NZ TRANSPORT AGENCY
WAKA KOTAHI

Auckland Transport
An Auckland Council Organisation

Wellington Street On Ramp

Transport Analysis Report

August 2012

Revision History

Revision Nº	Prepared By	Description	Date
A	Jonathan Slason	For Client Use	8/08/2012

Document Acceptance

Action	Name	Signed	Date
Prepared by	Jonathan Slason	Jonathan Slason	9/08/2012
Reviewed by	Andrew Murray	A Murray	9/8/2012
Approved by	Stephen Hewett	S Hewett	9/8/2012
on behalf of	Beca Infrastructure Ltd		

Executive Summary

NZ Transport Agency and Auckland Transport have commissioned this transport assessment of the Wellington Street on-ramp merge to State Highway 1 to determine how the ramp will be managed today and into the future referencing the operational impact of the State Highway and local road network.

This report summarises the assessment and evaluates the current conditions on the network, develops a vision for near term operations, and identifies a future management philosophy. It considers changes likely to occur on the network when the Wellington Street on-ramp re-opens and outlines a monitoring plan will be necessary to make future decisions on road network changes reflecting the vision for the Auckland City Centre Masterplan and realised operational objectives.

The decision as to how to manage the Wellington Street on-ramp today and into the future requires a thorough understanding of the local Auckland Council and Auckland Transport (AT) demands as well as the operational requirements the NZ Transport Agency (NZTA) have for the tunnel and the interconnected SH1 northbound traffic flow to the Auckland Harbour Bridge.

Immediate Study Objectives

The objectives of this study included the following:

- Develop a joint NZTA and Auckland Transport framework for the on-going review of the operation of the both the strategic and the local road network;
- Assess the changes to key movements from the City Centre to points north along the State Highway associated with the closure of the Wellington Street on-ramp;
- Develop an agreed future management philosophy on how the on-ramp will be controlled as part of a 'one-network' optimisation plan; and
- Identify physical and operational changes to the network to address changes and develop a monitoring plan to identify future management changes.

Findings

Through the assessment of the transportation network changes associated with the closure of the Wellington Street on-ramp the following findings have been made:

- Prior to Victoria Park Tunnel (VPT) the Wellington Street on-ramp served between 7,000 and 8,000 vehicles per day, predominately from the Freemans Bay, upper City Centre, and Eden Terrace catchments. The Victoria Park Viaduct had traffic flows just over 50,000 vehicles per day.
- During the PM peak period the recorded traffic flows on the ramp have reduced over time from approximately 800 vehicles per hour (pre ramp signalling) to 300 vehicle per hour (pre-VPT) through the ramp signalling programme to manage the efficient operations of the motorway. This resulted in extensive queuing which occurred on all approaches to the ramp along Wellington Street, Union Street, Howe Street, and Pitt Street.
- The successful operation of the tunnel is critical to the efficient operation of a significant part of the Auckland network including the critical northbound motorway entrance to the Auckland city and access to SH16 from SH1;
- The Wellington Street on-ramp has the potential to significantly impact the motorway traffic flows and operations within the merge area along SH1, particularly during the PM peak period;
- The Wellington Street on-ramp closure is estimated to have increased daily traffic flows on the following routes: Beaumont Street (approximately 3,500 vehicles per day (vpd), 58%), Curran

Street (approximately 1,500 vpd, 18%), Fanshawe Street (approximately 3,000 vpd, 21%), Franklin Street (approximately 1,800 vpd, 26%) , Victoria Street (approximately 2,500 vpd, 40%), and Wellington Street (approximately 1,800 vpd, 23%);

- The impacts on motorway accessibility of the Wellington Street on-ramp closure were found to be primarily in and around the Freemans Bay and Franklin Road corridor with increases in traffic flows en route to the Fanshawe Street on-ramp. Areas of Eden Terrace and the Upper City Centre were the most affected with increased travel time and/or distance to points north. The impacts within the wider areas were found to be minor;
- The closure resulted in increased bus travel time for movements in and around Curran Street, specifically for those destined to points north, with an overall average increase in travel times of 13%. No wider network bus travel time changes were identified to be associated with the closure;
- Currently, there is capacity available on the motorway to accommodate the Wellington Street on-ramp traffic outside of the weekday PM peak period without significantly impacting on the operation of the State Highway;
- During the PM peak period there is currently approximately 400 vehicles per hour capacity for the Wellington Street on-ramp. This is less than the expected demand, which would result in queues along Wellington Street and in the immediate vicinity during the PM peak period (similar to pre-VPT conditions);
- Although additional capacity has been provided via the VPT project, the current management philosophy should remain whereby the efficient operation of the SH1 mainline and SH16 Port Link will be maintained through ramp signalling of the entry points;
- It is envisaged that there will be increased use of the SH16 Port Link to minimise cross city traffic. This will reduce the available capacity for the Wellington Street on-ramp requiring additional management and reduction in the on-ramp traffic flow;
- On-going monitoring of the motorway traffic flows and operation as well as the local network effects should be reviewed on an annual basis to identify future risks and operational issues before they arise; and
- If the State Highway motorway operations begin to be impacted in the study area, a wider network performance and management review will be necessary to assess potential future changes in order to maintain safe and efficient flows along the strategic road network.

Conclusions

There is currently available capacity on the motorway network to open the Wellington Street on-ramp subject to significant management of the on-ramp flows during the weekday PM peak period, similar to pre-VPT levels.

There would be benefits to a number of local streets if Wellington Street on-ramp was re-opened including reduced flows and improved accessibility. However during the PM peak period the road network within the immediate vicinity of the on-ramp is likely to experience queuing and congestion similar to pre-VPT conditions.

The available capacity of the Wellington St on-ramp is expected to reduce over time as a consequence of growth on the Auckland transport network and increased usage of the SH16 Port Link to accommodate the City Centre Masterplan. This will require further management of the on-ramp to prevent significant disruption to the motorway operations.

Monitoring and regular reviews are recommended to inform the on-going management of the on-ramp.

Table of Contents

Appendices

1 Overview

This report provides the transport assessment of the Wellington Street on-ramp to State Highway 1.

Beca Infrastructure Ltd (Beca) has produced this report for the New Zealand Transport Agency (NZTA) and Auckland Transport (AT) with additional technical modelling input provided by Flow Transportation Ltd (Flow).

The focus of the review has been on the northbound movements from the Southern Highway, Northwestern Highway, and the City Centre to points north over the Auckland Harbour Bridge (AHB).

This report summarises this assessment and evaluates the current conditions on the network, develops a vision for near term operations, and identifies a future management philosophy and changes likely to occur on the network when the Wellington Street on-ramp re- opens it recommends a formal monitoring plan will be put in place that provides the necessary information to make future decisions on road network changes to allow the vision for Auckland City Centre to be realised.

1.1 Introduction and Background

During the course of the construction of the Victoria Park Tunnel (VPT) the northbound Wellington Street on-ramp was closed to accommodate construction works, temporarily reopened, and re-shut as it remains today. A significant amount of work involving traffic modelling, capacity assessments of key intersections, and putting in place specific mitigation measures were carried out.

The recently completed VPT project expanded the State Highway (SH) 1 network capacity for both northbound and southbound directions, connecting the northern and southern motorways.

The location of the Wellington Street on-ramp is important in terms of local access from the city centre, city fringe suburbs but also strategically important both in terms of its placement upstream of the VPT and downstream of the major SH16 to SH 1 merge. Collectively these elements create a complex set of demands and challenges to effectively manage and operate the roadway network efficiently.

During the closure, it was found that the previous on-ramp flow was being re-routed onto the wider network with few obvious impacts, while at the same time providing a substantial improvement to the upstream merge of the SH 1 – SH 16 Motorway to Motorway (M2M) link (at this time SH16 was a merge and did not have its own northbound lane to enter into).

The closure was full time, and remains as such, requiring potential users of the facility to divert onto the two other primary northbound entrances of Fanshawe Street and Curran Street motorway on-ramps. These vehicle trips do this by primarily travelling along Nelson Street, Victoria Street, Fanshawe Street, Beaumont Street, Ponsonby Road, Jervois Street, and Curran Street. These routes were the envisioned key routes to the Fanshawe Street and Curran Street on-ramps and would be affected by increased daily flows due to the Wellington Street on-ramp closure.

Since the full VPT scheme has become operational, a significant improvement in northbound flow on SH1 has been noted. This is expected to have occurred due to many changes on the road network including additional demands to SH16 ramps, both from the Port and the Northwestern and from the near completion of Newmarket Viaduct. As such, an important aspect of this review was to isolate the effects of the additional capacity northbound in the tunnel from the effects of the Wellington Street ramp.

The decision as to how to manage the Wellington Street on-ramp today and into the future requires a thorough understanding of the local Auckland Council and Auckland Transport (AT) demands as well as the operational requirements the New Zealand Transport Agency (NZTA) have for the tunnel and the interconnected SH1 northbound flow to the Auckland Harbour Bridge (AHB).

NZTA and AT has commissioned this report to determine how the ramp will be managed.

1.1 Immediate Study Objectives

The objectives of this study included the following:

- Develop a joint NZTA and Auckland Transport framework for the operation of the strategic and the local road network;
- Assess the changes to key movements from the City Centre to points north along the State Highway associated with the closure of the Wellington Street on-ramp;
- Develop an agreed future management philosophy on how the on-ramp will be controlled as part of a 'one-network' optimisation plan; and
- Identify physical and operational changes to the network to address changes and develop a monitoring plan to identify future management changes.

1.2 Project Control Group and Participants

The project control group (PCG) consisted of representatives from Auckland Transport Planning, Network Performance, and Operations teams and the NZTA Traffic Planning and Network Operations teams. The PCG was chaired by NZTA and jointly facilitated by the members.

Flow Transportation Consultants Ltd was engaged by the PCG to provide informal technical review as well as modelling input. GHD Consultants Ltd provided a review of on-site traffic conditions within the study area during a typical AM and PM peak period. Beca provided the overall technical guidance and input around the collection and the analysis of traffic data on the network.

Wes Edwards Consulting was retained by the NZTA as an independent peer reviewer.

1.3 Study Area

The area includes key access points from the city to the motorway and intersections along corridor routes of interest.

The study area for the technical review is shown in **Figure 1.1.**

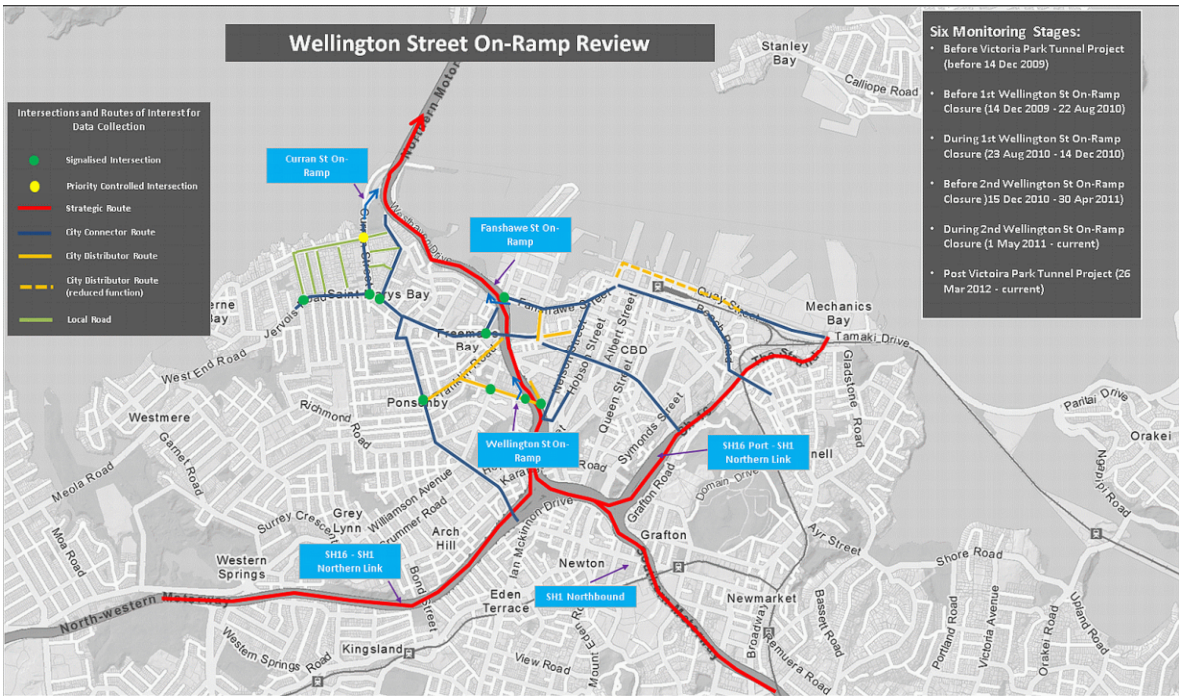


Figure 1.1 - Study Area and Data Collection Locations

1.4 Report Structure

This report is structured in the following manner to document the range of analysis and technical assessments carried out:

- **Approach and Methodology – Section 2**: Describes the data sources and approach for the analysis of the Wellington Street on-ramp review.
- **One-Network Strategic Principles – Section 3**: Provides an outline and guiding principles of a 'one-network' approach with objectives around the management of the interaction between the strategic state highway network and the local city street network;
- **Motorway Capacity and Performance– Section 4**: Assesses the current and likely future motorway conditions and the available capacity at the Wellington Street on-ramp merge with State Highway 1;
- **Travel Time Data – Section 5**: Motorway travel time data collected via a Bluetooth monitoring system.
- **Catchment Areas and network accessibility – Section 6**: A high level review of modelled travel time and distance changes associated with closure of the Wellington Street on-ramp;
- **SATURN Traffic Modelling – Section 7**: A more refined review of modelled traffic flow changes, travel time, and travel distance changes associated with the closure of the Wellington Street on-ramp;
- **Intersection Traffic Volumes – Section 8**: Analysis of specific traffic movements at intersections affected by the closure of the Wellington Street on-ramp;
- **Daily Flow – Tube Count Data – Section 9**: Daily traffic flow assessments along key roadway segments pre- and post- VPT on key routes affected by the Wellington Street on-ramp closure.
- **Bus Travel Time – Section 10**: Assessment of public transport travel times within the study area to identify changes associated with the closure of the Wellington Street on-ramp;

- **Local Network Enhancements – Section 11**: Identifies existing issues on the current network where potential improvements could be made to enhance traffic operations and safety;
- **Management of the Wellington Street On-Ramp – Section 12:** Describes options for managing the network to maximise the performance of the system and maintain flexibility to meet overall network operational goals; and
- **Findings and Conclusion – Section 13**

2 Approach and Methodology

2.1 Analysis of the Current Closure

2.1.1 Analysis Periods

The analysis of the Wellington Street on-ramp closure used data from a number of time periods over the course of the VPT project to assess the before, during, and after effects of the ramp closure.

Table 2.1 shows the time periods used in the analysis. The time periods have been selected to collect a sufficient number of data points and avoid the effects of public holidays and school holidays.

Table 2.1 - Wellington Street On-Ramp Analysis Periods

Scenario	Dates
Before VPT (before 14 Dec 2009	1 Jun 2009 - 30 June 2009 1 Nov 2009 - 30 Nov 2009
Before 1st Wellington on-ramp closure (prior to 23 Aug 2010)	1 Mar 2010 - 31 Mar 2010 1 Jun 2010 - 30 Jun 2010
1st Wellington on-ramp closure (23 Aug 2010 - 14 Dec 2010)	1 Sept 2010 - 24 Sept 2010 11 Oct 2010 - 30 Nov 2010
Before 2nd Wellington on-ramp closure (prior to 1 May 2011)	7 Feb 2011 - 15 Apr 2011
2nd Wellington on-ramp closure (1 May 2011 - current)	25 Oct 2011 - 31 Nov 2011
Post VPT (26 Mar 2012 - current)	23 Apr 2012 - 30 Jun 2012

A three hour period was adopted for each of the AM, IP and PM peaks. The peak-periods chosen in this study are from 7:00am to 10:00am, 11am to 2pm and 4pm to 7pm for AM, IP and PM peaks respectively.

2.1.2 Arterial traffic volumes

The project team collected traffic signal volume data, provided by the Joint Traffic Operations Centre (JTOC), at a number of intersections in the study area. These intersections were identified during preliminary catchment analyses, described in **Section 6.1**. The assessment reviews key movements through the intersections to understand the change in flows between each analysis period.

Daily Traffic volume information was also collected on a number of selected local roads. The 'before VPT' traffic information was obtained through tube counts from the RAMM database (Auckland Transport asset management tool) and the 'post VPT' condition was obtained by new manual traffic tube counts undertaken as part of this study.

The traffic volumes data were assessed to gain an understanding of the local road network performance before and after the VPT project and whether the flow changes associated with the Wellington Street on-ramp options are in-line with the expected changes from the modelling. The tube counts were compared to the collected traffic signal data to confirm trends and patterns of traffic flow changes.

2.1.3 Travel Time Effect on Buses

The Auckland Transport public transport team provided historic GPS travel time data for several services traveling through the study area during the most recent opening period and the current closure period.

