	Butters Ln (provide connection road from Pac Hwy on east side of bridge approach), Grieves St, Clarence St.	Kent St/Fitzroy St east/Clarence St south.
	9	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy, Kent St (LiLo only), Clarence St, Villers St.	Greaves St, Briemba St, Bromley St.	Alipou St (diverted to east side of embankment), Butters Ln.
	10	1	1	1	1	1	~~2~~	2	Ban larger trucks from using existing bridge	Via Villers St	Pacific Hwy, Breimba St (LiLo), Sutton St/Bromley St (LiLo only), Kent St, Clarence St, Villiers St.	McHugh St/Dovedale St , Woodward St.	None
Corridor 3	11	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Pacific Hwy, Breimba St (LiLo only), Kent St, Walker Cl, Clarence St, Villiers St.	McHugh St, Welley Ave.	None
	J	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Pacific Hwy, Kent St, Waratah Pl, Clarence St, Welley Ave, Villiers St.	McHugh St, Miller St, Breimba St.	None
	K	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Pacific Hwy, Alan Dahl Ave Clarence St, Knotts Cl (LiLo only), Villiers St, Chapman St, Prince St, Queen St, Bowtell Ave, Mary St, Loxton Ave, Alice St, Turf St.	Breimba St, Kent St, Duke St.	None
	12	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Villiers St	Pacific Hwy, Kiah Pl, Villiers St, Chapman St, Duke St, Prince St, Queen St, Mary St, Richards Cl, Alice St, Turf St.	Clearwater Cl (alt access provided), Mark Cl (alt access provided),Clarence St.	None
	L	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Pacific Hwy/Centenary Dr, Villiers St, Prince St, Queen St, Ford St, North St, Mary St, Alice St, Davey St, Turf St.	Island View Cl, Duke St.	Eggins Ln (minor diversion beside viaduct).
Corridor 4	14	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Pacific Hwy/Centenary Dr, Villiers (LiLo), Duke St north-east, Prince St, Morrisson St, Challinor St, Queen St/Grafton-Lawrence Rd, Mary St, Alice St, Davey Ave, Turf St/Summerland Way.	Duke St south-west, North St north-east.	Eggins Ln/Meona Ln (minor diversion beside viaduct).
	20	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Pacific Hwy, Prince St, Morrison St, Challinor St, Queen St/Grafton-Lawerence Rd, Mary St, Alice St, Davey Ave, Turf St/Summerland Way.	Duke St south-west.	Eggins Ln.
	21	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Centenary Dr/Pacific Hwy, Prince St, Morrison St, Challinor St, Queen St/Grafton-Lawerence Rd, Mary St, Alice St, Davey Ave, Turf St/Summerland Way.	Duke St south-west.	Eggins Ln.
	M	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Pacific Hwy, Prince St, Morrison St, Challinor St, Queen St/Grafton-Lawerence Rd, Mary St, Alice St, Davey Ave, Turf St/Summerland Way.	Duke St	None
Corridor 5	15	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Prince St	Pacific Hwy/Centenary Dr, Villiers St (LiLo), Duke St, Prince St, North St, Queen St/Grafton-Lawrence Rd, Summerland Way.	Kirchner St.	Eggins Ln (minor diversion beside viaduct).
	23	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Queen St	Pacific Hwy, Queen St/Grafton-Lawerence Rd, Summerland Way.	None	None
	25	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Queen St	Pacific Hwy, Queen St/Grafton-Lawrence Rd, Summerland Way.	None	Wants Ln (Perseverence Ln diverted beside viaduct).
	26	1	1	1	1	1	2	2	Ban larger trucks from using existing bridge	Via Queen St	Pacific Hwy, Great Marlow Rd (Ch2600), Grafton-Lawrence Rd, Summerland Way.	None	Wants Ln, Perserverance Ln.

