Transport Roads & Maritime Services

ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

Appendix D – Technical Paper: Traffic and transport

AUGUST 2014

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Executive Summary

Introduction

Roads and Maritime Services (Roads and Maritime) is seeking approval for a new road bridge over the Clarence River at Grafton (the project), on the NSW Mid North Coast. The approval is sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The additional crossing of the Clarence River at Grafton is identified as a medium to long term measure required to improve access across the Northern Rivers and Mid North Coast regions. The project involves the construction of a new road bridge linking Grafton and South Grafton about 70 metres downstream of the existing bridge, and upgrading parts of the road network to connect the new bridge to the existing road network.

Purpose of this report

This technical paper has been prepared to inform the environmental impact statement (EIS) for the project. The EIS has been prepared to address the requirements issued by the Director-General of the former NSW Department of Planning and Infrastructure (now Planning and Environment) on 3 October 2013 and the relevant provisions of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

The overall purpose of this study is to:

- Address the issues highlighted in the Director General‘s Requirements
- Assess key issues and requirements that need to be incorporated into the project concept design
- Address key traffic and transport objectives for the project
- Assess impacts of the bridge operation and construction on traffic, pedestrians and cyclists
- Identify mitigation and management measures for the proposed bridge and associated construction works.

Assessment approach

A methodology for assessment of the project from a traffic and transport viewpoint was developed based on the Director-General’s Requirements. The steps carried out are detailed as follows.

A review of the current transport context within the study area, including:

- Function of the local and regional road networks
- Existing traffic demand and constraints, through the gathering of traffic count data and travel time surveys
- Infrastructure and services currently in place for sustainable transport modes including train, bus, cycling and walking
- Utilisation of the road network by heavy vehicles
- Safety of the road network, through analysis of recent crash data.

Assess the transport impact of the project, taking into consideration:

- Forecast changes in local and inter-regional traffic within the area, based on planned infrastructure changes within the region and available demographic information
- Through the use of transport modelling tools, operational improvements for traffic, freight, sustainable transport modes and emergency services
- Changes in accessibility at a local (residents and businesses) and regional level
- Improvements in road safety.

Identify the potential effects of construction activities, including:

- Impacts to the road network
- Disruption to pedestrian and cyclist access
- Disruption to public transport services
- Property access.

Consultation

Roads and Maritime has consulted extensively with the community, including affected landholders throughout the route options development and assessment, selection of the preferred option, strategic concept design and EIS stages.

The consultation is planned to be ongoing throughout the exhibition of the EIS to ensure that the community and stakeholders are able to make informed responses to the EIS.

Current transport context

To quantify existing traffic loadings on the road network, a comprehensive set of data was collected. The data gathered, along with observations of traffic operations, indicate that the existing bridge is currently at capacity during peak periods. These delays are changing people's travel behaviour and daily activity patterns. It would appear from the traffic count data that bridge users have timed their trip to avoid the peak period traffic congestion, thus “spreading the peak” which is common in major urban areas. Grafton and South Grafton are to some extent beginning to operate as separate towns.

Roads and Maritime CrashLink database provided crash data for the Grafton area for the five year period from 1 January 2008 to 30 June 2013. The crash statistics revealed a total of 76 crashes. Of these crashes none resulted in fatalities, 34 resulted in injuries and 42 needed the vehicle to be towed away. Mapping of the crashes showed clusters in various areas along the alignment of higher order roads such as the Pacfiic Highway and along Summerland Way in proximity to the existing bridge. Crashes were particularly evident at the “kinks” in the existing bridge alignment which are the direct cause of congestion on a daily basis during peak periods, and pose issues to the safe movement of vehicles due to the tight turns required.

Traffic assessment

Assessment of the traffic impacts of the project has been predominantly undertaken through the use of three transport modelling tools developed during preliminary phases of the project, including:

- Strategic transport model – developed using Cube-TRIPS
- Micro-simulation model – developed using Paramics
- Isolated intersection models – developed using Sidra Intersection.

The strategic and micro-simulation models were calibrated to conditions in 2011, and have been developed for the future scenario years of 2019 (year of opening), 2029 and 2039.

Development of the models involved reviewing population and land use forecasts, as well as traffic volumes in Grafton and South Grafton. Traffic forecasts were developed in consultation with Clarence Valley Council and Planning and Environment to assess the traffic impacts of existing and likely future development and to estimate future demands across the river up to 2039. The dwelling targets were informed by the *Mid North Coast Regional Strategy 2006-31* (NSW Department of Planning, 2009). The modelling also assumed the Pacific Highway Upgrade: Woolgoolga to Ballina would be in operation by the year of opening (2019).

The modelling carried out indicated that without the provision of additional traffic capacity at the crossing, it is anticipated that current poor road network operating conditions would intensify, with prolonged periods of congestion at the existing bridge and significantly increased travel times. By implementing the project, it is anticipated that whilst certain roads will experience some increase in traffic volumes, significant travel time savings during peak periods will be provided to the community. Transport modelling indicates the project will incur travel time savings of over 1000 hours to road network users during the AM peak period in the year of opening. Furthermore, intersections proposed as part of the project are anticipated to operate at a level of service “C” or better for 20 years post opening (until 2039).

Freight and heavy vehicles

The travel time savings provided by the project would also provide benefit to heavy vehicle movements, including the removal of time restrictions for 25/26 metre long B-Double trucks crossing the Clarence River. Through the banning of larger heavy vehicles from the existing bridge, and the provision of new infrastructure along the project alignment, further operational and safety benefits for both freight operators and the community are anticipated.

Road Safety

It is anticipated that the project will deliver additional safety benefits through the application of proven intersection and roadway design principles, specifically at current poor locations such as the Pacific Highway’s intersections with the Gwydir Highway and Spring Street.

Public Transport, Pedestrians and Cyclists

The travel time savings provided by the project would also provide benefit to bus services that utilise the existing bridge. With bus operators advising a preference to continue using the existing bridge following completion of the project, it is anticipated that the project will have minimal impact on public transport services once the project becomes operational.

Pedestrian and cyclist links will be provided as part of the project. Overall it is considered that whilst there may be some minor changes to existing cycle routes, the facilities proposed provide:

- Good connectivity to the primary destinations identified in Council's PAMP
- Consistency with the key strategic movements identified in Council's pedestrian and cycle planning
- Crossings that are appropriate in light of anticipated traffic and pedestrian forecasts, and the safety considerations of the pedestrian types likely to use the facility.

In light of the above, it is considered that the project would meet the key traffic and transport project objectives to:

- Improve traffic efficiency between and within Grafton and South Grafton
- Enhance road safety for all road users over the length of the project.

Construction

Construction activity is anticipated to generate additional traffic over the construction period. It is anticipated that these traffic movements may temporarily affect road access and the level of service of the road network in certain localised areas of Grafton and South Grafton, with minimal impacts to pedestrians, cyclists and public transport operators. In order to ensure road network operating conditions are maintained at an acceptable level, construction traffic management measures shall be developed as part of a CEMP during the detailed design phase of the project. This would be developed to clearly demonstrate how the mitigation measures proposed would enable acceptable traffic operations and level of service on the road network during construction.

Glossary of terms and abbreviations

AADT	Average annual daily traffic The total volume of traffic passing a roadside observation point over a period of a year, divided by the number of days per year. It is calculated from mechanically obtained axle counts.
AM peak	Morning traffic peak period in Grafton. The three hour period between 7-10am was observed and showed that the most critical hour is 8-9am.
Austroads	Austroads is the association of Australian and New Zealand road transport and traffic authorities. Austroads classifies motor vehicles into 12 classes as follows: Light Vehicles: class 1 (eg sedan, 4WD) and class 2 (eg caravan). Buses: class 3 (2 axle bus) and class 4 (3 axle bus). Heavy Vehicles (rigid): class 3 (2 axle truck), class 4 (3 axle truck) and class 5 (4 axle truck). Heavy Vehicles (articulated): class 6 (3 axle articulated truck), class 7 (4 axle articulated truck), class 8 (5 axle articulated truck) and class 9 (6 axle articulated truck). Heavy Vehicles (B-Double): class 10 (25/26 metre long B-Double trucks), class 11 (double road train) and class 12 (triple road train).
Base case	Also known as “do nothing” case. Used in evaluating projects to compare the cost and benefit of the existing road (the base case) with another or a number of other projects or options. This is the scenario if no additional river crossing was built.
Base year	2011 – the initial year in which traffic data is gathered and observations are made on traffic operations, to inform the development of transport models.
Capacity	The nominal maximum number of vehicles that can travel along a road in a given time.
CBD	Central business district.
CVC	Clarence Valley Council.
‘Do minimum’	The ‘do minimum’ scenario includes some roadworks in addition to the Base Case that would be necessary to address localised congestion and capacity constraints as they arise to reasonably cater for expected demand in 2019. ‘Do minimum’ is the standard terminology used for traffic assessments.
‘Do nothing’	Refer “Base case” description above.
EIS	Environmental Impact Statement.
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW).
Level of service	A measure of the quality of road operating conditions, including speed, travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience.
Micro-simulation traffic model	A simulation model developed using a computer software package that has the ability to individually model each vehicle, including heavy vehicles, within a road network. It enables a realistic representation of driver behaviour such as overtaking and lane changing and can also illustrate network performance. It is a particularly useful tool in modelling congested road networks and for predicting the likely impact of changes in traffic patterns resulting from changes to traffic flow (demand) and/or changes to the physical environment (road network).
NSW	New South Wales.

Mode	A type or method of transport movement – including for the road corridor: cars, buses, bikes and pedestrians.
PM Peak	Afternoon traffic peak period in Grafton. The three hour period between 4-7pm was observed and showed that the most critical hour is 4-5pm.
Project	Additional Crossing of the Clarence River at Grafton
PROR	Preliminary Route Options Report – Final (Roads and Maritime, 2012).
Roads and Maritime	Roads and Maritime Services (formerly known as RTA: Roads and Traffic Authority).
RODR	Route Options Development Report (Roads and Maritime, 2012)
Shared path	A pathway used for both cyclists and pedestrians, usually located on the side of the road.
Strategic model	A tool for forecasting the implications of proposed transport infrastructure improvements by providing an understanding of likely travel patterns and network performance for different options. A strategic model was used to analyse the overall road network performance of the 25 preliminary route options that were assessed in the *PROR*. It is used for comparison of the likely network performance rather than for providing a detailed assessment of every individual component of the network. These aspects are better assessed by a microsimulation model.
TfNSW	Transport for New South Wales.
VHT	Vehicle hours travelled.
VKT	Vehicle kilometres travelled.

1 Introduction

Roads and Maritime Services (Roads and Maritime) is seeking approval for a new road bridge over the Clarence River at Grafton (the project), on the NSW Mid North Coast. The approval is sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The additional crossing of the Clarence River at Grafton is identified in the NSW Long Term Transport Master Plan as a medium to long term measure required to improve access across the Northern Rivers and Mid North Coast regions. The project involves the construction of a new road bridge linking Grafton and South Grafton about 70 metres downstream of the existing bridge, and upgrading parts of the road network to connect the new bridge to the existing road network. A detailed description of the project is provided in Section 1.3.

1.1 Purpose of this report

This technical paper has been prepared to inform the environmental impact statement (EIS) for the project. The EIS has been prepared to address the requirements issued by the Director-General of the former NSW Department of Planning and Infrastructure (now the Planning and Environment) on 3 October 2013 and the relevant provisions of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

The overall purpose of this study and report are to:

- Address the issues highlighted in the Director General‘s Requirements
- Summarise the background work on traffic and transport already carried out for the project
- Assess key issues and requirements that need to be incorporated into the project concept design
- Address key traffic and transport objectives for the project
- Assess impacts of the bridge operation and construction on traffic and pedestrians and cyclists
- Identify mitigation and management measures for the proposed bridge and associated construction works.

1.2 Traffic and transport project objectives

The project is needed to address short-term and long-term transport needs within Grafton and South Grafton.

The key traffic and transport objectives for the project are to:

- Enhance road safety for all road users over the length of the project
- Improve traffic efficiency between and within Grafton and South Grafton.

1.3 The project

A description of the project is provided in Chapter 5 and Chapter 6 of the environmental impact statement. This section provides a summary of the project.

The main elements of the project are shown in Figure 2 and Figure 2. The main components of the Grafton Bridge project are:

- Construction of a new road bridge over the Clarence River about 70 metres downstream (east) of the existing road and rail bridge, comprising two traffic lanes
- Construction of a new road to link the new bridge with Iolanthe Street in South Grafton
- Construction of a new road to link the new bridge with Pound Street in Grafton
- An approach viaduct, about 58 metres long, on the South Grafton side of the Clarence River and 29 metres long on the Grafton side.
- Upgrades to the road network in South Grafton to connect the new bridge to the existing road network, including:
    - Widening Iolanthe Street to four lanes
    - Widening the Gwydir Highway to four lanes between Bent Street and the Pacific Highway
    - Realigning the existing Pacific Highway to join Iolanthe Street near Through Street
    - Providing a new roundabout at the intersection of the Pacific Highway and Gwydir Highway
    - Providing a new roundabout at the intersection of Through Street and Iolanthe Street
    - Limiting Spring Street and the Old Pacific Highway to left in and left out only where they meet Iolanthe Street
    - Realigning Butters Lane
- Upgrades to the road network in Grafton to connect the new bridge to the existing road network, including:
    - Widening Pound Street to four lanes between Villiers Street and the approach to the new bridge
    - Providing traffic signals at the intersection at Pound Street and Clarence Street
    - Closing Kent Street where it is crossed by the bridge approach road
    - Realigning and lowering Greaves Street beneath the new bridge
    - Realigning Bridge Street to join directly to the southern part of Pound Street (east of the new bridge approach). There would be no direct connection between Pound Street south and the new bridge approach
    - Widening Clarence Street to provide formal car park spaces

    - Minor modifications to the existing Dobie Street and Villiers Street roundabout.
- Replacement of the existing three span concrete arch rail viaduct which crosses Pound Street in Grafton with a single span steel truss bridge
- Construction of a pedestrian and cycle path to provide connectivity between Grafton, South Grafton and the new bridge
- Provision of two signalised pedestrian crossings in South Grafton to improve accessibility and safety for pedestrians crossing Iolanthe Street and Gwydir Highway
- Construction of new pedestrian links to connect the new bridge with the existing bridge
- Provision of designated car park spaces in Pound Street and Clarence Street, including some off street parking, to maintain a similar number of existing car park spaces currently available in those two streets
- Flood mitigation works, which include raising the height of sections of the existing levee upstream from the new bridge in Grafton and South Grafton
- Construction of a stormwater detention basin and pump station in Grafton to manage local flooding
- Public utilities adjustment
- Ancillary facilities required for the construction of the project, including some or all of the following: site compounds, concrete batching plant, pre-cast facilities, and stockpile areas for materials and temporary storage of spoil and mulch.

This traffic and transport assessment has been prepared as a specialist component of the EIS to identify and assess the potential impacts of the project on traffic and transport and recommend management actions to avoid or minimise impacts. If approved, a further detailed design process would follow which may include refinements to the concept design as detailed in the EIS. These changes could be in a response to submissions raised during the EIS exhibition, design refinements to further minimise impacts and optimise design and traffic efficiency. In doing so it is likely to necessitate refinements to a number of project elements however these will not affect the key project elements described.

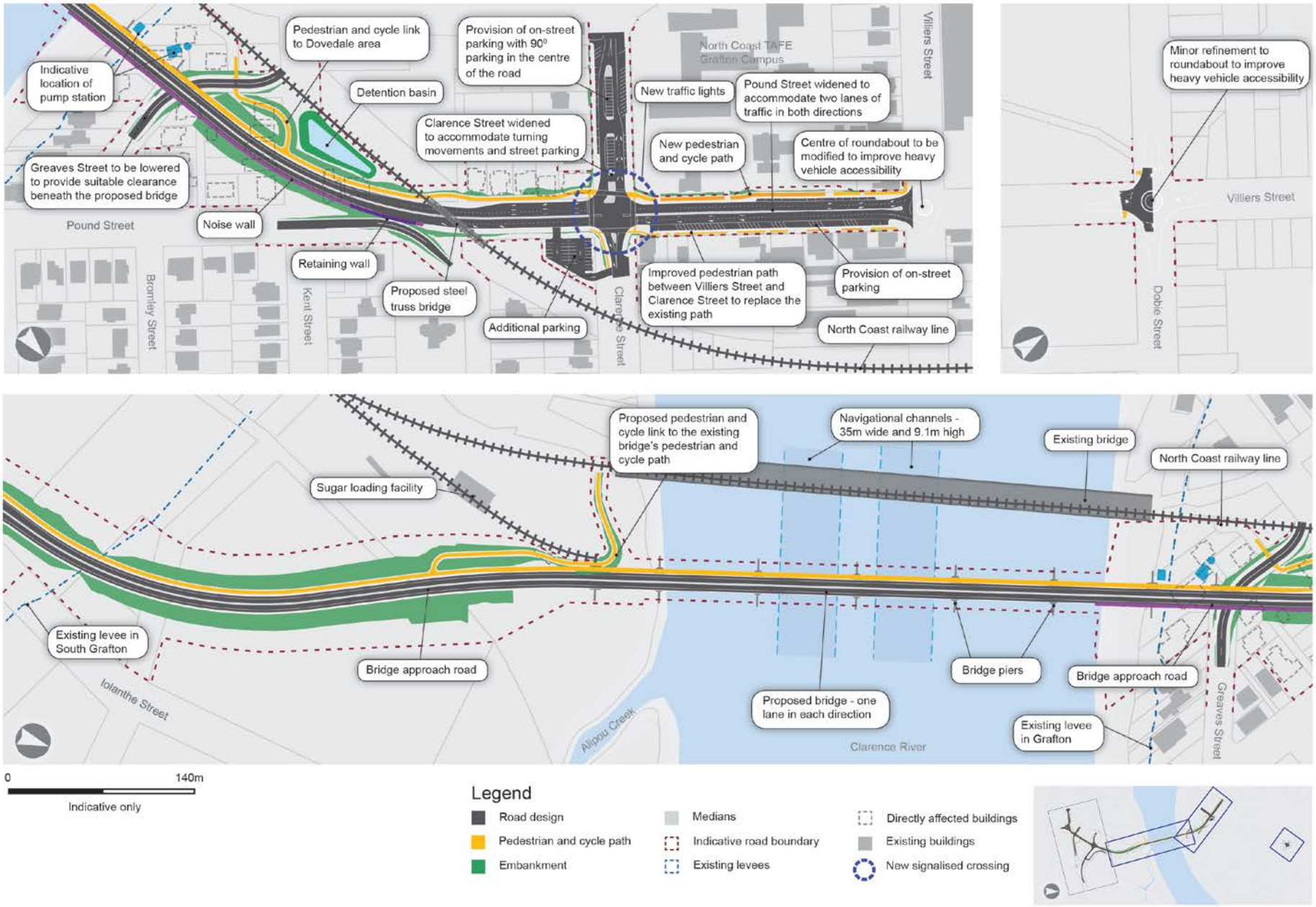


Figure 1: Project elements in Grafton

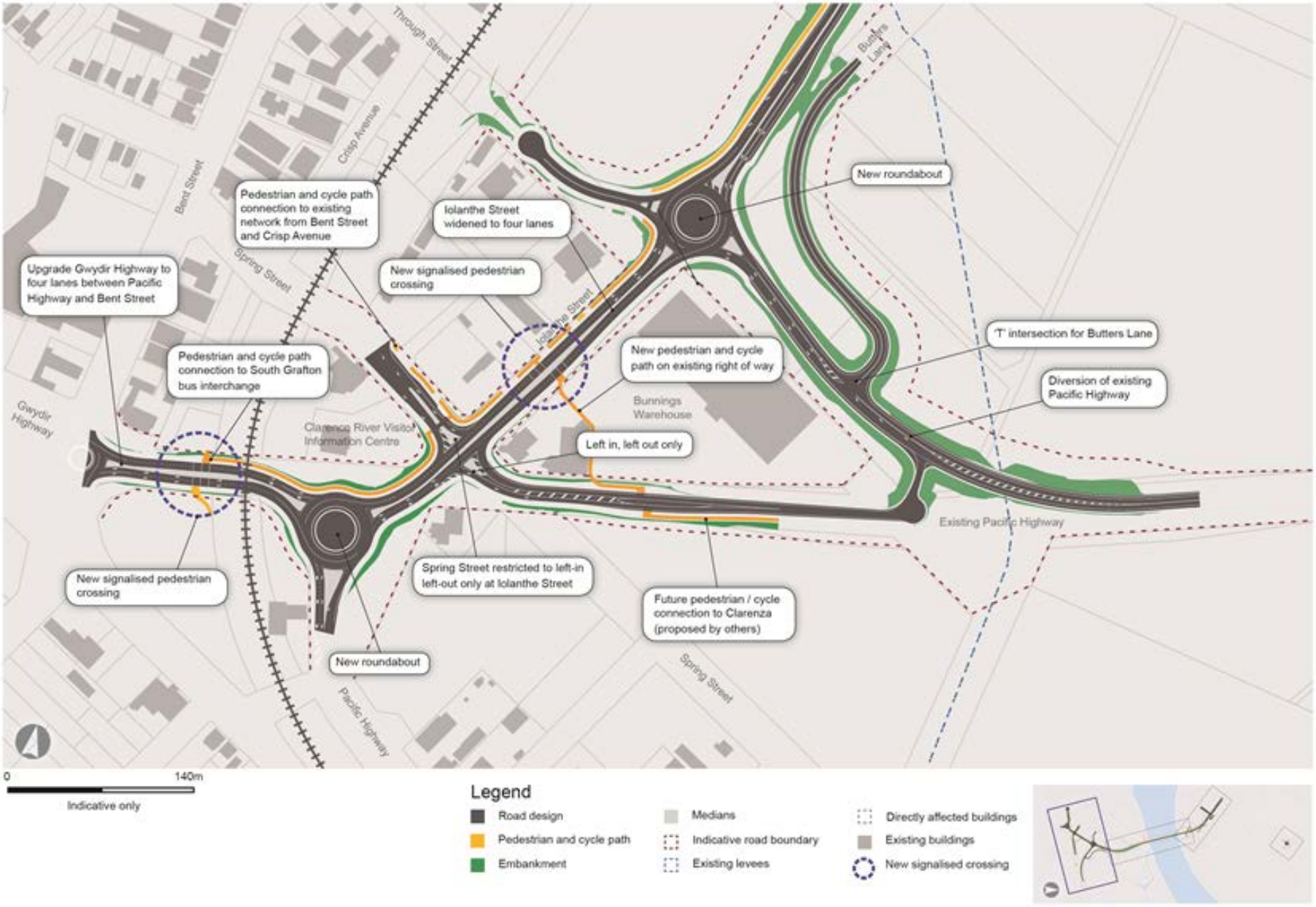


Figure 2: Project elements in South Grafton

1.3.1 Possible initial upgrades

While the overall project would be as per the above description, staging of the proposed project may be undertaken. The traffic modelling for the project suggests that all of the upgrades for the South Grafton local road network may not be required in the short to medium term. As such, Roads and Maritime may only provide the initial upgrades shown in Figure 3 at year of opening. The remainder of the South Grafton road network upgrades as described in Figure 2 would be completed as the roads and intersections that connect to the southern bridge approach road reach capacity during peak periods. The timing for completion of the remainder of the road network upgrades would depend on traffic performance, actual growth in traffic demand and availability of funding.

The key points of difference of the possible initial upgrades from the proposed project design are:

- The Pacific Highway would remain on its current alignment and connect with Iolanthe Street at a new roundabout at the Iolanthe Street/Spring Street intersection
- A signalised pedestrian crossing would be provided on the Pacific Highway about 100 m east of the Iolanthe Street intersection
- The fourth leg of the Iolanthe Street / Through Street roundabout would be a realigned Butters Lane, instead of the Pacific Highway.

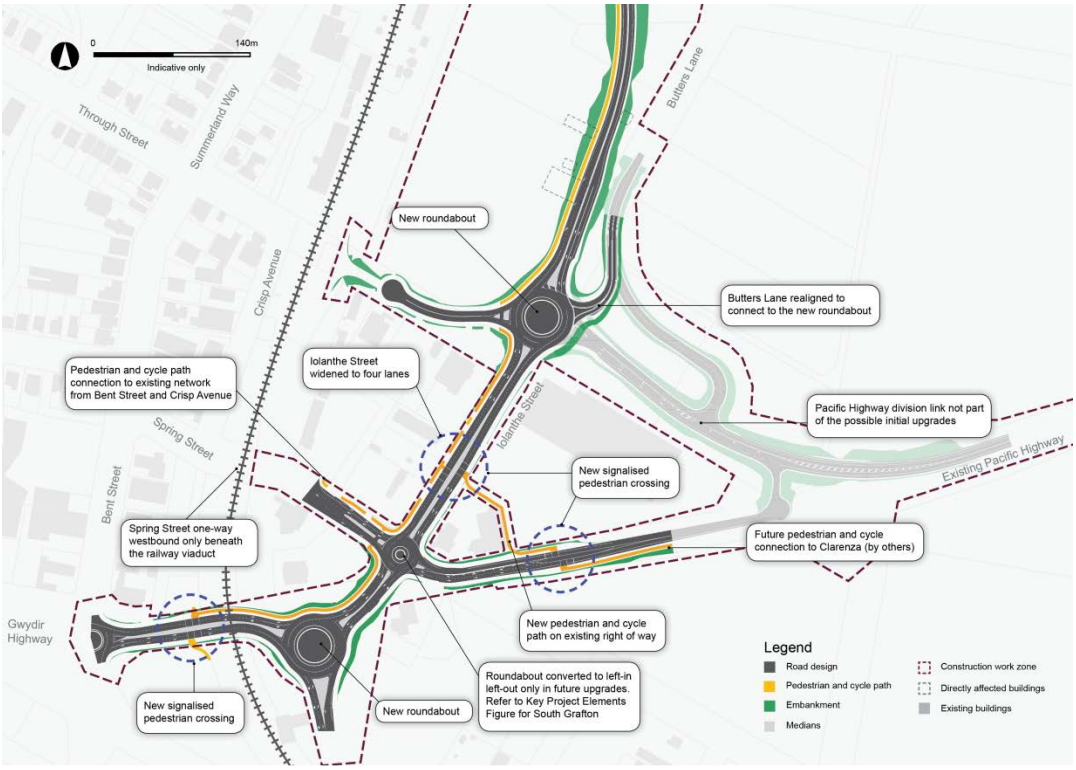


Figure 3: Possible initial upgrades

1.4 Director General's Requirements

The Director-General's Requirements for the Grafton Bridge Project were issued on 3 October 2013. The Director Generals Requirements relating to traffic and transport are shown in Table 1.

Table 1: Director General Requirements for Traffic and Transport

Director-General's requirement	Where addressed in this report
Details of how the following meet the traffic and transport objectives of the project, taking into account future growth areas and traffic (vehicular, cyclist and pedestrian) needs: - the preferred bridge alignment and design, - the proposed intersection of the Pacific Highway, Spring Street, and the southern approach road, - the proposed widening of the Gwydir Highway between the Pacific Highway and Bent Street, and intersection treatment at the intersection of the Gwydir Highway and Bent Street, and - associated bridge approaches and local road network treatments at Grafton and South Grafton;	For traffic – Sections 4.14.1.4 For heavy vehicles – Section 4.2 For buses – Section 4.4 For pedestrians and cyclists – Section 4.5
Operational traffic and transport impacts on the local and regional road network, with reference to access to adjoining residential, commercial and industrial land uses;	Sections 4.1, 4.7
Construction traffic and transport impacts of the project (including ancillary facilities) and associated management measures, in particular: - impacts to the road network (including safety and level of service), - pedestrian and cyclist access, and - disruption to public transport services and access to properties, having reference to the cumulative construction impacts taking into account other infrastructure preparing for or commencing construction;	Section 5
Integration of the bridge with existing and future pedestrian and cycle network in the local, regional and metropolitan context	Section 4.5.2
Consideration of design, and safety measures for pedestrian and cycle access on the bridge	Section 4.5.3
Justification for the proposed width of the bridge based on shared use by pedestrians, cyclists and public transport	Section 4.9
Details of pedestrian and cyclist access (dedicated or shared-use), and public transport and emergency vehicle access	Pedestrians and cyclists - Section 4.5 Public transport – Sections 4.3 and 4.4 Emergency vehicles – Section 4.8

1.5 Assessment approach

A methodology for assessment of the project from a traffic and transport viewpoint was developed based on the Director-General's Requirements specified in Table 1. The steps carried out are detailed as follows.

A review of the current transport context within the study area, including:

- Function of the local, regional and state road networks
- Existing traffic demand and constraints, through the gathering of traffic count data and travel time surveys
- Infrastructure and services currently in place for sustainable transport modes including train, bus, cycling and walking
- Utilisation of the road network by heavy vehicles
- Safety of the road network, through analysis of recent crash data.

Assess the transport impact of the project, taking into consideration:

- Forecast changes in local and inter-regional traffic within the area, based on planned infrastructure changes within the region and available demographic information
- Through the use of transport modelling tools, operational improvements for traffic, freight, sustainable transport modes and emergency services
- Changes in accessibility at a local (residents and businesses) and regional level
- Improvements in road safety.

Identify the effects of construction activities, including:

- Impacts to the road network
- Pedestrian and cyclist access
- Disruption to public transport services
- Property access.

The above aspects of the assessment are covered in further detail in subsequent sections of this report.

