Veitch Lister Consulting Pty Ltd

Canberra Travel Modelling Report

October 2014

PREPARED FOR
Infrastructure Australia

www.veitchlister.com.au

Canberra – Travel modelling report

Project No. 14-011

Date	Revision	Prepared By	Checked By	Approved By	Description
20/10/2014	A	LM/MJ	MV	MV	Draft Report
13/11/2014	B	LM/MJ	MV	MV	Final Report

Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

In April 2014 Veitch Lister Consulting (VLC) was commissioned by Infrastructure Australia (IA) to produce travel demand forecasts and transport network performance assessments for the ACT and its associated regions for 2011 and 2031. This document presents the results of this work.

The 2031 travel predictions and transport network performance assessments have been produced for a low transport investment scenario - i.e. the transport networks (road and public transport) used in the modelling only include current transport network infrastructure and services, supplemented by committed and "highly likely" transport network enhancements.

The travel predictions and transport system performance measures presented in this report have been generated using VLC's Zenith model - a four-step multimodal model encompassing the entire region. The area modelled encompasses the Greater ACT Region, as well as Goulburn, Yass and Queanbeyan (other regions).

1.2 Purpose of this investigation

The primary purpose of this consulting commission is to provide input to the Australian Infrastructure Audit (AIA) being conducted by Infrastructure Australia, by:

a) robustly predicting the scale of travel increase in the entire region, where it is likely to occur and the modes of travel that will be chosen;
b) assessing the degree to which the performance of the transport network will deteriorate by 2031 under a *low transport investment* scenario - including identification of those elements of the road network that will, by 2031, be generating large economic costs due to congestion, and sections of the rail network that will be subject to severe over-crowding; and
c) providing travel and transport system performance data suitable for input to the ACIL Allen Tasman economic model of the region.

1.3 Structure of report

The balance of the report is structured as follows:

Section 2: Land use assumptions used in the modelling

Section 3: Assumed 2031 base case transport networks

Section 4: Other modelling assumptions

Section 5: Methodology

Section 6: Travel demand increase in the Greater ACT Region 2011-2031

Section 7: Road network performance

Section 8: Public transport system performance

2. Land use assumptions

Land use and transport system operation are linked by complex, yet identifiable relationships which are investigated through transport modelling activities. It is crucial therefore to utilise the most current, rigorous land use dataset available to underpin the traffic modelling.

In this section, we outline the land use and demographic variables underpinning travel behaviour within the ACT, and describe the application of land use projections developed by VLC for the purpose of forecasting travel and the performance of the transport network within the regions.

2.1 Demographic dataset development

VLC has developed a current baseline demographic dataset to underpin traffic forecasting for this project. This dataset contains population, employment, education enrolment and visitor data for a base year of 2011 and future year 2031 appropriate for input into VLC's Zenith model. This demographic dataset developed as a result of this project contains the most current and rigorous small area demographic projections which form an essential input into transport modelling and traffic forecasting.

Datasets used as inputs in the development of the baseline demographic dataset include, but are not limited to:

- 2011 Australian Bureau of Statistics (ABS) Census of Population and Housing
- ABS Series B population projections and associated age structure data
- State Government household projections
- ABS Estimated Resident Population
- Local government land use data
- Enrolment data for primary, secondary and tertiary institutions
- Planning scheme data
- Tourism forecast data

Development has also included advice from local governments in relation to current planning intentions and expectations in the region.

2.1.1 Base year (2011) data development

Base year data has been derived from the 2011 Census of Population and Housing. Population variables have been derived from Estimated Resident Population data, rebased to the 2011 Census. Base year employment has been derived from Place of Work DZN data, with adjustments made to account for Census under-reporting, and "Not Stated" responses.

Enrolment data has been obtained from The Australian Curriculum, Assessment and Reporting Authority (ACARA), as well as contact with various primary, secondary and tertiary institutions to confirm enrolment figures, and associated employment. Visitor data, both domestic and international, has been obtained from the 2011 Census of Population and Housing.

2.1.2 Baseline dataset future year land use projection development

Future year projections for the baseline demographic in the various regions' datasets have been developed using the ABS Series B population projections. The population dataset is constrained to projections received from the Economic Regional and Planning Branch of the Chief Minister and Treasury Directorate at 2031. Base 2031 population projections are adjusted to match ABS Series B 2031 population. ABS population projections are provided at Greater Capital City Statistical Area, therefore the difference between base 2031 projected population and ABS Series B 2031 projected population is apportioned to small areas according to their share of growth between 2011 and 2031.

Future year employment has been based on the 2011 Journey to Work statistical relationships. Employment growth is distributed based on knowledge of known future developments and information obtained from local and regional planning instruments.

The ratio of domestic and international visitors to the number of usual residents at the small area level is assumed to be the same in future years and is applied to future years' total residents to forecast the number of domestic and international visitors. These figures are validated at aggregate levels to figures provided by relevant Government authorities.

For future enrolments, an age-cohort model has been used to allocate additional students to existing institutions based on notional capacities of institutions in the future. Any surplus students were then allocated to schools with additional capacity in neighbouring Small Areas at level 2 (SA2s), or new schools allocated to areas of high growth and/or where planning information is available.

Tertiary education centres are expected to experience a capped growth per year.

2.2 The Zenith model and small area demographics

The Zenith model for the regions takes into account information describing the location and scale of various land uses, activities and demographics across the region in reflecting the travel choices of households and firms.

When applying the model, the region is divided into a number of zones whose size depends on the scope of impacts being investigated and the resolution of information available. Forecasts of demographic variables for each zone used in the model include:

- Population – number of persons whose usual place of residence is within a zone
- Households – number of households including occupied private dwellings and group households
- White Collar Workers – persons employed in occupations classified as 'white-collar'
- Blue Collar Workers – persons employed in occupations classified as 'blue-collar'
- Dependants (0-17) – number of non-workers aged up to 17 years
- Dependants (18-64) – number of non-workers aged 18 to 64 years
- Dependants (65+) – number of non-workers aged 65 and over
- Cars – number of private motor vehicles garaged at occupied private dwellings

The model uses this information to generate profiles of households of different structure, the members of which would each make different choices regarding the frequency, purpose, location, period, mode and route of travel.

The model also defines a number of activities for which travel is undertaken. A number of socioeconomic and land use variables are used to determine the level of participation or attraction for each activity in each zone, which influences the number of trips undertaken for a range of purposes.

These activity variables include:

- Employment by industry (14 custom categories based on 1-digit ANZSIC industry divisions)
- Educational enrolment by 3 levels
- Demand information for special generators:
  - Airport passengers (3 categories)
  - Tourism and recreation visitation rates (4 categories)
  - Freight and logistics terminals demand forecasts

VLC have defined a small area cadastre for the region, for which data for all of the land use and demographic variables is maintained for the forecast horizon. This is aggregated as needed to provide an efficient zoning system for application of the Zenith model.

VLC has undertaken extensive data acquisition, research and fieldwork to ensure the accuracy of the demographic and socioeconomic data that underpins the forecasting of travel demand in the region. For the small area cadastre, the data for 2011 is developed from and validated against the Australian Bureau of Statistics Census of Population and Housing.

VLC maintains its own scenarios of land use projections, integrating planning information from various local, state and federal government bureaux, supplemented with its knowledge of proposed developments.

The following sections summarise the population and employment characteristics and forecasts for the region by SA3.

2.3 Population

2.3.1 Population projections for the region

The region as a whole comprises 11 SA3's, of which nine are in the Greater ACT Region. These areas vary in nature, from urban areas with high population densities to rural-fringe areas characterised by small local centres interspersed with open space and agricultural production areas.

The following sections summarise the population characteristics and projections for SA3's in the region.

Table 2-1 provides population estimates for the region by SA3 for 2011 and 2031.

These tables also show the absolute growth in population and the equivalent average annual growth rate.

The existing population for the study area is approximately 426,800 increasing to a projected 608,900 in 2031. For 2011 the Greater ACT Region contributed 86% of the population. This is projected to decrease slightly to 85% in 2031, due to the ACT estimated to have an annual growth rate of 1.8% while the other regions are expected to grow at 2% per annum.

Figure 2-1 illustrates the spatial pattern of population growth by small area for the ACT region and Queanbeyan only.

The highest projected rates of growth occur Gungahlin followed by North Canberra and Belconnen. In contrast Fyshwick - Pialligo – Hume are expected to remain static or contract slightly.

Table 2-1: Existing and Projected Populations in the Region

SA3	2011	2031	Growth	%	AAGR
North Canberra	49,900	71,500	+21,600	+43%	1.8%
South Canberra	25,100	37,100	+12,000	+48%	2.0%
Belconnen	94,700	110,100	+15,500	+16%	0.8%
Gungahlin	49,700	108,200	+58,500	+118%	4.0%
Woden	33,900	35,300	+1,500	+4%	0.2%
Weston Creek	23,200	22,300	-900	-4%	-0.2%
Tuggeranong	89,100	84,700	-4,400	-5%	-0.3%
Cotter - Namadgi	600	49,800	+49,200	+8828%	25.2%
Fyshwick - Pialligo - Hume	1,500	1,300	-200	-13%	-0.7%
Greater ACT Region (GCCSA)	***367,700***	***520,300***	**+152,600**	**+42%**	**1.8%**
Goulburn - Yass	6,800	9,600	+2,800	+41%	1.7%
Queanbeyan	52,300	79,000	+26,600	+51%	2.1%
Other regions	***59,100***	***88,600***	***+29,500***	***+50%***	***2.0%***
Total to SA3	***426,800***	***608,900***	**+182,100**	**+43%**	**1.8%**

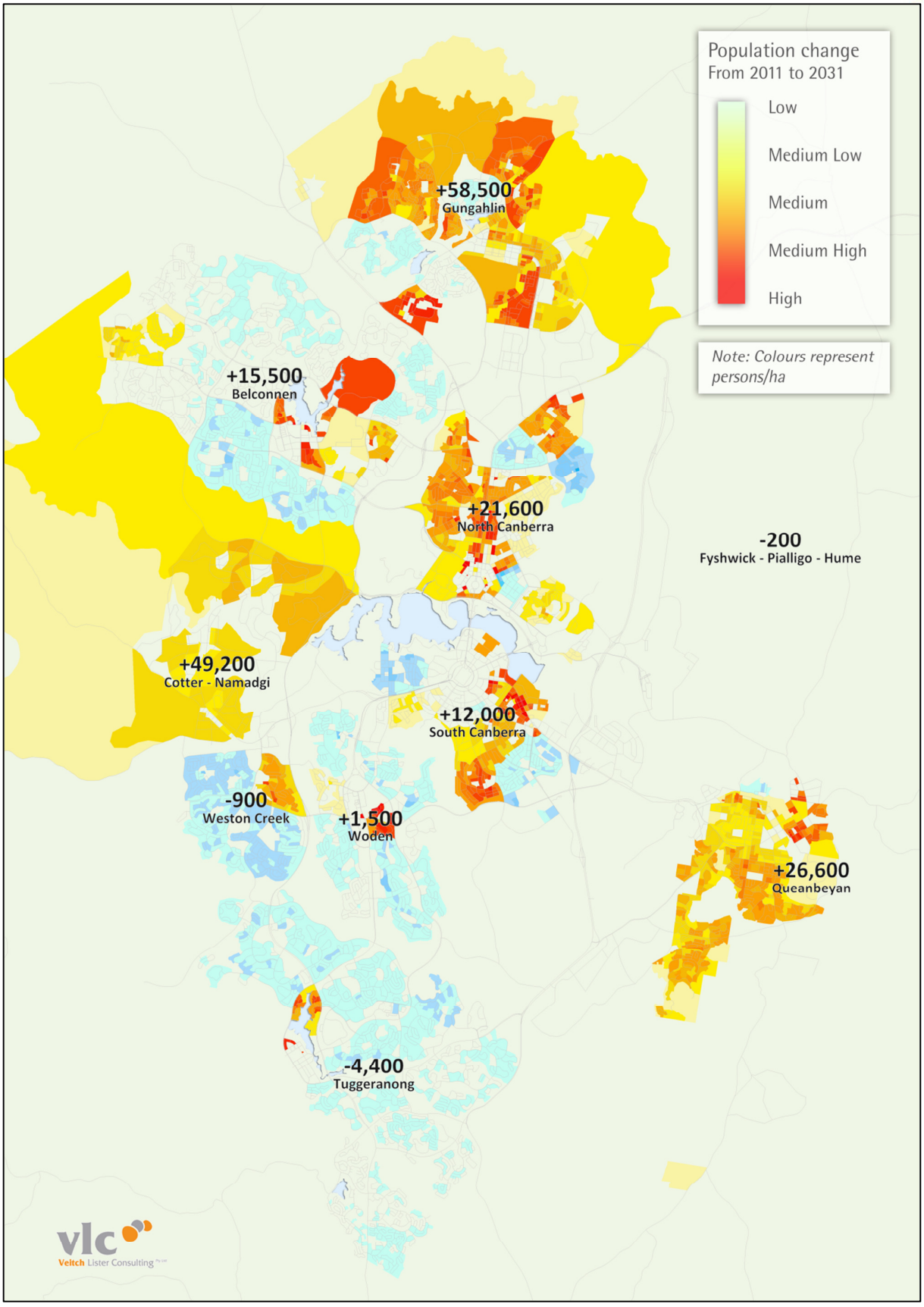

Figure 2-1: Projected population growth in the Greater ACT Region (2011 – 2031)

2.4 Employment

VLC has prepared forecasts for employment, consistent with the population projections constrained to the ABS B series forecast. The employment forecasts are based on projected levels of employment self-containment within each LGA, which recognise the structure planning of local authorities and the longer term infrastructure and development planning by the state government.

2.4.1 Employment characteristics and projections for the region

The Zenith model requires employment estimates and projection across a range of industries and occupations for the region. As well as indicating the number of jobs, this is also indicative of the opportunities to participate in a range of commercial and social activities, such as education, business, shopping, dining and entertainment, health and recreation, as well as activities generating freight.

Table 2-2 summarises existing and projected employment in the region as a whole, which is expected to grow by approximately 42 percent over the projection period.

Within the Greater ACT Region the highest rates of employment growth are expected in Gungahlin (93 percent), South Canberra (46 percent) and North Canberra (44 percent). Employment opportunities in Cotter and Namadgi are estimated to increase by 813 percent, albeit from a very low base. Figure 2-2 illustrates this pattern of growth.