Appendix E

Bridge Crossing Vehicle Totals by Type

Appendix E
Bridge Crossing Volume By Vehicle Type

Options	Existing Bridge (Northbound)				Existing Bridge (Southbound)				New Bridge (Northbound)				New Bridge (Southbound)			
	Light vehicle	Commercial Vehicle	Heavy Vehicle	Total	Light vehicle	Commercial Vehicle	Heavy Vehicle	Total	Light vehicle	Commercial Vehicle	Heavy Vehicle	Total	Light vehicle	Commercial Vehicle	Heavy Vehicle	Total
2011	2137	169	0	2306	1457	116	0	1573	0	0	0	0	0	0	0	0
2019																
Base Model	2560	203	0	2763	1746	138	0	1884	0	0	0	0	0	0	0	0
Option F	1596	127	0	1723	885	70	0	955	913	76	51	1040	810	68	51	929
Option E	1064	84	0	1148	559	44	0	603	1445	119	51	1615	1136	94	51	1281
Option 5	133	11	0	144	433	34	0	467	2376	192	51	2619	1262	104	51	1417
Option A	0	0	0	0	856	70	26	951	2509	203	51	2763	838	69	26	933
Option B	1235	100	26	1360	0	0	0	0	1274	103	26	1403	1695	138	51	1884
Option C	1375	109	0	1484	694	55	0	749	1134	94	51	1279	1001	83	51	1135
Option D	1510	120	0	1630	849	67	0	916	999	83	51	1133	846	71	51	968
Option D1	1509	120	0	1629	845	67	0	912	1000	83	51	1134	850	71	51	972
Option I	1376	109	0	1485	851	68	0	919	1133	94	51	1278	843	71	51	965
Option 6	1895	150	0	2045	0	0	0	0	614	53	51	718	1695	138	51	1884
Option 8	1524	121	0	1645	1119	89	0	1208	985	82	51	1118	575	50	51	676
Option 9	1811	144	0	1955	1414	112	0	1526	698	59	51	808	281	26	51	358
Option 10	1903	151	0	2054	1475	117	0	1592	606	52	51	709	220	21	51	292
Option 11	2175	172	0	2347	1698	135	0	1833	334	31	51	416	0	0	51	51
Option J	2201	175	0	2376	1698	135	0	1833	308	28	51	387	0	0	51	51
Option K	2241	178	0	2419	1698	135	0	1833	268	25	51	344	0	0	51	51
Option 12	2247	178	0	2425	1657	131	0	1788	262	25	51	338	38	7	51	96
Option L	2271	180	0	2451	1686	134	0	1820	238	23	51	312	8	5	51	64
Option 14	2311	183	0	2494	1658	131	0	1789	198	20	51	269	37	7	51	95
Option 20	2335	185	0	2520	1698	135	0	1833	174	18	51	243	0	0	51	51
Option 21	2317	184	0	2501	1691	134	0	1825	192	19	51	262	4	4	51	59
Option M	2339	185	0	2524	1698	135	0	1833	170	18	51	239	0	0	51	51
Option 15	2316	184	0	2500	1540	122	0	1662	193	19	51	263	155	16	51	222
Option 23	2361	187	0	2548	1696	135	0	1831	148	16	51	215	2	0	51	53
Option 25	2389	189	0	2578	1698	135	0	1833	120	14	51	185	0	0	51	51
Option 26	2398	190	0	2588	1698	135	0	1833	111	13	51	175	0	0	51	51
2029																
Base Model	3484	276	0	3760	2331	185	0	2516	0	0	0	0	0	0	0	0
Option F	1671	133	0	1804	1240	98	0	1338	1755	144	57	1956	1016	87	75	1178
Option E	1223	97	0	1320	884	70	0	954	2204	179	57	2440	1372	115	75	1562
Option 5	806	64	0	870	636	50	0	686	2621	212	57	2890	1621	134	75	1830
Option A	0	0	0	0	1108	91	38	1236	3427	276	57	3760	1148	94	38	1280
Option B	1693	137	29	1858	0	0	0	0	1734	140	29	1902	2256	185	75	2516