Isolating the travel time between specific locations for specific time periods assisted the identification of the effects changes to the network may have had on the bus network.

2.2 Accessibility

A version of the Auckland traffic model was used to estimate the distance, time and absolute flow changes associated with the on-ramp options. Catchment areas have been aggregated from the individual Traffic Analysis Zones (TAZs) from the regional model. This modelling helped inform the changes which specific geographic areas have experienced as part of the Wellington Street on-ramp closure.

2.3 Network Efficiency

The Auckland City SATURN travel model was used to gain an overall network perspective on the travel time and travel distance changes with and without the Wellington Street on-ramp open.

The model informs the likely changes that the closure or opening of the on-ramp may cause on wider road network.

2.4 Motorway Capacity Analysis

The traffic operations of the motorway were assessed at two levels. The first was a fixed flow calculation acknowledging the fire protection capacity of 5,400 vehicles per hour within the tunnel. The available capacity remaining at the Wellington on-ramp merge with SH1 was based on the differential assessment between mainline flows and estimated flows from the entry ramps.

The second process uses the Highway Capacity Manual (HCM 2010) to provide an estimate of possible Wellington on-ramp flow using the Merge On-Ramp analysis procedures. This model accounts for lane by lane flows, and level of service determinations to understand the quality of the merge under a range of flow conditions, from both the motorway and the on-ramp.

The HCM model was calibrated to today's traffic flow conditions entering the tunnel to better model the effects of the downgrade and other local conditions of the merge. The HCM model and other sources were used to guide how the motorway operates as a whole under different levels of flow from Wellington Street on-ramp.

2.5 Network Enhancements

This task was carried out based on field observations within the study area to identify possible enhancements to the network that could improve the operational and safety outcomes.

3 One-Network Strategic Framework

This section outlines guiding principles of a 'one-network' approach with objectives around the management of the interaction between the strategic state highway network and the local city street network.

NZTA and Auckland Transport have agreed to work more collaboratively and operate the Auckland road network as 'one network' rather than solely focusing on their individual jurisdictions[1].

It is acknowledged that Auckland City is an important economic region for New Zealand. Ensuring that it can continue to build on its ability to support population and economic growth requires the careful planning and management of the transportation infrastructure. The two items below present the target outcomes which were developed by NZTA and Auckland Transport during the course of this study.

- Prioritise considerations for strategically economically important movements: Movements relating to key economic activities such as access to international gateways (airport and port) need to be efficient and easy such that they can positively support the growth of these areas. Movements relate to the *accessibility (the ability to get to where you need to)* and the *mobility* or *efficiency (the ability to get to your destination reliably and quickly)* of the network. The network as a whole will need to be balanced between the national, regional and local responsibilities that it serves.
- City Centre Modal Shift: In close linkage to the desire to be the world's most liveable city and in support of the continual growth of the economic ability for Auckland, there is a need to encourage a modal shift to encourage trips made on public transport (PT) and active modes (walking and cycling) in the city centre. While there will continue to be a strong emphasis on providing the connections into the city centre for vehicles, first priority will be given to the modal shifts which are about people movement across the city.

The VPT and the adjacent links to the SH1 northbound through Curran Street, Fanshawe Street, Wellington Street, and the SH16 links form critical connections between the City Centre and the strategic network. This study identified the following principles:

- 'One Network' approach: The close collaboration between both NZTA who represent the State Highway network and AT who represent the local road network has been identified as important for any future planning. The remainder of the strategic framework therefore represents the views of both Road Controlling Authorities (RCA).
- Establishment of a Road Hierarchy: Auckland has an extensive local and State Highway network. In support of the 'one network' approach, the establishment of a road hierarchy will assist in providing a structure for any future planning. Some of the key elements from this are introduced below.

[1] Auckland Integrated Plan – Auckland Council Transport Committee Board Paper, 16 April 2012.

- State Highway Network – The State Highway Network is critical to the movement between regions in Auckland and for the specific movements of freight or commercial trips. The efficient functioning of this is vital for the on-going success of the city centre.
- Key Arterial Routes – With the importance of the State Highway (SH) network outlined an emphasis is placed on arterial routes and their ability to effectively connect and deliver to and from the SH network.
- City Centre – Following on from the desired modal patterns shift, there is a desire to minimise the east-west movement through the city centre in conjunction with a reduction in the use of Quay Street near the waterfront. The focus will be on how people rather than vehicles be more efficiently moved around in the city centre. In general, the road hierarchy should support access into all parts of the city centre but not encourage through movements for general movements, in particular the east-west movement.
- Motorway Connections – With these points being fixed, these need to be carefully considered to best support the road hierarchy and the proposed changes to the regional arterial network. Two levels of these connections include the 'city connectors' which are key strategic routes into the city, and the 'secondary distributor' links.

3.1.1 Coordination with other Strategic Objectives

The review has also been cognisant of themes emerging in the draft Auckland Integrated Transportation Plan - a comprehensive long-term transport and land use approach being developed by AT and NZTA to enable robust transport planning and decision-making.

This strategy articulates the 'one network' approach between AT and NZTA and takes account of the aspirations and initiatives of the Auckland Plan, City Centre Master Plan (CCMP) and Auckland Waterfront Plan.

Central to the Wellington Street on-ramp and the operation of the SH16 Motorway (Northwestern and Port Link) to SH 1 Motorway merge (hereafter referred to as the M2M) is the intention to route additional city centre traffic north along the SH16 Port Link through Wellesley Street, Alten Road, and Beach Road. These additional demands will fully utilise the one-lane configuration of the M2M link to be run at its physical capacity of approximately 1,800 vehicles per hour. This assumption is carried through this analysis for all future year scenarios.

4 Motorway Capacity and Performance

Key Findings:

The current available capacity for the Wellington Street on-ramp during the busy PM peak period is approximately 400 vehicles per hour.

The forecast capacity by 2016, with additional flow using the M2M, reduces available capacity for the Wellington Street on-ramp below 250 vehicles per hour requiring further management of motorway on-ramp access points.

4.1 Motorway Network

Since the removal of the Victoria Park Viaduct bottleneck, State Highway 1 northbound has operated at or near capacity approaching the Auckland Harbour Bridge. An analysis by the Auckland Motorway Alliance (AMA) found the following:

> "Flows are peaking at around 9,200 vehicles per hour…. Breakdown of flow has been observed on the uphill approach to the bridge following the opening of VPT (3 lanes), particularly in Lane 1 at the Curran Street merge, and Lane 5, the narrow lane adjacent to the AHB MLB. This implies current peak hour volumes northbound are close to the practical capacity of the AHB in the 5 lane peak configuration." AMA Draft Post-VPT Traffic Analysis, May 2012

The VPT configuration is in balance with this downstream capacity and the upstream lane configurations. However, careful management of the flows through the tunnel is critical to the operation of overall northbound capacity.

The management of VPT and access points to the northbound network are part of the overall network management of the local and strategic network.

The Wellington Street on-ramp is the closest to the VPT which has an operational capacity to minimise operational problems and congestion from forming within the tunnel. Any management of the Wellington Street on-ramp must be tied to the operational conditions within the VPT.

4.2 Tunnel Operations

The strategic network includes two important segments which are targeted for acceptable operations and level of service to minimise safety and operational management issues. These include the Auckland Harbour Bridge and the recently constructed VPT. Both facilities have targeted flow ranges and the adjacent motorway ramp signalling system has been in place to provide management of the mainline to minimise risk of operational breakdown on these facilities.

The operational threshold for the VPT has been set at 5,400 vehicles per hour entering the tunnel (average of 1,800 vehicles per hour per lane). This value has been set on a risk management analysis associated with the fire protection system and includes estimates of heavy vehicle percentages, dangerous goods vehicles, and risks of queuing or operational failure in the tunnel.

The agreed maximum sustained flow conditions within the tunnel would be at the point just before significant deterioration in traffic conditions. This is represented by level of service D as defined by the Highway Capacity Manual and generally equates to the 5,400 vehicle per hour fire protection threshold.

The maintenance of flow through the tunnel will minimise safety risks for those vehicles entering from the M2M ramps as well as those entering from Wellington Street. Therefore, a vehicle volume below the 5,400 vehicles per hour is a desirable objective to maintain and develop an operations plan around.

For additional discussion around Level of service and motorway flow refer to **Appendix C.**

4.3 Entrances and Exits

It is envisaged that the City Centre Masterplan and associated transport strategies prioritise the SH16 Port Link as a quality route away from the City Centre in an effort to minimise cross city traffic for those destined to points north. Therefore the capacity at the M2M merge and specifically the capacity for the SH16 Port Link is critical to the on-going management of the motorway and the Wellington Street on-ramp.

Figure 4.1 shows the analysis area and northbound motorway elements of the Central Motorway Junction.

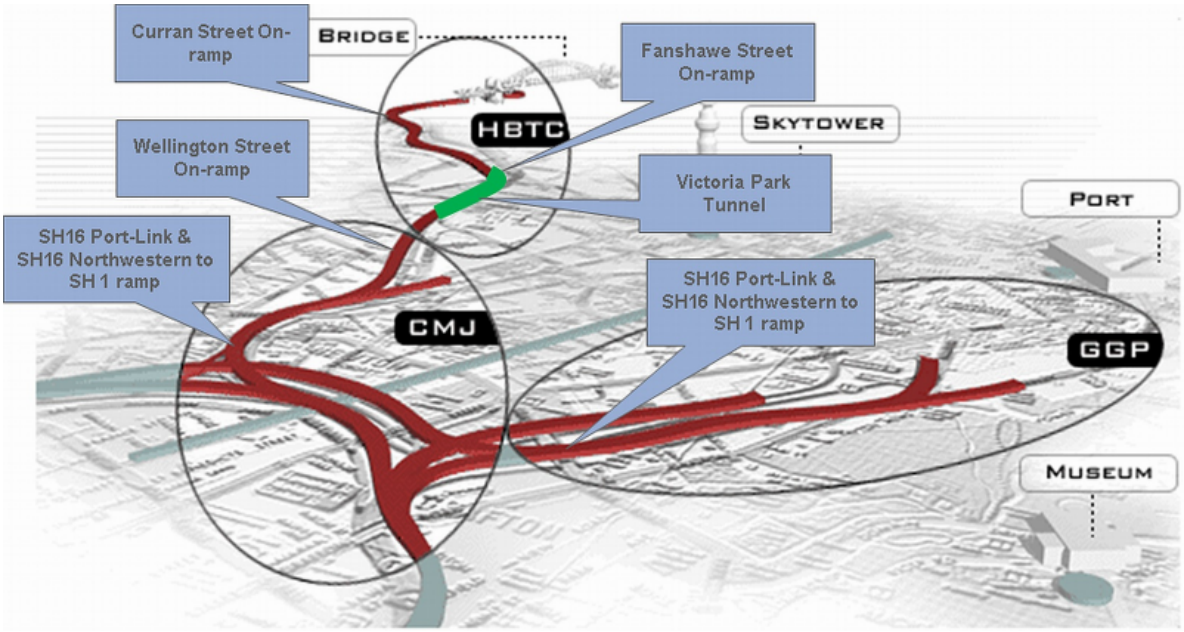


Figure 4.1 - Central Motorway Junction Schematic

4.3.1 Capacity at the M2M

The SH16 Port Link from the Grafton Gully and the SH16 Northwestern Link merge with State Highway 1 northbound at the M2M merge 350 metres upstream from the Wellington Street on-ramp joins SH1. The M2M merge creates a new lane on the motorway to form three lanes northbound through the VPT to the Fanshawe interchange.

The M2M is currently configured to serve one lane from the east (Port Link) and one lane from the west (Northwestern Motorway Link) with equal priority merging down to one lane after being metered through the ramp signalling system. With the ramp signals activated during the PM peak period the maximum sustained flow exiting the M2M is about 1,600 vehicles per hour. This flow can be maintained without exceeding the operational capacity of the tunnel, as discussed in **Section 4.2.**

It is envisaged that NZTA will operate the M2M link at it maximum capacity of 1,800 vehicles per hour over the next few years as demand increases from the SH16 Port Link. It is anticipated, in line with the comprehensive ‘one network’ vision in the draft Integrated Transportation Plan (ITP) that the SH16 Port Link will provide the majority of 1,800 hourly traffic flow. The SH16 ramps to SH1 will be required to be individually ramp signalled in order to achieve the higher priority from the Port Link.

4.3.2 Capacity at Wellington Street Merge

The Wellington Street on-ramp would enter the outside most lane (Lane 1) of the SH1 northbound approximately 200m before the tunnel. The physical location of the ramp in close proximity to the tunnel combined with the operational capacity constraints of the tunnel (5,400 vehicles per hour) makes the Wellington Street on-ramp operation critical to the Central Motorway Junction performance. It becomes a critical ramp, combined with the M2M, to manage the total flow entering the VPT and maintain acceptable traffic conditions.

The available capacity of the Wellington Street on-ramp is based on an assessment of the other higher priority flows entering the motorway upstream, with the balance being available for the Wellington Street on-ramp.

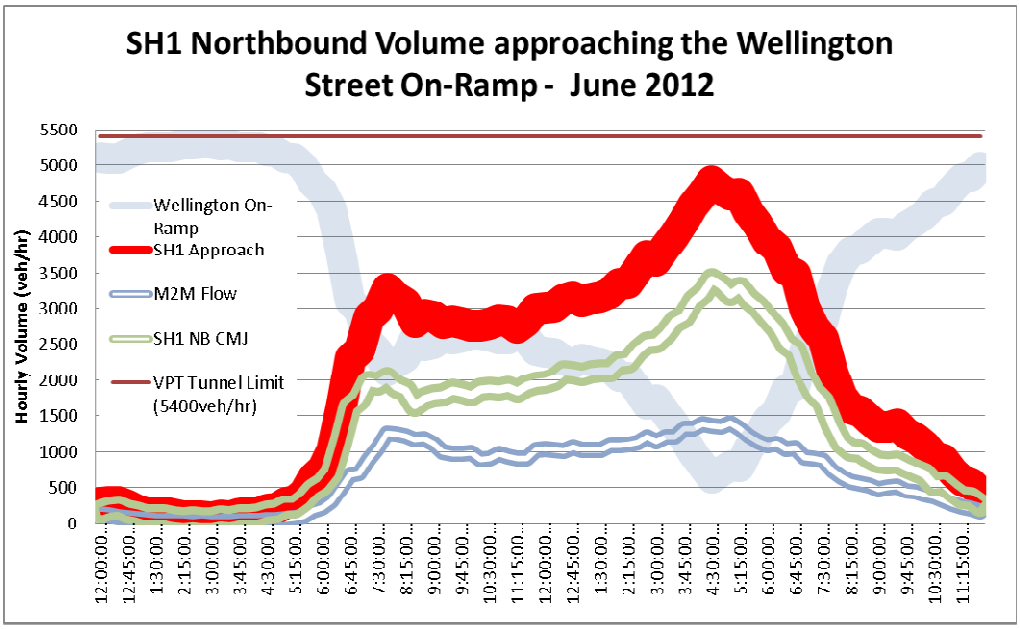


Figure 4.2 - Motorway Capacities at the Wellington Street Merge in 2012

Figure 4.2 shows the ranges (approximately 15th to 85th percentile flows) and profiles of observed flows along SH1 at the Wellington Street on-ramp merge area. The data indicates that during the PM peak period:

- The SH1 flow approaching the M2M results in 85th percentile flows just over 3,500 vehicles per hour;
- The M2M flow approaching the Wellington Street on-ramp area results in an 85th percentile flow about 1,500 vehicles per hour; and
- The combined flow along SH1 approaching the Wellington Street on-ramp area results in an 85th percentile flow of about 5,000 vehicles per hour.

The existing flows as of June 2012 demonstrate that during the PM peak period there is a maximum available capacity for the Wellington Street on-ramp of around 400 vehicles per hour.

4.4 Future Flows and Operations at the Wellington On-ramp Merge

The available capacity for the Wellington Street on-ramp is anticipated to decrease with time as future flows continue to grow and the City Centre Masterplan is implemented, sending additional traffic through the M2M link from the port. It is envisiaged that by 2016 the M2M will be fully utilised (up to 1,800 veh per hour), reducing the available Wellington Street capacity to hourly flow rates below 250 vehicles per hour.

The future flows on the network will be subject to a number of influences including the completion of the SH20 Western Ring Route[2], continued improvement to the public transport network, and other possible unknown changes affecting motorway demand.

[2] 2016 PM Western Ring Route EMME model with Auckland Plan land use

The estimated 2016 flows are shown in **Figure 4.3** below and include the additional flow from the M2M.

