Northern Corridor Improvements

Assessment of Transport Effects

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Executive summary

The need for the Project

On completion of the Waterview project in 2017, the Western Ring Route will have been completed to a motorway standard from its southern extent in Manukau to Albany Highway on the North Shore, with the State Highway 18 (SH18) to State Highway 1 (SH1) connection being the final incomplete section. As a result, the Northern Motorway Upper Harbour interchange, and the adjacent sections of SH1 and SH18, have been identified as critical sections of Auckland's motorway network. These sections of State highway currently operate with significant congestion, and this congestion is predicted to worsen following the completion of the Western Ring Route, and as a result of growth in population and employment anticipated for Albany (including the surrounding areas) and areas further north.

The Northern Busway provides an excellent and reliable route for public transport between the Constellation and Akoranga Bus Stations, but buses need to join the general traffic stream north of the Constellation Bus Station.

Accordingly, the Northern Corridor Improvements Project (the Project) seeks to achieve the following outcomes:

- To help facilitate interregional travel between Auckland and Northland by completing the Western Ring Route to motorway standard;
- To improve connectivity of SH1 and SH18 interchange;
- To improve safety, efficiency, reliability and the capacity of:
  - SH1 between SH18 and Albany; and
  - SH18 between SH1 and Albany Highway.
- To provide safe walking and cycling facilities adjacent to SH1 and SH18 and connections to local transport networks; and
- To extend the Northern Busway from Constellation Bus Station to the Albany Bus Station.

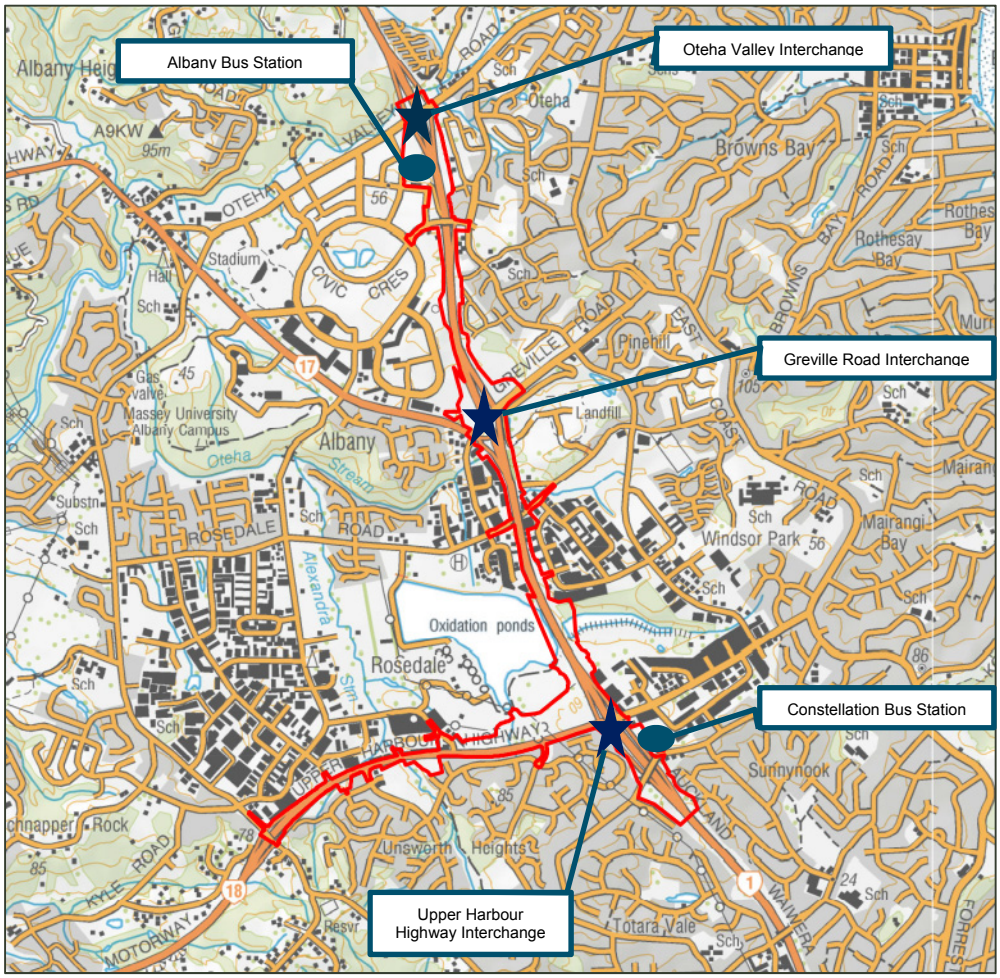
The Project

The Project is to include the following improvements (see **Figure ES1**):

- Upper Harbour Highway (SH18) is to be upgraded to full motorway status and separated from the local roads;
- New direct motorway to motorway connections are to be provided, from SH1 southbound to SH18 westbound, and SH18 eastbound to SH1 northbound;
- Additional (fourth and fifth) lanes are to be provided northbound on SH1 between the new SH18 eastbound connection and Greville interchange;

- An additional (fourth) lane is to be provided northbound on SH1 between Greville Interchange and Oteha Valley Interchange. This will allow an additional general traffic lane to be provided, next to the existing climbing lane;
- Additional (third and fourth) lanes are to be provided southbound on SH1 between Greville Interchange and the new SH18 westbound connection;
- Widening of the SH1 mainline (an additional lane), crossing the Upper Harbour (northbound) and Greville Interchanges (northbound and southbound);
- Extension of the Northern Busway from Constellation Bus Station to Albany Bus Station;
- Shared walking and cycle path on the eastern side of the Northern Motorway between the Constellation Bus Station and Greville Bus Station. Further walking and cycling connections are to be provided alongside SH18, between SH1 and the SH18 Albany Interchange; and
- Modified connections are to be provided to Paul Matthews Road, with local road access retained and walking and cycling access added along and across SH18.

Figure ES1 Extent of Project Area



Source: Base Map from LINZ

Basis of this assessment

This transport assessment has drawn on traffic and public transport forecasts from the Auckland Regional Transport model. More detailed traffic modelling has been carried out primarily using the Upper Harbour SATURN model. This traffic model has been used for several significant projects and it has been updated for the purposes of this study.

The assessment of effects during the construction of the Project has been based on forecast models for the year 2018. The assessment of the longer term effects of the Project are based on forecast travel demands and conditions, without and with the Project, in 2031.

Operational Effects along SH1

The Project is expected to increase daily flows on the Northern Motorway (SH1) by up to 28,600 vehicles per day, two way, in 2031, between the Greville Interchange and the SH18 direct connections (a 21% increase). Daily flows along the Upper Harbour Motorway (SH18), east of the Albany Highway interchange are expected to increase by 22,500 vehicles/day, two way, in 2031 (a 49% increase).

The effects of these increases will be significantly reduced by:

- The provision of additional capacity along SH1, between the SH18 direct connections and Oteha Valley Interchange;
- The provision of the SH18 direct connections between SH18 and SH1 (north); and
- Through the upgrade of SH18, between the Albany Highway and SH1 direct connections, to motorway standards.

As a result, travel times are predicted to improve, relative to the future scenario without the Project, even with these increases in flows. These improvements in travel times will vary by route, direction and time of day, but they are predicted to include decreases of over 10 minutes during the weekday morning and evening peaks[1].

Area Wide Traffic Effects of Project

While the Project is predicted to increase flows along both SH1 and SH18, decreases in flows are forecast on a number of parallel routes (based on 2031 traffic forecasts), most notably on:

- Albany Highway (reductions of up to 5,600 vehicles per day predicted, or 22%);
- Rosedale Road (reductions of up to 4,800 vehicles per day predicted, or 19%);
- Bush Road (reductions approximately 4,500 vehicles per day predicted, or 14%);
- William Pickering Drive (reductions of approximately 4,000 vehicles per day predicted, or 24%);
- Paul Matthews Road (reductions of approximately 3,300 vehicles per day predicted, or 13%);
- Apollo Drive (reductions of approximately 3,000 vehicles per day predicted, or 11%);
- East Coast Road (reductions of up to 2,900 vehicles per day predicted, or 8%); and
- Sunset Road (reductions of approximately 2,900 vehicles per day predicted, or 17%).

Conversely, traffic flows are predicted to increase on several arterial routes, particularly those that feed the Greville and Oteha Valley interchanges. Most notable among these is Albany Expressway, which is predicted to increase by up to 4,400 vehicles per day west of SH1 (an 11% increase).

In general, the Project is predicted to result in a decrease in forecast traffic flows on local streets, except for those closest to and that connect directly to Greville and Oteha Valley Interchanges. This will have corresponding effects on local property accesses; access will for example be improved on local roads that experience reductions in traffic volumes.

[1] Between SH1 at Oteha Valley Interchange and SH18 Albany Interchange southbound

Effects on Public Transport

The Project will offer significant benefits for public transport in terms of providing quicker and more reliable journeys by bus, through the extension of the Northern Busway to Albany Bus Station. In particular, northbound buses will no longer need to travel with general traffic at the Upper Harbour Interchange, as they leave the Constellation Bus Station. This will lead to benefits in terms of reduced travel times for buses, greater reliability of bus services and consequently a predicted increase in bus patronage. The increased patronage will in turn lead to less traffic congestion.

In addition, as noted above, the Project is expected to reduce general traffic volumes on several arterial roads in the areas surrounding the Project. These reductions will provide indirect benefits to public transport operators and users, by reducing congestion on these routes and improving bus travel times, where bus priorities are not already in place. Key among these will be East Coast Road, Bush Road, Rosedale Road, Apollo Drive, Paul Matthews Road, William Pickering Drive and Sunset Road, each of which are expected to experience reduced traffic.

Effects on Pedestrians and Cyclists

The Project will include shared use paths parallel to SH1 from Oteha Valley Road to Constellation Bus Station, and parallel to SH18 from Albany Highway to Constellation Bus Station.

The proposed SH1 shared use path will be located on the eastern side of the motorway and busway corridors, with connections to the wider network at Oteha Valley Road, Masons Road, McClymonts Road, Spencer Road, Greville Road, Rosedale Road, Arrenway Drive and at Constellation Bus Station.

The proposed SH18 shared use path will be located to the north of SH18 (east of Albany Highway), connecting to Albany Highway, William Pickering Drive, an existing shared use path beneath SH18 at Alexandra Creek, and at Paul Matthews Road. The proposed shared use path would then cross SH18 via the realigned Paul Matthews Road, continuing east to the south of Upper Harbour Highway with connections at Caribbean Drive and Constellation Bus Station.

Additional pedestrian/cycle facilities are to be provided at McClymonts Road and Paul Matthews Road.

In addition, and as noted above, the Project is in general expected to result in reduced traffic flows on existing arterial routes.

In summary, it is concluded that the Project's effects on pedestrians and cyclists will be positive, and that the Project will result in significantly improved safety and connectivity outcomes for active modes.

Safety Effects of Project

The Project is expected to result in an increase in traffic on the motorway and local arterials leading to the motorway, with corresponding reductions in traffic elsewhere on the local network. If all other factors are equal, the likelihood of a crash would be expected to increase where traffic volumes increase (as a result of increased exposure and speed), and decrease where traffic volumes reduce (as a result of reduced exposure). As such, the reductions in traffic on the local network will have positive effects in terms of safety.

In addition, the rate of crashes occurring on the motorway and its interchanges are also expected to reduce, despite increases in traffic volumes and speed, because the Project will deliver a range of safety improvements, including:

- Removing motorway to motorway traffic from the local road network, especially with regards to freight;
- Removing right turn movements from SH18 at Paul Matthews Road and Caribbean Drive;

- Reducing congestion and queuing on SH1, thereby reducing the incidence of rear-end type crashes;
- Improving street lighting throughout the Project extent;
- Providing increased shoulder widths;
- Improving existing crash barriers;
- The increased shoulder widths will allow forward visibility to be improved in certain locations; and
- Providing safe, separated pedestrian and cyclist facilities.

Predictions of the crash rates for SH1 and SH18 in 2031 with and without the Project have been developed. Crash reductions are predicted through sections of motorway that the Project will fundamentally change, particularly on SH18 east of Albany Highway, but small crash rate increases are predicted on sections outside the Project but where increases in traffic are expected as a result of the Project, such as on SH18 west of Albany Highway. It is acknowledged that an increase in traffic flows and an increase in the number of lane change manoeuvres introduced by the Project along SH1 may lead to an adverse effect in terms of the number of crashes between the Greville and Upper Harbour Interchanges. Also, the increase in forecast speeds in this area may lead to increases in the severity of crashes. In total however, a net reduction in annual injury crashes on the road network is expected, relative to 2031 predictions without the Project.

Effects during construction

It is understood that the precise method and sequencing of construction will be determined at a later date, by the contractor. However, the contractor will have to work within several constraints, as set out in the proposed conditions. The main points to note are:

- Construction is expected to take 3.5 years, but will affect different locations within the Project area at different times;
- Speed limit reductions are to be expected along SH1 and along SH18
- There is likely to be lane narrowing along SH1 and SH18, but the numbers of through traffic lanes and the location and extent of bus shoulder lanes and bus priority facilities along SH1 are to be retained as at present (as far as reasonably practicable); and
- McClymonts Road is to be kept open throughout the construction period, by the development of an off line bridge (as far as reasonably practicable). This is to allow eastbound buses from Albany Bus Station to reach the bus only on ramp at McClymonts Road, and to allow pedestrians to reach the Albany Bus Station.

Therefore the main effects of the construction works identified to date relate to:

- The effects of the speed limit and lane width reductions along SH1 and SH18;
- The effects of potential temporary works on Rosedale Road, at the motorway bridge;
- The effects of potential works along SH18 which may require the temporary banning of right turns to/from Paul Matthews Road; and
- The effects of construction related traffic, to and from the work sites.

The following points are noted in terms of predicted overall travel times during the construction period:

- Evening peak effects are predicted to be greater than morning peak effects;
- Understandably, full closure of Rosedale Road is predicted to result in greater effects than partial or one way closures;
- Operating Rosedale Road with two way, one lane working, with traffic signals, is predicted to result in lesser effects than one way operation;
- On Rosedale Road, eastbound operation is critical in the morning peak, while evening peak operation is more balanced; and

- Restrictions at Paul Matthews Road are predicted to result in smaller travel time increases than the full Rosedale Road closure.

Conclusion

The Northern Corridor Improvements Project will improve the efficiency and effectiveness of travel along the strategically significant routes of SH1, SH18 and the Northern Busway:

- The additional lanes along the mainline motorway, as well as the provision of direct connections between SH18 and SH1 (north), will ensure effective continuity of capacity. These improvements will offer efficiency gains throughout the Project area, which will benefit a significant volume of traffic, including freight movements;
- The extension of the Northern Busway, from the Constellation Bus Station to the Albany Bus Station, will provide a dedicated route for buses, allowing public transport passengers reliability of travel times;
- Additions and enhancements to walking and cycling facilities will also be made as part of the Project; and
- Overall, the Project will increase traffic volumes on SH1 and SH18, while generally reducing volumes on the local road network, for the benefit of local traffic, public transport and walking and cycling modes.

These improvements will enhance the capacity and efficiency of movement, for people and freight travelling within Auckland, and between Auckland and the north.

Contents

Appendices

Appendix H

Predicted Hourly Traffic Data – 2031 Sensitivity Tests

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Tables

Glossary of Abbreviations

Item	Description
AADT	Annual Average Daily Total (traffic flow)
AEE	Assessment of Environmental Effects
ART Model	Auckland Regional Transport Model
AUP	Auckland Unitary Plan (Operative in Part, 15 November 2016)
CAS	Crash Analysis System
CSA	Construction Support Area
DoT	(United Kingdom) Department of Transport
DSI	Death and serious injury
EEM	Economic Evaluation Manual
HCV	Heavy Commercial Vehicles
JMAC	Joint Modelling Applications Centre (the joint transport modelling team set up by NZ Transport Agency, Auckland Transport and Auckland Council). The team is responsible for running the regional transport models and for running or overseeing sub regional models)
KiwiRAP	New Zealand's road assessment programme
IPENZ	Institute of Professional Engineers New Zealand
NZMUGS	New Zealand (Transport) Modelling User Group
ONRC	One Network Road Classification
RoNS	Roads of National Significance
SH1	State Highway 1 / Northern Motorway
SH16	State Highway 16 / Northwestern Motorway
SH17	State Highway 17 / Albany Expressway
SH18	State Highway 18 / Upper Harbour Motorway
SH20	State Highway 20 / Southwestern Motorway
SUP	Shared Use Path
T2 Lane	Transit Lane, allowing only trucks, buses and vehicles with two or more occupants
TDG	Traffic Design Group
UHH	Upper Harbour Highway
V/C ratio	Volume to capacity ratio

Terms and Definitions

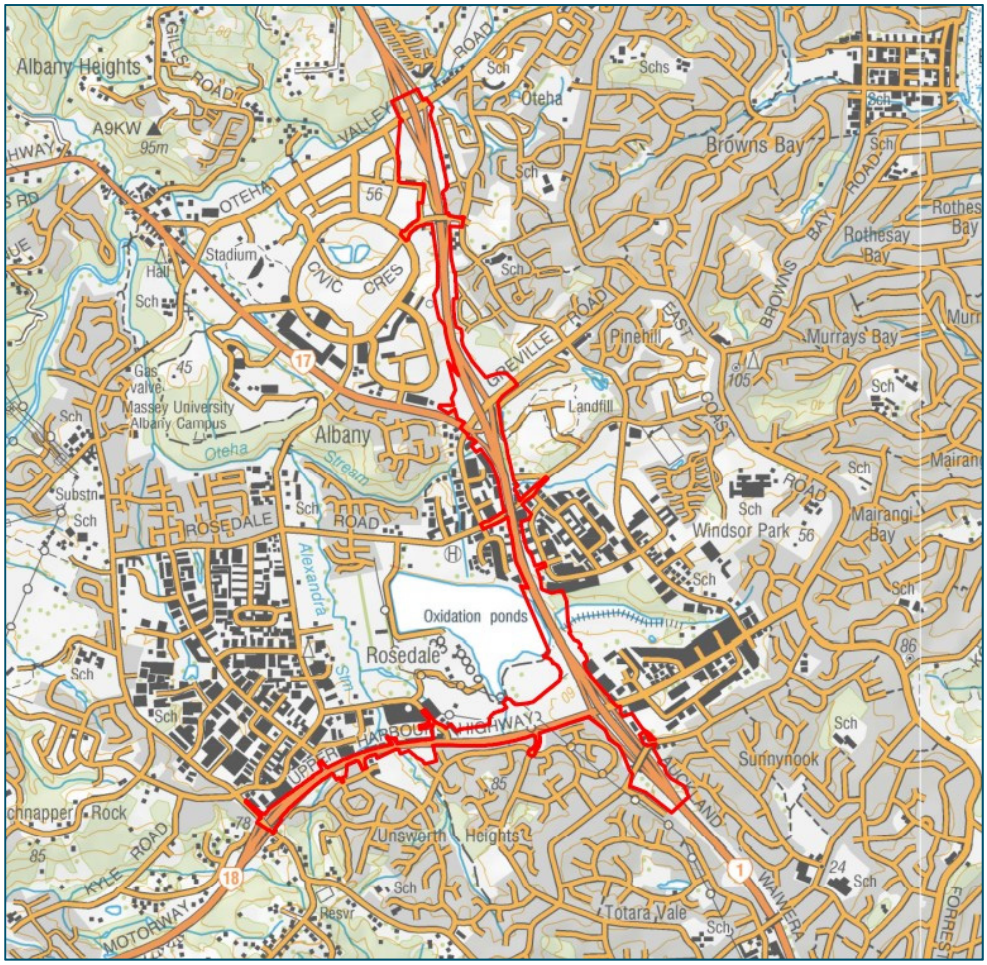
Item	Description
Project	Refers to the Northern Corridor Improvements Project including the extension to the Northern Busway and proposed Shared Use Pathway.
Project area	The area within the proposed designation(s) corridor for the Northern Corridor Improvements Project and that area abutting this corridor.

1 Description of Project

1.1 Project Background

The Northern Corridor Improvements Project (the Project) is an accelerated project. The Project area covers the area of SH18 between Albany Highway and Constellation Drive, and SH1 between Upper Harbour Highway interchange to just beyond the Oteha Valley Road Interchange as indicated on **Figure 1** below and confirmed in the suite of plans provided in **Volume 5**.

Figure 1 Extent of Project Area



Source: Base Map from LINZ

The Project proposes to upgrade the existing State highways within the Project area. In summary, the key elements of the Project are as follows:

- North and West Motorway Interchange connections – SH1/SH18;
- State highway capacity and safety improvements;
- Northern busway extension from Constellation Bus Station and connection to Albany Bus Station;
- Reconfiguration of Constellation Bus Station converting it from a terminus station to a dual direction station; and

- Shared Use Path (SUP) provision along existing SH1 and SH18 routes for the full extent of the Project corridor:
  - Constellation Bus Station to Oteha Valley Road;
  - Constellation Drive to Albany Highway; and
  - Intermediate linkages to local network.

1.2 Contents of this Report

This report is set out as follows:

- Section 2 provides background to the Project;
- Section 3 sets out the existing transport environment;
- Section 4 sets out the Project details, noting that a more detailed description of the Project, including its components and construction, is contained in section 5 of the Assessment of Environmental Effects (AEE);
- Section 5 summarises the nature of the transport modelling carried out for this assessment
- Section 6 sets out the Future Reference Case, meaning the future transport environment, without the Project;
- Section 7 sets out the transport effects of the Project, focussing on a future design year of 2031. These effects include area wide traffic effects, local traffic effects, safety effects, plus effects on walking, cycling and public transport;
- Section 8 sets out the transport effects of the construction phase of the Project;
- Section 9 summarises the results of a series of traffic modelling sensitivity tests; and
- Section 10 provides conclusions.

1.3 Other Reports

This report should not be read in isolation, as it is one of a suite of technical reports that has been prepared to inform the AEE for the Project. Other reports of relevance to the transport assessment include:

- Section 5 of the AEE and the General Arrangement plans (**Volume 5**) include further detail relating to the description of the Project;
- Section 7 of the AEE includes an assessment of alternatives. The authors of this report took part in the assessment of many of the alternatives considered;
- Section 8 of the AEE includes details of land owners and other affected parties, while the Consultation Summary Report documents the consultation that has been carried out with these affected parties;
- Section 11 of the AEE considers the extent to which the Project is consistent with policies, rules and requirements, including the requirements of the Resource Management Act;
- The Design and Construction Report (**Volume 3 – Technical Assessment 15**) provides further technical detail relating to the design of the Project. This report includes additional technical plans, and it summarises the evolution of the design of the Project, such as the changes made to the design due to the ongoing safety audit process; and
- Further details relating to the construction of the Project are set out in the Design and Construction Report.

2 Background

2.1 Road of National Significance

There are seven Roads of National Significance (RoNS) projects that are based around New Zealand's five largest population centres. The focus of these projects is on moving people and freight between and within these centres more safely and efficiently.

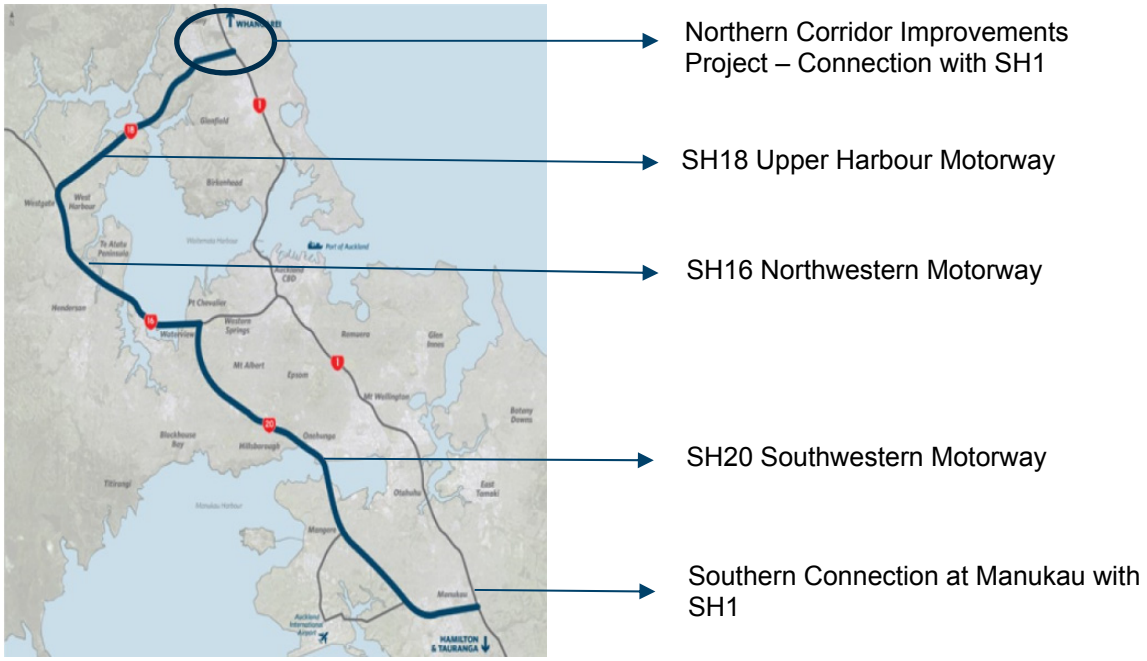
The Northern Corridor is part of the primary route between Auckland and Northland, and forms the northernmost link of the Western Ring Route, which is defined as one of the RoNS. The Western Ring Route project has an estimated cost of over $2.4 Billion. Once complete, the Western Ring Route will be an alternative to Auckland's SH1, linking Manukau, Auckland, Waitakere and the North Shore, improving network resilience and travel time reliability. After the completion of the currently under construction Waterview project, the Northern Corridor Improvements section will be the final section of Western Ring Route not completed to motorway standard.

In addition, SH1 and SH18 are classified as high volume, nationally significant routes.

The Project covers the area of SH18 between Albany Highway and Constellation Drive, and SH1 between Upper Harbour Highway Interchange and the Oteha Valley Interchange. The busway component of the works extends the Northern Busway further north, from Constellation Bus Station to Albany Bus Station.

A site location map that identifies the Western Ring Route and the location of the Project is shown in **Figure 2**.

Figure 2 Site Location, Western Ring Route



Source: NZ Transport Agency

2.2 The Auckland Accelerated Projects

In a speech by Prime Minister John Key on 28 June 2013, known as the "Backing Auckland" speech, Mr Key announced the acceleration of a number of transport projects in Auckland. The speech stated:

> *"Although conditions will improve as a result of current investment, the state highway network will come under further pressure as Auckland grows.*
>
> *The New Zealand Transport Agency has some projects on its books that would address congestion, capitalise on the benefits of the Western Ring Route and improve access to the airport.*
>
> *These include projects to:*

- *Deliver a complete motorway-to-motorway link between the Upper Harbour Highway and the Northern Motorway at Constellation Drive, upgrade the Greville Road interchange and improve the Northern Busway;*
- *Widen the Southern Motorway between Manukau and Papakura; and*
- *Reduce delays on the final State Highway 20A link to the airport from the north by upgrading it to motorway standard.*

The speech continued, stating that under funding assumptions at the time, construction of these projects may have been up to 10 years away from starting, but that the Government was not prepared to wait that long. The Transport Minister at the time, Minister Gerry Brownlee, asked the NZ Transport Agency for advice on how to bring forward the construction start dates for these projects, noting that additional funding was to be made available to enable this to happen.

Thus, the Project is one of the Government's Auckland Accelerated Projects, implying that it has high priority for funding and implementation.

2.3 The National State Highway Strategy

SH1, SH20, SH16 and SH18 (the Western Ring Route) are all classified as high volume, nationally significant routes in the NZ Transport Agency's National State Highway Strategy document[2]. This is separate from the Western Ring Route's status as one of the RoNS, and it is the highest classification of State highway in New Zealand and is reserved for strategic routes that provide the backbone to national economic growth and productivity.

2.4 Auckland Plan

The Auckland Plan sets out the strategy to make Auckland "the world's most liveable city". It sets out the proposed approach to accommodate an expected increase of Auckland's population by one million people, to reach 2.5 million by 2050. The transport targets are as follows:

- Double public transport from 70 million trips in 2012 to 140 million trips by 2022 (subject to additional funding);
- Increase the proportion of trips made by public transport into the city centre during the morning peak, from 47% of all vehicular trips in 2011 to 70% by 2040;
- Reduce road crash fatalities and serious injuries from 506 (2010) to no more than 410 in 2020;
- Reduce congestion levels for vehicles on the strategic freight network to or below the average of 2006-2009 levels (average daily speed of 45 km/h and average delay of 32 seconds per kilometre) by 2021); and

[2] Transit New Zealand (2007), "National State Highway Strategy", page 26

- Increase the proportion of people living within walking distance of frequent public transport stops from 14% (2011) to 32% by 2040[3].

The Plan seeks increases in the use of public transport, walking and cycling. However, growth in population and employment activity means that congestion is forecast to worsen. The Plan therefore foresees the need for a range of measures to manage congestion in Auckland, including completing the State highway network, upgrading the regional arterial road network, and selected improvements to other roads where network benefits would be achieved.

The Plan identifies the extension of the Northern Busway, from Constellation Bus Station to Silverdale Bus Station, as a project to be implemented between 2021 and 2030[4].

The Project will help deliver on these targets by extending the Northern Busway to Albany Station. This will make public transport more reliable and therefore more attractive for users (particularly during peak travel times). The Project will also reduce congestion for freight using SH18 and SH1, and improve road safety.

2.5 Auckland Regional Public Transport Plan

The Auckland Regional Public Transport Plan describes the public transport network that Auckland Transport proposes for the region. It shows the Northern Busway to Albany as forming part of the proposed rapid transit network[5], with that (top) level of the network being defined as being on a dedicated right of way, to achieve speed and reliability[6]. The Plan identifies the extension of the Northern Busway as part of the implementation plan, for the period 2018/19 to 2024/25[7].

2.6 The Need for the Project

The Northern Motorway Upper Harbour Interchange and the adjacent sections of SH1 and SH18 have been identified as critical sections of Auckland's road network, as they sit at the northern end of the Western Ring Route. On completion of the Waterview project in 2017, SH18 between Albany Highway and SH1 will become the only section of the Western Ring Route that is not constructed to motorway standard. These sections of State Highway currently operate with significant congestion, and this congestion is predicted to get worse following the completion the Western Ring Route, and as a result of growth in population and employment anticipated for Albany (including the surrounding areas) and areas further north.

The Northern Busway provides an excellent and reliable route for public transport between the Constellation and Akoranga Bus Stations, but buses need to join the general traffic stream north of the Constellation Bus Station. Bus services are as a result subject to congestion and travel time unreliability north of Constellation Bus Station.

The need for the Project is driven by the following:

- The need to complete the Western Ring Route by bringing the final section of this route to motorway standard;
- The need to relieve both existing and predicted future traffic congestion and travel time unreliability, particularly on SH1 and SH18, and at the interchange of these routes;
- The need to free bus services from congestion and travel time unreliability north of Constellation Bus Station by extending the Northern Busway;

[3] Auckland Council (2012), "Auckland Plan", page 312
[4] Ibid, page 334
[5] Auckland Transport (2015). "Regional Public Transport Plan", page 27
[6] Ibid, page 26
[7] Ibid, page 77

- The need to provide safe pedestrian and cycling connections along SH1 and SH18, as well as across both motorways; and
- The need to facilitate land use development within Auckland, as well as interregional travel between Auckland and Northland.

3 Existing Situation

3.1 Land Use

The Project area sits within the Upper Harbour Local Board area of the Albany Ward area in Auckland. The Upper Harbour area includes a mix of residential, commercial and light industrial land uses, and has seen major development in recent years.

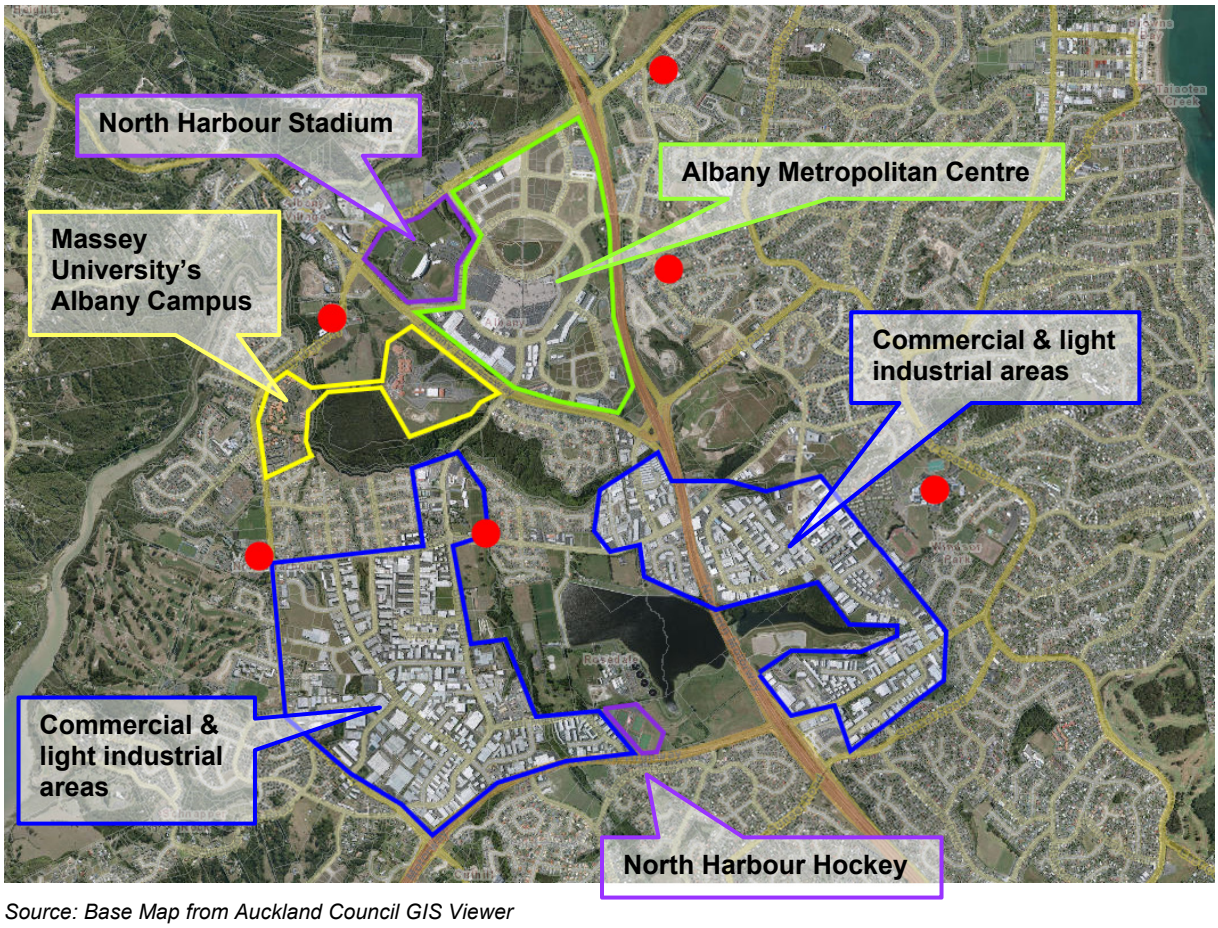
The area is home to the established Unsworth Heights community, with the Upper Harbour area housing approximately 53,670 residents. It also includes major regional facilities such as the Rosedale Wastewater Treatment Plant, North Harbour Hockey Stadium as well as land zoned public open space (such as Rosedale Park). The Upper Harbour area contains a significant proportion of Auckland's business community, and the number of businesses has consistently grown by 5.2% in 2014 to 9,240 and grown by 58.0% in the past 10 years[8].

The area services not only the local community (including the eastern residential suburbs of Sunnynook, Rosedale, Mairangi Bay, Murrays Bay, Rothesay Bay, Pinehill, Albany and Browns Bay), but also the wider Auckland region, particularly from the north and north-west (Dairy Flat, Helensville, Kaukapakapa). There are a number of significant attractions in the area. **Figure 3** illustrates the approximate land use characteristics in the vicinity of the Project, highlighting:

- Employment and economic activity in commercial and light industrial areas between SH1 / Constellation Drive and Albany Expressway / Greville Road (blue);
- Albany Metropolitan Centre shopping and retail precinct (green);
- Constellation Drive retail (blue);
- Massey University's Albany Campus (yellow);
- North Harbour (QBE) Stadium and North Harbour Hockey (purple);
- Access to East Coast Beach areas such as Mairangi Bay and Brown's Bay; and
- Schools including Rangitoto College, Oteha Valley School, Pinehill School, Albany Senior School, Kristin School, Pinehurst School and Albany Junior School (red circles).

[8] Auckland Council website, statistics on the economy in the Upper Harbour Local Board area extracted 26 February 2015

Figure 3 Main Land Uses in the North Harbour area



Source: Base Map from Auckland Council GIS Viewer

3.2 Surrounding Road Hierarchy

This section refers to a number of documents which set out the road hierarchy in the area.

3.2.1 The National State Highway Strategy

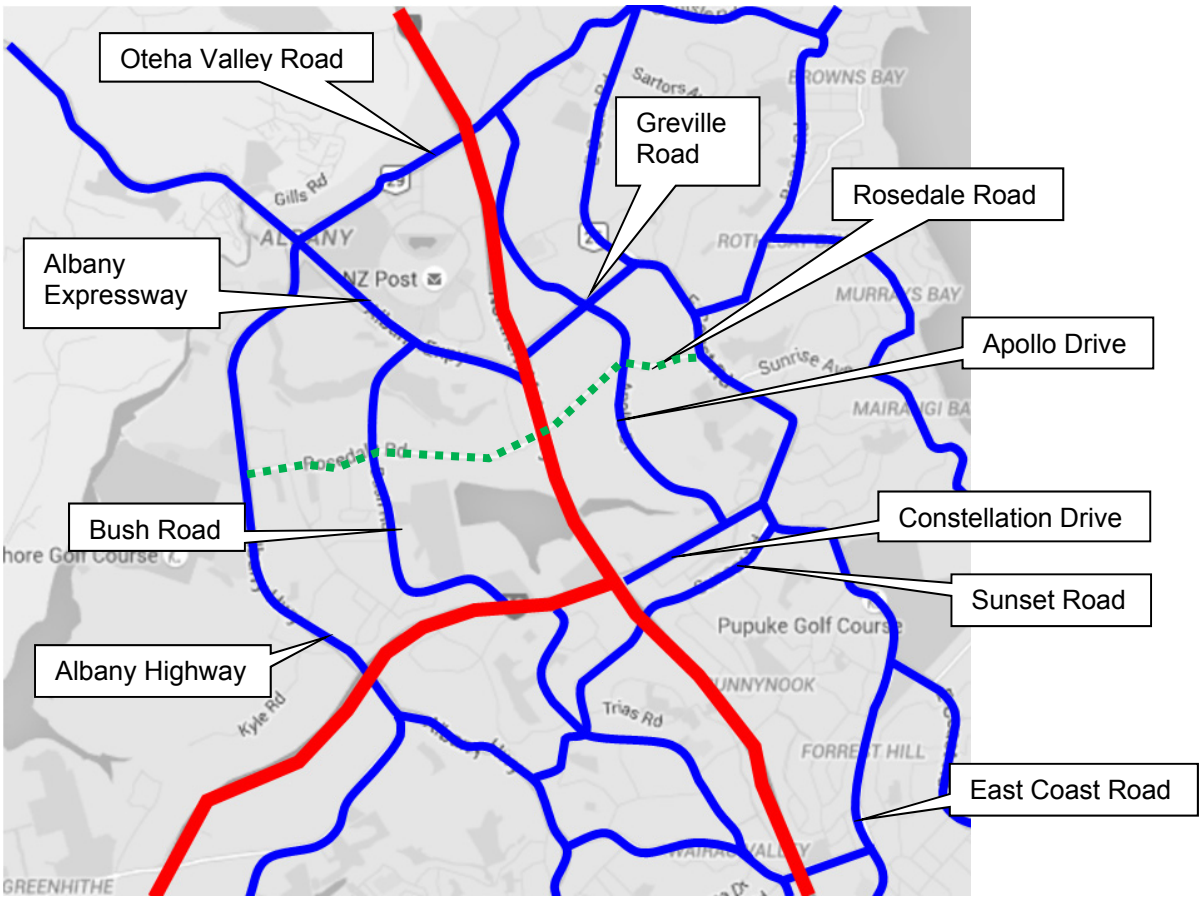
As noted in Section 2.3 above, SH1, SH20, SH16 and SH18 are all classified as high volume, nationally significant routes in the NZ Transport Agency's National State Highway Strategy document[9].

3.2.2 Auckland Unitary Plan

Figure 4 below shows the road hierarchy in the vicinity of the Project, as defined within the Auckland Unitary Plan (AUP, Operative in Part, 15 November 2016). The routes shown in red, being SH1 and SH18, are the nationally significant routes, as defined in the National State Highway Strategy, while all red and blue routes are defined as Arterials within the AUP.