Option C	1641	130	0	1771	784	62	0	846	1786	146	57	1989	1472	123	75	1670
Option D	1669	132	0	1801	990	78	0	1068	1758	144	57	1959	1267	106	75	1448
Option D1	1661	132	0	1793	971	77	0	1048	1765	145	57	1967	1285	108	75	1468
Option I	1603	127	0	1730	973	77	0	1050	1824	149	57	2030	1283	108	75	1466
Option 6	2204	175	0	2379	0	0	0	0	1223	101	57	1381	2256	185	75	2516
Option 8	1661	132	0	1793	1416	112	0	1528	1765	145	57	1967	840	73	75	988
Option 9	1912	152	0	2064	1736	138	0	1874	1514	125	57	1696	520	47	75	642
Option 10	2063	164	0	2227	1765	140	0	1905	1363	113	57	1533	491	45	75	611
Option 11	2228	177	0	2405	1974	157	0	2131	1198	100	57	1355	282	28	75	385
Option J	2264	180	0	2444	2001	159	0	2160	1162	97	57	1316	255	26	75	356
Option K	2304	183	0	2487	1992	158	0	2150	1122	94	57	1273	264	27	75	366
Option 12	2309	183	0	2492	1924	153	0	2077	1118	93	57	1268	332	32	75	439
Option L	2327	185	0	2512	2013	160	0	2173	1099	92	57	1248	243	25	75	343
Option 14	2304	183	0	2487	1948	154	0	2102	1122	94	57	1273	309	30	75	414
Option 20	2334	185	0	2519	2067	164	0	2231	1093	91	57	1241	189	21	75	285
Option 21	2319	184	0	2503	2000	159	0	2159	1108	92	57	1257	256	26	75	357
Option M	2333	185	0	2518	2110	167	0	2277	1094	91	57	1242	146	18	75	239
Option 15	2312	183	0	2495	1944	154	0	2098	1115	93	57	1265	312	31	75	418
Option 23	2405	191	0	2596	2029	161	0	2190	1021	86	57	1164	227	24	75	326
Option 25	2433	193	0	2626	2084	165	0	2249	994	83	57	1134	172	20	75	267
Option 26	2444	194	0	2638	2087	166	0	2253	983	82	57	1122	169	19	75	263
2039																
Base Model	3947	313	0	4260	2642	210	0	2852	0	0	0	0	0	0	0	0
Option F	1698	135	0	1833	1421	113	0	1534	2191	178	58	2427	1141	97	80	1318
Option E	1469	117	0	1586	1057	84	0	1141	2419	197	58	2674	1505	126	80	1711
Option 5	1225	97	0	1322	763	60	0	823	2664	216	58	2938	1800	149	80	2029
Option A	0	0	0	0	1258	103	40	1401	3889	313	58	4260	1304	107	40	1451
Option B	1644	133	29	1806	0	0	0	0	2245	180	29	2454	2562	210	80	2852
Option C	1756	139	0	1895	854	68	0	922	2133	174	58	2365	1708	142	80	1930
Option D	1775	141	0	1916	1083	86	0	1169	2114	172	58	2344	1479	124	80	1683
Option D1	1748	139	0	1887	1055	84	0	1139	2141	174	58	2373	1507	126	80	1713
Option I	1718	136	0	1854	1062	84	0	1146	2171	177	58	2406	1501	125	80	1706
Option 6	2315	184	0	2499	0	0	0	0	1574	129	58	1761	2562	210	80	2852
Option 8	1728	137	0	1865	1520	121	0	1641	2161	176	58	2395	1042	89	80	1211
Option 9	1960	155	0	2115	1817	144	0	1961	1929	158	58	2145	746	65	80	891
Option 10	2076	165	0	2241	1817	144	0	1961	1813	148	58	2019	746	65	80	891
Option 11	2253	179	0	2432	1979	157	0	2136	1636	134	58	1828	583	53	80	716
Option J	2263	179	0	2442	2039	162	0	2201	1626	134	58	1818	523	48	80	651
Option K	2283	181	0	2464	2072	164	0	2236	1606	132	58	1796	491	45	80	616