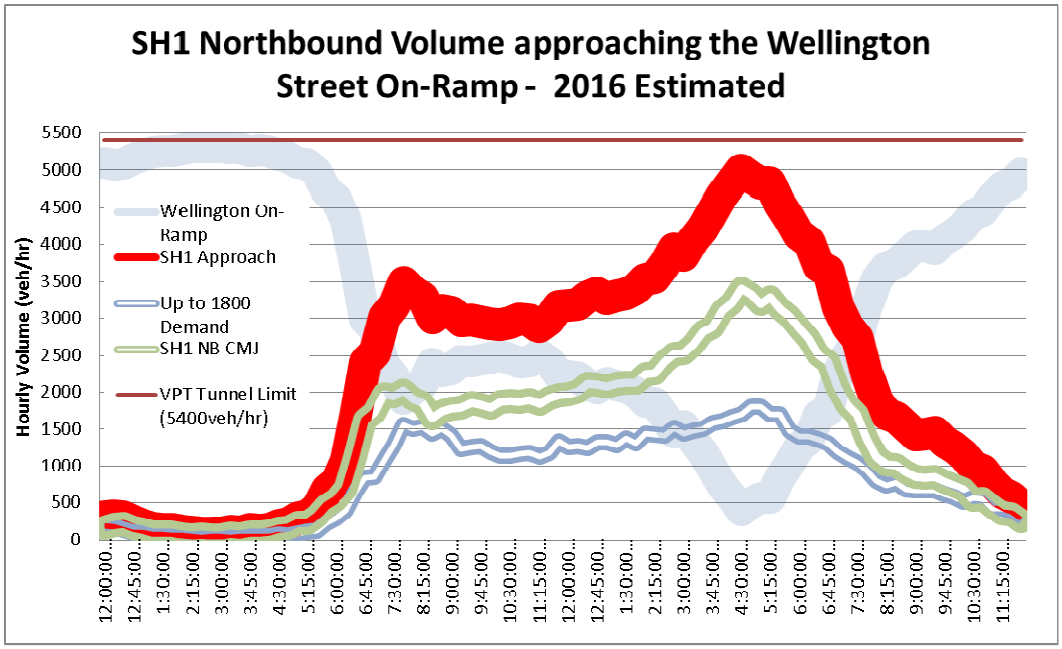


Figure 4.3 - Motorway Capacities at the Wellington Street Merge in 2016

Figure 4.3 shows that the ranges in future flows should be monitored to establish a management philosophy of the Wellington Street on-ramp merge to maintain the 5,400 vehicles per hour operational threshold in the VPT.

The actual conditions on the motorway and local network will vary from day to day and throughout the year. Should the ramp be re-opened, the management of the Wellington Street on-ramp will need to be carefully controlled through the local traffic signal system as well as the motorway ramp signalling system.

4.5 Historic Demands at the Wellington On-ramp Merge

The historic demands at the Wellington Street on-ramp prior to the CMJ upgrade in 2006 Wellington Street were significantly higher than what were occuring pre-VPT. The overall capactiy of the system, highlighted by the Saint Marys Bay section, hasn't changed over time. However, the make up of that flow has changed with an increased amount coming from the SH 1 approach and reductions in other local acces points.

The daily flows for some key motorway route segments are shown in **Figure 4.4.**

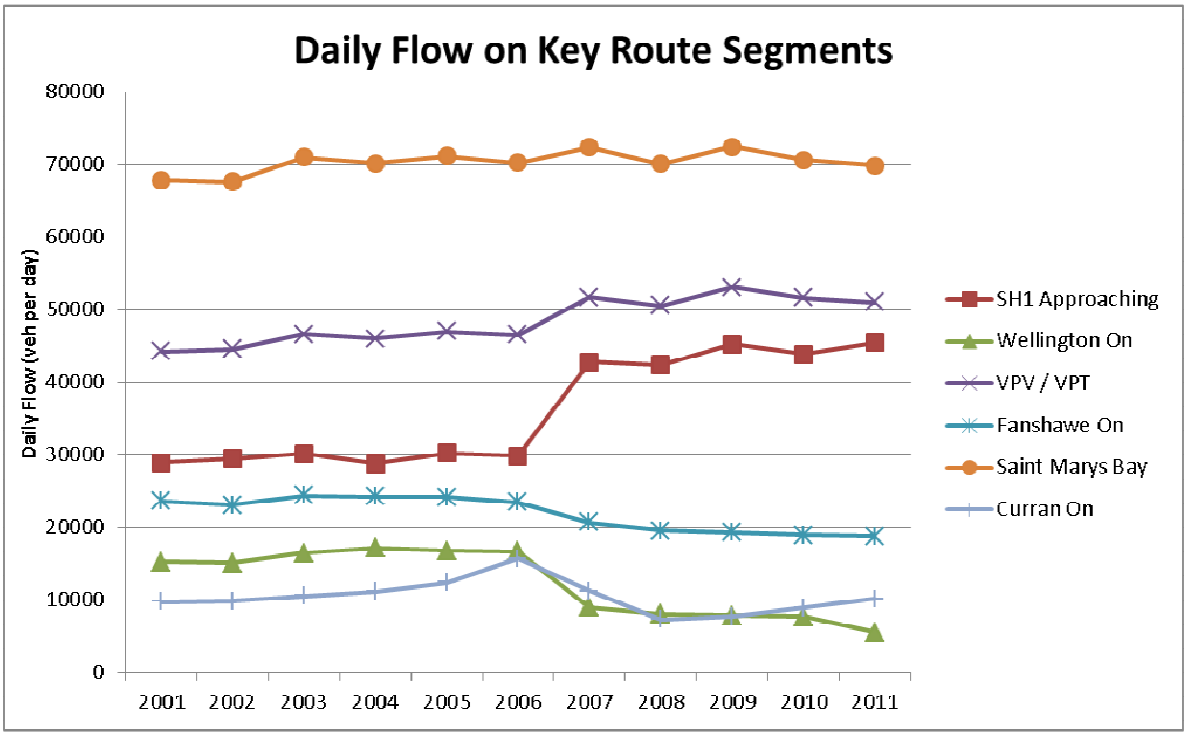


Figure 4.4 - Past Daily Traffic Flows on Key Route Segments of the Motorway

The ramp signaling system provided the ability to manage on-ramp access to the network to improve flow along the motorway mainline. The management of the Wellington Street on-ramp has reduced its peak on-ramp flows (after CMJ upgrades) from approximately 800 vehicles per hour to just over 300 vehicles per hour before the VPT project.

The expected demand for the on-ramp is likely to be between 7,000 and 8,000 vehicles per day which it was accomodating when it was last open. Based on pre-VPT daily flows it is esimated that the PM peak hour demands would be up to 800 vehicles per hour. These demands are likely to be in excess of the available capacity indicating that on-ramp queues and diversion are likely occur.

The historic daily and peak hour traffic flows on the Wellington Street on-ramp are shown in **Figure 4.5**.

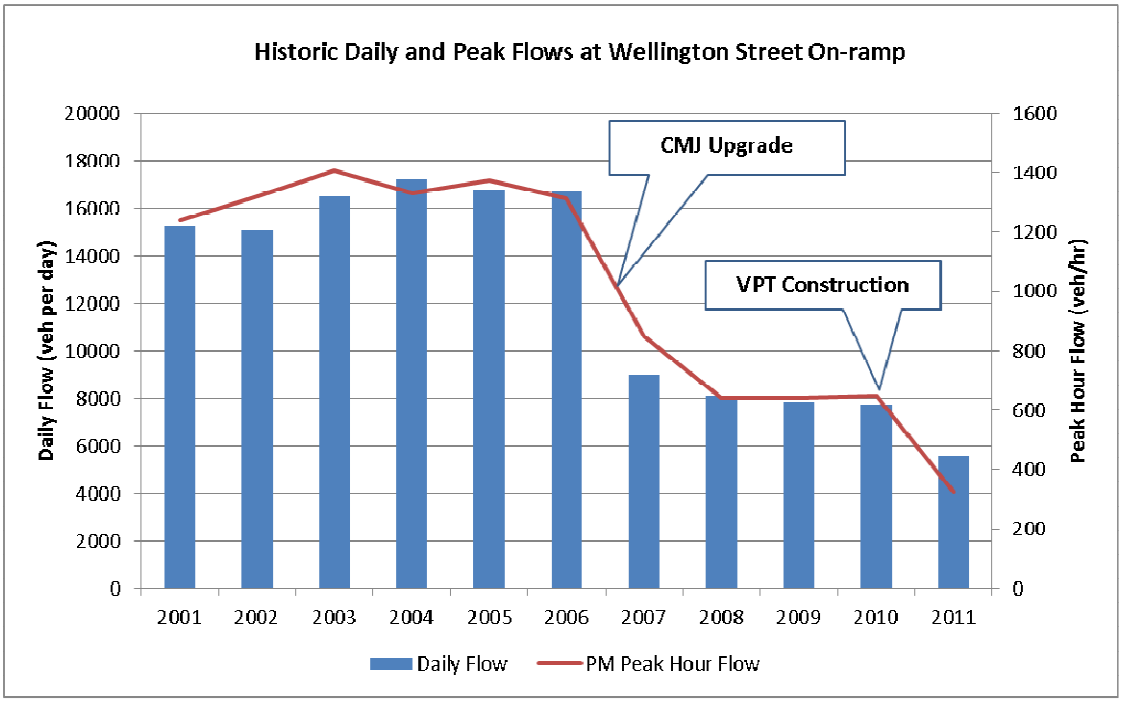


Figure 4.5 - Historic Daily and Peak Hour Flows at the Wellington Street On-ramp

5 Travel Time Data

Key Findings:

The northbound speeds are nearly free flow in the current configuration during all periods of the day with very stable flow.

The travel time from Tamaki Drive to SH1 via SH16 Port Link and the travel time through the City Centre are similar, 16 minutes and 18 minutes respectively.

Increased use of the SH16 Port Link to SH1 (St. Marys Bay) has improved the cross city route from Tamaki Drive via Fanshawe Street.

Travel time from Tamaki Drive to SH1 (St. Marys Bay) has been improved upon the opening of VPT.

5.1 Introduction

This section summarises the changes in travel times and trip reliability along the State Highway since the opening of the VPT, from the initial two lane configuration (opened 14 November) to the full three-lane configuration (opened 26 March 2012).

Bluetooth receivers collect anonymous signal data from Bluetooth devices, although each device has a unique signal enabling collection of origin and destination data between two sensors. Four Bluetooth devices have been installed at the locations shown in **Figure 5.1** enabling the collection of data for those users passing between two or more sensors.

The three routes which have been setup for data collection include:

- Tamaki Drive (Port entrance) to SH1 (St Marys Bay) via SH16 Port Link
- Tamaki Drive (Port entrance) to SH1 (St Marys Bay) via CBD; and
- SH1 (Khyber Pass Off-Ramp) to SH1 (St Marys Bay).

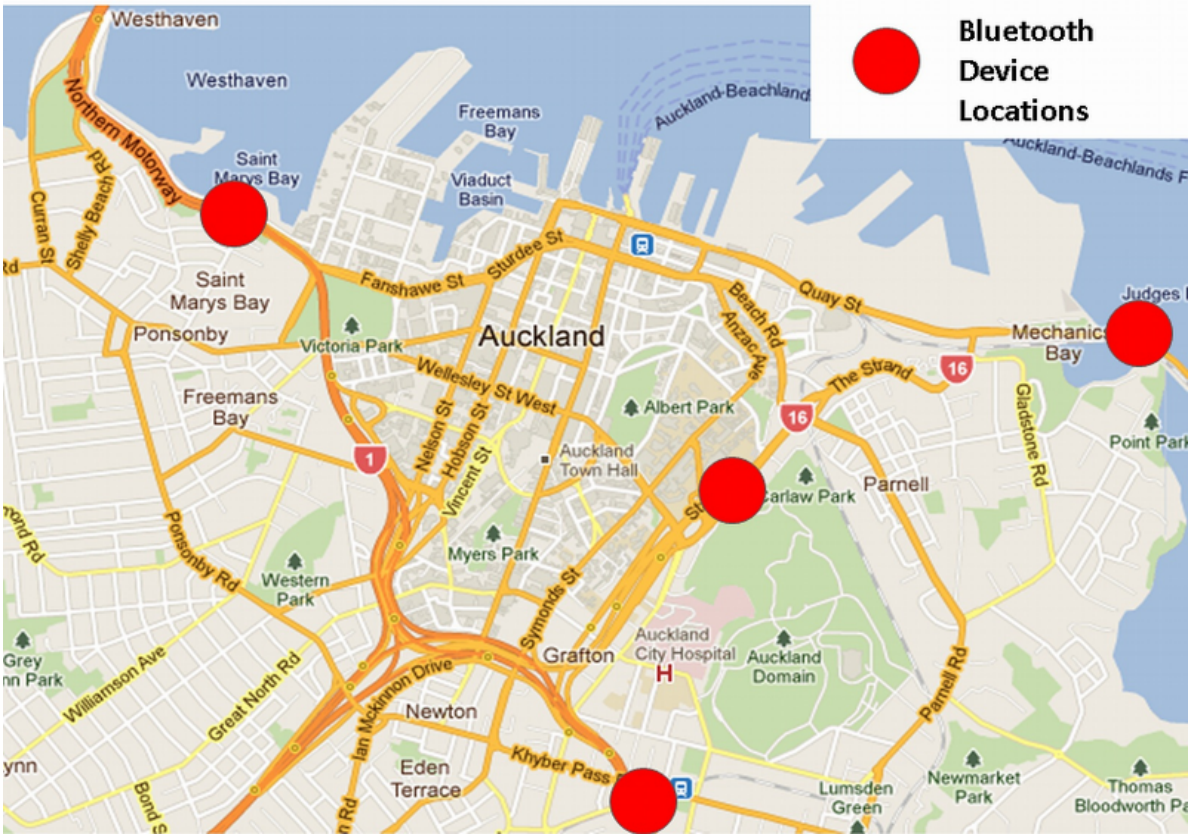


Figure 5.1 - Bluetooth Unit Locations

5.2 Methodology

Bluetooth data has been assessed for a period of time after the two-lane VPT configuration was opened and for a period after the full three-lane VPT opened. The weekdays were assessed in this analysis. Both time periods include the effects of the Wellington Street on-ramp closure.

The two-lane configuration was assessed between the 23 November 2011 and 26 March 2012 excluding school holidays.

The three-lane configuration was assessed between the 23 April 2012 and 22 June 2012 excluding ANZAC day and Queens Birthday.

Periodically, the Bluetooth devices were taken offline for a few days due to communication failure or maintenance. These dates were excluded from this analysis. The number of available days are displayed in **Table 5.1**.

Table 5.1: Bluetooth data availability (number of days)

	Before VPT open (23/Nov/2011 – 25/Mar/2012)	After VPT open (26/Mar/2012 – 26/Apr/2012)
Tamaki Drive to SH1 via SH16	37	43
Tamaki Drive to SH1 via CBD	37	43
SH1 Khyber Pass to SH1 St Marys Bay	41	43

For each movement and time period the median of the travel time over 20 minute intervals were calculated over the 24 hours between Monday to Friday. The 15th, median and 85th median profiles have also been plotted from the available data. The comparison of the 15th and 85th percentiles provide an indication of the travel time variability over the analysis period.

The data are displayed on the following graphs where the y-axis is the travel time in seconds. The cross markers are the median travel time taken at 20 min interval. The black line shows the 85th percentile and the green line shows the 15th percentile. The red line shows the median of the travel times.

5.3 Results

5.3.1 Travel Time changes from Tamaki Drive to SH1 via SH16

The two-lane VPT PM peak started at around 3pm (the red line), a significant peak period spread is evident in the afternoon.