[9] Transit New Zealand (2007), "National State Highway Strategy", page 26

Figure 4 Road Hierarchy



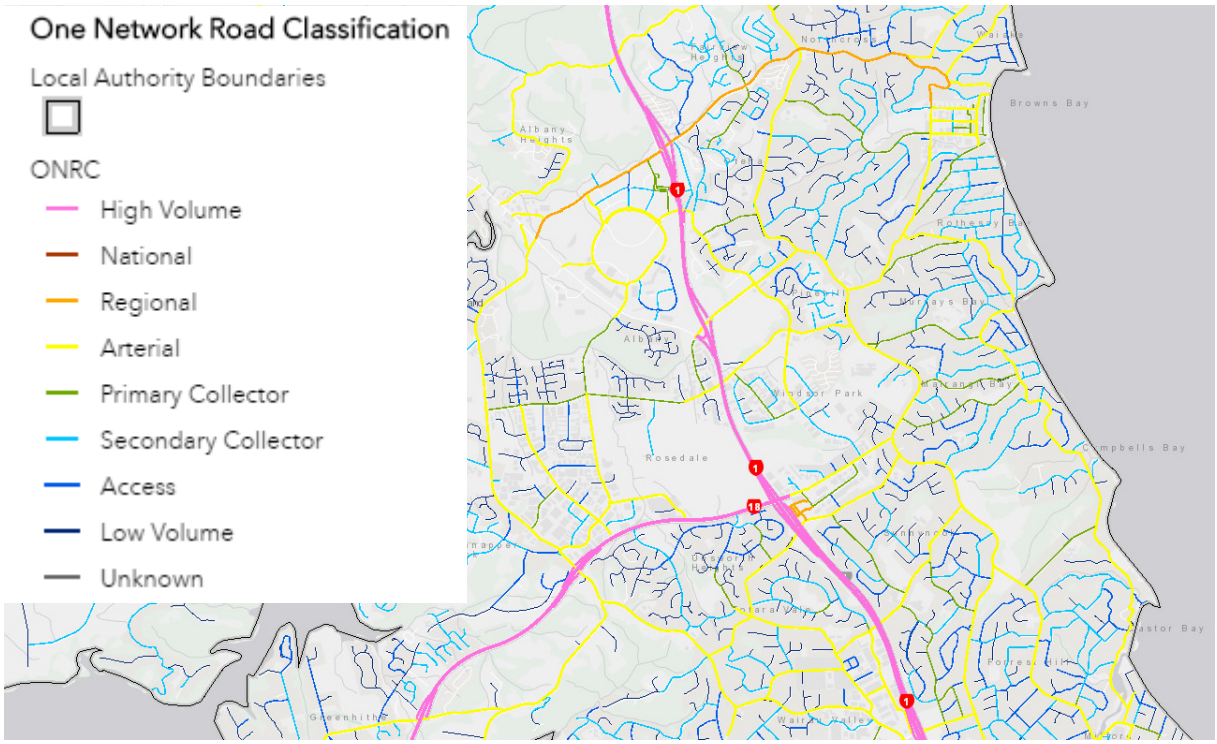
Source: Base Map from Google

3.2.3 One Network Road Classification

The NZ Transport Agency completed a road network classficatrion system for the extent of New Zealand in 2013, known as the One Network Road Classification (ONRC). This document aims to ensure road classifcations are applied consistently throughout the country.

The ONRC divides New Zealand's roads into six categories based on how busy they are, whether they connect to important destinations, or are the only route available. **Figure 5** below shows the ONRC for the Project area.

Figure 5 **One Network Road Classification for the Project area**



Source: NZ Transport Agency

3.2.4 Kiwi RAP

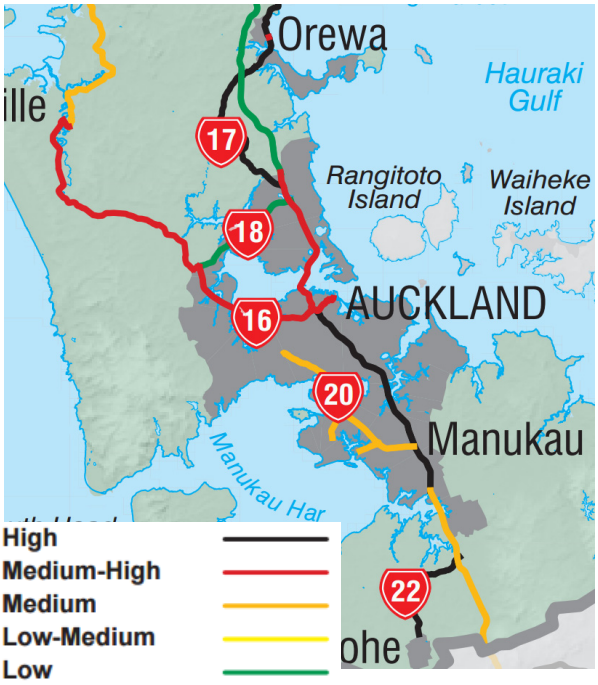
New Zealand's road assessment programme is known as KiwiRAP. The programme assesses state highway corridors with speed limits of 80 km/h or greater. This programme aims to improve the safety of the road network through identifying and treating crashes which are of high collective and or personal risk.

Collective Risk is a measure of the total number of fatal and serious injury crashes per kilometre over a section of road. Because Collective Risk is measured in terms of the number of crashes per kilometre of state highway, corridors with higher traffic volumes typically have a higher Collective Risk. Personal Risk is a measure of the risk to each individual using the state highway being assessed. Unlike Collective Risk, Personal Risk takes into account the traffic volumes on each section of state highway.

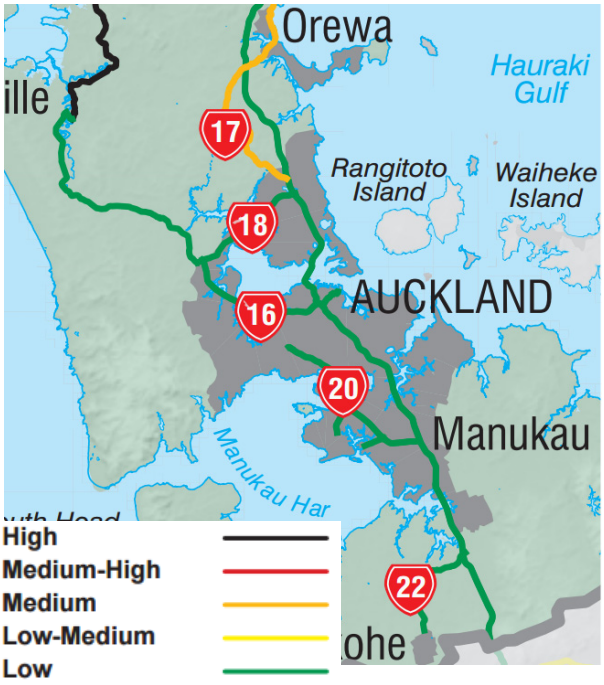
Figure 6 below shows the KiwiRAP ratings for the Project area.

Figure 6 KiwiRAP maps for the Project area

Collective Risk Map



Personal Risk Map



Source: KiwiRAP

3.3 Local Road Network

3.3.1 North-South Routes

Aside from SH1, the main north-south arterial routes on the local road network within the area of the Project are as follows:

- **Albany Highway:** Albany Highway is located to the west of SH1, and runs from Wairau Road, across SH18 (SH18 Albany Interchange) and connects to Albany Expressway. The road provides a local route, connecting the Beachhaven, Glenfield and Greenhithe areas to the North Harbour Industrial Estate and Albany. There are several schools on Albany Highway, along with the residential campus for Massey University;
- **East Coast Road:** East Coast Road runs along a ridge, providing access to the East Coast Bays. Connections to the strategic corridor from the west are via Constellation Drive, Greville Road and Oteha Valley Road;
- **Albany Expressway:** Albany Expressway connects the Albany Metropolitan Centre, North Harbour Stadium and employment areas with SH1 via the Greville Interchange. Albany Expressway is the old SH1 alignment, prior to the current SH1 alignment being constructed; and
- **Bush Road and Apollo Drive:** These roads provide access to the North Harbour and Apollo employment areas.

3.3.2 East-West Routes

Aside from SH18, the main east-west arterial routes within the area of the Project are as follows:

- **Oteha Valley Road:** Oteha Valley Road provides access between SH1 and the upper East Coast Bays, being Long Bay and Browns Bay on the eastern side of SH1. On the western side, Oteha Valley Road connects with the Albany Metropolitan Centre;
- **Constellation Drive:** Constellation Drive serves as a key east-west route for drivers travelling between SH18 (West Auckland) and the East Coast Bays, as well as providing connections to SH1 for business in the Constellation Drive and Apollo employment areas;
- **Greville Road:** Similarly to Oteha Valley Road to the north and Constellation Drive, Greville Road connects the East Coast Bays with SH1; and
- **Sunset Road and Rosedale Road (Local Road):** Each of these roads provide local crossing points across SH1, with each road passing through different land use activities. Sunset Road serves residential suburbs, with Rosedale Road serving mixed use industrial areas.

3.4 Current Layout of SH1

The layout of SH1 through the Project area was upgraded in 2014 to provide an additional northbound general traffic lane and a southbound bus shoulder lane, in order to reduce congestion and improve bus operations. The current layout of SH1, between Sunnynook Bridge and the Oteha Valley Interchange is as follows:

Northbound

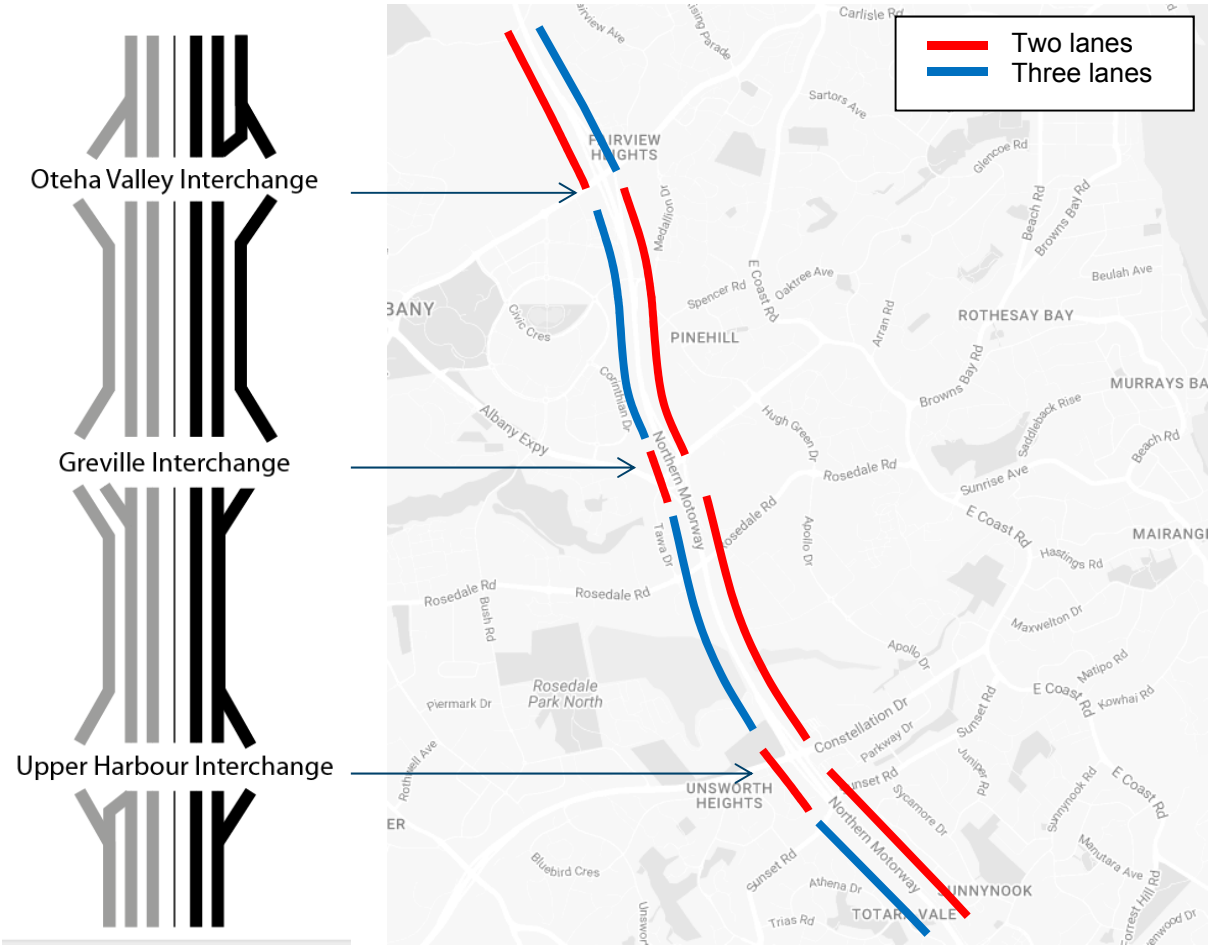
- Three main line lanes from the Sunnynook Bridge to the Upper Harbour Interchange off ramp, merging to two lanes approximately 625 metres beyond the Upper Harbour off ramp;
- A lane gain at the Upper Harbour on ramp, providing three main line lanes to the Greville Interchange;
- A lane drop at the Greville Interchange off ramp, providing two main line lanes through to the Greville Interchange on ramp; and
- Three main line lanes between Greville Interchange on ramp and Oteha Valley Interchange off ramp, with the kerbside lane acting as a climbing lane for heavy and/or slow moving vehicles.

Southbound

- Three main line lanes from the Oteha Valley Interchange on ramp through to the Greville Interchange off ramp, with the mainline merging to two lanes approximately 250 metres beyond the Greville Interchange off ramp: and
- Two main line lanes through the Greville Interchange, continuing through to beyond the Sunnynook Bridge.

This layout is shown indicatively in **Figure 7**.

Figure 7 Existing SH1 Lane Arrangement



Source: Base Map from Google

The SH20 Waterview project is due for completion in 2017 and when complete, the Western Ring Route will be complete, albeit not completely to motorway standard. The completion of the Waterview project will place additional pressure on the SH1 Upper Harbour Interchange and on the section of SH1 between the Upper Harbour Interchange and the Greville Interchange, noting that only two northbound lanes cross the Greville Interchange.

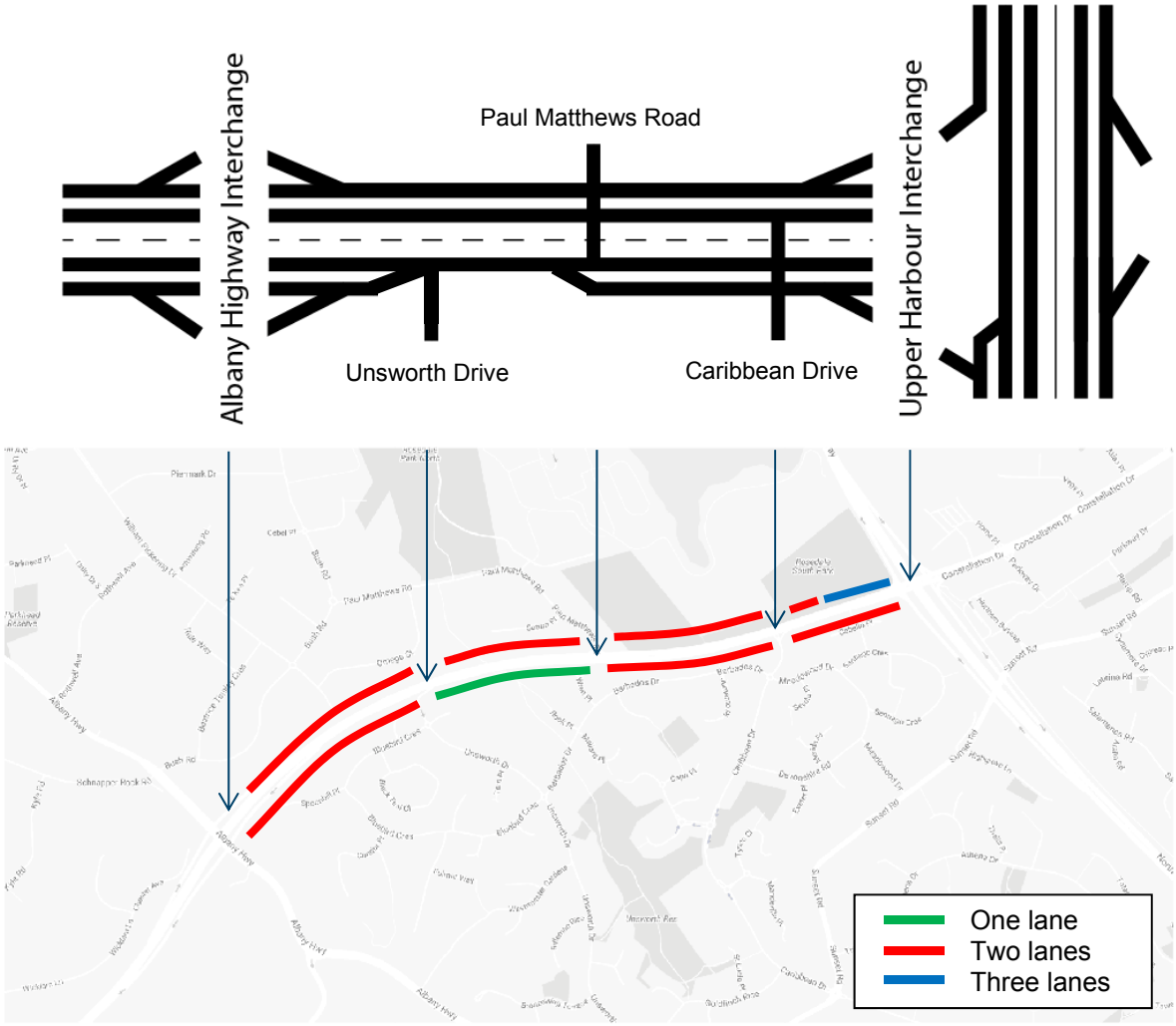
3.5 Current Layout of SH18

The layout of SH18 through the Project area has recently been improved, with improved stacking capacity being provided on the eastbound approach to the Upper Harbour Interchange with SH1. SH18 currently terminates to the east of the Albany Highway Interchange before transitioning into a corridor that provides local road access to the employment areas to the north (Paul Matthews Road), residential areas to the south (Caribbean Drive) and employment and residential areas to the east (Constellation Drive).

In order to ensure the Western Ring Route is an attractive and successful alternate route to SH1, it is essential that the northern end of the Western Ring Route, where it connects with SH1, provides suitable capacity and connections with SH1. Currently congestion occurs along SH18 given the capacity constraints at the at-grade signalised intersections, with queues also occurring on the local roads.

The layout of the eastern section of SH18 is shown indicatively in **Figure 8**. It is worth noting that there is a short section, between Paul Matthews Road and the Unsworth Drive exit, where there is only one westbound lane.

Figure 8 Existing SH18 / Upper Harbour Highway Lane Arrangement



Source: Base Map from Google

3.6 Current Interchanges and Cross Connections along SH1

The following interchanges and cross connections exist within the Project area (from south to north):

- A full interchange at SH1/Upper Harbour, with both north facing and south facing ramps;
- Rosedale Road passes under the motorway, without any connections to/from the motorway;
- A full interchange at SH1/Greville, with both north facing and south facing ramps;
- McClymonts Road passes over the motorway. The only connection with the motorway is a bus only southbound on ramp; and
- A full interchange at SH1/Oteha Valley Road, with both north facing and south facing ramps.

The interchange locations are shown indicatively in **Figure 7.**

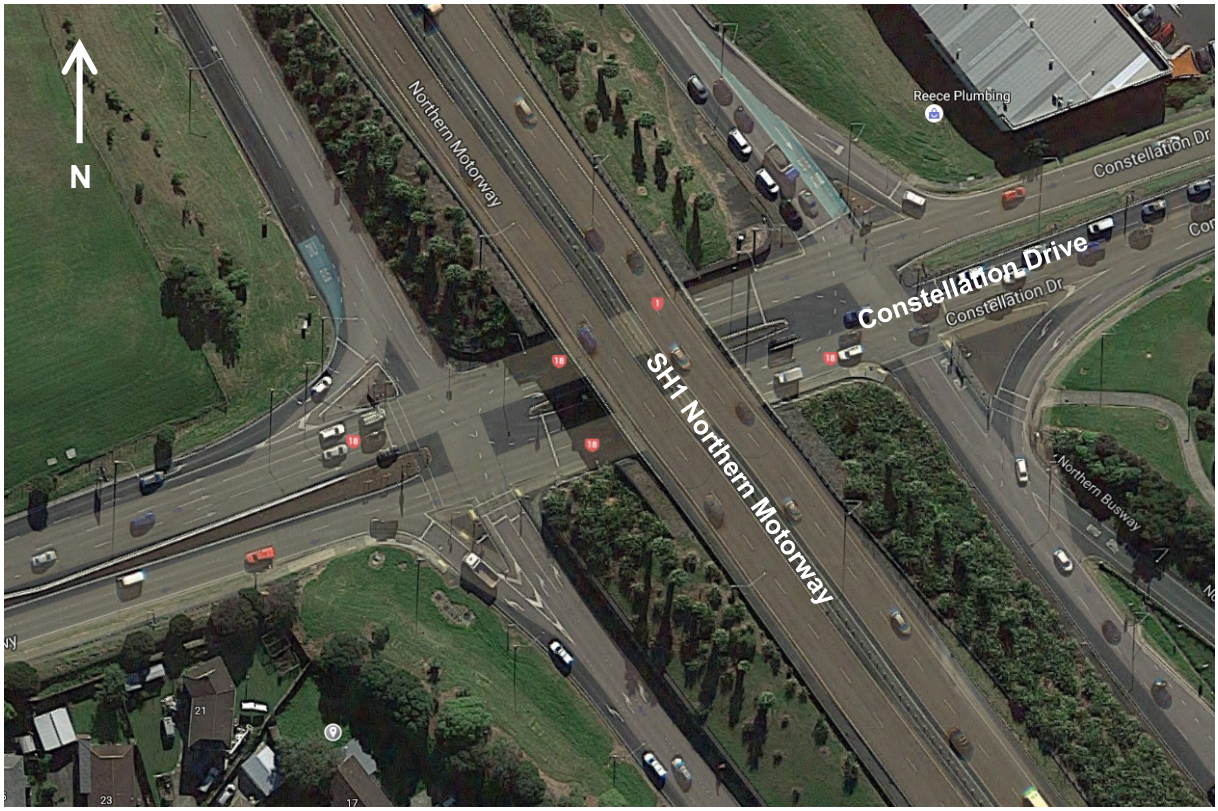
3.6.1 SH1 Upper Harbour Interchange

Upper Harbour Interchange includes both north facing and south facing ramps, with signalised intersections at the two intersections of the motorway ramps with Upper Harbour Drive (northbound ramps) and Constellation Drive (southbound ramps).

The interchange includes the following features (see **Figure 9**):

- Southbound buses have a short bus lane on the southbound off ramp, and can enter the Constellation Bus Station at the foot of the southbound on ramp;
- Both on ramps are metered, with two lane stop lines;
- The southbound on ramp has a T2 lane which bypasses the ramp meter signals;
- The northbound on ramp has a bus lane which bypasses the ramp meter signals; and
- The posted speed limit through the interchange (on the local road) is 50 km/hour.

Figure 9 Existing Layout at Upper Harbour/Constellation Interchange

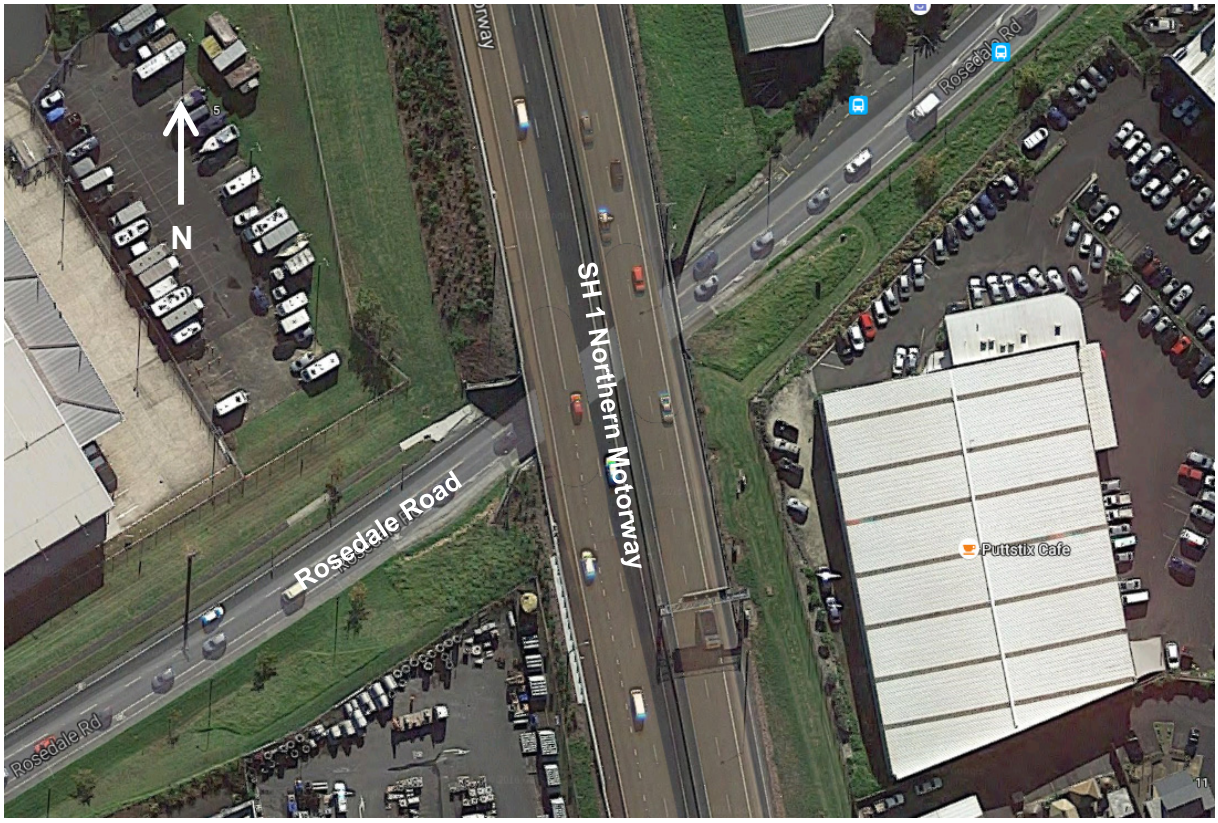


Source: Base Map from Google

3.6.2 Rosedale Road

Rosedale Road passes under the Northern Motorway, with no connections between the two, as shown in **Figure 10** below.

Figure 10 Existing Layout at SH1 and Rosedale Road



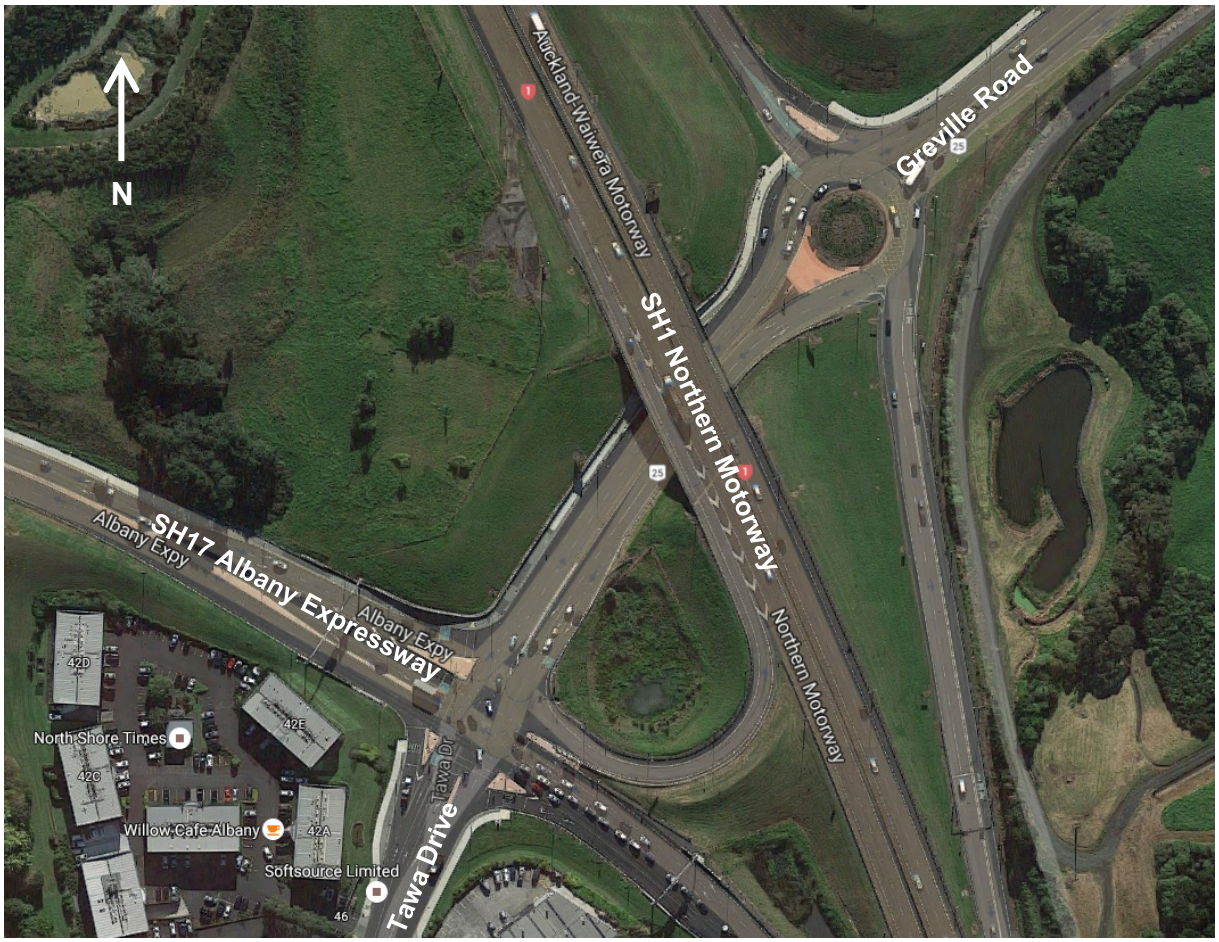
Source: Base Map from Google

3.6.3 SH1 Greville Interchange

The Greville interchange includes both north facing and south facing ramps. The interchange includes the following features (see **Figure 11**):

- The intersection of the northbound ramps with Albany Expressway is controlled by a signalised intersection, which replaced a roundabout layout in 2015;
- The intersection of the southbound ramps with Greville Road is controlled by a signalised tear drop roundabout, which prevents drivers on Greville Road (east) from performing a U-turn within the Interchange. The Greville Road (west) approach is signalised, in order to give priority to a short bus lane on the southbound off ramp (for Northern Express services) and to allow vehicles from the off ramp to enter the roundabout. The southbound off ramp is also signalised to provide a pedestrian crossing of this leg. However, the approach from Greville Road (east) is not signalised;
- Ramp metering signals operate on the southbound on ramp only, with the ramp including a T2 and Bus bypass lane; and
- The northbound on ramp consists of a sharp loop, which joins SH1 as a lane gain.

Figure 11 Existing Layout at Greville Interchange



Source: Base Map from Google

3.6.4 McClymonts Road

McClymonts Road passes over SH1, on a two lane bridge as shown in **Figure 12**. This bridge accommodates pedestrians on the northern side only. There are no connections between McClymonts Road and SH1 for general traffic, but there is a bus only southbound on ramp, for buses travelling from the Albany Bus station. Buses travelling from this station need to travel beyond the on ramp, U-turning at the McClymonts Road/Medallion Drive roundabout before turning left onto the bus only on ramp.

There is also a bus only northbound off ramp, just to the north of McClymonts Road, for buses travelling toward the Albany Bus Station.

Figure 12 Existing Layout at SH1 and McClymonts Road

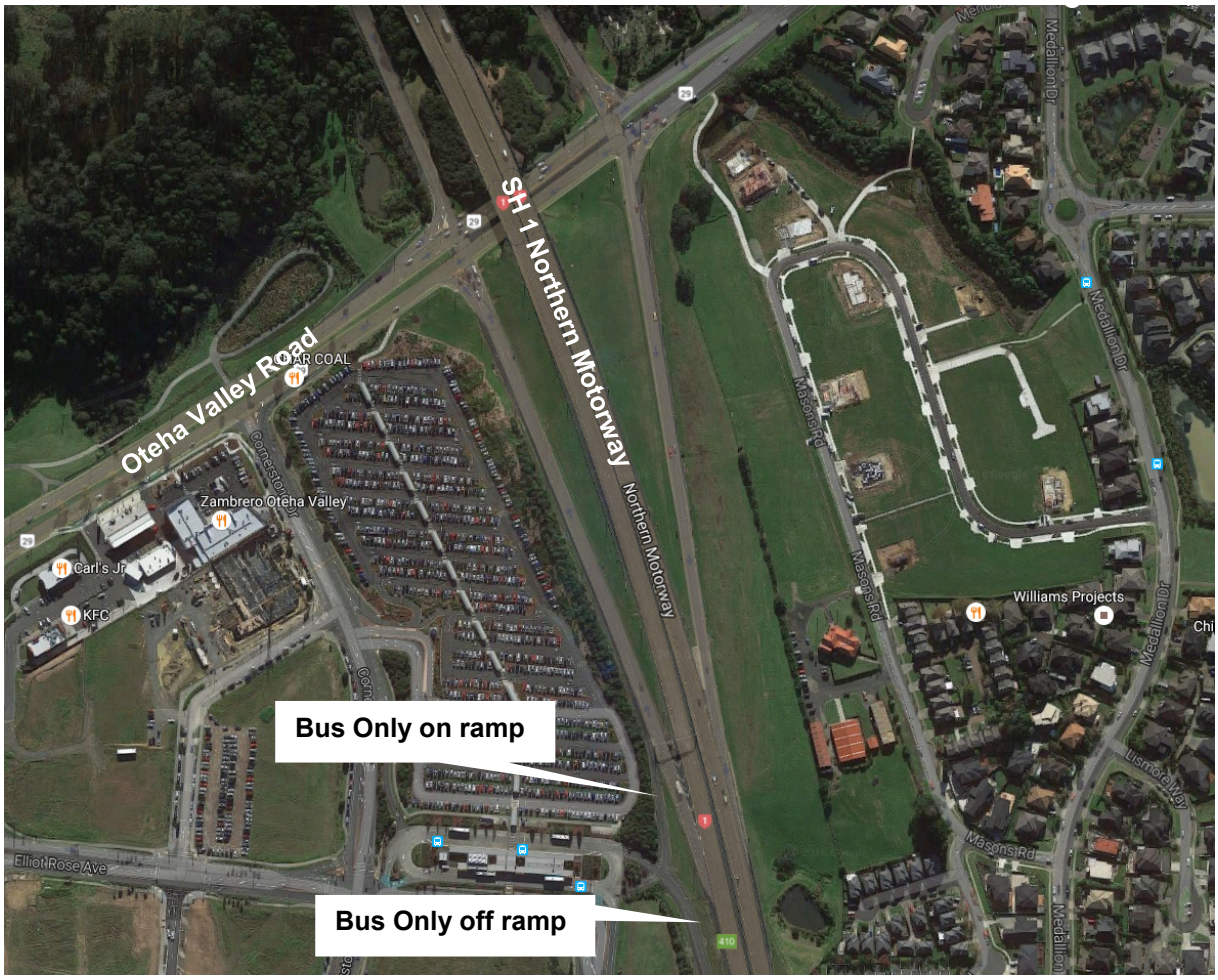
Source: Base Map from Google

3.6.5 SH1 Oteha Valley Interchange

The Oteha Valley Interchange includes both north facing and south facing ramps, with signalised intersections at the two intersections of the motorway ramps with Oteha Valley Road, as shown in **Figure 13**.

The layout includes a northbound bus only on ramp for traffic exiting the Albany Busway Station. This on ramp joins the general traffic off ramp, with buses either using the northbound on ramp to head to Silverdale, or turning right onto Oteha Valley Road.

Figure 13 Existing Layout at Oteha Valley Interchange



Source: Base Map from Google

3.7 Current Connections along SH18

The following interchanges/intersections exist within the Project area:

- A full interchange at SH1/Upper Harbour (see Section 3.6.1 above);
- An at grade T-intersection with Caribbean Drive;
- An at grade T-intersection with Paul Mathews Road;
- An off ramp (for left turning traffic only) into Unsworth Drive; and
- A full interchange at Albany Highway, with both east facing and west facing ramps.

The interchange locations are shown indicatively in **Figure 8.**

3.7.1 SH18/Caribbean Drive

Caribbean Drive ties into SH18 at a signalised T-intersection, as shown in **Figure 14**. The key features are as follows:

- There is a very short distance from the SH18/Caribbean Drive signals back to the Caribbean Drive/Barbados Drive roundabout, such that queues extend back from the single right turn lane onto SH18 frequently block the roundabout;

- The right turn bay for traffic turning into Caribbean Drive is very short, meaning that this right turn sometimes blocks through traffic (mainly during the weekday evening peak); and
- There are no pedestrian facilities along the northern side of SH18, and therefore no facilities for pedestrians across SH18

Figure 14 Existing Layout at SH18/Caribbean Drive and SH18/Paul Matthews Road

Source: Base Map from Google

3.7.2 SH18/Paul Matthews Road

Paul Matthews Road ties into SH18 at a signalised T-intersection, as shown in **Figure 14**. The key features are as follows:

- Westbound through traffic bypasses the intersection, via a "seagull" arrangement. (In other words, through traffic travelling west is shown a constant green arrow at the signals);
- The number of lanes for westbound traffic reduces from two to one, in the vicinity of this intersection;
- Traffic turning right out from Paul Matthews Road at the signalised intersection then merge into the single westbound lane with through traffic;
- Traffic turning left out from Paul Matthews Road merge with eastbound through traffic (i.e. the left turn is not signalised); and
- There are no pedestrian facilities across SH18.

3.7.3 SH18/Unsworth Drive

Westbound along SH18 (i.e. west from the Paul Matthews Road intersection), there is an exit to a petrol service station, followed by a westbound off ramp into Unsworth Drive, as shown in **Figure 15**. Traffic using this off ramp has to make a tight left turn, into this local street.

Figure 15 Existing Layout at SH18/Unsworth Drive and Albany Highway Interchange

Source: Base Map from Google

3.7.4 SH18/Albany Highway Interchange

Continuing westwards, is the interchange of SH18 with Albany Highway, as shown in **Figure 15**. This interchange provides full east facing and west facing ramps.

3.8 Existing Traffic Flows

Daily traffic flows along SH1 and SH18 have been sourced from the NZ Transport Agency Traffic Management System database, and the Auckland Transport count database. Traffic flows recorded in March 2015 have been downloaded and are summarised in **Figure 16** and **Figure 17**, representing average weekday and weekend flows.

Figure 16 Existing Weekday Traffic Flows (average daily vehicles in March 2015)

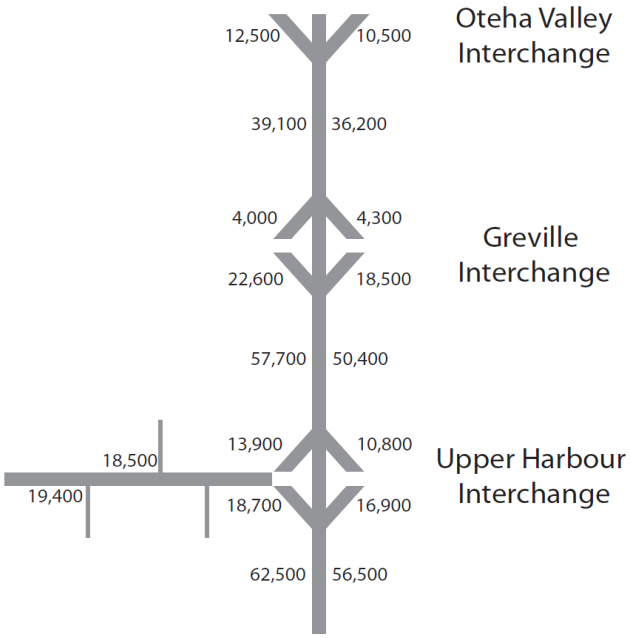
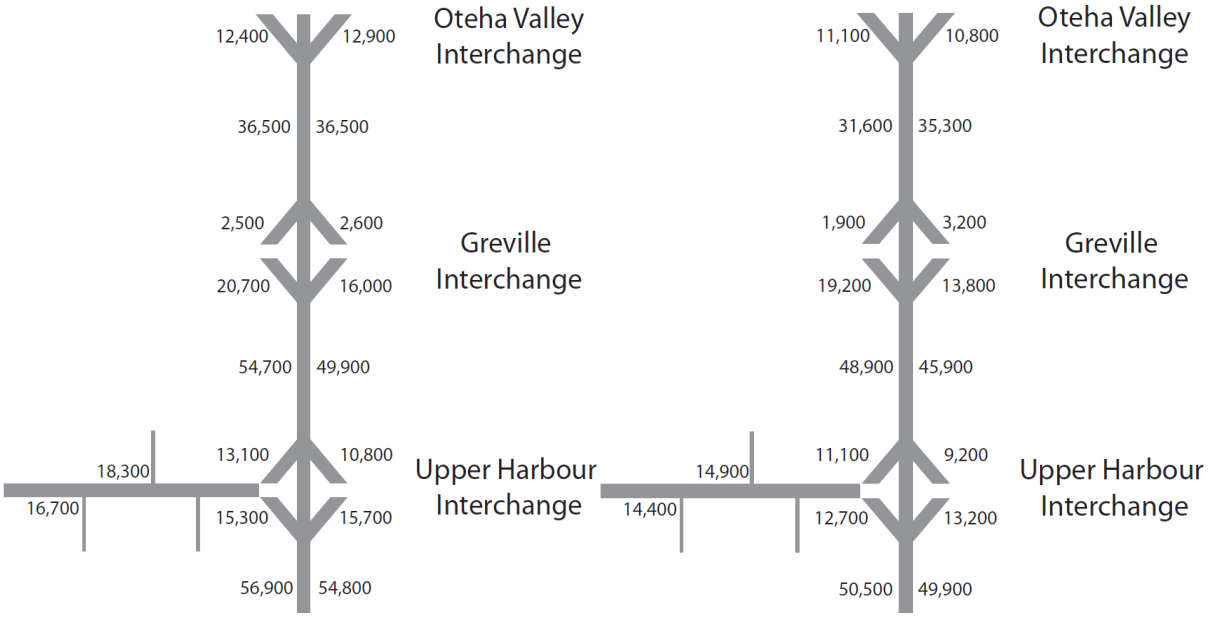


Figure 17 Existing Saturday (left) and Sunday (right) Traffic Flows (average daily vehicles, March 2015)



Two way flows along SH1 in March 2015 were as follows (see **Table 1**):

Table 1 SH1 Two Way Daily Volumes (March 2015)

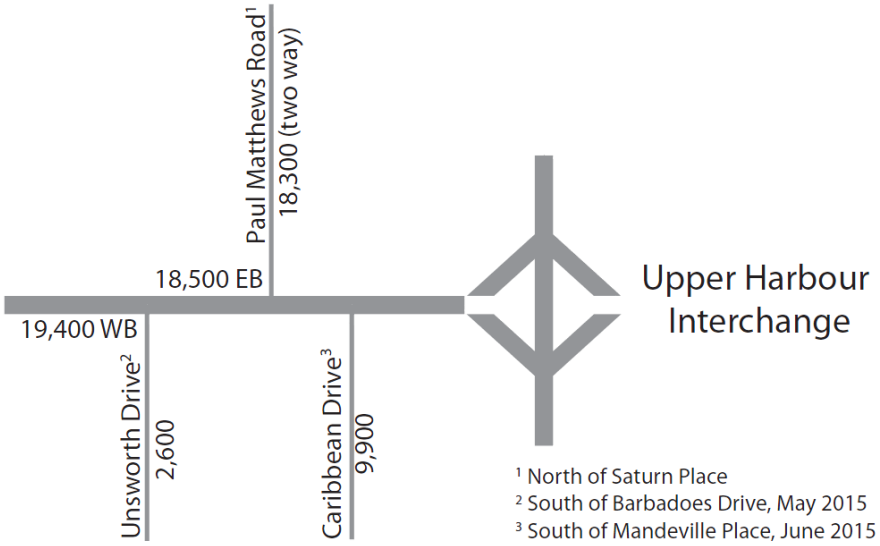
Section of motorway	Weekday	Saturday	Sunday
Between Greville and Oteha Valley Interchanges	75,300	73,000	66,900
Between Upper Harbour and Greville Interchanges	108,100	104,600	94,800
Between Tristram Avenue and Upper Harbour Interchanges	119,000	111,700	100,400

It can be seen that:

- The flows on SH1 reduce as one goes north; and
- Weekend flows are generally less than weekday flows, although Saturday flows are only a few per cent lower than those on weekdays.