In the other regions both Queanbeyan (53 percent) and Goulburn & Yass (69 percent) are expected to experience significant growth.

Table 2-2: Existing and Projected Employment in the Region

SA3	2011	2031	Growth	%	AAGR
North Canberra	71,500	102,800	+31,400	+44%	1.8%
South Canberra	35,700	51,900	+16,200	+46%	1.9%
Belconnen	29,000	36,300	+7,400	+25%	1.1%
Gungahlin	11,900	23,000	+11,100	+93%	3.3%
Woden	25,100	30,100	+5,000	+20%	0.9%
Weston Creek	4,100	4,900	+800	+20%	0.9%
Tuggeranong	19,400	23,300	+3,800	+20%	0.9%
Cotter - Namadgi	1,400	13,100	+11,700	+813%	11.7%
Fyshwick - Pialligo - Hume	27,800	32,900	+5,200	+19%	0.9%
Greater ACT region (GCCSA)	***225,900***	***318,300***	***+92,400***	***+41%***	***1.7%***
Goulburn - Yass	1,200	2,100	+800	+69%	2.6%
Queanbeyan	14,200	21,700	+7,500	+53%	2.1%
Other regions	***15,400***	***23,800***	***+8,400***	***+55%***	***2.2%***
Total to SA3	***241,300***	***342,100***	***+100,800***	***+42%***	***1.8%***

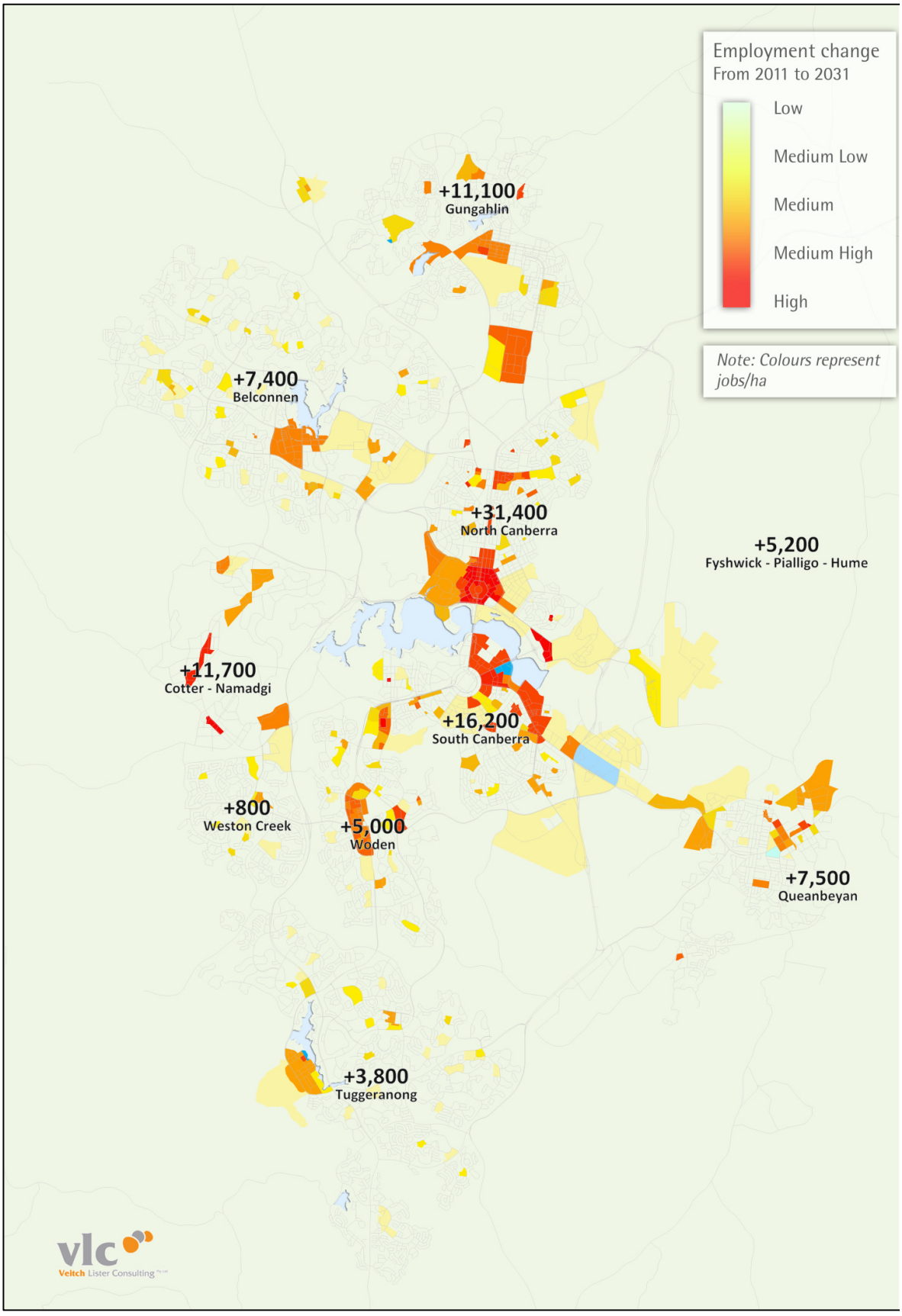

Figure 2-2: Projected employment growth in the Greater ACT Region between 2011 and 2031

3. Assumed base case transport networks

This section of the report describes the transport network improvements that have been assumed for the AIA base case networks. In order to assess properly the priorities for development of the transport network under the planned strategies for urban growth, the base case assumes a balance of committed future works, as well as those that are required to support the development of urban growth centres.

3.1 Road network assumptions

Table 3-1 summarises the major funded and committed works across the region. A full listing of all works (i.e. including minor projects) is provided in Appendix A of the report. Figure 3-1 clearly indicates the location of each of the proposed projects.

Table 3-1: Major new road infrastructure included in 2031 base case network

Project Nr	Project Description
1.	Majura Pwy
2.	Constitution Avenue
3.	Horse Park Dr extension
4.	Civic to Gungahlin Corridor Improvements
5.	Molonglo Infrastructure Investment
6.	Link Rd construction between Majura Pwy and Majura Rd
7.	Ashley Dr – Stage 1 - Duplication Erindale Dr between Ashley Dr and Sternberg Cr

Note: The full list of projects included as Appendix A.

3.2 Public transport network assumptions

The major public transport infrastructure enhancements are summarised in Table 3-2.

Table 3-2: Major new public transport infrastructure included in 2031 base case network

Item	Description
PT001	Citybound bus lane from Faulding Street to Monaro Hwy, 2 Major Bus Stops to service Canberra Eye Hospital
PT002	From Well Station Drive to Sandford Street Southbound
PT003	Duplication of road (by removing parking). One lane in each direction for general traffic and one dedicated bus lane (prioritised at intersections).

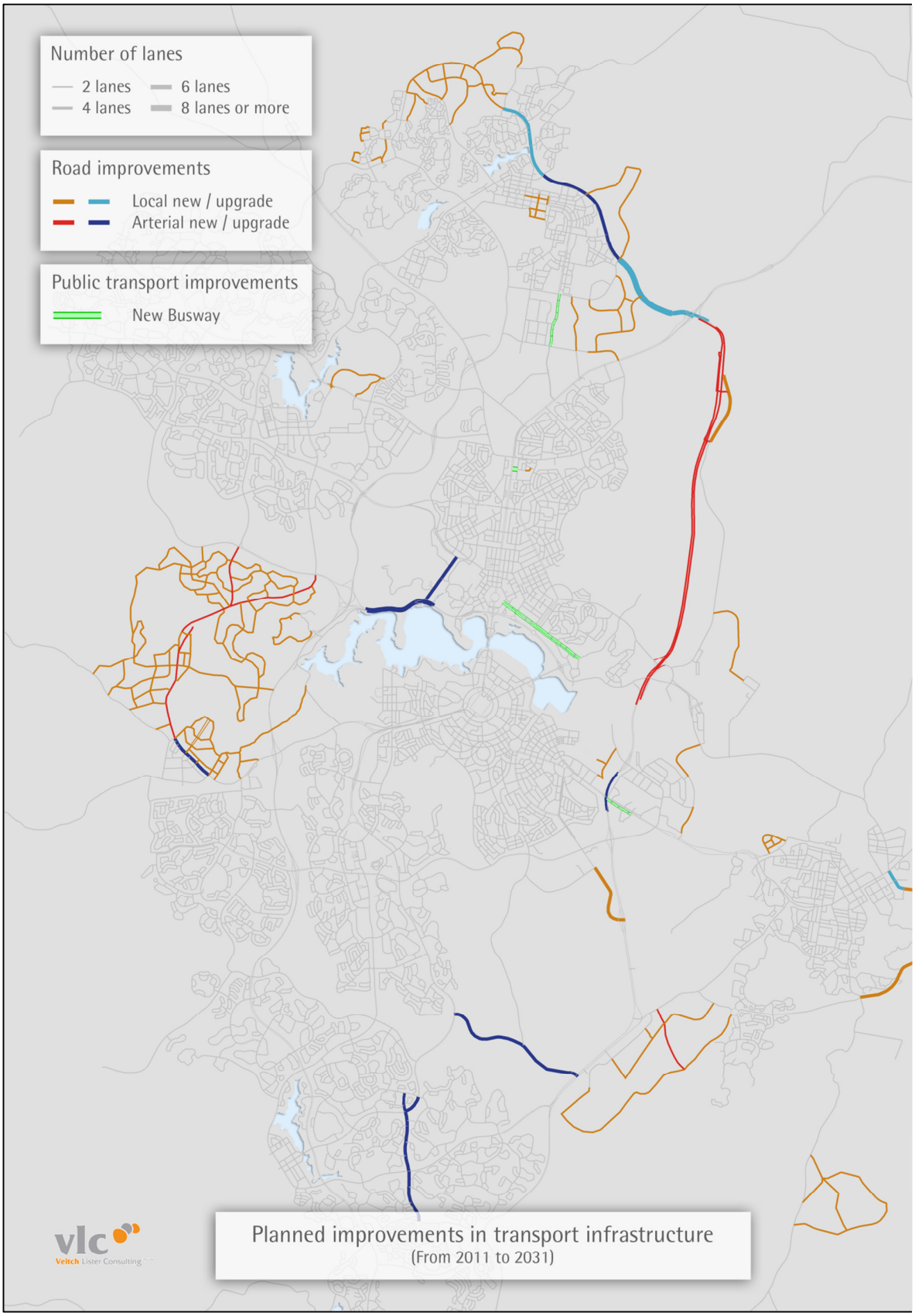

Figure 3-1: New transport infrastructure included in 2031 base case network

4. Pricing and behavioural assumptions

When individuals make choices regarding how, when and where to travel, they take into account the costs and convenience of each of the options available. These considerations may include the value of time spent travelling, the cost of fuel, public transport fares, parking charges and tolls, as well as longer term costs associated with vehicle ownership and use. Likewise firms that schedule commercial travel take into account the costs associated with operation and maintenance of the vehicle and labour costs of the driver or crew, as well as the efficiency of travel on each route and the cost of tolls.

The modelling of future travel in SEQ for the Australian Infrastructure Audit makes certain assumptions about how these costs will change, and how preferences affecting travel behaviour may evolve over time. These assumptions are based on available evidence and are intended to reflect the current policies of all levels of government.

4.1 Value of travel time

The value of time spent travelling and its influence on travel behaviour depends on a range of factors, such as the reason for travel, and the use to which the time might otherwise be put. The modelling of travel choices reflects preferences that imply different values of travel time for each trip purpose and for each mode of travel, including walking and waiting associated with using public transport and the use of toll roads.

There is a significant volume of behavioural research that suggests values of travel time increase with increasing income. For the purposes of the modelling on this project VLC has assumed that values of travel time remain at current levels in the future.

4.2 Fuel costs

There is a range of influences on the unit cost of fuel consumed in urban transport, which can be affected by global and local conditions. The most significant influences on the costs of fuel include:

- real increases in the price of transport fuels
- reduction in the rate of fuel consumption due to improved vehicle efficiency and increased use of more efficient fuels within the vehicle fleet

These two factors act to counter each other, and with insufficient evidence to indicate which will dominate in future, may well result in no real change in the average unit costs of fuel. The base case for the AIA has therefore assumed no real change in the unit of costs of fuel in future.

4.3 Public transport fares

While there have been real increases in public transport fares during recent years, there is a growing concern to maintain prices and provide off-peak discounts to encourage greater use of public transport. In order to maintain a neutral position on pricing, the base case for the AIA has assumed no real change in public transport fares.

4.4 Parking charges and supply

The availability and cost of parking can have a strong influence on the choice of destination or mode used for travel, particularly to CBD destinations, where high parking costs and a high level of public transport accessibility contribute to public transport being relatively attractive.

There are however, strong pressures on price arising from increasing demand and constrained supply of parking in the CBD and major activity centres.

With increasing demand and constrained supply of parking spaces, it is reasonable to expect that parking costs within the CBD and at major activity centres in the metropolitan area will experience real

increases of 1-2% per annum. The base case modelling for the AIA has assumed a real annual increase of 1.5% in parking charges.

4.5 Airport passenger demands

Travel demands associated with the region's airports are based upon forecasts of passenger demand by BITRE, categorised according to whether travel is for business, and for non-business travel, whether by residents of the region, or visitors.

The passenger demand estimates and forecasts assumed within the base case are provided in Table 4-2.

Table 4-1: Air passenger demand estimates and forecasts (average weekday)

Terminal	Year	Business	Local	Visitors	Total
Canberra International Airport	2011	6,000	2,000	1,000	9,000
	2031	11,600	3,900	2,600	18,100
	(% increase)	+93%	+95%	+160%	+101%

5. Methodology

The use of VLC's Zenith Travel model provides insights into urban transport at a high level of granularity. In order to allow for detailed analyses of the vast amount of data a number of spreadsheets have been created to inform the National Audit of Urban Infrastructure at different levels of data aggregation:

- Metrics from SA3 to SA3
- Key Model Statistics
- Corridor analysis
- Rail demand and supply analysis

This chapter describes the methodology.

5.1 Description of metrics

The Zenith model contains a wealth of information. This section describes the metrics and where applicable the calculations to generate these metrics.