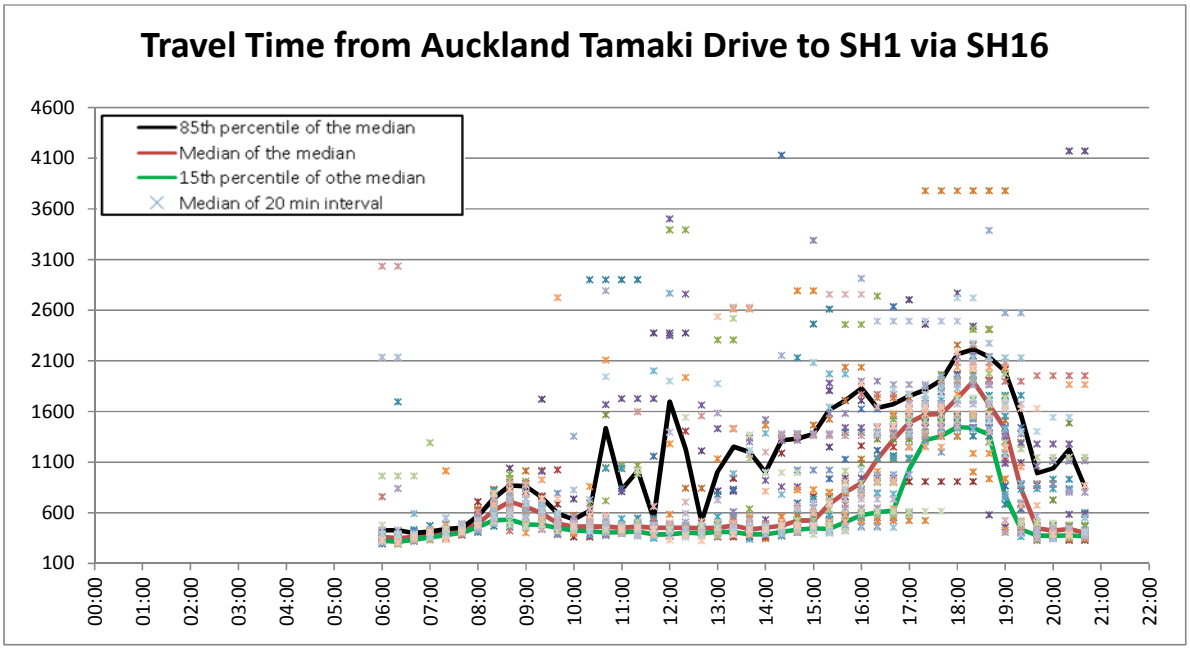


Figure 5.2 2-lane VPT: travel times from Tamaki Drive to SH1 via SH16

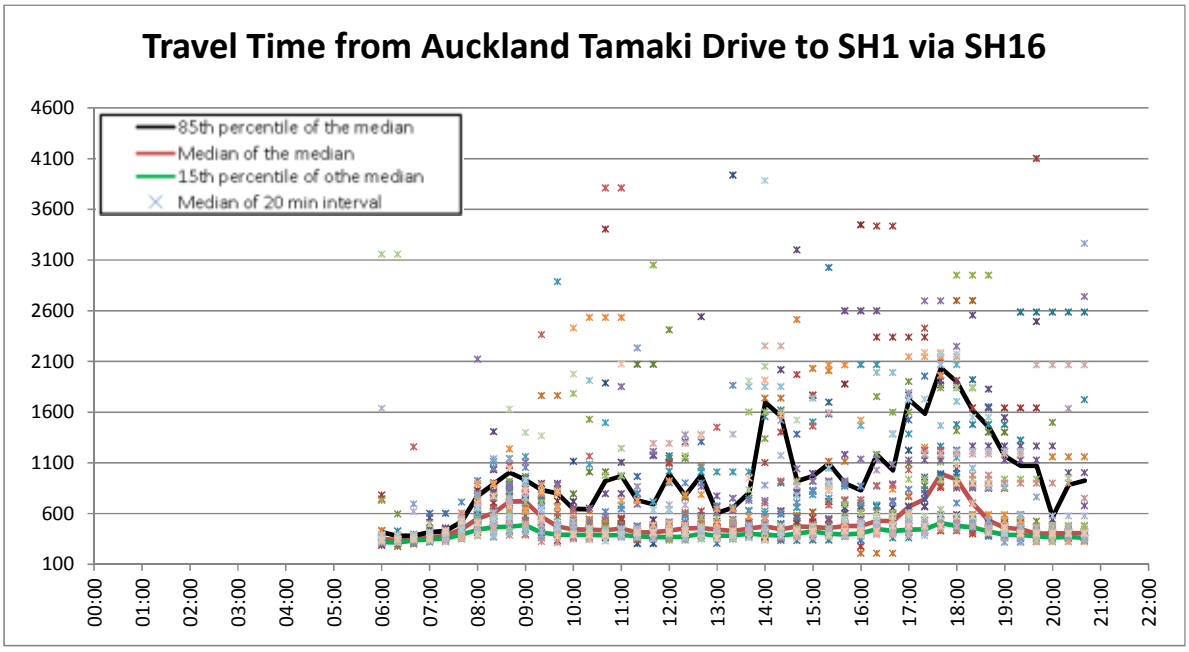


Figure 5.3 3-lane VPT: travel times from Tamaki Drive to SH1 via SH16

The full three-lane VPT results in a much small peak period, with the 15th and median travel times significantly reduced. The PM peak is not noticeable until 5pm where the travel time increases from 6 min to 15 min instead of up to 35 min in the two-lane configuration.

The variability looks to have improved with a tighter band between the 15th, median, and 85th percentile travel times.

Both travel time and variability have shown significant improvements under the three-lane scenario versus the two-lane VPT, with current travel times taking approximately 16 minutes from Tamaki Drive to St. Mary's Bay on SH16 through the Port Link.

5.3.2 Travel Time changes from Tamaki Drive to SH1 via CBD

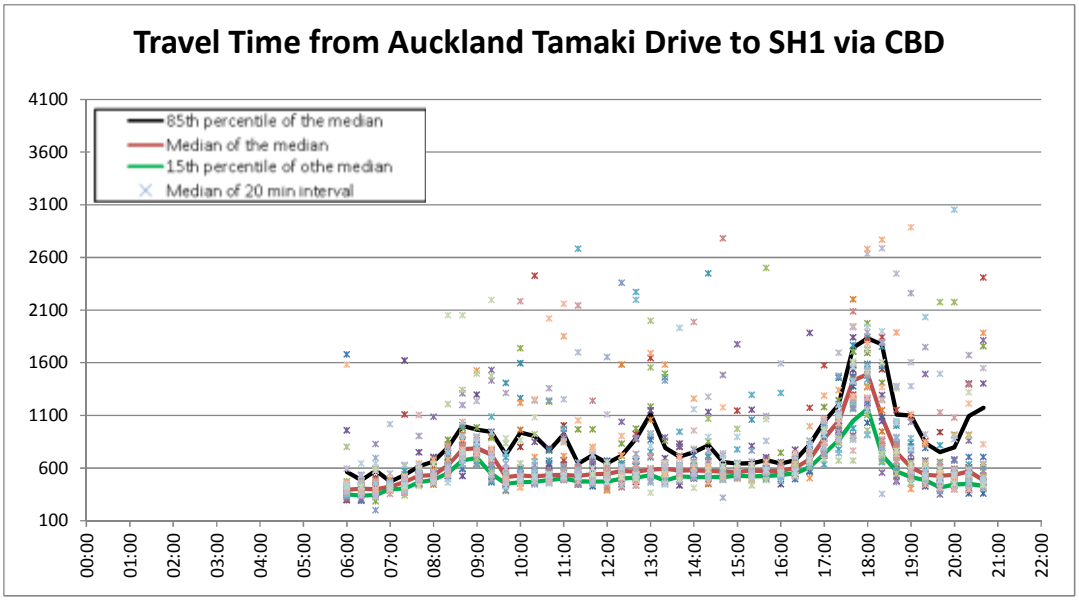


Figure 5.4 2-Lane VPT: travel times from Tamaki Drive to SH1 via City Centre

Two-lane VPT configuration indicates:

- The PM peak is the period with the highest travel times
- There is a sharp defined PM peak period focused around 6pm.

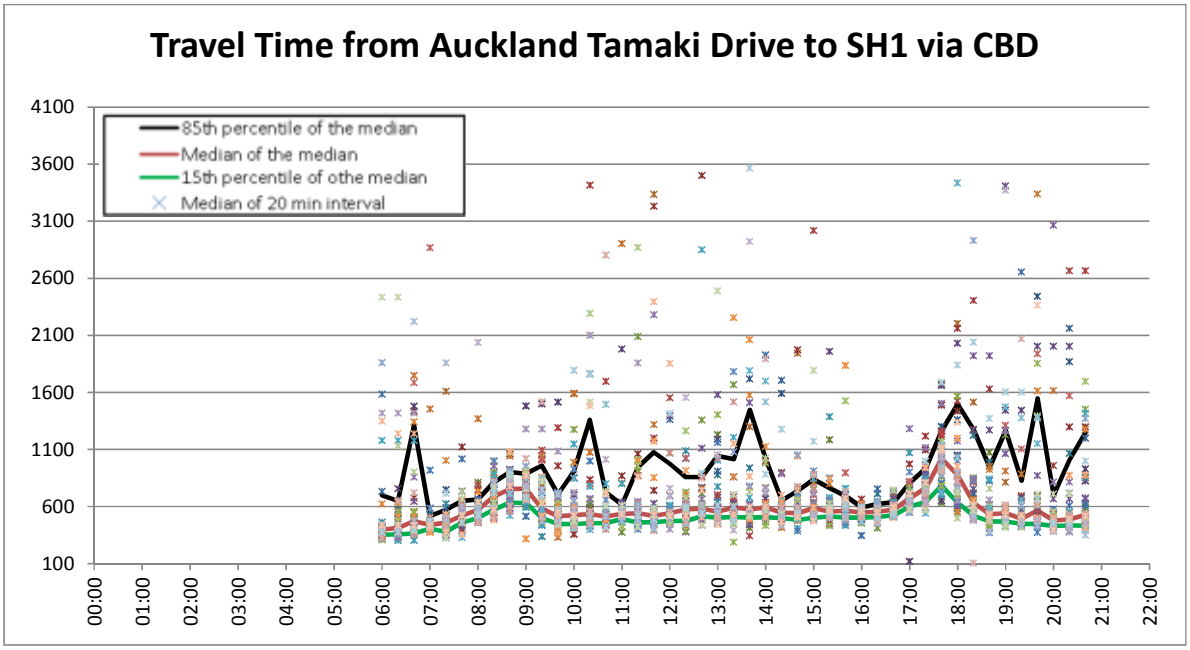


Figure 5.5 3-Lane VPT: travel times from Tamaki Drive to SH1 via City Centre

Three-lane VPT configuration indicates:

- The PM peak is the period with the highest travel times, although a noticeable AM period with travel times approaching in value to those seen in the PM peak.
- There is a sharp defined PM peak period focused around 5:30pm.
- There is a high degree of variability throughout the day.

The PM peak period profile remains similar between the two scenarios, with a start by 5pm and finish at 7pm. The travel time variability has increased relative to the two-lane VPT period, although the actual travel times have reduced.

The travel time during the peak hour increased up to 25 min during the 2-lane VPT open reducing to 18 min after the three-lane VPT open.

The current configuration requires approximately 18 minutes from Tamaki Drive to St. Mary's Bay through the City Centre. This is about the same as the via SH16 the Port Link, although the 85th percentile along the SH16 Port Link remains higher.

5.3.3 Travel Time improvement from SH1 Khyber Pass to SH1 St Mary's Bay

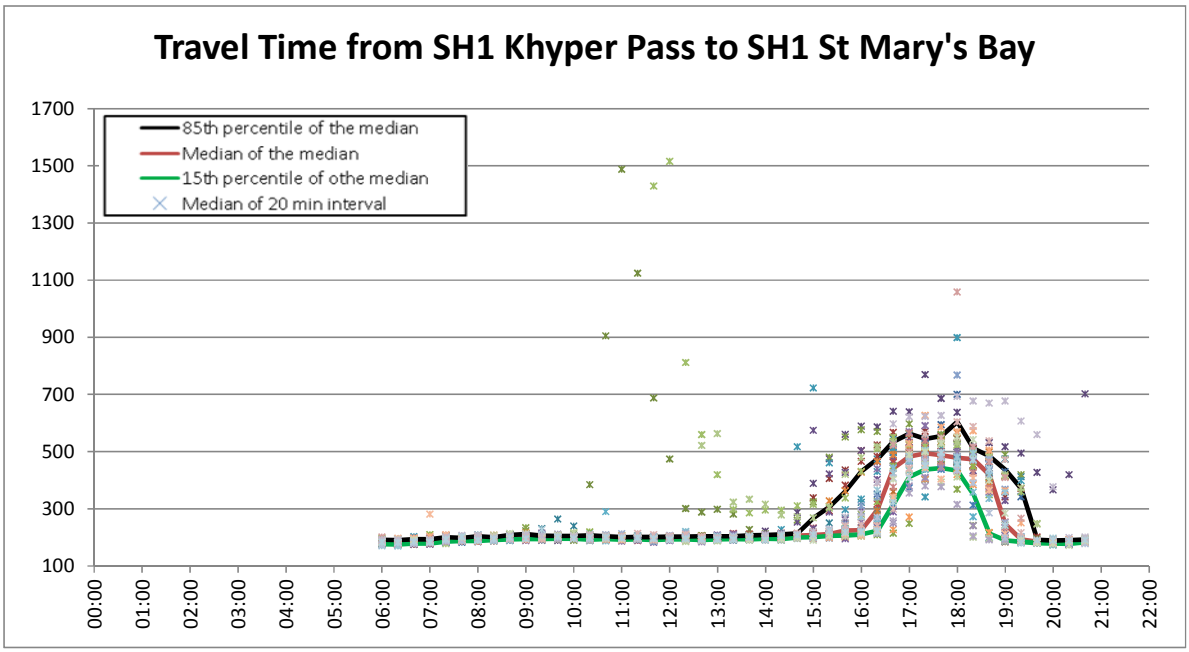


Figure 5.6 2-Lane VPT: travel times from SH1 Khyber Pass to SH1 St Mary's Bay

Two-lane VPT configuration indicates:

- The PM peak is the period with the highest travel times
- There is a long PM period starting from 4:15pm to nearly 7pm.
- The travel times were very stable with little variability.

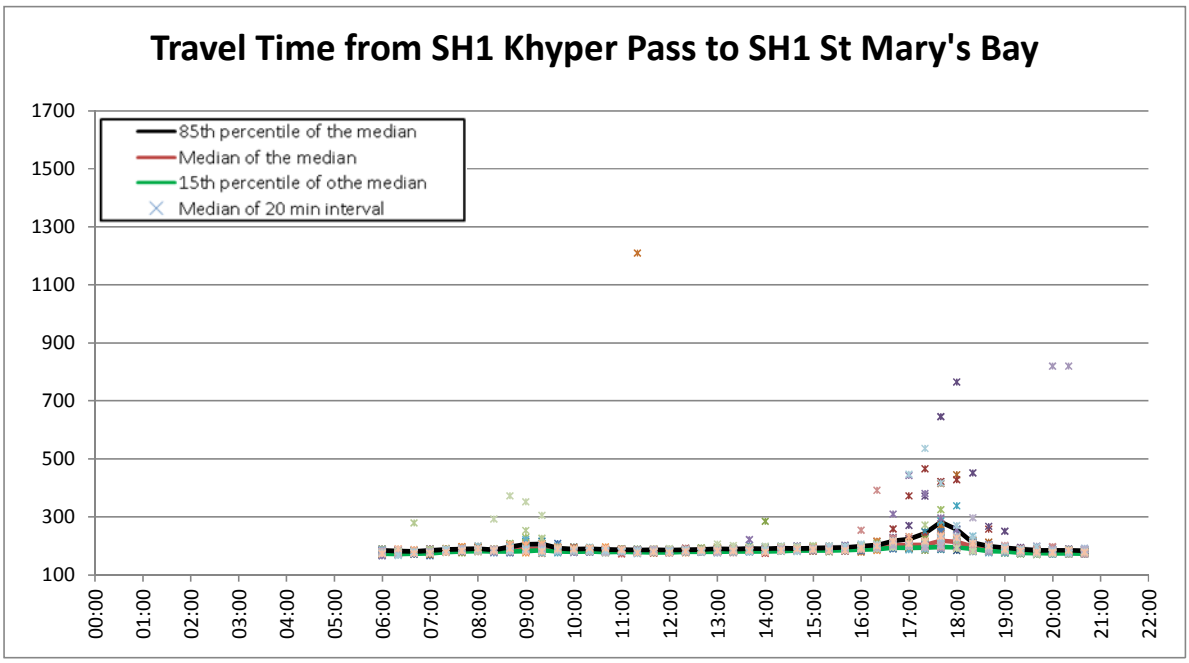


Figure 5.7 3-Lane VPT: travel times from SH1 Khyber Pass to SH1 St Mary's Bay

Three-lane VPT configuration indicates:

- The PM peak is the period with the highest travel times, although the flows indicate very little PM peak increase in travel times.
- There is a minor increase in the PM focused around the 5:45pm period.
- There is a very low variability to the SH1 travel times, with the 15th, median, and 85th percentiles having less than 2minutes difference.
- The median travel time during the PM peak is at free-flow, remaining nearly constant throughout the entire day.

The PM peak period profile shows almost no delay, with a very tight band of observed travel times.

The current configuration requires approximately 3 minutes from the Khyber Pass to St. Mary's Bay along SH1.This compares to a travel time of over 8 minutes during the two-lane VPT configuration.

5.4 Bluetooth travel time conclusions

Table 5.2 shows the travel time improvement on these routes. With the opening of Victoria Park Tunnel to three lanes all the travel times during PM peak have seen reductions and the variability of the travel time have decreased or remained similar as before the Three-lane VPT open.

Table 5.2 Travel time comparison between before and after VPT open

	Free Flow Travel Time (min)	Maximum median travel time (min) during PM Peak (5-7pm)		15th and 85th percentile of the median travel time (min) profile during PM Peak (5-7pm)	
		2-In VPT	3-In VPT	2-In VPT	3-In VPT
Tamaki Drive to SH1 (St. Marys Bay) via SH16	6	33	16	21 to 38	7 to 22
Tamaki Drive to SH1 (St. Marys Bay) via City Centre	8	25	18	18 to 32	13 to 25
SH1 Khyber Pass to SH1 (St. Marys Bay)	3	8	3	7 to 9	3 to 4

The travel times on the SH1 mainline have seen the most significant improvement, with northbound speeds nearly free flow in the current configuration. The spread between the 15th and 85th percentile around the median indicates that the variability has decreased to become quite stable.