In relation to SH18, existing weekday traffic volumes are provided in **Figure 18**.

Figure 18 Existing Weekday Traffic Flows: SH18 (average daily vehicles in March 2015)



Daily traffic volumes recorded on arterials surrounding the core study area are summarised in **Table 2**.

Table 2 Daily Traffic Flows on Key Local Roads (vehicles per day)

Road	Section of Road	5 Day Daily Flow (Two Way)	Date of Data
Apollo Drive	Constellation Drive to Antares Place	21,400	February 2015
Albany Highway	Sunset Road to Unsworth Drive	30,100	September 2015
Caribbean Drive	Mandeville Rise to Goldfinch Rise	10,000	June 2015
Constellation Drive	Parkway Drive to Atlas Place	15,200	February 2015
East Coast Road	Greville Road and Oaktree Avenue	15,600	June 2015
East Coast Road	Sunset Road and Constellation Drive	12,600	August 2015
Greville Road	SH1 Interchange and Hugh Green Drive	11,100	March 2015
Oteha Valley Road	East Coast Road and Mayfair Village	29,500	March 2015
Rosedale Road	Triton Drive to Tawa Drive	19,200	March 2015

3.9 Existing Traffic Flow Profiles

Existing peak hour traffic flow profiles are provided in the diagrams within **Appendix A**. These show the peak hour flow profiles along the motorway, in each direction, on a weekday, as well as on a Saturday and Sunday.

This information indicates that there are strong directional flows on SH1 in both peak periods (i.e. traffic in one direction is substantially higher than the other), with SH18 only experiencing a considerable flow difference in the morning peak hour. Generally, the northbound traffic on SH1 is greatest in the weekday evening peak hour, while the southbound direction is busiest during the weekend peak hour, followed by the morning peak hour. However the morning peak flows are constrained by the significant congestion experienced along the corridor during this period (refer Section 3.11.2).

3.10 Peak Traffic Flows

The plots in **Appendix A** indicate that the weekday peak hours are 6:00 to 7:00 am in the southbound and eastbound directions, 4:00 to 5:00 pm in the northbound direction, and 5:00 to 6:00 pm in the westbound direction.

The diagrams also provide information on the existing peak flows at weekends. The information indicates that the weekend peak typically occurs between 10:00 am and 1:00 pm. Furthermore, the weekend peak at Upper Harbour Interchange on SH1 and on SH18 west of Paul Matthews Road is greater than the midweek peak traffic volume.

It should be noted that these flows represent the volumes that can get to or through a particular section of road. That is to say, they do not represent the demand flows at peak periods.

3.11 Existing Operation of the Motorway Network

This section of SH1 and associated interchanges currently experiences high levels of congestion, resulting in delays and unreliable journey times. This is documented further in Section 3.11.2, in terms of minimum, maximum and average existing motorway journey times and speeds.

“Heat maps” showing areas of congestion along SH1, both during weekdays and at weekends, are provided within **Appendix A.**

Congestion along SH1 on weekdays is currently predominantly “tidal”, i.e. southbound in the morning peak and northbound in the evening peak:

- Southbound congestion in the weekday morning peak is a result of bottlenecks to the south of the Project area. While predominantly a morning peak issue, southbound congestion though Upper Harbour Interchange also occurs during the inter peak and evening peak periods, at the merges at the Greville and Upper Harbour southbound on ramps;
- The ultimate southbound bottleneck is the SH1/Esmonde Road interchange, where a busy on ramp joins three already full through lanes. Slow moving traffic regularly extends back through the Greville Road interchange, and often back to McClymonts Road or Oteha Valley Road, during the morning peak period; and
- Northbound flow breaks down during the weekday evening peak due to the reduction from three to two traffic lanes on SH1 within the Upper Harbour Interchange.

Congestion occurs at weekends, mainly on SH1 between the Upper Harbour and Greville Interchanges, in both directions:

- In the southbound direction, the bottleneck relates to the two lane section of SH1 from the Greville Interchange on ramp through to the Tristram Interchange off ramp; and

- In the northbound direction, no areas of congestion are shown in the heat maps at **Appendix A**, but congestion is known to occur from time to time at the three to two lane merge within the Upper Harbour Interchange.

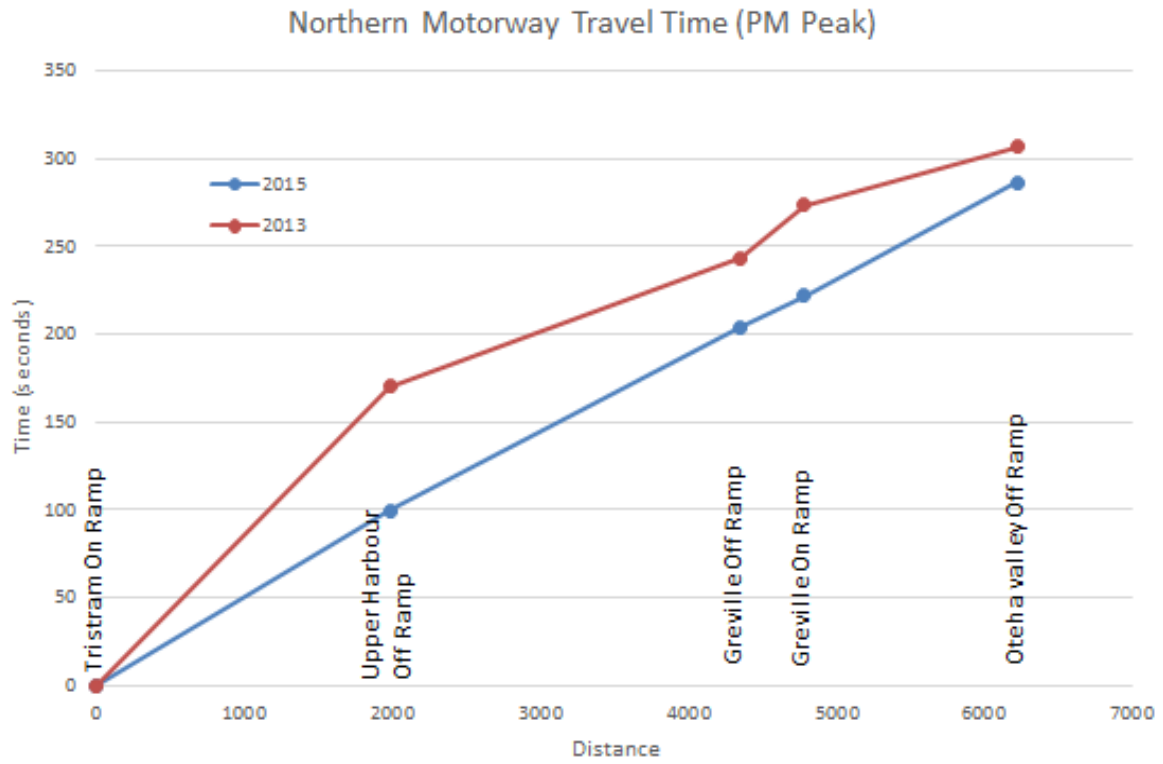
For the SH18 corridor, between Albany Highway and Constellation Drive, there is currently inherent conflict between 'through-traffic' and 'local access' traffic. There are four sets of traffic signals that restrict strategic traffic flow travelling between the SH18 and SH1 motorways, two of which provide local access[10].

3.11.1 Northern Motorway Improvements

The northbound auxiliary (i.e. third) lane between the Upper Harbour and Greville Interchanges was constructed in 2014. While the auxiliary lane did not remove the northbound constraint within the Upper Harbour Interchange, it has improved the operation of the merge and weave section between the Upper Harbour and Greville Interchanges.

Figure 19 shows the improvements observed in corridor performance, by comparing the 2013 travel times against those observed in 2015. While there has been an increase in traffic exiting SH1 at the Upper Harbour Interchange (as a response to the construction works on the Northwestern Motorway associated with the Western Ring Route project and growth at Hobsonville), the impacts of this reassignment on SH1 northbound travel times between the Upper Harbour and Greville Interchanges are likely to be minor, given that the Auckland Harbour Bridge controls the amount of traffic entering the North Shore.

Figure 19 Northbound Travel Times (Tristram to Oteha Valley Interchanges) – PM Peak (Average 4-6pm)



Source: Flow

[10] These are: two set of signals at the SH1 Upper Harbour Interchange, which operate under coordinated signal settings, plus the intersections of SH18 with Caribbean Drive and Paul Matthews Road.

3.11.2 Recorded Journey Times

Three-day-average journey time data for Tuesdays to Thursdays, obtained from the TomTom database, has been provided by the Transport Agency, for March 2015[11]. The following eight journey time routes have been analysed:

- Route 1 and 2: between the SH18 Albany Highway Interchange and the SH1 Oteha Valley Interchange, via SH18 and SH1;
- Route 3 and 4: between the Oteha Valley Road/Albany Highway intersection and the SH1 Tristram Interchange, via Albany Expressway (SH17) and SH1;
- Route 5 and 6: SH1 between the Tristram Interchange and the Oteha Valley Interchange; and
- Route 7 and 8: between the SH18 Albany Highway Interchange and the SH1 Tristram Interchange, via SH18 and SH1.

Figure 20 below illustrates each of the journey time routes.

Figure 20 TomTom Journey Time Routes

Source: Base Map from Google

A summary of the recorded journey times for each of the routes is summarised in **Table 3**. This table provides minimum (5th percentile), maximum (95th percentile) and average observed times.

[11] Data for Tuesdays to Thursdays has been taken as these are normally accepted as "neutral weekdays".

Table 3 Recorded 2015 Journey Times (mm:ss) and Average Speeds (km/h) (5th and 95th Percentile Journey Times in Brackets)

Route Description	Morning Peak	Inter Peak	Evening Peak
Route 1 – SH18 Albany Highway Interchange to SH1 Oteha Valley Interchange	7:30 (42 km/h) (4:05 to 22:30)	5:45 (55 km/h) (3:55 to 9:00)	6:30 (49 km/h) (4:00 to 11:20)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Highway Interchange	21:45 (16 km/h) (7:25 to 38:00)	6:20 (54 km/h) (4:15 to 8:30)	9:00 (38 km/h) (4:50 to 15:15)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	7:45 (55 km/h) (4:55 to 10:30)	7:50 (54 km/h) (4:45 to 10:40)	12:25 (34 km/h) (5:40 to 19:50)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	23:25 (18 km/h) (9:55 to 48:40)	7:35 (55 km/h) (5:05 to 10:50)	12:15 (34 km/h) (5:05 to 22:35)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	4:45 (78 km/h) (3:50 to 5:35)	4:50 (77 km/h) (3:50 to 5:40)	8:05 (46 km/h) (4:05 to 11:45)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	27:15 (14 km/h) (9:25 to 42:05)	4:35 (81 km/h) (3:55 to 5:25)	7:15 (51 km/h) (4:00 to 14:00)
Route 7 – SH1 Tristram Interchange to SH18 Albany Highway Interchange	7:10 (44 km/h) (3:40 to 11:15)	5:35 (56 km/h) (3:40 to 7:20)	11:15 (28 km/h) (4:30 to 19:25)
Route 8 – SH18 Albany Highway Interchange to SH1 Tristram Interchange	18:10 (18 km/h) (3:25 to 31:50)	5:40 (56 km/h) (3:40 to 8:05)	9:15 (34 km/h) (3:50 to 19:45)

Table 3 above demonstrates the congestion currently experienced along SH1 and SH18 during times of high traffic flows, with average speeds as low as 14 km/h recorded. The table also demonstrates the relatively poor travel time reliability currently experienced on many of the surveyed routes. For example, southbound travel times on SH1 during the morning peak range from 10 to 49 minutes, with an average time of 23 minutes.

3.12 Crashes within Project Area

A high level crash assessment has been carried out for the Project area. A search of the NZ Transport Agency's Crash Analysis System (CAS) has been completed for various five-year time frames dependent upon construction and completion of road upgrades within the study area.

The Project area has been assessed in sections as follows:

- SH1 Northbound from Sunset Road to McClymonts Road from 2009 to 2013 inclusive (prior to commencement of the construction works northbound on SH1);
- SH1 Northbound from Sunset Road to McClymonts Road during 2015 (post completion of the construction works);
- SH1 – Southbound from McClymonts Road to Sunset Road from 2011 to 2015 inclusive;
- SH18 –west of Unsworth Drive to SH1 from 2011 to 2015 inclusive;
- Greville Interchange immediate surrounds - West of SH1 from 2009 to 2013 inclusive (prior to commencement of the construction works which included changing the former roundabout on the western side of the interchange with traffic signals, and the partial signalisation of the eastern roundabout);
- Greville Interchange immediate surrounds - West of SH1 during 2015 (post completion of the construction works);

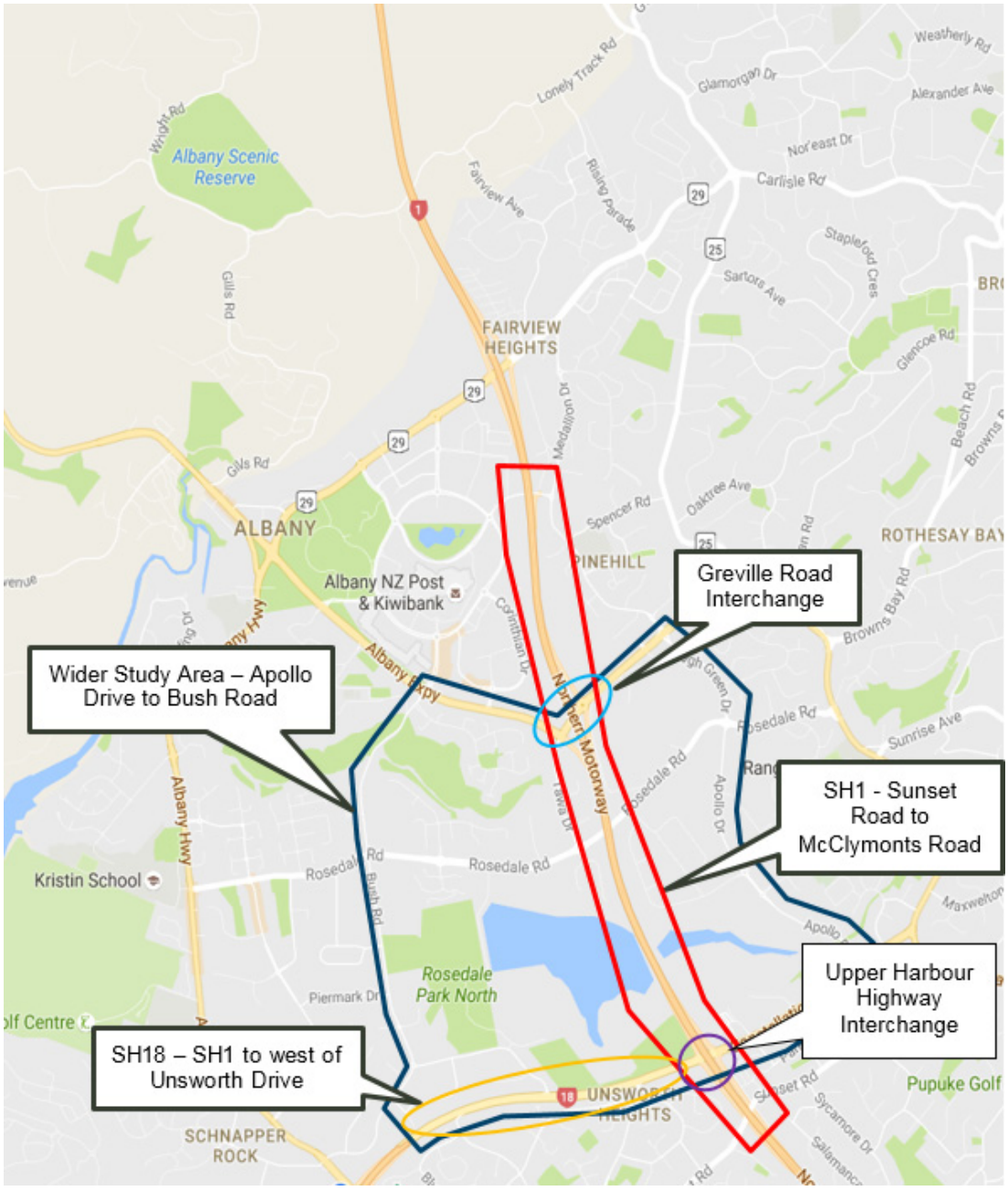
- Upper Harbour Interchange – Mainline within interchange from 2011 to 2015 inclusive; and
- Pedestrian and cyclist crashes – Bush Road to Apollo Drive from 2011 to 2015 inclusive.

In addition, a 2011 to 2015 CAS search has been undertaken in the surrounding area to help understand pedestrian and cyclist crashes on alternative active mode routes. The wider study area was that bounded by Bush Road, SH18, Apollo Drive, Hugh Green Drive, Greville Road and Albany Expressway.

The extent of the areas assessed is shown within **Figure 21.**

Crash diagrams are included within **Appendix B**.

Figure 21 Extent of Areas of Crash Analysis



Source: Base Map from Google

3.12.1 SH1 Northbound from Sunset Road to McClymonts Road, 2009 to 2013

A total of 366 crashes were reported on SH1 northbound from Sunset Road to McClymonts Road between 2009 and 2013 (inclusive). Of these crashes:

- 67 crashes were reported as resulting in minor injuries; and
- 2 crashes were reported as resulting in a serious injury.

Crashes have been categorised and recorded as having particular crash factors associated with them. Of the 366 reported crashes the following crash factors were reported:

- 11% of crashes were reported as having a crash factor of loss of control and/ or speed (39 crashes);
- 58% of crashes were reported as having a crash factor of intimidating driving, following too closely and/or failure to notice car slowing (214 crashes);
- 16% of crashes were reported as having a crash factor of swerving, changing lanes and/ or overtaking (58 crashes); and
- 15% of crashes were reported as having a crash factor of 'other' including unsecured load, alcohol, inexperience, obstruction on road, attention diverted and/ or illness (55 crashes).

3.12.2 SH1 Northbound from Sunset Road to McClymonts Road during 2015

A total of 35 crashes were reported on SH1 northbound from Sunset Road to McClymonts Road during 2015 (post completion of the construction works). Of these crashes:

- 9 crashes were reported as resulting in minor injuries.

Of the 35 reported crashes, the following crash factors were reported:

- 37% of crashes were reported as having a crash factor of loss of control and/ or speed (13 crashes);
- 11% of crashes were reported as having a crash factor of following too closely and/or failure to notice car slowing (4 crashes);
- 29% of crashes were reported as having a crash factor of swerving, changing lanes and/ or overtaking (10 crashes); and
- 23% of crashes were reported as having a crash factor of 'other' including alcohol, drugs, emotional, attention diverted and/ load not secured (8 crashes).

3.12.3 SH1 Southbound from Sunset Road to McClymonts Road, 2011 to 2015

A total of 210 crashes were reported on SH1 southbound from Sunset Road to McClymonts Road between 2011 and 2015 (inclusive). Of these crashes:

- 41 crashes were reported as resulting in minor injuries; and
- 6 crashes were reported as resulting in serious injury.

Of the 210 reported crashes, the following crash factors were reported:

- 14% of crashes were reported as having a crash factor of loss of control and/ or speed (29 crashes);
- 60% of crashes were reported as having a crash factor of intimidating driving, following too closely and/or failure to notice car slowing (125 crashes);
- 18% of crashes were reported as having a crash factor of swerving, changing lanes and/ or overtaking (38 crashes); and

- 9% of crashes were reported as having a crash factor of 'other' including alcohol, emotional (intentional collision), obstruction on road, attention diverted and/ or fatigue (18 crashes).

3.12.4 SH18 – West of Unsworth Drive to SH1 from 2011 to 2015

A total of 61 crashes were reported on SH18 between SH1 and just west of Unsworth Drive from 2011 to 2015 inclusive. Of these crashes:

- 12 crashes were reported as resulting in minor injuries.

Of the 61 reported crashes, the following crash factors were reported:

- 11% of crashes were reported as having a crash factor of loss of control and/ or speed (7 crashes);
- 46% of crashes were reported as having a crash factor of following too closely, misjudging the speed of their own vehicle and/or failure to notice car slowing (28 crashes);
- 28% of crashes were reported as having a crash factor of swerving, changing lanes and/ or overtaking (17 crashes);
- 5% of crashes were reported as having a crash factor of failure to give way at a priority traffic control and/or failure to give way when turning (3 crashes); and
- 10% of crashes were reported as having a crash factor of 'other' including alcohol, foot slipping off pedal, illness, attention diverted and/ dazzled by sun (6 crashes).

3.12.5 Greville Road Interchange (and immediate surrounds west of SH1)[12] 2009 to 2013

A total of 154 crashes were reported on and immediately around the Greville Road Interchange from 2009 to 2013 inclusive (prior to completion of the construction works). Of these crashes:

- 10 crashes were reported as resulting in minor injuries.

Of the 154 reported crashes, the following crash factors were reported:

- 2% of crashes were reported as having a crash factor of loss of control and/ or speed (4 crashes);
- 13% of crashes were reported as having a crash factor of following too closely and/or failure to notice car slowing (20 crashes);
- 14% of crashes were reported as having a crash factor of failure to give way at a priority traffic control and/or failure to give way when turning (22 crashes);
- 63% of crashes were reported as having a crash factor of being too far right or left, travelling straight ahead from a turning lane, changing lanes, incorrect position on the road, turning from incorrect lane, not checking for other vehicles and/or failure to signal (97 crashes); and
- 7% of crashes were reported as having a crash factor of 'other' including alcohol, evading enforcement, slipped pedal, attention diverted and/ or inexperience (11 crashes).

3.12.6 Greville Road Interchange (and immediate surrounds west of SH1 during 2015

A total of 30 crashes were reported on and immediately around the Greville Road Interchange in 2015 (post completion of the construction works). Of these crashes:

- 4 crashes were reported as resulting in minor injuries.

Of the 30 reported crashes, the following crash factors were reported:

- 17% of crashes were reported as having a crash factor of loss of control and/ or speed (5 crashes);

[12] Around 100 m from interchange on all legs

- 20% of crashes were reported as having a crash factor of following too closely and/or failure to notice car slowing (6 crashes);
- 3% of crashes were reported as having a crash factor of failure to give way at a priority traffic control and/or failure to give way when turning (1 crash);
- 47% of crashes were reported as having a crash factor of being too far right or left, changing lanes, overtaking, incorrect position on the road, turning from incorrect lane, not checking for other vehicles and/or failure to signal (14 crashes); and
- 13% of crashes were reported as having a crash factor of 'other' including alcohol, attention diverted, hitting parked vehicle and/ or inexperience (4 crashes).

3.12.7 Upper Harbour Highway Interchange (and immediate surrounds east and west of SH1)[13]

A total of 109 crashes were reported on and immediately around the Upper Harbour Highway Interchange from 2011 to 2015 inclusive (post completion of the construction works). Of these crashes:

- 24 crashes were reported as resulting in minor injuries.

Of the 109 reported crashes, the following crash factors were reported:

- 7% of crashes were reported as having a crash factor of loss of control and/ or speed (8 crashes);
- 46% of crashes were reported as having a crash factor of following too closely, misjudging speed of own or other vehicle and/or failure to notice car slowing (50 crashes);
- 35% of crashes were reported as having a crash factor of being too far right or left, failure to give way at a priority traffic control, travelling straight ahead from a turning lane, incorrect merging or lane change, incorrect position on the road, turning from incorrect lane, not checking for other vehicles, misjudged intentions of other drivers, cutting corners, blind spot, and/or failure to signal (38 crashes); and
- 12% of crashes were reported as having a crash factor of 'other' including alcohol, obstruction on road, parking brake not applied, fatigue, attention diverted and/ or unsecured load (13 crashes).

3.12.8 Pedestrian and Cyclist Crashes in Wider Study Area 2011 to 2015 inclusive

A search of the CAS database between Bush Road and Apollo Drive (refer **Figure 21)** shows that from 2011 to 2015 inclusive, eight crashes have been reported involving pedestrians and ten crashes involving cyclists were reported.

Of the 18 crashes, ten resulted in minor injuries and three resulted in serious injuries. One serious crash occurred at the intersection of Constellation Drive and Atlas Place, where a right turning car failed to give way to a cyclist. A second occurred on Greville Road where a vehicle collided with a pedestrian on the street. The third occurred at the intersection of Rosedale Road and Hugh Green Drive, where a car failed to give way and collided with a cyclist.

It is noted that four of the reported crashes occurred at the intersection of Parkway Drive and Constellation Drive.

A summary of the crashes reported in CAS within the Project area is provided in below in **Table 4**.

[13] Around 50 m east and west of the interchange noting that some crash data may be replicated in CAS data provided for SH18 from = Unsworth Drive to SH1

Table 4 Reported Crashes in Project Area (CAS database)

Route	Average crashes/year	Predominant crash factor/s
SH1 Northbound from Sunset Road to McClymonts Road from 2009 to 2013	0.4 serious injury crashes 13 minor injury crashes **73 total crashes**	Following too closely, intimidating behaviour and/or failure to notice car slowing
SH1 Northbound from Sunset Road to McClymonts Road during 2015	9.0 minor injury crashes **35 total crashes**	Loss of control and/or speed
SH1 – Southbound from McClymonts Road to Sunset Road from 2011 to 2015	1.2 serious injury crashes 8.2 minor injury crashes **42 total crashes**	Following too closely, intimidating behaviour and/or failure to notice car slowing
SH18 –SH1 to west of Unsworth Drive from 2011 to 2015	2.4 minor injury crashes **12 total crashes**	Following too closely, misjudging speed of own vehicle and/or failure to notice car slowing
Greville Interchange and immediate surrounds west of SH1 from 2009 to 2013	2.0 minor injury crashes **31 total crashes**	Too far right or left, incorrect lane position, changing lanes, not checking for other vehicles and/ or failure to signal
Greville Interchange and immediate surrounds west of SH1 during 2015	4.0 minor injury crashes **30 total crashes**	Too far right or left, incorrect lane position, changing lanes, not checking for other vehicles and/ or failure to signal
Upper Harbour Interchange and immediate surrounds east of SH1 from 2011 to 2015	4.8 minor injury crashes **22 total crashes**	Following too closely, misjudging speed of own vehicle and/or failure to notice car slowing
Bush Road to Apollo Drive - Pedestrian and Cyclist 2011 to 2015	0.6 serious injury 2.0 minor injury **4.8 total crashes**	Vehicle failed to give way, pedestrian crossing 'heedless of traffic'

Further analysis of the crashes reported in the Project area shows that the majority of crashes were rear-end/obstruction crashes. This is not unexpected in congested motorway conditions.

Changing lanes, overtaking and merging crashes were also noted as common crash events.

Serious Injury only crash maps indicate that crashes are scattered and are not concentrated within particular areas. There are no specific areas that have a noticeably higher number of crashes or crash types. However there may be localised problematic areas on the network which affect the overall safety of the network.

3.13 Pedestrian and Cycle Facilities

Pedestrians and cyclists are not currently allowed to travel along the SH1 motorway corridor.

The SH1 and SH18 corridors both present significant barriers to walking and cycling accessibility, with a general lack of provision along or across these routes. The Upper Harbour Highway and Greville Interchanges both form part of the existing or proposed Regional Cycle Network. While improvements at the Greville Interchange have recently been introduced, facilities through the Upper Harbour Interchange are limited.

Along SH18, there is a footpath on the southern side between the Upper Harbour Interchange and Caribbean Drive, but no facilities further west. Therefore, there is no walking/cycling connection

between the Constellation Bus Station and the employment area and the North Harbour Hockey stadium within the North Harbour Business Park (via Paul Matthews Road).

The majority of the other (i.e. non State highway) corridors in the area provide footpaths on both sides of the road, with a few exceptions. Existing cycle facilities are provided along a few routes, or sections of routes, with several significant gaps present. The gaps prevent cyclists from having a continuous, well connected route to their destination and often leave cyclists with no safe facility in the most challenging locations e.g. intersections and interchanges.

Auckland Transport undertakes cycle counts at specified locations annually. Count locations near the Project include:

- Oteha Valley Road / SH17 (Albany Expressway) / Albany Highway;
- Rosedale Road / Bush Road;
- Rosedale Road / East Coast Road; and
- Upper Harbour Drive / Albany Highway.

A summary of the total cyclists surveyed at the above locations for the last five years are summarised in **Table 5**. Results reflect the cyclists surveyed between 6:00am to 9:00am and 4:00pm to 7:00pm.

Table 5 Annual Cycle Count Summary (2011 – 2015)

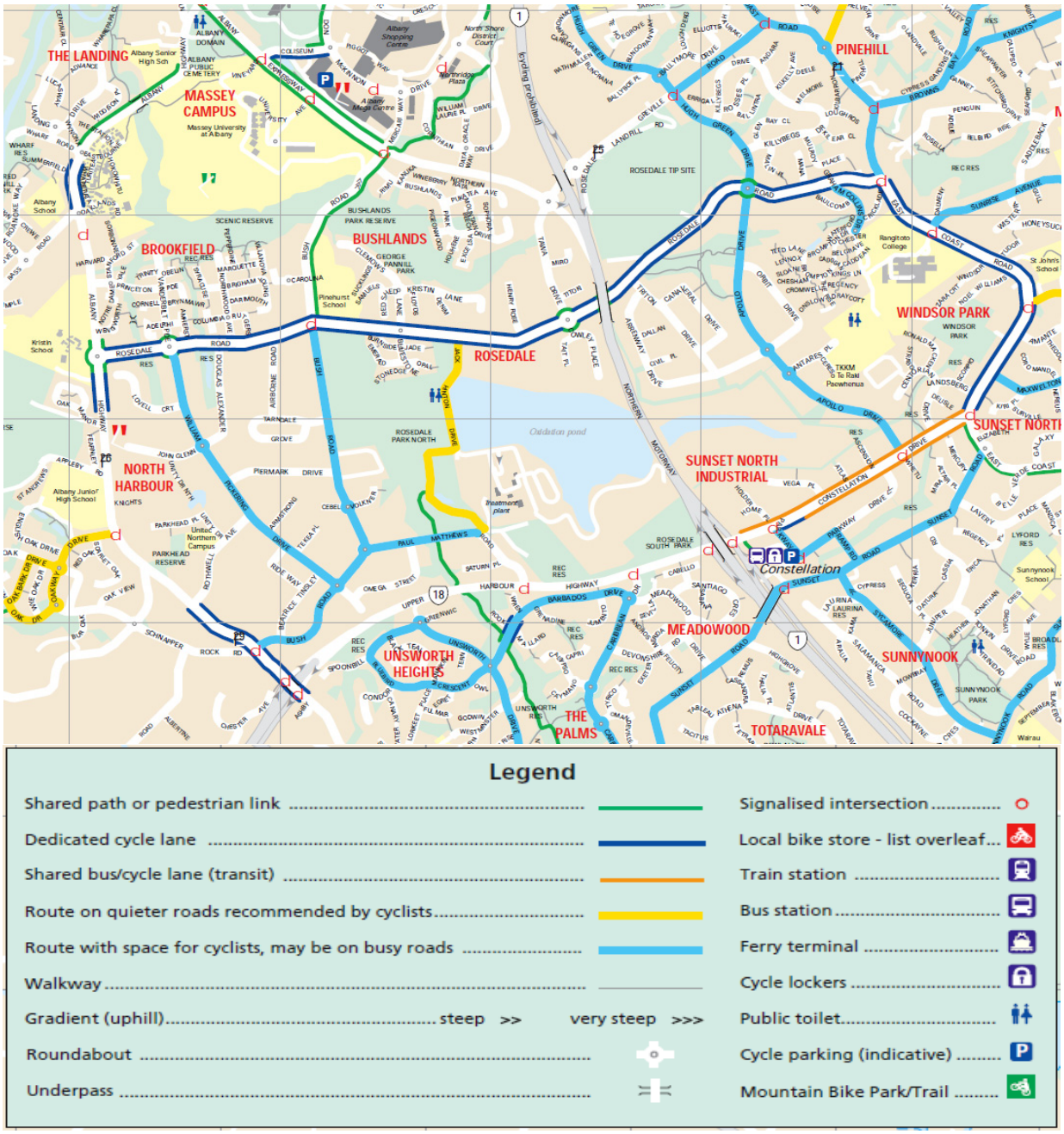
Intersection	2011	2012	2013	2014	2015
Oteha Valley Road / SH17 / Albany Highway	82	128	85	60	59
Rosedale Road / Bush Road	85	63	100	80	93
Rosedale Road / East Coast Road	143	118	112	85	104
Upper Harbour Drive / Albany Highway	148	187	134	75	87

Greater detail, in terms of the type of cyclist is included in the Albany Ward 2015 Auckland Region Manual Cycle Monitoring report[14].

An extract from Auckland Transport's Northern Cycle Map which depicts the Project area is shown in **Figure 22**.

[14] Gravitas Report, prepared for Auckland Transport, 2015 Auckland Region Manual Cycle Monitoring – Albany Ward, dated May 2015

Figure 22 Auckland Transport Northern Cycle Map



Source: Auckland Transport[15]

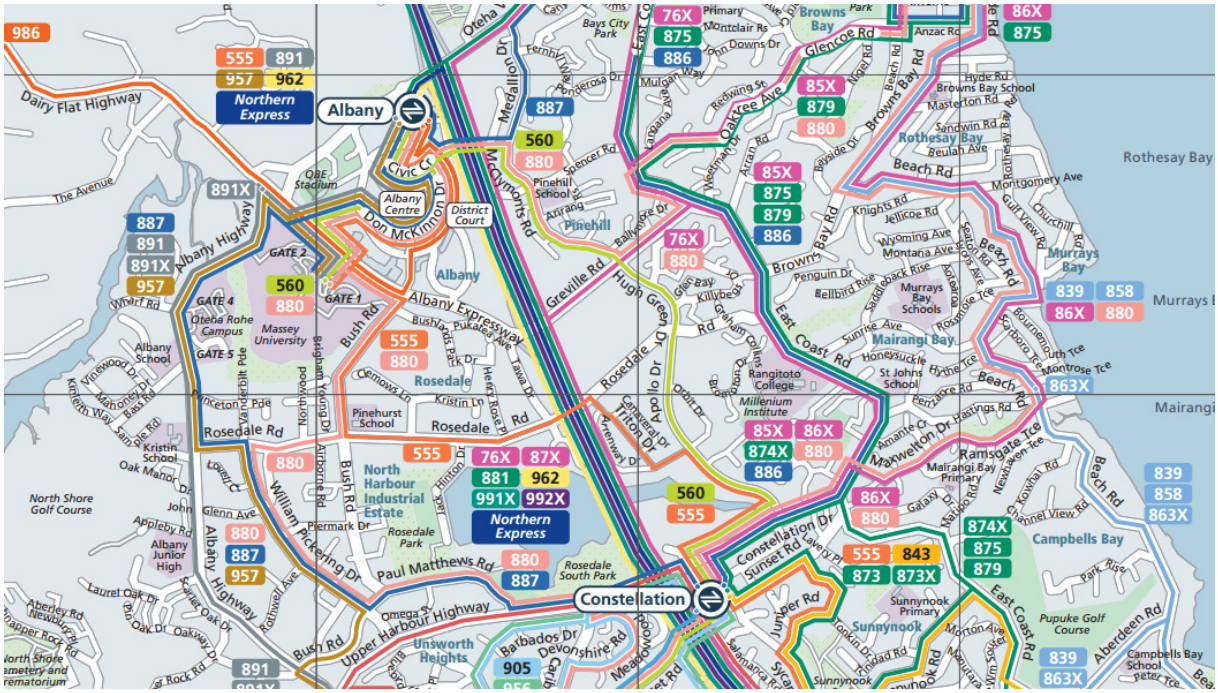
The map shows that dedicated cycle facilities are provided along Rosedale Road. The Albany Highway (north) project, now nearing completion, is providing good facilities for cyclists along Albany Highway, between Albany Interchange with SH18 and Oteha Valley Road.

[15] https://at.govt.nz/media/399608/northern-cycle-map.pdf

3.14 Public Transport Services

The public transport network currently in operation in the Project area is shown in **Figure 23**.

Figure 23 Existing Public Transport Network



Source: Auckland Transport[16]

The busiest bus route relates to the Northern Express, which operates between the City Centre, Constellation Bus Station and Albany Bus Station, with some services continuing to Silverdale Bus Station. Each of the bus stations located within the Project area provide Park and Ride facilities. Demand for these Park and Ride facilities is high, with both the Constellation and Albany facilities reaching 100% occupancy on weekdays, with parking generally overspilling onto the neighbouring streets.

With the Northern Busway currently terminating at the Constellation Bus Station, Northern Express services and other Busway services must mix with general traffic to reach Albany Bus Station and the Silverdale Park and Ride facility. This requires buses to circulate through the Upper Harbour Interchange and typically to share motorway lanes with general traffic. Southbound buses also exit the motorway at the Greville Interchange, passing through this interchange.

A number of bus priority measures exist in the areas surrounding the Project, including:

- A bus only northbound off ramp at McClymonts Road, directly feeding Albany Bus Station;
- A bus only on ramp from Albany Bus Station, onto the Oteha Valley northbound off ramp, for buses continuing further north, to Silverdale or Oteha Valley Road;
- A bus only southbound on ramp from McClymonts Road, indirectly servicing southbound buses from Albany Bus Station;
- Southbound bus shoulder lanes operate on SH1 during the commuter peaks, between the Greville and Upper Harbour Interchanges;

[16] Auckland Transport (June 2016), "Northern Bus Guide"

- A short length of bus lane on the Greville Interchange southbound off ramp;
- Greville Interchange southbound on ramp (T2 lane), noting that the priority lane is heavily utilised, resulting in buses being delayed on this facility;
- Upper Harbour Interchange southbound off ramp (bus priority lane);
- Upper Harbour Interchange northbound on ramp (bus ramp meter bypass lane); and
- T2 lanes operate along Constellation Drive during the peak commuter periods.

In August 2016, Auckland Transport implemented a new, zone based fare structure for public transport services across the region. This new fare structure allows passengers to transfer between public transport services without receiving a fare penalty, and will make it easier for users to make transfers at Albany and Constellation Bus Stations.

The public transport network currently operating on the North Shore is scheduled to change in 2018 – approximately at the time construction of the Project commences. This future new network is documented in Section 6.2.1.

3.15 Public Transport Demands

Surveys of the use of the Albany and Constellation Bus Stations were carried out in March 2013. The results are summarised at **Table 6**.

Table 6 Busway Station Patronage, 2013

	Morning Period (0630-0930)		Evening Period (1530-1830)		Daily (0630-1830)	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Albany	2,060	290	290	1,810	2,940	2,710
Constellation	1,610	390	460	1,250	2,640	2,200

The mode split of persons arriving at the stations are set out in **Table 7**.

Table 7 Busway Station Morning Period (0630-0930) Modes of Arrival, 2013

	Public Transport		Active Modes		Private Car		
	Bus	Bus (transfers)	Pedestrian	Cyclists	Kiss & Ride	Park & Ride (at station)	Park & Ride (on street)
Albany	5%	7%	9%	1%	23%	51%	4%
Constellation	10%	11%	27%	1%	18%	22%	11%

The flows using the Busway itself, during the weekday morning peak period, in 2013, were 2,600 southbound passengers between Albany and Constellation Bus Stations, and 5,700 passengers between Constellation and Sunnynook. The number trips made by public transport has been increasing annually.

3.16 Public Transport Journey Times

Buses travelling between Albany Bus Station and Constellation Bus Station use a combination of bus only facilities (such as bus on and off ramps at McClymonts Road, priority facilities (such as the ramp signal bypass lane at the Upper Harbour Interchange northbound on ramp), shoulder lanes along the

motorway, and general traffic lanes (such as those at the Upper Harbour Interchange for northbound buses leaving the Constellation Bus Station). This results in variable travel times, which are summarised at **Figure 24** and **Figure 25**, which show bus running times across a month of operation in May 2016.

Figure 24 Southbound Bus Travel Times between Albany and Constellation Bus Station, May 2016

Figure 25 Northbound Bus Travel Times between Constellation and Albany Station, May 2016

The above figures indicate that southbound average travel times range from about 5 minutes to 8 minutes, with maximum times of over 12 minutes generally occurring in the morning peak period. Northbound average travel times range from about 5 minutes to 7 minutes, with maximum times of about 13 minutes occurring in the evening peak period.