1.6 Assumptions and limitations

The majority of the assumptions made for the purposes of this assessment are associated with the development of transport models. Key assumptions for the traffic modelling undertaken are:

- The assumed date of opening of the additional crossing to traffic is 2019. Note that the actual year of opening will be subject to funding and may vary from this date.
- The Woolgoolga to Ballina upgrade of the Pacific Highway (which bypasses Grafton) will be open to traffic prior to the assumed date of opening of the additional crossing (2019).

- Large heavy vehicles (semi-trailers and 25/26 metre long B-Double trucks) will be prohibited from using the existing crossing, requiring such vehicles to use the additional (new) crossing. No time of day restrictions would be placed on heavy vehicle use of the proposed bridge. Buses and smaller (single unit) heavy vehicles would be able to use either bridge.
- Route choice between the existing Pacific Highway and Centenary Drive (rat-run) would remain proportionally the same in future years.
- The Pacific Highway would continue to be the priority designated freight route for heavy vehicles travelling between Sydney and Brisbane. It is not the intention of the additional crossing to provide an additional freight corridor or to attract more heavy vehicles onto the Summerland Way.
- Population growth and development forecasts are consistent with those identified in the *Mid North Coast Regional Strategy 2006-31* (NSW Department of Planning, 2009). The forecasts consider land capacity and have been developed in consultation with Clarence Valley Council and Planning and Environment. The more recent growth forecasts released by Planning and Environment are discussed in Section 3.1.
- The limits of the transport models extend to the boundaries of study area, with outputs extracted from the modelling focussed within the project area. These areas are defined in the following section.

1.7 Study area and project area

The extent of the study area is shown approximately in Figure 4. The study area includes the existing Clarence River bridge connecting Grafton and South Grafton as well as the areas of Junction Hill, Carrs Creek, Great Marlow, Clarenza, Waterview and South Grafton. The strategic transport 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.

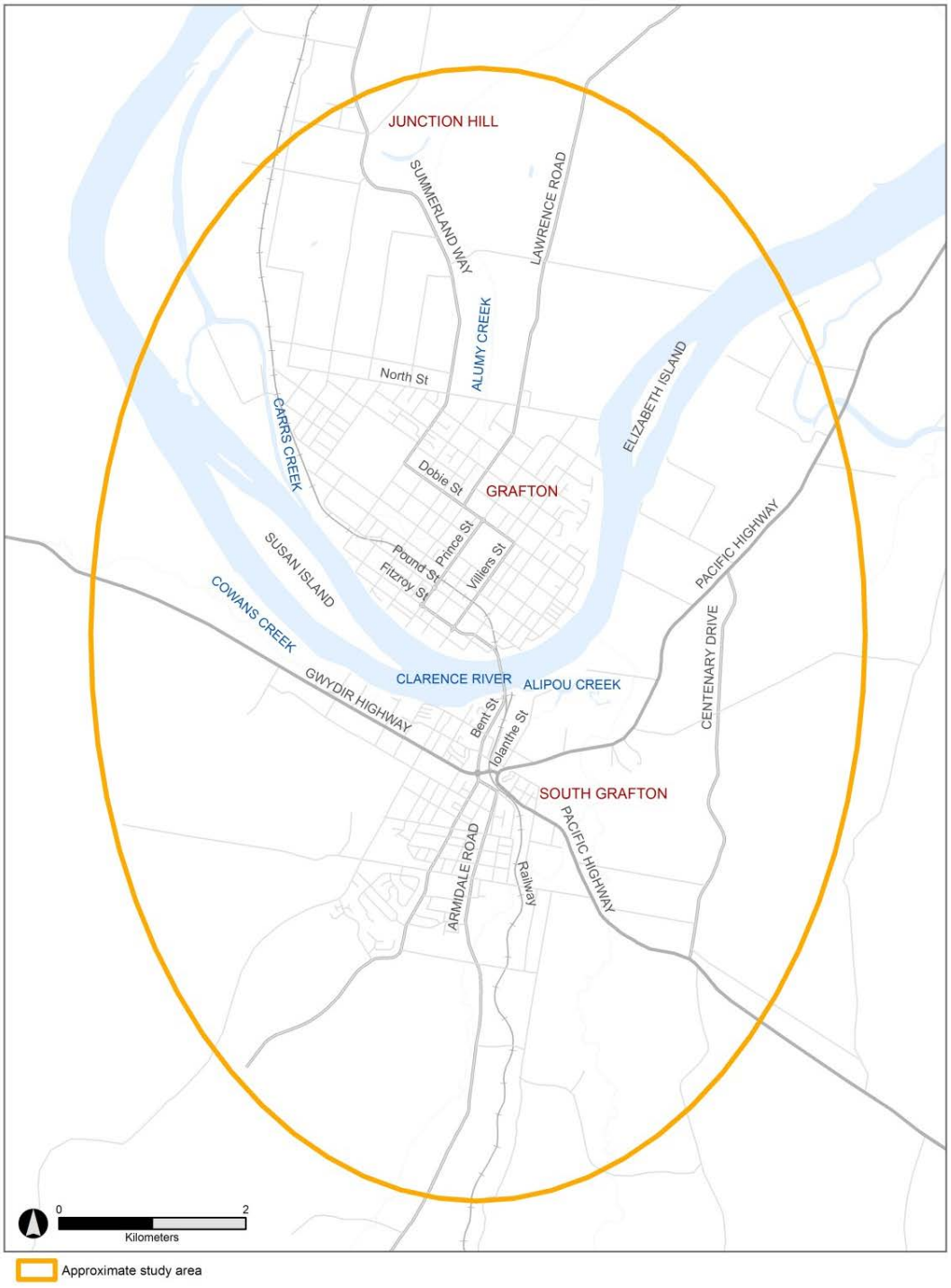


Figure 4: Study area

The extent of the project area is shown approximately in Figure 5. It encompasses the project during operation and construction, including the:

- Operational road boundary
- Permanent ancillary elements such as operational detention basin and pump station in Grafton
- Construction work zone, which includes temporary facilities such as South Grafton ancillary site, Pound Street ancillary site and the jetty for barge launching.

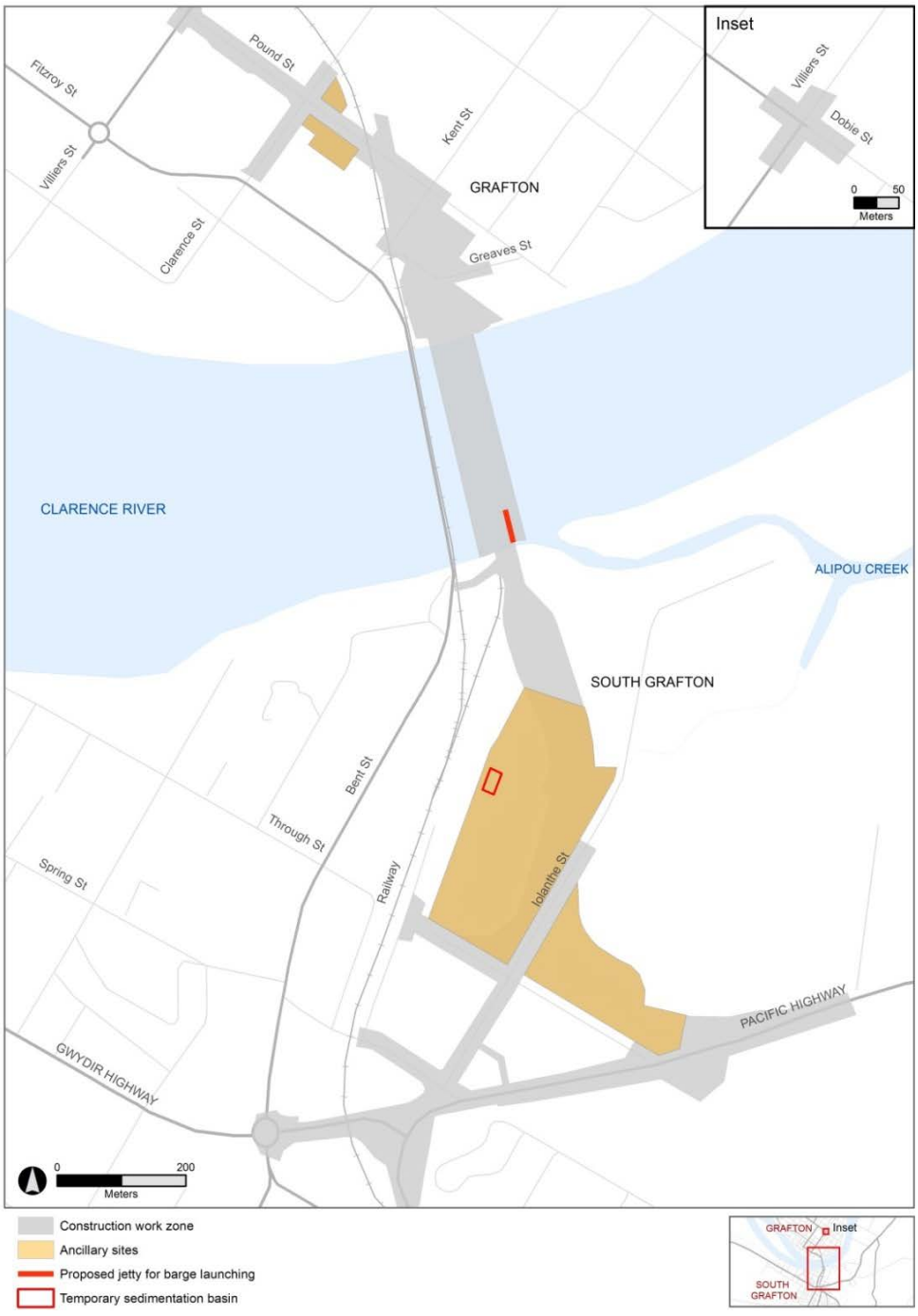


Figure 5: Project area

2 Existing context

2.1 Road network

The existing road network in the Grafton area is presented in Figure 6 which also shows the designated 25/26 metre long B-Double truck routes through Grafton.

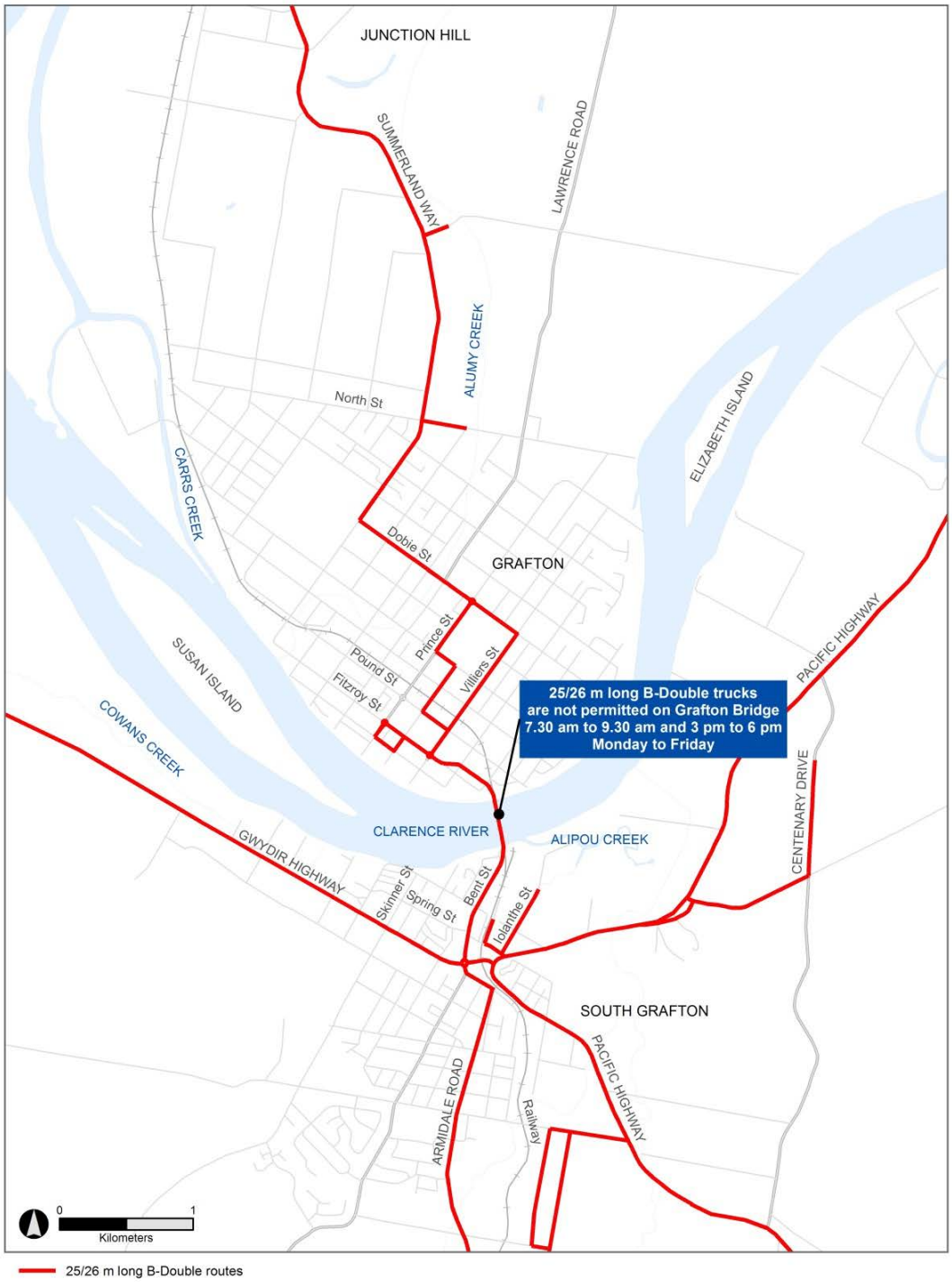


Figure 6: Grafton area existing road network

Heavy vehicles with an overall length not greater than 19 m are generally permitted to travel on all NSW roads with B-Double trucks up to 25 m being restricted to the approved NSW-wide B double routes with the local routes shown in Figure 6. Heavy vehicles over 25m being road train routes restricted to more specific routes generally in western NSW.

2.1.1 State roads

State controlled roads in the Grafton area include the Pacific Highway, the Summerland Way and the Gwydir Highway.

Pacific Highway

The Pacific Highway (Highway No 10) is part of the National Land Transport Network and is the major coastal road transport route between Sydney and Brisbane. At a regional level, the Pacific Highway connects South Grafton with Coffs Harbour and Woolgoolga to the south, and Woodburn and Ballina to the north. The Pacific Highway enters the Grafton city area from the south at South Grafton, connecting to various local streets and the Gwydir Highway on the east side of South Grafton. From this intersection (Pacific Highway/Gwydir Highway) the highway leaves South Grafton in a north-east direction following the Clarence River to the town of Maclean.

Gwydir Highway

The Gwydir Highway, a 567 km long State Road (Highway No 12), traverses the New England region from South Grafton to the inland areas of Glen Innes, Inverell, Warialda, Moree and Walgett. It crosses the New England tablelands and western plains and connects four interstate highways (Pacific, New England, Newell and Castlereagh). It is the only east-west B-Double truck route in the NSW northern region.

Summerland Way

The Summerland Way, a 199 km long north-south State Road (Route No 83) runs from the Mount Lindesay Highway near Woodenbong in the vicinity of the Queensland border to Grafton. It provides an inland link between southern Queensland, and the Richmond River and Clarence River Valleys in northern NSW. The Summerland Way passes through the towns of Casino and Kyogle and connects South Grafton and Grafton via the existing bridge.

The route was first constructed between Mt Lindesay Highway and Casino in 1935 as a developmental road, opening up better road access to the farming and agricultural land near the border ranges. During World War II, the section between Grafton and Casino was constructed as a flood-free defence route.

Although the route is designated for 25/26 metre long B-Double trucks, the Summerland Way does not currently comply with Roads and Maritime requirements for vertical clearance in Grafton. As shown in Table 2, headroom restrictions resulting from the existing elevated railway line through the centre of Grafton means that there are only nine locations where traffic can pass between central Grafton and the areas to the north.

At present, signage directs high vehicles along Villiers Street (5.0 m) rather than the designated MR83 route along Prince Street (4.0 m), based on the greater clearance available at Villiers Street. Nevertheless, the available clearance at 5.0 m meets Road and Maritime minimum requirements only where a convenient alternative route with the desirable 5.3 m clearance is available and signposted.

Table 2: Headroom restrictions for railway viaducts in Grafton CBD

Street in Grafton	Signposted clearance available (m)
Pound Street	3.6m
Mary Street	5.0m
Queen Street	4.0m
Prince Street	4.0m
Duke Street	5.0m
Villiers Street	5.0m
Clarence Street	3.2m
Pound Street	4.0m
Kent Street	4.0m

It is also important to note that access for 25/26 metre long B-Double trucks at the existing bridge is restricted during peak traffic periods.

Within Grafton, the Summerland Way links the CBD with South Grafton via the existing bridge. The Summerland Way is where most local businesses in central Grafton (on Fitzroy and Prince streets) and South Grafton (on Bent Street) are located and it provides the main access road to Grafton Shopping World. It is a 50 km/h street with no traffic signals, and two lanes in each direction between Clarence Street and Duke Street. It has conventional roundabouts at the main intersections and designated pedestrian crossings at selected locations.

2.1.2 Regional roads

Regional roads that connect Grafton and South Grafton with other towns and villages within the region are:

- Lawrence Road, connecting Grafton with Lawrence and Maclean (to the north-east).
- Armidale Road, connecting South Grafton with the villages of Coutts Crossing and Ebor (to the south) and the Northern Tablelands at Armidale.

2.1.3 Local road network

The key local roads within the Grafton and South Grafton centres are:

Grafton

- Villiers Street – connecting the Grafton centre and residential areas to the northeast, as well as accommodating high vehicles using route MR83
- Pound Street – providing access to Shopping World and a number of other small businesses, as well acting as a secondary access road (rat-run) to the existing bridge

South Grafton

- Skinner Street – providing access to the small urban hub at its northern end, and connection to regional centres to further southwest of Grafton via Rushforth Road at its southern end
- Spring Street – acting as a secondary route (rat-run) between Bent Street and the Pacific Highway at its eastern end, and providing access to a reasonable amount of small businesses along its entire length.

2.2 Traffic demand

Traffic data for the project has been collected from a number of sources including Roads and Maritime, Clarence Valley Council, and previous reports and studies. The data includes origin and destination surveys, automated classified tube counts, travel time surveys, intersection counts and video traffic counts.

Over 68 sites around Grafton have been used for data collection throughout the project, with the sites on key roads within the region including:

- Pacific Highway
- Armidale Road
- Bent Street
- Fitzroy Street
- Dobie Street
- Gwydir Highway
- Pound Street
- Prince Street
- Summerland Way
- Villiers Street, and
- Many others.

The range of different survey methods used were:

- Tube counts – which collects 24 hour data over an extended period and provides counts for different vehicles types. The tube count

method was extensively used in Grafton to obtain a summary of traffic volumes, directions, daily profiles and vehicle class proportions.

- Intersection counts – are typically manual counts and are used to collect data for localised validation of traffic behaviour. The intersection count data was predominantly collected during the AM and PM peak periods and has informed the validation of transport models.
- Video traffic counts – were used to collect turning movement data at key intersections. They are a more cost effective method of data collection than manual turning movement counts and provide the same data as manual traffic counts.
- Origin destination surveys – video technology was used to record vehicle number plates which are then matched with video survey records at other sites to determine the origin/ destination of travellers in the system. Due to issues with legibility of number plates during the night time hours the origin destination surveys were conducted over 5am to 7pm time frame. The surveys were supported by tube counts.

Traffic data collected between 2006 and 2011 is summarised in Table 3.

Table 3: Summary of survey data collected

Year	Sites surveyed	Survey type		
		Tube	Intersection	Origin - destination
2006	4	4	-	-
2007	14	-	14	-
2008	4	4	-	
2009	24	10	14	-
2010	34	26	-	8
2011	56	54	2	-

Key information from the traffic data collected is presented in the following sections.

2.2.1 Network traffic demands

The traffic data described in Section 2.2 formed the basis for the development of a strategic traffic model that was established for the project. The model was validated and calibrated to the 2011 data collected with the Base Case model considered an accurate representation of the count data (*Strategic Traffic Assessment* (GTA, 2011)).

Figure 7 illustrates the estimated daily traffic demand on the existing road network for all vehicles, as output by the strategic model. Note that the daily traffic volumes output from the model are factored AM peak volumes and as such the directional flows may be biased towards morning peak flows. Only total link flows (the addition of each directional flow) should be considered within these plots. Peak to daily factors were derived from the gathered traffic count data.

Figure 7 demonstrates that the following are the primary roads within the network in terms of the volumes of daily traffic accommodated (volumes vary by road section).

- Grafton
  - Fitzroy Street (9,000 to 24,000 vehicles per day)
  - Villiers Street, north of Fitzroy Street (9,000 to 16,000 vehicles per day)
  - Pound Street (8,000 to 11,000 vehicles per day).
- South Grafton
  - Bent Street (21,000 to 23,000 vehicles per day)
  - Pacific Highway (10,000 to 12,000 vehicles per day)
  - Gwydir Highway (8,000 to 11,000 vehicles per day).

Figure 7: Existing traffic flows (vehicles per day) in the vicinity of the project (Source: Grafton Strategic Model – Base Year 2011)

2.2.2 Existing bridge traffic demands

All vehicles

The key findings of the origin and destination survey undertaken on Thursday 19 August 2010 relating to all vehicles crossing the existing Grafton Bridge (see Figure 8) were:

- Three per cent of the trips are through trips (external to external) that originate and terminate outside Grafton and South Grafton
- The majority of trips (97 per cent) crossing the bridge have an origin and/or destination within Grafton or South Grafton.

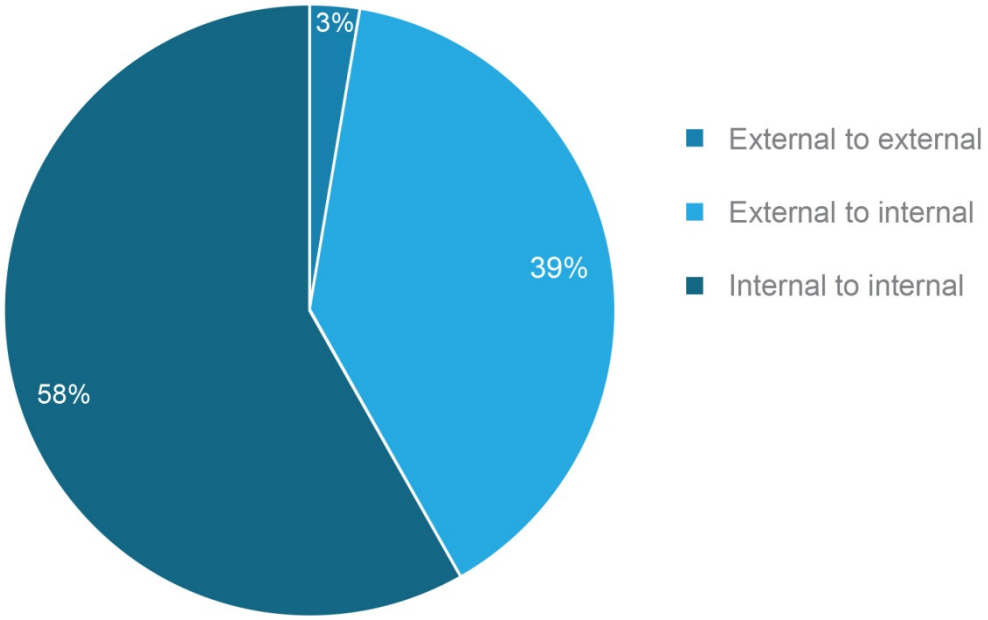


Figure 8: All vehicle trip types crossing Grafton Bridge taken from the origin and destination survey, 19 August 2010 (5 am - 7 pm) (Source: *Heavy Vehicle Traffic Study* (Roads and Maritime, 2011)).

The key findings of the classified tube counter surveys between Thursday 19 August 2010 and Thursday 26 August 2010 relating to all vehicles crossing the existing Grafton Bridge (see Figure 9) were:

- The weekday average volume across the Clarence River during the period of measurement was approximately 27,578 vehicles per day
- The majority of vehicles (both light and heavy) use the bridge during the day
- Friday provides the highest daily traffic volumes for all trips across the bridge
- Sunday traffic volumes are the lowest
- In the AM peak (between 7 am and 10 am) period most traffic is northbound into Grafton

- In the PM peak (between 4 pm and 7 pm) period, the traffic flow is more even in both directions but the predominant traffic flow is southbound.

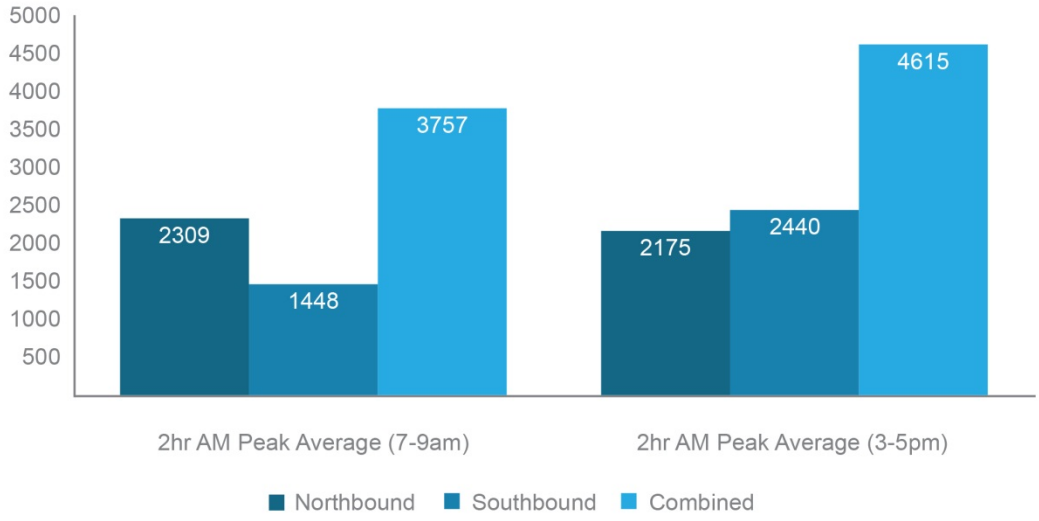


Figure 9: Bridge traffic count results for all vehicles peak hour weekday average from classified tube count results, August 2010 (Source: *Heavy Vehicle Traffic Study* (Roads and Maritime, 2011)).

Heavy vehicles

The key findings of the origin and destination survey undertaken on Thursday 19 August 2010 relating to heavy vehicles crossing the existing Grafton Bridge (see Figure 10) were:

- Twelve per cent of heavy vehicles are making through trips that do not have an origin or destination within Grafton or South Grafton
- The majority of heavy vehicles (88 per cent) crossing the Grafton Bridge have an origin and/or destination within Grafton or South Grafton.

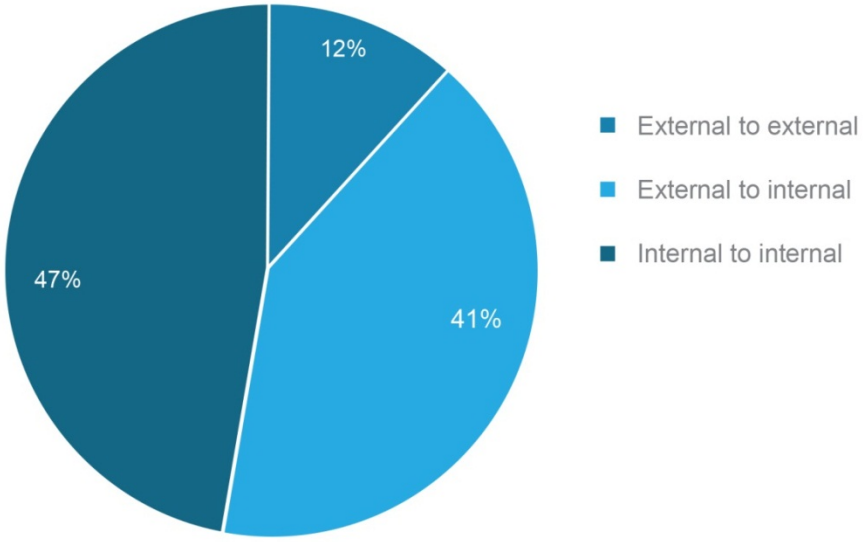


Figure 10: Heavy vehicle trip types crossing Grafton Bridge taken from the origin and destination survey, 19 August 2010 (5 am - 7 pm) (Source: *Heavy Vehicle Traffic Study* (Roads and Maritime, 2011)).

Key findings of the classified tube counter survey between Thursday 19 August 2010 and Thursday 26 August 2010 relating to heavy vehicles crossing the existing Grafton Bridge (see Figure 11) were:

- The weekday average heavy vehicle volume across the Grafton Bridge is approximately 1,408
- 186 heavy vehicles (5 per cent of total traffic) crossed the bridge during the AM peak periods
- 472 heavy vehicles (10 per cent of total traffic) crossed the bridge during the PM peak periods
- The number of heavy vehicles crossing the bridge during peak hours is influenced by the ban on B-Double trucks greater than 25 m length using the Grafton Bridge between 7.30 am and 9.30 am and between 3 pm and 6 pm.