5.1.1 Network (lane) kilometres

The Zenith model describes travel demands on individual links (sections of road) for roads generally carrying over 3,000 vehicles per day. The total number of kilometres this network encompasses is described in this metric. A link that can be travelled in both directions will be accounted for in each direction. Network lane kilometres describe a similar metric but also take into account the number of lanes for each link and direction.

5.1.2 Demand

Demand is measured in trips. Depending on the mode of travel these trips can be either vehicular trips (car, light or heavy goods vehicles) or person trips (car driver or car passenger, public transport and active transport).

5.1.3 Speeds

Speeds can either be reported under free-flow or under congested conditions. The free-flow speeds are the input speeds to the travel model whereas the congested speeds are a result of traffic impeding other traffic.

5.1.4 Vehicle Kilometres Travelled (VKT), Passenger Kilometres Travelled (PKT)

The number of vehicle kilometres travelled is a key part of the network performance indicators. This metric is calculated by multiplying the demand on a link by the length of this link. In a similar way passenger kilometres travelled can be calculated.

5.1.5 Vehicle Hours Travelled (VHT), Passenger Hours Travelled (PHT) and Hours of Delay

The number of Vehicle Hours Travelled is calculated by multiplying the vehicle demand on a link by the time to traverse that link in the network. This metric can be reported either under free-flow or congested conditions. The difference between the Vehicle Hours Travelled under free-flow and congested conditions results in the Hours of Delay metric. Passenger Hours Travelled is a similar metric which is based on the passenger demand on a link.

5.1.6 Traffic Volume over Capacity Ratios

Volume over Capacity ratios or V/C ratios in short are calculated by dividing the vehicular demands by the capacity of a link. For peak periods the maximum peak hour demand is used to calculate the V/C ratios. In the off-peak situation the average demand is used. It is worth noting that goods vehicles

are weighted the same as cars. This might cause lower than actual V/C ratio's on roads with high volumes of goods vehicles. However the weighting of goods vehicles would also be included the capacity of a road, the magnitude of difference therefore is expected to be generally limited. A public transport trip that utilises a car to access a stop is excluded from the vehicular demands. Buses are also excluded from the vehicular demands. This could potentially result in understated V/C ratios around stations and bus corridors but generally not to any significant degree.

5.1.7 Public Transport Volume over Capacity Ratios

Determining V/C ratios for public transport take into account the number of passengers on a particular service and the capacity of the vehicle used for that service. This capacity can either be expressed as seated or crush capacity. The seated capacity is total number of seats in a vehicle. The absolute maximum number of passengers a vehicle can (legally) carry is the crush capacity. Depending on the metric either the seated or crush capacity is used. The method to determine seated and crush capacities is described in Appendix C.

5.1.8 LOS

An LOS analysis provides an indication of where the road network would fail to meet desired standards of service under the travel demands and traffic volumes forecast. By extension, it illustrates where such behavioural changes are likely to impact on forecasts to some degree, if these levels of congestion result in a change in travel behaviour.

The ability of a road to maintain high levels of service under increasing traffic levels depends upon its design standard and access controls, junction operation and coordination, degree of separation of conflicting movements, as well as its local environment and relation to connecting roads. Higher standards of roads, junctions and network management are able to provide better performance under similar levels of congestion (ratio of volume to capacity) than those of a lower standard. Austroads defines six threshold levels for standardised performance assessment, for which we describe how this affects driver behaviour, and provide typical threshold levels of congestion for three standards of

Table 5-1: AustRoads Level of Service (LOS) definitions

Level of service		Threshold ratio of volume to capacity		
		Motorway	Arterial	Local
A	Drivers may travel at desired speed, and manoeuvre freely, experiencing no delay due to other traffic	0.50	0.40	0.35
B	Drivers will incur occasional minor delays and restrictions to manoeuvre due to other traffic	0.65	0.60	0.50
C	Drivers will experience interrupted travel, with minor delays and stops, but with network operating efficiently providing predictable travel times	0.85	0.75	0.65
D	Drivers will experience occasional major delays, with variable travel times due to conflicting traffic and volumes approaching capacity	1.00	0.90	0.80
E	Drivers will experience frequent major delays, with volumes at or exceeding capacity for short periods, unpredictable travel times	1.15	1.05	0.95
F	Drivers will experience severe congestion and delays, with volumes exceeding capacity for long periods, strong influence on route choice			

5.1.9 Fuel Consumption and Greenhouse Gas Emissions

Vehicle fleet mix can be expected to change reflecting the entry of hybrid, plug in hybrids and electric vehicles challenging the dominant market position of vehicles powered by an internal combustion engine (ICE). Most evidence available today is about hybrid vehicles. Hybrid cars use an ICE engine as well as electrical generators and motors. They are very fuel efficient using around 50 per less fuel in normal use than ICE powered cars and a similar amount less in GHG emissions, with performance differing by make.

The fuel efficiency and fleet mix assumptions used when estimating Greenhouse Gas Emissions in 2011 and 2031 are presented in Tables 5-2 and 5-3.

Table 5-2: Relative fuel intensity assumptions

Year	Mode	ICE	Hybrid	PHEV	Electric
2011	Cars	94.9%	87.1%	42.8%	0.0%
	Commercial vehicles	94.9%	88.4%	42.8%	0.0%
2031	Cars	76.9%	61.4%	22.8%	0.0%
	Commercial vehicles	76.9%	66.3%	22.8%	0.0%

Table 5-3: Fleet mix composition assumptions

Year	ICE	Hybrid	PHEV	Electric
2011	100.0%	0.0%	0.0%	0.0%
2031	80.5%	18.0%	1.5%	0.0%

5.2 Metrics by SA3 to SA3

This analysis disaggregated urban transport activity according to the origin and destination of trips to and from a pair of SA3s (ABS level 3 statistical areas).

Table 5-4 shows an example of the format of the data provided. Metrics are presented in matrix format where the horizontal rows contain the origin SA3 sectors and the vertical columns contain the destination SA3 sectors. A visual representation of the SA3 sectors is provided in Appendix C. For each origin & destination pair metrics are provided for 2011 and 2031 together with the absolute and relative growth between 2011 and 2031. Subtotals for the region are available together with a grand total for the modelled area.

The full matrix is available at:

vlc_yymmdd_01_ACT_Tables by SA3.xlsx

Table 5-4: Example of Metrics by SA3 to SA3

To SA3 sector

From SA3 sector	North Canberra				South Canberra			
	2011	2031	Diff	%Diff	2011	2031	Diff	%Diff
North Canberra	275,799	400,470	+124,671	+45%	36,716	52,867	+16,150	+44%
South Canberra	36,716	52,867	+16,150	+44%	123,056	182,414	+59,358	+48%
Belconnen	45,305	55,932	+10,628	+23%	10,532	12,899	+2,368	+22%
Gungahlin	22,062	44,073	+22,011	+100%	3,919	8,042	+4,123	+105%
Woden	10,970	12,802	+1,833	+17%	16,891	20,485	+3,593	+21%
Weston Creek	6,246	6,694	+447	+7%	5,185	6,032	+847	+16%
Tuggeranong	14,342	15,649	+1,306	+9%	11,694	13,426	+1,732	+15%
Cotter - Namadgi	707	17,885	+17,178	+2430%	506	8,665	+8,159	+1612%
Fyshwick - Pialligo - Hume	12,315	16,237	+3,922	+32%	14,581	19,885	+5,304	+36%
Australian Capital Territory	424,462	622,608	+198,146	+47%	223,081	324,716	+101,635	+46%
Goulburn - Yass	4,117	5,579	+1,461	+35%	1,160	1,587	+428	+37%
Queanbeyan	14,544	21,368	+6,825	+47%	10,572	16,684	+6,112	+58%
Other regions	18,661	26,947	+8,286	+44%	11,731	18,271	+6,540	+56%
Total to SA3	443,123	649,555	+206,432	+47%	234,812	342,987	+108,175	+46%

All metrics are available for the morning peak (7-9am), the evening peak (4-6pm), off peak and daily. Certain metrics are only available for certain activity and mode combinations. Table 5-5 below details the availability of metrics by activity and mode combination.

Table 5-5: Availability of metrics by activity and mode combination

Metric	Activity	Modes
Demand, VKT, VHT	Work, Business, Other, Total	Car, Person Car, (Light, Heavy) Commercial Vehicles, Public Transport, Active Transport
Hours of Delay	Work, Business, Other, Total	Car
	Total	Commercial Vehicles
Fuel, Green House Gas Emissions	Total	Car, Commercial Vehicles

5.3 Corridor Analysis

In order to assess National significant infrastructure at corridor level a substantial number of corridors have been defined in the region. Generally a corridor is defined around a major transport facility.

All of the more major road corridors in the Greater ACT Region were identified and subjected to more detailed analysis in terms of how they perform in 2011 and 2031. Some corridors include more than one road route when routes are competing. For example, Parkes Way, Tuggeranong Pkw, Drakeford Drive, Yarra Glen, Melrose Drive and Athllon Drive

A total of 17 important corridors were identified, as shown in Figure 5-1.

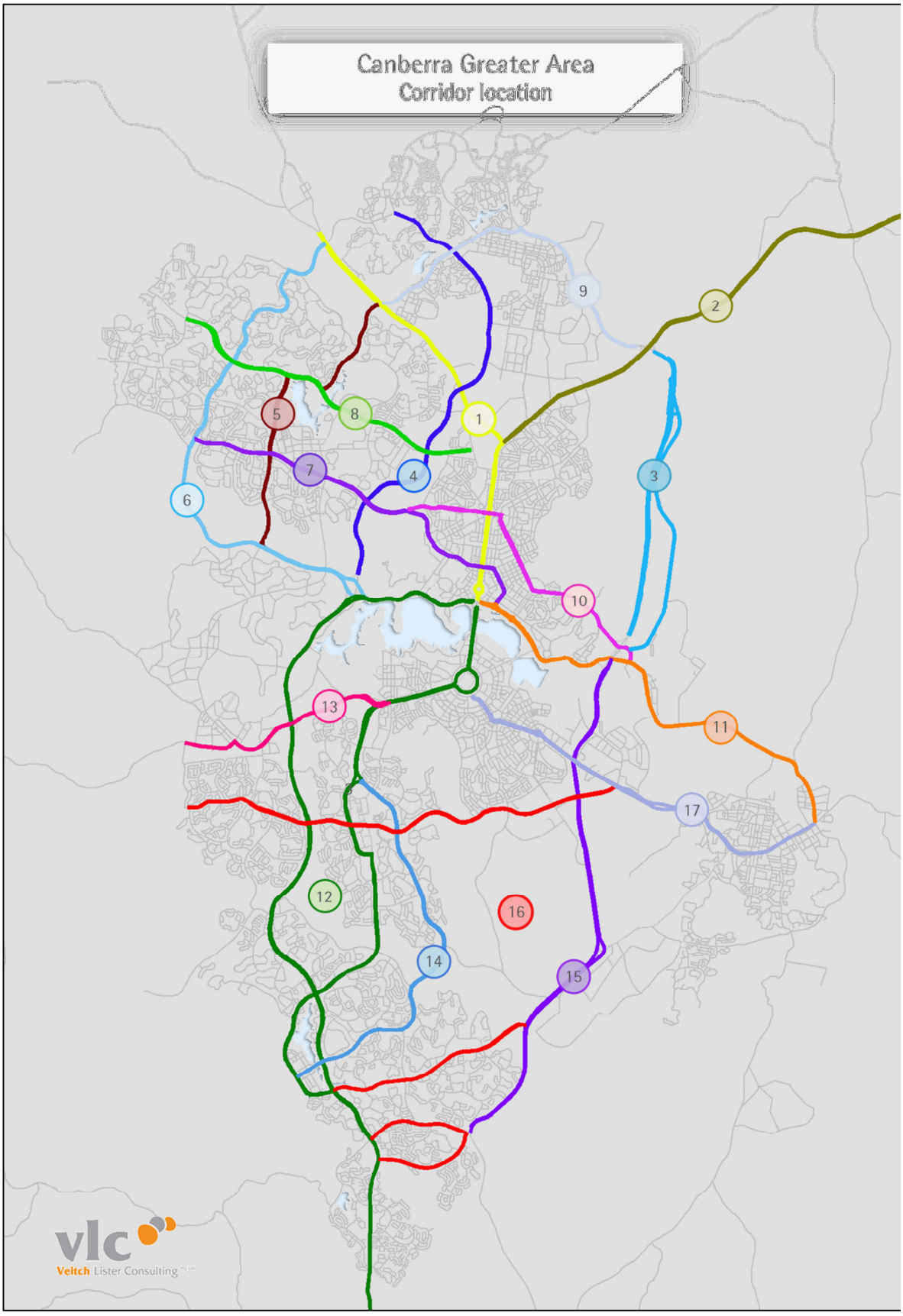

Figure 5-1: Corridor locations: ACT region

Each of the major roads in each corridor was then divided up into subsections, based on variations in the road's characteristics - such as the number of traffic lanes, posted speed and likely changes in traffic demand. How the roads in the Corridor 16 were split into subsections is shown in Figure 5-2.

The Zenith model has then been used to produce a number of metrics that, in combination, help define the importance of the various section of ACT's higher order road network, their economic contribution and how efficiently they perform in 2011 and 2031. Such information is important, as it guides transport planners to those portions of the road network that will in the future be generating large economic cost due to congestion, yet still be making a large economic contribution as a result of the number of vehicle-kilometres of travel they accommodate each weekday.

The full set of metrics produced for each subsection of road in each corridor are listed in Table 5-6.

