Northern & Western Geelong Growth Areas

Movement and Access Report (Reduced Size Format)

Prepared by: GTA Consultants (VIC) Pty Ltd for City of Greater Geelong

on 14/06/19

Reference: V152200

Issue #: B

GTAconsultants

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Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
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EXECUTIVE SUMMARY

Northern and Western Geelong Growth Areas

The City of Greater Geelong (CoGG) is currently preparing a draft Framework Plan that, if adopted, will guide the development of land use in the Northern and Western Geelong Growth Areas. This Movement and Access report sets out an assessment of the traffic and transport impacts associated with the proposed land use uplift; which includes some 38,600 dwellings (equating to 108,000 new residents), 19,000 jobs and 12,000 enrolments.

With Geelong expected to reach around 500,000 residents by 2051, the two growth areas represent about 42% of the overall growth during this period, with the balance of growth predominantly relating to Armstrong Creek and infill development in the existing areas of Geelong. The forecast urban growth will undoubtedly have an impact on the way in which people move and travel in and around Geelong.

The introduction of the two growth areas will generate some 482,000 additional trips that will be the equivalent of 20% of all trips in the Geelong network across an average day. Across the day, around 60% of these trips will be contained internal to the growth areas, 30% will travel through the existing areas of Geelong such as the Geelong CBD and Waurn Ponds, with the remainder travelling to areas outside of Geelong, including Melbourne.

Strategic transport modelling completed as part of this work indicates that at full development of the growth areas there will be significant increase in traffic volumes at each of the key Geelong Ring Road interchanges servicing the NWGGA, including Bacchus Marsh Road (from 10,000 in 2016 to 47,500vpd in 2051), Anakie Road (4,100 to 22,800vpd), Midland Highway (12,100 to 54,200vpd) and Hamilton Highway (15,900 to 63,800vpd). The quantum of volume will require investment and upgrades to the interchanges with the Geelong Ring Road that would warrant further investigations by the state.

A typical morning peak hour trip from the Western Growth Area to the Geelong CBD that currently takes around 13 minutes will increase to around 21[1] minutes, whilst a trip from the northern Growth Area will increase from 15 minutes to around 18 minutes. Much higher travel times would be experienced if people do not alter their travel behaviour, which in Geelong is characterised with short and sharp peaks that typically occur around the start and finish times of work and school.

To counter the expected growth and its challenges, a need to promote the use of alternate modes of transport and changes to the current travel behaviour will be required. The COGG has developed Clever and Creative future document which sets out the aspirations of the Geelong Community including a target of "50 per cent of journeys to work are made by public transport, walking or cycling". In comparison, the 2016 ABS data indicates that 10% of journeys to work are currently completed by sustainable modes.

Internal to the two growth areas, the modelling identified that the performance of the road network surrounding the NGGA operated better than the WGGA. This outcome is a result of a combination of factors, including greater quantum of development (land use) located in the WGGA (more traffic generation), less road links servicing the WGGA (less route choice) and greater future background traffic volumes on the WGGA external road network (Midland Highway and Hamilton Highway).

The internal networks within the growth areas have been designed appropriately and would be able to accommodate the expected traffic demands. However, the analysis highlighted a number of challenges on the external road network with access to the Geelong Ring Road and established areas of Geelong experiencing significant increases in peak and daily traffic. Accordingly, this assessment has identified a number of interventions, particularly around the WGGA, that could be considered to reduce vehicle trip generation and improve the operation of the overall transport network. These interventions include leveraging off the strong walking and cycling links around the clever and creative corridor, as well as critical locations for public transport priority.

[1] Traffic volume and average travel time estimates across the entire two hour peak period based on PC04 which assumes the external arterial road network is upgraded.

One such intervention is the inclusion of a dedicated public transport connection across the Geelong Ring Road to Church Street which would be similar to the dedicated public transport links in Brisbane and Wellington in New Zealand. A public transport only link at Church Street would result in more reliable, direct and faster peak hour travel times for residents of WGGA with the potential for journey time savings to the Geelong CBD (when compared to the expected car journey times). This intervention and others identified in this report will be required to be explored in greater detail through separate studies or through the development of the Precinct Structure Plans.

This report specifically addresses a number of key questions that will guide the development of the transport network within the Framework Plan. These key questions and a summary of a response to each is provided in Table ES1.

Table ES1: Key Questions and Report Findings

Item	Response
What will travel be like in Geelong in 2051?	Currently the road network peak periods in the morning and afternoon are relatively short; in the order of 30 minutes each. This peak will extend for longer periods during the AM and PM peak as traffic volumes increase. The modelling indicates that average vehicle speeds across the Geelong network are forecast to reduce from an average of 59kmh to 52kmh between now and 2051 for the AM peak period (57kmh to 48kmh in the PM peak period). As road network congestion increases, existing motorists will be required to change their travel patterns, this will result in trip reprogramming (travel at a different time), trip substitution (use an alternate mode) or trip redistribution (use an alternate route). The combination of the above factors will mean that in the future residents of Geelong will need to change their current travel habits. For example, in the future there will no longer be an expectation that residents can drive wherever and whenever they like in Geelong in 10 to 15 minutes, particularly during the peak periods.
Does the external arterial road network need to be upgraded?	The external road network servicing the NWGGA will need to be upgraded to accommodate the future demands generated by the NWGGA. Specifically, Midland Highway, Hamilton Highway, and Bacchus Marsh Road will need to be upgraded from 1 to 3-lanes in each direction and Anakie Road from 1 to 2-lanes in each direction.
Is there adequate capacity at the Geelong Ring Road interchanges?	The existing interchanges will need to be upgraded to accommodate the forecast traffic volume demands. The Hamilton Highway and Midland Highway interchanges are forecast to carry traffic volumes of greater than 50,000vpd. This level of activity is consistent with traffic volumes at some of Melbourne's busiest Freeway interchanges (i.e. Western Ring Road / Ballarat Road).
How many road connections are required from the NGGA to Anakie Road?	The modelling indicates that the number of road connections from the NGGA to Anakie Road could be reduced from four currently shown on the draft Framework Plan to three.
What are the impacts of providing a road connection for cars to Church Street from the WGGA?	A connection from the WGGA across the Geelong Ring Road would reduce traffic volumes on Midland Highway by 5% and Hamilton Highway by 9%. In addition, a Church Street connection would increase volumes on Church Street to the east of the Geelong Ring Road from approximately 9,000vpd to 17,000vpd.
What are the impacts of realigning the arterial road to the east side of the lake in the WGGA?	Realigning the WGGA arterial road will reassign a proportion of the north-south traffic to the new alignment to the east of the quarry lake. There will be a negligible impact to the forecast traffic demands to the surrounding roads (such as Dog Rocks Road and Fyansford-Gheringhap Road).
What happens if Batesford South is not developed?	If Batesford South PSP Area was to remain undeveloped it would reduce the overall traffic generation from the WGGA and also reduce the interconnectivity between the north and south developable areas. This would result in an increase in the forecast traffic volumes on Hamilton Highway.
What are the impacts of a greater mode share split to public transport?	A greater mode share to public transport for the NWGGA (up to 15%) would reduce forecast traffic volumes across the network, including reductions of approximately 9% at each of the interchanges.

Item	Response
	This would improve the operation of the road links servicing NWGGA.
What are the impacts of the alternate road network layout for the NGGA?	The alternate road network for the NGGA would provide a more conventional spacing between the higher road network and would in turn increase the forecast daily traffic volumes on the clever and creative corridor.

This report supports the transport requirements for the delivery of sustainable new communities for the two Growth Area's as part of the development of the Framework Plan. The development of this Movement and Access Report is the beginning of a process that will seek to determine in greater detail the transport requirements to support growth in the growth areas and Greater Geelong.

In supporting the Framework Plan, a number of additional studies and investigations have been identified that will need to be undertaken to address a number of transport issues identified in this report. The additional studies would be required to assist stakeholders with their decision making to determine the following (but not limited to):

- The detailed layouts for on road and public transport infrastructure to determine their constructability, cost and land availability
- The design and form of the interchanges on the Geelong Ring Road (including a capacity assessment)
- Identifying the need and form of transport to access to the Deakin University (and Waurn Ponds) precincts
- The suitability of the public transport priority measures for the established areas of Geelong
- V-Line Station commuter car parking (including review of unconstrained demands) capacity and upgrade requirements
- The feasibility of the potential high capacity public transport corridor for Church Street including the connection across the Geelong Ring Road
- The potential for a new connection to the Geelong Ring Road in the vicinity of Church Street to the Western Growth Area
- The potential to link with and integrate a connecting to the Geelong-Ballarat Railway line, and
- Understanding the capacity of Barwon River crossings to accommodate growth in Greater Geelong

The above items will be key inputs into the PSP process as well as assisting stakeholders in understanding broader issues that relate to Geelong.

Th**is 'Reduced Size Format' report has had the** bulk of the appendices removed to allow the report to be more user friendly in terms of printing and downloading requirements.

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Appendices

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1. INTRODUCTION

The Northern and Western Geelong Growth Areas (NWGGA) is forecast to be home to approximately 108,000 residents. This Movement and Access report sets out the transport impacts of the proposed land uses.

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1.1. Background

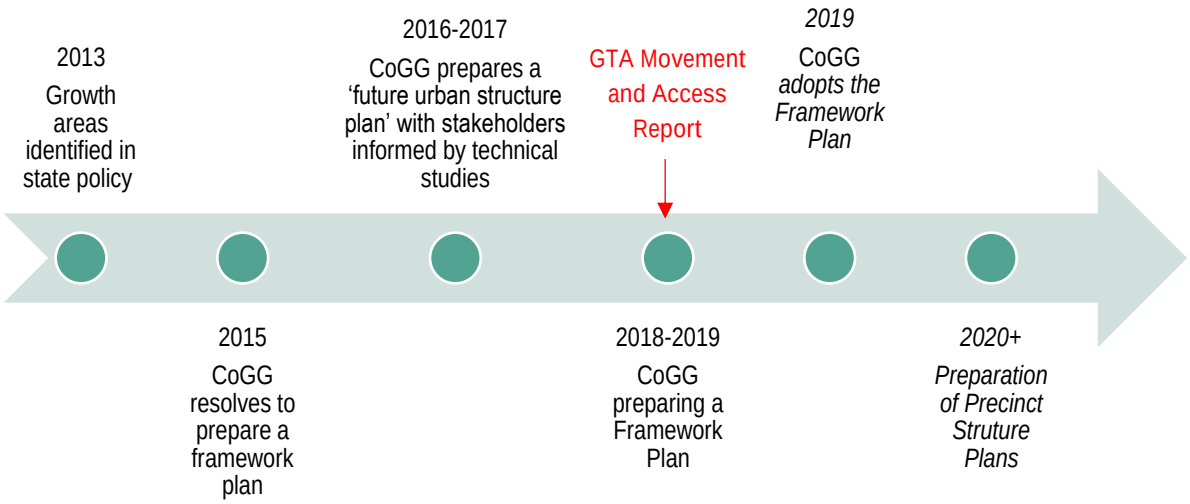
The Northern and Western Geelong Growth Areas (NWGGA) are two greenfield development projects that aims to deliver a vibrant community where people can live, work and shop. The Northern Geelong Growth Area (NGGA) is located approximately 12km to the northwest of the Geelong CBD and 7km west of Lara, whilst the Western Geelong Growth Area (WGGA) is located approximately 5km west of the Geelong CBD.

The 'Future Urban Structure Plans' prepared by the CoGG identified movement networks, land uses and open space networks for the two Growth Areas. For reference the draft Future Urban Structure Plan for each Growth Area is provided in Figure 1.2 at the end of this section.

CoGG is now preparing a 'Framework Plan' which will guide future land use development and infrastructure delivery for each of the Growth Areas. This 'Movement and Access Report' tests the appropriateness of the movement network identified for the Framework Plan. Should the Framework Plan be adopted by CoGG, a series of Precinct Structure Plans (PSP) will be prepared for each Growth Area.

The timeline for the NWGGA project, including GTA's input, is presented in Figure 1.1.

Figure 1.1: NWGGA Project Timeline



Information sourced from https://www.geelongaustralia.com.au/futuregrowth/default.aspx

1.2. Purpose & Structure of this Report

This 'Reduced Size Format' report has had the bulk of the appendices removed to allow the report to be more user friendly in terms of printing and downloading requirements.

This Movement and Access report sets out an assessment of the transport impacts of the proposed Framework Plan, including consideration of the following:

1. Existing conditions pursuant the transport network in the vicinity of the site – *refer to Section 2 of this report*
2. Proposed land uses and transport network identified in the Framework Plan – *refer to Section 3 of this report*
3. Performance of the base transport network using strategic modelling – refer to Section 4 of this report *(and Appendix A, B and C)*.
4. Testing alternate transport network scenarios and presenting road network recommendations – refer to Section 5 of this report *(and Appendix D, Appendix E and Appendix F)*.
5. Recommendations relating to sustainable transport measures, including pedestrians, cyclists and public transport – refer to Section 6 of this report.

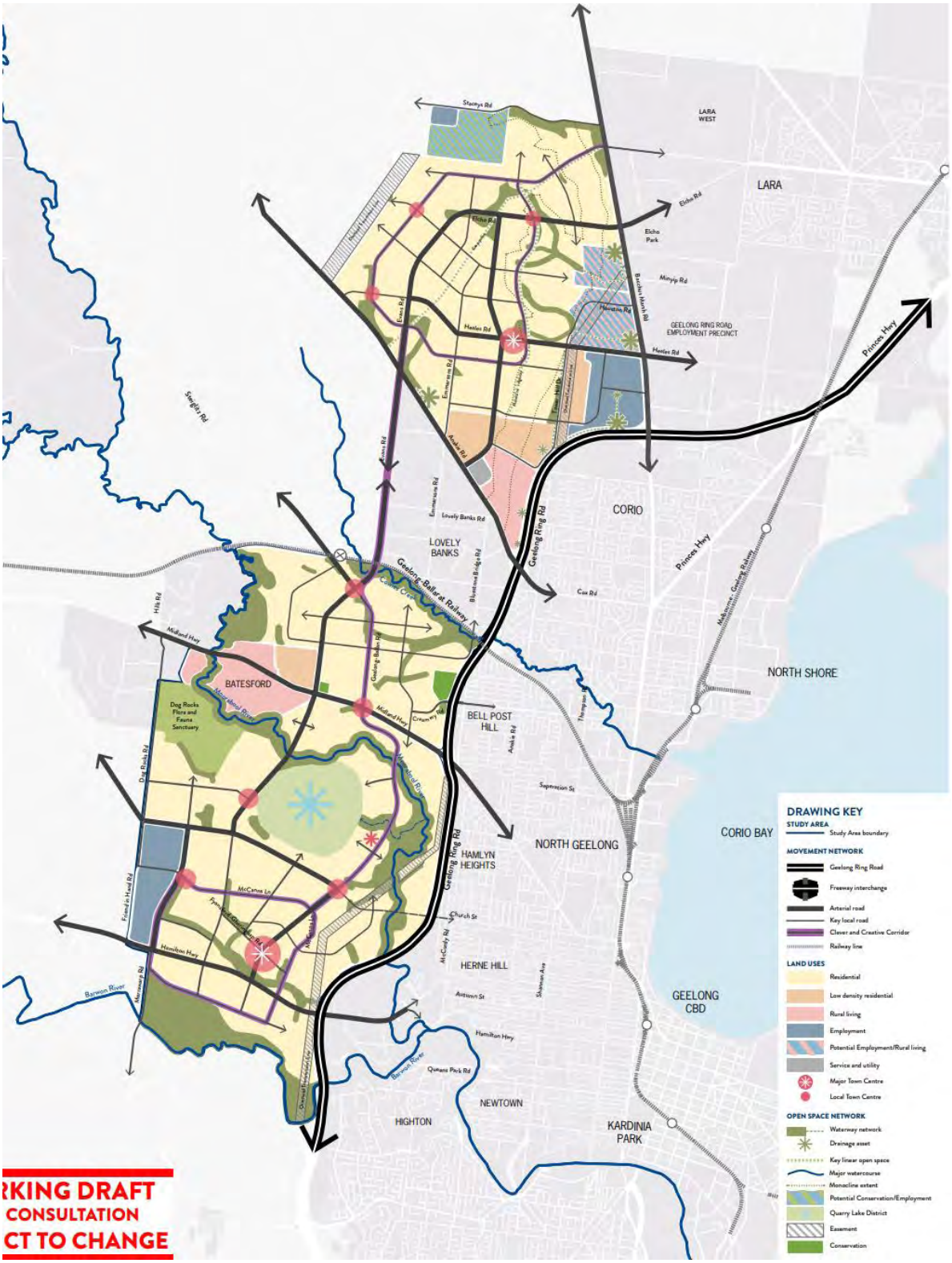
6. Review of cross-sections and gradients– refer to Section 7 of this report.

1.3. References

In preparing this report, reference has been made to the following:

- Greater Geelong Planning Scheme
- Draft 'Future Urban Structure Plan' prepared by CoGG (dated 28 March 2018)
- 'Geelong Growth Areas Validation Report VITM Model Development' prepared by GTA dated 11 September 2018
- an inspection of the site and its surrounds
- other documents as nominated.

Figure 1.2: Future Urban Structure Plan (Working Draft)



Sourced from CoGG Website : https://www.geelongaustralia.com.au/common/public/documents/8d5b4f6cba5a9d6-180328nwggadraftnorthfpv11.pdf
Note: This road network represents the standard project case road network that has been modelled as part of this assessment, additional road network sce narios have also been assessed.

2. EXISTING CONDITIONS

The NWGGA project areas currently have good road network access with poor public and active transport access. Accordingly, current residents and workers in the two areas have a high reliance on private vehicle travel.

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2.1. Growth Area Location

The NGGA comprises an area of 2,089ha and is located approximately 12km to the northwest of the Geelong CBD and 7km west of Lara. Land use zoning within the NGGA is a mix of Farm Zone (FZ), Urban Growth Zone (UGZ) and Rural Living Zone (RLZ). The southern and eastern portions of the land contain some largely residential built up areas. Key existing land uses include:

- Geelong Baptist College
- Barwon Water Lovely Banks Basins.

The WGGA comprises an area of 3,245ha and is located approximately 5km west of the Geelong CBD. Land use zoning within the WGGA is primarily a mixture of Farm Zone (FZ), Special Use Zone – Schedule 7 (SUZ7) and Rural Conservation Reserve – Schedule 12 (RCZ12). The area contains a number of rural and low density residential uses. Key existing land uses include:

- Batesford Township
- Batesford Quarry
- Dogs Rocks Flora & Fauna Reserve
- Covenant College
- Rollins Primary School
- Bell Park Sports Club
- Eldorado Tourist Park.

The location of the NWGGA in relation to the existing Geelong township is presented in Figure 1.2.

2.2. Road Network Characteristics

The road network within and surrounding the NWGGA varies between primary arterial roads and unsealed 'dry weather only' local roads. Bacchus Marsh Road and Anakie Road are the key roads that service the NGGA, whilst Midland Highway and Hamilton Highway are the key roads that service the WGGA. Each of these key roads provide interchange access to the Geelong Ring Road which separates the NWGGA from the established areas of Geelong. With the exception of Anakie Road, which is a Council controlled road, each of the key roads are state arterial roads.

The characteristics of the key roads servicing the NWGGA are summarised in Table 2.1.

Table 2.1: Existing Characteristics of Key Roads

Road Link	Number of Traffic Lanes	Active Travel Provision	Speed Limit	Daily Traffic Volume [1]
Bacchus Marsh Road	1 lane in each direction	Shared path south of Heales Road	70-100km/h	11,400vpd
Anakie Road	1 lane in each direction	Footpath south of Geelong Baptist College	80-100km/h	NA
Midland Highway	1 lane in each direction	Shared path provided on north side	70 – 80 km/h (varies) [1]	14,000vpd
Hamilton Highway	1 lane in each direction	None	80 km /h	9,600vpd
Geelong Ring Road	2 lanes in each direction	Shared path provided on south and east side	100km/h	27,000vpd

[1] Traffic volume information sourced from VicRoads AADT traffic volume database for arterial roads (2016 data).

2.3. Transport Modelling

The SVITM Reference Case model for the study area has been refined and presented to provide a comparison in order to determine the suitability of the model for testing the impact of future land-use change and precinct structure plans.

The model's land use and demographic data was updated to incorporate data provided by SGS Economics. Additionally, the transport network was updated to reflect the current configuration and to match its existing operation.

The model outputs were presented against observed traffic data. However, it should be noted that there were limitations in the amount of traffic data available for the study. As such, this has restricted the ability for a more forensic review to be undertaken. With this in consideration, the model was found to broadly replicate the performance of the transport network, in particular around the Geelong Ring Road and its interchanges.

The development of the network was undertaken in close consultation with the Department of Transport (DoT) and the City of Greater Geelong. A meeting was held with officers from the Department of Transport (dated 12 September 2018) in which they confirmed the acceptability and suitability of the validation report. Given the scope of works is investigating the performance of the network some 35 years into the future, these limitations can be included in the interpretation of results and outputs (if required). Based on the above discussion, the Geelong Base Model is considered suitable and has been used in testing future land use and development in Geelong.

The existing journey times extracted from SVITM for vehicles travelling from the NGGA and WGGA are presented in Figure 2.1 and Figure 2.2, respectively. It is noted that the journey travel times are calculated over a 2-hour period for the AM and PM peak periods. Further, the journey travel times are based on link speeds and do not take into account specific intersection delays.

Figure 2.1: Journey Travel Times – NGGA (AM Peak 2-Hour)

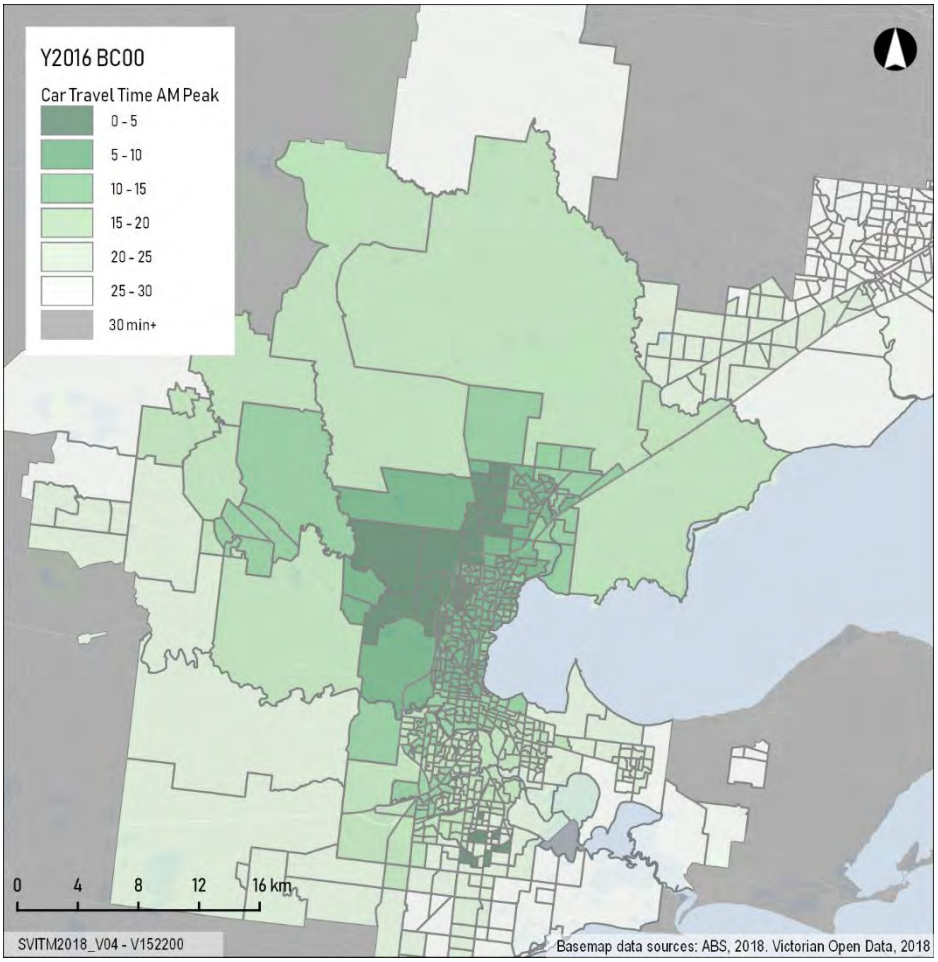
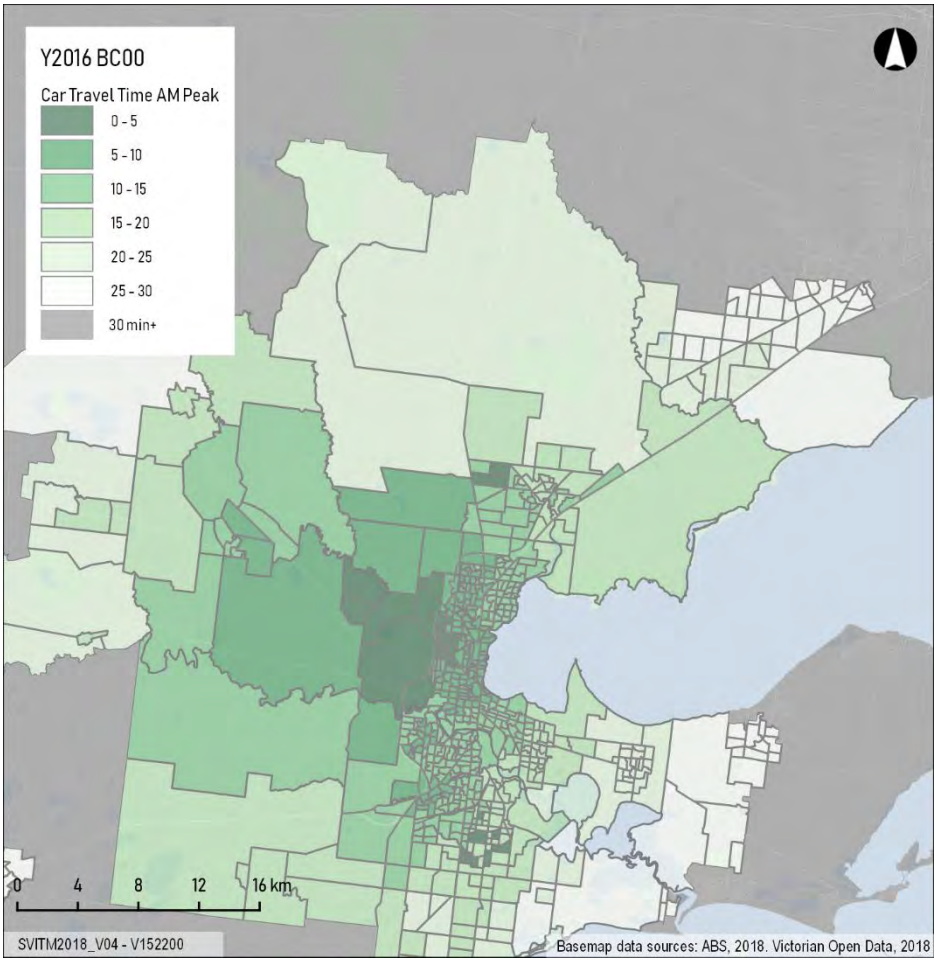


Figure 2.2: Journey Travel Times – WGGA (AM Peak 2-Hour)



Further detail regarding the model development including validation is provided in Section 4.

2.4. Public Transport Network

There are presently limited public transport opportunities in the vicinity of the NWGGA.

There is currently one local public transport route which travels near the NGGA. Bus Route 10 from Lara to Corio Shopping Centre operates along Bacchus Marsh Road with a stop located at O'Briens Road at the southeast corner of the NGGA. This service typically operates hourly.

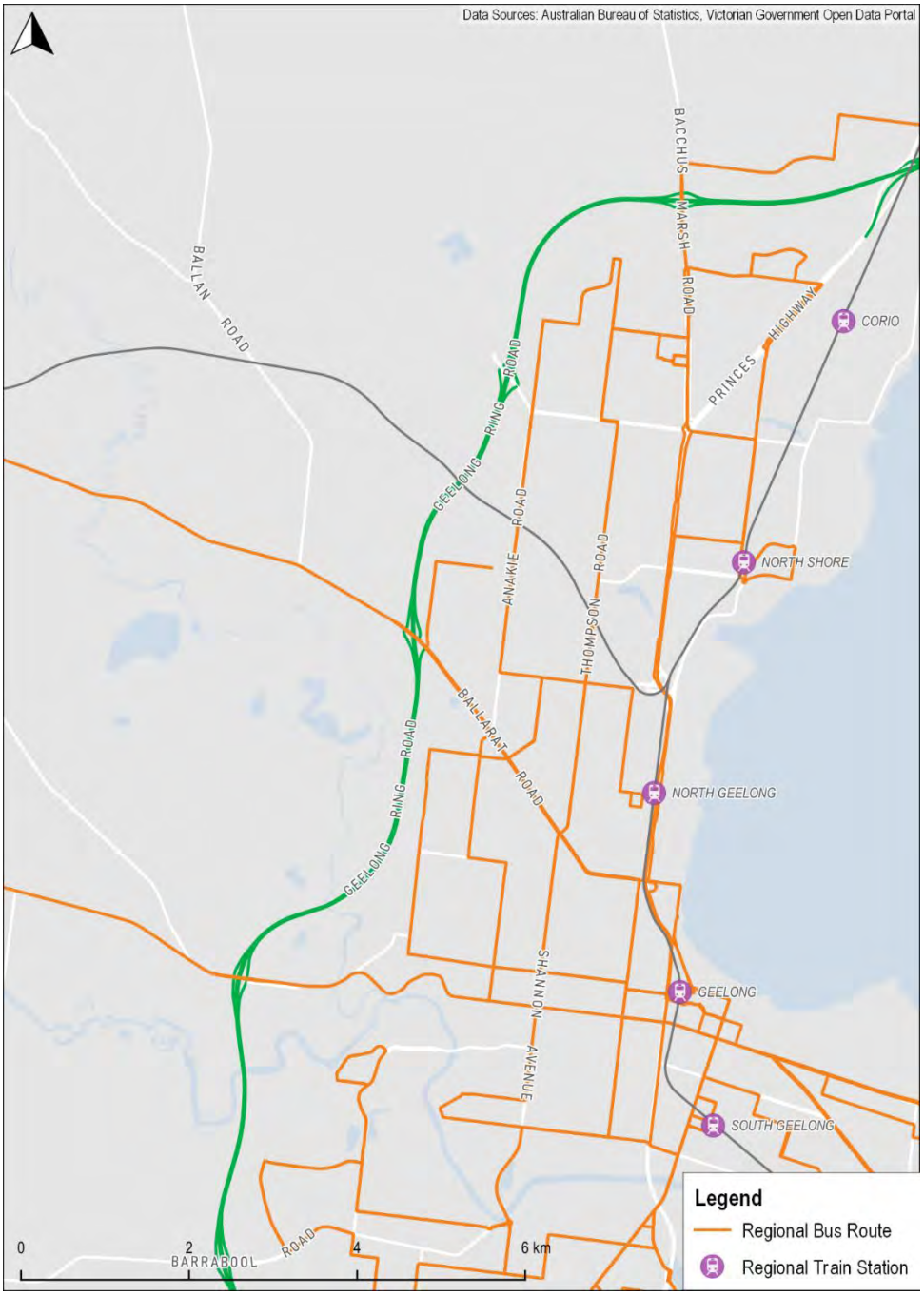
There is currently one local public transport route which travels through the WGGA. Bus route 19 from Geelong to Bannockburn operates along the Midland Highway. However, there is only one daily service in each direction. In addition, bus route 25 operates just outside of the WGGA and travels along the Midland Highway and Rollins Street (from the Midland Highway to Creamery Road) to the east of the Geelong Ring Road. The bus travels between Bell Post Hill and the Geelong Railway Station and operates at 20 and 25-30 minute frequencies on weekdays and weekends respectively.

Lara train station is located approximately 8.5km to the northeast of the NGGA and Corio train station is located approximately 7.5km to the southeast of the NGGA, whilst the North Geelong and Geelong train stations are located approximately 6km east of the WGGA. Both stations are on the Geelong-Melbourne Line and provide frequent services between the two destinations, with 20 minute frequencies off peak and more frequent services during commuter peak hours.

The Ballarat – Geelong train line forms the northern boundary of the WGGA and currently caters for freight rail only. Passenger services previously operated along this section of the rail line with the former Moorabool Railway Station abutting the area, however these services ceased some decades ago.

The existing bus routes and railway stations servicing NWGGA and Geelong are summarised in Figure 2.3. The level of existing public transport accessibility (or lack of) is commensurate to the current land uses currently contained within the growth areas.