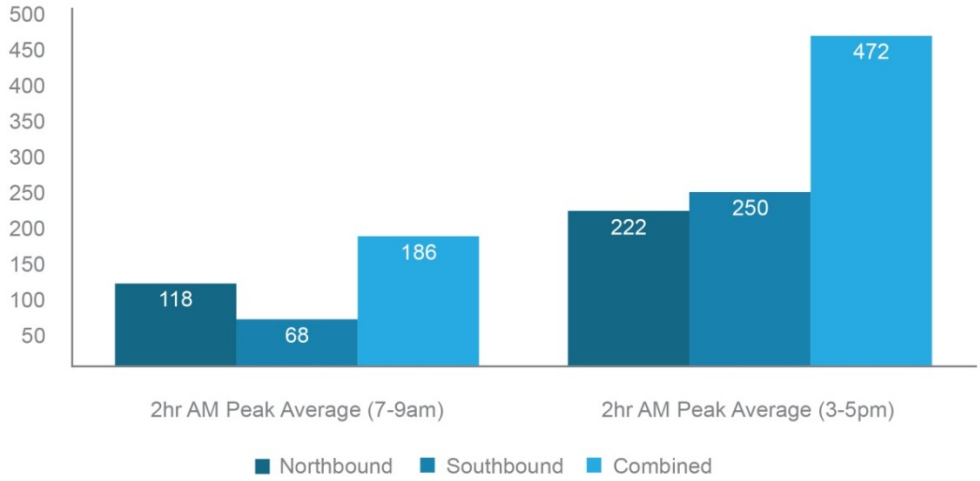


Figure 11: Bridge traffic count results for heavy vehicles peak hour weekday average from classified tube count results, August 2010 (Source: *Heavy Vehicle Traffic Study* (Roads and Maritime, 2011)).

2.2.3 Bridge capacity

The discussion outlined in this section and in Section 2.2.2 (existing traffic demands) were based on traffic a count survey conducted in August 2010. Data from this survey is considered suitable to determine whether the existing bridge is at capacity during peak periods because there have been no significant changes to the road network or land uses since these counts were carried out that would result in changes in travel patterns. This, along with expected growth in the Grafton area (refer to Section 3.1) suggests that there would not be a reduction in demand for travel across the bridge since the counts were conducted.

The traffic counts carried out in August 2010 indicate that the bridge was carrying 1360 vehicles per hour in the northbound direction for the AM peak and 1330 vehicles per hour in the southbound direction for the PM peak. The *Guide to Traffic Management Part 3: Traffic studies and analysis* (Austroads, 2009) indicates that the theoretical capacity of the bridge could be considered to be in the range of 900 to 1400 vehicles per lane per hour. Furthermore, congestion and traffic delays are observed at the bridge approaches during peak periods.

This indicates that the bridge is at capacity during peak periods. These delays are changing people's travel behaviour and daily activity patterns. 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 beginning to operate as separate towns.

2.2.4 Historical traffic growth

Historical Roads and Maritime traffic data recorded for a number of years at the existing bridge is presented in Table 4. The traffic volumes in this table are expressed as annual average daily traffic (AADT) and therefore take into account weekday and seasonal variations including holiday peaks. For this reason AADT flows can be higher or lower than measured flows on a particular day. This information has been used to estimate the growth in traffic in Grafton, presented in Table 5.

Table 4: Historical annual average daily traffic count data across the Clarence River, Grafton

	1990	**2004**	**2009**
Annual average daily traffic	20,548	23,641	24,193

Table 5: Historical annual average traffic growth rates across the Clarence River, Grafton

	1990-2004	**2004-2009**	**1990-2009**
Average annual growth (No)	205	118	218
Average annual growth (%)	1.0	0.5	0.9

Historical traffic counts show that traffic volumes across the bridge have had an average annual growth of 0.9 per cent per annum between 1990

and 2009. Traffic growth on the bridge was 0.5 per cent per annum for the five year period between 2004 and 2009.

2.3 Freight network

An existing freight network passes through the Grafton area using the existing State roads including Pacific Highway, Gwydir Highway and Summerland Way, crossing the existing Grafton Bridge. The main freight routes in the Grafton area are the designated 25/26 metre long B-Double truck routes shown on Figure 6. Freight operators use these routes to transport goods to and from the Grafton area, as well as through Grafton to access other major centres.

2.4 Rail services

Grafton City railway station operates out of South Grafton (near the corner of Bent Street and Through Street) and is on the North Coast Line. The line is the primary rail route in the Mid North Coast and Northern Rivers regions and forms part of the rail corridor between Sydney and Brisbane. The line begins at Maitland and ends at the Roma Street railway station in Brisbane passing through towns such as Taree, Wauchope, Macksville, Nambucca Heads, Coffs Harbour, Casino and Kyogle.

The line is utilised by both passenger and freight operators. The Grafton, Casino and Brisbane express passenger trains (XPT) each run daily from Sydney and stop at Grafton.

2.5 Bus services

Busways is the main public bus operator in Grafton providing regular services to Grafton and South Grafton and the towns and villages of Ulmarra, Maclean, Yamba, Iluka, Copmanhurst and Jackadgery. Routes covering Grafton and South Grafton are presented in Figure 12. The figures illustrate that several routes converge at the Summerland Way corridor through the centre of Grafton and at the existing bridge crossing, whilst deviating to Through Street and Spring Street in South Grafton.

A number of coach companies provide services to/from Grafton and towns / regional centres such as Lismore, Yamba, Maclean, Lawrence, Corindi Beach, Woolgoolga, Byron Bay, Moree, Copmanhurst, Cangai and also long distance services to Brisbane and Sydney.

Three bus companies took part in a survey undertaken for the *Heavy Vehicle Traffic Study* (Roads and Maritime, 2011). The reports indicated that typically buses operate from 5.30 am to 8.30 pm Monday to Friday and from 7.30 am to 3.30 pm on Saturdays. Its fleet moves approximately 2,500 students each morning and about 2,000 general passengers per day.

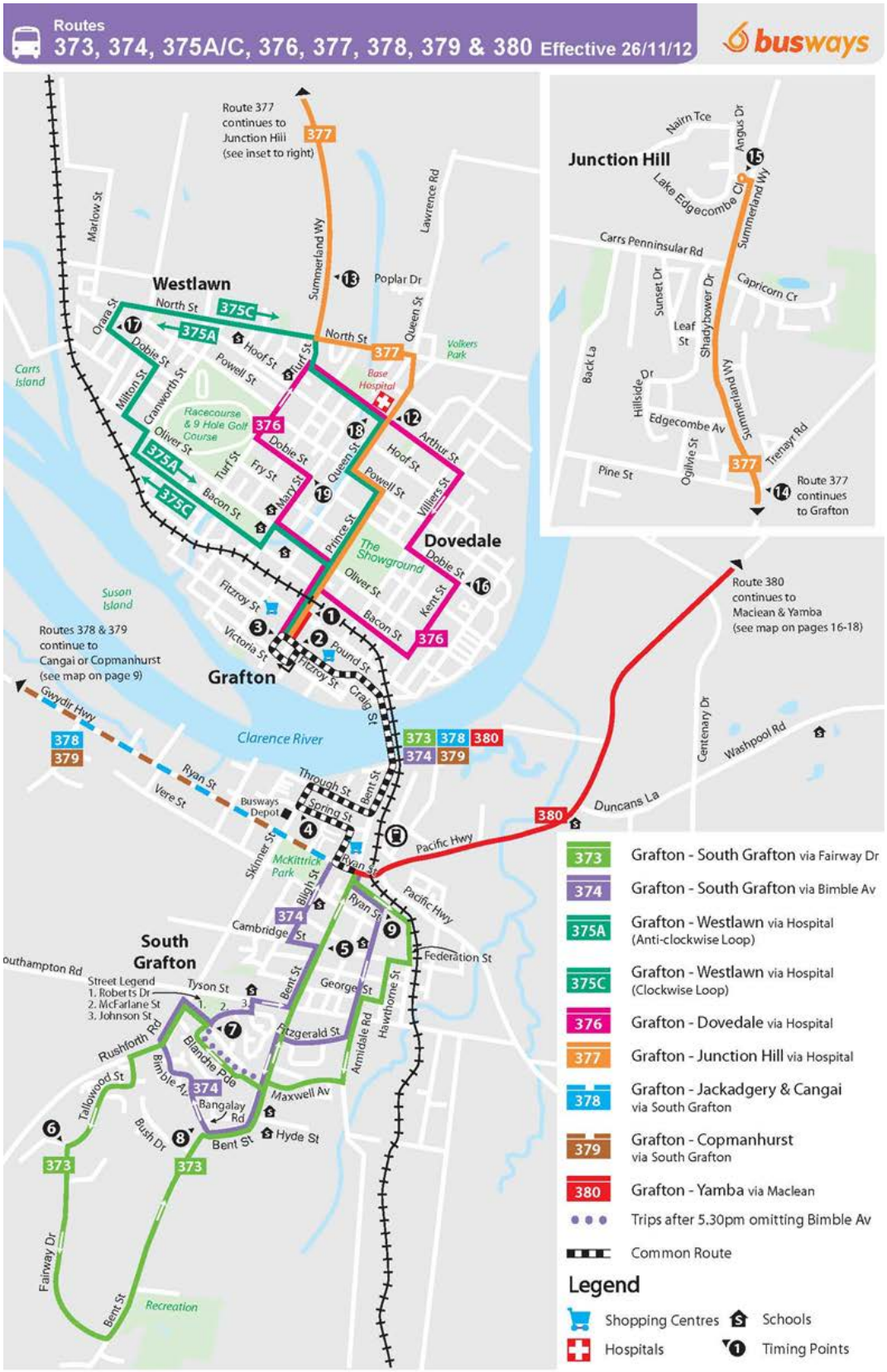


Figure 12: Busways routes in the Grafton area

2.6 Pedestrian and cycle network

A description of the current facilities for pedestrians and cyclists within the study area is given in this section. Figure 13 over page illustrates the current cycle network within Grafton.

In order to gauge current travel patterns on the Grafton cycle network, information has been extracted from an application-based data source. Strava is a mobile and online application that allows users to track their ride using a GPS device, and upload their data. This data is then used to update a global heat map every hour. It is acknowledged that this source is limited to application users, which are considered likely to be more heavily comprised of sporting / commuter riders rather than leisure. Notwithstanding this the data is still considered a useful tool for gauging the preferred travel routes of users. The heat map for the Grafton area is shown in Figure 14 below. Note that blue lines indicate minor use, thicker red lines indicate heavier cycle ridership.

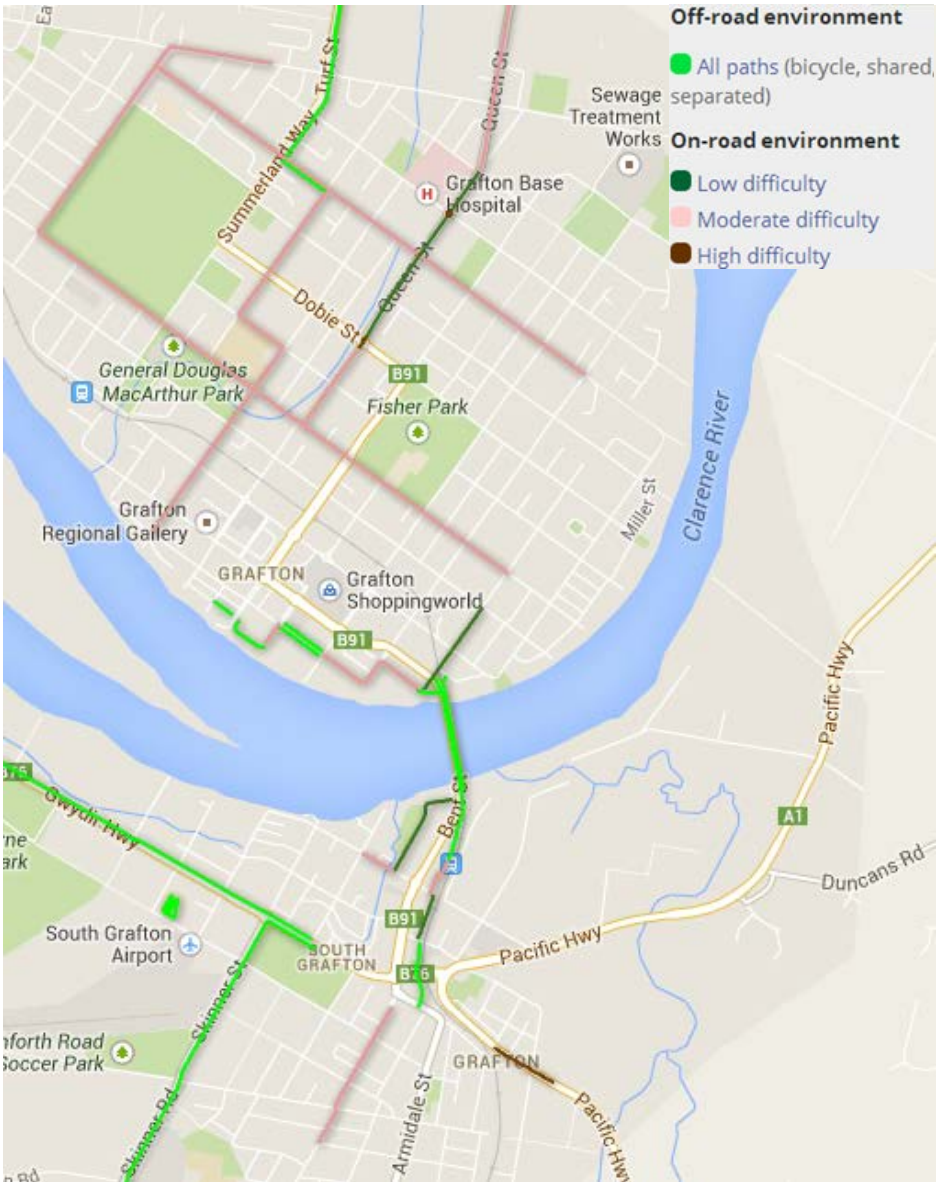


Figure 13: Grafton cycle links

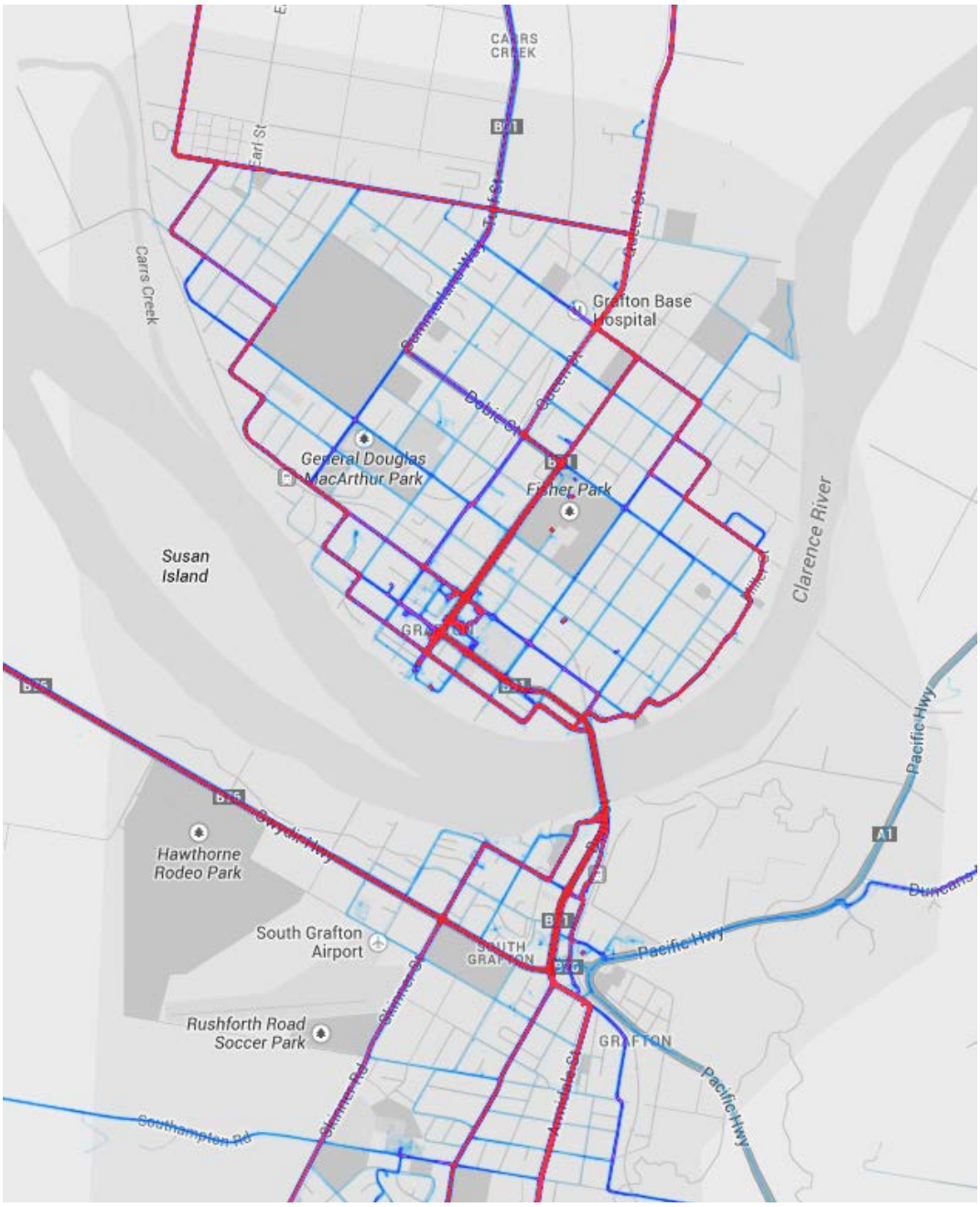


Figure 14: Grafton cycle heatmap indicating travel patterns (source: labs.strava.com/heatmap)

Regional network

As illustrated in Figure 13, the cyclist links connecting Grafton with its surrounds include:

- An off-road shared path at the southwest within the Gwydir Highway corridor, connecting South Grafton with Waterview Heights
- An off-road shared path to the north adjacent the Summerland Way, connecting Grafton with Junction Hill
- No formal links along the Pacific Highway. The cyclist links between South Grafton and nearby towns along the highway are sparse and disconnected.

The heatmap indicates that Strava users:

- Cycle to the northeast via Grafton-Lawrence Road in preference to the Pacific Highway
- Access Junction Hill and areas further north via Back Lane and Marlow Street in preference to the Summerland Way
- Heavily utilise the Gwydir Highway and Armidale Road in South Grafton, whilst avoiding the Pacific Highway

Existing bridge

A dedicated shared bicycle and pedestrian path is provided along both sides of the existing bridge at the rail line level (lower deck). These two-way paths are provided with railings for pedestrian and cyclist safety. At an approximate width of 1.5 metres between handrails, the paths on the existing bridge are considered to be narrow.

South Grafton

On the southern side of the river, the path extends from the bridge to the Grafton Rail Station parking area, and is discontinued at the southern end of Crisp Avenue. From here, users are required to share the road with general traffic for a brief section before connecting with the shared path running from Spring Street to Armidale Road, across the Gwydir Highway, parallel to and west of the railway corridor. This route requires crossing of Spring Street, Gwydir Highway and Armidale Road, all of which are heavily trafficked roads. Daily traffic volumes at the Gwydir Highway and Armidale Road exceed 11,000 vehicles per day and there are no formal arrangements for cyclists or pedestrians to cross these roads.

There are also currently no specific facilities for pedestrians and cyclists to get from the end of the shared path at Crisp Avenue eastbound to or across the Pacific Highway. The current route uses unformed road verges or the existing road formation to get to the Pacific Highway. For students trying to access McAuley Catholic College to the north, pedestrians and cyclists would need to cross the Pacific Highway to get to Hennessey Drive and the college. The Pacific Highway in South Grafton currently carries in the order of 12,000 vehicles per day (depending on section) and represents a significant hazard to pedestrians and cyclists wishing to cross it.

In terms of other links or paths within the project boundary, there are minimal notable facilities that are in addition to the above. At Iolanthe Street a short, disconnected footpath exists at the frontage to the Supercheap Auto site. There are no other formal paths along the Pacific Highway, Gwydir Highway or Spring Street within the project boundary.

Grafton

On the northern side of the river the shared pathway extends from the bridge crossing to Greaves Street where it meets with the local road network which generally has no dedicated facilities for cyclists. Grafton's current city cycle routes guide cyclists to use minor streets to the west to access areas closer to the river, and Kent Street and Oliver Street to access areas to the north.

Pedestrian footpaths are generally provided on at least one side of the roadway in central Grafton, however less connectivity is provided on streets further away from the centre.

In terms of other links or paths within the project boundary, there are minimal notable facilities that are in addition to the above. A footpath exists along the southwest side Pound Street which serves as a pedestrian connection between the Grafton centre and residential areas to its southeast.

2.7 Road safety and crash data

Roads and Maritime CrashLink database provided crash data for the Grafton area for the five year period ending 30 June 2013. The data includes crashes that:

- Were reported to the Police
- Occurred on a road open to the public
- Involved at least one moving road vehicle
- Resulted in a fatality, an injury, or a vehicle being towed away.

There may have been other minor incidents during this period; however, these are not included in Roads and Maritime CrashLink database as they may not have been reported.

The crash statistics revealed a total of 76 crashes. Of these crashes none resulted in fatalities, 34 resulted in injuries and 42 needed the vehicle to be towed away. The locations of these crashes are mapped in Figure 15.

The mapping of the crashes shows clusters in various areas along the alignment of higher order roads. This is typical given that these roads carry larger traffic volumes. The crash clusters are described below.

- **Pacific Highway** near intersections with Spring Street and Gwydir Highway - this area is characterised by closely spaced priority-controlled intersections with poor geometry
- **Bent Street** near its intersections with the Gwydir Highway and Through Street – characterised by roundabout intersections that experience a significant volume of daily traffic (most crossing the river)
- **Grafton Bridge** – most crashes are shown to occur near the “kinks” in the existing bridge alignment which are the direct cause of congestion on a daily basis during peak periods, and pose issues to the safe movement of vehicles due to the tight turns required
- **Fitzroy Street** near its intersections with Pound Street and Clarence Street – this area is characterised by intersections that experience congestion particularly along the southbound carriageway in the evening peak period.

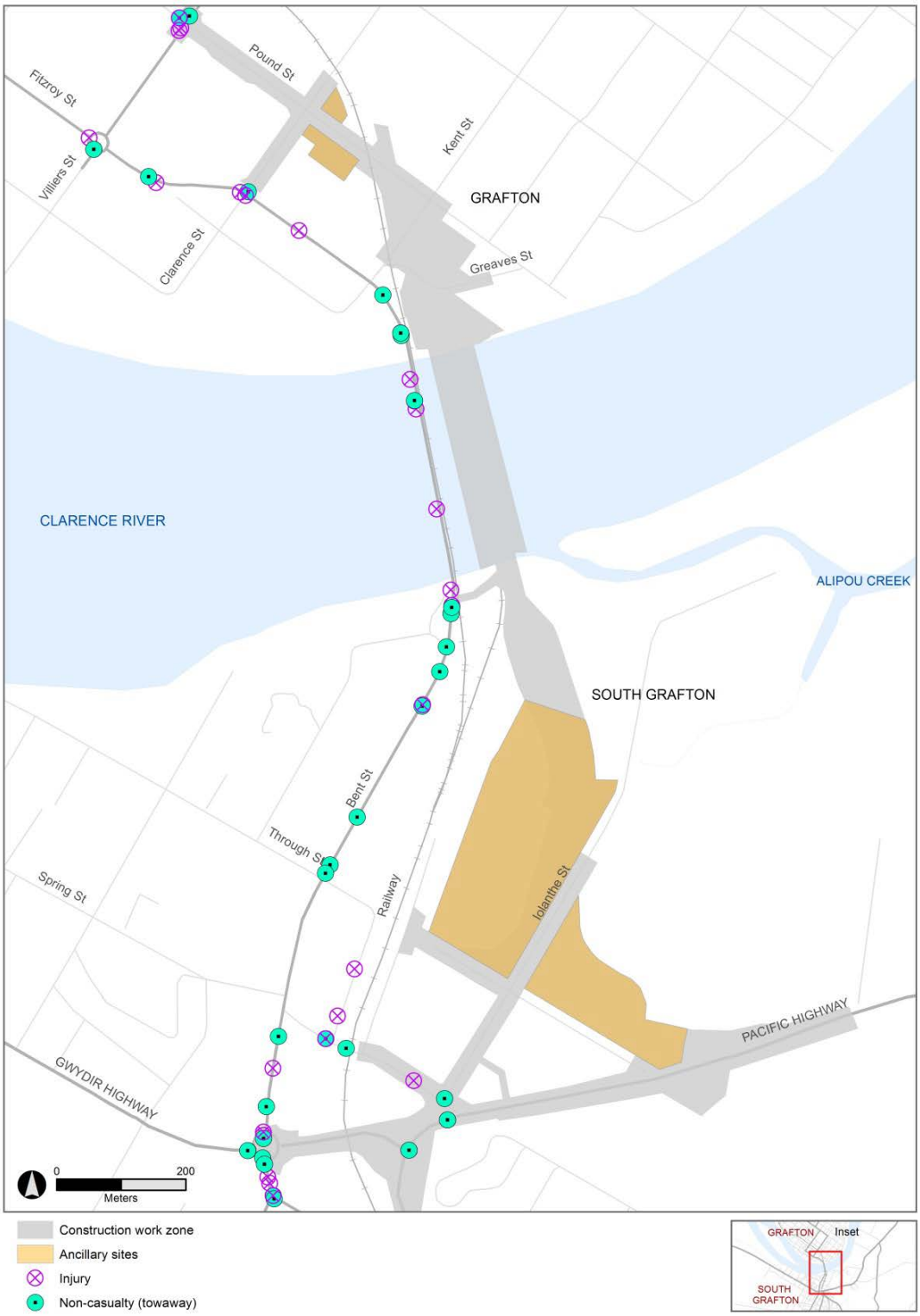


Figure 15: Recorded crash locations 2008-2013

2.8 Existing emergency response and evacuation routes

The flood evacuation plan for Grafton is documented in the *Clarence Valley Council Local Flood Plan* (SES, 2012). The plan defines three main evacuation routes out of Grafton (Figure 16):

- Two routes north, to Junction Hill
- One route across the existing Grafton Bridge to South Grafton.

Overtopping of the Grafton levees during a large flood event results in ponding within the floodplain between Grafton and Junction Hill and cuts the evacuation routes to the north. When this occurs, the only flood free route available for evacuation is via the existing Grafton Bridge to South Grafton. As such, the efficiency of flood evacuation within Grafton is largely constrained by traffic movement across the bridge.

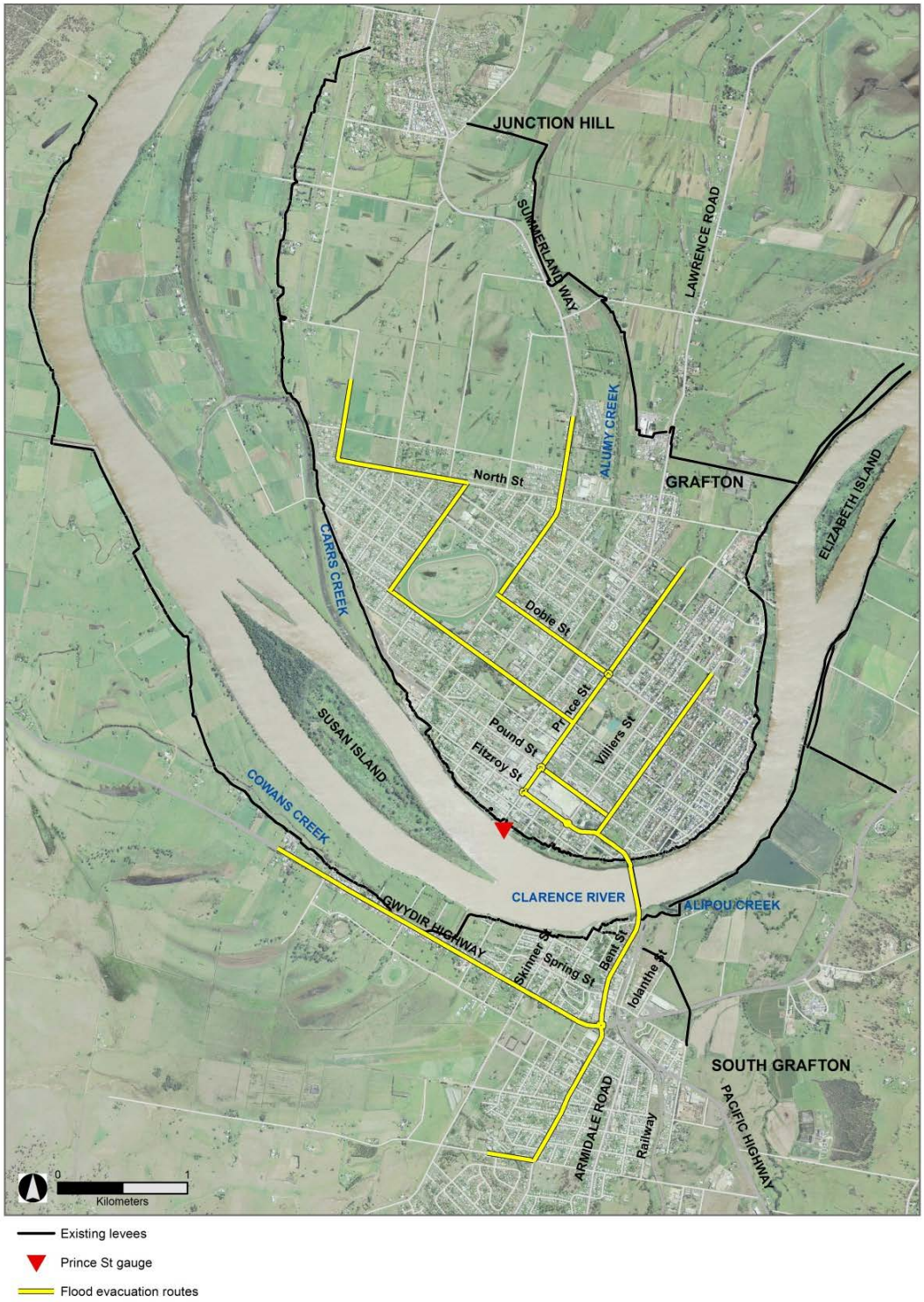


Figure 16: Evacuation route under the Clarence Valley Council Local Flood Plan (SES, 2012)

3 Local transport planning

3.1 Future traffic growth

Strategic transport modelling of Grafton and its surrounds was carried out to develop a detailed understanding of the existing and future traffic demands and patterns for the Grafton and South Grafton areas.