The routes from Tamaki Drive to SH1 (St. Marys Bay) also have shown improvements. The travel time from Tamaki Drive to SH1 (St. Marys Bay) via SH16 used to take longer (33 min) than via the City Centre (25 min), but after the VPT open, the travel times between those routes are quite similar.

The current travel times through the City Centre suggest that there is an opportunity to reprioritise the City Centre route to achieve improved access from the Wynyard Quarter by reopening the right turn out of Beaumont Street onto the Fanshawe Street on-ramp and providing more green time for Halsey Street movements with Fanshawe Street.

6 Catchment Areas and network accessibility

Key Findings:

Most areas with the largest increase in travel distance have only minor increases in travel time. Those most impacted with longer travel times are those within the City Centre who are forced to use already busy routes to access the motorway.

The aggregate system wide effects of the Wellington Street on-ramp closure resulted in an average increase in distance travelled of 0.6km per vehicle during the AM period and 0.5km per vehicle during the PM period and an average travel time of 1.18 minutes per vehicle during the AM period and 1.82 minutes per vehicle during the PM period.

6.1 Catchment Areas

The Auckland traffic model (AMETI version) was used by Beca to develop a visual representation of the modelled traffic routes from zones in and around the City Centre. The catchment zones informed subsequent stages of investigation and analysis around the changes occurring on the network as part of the final stages of the VPT construction and may happen as a result of opening the Wellington Street on-ramp.

Figure 6.1 and **Figure 6.2** display the catchments for each of the major entrance points to the northbound State Highway network.

Figure 6.1- AM Peak Period Catchment

source: AT EMME Model

Figure 6.2 - PM Peak Period Catchment

source: AT EMME Model

These catchment areas show the least cost path to the Auckland Harbour Bridge.

The catchments for northbound travel include:

- Light Blue: Curran Street on-ramp
- Red: Wellington Street on-ramp
- Gold: Fanshawe Street on-ramp
- Tan: SH 16 Northwestern
- Green: SH16 Port Link
- Dark Blue: SH1 Southern Motorway

6.2 Accessibility through Network

Scenarios with the ramp open versus ramp closed were assessed in the AMETI traffic model on a number of different measures; including:

- Travel time;
- Travel Distance; and
- Number of Vehicles affected.

The model assessed the geographic areas most physically impacted by the closure of the Wellington Street on-ramp. This does not include the effects that others may have experienced as part of the diversion these users have had to make to access the northbound state highway (i.e. the analysis only includes those who would use the Wellington Street on-ramp).

6.2.1 Distance and travel time changes

The travel distance analysis indicates that those in the upper city centre would travel an additional 0.3 to 0.6km, while those south of SH16 (Sandringham area) as well as eastern city centre would travel up to 3.5km more without the Wellington on-ramp open.

Figure 6.3 through **Figure 6.5** show the changes in travel distance associated with the closure of the on-ramp.

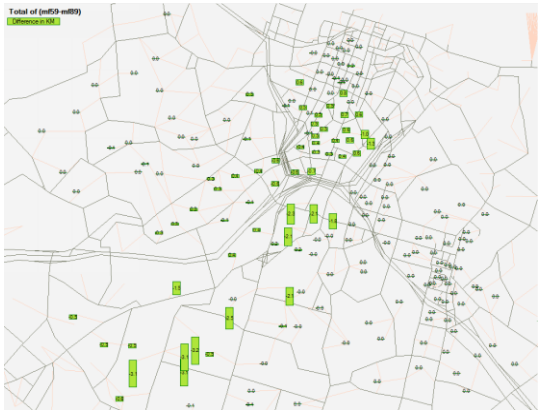
The analysis indicates that the majority of the users who will have to travel the longest additional time are largely based around the upper city centre area, with up to 4 minutes during the PM Peak.

Figure 6.6through **Figure 6.8** show the changes in travel time associated with the closure of the on-ramp.

However, those most affected by increases in travel distances have other options for northbound travel, with small overall increases in travel time. Those in the western upper city centre are the most affected by increases in travel time as they have to travel through congested city streets to access the motorway, while those in the east city centre and south of SH16 can quickly access the motorway elsewhere and largely avoid congestion.

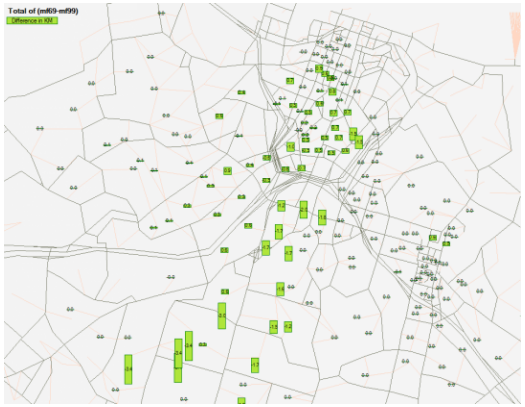
Other areas, such as Herne Bay, show that there are minimal changes to either the additional distance or additional time associated with the Wellington Street on-ramp closure.

Figure 6.3 - AM Peak Period KMs



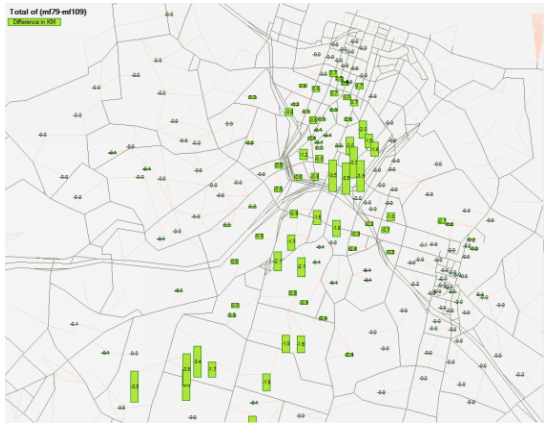
source: AT EMME Model

Figure 6.4 - IP Peak Period KMs



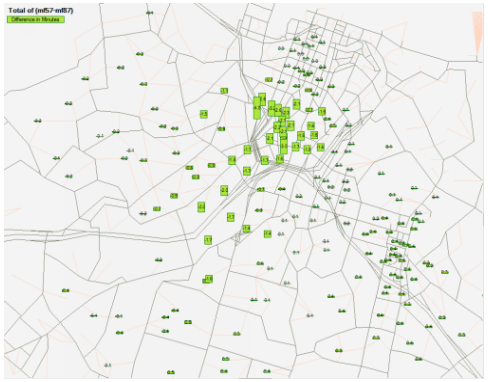
source: AT EMME Model

Figure 6.5 - PM Peak Period KMs



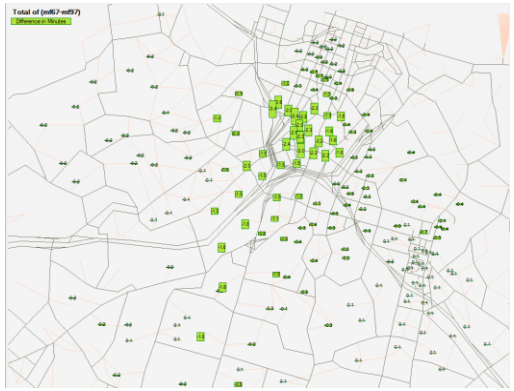
source: AT EMME Model

Figure 6.6 - AM Peak Period Min



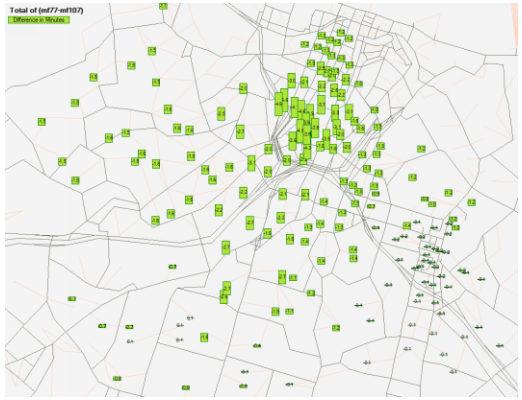
source: AT EMME Model

Figure 6.7 - IP Peak Period Min



source: AT EMME Model

Figure 6.8 - PM Peak Period Min



source: AT EMME Model

6.2.2 Vehicle weighted distance and time

The above analysis shows changes in travel times and travel distances for each modelled area, but does not reflect the number of vehicles affected by the change. The same analysis was carried out with the times and distances weighted by the number of vehicles affected within each zone.

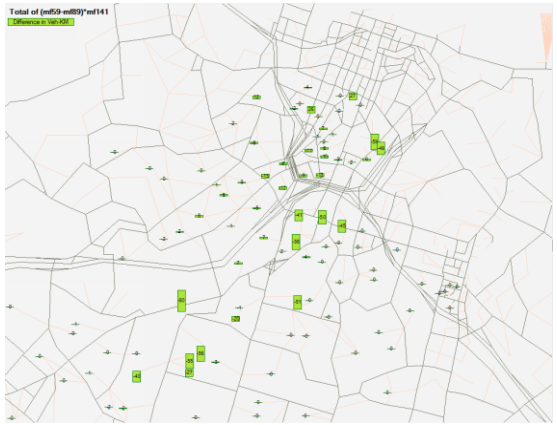
Figure 6.9 through **Figure 6.11** show the changes in vehicle-kilometres associated with the closure of the Wellington on-ramp.

Figure 6.12 and **Figure 6.14** through show the changes in vehicle-minutes associated with the closure of the Wellington on-ramp.

The analysis indicates that the majority of the users who will have to spend additional time travelling because of the closure of the Wellington Street on-ramp are located throughout the immediate adjacent areas, namely Ponsonby, upper City Centre, Eden Terrace, and Freemans Bay.

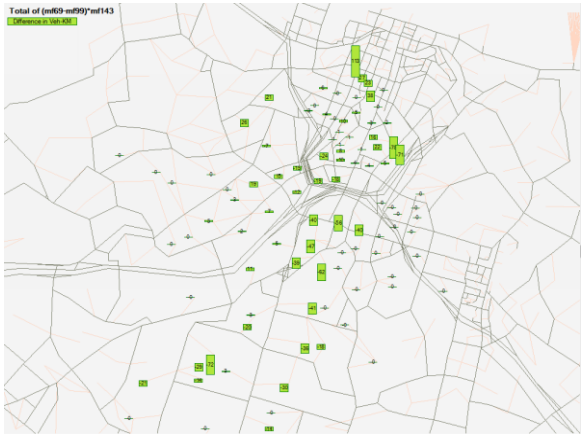
The aggregate system wide effects of the temporary closure resulted in an average increase in distance travelled of 0.6km per vehicle during the AM period and 0.5km per vehicle during the PM period and an average of 1.18 minutes per vehicle during the AM period and 1.82 minutes per vehicle during the PM period.

Figure 6.9 - AM Peak Period Veh-KMs



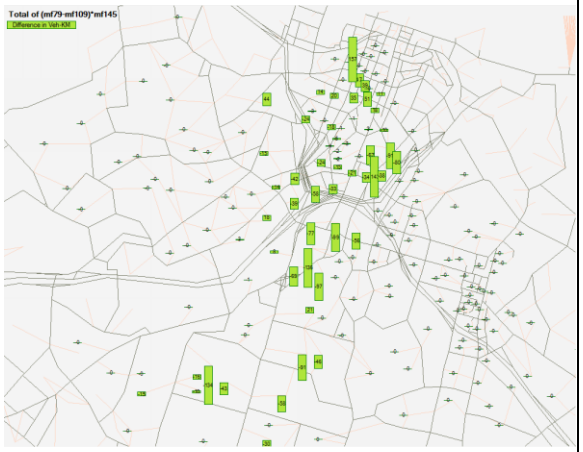
source: AT EMME Model

Figure 6.10 - IP Peak Period Veh-KMs



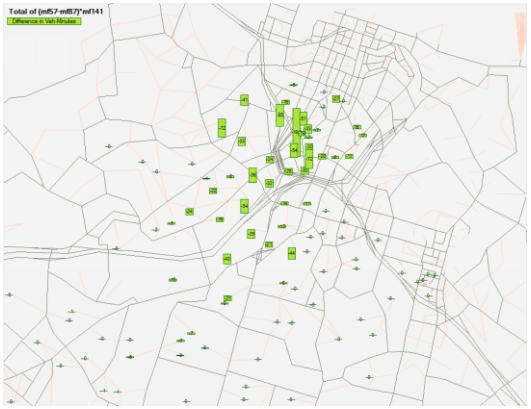
source: AT EMME Model

Figure 6.11 - PM Peak Period Veh-KMs



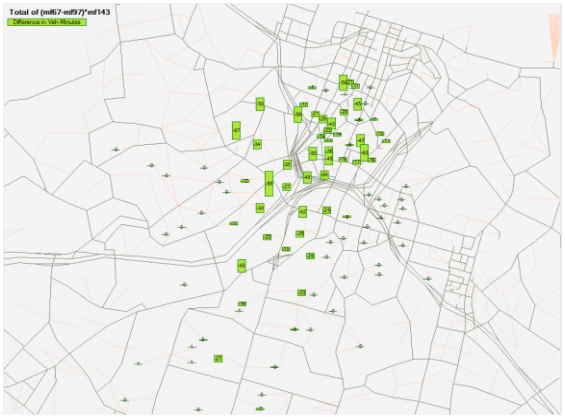
source: AT EMME Model

Figure 6.12 - AM Peak Period Veh-Minutes



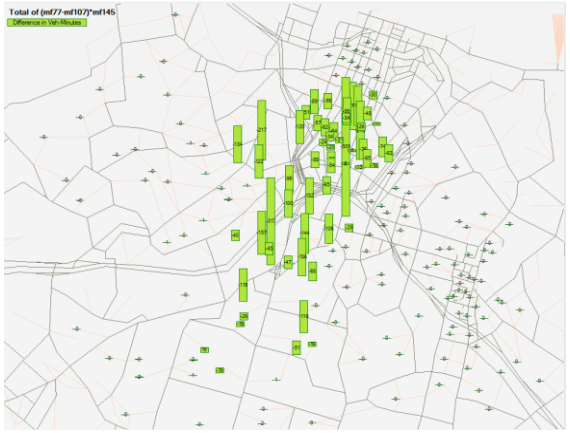
source: AT EMME Model

Figure 6.13 - IP Peak Period Veh-Minutes



source: AT EMME Model

Figure 6.14 - PM Peak Period Veh-Minutes



source: AT EMME Model

7 SATURN Traffic Modelling

Key Findings:

The SH16 Port Link and Fanshawe Street on-ramp were identified as the likely diversion routes for Wellington Street on-ramp traffic.

Motorway travel times improves with the closure of the on-ramp.

Eden Terrace and the City Centre are the most affected regions with additional travel time and travel distance with the closure of the Wellington Street on-ramp.

The Auckland Transport 2010 City Centre SATURN traffic model provides a more detailed assignment model to assess changes in the network associated with the VPT and where flows will change with the opening of the Wellington On-ramp. The model was also used to determine how travel times and distances would be affected within the city and along the strategic network.

This traffic mode was not purposely built to assess the Wellington Street area, nor calibrated in detail in the study area west of SH1. However, it is considered useful to provide an indication of the likely changes in traffic patterns due to the Wellington Street on-ramp configuration.

In running the model there were assumptions regarding the SH16 ramps and the Wellington ramps, whereby they would be managed in the model to maintain efficient operations on the mainline. Those assumptions were:

- Wellington Street on-ramp was limited to 350 vehicles per hour during PM peak period.
- SH16 Ramp was limited to 1,450 vehicles per hour when the Wellington Street on-ramp was open and up to 1,800 vehicles per hour when the Wellington Street on-ramp was closed.

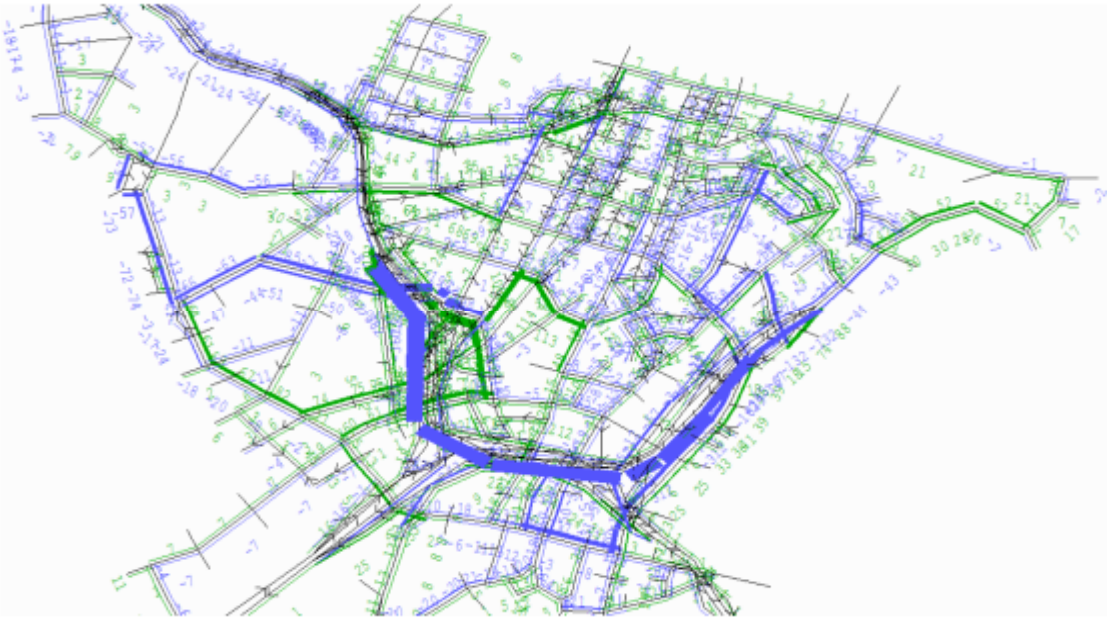
7.1 Model Flow Changes

The SATURN model can display the locations on the network which would experience changes in their base flow associated with the Wellington Street on-ramp. The AM and the PM peak periods were assessed for a future 2021 analysis year. Due to the lack of specific model calibration the absolute value (or magnitude) of the flow changes are subject to uncertainty. It is the relative degree to which the shifts occur which is useful because they identify the areas most likely to be impacted the most by the full completion of the VPT project.