Figure 2.3: Existing Public Transport Services – NWGGA



2.5. Active Travel Network

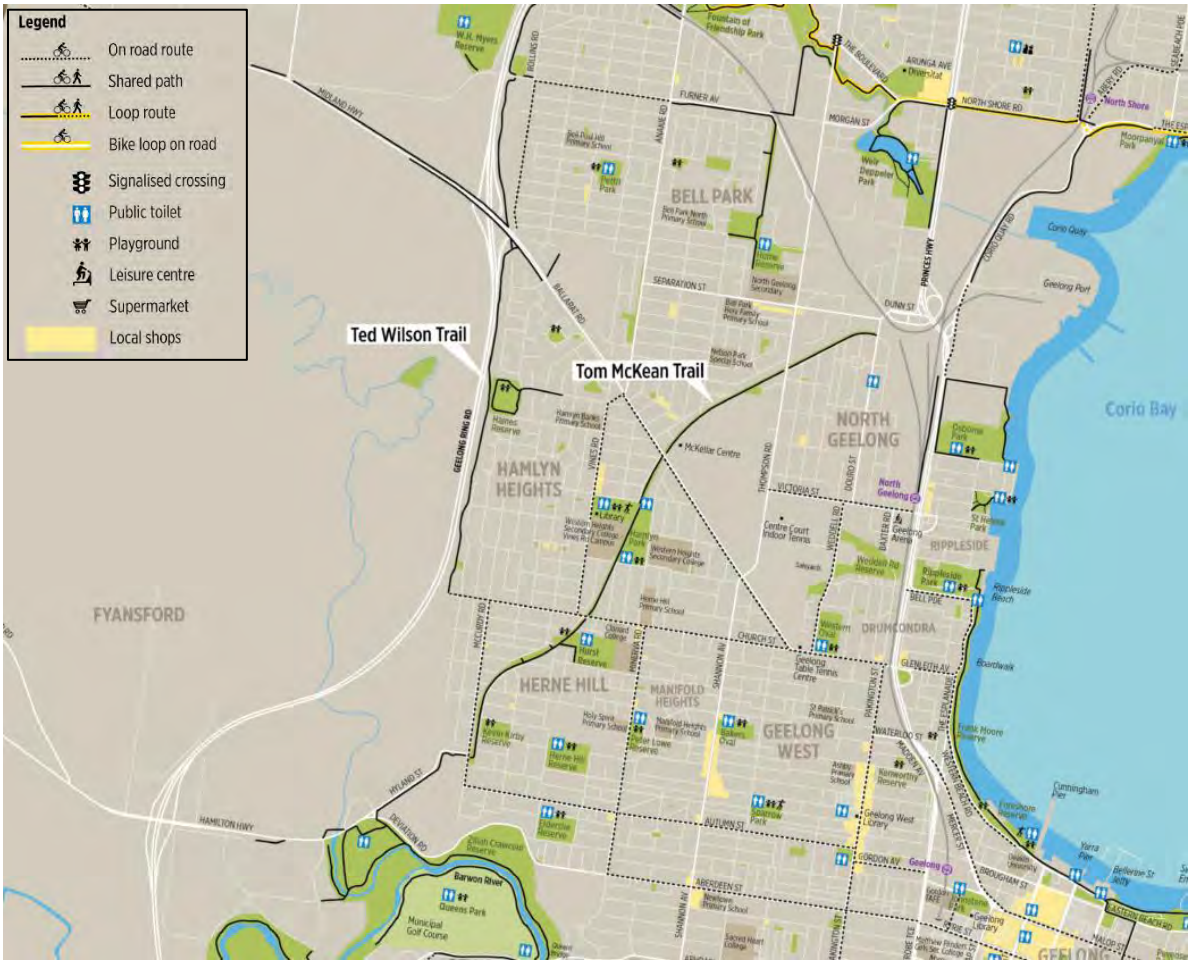
There are presently very limited formal active transport opportunities within the NWGGA. There is however an established shared path network constructed as part of the Geelong Ring Road project which provides an orbital path from Broderick Road in Corio to Church Street to Hamlyn Heights. This orbital path connects to shared paths at Bacchus Marsh Road, Anakie Road, Cowies Creek and Midland Highway. However, the Bacchus Marsh Road, Anakie Road and Midland Highway connections do not currently provide continuous shared path connections into Geelong CBD.

The existing active transport provisions for the NGGA and WGGA are presented in Figure 2.4 and Figure 2.5, respectively.

Figure 2.4: Existing Active Transport Provisions – NGGA

Sourced from CoGG website - https://www.geelongaustralia.com.au/parks/paths/article/item/8d18a8eae993311.aspx

Figure 2.5: Existing Active Transport Provisions – WGGA

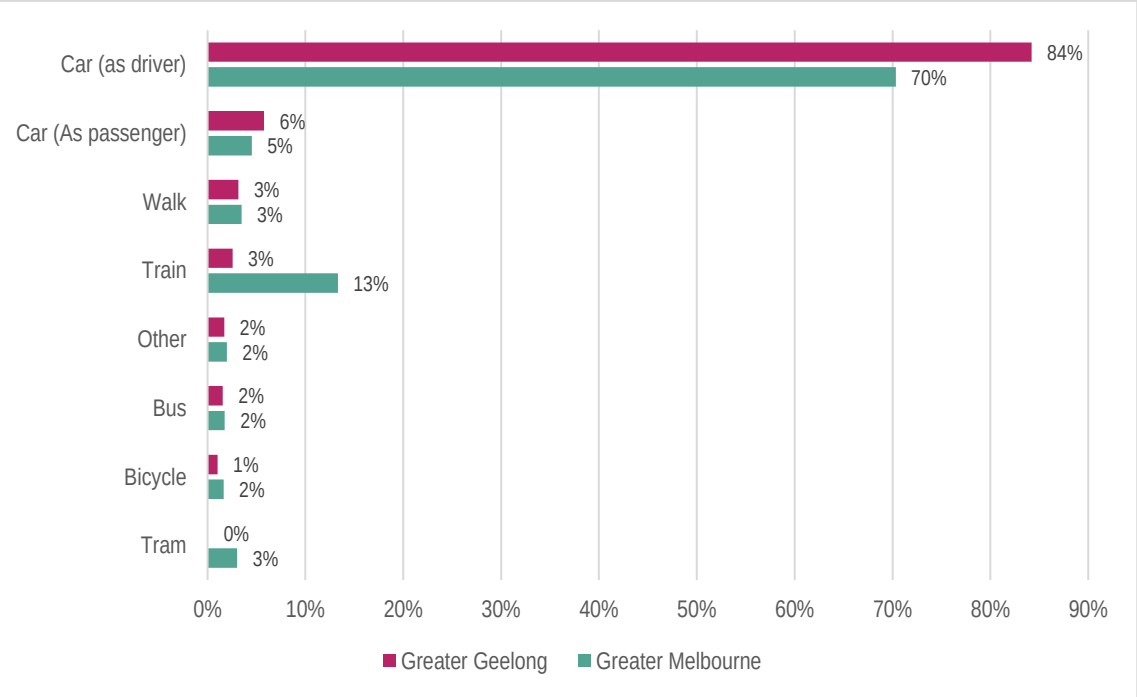


Sourced from CoGG website - https://www.geelongaustralia.com.au/parks/paths/article/item/8d18a8eae993311.aspx

2.6. Existing Travel Behaviour

Guidance on existing travel behaviour has been sourced from the Australian Bureau of Statistics (ABS) 2016 Census data, which provides information regarding journey to work mode choices. Data for a number of areas within Geelong and wider Victoria have been extracted to determine the variance in travel behaviour between the different locations[1]. This data is provided in Figure 2.6.

Figure 2.6: ABS Journey to Work Data – Greater Geelong v Greater Melbourne



The data indicates that the existing residents of the Greater Geelong area rely heavily on private vehicle use to get to/from work. Key findings from the ABS data includes:

- 90% of Geelong residents use private vehicle to get to work, compared to 75% for Greater Melbourne
- 5% of Geelong residents use public transport to get to work, compared to 19% for Greater Melbourne
- 4% of Geelong residents use active travel modes to get to work, compared to 5% for Greater Melbourne.

Additionally, Victorian Integrated Survey of Travel and Activity (VISTA) data has also been sourced for Geelong and the inner, middle and outer areas of Melbourne. VISTA data relates to all journeys rather than just journeys to work (as captured by the ABS data). This data is presented in Table 2.2.

Table 2.2: Existing VISTA Mode Share Data Residential Trips Geelong Compared to Melbourne

Mode	All	Inner Melbourne	Middle Melbourne	Outer Melbourne	Geelong
Vehicle Driver	52%	42%	52%	57%	57%
Vehicle Passenger	24%	18%	24%	26%	23%
Train	5%	7%	5%	3%	1%
Tram	1%	4%	1%	0%	0%
Bus	2%	1%	2%	1%	2%
Bicycle	2%	5%	1%	1%	2%
Walking	15%	23%	15%	11%	15%
Total	100%	100%	100%	100%	100%

The data indicates that the existing travel behaviour of residents in the City of Greater Geelong generally aligns with areas of outer Melbourne, with high private vehicle usage (80%) and relatively low usage of alternate transport modes (20%). The VISTA data suggests that the existing travel behaviour for Geelong is generally consistent with outer Melbourne areas.

Overall the ABS and VISTA mode share splits for Geelong are not surprising given the relative ease of getting around Geelong by private vehicle.

A further review of the ABS journey to work data indicates the following employment destinations for residents of Greater Geelong:

- 82% to Greater Geelong
- 10% to Metropolitan Melbourne comprising of:
  - 4.8% to City of Melbourne
  - 2.7% to Wyndham
  - 0.9% to Hobsons Bay
  - 0.8% to Hume (includes Melbourne Airport).
- 8% to other areas (Surf Coast, Golden Plains, etc.)

Of note, the data suggests that around 10% of workers in Geelong do travel to metropolitan Melbourne.

2.7. Summary

A summary of the key findings of the existing conditions is presented below:

- The broader Geelong road network generally operates within its theoretical capacity, although a number of key road links are beginning to approach their capacities.
- The existing Geelong Ring Road interchanges currently operate below their theoretical capacities.
- The alignment of the Geelong Ring Road acts as a barrier to vehicles accessing the established areas of Geelong from the NWGGA.
- Given the undeveloped nature of the study area there is minimal public transport accessibility.
- An existing active travel network is provided along the Geelong Ring Road with onward links to inner Gelong provided at Cowies Creek, Midland Highway, Anakie Road and Bacchus Marsh Road. Noting that for the most part these links do not provide a continuous connection to Geelong CBD.
- Private vehicle is the dominant travel mode for residents of Geelong.

3. NWGGA OVERVIEW

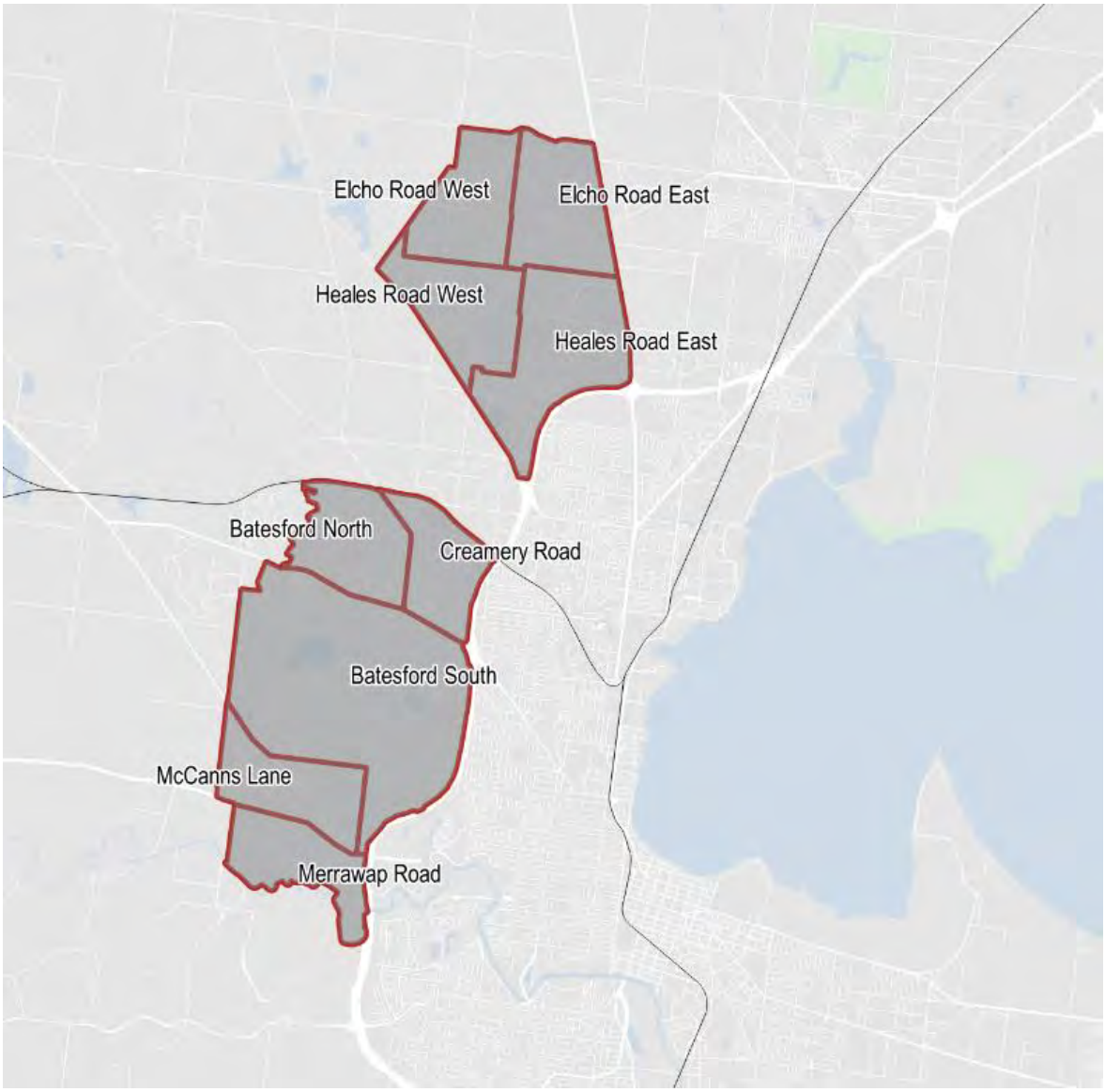
The 'Future Urban Structure Plans' prepared by the CoGG identifies the movement network, land use and open space network for the NWGGA. An overview of the movement network and land uses is presented in the following section.

03

3.1. Overview

A total of nine PSP areas have been identified for the NWGGA, including four within the NGGA and five within the WGGA. The location of each of the PSP areas is presented in Figure 3.1.

Figure 3.1: Overview of PSP Areas



3.2. Land Uses

3.2.1. NWGGA Summary

CoGG in conjunction with SGS Economics have determined the future land uses within the NWGGA. A summary of the forecast population, dwellings, employment and enrolment numbers for each PSP Area for the 2031 and 2051 design years are presented in Table 3.1.

Table 3.1: NWGGA Land Use Summary

PSP Area	2031				2051			
	Population	Dwellings	Employment	Enrolments	Population	Dwellings	Employment	Enrolments
Elcho Road West	3,080	1,100	390	670	11,480	4,100	750	1,730
Elcho Road East	5,880	2,100	150	270	12,040	4,300	240	670
Heales Road West	3,920	1,400	2,110	670	14,000	5,000	3,640	2,530
Heales Road East	840	300	190	270	8,960	3,200	4,380	670
NGGA Sub Total	*13,720*	*4,900*	*2,840*	*1,880*	*46,480*	*16,600*	*9,010*	*5,600*
Batesford North	5,570	1,990	380	860	12,070	4,310	600	1,830
Creamery Road	5,880	2,100	370	280	7,730	2,760	520	800
Batesford South	310	110	920	360	26,010	9,290	4,480	2,380
McCanns Lane	3,720	1,330	2,480	250	9,300	3,320	4,170	1,190
Merrawarp Road	4,650	1,660	170	290	6,500	2,320	200	560
WGGA Sub Total	*20,130*	*7,190*	*4,320*	*2,040*	*61,610*	*22,000*	*9,970*	*6,750*
Total (combined)	33,850	12,090	7,160	3,920	108,090	38,600	18,980	12,360

Valid for PC01-PC10. PC11 & PC12 contain no development within Batesford South.

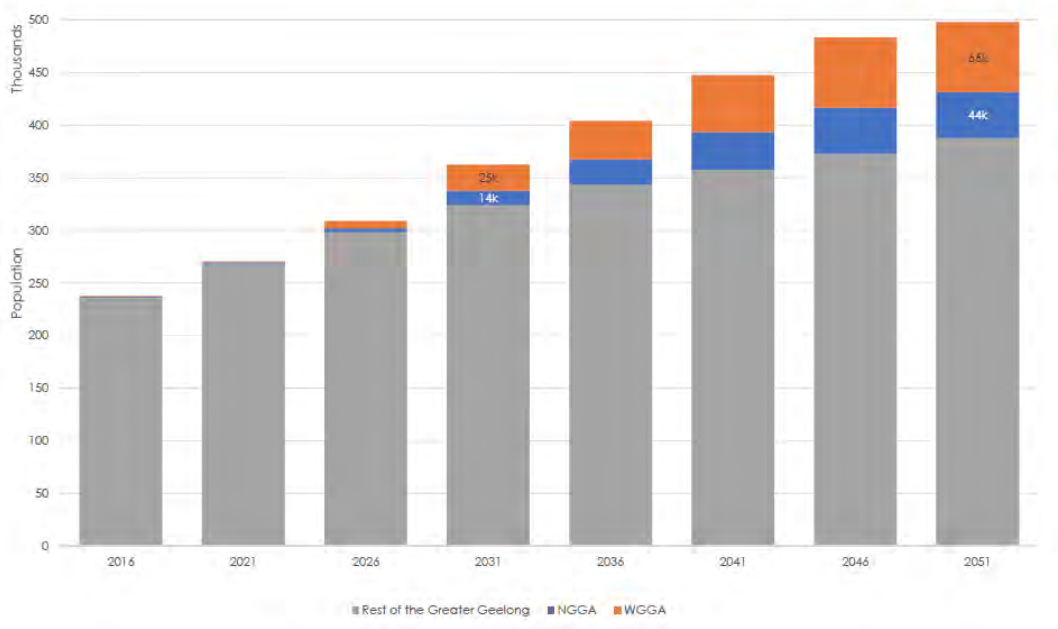
Table 3.1 indicates that ultimately the NWGGA is forecast to accommodate approximately 108,000 residents, 19,000 jobs and 12,000 enrolments. Approximately 46,000 residents will be located within the NGGA and 62,000 residents within the WGGA. The expected employment is generally even across the two growth areas, however it is noted that it is considerably low as a proportion of the population. As such, there will still be a high proportion of residents expected to travel outside of both growth areas to access employment.

All of the enrolments in the growth areas are primary and secondary and do not include any tertiary facilities.

3.2.2. Geelong Population Forecast

The forecast population growth of Geelong, the NGGA and the WGGA between 2016 and 2051 is presented in Figure 3.2. The data indicates that the overall population of Geelong is forecast to increase from approximately 240,000 in 2016 to 500,000 in 2051 (an increase of 260,000 residents). The NWGGA represents about 42% of the overall population growth forecast during this period, with the balance of growth predominantly relating to Armstrong Creek and infill development.

Figure 3.2: Population Forecasts (2016 to 2051)

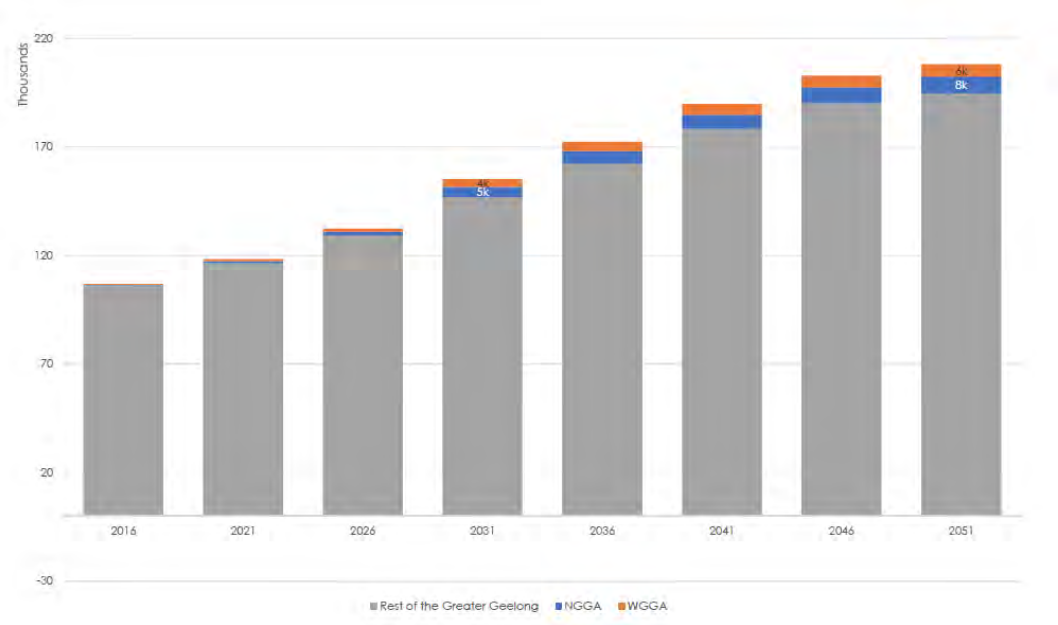


Sourced from SGS Economics data provided to the project team.

3.2.3. Geelong Employment Forecast

The forecast employment growth of Geelong, the NGGA and the WGGA between 2016 and 2051 is presented in Figure 3.3. The data indicates that overall employment in Geelong is forecast to increase from approximately 105,000 in 2016 to 205,000 in 2051 (an increase of 100,000 jobs). The NWGGA represents about 14% of the overall jobs growth forecast during this period.

Figure 3.3: Employment Forecasts (2016 to 2051)

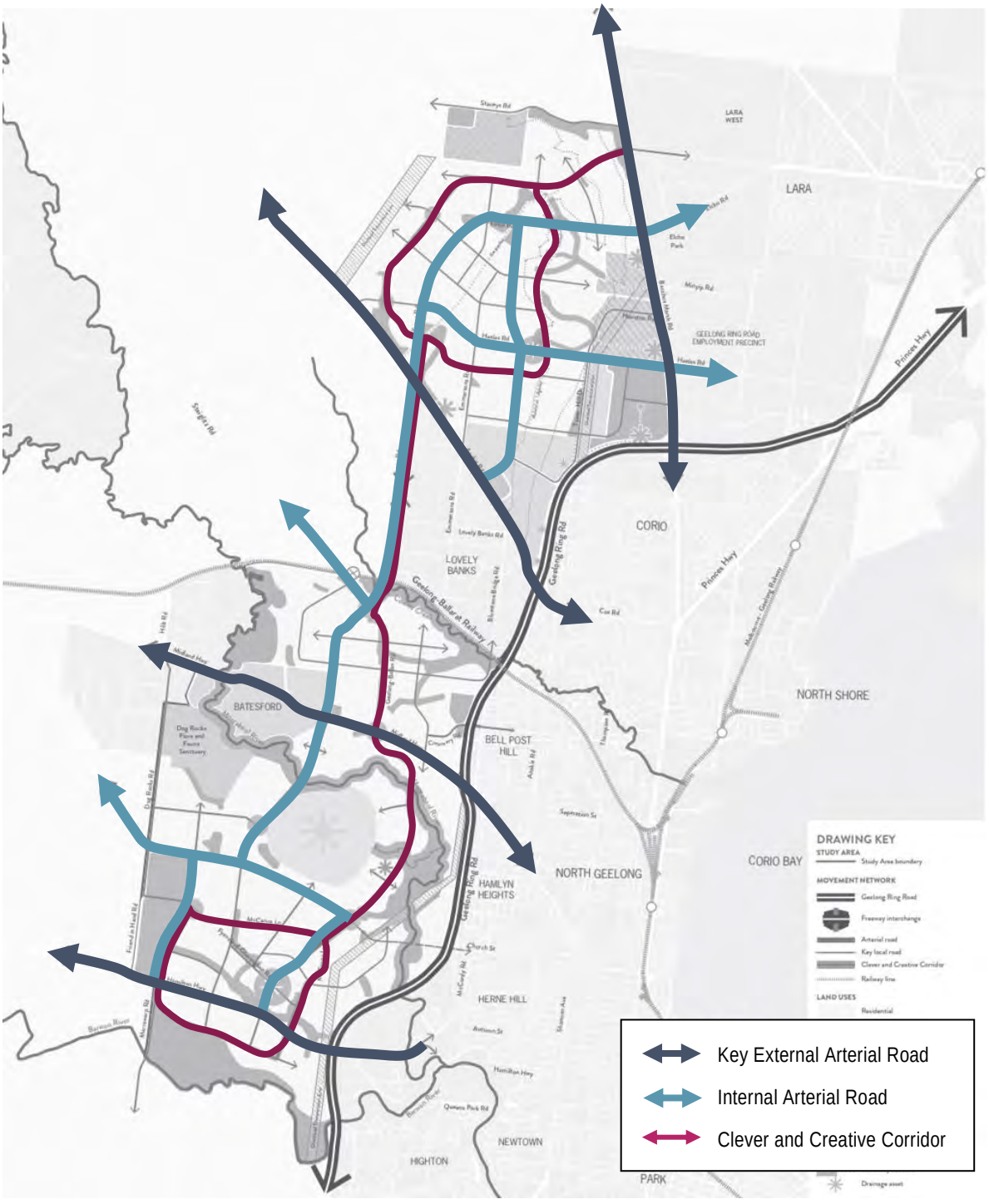


Sourced from SGS Economics.

3.3. Road Network

The proposed arterial and clever and creative corridor road network is presented in Figure 3.4. This road network will be complemented with a series of Council controlled roads, including connector roads, access streets and local roads. This road network represents the standard project case road network that has been modelled as part of this assessment, additional road network scenarios have also been assessed and are presented in Section 4.2.

Figure 3.4: Proposed NWGGA Higher Order Road Network



This road network, along with a number of alternative road network scenarios, has been tested as part of this report. Ultimately, the road network assessed as part of PC04b has been adopted for the framework plan.

The movement network for the NGGA will be configured with three major access points (arterial road or Clever and Creative Corridor) to Bacchus Marsh Road and one major access point to Anakie Road. These major access points will be complemented with a series of lower order connections (i.e. Council connector roads) to the existing arterial road network.

The movement network for the WGGA will be configured with two major access points (arterial road or Clever and Creative Corridor) to Hamilton Highway and two major access points to Midland Highway. Again, these major access points will be complemented with a series of lower order connections to the existing arterial road network.

The base road network does not include any additional road links across the Geelong Ring Road.

3.3.1. Clever and Creative Corridor

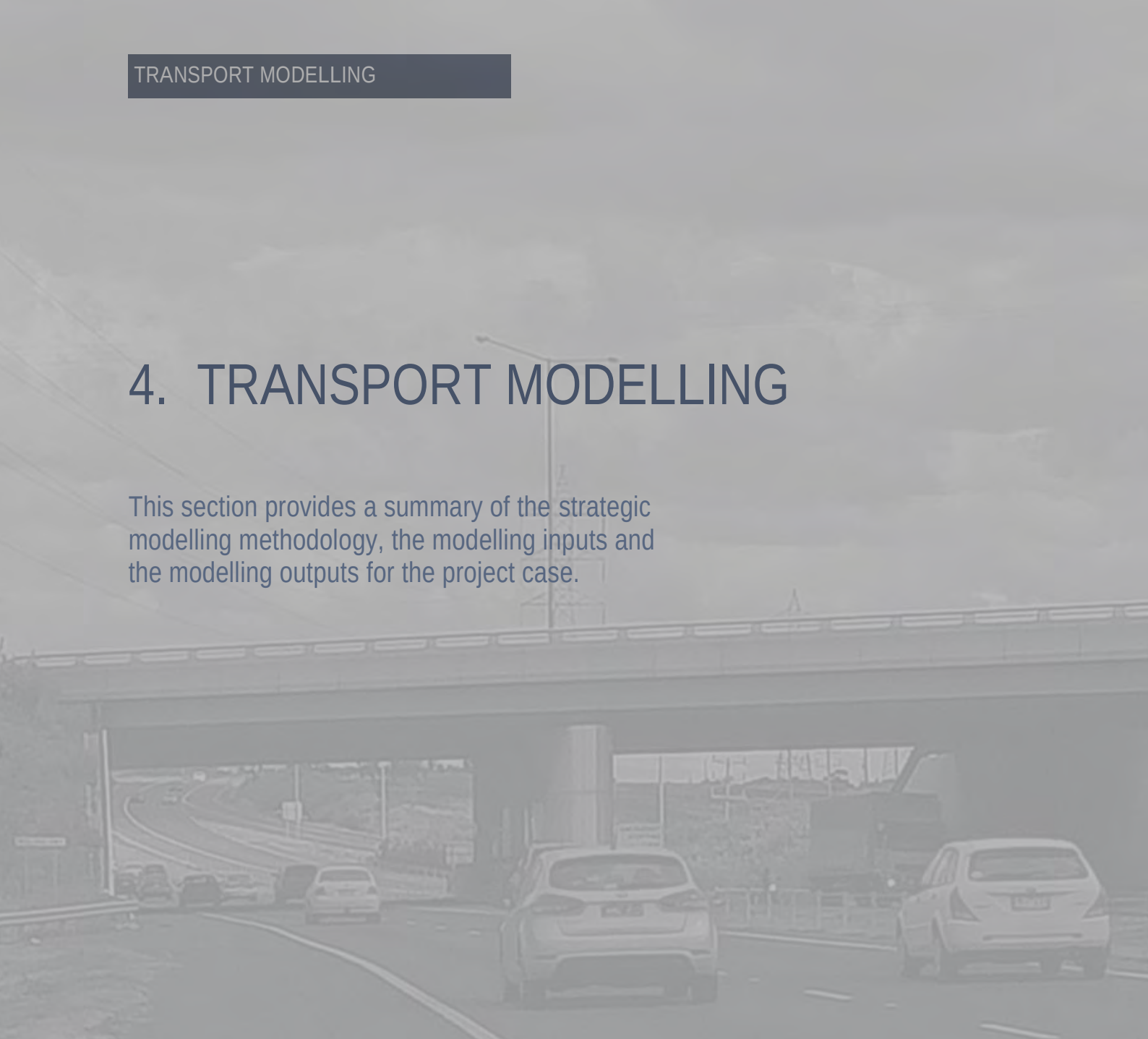
The Clever and Creative Corridor is intended to be a boulevard that prioritises public transport, walking and cycling modes and connects key land uses together, such as activity centres, schools and open space. The Clever and Creative Corridor has been identified as a means to meet the objectives of the 20 minute neighbourhood; which is identified in Plan Melbourne as "giving people the ability to meet most of their everyday needs within a 20-minute walk, cycle or local public transport trip of their home".

The Clever and Creative Corridor forms a loop in both growth areas and is linked by Evans Road. Additionally, it provides a connection to a potential future railway station located at the northern end of the WGGA on the disused Geelong to Ballarat line. From a "movement and place" perspective the Clever and Creative Corridor will have a greater place function (whilst maintaining its movement function) compared to a traditional connector or arterial road.

From a modelling perspective the Clever and Creative Corridor has been modelled as a low speed link (40kmh) with restricted vehicle movements (right turn bans) at key locations along the link.

4. TRANSPORT MODELLING

This section provides a summary of the strategic modelling methodology, the modelling inputs and the modelling outputs for the project case.



04

4.1. Overview

4.1.1. Strategic Modelling

Transport modelling is used around the world to forecast the number of users (demand) that will travel on a transport system at a given point in time. There are generally three layers of models: strategic, tactical and operational. As part of this project strategic transport modelling has been used to understand how the NWGGA will function in the future with consideration of the broader context it sits within.

The traditional approach to strategic transport modelling is undertaken through the following four-step process, noting they are iterative and there are feedback loops within the process:

1. Trip Generation – how many users are travelling
2. Trip Distribution – where users are travelling to and from
3. Mode Choice – what form of transport users choose to make a trip
4. Route Assignment – what routes users take.

The four-step model provides the fundamental basis for insights into future transport patterns. However, the more significant the levels of development and/or the transport initiatives being implemented, the more an iterative approach guided by a top-down transport vision and strategy should be used to arrive at an 'acceptable' solution or 'desired' arrangements. Relying on a model to reflect how people will behave or consider interconnected urban form factors is beyond its capability.

This more iterative outcome-based approach to modelling reflects a major shift in transport planning away from trying to provide 'enough' road network capacity to a more integrated and user centric transport and land use approach.

An overview of this shift and its considerations are outlined in Table 4.1. These 'new' considerations align with the overarching strategic context set out in the various background reports and technical studies. For example, one of the scenarios tested considers the impact of an increased take up of public transport usage.