The spreadsheet containing the metrics by road subsection for all the identified corridors in Canberra is titled **vlc_yymmdd_02_ACT_Corridor Analysis.xlsx**

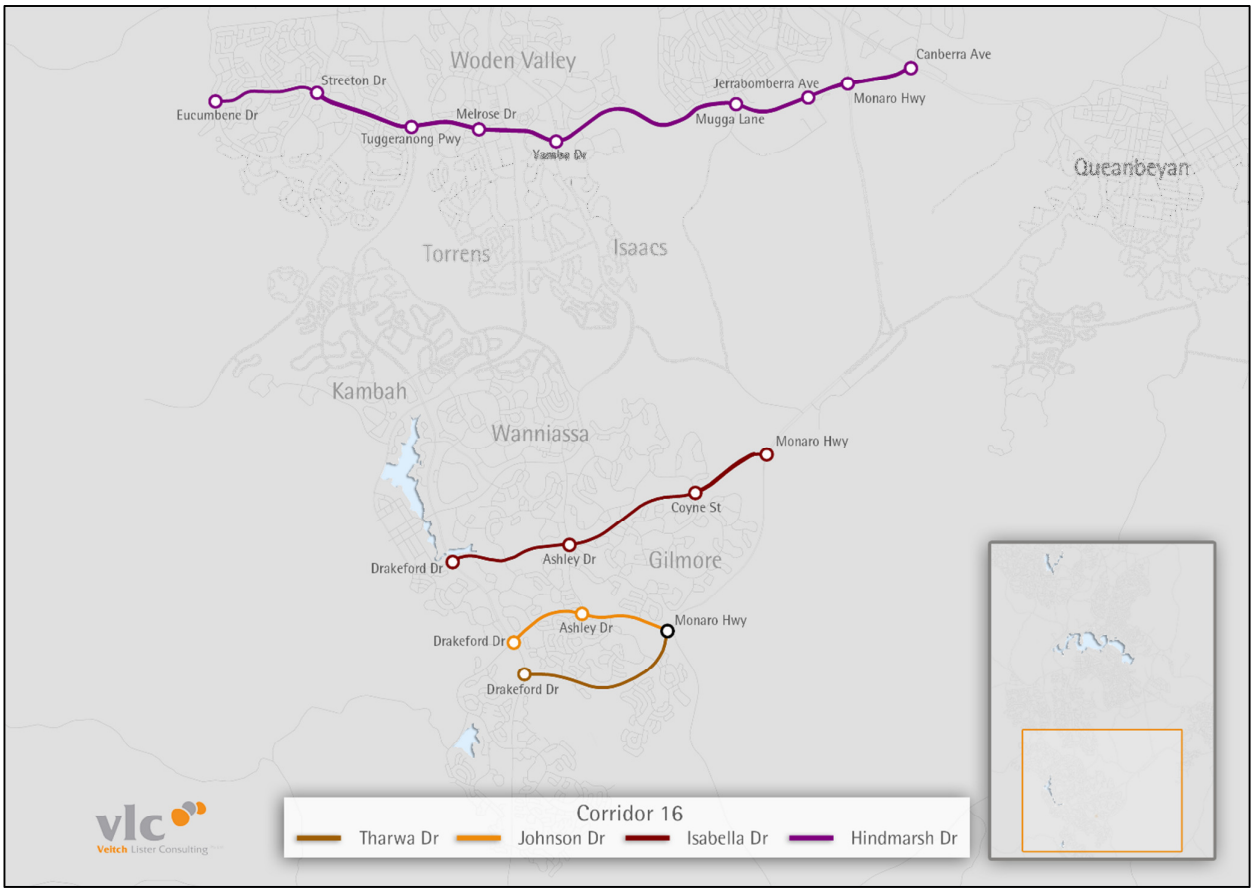

Figure 5-2: Subsections in Corridor 16

Table 5-6: Metrics reported for major road subsections

Type	Metric
Corridor Type	Corridor Type
Length	Total Length (km)
Capacities (veh/hr)	Average Hourly Capacity per km
Traffic volumes weighted by vehicle kilometers (busiest peak hour)	Average Peak Hour Traffic Volumes Average Peak Hour CV Volumes % Average Peak Hour CV Volumes
Traffic speeds under freeflow (modelled) and congested conditions	Average Speed Freeflow (kph) Average Speed Congested (kph)
Travel Times under freeflow (modelled) and congested conditions	Total Travel Time Freeflow (min) Total Travel Time Congested (min)
Network performance daily	Total Vehicle Kilometers Travelled (km) Total Vehicle Hours Travelled Congested (hrs) Total Vehicle Hours Travelled Freeflow (hrs) Total hours of delay (hrs)
Level of Service (Traffic) (busiest peak hour)	Minimum Level of Service Average Level of Service Maximum Level of Service
Traffic V/C (busiest peak hour)	Weighted V/C Traffic

6. Travel demand increase in the Greater ACT Region

6.1 Introduction

This section of the report provides the Zenith model's travel estimates and forecasts for 2011 and 2031 for the Greater ACT Region, as well as the model's high level assessment of the performance of the transport network for these two time horizons under a *low transport network investment* scenario. More detailed information on travel demands and network performance at specific locations in the road and public transport networks is provided in Sections 7 and 8 of the report.

6.2 Forecast growth in person travel by mode (2011-2031)

Table 6.1 summarises the model's estimates of person trips by mode and by time of day for the modelled area.

Overall the number of person trips are projected to increase by 39 percent, with the highest increase expected for public transport trips, at 53 percent. Person car trips are expected to experience the lowest growth at 35 percent.

Table 6-1: Change in person travel in the modelled area (2011-2031)

Model Statistics		2011	2031	Change	% change
Person car trips	AM	273,008	366,793	+93,784	+34%
	OP	1,081,504	1,467,792	+386,288	+36%
	PM	261,296	352,963	+91,667	+35%
	24H	1,615,808	2,187,548	+571,739	+35%
PT trips	AM	17,321	27,934	+10,613	+61%
	OP	35,730	50,648	+14,918	+42%
	PM	12,513	21,559	+9,046	+72%
	24H	65,565	100,141	+34,576	+53%
Walk/cycling trips	AM	62,672	104,130	+41,458	+66%
	OP	328,700	479,765	+151,065	+46%
	PM	66,020	104,805	+38,785	+59%
	24H	457,391	688,700	+231,309	+51%
Total trips	AM	353,001	498,856	+145,855	+41%
	OP	1,445,934	1,998,205	+552,271	+38%
	PM	339,829	479,327	+139,498	+41%
	24H	2,138,764	2,976,388	+837,624	+39%

However, motorised travel is dominated by person car trips, but decreasing slightly by 2031 (i.e. 76 percent and 73 percent for 2011 and 2031 respectively). In contrast active transport trips are expected to increase from 21 percent to 23 percent in the same time period. In contrast, the mode split to public transport is stable at about 3 percent.

Not surprisingly the mode split to public transport is higher in peak periods (5 percent in 2011 and 6 percent in 2031 for the AM peaks) reflecting higher levels of service in the peaks and ambient road congestion.

6.3 Growth in vehicular travel and road network performance in 2011 and 2031

Table 6-2 summarises the modelled changes with regard to vehicular travel in the Greater ACT Region. Results from Table 6-1 and Table 6-2 indicate that:

a) Overall daily person trips increase from approximately 2.1m trips per day to close to 3m in 2031 (39 percent)

b) This level of growth is similar across each of the time periods (that is, by time of day), with the peak periods expected to growth slightly faster

c) The projected increase in car kilometres (38 percent) is slightly higher than the increase car trips (by 38 percent), indicating a slight increase in the average trip length.

d) Vehicle hours increase disproportionately (by approximately 55 percent) reflecting a significant decline in average speeds across the network (6 kms/hr)

e) Not unexpectedly, given the assumed infrastructure investment strategy, the decline is most pronounced in the peak periods.

Table 6-2: Growth in vehicular travel in the Modelled Area

Traffic statistics		2011	2031	% change
Car trips	AM	210,834	281,184	+33%
	OP	801,928	1,081,775	+35%
	PM	206,579	277,360	+34%
	24h	1,219,341	1,640,318	+35%
Car kilometres	AM	2,028,427	2,834,043	+40%
	OP	7,036,486	9,677,671	+38%
	PM	2,025,394	2,822,503	+39%
	24h	11,090,308	15,334,218	+38%
Car hours	AM	43,137	77,180	+79%
	OP	117,571	165,392	+41%
	PM	40,766	69,447	+70%
	24h	201,474	312,019	+55%
Car Average assigned speed (kph)	AM	47.0	36.7	-22%
	OP	59.8	58.5	-2%
	PM	49.7	40.6	-18%
	24h	55.0	49.1	-11%
Commercial Vehicle trips	AM	9,155	12,904	+41%

Traffic statistics		2011	2031	% change
	OP	44,912	62,960	+40%
	PM	10,754	15,205	+41%
	24h	64,821	91,069	+40%
Commercial Vehicle kilometres	AM	129,367	188,881	+46%
	OP	695,446	968,671	+39%
	PM	151,372	210,720	+39%
	24h	976,185	1,368,272	+40%
Commercial Vehicle hours	AM	2,229	3,927	+76%
	OP	10,418	14,669	+41%
	PM	2,606	4,137	+59%
	24h	15,253	22,734	+49%
Commercial Vehicle Average assigned speed (kph)	AM	58.0	48.1	-17%
	OP	66.8	66.0	-1%
	PM	58.1	50.9	-12%
	24h	64.0	60.2	-6%
Total trips	AM	219,989	294,088	+34%
	OP	846,840	1,144,734	+35%
	PM	217,333	292,565	+35%
	24h	1,284,162	1,731,387	+35%
Total kilometres	AM	2,157,794	3,022,924	+40%
	OP	7,731,933	10,646,342	+38%
	PM	2,176,766	3,033,224	+39%
	24h	12,066,493	16,702,490	+38%
Total hours	AM	45,366	81,107	+79%
	OP	127,989	180,061	+41%
	PM	43,372	73,584	+70%
	24h	216,727	334,752	+54%
Total Average assigned speed (kph)	AM	47.6	37.3	-22%
	OP	60.4	59.1	-2%
	PM	50.2	41.2	-18%
	24h	55.7	49.9	-10%

6.4 Growth in public transport ridership (2011-2031)

Table 6-3 below summarises the bus boardings for the base year and the 2031 forecasts in terms of patronage and network supply indicators by time of day.

The following points are notable:

a) Total bus boardings are expected to increase by 69 percent over the period; this is in contrast to the 53 percent increase in public transport trips (implying a higher level of interchanging is expected to occur).

b) While in-vehicle passenger kilometres are projected to increase by 63 percent, the in-vehicle passenger hours increase by 86 percent, which is an indication of the relative decline in average speeds within in a road network that is expected to experience increasing congestion levels.

Table 6-3: Predicted growth in public transport ridership (2011-2031)

Public transport statistics		2011	2031	% change
Total bus boardings	AM	18,867	31,784	+68%
	OP	40,369	66,953	+66%
	PM	14,107	25,001	+77%
	24h	73,343	123,738	+69%
In vehicle passenger kilometres	AM	191,783	308,137	+61%
	OP	320,529	518,016	+62%
	PM	139,834	240,069	+72%
	24h	652,146	1,066,222	+63%
In vehicle passenger hours	AM	6,429	12,609	+96%
	OP	9,292	15,666	+69%
	PM	4,485	9,253	+106%
	24h	20,205	37,528	+86%

It should be noted that, under the *low transport network investment* scenario, the existing frequencies of currently operating public services have been retained in the 2031 model run, thus no change in in-service vehicle kilometres is expected, as shown in Table 6-4.

Table 6-4: Increase in in-service public transport vehicle-kilometres (2011-2031)

Public transport statistics		2011	2031	% change
In-Service Kilometres by Bus	AM	14,591	14,591	*0%*
	OP	46,930	46,930	*0%*
	PM	13,217	13,217	*0%*
	24h	74,738	74,738	*0%*

Points to note from Table 6-3 and Table 6-4 are as follows:

a) Total weekday bus in-service vehicle kilometres not changed

b) The expected increase in bus boardings (69%) is significantly higher than the expected population growth (43%)

7. Road network performance

7.1 Introduction

This section of the report presents the Zenith model's predictions as to how traffic demand in the Greater ACT Region will increase between 2011 and 2031, and how these predicted increases will affect the performance of the road network under a *low road network investment* scenario that assumes only committed and "highly likely" road projects will be initiated in the future.

7.2 Increase in traffic (2011-2031)

Figure 7-1 shows the Zenith model's predicted increases in weekday traffic flows in Greater ACT (shown in dark green) between 2011 and 2031.

Daily (weekday) traffic demand is forecast to increase significantly (2011-2031) on Parkes Way in the vicinity of the CBD and on Gungahlin Road towards Belconnen.

The volumes along Majura Road are expected to decrease by over 7 percent after the construction of the link road between Majura Pwy and Majura Road. Some increases are also expected Monaro Highway southwards from the new link road.

The predicted changes in traffic volume (2011-2031) in the AM and PM peaks are shown in Figure 7-2 and Figure 7-3.