The net change in traffic flows due to the closure of the Wellington Street on-ramp are shown in **Figure 7.1** and **Figure 7.2** for the AM and PM peak hours respectively. Blue represents an increase and green a decrease when the ramp is closed.

Figure 7.1 - 2021 AM Model with and without Wellington Street On-Ramp Difference Plot

Figure 7.2 - 2021 PM Model with and without Wellington Street On-Ramp Difference Plot



From the analysis of the two peak periods the following conclusions can be made:

- The SH16 Port link plays an important role for allowing the upper city centre as well as Eden Terrace and Grafton neighbourhoods to access SH 1 northbound;
- Beaumont Street and Fanshawe Street would see a decrease with Wellington Street open;
- A minor amount of traffic will be taken off of Ponsonby Road, Jervois Street, and Curran Street as a result of opening Wellington Street.

7.2 Travel Time and Distance Methodology

The Auckland Transport 2010 City Centre SATURN traffic model was used to assess the wider network impact on the Wellington Street On-ramp closure on travel times and travel distances through the network.

It is important to note that in this analysis of travel time and distance, all vehicles are treated equally. This may not necessarily reflect the economic and strategic planning outcomes to distinguish between specific trip purposes which may be valued higher than a conventional commuter trip (e.g. truck trips, freight trips, high capacity vehicles, etc.)

Additional details are included in **Appendix D.**

7.2.1 Origin – Destinations

The 1 hour AM peak and PM peak Origin – Destination (OD) demand, OD travel time, and OD distance from the two scenarios (Wellington Street on-ramp open and Wellington Street on-ramp close) were provided from the Flow Transportation Specialists Ltd. The future year 2021 was the selected period to investigate the changes.

The vehicle hours and vehicle kilometre travelled (VKT) were calculated for both scenarios and the difference (Wellington Street on-ramp open – Wellington Street on-ramp close) are calculated. Similar to the catchment analysis in **Section 6** the travel time and distance are weighted by the number of vehicles making the specified movements.

260 traffic analysis zones from the SATURN model were grouped into nine sectors to assess changes in different catchments. These were roughly informed by early outputs from the AMETI modelling (see **Section 6**). The nine sectors are shown in **Figure 7.3**.

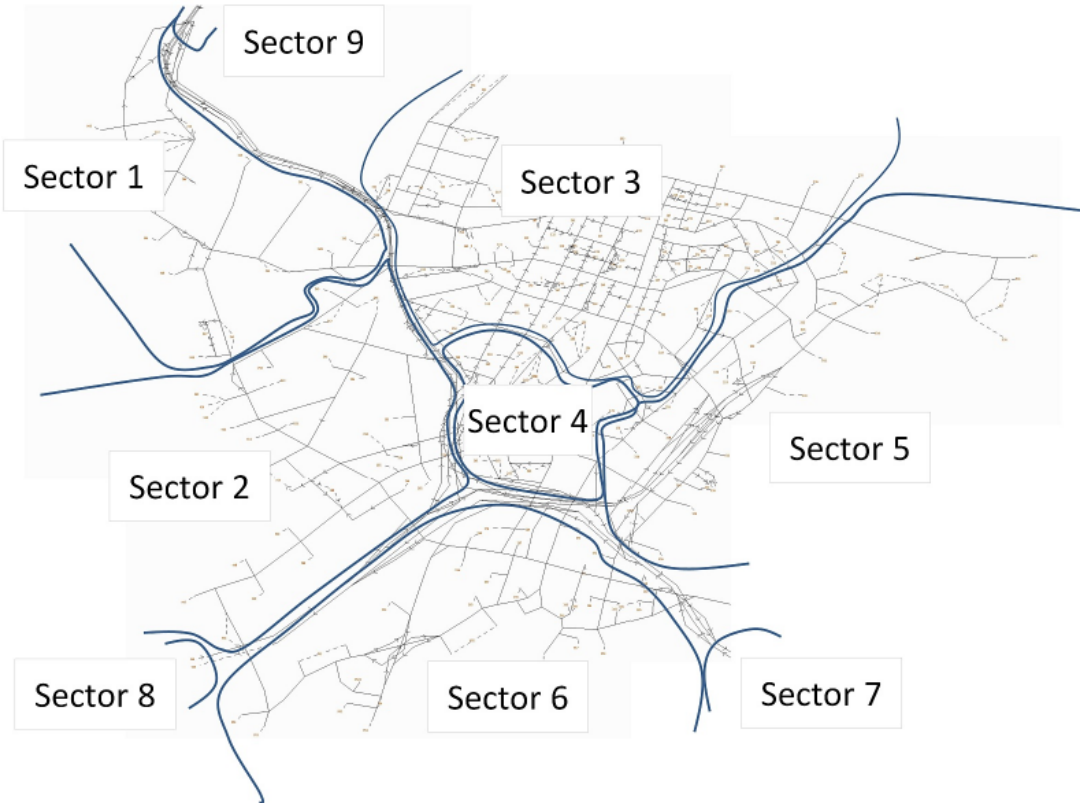


Figure 7.3 - Sector Definition

7.2.2 Vehicle-hour Results

The model predicted changes in Vehicle-Hours for the PM peak include:

- Sector 8 - Northwestern Highway: had the largest improvement in vehicle-hours (-24.58 veh-hrs) with the closure.
- Sector 5 – Grafton Gully, Parnell: had the second largest improvement in vehicle-hours (-12.39 veh-hrs) with the closure.
- Sector 3 – Mid- and Lower- City Centre had the largest deterioration in vehicle-hours (22.79veh-hrs) with the closure, slightly less than the improvement from Sector 8.

The model suggested that local city movements, excluding motorway to motorway movements, would be negatively impacted by the closure with a net increase in vehicle-hours (14veh-hrs) due to the closure.

The closure had the greatest positive impact on traffic flow from both of the SH16 ramps, the Northwestern and the Port Link.

In agreement with the AMETI traffic modelling, the Sector 3 City Centre area was the most negatively affected because of the diverted Wellington Street on-ramp traffic causing additional delays to City Centre traffic.

7.2.3 Vehicle-Kilometre Travelled Results

The model predicted changes in VKT for the PM peak include:

- Sector 4 – Upper City Centre: had the largest increase in VKT, especially for movements to the AHB, with an overall increase of 250.3 VKT with the closure.
- Sector 6 – Eden Terrace: had the second largest increase in VKT, especially for movements to the AHB, with an overall increase of 183.4 VKT with the closure.
- Sector 3 – Mid- and Lower- City Centre: had the third largest increase in VKT, especially for movements to the AHB, with an overall increase of 176.1 VKT with the closure.

The model suggested that local city movements, excluding motorway to motorway movements, would see a general reduction of 141 VKT during the PM peak due to the closure.

7.2.4 Travel time on State Highway

The predicted travel time on the state highway was obtained from the SATURN model for the AM and PM peak periods. The three routes assessed are shown in **Figure 7.4** , these include:

- Route 1: SH16 Port to Auckland Harbour Bridge;
- Route 2: SH1 South to Auckland Harbour Bridge; and
- Route 3: SH16 to Auckland Harbour Bridge.

Figure 7.4 - Travel time on the State Highway

The SATURN model predicted travel times on the motorway network indicate the following:

- AM Peak: The closure of the Wellington Street on-ramp reduces the travel time for motorway routes.
- PM Peak: the closure of the Wellington Street on-ramp reduces the travel time for the two SH16 movements from the Northwestern and the Port but increases the south to north movement along SH1.

When the Wellington Street on-ramp is closed during PM peak it is believe that the model indicates:

- Highway capacity on SH1 at the point of the Wellington Street on-ramp (because it's closed);
- More traffic using SH16 and Port link (those movement are faster); and
- More traffic interference with SH1 traffic which slows SH1 mainline flow.

The modelled travel time results are shown in **Table 7.1**.

Table 7.1 - SATURN Travel Times for Motorway Routes (minutes)

Travel Time (min)	Wellington Street On Ramp Open		Wellington Street On Ramp Closed	
	AM	PM	AM	PM
Route 1: SH16 Port to the Harbour bridge	5.2	9.6	5.0	7.5
Route 2: Southern Motorway to the Harbour bridge	7.1	12.6	6.8	13.1

Route 3: Northwestern to the Harbour bridge	4.9	9.2	4.6	7.0

These results are dependent on the assumptions made around ramp arrangement and priorities at merge points. For example, the Southern Motorway in Route 2 is shown to operate better when open, this is because of the modelled assumptions of reduced flow at the M2M when the Wellington Street on-ramp is open.

8 Intersection Traffic Volumes

Key Findings:

The recorded traffic flows identified the Fanshawe Street on-ramp was the primary diversion route, receiving approximately 6,500 additional vehicles per day with the closure of the Wellington Street on-ramp.

Curran Street on-ramp flow increased approximately 1,500 vehicles per day with the closure of the Wellington Street on-ramp.

8.1 Wellington Street On-Ramp Effects

A review of localised traffic conditions was conducted by reviewing traffic signal volume data during the project study periods (see **Table 2.1**) to understand changes on the local network during the construction of the VPT and specifically those changes associated with the Wellington Street on-ramp closure.

The movements selected for analysis were identified based on the SATURN difference flow plots which illustrated the locations on the local network that were likely to have experienced traffic changes due to the Wellington Street on-ramp closure.

Additional details are included in **Appendix B.**

8.2 Methodology

A number of specific movements at selected signalised intersections were identified as those most likely to be affected by the changes in traffic flow associated with the ramp closure. These movements were assessed using historic traffic signal volume data obtained from the JTOC.

Key movements and intersections in the assessment include:

- Total eastbound movement at the Jervois Road / Wallace Street Intersection – this movement is selected to inform the traffic flow changes from the western areas of the Curran Street on-ramp catchment
- Total turning volumes (a combination of left turning and right turning movements) into Curran Street at the Jervois Road/ Curran Street Intersection – this movement is selected to capture the majority of flows Curran Street.
- Total westbound movement at the Jervois Road / Shelly Beach Road Intersection – this movement is selected to inform the traffic flow changes from the eastern catchment area Curran Street
- Total northbound movement at the Ponsonby Road/ Franklin Road Intersection – this movement is selected to assess traffic attracted to Ponsonby Road to travel north;

- Right turning movement from Franklin Road to Ponsonby Road – this movement is studied to understand the possible traffic diversion from Wellington Street on-ramp to Curran Street on-ramp catchment using Franklin Road.
- Total eastbound and westbound movements along Wellington Street intersecting with Hepburn Street, Wellington Street on-ramp, and Union Street.
- Right turning movement from Victoria Street to Beaumont Street - this movement is studied to understand the flow changes heading to Beaumont Street from a number of points within the City Centre and Wellington Street via Victoria Street.
- Straight through movement from Victoria Street to College Hill – this movement is studied to understand possible diversion towards Curran Street on-ramp from the Fanshawe Street on-ramp and Wellington Street on-ramp catchment areas
- Fanshawe Street on-ramp. Both the left turn from Beaumont Street and the through movement from Fanshawe Street were assessed.

8.3 Assessment of SCATS Data

The historic SCATS traffic signal volume data was obtained for the study analysis periods (see **Table 2.1)** and selected to include approximately four to eight weeks of traffic data for each study scenario, excluding school and public holidays. It is considered that the data sample size was sufficient to analyse and draw conclusions for each study scenario.

8.3.1 Data Processing

Pre VPT traffic flow was established by assessing six days of volume data from March 2009.

For the post VPT analysis five days of data was used from April and May 2012. The volumes across these days were averaged (arithmetic mean) to calculate the average hourly traffic flow before and after the VPT project completion. During the analysis any anomalous data was manually removed and only data from Tuesday, Wednesday and Thursday were used to capture flow under typical traffic conditions.

The individual traffic volume data were processed on a daily basis and aggregated to review a week of data. The weekly profile of all five days was assessed to identify outliers (e.g. as a result of faulty detector, road closures or detours), which was likely to bias the average traffic flows. This manual process identified the anomalous data to exclude it from the average calculations (arithmetic mean) so that a 5-day weekday average can represent the traffic flows under typical traffic conditions for individual studied movements.

The key findings through the data processing include:

- The Wellington Street/ Wellington Street on-ramp intersection was configured to a signalised intersection and connected to SCATS system from January 2011. Thus, no traffic flow data was available in the first three study scenarios prior to the second closure of Wellington Street on-ramp
- Given the construction activities taking place at the Fanshawe Street/ Beaumont Street intersection, there was no SCATS flow data recorded for the second study scenario (14 December 2009 – 23 August 2009)
- The shared straight through and left turning movement on College Hill approach towards the Victoria Street/ Beaumont Street intersection was found to have a significant traffic flow variability for the '2nd Wellington Street on-ramp closure' and 'Post-VPT' periods in comparison with the other study scenarios. Both study scenarios have Wellington Street on-ramp closed and it is noted that there was no other roadwork taking place in the vicinity of the intersection but the flows during '2nd Wellington Street on-ramp closure' is approximately four times higher than that

in ‘Post-VPT’ scenario and nearly doubled than the rest of study scenarios. The significance of such variability suggest that the SCATS detector for this shared movement is likely faulty. However the other movements at this intersection seem to have a similar flow profiles as well as a similar level of flow.

- The eastbound and westbound flows on Wellington Street in theory would have shown similar level of traffic volumes at the Wellington Street/ Wellington Street on-ramp intersection and Wellington Street/ Union Street intersection respectively, given the close proximity of the two intersections with no major side road in-between. However initial data suggests inconsistent traffic volumes recorded at these two intersections. The tube count data which was recorded for the ‘Before -VPT’ and ‘Post – VPT’ scenarios was therefore referenced to check the validity of the SCATS data. It is noted that the SCATS counts recorded at the Wellington Street/ Union Street intersection has similar flows to the tube counts for both ‘Before VPT’ and ‘Post-VPT’ scenarios except the eastbound flow in ‘Before VPT’ scenario. Thus, it is suggested that the SCATS counts collected at Wellington Street/ Wellington Street on-ramp intersection and the eastbound flow data obtained in ‘Before VPT’ scenario at Union Street intersection should not be included due to the large discrepancy identified.
- The Fanshawe Street/ Beaumont Street intersection was upgraded to include one additional off-ramp lane through the VPT project. Thus, the traffic detector numbers were updated for the ‘Post-VPT’ scenario and the SCATS study has already incorporated this change and included the correct detectors in the study.

Figure 8.1 illustrates the locations where traffic signal data was collected for the purpose of this study as well as the key changes in daily flow associated with the Wellington Street on-ramp closure. At key intersections, the movements of interest have been shown in blue.