Table 4.1: The Changing Transport Planning Paradigm

Concept	Old Paradigm	New Paradigm
Definition of transport	Movement	Accessibility
Modes	Cars (and heavy rail)	Multimodal – walking, cycling, freight, services, public transport, driving
Outcomes	Congestion (free flow versus speeds), time cost savings, vehicle Kms	Congestion, reliability, productivity, regeneration, safety, emissions, urban realm and plan, supporting land use objectives
Impacts Consider	Speeds, congestion (free flow versus speeds) vehicle operating costs and fares, crash and emission based on vehicle kms	Triple bottom line assessment considering economic, social and environmental outcomes
Performance indicators	Speeds	Level of service (all modes), access (catchments), user experience, safety, security, and environmental impacts
Favoured transport improvements	Capacity	Improve all transport options, demand management, and informing city planning
Planning scope	Planning for transport is isolated	Integrated planning that is iterative and supports wider aims and embed consultation in the process.

Table adapted from Litman (2013) *The New Transportation Planning Paradigm*, Institute Transportation Engineers Journal, June 2013.

4.1.2. Model Details

Transport modelling has been undertaken using the State-wide version of the Victorian Integrated Transport Model (S-VITM). S-VITM is a tool held by Transport for Victoria (TfV) to assist in the planning of road and public transport infrastructure in Victoria.

The version of S-VITM used as a starting point for this project is the S-VITM-2018 held by TFV, which covers the whole transport network of the state of Victoria. It was the latest S-VITM version available at the commencement of the project (the use of this model version was agreed with Department of Transport officers at the commencement of the project). Comparing the previous VITM and S-VITM models, the lasts version has following enhancements:

- Enhancements made to the public transport rail station park and ride model, including the provision of station parking constraints
- The inclusion of the dynamic level crossing delay calculations
- The integration of the Freight Movement Model.

S-VITM is a multimodal strategic model that uses future population, employment and land use data projections to forecast travel behaviour and the impacts of changes to the road and public transport networks. It is important to understand the limitations and assumptions used in the modelling when making an assessment based upon the model outputs.

4.1.3. Model Limitations

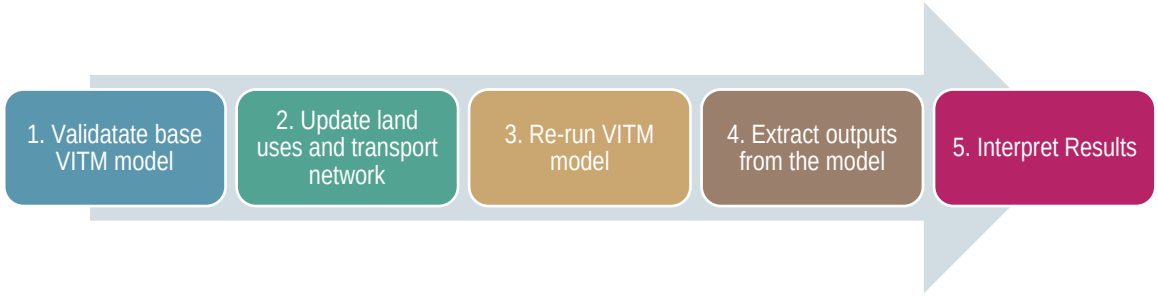
Strategic models are based on mathematical modelling which provides a simplification of travel behaviour for a given network and time period. The main limitations in using strategic models vary. For this model, limitations include:

- Level of detail – strategic models cannot model detailed characteristics of traffic behaviour, such as lane changing, queuing, signal timings or other operational aspects. Detail in land use and demographics are also lost in the aggregation of zones.
- Accuracy of input assumptions – strategic models require inputs relating to land use and the road network and cannot produce outputs that are more accurate than the data used. For example, population, employment and enrolment numbers are all inputs into the model for the trip generation component of the model.
- Estimation of real-world behaviours – the model relies on mathematical modelling which aims to estimate real world behaviours. However, it does not consider other factors that influence travel behaviour such as user perception and driver awareness.

4.1.4. Model Process

An overview of the model process is presented in Figure 4.1.

Figure 4.1: S-VITM Modelling Process Chart



The S-VITM has been separately validated, with the model validation process and outcomes presented in the GTA Report 'Geelong Growth Areas Validation Report VITM Model Development' dated 11 September 2018. This report concluded that:

"…the model was found to broadly replicate the performance of the transport network, in particular around the Geelong Ring Road and its interchanges."

"… the information presented in this report indicates that the Geelong Base Model is suitable for use in testing future land use and development in Geelong."

The subsequent steps from the above process chart are set out in the following sections.

4.1.5. Model Scenarios

A number of modelling scenarios have been run to test various land use and road network assumptions, such as with and without external arterial road upgrades, modified internal road network for the NGGA, different alignments for river crossings in the WGGA, consideration of a Church Street connection, with and without development of the existing quarry and public transport usage.

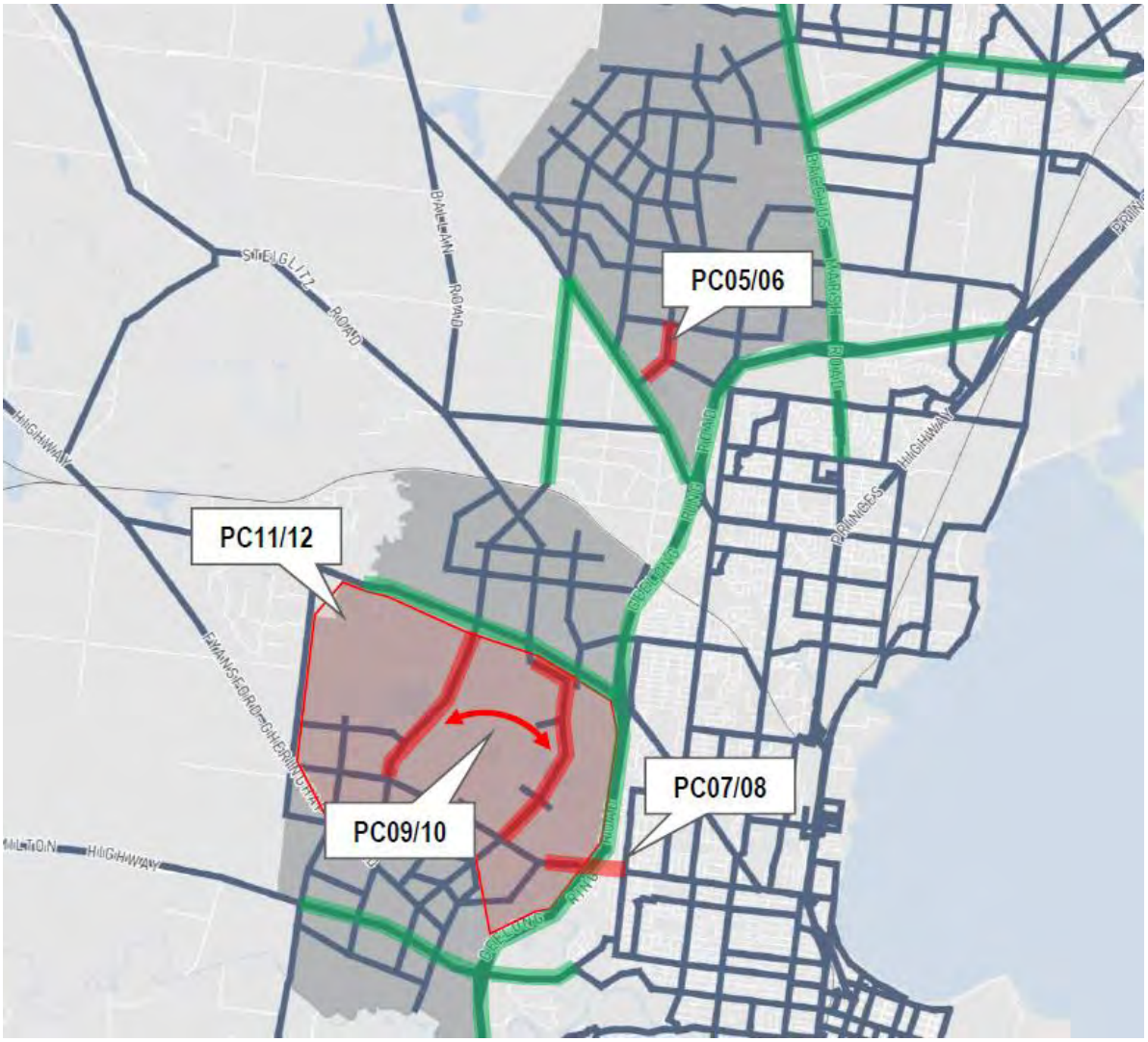
A summary of the modelling scenarios is provided in Table 4.2 and Figure 4.2

Table 4.2: Overview of Modelled Scenarios

Model Run	Description	Daily Traffic Volume Results Reference
BC01	2031 base case with no development at NWGGA	Appendix A
PC01	Interim 2031 project case without external road upgrades	Appendix B
PC02	Interim 2031 project case with external road upgrades	Appendix B
BC02	2051 base case with no development at NWGGA	Appendix A
PC03	Ultimate 2051 project case without external road upgrades	Appendix C
PC04	Ultimate 2051 project case with external road upgrades	Appendix C
PC05	Ultimate 2051 project case without external road upgrades and one vehicle connection to Anakie Road removed from NGGA	Appendix D
PC06	Ultimate 2051 project case with external road upgrades and one vehicle connection to Anakie Road removed from NGGA	Appendix D
PC07	Ultimate 2051 project case without external road upgrades and Church Street connection across Ring Road	Appendix D
PC08	Ultimate 2051 project case with external road upgrades and Church Street connection across Ring Road	Appendix D
PC09	Ultimate 2051 project case without external road upgrades with realigned arterial road in WGGA	Appendix D
PC10	Ultimate 2051 project case with external road upgrades with realigned arterial road in WGGA	Appendix D
PC11	Ultimate 2051 project case (excluding development of Batesford South PSP – i.e. Quarry) without external road upgrades	Appendix D
PC12	Ultimate 2051 project case (excluding development of Batesford South PSP – i.e. Quarry) with external road upgrades	Appendix D
PC04A	Ultimate 2051 project case with external road upgrades and increased public transport usage	Appendix E
PC04B	Ultimate 2051 project case with external road upgrades and modified road network in NGGA	Appendix F

Note: The definition of with and without external road upgrades is presented in Section 0.

Figure 4.2: Overview of Scenarios Tested



4.2. Model Inputs

4.2.1. Land Uses

The S-VITM has been coded with the updated land use assumptions presented in Section 3.2 and summarised in Table 4.3. The model has also been updated to reflect revised land use forecasts for the remainder of Geelong. Specifically, this includes an accelerated population growth rate (beyond that assumed in the base model) provided by SGS Economics on behalf of CoGG .

Table 4.3: Summary of NWGGA Land Uses

Design Year	Growth Area	Population	Dwelling	Employment	Enrolment
2031	NGGA	*13,720*	*4,900*	*2,840*	*1,880*
	WGGA	*20,130*	*7,190*	*4,320*	*2,040*
	Total	33,850	12,090	7,160	3,920
2051	NGGA	*46,480*	*16,600*	*9,010*	*5,600*
	WGGA	*61,610*	*22,000*	*9,970*	*6,750*
	Total	108,090	38,600	18,980	12,360

Note: A reduced land use has been adopted for PC11 and PC12 which do not include development in the Batesford South PSP Area.

The 2051 future year population and employment forecasts are illustrated spatially in Figure 4.3 and Figure 4.4, respectively. The data indicates that the population density of the future growth areas is broadly consistent with the established areas of Geelong, whilst the employment density indicates that the employment density of the growth areas is lower than the established areas of Geelong. This suggests that a high proportion of residents will need to travel from the growth area for their employment.

Figure 4.3: S-VITM 2051 Population Forecast

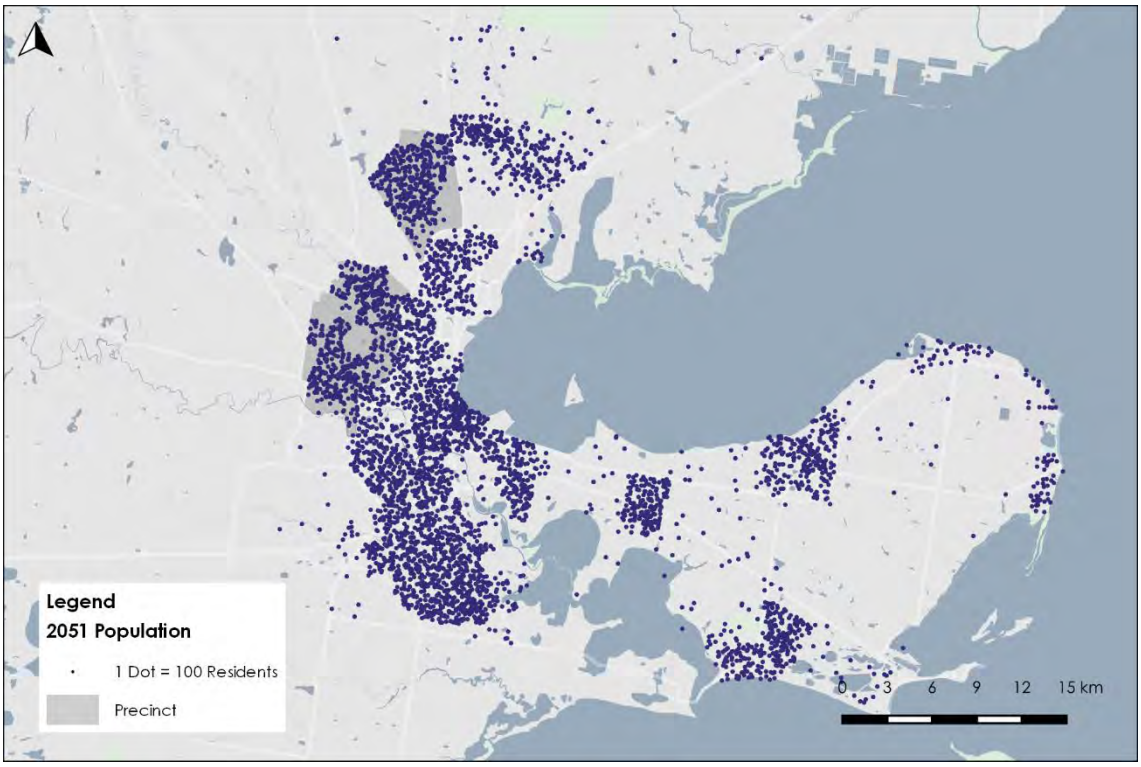
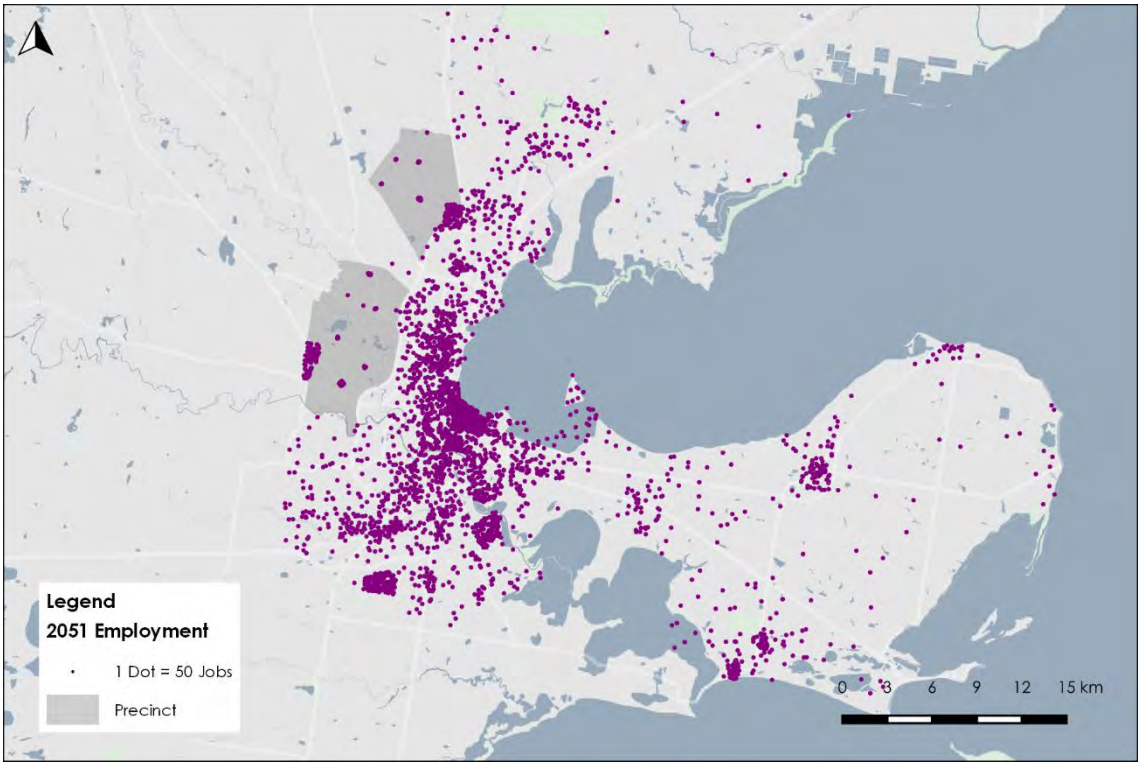


Figure 4.4: S-VITM 2051 Employment Forecast



4.2.2. Road Network

The 'without upgrades' scenario represents the road network assumed in the S-VITM 2051 base model. The 'with upgrades' scenario represents the external road network upgrades assumed as part of the Framework Plan. The key changes between the two scenarios being:

- Bacchus Marsh Road upgraded from two to three lanes in each direction between the Ring Road and Elcho Road
- Anakie Road upgraded from one to two lanes in each direction between the Ring Road and Evans Road
- Midland Highway upgraded from two to three lanes in each direction between the Ring Road and the WGGA Arterial
- Hamilton Highway upgraded from one to two lanes in each direction between Hyland Street and the WGGA clever and creative corridor
- Geelong Ring Road upgraded from two to three lanes in each direction between Corio and Waurn Ponds.

The coded road networks for the 'without upgrades' scenario and 'with upgrades' scenario are presented in Figure 4.5 and Figure 4.6, respectively. It is noted that the internal road network is the same for each.

In order to replicate intent of the Clever and Creative Corridor (as described in Section 3.3) in the S-VITM, the link has been coded with reduced speeds and turn bans.

Figure 4.5: S-**VITM 2051 Road Network 'Without Upgrades' (PC03)**

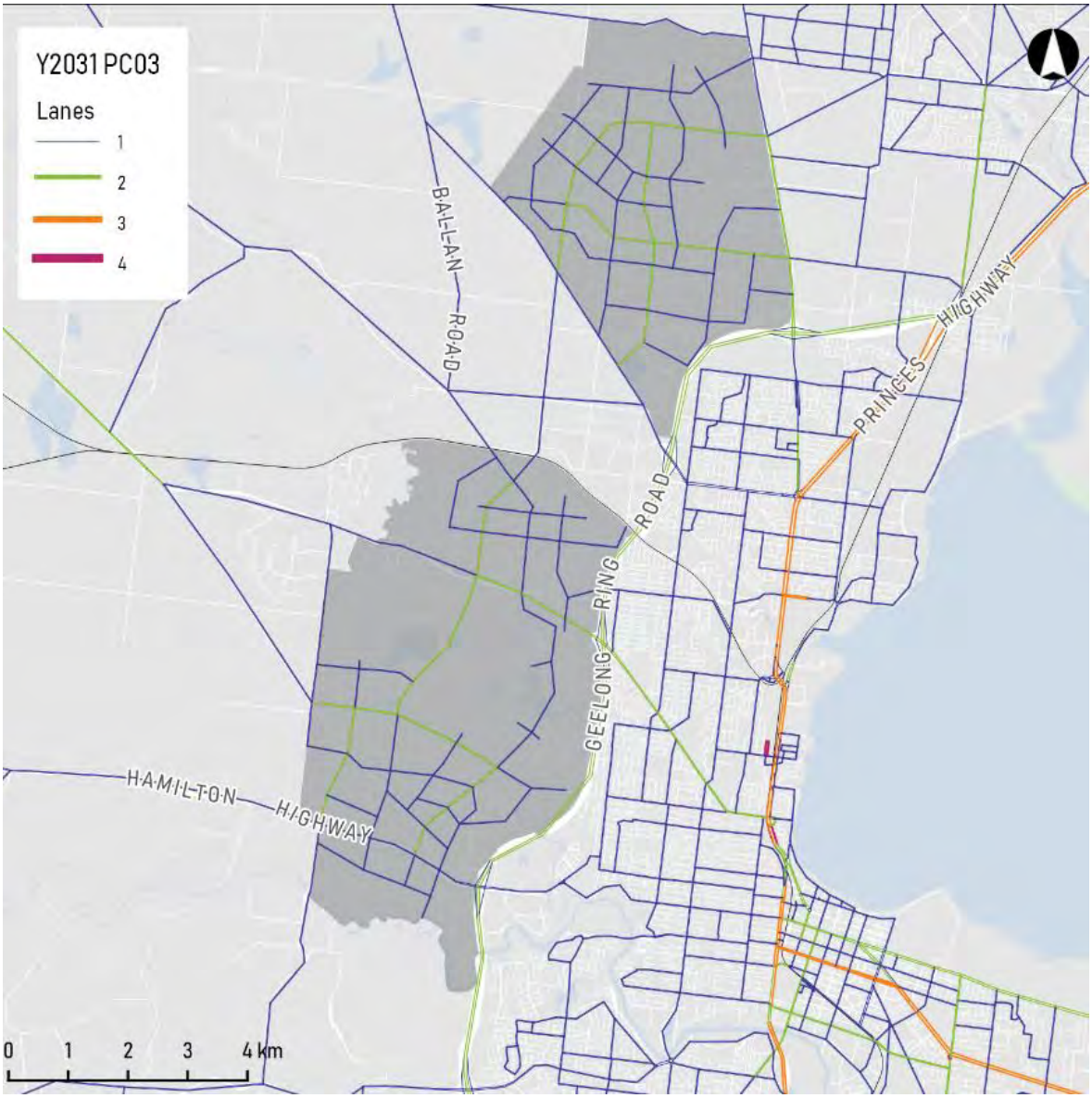
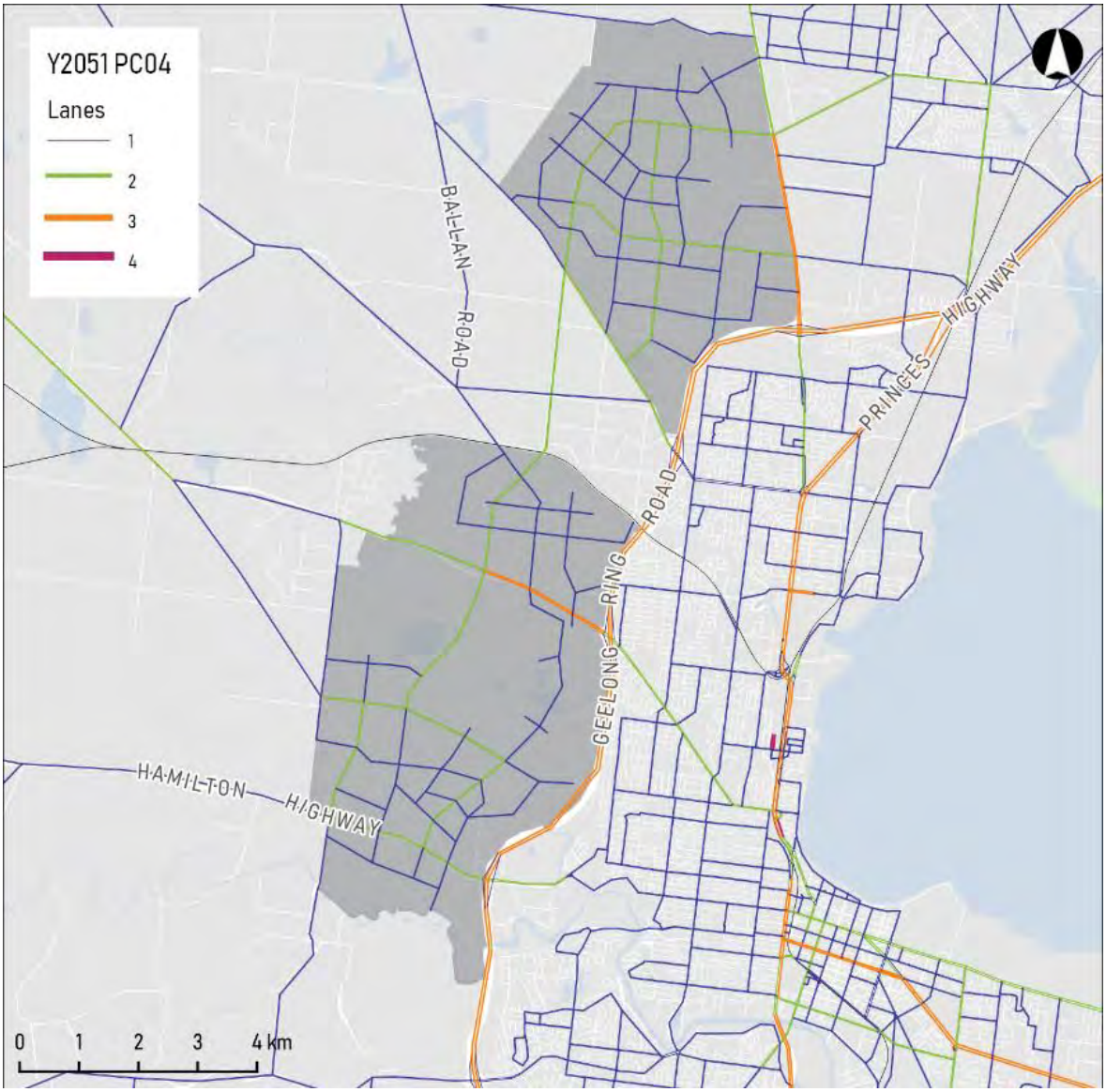


Figure 4.6: S-**VITM 2051 Road Network 'With Upgrades' (PC04)**



4.2.3. Public Transport

The adopted bus routes are presented in Figure 4.7 for 2031 and Figure 4.8 for 2051, with the on and off-peak headways (i.e. frequencies) for these services summarised in Table 4.4. These inputs were agreed with representatives from DoT and Public Transport Victoria.

Figure 4.7: NWGGA Bus Routes 2031

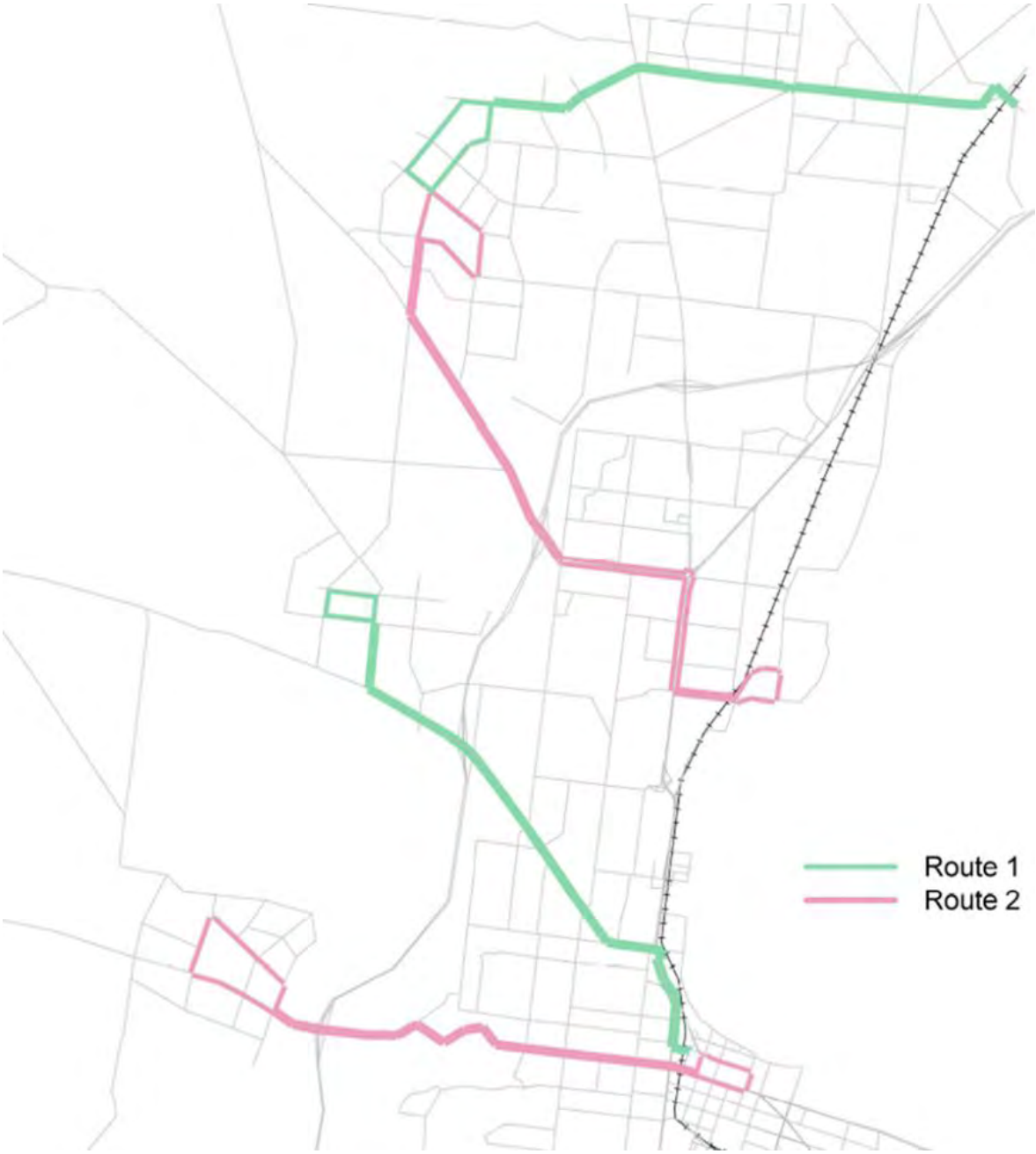
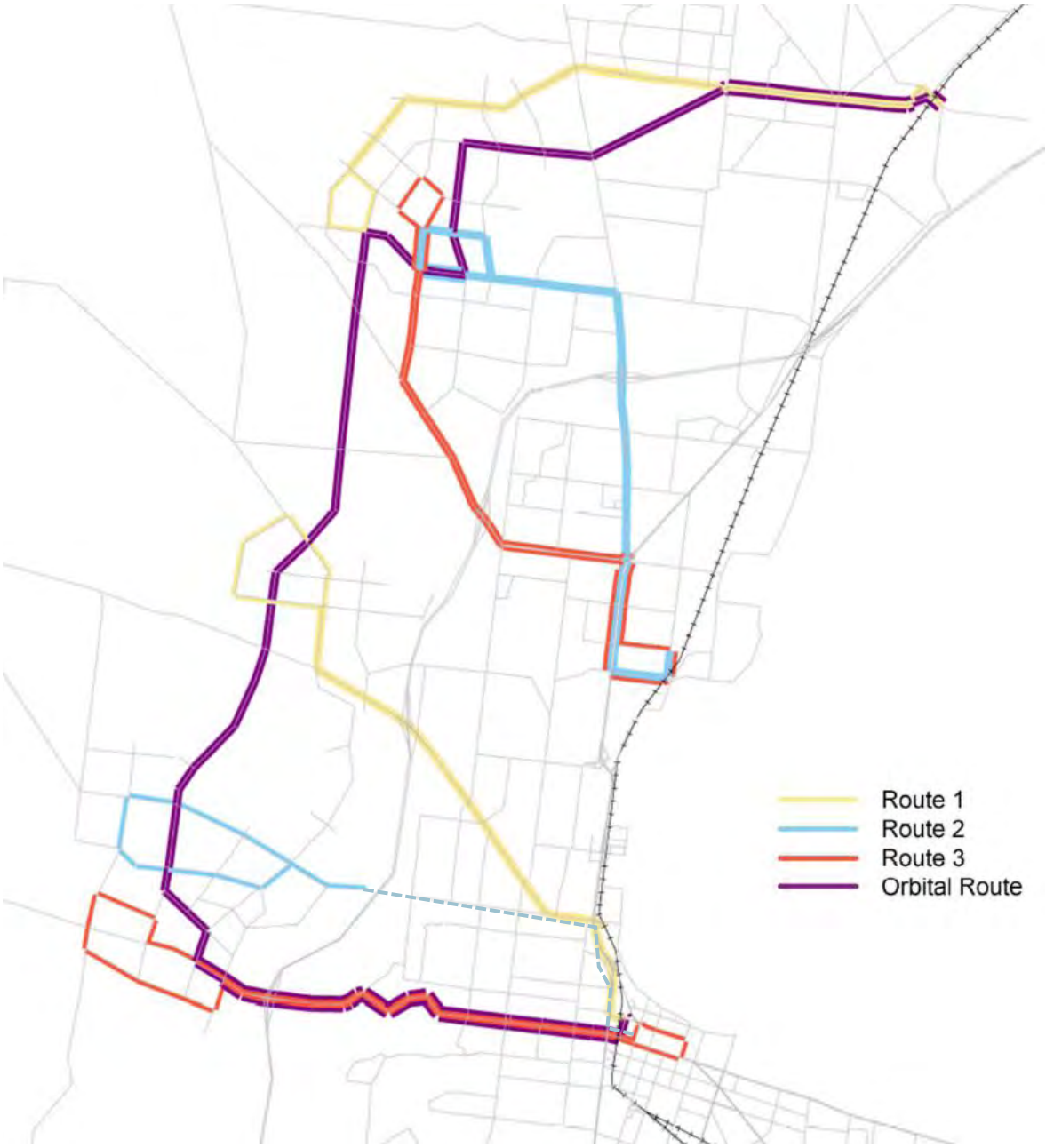


Figure 4.8: NWGGA Bus Routes 2051



Note: Route 2 in WGGA connected to CBD in PC07 and PC08 only.