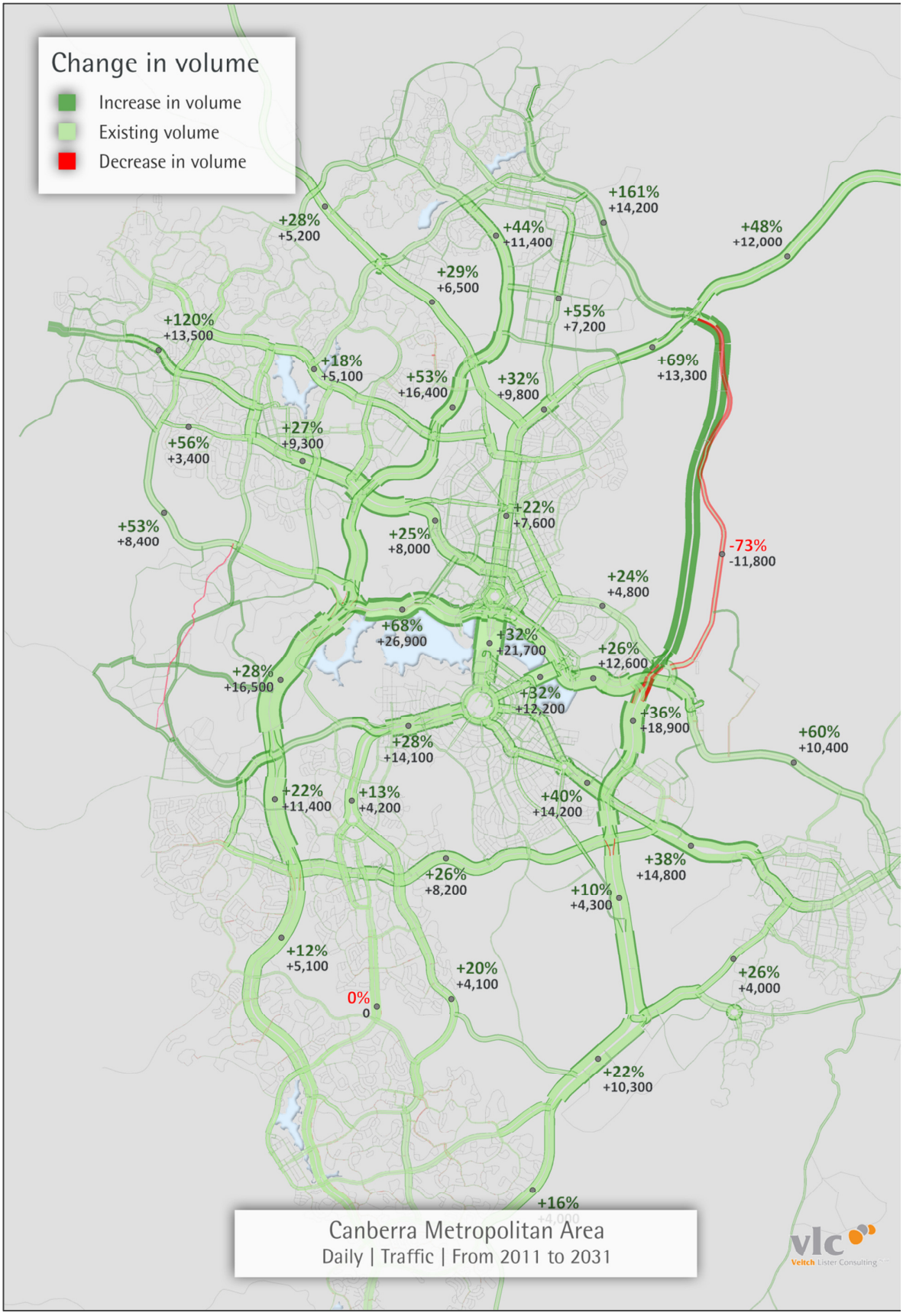

Figure 7-1: Predicted increase in Canberra weekday traffic (2011-2031)

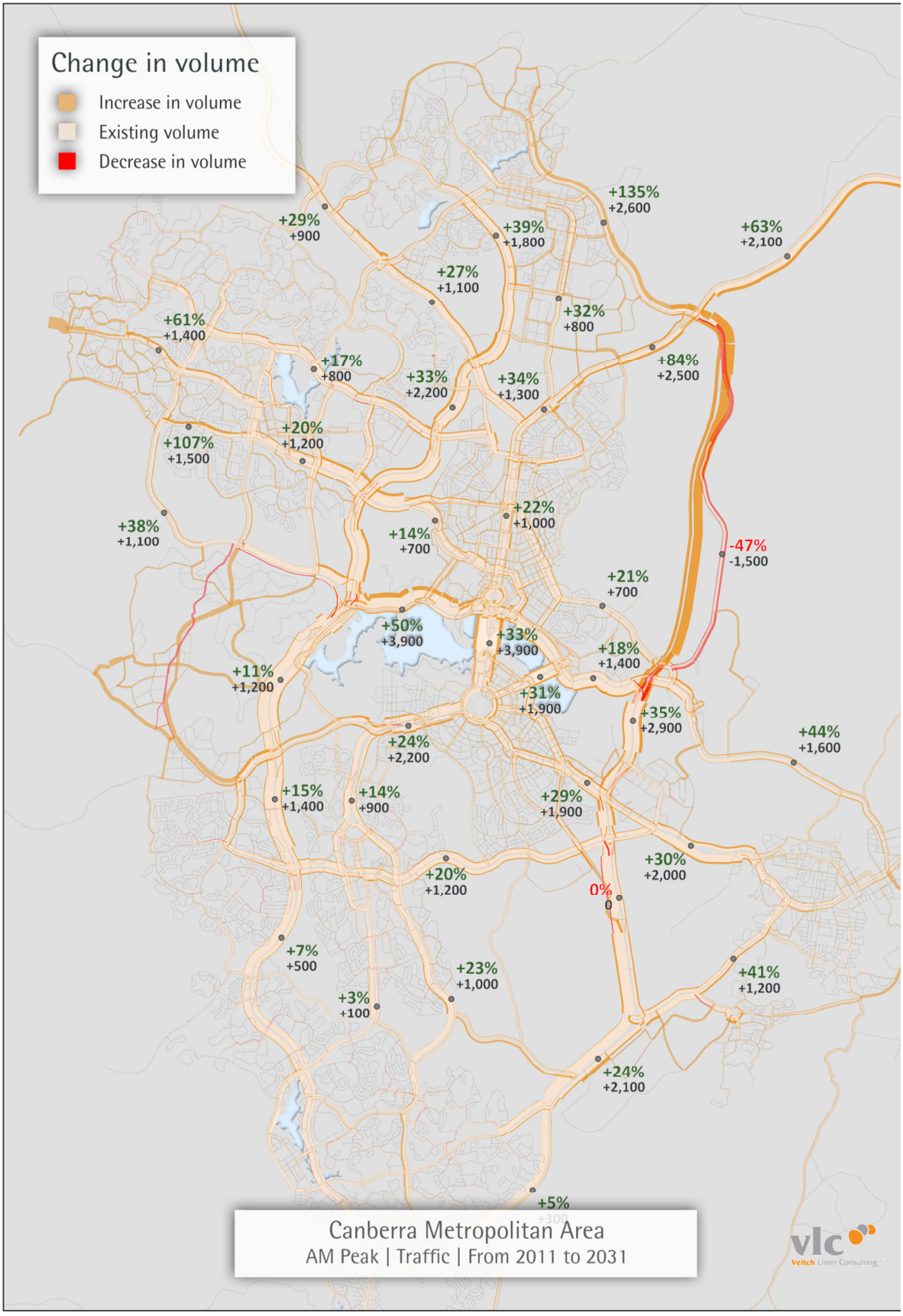

Figure 7-2: Predicted increase in Canberra weekday AM peak traffic (2011-2031)

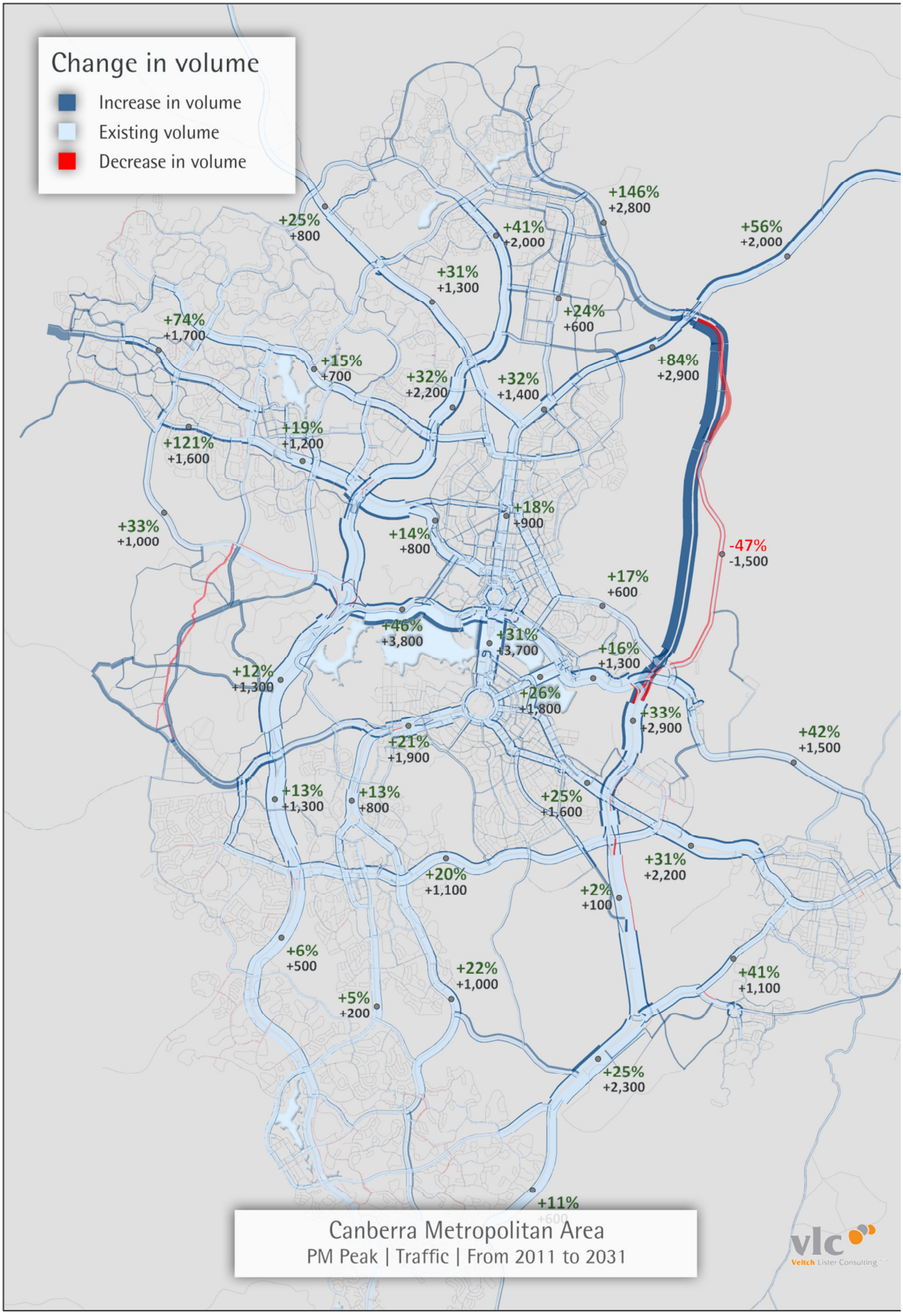

Figure 7-3: Predicted increase in Canberra weekday PM peak traffic (2011-2031)

7.3 Volume/capacity ratios (V/C)

The Zenith model's assessment of the performance of the road network in 2011 and 2031 can be gauged from volume/capacity ratio plots (V/C).

Figure 7-4 to Figure 7-6 show the Zenith model's estimates of V/C for the road network in 2011 for the maximum AM peak hour, typical off-peak hour and maximum PM peak hour respectively.

Figure 7-7 to Figure 7-9 present the same information for 2031 based on the Zenith model's traffic forecasts.

V/C ratios are used to gauge the level of congestion in the road network. Significant congestion and delays occur at the V/C ratio approaches unity. Should the V/C ratio exceed unity then the excess demand can only be accommodated by drivers choosing to switch to the shoulders of the peak thereby extending the duration of the peak, changing their destination, changing mode, or not making the journey at all.

Referring to Figures 7-4 and 7-6 it is evident that a significant part of Canberra's network is already operating at or close to capacity in both peak periods.

The following routs are already over capacity in 2011 in the morning peak hour:

- Canberra Avenue, between Canberra and Quenbeyan;
- Adelaide Avenue, west of Capital Hill;
- Tuggeranong Parkway, south of Hindmarsh Drive;
- Athllon Drive, through Mawson;
- Kings Avenue, east of Capital Hill;
- Morshead Drive, south-east of King Avenue.

Monaro Highway is expected to operate at capacity. The direction of the roads operating over capacity in the AM peak is towards the Capital Hill, while the opposite is true in the PM peak.

Figure 7-5 shows the 2011 situation during a typical hour in the midday off-peak. Most of the Canberra's road network operates at well below its practical capacity