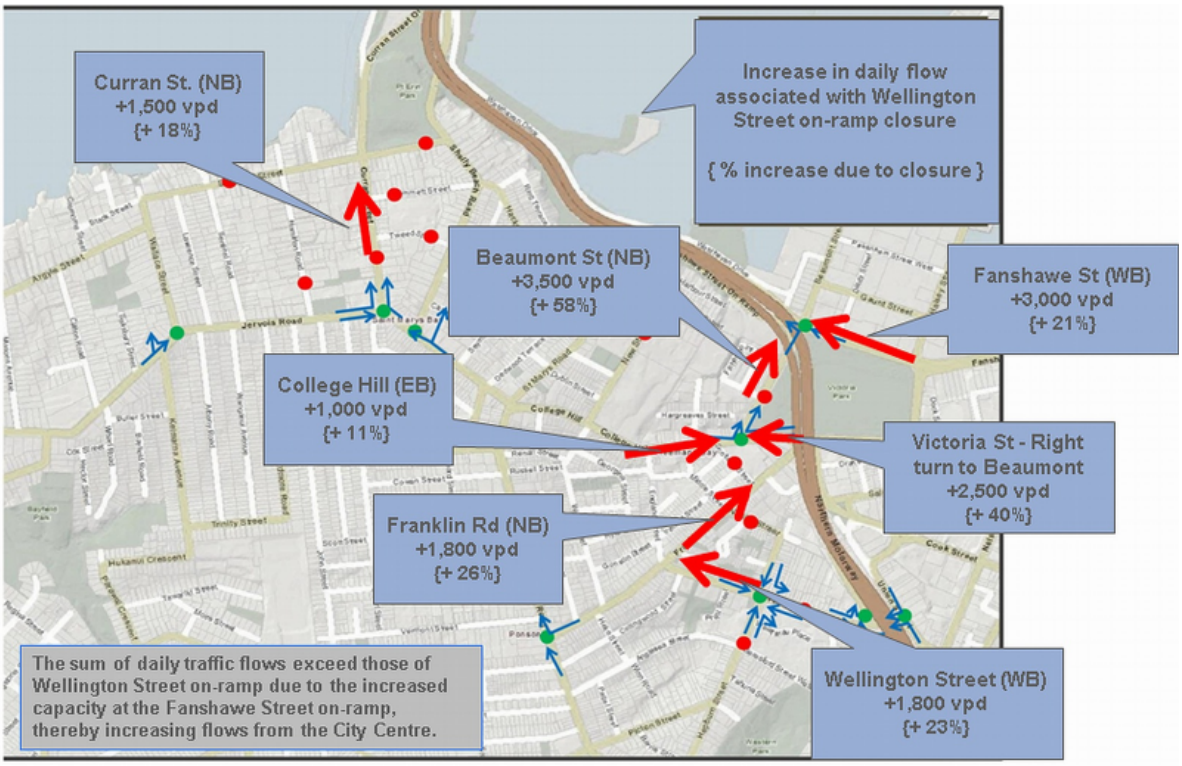


Figure 8.1 – Data Collection Locations, Key Movements and Daily Volume Changes Associated with Wellington Street On-Ramp Closure

The traffic signal flow analysis indicates that the effects of the Wellington Street on-ramp were large enough to be noticed on the daily level. Points of interest include:

- **Curran Street**
  - The AM peak flow increased approximately 125 veh/hr (18%);
  - The PM peak flow increased by 100veh/hr (11%). The total daily flows increased by 1,500 veh/day (18%)
  - The most significant of the changes occurred between the hours of 10pm and midnight with hourly flows increasing beyond 250 veh/hr (compared with 100 veh/hr prior to VPT).
- **Wellington Street**
  - There was an increase in flow by 100 veh/hr (20%) almost consistently throughout the day heading westbound from the city.
  - The total daily westbound flow increased approximately 1,800 veh/day (23%) because of the on-ramp closure.
  - Based on tube counts on Franklin Road, most of this traffic turned right onto Franklin Road towards the motorway at the Fanshawe Street on-ramp.
- **College Hill / Victoria Street**
  - There was a net increase throughout the day for both the eastbound movement down College Hill and the westbound movement from Victoria Street (double right-turn movement into Beaumont Street).

  - Overall, the right-turn to Beaumont saw a significant increase in traffic throughout the day with a daily volume change of over 2,500 vehicles per day (23%)
- **Beaumont Street**
  - Beaumont Street was provided additional green-time and capacity for motorway access with the removal of the right-turn phases from Beaumont Street north and south.
  - The left turn movement onto the motorway increased by approximately150 veh/hr (75%) during the AM peak, 200 veh/hr (23%) during the PM peak and by 3,500 vehicles across a single day (58% increase).
- **Fanshawe Street**
  - Additional capacity was also given to the westbound movement onto the motorway when the right turn movements on Beaumont Street were banned.
  - The AM peak increased by almost 150 veh/hr (28%) while the PM peak increased by over 300 veh/hr (15%). There was a daily increase of 3000 veh/day (21%) accounting for a shift from the right –turn movement from Beaumont Street north which resulted in additional traffic entering Fanshawe Street from via Halsey Street
- **Ponsonby Road / Franklin Road**
  - Northbound AM peak flows increased approximately 150 veh/hr (13%) with daily flows increasing by approximately 700 veh/day (5%).
  - Dissimilar to other arterial routes, the northbound PM flows remain approximately unchanged.
  - During the inter-peak period had an average northbound increase of 100 veh/hr (11%) leading up to the PM peak.
- **Franklin Road (Right Turning to Ponsonby Road)**
  - The flows across the entire day remain similar to magnitudes experienced before the VPT project began.
  - The negligible change observed, further validates that additional volume from the Wellington Street westbound movement is heavily biased to the right turn onto Franklin Road heading towards Victoria Street.

9 Daily Flow – Tube Count Data

Key Findings:

The movements which experienced greater than 40% increases in daily traffic volume are Shelly Beach Road northbound and Franklin Road northbound

The movements which experienced 10-20% increases in daily traffic volume are Curran Street northbound, Beaumont Street northbound and Wellington Street westbound

Heavy commercial vehicles represent approximately 2% of measured traffic flow

Tube count data was requested to serve the two purposes of verifying the observations through the use of an alternative count source and also provide an understanding of key local roads which do not have the convenience of being measured using SCATS. Tube counts need to be specifically requested for data capturing to occur and hence there are limitations to the dates of information provided. The following section outlines the methodology behind the planning, capturing and analysis of the data and key observations deriving from this work.

Please refer to **Appendix A** for further details.

9.1 Methodology

In line with the other analyses for this review, comparative periods were chosen to assess variations that may be linked to the closure of the Wellington Street on-ramp.

9.2 RAMM Analysis

Using the RAMM database, locations where historical tube count data has been collected was sourced. For the purpose of the analysis, a series of locations comprising data collected in 2009 through to early 2010 was chosen and the specific locations are shown below in **Figure 9.1**. Locations were chosen to represent key local roads around the Curran Street precinct, across Freemans Bay near Wellington Street On-ramp and along the corresponding detour via Franklin Road to Beaumont Street. Daily profiled data was then sourced from Auckland Transport's database.

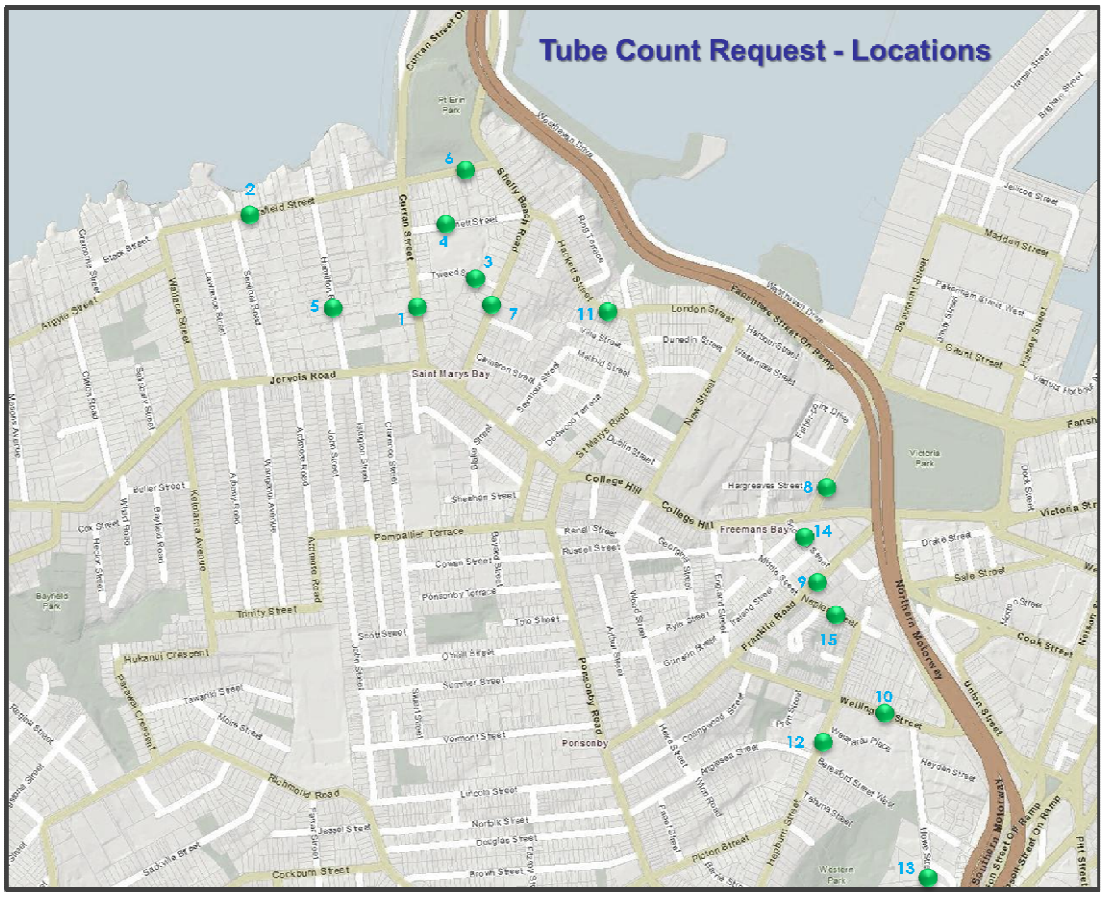


Figure 9.1 Tube Count Data Collection Locations

9.3 Tube Count Survey

A seven day tube count survey was conducted for the locations in **Figure 9.1** between the dates of 14th to 22nd of June 2012 (slight variations in dates for each site due to resource availability). The site locations for the 2012 survey replicate those from 2009/2010 where feasible and this is the case for the majority.

TEAMTraffic was retained to carry out specific ADT tube counts along links within the study area aligned with previous RAMM database counts.

9.4 Comparative Analysis

A comparison was made between the 2009/2010 and 2012 data for the hourly flow and overall daily flow for each location. The data was filtered for anomalies created by such events as an incident. This allowed for five and seven day averages to be produced that fairly represent the conditions. For each road, comparisons were only made for the direction of travel towards the Curran Street on-ramp or Fanshawe Street on-ramp.

9.5 Key Observations

The overall change in traffic was measured based on the average overall daily traffic flow. **Table 9.1** shows the percentage change in overall daily traffic flow for each tube count site. Detailed 24 hour profiles for each site can be found in the appendices to this report. Some of the key findings include:

- The average percentage change in the overall daily traffic flow between 2009/2010 and 2012 is in the order of 4%;
- The movements which experienced greater than 40% increases in daily traffic volume are Shelly Beach Road northbound and Franklin Road northbound;
- The movements which experienced 10-20% increases in daily traffic volume are Curran Street northbound, Beaumont Street northbound and Wellington Street westbound;
- All five movements mentioned above (Shelly Beach northbound, Franklin Road northbound, Curran Street northbound, Beaumont Street northbound and Wellington Street westbound) also displayed slightly higher and more pronounced peaks (AM and PM) in 2012;
- Smaller changes in traffic volume was witnessed at Emmet Street with the AM peak noticeably higher than previous;
- Hamilton Street northbound, Hackett Street westbound and Wellington Street eastbound all showed signs of decrease in vehicle volumes; and
- Data at Sarsfield Street EB and Tweed Street WB are deemed difficult to compare due to the Northshore No.1 Watermain upgrade works during historical data collection dates. For this reason, there were significant drops in vehicle volumes at these locations.

Table 9.1 - Percentage Change in Overall Daily Traffic Flow

Site	Location Description	5 Day Difference	7 Day Difference
Curran Street NB	Between Jervois Road and Tweed Street	12%	13%
Sarsfield Street EB*	Between Hamilton Road and Sentinel Road	-29%	-26%
Tweed Street WB*	Towards the Shelly Beach Road End	-41%	-29%
Emmett Street WB	Just past halfway on the Curran Street End	9%	8%
Hamilton Road NB	Just past halfway on the Jervois Road End	-10%	-10%
Shelly Beach Road NB	Between Tweed Street and Westwood Tce	44%	42%

Beaumont Street NB	Near the cycle store towards the Victoria Street end	11%	16%
Franklin Road NB	Between Scotland Street and Napier Street	42%	41%
Wellington Street WB	Between Hepburn Street and Howe Street	18%	10%
Wellington Street EB	Between Hepburn Street and Howe Street	-6%	-9%
Hackett Street WB	Between St Marys Road and Ring Terrace	-1%	-3%
Howe Street NB	Between Whitson Terrace ad Hopetoun Overbridge	No historical data	No historical data
Average		4% (15%)	5% (12%)

**Historical data was from 2010 when a large watermain was being installed on Jervois Road and Curran Street. This work impacted the surrounding network and the resultant traffic patterns.*

9.6 Tube Count Data Summary

The comparison of traffic volumes on local roads between 2009/2010 and 2012 showed that there was a net increase in traffic volume in 2012. This is increase is about 4%. An increase was witnessed in a number of locations with some noticeably higher than others. In general, the detour route via Franklin Road and Beaumont Street saw higher increases as expected. Curran Street, being a main feeder onto the motorway, naturally saw increases across the day but these were acceptable at around 13%. However, It was surprising to see that Hamilton Road northbound and Hackett Street westbound both saw drops in volumes.

9.7 Heavy Commercial Vehicle Traffic

The tube counters collect traffic count data by vehicle class allowing a review of the percent of the total traffic which was considered a heavy commercial vehicle (HCV). Classes 3 through 13 were used in the estimation of HCVs.

Table 9.2 displays the HCV percentages by time of day for the five day weekday and the full seven day week.

Table 9.2 - Heavy Commercial Vehicle Percentages for Key Movements

Count Location	AM (6- 9am)	Interpeak (9am – 4pm)	PM (4-7pm)	Evening (7pm – 6am)
Beaumont Street NB				
5 Day	7.1%	6.3%	5.1%	4.3%
7 Day	6.2%	5.5%	4.5%	3.6%
Curran Street NB				
5 Day	2.3%	2.6%	2.1%	2.4%
7 Day	2.3%	2.4%	2.0%	2.3%
Franklin Road NB				
5 Day	2.7%	3.1%	1.7%	2.1%

7 Day	2.8%	2.6%	1.5%	1.7%
Wellington Street WB				
5 Day	4.2%	3.8%	2.2%	2.5%
7 Day	3.7%	3.5%	2.2%	2.3%
Wellington Street EB				
5 Day	4.8%	3.1%	1.7%	2.0%
7 Day	4.3%	2.8%	1.7%	2.0%
Sarsfield Street (West of Shelly Beach) WB				
5 Day	1.4%	1.9%	0.6%	6.6%
7 Day	1.0%	1.6%	0.4%	4.8%
Sarsfield Street (East of Sentinal) EB				
5 Day	0.9%	1.5%	0.6%	0.5%
7 Day	1.3%	1.3%	0.4%	0.4%
Shelly Beach Road NB				
5 Day	2.5%	2.7%	1.6%	6.7%
7 Day	2.4%	2.7%	1.5%	5.8%

The HCV analysis indicates the following:

- Beaumont Street toward the motorway has the highest percentage of HCVs within the routes studied;
- Some HCVs are traveling along Shelly Beach Road and along Sarsfield during the evening time period. These HCVs are associated with motorway temporary traffic management; and
- Wellington Street westbound away from the city has the second highest level of HCVs as a percent of total traffic.

10 Bus Travel Time

Key Findings:

Bus services 004, 962 and 966 showed large increases in travel time in the outbound direction when compared to when the Wellington Street on-ramp was open. The increase in travel time for the bus services are 32%, 29% and 45% respectively

The increase in travel time correlates with an increase in traffic flow and congestion at points in and around the Jervois Road / Curran Street area partially attributed to the Wellington Street on-ramp closure.

Bus travel time data was sourced from AT to assess the local network performance integrity from the perspective of public transport. The public bus fleet are equipped with GPS devices providing a continuous stream of time stamp data for arrival and departure times for each stop along the route. Whilst the travel times are for bus routes, it is also assumed that these times can be a proxy for general vehicle travel times along these routes. The following details the methodology for capturing the data and the analysis of the information. The key findings are also presented below.

Individual bus service summaries are found in **Appendix E**.

10.1 Methodology

Bus service data was requested from AT to capture a period with and without the closure of the Wellington Street on-ramp. With changes made to bus routes across the Auckland city network in August of 2011 (new Flagship service), and the lack of data prior to the start of 2011 the analysis data was limited to a period before the May 2011 closure of the on-ramp and the period before that when the ramp was open.

A list of the bus routes of interest are shown below with **Figure 10.1** displaying where each service travels within the analysis cordon.

Each bus route extends beyond the study area for this study. For this reason, a cordon was established to isolate the relevant travel times for the following analysis The cordon extends west between St Lukes and Newton Road and on the eastern side just goes beyond the SH1 corridor.