Table 4.4: NWGGA On and Off-Peak Bus Headways

Peak Period	AM Peak Period	Inter Peak	PM Peak Period	Off Peak
2031	10 minutes	20 minutes	10 minutes	20 minutes
2051	10 minutes	20 minutes	10 minutes	20 minutes

Overall, whilst the public transport proposed provides some coverage of the two growth areas, the headways are considered to be low. Further, the NGGA does not provide direct connections to the Geelong CBD. From a modelling perspective, the bus routes will require use of the same links as vehicles which when they become congested would result in links that would be unattractive for PT use.

4.3. Model Outputs

4.3.1. Mode Share

Travel behaviour through S-VITM is generally considered in terms of travel costs, especially in terms of travel time, with the longer it takes to get somewhere by a given mode the less likely they will be attracted to use it. Travel between zones within the model focuses on public transport and private car use, with walking and cycling mode shares being identified separately and user numbers removed from the output demands.

The proportion of mode share for car and public transport in 2031 and 2051 are summarised in Table 4.5.

Table 4.5: NWGGA Mode Splits within S-VITM (PC02 & 04)

Growth Area	Year	Car (Driver and Passenger)	Public Transport	Active Transport
NGGA	2031	90.8%	1.2%	8%
	2051	90.3%	1.7%	8%
WGGA	2031	90.8%	1.2%	8%
	2051	90.3%	1.7%	8%

The modal share results show that car is the main travel mode for NWGGA and is not expected to change substantially between 2031 and 2051. This modelled mode share suggests a similar reliance on private vehicle travel to the existing residents in the City of Greater Geelong (refer to Section 2.6).

The Clever and Creative Future Strategy sets out a measure of success of *'50 per cent of journeys to work are made by public transport, walking or cycling'*. This modal target applies for the entire municipality and is considered aspirational for a greenfield context. In reality, it is expected that the highest mode share change would occur in the established inner urban areas where there a strong public transport, bike and pedestrian links to the Geelong CBD. Notwithstanding, the S-VITM outputs are that of the current trends and data available, highlighting what the outcome would be under a business as usual approach to travel in Geelong and the growth areas.

4.3.2. Traffic Generation

A summary of the daily traffic generation for the NGGA, WGGA and the remainder of Geelong LGA is presented in Table 4.6. The data is broken down by home to work, home to study, home to shopping/leisure and other non-home based trips.

Table 4.6: NWGGA and Geelong LGA Traffic Generation

Location	Trips to/from Home			Residential Trips per Dwelling	Non-Home Trips [1]	Total	Total Trips per Dwelling
	Work	Study	Leisure/ Shopping				
NGGA	42,325	18,339	95,131	9.4	55,448	211,244	12.7
WGGA	56,703	20,132	123,607	9.2	70,492	270,934	12.6
NWGGA (NGGA + WGGA)	99,028	38,471	218,738	9.3	125,940	482,178	12.6
Geelong LGA	474,831	158,731	824,173	9.0	574,472	2,032,207	12.5

[1] Non-home trips includes all trips not originating to or destined for home. For example, a trip from school to the shops or a trip from the office to lunch, etc.

Table 4.6 indicates that each dwelling within NWGGA could be expected to generate 9.2 to 9.4 movements per day, which is slightly greater than the average of 8.8 movements per day for the overall Geelong LGA. It is noted that the '12.6 trips per dwelling' figure includes non-residential trips generated by the growth areas (such as work to shop trips or trips generated by people who work in the growth areas but live outside the growth areas).

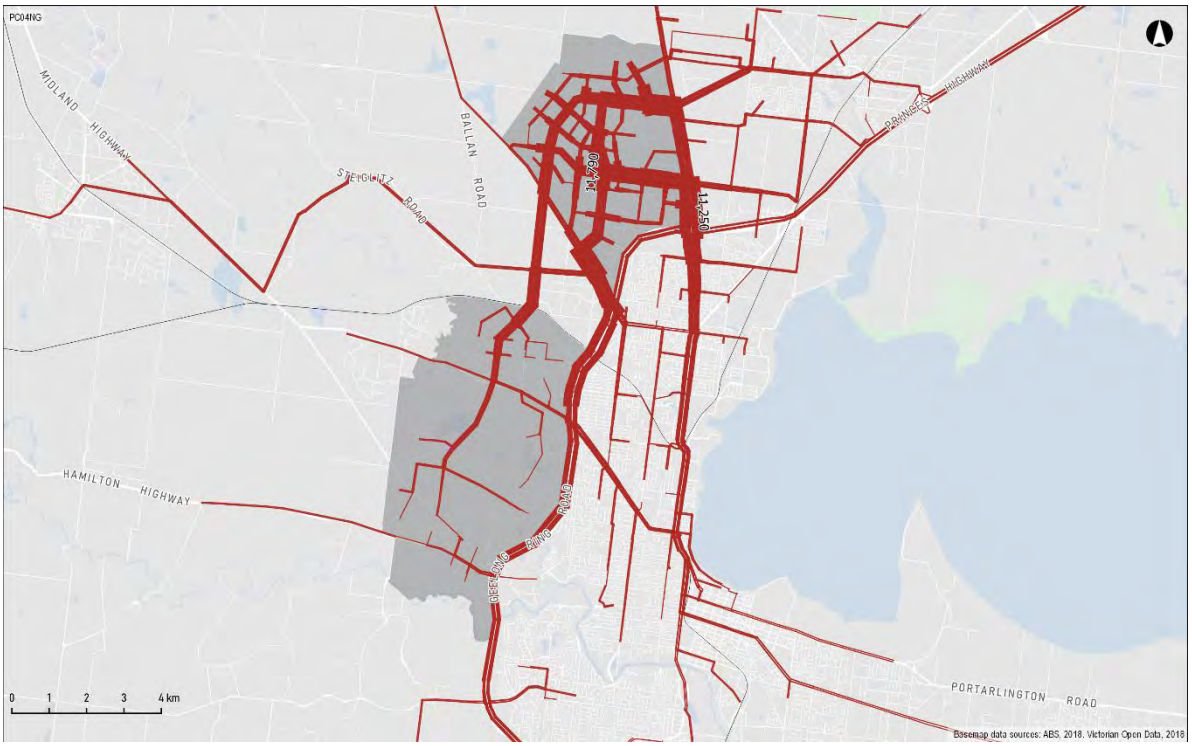
Typically, a daily traffic generation rate of 8 to 10 movements per dwelling is adopted for greenfield sites. Moreover, it is not unreasonable to expect the traffic generation rate for the NWGGA to be higher than the remainder of the Geelong LGA given that it is located on the outskirts of the established residential areas and has a comparative lack of access to public transport.

4.3.3. Trip Distribution

The select link analysis for the NGGA and WGGA, which shows the distribution of car trips generated and attracted to the growth areas at full development in 2051, are presented in Figure 4.9 and Figure 4.10, respectively. The thickness of the red line indicates the level of traffic volume on a particular link in the road network travelling to and from the PSP. The thickness of the link is a direct correlation to the proportion of volume.

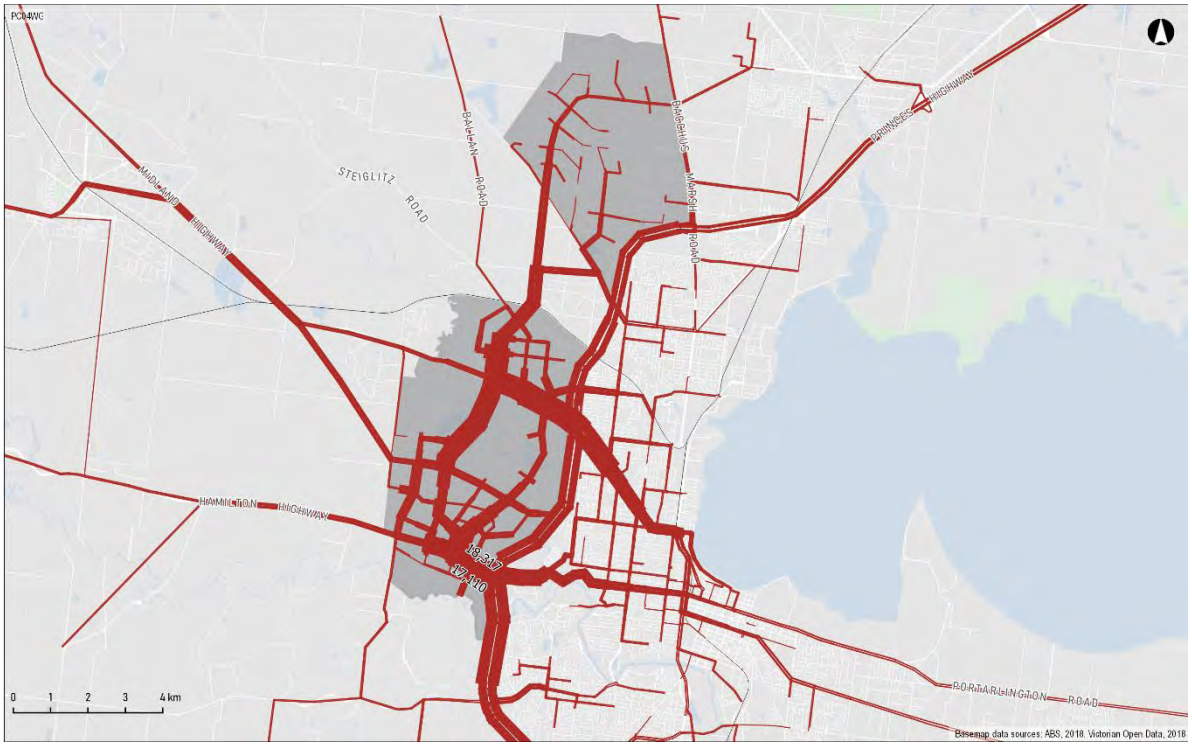
The analysis indicates that for the NGGA the key attractors are the Geelong CBD, the WGGA and the Geelong Ring Road with connections to Waurn Ponds and towards Melbourne.

Figure 4.9: NGGA Traffic Distribution 2051



The analysis indicates that for the WGGA the key attractors are the Geelong CBD, the NGGA and the Geelong Ring Road with connections to Waurn Ponds and towards Melbourne.

Figure 4.10: WGGA Traffic Distribution 2051



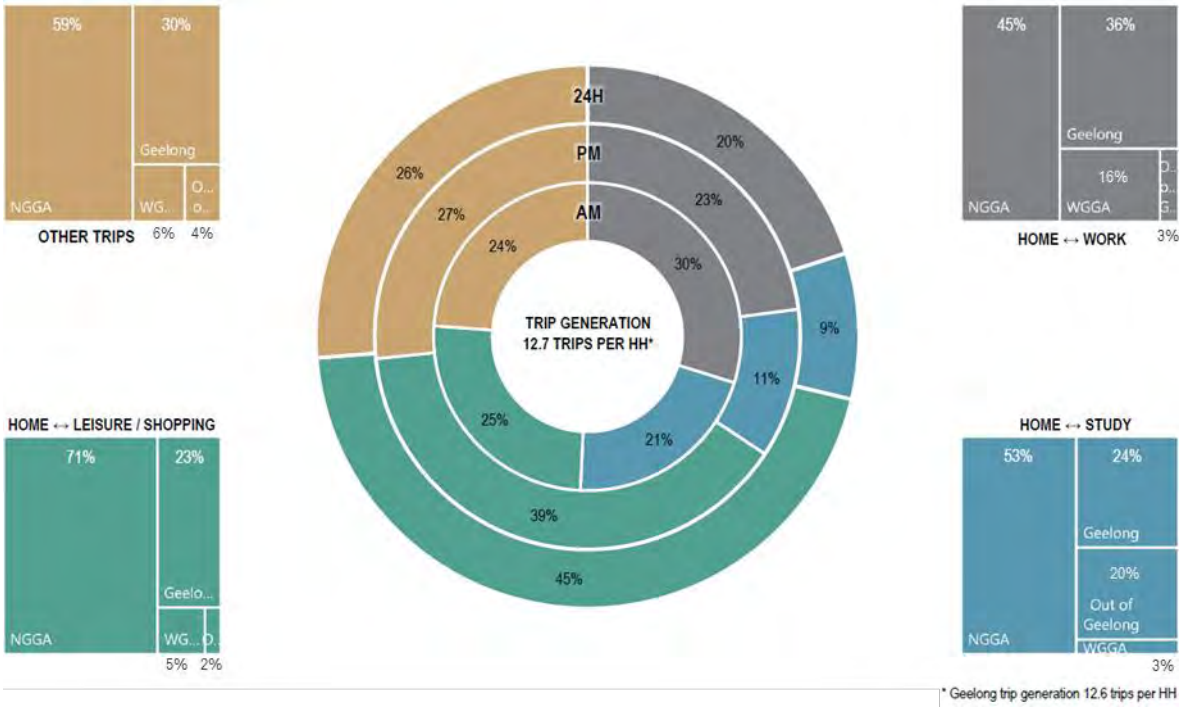
It is noted that the traffic distributions indicate that approximately 6% of all vehicle trips are distributed to towards Metropolitan Melbourne on the Princes Freeway. This compares to approximately 10% of work trips towards Melbourne as identified in ABS journey to work data. It is noted that the model includes all trip types, including work, education, leisure/shopping and other trip types. The non-work trip types have a lower distribution towards Metropolitan Melbourne hence the total tip distribution being less than 10%.

4.3.4. Trip Purpose

The trip purpose for the NGGA and WGGA, which shows the trip type and distribution of car trips generated to each growth area at full development in 2051, are presented in Figure 4.11 and Figure 4.12, respectively. ,Figure 4.11 shows that for the NGGA, 20% of daily trips are home to work trips, 9% home to study (or education), 45% home to leisure/shopping and 26% other trip types. The data further indicates that of the various trip types, in the order of 50% of these would be contained within the growth area, with 45% of home to work, 53% of home to study trips, 71% of home to leisure/shopping trips and 59% other trips. This information is also provided for the figures that represent the AM and PM peak periods.

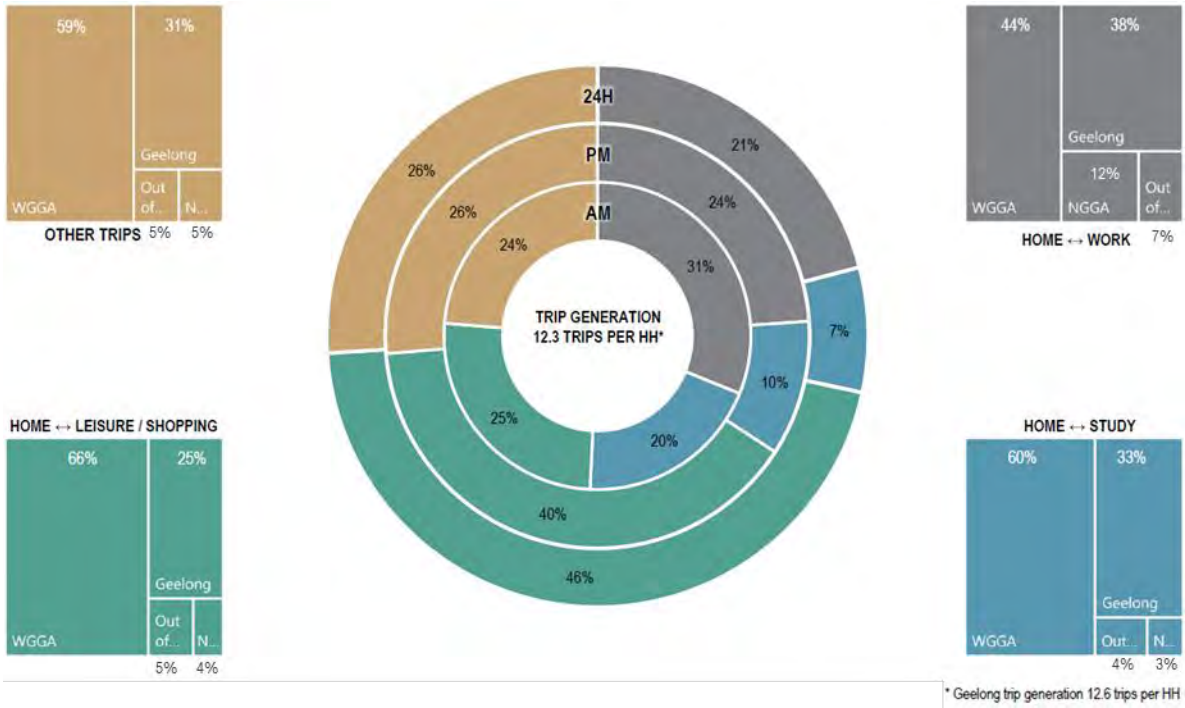
The trip purpose and distribution indicate that a high proportion of trips are contained within the growth areas themselves without impacting on the external road network (i.e. trip containment).

Figure 4.11: NGGA Trip Purpose and Distribution



(Note: the percentage distributions provided in the boxes relates to the daily trip distribution)

Figure 4.12: WGGA Trip Purpose and Distribution



(Note: the percentage distributions provided in the boxes relates to the daily trip distribution)

4.3.5. Model Volume Plots

The daily difference plots for PC03 and PC04 against the 2051 base case are presented in Figure 4.13 and Figure 4.14, respectively. Red links are those that increase in volume with the introduction of external road upgrades, whilst the blue links are those links that reduce in volumes as a result of the external road upgrades. The thickness of the line represents the quantum of the volume difference.

Figure 4.13: PC03 (without External Road Upgrades) Difference Plot PC03 and 2051 Base Case

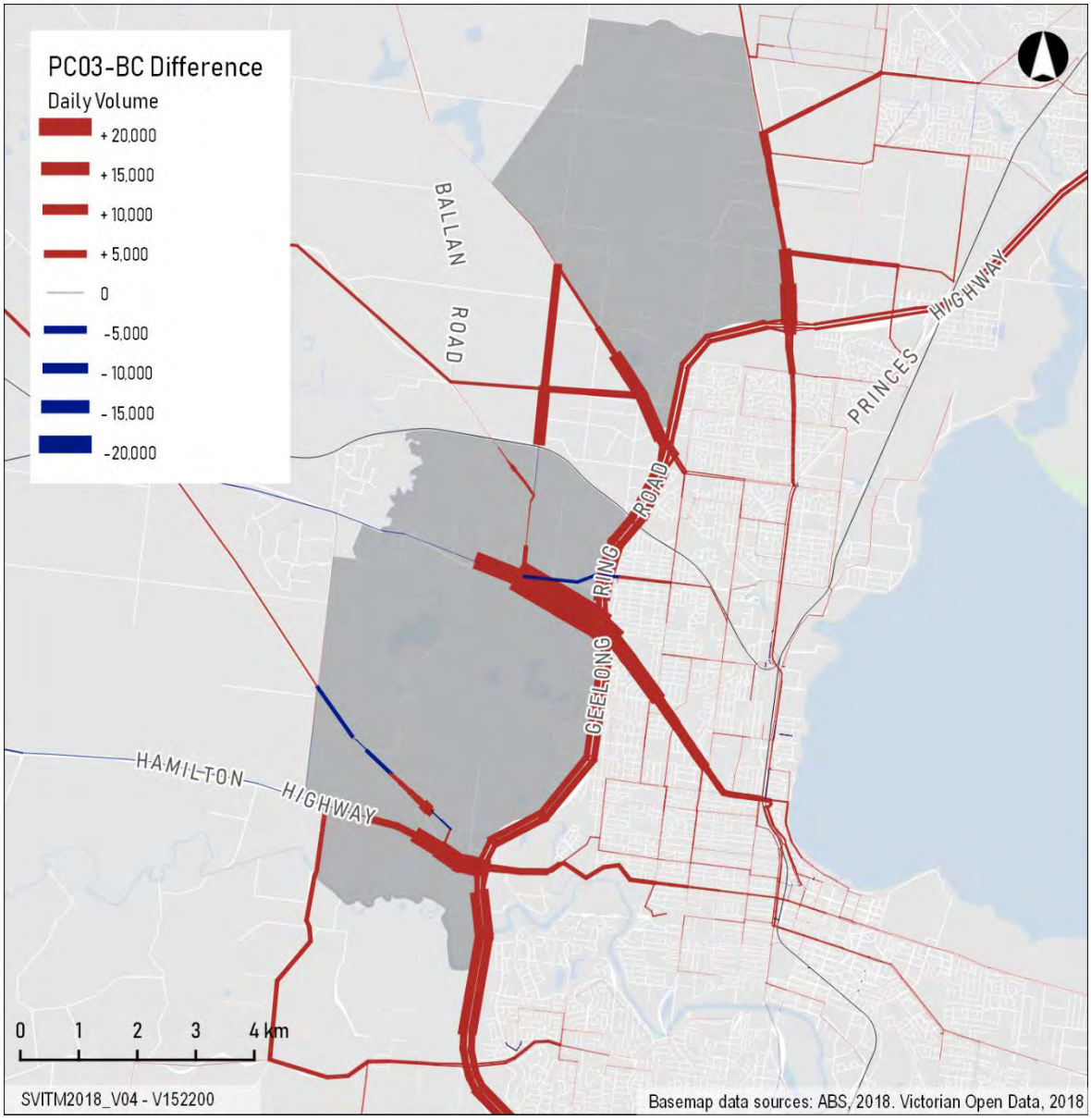
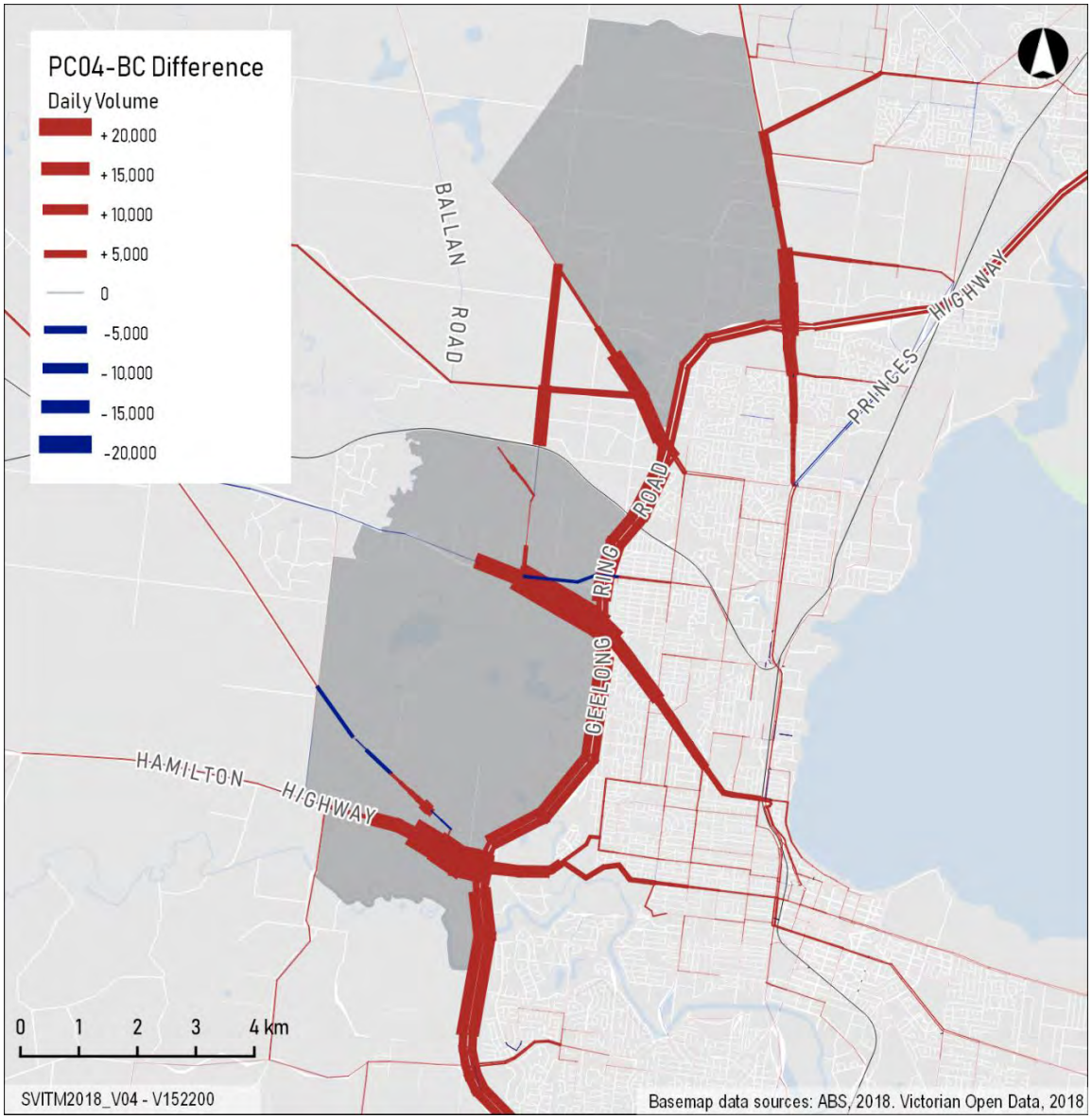


Figure 4.14: PC04 (with External Road Upgrades) Difference Plot PC03 and 2051 Base Case



4.3.6. Arterial Road Traffic Volumes at Interchanges

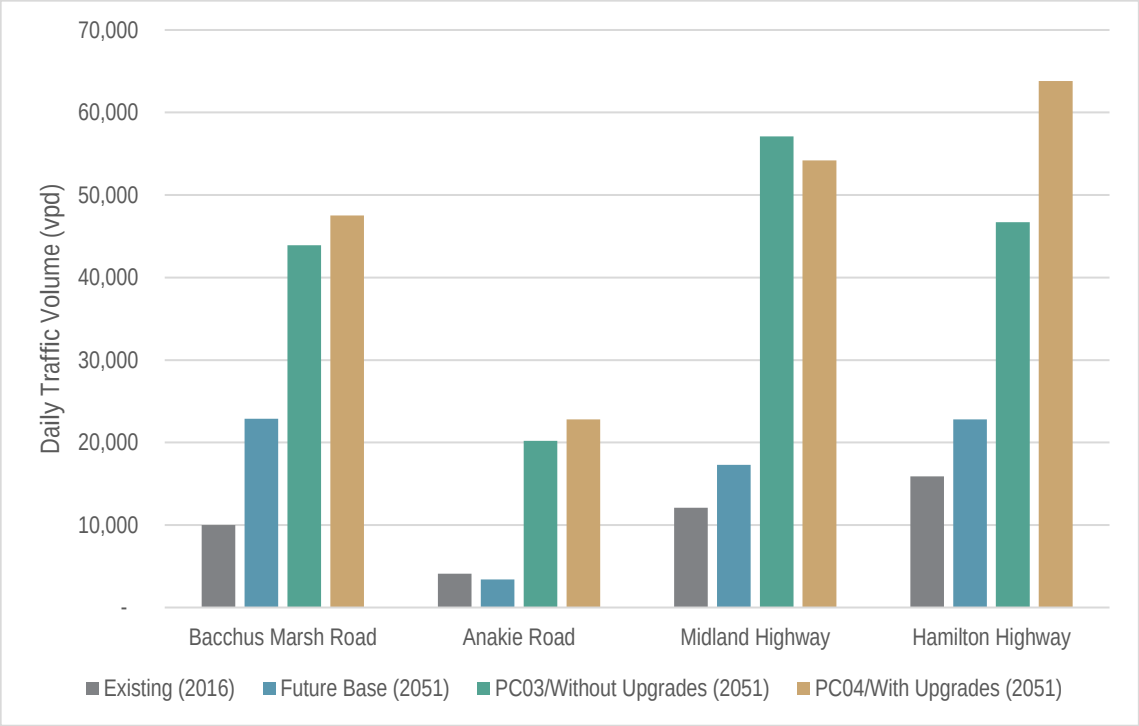
The existing and forecast base PC03 and PC04 for 2051 traffic volumes at each of the Geelong Ring Road interchanges is presented in Figure 4.15[2]. The data indicates substantial traffic volume increases at each of the interchanges, as follows (existing to PC04):

- Bacchus Marsh Road: from 10,000vpd to 47,500vpd
- Anakie Road: from 4,100vpd to 22,800vpd
- Midland Highway: from 12,100vpd to 54,200vpd
- Hamilton Highway: from 15,900vpd to 63,800vpd

[2] The traffic volume data is based on two-way approach (or link) volumes to the Geelong Ring Road from the NWGGA.

Traffic volumes on the Geelong Ring Road itself are forecast to increase from 16,000 to 19,000vpd in each direction to 28,000 to 36,000vpd in each direction.

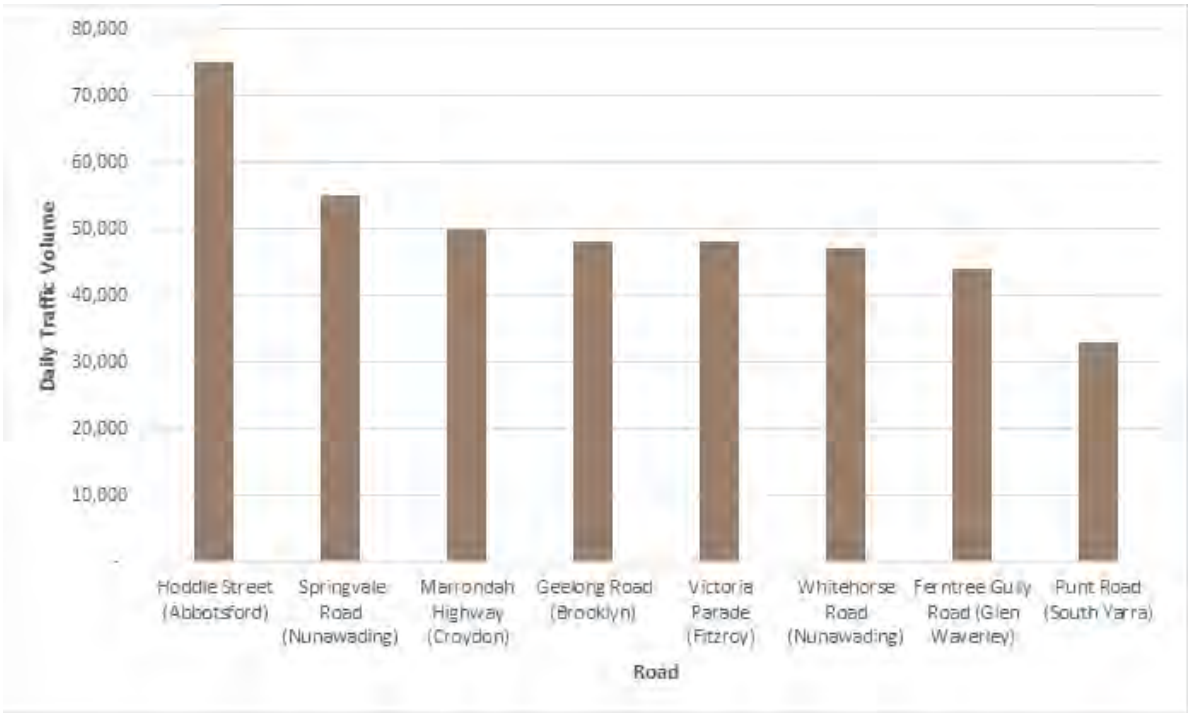
Figure 4.15: Existing (2016), Future Base (2051), PC03 and PC04 Daily Traffic Volume Forecasts



Further discussion regarding the implications of these daily traffic volume projections are provided in Section 5.2.

Existing traffic volumes for key arterial roads from Metropolitan Melbourne are presented in Figure 4.16 and provide context for the future traffic volumes forecasts. In this respect, the future daily traffic volumes on Bacchus Marsh Road, Midland Highway and Hamilton Highway are forecast to be comparable to the existing volumes on roads such as Springvale Road, Whitehorse Road and Ferntree Gully Road in Melbourne.