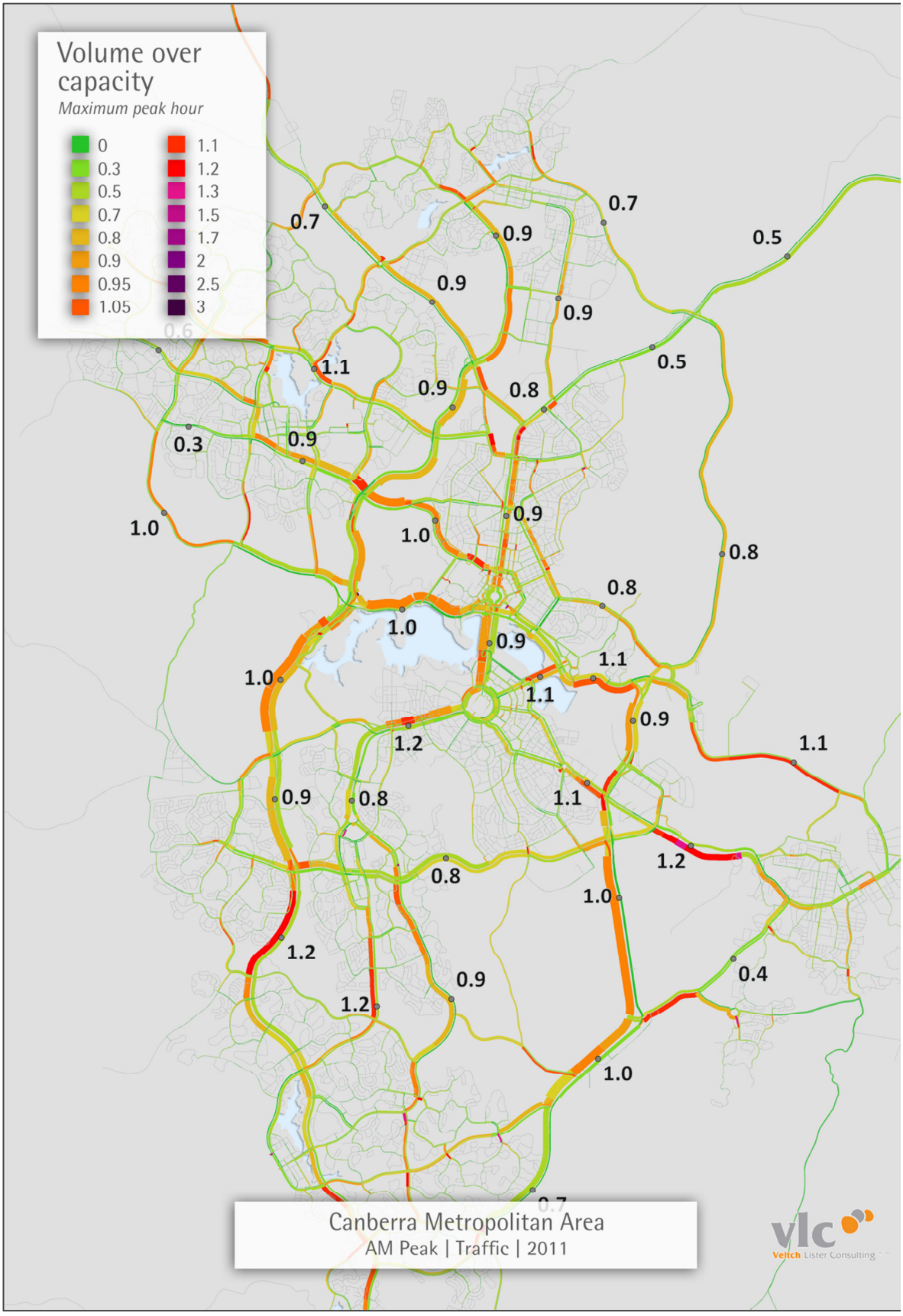

Figure 7-4: Road network volume/capacity ratios in 2011 - AM maximum peak hour

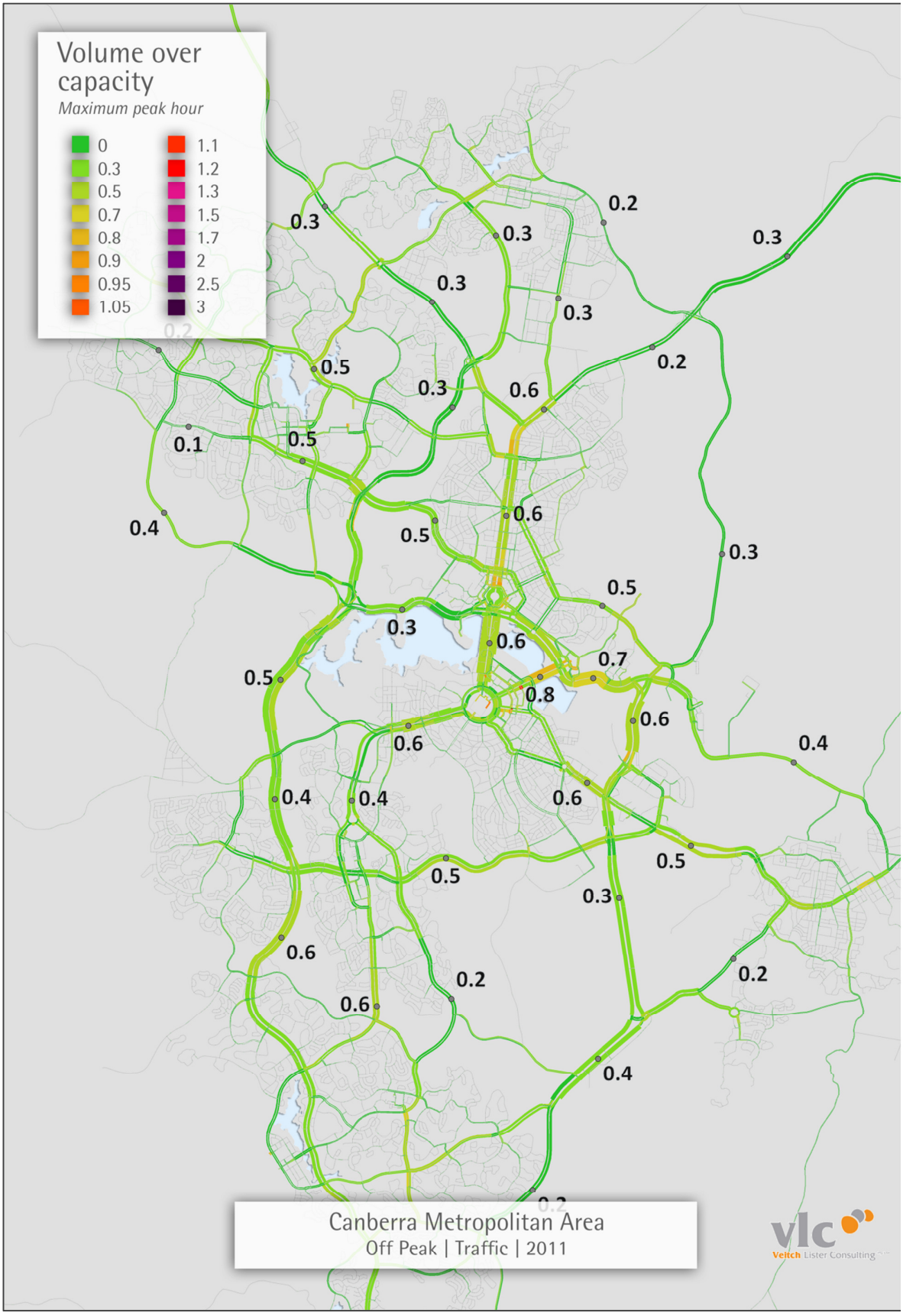

Figure 7-5: Road network volume/capacity ratios in 2011 - daytime off-peak

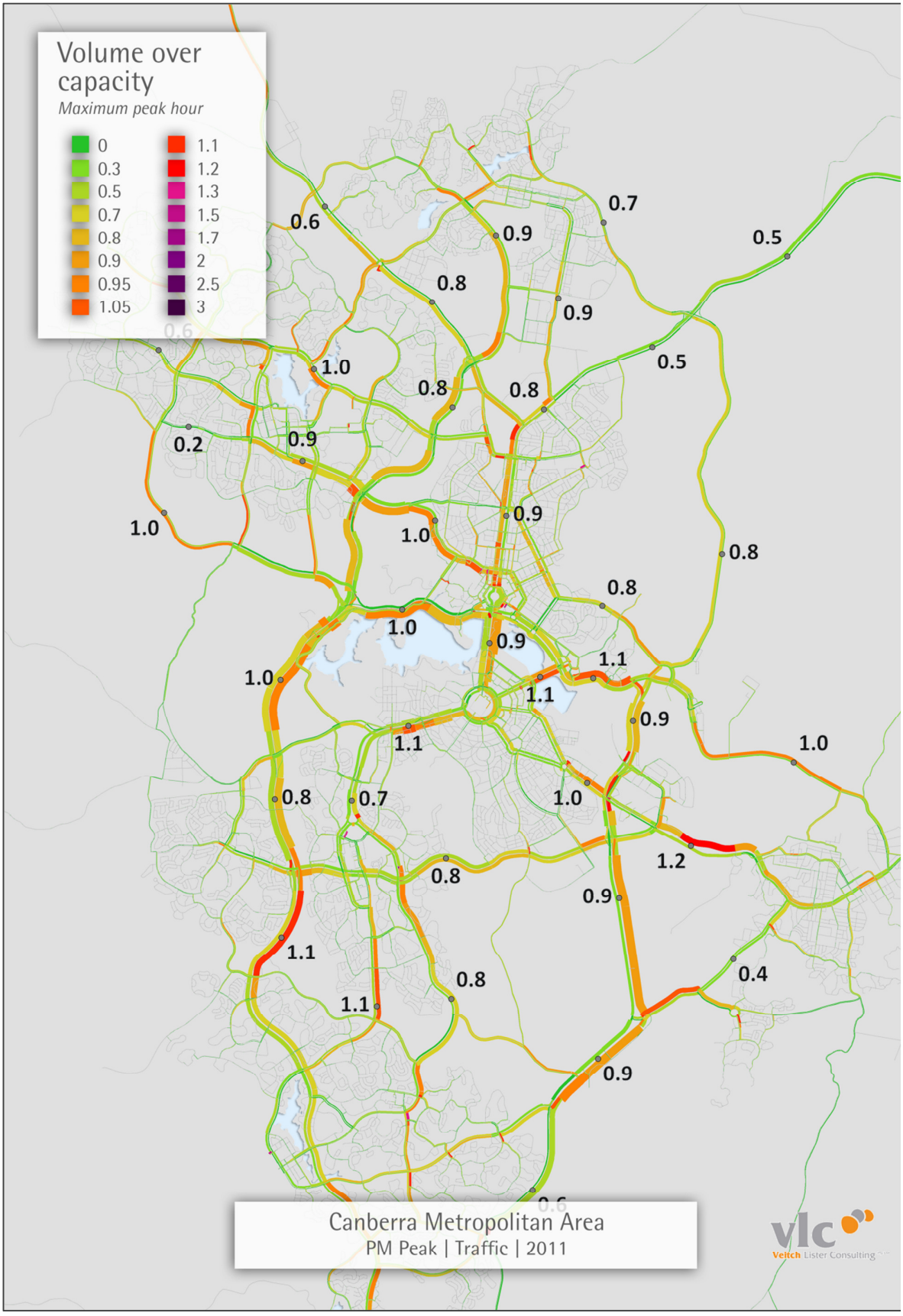

Figure 7-6: Road network volume/capacity ratios in 2011 - PM maximum peak hour

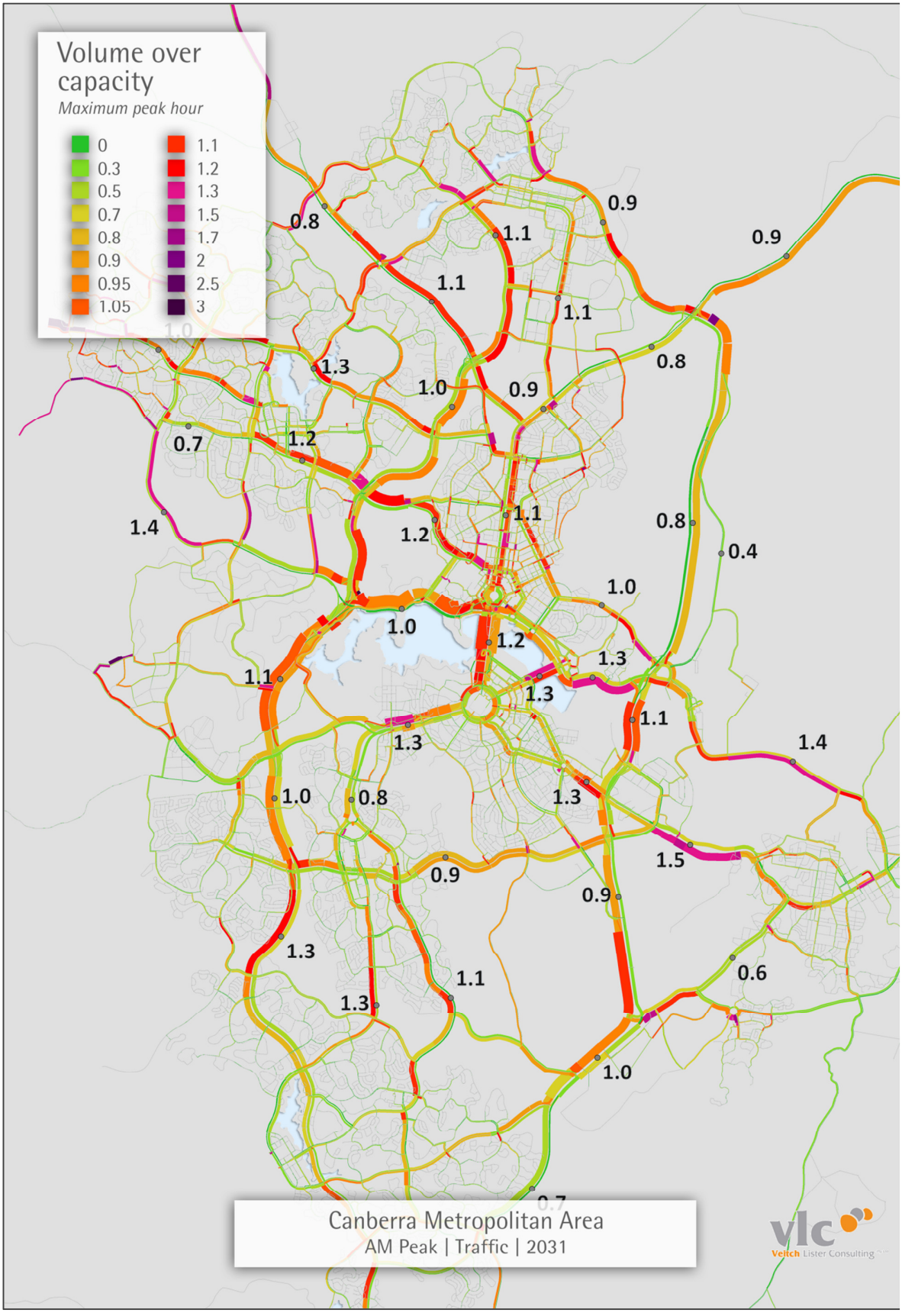

Figure 7-7: Road network volume/capacity ratios in 2031 - AM maximum peak hour

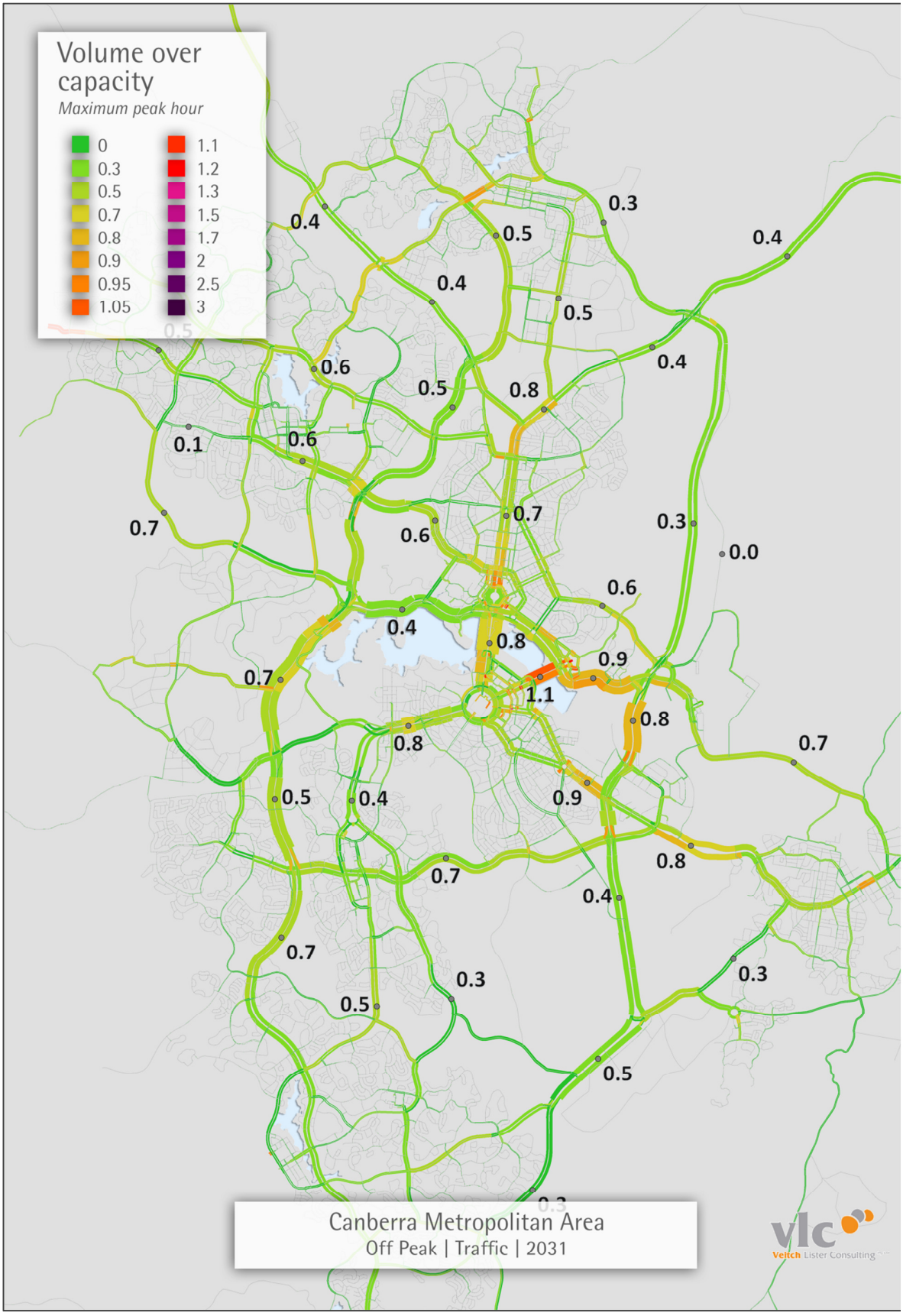

Figure 7-8: Road network volume/capacity ratios in 2031 - daytime off-peak

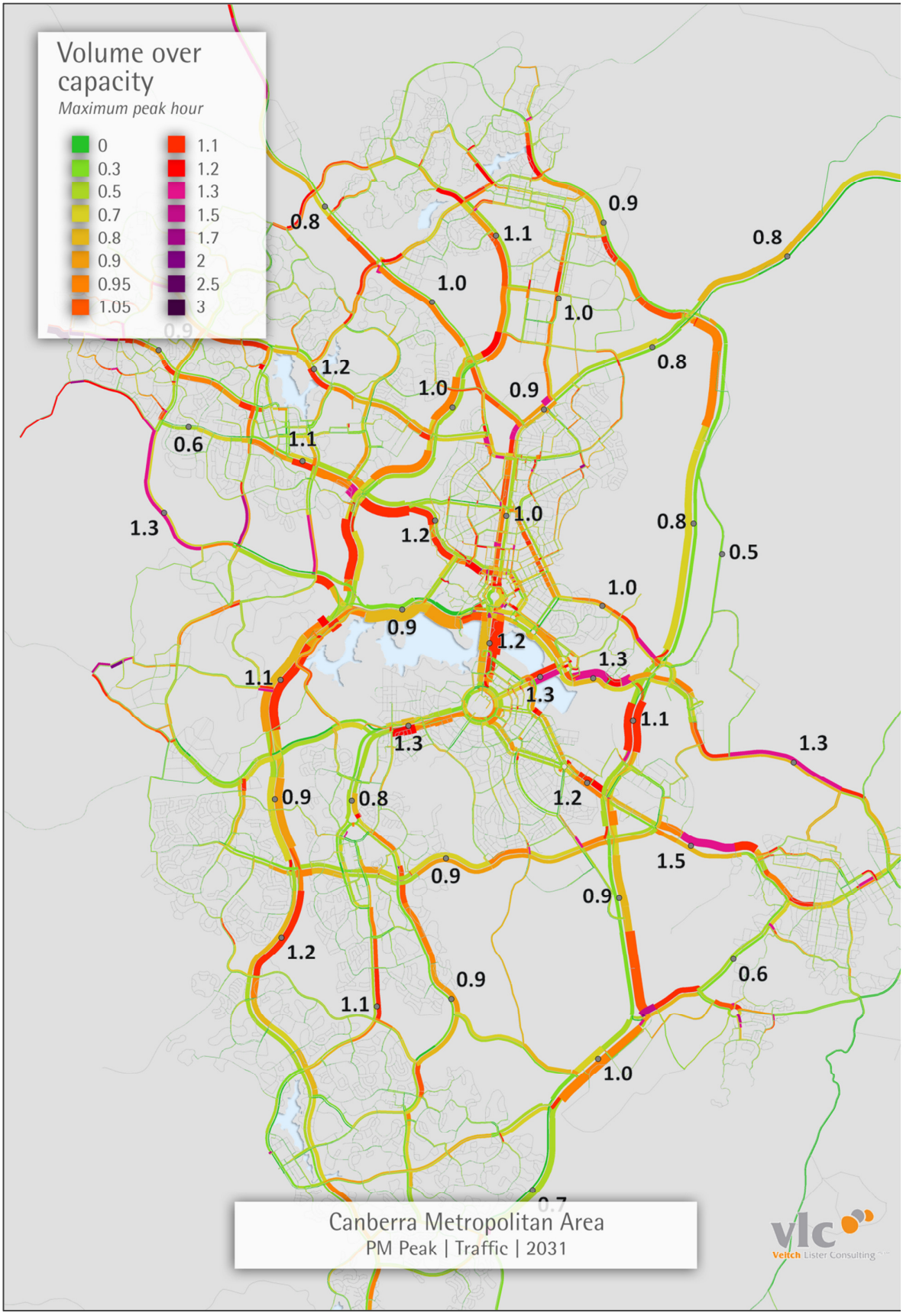

Figure 7-9: Road network volume/capacity ratios in 2031 - PM maximum peak hour

Figure 7-7 (previous) presents V/C ratios across the Canberra road network using the Zenith model's 2031 AM peak traffic forecasts for a *low road network investment* scenario.

It is clearly evident that, if the Zenith model's forecasts are correct, then a significant proportion of Canberra's road network will be unable to accommodate the predicted demand. Even the newly constructed link road in the north-east will be operating close to or at capacity. The only way such levels of travel demand can be accommodated is by traffic diverting to the shoulders of the peak (peak spreading), or by travellers changing their travel behaviour (mode of travel, destination, etc.).

Figure 7-9 suggests that a similar scale of problem will emerge in the PM peak.

In the daytime off-peak in 2031 (refer Figure 7-8) the Zenith predicts that most of the major road network will still have spare capacity. However, the model suggests that Kings Avenue will be operating over capacity and there will be little spare off-peak capacity on Commonwealth Avenue, Morshead Drive, Monaro Highway and Canberra Avenue.

7.4 Change in travel times (2011-2031)

This section of the report translates the forecast increase in levels of congestion in the Greater ACT Region in 2031 (as described in Section 7.3), into the likely implications for AM peak car travel times to key destinations. Two key destinations are considered:

- The Canberra CBD; and
- Canberra Airport.

Figure 7-10 through to Figure 7-13 provide 2011 and 2031 travel time contours for car travel to these two destinations in the AM peak, under a *low investment road network* scenario.