Modelling for the *Strategic Traffic Assessment* (2011) 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 Planning and Environment to assess the traffic impacts of existing and likely future development and to estimate future demands across the river up to 2039. The dwelling targets were informed by the *Mid North Coast Regional Strategy 2006-31* (NSW Department of Planning, 2009).

The distribution of dwelling locations within Clarence Valley local government area and average household occupancy rates were provided by Clarence Valley Council. The key residential growth areas were identified as Junction Hill, Waterview Heights, and Clarenza. It was assumed that take up of the development would occur in Junction Hill initially, followed by Waterview Heights and finally Clarenza.

It is noted that in August 2013, Planning and Environment released revised preliminary population projections. The 2013 preliminary projections are lower than the 2009 projection series across the local government area. However, these were provided at local government area level only, not at a statistical local area (SLA) level.

Based on the above, it was considered the level of detail of the information was insufficient to infer the impacts of the revised population forecasts on the project, and more disaggregated (i.e. SLA level) 2013 series projections were required. As such, for the current phase of the project the 2013 revised forecasts were not considered suitable for application within the strategic modelling. If more detailed information becomes available during the detailed design phase of the project, a review should be undertaken to assess the suitability of incorporating the revised projections.

Based on the above, a summary of the resulting growth in traffic demand for trips across the existing bridge is set out in Table 6 for both the AM and PM peak periods.

Table 6: Peak period traffic forecasts

Year	AM peak (7am to 9am)		PM peak (3pm to 5pm)	
	Total trips (vehicles)	Growth rate per annum (%)	Total trips (vehicles)	Growth rate per annum (%)
2011	12,456	-	14,641	-
2019	14,040	1.5	15,963	1.1
2029	18,130	2.6	20,554	2.6
2039	21,232	1.6	23,833	1.5

Note that for growth between 2011 and 2019, trips were distributed across the network so that the theoretical capacity of the bridge was not exceeded in the peak periods. This approach is considered representative of expected operating conditions prior to the introduction of additional capacity at the river crossing, and a resumption of “normal” travel patterns in Grafton. This is discussed further in the following section.

3.2 Transport infrastructure planning

3.2.1 Pacific Highway Upgrade – Woolgoolga to Ballina

The Pacific Highway is currently being upgraded to dual carriageway standard from Sydney to the Queensland border with funding from both the NSW and Commonwealth governments. Roads and Maritime has announced the preferred route for the Pacific Highway upgrade in the vicinity of Grafton. The preferred route which passes between Glenugie, east Tucabia and Tyndale is shown in Figure 17.

The new corridor will create a Grafton bypass with interchanges located at Glenugie to the south of the study area and Tyndale to the north. For the purposes of this assessment it has been assumed that the Grafton bypass route will be completed prior to the opening of the additional crossing (2019).

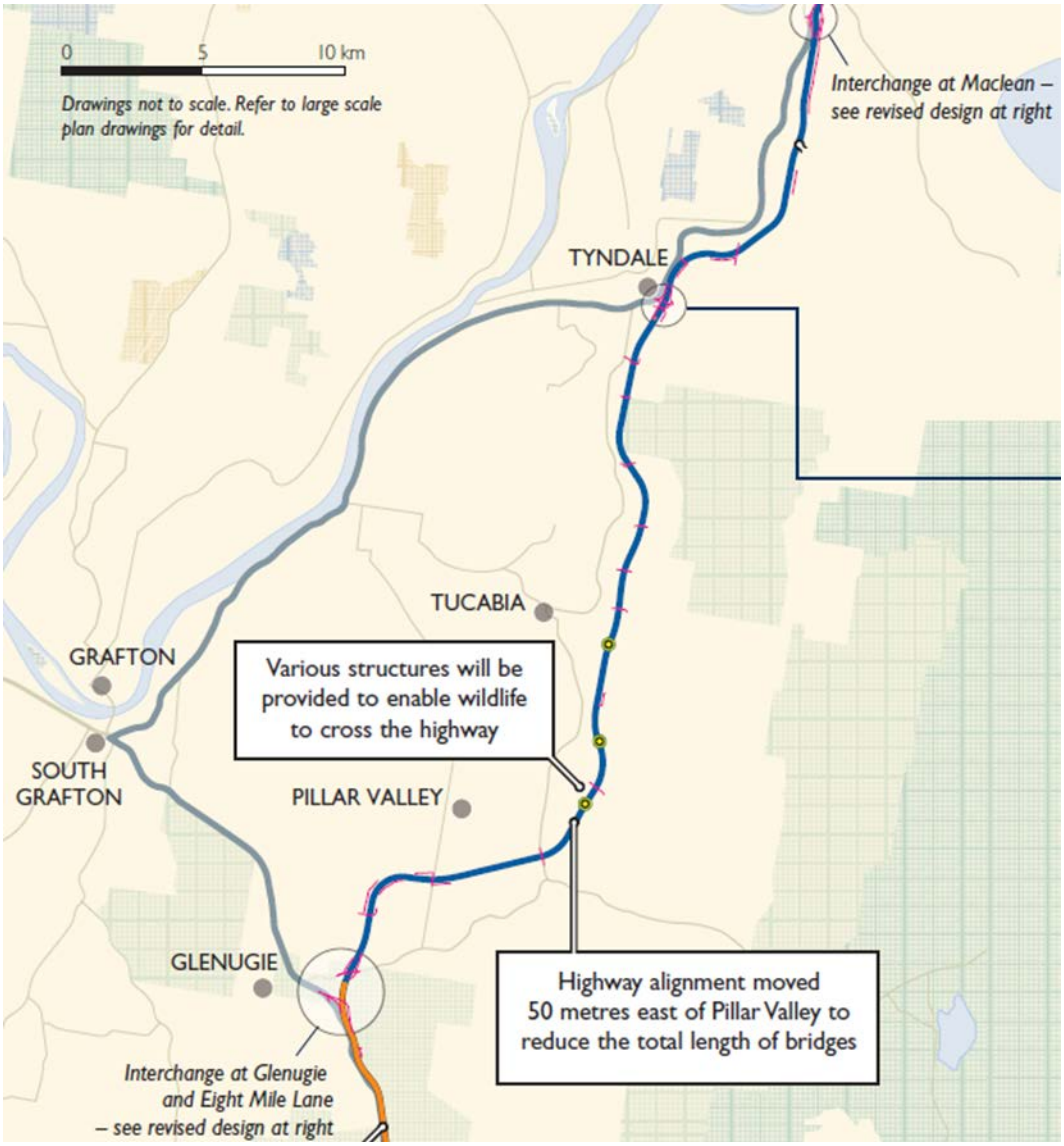


Figure 17: Pacific Highway Upgrade Woolgoolga to Ballina – Glenugie to Tyndale Section

3.2.2 Bike Plan and Pedestrian Access and Mobility Plan (PAMP)

Clarence Valley Council's *Bike Plan and Pedestrian Access and Mobility Plan* (PAMP) (CVC and QED, 2008) is a comprehensive strategic approach to identifying a cycling and pedestrian network. The plan's objectives are to:

- Increase use of the bike and pedestrian network for short trips
- Reduce the number of missing links and severance within the bike and pedestrian network
- Reduce the number of bike and pedestrian accidents
- Improve connectivity with other transport modes, particularly bus, car and train

- Provide pedestrian facilities that cater for the needs of all pedestrians including people with disabilities, commuters, children, seniors and recreational walkers
- Meet obligations under the Commonwealth Disability Discrimination Act 1996 and Disability Standards for Accessible Public Transport
- Link with Safer Routes to Schools projects
- Allow the bike and pedestrian networks to complement each other (both existing and planned networks).

The plan defines the routes within the area as:

- Primary Destination Zone. These are zones that are most frequent destinations for example the Grafton CBD.
- Secondary Destination Zone. These are zones of pedestrian / cycle activity related to an individual land use (rather than an area like primary zones). In the case of the Grafton area these mainly relate to schools but can also be parks, sports fields, local shopping precincts etc.
- General Access Route. These provide for the basic level of access from residential areas to destination zones (and vice versa) in the towns.
- Local Access Route. These are short routes providing local linking opportunities to increase pedestrian and cycling permeability.
- Regional Cycling Route. Regional cycling routes are those (generally main/arterial) roads that form longer distance routes. They are mainly intended to provide for fast and unhindered travel between the major regions of towns and urban areas.
- Recreational / Off Road Route. These are routes that take advantage of local facilities to provide recreational opportunities.

Figure 18: Pedestrian and cycle network as published in the PAMP in the vicinity of the proposed route

3.2.3 Clarenza Cycleway Options Study

The *Clarenza Cycleway Options Study (CVC and Lewis Ford & Associates Consulting Engineers, 2012)* identifies and assesses route options for the construction of a shared footpath / cycleway facility between the existing shared path at the Grafton City railway station and the McAuley Catholic College in Hennessy Drive, off the Pacific Highway at Clarenza. The need for this was identified following the finalisation of the Clarence Valley Council PAMP.

The study split the route into three sections, presenting one route from Grafton City railway station to the Pacific Highway carriageway (near Bunnings Warehouse), four route options between the Pacific Highway (including its crossing) and the South Grafton Levee Crossing, and two route options between the levee crossing and the McAuley Catholic College. These options are illustrated in Figure 19 below.

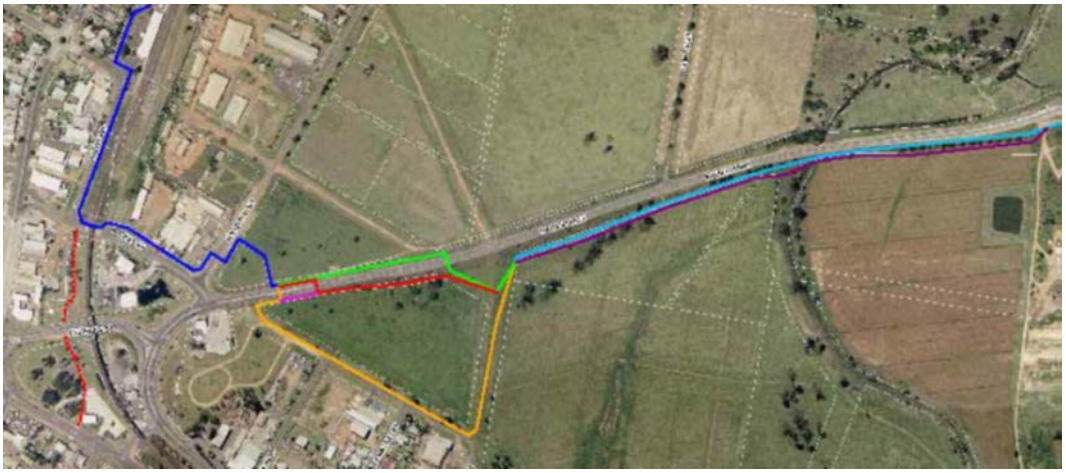


Figure 19: Options presented within the Clarenza Cycleway Options Study

At its meeting in June 2012, Council adopted an alignment for the cycleway and decided to commence discussions with Roads and Maritime on the options of a bridge, at-grade or tunnel crossing of the existing Pacific Highway. Due to funding constraints associated with a grade separated crossing, and uncertainties relating to the Grafton Bridge project, options for a crossing point on the Pacific Highway have not progressed further.

4 Assessment of impacts – operation

Assessment of the traffic impacts of the project has been predominantly undertaken through the use of three transport modelling tools, including:

- Strategic transport model – developed using Cube-TRIPS. For further information on the development of the model, refer to the *Technical Paper - Strategic Traffic Assessment* (GTA, 2012) included within the PROR.
- Micro-simulation model – developed using Paramics, primarily for the purpose of design development and analysis. For further information on development of these models, refer to the *Technical Paper - Traffic Assessment* (GTA, 2012) included within the RODR.
- Isolated intersection models – developed using Sidra Intersection, for intersections included as part of the project to determine level of service (LOS) for key intersections.

The strategic and micro-simulation models were calibrated to conditions in 2011, and have been developed for the future scenario years of 2019 (year of opening), 2029 and 2039.

The above tools have been used to assess the project against the Director-General's Requirements.

4.1 Impacts on the road network

4.1.1 Changes to travel patterns

As noted in Section 2.2.3, delays at the bridge approaches during peak periods are already changing people's travel behaviour and daily activity patterns. Traffic count data suggests that bridge users are timing their trips to avoid the peak period traffic congestion. It is anticipated that as Grafton and South Grafton develop, this effect will amplify.

The strategic model was used to assess changes in travel patterns as a result of the project. To assess the impact of the proposed additional crossing, a "do-minimum" scenario was modelled in addition to the project scenario. This consisted of existing conditions (i.e. no new bridge) with only planned upgrades (i.e. the Pacific Highway upgrade - Woolgoolga to Ballina) and forecast growth. This model scenario was developed to:

- Understand future traffic conditions without the provision of an additional crossing of the Clarence River
- Provide a base case for assessing the changes in traffic conditions and travel patterns as a result of the proposed additional crossing.

Both the project and do-minimum scenarios were modelled for each 10-year interval from 2019 to 2039. Traffic volume plots for each scenario are included in Appendix A.

The impact of the additional crossing on traffic patterns is illustrated in Figure 20 over page. This figure shows the difference in daily traffic

volumes on the road network (between the do-minimum and project scenarios) for the year of opening of 2019.

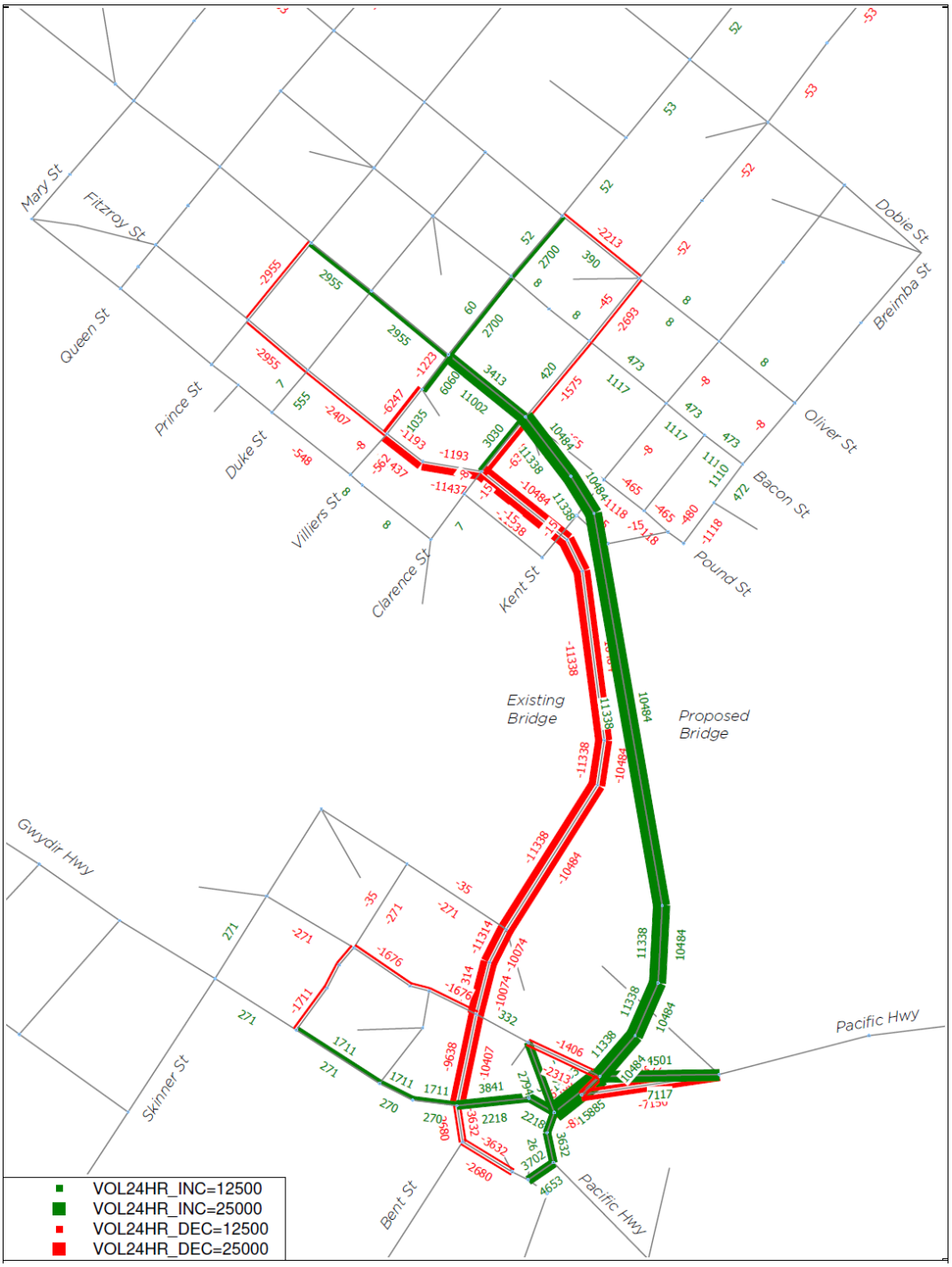


Figure 20: Changes in 2019 daily traffic flows in the vicinity of the project

The traffic volumes at each river crossing for the AM peak of each modelled year are also summarised in Table 7.

Table 7: Summary of AM peak traffic demand at bridge crossings

Year	Scenario	Existing Bridge		Additional Crossing	
		Northbound	Southbound	Northbound	Southbound
2011	Base	2,306	1,573	-	-
2019	Do-minimum	2,763	1,884	-	-
	Project	1,237	473	1,526	1,411
2029	Do-minimum	3,760	2,516	-	-
	Project	1,676	529	2,084	1,987
2039	Do-minimum	4,260	2,852	-	-
	Project	1,779	831	2,481	2,021

The information output from the strategic model indicates that the introduction of the second crossing will enable significant traffic demand between Grafton and South Grafton to be redistributed from the currently over-capacity existing bridge to the new additional crossing. About 65% of peak period traffic is anticipated to use the additional crossing in its first 20 years of operation.

The change in route choice as a result of the project is predominantly contained within the trunk road network within Grafton and South Grafton, with wider network impacts relatively minor. This is characterised by:

- Increased traffic along Pound Street in Grafton, with corresponding similar decreases along Fitzroy Street
- Increased traffic along Iolanthe Street and sections of the Gwydir Highway in South Grafton, with corresponding similar decreases along Bent Street
- Relatively minor impacts on the wider network at the Pacific Highway, Gwydir Highway (west of Skinner Street), and the Summerland Way (north of central Grafton).

The output from the strategic model also indicates the project will facilitate a reduction in rat-running through Skinner Street, Spring Street and Through Street to the north of Gwydir Highway

A discussion of how these changes in travel patterns impact on traffic performance is discussed in the following two sections.

4.1.2 Network-wide performance

A selection of key network performance indicators have been extracted from the strategic model. These have been extracted to give a broad indication of the change in traffic performance associated with the project. A description of these key indicators is given below:

- Vehicle kilometres travelled (VKT) – this represents the total distance travelled by all trips within the network

- Vehicle hours travelled (VHT) – this represents the total time travelled by all trips within the network
- Average speed (km/h) – average speed of trips made in the modelled network.

Key results of the two hour AM peak strategic model are shown in Table 8 below, which are aimed at giving a summary and comparison between the two scenarios at a broad level. Note that these outputs assume growth is unconstrained in the Do-minimum scenario (ie. in line with demographic forecasts).

Table 8: Network statistics summary (*Strategic Traffic Assessment* (GTA, 2011))

Year	Scenario	VKT (km)	VHT (hrs)	Average Speed (km/h)
2011	Base	70,832	1,751	40.5
2019	Do-minimum	86,240	3,298	26.1
	Project	86,422	1,986	43.5
2029	Do-minimum	115,888	9,167	12.6
	Project	116,140	2,688	43.2
2039	Do-minimum	136,816	14,067	9.7
	Project	136,990	3,192	42.9

The modelling of the do-minimum scenario determined that as traffic demand across the river increases, additional capacity would be required. Doing nothing would lead to unacceptable road network operating conditions due to prolonged periods of congestion on the existing bridge and significantly increased travel times. Without the additional crossing, the network is anticipated to move at an average speed of approximately 26.1 km/h by 2019, assuming traffic demands grows in line with demographic forecasts.

The information detailed above indicates that the introduction of the second crossing will have the following impacts within Grafton:

- Significantly reduced overall travel times, with network wide travel time savings of about 40% in the year of opening
- Minor impacts on travel distances required to make trips. This result is expected because the existing and proposed bridge are relatively close so there would be little change in the travel path for most trips.
- Significantly improve average travel speeds.

4.1.3 Intersection performance

Ensuring intersections perform satisfactorily helps ensure the road network is both an efficient and a safe one. The intersections within the project area that will be directly impacted by the project and a description of the proposed works at each location are provided in Table 9.

Table 9: Intersection upgrade works

Intersection	Works
Pound Street / Villiers Street	Retained as all movements, 4-leg roundabout. Widening is also proposed at the southeast Pound Street leg to accommodate increases in traffic from the new bridge.
Pound Street / Clarence Street	Upgraded to signalised intersection, with a four lane Pound Street carriageway. This upgrade is driven by the increases in traffic from the bridge, and the needs to accommodate pedestrians crossing Pound Street and / or accessing the TAFE.
Iolanthe Street / Pacific Highway / Through Street	Upgraded from three-leg priority controlled intersection to 4-leg roundabout, including realignment of the Pacific Highway. In combination with the below, the driver for this upgrade is to provide additional capacity for traffic accessing the new bridge, and to improve existing deficiencies at the highway's intersection with Spring Street.
Gwydir Highway / Pacific Highway	Upgraded to three-leg roundabout, with widening of the Gwydir Highway to four lanes. This upgrade is proposed to increase traffic capacity at this intersection which is forecast to reach capacity in the short term.
Gwydir Highway / Bent Street / Ryan Street	Retained as all movements, 4-leg roundabout.

In general, the key driver for upgrading the above intersections is to support forecast traffic demands at the new bridge. The exception to this is the upgrade of the Pacific Highway / Gwydir Highway intersection. Micro-simulation modelling of the do-minimum scenario determined that the existing give-way right turn movement from the Gwydir Highway to the Pacific Highway would be approaching capacity during peak periods in 2019. Doing nothing would lead to unacceptable traffic conditions.

To demonstrate that the upgrades proposed meet the traffic and transport objectives for the project, intersection analyses have been carried out to ensure that intersections within the project boundary operate at an acceptable level of service (LOS). The LOS performance metric is based on the average delay per vehicle at each intersection. LOS ranges from A (very good) to F (unsatisfactory). This is further described in Table 10.

Table 10: Level of service ranges

Level of Service	Average Vehicle Delay (seconds)	Traffic Signals and Roundabouts	Priority Intersections ('Stop' and 'Give Way')
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	>71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

For the purposes of this project, the minimum desirable performance for an intersection has been identified as a LOSE in 2039.

Analyses of intersections proposed as part of the project have been carried out using Sidra Intersection software package. The analyses were carried out based on the following:

- All default parameters within Sidra were adopted with the exception of basic saturation flow. This was reduced from the default value of 1950 through car units per hour to 1800. This reduction was applied to reflect the anticipated reduction in traffic capacity due to the number of closely spaced intersections within Grafton, and the traffic turbulence associated with on-street parking manoeuvres.
- Traffic volumes were extracted from the micro-simulation models. Volumes from the strategic model were not used because of the more course zone structure and traffic assignment within these models.

A summary of the analysis is shown in Table 11 below. Note the analysis also includes results for the possible initial upgrade design. A discussion on the general performance and safety impacts at the intersections is given in Table 12.

Table 11: Intersection level of service

Intersection	2039 intersection performance (LOS)				
	Overall LOS		Worst Movement LOS		
	AM peak	PM peak	AM peak	PM peak	Movement
Intersections proposed as part of the project					
Pound Street / Villiers Street	B	C	B	E	Villiers Street (N) Left Turn
Pound Street / Clarence Street	B	B	F	F	Clarence Street (N) Left Turn

Intersection	2039 intersection performance (LOS)				
	Overall LOS		Worst Movement LOS		
	AM peak	PM peak	AM peak	PM peak	Movement
Iolanthe Street / Pacific Highway / Through Street	B	B	C	C	Pacific Highway (E) Right Turn
Gwydir Highway / Pacific Highway	A	A	B	C	Pacific Highway (S) Right Turn
Gwydir Highway / Bent Street / Ryan Street	A	C	B	F	Ryan Street Approach
Possible initial upgrades					
Gwydir Highway / Pacific Highway	A	A	B	B	Pacific Highway (S) Right Turn
Iolanthe Street / Pacific Highway / Spring Street	E	E	F	F	Pacific Highway approach (AM), Iolanthe Street north approach (PM)
Iolanthe Street / Through Street / Butters Lane	A	A	B	B	Butters Lane Right Turn

Table 12: General intersection performance and safety impacts

Intersection	Upgrade Proposed	Impact
Intersections proposed as part of the project		
Pound Street / Villiers Street	This intersection would be widened to a four-leg roundabout at the south-east Pound Street leg to accommodate increases in traffic from the proposed bridge.	The form of this intersection is not proposed to change significantly. The increased traffic along Pound Street attracted by the new bridge is anticipated to be accommodated by the proposed adjustments at the south-eastern leg, as such impacts on performance and safety are anticipated to be minor.
Pound Street / Clarence Street	Traffic lights would be installed, and Pound Street widened to four lanes to accommodate increased traffic from the bridge and safely accommodate pedestrians crossing Pound Street and/or accessing the TAFE.	The role of this intersection will change significantly from the existing situation whereby its main function is facilitating a rat-run to the existing bridge. The analysis indicates the proposed intersection will perform at an acceptable level of service, whilst safety of the intersection will be upheld through the provision of traffic signals.
Iolanthe Street / Pacific Highway / Through Street	This intersection would be upgraded to a four-leg roundabout, and Pacific Highway realigned to provide additional capacity for traffic accessing the proposed bridge, and to improve traffic flow at the highway's intersection with Spring Street.	The role of this intersection will change significantly from the existing situation whereby its main function is facilitating the small volume of traffic accessing local business and residences. Although traffic volumes are anticipated to increase, the analysis indicates the proposed intersection will perform at an acceptable level of service, whilst safety of the intersection should be upheld through the provision of a large roundabout with sufficiently spaced conflict zones.

Intersection	Upgrade Proposed	Impact
Gwydir Highway / Pacific Highway	This intersection would be upgraded to a three-leg roundabout, and Gwydir Highway widened to four lanes to increase traffic capacity of the intersection.	Preliminary analysis of the existing intersection has demonstrated that without an upgrade, the right turn movement from the Gwydir Highway would perform at a level of serice F by year of opening. At priority controlled intersections, this can lead to increased chances of agressive / forceful driver behaviour. Provision of the roundabout upgrade will help ensure adequate intersection performance (LOS A in 2039) and safe operation.
Gwydir Highway / Bent Street / Ryan Street	Retained as all movements, four-leg roundabout	The form of this intersection is not proposed to change significantly. The intersection analysis indicates that the intersection will perform with an acceptable level of service in 2039. In light of the above, safety implications at this location are anticipated to be minor.
Possible initial upgrades		
Gwydir Highway / Pacific Highway	As described above.	As described above.
Iolanthe Street / Pacific Highway / Spring Street	The Pacific Highway would remain on its current alignment and connect with Iolanthe Street at a new roundabout at the Iolanthe Street/Spring Street intersection. A pedestrian crossing with traffic lights would be provided on the Pacific Highway about 100 m east of the Iolanthe Street intersection.	In the existing situation, this intersection configuration includes two closely-spaced priority controlled intersections, with recorded crashes in the last five years. It is anticipated that the proposed roundabout will improve the road geometry and hence safety and traffic operations in the area.
Iolanthe Street / Through Street / Butters Lane	This intersection would be upgraded by realigning Butters Lane, which would become the fourth leg of the roundabout, instead of the Pacific Highway.	As per the Iolanthe Street / Pacific Highway / Through Street upgrade discussed above, however performance of the intersection is anticipated to be even higher in light of the eastern approach servicing residents of Butters Lane only (instead of the realigned Pacific Highway).

Based on the information provided in the tables above, the analysis indicates that the intersections proposed as part of the project would perform within acceptable limits of operation in 2039 peak periods. All movements at these intersections (including those operating at a LOS F) are anticipated to operate within capacity. By extension it is also considered that the above results indicate the performance of the intersections will help ensure an efficient and safe operation of the road network through to 2039.