Figure 4.16: Existing (2017) Traffic Volumes on Key Arterial Roads in Melbourne



[traffic volume data sourced from VicRoads website for 2017 – some volumes may be higher at key junctures/interchanges]

Each of the key roads listed in Figure 4.10 have some form of public transport priority either at intersections or at mid-block locations.

4.3.7. Journey Times

The expected travel times from the NGGA and WGGA to the Geelong CBD, Avalon Airport and Waurn Ponds Shopping Centre for the existing (2016), 2051 base case, PC03 and PC04 for the AM peak period are presented in Table 4.7. It is noted that the journey travel times are calculated over a two-hour period for the AM and PM peak periods. Further, the journey travel times are based on link speeds and do not take into account specific intersection delays. Hence the future travel times would likely be greater than those quoted.

Table 4.7: NWGGA Travel Times AM Peak 2-Hour

Destination	NGGA				WGGA			
	2016 (Existing)	2051 Base Case	PC03	PC04	2016 (Existing)	2051 Base Case	PC03	PC04
To Geelong CBD	15 min	16 min	22 min	18 min	13 min	16 min	30 min	21 min
To Avalon Airport	14 min	14 min	15 min	15 min	23 min	24 min	32 min	27 min
To Waurn Ponds Shopping Centre	19 min	19 min	21 min	21 min	12 min	14 min	21 min	18 min

Note: PC03 without external road upgrades, PC04 with external road upgrades.

Table 4.7 indicates that the travel times for the NGGA are forecast to increase by 2 to 6 minutes under PC03 (against the 2051 base case), with travel times forecast to increase by 1 to 2 minutes under PC04. Whilst the travel times for the WGGA are forecast to increase by 8 to 15 minutes under PC03 (against the 2051 base case), with travel times forecast to increase by 3 to 6 minutes under PC04.

The data indicates substantial travel time changes between PC03 and PC04 for the WGGA, suggesting that the arterial road network for PC03 will experience congestion and low travel speeds.

The data indicates only modest travel time changes between PC03 and PC04 for the NGGA.

4.3.8. Other Plots

A range of other outputs have been extracted from the model to assist in the understanding of travel demand for each of the project cases (PC01 to PC12). These outputs are provided at Appendix A to Appendix D, and include the following:

- AM and PM Peak Period 2 Hour Vehicle Volumes **(refer to 'Full' report for detail**s)
- Volume to capacity plots for the AM and PM peak periods **(refer to 'Full' report for** details)
- Daily volume plots
- Link speed plots **(refer to 'Full' report for details)**
- Select Link Analysis **(refer to 'Full' report for details).**

4.4. Road Network Performance

4.4.1. Preamble

The volume to capacity ratio (degree of saturation) is a good indicator as to the operation of the network at specific link locations. The volume to capacity ratio (VCR) is also able to be correlated with the Level of Service Definitions as defined by VicRoads outlined in Table 4.8.

Table 4.8: Level of Service Definitions

LOS	Definition	Volume to Capacity Ratio
A	Virtually free flow; completely unimpeded	0.0-0.6
B-C	Stable flow with delays; less freedom to manoeuvre	0.6-0.8
D-E	Operating conditions at or near capacity; unstable flow	0.8-1.0
F	Forced flow; breakdown conditions	1.0+

Source: VicRoads Transport Modelling Guidelines. Volume 2: Strategic Modelling

It is noted that the volume to capacity plots are based on two-hour traffic volume forecasts and are bi-directional. The current Geelong morning and evening peak periods typically last for about 30 minutes. The increased demands will result in "peak spreading" where the future peak period will last longer than the current 30 minutes. Accordingly, the changes to the VCR plots are not as pronounced as could be otherwise expected (i.e. if the VCR was based on a continued 30 minute peak hour). In reality, the resultant outcome of the increase in demand would be the need for residents to alter their travel behaviour by either travelling at lower speeds or a different times during the peak period.

4.4.2. Internal Road Network

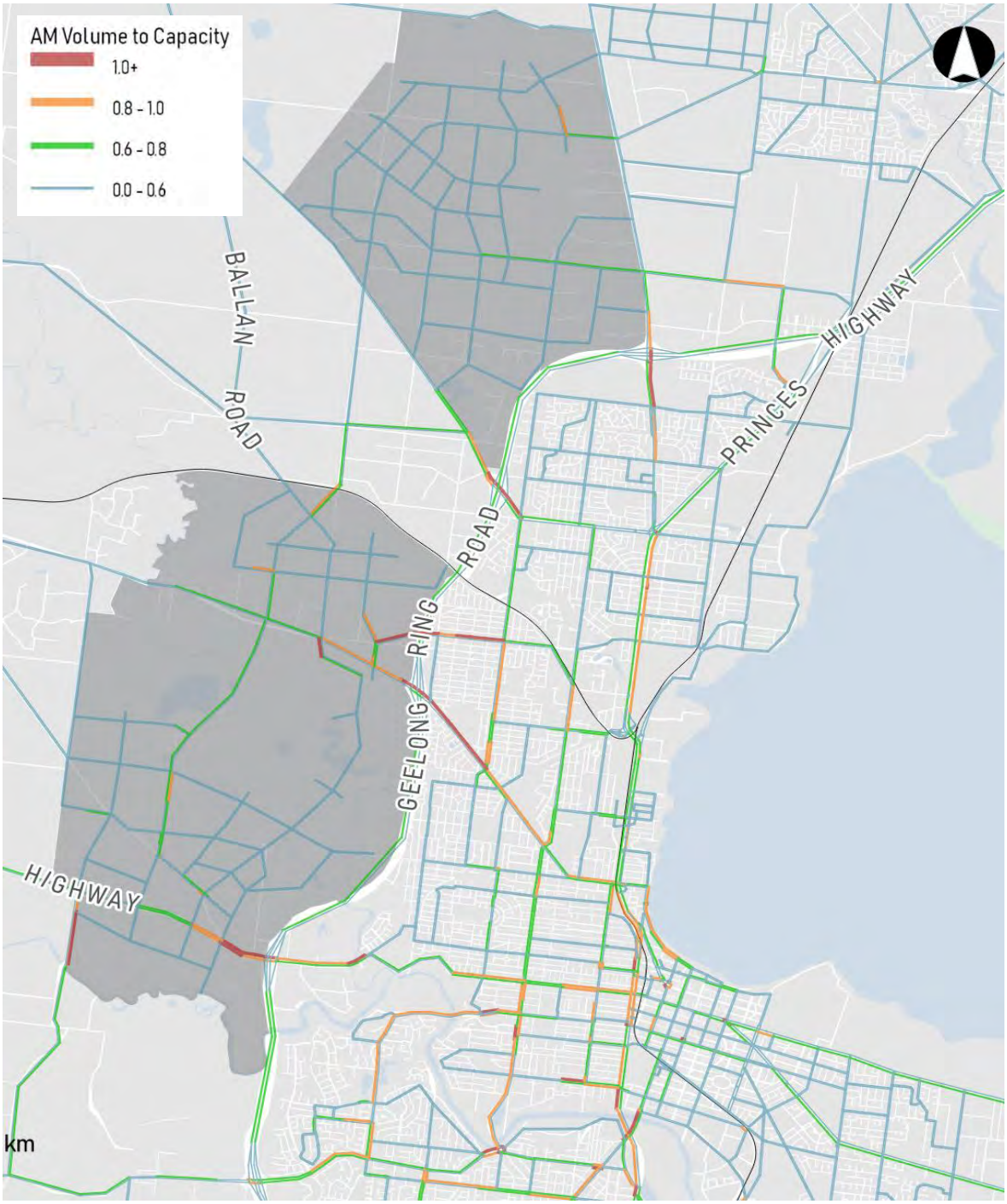
The VCR for the NWGGA during the AM peak period for BC02, PC03 and PC04 is presented in Figure 4.17 to Figure 4.19.

The VCR plots for PC03 indicate that the road network Is operating at its capacity at each of the interchanges with the Geelong Ring Road and on approach to a number of the interchanges.

Figure 4.17: 2051 Base Case Volume to Capacity Ratio

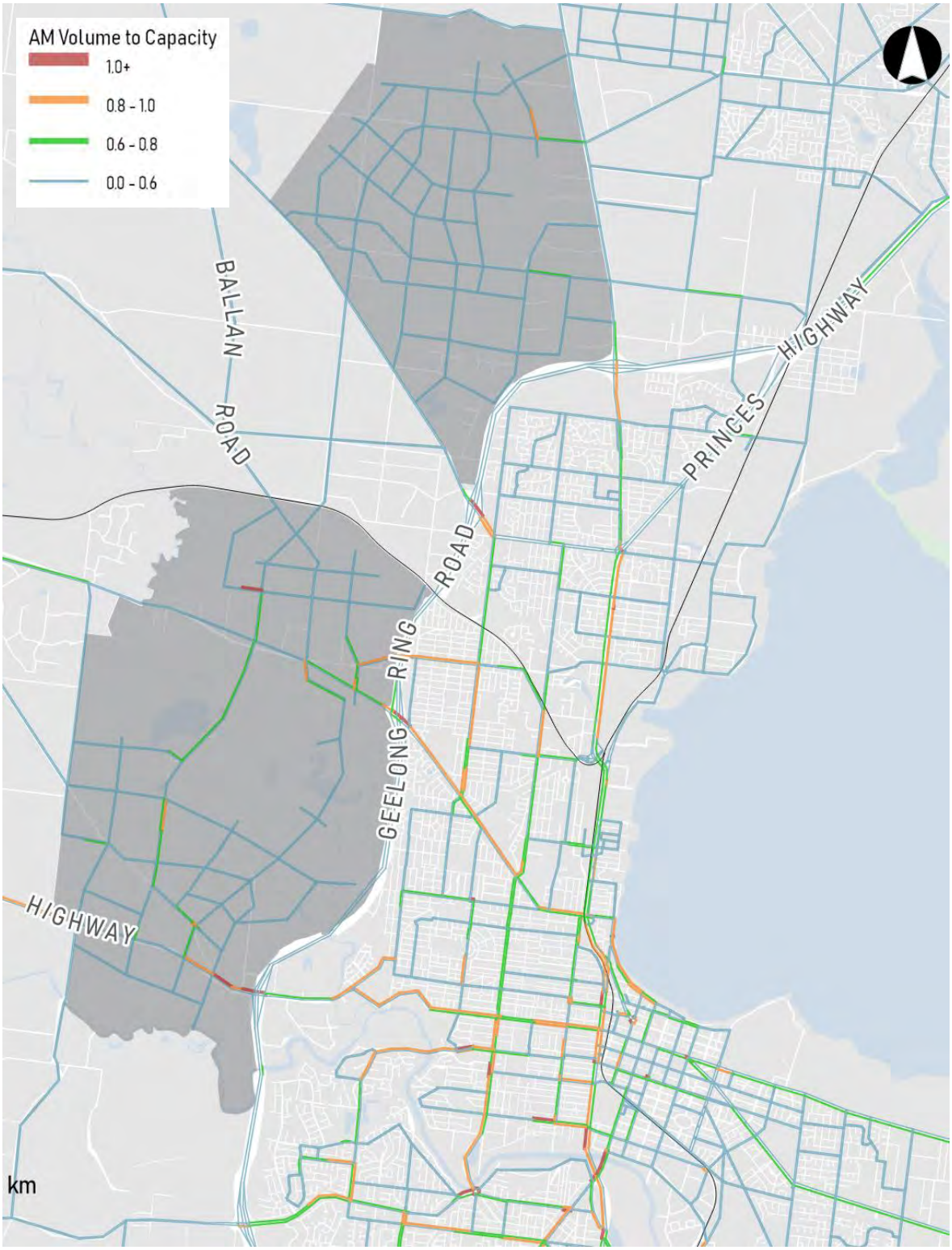
The VCR plots for BC02 indicate that the road network Is operating at its capacity at the Hamilton Highway interchange with the Geelong Ring Road.

Figure 4.18: PC03 (without External Road Upgrades) Volume to Capacity Ratio



The VCR plots for PC03 indicate that the road network Is operating at its capacity at each of the interchanges with the Geelong Ring Road and on approach to a number of the interchanges. As stated previously, the links that are over capacity (i.e. are red) will experience over saturated conditions across the two-hour period and not the short typical 30minute peak that is experienced today.

Figure 4.19: PC04 (with External Road Upgrades) Volume to Capacity Ratio



The VCR plots for PC04 indicate that the road network is operating near its capacity at each of the interchanges with the Geelong Ring Road, with noticeable improvements on the approaches to the interchange compared to PC03.

Indeed, a high proportion of links improve to DOS values of under 1.0, however links that are orange will experience some form of congestion, particularly if residents do not alter their travel behaviour.

4.4.3. External Arterial Roads

At Geelong Ring Road

The VCR outputs for each of the arterial road approaches to the Geelong Ring Road interchanges is presented in Table 4.9. The VCR outputs indicate that each of the road links at the interchanges would be operating with a LOS F under PC03. There is a marked improvement for PC04, although there are still constraints at the Hamilton Highway and on a number of links on the inside of the Geelong Ring Road.

Table 4.9: Peak Period (two hour) Volume to Capacity Outputs and Level of Service

Road	Location	2051 Base		PC03 (without Upgrades)		PC04 (with Upgrades)	
		AM	PM	AM	PM	AM	PM
Bacchus Marsh Road	North of Ring Road	A	A	D-E	D-E	B-C	B-C
	South of Ring Road	B-C	D-E	F	F	D-E	D-E
Anakie Road	West of Ring Road	A	A	D-E	F	B-C	B-C
	East of Ring Road	A	D-E	F	F	D-E	F
Midland Highway	West of Ring Road	A	A	D-E	D-E	B-C	B-C
	East of Ring Road	B-C	D-E	F	F	D-E	F
Hamilton Highway	West of Ring Road	D-E	F	F	F	F	F
	East of Ring Road	A	A	D-E	D-E	B-C	B-C

Note: the critical direction has been adopted for each link.

In Geelong

The VCR outputs for a number of key existing roads within Geelong is presented in Table 4.9. The VCR outputs indicate that the majority of the key existing roads will be operating with a LOS D-E, with Ballarat Road and Moorabool Street forecast to be operating with LOS F (suggesting that capacity enhancement works may be required at these locations).

Table 4.10: Peak Period (two hour) Volume to Capacity Outputs and Level of Service

Road	Location	2051 Base		PC03 (without Upgrades)		PC04 (with Upgrades)	
		AM	PM	AM	PM	AM	PM
Aberdeen Street	West of Shannon Ave	D-E	D-E	D-E	D-E	D-E	D-E
Ballarat Road	West of Anakie Rd	D-E	D-E	F	F	D-E	F
Elcho Road	East of Bacchus Marsh Rd	A	A	A	B-C	A	A
Shannon Avenue	South of Aberdeen St	D-E	D-E	D-E	D-E	D-E	D-E
Church Street	West of Pakington St	D-E	D-E	D-E	D-E	D-E	D-E
Melbourne Road	North of Separation St	D-E	D-E	D-E	D-E	D-E	D-E
Moorabool Street	At Barwon River	F	F	F	F	F	F
Cox Road	East of Anakie Rd	A	A	B-C	B-C	A	B-C
Thompsons Road	North of Separation St	B-C	B-C	D-E	D-E	D-E	D-E
Anakie Road	South of Cox Rd	A	A	B-C	B-C	B-C	B-C

Note: the critical direction has been adopted for each link.

4.4.4. Network Average Vehicle Speeds

An overview of the network wide average vehicle speeds for the existing, BC02, PCO3 and PC04 are presented in Table 4.11. The data has been segregated into freeway, arterial and other roads and takes into account all vehicles in the model and not just those accessing NWGGA.

Table 4.11: Network Average Vehicle Speeds – All Vehicles (km/h)

Link Type	Existing		2051 Base Case		PC03 (without Upgrades)		PC04 (with Upgrades)	
	AM	PM	AM	PM	AM	PM	AM	PM
Freeway	92.19	92.34	92.45	91.76	91.41	89.30	92.29	91.75
Primary Arterial	61.20	59.38	57.81	54.95	50.99	47.04	54.14	50.24
Secondary Arterial	47.67	45.58	42.45	39.57	41.07	38.12	41.31	37.97
Local / Collectors	39.16	37.65	36.35	34.07	33.89	31.14	35.10	32.31
Other	42.53	41.56	39.66	39.56	39.40	39.25	39.36	39.11
Total	59.34	56.91	54.58	51.69	49.68	45.93	52.02	48.43

The data indicates that only modest changes to average vehicle speeds is forecast for each of the modelling periods. For example, during the AM peak hour existing average vehicle speeds are forecast to reduce from 59.3km/h to 54.6km/h for the base case (2051 no development of NWGGA), following the development of the growth areas the average vehicle speeds are forecast to further reduce to 49.7km/h for PC03 ('without external road upgrades') and 52.0km/h for PC04 ('with external road upgrades'). This represents a 9% average vehicle speed reduction across the network between the 2051 base case and PC03 scenario and a 5% reduction between the 2051 base case and PC04 scenario.

5. MODELLING OUTCOMES

This section identifies and responds to the key transport modelling questions, which will guide the development of the Framework Plan.

05

5.1. Preamble

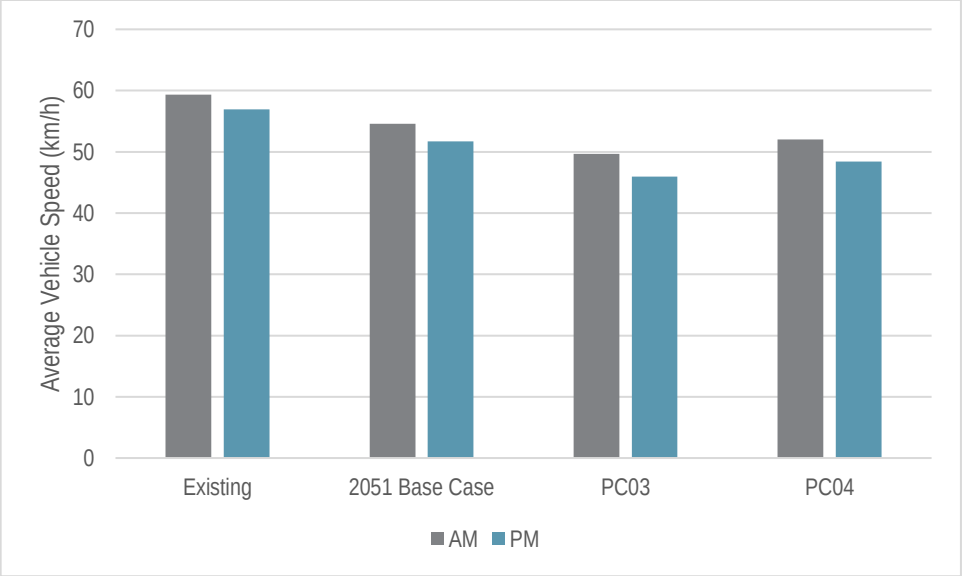
The purpose of this modelling task is to inform the development of the Framework Plan for the NWGGA. In this respect, there are a number of key issues that need to be resolved. These key issues have been reproduced below and responded to thereafter:

1. What will travel be like in Geelong in 2051?
2. Does the external arterial road network need to be upgraded?
3. Is there adequate capacity at the Geelong Ring Road interchanges?
4. How many road connections are required from the NGGA to Anakie Road?
5. What are the impacts of providing a road connection for cars to Church Street from the WGGA?
6. What are the impacts of realigning the arterial road to the east side of the lake in the WGGA?
7. What happens if Batesford South is not developed?
8. What are the impacts of a greater mode share split to public transport?
9. What are the impacts of the alternate road network layout for the NGGA?

5.2. What will travel be like in Geelong in 2051?

Geelong's population is forecast to increase from 240,000 people in 2016 to 500,000 people in 2051 (approx.). There is currently a finite amount of road space within the established areas of Geelong with limited ability to widen or increase the capacity of a number of key corridors into and through Geelong (excluding the removal of parking). Accordingly, vehicle travel in Geelong will become more difficult with increased travel times and reduced speeds forecast for peak hour trips. Figure 5.1 sets out a summary of the forecast average vehicles speeds in Geelong.

Figure 5.1: Average Vehicle Speeds (Geelong Network)



The data indicates that during the AM peak 2-hour period that average vehicle speeds across the network are forecast to reduce from 59.3km/h to 54.6km/h between 2016 and 2051 without the development (i.e. base case), with the development forecast average vehicle speeds are forecast to reduce to between 49.7km/h (PC03) and 52.0km/h (PC04); this corresponds to a reduction of between 12 and 16% compared to 2016. These changes are a the cumulative totals of all links within Geelong and include variances across the network.

The data indicates that during the PM peak two-hour period that average vehicle speeds across the network are forecast to reduce from 56.9km/h to 51.7km/h between 2016 and 2051 without the development (i.e. base case), with the development forecast average vehicle speeds are forecast to reduce to between 45.9km/h (PC03) and 48.4km/h (PC04); this corresponds to a reduction of between 15 and 19% compared to 2016.

The volume to capacity ratio (VCR) plots presented in Section 4.4 indicate that some links in Geelong, such as Ballarat Road (between Anakie Road and the Ring Road) and Moorabool Street (crossing the Barwon River) will be operating with LOS F (or above their theoretical capacities).

In this respect it is commonly recognised that as road networks become increasingly congested, travel choices and behaviour typically change. This can result in trip redistribution, trip reprogramming, or trip substitution, as discussed below:

- Trip redistribution: In the future motorists in Geelong may be required to take a different route choice compared to their current route choice to avoid the additional traffic demands generated by the growth areas. This will likely result in higher traffic volumes on some lower classified roads.
- Trip reprogramming: Trip 'reprogramming' is referred to as the ability for motorists to shift the timing of their trip either earlier or later as to avoid peak periods. Currently the peak period in Geelong is quite short (approximately 30 minutes) this could be expected to extend to closer to two hours, as future residents are likely to reconsider their need to travel during absolute peak times.
- Trip substitution: Some existing motorists from the inner suburbs of Geelong will likely substitute driving for an alternative mode as car use becomes a less-convenient transport mode for peak hour travel. This outcome would align with the aspirations of the Clever and Creative future document.

The combination of the above factors will mean that in the future residents of Geelong will need to change their current travel habits. For example, in the future there will no longer be an expectation that residents can drive wherever and whenever they like in Geelong in 10 to 15 minutes. Rather drivers in Geelong will need to modify their travel behaviour in terms of when, where and how they travel.

5.3. Does the external arterial road network need to be upgraded?

Each of the road network scenarios have been assessed with and without the external arterial roads being upgraded. A summary of the number of lanes assumed, theoretical capacity[3] and the forecast traffic volumes on each of the arterial roads is provided in Table 5.1 and Figure 5.2. For simplicity, only PC-03 and PC-04 have been presented in the below table, noting that each of the subsequent scenario tests exhibited similar outcomes.

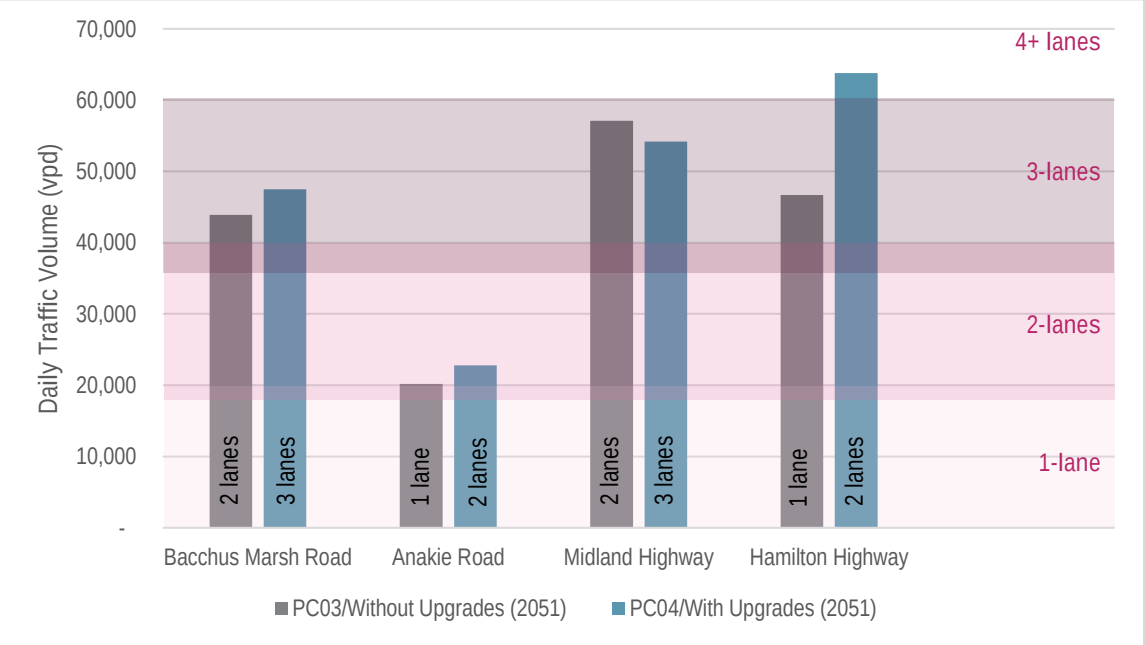
[3] Capacity limits sourced from Austroads Standards "Guide to Traffic Management – Part 3 Traffic Studies and Analysis" document from Table 4.3 as follows: 2-lane road: 18,000vpd, 4–lane road: 36,000vpd, 6-lane road 54,000vpd. Additionally, the capacity thresholds are also based on the industry "rule of thumb" for road network planning: 2-lane road: 20,000vpd, 4–lane road: 40,000vpd, 6-lane road 60,000vpd. It is noted that there are numerous examples of roads in Victoria operating satisfactorily which carry traffic volumes greater than the above thresholds.

Table 5.1: External Arterial Road Upgrades

Road Links	PC03 (without Upgrades)			PC04 (with Upgrades)		
	No. of Traffic Lanes	Indicative Two-Way Capacity [1]	Forecast Daily Traffic Volume	No. of Traffic Lanes	Indicative Two-Way Capacity [1]	Forecast Daily Traffic Volume
Bacchus Marsh Road	2	36,0000 to 40,000vpd	43,900vpd	3	54,000 to 60,000vpd	47,500vpd
Anakie Road	1	18,000 to 20,000vpd	20,200vpd	2	36,000 to 40,000vpd	22,800vpd
Midland Highway	2	36,0000 to 40,000vpd	57,100vpd	3	54,000 to 60,000vpd	54,200vpd
Hamilton Highway	1	18,000 to 20,000vpd	46,700vpd	2	36,000 to 40,000vpd	63,800vpd

Note: Analysis based on link approach volumes to Geelong Ring Road from NWGGA (i.e. outside of Geelong Ring Road).

Figure 5.2: Arterial Road Traffic Volumes – without (PC03) and with (PC04) Upgrades



The analysis indicates that each of the arterial roads would be operating above their theoretical capacities at the interchanges under the 'without external upgrades' option. Whilst under the 'with external upgrades' option Bacchus Marsh Road, Anakie Road and Midland Highway would be operating within their theoretical capacities at the interchanges. However, Hamilton Highway would continue to be operating above its theoretical capacity assuming 2 lanes in each direction at the interchange.

Consistent with the above the volume to capacity plots provided Section 4.4 indicate that under PC03 each of the road links would be operating with a LOS F during at least one of the road network peak hours, noting that a LOS F is defined as "forced flow; breakdown conditions". These operating conditions are reflected in the forecast journey times which suggest 17 to 43% greater journey times for PC03 compared to PC04.

The level of service and journey time metrics indicate unacceptable outcomes under the 'without upgrades' scenario.

The network average vehicle speeds presented in Section 4.4 indicate that network wide vehicle speeds are forecast to reduce by 5% between the 'with upgrades' and 'without upgrades' scenarios.

It is therefore recommended that each of Bacchus Marsh Road, Midland Highway and Hamilton Highway be upgraded to include three (3) lanes in each direction. This would include the Hamilton Highway being configured with three lanes in each direction between the Geelong Ring Road and the first north-south arterial road accessing the WGGA. It is recommended that Anakie Road be upgraded to include two lanes in each direction.

5.4. Is there adequate capacity at the Geelong Ring Road interchanges?

The forecast traffic volumes presented in Section 4 identified substantial traffic volumes at each of the Geelong Ring Road interchanges. A summary of the daily 2016, 2051 base case and PC04 forecast traffic volumes approaching each of the interchanges is presented in Table 5.2.

Table 5.2: Forecast Interchange Daily Traffic Volumes

Interchange Location	2016	2051 Base Case	PC04
Bacchus Marsh Road	17,300vpd	44,200vpd	79,900vpd
Anakie Road	11,200vpd	14,000vpd	39,400vpd
Midland Highway	29,200vpd	44,800vpd	100,300vpd
Hamilton Highway	20,600vpd	33,900vpd	90,900vpd

Note: sum of approach and departure traffic volumes on intersecting roads to Ring Road – i.e. two-way volumes on the east and west side of the Geelong Ring Road (excludes vehicles on the Ring Road itself).

Table 5.2 indicates that significant traffic volume growth is forecast at each of the interchanges, approximately 4-fold between 2016 and 2051. The level of traffic volume growth suggests that each of the interchanges will require mitigation measures to increase their capacities. These capacity enhancements could include the provision of double left turns or triple right turn at key movements, or the provision of additional through traffic lanes at the interchange itself.

Table 5.3 provides a summary of daily traffic volumes (sourced from VITM) for existing freeway interchanges in metropolitan Melbourne. This table indicates that, whilst the forecast traffic volumes for NWGGA are high, they are comparable to other interchanges in the Victorian/Melbourne context.

Table 5.3: Comparison of Interchange Daily Traffic Volumes (approximate)

Interchange Location	2016
Ballarat Road / Western Ring Road	94,000vpd
Sunshine Avenue / Western Ring Road	76,000vpd
Blackburn Road / Monash Freeway	85,000vpd
Cooper Street / Hume Freeway	98,000vpd

Note: sum of approach and departure traffic volumes on intersecting roads to Freeway (excludes vehicles on the Freeway itself).

For reference the footprint / land take of the Ballarat Road and Sunshine Avenue interchanges with the Western Ring Road are illustrated in Figure 5.3 and Figure 5.4, respectively. The capacity provided at these interchanges indicates that the future Geelong Ring Road interchanges may need to include triple turn lanes and additional through lanes at the interchanges to cater for the forecast demands.

Figure 5.3: Existing Ballarat Road / Western Ring Road Interchange Layout (94,000vpd)

Figure 5.4: Existing Sunshine Avenue / Western Ring Road Interchange Layout (76,000vpd)

5.5. How many road connections are required from the NGGA to Anakie Road?

Refer to PC-05 and PC-06

The Framework Plan road network described in PC-03 and PC-04 includes four connections (2 arterial roads and 2 connector roads) to Anakie Road from the NGGA. One of the arterial road links travels through the current rural living zone. This scenario tests the traffic volume impacts of removing this easternmost connection from the future year road network.

A summary of the resultant forecast daily traffic volumes for each of the connections to NGGA under each scenario are provided in Table 5.4.

Table 5.4: Connections to Anakie Road – Daily Traffic Volumes

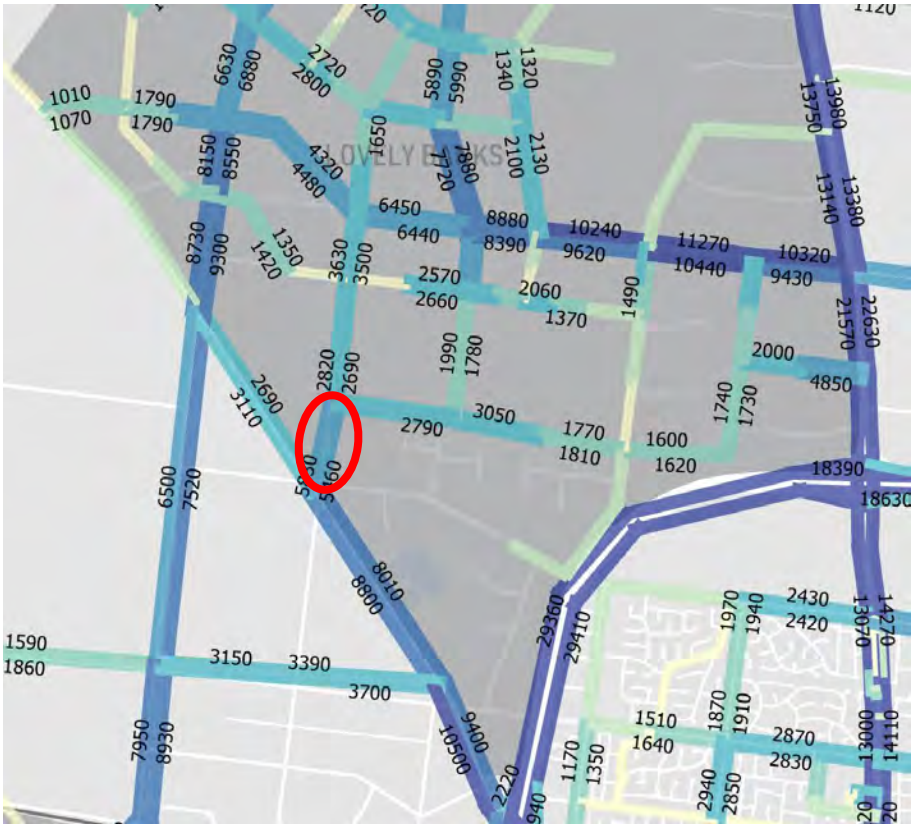
Road Link	Classification	Forecast Daily Traffic Volume	
		PC-04 (with 4 connections)	PC-06 (with 3 connections)
New Eastern Road	Arterial	14,330vpd	-
Emmersons Road	Connector	4,050vpd	11,290vpd
Evans Road	Arterial	14,860vpd	18,030vpd
New Western Road	Connector	2,050vpd	2,080vpd

The analysis indicates that with 4 connections to Anakie Road each of the arterial roads carries approximately 15,000vpd, with Emmersons Road carrying approximately 4,000vpd. Removing the arterial road from within the Rural Living Zone increases traffic volumes on Emmersons Road to approximately 11,000vpd and Evans Road to approximately 18,000vpd.