Referring to Figure 7-10 and Figure 7-11, it is evident that the Zenith model predicts some contraction of the travel time contours for car around the Canberra CBD by 2031. For example, AM peak car travel times are forecast to increase for travel between Monash and the CBD from 20 minutes to 22 minutes; an increase of 7 percent.

Figure 7-12 and Figure 7-13 also show a contraction, especially to the north-west of the AM peak travel time contours for car around Canberra Airport by 2031. The travel time for travelling to the airport from Belconnen by car is forecast to increase from 21 minutes in 2011 to 24 minutes in 2031; an increase of 24 percent. Equally the travel time by car from the airport to Monash is expected to grow by 12 percent, from 19 minutes to 21 minutes.

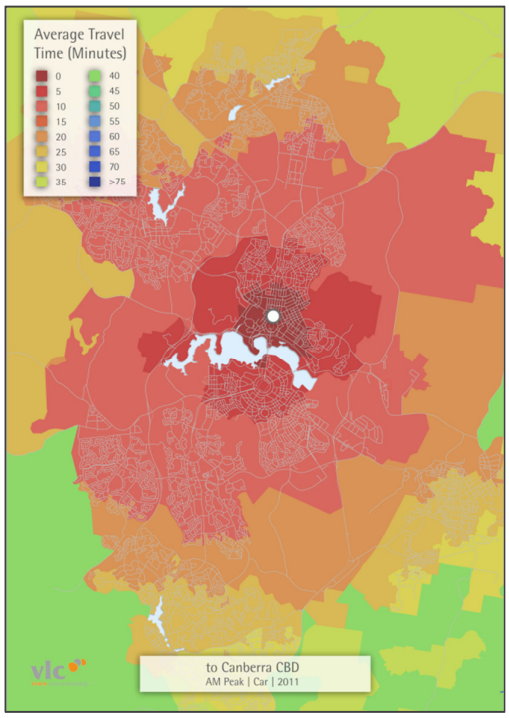

Figure 7-10: Canberra CBD | Road | AM Peak | 2011

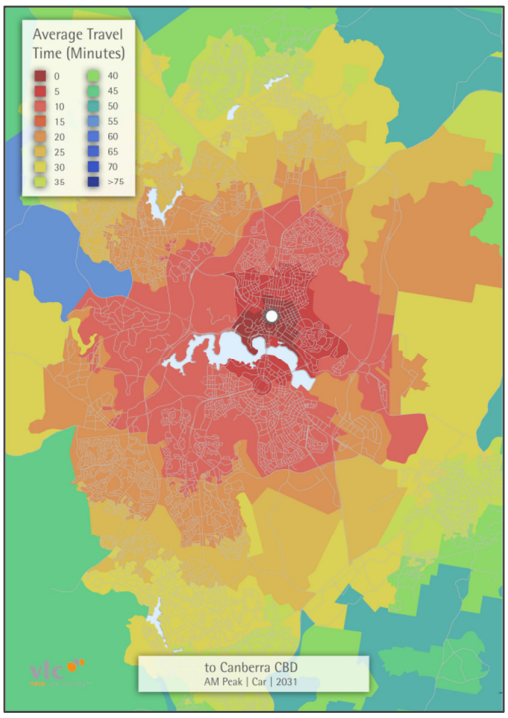

Figure 7-11: Canberra CBD | Road | AM Peak | 2031

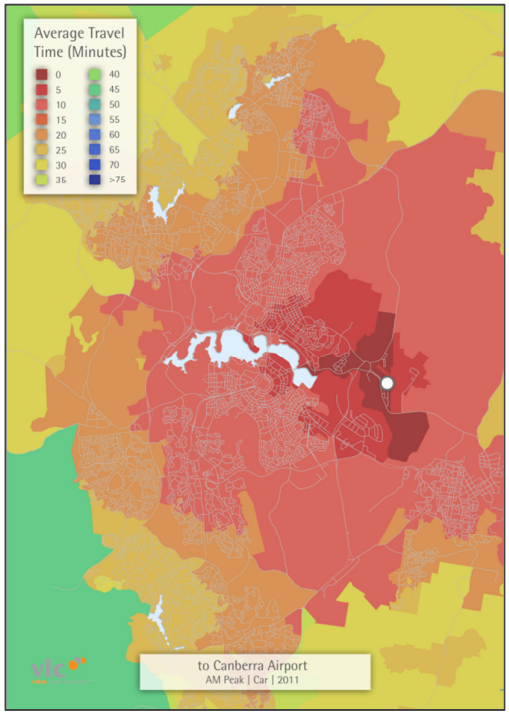

Figure 7-12: Canberra Airport | Road | AM Peak | 2011

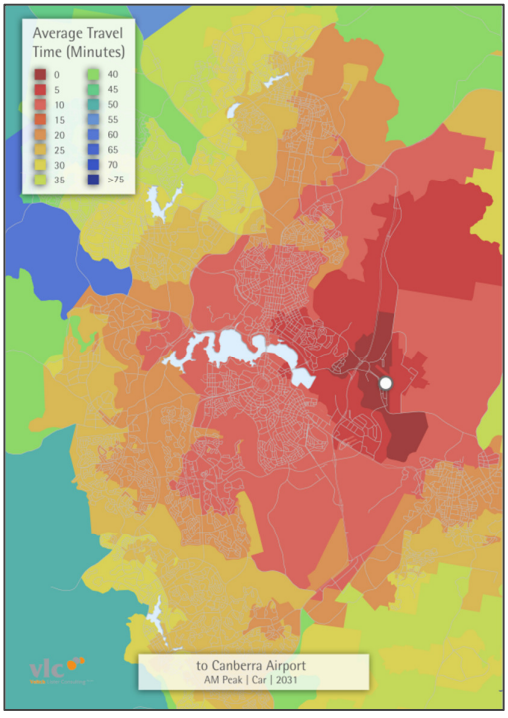

Figure 7-13: Canberra Airport | Road | AM Peak | 2031

8. Public transport system performance

8.1 Introduction

This section of the report presents the Zenith model's predictions as to extent that public transport ridership will increase in the future in the Greater ACT Region between 2011 and 2031, and how these predicted increases will affect the performance of the public transport system under a *low public transport investment* strategy, that only includes committed and "highly likely" public transport projects.

A conservative assumption has been adopted regarding public transport service frequencies, in that the current frequencies of existing bus services have not been increased.

8.2 Forecast increase in demand on the public transport system (2011-2031)

Figure 8-1 shows the Zenith model's forecast increase in daily passenger loading on the bus network between 2011 and 2031.

The figure indicates that most increases are expected to the north of the CBD, with the largest increase in daily loadings expected between the CBD and Gungahlin; and to a lesser degree to Belconnen.

Lower levels of increase in loadings are expected southwards towards Tuggeranong.