Both figures above demonstrate that there is significant variability in bus travel times, particularly in the evening peak for northbound bus travel, but throughout the day for southbound bus travel.

3.17 Freight

SH1 is an important route for freight travelling between Auckland and Whangarei and Northland. The Heavy Commercial Vehicle (HCV) percentage, based on available traffic information, is as high as 8% in 2015, as recorded on the Upper Harbour Interchange southbound off ramp, and 5% on SH1, north of the Upper Harbour Interchange.

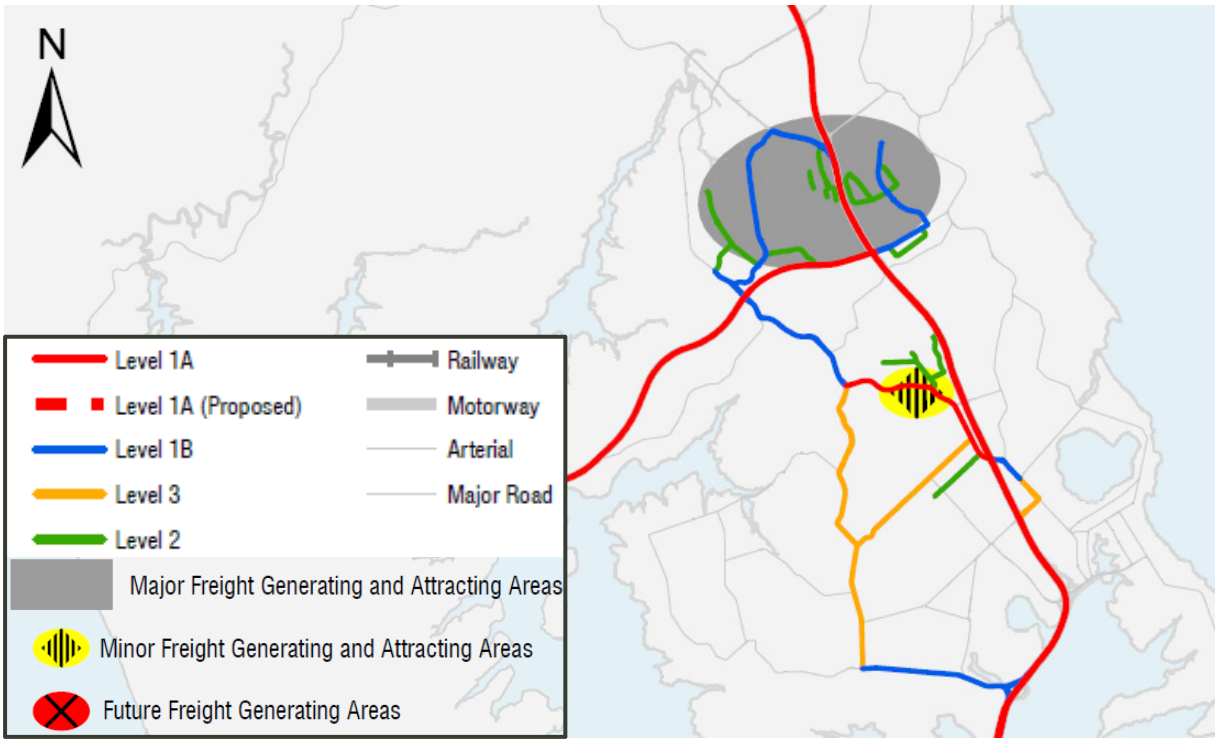
The average daily number of HCVs on SH1, travelling between the Upper Harbour and Greville Interchanges is in the order of 5,200 HCVs, as illustrated in **Figure 26**. Fewer HCVs currently use the surrounding arterial roads, although these roads still carry significant volumes of freight.

Figure 26 Existing Daily Heavy Commercial Vehicle Movements (two-way)

Source: Base Map from Google

A large portion of the land adjacent to the Project area is identified as major freight generating and attracting areas, as shown in **Figure 27**. Specifically these include employment areas, such as the North Harbour Business Park, Constellation and Apollo Business areas, and the Albany Metropolitan Centre. These areas are accessible by both the Greville and Upper Harbour Interchanges.

Figure 27 Regional Freight Network



Source: Auckland Transport

The **Figure 27** is taken from a background report from the Auckland Transport Alignment Project. The report specifically refers to the Upper Harbour Highway and it states that this is a major freight location. The report classifies it as a hotspot for freight, operating at level of service F during the inter-peak period.

The Greville Interchange, along with Upper Harbour Interchange will continue to provide a significant freight function.

As noted earlier, there are a number of ramp signal bypass lanes on the motorway on ramps within the area of the Project, and freight vehicles are generally allowed to use these facilities. The exception is the ramp bypass lane on the Upper Harbour northbound on ramp, which is used by buses only. Also, the main purpose of the northbound kerbside lane which starts from the Greville interchange northbound on ramp, where the northbound carriageway widens from two to three lanes, is a climbing lane for slow moving/heavy vehicles, due the gradient of that section of highway.

4 The Project

4.1 Project Objectives

The objectives of the Project are as follows:

- To help facilitate interregional travel between Auckland and Northland by completing the Western Ring Route to motorway standard;
- To improve connectivity of the SH1 and SH18 interchange;
- To improve safety, efficiency, reliability and the capacity of:
  - SH1 between SH18 and Albany; and
  - SH18 between SH1 and Albany Highway.
- To provide safe walking and cycling facilities adjacent to SH1 and SH18 and connections to local transport networks; and
- To extend the Northern Busway from Constellation Bus Station to the Albany Bus Station.

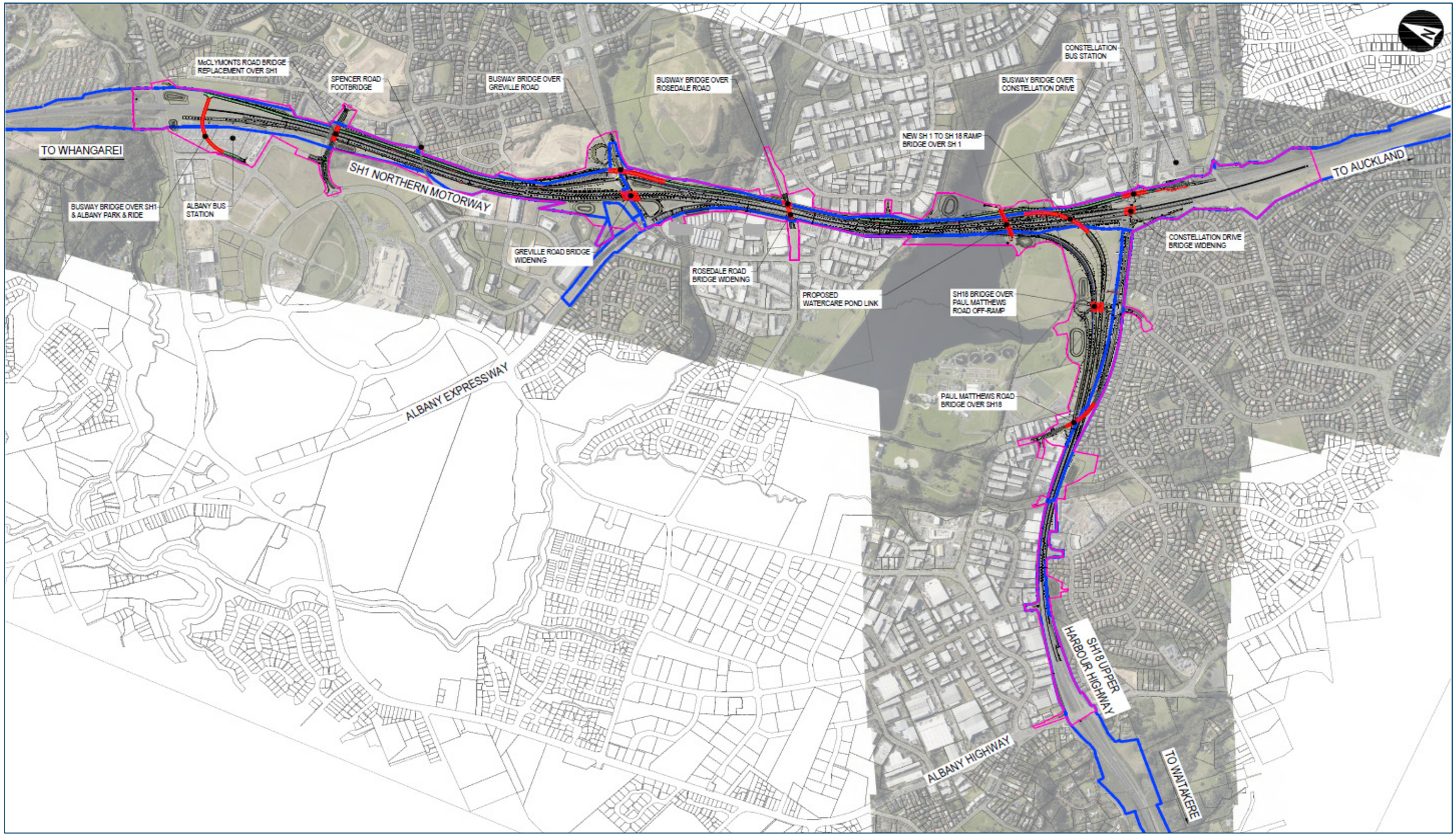
4.2 Project Details

The Project is to include the following improvements:

- Upper Harbour Highway (SH18) is to be upgraded to full motorway status and separated from the local roads;
- New direct connections are to be provided, between SH1 (north) and SH18 (westbound), and between SH18 and SH1 (north)(eastbound);
- The existing third northbound lane on SH1 will be extended across the Upper Harbour Interchange as far as the new connection from SH18;
- Additional (fourth and fifth) lanes are to be provided northbound on SH1 between the new SH18 eastbound connection and the Greville interchange;
- An additional (fourth) lane is to be provided northbound on SH1 between the Greville Interchange and the Oteha Valley Interchange. This will allow an additional general traffic lane to be provided, next to the existing climbing lane;
- Additional (third and fourth) lanes are to be provided southbound on SH1 between the Greville Interchange and the new SH18 westbound connection;
- There will be a lane drop, from four to three lanes, southbound on SH1, at the new connection to SH18, but the third lane will continue beyond the Upper Harbour southbound off ramp;
- An additional lane will be provided on SH1, across the Greville Interchange, in both the northbound and southbound directions;
- Extension of the Northern Busway from the Constellation Bus Station to the Albany Bus Station;
- Shared walking and cycle path on the eastern side of the Northern Motorway between the Constellation Bus Station and the Albany Bus Station;
- Further walking and cycling connections are to be provided alongside SH18, between SH1 and the SH18 Albany Interchange; and
- Modified connections are to be provided to Paul Matthews Road, with local road access retained and walking and cycling access added along and across SH18.

The proposed layout along the mainline of the motorway is shown conceptually in **Figure 28**, with the full series of General Arrangement plans provided within **Volume 5** of the AEE.

Figure 28 Proposed Layout of the Project



Source: Aurecon

5 Transport Models

5.1 Modelling Approach

The assessment of the Project has been informed by a series of traffic and transport models:

- The Auckland Regional Transport (ART) model has been used to assess the likely public transport benefits of the Busway Extension, and to identify the anticipated changes in traffic flows, which have been fed through to the following traffic models;
- The Upper Harbour SATURN model has been used to identify the predicted performance of the road network, at a general level, and the road user benefits of the Project, used for the economic assessment, have been derived from this model; and
- In addition, estimates of cyclist and pedestrian demands on the proposed new shared paths have been assessed using the Auckland Cycle Model.

5.2 ART Model

The ART model was originally developed for the Auckland Regional Council, and until fairly recently was operated by the Auckland Council. It is now operated by the Joint Modelling Applications Centre (JMAC), which is a joint venture run by the NZ Transport Agency, Auckland Transport and Auckland Council.

The ART model is a strategic model which covers the whole of the Auckland Region, from south of Pukekohe to Wellsford. The latest version of the model was validated to 2006 transport demands and conditions, based on a comprehensive set of household travel surveys. A limited revalidation exercise (i.e. without new household travel surveys) has since been carried out, to ensure that the model reflects 2013 flows and conditions.

The model has been subject to peer review by Luis Willumsen, an internationally recognised transport modeller.

The ART model is a “four stage” model, with these four stages being trip generation, trip distribution, mode split and assignment. As a result, the model’s primary purpose is to develop trip forecasts by each mode, based on a given land use scenario, and the future model runs indicate the anticipated effects of investment in all transport modes. This includes the greater emphasis in travel by modes other than the private vehicle, through investment in public transport, walking and cycling and in travel demand management (in a variety of forms). The effects on forecast demands for public transport are derived by the model itself, but the effects of some forms of travel demand management are based on manual assumptions. (For example, it is assumed that investment in travel plans for schools will lead to reductions in car borne trips associated with those schools, and manual corrections are made to the traffic forecasts for the relevant model zone). The travel demand management assumptions contained in the ART model are summarised as follows:

- Workplace initiatives:
  - Working from home: an increase from 6.9% in 2006 to 10% in 2041;
  - CBD – reduction in car trips to work: a 9% reduction from 2006 levels by 2021;
  - Regional centres – reduction in car trips to work: a 7.5% reduction from 2006 levels by 2011; and
  - Non regional centres – reduction in car trips to work: a 1.5% reduction from 2006 levels by 2026.

- Education initiatives:
  - Trip change to active and public transport: 20% shift by 2051 from 2006 base.
- Community initiatives:
  - Home based shopping and recreation etc, change: 3.75% shift by 2051 from 2006 base.

The ART model has been used for the vast majority, if not all, transport modelling assessments of the significant transport projects in the Auckland region over the last decade.

For this assessment, the ART model has been used to inform the traffic models (see below) in terms of forecast changes in traffic demands, and to identify the predicted change in public transport patronage.

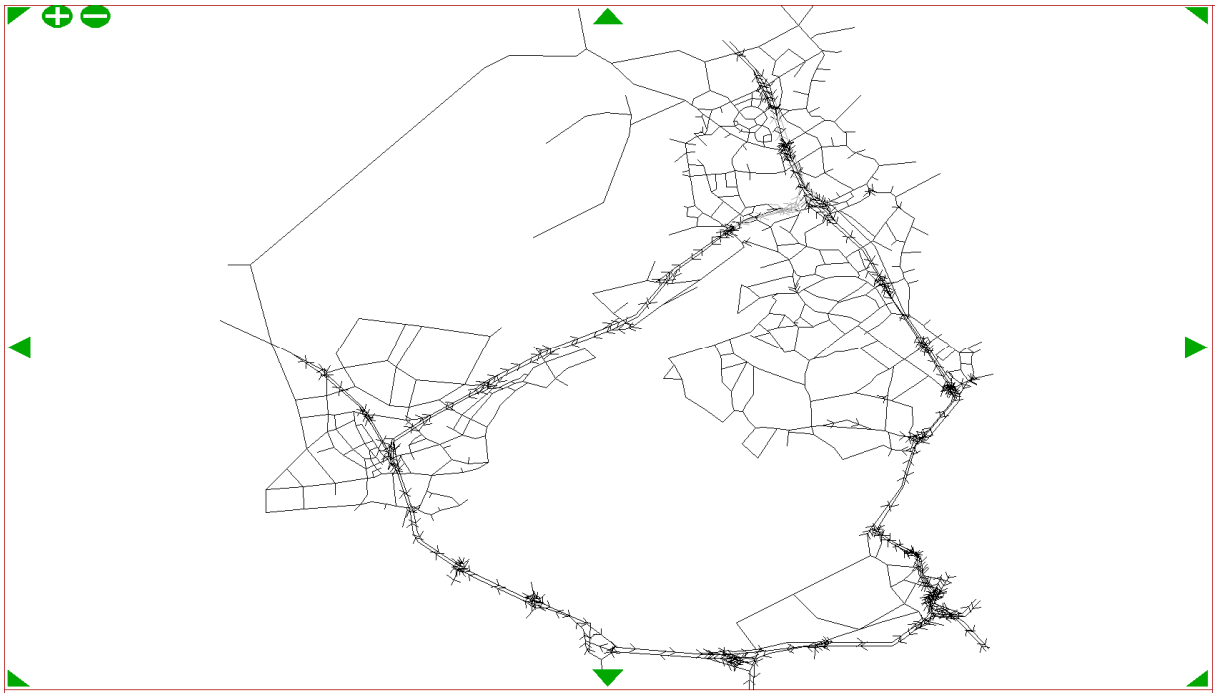
5.3 Upper Harbour Traffic Model

The Upper Harbour SATURN traffic model was initially developed in 2001 to facilitate the assessment of the Upper Harbour motorway project, from Albany Highway to Westgate. The Upper Harbour model was updated in 2012 to reflect existing traffic flows and 2026 and 2041 future forecast years.

The extent of the Upper Harbour model is shown in **Figure 29** below. It covers the route around the Waitemata Harbour, including:

- SH1, from the Central Motorway Junction to north of Oteha Valley Road;
- SH16 from the Central Motorway Junction to Coatesville Riverhead Highway; and
- SH18 from Westgate to Constellation Drive.

Figure 29 Extent of Upper Harbour SATURN Model



The coverage of the network of relevance to this assessment is shown in **Figure 30** below. The Upper Harbour model includes all of the roads of significance within the Albany, North Harbour, the Unsworth area, and beyond.

Figure 30 Extent of Upper Harbour SATURN Model, on northern North Shore

Therefore the extent of the Upper Harbour SATURN model allows both the local and the area wide traffic effects of the Project to be assessed, with the model able to assess the extent of rerouting around the Waitemata Harbour (i.e. via SH18 and SH16, instead of SH1). However, the regional wide traffic effects (such as rerouting from SH1 to SH20) are assessed via the ART model.

Subsequent sections of this report refer both to demand flows and arrival flows.

- Demand flows indicate the volumes of traffic wishing to pass along a particular road during a particular time period; and
- Arrival flows (also referred to as “actual flows”) reflect the fact that some flows are constrained from reaching a location, during a particular time period. In congested areas such as Auckland, these arrival flows are generally lower than the demand flows. To give a simple example, the arrival flow able to cross the Auckland Harbour Bridge, southbound in the morning peak, is significantly lower than the demand flow.

It is important to provide both sets of flows for the following reasons:

- Arrival flows are used within the model as the basis of the operational assessment; and
- However it is also important to be aware of the forecast increases in demands.

5.3.1 Base Model

The Upper Harbour SATURN model was originally calibrated and validated against criteria defined in the NZ Transport Agency Economic Evaluation Manual (EEM). The updated 2012 traffic model was peer reviewed by Traffic Design Group (TDG) in March/April 2012, and TDG concluded that the model had been appropriately developed, and that in the majority of cases, achieved the thresholds specified for calibration and validation in the EEM.

During 2014, the Transport Agency, in conjunction with the NZ Modelling User Group (NZMUGS) published a new document “Transport Model Development Guidelines” (July 2014).

In order to ensure the Upper Harbour SATURN model is robust and fit for the purpose of informing the detailed design and economic evaluation (i.e. the Detailed Business Case) of the Project, the model

was updated to 2015 traffic flows and conditions, within the core study area. Further details are provided in the Upper Harbour SATURN Model Update Report dated August 2015, provided at **Appendix C**. That report has been peer reviewed by TDG.

Weekday morning peak, inter peak and evening peak period models have been developed to reflect existing traffic conditions. The modelled periods represent the average hours during the two hour morning peak, inter peak and evening peak periods (i.e. 07:00 to 09:00, 12:00 to 14:00 and 16:00 to 18:00), as was the case for the previous model calibration and validation.

It needs to be noted that there is no weekend model. Existing peak flows at weekends, relative to those during weekdays, were set out within Section 3 above, and the assessment of the effects of the Project at Section 7 below refers to the effects during the weekend.

5.3.2 Future Models

As noted above, the base models relate to the year 2015. Forecast traffic models have been developed for the years 2018, 2021, 2031 and 2041.

The 2021 model was originally used to assess the effects of the Project during construction, but these effects have now been assessed using a 2018 version of the model.

The majority of this Report focuses on the year 2031, which reflects a period some ten years after the anticipated opening of the Project. 2031 conditions have been assessed for a Future Reference Case (without the Project) and a scenario with the Project.

Changes in forecast flows (between 2015 and 2031) have been derived from the ART model. The ART model has been run both without and with the Project, and the forecast changes in demands have been fed through to the SATURN models.

5.3.3 Estimates of Daily Flows

As noted above, traffic models have been developed for the weekday morning peak, inter peak and evening peak periods. For this assessment, these flows have been factored up to provide estimates of daily flows, using the default factors used for the ART model, namely:

Daily flows = 1.4 x (2 x morning peak) + (7 x inter peak) + 2 x evening peak)[17]

Information on how the above formula works through is provided at **Table 8**.

Table 8 Observed and Modelled Daily Flows (two way)

Location	March 2015 Weekday Count	2015 AADT (Count)	2015 Modelled Daily Flow
SH1: Oteha Valley Road to Greville Rd	75,300	68,000	68,500
SH1: Greville Rd to Constellation	108,100	98,200	103,500
SH18 east of Albany Highway	37,900	33,400	34,200

The above table indicates that the modelled flows sit between the weekday daily flows, and the AADT.

[17] The number of hours per time period given here (e.g. 2 x morning peak) is based on the fact that the SATURN models relate to one hour periods. The ART model uses two hour model periods, so the number of hours per day used to derive daily flows from the ART model is less (e.g. 1 x morning peak)

6 Future Reference Case

It is normal practice to compare the effects of a transport project against a future "Do Minimum" scenario. In Auckland, the term "Do Minimum" may be somewhat misleading, as it represents a scenario which includes quite significant change, both in the form of changes in travel demands and in transport investment. As a result, this assessment compares the Project against a "Future Reference Case".

6.1 Changes in Land Uses

As noted within Section 5 above, the Upper Harbour SATURN model derives traffic forecasts from the ART model. As a result, the forecasts represent the effects of any land use changes at a macro level.

The land use assumptions with the ART model runs are the same for the Future Reference Case as for the scenario with the Project, as set out in **Table 9** to **Table 11**. The land use projections have been obtained from Auckland Council's "Scenario I9". This scenario represents a medium growth forecast and is the version currently accepted by the NZ Transport Agency and Auckland Transport for the assessment of transport projects within the Auckland region.

Table 9 Predicted Households in Vicinity of the Project

Location	2015	ART Model Forecasts			Growth		
		2016	2021	2031	2015 to 2016	2016 to 2021	2021 to 2031
Fairview	1,050	1,100	1,200	1,350	+50	+100	+150
Northcross	1,700	1,750	1,800	1,900	+50	+50	+100
Pinehill	1,200	1,200	1,250	1,250	-	50	-
Windsor Park	750	750	750	800	-	-	50
Albany	2,000	2,250	3,350	5,300	+250	+1100	+1950
North Harbour East	1,150	1,200	1,200	1,200	+50	-	-
North Harbour West	2,200	2,200	2,250	2,350	-	+50	+100
Greenhithe	2,600	2,650	2,850	3,250	+50	+200	+400
Unsworth Heights	1,900	1,950	2,000	2,050	+50	+50	+50
Total	**14,550**	**15,050**	**16,650**	**19,450**	**+500**	**+1,600**	**+2,800**

Table 10 Predicted Population in Vicinity of the Project

Location	2015	ART Model Forecasts			Growth		
		2016	2021	2031	2015 to 2016	2016 to 2021	2021 to 2031
Fairview	3,250	3,250	3,400	3,600	-	+150	+200
Northcross	4,900	4,950	5,050	5,250	+50	+100	+200
Pinehill	4,250	4,300	4,350	4,450	+50	+50	+100
Windsor Park	1,750	1,800	1,850	1,950	+50	+50	+100
Albany	5,300	5,850	8,600	13,850	+550	+2,750	+5,250
North Harbour East	3,050	3,100	3,150	3,300	+50	+50	+150
North Harbour West	7,200	7,250	7,350	7,450	+50	+100	+100
Greenhithe	8,050	8,150	8,400	8,800	+100	+250	+400
Unsworth Heights	5,950	6,000	6,000	6,100	+50	-	+100
Total	**43,700**	**44,650**	**48,150**	**54,750**	**+950**	**+3,500**	**6,600**

Table 11 Predicted Employment in Vicinity of the Project

Location	2015	ART Model Forecasts			Growth		
		2016	2021	2031	2015 to 2016	2016 to 2021	2021 to 2031
Fairview	300	300	300	300	-	-	-
Northcross	550	550	550	550	-	-	-
Pinehill	700	700	700	750	-	-	+50
Windsor Park	8,850	8,800	8,900	9,000	-50	+100	+100
Albany	8,000	8,150	9,400	11,700	+150	+1,250	+2,300
North Harbour East	12,400	12,350	12,500	12,550	-50	+150	+50
North Harbour West	1,600	1,600	1,600	1,650	-	-	50
Greenhithe	1,150	1,150	1,150	1,150	-	-	-
Unsworth Heights	450	450	450	500	-	-	50
Total	**34,000**	**34,050**	**35,550**	**38,150**	**50**	**1,500**	**2,600**

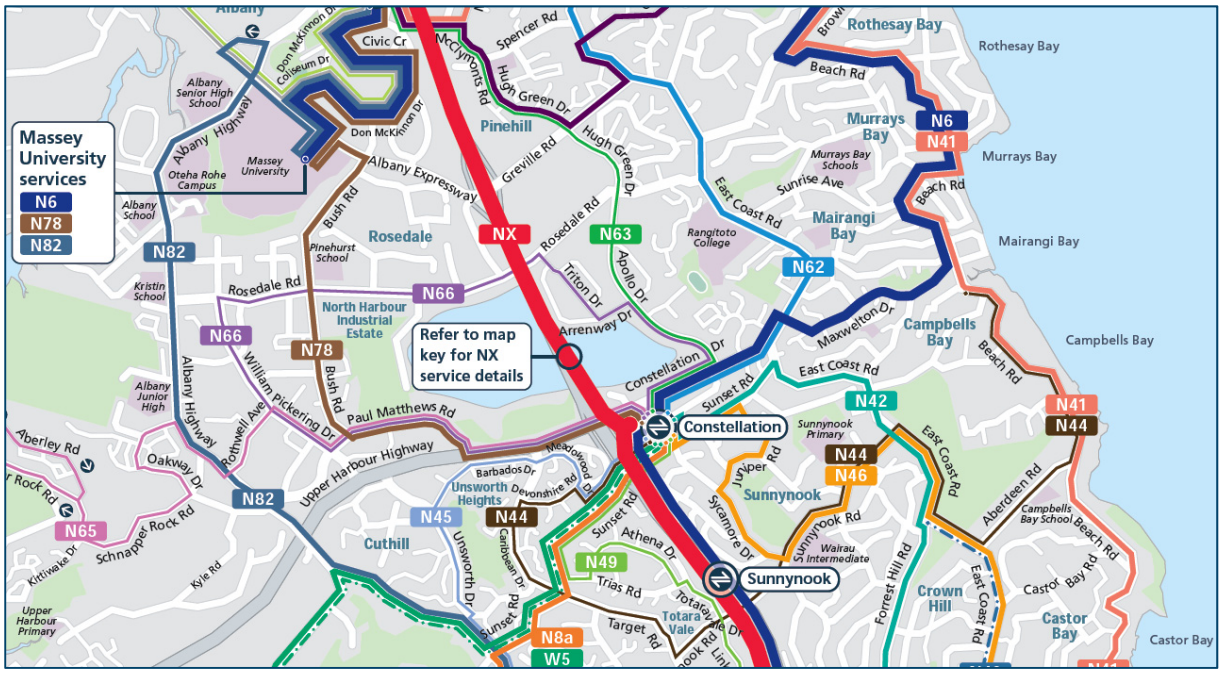
The above tables demonstrate the level of growth forecast for North Auckland in the medium to long term. Some additional 4,400 households are anticipated between 2016 and 2031, along with over 4,100 additional jobs. Changes in Transport Networks

6.2 Public Transport

Auckland Transport has recently completed consultation on new North Shore bus services associated with its "New Network". Generally, the New Network will see existing services consolidated to provide a simpler public transport network, with improved frequencies and greater emphasis on connections to the Rapid Transit Network (the Northern Busway). This New Network is expected to be rolled out across the North Shore in 2018, and **Figure 31** provides an extract from the New Network for the North Shore. A full version of this map is provided at **Appendix D**, which provides additional details of each of the routes, plus the likely route frequencies. It is important to note that the map at **Appendix**

D states that the stated frequencies are the minimum expected (i.e. frequencies of, for example, at least every 10 minutes). Information from Auckland Transport indicates that the number of buses travelling between Albany Bus Station and Constellation Bus Station in 2031 is expected to be 80 buses per hour in the peak directions, in the peak periods[18], with 27 buses per direction per hour in the inter peak period. This gives capacities of around 4,000 persons in the peak directions in the peak periods, and 1,450 persons per direction per hour in the inter peak period[19].

Figure 31 Auckland Transport's New Bus Routes – North Shore



Source: Auckland Transport[20]

Under the proposed New Network, the Northern Express (NX in **Figure 31**) will continue to form the backbone of the North Shore public transport network. It will also feature a Frequent Service (N6), operating at least every 15 minutes from Massey University to Takapuna via Albany Bus Station, Browns Bay and Constellation Bus Station. This will be supported by a network of Connector Services (at least every 30 minutes), Local Services and Peak Period Services.

A key component of this New Network is for additional feeder bus services allowing greater numbers of people to reach the main busway stations by bus, with an accompanying reduction in the proportion of people using Park and Ride at these main busway stations (see Section 6.2.4 below). These busway stations will serve the following areas:

- Feeder services using the Constellation Bus Station will serve the East Coast Bays (Mairangi Bay, Murrays Bay, Rothesay Bay, Browns Bay), Unsworth Heights, North Harbour (and the residential areas to the west); and
- The Albany Bus Station will be fed by buses from the northern East Coast Bays (Browns Bay, Torbay and Long Bay) and North Cross, to the east, and the Albany Metropolitan Centre to the west.

These services will use the following routes:

[18] These peak directions are southbound in the morning peak and northbound in the evening peak

[19] These figures are based on a capacity of 50 persons per bus. This assumption is considered reasonable, given that many Northern Express buses are double decker buses

[20] Auckland Transport (May 2016), "North Shore New Network Post – Consultation"

- Buses will approach the Constellation Bus Station via a number of routes, including East Coast Road/Constellation Drive, Apollo Drive/Constellation Drive, Sunset Road, William Pickering Drive/Paul Matthews Road, and Bush Road/Paul Matthews Road. Transit lane facilities already exist on Constellation Drive; and
- Buses will approach the Albany Bus Station via Oteha Valley Road and McClymonts Road from the east and Civic Crescent Don McKinnon Drive from the east. A Corridor Management Plan for Oteha Valley Road[21] has recommended the provision of transit lanes along that corridor, to improve the level of service for buses on this route, although we understand that this proposal is not yet committed.

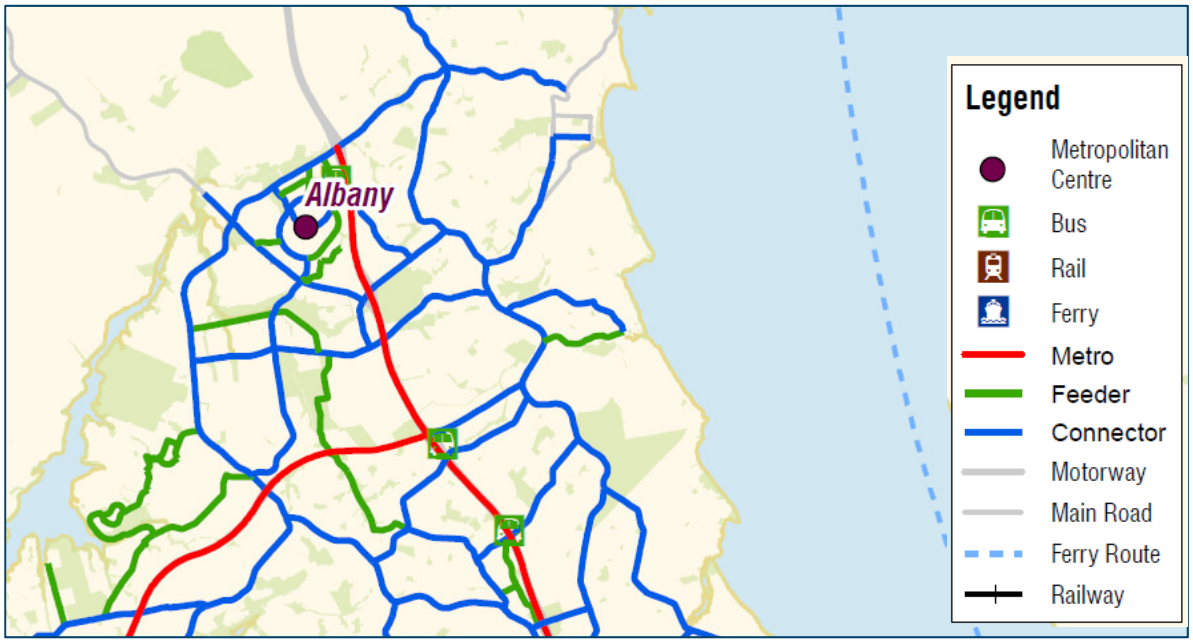
6.2.1 Proposed Auckland Cycle Network

The Auckland Cycle Network outlines the proposed cycle network in Auckland. Auckland Transport classifies proposed cycle infrastructure within the network into three categories as follows:

- Cycle Metros – Regional links connecting metropolitan centres, public transport interchanges and other key regional destinations. These routes provide the highest level of service on physically separated cycle infrastructure, often following motorway or rail corridors;
- Cycle Connectors – Links to the cycle metros and key local destinations such as public transport interchanges, town centres, residential areas and schools. These routes generally follow arterial roads and may or may not provide physical separation from general traffic; and
- Cycle Feeders – Lower order neighbourhood accesses and links to the cycle connectors and cycle metros, community facilities, schools, parks, reserves and local services.

Figure 32 shows the proposed Auckland Cycle Network in the vicinity of the Project.

Figure 32 Proposed Auckland Cycle Network



Source: Auckland Transport [22]

The above figure shows that a Cycle Metro facility is proposed parallel to both SH1 from Oteha Valley Road southwards, and on SH18. A network of Cycle Connectors is proposed on key routes to support the Cycle Metros, notably on:

[21] Aecom (2014), "Oteha Valley Road Corridor Management Plan"
[22] Auckland Transport (September 2015), "Auckland Cycle Network"

- Oteha Valley Road;
- McClymonts Road/Hugh Green Drive;
- SH17 (Albany Expressway) and Greville Road;
- Rosedale Road;
- Constellation Drive; and
- Albany Highway

The two Cycle Metros will form key cycle connections to the Albany and Constellation Bus Stations and to Albany Metropolitan Centre. Via future extensions to these Cycle Metro facilities to the south and west, they will also provide key onward connectivity to the Takapuna Metropolitan Centre, Auckland City Centre and Central Auckland destinations, and across the Upper Harbour Bridge to the Westgate Metropolitan Centre and West Auckland destinations.

6.2.2 Road Network Improvements

The 2018 network, used to assess the effects during construction, is essentially the base network, plus:

- The completion of the Albany Highway (north) project, i.e. north from Bush Road, as construction of this Project was completed in October 2016;
- The completion of the SH20 Waterview Connection (currently under construction);
- The completion of the associated upgrades to the SH16 Northwestern Motorway, between the St Lukes interchange and Lincoln Road (currently under construction); and
- Widening of SH16 from Lincoln Road to Westgate (not currently under construction, but expected to be completed by the NZ Transport Agency in 2018).

The location of these improvements is shown in **Figure 33.**

Figure 33 Location of Proposed Road Network Improvements for 2018

Source: Base Map from Google

The 2021 Future Reference Case contains the same network as the 2018 network above.

The 2031 Future Reference Case additionally includes the following changes to the road network:

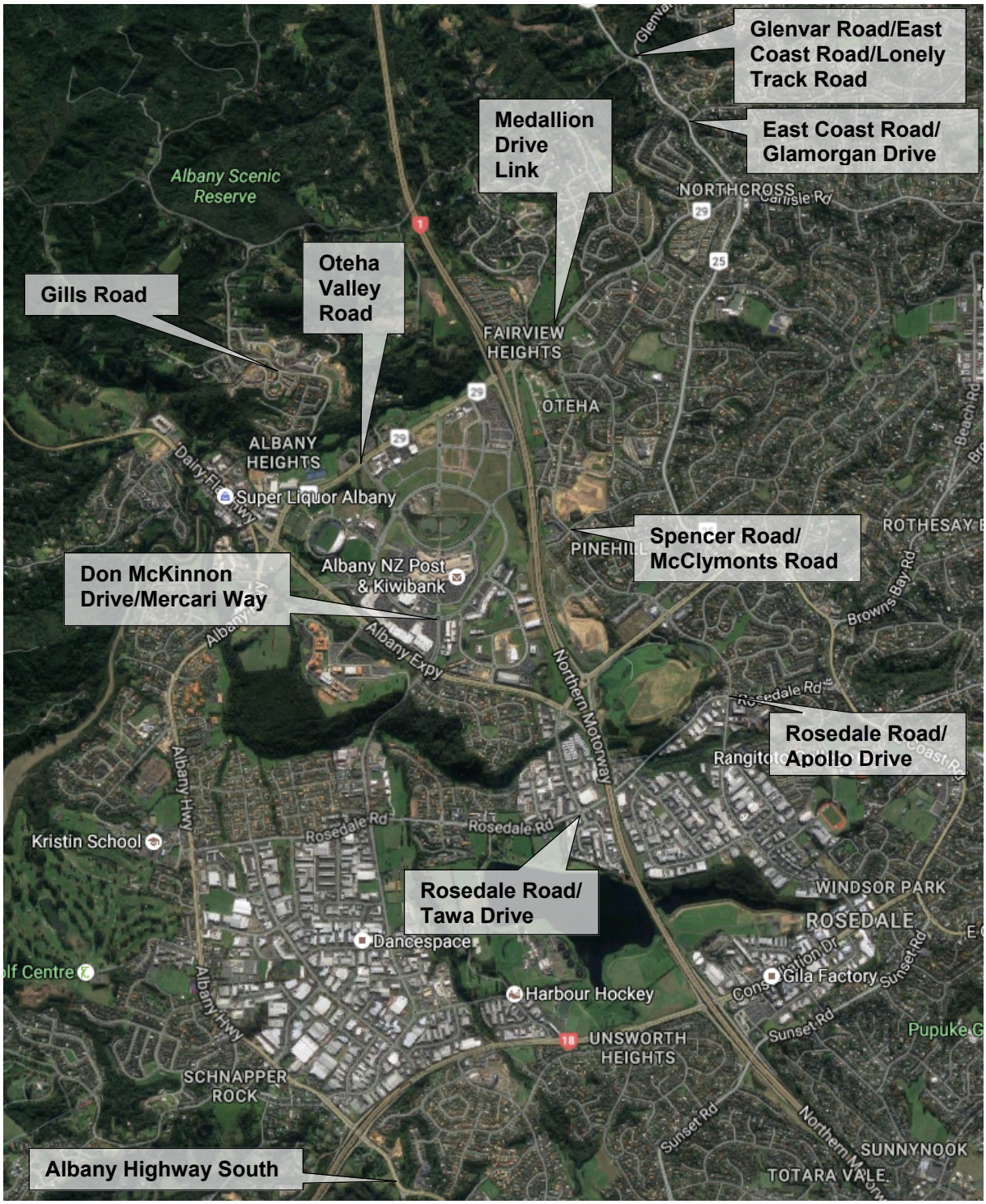
- Changes to the intersection control at Rosedale Road/Tawa Drive and Rosedale Road/Apollo Drive, and Don McKinnon Drive/Mercari Way, from roundabouts to traffic signals;
- The Long Bay Transport Improvements along Glenvar Road and East Coast Road, including widening of East Coast Road to two traffic lanes per direction between Glenvar Road and Oteha

Valley Road, the installation of a roundabout at East Coast Road/Glenvar Road/Lonely Track Road and traffic signals at East Coast Road/Glamorgan Drive;

- Spencer Road Realignment, including a roundabout at McClymonts Road;
- Additional capacity on Albany Highway South;
- The provision of a new link from Oteha Valley Road to Gills Road; and
- The proposed new Medallion Drive link, which will extend north from Oteha Valley Road to connect into Fairview Avenue.

The location of these improvements is shown in **Figure 34**.

Figure 34 Location of Proposed Road Network Improvements for 2031



Source: Base Map from Google

Various additional transport investments are included in the model, within the North West area (i.e. remote from the Project), including:

- SH16/Northside Drive interchange;
- SH16 Brigham Creek Road Grade Separation;

- Four laning of SH16, north of Brigham Creek Road;
- Brigham Creek Road Upgrade;
- Fred Taylor Drive upgrade;
- East-West Link between Fred Taylor Drive and Brigham Creek Road; and
- Hobsonville Road upgrade.

The above projects have been included in the future model following discussions with Auckland Transport, based on the currently anticipated investment in transport. The projects include a number of uncommitted projects which are located away from the Project, meaning that their inclusion is unlikely to significantly affect the evaluation. Indeed it should be noted that the 2031 land use forecasts included within the ART model reflect the medium growth forecast for the region, and based on current trends, it is exceedingly likely that these growth forecasts will materialise, and therefore some form of transport investment needs to be assumed for the transport models to give meaningful results. Nevertheless, a number of sensitivity tests are provided within Section 9, to establish the effects of lower or higher growth, or of different transport improvements.

6.2.3 Park and Ride

Auckland Transport's parking strategy (Strategy) sets out the proposed management of parking, both on and off street. The Strategy states that Park and Ride facilities are an integral part of the public transport network and can be regarded as extensions to stations and terminals. The Strategy proposes around 10,000 additional Park and Ride spaces by 2046, including 300-500 at Silverdale and over (an additional) 500 spaces at both Albany and Constellation[23]. A small Park and Ride facility already exists at Silverdale, and there is consent for a larger facility to be implemented.