Possible initial upgrades

If the project is staged as per the possible initial upgrades described in Section 1.3.1, the 2039 analysis indicates that the Pacific Highway / Iolanthe Street / Spring Street roundabout would:

- Operate at a level of service E
- Generate potentially significant queues at the Pacific Highway approach in the morning peak periods, and along the northern Iolanthe Street approach in the evening peak periods
- Incur significant delays to those accessing South Grafton during peak periods
- Have minimal spare capacity to accommodate additional local development.

In order to mitigate these issues, the remainder of the project elements in South Grafton would need to be constructed.

4.1.4 Impacts on the regional road network

As illustrated in Figure 20, the impact of the project on the wider road network in terms of traffic movements (i.e. external to central Grafton and South Grafton) is anticipated to be minimal. The State roads of the Gwydir Highway and Summerland Way, and regional roads of Lawrence Road and Armidale Road (described in section 2.1), would continue to function as per their existing role, connecting communities to the west, north and south.

The existing Pacific Highway would serve a lesser role than currently due to the impact of the Pacific Highway upgrade: Woolgoolga to Ballina, particularly the section from Tyndale to Glenugie. The realigned highway will resume the role as the main north-south route connecting regional centres along the coastline. The existing highway corridor would be downgraded, serving as a connector between the upgraded highway and Grafton, as well as communities along the Gwydir Highway and Summerland Way. This impact is not considered an impact of the project, but because of the Pacific Highway upgrade.

4.2 Impacts to freight and heavy vehicle operations

The project is anticipated to provide travel time savings for both heavy and light vehicles and improve freight operations.

The additional bridge crossing and associated road upgrades have been designed considering heavy vehicle requirements. The changes to heavy vehicle operations proposed as part of the project include:

- Banning of articulated and 25/26 metre long B-Double trucks from the existing bridge
- The provision of new infrastructure to cater for heavy vehicles. Roads that form part of the 25/26 metre long B-Double truck route have been

designed to accommodate the turning movements of such vehicles, while other main roads have been designed to accommodate 19 metre general access vehicles. Minor / restricted roads have been designed to accommodate a 12.5 metre rigid truck.

A plot illustrating the change in heavy vehicle traffic flows in the year of opening as a result of the additional crossing and proposed ban at the existing crossing is illustrated in Figure 21. It is anticipated that the impacts of the above changes would be:

- Increased service life of the existing bridge through reducing freight vehicle loadings
- Freight operators would no longer be time-restricted in crossing the river
- Improved traffic flow at the 'kinks' in the existing bridge. At these locations smaller vehicles are often currently required to stop to allow larger articulated vehicles to negotiate the kinks. It is considered that the banning of articulated vehicles at the existing crossing would improve the efficiency of these conflict areas, also creating a safer environment for other users of the bridge.
- Large vehicle operators would need to adjust their routes through Grafton:
    - Those travelling through Grafton along Summerland Way would be diverted along Pound Street, the new crossing and Iolanthe Street
    - Operators accessing local business in Grafton and South Grafton (eg Bunnings Warehouse and other local industry) may also need to reroute.
- In light of the above, heavy vehicle volumes along the existing Summerland Way alignment (Fitzroy Street to Bent Street) are anticipated to decrease. This will occur in tandem with comparable increases along the new alignment including at Pound Street (as far as Villiers Street) and Ioalanthe Street. Heavy vehicles using the new route would do so with the travel time savings and efficient intersection performance demonstrated in section 4.1.

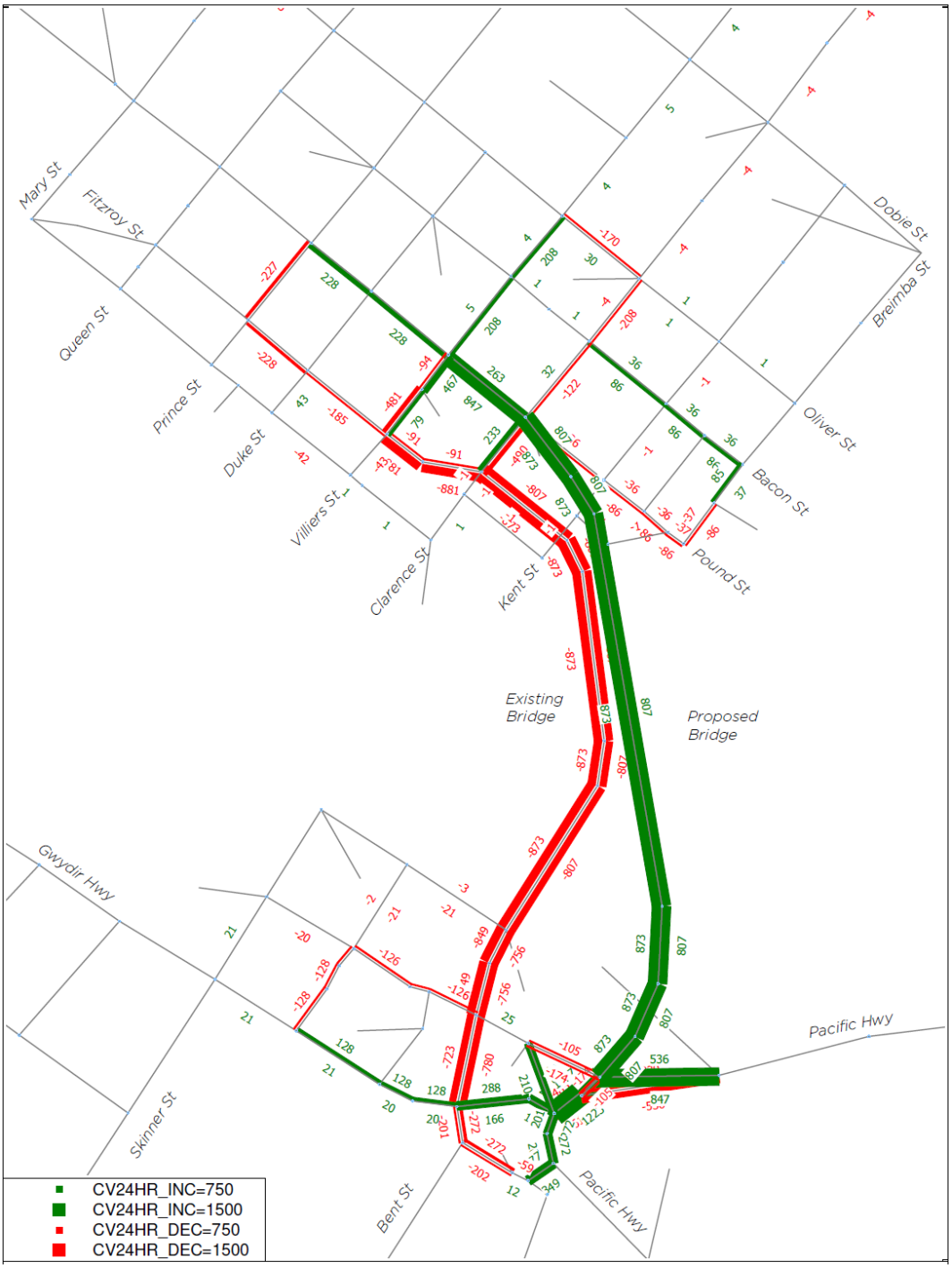


Figure 21: Changes in 2019 daily heavy vehicle flows in the vicinity of the project

4.3 Impacts to rail services

There will be no obstruction to the functioning of the North Coast Line services operating out of the Grafton City railway station (in South Grafton) during the operation of the project.

4.4 Impacts to bus services

During the design development process, consultation was carried out with bus service operators to gather information on how the project may affect bus operations in Grafton. The key outcomes of this process were that bus operators:

- Would prefer to continue to use the existing bridge following completion of the project
- Have concerns that the existing bridge would still experience congestion at the northbound approach to the existing bridge during morning peak periods, and a northbound bus lane may need to be provided to allow improved bus priority at this approach
- Have the opinion that further restriction of larger vehicles may be required in order to minimise the periods when long vehicles may impede the opposing flow of vehicles at the 'kinks' in the existing bridge alignment.

In response to the above points, the project allows existing bus routes on the existing bridge to be retained, while effectively removing a large proportion of cross-river traffic from the existing bridge and approaches. The traffic modelling shows the existing bridge would experience free-flow conditions in the AM and PM peaks through to 2039, with traffic volumes on the existing bridge still lower than they are currently. By removing a large proportion of traffic from the existing bridge, bus routes using the existing bridge would benefit from less congestion, improved and more consistent travel times providing greater reliability.

In regard to the preclusion of additional vehicle classes at the existing bridge, the traffic modelling suggests that a new bridge combined with a ban on 25/26 metre long B-Double trucks and semi-trailers using the existing bridge would be sufficient to free up movement on the existing bridge as noted above. Even so, the implementation of additional heavy vehicle bans in the future would not be precluded. Rigid trucks and buses (Austroads Classes 3, 4 and 5) are not affected by the existing heavy vehicle restrictions and currently represent only about five per cent of traffic using the existing bridge in peak hours. Their usage of the existing bridge following opening of the additional crossing should be monitored to identify any adverse impacts on capacity, bus operations and safety.

It is considered that the proposed bridge and approach roads would be capable of accommodating bus operations, should service providers choose to use the new crossing in the future for either new or existing services. Opportunities to provide bus stops along the approach roads exist at either end of the bridge. Given that frequencies of bus services in Grafton are quite low, it is anticipated that they would have minimal impact on traffic operations.

4.5 Pedestrian and cycle access

An assessment of the pedestrian and cycle facilities proposed as part of the project has been carried out. The assessment focussed on the level to which the proposed facilities provide connection at both a local and wider

network level, and how the design facilitates safety for pedestrians and cyclists. The primary reference documents for the purposes of the assessment are:

- Clarence Valley Council's PAMP (2008)
- Clarence Valley Council's Clarenza Cycleway Options Study (2012)

These documents are discussed in Sections 2.6.2 and 2.6.3 respectively.

4.5.1 Key routes and destinations

The main purpose of the proposed pedestrian and cycle links are to improve connectivity for the key strategic movements identified in Council's pedestrian and cycle planning. Following a review of the existing conditions and relevant documentation, the following were identified as primary destinations / routes requiring sound connectivity as part of the project:

- Strategic connections:
  - Gwydir Highway – allowing access to areas in the west such as Waterview Heights
  - Pacific Highway to the south – allowing access to South Grafton and Clarenza
  - Pacific Highway to the north – allowing access to the north including the McAuley Catholic College and Clarenza.
- Localised access:
  - Grafton commercial precinct (centred around Pound Street, Fitzroy Street and Prince Street)
  - North Coast TAFE Campus
  - Iolanthe Street commercial precinct (centred along Iolanthe Street between Through Street and Spring Street).

4.5.2 Integration with existing and proposed pedestrian and cycle paths

The pedestrian and cycle facilities proposed as part of the project are illustrated in Figure 22 below.

Figure 22: Proposed cyclist / pedestrian facilities

Bridge crossings

The facilities proposed at the river crossings include:

- The retained (narrow) shared paths at the existing bridge
- A new 2.5m wide shared path at the new bridge crossing

All associated connections at the approaches to the existing bridge will also be retained. The associated connections to the new bridge path are discussed in the following.

South Grafton

The proposed pedestrian and cyclist facilities in South Grafton include a combination of pedestrian and cycle paths and signalised pedestrian crossings at key locations to provide for both local and wider network connections. The proposed pedestrian and cyclist facilities for the project in South Grafton consist of:

- A pedestrian and cycle path from the new bridge crossing, along the western side of Iolanthe Street and connecting to the Gwydir Highway at the southwest corner of the project boundary. This path will provide a link between Grafton, the growing commercial precinct along Iolanthe Street and wider areas surrounding South Grafton.
- A signalised pedestrian crossing on Iolanthe Street midway between Spring Street and Through Street. This will provide a safe crossing of Iolanthe Street, and also providing safe pedestrian access between businesses on either side of Iolanthe Street.
- A new pedestrian and cycle path along an existing right of way located at the southern boundary of the Bunnings Warehouse site. This will provide access between the Pacific Highway and Iolanthe Street. This proposal is consistent with Council's planning (refer *Clarenza Cycleway Options Study*) and the Bunnings development conditions, which use this right of way to provide a connection between the Pacific Highway and Crips Avenue, via Spring Street.
- A staged mid-block crossing of the Gwydir Highway. This crossing will facilitate access between the newly proposed shared path along Iolanthe Street and both the Gwydir Highway and areas to the south (via the existing path through Silver Jubilee Park). It will also facilitate access to the existing path through Derek Palmer Place and the bus interchange at the Clarence River Visitor Information Centre to the north.

Grafton

Within Grafton the proposed pedestrian and cyclist facilities include:

- A pedestrian and cycle path on the western side of Pound Street between Villiers Street and the new bridge
- Signalised pedestrian crossings at all legs of the Pound Street / Clarence Street intersection.

The pedestrian and cycle path will provide connectivity between the commercial centre of Grafton, the TAFE and destinations south of the crossing, with limited conflict with traffic. The signalised intersection of Pound Street / Clarence Street will allow safe access between these attractors and the residential areas to the north of Pound Street. They will also provide safe and direct connection between the TAFE and the proposed car park on the opposite north-east corner of the intersection.

The proposed alignment of the northern bridge approach will require adjustment to the existing bicycle route between the bridge shared path and the on-road route along Kent Street. When the project is in operation, cyclists will have the choice of:

- Continuing to access the existing route along Kent Street (from either bridge) by rerouting via Greaves Street and Pound Street.
- Traveling on-road along Clarence Street in place of Kent Street. This route would use the safe crossing of Pound Street via the newly provided traffic signals at the Clarence Street / Pound Street intersection.

The impact of the above is considered minor, in the overall context of the viable route options available to cyclists.

Overall, it is considered that the facilities proposed as part of the project:

- Provide good connectivity to the primary destinations identified in Council's PAMP
- Provide facilities that are consistent with the key strategic movements identified in Council's pedestrian and cycle planning
- Are in line with Council's current planning.

4.5.3 Design and safety

One of the project objectives is to *enhance road safety for all road users over the length of the project*. It is considered a supporting objective of this project to provide safe facilities for pedestrians and cyclists. It was agreed through development of the concept design that facilities would be designed taking into consideration:

- Shared path widths and grades, particularly at the bridge
- Treatment types at mid-block and intersection crossings

Pedestrian and cycle path design

A review of additional relevant guidelines was carried out to inform the design and included a review of:

- *NSW Bicycle Guidelines* (RTA, 2005)
- *Guide to Road Design Part 6A: Pedestrian and Cyclist Paths* (Austroads, 2009)
- *AS 1428.1- 2009: Design for Access and Mobility – General Requirements for Access – New Building Work*.

The outcome of this review was that the pedestrian and cycle paths would be designed to a minimum width of 2.5 metres. This is consistent with the absolute minimum width required for a commuter class facility in accordance with the Austroads guidelines and within the desirable path width range stipulated within the CVC PAMP. This also provides more than the 1.8 metres required to allow two wheelchairs to pass (AS 1428.1). In regards to the width of the path at the bridge, an additional 300 millimetre clearance has been provided to each of the rub rails provided along the bridge section, providing a total width of 3.1m.

The review of the guidelines also yielded that paths should be designed to a maximum desirable downhill grade of 5% and uphill grade of 3 %. Path grades within the project are critical at the proposed bridge and its approaches. At the southern approach, grades have been limited to between 1.5% and 2% which meets the guidelines. However, it is anticipated that the grades at the northern approach would range between 3.7% and 4.2%.

Crossing treatments

An assessment of the mid-block crossings proposed as part of the project works was carried out. The assessment took into account the anticipated difficulty of crossing the relevant roads and the requirements of the pedestrian user types expected to use the facility. The proposed mid-block crossings include those at:

- Iolanthe Street
- Gwydir Highway.

Sensitivity testing was carried out using the *Pedestrian Crossing Prioritisation Workbook* developed by the Queensland Department of Transport and Main Roads as part of the *Traffic Road Use Management Manual* (TRUM). This tool assesses crossing points in terms of traffic flows, pedestrian flows and other environmental factors, while allocating points for other factors relevant to desirability of providing a crossing facility.

The analysis was carried out using 2039 peak period traffic flows at each location. The outcomes of the analysis are provided below:

- Each crossing location would operate at a level of service F for pedestrians if the crossings were not staged
- The Iolanthe Street and Gwydir Highway crossings would operate at a level of service F for pedestrians if also not signalised.

Based on this signalised crossings are proposed at the Iolanthe Street and Gwydir Highway to ensure the safety of pedestrians. The crossings have been designed as staged crossings. This has been proposed to reduce crossing times of pedestrians, and minimise queues and delays to through traffic.

As part of the potential initial upgrades (in which the Pacific Highway realignment is not constructed), a signalised staged crossing is also proposed at the Pacific Highway. The crossing would be signalised because of the heightened sensitivity to school students (accessing

McCauley's Catholic College) anticipated to use the crossing, and the volume of daily traffic on the highway.

4.6 Road safety

Current crash location hotspots include areas along the Pacific Highway (near its intersections with Spring Street and Gwydir Highway) and along the Summerland Way, particularly at the kinks in the bridge alignment and at heavily trafficked intersections at each end of the crossing (refer to Section 2.7 for recent crash history).

Safety of the roadways and intersections has been considered throughout the development of the concept design. It is anticipated that the project would deliver safety benefits through the following mechanisms:

- Removal of larger articulated vehicles from the existing bridge, forcing these vehicles to use the new crossing. This would improve the operational safety at the kinks in the existing bridge alignment.
- Reduction in the number of crashes along the existing Summerland Way route. This would be enabled through reduced exposure (traffic volumes), congestion and speed differentials along the existing bridge, reducing the anticipated frequency of bumper-to-bumper incidents and aggressive driving behaviour.
- Reduction in the number of crashes at Pacific Highway's intersections with the Gwydir Highway and Spring Street through upgrading the existing set of closely spaced intersections
- Provision of median-separation of the Iolanthe Street and Pound Street carriageways. This has been incorporated into the design as a safety feature limiting the amount of priority-controlled right turn movements across heavily trafficked roads.
- Improved intersection and roadway design that allows for the safe movement of appropriate design vehicles, provides sufficient traffic capacity and appropriately manages conflicts between vehicles and pedestrians.

In order to ensure that safety measures continue to be incorporated into the project throughout detailed design, it is further recommended that road safety audits should be carried out during the detailed design stage, with any issues raised appropriately addressed.

4.7 Impacts to adjoining land uses

A majority of the roadway works associated with the project are bounded by a mix of industrial, commercial, and retail land uses. The exception to this is some residential land at the northern bridge approach in Grafton. The design has been progressed in consultation with impacted businesses, taking into account their need for access and parking. A summary of the impacts is provided in Table 13.

Table 13: Impacts to adjoining land uses

Item	Impact considerations
South Grafton	
Development proposed at northwest corner of the existing Spring Street / Iolanthe Street intersection	Access locations proposed as part of the approved development application for the site have been incorporated into the design. Additionally, turn movement restrictions put in place once the additional crossing is open to traffic have been incorporated into the development application design plans.
Petrol station on the Pacific Highway, opposite the Iolanthe Street / Pacific Highway intersection	Property currently has two closely spaced driveway crossovers with an internal one-way traffic flow arrangement. Because of the realignment of the highway at this location and the proximity of the proposed Pacific Highway / Iolanthe Street intersection, one of the driveway crossovers will be removed. It is not anticipated that this will cause significant issues for traffic movement within the site. Appropriate further investigations will be carried out during detailed design, including consultation with the property owner.
Parking in South Grafton	No on-street parking will be permitted on carriageways constructed as part of the project. This is in order to maintain the hierarchal function that these roads must provide in terms of traffic movement. There is no formal parking in these areas currently. Existing and proposed developments along this frontage will need to provide an adequate level of parking provision within their site
Median separation of Iolanthe Street carriageway	This limits movements at local driveway crossovers to left-in and left-out movements. This has been incorporated into the design as a safety feature limiting the amount of traffic turning right across heavily trafficked roads. It is considered that the roundabouts proposed along the Iolanthe Street corridor will allow a majority of connectivity to the affected sites to be retained. For some properties, this may mean a minor increase in travel distances when accessing these sites compared to the existing situation.
Grafton	
Property access around the northern bridge approach	All properties that are not proposed to be acquired for the project will retain access
Parking within project boundary along Pound Street and Clarence Street	Angled parking currently in place along the northern side of Pound Street (between Villiers Street and Clarence Street) and outside the TAFE at Clarence Street will be formalised and maintained. Current informal parking along the southern side of Pound Street will be replaced with formal parallel parking. Informal parking along Clarence Street will be replaced with new median parking bays adjacent the TAFE. A new parking area will also be constructed at the north-eastern corner of the Clarence Street / Pound Street intersection. The net result of the above works is a reduction of two parking spots in the area, which is considered minor.

Item	Impact considerations
Localised median separation of Pound Street carriageway	This limits movements at local driveway crossovers to left-in and left-out movements. This has been incorporated into the design as a safety feature limiting the amount of traffic turning right across higher order roads. It is considered that the existing roundabout at the Villiers Street / Pound Street intersection will allow a majority of connectivity to the affected sites to be retained. For some properties, this may mean a minor increase in travel distances when accessing these sites compared to the existing situation.

4.8 Impacts to emergency services

During design development, feedback was sought through consultation from the following authorities:

- Ambulance Service of NSW
- Fire and Rescue NSW (previously known as New South Wales Fire Brigades)
- NSW State Emergency Service.

Ambulance Service of NSW

Discussions with the Ambulance Service of NSW indicated that congestion on the existing bridge was rarely a critical problem, and they did not indicate either a preference for location, or matters to be incorporated into the design.

Fire and Rescue NSW

Following discussions, Fire and Rescue NSW acknowledged that the project would provide an ideal distribution of traffic between the existing and new bridges, providing potential benefits on emergency response times. It was also highlighted that the project would provide improved access to:

- South Grafton and the Pacific Highway, from the primary station in Grafton
- The township of Grafton, from the South Grafton Fire Station.

NSW State Emergency Service

Roads and Maritime met with representatives from the NSW State Emergency Service. Discussions were centred on evacuation routes for Grafton in flood events, the timing at which various roads became inaccessible under different flood scenarios, and the anticipated impact the project would have during such events. The key outcomes of the discussions were as follows:

- The project objectives include no worsening with regards to evacuation routes, with the bridge proposed at a level above a 1 in 100 flood event, and the bridge approach roads at a level to withstand a 1 in 20 year flood event.

- In terms of the immediately surrounding local roads in Grafton and South Grafton, it was determined that existing low points in the network will remain the same. However, the Iolanthe Street area is likely to provide a little extra time in a 1 in 100 flood event for evacuation routes as the flood waters come from the west along the Gwydir Highway.
- The addition of a new crossing would make it easier for evacuating the town, given there would be an additional bridge in place with a better design for moving vehicles and people out of town.
- It was noted during the January floods in 2013 there was a vehicle breakdown on the existing bridge which made it difficult for vehicles evacuating the town to cross the river. The availability of a second crossing will help ensure adequate traffic capacity is provided across the river in the event of an incident on one of the bridges.

General

The project would maintain current evacuation routes as presented in Section 2.8 but would improve the overall efficiency of evacuation. The efficiency of flood evacuation within Grafton is largely constrained by traffic movement across the existing bridge. The proposed bridge would increase traffic capacity across the Clarence River which would benefit flood evacuation in Grafton.

Overall it is considered that the project would enable enhanced access and efficiency of emergency services. Ongoing consultation with emergency service providers during detailed design should be carried out to ensure that potential impacts of the project on emergency service operations are avoided.

4.9 Width of the bridge crossing

An assessment of the proposed width on the bridge has been carried out based on the forecast need to accommodate traffic, pedestrians, cyclists and public transport services.

The proposed bridge will be a two-lane two-way bridge with a shared path on the upstream side as shown in Figure 23.

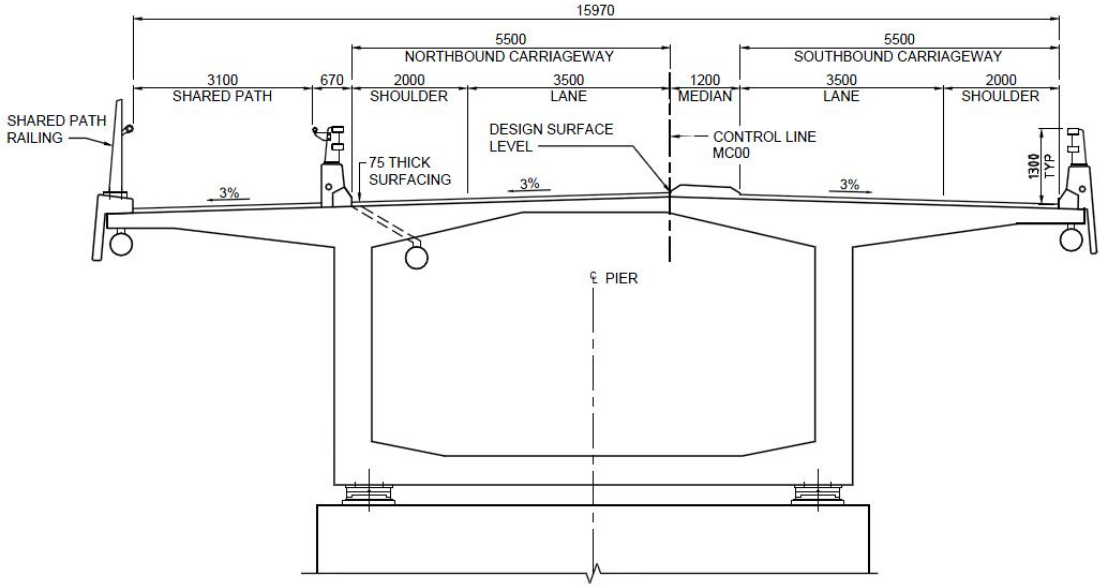


Figure 23: Typical cross section of the proposed bridge

From a traffic capacity perspective, the transport modelling carried out indicates that the provision of single lane in each direction would be sufficient to accommodate free flow conditions through to 2039. Beyond 2039 it is anticipated that as the traffic capacity of the proposed bridge reaches capacity, drivers will reroute to utilise the spare capacity at the existing bridge.

In terms of the dimensions of the bridge cross-section, the bridge geometry has been designed taking into account the following minimum requirements:

- Traffic lanes – 3.5m
- Hard shoulder – 2m
- Raised medium – 1.2m
- Shared path – 3.1m (2.5m effective path width plus 0.3m lateral clearance to railings each side).

Widths specific to the main carriageway are stipulated in accordance with Roads and Maritime Supplement to *Austroads Guide to Road Design Part 3: Geometric Design*. The proposed cross section is consistent with the required provision of minimum 5.5m trafficable width between kerbs / barriers to allow for the passing of broken down vehicles should a breakdown occur.

In terms of public transport provisions, rail services are anticipated to continue to operate along the existing North Coast Line and as such are not a driver in determining an appropriate bridge width for the new crossing. As identified in Section 4.4, bus services are not currently proposed to operate along the bridge however would not be precluded from doing so in the future. The lane widths proposed will be sufficient to accommodate the movement of large vehicles, including buses.

In terms of accommodating the needs of pedestrians and cyclists along the bridge, a shared pathway of 3.1m clear width is proposed. As

discussed in Section 4.5.3, a review of the relevant guidelines was undertaken. The outcome of the review was that shared paths would be designed to a minimum width of 2.5 metres. Austroads also recommends providing clearances for bicycles to potential hazards beside a path. For fences and other obstacles that have smooth features and are aligned parallel to the path, the absolute minimum clearance is 0.3m each side. Hence, the shared path width of 3.1m (2.5m effective path width plus 0.3m lateral clearance each side) is proposed on the new bridge.

It is anticipated that pedestrian and cyclist volumes on the new shared path would be low due to the provision of a parallel route in the existing bridge path. The 3.1m clear width between barriers for the shared path on the bridge is considered appropriate, and consistent with the widths adopted on other similar long bridges.

5 Assessment of impacts – construction

5.1 Construction overview

This section describes how the proposed project would be built. It includes a description of possible staging, sequencing and activities associated with construction of the project.

Delivery

If the proposed project proceeds, Roads and Maritime would consider the options for project delivery and select the most suitable method. The preferred method would be selected and implemented in compliance with the environmental impact statement (EIS) and the conditions of approval for the proposed project.

Project staging

Project staging refers to the order in which parts of the proposed project are constructed and opened to traffic, regardless of the delivery method proposed.

While the overall project would be built as described in this section, staging of the proposed project may be considered. Possible staging of the proposed project is focussed around the connection of the proposed bridge to South Grafton. The possible initial upgrades and the proposed project are described in Section 1.3.

Construction staging may affect the timeframe for completion of the proposed project. Other construction staging scenarios may be considered by Roads and Maritime. Any construction staging arrangements would be made on consideration of:

- The need for the additional works
- The availability of construction funding
- The sequence in which completed sections could be opened to traffic
- Traffic performance of the possible stages.

There is also the possibility the proposed project would be constructed as a single project.

Construction timing

Construction of the proposed project is anticipated to start in mid-2015 (funding permitted) and take about three years. The NSW Government has nominated the end of 2019 as the desired completion date for the purpose of the EIS. The actual timing of construction, opening to traffic and completion would depend on the availability of construction funding.

The construction program in Figure 24 is indicative only and may change based on further work during detailed design. The timing and duration of construction activities may also be influenced by:

- Wet weather periods

- Changes to construction methods and/or materials
- The uncovering of unexpected items (such as heritage items).