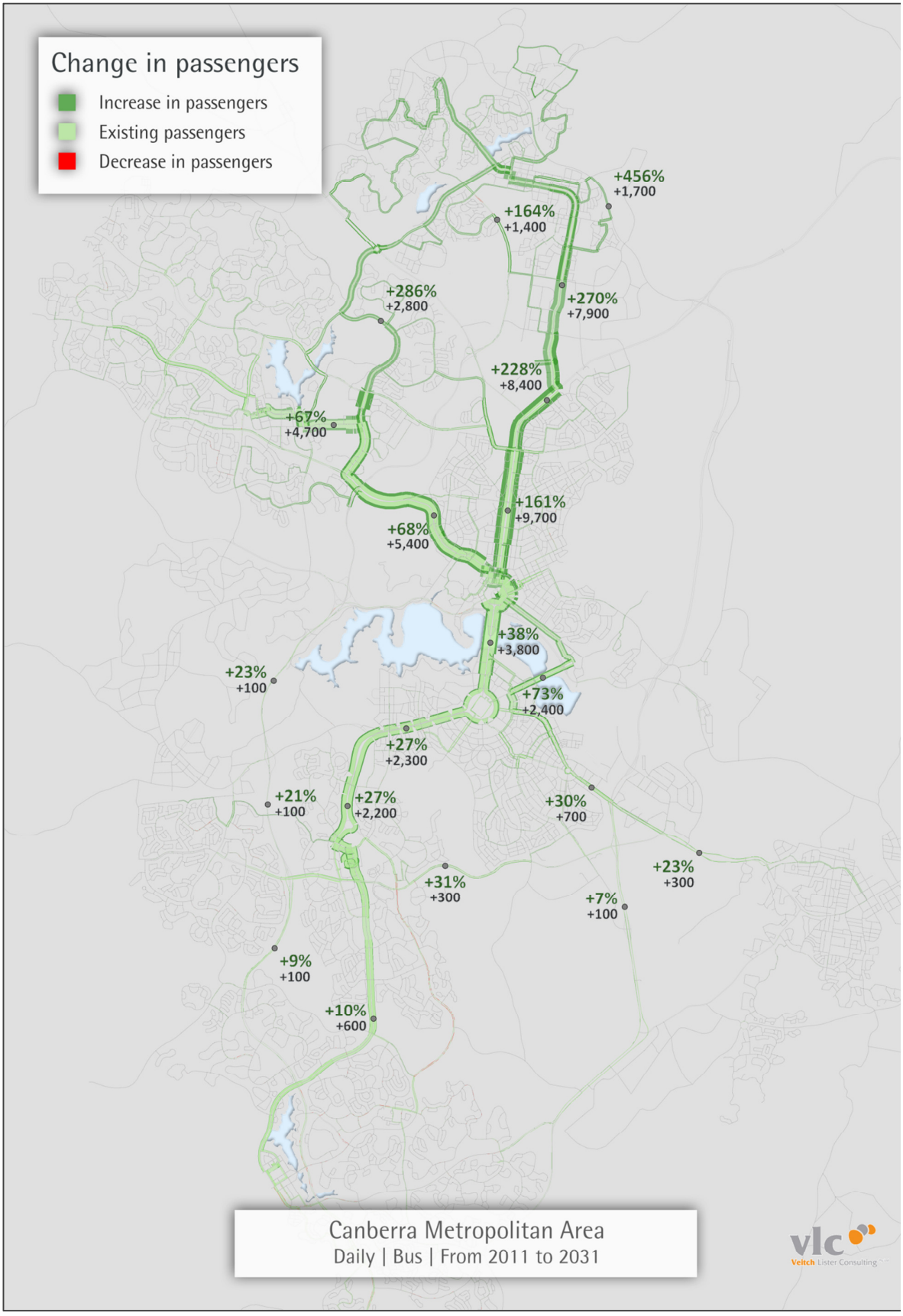

Figure 8-1: Increase in weekday bus passenger loading (2011-2031)

8.3 Bus loadings relative to seating and crush capacity

Figure 8-2 that follows shows the Zenith model's weekday AM peak (one hour) passenger load on the bus network relative to the available seating capacity in 2011 and 2031, while Figure 8-3 plots the weekday passenger load relative to the "crush" capacity, the latter being assumed to be 60% above the seating capacity.

Referring to Figure 8-2, it shows that the Zenith model's estimated 2011 passenger demand on the bus network to be at the seating capacity on the three main lines to Belconnen, Gungahlin and Tuggeranong l lines as they approach the Canberra.

By 2031 the Zenith model suggests that, if bus frequencies are not increased in the AM peak then capacity is at a premium, especially from the north, and most notably from Gungahlin.

Figure 8-3 shows that average bus passenger loads across the AM peak (one hour) in 2011 were below the defined crush capacity. This does not mean that individual buses are not operating at, or above, the defined crush capacity at the peak of the peak.

Figure 8-3 further indicates that by 2031, if bus frequencies are not increased, then mainly the bus services from the north would be operating over capacity, especially the services to Gungahlin

.

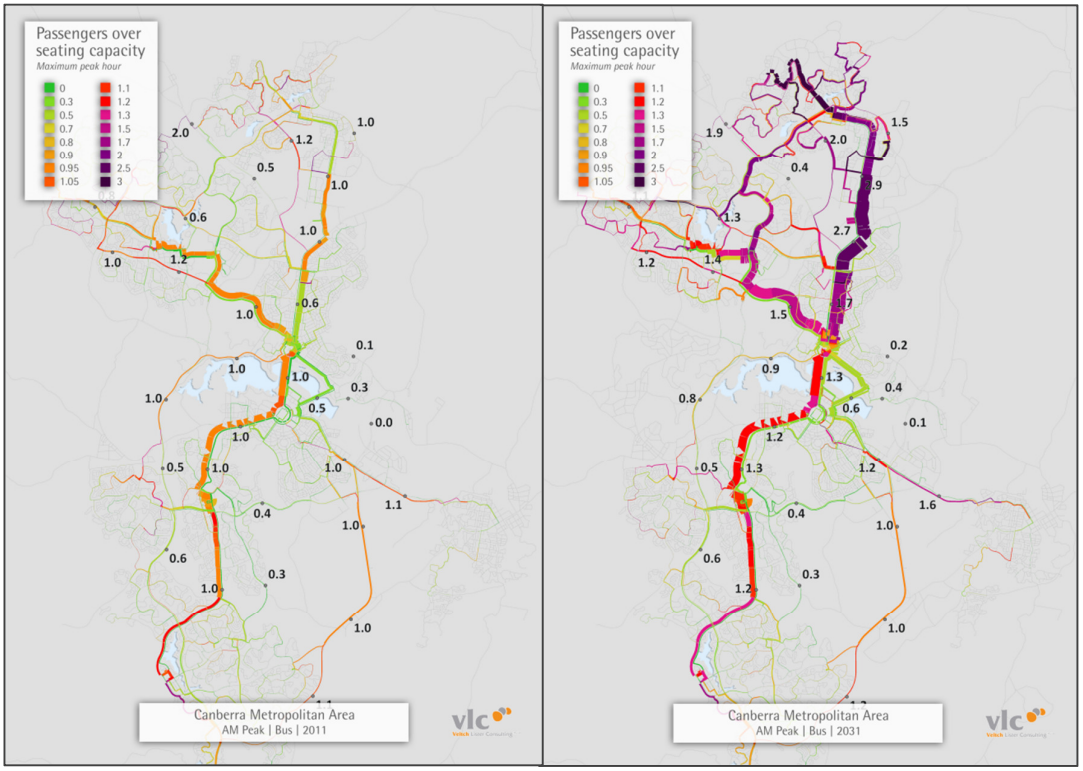

Figure 8-2: Bus weekday passenger demand relative to seating capacity (2011 and 2031)

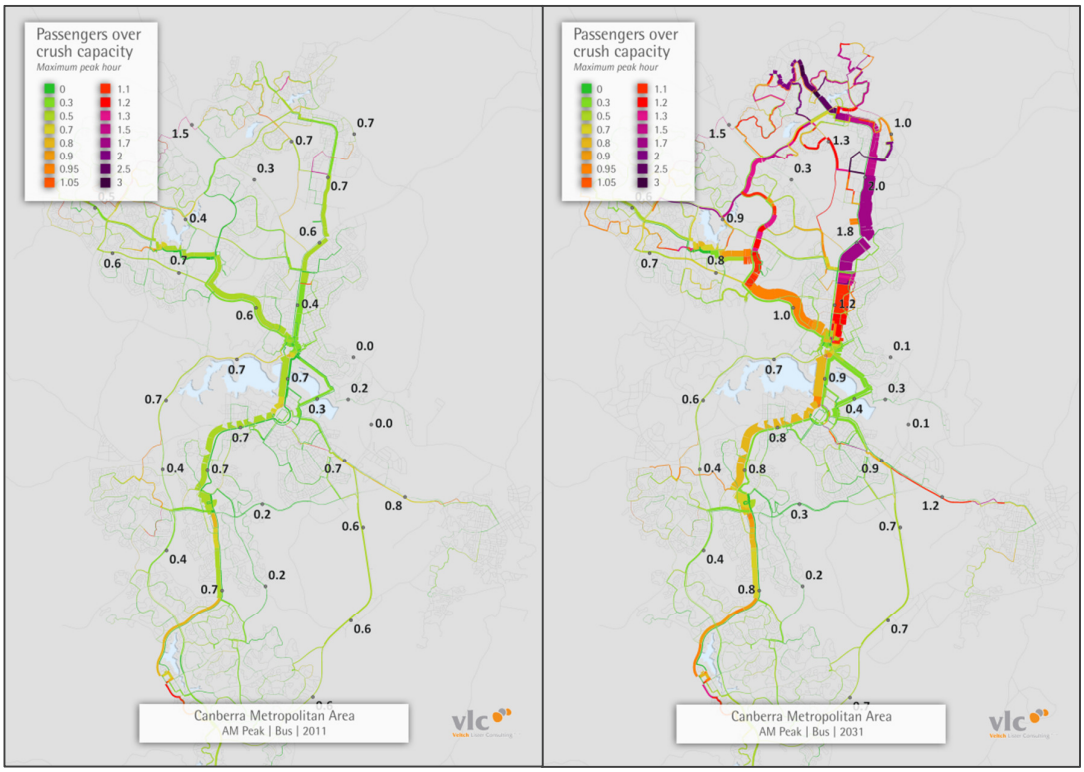

Figure 8-3: Bus weekday passenger demand relative to crush capacity (2011 and 2031)

Appendix A:
Transport Infrastructure Improvements
2031 Base Case Network

Full list of transport infrastructure improvements included in the 2031 base case network

Item	Road
1	New roadways providing access to residential developments in Eastlake
2	Construction of third lane from Glenloch Interchange to Edinburgh Avenue (both directions)
3	Duplication between Canberra Ave and Newcastle St
4	Duplication of road between Dunrossil Drive and Lady Denman Drive.
5	Connect Sandford (Morisset) Street from Flemington Road to the Antill Street Roundabout on the Federal Highway
8	Additon of one lane in each direction for Ashley Drive (between Sternberg Crescent & Isabella Drive)
9	11.5 km of dual carriageway linking Monaro Highway and the Federal Hwy
11	Extension of sections east and west of Moncrieff, complete missing section of Horse Park Drive
13	Connect Edwin Land Parkway to Yass Rd in Queanbeyan
15	New roadways providing access to residential developments
21	Shown in StreetPro 2013 and Google Maps
22	Shown in StreetPro 2013 and Google Maps
28	Roads for 2014 PT Stops
29	New roads as shown in Roads ACT 2031 layer
33	New roadways providing access to residential developments
34	New roadways providing access to residential developments
35	New roadways providing access to residential developments
36	New roadways providing access to residential developments
37	New roadways providing access to residential developments
38	Extension of Ruden Cutler Drive to Horse Park Drive
39	Internal roads for Coombs Estate
41	New roadways providing access to residential developments
43	Upgrading all Cotter Road to four-lanes
44	New roads based on Master Plan
45	Internal road for growth area and current zoning
46	Majura Pwy
47	Constitution Avenue
48	Horse Park Dr extension
49	Civic to Gungahlin Corridor Improvements
50	Molonglo Infrastructure Investment
51	Link rd construction btn Majura Pwy and Majura Rd
52	Ashley Dr – Stage 1 - Duplication Erindale Dr btn Ashley Dr and Sternberg Cr

Appendix B:
Public transport capacity assumptions

ACTION Bus Capacity Coding

General

Coding of ACTION bus fleet capacities was based on information provided by the ACTION website. Information for each bus type was sourced from; http://www.action.act.gov.au/About_ACTION/our_fleet. The capacity of a typical service was therefore calculated by combining seat and crush capacity information with information on the fleet makeup.

The 2031 model was assumed to use the same fleet mix, but only using wheelchair-accessible vehicles, as per ACTION's commitment to use a 100% wheelchair-accessible fleet by 2022.

Bus Capacity	Delivery of Fleet	Units	Seating capacity	Crush capacity	Wheelchair Accessible
Dennis Dart SLF	1997	25	27	50	TRUE
RENAULT PR1OO.2 MK I	1988	118	42	69	FALSE
Renault PR100.2 MK II	1993	113	43	70	FALSE
SCANIA L94UB CB60	2004	54	45	62	TRUE
MAN A69 18.310 HOCLNL	2008	16	45	60	TRUE
MAN A69 18.320 HOUCL-R-NL	2009	89	45	67	TRUE
IRISBUS AGORALINE	2004	20	46	77	TRUE
SCANIA K320UB CB80	2014	77	48	66	TRUE
Renault PR100.3	1993	42	49	75	FALSE
SCANIA K320UB 14.5m 6 X 2*4 CB60	2010	26	53	101	TRUE
SCANIA K360UA 6 X 2/2 CB80	2012	33	65	107	TRUE

Source: http://www.action.act.gov.au/About_ACTION/our_fleet

Appendix C:
ABS Statistical Areas level 3


Goulburn - Yass
Gungahlin
Queanbeyan
Belconnen
North Canberra
Fyshwick - Pialligo - Hume
South Canberra
Weston Creek
Woden
Tuggeranong
Queanbeyan
Canberra Metropolitan Area
Statistical Area level 3 (SA3)
vlc
Veitch Lister Consulting