Option 12	2288	182	0	2470	2093	166	0	2259	1600	132	58	1790	469	44	80	593
Option L	2303	183	0	2486	2122	168	0	2290	1586	130	58	1774	441	41	80	562
Option 14	2331	185	0	2516	2153	171	0	2324	1558	128	58	1744	409	39	80	528
Option 20	2350	186	0	2536	2168	172	0	2340	1539	127	58	1724	394	38	80	512
Option 21	2351	187	0	2538	2150	170	0	2320	1537	127	58	1722	413	39	80	532
Option M	2362	187	0	2549	2183	173	0	2356	1527	126	58	1711	380	36	80	496
Option 15	2343	186	0	2529	2118	168	0	2286	1546	127	58	1731	444	42	80	566
Option 23	2410	191	0	2601	2213	175	0	2388	1479	122	58	1659	350	34	80	464
Option 25	2436	193	0	2629	2229	177	0	2406	1453	120	58	1631	333	33	80	446
Option 26	2444	194	0	2638	2232	177	0	2409	1445	119	58	1622	330	33	80	443
2049																
Base Model	4479	355	0	4834	2992	237	0	3229	0	0	0	0	0	0	0	0
Option F	1865	148	0	2013	1635	130	0	1765	2556	207	58	2821	1276	108	80	1464
Option E	1765	140	0	1905	1357	108	0	1465	2656	215	58	2929	1554	130	80	1764
Option 5	1657	131	0	1788	918	73	0	991	2764	224	58	3046	1994	164	80	2238
Option A	0	0	0	0	1464	119	40	1623	4421	355	58	4834	1448	118	40	1606
Option B	2123	171	29	2323	0	0	0	0	2297	185	29	2511	2912	237	80	3229
Option C	1952	155	0	2107	1002	79	0	1081	2469	200	58	2727	1910	158	80	2148
Option D	1972	156	0	2128	1182	94	0	1276	2449	199	58	2706	1729	144	80	1953
Option D1	1909	151	0	2060	1136	90	0	1226	1798	147	58	2003	2490	204	80	2774
Option I	1926	153	0	2079	1173	93	0	1266	2495	202	58	2755	1739	144	80	1963
Option 6	2350	186	0	2536	0	0	0	0	2069	169	58	2296	2912	237	80	3229
Option 8	1952	155	0	2107	1635	130	0	1765	2469	200	58	2727	1276	108	80	1464
Option 9	2022	160	0	2182	1849	147	0	1996	2399	195	58	2652	1062	91	80	1233
Option 10	2104	167	0	2271	1828	145	0	1973	2317	188	58	2563	1084	92	80	1256
Option 11	2272	180	0	2452	2005	159	0	2164	2149	175	58	2382	907	78	80	1065
Option J	2312	183	0	2495	2069	164	0	2233	2109	172	58	2339	843	73	80	996
Option K	2315	184	0	2499	2096	166	0	2262	2105	172	58	2335	816	71	80	967
Option 12	2295	182	0	2477	2152	171	0	2323	2126	173	58	2357	759	67	80	906
Option L	2360	187	0	2547	2236	177	0	2413	2061	168	58	2287	676	60	80	816
Option 14	2361	187	0	2548	2250	179	0	2429	2060	168	58	2286	661	59	80	800
Option 20	2388	189	0	2577	2267	180	0	2447	2033	166	58	2257	645	57	80	782
Option 21	2334	185	0	2519	2269	180	0	2449	2087	170	58	2315	643	57	80	780
Option M	2341	186	0	2527	2277	181	0	2458	2079	170	58	2307	634	57	80	771
Option 15	2334	185	0	2519	2253	179	0	2432	2087	170	58	2315	658	59	80	797
Option 23	2439	194	0	2633	2321	184	0	2505	1981	162	58	2201	591	53	80	724
Option 25	2494	198	0	2692	2331	185	0	2516	1927	157	58	2142	581	52	80	713
Option 26	2471	196	0	2667	2340	186	0	2526	1950	159	58	2167	571	52	80	703