However, while additional Park and Ride spaces may be expected at these three bus stations, it is important to note that Auckland Transport does not expect to accommodate all parking demands at each station through the provision of unlimited extra car parks. Instead, it is to be expected that a greater proportion of bus users will walk or cycle to the Albany Bus Station in the future, as development continues to occur within the metropolitan centre, within the walking and cycling catchment of the station. Also, the proposed new bus network being rolled out by Auckland Transport in 2018 (referred to within Section 6.2.1 above) will also encourage more use of feeder bus services.

6.3 Traffic Demands

The net effects of the above changes in land use and transport investment on total traffic demands within the area of the Upper Harbour SATURN traffic model, between 2015 and 2031, are set out in **Table 12**.

Table 12 SATURN Traffic Demand Comparison between 2015 Base and 2031 Reference Case

Time Periods	2015 Base	2031 Reference Case	Difference
Morning Peak	87,795	107,815	+20,020
Inter Peak	78,420	104,405	+25,985
Evening Peak	98,960	122,645	+23,685

The effects of the above changes in overall traffic demands in terms of daily flows along the Northern Motorway and the Upper Harbour Motorway are set out in **Table 13**. **Table 14** below does the same

[23] Auckland Transport (2015), "Parking Strategy", page 37

for the local road network. In both cases, predicted forecast 2031 Reference Case flows are compared to 2015 Base Model flows.

The following tables relate to daily flows and details of the base and forecast hourly flows, for each of the weekday morning, inter peak and evening peak models, are provided at **Appendix E**.

Table 13 2031 Forecast Motorway Weekday Traffic Flows (two way, vehicles per day), 2015 Base Model and Forecast 2031

Road	2015 Base Model	2031 Reference Case	Difference	2015	2031 Reference Case	Difference
SH1	**Northbound**			**Southbound**		
North of Oteha Valley Rd	29,700	45,300	+15,600	26,500	41,500	+15,000
Oteha Valley Rd Interchange	23,100	32,700	+9,600	21,100	30,200	+9,100
Greville Rd to Oteha Valley Rd	38,300	54,500	+16,200	30,200	40,500	+10,300
Greville Rd Interchange	35,400	49,800	+14,400	27,700	33,800	+6,100
Greville Rd to Upper Harbour	56,900	75,000	+18,100	46,500	57,400	+10,900
Upper Harbour Interchange	43,900	56,100	+12,200	34,200	40,900	+6,700
Upper Harbour to Tristram Ave	60,100	72,600	+12,500	53,300	58,800	+5,500
SH18	**Eastbound**			**Westbound**		
Tauhinu Rd to Greenhithe Rd	25,300	41,500	+16,200	25,600	40,100	+14,500
Greenhithe Rd to Albany Hwy	28,600	47,000	+18,400	29,100	46,600	+17,500
Albany Highway Interchange	13,400	22,900	+9,500	15,800	21,200	+5,400
East of Albany Highway	16,700	24,000	+7,300	17,600	21,800	+4,200

Table 14 Weekday Traffic Flows on Key Routes (two way, vehicles per day), 2015 Base Model and Forecast 2031

Road	2015 Base Model	2031 Reference Case	Difference
Sunset Road (near SH1)	13,800	17,000	+3,200
Constellation Drive (east of Apollo Dr)	18,700	25,000	+6,300
Rosedale Road (west of Tawa Dr)	26,100	24,700	-1,400
Rosedale Road (west of Apollo Dr)	15,900	14,100	-1,800
McClymonts Road (west of Medallion Dr)	28,800	35,200	+6,400
Oteha Valley Road (east of SH1)	28,900	39,400	+10,500
Oteha Valley Road (west of Munroe Ln)	19,900	19,700	-200
Greville Road (east of SH1)	17,800	28,100	+10,300
Albany Highway (south of Wharf Rd)	17,600	25,200	+7,600
Albany Highway (south of Rosedale Rd)	21,600	24,000	+2,400
Albany Highway (south of Upper Harbour Dr)	30,800	42,800	+12,000
Albany Expressway (west of SH1)	31,600	38,900	+7,300
Albany Expressway (west of Bush Rd)	19,500	28,800	+9,300
William Pickering Drive (north of Piermark Dr)	13,500	16,800	+3,300
Bush Road (north of Piermark Dr)	28,100	31,700	+3,600

Road	2015 Base Model	2031 Reference Case	Difference
Tawa Drive (north of Rosedale Rd)	18,100	15,900	-2,200
Apollo Drive (north of Constellation Dr)	25,100	27,400	+2,300
East Coast Road (north of Greville Rd)	17,200	24,000	+6,800
East Coast Road (north of Browns Bay Rd)	16,200	21,200	+5,000
East Coast Road (north of Constellation Dr)	31,200	38,100	+6,900
Unsworth Drive (north of Albany Hwy)	5,700	7,200	+1,500
Unsworth Drive (south of Barbados Dr)	3,300	3,200	-100
Paul Matthews Road (east of Bush Rd)	26,000	25,200	-800
Caribbean Drive (North of Goldfinch Rise)	14,500	17,700	+3,200

The above tables indicate that daily traffic flows are generally predicted to increase between the 2015 Base and the 2031 Future Reference Case. The increases in flows on the State highways are explored in more detail, by reference to recent trends, as set out in **Table 15**.

Table 15 Trends in Average Annual Daily Traffic Flows on SH1 and SH18 (vehicles per day)

	Flows on SH1: Upper Harbour to Greville		Flows on SH18: East of Albany Highway	
	Northbound	Southbound	Eastbound	Westbound
2011	45,600	44,350	13,500	12,400
2012	45,900	45,250	14,950	14,050
2013	46,600	45,200	15,300	14,700
2014	46,000	45,450	15,650	15,200
2015	51,100	47,100	16,900	16,400
2015 Model	56,900	46,500	16,700	17,600
2021 Model	67,200	53,100	20,000	18,000
2031 Model	75,000	57,400	24,000	21,800

The above tables indicate that:

- Traffic flows increased at a fairly low rate on SH1 between 2011 and 2014. The demands may have been constrained by the construction works over the latter part of this period;
- There was a more significant increase northbound on SH1, in 2015, due to the completion of the auxiliary lane, between the Upper Harbour and Greville Interchanges;
- There have been significant increases in flows of over 25% on SH18, between 2011 and 2015. There was a stepped change in flows, following the completion of the SH18 Hobsonville Deviation in 2011;
- The modelled flows in 2015 are within 5% of the observed flow on SH1 and 3% on SH18 (at the single points noted), relative to the 2015 counts. These discrepancies are not particularly significant, but they indicate that the forecasts for SH18 may be about 5,000 vehicles/day too high on this section of SH1 and 1,000 vehicles/day too high on SH18;

- The predicted forecast flows for 2031 indicate increases of around 28% on SH1 and 34% on SH18 (at a daily level) over the 16 year period from 2015 to 2031, giving annual increases of around 1.8% and 2.1% on SH1 and SH18, respectively; and
- The higher growth rate on SH18 is likely to be a result of the completion of the SH20 Waterview Connection and associated upgrades along the SH16 Northwestern Motorway, as well as the uptake of growth around the Hobsonville and Whenuapai areas.

It should be stressed that the accuracy of forecasts will depend on several factors, including the accuracy of the land use forecasts and on people's changes in travel behaviour over time. In terms of land use forecasts, while the information used is the best current estimate available, it is likely that the scenario should refer to whatever year the land use forecasts are realised, rather than specifically to a particular calendar year.

6.4 Traffic Operations

Forecast travel times have been obtained from the SATURN models for the same eight journey times documented previously in Section 3.11.2. These journey time routes are illustrated again in **Figure 35** below, and a summary of the predicted forecast journey times for each of the routes is summarised in **Table 16**.

Figure 35 Journey Time Routes

Source: Base Map from Google

Table 16 2015 Base Model and Forecast 2031 Reference Case Journey Times (m:ss)

Route Description	Morning Peak		Inter Peak		Evening Peak	
	2015 Base Model	2031 Reference Case	2015 Base Model	2031 Reference Case	2015 Base Model	2031 Reference Case
Route 1 – SH18 Albany Highway Interchange to SH1 Oteha Valley Interchange	7:15	10:10 (+2:55)	4:55	6:50 (+1:55)	7:05	12:55 (+5:50)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Highway Interchange	10:55	18:55 (+8:00)	6:55	9:25 (+2:30)	9:40	16:10 (+6:30)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	8:25	9:20 (+0:55)	7:35	8:45 (+1:10)	13:00	17:50 (+4:50)

Route Description	Morning Peak		Inter Peak		Evening Peak	
	2015 Base Model	2031 Reference Case	2015 Base Model	2031 Reference Case	2015 Base Model	2031 Reference Case
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	21:45	21:25 (-0:30)	6:55	10:10 (+3:15)	12:15	11:45 (-0:30)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	5:05	6:25 (+1:20)	4:05	5:25 (+1:20)	9:00	15:05 (+6:05)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	17:15	21:25 (+4:10)	4:40	7:35 (+2:55)	6:15	9:05 (+2:50)
Route 7 – SH1 Tristram Interchange to SH18 Albany Highway Interchange	7:15	9:00 (+1:45)	5:30	7:20 (+1:50)	11:30	14:55 (+3:25)
Route 8 – SH18 Albany Highway Interchange to SH1 Tristram Interchange	19:10	17:25 (-1:45)	6:30	8:35 (+2:05)	9:35	10:15 (+0:40)

The above table indicates that motorway travel times are generally predicted to increase between the 2015 Base and the 2031 Future Reference Case, with the greatest increases predicted in the morning and evening peaks, on routes 1 and 2. The areas of congestion are shown at **Appendix F**, which shows links which are predicted to operate at higher than 85% of capacity. These plots indicate that congestion is predicted, in the 2031 Future Reference Case, at the following locations:

- Along the motorway between the Greville and the Upper Harbour interchanges;
- At the Upper Harbour interchange;
- At the at grade intersections along SH18; and
- At the single lane section of SH18, westbound, adjacent to Unsworth Drive.

Congestion is also predicted to develop in the inter peak period, again at the Upper Harbour Interchange. Weekend congestion can also be expected to increase, relative to the existing situation.

Section 3.11.2 previously demonstrated that there is poor travel time reliability on many of the above motorway routes, with significantly variable travel times. With travel times and congestion generally predicted to increase between the 2015 base and the 2031 Reference Case, travel time reliability is also expected to generally worsen.

7 Assessment of Effects of Project

7.1 Traffic Demands

The net effects of the Project on total traffic demands within the area of the Upper Harbour SATURN traffic model, are set out in **Table 17**.

Table 17 SATURN Traffic Demand Comparison between 2031 Reference Case and 2031 with Project

Time Periods	2031 Reference Case	2031 with Project	Difference
Morning Peak	107,815	107,925	+110
Inter Peak	104,405	104,515	+110
Evening Peak	122,645	122,645	+0

The above table indicates that the Project is not predicted to lead to significant volumes of induced traffic, overall.

7.2 Area Wide Traffic Effects of Project

The Project is predicted to result in an increase in traffic on SH1 and SH18, with some users of alternative routes such as Albany Highway predicted to be attracted to the new motorway links at the Upper Harbour Interchange and the increases in capacity both along SH1 and SH18. There is additionally expected to be an element of 'induced demand', with some users choosing to undertake trips that they wouldn't carry out if the Project does not proceed. It is additionally predicted to result in various changes in flows on other adjacent arterial routes; generally reductions but with some exceptions. **Figure 36** illustrates the predicted forecast changes in daily traffic flows across the wider network resulting from the Project. Increases in flows due to the Project are shown as green bands while decreases are shown as blue bands.

Figure 36 2031 Predicted Daily Traffic Flow Difference Plot, with and without Project[24]

The predicted changes in the daily vehicle flows are set out in more detail in **Table 18** below, with flows rounded to the nearest 100 vehicles/day. Further details on the effects of the Project on the State Highways are set out in Section 7.3 below.

[24] It will be noted that traffic flow differences along SH18 between the Upper Harbour Interchange and the Albany Highway interchange are missing from this plot. This is due to the significant differences in the network between the two scenarios, meaning that part of the network does not exist, either for the scenario without or with the Project, meaning that differences cannot be shown. Similarly, the plot does not show the flows on the new links, such as the links between SH1 (north) and SH18, as these links only exist for the scenario with the Project.

Table 18 Predicted 2031 Forecast Weekday Traffic Flows (two way, without and with Project, vehicles per day)

	2031 Reference Case	2031 Project	Difference
SH1: Greville Road to Oteha Valley Road	95,000	100,400	+5,400
SH1: Upper Harbour to Greville Road	132,400	161,000	+28,600
SH18: west of Paul Matthews Road	45,800	68,300	+22,500
Sunset Road (near SH1)	17,000	14,100	-2,900
Constellation Drive (east of Apollo Dr)	25,000	24,700	-300
Rosedale Road (west of Tawa Dr)	24,700	19,900	-4,800
Rosedale Road (west of Apollo Dr)	14,100	13,700	-400
McClymonts Road (west of Medallion Dr)	35,200	36,300	+1,100
Oteha Valley Road (east of SH1)	39,400	41,700	+2,300
Oteha Valley Road (west of Munroe Ln)	19,700	18,500	-1,200
Greville Road (east of SH1)	28,100	30,700	+2,600
Albany Highway (south of Wharf Rd)	25,200	19,600	-5,600
Albany Highway (south of Rosedale Rd)	24,000	18,800	-5,200
Albany Highway (south of Upper Harbour Dr)	42,800	44,800	+2,000
Albany Expressway (west of SH1)	38,900	43,300	+4,400
Albany Expressway (west of Bush Rd)	28,800	30,200	+1,400
William Pickering Drive (north of Piermark Dr)	16,800	12,800	-4,000
Bush Road (north of Piermark Dr)	31,700	27,200	-4,500
Tawa Drive (north of Rosedale Rd)	15,900	14,400	-1,500
Apollo Drive (north of Constellation Dr)	27,400	24,400	-3,000
East Coast Road (north of Greville Rd)	24,000	23,800	-200
East Coast Road (north of Browns Bay Rd)	21,200	21,200	-
East Coast Road (north of Constellation Dr)	38,100	35,200	-2,900
Unsworth Drive (north of Albany Hwy)	7,200	7,600	+400
Unsworth Drive (south of Barbados Dr)	3,200	2,500	-700
Paul Matthews Road (east of Bush Rd)	25,200	21,900	-3,300
Caribbean Drive (North of Goldfinch Rise)	17,700	16,300	-1,400

The Project is predicted to increase flows along both SH1 and SH18. Decreases are forecast on a number of parallel routes, most notably on:

- Albany Highway (reductions of up to 5,600 vehicles per day predicted, or 22%);
- Rosedale Road (reductions of up to 4,800 vehicles per day predicted, or 19%);
- Bush Road (reductions approximately 4,500 vehicles per day predicted, or 14%);
- William Pickering Drive (reductions of approximately 4,000 vehicles per day predicted, or 24%);
- Paul Matthews Road (reductions of approximately 3,300 vehicles per day predicted, or 13%);
- Apollo Drive (reductions of approximately 3,000 vehicles per day predicted, or 11%);

- East Coast Road (reductions of up to 2,900 vehicles per day predicted, or 8%); and
- Sunset Road (reductions of approximately 2,900 vehicles per day predicted, or 17%).

Conversely, traffic flows are predicted to increase on several arterial routes, particularly those that feed Greville and Oteha Valley Interchanges. Most notable among these is Albany Expressway, which is predicted to increase by up to 4,400 vehicles per day west of SH1 (an 11% increase).

In general, the Project is predicted to result in a decrease in traffic flows on local streets, but for those closest to, and that connect directly to, the Greville and Oteha Valley Interchanges. This will have corresponding effects on local property accesses; access will for example be improved on local roads that experience reductions in traffic volumes.

The tables above relate to daily flows and details of the forecast hourly flows, for each of the weekday morning, inter peak and evening peak models are provided at **Appendix E.** This Appendix provides details for the base model, and the forecast (2031) models without and with the Project.

7.3 Traffic Operation of Motorway

7.3.1 Traffic Flows

Table 19 sets out the predicted daily flows along the Northern Motorway and the Upper Harbour Motorway.

Table 19 Predicted 2031 Forecast Motorway Weekday Traffic Flows (two way, without and with Project, vehicles per day)

	Northbound/Eastbound			Southbound/Westbound		
Road	**2031 Reference Case**	**2031 Project**	**Difference**	**2031 Reference Case**	**2031 Project**	**Difference**
SH1						
North of Oteha Valley Rd	45,300	45,700	+400	41,500	42,500	+1,000
Oteha Valley Rd IC	32,700	33,700	+1,000	30,200	31,500	+1,300
Greville Rd to Oteha Valley Rd	54,500	55,400	+900	40,500	45,100	+4,600
Greville Rd Interchange	49,800	52,400	+2,600	33,800	42,000	+8,200
Greville Rd to Upper Harbour	75,000	86,700	+11,700	57,400	74,300	+16,900
Upper Harbour Interchange	56,100	56,700	+600	40,900	40,400	-500
Upper Harbour to Tristram Ave	72,600	77,100	+4,500	58,800	58,400	-400
SH18						
Tauhinu Rd to Greenhithe Rd	41,500	44,400	+2,900	40,100	45,400	+5,300
Greenhithe Rd to Albany Hwy	47,000	51,100	+4,100	46,600	53,000	+6,400
Albany Highway Interchange	22,900	29,300	+6,400	21,200	32,100	+10,900
East of Albany Highway	24,000	32,700	+8,700	21,800	35,600	+13,800

Increased traffic is predicted on almost all sections of SH1 and SH18, with the greatest increases predicted where the Project is expected to deliver additional traffic capacity, namely:

- Along SH1 between the Upper Harbour and Greville Interchanges and through the Greville Interchange; and
- SH18 east of Albany Highway.

A significant increase in traffic is predicted on SH18 through the Albany Highway Interchange, and to a lesser degree further west, although the Project does not increase traffic capacity on these sections of motorway.

7.3.2 State Highway Travel Times

Predicted forecast travel times between the three state highways have been obtained from the SATURN models for the same eight journey times documented previously in Sections 3.11.2 and 6.4. A summary of the predicted forecast journey times for each of the routes, with and without the Project, is summarised in **Table 20**.

Table 20 Predicted Forecast 2031 Reference Case and Project Journey Times (mm:ss)

Route Description	Morning Peak		Inter Peak		Evening Peak	
	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project
Route 1 – SH18 Albany Interchange to SH1 Oteha Valley Interchange	10:10	3:40 (-6:30)	6:50	3:45 (-3:05)	12:55	6:45 (-6:10)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Interchange	18:55	6:30 (-12:25)	9:25	4:45 (-4:40)	16:10	6:00 (-10:10)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	9:20	8:00 (-1:20)	8:45	8:25 (-0:20)	17:50	10:10 (-7:40)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	21:25	18:30 (-2:55)	10:10	9:15 (-0:55)	11:45	12:15 (+0:30)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	6:25	4:30 (-1:55)	5:25	4:55 (-0:30)	15:05	7:30 (-7:35)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	21:25	16:25 (-5:00)	7:35	6:05 (-1:30)	9:05	7:15 (-1:50)
Route 7 – SH1 Tristram Interchange to SH18 Albany Interchange	9:00	7:00 (-2:00)	7:20	6:05 (-1:15)	14:55	8:10 (-6:45)
Route 8 – SH18 Albany Interchange to SH1 Tristram Interchange	17:25	15:10 (-2:15)	8:35	7:30 (-1:05)	10:15	8:40 (-1:35)

As shown in this table, the Project is predicted to significantly reduce travel times for general traffic on SH1, SH18 and SH17, even though the state highways will be carrying more vehicles. Notable forecast travel time savings include:

- 10 to 12 minute travel time savings from SH1 (north) to SH18 in both commuter peaks, and six minutes in the reverse direction;
- A seven minute travel time saving northbound from SH1 (south) to SH18 in the evening commuter peak;
- An eight minute travel time saving from SH1 (south) to SH17 in the evening commuter peak; and
- An eight minute travel time saving on SH1 northbound in the evening commuter peak, and a five minute saving southbound in the morning commuter peak.

Travel time savings are predicted for the remaining state highway to state highway movements shown above, for all three modelled periods. Generally these savings are in the order of one to two minutes.

Travel time reliability was noted to be an existing concern on many of the above motorway routes in Section 3.11.2, with this reliability expected to generally deteriorate over time. By providing additional capacity on the motorway network, the Project is expected to result in travel time reliability benefits, with less variable travel times than without the Project, as the motorway is predicted to operate within capacity for most of the day – a significant improvement over the Future Reference Case.

7.3.3 Operation of Upper Harbour Interchange

The proposed layout at the Upper Harbour Interchange is shown within Sheets 6 and 8 of the General Arrangement Plans, provided within Volume 5 of the AEE.

The operation of the interchange will be significantly improved by the provision of the direct (grade separated) connections between SH18 and SH1 (north) and by the extension of the busway, with a two way bus link to be provided over Constellation Drive.

- The SH18 and SH1 (north) connections will eliminate north to west and west to north motorway to motorway traffic from passing through the interchange, allowing the existing interchange to better serve "local" movements; and
- The busway extension will allow buses to avoid the general traffic congestion at the interchange, and the removal of these buses will release capacity for general traffic.

In addition, the physical layout at the existing Upper Harbour Interchange will change as follows:

- The bus lane within the southbound off ramp, and the bus only entry to the Constellation Bus Station from the Upper Harbour southbound on ramp, will be removed, due to the provision of the busway extension;
- The bus only ramp signal bypass lane on the northbound on ramp will be removed; and
- The single left turn give way lane from the northbound off ramp will be changed to two lanes, which will operate under signal controls.

The models predict that the provision of extra capacity will lead to the reassignment of some traffic toward the interchange, but the overall volumes of traffic passing through the existing interchange will decrease by around 5,500 vehicles per day, due to the provision of the new motorway to motorway links.

Details of the predicted operation of the interchange, without and with the Project, in 2031, are set out in **Appendix G**, in terms of the forecast volume to capacity (V/C) ratios.

In theory, a V/C ratio of 100% means that the volume equals the capacity, and an intersection at this level is said to be operating at theoretical capacity. In practice, conditions tend to become congested at values less than 100%, and intersections operating at V/C ratios of 85 to 90% are said to be operating at "practical capacity".

The information within **Appendix G** indicates that the interchange will be operating over capacity, in the Future Reference Case, with some movements operating at over 100% in the morning and evening peaks, and some movements operating at or very close to 100% in the inter peak period. The tables within **Appendix G** indicate that the signal timings have been fairly well optimised, indicating that there may be little opportunity to resolve these forecast issues with the Future Reference Case, by simple phase retiming.

The tables at **Appendix G** indicate that the interchange will operate as follows, with the Project in place:

- One movement is predicted to be operating above 90% in the morning peak. However, the other critical movements are predicted to be operating at around 85%, indicating that the timings could be slightly further optimised, bring down the maximum figure of 93% (the through movement from the west, at the western intersection);

- Several movements are predicted to be operating at between 80 and 88% in the inter peak; and
- Three movements are predicted to be operating at 98 to 101%, during the evening peak.

7.3.4 Operation of Greville Interchange

The proposed layout at the Greville Interchange is shown within Sheets 3 and 4 of the General Arrangement Plans.

The physical layout at the Interchange will not change significantly as a result of the Project, although the recently part signalised teardrop roundabout at the eastern side will be replaced by a more conventional signalised intersection. Therefore (apart from this change to the eastern intersection), the main changes in traffic operations will relate to the changes in traffic flows and congestion as follows:

- The capacity of the two lane southbound section of SH1, from Greville to Upper Harbour Interchange is currently the main bottleneck affecting the interchange. Ramp signals are used to manage the rate of entry onto the motorway, and queues regularly extend back to the interchange;
- The provision of additional southbound capacity on the motorway will therefore assist in allowing a higher rate of flow onto the motorway;
- In addition, southbound buses currently use the southbound off-ramp to bypass queues on the motorway, using the ramp bypass lane to re-join the motorway. With the Project, these buses will use the busway extension, therefore reducing the flow passing through the eastern intersection; and
- In the northbound direction, the situation will be quite different. The increase in capacity on the motorway from the Upper Harbour Interchange to the Greville Interchange will increase the rate at which traffic can reach the northbound off ramp. This movement is very busy during the weekday evening peak and the traffic signal timings will need to ensure that queues do not extend back from the signals to the motorway main line. This priority (for traffic using the off ramp) implies less "green time" at the traffic signals, for other movements.

The information within **Appendix G i**ndicates that:

- The SATURN model predicts that the full signalisation of the eastern intersection will operate satisfactorily, with maximum Volume/Capacity ratios of 72% and 84% in the morning and evening peaks respectively. One movement in the inter peak is predicted to be operating at 98%, but low volume/capacity ratios on other movements indicate that this can be resolved by re-optimising the phase times. Therefore, the capacity of this intersection will not limit the rate of entry onto the motorway; and
- The SATURN model predicts reductions in flows, northbound on Tawa Drive and eastbound on Albany Expressway, during the evening peak, as a result of the Project, and this will offset the effect of the reduction in green times likely to be given to those approaches. The Tables at **Appendix G** indicate that three turns will be operating at or over 100% in the evening peak, but this is due to the extra green time given in the traffic model to the northbound motorway off ramp, with that approach predicted to be operating with a maximum degree of saturation of 81%. This indicates that further signal phase time re-optimisation, perhaps seeking to have a maximum volume to capacity ratio of 90% on the off ramp, would reduce the significance of this issue.

7.3.5 Northbound Capacity on SH1

The Project is to include the following improvements northbound along SH1:

- The existing third northbound lane on SH1 will be extended across the Upper Harbour Interchange as far as the new connection from SH18;
- Additional (fourth and fifth) lanes are to be provided between the new SH18 eastbound connection and the Greville interchange;
- An additional (third) lane will be provided across the Greville Interchange; and

- An additional (fourth) lane is to be provided between the Greville Interchange and the Oteha Valley Interchange. This will provide an additional general traffic lane, alongside the existing climbing lane.

A particular issue in the design of the Project has been the "weaving" of northbound traffic, between the Upper Harbour and Greville Interchanges[25]. The two northbound weaving movements arising from the Project are:

- Traffic from SH1, south of the Upper Harbour Interchange, leaving at the Greville Road off ramp; and
- Traffic from the SH18 to SH1 (north) connection, continuing on SH1 beyond Greville Road.

The Project is at the northern end of the Western Ring Route, and traffic on SH1 and SH18 will be moving out from the constrained motorway network toward the less constrained areas to the north. The fifth northbound lane between the Upper Harbour and Greville Interchanges has been introduced to the Project to provide more space for traffic to weave safely and the proposal has been approved by safety engineers at the NZ Transport Agency and by the safety reviewers. However, this section of weaving will be very busy, with maximum arrival flows of around 7,200 vehicles/hour (in the five lanes) during the evening peak. Ramp signals are proposed on the SH18 to SH1 (north) connection in order to manage the flow levels in the weaving area within the weekday evening peak.

Widening of the northbound motorway, on the approach to the northbound Greville off ramp, will increase the rate that traffic can reach the sections further to the north, leading to the need to provide the additional (third) lane across the Greville interchange, and the additional (fourth) lane north from the Greville on ramp.

As noted in Section 3.15 above, the existing third (kerbside) lane north from the Greville on ramp currently operates as a climbing lane for slow moving/heavy vehicles, and surveys indicate that there is a significant speed differential between these vehicles and cars/light vehicles in the adjacent lanes. Given this speed differential and the safety implications associated with the speed and number of northbound motorists mixing with slow moving vehicles, the continued provision of three lanes north of the Greville on ramp was highlighted as a risk by the safety reviewers. The outcome of this has resulted in the need to provide an additional (fourth) lane through to the Oteha Valley Interchange. The maximum arrival flow is predicted to be about 5,100 vehicles/hour, in the evening peak. If this figure includes 7% HCVs, this would imply about 4,750 vehicles/hour in two lanes, if the additional lane was not provided, and if all cars/light vehicles tried to avoid the slow/climbing lane.

7.3.6 Southbound Capacity on SH1

The Project is to include the following improvements southbound on SH1:

- An additional (third) lane will be provided across the Greville Interchange;
- Additional (third and fourth) lanes are to be provided between the Greville Interchange and the new SH18 westbound connection; and
- There will be a lane drop, from four to three lanes, at the new connection to SH18, but the third lane will continue beyond the Upper Harbour southbound off ramp.

As noted above, a particular issue in the design of the Project has been the weaving of northbound traffic between the Upper Harbour and Greville Interchanges. Weaving of southbound traffic also needs to be considered, but the situation is somewhat different:

[25] Weaving occurs where a stream of traffic on a motorway must change lanes to the right, while a second stream of traffic must change across the same lanes to the left, within a short section of motorway. Depending on the volume of traffic and the length of the weaving manoeuvres, these may result in conflicts and safety concerns.

- Conditions southbound on SH1 are very congested during the busy morning peak period, with slow moving traffic already regularly extending back to Oteha Valley Road as a result of downstream constraints on SH1; and
- Some southbound traffic is expected to reroute from SH1 via the Auckland Harbour Bridge, to the Western Ring Route, but traffic conditions on SH1, south of the Upper Harbour Interchange, are expected to continue to be congested, meaning that the weave between the Greville and Upper Harbour Interchanges is expected to be at fairly slow speeds during the morning peak period; and
- The peak southbound flows in the morning peak are generally lower than those northbound in the evening peak.

As noted above, the provision of additional southbound lanes on the motorway, between the Greville and Upper Harbour Interchanges will allow a greater rate of flow to join the motorway than is currently the case. The satisfactory weaving of traffic will need to include continued ramp signals on the Greville Interchange southbound on ramp (and other ramps to the north) – even though these signals will be able to allow more traffic through than is currently the case. However, the information within Tables E1 and E5 (within **Appendix E**) indicates that while more traffic will be able to pass through the Greville and Upper Harbour interchanges as a result of the Project, the Project is expected to lead to a reduction in arrival flows south of the Upper Harbour interchange, in both the weekday morning and evening peaks, due to the expected reassignment of some traffic from SH1 to SH18 (and the Western Ring Route). Table E3 indicates that arrival flows south of the Upper Harbour Interchange are predicted to be the same in the inter peak, without and with the Project.

The reductions in arrival flows during the morning peak period, south of the Upper Harbour Interchange, relative to the Future Reference Case, can be expected to improve conditions back from the SH1/Esmonde Road bottleneck, during this congested time period.

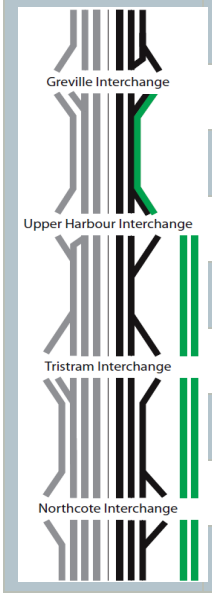
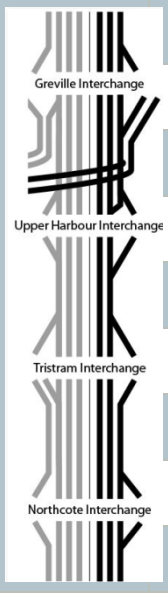
7.3.7 State Highway Operation on Weekends

The weekend peak periods have not expressly been modelled. However the operation of the Northern Motorway during weekends has been assessed by factoring up model outputs from the forecast 2031 inter peak periods. **Table 21** below compares the arrival traffic flows for the southbound sections of the Southern Motorway, for:

- The existing weekday inter peak and weekend peaks;
- The predicted 2031 weekday inter peak with and without the Project, based on SATURN model outputs; and
- The estimated 2031 weekend peak with and without the Project, obtained by factoring the existing weekend peak flows by the percentage growth in inter peak flows.

In the below table, sections of motorway that are currently operating at or close to capacity, or predicted to in the future, are highlighted red.

Table 21 Southbound Arrival Traffic Flows per Hour on SH1, Weekday Inter Peak and Weekend Peaks

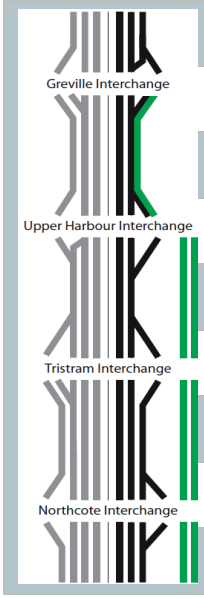
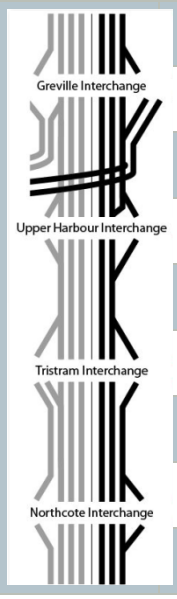
Existing Lane Layout	Existing Traffic Volumes		2031 Reference Case Traffic Volumes		Project Lane Layout	2031 Project Traffic Volumes	
	Weekday Inter Peak	Weekend Peak	Weekday Inter Peak	Weekend Peak		Weekday Inter Peak	Weekend Peak
	2,150	2,650	2,600	2,800		2,850	3,550
	2,000	2,500	2,250	2,800		2,700	3,400
	3,400	3,750	3,800	4,200		4,900	5,450
	2,650	2,950	2,850	3,150		2,850	3,200
	3,900	4,200	4,100	4,400		4,100	4,400
	3,050	3,200	3,550	3,700		3,550	3,700
	3,950	4,150	4,500	4,700		4,450	4,700
	3,300	3,450	3,550	3,700		3,500	3,650
	3,950	4,050	4,450	4,550		4,400	4,500

Currently southbound traffic flows during the weekend peak operating at capacity between Greville and Upper Harbour interchanges, and between Upper Harbour and Tristram interchanges. Without the Project, this is predicted to continue to be the case, albeit to a greater degree. With the Project, southbound weekend traffic flows between Greville and Upper Harbour interchanges are predicted to operate within capacity. Between the Upper Harbour and Tristram interchanges, the increases in traffic able to pass through from the sections of motorway to the north are predicted to be offset by increases in traffic switching from SH1 to SH18. As a result, as noted in Section 7.3.6 above, southbound traffic flows south of the Upper Harbour interchange with the Project are predicted to be consistent with those without the Project, during the weekday inter peak, and therefore during the weekend peaks, with comparable congestion expected.

It is noted that the same sections of motorway are predicted to operate at or close to capacity in 2031 between both the inter peak and weekend peaks (both with and without the Project). This indicates that the southbound Project travel time benefits during the weekend peak are likely to be comparable to those predicted for the inter peak.

Table 22 below goes on to present the same SH1 arrival traffic flows for the northbound direction.

Table 22 Northbound Arrival Traffic Flows per Hour on SH1, Weekday Inter Peak and Weekend Peaks

Existing Lane Layout	Existing Traffic Volumes		2031 Reference Case Traffic Volumes		Project Lane Layout	2031 Project Traffic Volumes	
	Weekday Inter Peak	Weekend Peak	Weekday Inter Peak	Weekend Peak		Weekday Inter Peak	Weekend Peak
	2,150	2,650	3,250	4,000		3,350	4,100
	1,950	2,450	3,000	3,750		3,150	3,950
	3,550	4,050	4,700	5,350		5,250	6,000
	2,700	3,000	3,600	4,000		3,600	4,000
	4,000	4,050	4,750	4,800		5,000	5,050
	3,150	2,950	4,000	3,750		4,150	3,900
	4,250	3,950	5,100	4,750		5,200	4,850
	3,500	3,300	4,050	3,800		4,150	3,950
	3,950	3,750	4,500	4,300		4,600	4,400

Currently, the northbound sections of SH1 generally operate satisfactorily during the weekend peaks, with the possible exception being the three to two lane merge above the Upper Harbour Interchange. In 2031 without the Project, the northbound sections through both Upper Harbour and Greville Interchanges are predicted to operate at or close to capacity, while the Project is expected to relieve this congestion.

As a result, northbound weekend peak operations are predicted to be improved due to the Project, more so than northbound inter peak operations.

7.3.8 Operation of Paul Matthews Road/Caribbean Drive Intersections

The proposed layout at the Paul Matthews Road/Caribbean Drive intersection is shown within Sheet 8 of the General Arrangement Plans.

Congestion is currently experienced by traffic heading to or from Paul Matthews Road and Caribbean Drive onto or off SH18, and this is predicted to get worse following the completion of the Western Ring Route (referring to the SH20 Waterview Connection and the upgrade works along the Northwestern Motorway).

The Project will remove motorway to motorway traffic between SH18 and SH1 (north) from these local intersections, but it will also change the two existing T-intersections (SH18/Paul Matthews Road and SH18/Caribbean Drive) to a single signalised intersection which will also serve the new ramps to/from SH18.

The SATURN model indicates that the Project will improve travel times for persons heading to/from Paul Matthews Road and Caribbean Drive, from/to SH18.

The information within **Appendix G** indicates that:

- Both the SH18/Paul Matthews Road and the SH18/Caribbean Drive intersections will be operating over capacity, with the Future Reference Case, with volume to capacity ratios of up to 107% at both intersections in the morning peak, and up to 102% in the evening peak; and
- The combined intersection, proposed as a result of the Project, is predicted to operate with maximum volume to capacity ratios of 97% in the morning peak and 102% in the evening peak.

7.3.9 SH18/Unsworth Drive

The upgrade of SH18/Upper Harbour Highway to motorway standard will require the closure of the existing left turn into Unsworth Drive (see Sheet 9 within the General Arrangement Plans). This is currently a fairly lightly trafficked movement[26], and access to the northern end of Unsworth Drive will still be possible via Caribbean Drive. As noted above, congestion in the Paul Matthews Road/Caribbean Drive areas is predicted to get worse between now and 2031 if the Project does not proceed, and the SATURN model indicates that access to Unsworth Drive from Paul Matthews Road or Caribbean Drive will be quicker as a result of the Project, despite the closure of the direct access from SH18 to Unsworth Drive.

7.4 Effects on Pedestrians and Cyclists

The Project proposes implementation of 3.0 m shared use paths parallel to SH1 from Oteha Valley Road to Constellation Bus Station, and parallel to SH18 from Albany Highway to Constellation Bus Station.

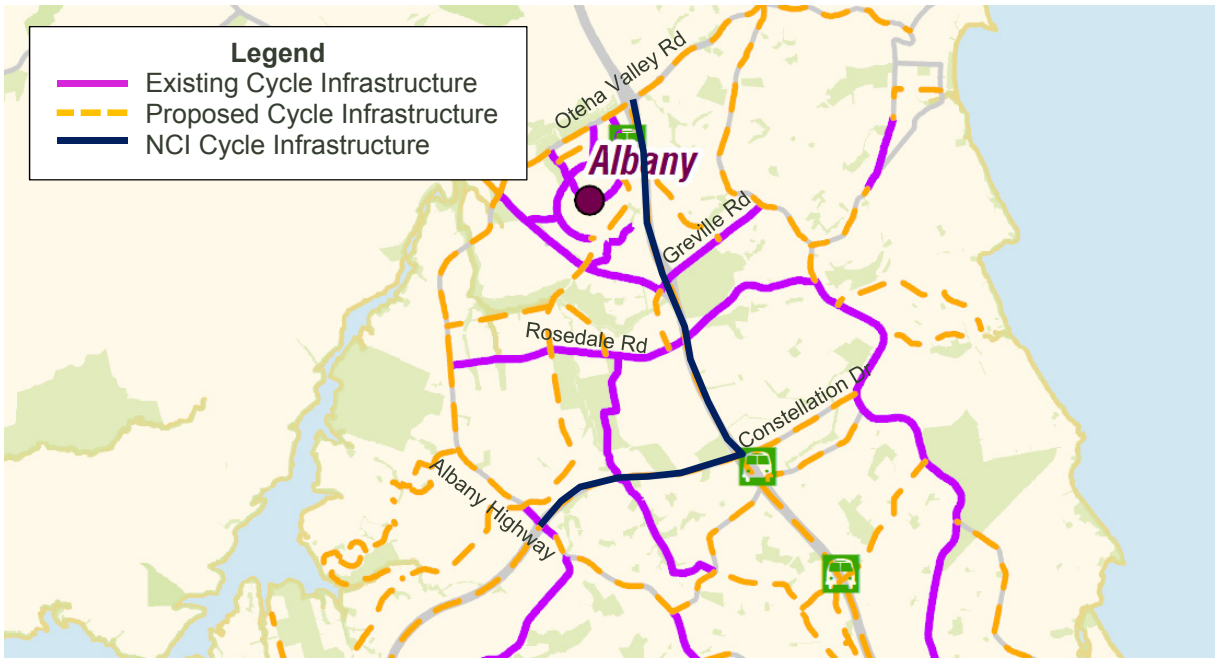
The proposed SH1 shared use path is located on the eastern side of the motorway and busway corridors, with connections to the wider network at Oteha Valley Road, Masons Road, McClymonts Road, Spencer Road, Greville Road, Rosedale Road, Arrenway Drive and at Constellation Bus Station

The proposed SH18 shared use path is located to the north of SH18 at its western end, connecting Albany Highway, William Pickering Drive, an existing shared use path beneath SH18 at Alexandra Stream, and at Paul Matthews Road. The proposed shared use path would then cross SH18 via the realigned Paul Matthews Road, continuing east to the south of Upper Harbour Highway with connections at Caribbean Drive and Constellation Bus Station.

Figure 37 illustrates how the proposed new cycle infrastructure delivered by the Project integrates with the surrounding existing and proposed cycle infrastructure.

[26] Peak hour traffic volumes when surveyed on Tuesday 9 August 2016 were 170 vehicles/hour in the morning peak, 85 vehicles/hour in the inter peak, and 105 vehicles/hour in the evening peak

Figure 37 Auckland Cycle Network, Post Project



Source: Base Map from Auckland Transport

In general, the shared use paths proposed will provide connections where presently there are none, and as a result, the effects of the Project on walking and cycling are considered to be positive. Connectivity for pedestrians and cyclists will be significantly improved both north-south along the SH1 corridor and east-west parallel to SH18 through the provision of continuous, safe, shared paths along these corridors, bridging a significant gap in the existing walking and cycling network.