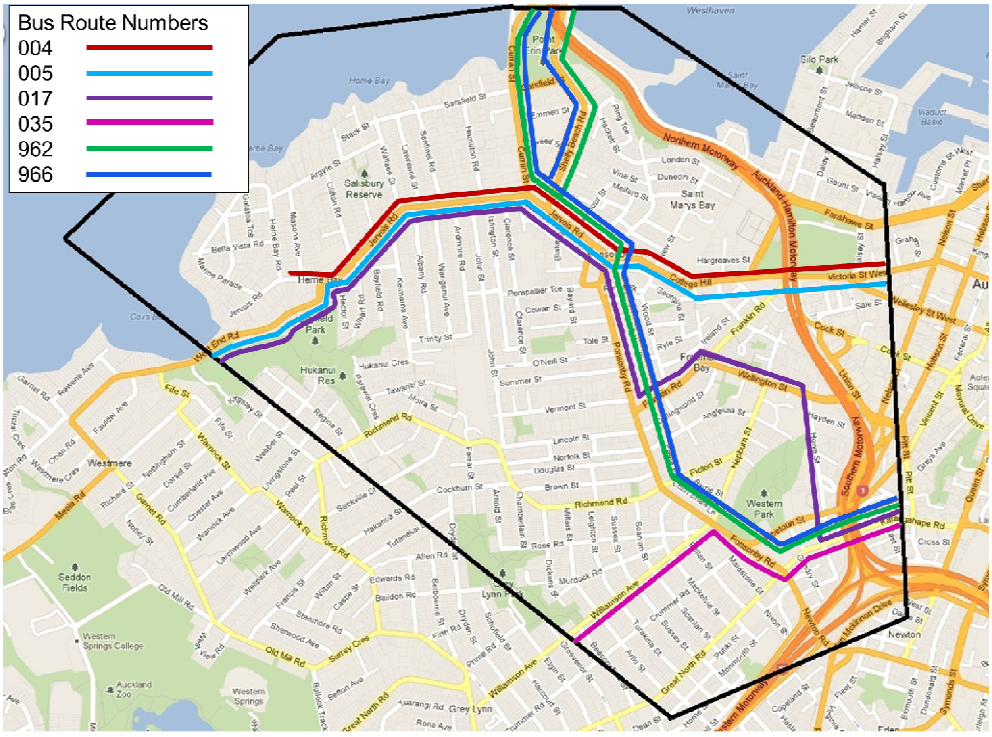


Figure 10.1 – Bus Routes and Study Area

10.2 Analysis

The travel time data provided has the arrival time for each bus stop and a departure time from each bus stop. The travel time within the cordoned area was then determined for each of the services listed above. This was done for each run of the service and for each day of the week.

The average travel time utilised data from Monday to Thursday for a five week period before and after the closure. Using this data, a comparison was made on the travel times for each service before and after the closure. The results in **Section 10.3** have been presented for the AM (6-9am) and the PM (4-7pm) peak periods.

As a form of verification, two routes outside of the cordon were also assessed to give perspective of any similarities in changes between the before and after periods of the ramp closure.

Anomalies in the data were filtered out from the data set to prevent unnecessary skewing of the results.

10.3 Key Findings

10.3.1 Within Cordoned Study Area

Table 10.1 shows the overall average change in travel time before and after the ramp closure. **Table 10.2** shows the average change in travel time before and after the ramp closure for each service during the AM and PM peaks.

The overall average change in travel time before sees an increase in the order of 13%. Although this overall change is noticeable, it is important to understand that the travel time increases were largely contained to specific routes.

Table 10.1: Overall Average Change in Travel Time

	Absolute Change (Mins)	Percentage Change
6-9am	-0.06	-0.12%
4-7pm	1.42	12.72%

Bus services 004, 962 and 966 showed large increases in travel time in the outbound direction. The increase in travel time for the bus services are 8%, 29% and 45% respectively. Bus services 962 and 966 travel to the North Shore using the Curran Street on-ramp. The increase in travel time infers a connection to the witnessed increase in volume using the ramp during the peaks.

Table 10.2: Change in Average Travel Time For Specific Routes

Service	Absolute Change (Mins)	Percentage Change
004 Inbound		
6-9am	-0.14	-1.01%
4-7pm	-0.47	-11.82%
004 Outbound		
6-9am	-0.02	-0.56
4-7pm	0.20	8.07
005 Inbound		
6-9am	-0.32	-3.67%
4-7pm	0.54	11.55%
005 Outbound		
6-9am	0.07	0.02%
4-7pm	-0.09	-0.03%
035 Inbound		
6-9am	0.37	5.56%
4-7pm	-0.10	-1.42%
035 Outbound		
6-9am	0.19	1.21%

4-7pm	-0.50	-3.26%
962 Inbound		
6-9am	-0.72	-5.07%
4-7pm	N/A	N/A
962 Outbound		
6-9am	N/A	N/A
4-7pm	4.44	29.43%
966 Inbound		
6-9am	0.20	2.86%
4-7pm	N/A	N/A
966 Outbound		
6-9am	N/A	N/A
4-7pm	5.94	44.94%

10.3.2 Outside Cordoned Study Area

A sample of two routes within the provided data set from AT was examined to assess changes outside of the cordoned area during the same time periods.

1) 966 – Onewa Road, Birkdale Road, Birkenhead Road

2) 962 – Karangahape Road, Khyber Pass, Broadway

Table 10.3 and **Table 10.4** below show the average change in travel time before and after the ramp closure. Of the services assessed, it is evident from the results that there is a very small change in the average travel time outside of the cordoned area.

Table 10.3: Change in Average Travel Time - Onewa Road, Birkdale Road, Birkenhead Road

Direction	Absolute Change (Mins)	Percentage Change
Inbound	0.33	2.52%
Outbound	-0.18	-1.34%

Table 10.4: Change in Average Travel Time – Karangahape Road, Khyber Pass, Broadway

Direction	Absolute Change (Mins)	Percentage Change
Inbound	-0.90	-9.77%
Outbound	0.03	0.90%

The outside cordon bus travel time data suggests that no consistent citywide trend was occurring within bus travel times.

10.4 Bus Travel Time Data Summary

Six bus services were selected (004, 005, 017, 035, 962, and 966) to provide a sample of information along important road segments. These six routes serve as a reasonable representation from which to understand the overall travel time impact attributed by the Wellington on-ramp closure.

The average change in travel time across all of the sample bus services was about 13%. There were some specific routes (004, 962, and 966), which experienced larger than average increases in their travel time within the defined cordon area. These services were heading outbound (northbound) from the city centre and correlated to the PM peak.

Outside of the defined study area, there was negligible change in the travel time for the bus services reviewed.

Overall, there was little change in the bus services assessed with the majority of the significant travel time delays corresponding to routes serving the northbound movement during the PM peak.

11 Local Network Enhancements

The traffic conditions around the Wellington Street on-ramp area and Curran Street area were reviewed to understand the operations and general traffic conditions that current demands in the area have on the road network. The review included a general observation of current conditions and does not attempt to determine to what extent the current conditions may relate to the Wellington Street closure.

11.1 Challenges on the current network

- **Wellington Street – Franklin Road:** The heavy right-turn flow from Wellington Street into Franklin Road and northbound traffic flow on Franklin road increased in attractiveness with Wellington Street on-ramp closed. The flow at the intersection could be monitored to determine whether a traffic signal could provide a safer type of intersection control.
- **Victoria Street – Beaumont Street:** The heavy right-turn from Victoria Street into Beaumont Street increased in attractiveness with the Wellington on-ramp closed. It may be desirable that the signal timings be checked to provide sufficient green time maximums to manage this demand. With the Wellington Street on-ramp open, this movement may operate acceptability.
- **Cook Street to Nelson Street**: The right turn movement should be assessed as to whether vehicles are traveling down Nelson Street to Fanshawe Street or traveling to the Wellington Street on-ramp. The capacity for the Cook Street to Nelson Street turn could be reviewed.

11.2 Challenges on the future network

It is expected that a re-opening of the Wellington Street on-ramp will see a reversal of some of the additional flows shown in **Figure 8.1**. However, it is likely that a portion of those flows will remain on the routes in **Figure 8.1** due to driver behaviour responding to the improvements on the network following the completion of the VPT. The opening of the Wellington Street on-ramp will bring additional changes to the network.

The opening of the Wellington Street on-ramp will bring additional changes to the network.

- **Wellington Street Corridor:** The corridor will likely experience queuing and congestion during the PM peak period with demands likely to exceed the ramp signal capacity of the on-ramp. The queuing and related signal timings will have to be monitored to minimise effects further upstream and downstream. Upstream signals which had prior queuing and operational issues when Wellington Street on-ramp was open include Pitt Street, Union Street, Cook Street, Howe Street, and the Hobson and Nelson interchanges.
- Pedestrian protection and phasing at the Wellington Street on-ramp signal could be reviewed with the Freemans Bay Primary School. Specifically the level and type of pedestrian protection across the mouth of the on-ramp should be reviewed. Overall, the patterns and behavior of pedestrians in the area should be reviewed to minimize safety problems in and around the ramp

area. The pedestrian phasing will be taking into account with the phasing and coordination with the traffic signals along Wellington Street.

11.3 Other Network Improvements

In addition to the issues above, the following issues unrelated to Wellington Street on-ramp were noted:

- Curran Street: The PM peak period is generally constrained northbound because of the motorway on-ramp. The speed at the bottom of the hill was identified as an issue as to how pedestrians and cyclists are safely accommodated at the busy Curran Street – Sarsfield Street intersection. The intersection should be reviewed to assess potential safety improvements as part of on-going network management.

12 Management of the Wellington Street On-Ramp

12.1 Monitoring

The operations at the Wellington Street on-ramp merge with SH1 will vary from day to day and change over time as other network improvements come on line and general growth and development continues. Actively the ramp will be managed by the ramp signal system controlled by the JTOC and NZTA. However, monitoring trends over a longer time period requires active data collection and comparison to understand trends and develop network solutions.

From the opening day of the ramp a monitoring plan should be implemented to evaluate the following items which would impact on the safety and efficiency of the road network:

- VPT operations and SH1 mainline operations at the Wellington Street on-ramp merge should be reviewed against operational assessments (HCM merge capacity analysis) to determine actual physical capacities of the merge.
- Local signals on Wellington Street should be reviewed to ensure that signal coordination and detectors are correctly picking up vehicles between the new on-ramp signals and the Wellington Street – Union Street intersection.
- Local City Centre signals, specifically around Wellington Street, Union Street, Pit Street, and the Hobson/Nelson interchange, may need to be reviewed for queue management and signal coordination;
- Pedestrian safety at the new Wellington Street on-ramp traffic signals. The presence of signals across the mouth of the on-ramp encourages more pedestrians to cross at the on-ramp. Pedestrian protection should be reviewed as well as the general pedestrian desire lines through the interchange. The adjacent school on Wellington Street is an important user group which should be safely catered for; and
- Volume trends and changes in flows from SH1 north, the M2M, and Wellington Street as well as further downstream at Fanshawe Street, Curran Street, and the AHB need to be monitored to determine if any changes to the on-ramp flows will need to be pursued.
- Travel time changes (using the Bluetooth system) along the network can be used assess route choice as well as general preference

12.2 Optimisation Recommendations

The monitoring of the Wellington Street on-ramp and the motorway network through a variety of data sources can enable the City Centre plans to take shape and understand what changes to the management philosophy could be made to bring about further desired changes.

Areas of optimisation include:

12.2.1 Bluetooth Data Collection

The Bluetooth data collection system has been implemented on the network to capture the eastern and southern flows through the CMJ en route to St. Mary's Bay.

The Bluetooth system should be expanded to capture the balance of western trips. This would include additional sensor units on the North-western, far enough west to capture all queuing impacts of the North-western merge, and an additional unit(s) north of Curran Street on the AHB. These additional two units would enable comparison of travel times from south, east, and west, through the city, VPT, or through local streets and Curran Street to points north.

Bi-annual Bluetooth travel time surveys could be a measure to provide an active management of the network and compare recent trends with past operations.

12.2.2 Advanced Traffic Management System Loops

The advance traffic management system loops installed on the motorway can inform general traffic flows over time on a number of the roadway links in the study area. An annual comparison of these flows should be carried out to identify trends and changes to the demands coming from different areas of the network.

The traffic flow changes can monitor the success of the SH16 Port Link in delivering City Centre traffic out of the city and around the city rather than through the city to points north.

Specifically the future changes associated with the Waterview/ SH20 connection opening will be one to monitor before and after changes closer to 2016.

12.2.3 Traffic Signals

Local traffic signals need to be coordinated to improve the delivery of car traffic through the city to the SH16 Port as well as manage demands which would like to travel to Wellington Street but should continue to use Victoria Street, Beaumont Street, Nelson Street, and Fanshawe Street.

The management and future constraints on capacity at the Wellington Street will encourage some motorists to use the alternative routes which were developed during the closure. These include Upper Queen Street, K'Rd, Pitt Street, Nelson Street, and a number of other local arterials in the city. Traffic signals should be reviewed to prioritise these movements which may increase in attractiveness in the future as Wellington Street on-ramps become increasingly controlled.

12.2.4 SH16 Motorway to Motorway Merge

The future use of the SH16 Port Link to realise the City Centre vision by moving northbound traffic around the City rather than through the City will require a higher priority to be placed on the Port Link versus the North-western Link. This priority would be most easily achieved through the individual ramp signalling of each of the SH16 approaches to the M2M area. As separate ramp signals, the flow rates for the Port Link and the North-western Link can be varied to better meet the operational objectives of the City Centre

13 Findings and Conclusion

13.1 Findings

Through the assessment of the transportation network changes associated with the closure of the Wellington Street on-ramp the following findings have been made:

- Prior to VPT the Wellington Street on-ramp served between 7,000 and 8,000 vehicles per day, predominately from the Freemans Bay, upper City Centre, and Eden Terrace catchments. The Victoria Park Viaduct had traffic flows just over 50,000 vehicles per day.
- During the PM peak period the recorded traffic flows on the ramp have reduced over time from approximately 800 vehicles per hour (pre ramp signalling) to 300 vehicle per hour (pre-VPT) through the ramp signalling programme to manage the efficient operations of the motorway. This resulted in extensive queuing which occurred on all approaches to the ramp along Wellington Street, Union Street, Howe Street, and Pitt Street.
- The successful operation of the tunnel is critical to the efficient operation of a significant part of the Auckland network including the critical northbound motorway entrance to the Auckland city and access to SH16 from SH1;
- The Wellington Street on-ramp has the potential to significantly impact the motorway flows and operations within the merge area along SH1, particularly during the PM peak period;
- The Wellington Street on-ramp closure is estimated to have increased daily flows on the following routes: Beaumont Street (approximately 3,500 vpd, 58%), Curran Street (approximately 1,500 vpd, 18%), Fanshawe Street (approximately 3,000 vpd, 21%), Franklin Street (approximately 1,800 vpd, 26%) , Victoria Street (approximately 2,500 vpd, 40%), and Wellington Street (approximately 1,800 vpd, 23%);
- The impacts on motorway accessibility of the Wellington Street on-ramp closure were found to be primarily in and around the Freemans Bay and Franklin Road corridor with increases in traffic flows en route to the Fanshawe Street on-ramp. Areas of Eden Terrace and the Upper City Centre were the most affected with increased travel time and/or distance to points north. The impacts within the wider areas were found to be minor;
- The closure resulted in increased bus travel time for movements in and around Curran Street, specifically for those destined to points north, with an overall average increase in travel times of 13%. No wider network bus travel time changes were identified to be associated with the closure;
- Currently, there is capacity available on the motorway to accommodate the Wellington Street on-ramp traffic outside of the weekday PM peak period. During the PM peak period there is currently approximately 400 vehicles per hour capacity for the Wellington Street on-ramp. This is less than the expected demand, which would result in queues along Wellington Street and in the immediate vicinity during the PM peak period (similar to pre-VPT conditions);
- Although additional capacity has been provided via the VPT project, the current management philosophy should remain whereby the efficient operation of the SH1 mainline and SH16 Port Link will be maintained through ramp signalling of the entry points;
- It is envisaged that there will be increased use of the SH16 Port Link to minimise cross city traffic. This will reduce the available capacity for the Wellington Street on-ramp requiring additional management and reduction in the on-ramp flow;
- On-going monitoring of the motorway flows and operation as well as the local network effects should be reviewed on an annual basis to identify future risks and operational issues before they arise; and

- If the State Highway motorway operations begin to be impacted in the study area, a wider network performance and management review will be necessary to assess potential future changes in order to maintain safe and efficient flows along the strategic road network.

13.2 Conclusions

There is currently available capacity on the motorway network to open the Wellington Street on-ramp subject to significant management of the on-ramp flows during the weekday PM peak period, similar to pre-VPT levels.

There would be benefits to a number of local streets if Wellington Street on-ramp was re-opened including reduced flows and improved accessibility. However during the PM peak period the road network within the immediate vicinity of the on-ramp is likely to experience queuing and congestion similar to the pre-VPT conditions.

The available capacity of the Wellington St on-ramp is expected to reduce over time as a consequence of growth on the Auckland transport network and increased usage of the SH16 Port Link to accommodate the City Centre Masterplan. This will require further management of the on-ramp to prevent significant disruption to the motorway operations.

Monitoring and regular reviews are recommended to inform the on-going management of the on-ramp.

Appendix A

Tube Count Data

Appendix B

Traffic Signal Volume Data

Appendix C

Motorway Level of Service

Appendix D

SATURN Travel Time and Distance Data

Appendix E

Public Transport: Bus Travel Times