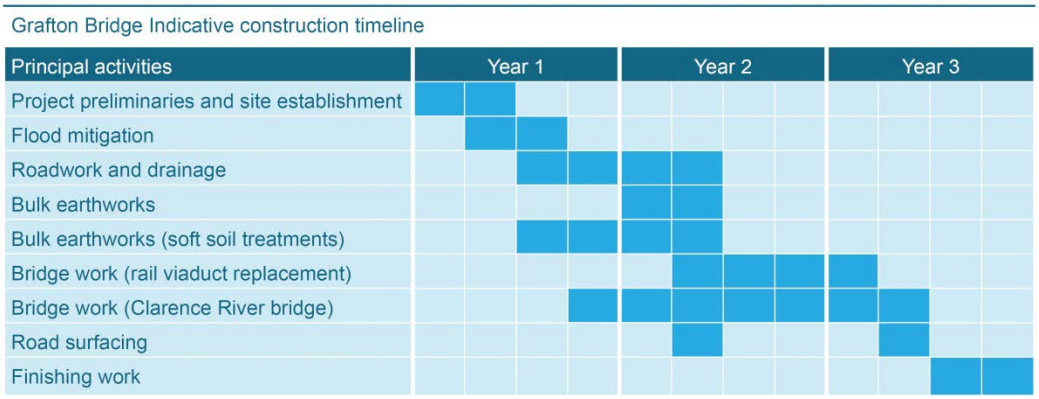


Figure 24: Grafton Bridge project indicative construction timeline

Construction works

The project would be built using conventional methods used on most highway projects. These methods may be modified to address site-specific environmental or engineering constraints. The typical construction sequence and activities shown in Table 14 are based on standard construction practices and are informed by the concept design for the proposed project.

The activities listed in Table 14 provide sufficient detail to allow an assessment of the likely nature and extent of traffic impacts during construction. It is not a full list of all tasks and obligations, and it is possible that activities would not occur in the precise order listed.

The construction contractor would refine construction methods during detailed design in view of the site constraints and in accordance with any conditions of approval.

Table 14: Typical construction activities and plant

Component	Typical activities	Typical plant and equipment
Preliminary activities and site establishment	Property acquisition and adjustments, including property access changes Detailed geotechnical investigations and survey Dilapidation surveys General site clearance, site establishment work, fencing and signage Establishment of temporary construction facilities and compound sites including the site office Temporary traffic management arrangements Progressive installation of environmental controls including temporary or permanent fencing, and erosion and sediment control measures Construction of temporary drainage controls Clearing and removal of vegetation Diversion of utilities	Trucks Generators Light vehicles Excavators Chainsaws Mulchers Water carts Cranes Drilling rigs
Flood mitigation works	Clearing of vegetation (where required) Stripping of topsoil Placement and compaction of earthwork Reinstatement of topsoil and planting / grass seeding to establish vegetation Upgrade of flood mitigation structures Adjustments to minor structures within built areas Adjustment of control gates and regulatory devices	Excavators Dump trucks Compactors Graders Loaders Water carts Profilers Bulldozers Vibratory rollers

Component	Typical activities	Typical plant and equipment
Roadwork and road surfacing	Stripping of topsoil, removal of trees and other vegetation Construction of temporary local traffic management diversions Placement and compaction of earthwork Road widening, including construction of box cuts and road surfaces Staged construction on local roads Installation of traffic signals, roadside furniture and lighting Installation of road markings Construction of any retaining walls and subsurface drainage Construction of road surface Construction of pedestrian and cycle path Progressive landscaping and tree planting	Chainsaw Graders Backhoes Trucks Water carts Vibratory compactors Bitumen sprayers Vibratory rollers Rubber tyred rollers
Drainage	Construction of drainage, including kerb and gutter (where required) Major drainage work – eg cross-drainage structures and Pound Street drainage, including the pump station Installation of cross-drainage, including culverts and inlet and outlet work, such as channel diversions and scour protection Installation of longitudinal and vertical drainage in cuttings and embankments Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required)	Trucks Bulldozers Excavators Concrete pumps Concrete trucks
Bulk earthwork	Stripping topsoil and stockpiling it for reuse in landscaping Materials haulage Soft soils treatment Construction of embankments Stockpiling	Trucks Bulldozers Excavators

Component	Typical activities	Typical plant and equipment
Bridge work	Establishment of batching plant Preparation of bridge work areas including temporary piling pads, access platforms Installation of bridge foundations (driven or bored piles, pile caps and footings) Construction of new bridge superstructure and piers Replacement of ARTC rail viaduct at Pound Street Construction of bridge superstructure including deck and pavement work (cast in-situ or pre-cast bridge elements) Construction of noise barrier	Batching plant Piling rigs Concrete pumps Concrete trucks Cranes Barge(s) Excavators Trucks Small equipment
Finishing work	Remove temporary work Restoration and landscaping of temporary sites General site clean-up Restoration of topsoil and revegetation of batters Removal of temporary environmental controls Site clean-up and demobilisation, including restoration of ancillary sites and construction access roads (where required)	Trucks Generators Light vehicles Cranes

5.2 Construction traffic movements

A small temporary increase in traffic volumes is expected during the construction period as a result of commuting workers and management staff to site, deliveries of equipment and the haulage of materials to and from the work sites.

5.2.1 Workforce

The size and composition of the construction workforce would vary throughout the construction period depending on the activities being carried out and possible staging of the project. Workforce numbers throughout the construction period have been estimated based on the indicative programme that has been developed for the purpose of this environmental impact statement. An estimated peak workforce of about 70 to 90 people is anticipated. The average size of the construction workforce on site would be about 55 people including management staff, contractors and subcontractors. It is anticipated that the work force would generate about 60 trips (30 in, 30 out) on an average working day. This takes into account carpooling behaviours typically observed among workers on similar projects.

The standard hours for construction work are the standard hours recommended by the *Interim Construction Noise Guidelines* (DECC, 2009):

- Weekdays: 7am to 6pm
- Saturdays: 8am to 1pm
- Sundays and public holidays: no work.

Based on the above, it is considered that the work-based trips generated by the workforce would occur before 7am in the morning and after 6pm in the evening. Current observations indicate that the peak traffic periods, during which congestion is experienced at the existing bridge crossing, are between 7am and 8am in the morning and 3pm to 4pm in the afternoon. As such, it is considered that traffic generated by the workforce for trips to and from site, would not coincide with general peak period traffic and hence have minimal impact on peak period traffic operations.

5.2.2 Deliveries

In addition to trips generated by workforce and materials haulage, trips would also be generated by deliveries to site. Deliveries to site are expected to involve around 20 trips per day.

Deliveries, where, feasible, should be timed so as to occur outside of peak traffic periods, in order to minimise the impact on road network operations.

5.2.3 Materials haulage

The typical materials that would be used for the construction of the project include:

- Earthworks materials, such as topsoil, general fill material, and select fill
- Aggregates for drainage construction, concrete and asphalt production and spray seals
- Sand for drainage construction and concrete and asphalt production
- Cement and fly ash for concrete production
- Concrete for drainage construction, pavement construction, bridgeworks and miscellaneous work such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Road base for constructing flexible pavements
- Bitumen for spray seals and asphalt production
- Precast concrete elements for drainage construction (culverts, pits and headwalls), bridge construction (bridge piles, girders and parapets) and miscellaneous work
- Steel for bridge girders, barrier railings and reinforcement in concrete.

Estimates of total requirements for each main material are provided in

Table 15. Haulage truck trips likely to be generated by the proposed construction works have also been estimated based on indicative quantities of main materials and the construction program. The calculations are based on the appropriate use of concrete mixers (7m^3), rigid trucks (10m^3), and truck and dogs (25m^3).

Table 15: Haulage truck trip estimates

	Quantity	Unit	Total number of truck trips
Grafton road works			
Earthworks (cut to fill)	13,400	m^3	-
Earthworks (imported fill from external facility)	0	m^3	-
Concrete	4,300	m^3	620
Sprayed Bituminous Surfacing	27,800	m^2	10
Dense grade Asphalt (DGB)	2,800	m^3	210
Steel reinforcement	5	tonnes	10
Grafton Flood mitigation - Levee works			
Imported fill	32,700	m^3	2,050
Concrete	180	m^3	30
Bridge works			
Concrete bridge	19,000	m^3	2800
Steel reinforcement	3,800	tonnes	120
Bridge deck wearing surface	1,260	m^3	100
Concrete for bridge piles	1,000	m^3	150
Steel reinforcement for bridge piles	160	tonnes	10
South Grafton road works			
Earthworks (cut to fill)	8,900	m^3	-
Earthworks (imported fill from external facility)	100,000	m^3	6,250
Concrete	12,680	m^3	1,820
Sprayed Bituminous Surfacing	83,330	m^2	20
Dense grade Asphalt (DGB)	8,400	m^3	630
Steel reinforcement	15	tonnes	20
South Grafton Flood mitigation - Levee works			
Imported fill	60,700	m^3	3,800
Concrete	325	m^3	50
Total			**18,700**

As shown in

Table 15 above, it is estimated that a total of 18,700 truck trips would be required during construction of the project. These trips would be distributed over approximately a three year construction period. Although

the number of trips would vary day to day, this implies an indicative average rate of about 20 materials truckloads per working day, for a total average generation of 40 trips per working day, throughout these three years.

There are a number of existing, approved or potential quarries near the project area, and it is expected that sufficient material resources are available in the local area to build the project. These sites are shown in Figure 25. Quarry status and potential materials to be gained are summarised in Table 16. Although the identified quarries have been limited to the Clarence Valley local government area, there are many other quarries further afield in Coffs Harbour and the greater Northern Rivers region, if local resources prove insufficient.

The construction contractor would be required to source general fill material and concrete components (eg aggregates) from local quarries or concurrent projects in the Northern Rivers region (eg the Pacific Highway upgrade). Further investigations would be completed during detailed design to determine the source of each material.

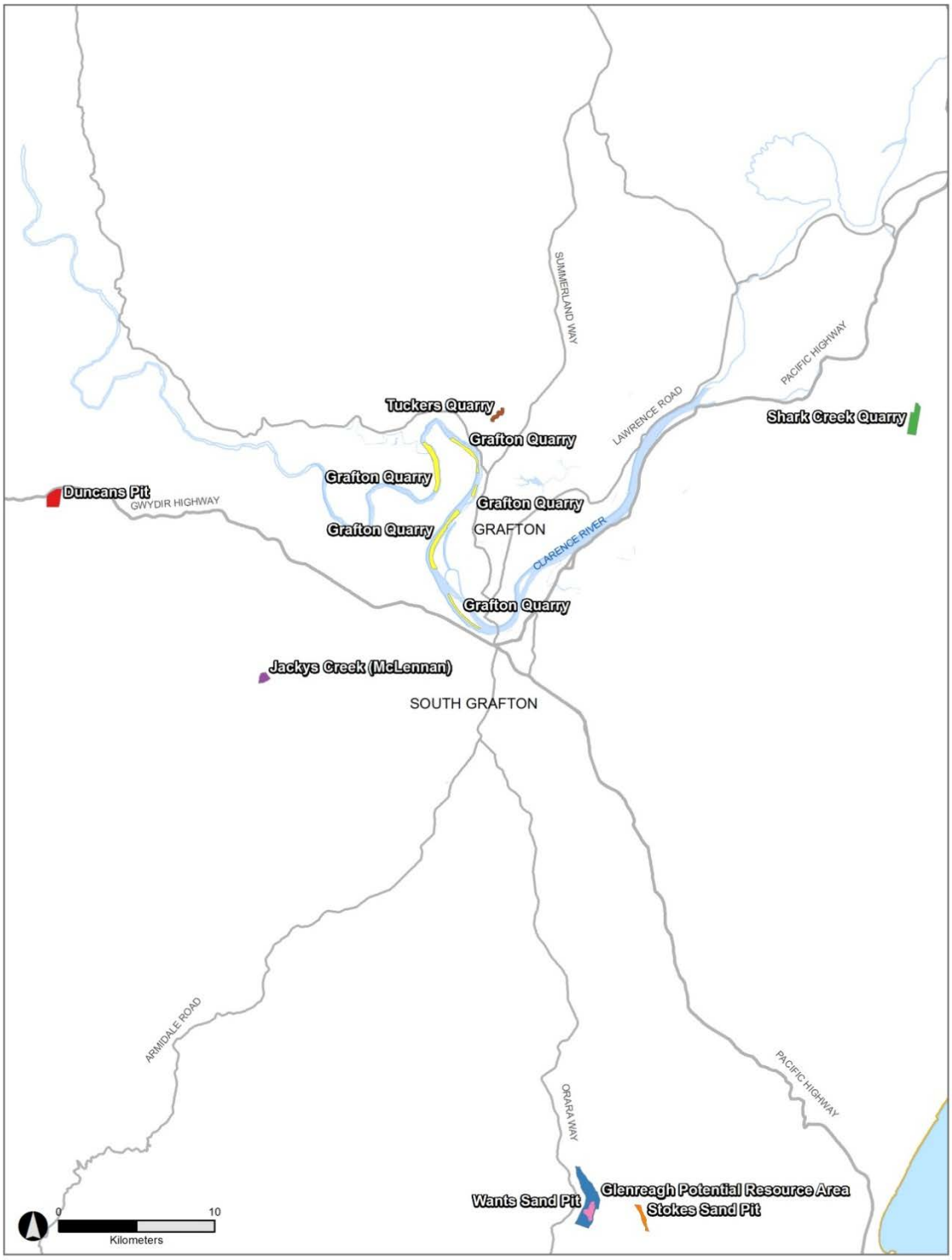


Figure 25: Potential source of materials within the Clarence Valley local government area

Table 16 Potential source of materials within the Clarence Valley local government area

Quarry name	Location	Main commodity	Comment
Grafton Quarry (Boral)	Clarence River, Grafton	Construction sand and gravel	Five sites within the Clarence River. Life effectively unlimited (with replacement), close to the proposed project.
Wants Pit (Kevin Want)	Sherwood Road	Construction sand	Also known as Wants Sand Pit in Clarence Valley Resource Audit. Operating intermittently. Resource unquantified.
Glenreagh Pit	Coramba / Grafton Road	Construction sand	Incorporated in the Glenreagh Potential Resource Area (Clarence Valley Resource Audit). Resource unquantified but potentially large.
McLennans Quarry	Gwydir Highway, 35 km from Grafton	Can make full range of construction materials including heavy duty road surface materials	Also known as Duncans Pit (Clarence Valley Resource Audit). Resource possibly 10 million tonnes. 50-year life at extraction limit of 200,000 tonnes per annum.
Tuckers Quarry	Near Orchard Road, Grafton	Ironstone quarry, developing as sandstone quarry	Recent production of 50,000 tonnes per annum. Sandstone resource up to 50 million tonnes.
Shark Creek Quarry (Alison Alcott)	Shark Creek near Byron Lane	Coarse aggregate	Resource 1.6 million tonnes. Only hard rock source of complying coarse aggregate (established by Roads and Maritime testing) close to the Pacific Highway between Ballina and Woolgoolga.
Stokes Sand Pit	No information	Construction sand	Proposed production rate of 40,000 tonnes per annum. Residual sand resource approximately 2 million tonnes.
Jackys Creek (McLennan)	Old Glen Innes Road, Grafton	Prepared road base	Recent production rate of 50,000 m3 pa (loose). Adjacent to Jackys Creek Potential Resource Area (Clarence Valley Resource Audit).

Haulage routes and access to ancillary facilities

The proposed construction ancillary facilities and levee stockpile areas are shown in Figure 26 and potential access points to the road network are shown in Figure 27.

Ancillary sites in Grafton and South Grafton and stockpile areas along the levee would be accessed via existing roads. The two adjoining sites that form the South Grafton ancillary facility would be accessed via Iolanthe Street. The site located at the eastern side of Iolanthe Street would also have an access point at the Pacific Highway. The two adjoining sites at the Pound Street viaduct ancillary facility would have access via Pound Street.

Levee stockpile areas located along the banks of the Clarence River to the west of the bridge crossings would utilise existing roads to access the trunk road network.

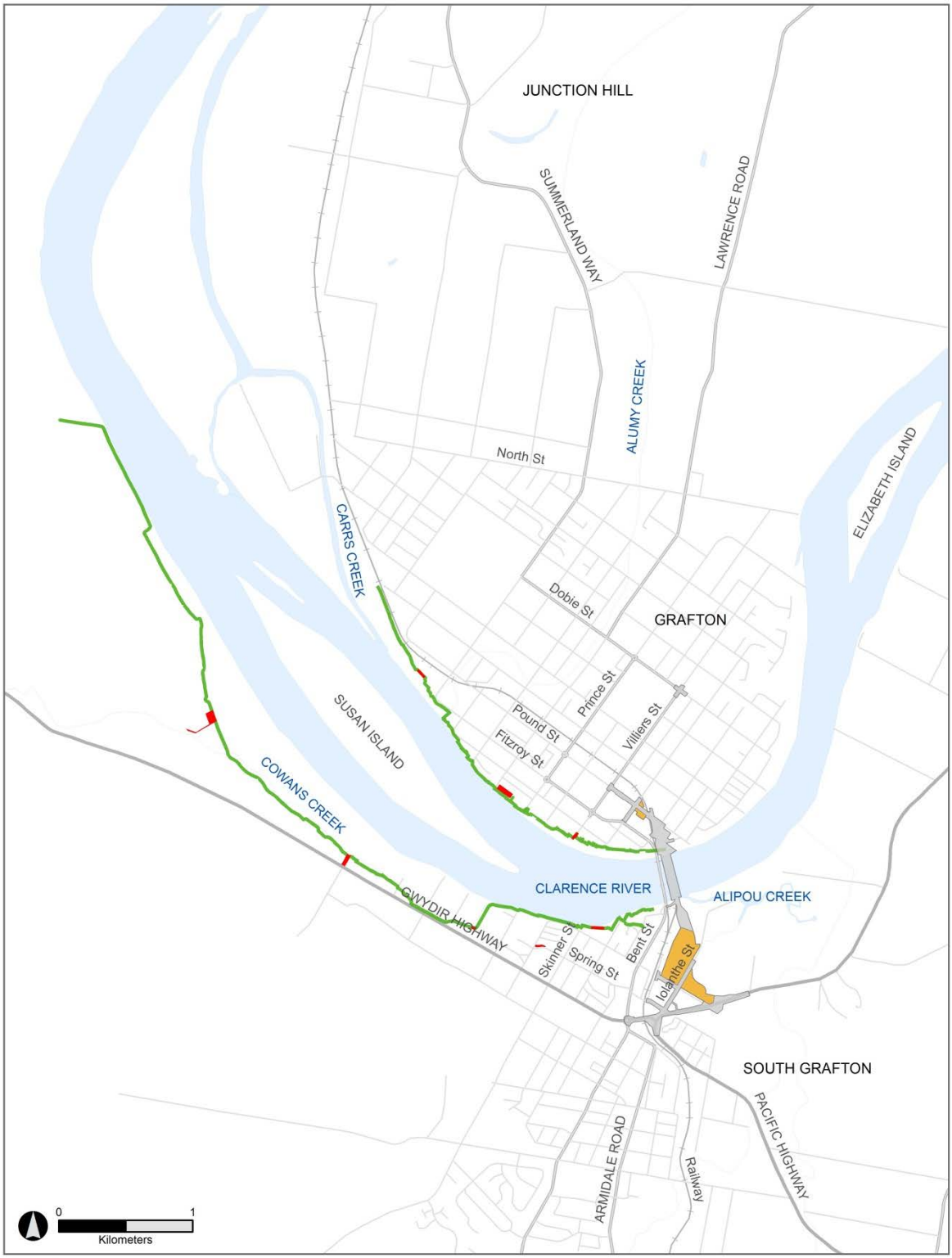


Figure 26: Ancillary sites and levee stockpile areas

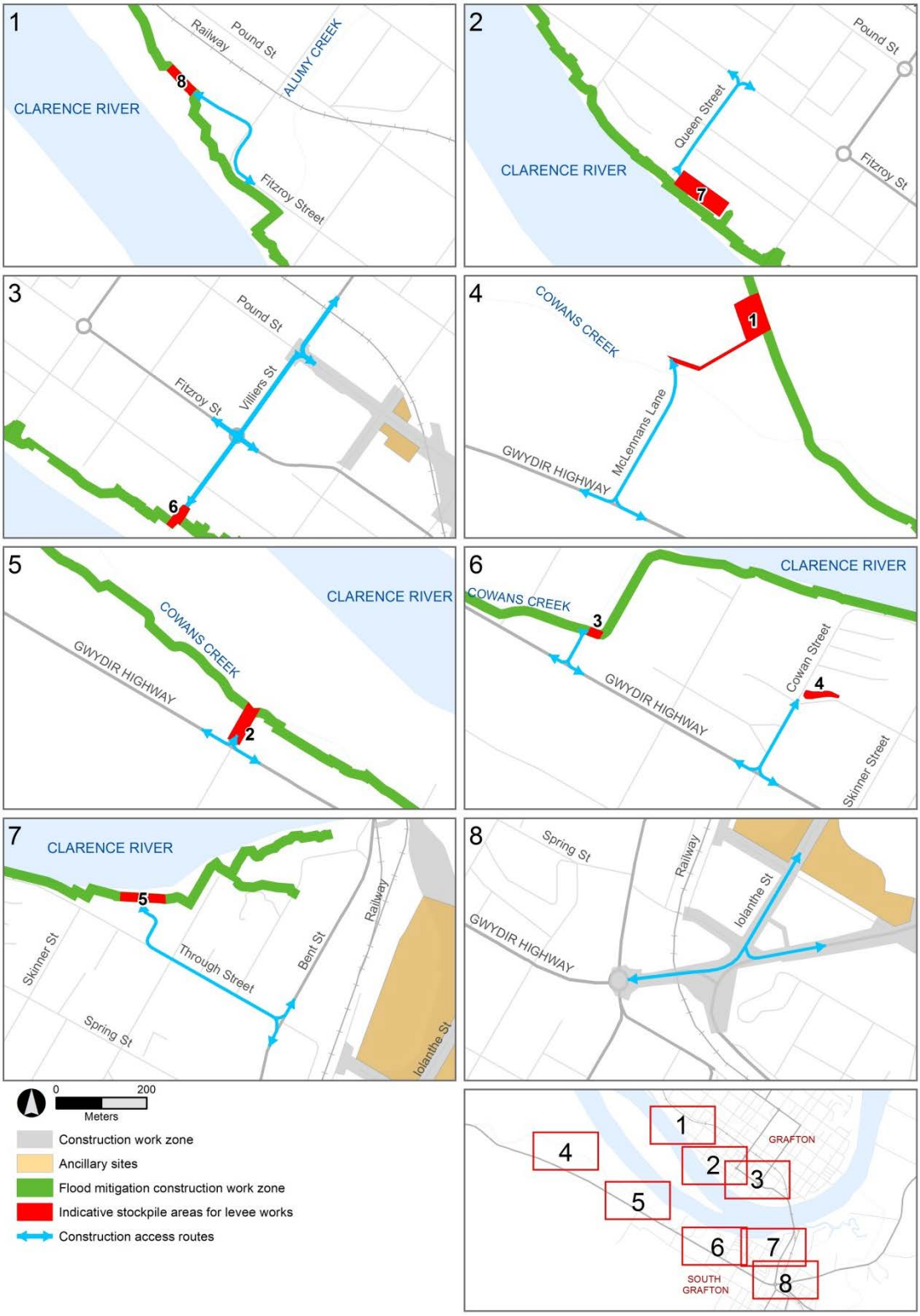


Figure 27: Potential construction site access routes

As identified above, further investigation is required to determine the exact sources of each material during detailed design. As such, routes providing connection between ancillary sites, levee stockpile areas and their respective materials sources will be confirmed during detailed design. However, it is anticipated that the roads most likely to be used as haulage routes within the vicinity of the project are:

- Summerland Way, Villiers Street and Pound Street in Grafton
- Bent Street, Pacific Highway, Gwydir Highway and Iolanthe Street in South Grafton.

The timing of vehicle activity associated with the above would take into account bridge access restrictions and avoid vehicle movements in the peak traffic periods to minimise impacts on traffic operations.

5.3 General traffic management and impacts on the road network

Changes to traffic and access conditions due to road works

Road network upgrades in South Grafton and Grafton may require temporary road closures or reductions in traffic capacity, on-street parking access or pedestrian / cyclist path access. The following streets may be directly impacted by road works construction zones:

- Grafton
  - Clarence Street, between Fitzroy Street and Bacon Street
  - Kent Street, between Fitzroy Street and Bacon Street
  - Pound Street, between Villiers Street and Bromley Street.
- South Grafton
  - Butters Lane
  - Through Street, between the rail corridor and Iolanthe Street
  - Iolanthe Street
  - Spring Street
  - Pacific Highway
  - Gwydir Highway.

The following road closures are expected to occur in Grafton during construction:

- Greaves Street, in the vicinity of the northern approach to the new bridge crossing. This street carries very low traffic volumes. Residents to the north would be required to detour via Bacon Street. Those to the south of the closure would be required to detour via Fitzroy Street.
- Pound Street, between Kent and Clarence. This section would be temporarily closed while the structure that will replace the Pound Street viaduct is lifted into place. This street section carries a relatively low volume of traffic at approximately 1500 vehicles per weekday, and approximately 160 vehicles per hour during peak periods. During this

closure, a detour would be in place via the existing parallel road at Bacon Street.

It is anticipated that all activities associated with road works would occur within the project boundaries identified in Section 1.3.

General traffic management and access

Appropriate traffic control measures would be determined on a site by site basis and would include a combination of temporary lane closures, realignments, or detours along with associated temporary fencing, visual barriers (such as witches hats), use of traffic controllers and signage. Property access would also need to be maintained during construction works as appropriate.

Local roads used for construction access would be repaired where required (they would be widened and/or have the pavement strengthened) and maintained in serviceable condition.

Where possible and feasible, machinery and materials required to be delivered over long distances could be transported to Grafton by rail and hauled to site by road transport. All other goods would be transported by road at times that would minimise impact on peak period traffic operations. Consultation should be initiated with the appropriate rail operators / owners to explore this opportunity at the appropriate design stage.

Impacts on level of service

It is anticipated that the cumulative impact of the above construction activities may have some impact on the level of service of the road network. If these impacts are not given due consideration or go unmanaged, safety and efficiency of the road network may be compromised. It is considered that once the haulage routes and construction sequencing have been confirmed by a contractor, traffic analysis would be able to be undertaken to quantify the impacts on level of service during critical construction periods. Based on the outcomes of the analysis, traffic management measures would be identified and included as part of a Construction Environmental Management Plan (CEMP). These would be developed to clearly demonstrate how the mitigation measures proposed would enable acceptable traffic operations and level of service on the road network during construction.

Impacts on emergency response and evacuation

The project would not impact on existing evacuation routes or emergency services during construction. Emergency services would be notified on traffic conditions changes (eg partial or total road closures) during construction.

Impacts to freight services

Access across the existing Grafton Bridge would be maintained during construction, however surrounding road network upgrades as part of the project may cause delays which would have a minor impact on the freight services travelling through, to or from the Grafton area during construction.

5.4 Disruption to rail services

As part of the reconstructive works of the viaduct at Pound Street, it is anticipated that the rail line would need to be temporarily closed. This would require closure of the North Coast Line service for the same period. In order to mitigate the impact of this closure, efforts will be made to ensure these works coincide with other works required along the line. This is usually done in off peak periods of the year in terms of patronage and freight movements, minimising impact on rail operations.

During this period, alternative passenger transport services should be provided where possible. For regional trips to other communities in the area, coach services should be provided.

Freight trains would not be able to operate during the closure period. Engagement with freight operators should be undertaken to ensure impact on freight mobility is minimised.

5.5 Disruption to bus services

The proposed works and traffic management measures are not expected to directly impact upon on bus services, with proposed road closures not to occur on existing bus routes within the study area. As such, the level of disruption to be inflicted on bus services is anticipated to be low.

5.6 Disruption to pedestrian and cyclists

Road works construction zones may impact on access to pedestrian and cycle paths in Grafton and South Grafton.

In South Grafton, works associated with the Gwydir Highway widening may impede crossing of the highway between Derek Palmer Place and Silver Jubilee Park. This may require cyclists to detour via Bent Street.

In Grafton, the works at the rail viaduct and the road upgrades at Pound Street may require closure of the route from the existing bridge to residential areas in the north along Kent Street. Cyclists and pedestrians may need to detour via Villiers Street, or an alternate temporary route established.

5.7 Cumulative construction impacts

Cumulative construction impacts are incremental impacts that are caused by foreseeable future activities which, when combined, may have a cumulative effect. Other projects relevant to the construction traffic and transport assessed in this report have been identified, taking into account:

- Location – other projects located close to the construction work zone boundary of this project (ie within the suburbs intersected by the bridge alignment or the sections of levee to be raised).
- Project timeframe – other projects likely to be under construction concurrently with the construction of the proposed project.

- Project size – projects were identified by virtue of being listed on Planning and Infrastructure Major Projects Register and through consultation with Roads and Maritime and Clarence Valley Council.

Table 17 lists the projects that meet the above criteria, and therefore have potential to contribute to cumulative impacts during the construction stage of the project. It includes the location and a brief description of the project, project status, construction timeframe and likely impacts based on the information available.