Appendix F

Forecast Population Growth

APPENDIX F
Forecast Population Growth

			Historic Growth				Forecast Population (People)					
Cencus Collection District	State Suburb	Zone Modelled	2001	2006	growth p.a	2011 Adjusted	Additional (Person)	2021	Additional (Person)	2031	2041	2049
1060403	Junction Hill	29	659	645	-0.42%	634	1,235	1,869	1,205	3,074	3,074	3,074
1060413	Junction Hill	57	363	373	0.55%	381		381		381	381	381
Total			**1,022**	**1,018**		**1,015**	**1,235**	**2,250**	**1,205**	**3,455**	**3,455**	
1060601	Grafton	1	432	539	4.95%	646		646		646	646	646
1060602	Grafton	44	880	857	-0.52%	839		839		839	839	839
1060603	Grafton	13,52	577	577	0.00%	577		577		577	577	577
1060604	Grafton	2	395	423	1.42%	447		447		447	447	447
1060605	Grafton	45	550	557	0.25%	563		563		563	563	563
1060606	Grafton	3,46	589	541	-1.63%	506		506		506	506	506
1060607	Grafton	4	374	359	-0.80%	347		347		347	347	347
1060608	Grafton	40	234	250	1.41%	264	54	318		318	318	318
1060608	Grafton	53	234	250	1.41%	264		264		264	264	264
1060609	Grafton	5,48	422	500	3.70%	574		574		574	574	574
1060610	Grafton	47	756	755	-0.03%	754		754		754	754	754
1062201	Grafton	41,10,43	516	452	-2.48%	407		407		407	407	407
1062202	Grafton	7	676	750	2.19%	816		816		816	816	816
1062203	Grafton	42,11	625	425	-6.40%	316		316		316	316	316
1062204	Grafton	6,49	726	685	-1.13%	654		654		654	654	654
1062205	Grafton	51,12,9	434	399	-1.61%	373		373		373	373	373
1062206	Grafton	8	661	652	-0.27%	645		645		645	645	645
1062207	Grafton	50	461	493	1.39%	520		520		520	520	520
1062208	Grafton	50	445	492	2.11%	534		534		534	534	534
1060410	Grafton	54,55	481	598	4.86%	714	440	1,154		1,154	1,154	1,154
Total			**9,986**	**9,956**	**0.21%**	**10,761**	**494**	**11,255**	**-**	**11,255**	**11,255**	
1060701	South Grafton	25	623	601	-0.71%	584	279	863	299	1,162	1,162	1,162
1060703	South Grafton	25	561	555	-0.21%	550	251	801	269	1,070	1,070	1,070
1060712	South Grafton	25	472	677	8.69%	912	211	1,123	227	1,350	1,350	1,350
1060704	South Grafton	14,15	543	579	1.33%	610		610		610	610	610
1060705	South Grafton	17,18	527	499	-1.06%	478		478		478	478	478
1060707	South Grafton	19,20	456	363	-4.08%	304		304		304	304	304
1060708	South Grafton	16,27,28	328	302	-1.59%	283		283		283	283	283
1060709	South Grafton	26	680	636	-1.29%	603		603		603	603	603
1060710	South Grafton	23	770	796	0.68%	818		818		818	818	818
1060711	South Grafton	24	456	469	0.57%	480		480		480	480	480
1060713	South Grafton	24	467	454	-0.56%	444		444		444	444	444
Total			**5,883**	**5,931**		**6,065**	**741**	**6,806**	**795**	**7,601**	**7,601**	
1060706	Clarenza	21,22	317	387	4.41%	456	926	1,382	904	2,286	5,190	7,513
1060706	Clarenza	58	159	194	4.41%	228		228		228	228	228
Total			**476**	**581**		**684**	**926**	**1,610**	**904**	**2,514**	**5,418**	**7,741**
1060411	Great Marlow	56,59	217	249	2.95%	278		278		278	278	278
GRAND TOTAL INTERNAL			**17,584**	**17,735**		**18,803**		**22,199**		**25,103**	**28,007**	
External												
Summerland Way	Casino	30	10038	10504	0.93%	10,894		11,906		13,011	13,011	13,011
Lawrence	Lawrence	31	426	390	-1.69%	364		302		251	251	251
Pacific Hwy	Townsend Maclean - Gulmarrad	32	3856	4110	1.32%	4,327	494	4,821	544	5,365	5,365	5,365
Washpool Rd		33									-	-
Pacific Hwy	Woolgoolga	34	4694	4811	0.50%	4,907	245	5,152	257	5,409	5,409	5,409
Swallow Rd		35									-	-
Armidale Rd	Coutts crossing	36	523	571	1.84%	613	173	786	169	955	955	955
Bent St		37									-	-
Rushforth Red	Coutts crossing	38	523	571	1.84%	613	173	786	169	955	955	955
Gwydir Hwy	Waterview Heights	39	796	781	-0.38%	769	1,205	1,974	1,176	3,150	3,150	3,150

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