The Project will also assist in remedying the past severance caused by the motorway corridors, by providing new pedestrian and cyclist connections across these corridors, at:

- McClymonts Road where the southern side of the existing bridge over SH1 will be fitted with a new footpath where presently there is none; and
- Paul Matthews Road, where a new shared use path will provide north-south connectivity across SH18, improving access to the North Harbour Hockey stadium, North Harbour Industrial area and the Unsworth Heights community.

The Project will generally support recent Auckland Transport pedestrian and cyclist improvements on Oteha Valley Road, Greville Road, Rosedale Road and Albany Highway.

The Project is in general expected to result in reduced traffic on existing arterial routes, as discussed in Section 7.1. This will indirectly benefit both pedestrians and cyclists, particularly vulnerable road users such as school children. The most notable among improved routes (based on 2031 forecasts) include:

- Albany Highway, where predicted traffic reductions of up to 22% will benefit active mode users at Albany Primary School, Albany Junior High School, Kristin School, Albany Senior High School and Massey University;
- Bush Road and Rosedale Road, where predicted traffic reductions of up to 14% and 19% respectively will benefit active mode users at Pinehurst School; and
- East Coast Road where predicted traffic reductions of up to 8% will benefit active mode users at Rangitoto College.

Conversely, increased traffic on routes such as Albany Expressway and Greville Road will adversely affect pedestrians and cyclists.

In summary, the Project's effects on pedestrians and cyclists are positive and the Project will result in significantly improved safety and connectivity outcomes for active modes.

7.5 Effects on Public Transport

The Project includes the extension of the Northern Busway from the Constellation Bus Station to the Albany Bus Station. The current route used by buses north of Constellation Bus Station includes some dedicated facilities, some shoulder running along the motorway, plus some sections of road where buses can be caught up in general congestion. This is particularly the case for northbound buses passing through the Upper Harbour Interchange.

The Project will, therefore, offer benefits for public transport in terms of providing quicker and more reliable journeys by bus, as a result of the following improvements:

- A two lane dedicated busway alongside the Northern Motorway;
- At its northern end, the busway will include a connection over the motorway, into the Albany Bus Station; and
- At the southern end, the busway will pass over Constellation Drive, and tie into Constellation Bus Station. This will require changes within the Constellation Bus Station, including the provision of a new platform for northbound buses.

The above improvements will lead on to benefits in terms of reduced travel times for buses and improvements in the reliability of bus services. The provision of reliable bus services should assist to increase patronage.

As highlighted previously, the Project is expected to reduce general traffic volumes on several arterial roads in the area. These reductions will provide indirect benefits to public transport operators and users, by reducing congestion on these routes and improving bus travel times, where bus priorities are not already in place. Key among these will be East Coast Road, Bush Road, Rosedale Road, Apollo Drive, Paul Matthews Road, William Pickering Drive and Sunset Road, each of which are predicted to experience reduced traffic. It is noted however that while a significant reduction in traffic is predicted on Albany Highway, this route has recently gained T2 lanes, so will benefit somewhat less from the reduction.

7.5.1 Travel Time and Reliability Benefits

Table 23 below presents the predicted average travel times for buses travelling between Albany and Constellation Bus Stations in 2031, based on the SATURN models.

Table 23 Predicted 2031 Bus Travel Times, Albany to Constellation

	Travel Time Without Project		Travel Time With Project		Travel Time Difference	
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Morning Peak	7:35	7:50	3:35	3:35	-4:00	-4:15
Inter Peak	8:10	8:20	3:35	3:35	-4:35	-4:45
Evening Peak	14:15	7:55	3:35	3:35	-10:40	-4:20

Section 3.16 previously demonstrated that existing average northbound bus travel times range from 5 minutes off peak to 7 minutes during the evening peak. In 2031, and without the Project, travel times

are predicted to increase to 8 minutes through the day, rising to over 14 minutes in the evening commuter peak due to congestion passing through Upper Harbour Interchange. This forecast average evening peak travel time broadly matches the existing maximum observed northbound travel time.

The existing average southbound bus travel times from the Albany Bus Station to the Constellation Bus Station ranged from 5 minutes off-peak through to 8 minutes during the morning peak period. In 2031 and without the Project, average southbound travel times are predicted to be 8 minutes throughout the day. In this instance, southbound bus travel times are expected to be less susceptible to increasing general traffic congestion than northbound buses, due to the existing southbound bus shoulder running lanes on SH1 and southbound bus priority through the Greville Road Interchange.

The Project is predicted to substantially reduce forecast 2031 bus travel times to approximately 3½ minutes in both directions and in all time periods. Consistent travel times are predicted regardless of direction and time period, as the proposed Northern Busway Extension will remove bus services from general traffic congestion for the entire route between the Albany and Constellation Bus Stations. Bus travel times on the busway extension will instead be governed by the operating speeds of the proposed busway extension.

The reduced travel times will result in operational travel time savings for bus operators, as well as travel time savings for passengers – see Section 7.5.2 for forecasts of passenger numbers affected. The predicted travel times will also result in travel time reliability benefits for both bus operators and passengers, particularly for northbound services during the evening peak.

7.5.2 Patronage Benefits

Table 24 below presents the bus patronage forecasts on SH1 under the Future Reference Case, and on the Northern Busway under the Project scenario. Patronage projections are shown for 2021 and 2031, for a location north of Constellation Bus Station, and have been obtained from the ART model.

Table 24 Predicted Patronage (Two hour volumes in passengers)

	Without Project		With Project		Difference	
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
2021						
Morning Peak	1,260	3,670	1,360	3,960	+100 (8%)	+290 (8%)
Evening Peak	3,130	1,320	3,590	1,420	+460 (15%)	+100 (8%)
2031						
Morning Peak	1,610	4,500	1,730	4,850	+120 (7%)	+350 (8%)
Evening Peak	3,800	1,680	4,390	1,800	+590 (16%)	+120 (7%)

The model predicts that in both 2021 and 2031, the proposed Northern Busway Extension will result in increases in bus patronage between the Albany and Constellation Bus Stations. The patronage in the morning peak period is predicted to increase by some eight percent in both northbound and southbound directions, while the increases in the evening peak are predicted to be around fifteen percent in the northbound direction and seven or eight percent in the southbound direction.

The forecast increases in bus patronage are significant, with over 700 additional bus passengers predicted during the evening peak in 2031.

The maximum forecast patronage is 4,850 persons travelling southbound in the morning peak (two hour) period. This is well within the expected capacity of 4,000 persons per hour, in the peak direction, noted in Section 6.2 above, based on the expected number of buses.

The largest increases are predicted in the northbound direction during the evening peak. This reflects the significant northbound evening peak bus travel time saving predictions presented in Section 7.5.1 previously. These new bus passengers will be a combination of:

- New trips not previously undertaken;
- Existing bus passenger trips that reroute via the Northern Busway Extension (with for example a user choosing to catch the Northern Express from Albany to Constellation, followed by an onward bus to Glenfield, rather than a direct Albany-Glenfield bus via Albany Highway); and
- Existing trips by other modes that switch to public transport.

This latter behaviour change will in particular result in benefits for the Project, by removing vehicle traffic from the road network during the commuter peak periods. This in turn will provide wider network benefits in the form of reduced private car travel times, improved travel time reliability, and reduced congestion, emissions, vehicle operating and crash costs.

The increased patronage expected on the Northern Busway due to the Project will result in increased passengers at the busway stations, as well as increased passengers on feeder bus services. The increases at the busway stations will in turn result in:

- Increased demand for car parking in and around these stations;
- Increased demand for 'kiss and ride' (i.e. pick up or drop-off) facilities at these stations;
- Increased demand for walking and cycling facilities to and from these stations; and
- Increased passengers on feeder bus services to and from these stations.

As noted previously, up to 700 additional passengers (two way) are predicted during the evening peak period in 2031 due to the Project. There is currently very limited spare parking capacity at or adjacent to the busway stations. However, additional parking spaces are to be provided at the Silverdale, Albany and Constellation Bus Stations, as proposed within Auckland Transport's parking strategy (see Section 6.2.4). Perhaps more importantly, Section 6.2.2 noted that it is to be expected that a greater proportion of bus users will walk or cycle to the busway stations in the future, and the proposed new bus network being rolled out by Auckland Transport in 2018 will also encourage more use of feeder bus services serving the Albany and Constellation Bus Stations. The Project is predicted to lead to reductions in traffic flows on a number of routes serving these busway stations, allowing improved levels of service for buses on these routes. An increase in flows is forecast along the eastern section of Oteha Valley Road, but as noted within Section 6.2.2, Auckland Transport may implement transit lanes along that route.

It is noted that the Albany Bus Station carpark operates at 100% occupancy on weekdays, and has done so since it was expanded to 1,100 spaces in 2012. Busway patronage has grown by 25% per annum over this period[27], with much of this led by growth at Albany (the busiest station). It is expected that this growth has been enabled by an increase in walking, cycling and feeder bus use, rather than an increase in park and ride, and this trend is expected to continue into the future.

Also, we are aware that Auckland Transport is considering enhancements to the Albany Bus Station, with perhaps an additional platform for buses at the station.

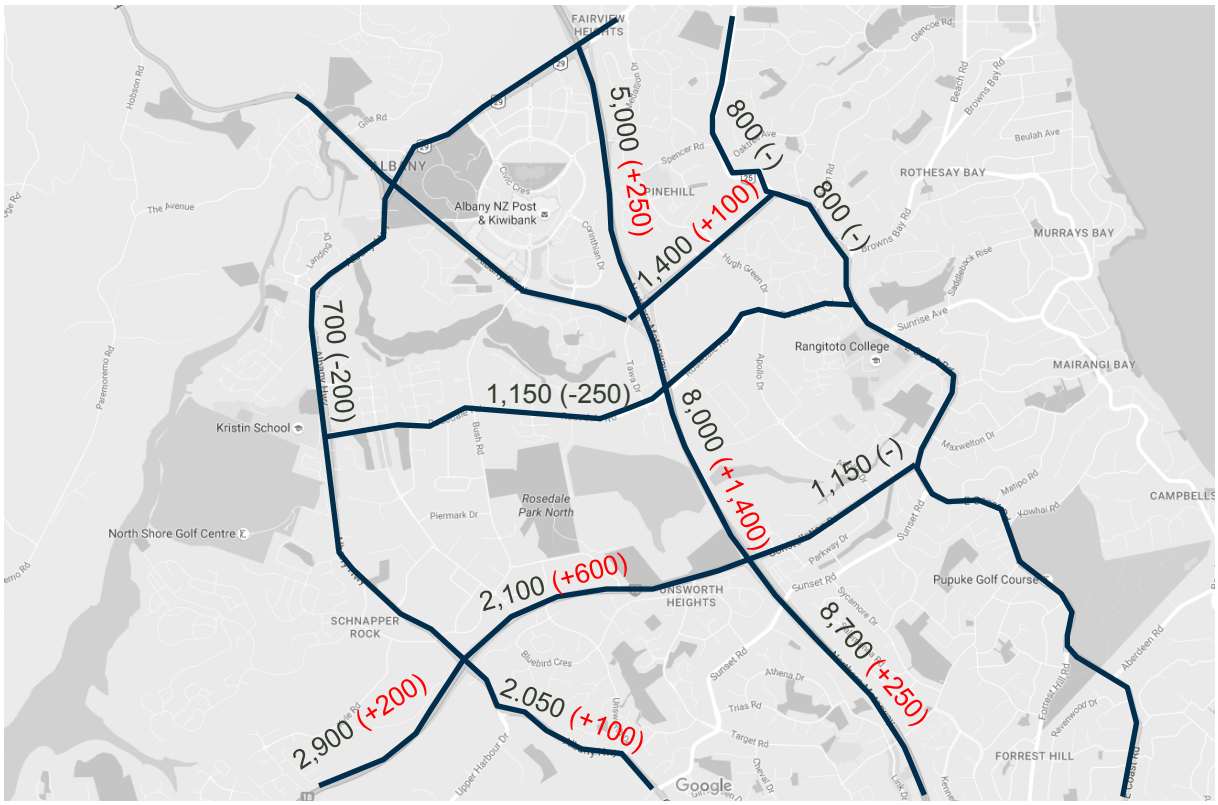
[27] 197,000 boardings in October 2012, 392,000 in October 2016; Auckland Transport

7.6 Effects on Freight

The effects of the Project on freight traffic will generally be the same as those for general traffic, as the only existing freight facilities on the network are the bypass lanes at some of the ramp signals.

Figure 38 illustrates the forecast daily HCV movements on the motorway network and the surrounding arterial network in 2031 with the Project. Also shown is the predicted increase/decrease, relative to the 2031 Reference Case.

Figure 38 Forecast 2031 Daily Heavy Commercial Vehicle Movements with Project (two-way) (changes due to Project in brackets)



Source: Base Map from Google

SH1 is one of Auckland's primary freight routes, with up to 5,200 daily heavy vehicle movements between the Greville and Upper Harbour Interchanges in 2015. In 2031 without the Project, this is expected to increase to approximately 6,600 HCVs per day. SH18 currently carries fewer freight movements, but it still carries a significant volume, with 1,050 daily heavy vehicle movements between Unsworth Drive and Paul Matthews Road. This latter figure is expected to increase as a result of the completion of the Western Ring Route, and 1,500 HCVs per day are predicted in 2031 without the Project. The Project is predicted to consolidate HCV movements onto the motorway network, in turn removing some HCVs from the local road network[28].

The Project will provide direct benefits to through freight movements by reducing motorway travel times on both SH1 and SH18. In addition, the SH18 to SH1 (north) direct connection is to include ramp signals for general traffic, with a bypass lane for trucks. As such, trucks will be able to bypass these signals when they operate.

[28] It is acknowledged that the SATURN traffic model does not model cars and HCVs separately. Therefore the forecast changes in HCVs are derived from the forecast changes in total traffic volumes

Benefits will also be gained by freight movements on arterial roads, most notably Bush Road, Rosedale Road, Apollo Drive and William Pickering Drive. Each of these arterial routes supports industrial activity within the North Harbour Industrial Area, Constellation and Apollo Business and Retail areas, and each are predicted to experience reductions in traffic as a result of the Project. Freight activity to the Albany Metropolitan Centre will also benefit from the Project.

7.7 Crash Assessment

As noted previously, the Project is expected to result in an increase in traffic on the SH1 and SH18 motorways and on Greville Road, Oteha Valley Road and Albany Expressway, with corresponding reductions in traffic elsewhere on the local network. If all other factors are equal, the likelihood of a crash could be expected to increase where traffic volumes increase, and decrease where traffic volumes reduce.

In the absence of other factors therefore, the likelihood of crashes on SH1 and SH18 could be considered to increase due to the increase in exposure. However, the risk of crashes occurring is expected to reduce as a result of the Project, because the Project includes improved safety elements compared to the Reference Case, by:

- Removing motorway to motorway traffic from the local road network, especially with regards to freight;
- Removing right turn movements from SH18 at Paul Matthews Road and Caribbean Drive;
- Reducing congestion and queuing on SH1, thereby reducing the incidence of rear-end type crashes;
- Improving street lighting throughout the Project extent;
- Improving existing crash barriers;
- Providing increased shoulder widths;
- The improvements to the shoulder widths will allow forward visibility to be improved at certain locations; and
- Providing safe, separated pedestrian and cyclist facilities.

It is noted that the Project will result in some increase in weaving traffic movements, as documented in Sections 7.3.5 and 7.3.6. These weaving movements are however being mitigated by:

- The proposed fourth and fifth northbound lanes between the Upper Harbour and Greville Interchanges, providing more road space for northbound weaving traffic movements to shift lanes safely;
- The use of ramp signals on the SH18 to SH1 northbound link during the evening peak period, to manage flow levels within the northbound weave area;
- The proposed third northbound lane through the Greville Interchange, and the fourth lane north of Greville Interchange, to separate out lower speed heavy vehicles joining the motorway at Greville Road from higher speed traffic in adjacent lanes;
- The proposed third and fourth southbound lanes between the Greville and Upper Harbour Interchanges, providing more road space for southbound weaving traffic movements to shift lanes safely;
- Continued use of southbound ramp signals at Oteha Valley Road and Greville Road, to manage flow levels within the southbound weave area; and
- The proposed third southbound lane drop within the Upper Harbour Interchange, providing additional distance for traffic entering at Greville Road (lane four) to merge into the through lane (lane two), relative to a layout where the third lane exits at Upper Harbour.

Together, the above mitigation measures have been approved by safety engineers at the NZ Transport Agency and by the safety reviewers. The net effect of the weaving manoeuvres and the proposed mitigation is considered crash-neutral, and after completion of the Project, the sections of SH1 in question are expected to operate with typical crash rates for urban motorways.

Predictions of the crash rates for SH1 and SH18 in 2031 with and without the Project are provided in **Table 25**. Crash rates (and implications of the Project) have been evaluated according to the procedures documented in the Transport Agency's Crash Estimation Compendium, and differ on each section of roadway according to:

- The availability of historical crash data;
- Whether the Project results in a 'fundamental change' to the operation of each section of road, such as by the addition of extra lanes; and
- The type of roadway (generally motorway, except the existing urban arterial section of SH18 from Albany Highway to SH1).

Table 25 2031 Typical Injury Crash Rates and Site Specific Injury Crash Rates

Road	Ref Case Site Specific Crash Rate	Project Typical Crash Rate	Change in Crash Rate	Ref Case Site Specific Crash Rate	Project Typical Crash Rate	Change in Crash Rate
	Northbound			**Southbound**		
SH1 Oteha Valley Road interchange	2.34	0.70	-70%	0.71	0.75	+6%
SH1 Oteha Valley Road to Greville Road	2.14	2.22	+4%	3.64	1.18	-68%
SH1 Greville interchange	1.82	0.79	-57%	1.74	0.91	-48%
SH1 Greville Road to Upper Harbour	2.59	3.16	+22%	2.40	3.19	+33%
SH1 Upper Harbour interchange	6.59	2.26	-66%	4.86	1.25	-74%
SH1 Upper Harbour Tristram Avenue	6.60	7.18	+9%	3.19	3.16	-1%
SH1 Total	**22.1**	**16.3**	**-26%**	**16.5**	**10.4**	**-37%**
	Eastbound			**Westbound**		
SH18 Greenhithe Road to Albany Highway	2.04	2.30	+13%	1.69	2.02	+20%
SH18 Albany Highway interchange	0.33	0.47	+45%	0.37	0.69	+84%
SH18 Albany Highway to SH1	2.04	1.37	+33%	1.88	1.50	-20%
SH18 Total	**4.4**	**4.2**	**-6%**	**3.9**	**4.2**	**+7%**
				Both Directions		
Motorway Network Total				**46.9**	**35.1**	**-25%**

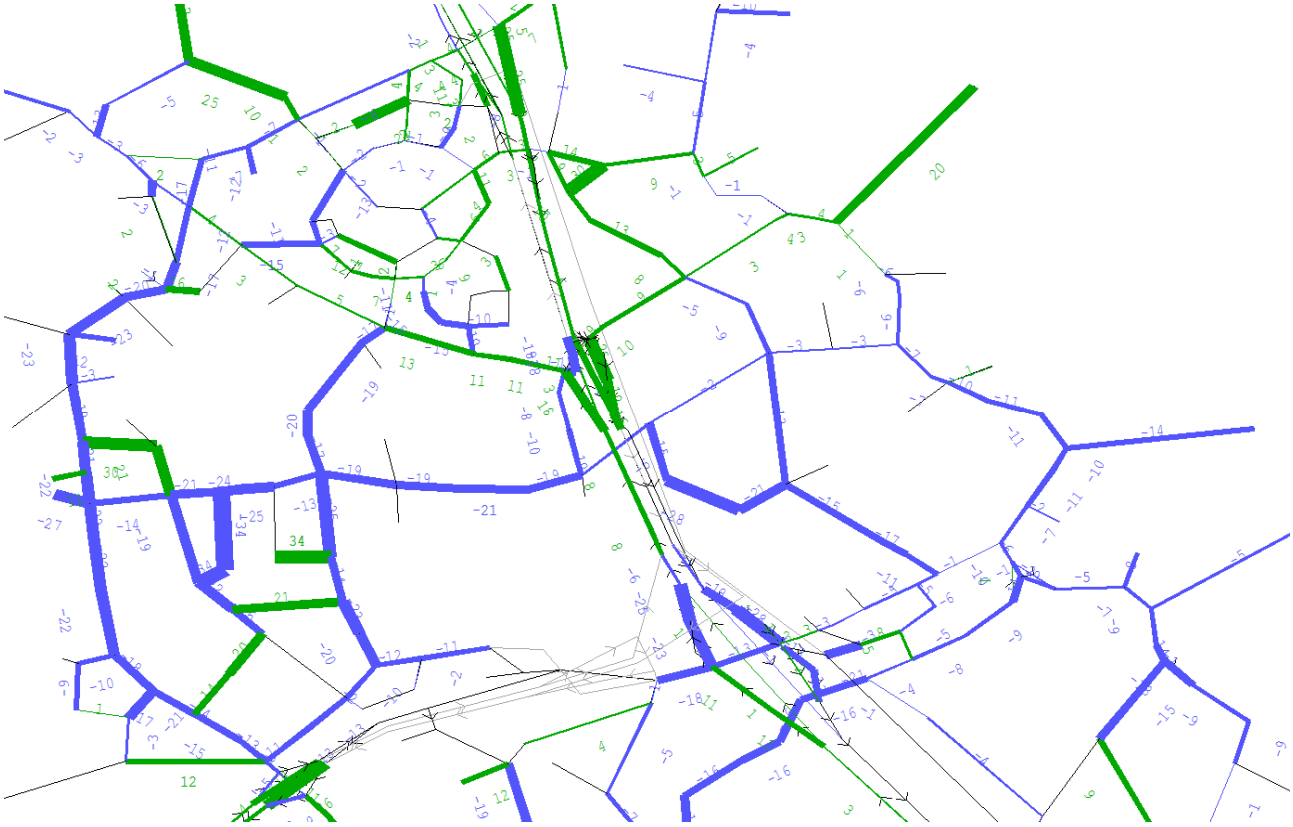
The Project is predicted to result in mixed changes in crash rates on the various sections of the State highway network, with reductions through those sections of motorway that the Project will fundamentally change, particularly on SH18 east of Albany Highway, where the existing urban arterial will be upgraded to motorway standard.

Increased crash rates are predicted on sections of motorway where increased traffic is expected but are not being improved by the Project, particularly on SH18 west of Albany Highway. The net effect on the motorway network is expected to be a reduction in annual injury crashes from 39 to 27 on SH1 (31% reduction), and to remain constant at 8 annual crashes on SH18. Overall, the Project is

predicted to result in a 25% reduction in crashes on the section of motorway network assessed, relative to the 2031 Reference Case.

The Project is expected to generally reduce traffic volumes on the local road network, with traffic volumes on roads such as Albany Highway expected to reduce by up to 22% (as compared with the future scenario without the Project). This is illustrated in **Figure 39**, which shows the predicted percentage change in two-way daily traffic volumes on the local road network. While not separately assessed by the above method, this is expected to generally reduce the rate of crashes occurring on the local road network by an equivalent proportion.

Figure 39 2031 Predicted Percentage Change in Two-Way Daily Traffic Flows with Project



Similarly, the Project will provide off road cycle facilities, thereby shifting existing cycle trips from parallel routes without cycle infrastructure, such as East Coast Road and Bush Road, reducing the incidence of cycle crashes on these routes.

The Project may change the severity of crashes occurring on SH1 and SH18, in that faster operating speeds will result in higher severity crashes. The Crash Estimation Compendium documents proportions of crashes resulting in death and serious injury (DSI) as follows:

- 26% on midblock sections of roads with a 100 km/hr operating speed (e.g. uncongested motorways);
- 22% on midblock sections of roads with a 70 km/hr operating speed; and
- 15% on midblock sections of roads with a 50 km/hr operating speed (e.g. congested motorways).

On the basis of the forecast travel times documented previously in **Table 20** (Section 7.3.2), the following average speeds and resulting proportions of total crashes that result in DSI are predicted on SH18 and SH1 with and without the Project:

Table 26 Predicted SH1 and SH18 Operating Speed Ranges and resulting Proportions of DSI Crashes[29]

	2031 Reference Case		2031 Project	
	Average Speed Range	**Proportion of DSI Crashes**	**Average Speed Range**	**Proportion of DSI Crashes**
Morning Peak	18-59 km/hr	5%-18%	22-84 km/hr	7%-24%
Inter Peak	37-69 km/hr	11%-22%	45-77 km/hr	14%-23%
Evening Peak	21-41 km/hr	6-12%	34-54 km/hr	10%-16%

Increases in the proportion of DSI crashes on the motorway are predicted, with for example the proportion of DSI crashes in the morning peak predicted to increase from 5%-18% to 7%-24%. From a network perspective however, the overall number of DSI crashes is not predicted to change significantly due to the Project, with potentially more DSI crashes on the motorway (due to higher speeds) and fewer DSI crashes on the local road network (due to fewer crashes)

It is also expected that the above increases in DSI crash proportions on the motorway will be partially mitigated by the proposed improvement in shoulder widths, medians and barriers. In addition, crash severity on the local road network will reduce, where for example the existing 80 km/hr intersections of SH18 with Paul Matthews Road and Caribbean Drive (27% DSI rate) will be replaced with 50 km/hr intersections (13% DSI rate).

Table 27 presents a summary of the expected crash effects of the Project, in terms of crash exposure (vehicle-km travelled), crash risk (crashes per vehicle-km travelled), annual crash rate, and crash severity.

Table 27 Summary of Project Crash Effects

Road Type	**Crash Exposure (veh-km travelled)**	**Crash Risk (crashes per veh-km)**	**Crash Rate (crashes per year)**	**Crash Severity**
SH1 and SH18 motorways	Increased	Reduced	Reduced	Increased
Motorway interchanges	Variable[30]	No change	Variable	No change
Local roads	Reduced	No change	Reduced	Reduced
Overall Network	**No change**	**Reduced**	**Reduced**	**Variable**

Overall, the Project is expected to reduce crash rates (crashes per year), due to the predicted crash rate reduction on SH1 and SH18 (refer **Table 25**), and due to the significant reduction in traffic on the local road network. Crash severity effects will be variable, but on balance, the Project is expected to deliver net crash benefits.

[29] Proportions of DSI linearly interpolated between values in Crash Estimation Compendium

[30] Reduced traffic generally predicted through Upper Harbour interchange ramps, increased traffic through Greville Road and Oteha Valley Road ramps, and mixed changes at Albany Highway ramps.

8 Assessment of Effects during Construction

Traffic effects during construction have been assessed against a 2018 pre-construction Reference Case model (i.e. a network without the infrastructure upgrades associated with the Project). This model has been derived from interpolation of demands from the 2015 base model and the 2021 forecast model, in order to represent some level of increased demand to reflect land use development currently underway, particularly in Long Bay and Albany Metropolitan Centre, and to reflect the completion of the SH20 Waterview Connection and SH16 widening.

The predicted effects from these assessments are summarised in the following section.

It is understood that the precise method and sequencing of construction will be determined at a later date, by the contractor. However, the Project Team has put together a possible, realistic staging sequencing for construction activities, as set out in Section 6 of the Design and Constructability Report. Construction is expected to take 3.5 years, but will affect different locations within the Project area at different times.

It is also understood that the contractor will have to work within several constraints, as set out in the proposed conditions. The main points to note from these proposed conditions are as follows:

- Temporary speed limit reductions are to be expected along SH1 and along SH18, for the majority of the construction period;
- There is likely to be lane narrowing along SH1 and SH18, but the number of through traffic lanes and the location and extent of bus shoulder lanes along SH1 and bus priorities at the interchanges are to be retained as at present, as far as reasonably practicable. These restrictions are likely to be in place for the majority of the construction period.
- McClymonts Road is to be kept open for two way traffic throughout the construction period, as far as reasonably practicable, by the development of an off line bridge. This is primarily to allow eastbound buses from Albany Bus Station to reach the southbound bus only on ramp at McClymonts Road, and to allow pedestrians from the east to reach the Albany Bus Station;
- Rosedale Road is to be kept open for traffic and pedestrians throughout the construction period, with one way shuttle working, with signalised control to be permitted; and
- Access between SH18 and Paul Matthews Road is to be kept open for traffic throughout the construction period, but right turn bans (to and from Paul Matthews Road) is to be permitted, to allow the works to be implemented along SH18.

Therefore the main effects of the construction works identified to date relate to:

- The effects of the speed limit and lane width reductions along SH1 and SH18;
- The effects of potential temporary works on Rosedale Road, at the motorway bridge;
- The effects of potential works along SH18 which may require the temporary banning of right turns to/from Paul Matthews Road; and
- The effects of construction related traffic heading to/from the sites.

8.1 Traffic Effects of temporary works along the motorway

The effects of temporary traffic management restrictions applied to SH1 (Oteha Valley Interchange to south of Upper Harbour Interchange) and SH18 (Albany Highway Interchange to east of SH1) have been assessed in a test, termed “Scenario A”. Generally these restrictions have reduced operating speeds from 100 km/h to 80 km/h and from 80 km/h to 60 km/h, and reduced traffic capacities by 10%. This assumption of a 10% reduction in capacity sits at the upper end of observed effects during the

current works along the SH16 Causeway, and the previous works relating to the northbound auxiliary lane between the Upper Harbour and Greville Interchanges.

The predicted effects of this construction scenario are summarised in **Table 28,** in terms of predicted network-wide travel times. Little weight should be given to the absolute values, as the travel times shown are dependent on the size of the network modelled. Instead, the travel time increases due to the construction scenario can be compared to the Reference Case, and against the effects of subsequent tests, set out below.

Table 28 2018 Model Summary Statistics – Total Travel Time (vehicle-hours)

Construction Scenario	Morning Peak		Evening Peak	
	Time	Difference	Time	Difference
Reference Case	19,920	n/a	19,000	n/a
Scenario A: Temporary motorway works	20,120	+200	19,290	+290

The temporary traffic restrictions are predicted to increase overall travel times by approximately 1% in both peak periods, relative to the Reference Case, although it is recognised that this may highlight some more significant differences at a local scale. Therefore, predicted travel times on the state highway network are shown in **Table 29.**

Table 29 2018 State Highway Modelled Journey Times (mm:ss)

Construction Scenario	Morning Peak		Evening Peak	
	Time	Difference	Time	Difference
SH1 (Lonely Track Road to Sunnynook Road)				
Northbound	6:00	6:35 (+0:35)	13:40	14:40 (+1:00)
Southbound	19:30	20:35 (+1:05)	8:40	9:00 (+0:20)
SH18 and Constellation Drive (Upper Harbour Bridge to East Coast Road)				
Eastbound	12:45	13:00 (+0:15)	12:45	13:05 (+0:20)
Westbound	11:30	11:55 (+0:25)	14:50	15:55 (+1:05)

Journey times are predicted to increase by approximately 20 seconds, due to the speed reductions on the motorways. Additional increases in journey times (i.e. over and above this 20 seconds) are a result of increased congestion in the peak directions:

- Southbound on SH1 in the morning peak; and
- Northbound on SH1 and westbound on SH18 in the evening peak.

8.2 Effects of Other Temporary works

8.2.1 Effects on General Traffic

Six further temporary construction scenarios have been assessed, based on the work carried out by the Project Team on realistic (temporary) construction scenarios. Each of these scenarios has been assessed in conjunction with Scenario A above, as documented below:

- Scenario B: Scenario A plus the full closure of the Rosedale Road underpass beneath SH1;
- Scenario C: Scenario A plus Rosedale Road operating with only one lane for two way traffic, with traffic signal controls (i.e. there will be one way working, at a time);

- Scenario D: Scenario A plus Rosedale Road operating as a one way (eastbound) link;
- Scenario E: Scenario A plus Rosedale Road operating as a one way (westbound) link;
- Scenario F: Scenario A plus Right turn movements into and out of Paul Matthews Road banned at SH18; and
- Scenario G: Scenarios A, C and F combined.

The results of these tests are summarised in **Table 30**, in terms of network-wide travel times.

Table 30 2018 Model Summary Statistics – Total Travel Time (vehicle-hours)

Construction Scenario	Morning Peak		Evening Peak	
	Time	Difference	Time	Difference
Reference Case	19,920	n/a	19,000	n/a
Scenario B: Rosedale Road closure	20,670	+750 (+4%)	19,750	+750 (+4%)
Scenario C: Rosedale Road signals	20,200	+280 (+1%)	19,490	+490 (+3%)
Scenario D: Rosedale Road eastbound	20,240	+320 (+2%)	19,720	+720 (+4%)
Scenario E: Rosedale Road westbound	20,640	+720 (+4%)	19,960	+960 (+5%)
Scenario F: Paul Matthews restrictions	20,460	+540 (+3%)	19,590	+590 (+3%)
Scenario G: Rosedale signals & Paul Matthews restrictions	20,550	+630 (+3%)	19,690	+690 (+4%)

The following points are noted in terms of predicted overall travel times:

- Evening peak effects are predicted to be greater than morning peak effects;
- Understandably, full closure of Rosedale Road is predicted to result in greater effects than partial or one way closures;
- Operating Rosedale Road with two way, one lane working with traffic signals is predicted to result in lesser effects than one way operation;
- On Rosedale Road, eastbound operation is critical in the morning peak, while evening peak operation is more balanced; and
- Restrictions at Paul Matthews Road are predicted to result in smaller travel time increases than the full Rosedale Road closure.

The predicted effects on key arterial routes are shown in **Table 31.** Where predicted changes are greater than 10% of the Reference Case traffic flows, these have been highlighted red.

Table 31 Predicted 2018 Daily Flows – Scenarios B to G

	Reference case	B Rosedale Closed	C Rosedale Signals	D Rosedale E/bound	E Rosedale W/bound	F Paul Matthews	G Rosedale Signals + Paul Matthews
East-West Daily Flows at SH1							
Lonely Track Road	2,900	3,200	2,900	2,900	3,100	2,800	2,900
Oteha Valley Road	24,600	26,200	25,000	25,400	26,000	24,900	25,300
McClymonts Road	17,500	19,800	18,000	19,300	18,500	17,500	18,200
Greville Road	22,000	26,800	23,500	23,800	26,400	21,900	23,700
Rosedale Road	15,400	0	10,400	6,700	4,200	16,000	10,400

	Reference case	B Rosedale Closed	C Rosedale Signals	D Rosedale E/bound	E Rosedale W/bound	F Paul Matthews	G Rosedale Signals + Paul Matthews
Constellation Drive	30,900	33,000	31,400	31,600	32,600	31,700	32,100
Sunset Road	15,300	16,400	15,900	16,100	16,100	15,800	16,000
North-South Daily Flows north of SH18/Constellation Drive							
Albany Highway	36,400	35,800	35,400	35,900	35,400	37,200	37,400
Paul Matthews Road	21,100	24,200	22,000	22,600	23,600	15,400	15,900
SH1	77,300	79,700	77,300	77,800	79,400	80,300	80,700
Apollo Drive	19,800	20,000	19,900	19,300	19,700	20,900	20,900
East Coast Road	28,500	28,900	28,500	29,200	29,000	29,200	28,900

Restrictions to Rosedale Road (Scenarios B to E) are predicted to result in increased traffic flows on McClymonts Road, Greville Road, Constellation Drive and Sunset Road, increasing pressure on these routes. The most significant of these increases is on Greville Road, where increased congestion during the peak periods is expected.

Two way, one way working on Rosedale Road is predicted to result in less traffic redistribution than one-way operation, and eastbound operation is predicted to result in less traffic redistribution than westbound operation.

Restrictions to Paul Matthews Road are predicted to result in relatively small changes in daily flows on other routes north of SH18/Constellation Drive, less than 10% in all cases. Restricting right turn movements at Paul Matthews Road in conjunction with signalising Rosedale Road is similarly predicted to result in only modest changes in traffic flows.

8.2.2 Effects on Bus Operations

Auckland Transport's proposed new bus network plan was shown previously in Section 6.2.1. The temporary traffic restrictions tested above are generally expected to have the following effects on these bus services:

- It is understood that the existing extent of the bus shoulder lanes along the motorway and the bus priorities at the interchanges, will be retained during the construction of the Project, as far as reasonably practicable. As a result, impacts on Northern Express services and other bus services on the SH1 main line are expected to be minor;
- Rosedale Road will be used by the N66 Local service in both directions. The closure of the Rosedale Road bridge, or one way operation, would therefore adversely affect this route; and
- Paul Matthews Road will be used by the N78 Connector service and the N65 and N66 Local services. The elimination of right turns into Paul Matthews Road will affect these routes.

Indirect impacts would also be felt by bus services that use routes not directly affected by the proposed construction scenarios, but are predicted to experience increased congestion during these scenarios. This notably includes the Northern Express (southbound) services on McClymonts Road, which will be adversely affected by any increased congestion at the McClymonts Road/Medallion Drive roundabout. To a lesser extent, the N6 route which is a 'Frequent' service operating at least every 15 minutes, will be affected by any increased congestion on Oteha Valley Road and Constellation Drive.

8.2.3 Effects on Pedestrians and Cyclists

The following table summarises surveys of pedestrian and cyclist activity at Rosedale Road where it crosses SH1, carried out on Thursday 7 July 2016.

Table 32 Rosedale Road Active Mode Trips

Peak Hour	Eastbound		Westbound		Total
	Pedestrians	Cyclists	Pedestrians	Cyclists	
Morning peak hour	5	4	2	2	13
Inter peak hour	4	3	5	0	12
Evening peak hour	3	2	14	3	22

If Rosedale Road was to be closed to pedestrians and cyclists during any stage of the works, this would result in a significant detour, with the nearest alternative route across SH1 at Greville Road being one to two kilometres longer (depending on origin and destination). The alternative route to the south is less viable, as there are no footpaths on Constellation Drive west of Caribbean Drive, and Constellation Drive is not suitable for cycling. Rosedale Road however carries very few active mode trips in any of the surveyed periods, and the closure of this route to active trips would, as a result, affect only relatively few users.

Pedestrians are currently not able to cross SH18 to get to Paul Matthews Road. Therefore the temporary closure of the right turns, across SH18, will not adversely affect pedestrians.

8.2.4 Effects on Parking

The construction of the busway link over the Northern Motorway to Albany Bus Station is likely to temporarily affect the capacity of the Park and Ride facility at Albany. This will need to be carefully managed, and it is likely that some temporary parking areas may be provided to mitigate these effects. It is noted that Auckland Transport currently owns the vacant block of land at 125 McClymonts Road, immediately adjacent to Albany Bus Station. This land is approximately one hectare in size and could be used for temporary busway parking during construction. Improved pedestrian connections would be necessary to better connect this land to the station however.

A portion of the existing parking at Albany Bus Station is understood to be by users from the Hibiscus Coast and rural Rodney, with 17% and 13% of Albany Bus Station park and ride users surveyed as such in 2013. Accordingly, the temporary loss of parking at Albany Bus Station during construction could be mitigated by additional parking at Silverdale Bus Station, where works to extend the existing parking area are progressing.

8.2.5 Mitigation of Temporary Effects

The temporary effects of construction will be mitigated to a significant degree by the proposed conditions, which as noted above, will require the following, as far as reasonably practicable:

- The retention of the existing number of through traffic lanes along SH1 and SH18;
- The retention of existing bus shoulder lanes along SH1 and bus priorities at interchanges;
- The retention of vehicle and pedestrian connectivity on McClymonts Road, over SH1; and
- The retention of at least one traffic lane on Rosedale Road, beneath SH1.

The effects of the construction should be further mitigated by the following measures:

- By minimising disruption to public transport;

- By ensuring that any short period construction works which affect capacity are carried out during time periods when they will cause least disruption;
- By the provision of good advanced traveller information, such that travellers are aware of the likely works and what travel alternatives are available; and
- By active management of the network during the construction period.

8.3 Construction Support Areas

The General Arrangement plans provided within Volume 5 indicate six Construction Support Areas (CSA). Further details relating to these proposed CSA are provided at Section 7.14 of the Design and Constructability Report.

8.3.1 CSA 1 - Paul Matthews Road

CSA is to have access off Paul Matthews Road.

This CSA will provide a potential entry/ exit point for the construction zone of the north facing ramps. The location affords access to a possible, unobstructed haul road to CSA 2, without having to use the existing SH18 and hence potentially minimising traffic disruption.

This CSA is likely to include a welfare lunchroom and 10 car parking spaces

The yard may also contain a Project office, if an existing building on-site can be repurposed for this.

8.3.2 CSA 2 - North-facing ramps

The CSA in the vicinity of the north-facing ramps is likely to have access via a potential haul road from the site on Paul Matthews Road.

8.3.3 CSA 3 – Greville Road West

The proposed CSA on Greville Road west is likely to have access from Albany Expressway.

This CSA is likely to include an office, a welfare/lunchroom and 10 car parking spaces.

8.3.4 CSA 4 – McClymonts Road

A CSA is likely to be required south of McClymonts Road, and is likely to have an access on the northbound SH1 carriageway and via a potential haul road from CSA3.

This CSA is likely to include a welfare/lunchroom and 10 car parking spaces.

8.3.5 CSA 5 – Rosedale Road

Access to this CSA will likely be via Arrenway Drive.

This CSA is likely to include a welfare/lunchroom and 10 car parking spaces.

A Project office may be located at this CSA (as an alternative to the Project office proposed for CSA1).

This CSA is also a favourable location for an earthworks/ storage compound, affording possible offline access to the SH1 and Moro Pond.

8.3.6 CSA 6 – Greville Road East

The proposed CSA on Greville Road east is located within Zone 7, and will likely have access from Greville Road.

This CSA is likely to include a welfare/lunchroom and 10 car parking spaces.

9 Sensitivity Tests on Transport Assessment

9.1 Effects of Alternative Traffic Forecasts for 2031

The traffic effects documented in this technical assessment are based on 2031 traffic projections. There is an inherent level of uncertainty around these projections, and they may in actuality vary due to (among others):

- Differing patterns of land use development to those assumed;
- Differing background transport investment to that assumed;
- Technological changes that affect how we travel;
- Behavioural changes that affect how we travel (noting that behaviour change is currently taken into account, based on the ART model forecasts); and
- Changes to the costs of travel.