The typical volume threshold for a connector road (which Emerson Road is defined as) is 7,000vpd; under the scenario with 3 connections this threshold is exceeded. However, it is noted that the 7,000vpd threshold is largely driven by amenity impacts rather than vehicle capacity constraints. In this respect, should only 3 connections ultimately be provided to Anakie Road it is recommended that where forecast traffic volumes on Emmersons Road exceed 7,000vpd that direct vehicle access to private residential lots be restricted.

The extent of where traffic volumes are forecast to exceed 7,000vpd on Emmersons Road is illustrated in Figure 5.5.

Figure 5.5: Emmersons Road where Traffic Volumes Exceed 7,000vpd



Note: Assuming only 3 connections are provided to Anakie Road from NGGA

5.6. What are the impacts of providing a road connection for cars to Church Street from the WGGA?

Refer to PC-07 and PC-08

The Framework Plan includes three key road links servicing the WGGA; Midland Highway, Hamilton Highway and Evans Road (to NGGA). An additional road link across the Geelong Ring Road could be provided at Church Street connecting the WGGA with Hamlyn Heights.

A comparison of the arterial road traffic volumes for PC04 (without Church Street connection) and PC08 (with Church Street connection) is presented in Figure 5.6.

Figure 5.6: Arterial Road Traffic Volume – with Church Street Connection

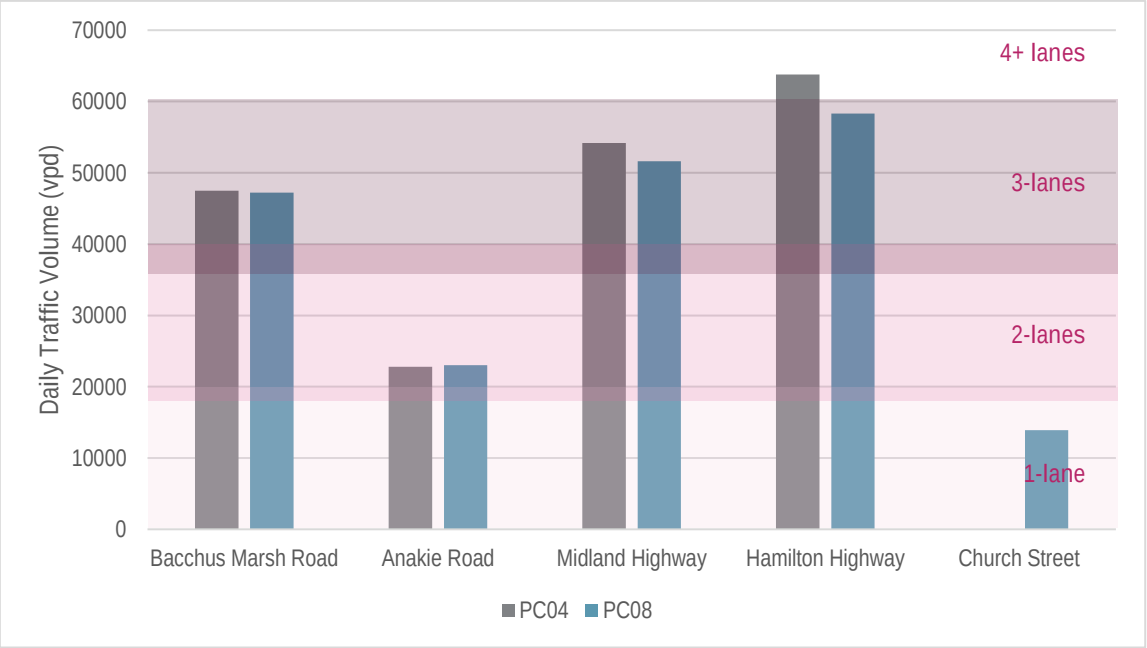
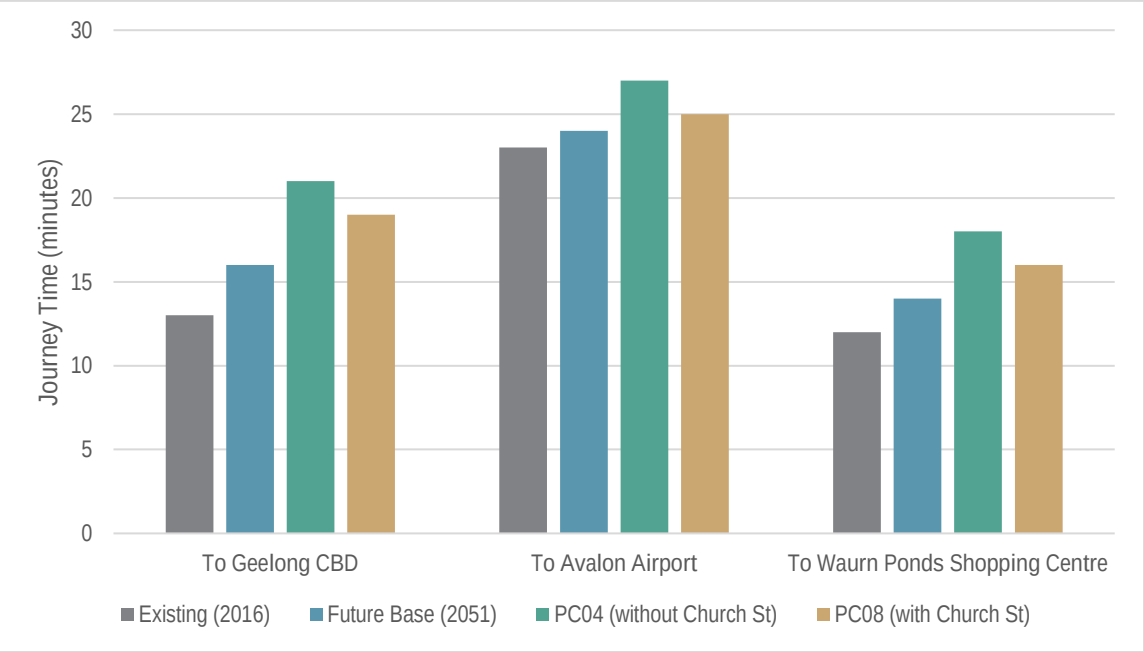


Figure 5.6 indicates that the Church Street connection scenario is forecast to reduce traffic volumes on Midland Highway by approximately 5% and Hamilton Highway by approximately 9% at each of the interchanges. Of particular note, the reduced traffic generation from NWGGA is forecast to reduce the volumes on Hamilton Highway below the indicative daily thresholds for a 3-lane road. The Church Street connection is not forecast to have a material impact on the future operation of Bacchus Marsh Road or Anakie Road.

The existing, future base, PC04 (without Church Street connection) and PC08 (with Church Street connection) journey times for the WGGA (only) are presented in Figure 5.7. The journey time data indicates that a journey time reduction of 2 minutes is predicted for each of the routes with the introduction of the Church Street connection (i.e. between PC04 and PC08).

Figure 5.7: WGGA Journey Time Comparison with and Without Church Street Connection



A summary of the daily traffic volumes along Church Street, with and without the connection are provided in Table 5.5.

Table 5.5: Church Street Daily Traffic Volumes – With and Without Church Street Connection

Scenario	Daily Traffic Volume Forecasts			
	West of McCurdy Road	Between McCurdy Road and Vines Road	Between Vines Road and Minerva Road	Between Minerva Road and Shannon Avenue
PC04 (without Church Street connection)	<1,000vpd	9,400vpd	10,000vpd	9,600vpd
PC08 (with Church Street connection)	15,100vpd	17,400vpd	14,9000vpd	12,000vpd

Church Street is currently classified as a local road west of McCurdy Road, a Road Zone 1 between McCurdy Road and Vines Road and a Road Zone 2 between Vines Road and Ballarat Road. It is configured with a single traffic and shared cycle/parking lane in each direction. Low density residential dwellings, with direct driveway access, are typically provided along the length of Church Street.

The forecast future traffic volumes are still within the acceptable limits of a single lane in each direction road (20,000vpd). However, residents will find it increasingly difficult to access their properties directly from Church Street, particularly at the western end where traffic volumes are forecast to be greater than 15,000vpd.

Further discussion regarding the future role of a Church Street connection for the WGGA is provided in Section Section 6.3.

5.7. What are the impacts of realigning the arterial road to the east side of the lake in the WGGA?

Refer PC-09 and PC-10

The Framework Plan for the Batesford South PSP includes an arterial road aligned to the west of the quarry lake and the clever and creative corridor aligned to the east of the quarry lake. An alternate scenario has been modelled which flips the alignment of the arterial road to the east and clever and creative corridor to the west side of the quarry lake.

The resultant daily traffic volumes on each of the key roads for each scenario are summarised in Table 5.6,

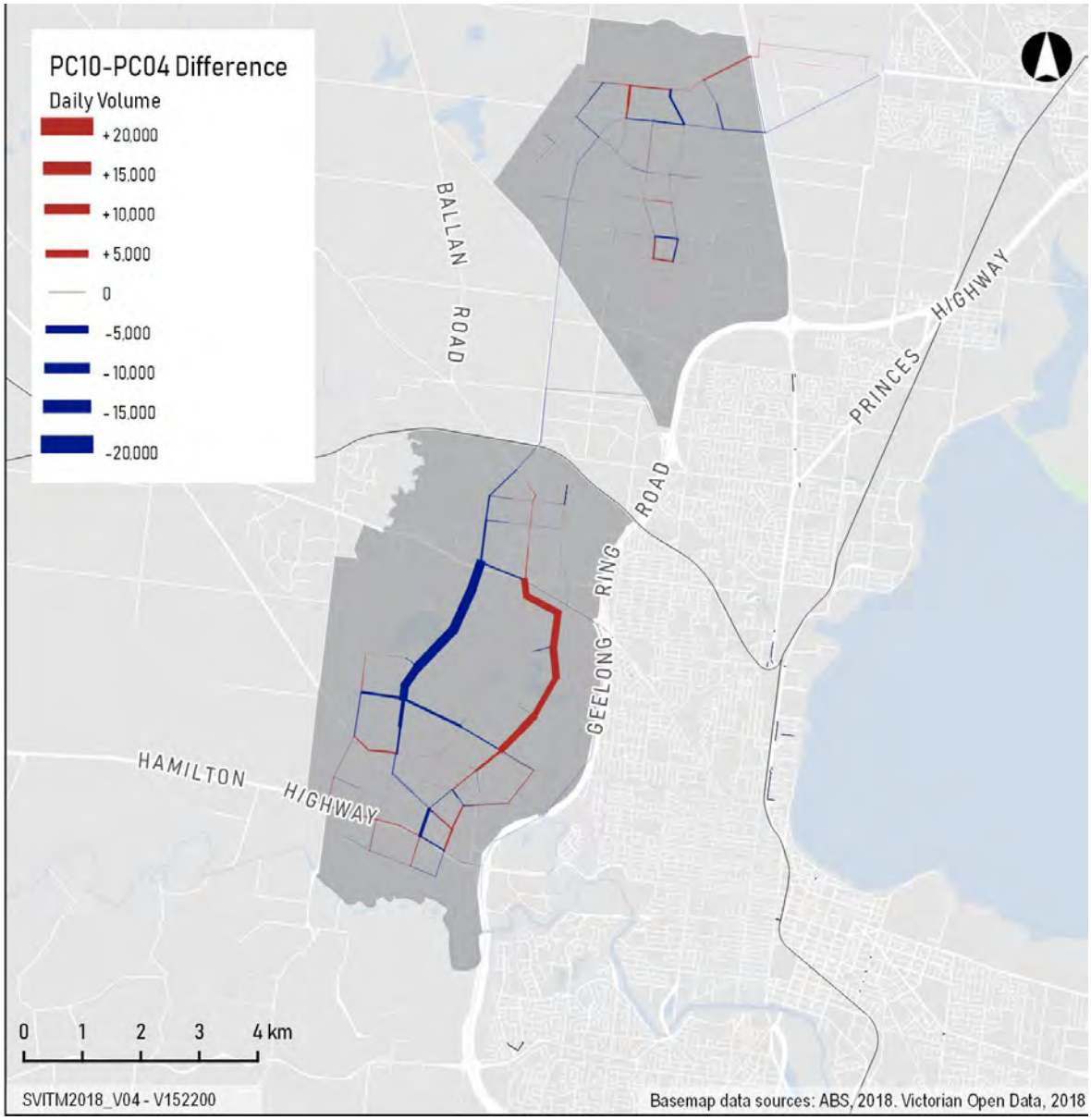
Table 5.6: WGGA Arterial Road and Clever and Creative Corridor Traffic Volumes (PC04 and PC10)

Scenario	Daily Traffic Volume Forecast	
	Arterial Road	Clever and Creative Corridor
PC04 (Western Arterial Alignment)	24,900vpd	7,600vpd
PC10 (Eastern Arterial Alignment)	17,200vpd	12,400vpd

Table 5.6 indicates that greater traffic volumes are forecast on the arterial road compared to the clever and creative corridor under each scenario, noting a more pronounced difference in volumes forecast for PC04.

A plot showing the difference in volumes between the Western and Easter alignment is provided in Figure 5.8. The red links are those that increase in volume with clever and creative corridor to the east of the quarry lake, whilst the blue links are those links that reduce in volumes with clever and creative corridor to the east of the quarry lake. The thickness of the line represents the quantum of the volume difference.

Figure 5.8: Realignment of WGGA Arterial Road – Daily Traffic Volume Difference Plot (PC04 and PC10)



The plots indicate that the realignment of the arterial and clever and creative corridor have minimal impact on the forecast traffic volumes on the broader surrounding road network (for example there is negligible change in volumes on Dog Rocks Road and Fyansford-Gheringhap Road).Reference to the predicted journey times indicates only negligible changes (less than 1 minute) for each of the destinations from WGGA with and without the realignment of the arterial road.

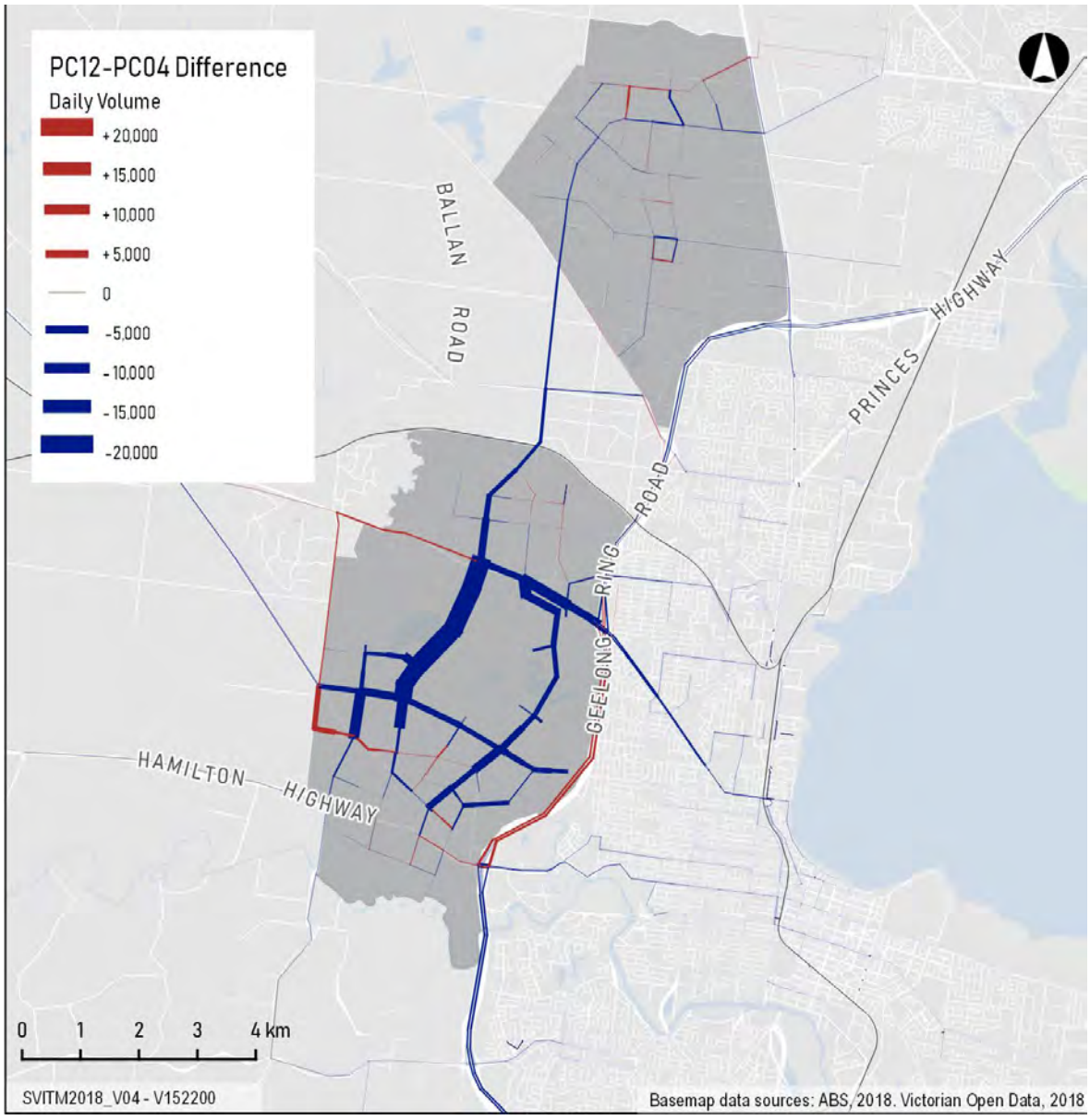
5.8. What are the impacts if Batesford South is not developed?

Refer PC-11 and PC-12

The Framework Plan includes the redevelopment of the area currently occupied by the Fyansford Quarry. Due to the continued operation of the facility and the complexity of redeveloping the quarry, there is a possibility that this area may not be developed by the 2051 time horizon contemplated in this modelling task. In this respect, a modelling scenario has been run which excludes land use development and road connections through the Batesford South PSP Area.

The daily traffic volume difference plot for the with and without development in Batesford South PSP Area is presented in Figure 5.9. The red links are those that increase in volume without the Batesford South PSP, whilst the blue links are those links that reduce in volumes without the Batesford PSP. The thickness of the line represents the quantum of the volume difference.

Figure 5.9: No Development in Batesford South – Daily Traffic Volume Difference Plot (PC04 and PC12)



The difference plot indicates, that despite an overall decrease of traffic generation in the WGGA, increased traffic volumes are forecast for Hamilton Highway. This is as a result of the reduced accessibility and connectivity of the northern and southern areas of the WGGA. Indeed, the southern area (McCanns Lane and Merrawarp Road PSP Areas) would effectively be only accessed from Hamilton Highway, despite accommodating approximately 5,600 dwellings and 4,400 jobs. Under this scenario (PC12), traffic volumes on Hamilton Highway at the Geelong Ring Road are forecast to increase to 64,900vpd compared to 63,800vpd under full build out (PC04).

The traffic volumes on Midland Highway are forecast to reduce from 54,200vpd to 44,200vpd as a result of no development in Batesford South PSP. Only minimal traffic volume changes are forecast for Anakie Road and Bacchus Marsh Road in NGGA as a result of no development in Batesford South PSP.

5.9. What are the impacts of a greater mode share split to public transport?

Refer PC-04A

The modelling for PC04 indicates a mode share of 1.7% to public transport; this mode share is determined by the model and is based on existing ABS journey to work data and the accessibility of public transport in the model (i.e. the bus and rail network coded into the model). This effectively represents a "business as usual" approach without intervention.

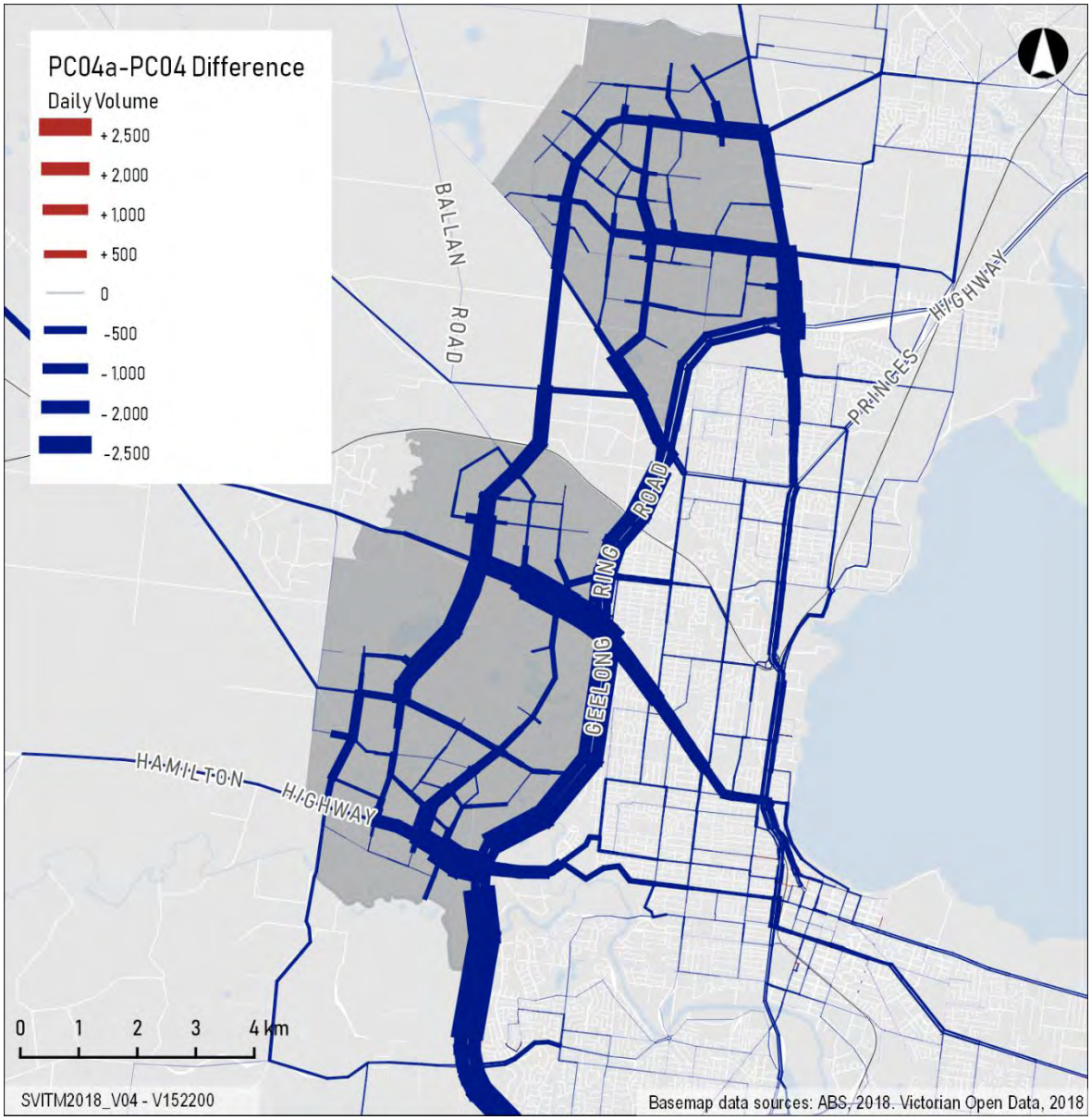
In order to determine the impacts of a greater split of public transport the model has been "hard coded" to increase the mode share to public transport[4]. This results in an overall mode share of approximately 15% to public transport for 2051 and in turn a reduction in private vehicle trips. A summary of the overall trip generation to the growth areas assuming the "business as usual" and increased public transport scenarios is presented in Table 5.7.

Table 5.7: Resultant Traffic Generation with Increased Public Transport Mode Share

Location	Business as Usual Approach (PC-04)		Increased Public Transport (PC-04A)	
	Total Trips	Total Trips per Dwelling	Total Trips	Total Trips per Dwelling
NGGA	211,244	12.7	187,626	11.3
WGGA	270,934	12.6	240,783	10.9
Geelong LGA	2,032,207	12.5	2,030,549	12.5

[4] The following public transport mode shares have been adopted – 20% for employment trips contained within the NWGGA, 15% for employment trips between the NWGGA and outside the NWGGA and 10% for all other trips generated within the NWGGA.

Figure 5.10: Increased Public Transport Usage – Daily Traffic Volume Difference Plot (PC04 and PC4A)



The reduction in overall vehicle trip generation from NWGGA in turn reduces the forecast traffic volumes on each of the key arterial roads accessing the site. A comparison of the arterial road traffic volumes for "business as usual" and increased public transport scenarios is presented in Figure 5.11.

Figure 5.11: Arterial Road Traffic Volume – with Increased Public Transport

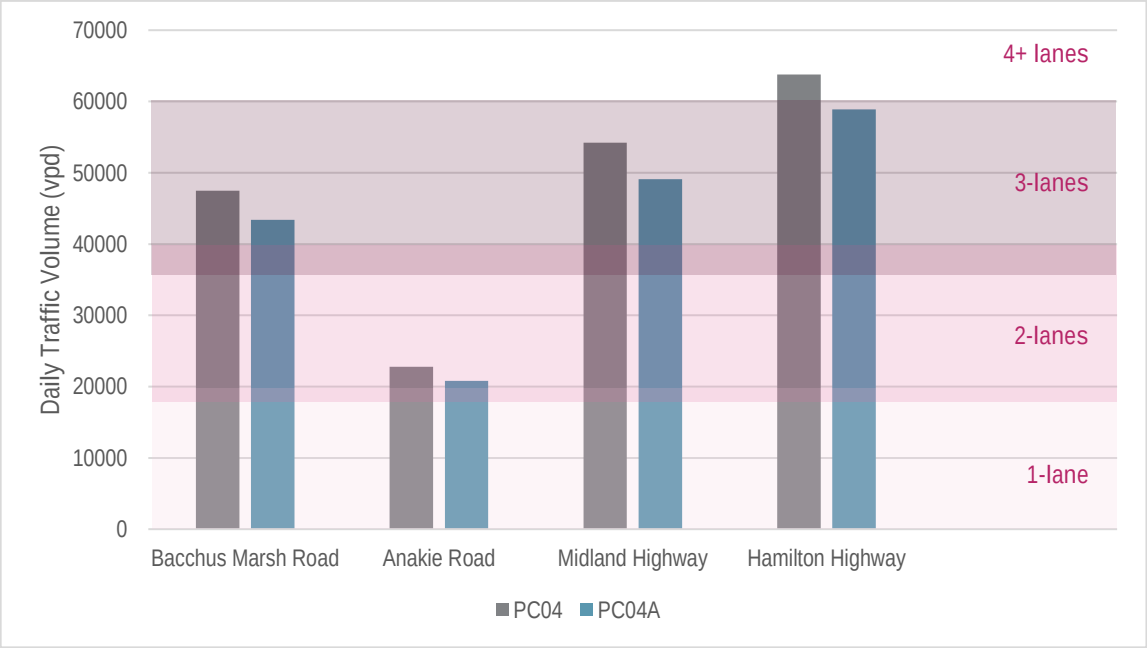


Figure 5.11 indicates that the increased public transport scenario is forecast to reduce the arterial road traffic volumes by approximately 9% at each of the interchanges. Of particular note, the reduced traffic generation from NWGGA is forecast to reduce the volumes on Hamilton Highway below the indicative daily thresholds for a 3-lane road.

The journey time data indicates that a journey time reduction of 1 to 2 minutes is predicted for journeys to the Geelong CBD and Waurn Ponds from the WGGA with the increased public transport usage scenario (i.e. between PC04 and PC04A). There are negligible changes to journey times for trips to Avalon Airport from WGGA or for all trip destinations from NGGA with the increased public transport usage.

Further discussion regarding the role of public transport for the NWGGA is provided in Section 6.3.

5.10. What are the impacts of the alternate road network layout for the NGGA?

Refer PC-04B

An alternate road network for the NGGA compared to the Framework Plan road network was considered. In summary, the revised road network achieves a more conventional spacing between the proposed arterial roads and the clever and creative corridor. This is achieved by the following modifications:

- Realignment of the main arterial road connecting Evans Road to Elcho Road more central to the site
- Removal of the north-south arterial north of Heales Road
- Realignment of the clever and creative corridor.

The road network modifications between PC04 and PC04B are presented in Figure 5.12 and Figure 5.13, respectively.

Figure 5.12: Road Network – Framework Plan (PC04)

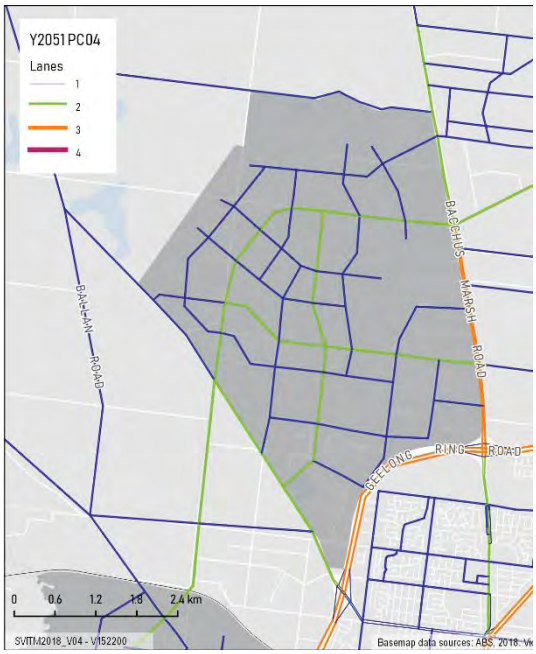
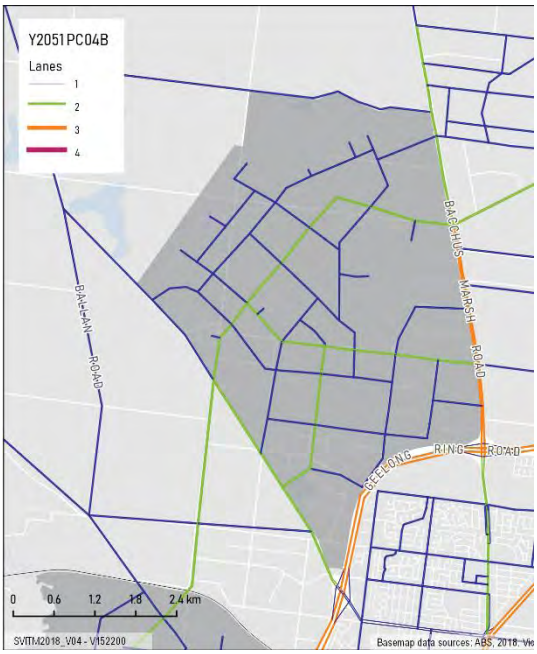


Figure 5.13: Road Network – Alternate NGGA (PC04B)



The benefit of adopting a more conventional spacing between each of the major road links, is that it distributes the traffic move evenly and in this instance distributes increased traffic volumes to the clever and creative corridor. Reference to Figure 5.14 and Figure 5.15 illustrates the increase in traffic volumes along the corridor.