Table 17: Projects with potential to contribute to cumulative impacts along with the proposed project

Description	Status	Assumed key impacts based on current knowledge
Pacific Highway Upgrade – Woolgoolga to Ballina		
155 km section of the highway upgraded to four-lane dual carriageway between Woolgoolga and Ballina. The highway would bypass South Grafton. Timeline: Subject to approval, construction would likely to start in 2015.	NSW Planning approval received 24 June 2014. This approval has now been forwarded to the Federal Department of the Environment, for consideration under the *Environmental Protection and Biodiversity Conservation Act 1999*.	Increased construction traffic. This will be influenced by timing of the delivery of the upgrade, and the location of workforce accommodation and material sources.
Proposed service station, fast food restaurant and café at the intersection of Spring Street and Iolanthe Street, South Grafton		
Development of a service station (185 m^2), restaurant and café (30 seat capacity) on an existing car yard site at the intersection of Spring Street and Iolanthe Street, South Grafton. A total of 20 on-site car parking spaces will be provided. Timeline: Unknown.	Application has been approved by Clarence Valley Council with conditions	Increased construction traffic, parking and access in South Grafton
Lapsed Homemaker Centre development approval at the intersection of Through Street and Iolanthe Street, South Grafton		
Bulky goods retailing development comprising three interconnected buildings (12,000 m^2) arranged around a communal car park. Timeline: Unknown.	Approval has lapsed. However it sets precedence for future use of the site.	Increased construction traffic, parking and access in South Grafton
Future urban development projects		

Description	Status	Assumed key impacts based on current knowledge
The key residential growth areas identified by Clarence Valley Council and documented in the *Mid North Coast Regional Strategy 2006-31* (DP&I, 2009) relevant to the project are Junction Hill, Waterview Heights, and Clarenza. Timeline: For the purposes of this EIS, It was assumed that take up of the development would occur in Junction Hill initially, followed by Waterview Heights and finally Clarenza.	Areas have been identified	Operational traffic, parking and access

As shown in Table 17, it is not certain when these projects will commence construction and be completed, as is the extent and nature of any impacts. The likely impacts of these projects would be assessed as part of the development consent process by the relevant approval authority.

The projects identified in Table 17, when considered with the construction of the Grafton Bridge project may result in cumulative construction traffic and transport environmental impacts. The likely impacts are:

- Cumulative traffic disruptions to road users travelling to and from Grafton via Pacific Highway.
- Cumulative traffic disruptions to road users travelling between Grafton and South Grafton across the existing bridge.

Cumulative impacts for the construction works would be managed and mitigated through traffic management measures that the construction contractor would be required to develop, implement and adhere to. Subject to the preparation and successful implementation of this plan, no additional mitigation measures would be required.

6 Environmental management measures

The route options development process and concept design investigation for the project have sought to minimise traffic and transport impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the traffic and transport impacts during construction and operation as described in Table 18. The management and mitigation measures draw on best management practice, government standards and guidelines and specialist knowledge. Potential impacts for both construction and operation phases of the Grafton Bridge project are summarised in the table below and proposed management and mitigation measures outlined.

Table 18: Traffic and transport environmental management measures

Issue	Environmental management measure	Responsibility	Timing
Road safety audit	Roads and Maritime will conduct a project road safety audit as part of detailed design to identify and address potential safety issues associated with the operation of the project	Roads and Maritime	Detailed design
Construction impacts on public transport	Access to bus stops will be maintained during construction in consultation with the bus operators where feasible and reasonable.	Roads and Maritime	Pre-construction

Issue	Environmental management measure	Responsibility	Timing
Construction traffic impacts	Construction traffic management measures will be developed and identified as part of the construction environmental management plan. The plan will: • Detail how the traffic associated with construction activities will be managed in accordance with the relevant standards, including *Traffic Control at Work Sites* (Roads and Maritime, 2010), AS1742 and Roads and Maritime Specification G10 • Confirm haulage routes between material source sites and ancillary site / flood levee stockpile access locations • Quantify the impacts on level of service during critical construction periods and demonstrate how the mitigation measures proposed will enable acceptable traffic operations and level of service on the road network during construction • Identify how the continuous, safe and efficient movement of traffic for both the public and construction workers will be maintained • Identify site-specific traffic control measures (including signage) to be provided to manage and regulate traffic movements at relevant locations during construction • Identify access arrangements at both construction sites and quarry sites, detailing vehicle ingress / egress movements • Include requirements and methods to consult and inform the local community of impacts on the local road network and traffic • Describe impacts on all transport modes, identifying appropriate mitigation measures in accordance with the relevant guidelines and in consultation with relevant parties (ie bus and rail operators). • Consider other developments and projects that may also be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic.	Construction contractor Roads and Maritime	Pre-construction Construction

Issue	Environmental management measure	Responsibility	Timing
Construction traffic impacts	Construction deliveries will be timed to occur outside peak traffic periods when feasible and reasonable, to minimise impacts on road network. Where feasible and reasonable, machinery and materials to be delivered over long distances will be transported to Grafton by rail and hauled to site by road transport. Consultation will be initiated with the appropriate rail operators / owners to explore this opportunity at the appropriate design stage. Emergency services will be notified in advance of changes to traffic conditions (eg partial or total road closures).	Construction contractor Roads and Maritime	Construction
Construction impacts on the road network	Local roads used for construction access will be repaired where required and maintained in serviceable condition.	Construction contractor Roads and Maritime	Construction
Construction impacts on public transport	Roads and Maritime will coordinate the placement of the new Pound Street bridge with ARTC to ensure the North Coast Line possession coincides with other works required along the line. In addition, North Coast Line users (passengers and freight operators) will be notified of impending changes to minimise impacts on them.	Construction contractor Roads and Maritime	Construction

7 Conclusion

Congestion and traffic delays are observed at the existing Clarence River bridge crossing in Grafton during peak periods on a daily basis. The bridge is at capacity during peak periods, causing journey delays to the community. Grafton and South Grafton are to some extent beginning to operate as separate towns.

Without the provision of additional traffic capacity at the crossing, it is anticipated that current poor road network operating conditions would intensify, with prolonged periods of congestion at the existing bridge and significantly increased travel times. Without the additional crossing, the network is anticipated to move at an average speed of less than 16.1 km/h by 2029, assuming traffic demands grow in line with demographic forecasts.

By implementing the project, it is anticipated that whilst certain roads will experience some increase in traffic volumes, significant travel time savings during peak periods will be provided to the community. Transport modelling carried out indicates the project will incur travel time savings of over 1000 hours to road network users during the AM peak period in the year of opening. Furthermore, intersections proposed as part of the project are anticipated to operate at a level of service “C” or better for 20 years post opening (until 2039).

The travel time savings provided by the project would also provide benefit to heavy vehicle movements, including the removal of time restrictions for 25/26 metre long B-Double trucks crossing the Clarence River. Through the banning of larger heavy vehicles from the existing bridge, and the provision of new infrastructure along the project alignment, further operational and safety benefits for both freight operators and the community are anticipated.

It is anticipated that the project will deliver additional safety benefits through the application of proven intersection and roadway design principles, specifically at current poor locations such as the Pacific Highway’s intersections with the Gwydir Highway and Spring Street.

The travel time savings provided by the project would also provide benefit to bus services that utilise the existing bridge. With bus operators advising a preference to continue using the existing bridge following completion of the project, it is anticipated that the project will have minimal impact on public transport services once the project becomes operational.

Pedestrian and cyclist links will be provided as part of the project. Overall, it is considered that whilst there may be some minor changes to existing cycle routes the facilities proposed provide:

- Good connectivity to the primary destinations identified in Council’s PAMP
- Consistency with the key strategic movements identified in Council’s pedestrian and cycle planning

- Crossings that are appropriate in light of anticipated traffic and pedestrian forecasts, and the safety considerations of the pedestrian types likely to use the facility.

In light of the above, it is considered that the project would meet the key traffic and transport project objectives to:

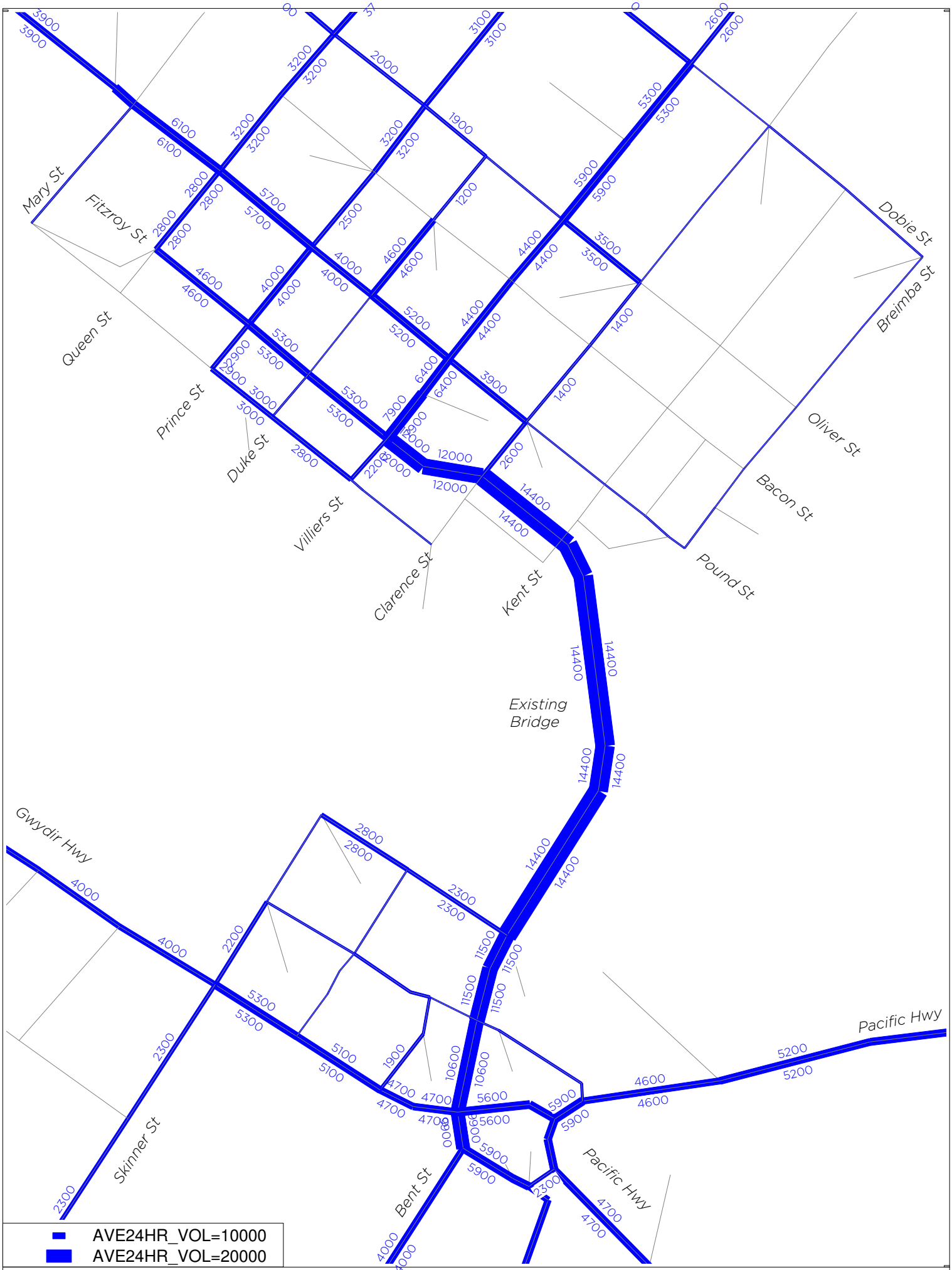
- Improve traffic efficiency between and within Grafton and South Grafton
- Enhance road safety for all road users over the length of the project.

Construction activity is anticipated to generate a reasonable volume of traffic over the construction period. It is anticipated that these movements may temporarily affect road access and the level of service of the road network in certain localised areas of Grafton and South Grafton, with minimal impacts to pedestrians, cyclists and public transport operators. In order to ensure road network operating conditions are maintained at an acceptable level, construction traffic management measures shall be developed as part of a CEMP during the detailed design phase of the project. This would be developed to clearly demonstrate how the mitigation measures proposed would enable acceptable traffic operations and level of service on the road network during construction.

Appendix A

Strategic Model Outputs

A1 Daily Traffic Volume Plots – All Vehicles

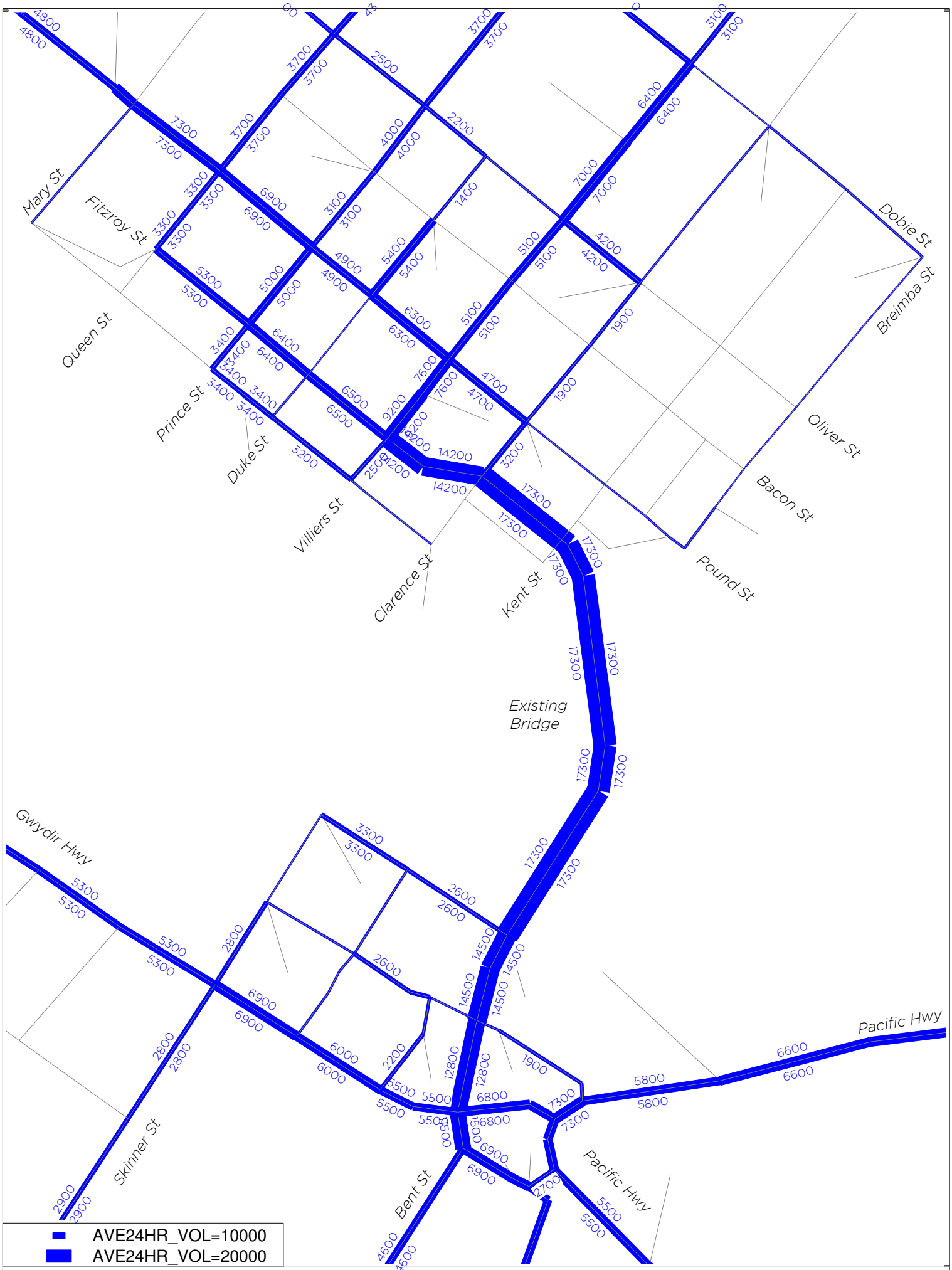


GTA Grafton Cube Strategic Model

Grafton_Base_2011

24-hour traffic volumes (average one-way flow)

cube

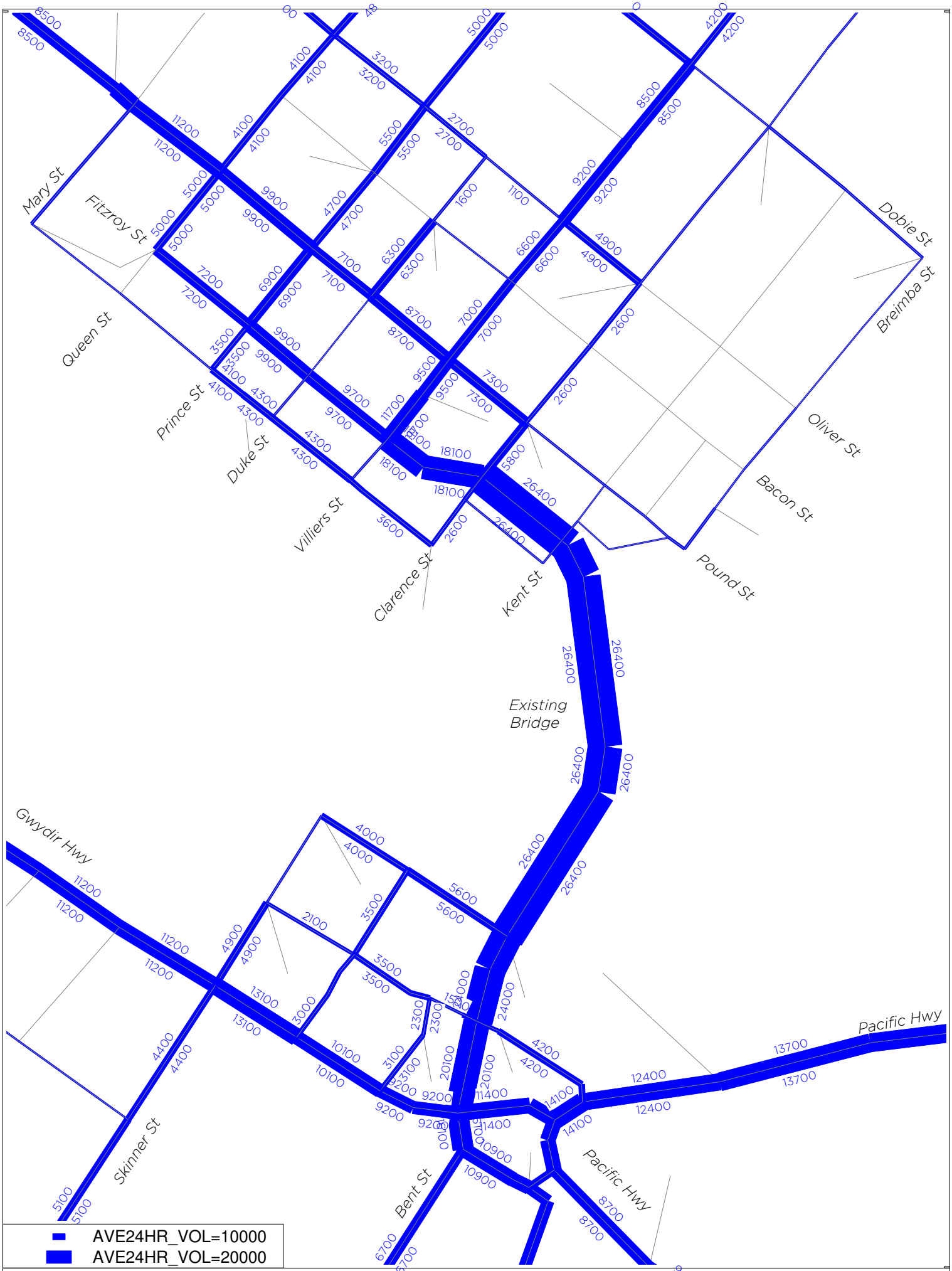


GTA Grafton Cube Strategic Model

Grafton_Base_2019

24-hour traffic volumes (average one-way flow)

cube

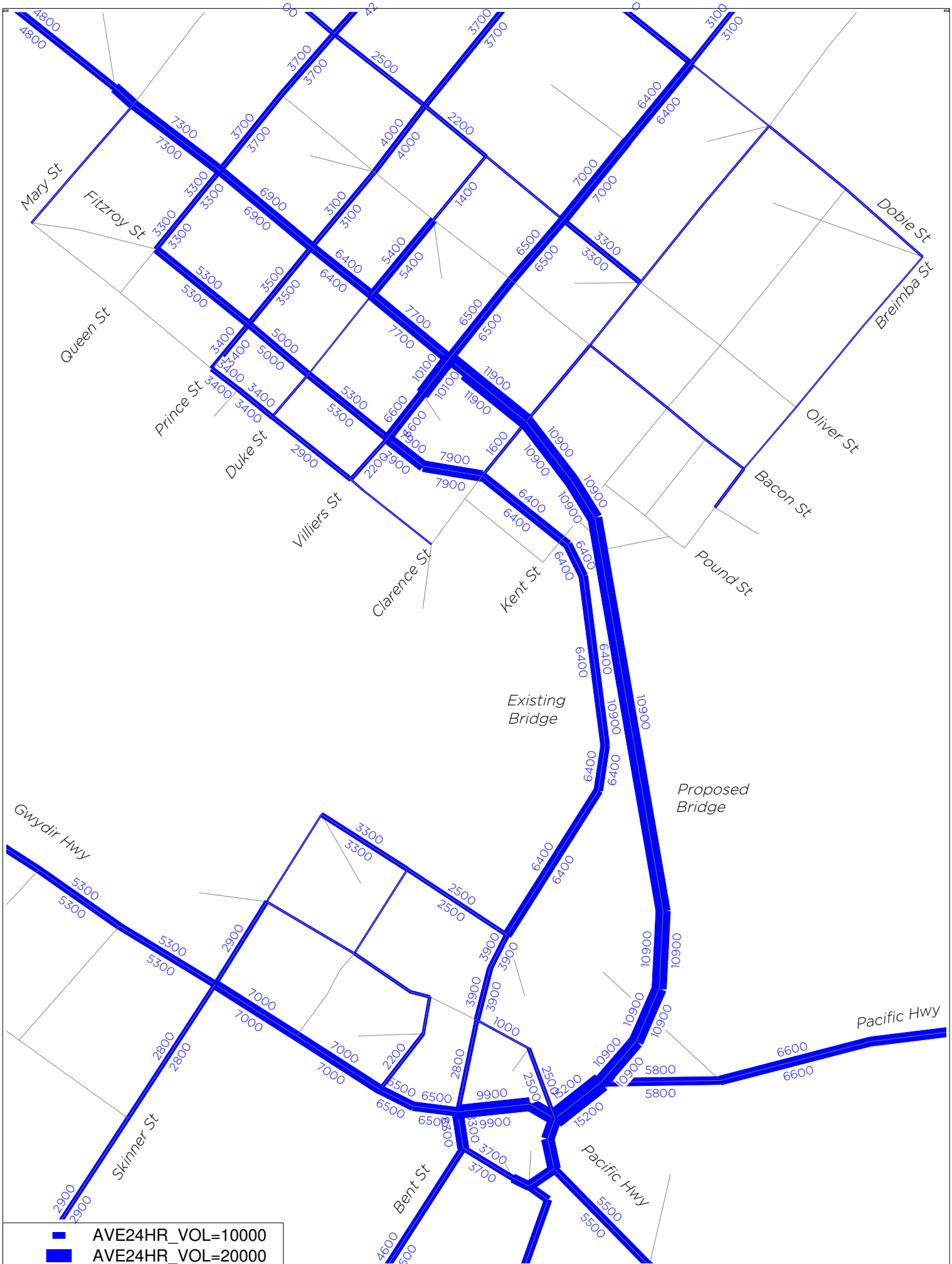


GTA Grafton Cube Strategic Model

Grafton_Base_2039

24-hour traffic volumes (average one-way flow)

cube

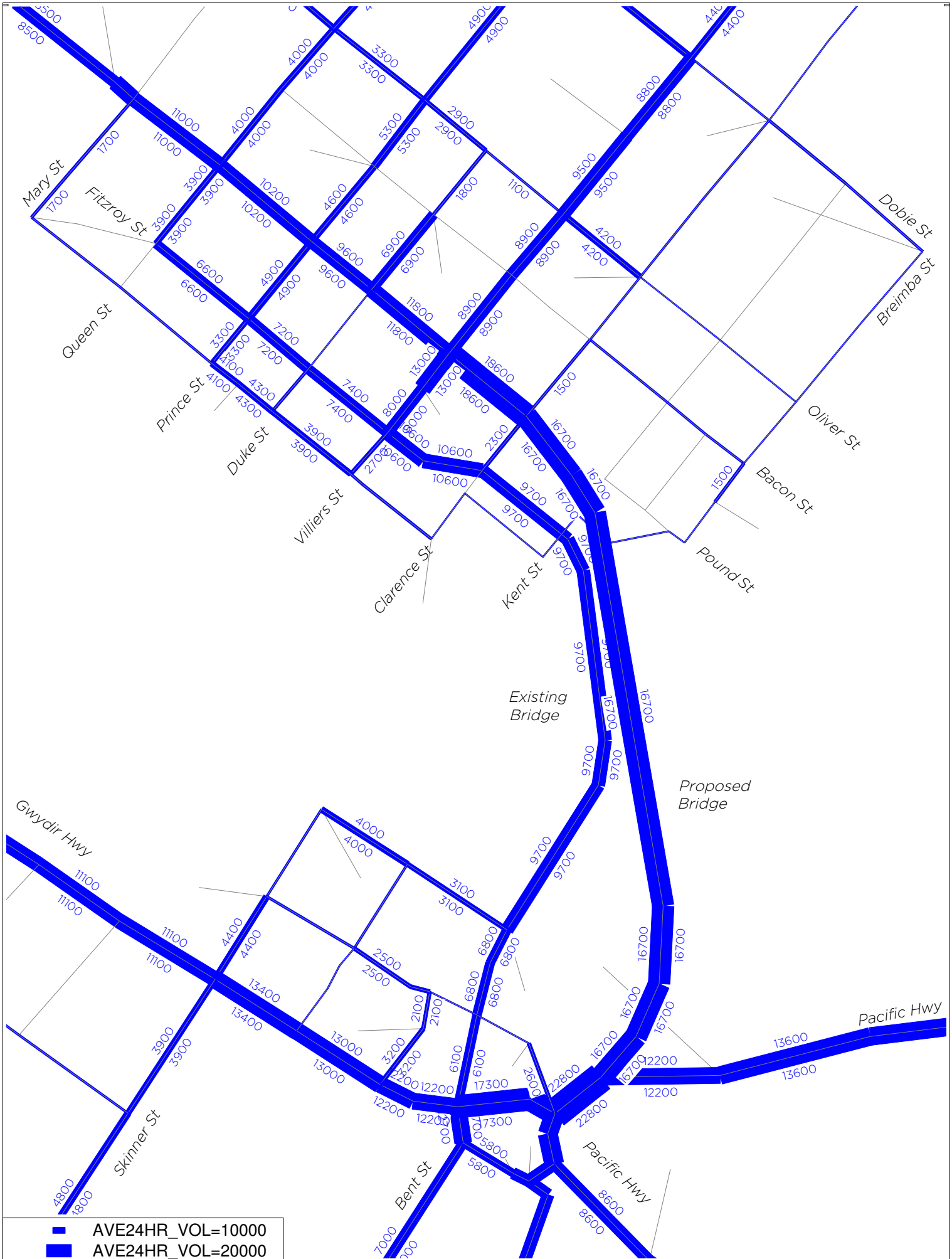


GTA Grafton Cube Strategic Model

Grafton_optC_2019

24-hour traffic volumes (average one-way flow)