There is currently no formal guidance within New Zealand on testing the issue of travel demand uncertainty, but the NZ Transport Agency has stated that it is good practice to consider a range of forecasts[31], and a recent paper prepared for the New Zealand Transport Modelling User Group has put forward suggestions on "good practices"[32].

Guidance on this issue can be taken from a UK Department of Transport publication[33], which recommends carrying out low and high growth tests, based on:

P times the square root of the number of years after the base year

Where P is 2.5% for highway projects. In the case of the Project, the forecast 2031 demands are 16 years beyond the 2015 Base model, suggesting that tests could be carried out with demands 10% lower and higher than the "default" forecast. However, it is accepted that this +/-10% should only be taken as a "rule of thumb", and attention should be given to local circumstances.

A test with +10% higher demands has been carried out, but a lower set of demands has instead been derived by applying 2021 forecast demands to the 2031 network. This represents a scenario where future land use development is significantly slower than currently expected for 2031, but it could represent a scenario with, for example, significantly greater diversion of trips to public transport. [34]

The results of these demand sensitivity tests are summarised in **Table 33** and **Table 34,** in terms of forecast travel times on the motorway network.

Table 33 Forecast 2031 Morning Peak Journey Times (mm:ss), Demand Sensitivity Tests

Route Description	2021 Demands		Default Demands		+10% Demands	
	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project
Route 1 – SH18 Albany Interchange to SH1 Oteha Valley Interchange	8:00	3:40 (-4:20)	10:10	3:40 (-6:30)	13:15	3:45 (-9:30)

[31] Paper by G Bellis, NZ Transport Agency, to the 2013 NZMUGS Conference
[32] Clark I (2016), "Travel Forecasting Uncertainty: Good Practice Note", NZMUGS Conference
[33] Department of Transport (2014), "TAG Unit M4, Forecasting and Uncertainty"
[34] Section 5 referred to the development of 2041 forecasts. However, these assumed the provision of an Additional Waitemata Harbour Crossing, which is not yet committed, so this test has not been used

Route Description	2021 Demands		Default Demands		+10% Demands	
	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Interchange	15:30	5:55 (-9:35)	18:55	6:30 (-12:25)	26:20	7:00 (-19:20)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	8:50	7:35 (-1:15)	9:20	8:00 (-1:20)	11:25	9:30 (-1:55)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	18:55	16:35 (-2:20)	21:25	18:30 (-2:55)	26:35	22:10 (-4:25)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	6:00	4:25 (-1:35)	6:25	4:30 (-1:55)	6:50	4:30 (-2:20)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	18:30	14:20 (-4:10)	21:25	16:25 (-5:00)	27:20	19:30 (-7:50)
Route 7 – SH1 Tristram Interchange to SH18 Albany Interchange	8:25	6:55 (-1:30)	9:00	7:00 (-2:00)	9:55	7:30 (-2:25)
Route 8 – SH18 Albany Interchange to SH1 Tristram Interchange	14:25	13:20 (-1:05)	17:25	15:10 (-2:15)	23:50	19:50 (-4:00)

Table 34 Forecast 2031 Evening Peak Journey Times (mm:ss), Demand Sensitivity Tests

Route Description	2021 Demands		Default Demands		+10% Demands	
	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project	2031 Reference Case	2031 Project
Route 1 – SH18 Albany Interchange to SH1 Oteha Valley Interchange	11:30	6:25 (-5:05)	12:55	6:45 (-6:10)	16:25	8:25 (-8:00)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Interchange	15:20	5:35 (-9:45)	16:10	6:00 (-10:10)	22:25	6:25 (-16:00)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	15:50	9:45 (-6:05)	17:50	10:10 (-7:40)	22:15	11:00 (-11:15)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	10:40	11:00 (+0:20)	11:45	12:15 (+0:30)	18:35	15:30 (-3:05)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	12:50	6:55 (-5:55)	15:05	7:30 (-7:35)	19:35	8:15 (-11:20)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	7:55	6:25 (-1:30)	9:05	7:15 (-1:50)	12:30	8:35 (-3:55)
Route 7 – SH1 Tristram Interchange to SH18 Albany Interchange	14:05	7:50 (-6:15)	14:55	8:10 (-6:45)	20:25	9:10 (-11:15)
Route 8 – SH18 Albany Interchange to SH1 Tristram Interchange	9:10	7:50 (-1:20)	10:15	8:40 (-1:35)	12:10	11:45 (-0:25)

Under the low growth scenario with 2021 traffic demands, motorway travel times are understandably predicted to reduce accordingly. Similarly, changes in travel times due to the Project are predicted to lessen. Nonetheless, travel time reductions of up to ten minutes continue to be predicted (SH1 north to SH18, morning and evening peaks), and reductions on other routes are generally predicted to be

between one and six minutes. This demonstrates that the Project is expected to continue to provide benefits to the network, even under a low demand future scenario.

If traffic demands are 10% higher than forecast, motorway travel times are predicted to be very much longer than under the default scenario. The travel time savings due to the Project are also predicted to significantly increase, with savings of up to 19 minutes predicted (SH1 north to SH18, morning peak).

Forecast hourly traffic flows on the motorway network and on key local roads are additionally included in **Appendix H**. Tables H5 and H6 in particular demonstrate a key issue relating to the operation of the northbound section of SH1 during the evening peak. This is that while increases in **demands** are forecast between the three tests[35], northbound from Tristram Avenue to the Upper Harbour Interchange, the increases in **arrival flows** are predicted to be quite modest[36], due to the capacity of the network to the south. This will limit the future increase in flows within the weaving section, between the Upper Harbour and Greville interchanges.

9.2 Effects of Alternative Traffic Network in 2031

Section 6.2.3 above noted that the 2031 models assume the completion of a number of transport projects that are not assumed to be complete in the 2018 (or 2021) models. That section also stated that some form of transport improvements in these areas is likely, in response to land use changes, but a sensitivity test has been carried out on the 2031 traffic forecasts but with the 2018/2021 network. This sensitivity test examines a future scenario where land use development occurs as currently predicted, but where investment in the transport network is delayed.

The results of this sensitivity test are summarised in **Table 35** and **Table 36** below, in terms of modelled journey times on the motorway network.

Table 35 Forecast 2031 Morning Peak Journey Times (mm:ss), Demand Sensitivity Tests

Route Description	2031 Network & Demands (Default Scenario)		2021 Network 2031 Demands	
	Reference Case	Project	Reference Case	Project
Route 1 – SH18 Albany Interchange to SH1 Oteha Valley Interchange	10:10	3:40 (-6:30)	11:35	3:45 (-7:50)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Interchange	18:55	6:30 (-12:25)	15:50	3:40 (-12:10)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	9:20	8:00 (-1:20)	9:55	9:25 (-0:30)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	21:25	18:30 (-2:55)	18:40	19:30 (+0:50)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	6:25	4:30 (-1:55)	6:30	4:30 (-2:00)

[35] The forecast demands, northbound from Tristram Avenue to the Upper Harbour interchange are 5,870 vehicles/hour for the test with 2021 demands, 6,120 vehicles/hour for the test with default 2031 demands and 6,800 vehicles/hour for the test with 2031 demands + 10%

[36] The forecast arrival flows, northbound from Tristram Avenue to the Upper Harbour interchange are 5,670 vehicles/hour for the test with 2021 demands, 5,840 vehicles/hour for the test with default 2031 demands and 6,000 vehicles/hour for the test with 2031 demands + 10%

Route Description	2031 Network & Demands (Default Scenario)		2021 Network 2031 Demands	
	Reference Case	Project	Reference Case	Project
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	21:25	16:25 (-5:00)	15:00	14:05 (-0:55)
Route 7 – SH1 Tristram Interchange to SH18 Albany Interchange	9:00	7:00 (-2:00)	10:05	6:50 (-3:15)
Route 8 – SH18 Albany Interchange to SH1 Tristram Interchange	17:25	15:10 (-2:15)	18:55	14:45 (-4:10)

Table 36 Forecast 2031 Evening Peak Journey Times (mm:ss), Demand Sensitivity Tests

Route Description	2031 Network & Demands (Default Scenario)		2021 Network 2031 Demands	
	Reference Case	Project	Reference Case	Project
Route 1 – SH18 Albany Interchange to SH1 Oteha Valley Interchange	12:55	6:45 (-6:10)	15:00	7:55 (-7:05)
Route 2 – SH1 Oteha Valley Interchange to SH18 Albany Interchange	16:10	6:00 (-10:10)	13:30	3:30 (-10:00)
Route 3 – SH1 Tristram Interchange to Oteha Valley Road/Albany Highway Intersection	17:50	10:10 (-7:40)	18:30	10:25 (-8:05)
Route 4 – Oteha Valley Road/Albany Highway Intersection to SH1 Tristram Interchange	11:45	12:15 (+0:30)	10:45	14:15 (+3:30)
Route 5 – SH1 Tristram Interchange to SH1 Oteha Valley Interchange	15:05	7:30 (-7:35)	15:15	7:05 (-8:10)
Route 6 – SH1 Oteha Valley Interchange to SH1 Tristram Interchange	9:05	7:15 (-1:50)	5:05	4:50 (-0:15)
Route 7 – SH1 Tristram Interchange to SH18 Albany Interchange	14:55	8:10 (-6:45)	16:00	8:15 (-7:45)
Route 8 – SH18 Albany Interchange to SH1 Tristram Interchange	10:15	8:40 (-1:35)	12:00	9:55 (-2:05)

The sensitivity test demonstrates that, without the investment in the transport network expected between 2018 and 2031, the Project is still predicted to result in significant journey time savings on the motorway network. In some instances these savings are greater than in the default 2031 scenario, but in other instances these savings are less.

In the case of Route 4 (SH17 to SH1 southbound), the Project is predicted to result in increased journey times in both commuter peak periods. In this instance, the default scenario assumes that two roundabouts on Rosedale Road (at Tawa Drive and Apollo Drive) will be replaced by traffic signals by 2031, increasing east-west capacity on this route and relieving pressure at the Greville Interchange. Without these traffic signals in the sensitivity test, Greville Interchange is predicted to come under increased pressure, which the Project is predicted to exacerbate.

9.3 Effects of Alternative Traffic Forecasts for 2018

Section 6.2.3 above noted that the 2018 models assume the completion of the widening of SH16 between Lincoln Road and Westgate. It is most likely that these works will be completed before construction works associated with the Project, but tests have been carried out on the effects of this assumption. These tests indicated that the completion of the widening of SH16 is generally predicted to lead to slightly greater temporary adverse effects associated with the Project, during the morning peak, but slightly lower adverse effects in the evening peak. The difference in effects are generally within.+/- 10%.

10 Conclusions

This report has examined the transport effects of the Northern Corridor Improvements Project, and it has demonstrated that the Project will achieve the following outcomes:

- It will help facilitate interregional travel between Auckland and Northland by completing the Western Ring Route to motorway standard;
- It will improve connectivity of the SH1 and SH18 interchange;
- It will improve safety, efficiency, reliability and the capacity of:
  - SH1 between SH18 and Albany; and
  - SH18 between SH1 and Albany Highway.
- It will provide safe walking and cycling facilities adjacent to SH1 and SH18 and connections to local transport networks; and
- The extension of the Northern Busway from Constellation Bus Station to the Albany Bus Station will allow the Project to significantly improve travel times and travel reliability for bus users.

Appendices


25 Greville Rd 0·5
18 Upper Harbour Hwy 2·5
21 Tristram Ave 5·5
Auckland

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Appendix A
Existing Traffic Flow Data

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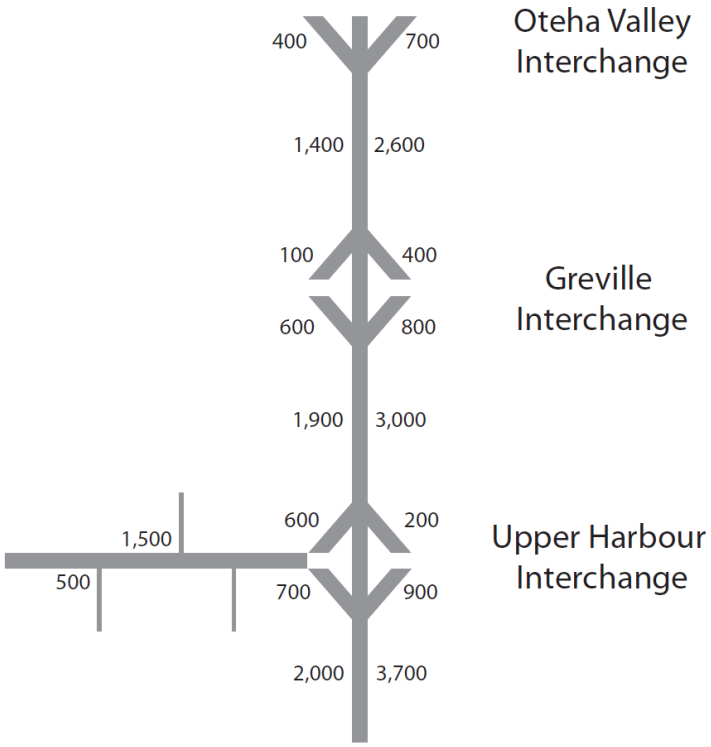
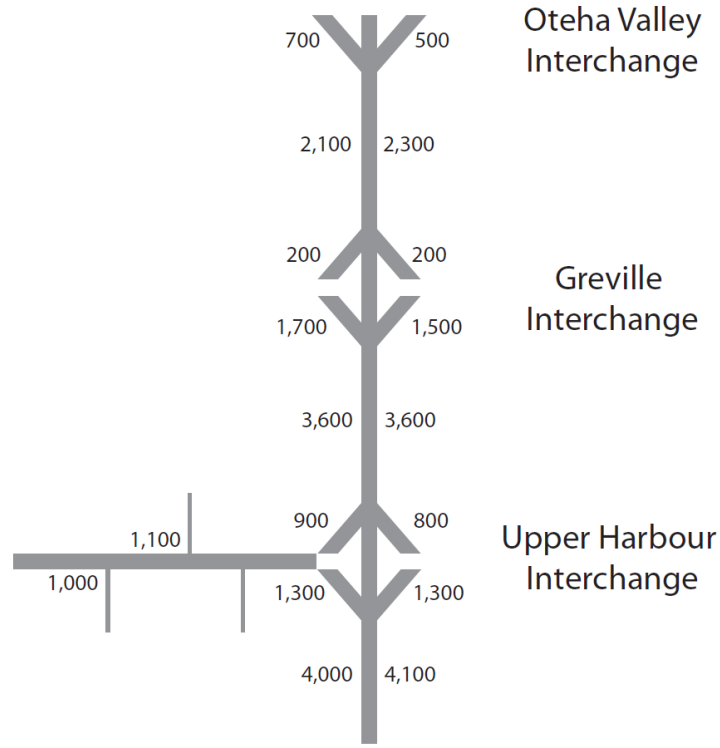
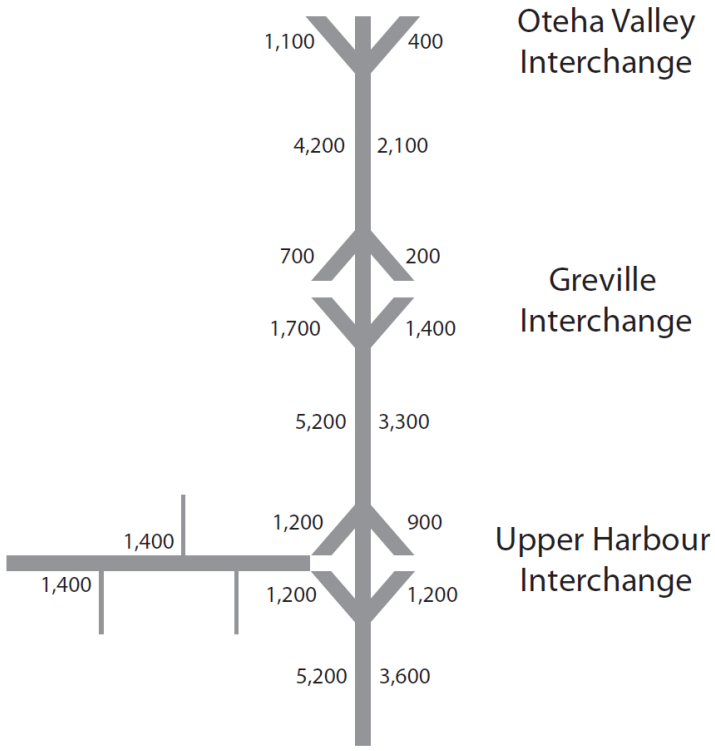
Weekday Morning Peak Hour Flow, March 2015



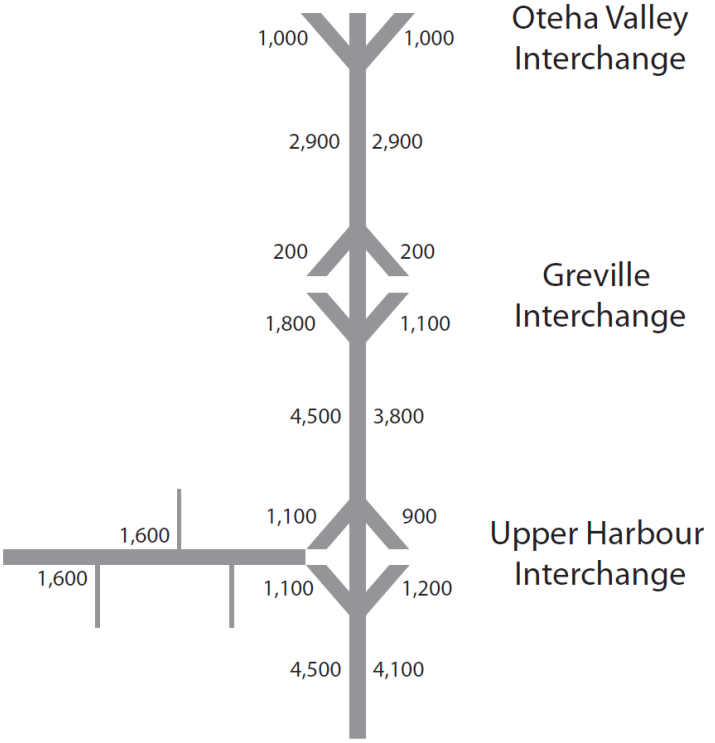
Weekday Inter-peak Peak Hour Flow, March 2015



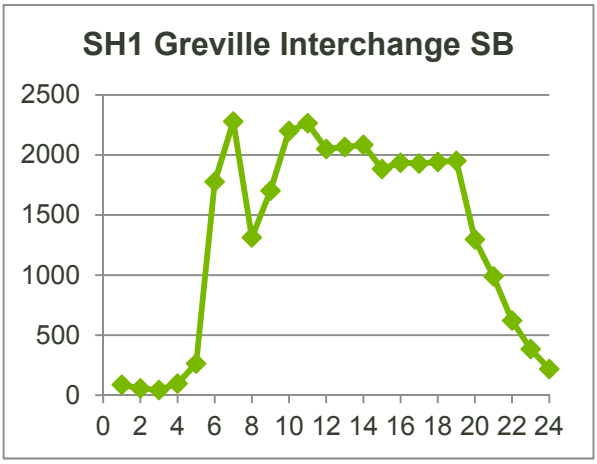
Weekday Evening Peak Hour Flow, March 2015