Figure 5.14: Clever and Creative Corridor – Daily Traffic Volumes (PC04)

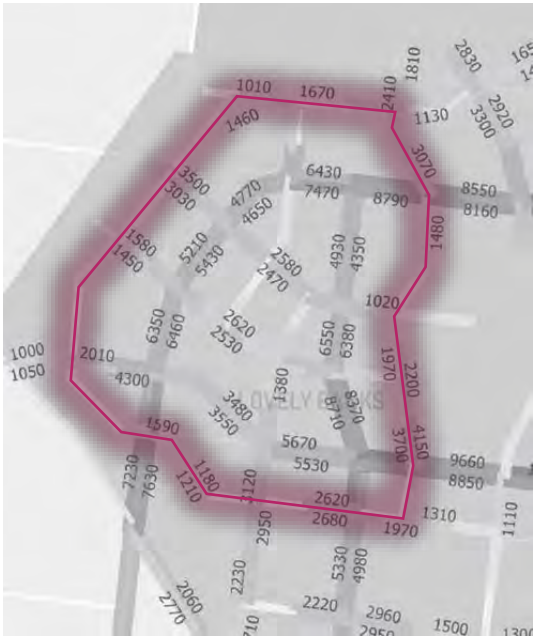
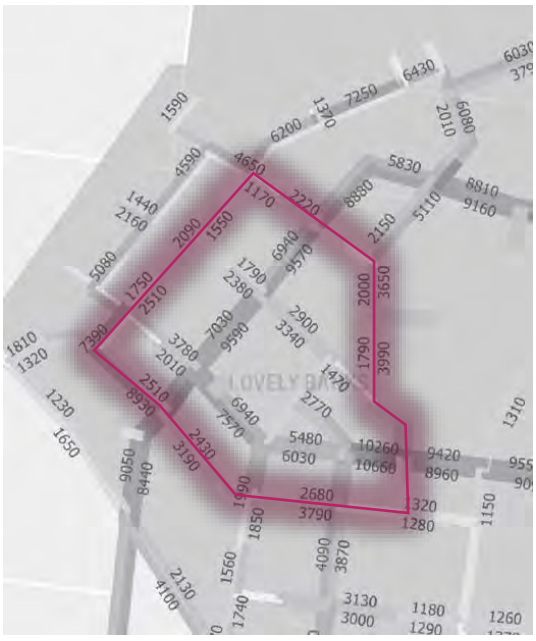


Figure 5.15: Clever and Creative Corridor – Daily Traffic Volumes (PC04B)



It is further noted that the resultant traffic volumes on the alternate arterial road network are still within acceptable limits, with the main arterial forecast to carry 17,500vpd compared to 14,900vpd for PC04.

Based on the above outcomes, it was determined that the alternate road network for the NGGA would be adopted as part of the Framework Plan, noting that it requires less arterial roads, decreases overall infrastructure requirements, increases volumes on the clever and creative corridor and maintains adequate capacity on each of the other internal roads.

6. SUSTAINABLE TRANSPORT

There are numerous national, state and local planning documents that reveal consistent themes centred around supporting behaviours which help deliver more sustainable communities. Accordingly, the provision of a 'best in class' active and public transport network will be integral to the delivery of a successful transport outcome for the NWGGA.

06

6.1. Preamble

Current best practice urban transport planning is to prioritise active transport, with public transport being the second priority, followed by freight and then private vehicles being the lowest priority. This approach maximises amenity, health and community. The planning of the transport network for the NWGGA has adopted this hierarchy of priority.

The Clever and Creative future document sets out the aspirations of the Geelong Community to 2047. The document sets out nine aspirations, including the following relating to transport; "a fast, reliable and connected transport network". Specifically, the document goes onto recommend a future mode share target of "50 per cent of journeys to work are made by public transport, walking or cycling". The 2016 ABS data indicates that 10% of journeys to work are currently completed by sustainable modes.

An overview of the key active travel principles has been sought from the following:

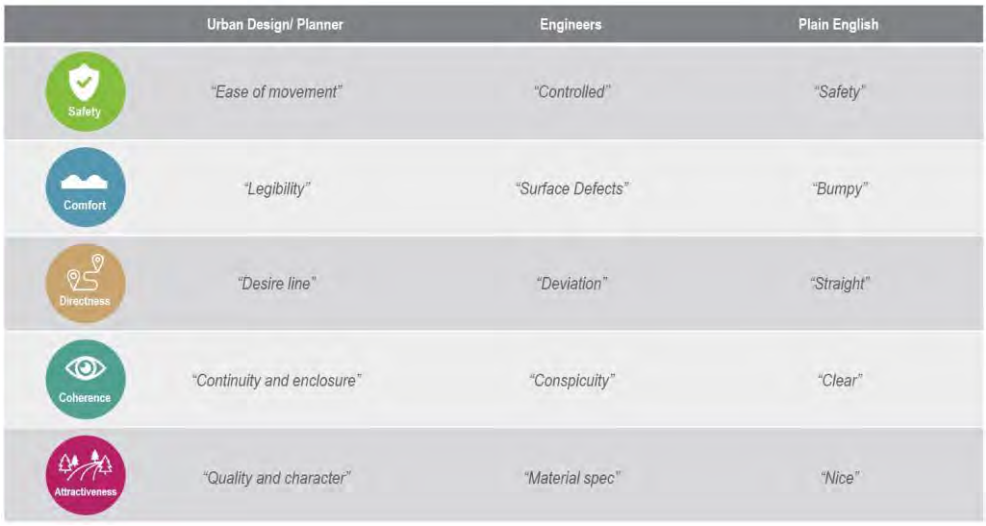
- Urban Movement 'Bee a Champion' Training Course, November 2018 (United Kingdom)
- "The Dutch five for cycling".

The five key principles for pedestrian planning as defined by Urban Movement (UK) are reproduced below:

1. *"Streets should be placer where people chose to spend time socialising rather than just passing through.*
2. *Street design should focus on moving people rather than traffic.*
3. *Dedicated separate space should be provided for walking and for cycling traffic.*
4. *People should feel safe, relaxed and secure on the street and not just in a car.*
5. *People should feel like they can stroll without delay and linger without issue."*

There are five guiding principles that underpin cycling design in the Netherlands (which has one of the highest cycling mode shares in the world); coherent, direct, attractive, safe and comfortable. The simplistic definition of each of these principles is summarised in Figure 6.1 for urban planners, engineers and the public.

Figure 6.1: The Five Principles of Cycling Design in the Netherlands Explained



The active travel network for NWGGA should be developed in accordance with the above guiding principles for good walking and cycling design.

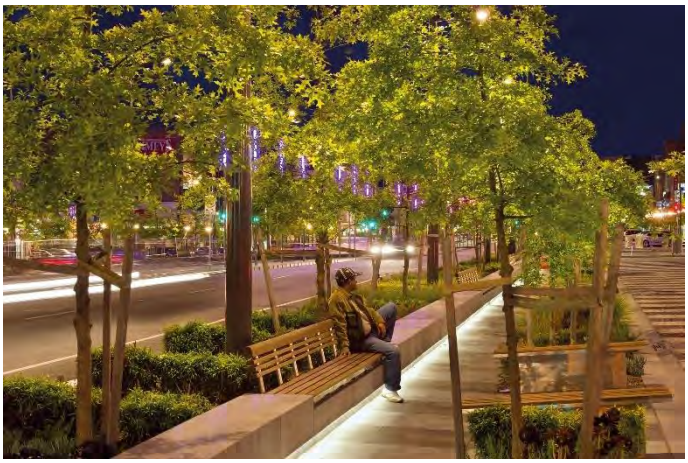
Examples of best practice street design are provided in Figure 6.2, Figure 6.3 and Figure 6.4.

Figure 6.2: Example of an Activated Shared Path

Figure 6.3: Potential Local Street Environment

(Example of a local street in Perth, WA)

Figure 6.4: Potential Arterial Road Environment



(Example of an Arterial Road at Lonsdale Street, Dandenong)

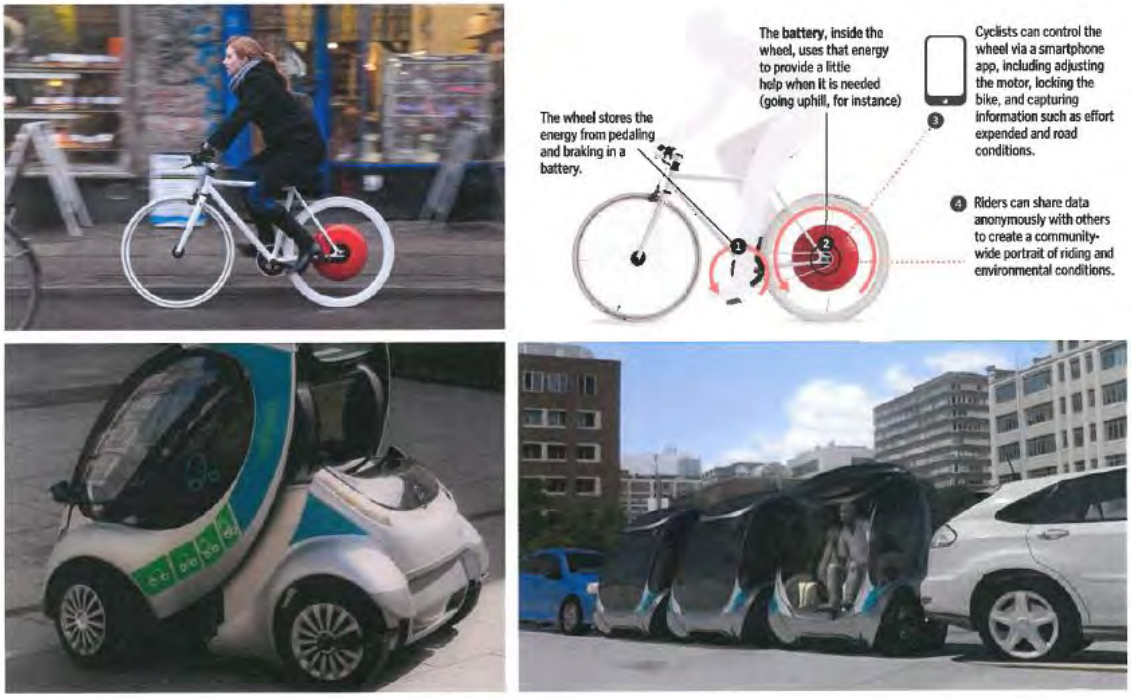
6.1.1. Emerging Transport Technologies

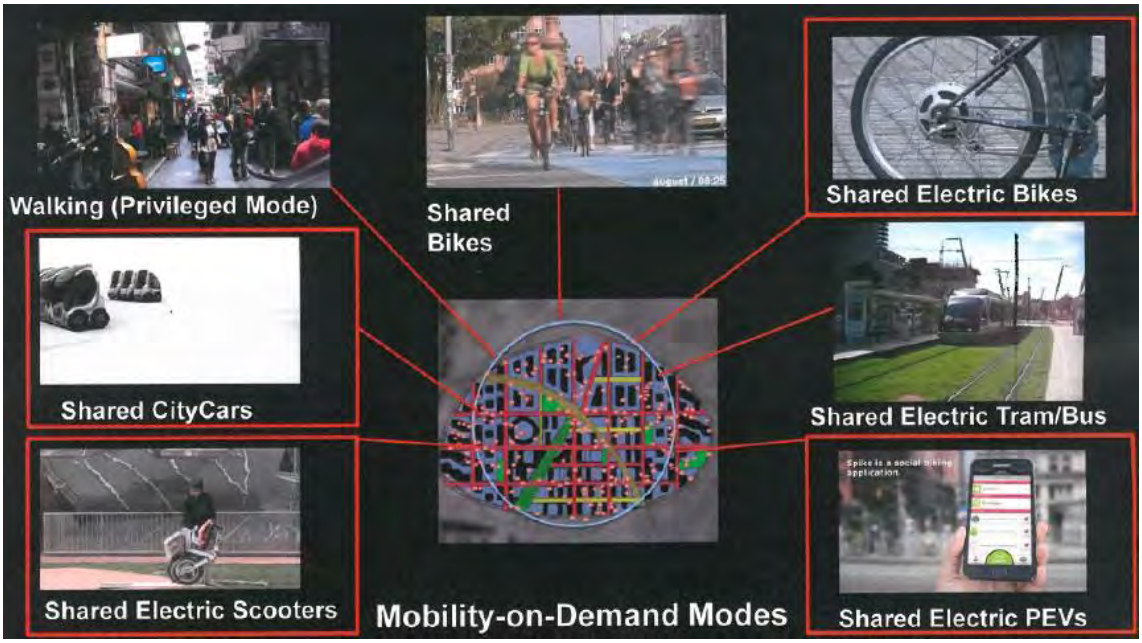
In developing the transport network for the NWGGA, consideration should be given to not just the current transport modes and patterns, but emerging and potential future technologies including:

- Electric bicycles
- Electric scooters
- Driverless buses
- Autonomous cars.

Examples of these are shown below.

Figure 6.5: Examples of Emerging Transport Technologies





It is likely that the introduction of these technologies would change the way travel occurs not only across the network but also across the day. The analysis undertaken to date is based on known and current trends and does not consider significant uptakes in new technology as the impact and take up is currently unknown.

6.2. Active Travel

A connected, well integrated and expansive pedestrian and cycling network is to be delivered within the NWGGA to promote the use of these modes for local travel and a proportion of longer distance journeys and encourage mode shift away from private vehicle. This includes the provision of a comprehensive network of shared paths on arterial roads and connector streets, waterway corridors, rivers and key natural features (i.e. lake and monocline).

The internal facilities would be complemented with the following connections:

- Connect to existing Ted Wilson and Todd McKean shared path trails
- Connect to the existing Geelong Ring Road shared path
- New shared path connection across the Geelong Ring Road at Church Street (WGGA) and Sutcliffe Reserve (NGGA)
- Onward connections to the Principal Bicycle Network at Ballarat Road, Hamilton Highway and Bacchus Marsh Road.

The resultant active travel networks for the NGGA and WGGA are presented in Figure 6.6 and Figure 6.7, respectively.

Figure 6.6: Proposed Active Travel Network - NGGA

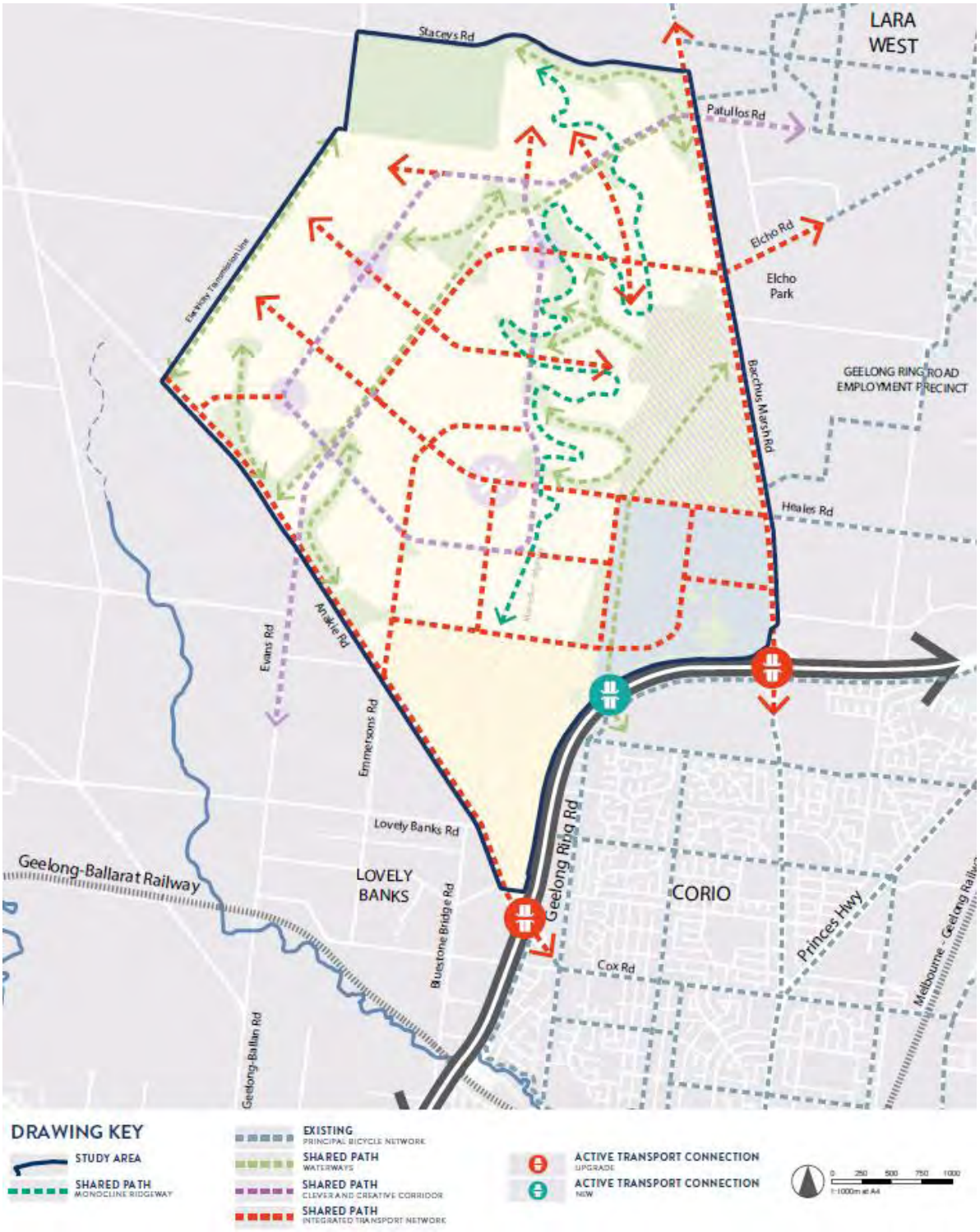
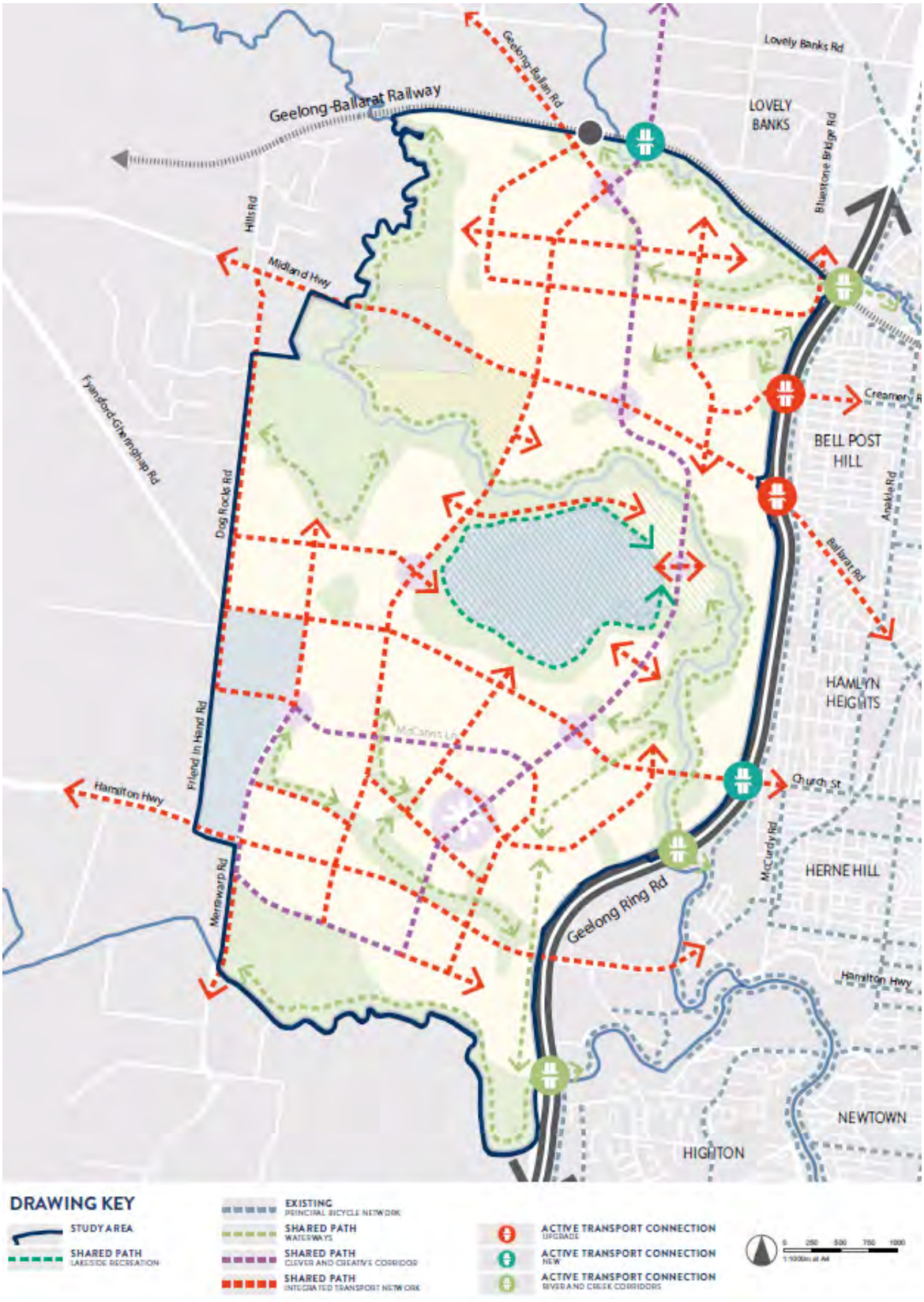


Figure 6.7: Proposed Active Travel Network - WGGA



6.3. Public Transport

6.3.1. Increased Public Transport Usage Scenario

A business as usual approach to travel from the growth areas to other areas of Geelong will result in a high level of on road vehicular traffic. The resultant outcome will be increased congestion at key intersections with slow travel times to and from key attractors. The increased public transport usage scenario (PC04A) presented in Section 5.9 showed significant network benefits, including (but not limited to):

- Reduction in traffic volumes at each of the Geelong Ring Road interchanges of approximately 9%
- Journey time savings of 1 to 2 minutes to Geelong CBD and Waurn Ponds from WGGA
- Reduction of traffic volumes on Hamilton Highway below the threshold of a 6-lane road.

This scenario assumes a public transport mode share of 10 to 20% (dependent on type and destination). These public transport mode shares will not be achieved adopting a "business as usual" approach. In order to achieve the target public transport mode share of approximately 15% there will need to be a "game changer" for public transport services within Geelong.

For the vast majority of their trips buses that operate in the Geelong network typically share road space with private vehicles. This combined with often circuitous routes and buses stopping to pick up and drop off passengers results in travel times for buses that are substantially worse off than those for private vehicle travel. This is demonstrated in Table 6.1 which identifies the typical travel time by bus and private vehicle for key bus routes in Geelong.

Table 6.1: Comparison of Existing Bus and Private Vehicle Travel Times in Geelong

Route / Destination	Bus Travel Time	Private Vehicle Travel Time	Difference
Route 20 Corio Shopping Centre to Geelong Station	22 minutes	13 minutes	+9 minutes (+70%)
Route 1 Deakin University to Geelong Station	31 minutes	17 minutes	+14 minutes (+45%)
Route 25 Bell Post Hill to Geelong Station	35 minutes	12 minutes	+23 minutes (+65%)

Note: Based on AM peak hour travel and using PTV scheduling information and average google travel times for driving.

It is evident that public transport (i.e. bus) travel times in Geelong are far inferior to private vehicle travel times. Accordingly, public transport mode shares in Geelong are currently low and as described in Section 2.6 well below that of greater Melbourne (5% compared to 19% based on ABS journey to work data).

6.3.2. Church Street Connection

The modelling outcomes presented in Sections 4 and 5 indicate that the transport network servicing the NGGA is predicted to operate satisfactorily, whilst the transport network servicing the WGGA will require intervention for it to operate at acceptable levels. This is largely as a result of traffic from WGGA being funnelled into two roads accessing Geelong, including Hamilton Highway which has a constrained road environment (topographical constraints along Deviation Road) between Geelong Ring Road and Geelong itself.

One potential intervention measure that has been identified is the delivery of a bus and active travel link (no private vehicles) connecting the WGGA to Church Street. Restricting the link to buses only and not private vehicles will provide a "competitive advantage" to public transport users over private vehicles in the WGGA.

The volume to capacity plots presented in Figure 4.19 indicates that Church Street is forecast to operate with a LOS C or better during the road network peak hours. This indicates that compared to the other routes (i.e. Midland Highway and Hamilton Highway) to the WGGA there will be reduced congestion along the Church Street corridor.

The indicative alignment of a future bus route along Church Street is identified in Figure 6.8.

Figure 6.8: Church Street – Public Transport Corridor Alignment

Initial estimates suggest that a bus operating between the centre of the WGGA and Geelong CBD could complete this route in approximately 17 minutes[5] (assuming bus priority measures are provided along this route). This represents a travel time saving of 20% compared to the predicted car journey time for PC04 (i.e. 17 minutes compared to 21 minutes). In contrast, reference to Table 6.1 above indicates that currently bus travel in Geelong incurs a time disadvantage rather than saving.

It is acknowledged that there will be a number of construction challenges associated with the delivery of a bus and active travel link across the Geelong Ring Road at Church Street. That being said, there are a number of examples of equally challenging bus and active travel infrastructure projects that have previously been delivered in Australia. These are presented in Table 6.2.

[5] Estimate based on 7km path of travel at an average travel speed of 25km/h. This bus travel time estimate could be further improved by implementing further bus priority measures identified in the following Section.

Table 6.2: Similar Scaled Bus Infrastructure Projects in Australia

Location		Description
Eleanor Schonell Bridge, Brisbane		The $55.5 million, 185m long bridge across the Brisbane River was completed in December 2006. The bridge caters for pedestrians, cyclists and buses only and connects University of Queensland's St Lucia campus to Woolloongabba. Private vehicle travel for students to the University reduced from 39% to 22% and bus travel increased 27% to 53% between 2002 and 2011 [1]
Bennelong Bridge, Sydney		The $63 million 330m long bridge across Sydney Harbour was completed in May 2016. The bridge caters for pedestrians, cyclists and buses only and connects Wentworth Point and Rhodes. At the time, the bridge was the largest privately funded piece of public infrastructure to be delivered by a developer. The bridge was delivered to ease congestion at Wentworth Point and allow for greater development densities to be delivered at the site.
O-Bahn City Access Project, Adelaide		The $160 million, 670m long bus only tunnel was completed in December 2017. The tunnel connects the O-Bahn bus system from Gilberton into the Adelaide CBD. The project has improved travel times and reliability for approximately 30,000 bus passengers per day. A series of pedestrian and cycling improvements were delivered in conjunction with the tunnel project.

[1] Source: https://blogs.crikey.com.au/theurbanist/2014/07/16/the-bridge-does-it-have-to-carry-cars-to-be-successful/

6.3.3. Other Bus Priority Measures

When planning road space, further bus priority measures should be considered for the NWGGA and for the key routes linking the growth areas to the Geelong CBD (Bacchus Marsh Road, Midland Highway, Church Street, etc). These measures could include:

- Bus lanes
- Bus jump lanes at signalised intersections
- Bus priority phases at signalised intersections.

The benefits of providing public transport priority cannot be understated as without these types of facilities the attractiveness of public transport for residents will be limited. Recent data provided from Transport for Victoria has demonstrated a direct uplift in public transport patronage with the introduction of bus priority measures.

Additionally, it is recommended that bus services be delivered upfront to encourage public transport usage from day one rather than once a household has developed a reliance on private vehicle travel. Early investment in public transport will result in strong travel behaviour that will act as a legacy for the growth and development of the two areas.

Examples of these facilities are provided in Figure 6.9 to Figure 6.11. The indicative location of where bus priority measures could be located within the external network are illustrated in Figure 6.12. Bus priority measures will be provided on the NWGGA internal road network, with specific locations to be identified at the PSP stage.

Figure 6.9: Dedicated Bus Lanes

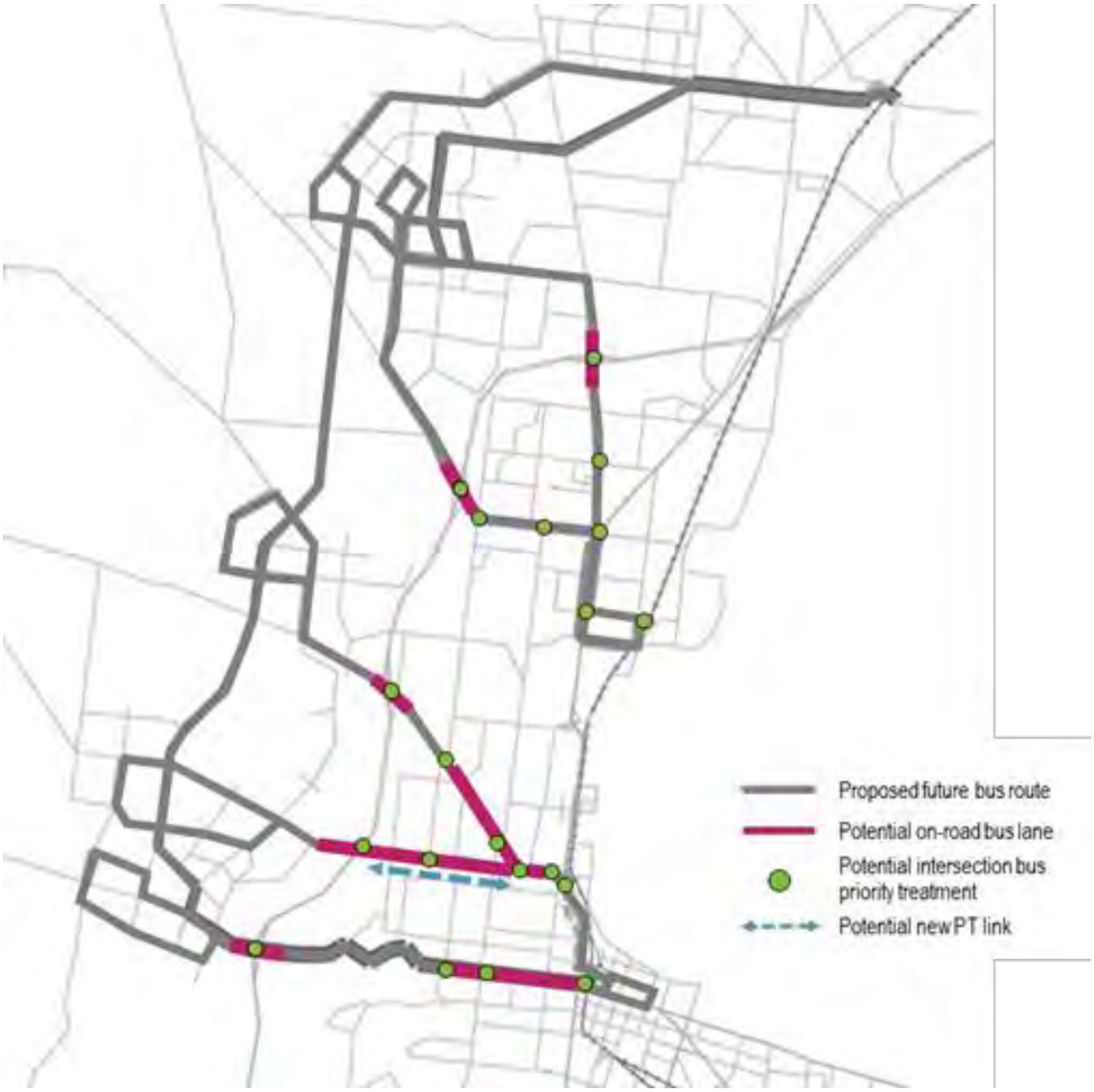
(Hoddle Street, Abbotsford)

Figure 6.10: Bus Jump Lane

(Springvale Road / Lower Dandenong Road Intersection, Keysborough)

Figure 6.11: Bus Priority Phases

Figure 6.12: Potential Locations of External Bus Priority Measures (subject to further investigation)

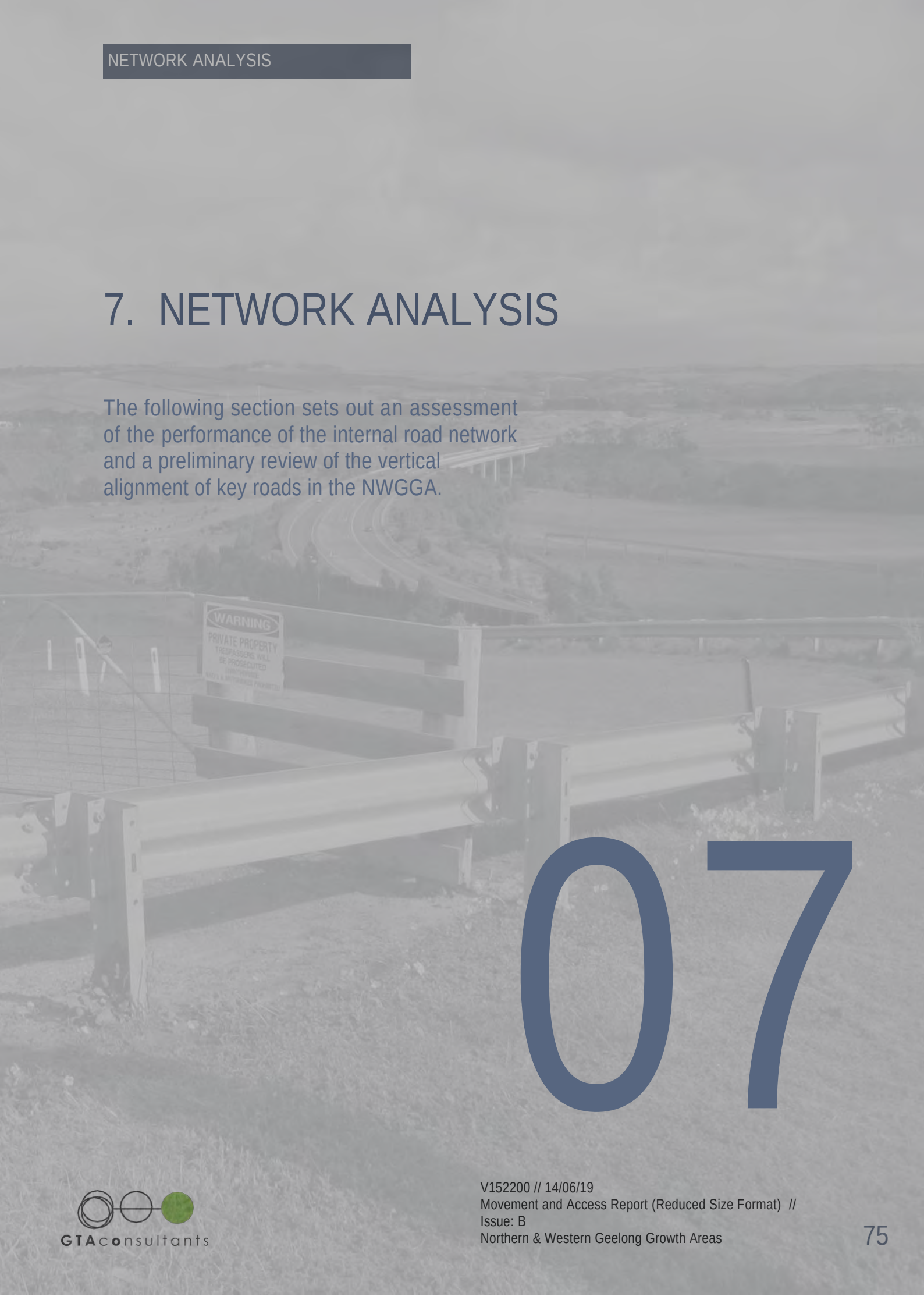


6.3.4. Commuter Car Parking

The NWGGA will result in increased demands for commuter car parking at the existing railway stations along the Geelong Line, most notably North Gelong and Lara Railway Stations. The issue of commuter car parking has not been addressed as part of this assessment. The impact of the NWGGA but should be considered as part of the commuter car parking study currently being prepared on behalf of the Department of Transport.