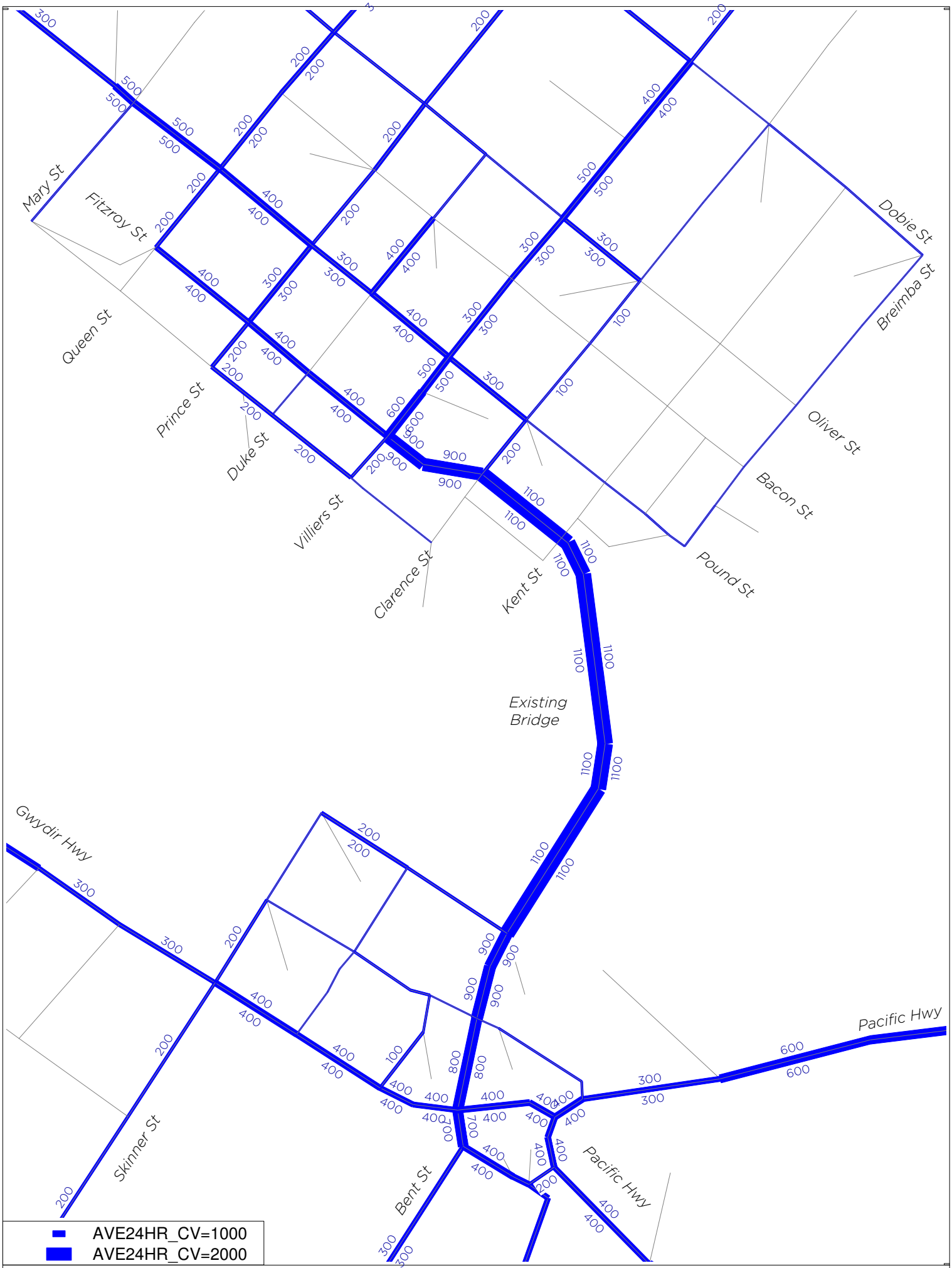
cube



GTA Grafton Cube Strategic Model
Grafton_optC_2039
24-hour traffic volumes (average one-way flow)

cube

A2 Daily Traffic Volume Plots – Heavy Vehicles

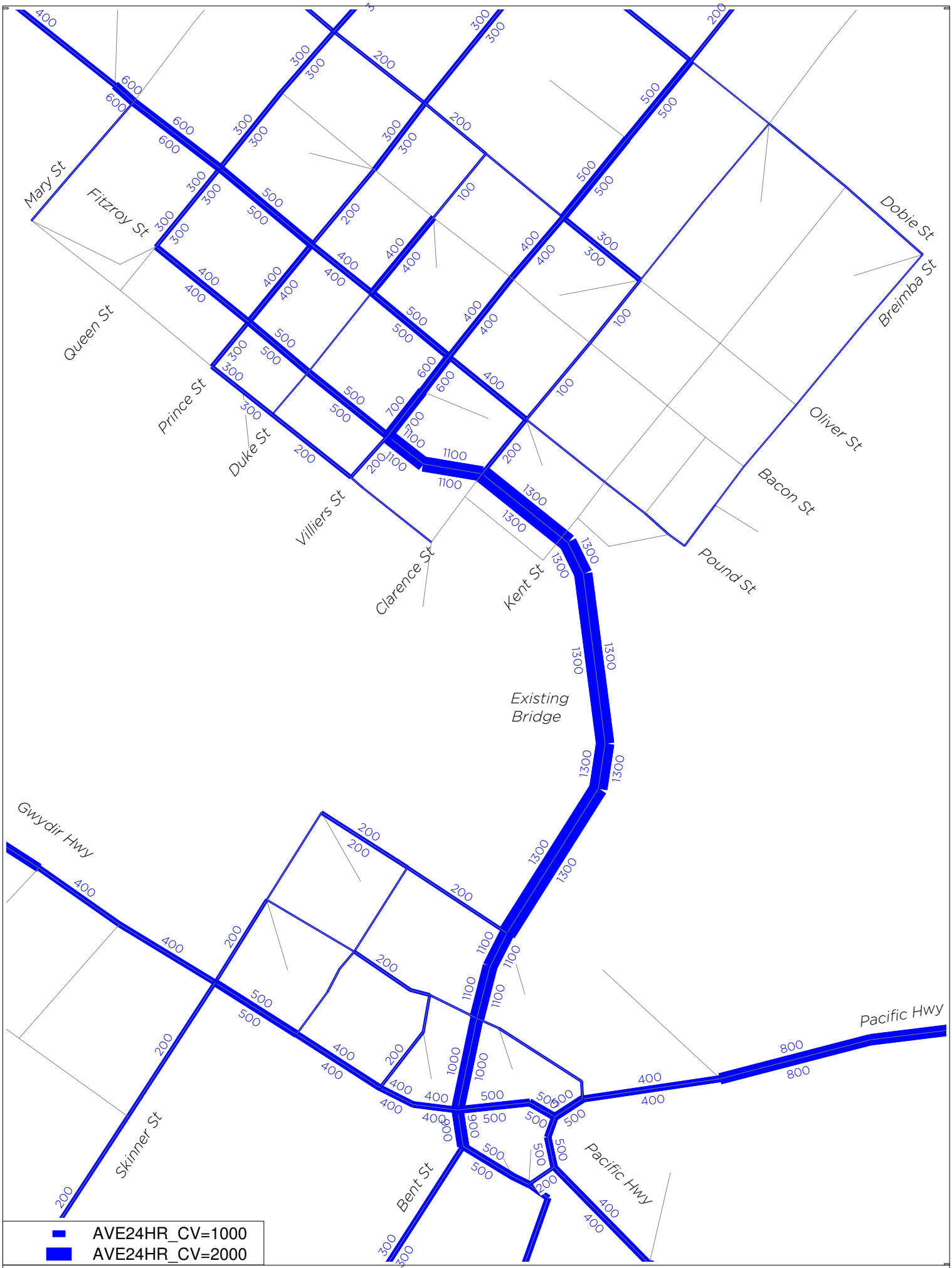


GTA Grafton Cube Strategic Model

Grafton_Base_2011

24-hour heavy vehicle traffic volumes (average one-way flow)

cube

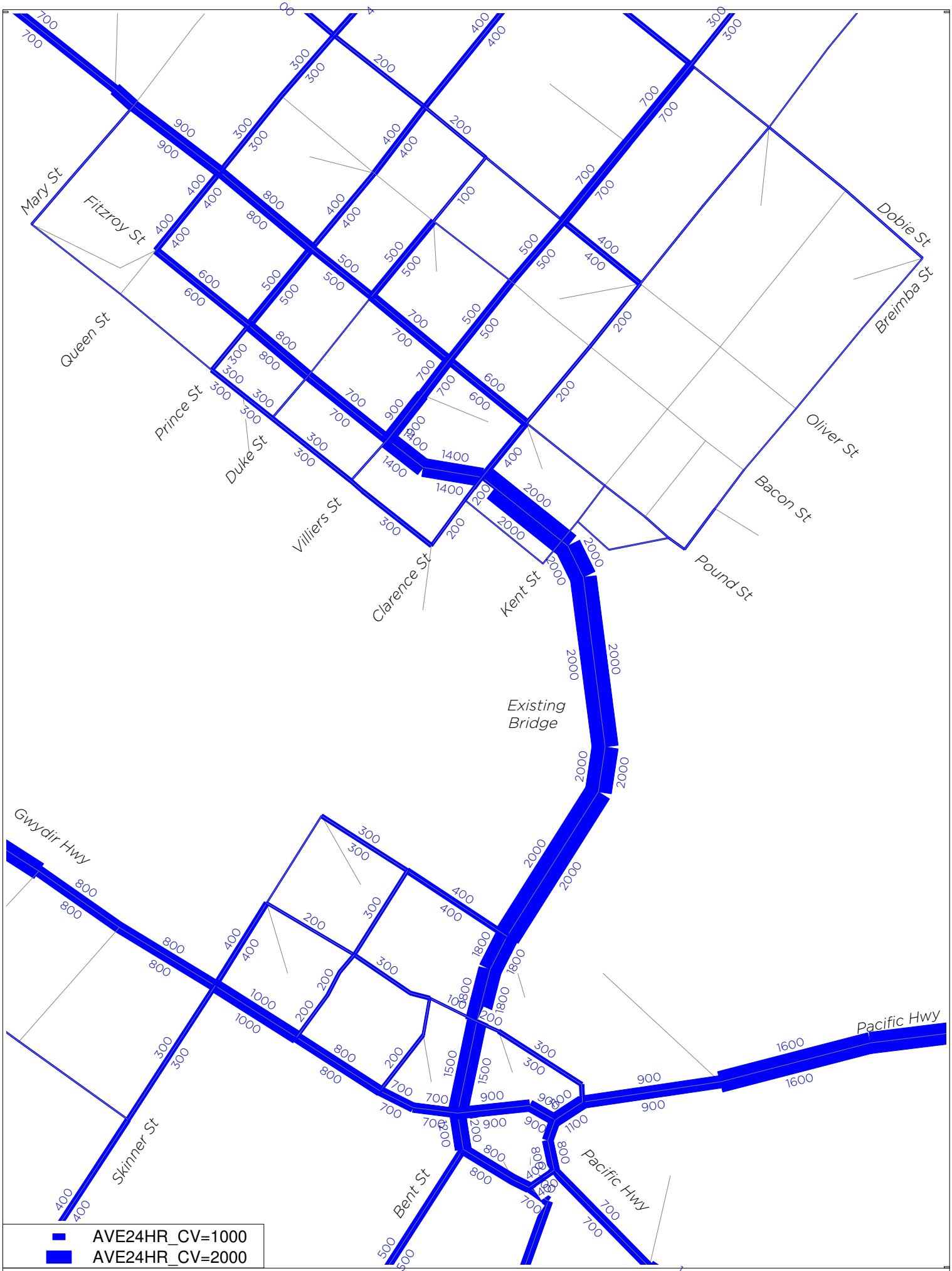


GTA Grafton Cube Strategic Model

Grafton_Base_2019

24-hour heavy vehicle traffic volumes (average one-way flow)

cube

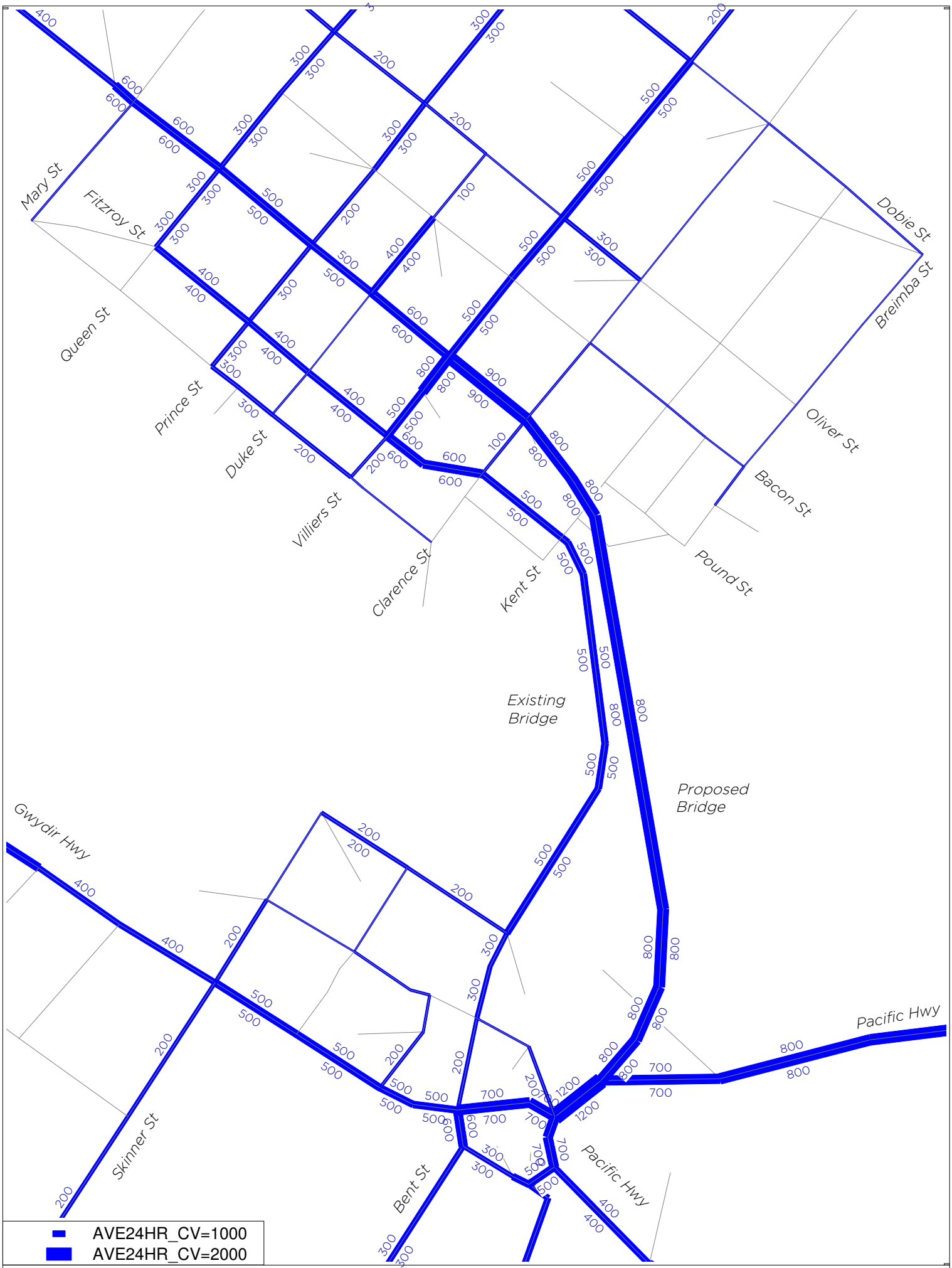


GTA Grafton Cube Strategic Model

Grafton_Base_2039

24-hour heavy vehicle traffic volumes (average one-way flow)

cube

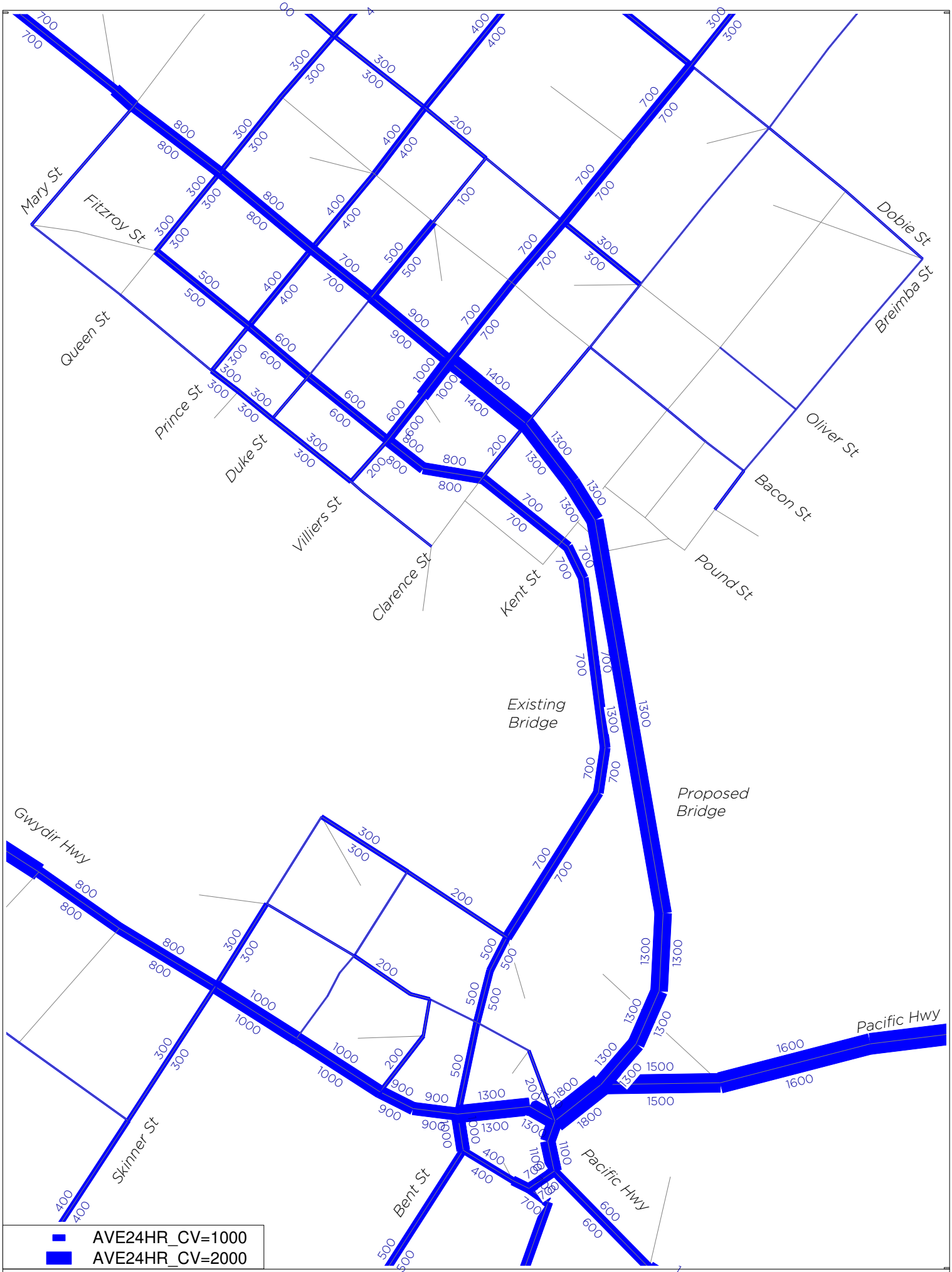


GTA Grafton Cube Strategic Model

Grafton_optC_2019

24-hour heavy vehicle traffic volumes (average one-way flow)

cube



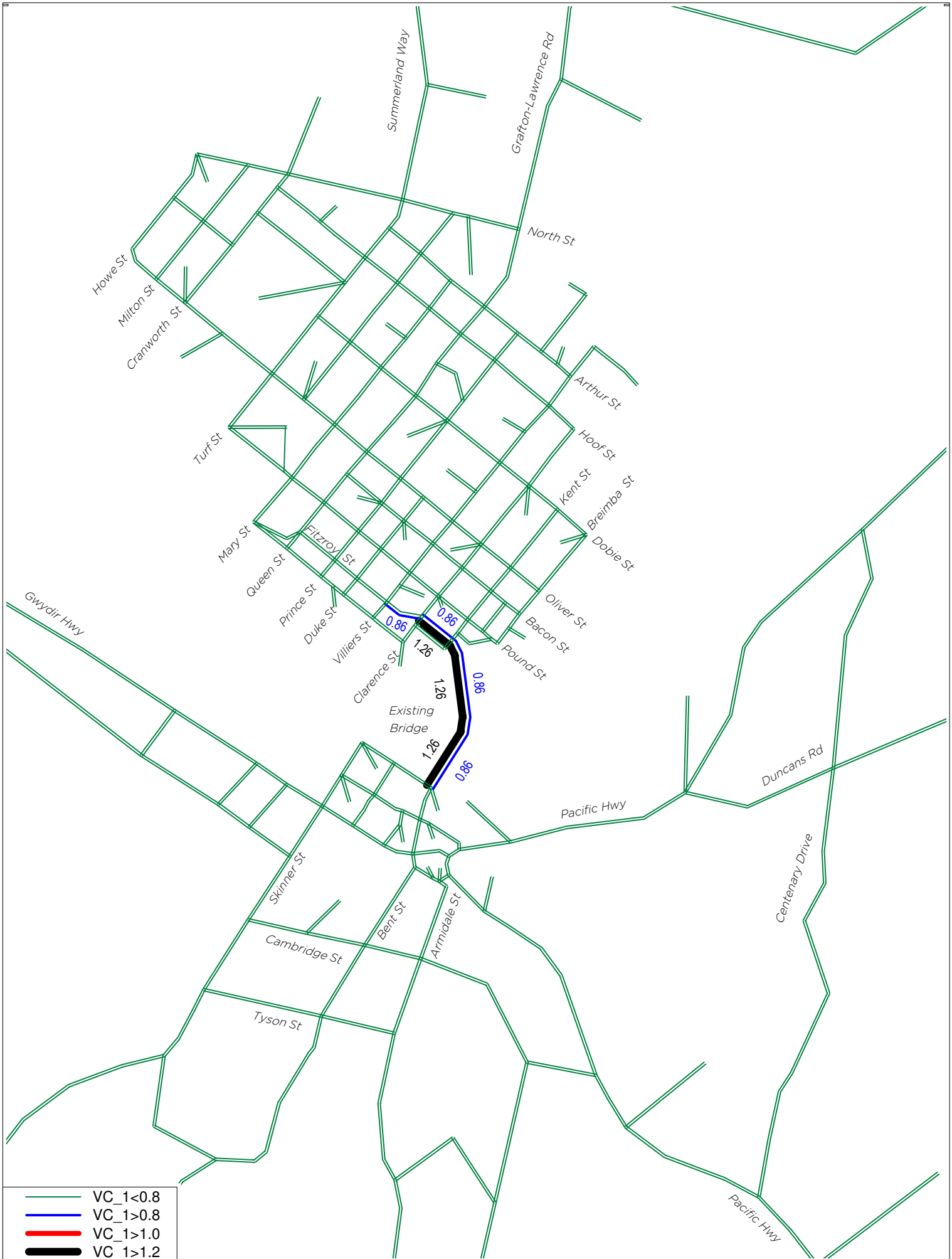
GTA Grafton Cube Strategic Model

Grafton_optC_2039

24-hour heavy vehicle traffic volumes (average one-way flow)

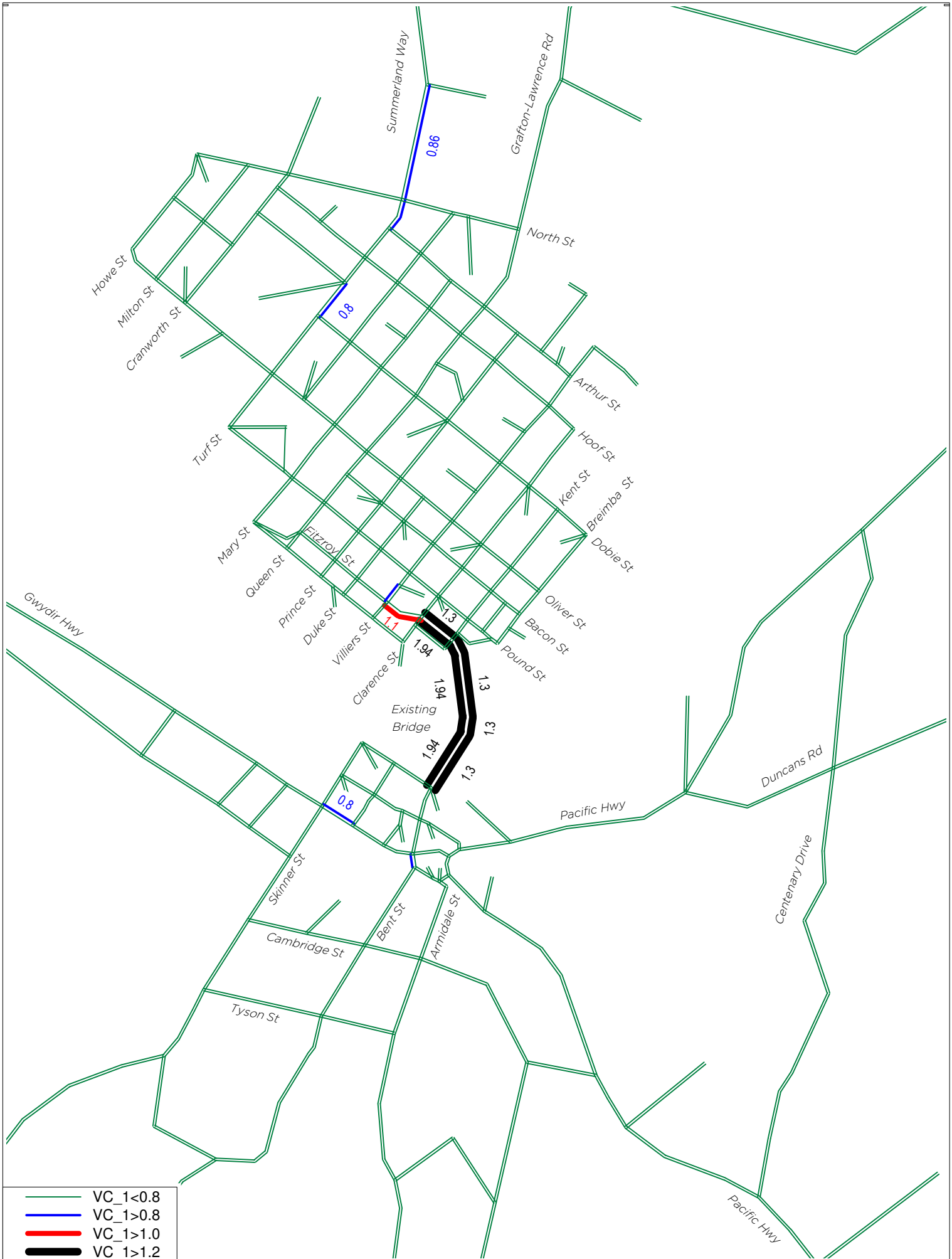
cube

A3 Volume to Capacity Ratio Plots



GTA Grafton Cube Strategic Model
Grafton_Base_2019
Volume-capacity ratio

cube

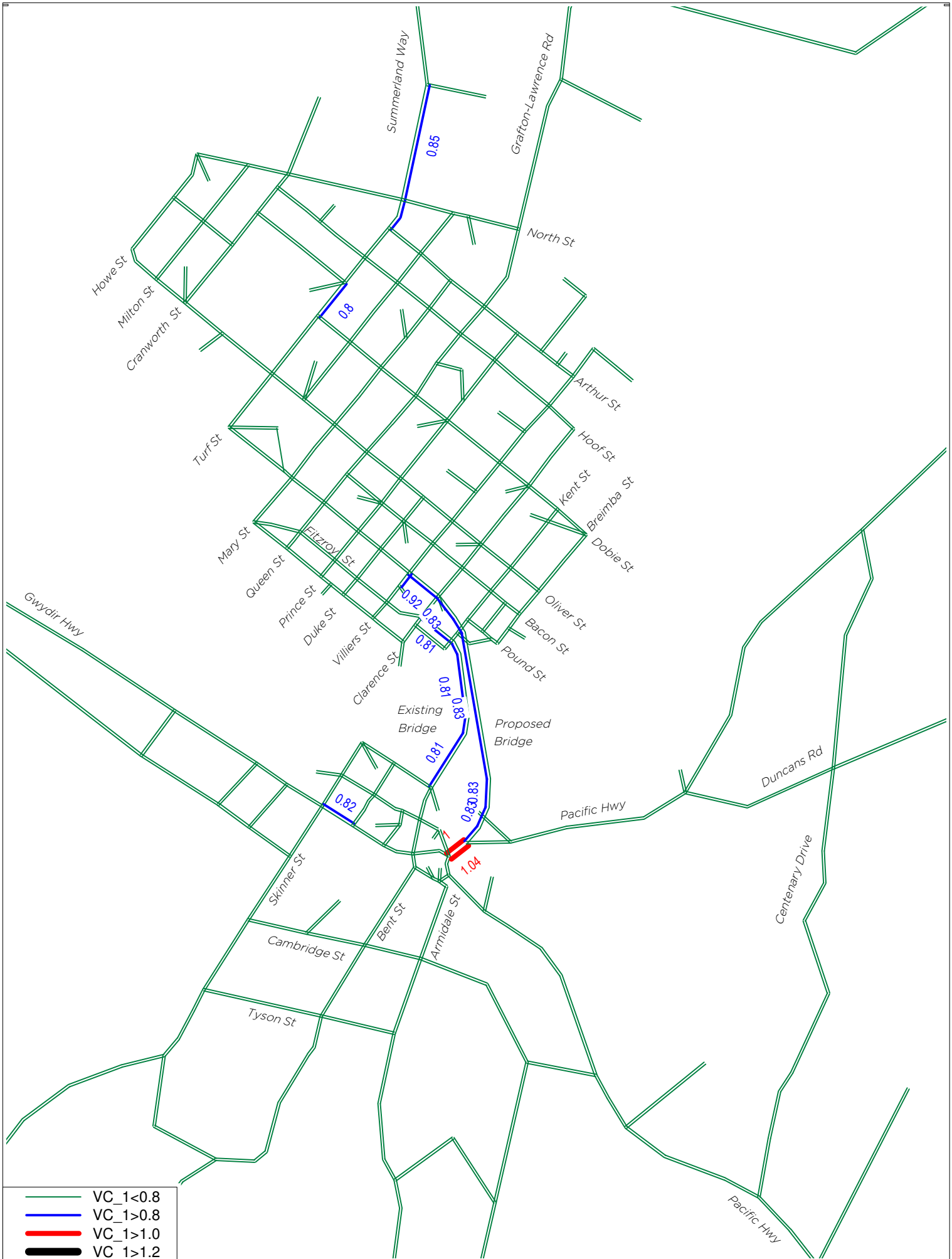


GTA Grafton Cube Strategic Model
Grafton_Base_2039
Volume-capacity ratio

cube

GTA Grafton Cube Strategic Model
Grafton_optC_2019
Volume-capacity ratio

cube



GTA Grafton Cube Strategic Model
Grafton_Base_2039
Volume-capacity ratio

cube