7. NETWORK ANALYSIS

The following section sets out an assessment of the performance of the internal road network and a preliminary review of the vertical alignment of key roads in the NWGGA.



07

7.1. Internal Road Network Cross-Sections

A summary of the future (2051) daily traffic volumes on key internal roads are presented in Figure 7.1, Figure 7.2 and Table 7.1. The red and blue dots on Figure 7.1 and Figure 7.2 represent the count locations presented in Table 7.1. The volumes reported are for PC04.

Figure 7.1: VITM Daily Traffic Volume Plot NGGA

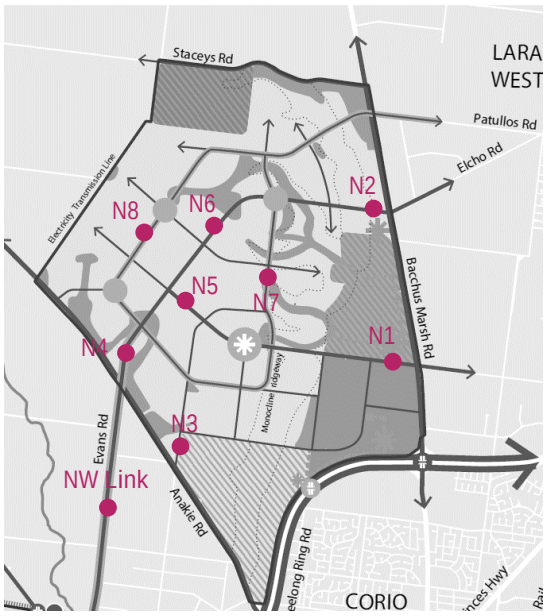


Figure 7.2: VITM Daily Traffic Volume Plot WGGA

Table 7.1: Summary of Ultimate Daily Volumes on Key Internal Roads (2051)

No.	Road Name	Expected Daily Traffic Volume	Proposed Classification and No. lanes	Capacity Limit (based on No. lanes)
N1	Heales Road (east)	17,300vpd	Arterial (4 lanes)	36,000 to 40,000vpd
N2	Elcho Road (east)	19,600vpd	Arterial (4 lanes)	36,000 to 40,000vpd
N3	Emmersons Road (south)	3,400vpd	Connector (2 lanes)	18,000 to 20,000vpd
N4	Evans Road (south)	17,500vpd	Arterial (4 lanes)	36,000 to 40,000vpd
N5	Heales Road (west)	14,500vpd	Arterial (4 lanes)	36,000 to 40,000vpd
N6	Evans Road (north)	14,700vpd	Arterial (4 lanes)	36,000 to 40,000vpd
N7	C & C Corridor (north)	5,700vpd	Clever & Creative Corridor (2 lanes)	18,000 to 20,000vpd
N8	C & C Corridor (WEST)	4,300vpd	Clever & Creative Corridor (2 lanes)	18,000 to 20,000vpd
NW Link	Evans Road Link	18,000vpd	Arterial (2 lanes)	18,000 to 20,000vpd
W1	Merrawarp Road (north)	12,000vpd	Arterial (4 lanes)	36,000 to 40,000vpd
W2	New N-S Arterial (south)	16,500vpd	Arterial (4 lanes)	36,000 to 40,000vpd
W3	New E-W Arterial (central)	7,900vpd	Arterial (4 lanes)	36,000 to 40,000vpd
W4	New N-S Arterial (north)	24,900vpd	Arterial (4 lanes)	36,000 to 40,000vpd
W5	Lynnburn Road (south)	28,200vpd	Arterial (4 lanes)	36,000 to 40,000vpd
W6	Geelong-Ballan Road (south)	8,600vpd	Clever & Creative Corridor (2 lanes)	18,000 to 20,000vpd
W7	C & C Corridor (north)	7,600vpd	Clever & Creative Corridor (2 lanes)	18,000 to 20,000vpd

Table 7.1 indicates that in all of the locations, there is ample capacity in the proposed internal road network to accommodate the forecast traffic volumes following full development of NWGGA. Indeed, the forecast traffic volumes indicate, that for the most part, each of the proposed 4-lane arterial roads could be reconfigured to reduce the number of private vehicle traffic lanes from 4 to 2 lanes and reallocate traffic lanes to provide improved public transport priority (i.e. bus lanes).

Further investigation of the usage of the allocated road space should be undertaken through the design process, including consideration of road management within local town centres and through school precincts. This could be understanding the appropriate and best use of road space in the form of lane management, parking management and Public Transport Priority.

7.2. Vertical Alignment

The recommended maximum grades for greenfield design in the NWGGA have been provided by CoGG (and sourced from engineering publications including the Infrastructure Design Manual (IDM), Austroads Guide to Road Design Part 3: Geometric Design and Public Transport Guidelines for Land Use and Development). The recommended grades that should apply to the growth areas are summarised in Table 7.2.

Table 7.2: Recommended Maximum Mean Average Grades

Link Type	Maximum Grades	
	Desirable	Desired Maximum
Higher Use Roads	5%	10%
Lower Use Roads	10%	-
Local Streets	10%	-
Bus Routes	6%	9%
Active Transport Prioritised Routes	3%	5%
Active Transport On-Road	To be assessed on a case by case basis	

Accordingly, the higher order road network should be configured with a desirable grade of 5%, with desirable maximum grades of up to 9% for short distances. The Austroads Guide indicates that the desirable maximum length of grades greater than 6% is 300m (Table 8.4 of the Guide). The public transport guidelines and infrastructure design manual do not provide any guidance on maximum lengths for short-term grades.

Notwithstanding, the appropriate and achievable grades will need to be determined as part of separate investigations that, amongst other items, should consider inputs such as required cross sections, constructability, amenity, engineering feasibility and connectivity.

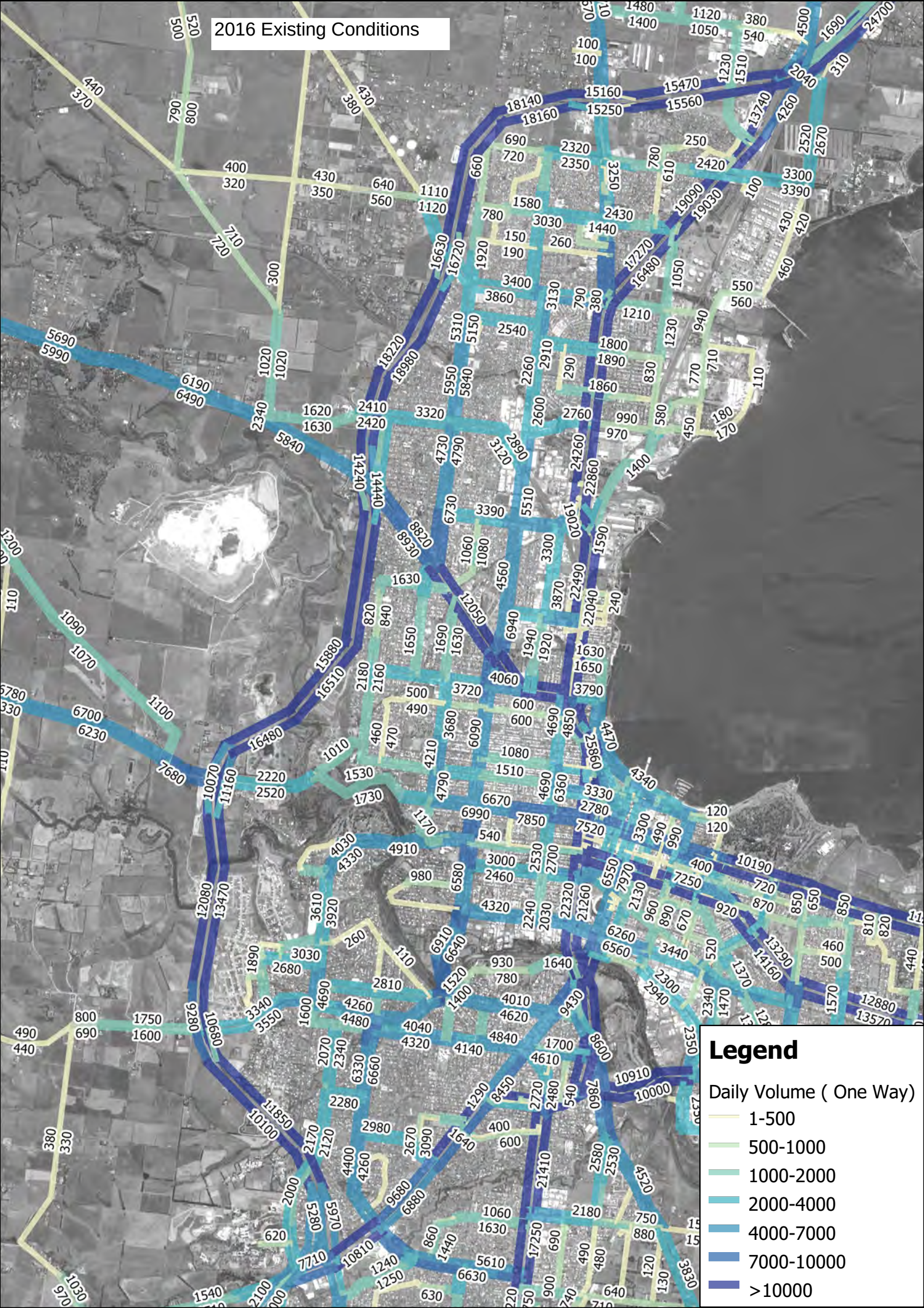
It is acknowledged that the local topography will pose challenges and will need to be mitigated as part of the detailed design (e.g. monocline, quarry, stockpiles, steep Moorabool River escarpments, Church Street and rail overpasses).

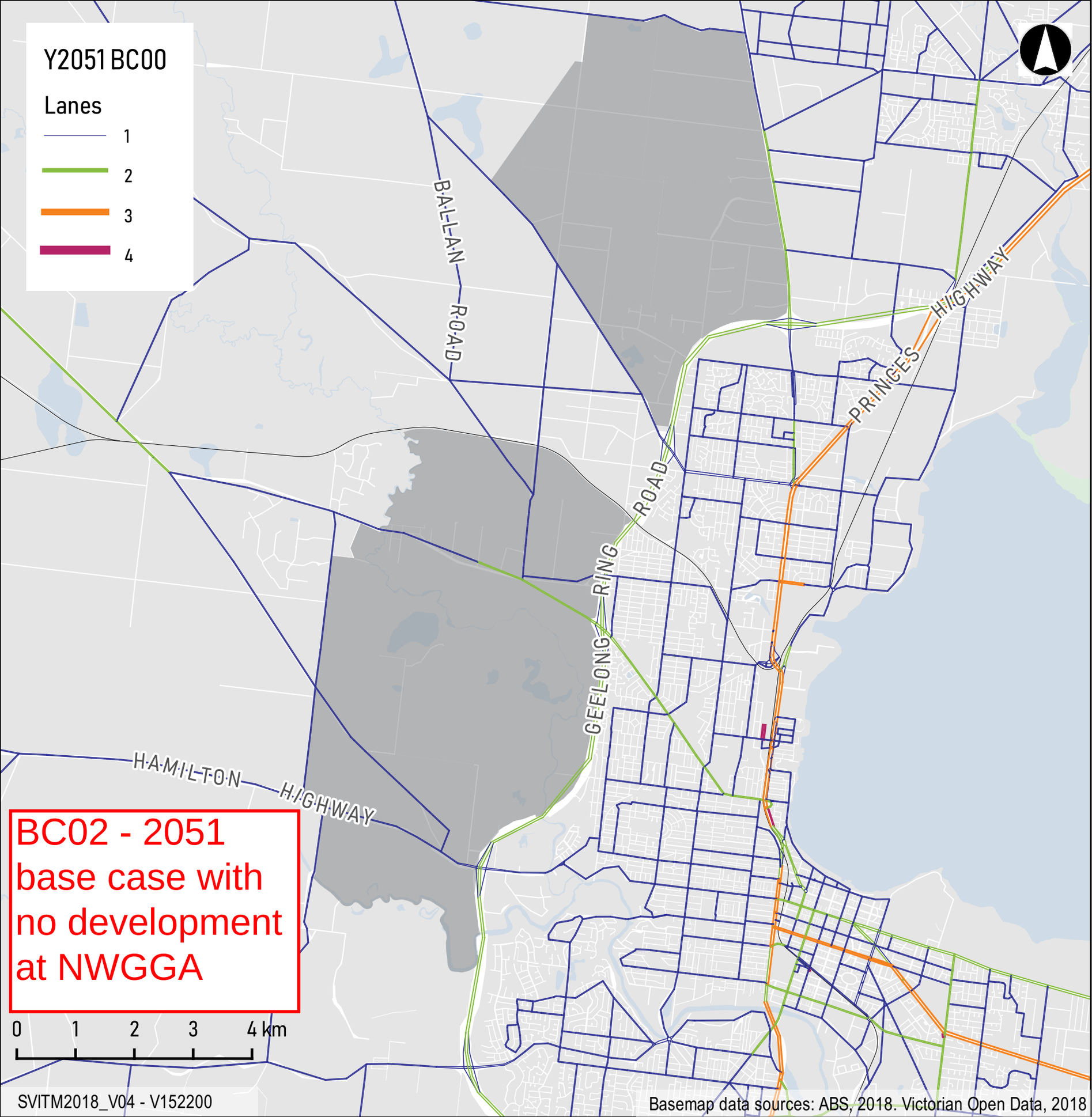
A. 2016, 2031 AND 2051 BASE CASE MODEL OUTPUTS

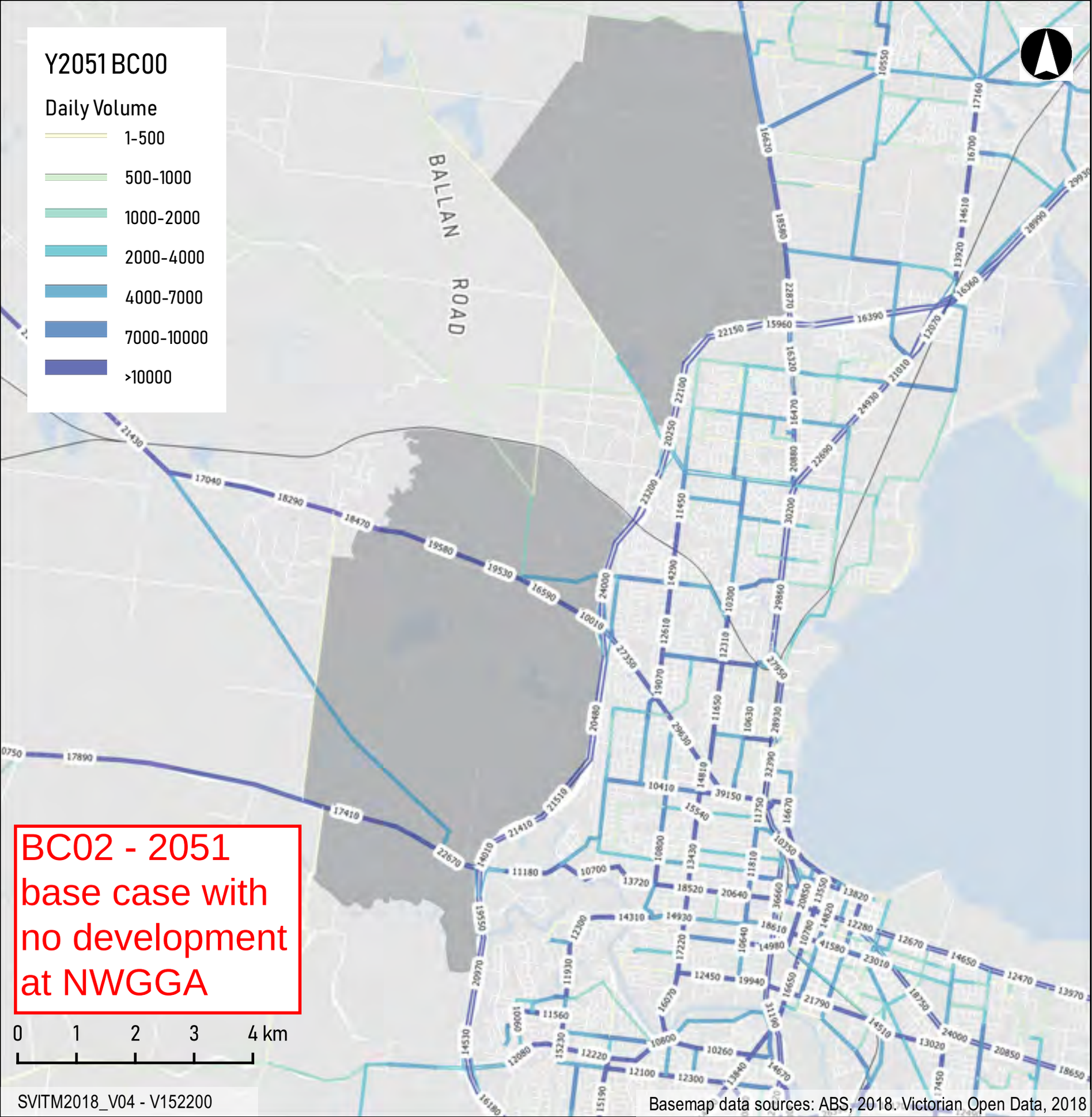
The daily volume plots for 2016, 2031 and 2051 are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for 2016, 2031 and 2051 are provided in the 'Full' report. These plots assume no development in NWGGA.

A


2016 Existing Conditions
Legend
Daily Volume (One Way)
1-500
500-1000
1000-2000
2000-4000
4000-7000
7000-10000
>10000


Y2051 BC00
Lanes
1
2
3
4
BALLAN ROAD
PRINCES HIGHWAY
GEELONG RING ROAD
HAMILTON HIGHWAY
BC02 - 2051 base case with no development at NWGGA
0 1 2 3 4 km
SVITM2018_V04 - V152200
Basemap data sources: ABS, 2018. Victorian Open Data, 2018


Y2051 BC00
Daily Volume
1-500
500-1000
1000-2000
2000-4000
4000-7000
7000-10000
>10000
BALLAN ROAD
BC02 - 2051 base case with no development at NWGGA
0 1 2 3 4 km
SVITM2018_V04 - V152200
Basemap data sources: ABS, 2018. Victorian Open Data, 2018

B. 2031 MODEL OUTPUTS

The daily volume plots for 2031 project cases are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for 2031 are provided in the 'Full' report (PC-01 & PC-02). These plots assume partial development of the NWGGA.

B

PC01 - Interim 2031 project case without external road upgrades

Y_203 PC01

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

LOVELY BANKS
SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
LARA
CORIO
SHELL PARADE
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
BELL POST HILL
NORLANE
STATION STREET
NORTH SHORE
BELL PARK
NORTH GEELONG
FYANSFORD
HAMLYN HEIGHTS
RIPPLESIDE
DRUMCONDRA
HERNE HILL
MANIFOLD HEIGHTS
GEELONG WEST
GEELONG
EAST GEELONG
NEWTOWN (GREATER GEELONG)
NEWCOMB
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
WHITTINGTON
BARRABOOL
CERES
BARRABOOL ROAD
WANDANA HEIGHTS
BELMONT
BREAKWATER
ST ALBANS PARK
CHARLEMONT
STONEHAVEN
HAMILTON HIGHWAY
WAURN PONDS
MARSHALL

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Basemap data sources: ABS, 2018. Victorian Open Data, 2018

PC02 - Interim 2031 project case with external road upgrades

Y2031 PC02

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

ANAKIE
SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
LOVELY BANKS
LARA
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
BELL POST HILL
NORTH SHORE
BELL PARK
CORIO
HAMLYN HEIGHTS
RIPPLESIDE
HERNE HILL
GEELONG WEST
NEWTOWN (GREATER GEELONG)
EAST GEELONG
BARRABOOL
CERES
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BARRABOOL ROAD
WANDANA HEIGHTS
BELMONT
BREAKWATER
WAURN PONDS
MARSHALL
CHARLEMONT

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Basemap data sources: ABS, 2018. Victorian Open Data, 2018

C. 2051 MODEL OUTPUTS

The daily volume plots for 2051 project cases are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for 2051 are provided in the 'Full' report (PC-03 & PC-04). These plots assume full development of the NWGGA.

C

PC03 - Ultimate 2051 project case without external road upgrades

Y_205 PC03

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

ANAKIE
LARA
SUTHERLANDS CREEK
BALLAN ROAD
LOVELY BANKS
MOORABOOL
STEIGLITZ ROAD
CORIO
SHELL PARADE
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
BELL POST HILL
NORLANE
STATION STREET
NORTH SHORE
BELL PARK
NORTH GEELONG
STONEHAVEN
FYANSFORD
HAMLYN HEIGHTS
RIPPLESIDE
DRUMCONDRA
HERNE HILL
MANIFOLD HEIGHTS
GEELONG WEST
NEWTOWN (GREATER GEELONG)
EAST GEELONG
BARRABOOL
CERES
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
NEWCOMB
WANDANA HEIGHTS
BELMONT
WHITTINGTON
BARRABOOL ROAD
BREAKWATER
ST ALBANS PARK
CHARLEMONT
WAURN PONDS
MARSHALL

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

PC04 - Ultimate 2051 project case with external road upgrades

Y2051 PC04

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

ANAKIE
SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
BARRABOOL
CERES
BARRABOOL ROAD
WANDANA HEIGHTS
WAURN PONDS
HAMLYN HEIGHTS
HERNE HILL
GEELONG WEST
NEWTOWN (GREATER GEELONG)
BELL POST HILL
BELL PARK
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BELMONT
CORIO
NORTH SHORE
EAST GEELONG
NEWCOMB
NORTH GEELONG
RIPPLESIDE
DRUMCONDRA
BREAKWATER
ST ALBANS PARK
CHARLEMONT
MARSHALL

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

D. 2051 MODEL OUTPUTS SCENARIO TESTING

The daily volume plots for 2051 scenario cases are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for each of the 2051 scenario tests are provided in the 'Full' report (PC-03, PC-04, PC-05, PC-06, PC-07, PC-08, PC-09, PC-10, PC-11 & PC-12). These plots assume full development of the NWGGA.

D

Y2051 PC05

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC05 - Ultimate 2051 project case without external road upgrades and one vehicle connection to Anakie Road

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
BARRABOOL
MERRIAWARP ROAD
CERES
WANDANA HEIGHTS
WAURN PONDS
HAMLYN HEIGHTS
GEELONG
BELL POST HILL
BELL PARK
HERNE HILL
NEWTOWN (GREATER GEELONG)
HIGHTON
BELMONT
GEELONG WEST
CORIO
NORTH SHORE
NORTH GEELONG
BREAKWATER
ST ALBANS PARK
RIPPLESIDE
DRUMCONDRA
NEWCOMB
SOUTH GEELONG
THOMSON (GREATER GEELONG)
EAST GEELONG
MARSHALL
CHARLEMONT

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

PC06 - Ultimate 2051 project case with external road upgrades and one vehicle connection to Anakie Road

Y2051 PC06

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
HAMILTON HEIGHTS
HERNE HILL
MANIFOLD HEIGHTS
GEELONG WEST
NEWTOWN (GREATER GEELONG)
BELL POST HILL
NORLANE
BELL PARK
CORIO
NORTH SHORE
EAST GEELONG
NEWCOMB
SOUTH GEELONG
THOMSON (GREATER GEELONG)
WHITTINGTON
BREAKWATER
ST ALBANS PARK
CHARLEMONT
MARSHALL
NORTH GEELONG
RIPPLESIDE
DRUMCONDRA
BARRABOOL
CERES
BARRABOOL ROAD
HIGHTON
WANDANA HEIGHTS
WAURN PONDS

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Y2051 PC07

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC07 - Ultimate 2051 project case without external road upgrades and Church Street connection across Ring Road

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FORDFORD
WAURN PONDS
WANDANA HEIGHTS
BARRABOOL
MERRAWARP ROAD
CERES
HIGHTON
HAMLYN HEIGHTS
MARSHALL
BELL POST HILL
BELL PARK
BELMONT
GEELONG WEST
NEWTOWN (GREATER GEELONG)
SOUTH GEELONG
THOMSON (GREATER GEELONG)
NORTH GEELONG
EAST GEELONG
NEWCOMB
NORTH SHORE
BREAKWATER
ST ALBANS PARK
CHARLEMONT
RIPPLESIDE
DRUMCONDRA
CORIO
LOVELY BANKS

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Y2051 PC08

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC08 - Ultimate 2051 project case with external road upgrades and Church Street connection across Ring Road

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
BARRABOOL
MERRAWARP ROAD
CERES
WANDANA HEIGHTS
WAURN PONDS
HAMLYN HEIGHTS
HERNE HILL
BELL POST HILL
BELL PARK
NEWTOWN (GREATER GEELONG)
HIGHTON
BELMONT
GEELONG WEST
NORTH GEELONG
RIPPLESIDE
DRUMCONDRA
CORIO
NORTH SHORE
EAST GEELONG
NEWCOMB
BREAKWATER
ST ALBANS PARK
CHARLEMONT
MARSHALL

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Y2051 PC09

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC09 - Ultimate 2051 project case without external road upgrades with realigned arterial road in WGGA

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
STONEHAVEN
FYANSFORD
WAURN PONDS
WANDANA HEIGHTS
HAMLYN HEIGHTS
BARRABOOL
MERRAWARP ROAD
CERES
HIGHTON
BELL POST HILL
BELL PARK
HERNE HILL
NEWTOWN (GREATER GEELONG)
CORIO
NORTH SHORE
NORTH GEELONG
BREAKWATER
RIPPLESIDE
DRUMCONDRA
NEWCOMB
EAST GEELONG
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BELMONT
MARSHALL
CHARLEMONT
ST ALBANS PARK

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Y2051 PC10

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC10 - Ultimate 2051 project case with external road upgrades with realigned arterial road in WGGA

ANAKIE
SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
WANDANA HEIGHTS
WAURN PONDS
BARRABOOL
MERRAWARP ROAD
CERES
HAMLYN HEIGHTS
HERNE HILL
MANIFOLD HEIGHTS
GEELONG WEST
BELL POST HILL
NEWTOWN (GREATER GEELONG)
HIGHTON
BELL PARK
BELMONT
CORIO
NORTH SHORE
EAST GEELONG
NEWCOMB
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BREAKWATER
ST ALBANS PARK
RIPPLESIDE
DRUMCONDRA
MARSHALL
CHARLEMONT

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

PC11 - Ultimate 2051 project case (excluding development of Batesford South PSP – i.e. Quarry) without external

Y2051 PC11

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
BARRABOOL
MERRIAWARP ROAD
CERES
WANDANA HEIGHTS
WAURN PONDS
BELL POST HILL
NORLANE
BELL PARK
HAMLYN HEIGHTS
HERNE HILL
NEWTON (GREATER GEELONG)
HIGHTON
NORTH SHORE
NEWCOMB
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BELMONT
BREAKWATER
RIPPLESIDE
DRUMCONDRA
CORIO
MARSHALL
CHARLEMONT

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

Basemap data sources: ABS, 2018. Victorian Open Data, 2018

Y2051 PC12

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC12 - Ultimate 2051 project case (excluding development of Batesford South PSP – i.e. Quarry) with external

ANAKIE
SUTHERLANDS CREEK
BALLAN ROAD
MOORABOOL
STEIGLITZ ROAD
LARA
CORIO
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
BELL POST HILL
NORLANE
NORTH SHORE
BELL PARK
STONEHAVEN
FYANSFORD
HAMLYN HEIGHTS
RIPPLESIDE
DRUMCONDRA
HERNE HILL
NEWTOWN (GREATER GEELONG)
EAST GEELONG
BARRABOOL
CERES
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
NEWCOMB
BARRABOOL ROAD
WANDANA HEIGHTS
BELMONT
BREAKWATER
WAURN PONDS
MARSHALL
CHARLEMONT

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

E. INCREASED PUBLIC TRANSPORT MODEL OUTPUTS

The daily volume plot for 2051 increased public transport scenario are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for the 2051 increased public transport scenario are provided in the 'Full' report (PC-4A). These plots assume full development of the NWGGA.

E

Y2051 PC04

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC04A - Ultimate 2051 project case with external road upgrades and increased public transport usage

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
WAURN PONDS
WANDANA HEIGHTS
BARRABOOL
CERES
BARRABOOL ROAD
HIGHTON
BELL POST HILL
BELL PARK
HERNE HILL
HAMLYN HEIGHTS
NEWTOWN (GREATER GEELONG)
GEELONG WEST
NORTH GEELONG
CORIO
NORTH SHORE
BREAKWATER
RIPPLESIDE
BELMONT
GROVEDALE
THOMSON (GREATER GEELONG)
SOUTH GEELONG
EAST GEELONG
NEWCOMB
WATERDALE
ST ALBANS PARK
CHARLEMONT
MARSHALL
GRUMCONDRA

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

F. ALTERNATE NGGA ROAD NETWORK MODEL OUTPUTS

The daily volume plot for 2051 alternate NGGA road network scenario are provided on the following pages.

The AM and PM peak hour and daily model volume, volume to capacity and select link analysis plots for the 2051 alternate NGGA road network scenario are provided in the 'Full' report. These plots assume full development of the NWGGA.

F

Y2051 PC04

Daily Volume

- 1-500
- 500-1000
- 1000-2000
- 2000-4000
- 4000-7000
- 7000-10000
- >10000

PC04B - Ultimate 2051 project case with external road upgrades and modified road network in NGGA

SUTHERLANDS CREEK
MOORABOOL
BALLAN ROAD
STEIGLITZ ROAD
GHERINGHAP
BATESFORD
FYANSFORD-GHERINGHAP ROAD
STONEHAVEN
FYANSFORD
HAMLYN HEIGHTS
HERNE HILL
MANIFOLD HEIGHTS
GEELONG WEST
BELL POST HILL
LOVELY BANKS
BELL PARK
NEWTOWN (GREATER GEELONG)
HIGHTON
SOUTH GEELONG
THOMSON (GREATER GEELONG)
BELMONT
WANDANA HEIGHTS
WAURN PONDS
BARRABOOL
CERES
BARRABOOL ROAD
CORIO
NORTH SHORE
NEWCOMB
BREAKWATER
RIPPLESIDE
DRUMCONDRA
EAST GEELONG
MARSHALL
CHARLEMONT
ST ALBANS PARK

0 0.5 1 1.5 2 km

SVITM2018_V04 - V152200

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