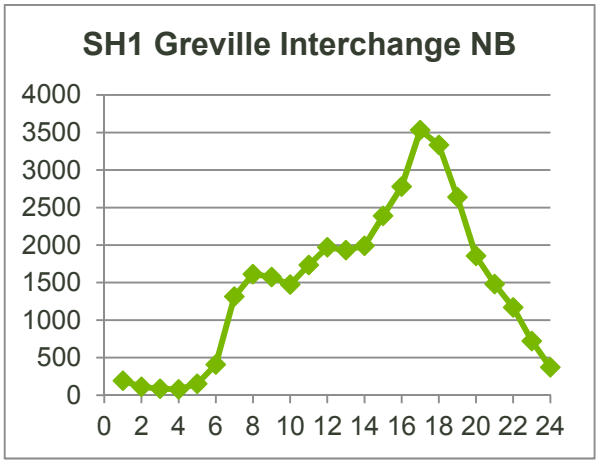


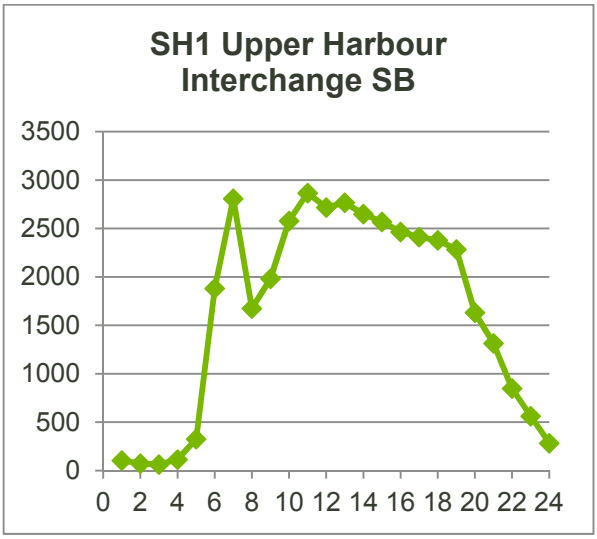
Weekend Peak Hour Flow, March 2015

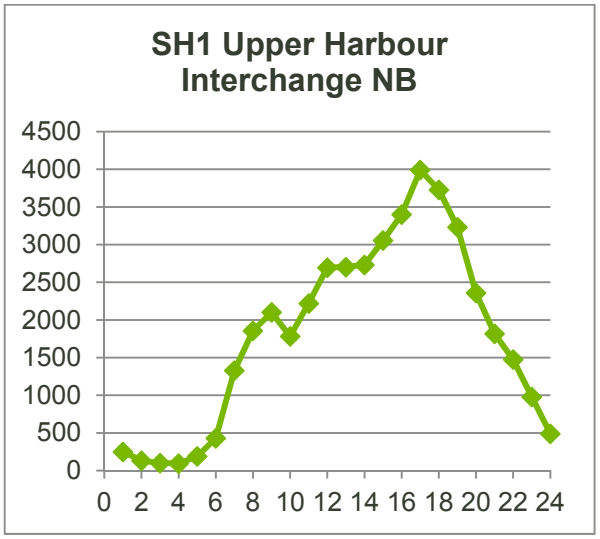


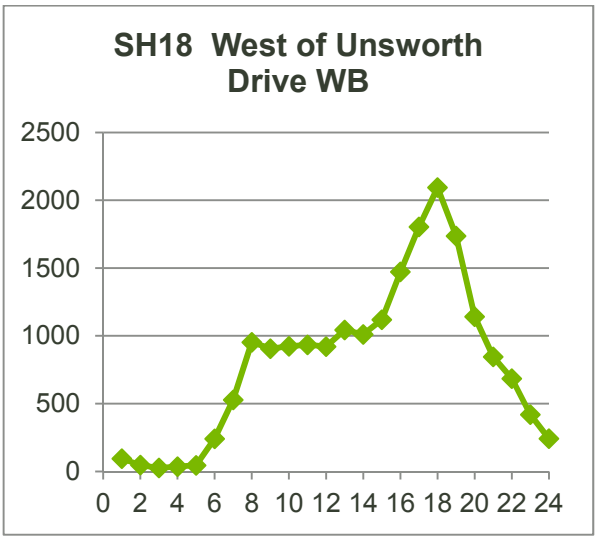
Weekday flows, Wednesday 16 March 2015

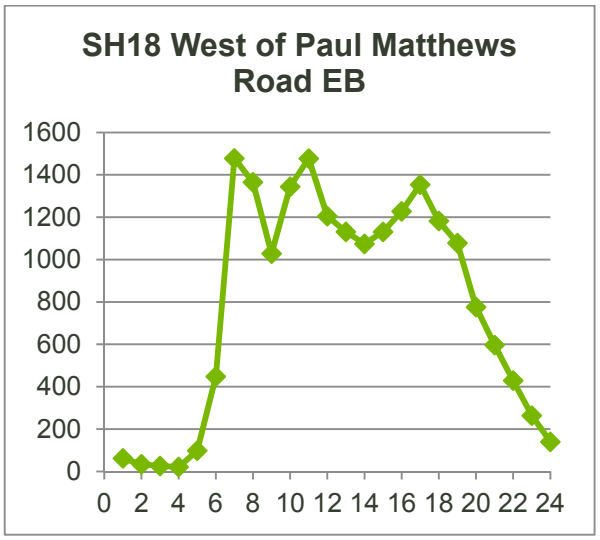




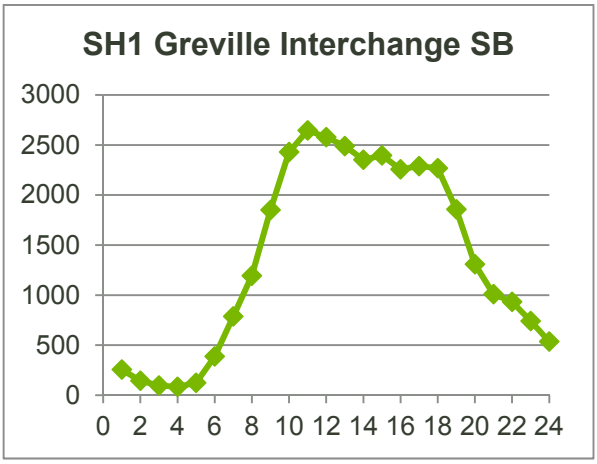


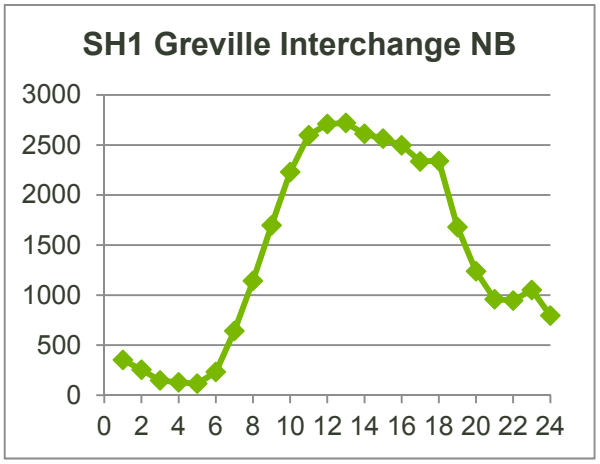


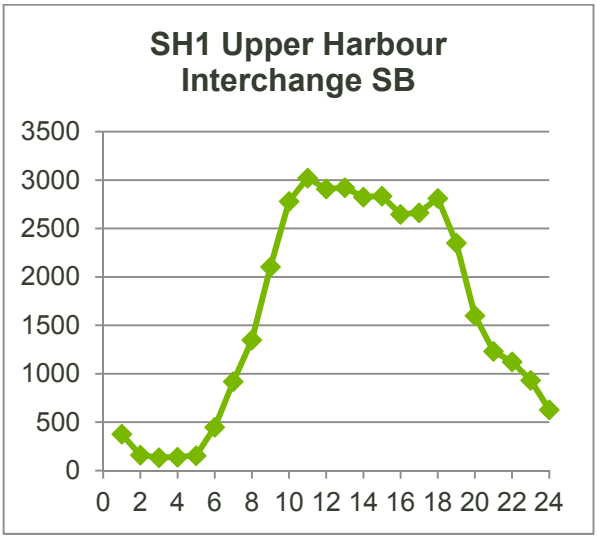


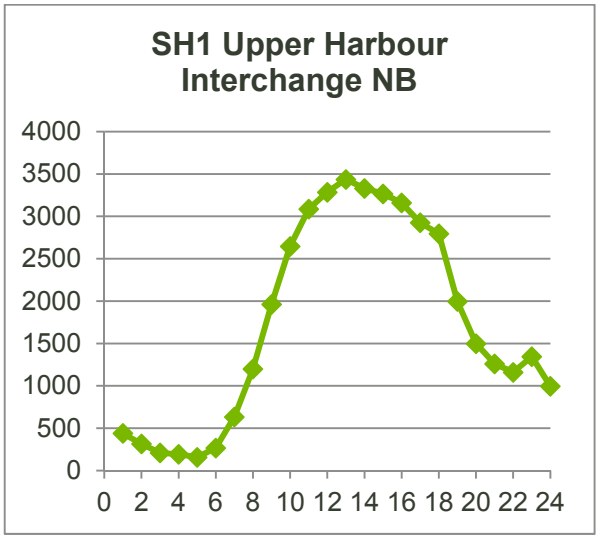


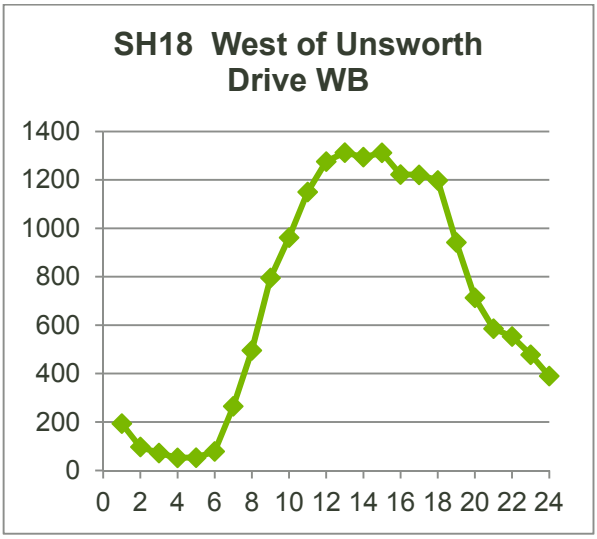
Saturday flows, 19 March 2015

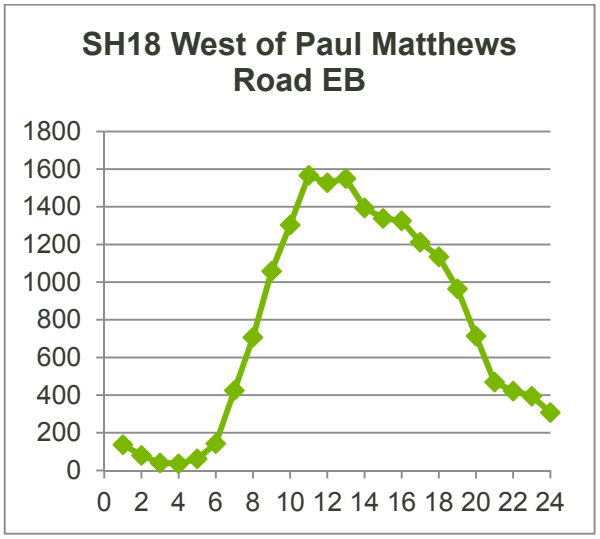




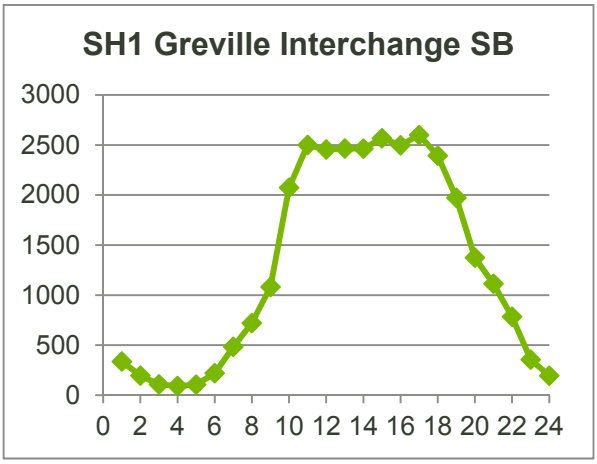


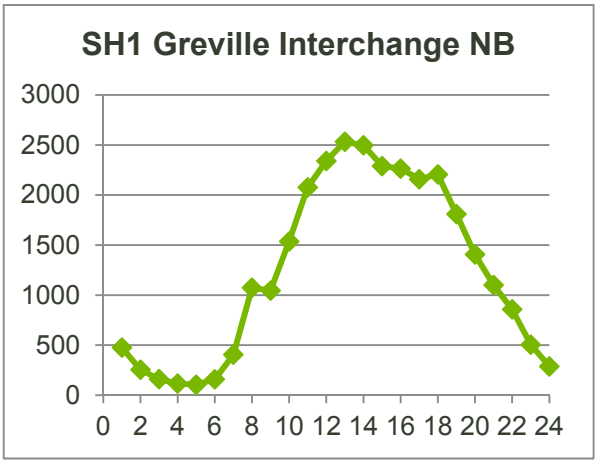


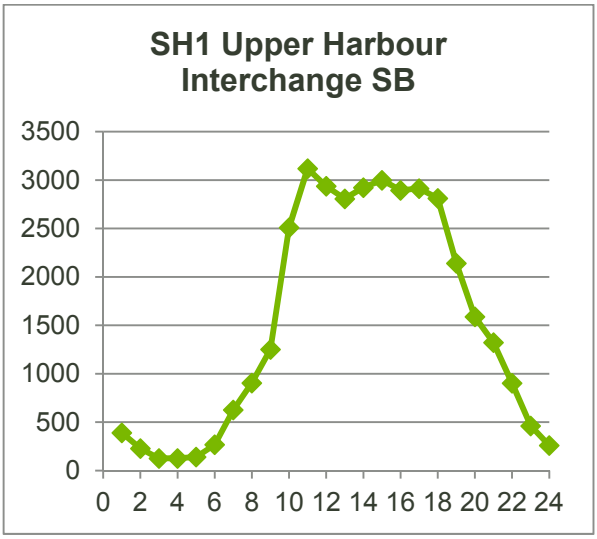


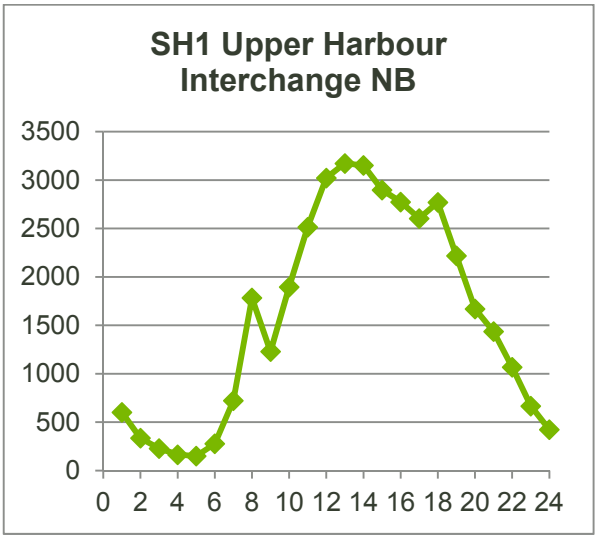


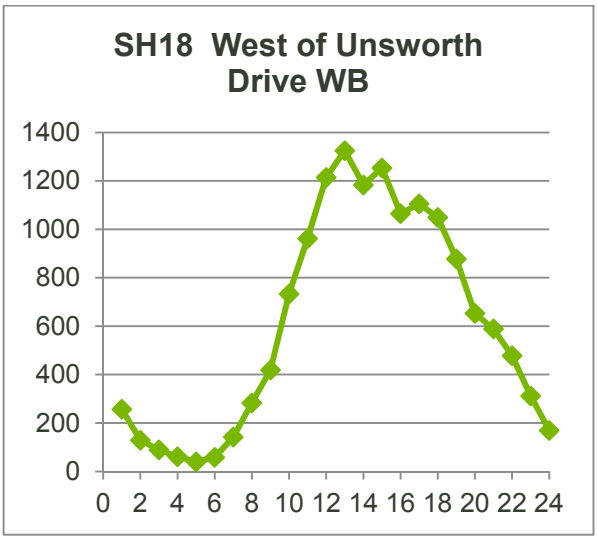
Sunday flows, 20 March 2015

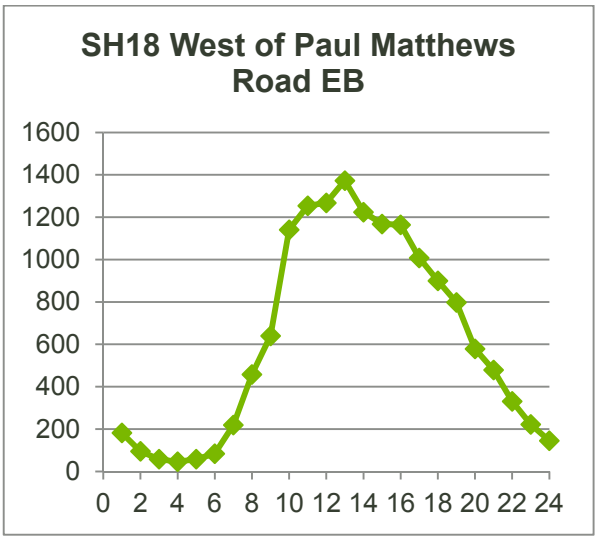




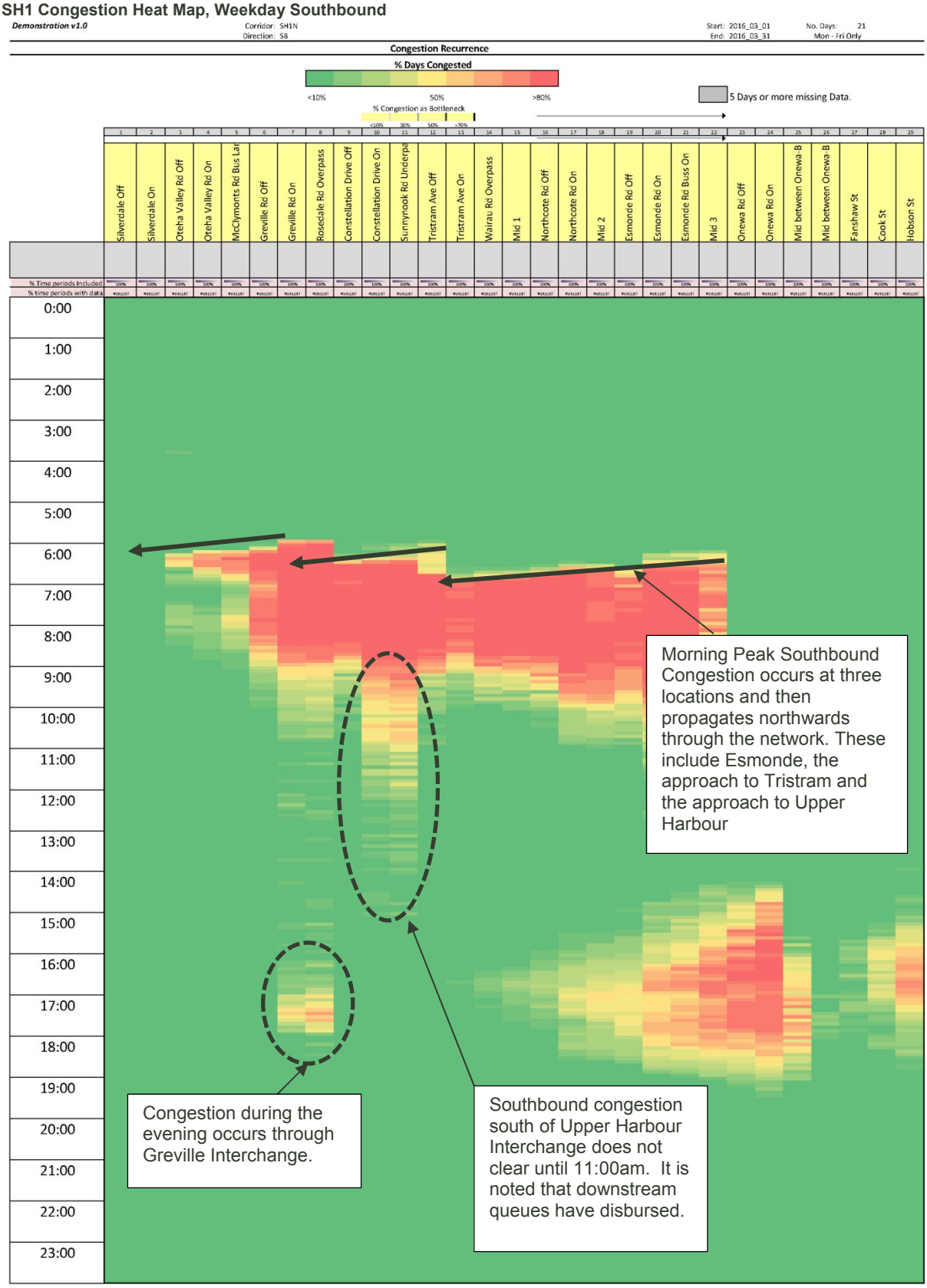




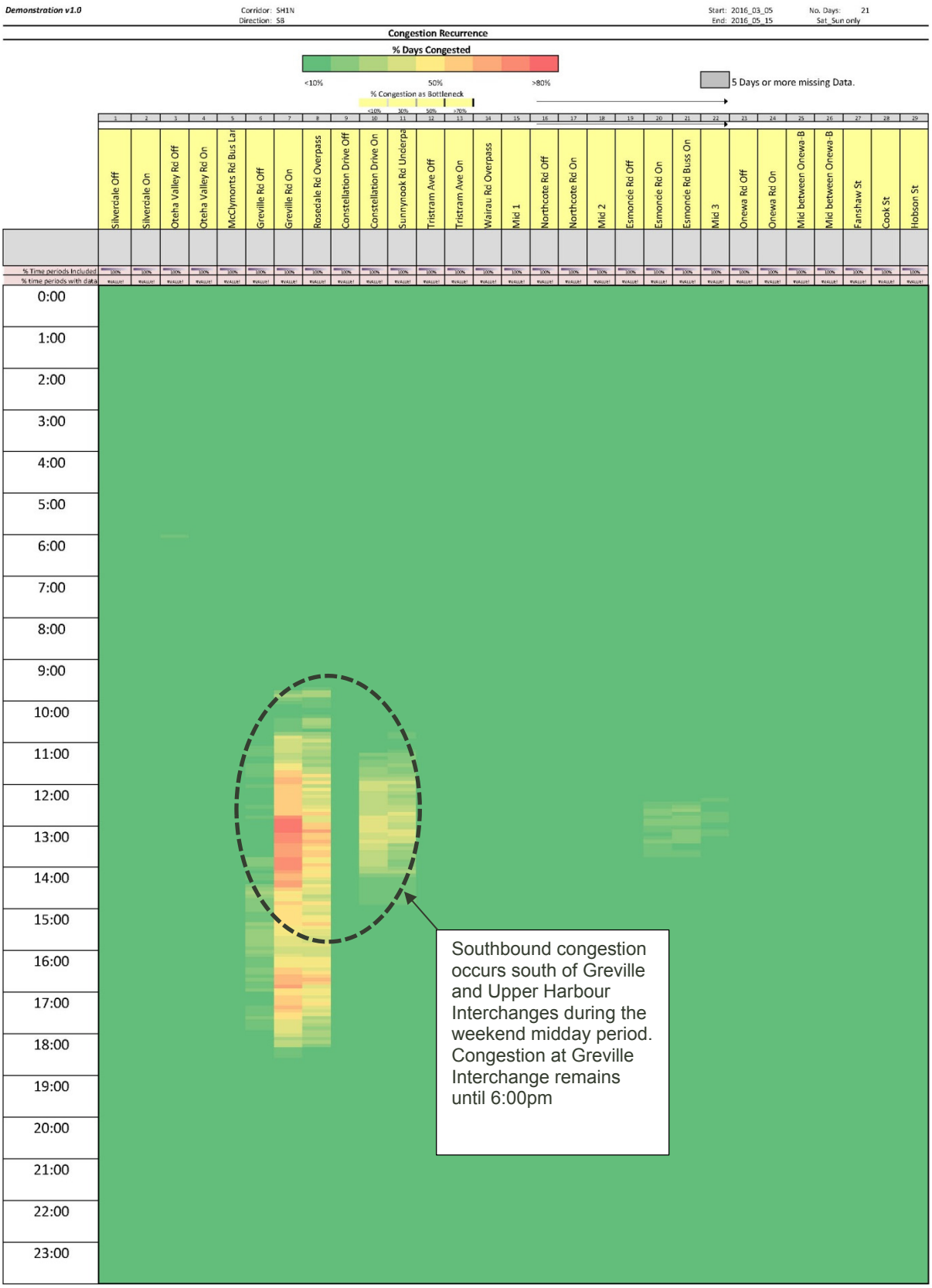




SH1 Congestion Heat Map, Weekday Southbound



SH1 Congestion Heat Map, Weekend Southbound



SH1 Congestion Heat Map, Weekday Northbound

Corridor Bottleneck Analysis Tool

Demonstration v1.0

Corridor: SH1N
Direction: SB

Start: 2016_03_01 No. Days: 21
End: 2016_03_31 Mon - Fri Only

Congestion Recurrence

% Days Congested

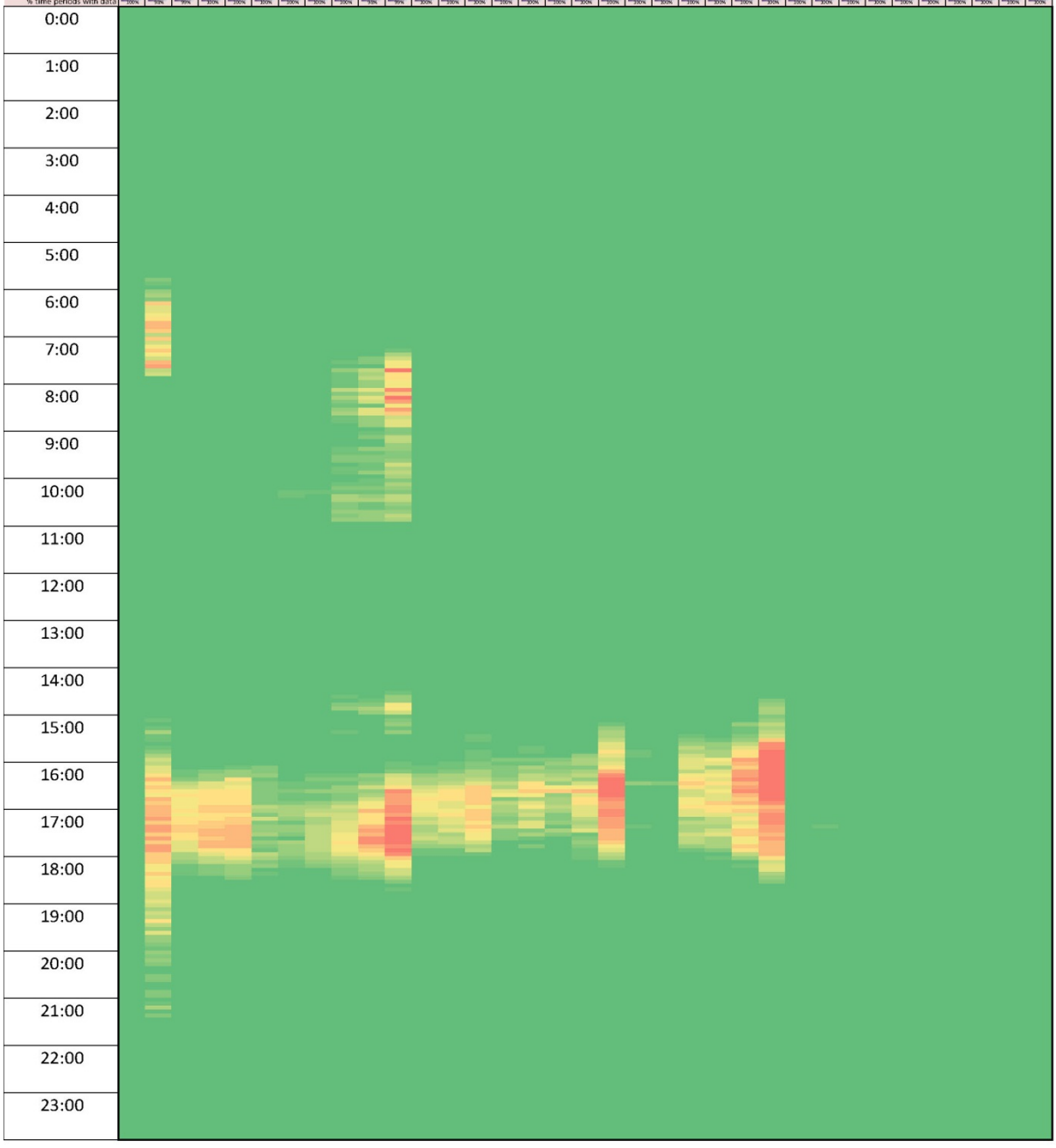
<10% 50% >80%

5 Days or more missing Data.

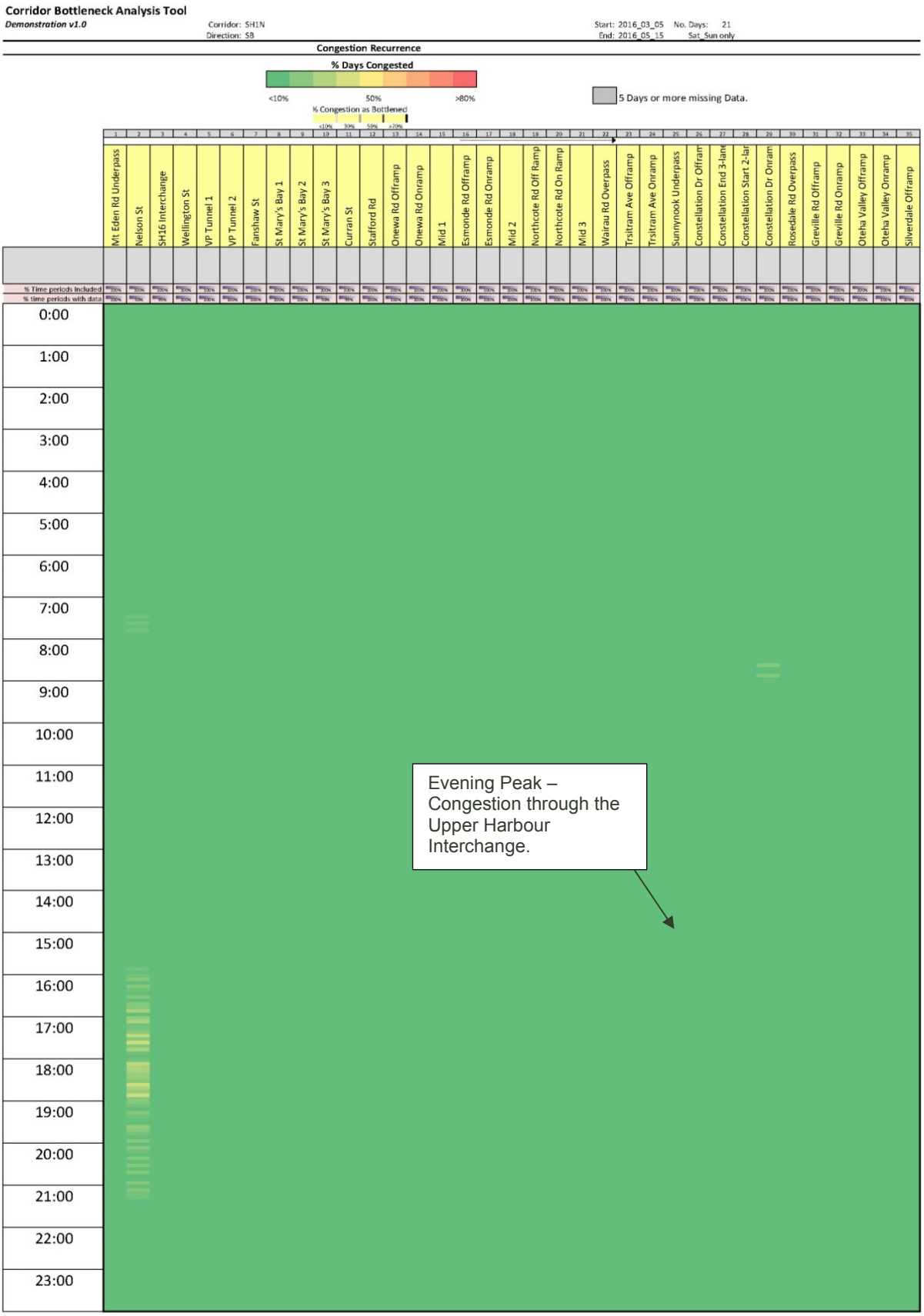
% Congestion as Bottleneck

<10% 30% 50% >70%

	Mt Eden Rd Underpass	Nelson St	SH16 Interchange	Wellington St	VP Tunnel 1	VP Tunnel 2	Fanshaw St	St Mary's Bay 1	St Mary's Bay 2	St Mary's Bay 3	Curran St	Stafford Rd	Onewa Rd Offramp	Onewa Rd Onramp	Mid 1	Esmonde Rd Offramp	Esmonde Rd Onramp	Mid 2	Northcote Rd Off Ramp	Northcote Rd On Ramp	Mid 3	Wairau Rd Overpass	Trsitram Ave Offramp	Trsitram Ave Onramp	Sunnynook Underpass	Constellation Dr Offram	Constellation End 3-lane	Constellation Start 2-lar	Constellation Dr Onram	Rosedale Rd Overpass	Greville Rd Offramp	Greville Rd Onramp	Oteha Valley Offramp	Oteha Valley Onramp	Silverdale Offramp
% Time periods Included	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% time periods with data	100%	99%	99%	100%	100%	100%	100%	100%	100%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



SH1 Congestion Heat Map, Weekend Northbound



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Appendix B
Crash Diagrams

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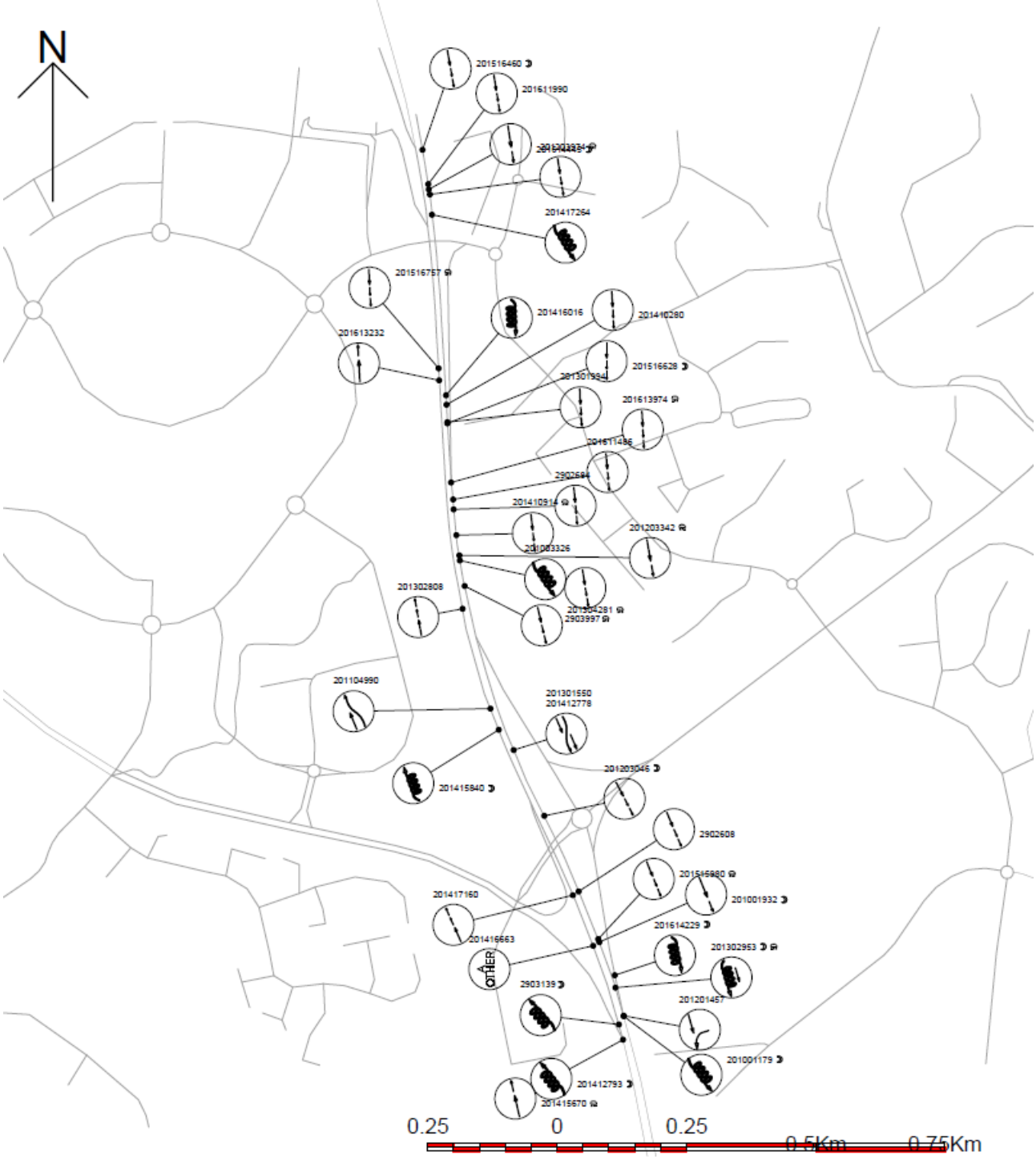
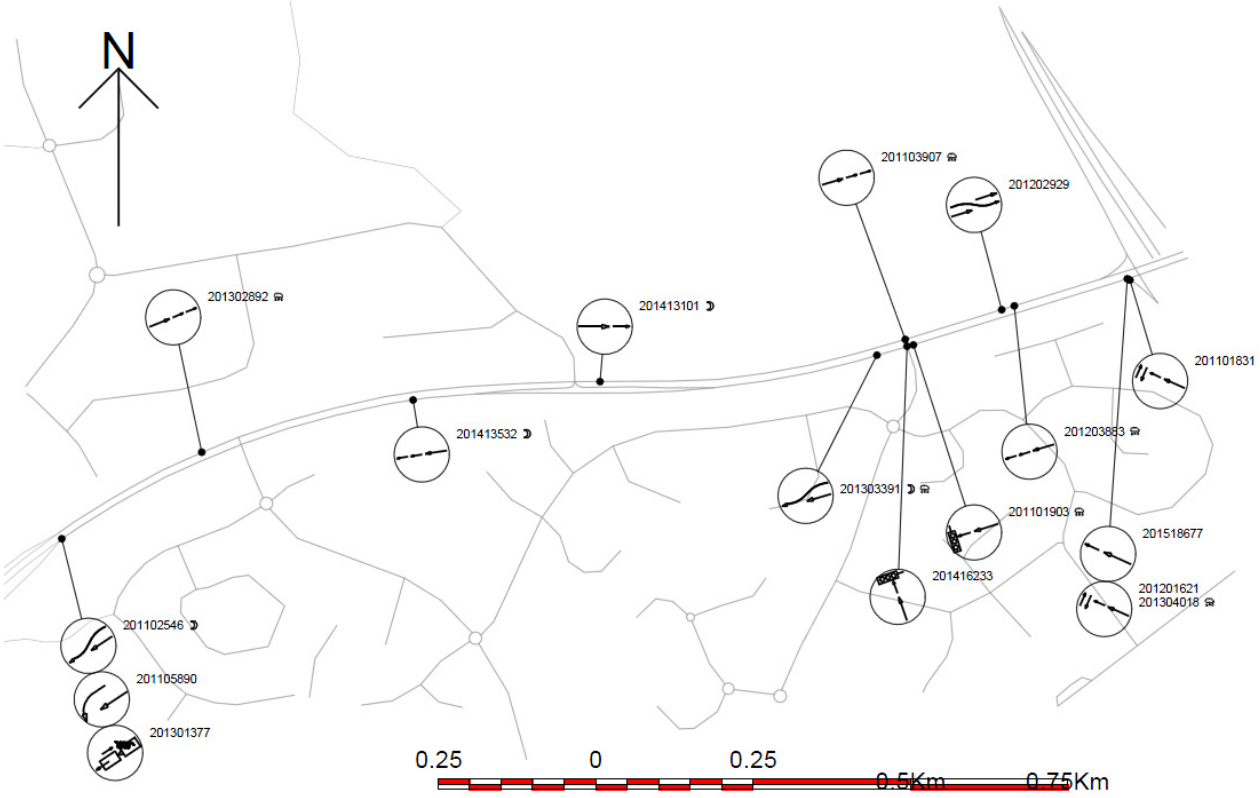
Crash Diagram – Injury Crashes, SH1 Rosedale Road to McClymonts Road, 2009-2013

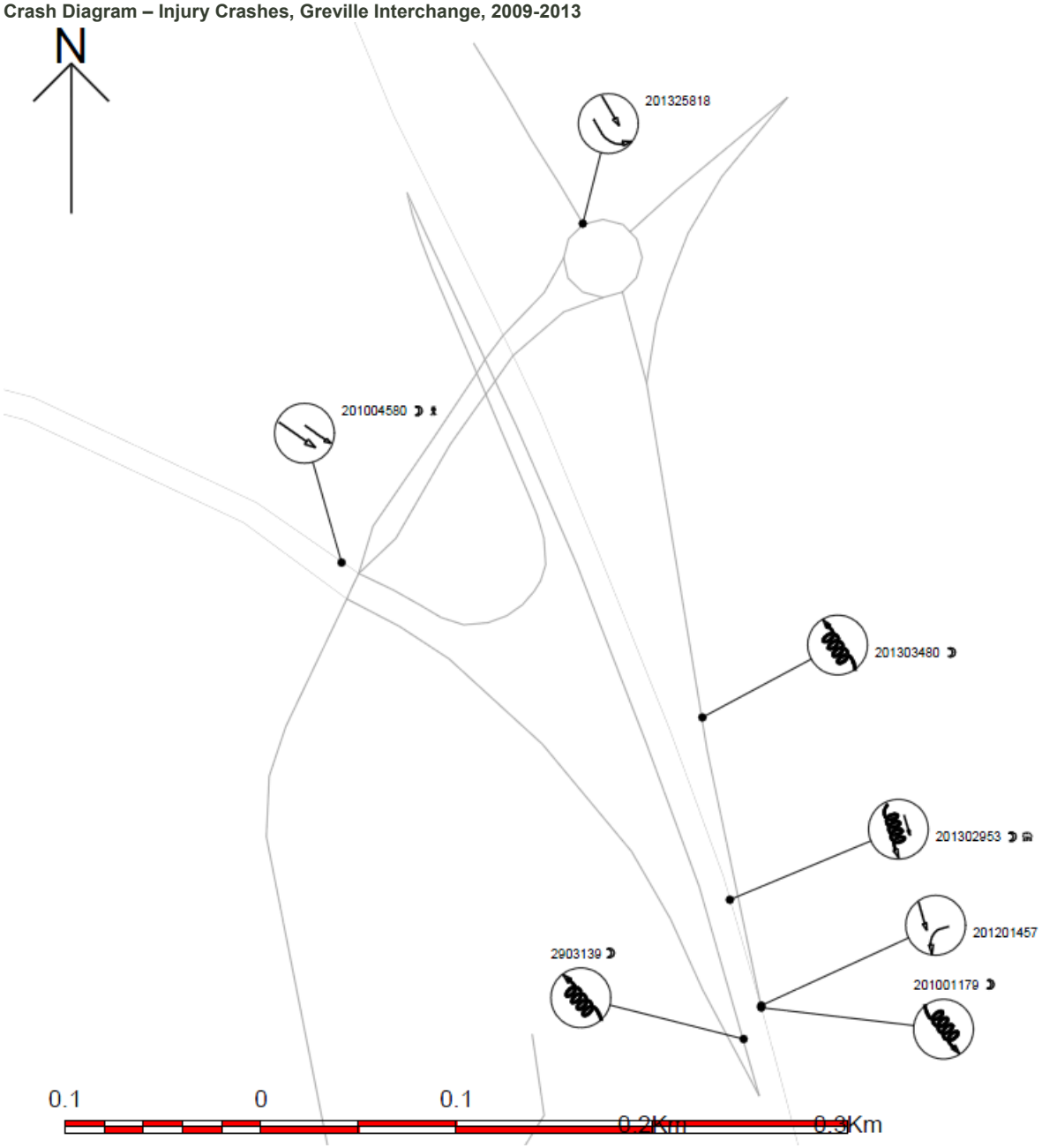


Crash Diagram – Injury Crashes, SH1 Sunset Road to Rosedale Road, 2009-2013

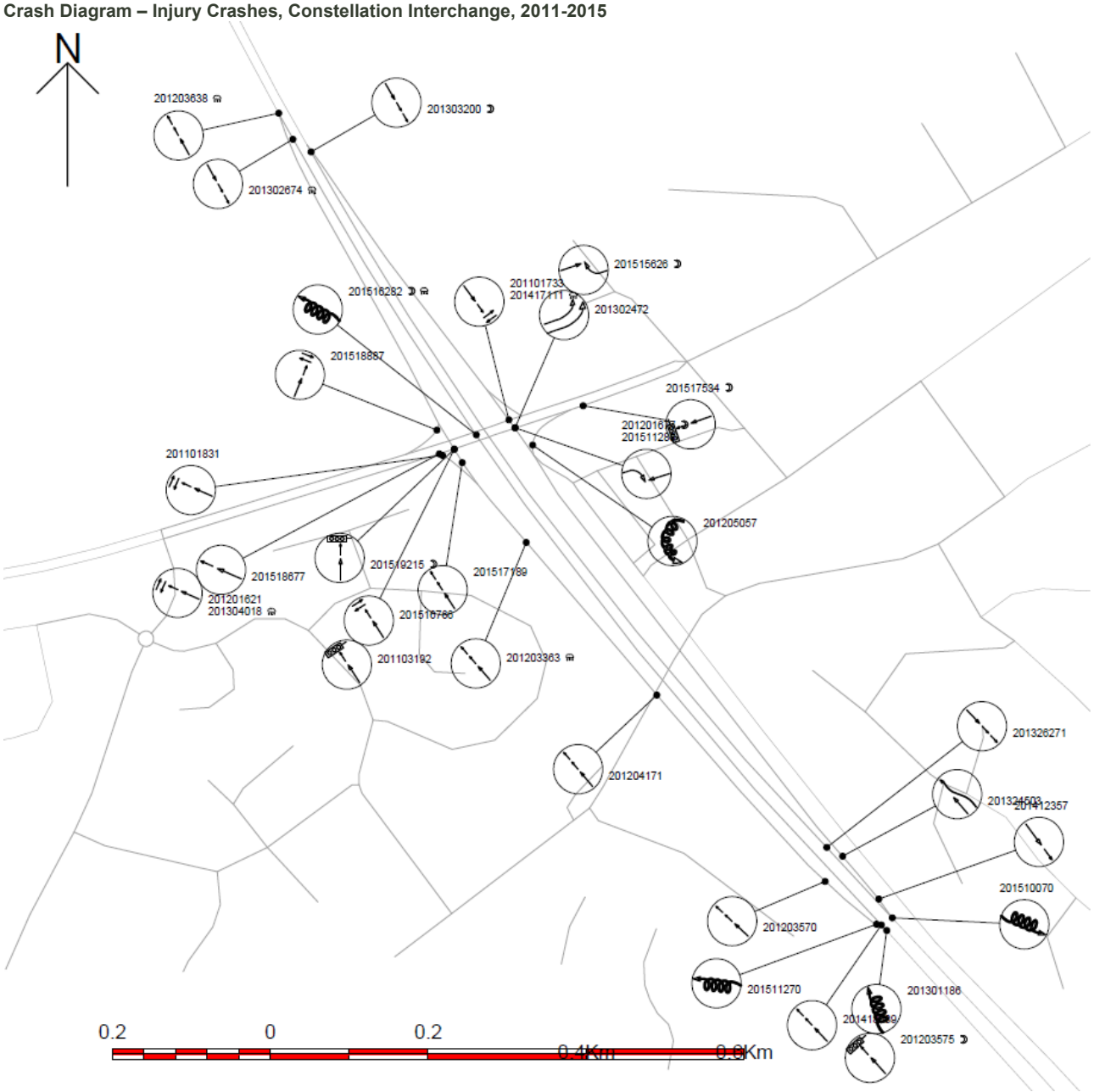
Crash Diagram – Injury Crashes, SH18 West of Unsworth Drive to SH1, 2011-2015



Crash Diagram – Injury Crashes, Greville Interchange, 2009-2013



Crash Diagram – Injury Crashes, Constellation Interchange, 2011-2015



Crash Diagram – Pedestrian and Cyclist Crashes

Appendix C

Upper Harbour SATURN Model Update Report (August 2015)

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Northern Corridor Improvements

Upper Harbour SATURN Model Update

August 2015

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TRANSPORTATION SPECIALISTS

Project:	**Assessment of Transport Effects (including walking & cycling and Construction)**
Title:	
Document Reference:	**P:\NZTA\127 NCI DBC\aee ita\Assessment_of_Transport_Effects 161116.docx**
Prepared by:	**Qing Li**
Project Manager	**Terry Church**
Reviewed by:	**Terry Church**

Revisions:

Date	Status	Reference	Approved by	Initials
9 July 2015	A - Draft	R1A150709	T Church	
24 July 2015	B	R1B150724	T Church	
25 August 2015	C	R1C150825	I Clark	

CONTENTS

APPENDICES

1 INTRODUCTION

This report provides a summary of the recent update to the Upper Harbour SATURN traffic model which is being used to inform the Detailed Business Case (preferred option and economic analysis) of the Northern Corridor Improvements (NCI) project ("the Project").

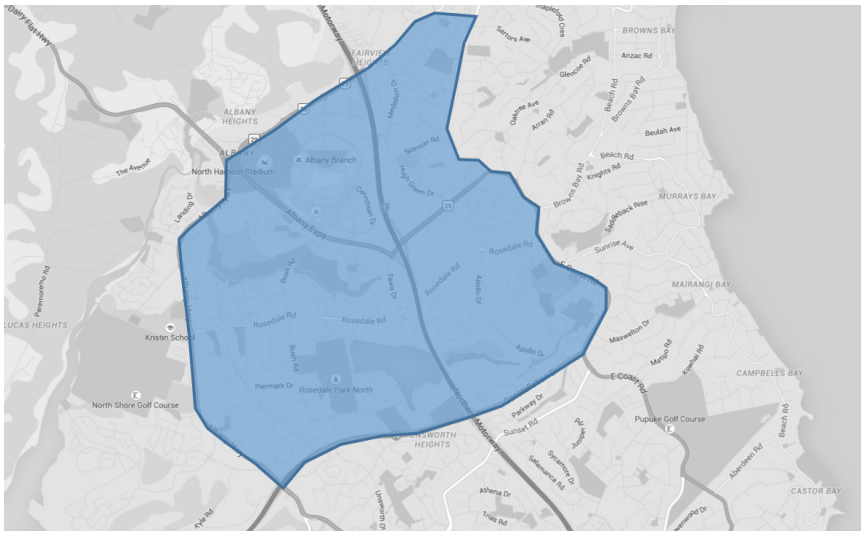
The Upper Harbour SATURN traffic model was originally calibrated and validated against criteria defined in the NZ Transport Agency Economic Evaluation Manual (EEM). During 2014, the NZ Transport Agency, in conjunction with the NZ Modelling User Group (NZMUGS) published a new guiding document "Transport Model Development Guidelines" (July 2014), and this report refers to criteria from both documents.

The update of the Upper Harbour SATURN model has not relied on matrix estimation. Instead, the update continues to rely on the validated 2008/09 demands, and has applied five out of seven years growth between the 2006 and 2013 Auckland Regional Transport (ART) model traffic demands and two out of three years growth between the 2013 and 2016 ART traffic demands, to bring the Upper Harbour SATURN traffic demands up to 2015. Some minor modifications have then been applied to the resulting traffic demand set, to better align the traffic demands with the 2015 traffic counts. This methodology essentially updates the initial 2008 SATURN model to a 2015 SATURN model which will provide the platform for forecast scenarios.

The model update has concentrated on the core study area. Construction works on the Northwestern Motorway have inhibited the model from being fully revalidated and with the original traffic model being based on the validation targets set in the EEM, the accuracy of the model update within the core area does not reach all of the more recent validation targets stipulated in the 2014 Transport Model Development Guideline (for NZ Transport Agency project models). Most of the key targets however are achieved, being RMSE, R-squared, link counts and journey times.

The model update focusses on the core area, defined broadly as Oteha Valley Road in the north, Upper Harbour Highway in the south, East Coast Road to the east and Albany Highway to the west, as highlighted in Figure 1.

Figure 1: Core Area of Northern Package SATURN Model



Weekday morning peak, inter peak and evening peak period models have been developed to reflect existing traffic conditions. The modelled periods represent the average hours during the two hour

morning peak, inter peak and evening peak periods (ie 07:00 to 09:00, 12:00 to 14:00 and 16:00 to 18:00), as was the case for the previous calibration and validation.

2 CONSIDERATIONS IN UPDATING THE MODEL TO 2015

The Upper Harbour SATURN model has been updated, as opposed to revalidated, as a result of several challenges associated with the fluid nature of traffic demands.

This report summarises the process used to assess the performance of the updated model (to 2015) when assessed against industry guidelines. Traffic information has been collected within the core study area for 2015, with 2015 travel time data being collected along key routes within the study area, as well as along each of the state highways included in the model. The state highway travel time data assesses the performance of the model against 2013 and 2015 data, in order to check the calibration of the model without and with the effects of the Northwestern Motorway construction works.

A sensitivity test has been run to given an appreciation of how the model reacts when considering the construction works on the Northwestern Motorway, to demonstrate how the model reacts and compares to observed data. This has been treated as a sensitivity test, as the traffic demands from the ART model do not assume the capacity reductions resulting from the construction works.

A summary of the matters which have affected the model update is provided below.

2.1 Northwestern Motorway Improvements

Significant construction works are being undertaken along a 9 kilometre section of the Northwestern Motorway, associated with the SH20 Waterview Connection Project, the SH16 Causeway widening, and the SH16/Te Atatu and SH16/Lincoln Road interchange upgrades. Construction works on the Northwestern Motorway have been underway since November 2010, with the start of the Lincoln Road interchange upgrade.

The significance of the construction works presents challenges, in that traffic volumes across the state highway network include an element of reassignment as a result of the increased travel times on the Northwestern Motorway. While an increase in commuter period traffic volumes has been observed along the western and southern sections of the NCI study area (sections of SH18 and SH1 respectively), with a corresponding reduction on the Northwestern Motorway, it is unclear how much of the change is a result of the construction works or natural growth.

The construction works along the Northwestern Motorway are due for completion in early 2017 and hence vehicle patterns and resulting traffic volumes are expected to alter from those experienced in 2015, following the return of reliable travel times on the Northwestern Motorway. The update of the Upper Harbour model has therefore avoided calibrating the construction works on the Northwestern Motorway, as the construction works and current network patterns will not be carried through to the forecast models. As such, there is a need for caution and some flexibility when calibrating the model along the Northwestern corridor at this time. Furthermore, the traffic demands received from the regional model for 2013 and 2016 do not include the construction work and resulting corridor delays, and therefore do not include reassignment of traffic away from the corridor. These factors inhibit the development of a true 2015 scenario.

2.2 Northern Motorway Northbound Auxiliary Lane

The northbound auxiliary lane between the Upper Harbour and Greville Road interchanges and Upper Harbour Highway improvements were completed in early 2015 and these works therefore form part of the Future Reference Case for the NCI project. These projects provide benefits to eastbound vehicles on SH18 and northbound vehicles on SH1, which need to be reflected in the models, but the model needs to be cognisant of the traffic volume changes resulting from the Northwestern Motorway works.

An update of the Upper Harbour SATURN model to 2015 enables the travel times between Upper Harbour and Greville Interchange to be checked, to ensure that the model is reflecting the performance of the Northern Motorway following the recent capacity improvements.

2.3 Regional Model Updates

The Auckland Regional Transport model currently retains 2006 as the base model year, with 2013 (and all other years post 2013) being forecast scenarios. Auckland Council is currently going through a model update exercise, focussing on the performance of 2013. The traffic demands obtained for 2013 reflect the "bg" version of 2013, where the zone land use details match 2013 census information for population and employment. The 2013 demands received however retain the "ai" information for primary, secondary and tertiary school trips. Council's intention is to use the latest land use information (which aligns with the 2013 Census) and calibrate and validate the ART 2013 model to observed data.

With 2015 being a forecast year in the ART model, it was considered appropriate for the Upper Harbour model update to reflect an "update" to 2015, rather than a complete revalidation.

3 BACKGROUND

3.1 Upper Harbour Scheme Assessment

The Upper Harbour SATURN traffic model was initially developed in 2001 to facilitate the assessment of the Upper Harbour project. The Upper Harbour project consisted of the SH18 Greenhithe Deviation, SH18 Hobsonville Deviation and SH16 Extension projects. The model was peer reviewed by Traffic Design Group, and was deemed fit for the purpose of informing the scheme assessment (design and economic evaluation) of the Upper Harbour project.

3.2 SH18 Strategic Transport Improvement Study

In 2012 the NZ Transport Agency requested that the Upper Harbour SATURN traffic model be updated to reflect the most recent land uses and traffic flows, as well as to establish updated forecasts for the future years of 2026 and 2041 (based on Scenario I land use). The model's primary purpose was to assist with the SH18 Strategic Transport Improvement Study, with regard to assessing proposed options that may provide additional capacity or better utilise existing capacity along the Upper Harbour Corridor. The update of the model concentrated on the robustness of the model between Hobsonville and the North Harbour Industrial Estate areas, along SH18. The model's secondary purpose was to assist with project assessments in the wider Albany area and State Highway network. As such, the performance of the network concentrated on SH18, whilst also ensuring the alternative routes to SH18 reasonably reflected existing observations. Again, this model was peer reviewed by Traffic Design Group in March/April 2012, and TDG concluded that the model had been appropriately developed, and that in

the majority of cases, achieved the thresholds specified for calibration and validation in the EEM. Relevant documents include:

- Flow Report: Upper Harbour Corridor SATURN Model, Model Development Report, dated May 2012, Reference R1D120529.
- Traffic Design Group Peer Review Report: NZ Transport Agency, Upper Harbour Model Peer Review – Peer Review Report, dated March 2012, Reference 11526
- Traffic Design Group Peer Review Letter: Letter to Mr Scott Wickman, NZ Transport Agency – Upper Harbour Corridor SATURN Model – Model Development Report, Peer Review.

3.3 Auckland Accelerated Projects – Northern Corridor

In 2013 the performance of the Upper Harbour SATURN model was checked along the state highway network for the purposes of informing the Auckland Accelerated Project for the Northern Corridor. The update ensured that the performance of the network reflected traffic conditions following the opening of several major roading projects including the Victoria Park Tunnel, SH18 Hobsonville Deviation and SH16 Extension.

3.4 Northern Corridor Improvements – Indicative Business Case

The above version of the model was also used to inform the Northern Corridor Improvements Indicative Business Case (IBC). It was used to assess the long list of options and carry out the IBC economic assessment. At the time of the IBC assessment, Auckland Council was updating the regional land use forecasts. Through this process it was determined that the traffic model and land use projections needed to be updated for the Detailed Business Case. As the model and the assumptions included in the model were to be updated, this model was not peer reviewed.

4 NORTHERN CORRIDOR IMPROVEMENTS – DETAILED BUSINESS CASE

Following the completion of the IBC, Auckland Council has completed its preliminary work on the latest Auckland Regional land use forecasts, referred to as Scenario I9. In addition to this, Auckland Council has also improved the ART 2013 forecast model with the land use information aligning with 2013 census information. It is noted that the 2013 ART model remains active, with Council's work in validating the ART model expected to be complete in November 2015. Until this work has been completed, the Regional Model will retain the 2006 baseline.

In order to ensure the Upper Harbour SATURN model is robust and fit for the purpose of informing the detailed design and economic evaluation (ie the Detailed Business Case), there was a need to update the model within the core study area, using the most appropriate information available at the time, and to have the model peer reviewed. There are however there are several challenges in updating the wider area model, as summarised in Section 2. These challenges are as follows:

- The Northwestern Motorway construction works
- The completion of the northbound auxiliary lane between the Upper Harbour and Greville interchanges on the Northern Motorway
- Natural growth
- The rate of land use development occurring within the growth areas of Hobsonville Peninsula and Long Bay, with some pockets of the model needing modifications to correct the traffic demands, such that they align closer with the 2015 traffic counts.

The peer reviewer of the model is Traffic Design Group, who were responsible for the reviews of the previous versions of the model. Matters detailed in this report have been discussed with the reviewer, and a response to the peer review of a preliminary version of this report is provided at Section 9.

4.1 Northwestern Motorway Works

4.1.1 Traffic Counts

Construction works have been underway on the Northwestern motorway for some time, which have resulted in narrow traffic lanes, braided traffic lanes, work site entry and exit points, and reduced speed limits, as well as visual impacts. This has led to reduced traffic flows and speeds, as typically expected with significant temporary traffic management.

To determine the effect caused by the traffic management along approximately 9 km of motorway, traffic counts have been sourced from the NZ Transport Agency's TMC website for 2013 and 2015 for

the average peak hours (7-9 am, 4-6 pm), as well as over five hour periods (5-10 am, 2-7 pm). The traffic flow differences are summarised in Table 1.

Table 1: Traffic Flow Differences between 2013 and 2015 (relative to 2013)

Location	Eastbound/Southbound		Westbound/Northbound	
	Average Peak Hour	5 Hour Period	Average Peak Hour	5 Hour Period
SH1 - Northern Motorway (Auckland Harbour Bridge)	-50 AM -400 PM	+510 AM (2%) -1600 PM (-6%)	-125 AM -75 PM	+210 AM (1%) -1600 PM (-4%)
SH18 - Upper Harbour Bridge	**+425 AM** +225 PM	**+1590 AM (21%)** +1010 PM (16%)	+10 AM **+425 PM**	+285 AM (5%) **+1825 PM (19%)**
SH16 Lincoln Road	**-320 AM** +125 PM	**-675 AM (-7%)** +990 PM (15%)	+210 AM +90 PM	+700 AM (18%) +580 PM (6%)
SH16 St Lukes Interchange	-365 AM -25 PM	-200 AM (-1%) -55 PM (-1%)	-60 AM **-300 PM**	275 AM (4%) **-450 PM (-3%)**

Making comparisons between the above points in the network are difficult, given the level of works that have been occurring around the network since November 2010. The following points are noted:

- Lincoln Road construction works were underway in 2013, and as such, the level of temporary traffic management in 2013 may have been affecting flow more so than that in 2015, where flows show an increase, except for eastbound in the morning peak
- Flows on the Harbour Bridge during the morning peak period have been relatively stable, whereas reductions are observed during the evening peak. However, it is noted that the flow differences on the Auckland Harbour Bridge are influenced by the performance of the network upstream
- An increase in hourly flows on SH18 eastbound, and a corresponding decrease in flows on SH16 eastbound are observed during the AM peak. While the quantum of traffic differs, similar trends can be seen during the 5 hour period
- An increase in hourly flows on SH18 westbound, and a corresponding decrease in flows on SH16 westbound are observed during the PM peak. While the quantum of traffic differs, similar trends occur during the 5 hour period.

4.1.2 Journey Times

Travel time information has also been sourced from the NZ Transport Agency using TomTom data. The data has been provided for the purposes of assisting the NZ Transport Agency with the update of the Upper Harbour SATURN model only. Travel times for 2012, 2013 and 2015 are set out in Table 2.

Table 2: Northwestern Motorway Average Travel Time Comparison

Period	2012	2013	2015 (% diff – 13'-15')
Eastbound – Hobsonville Interchange to Newton Interchange			
Morning Peak Period (07:00-09:00)	27:55	24:00	28:30 (19%)
Inter Peak Period (12:00-14:00)	09:35	09:45	12:20 (27%)
Evening Peak Period (16:00-18:00)	10:00	09:45	17:00 (74%)
Westbound – Newton Interchange to Hobsonville Interchange			
Morning Peak Period (07:00-09:00)	12:10	12:15	15:05 (23%)
Inter Peak Period (12:00-14:00)	11:55	11:55	14:25 (21%)
Evening Peak Period (16:00-18:00)	24:10	29:45	33:00 (11%)

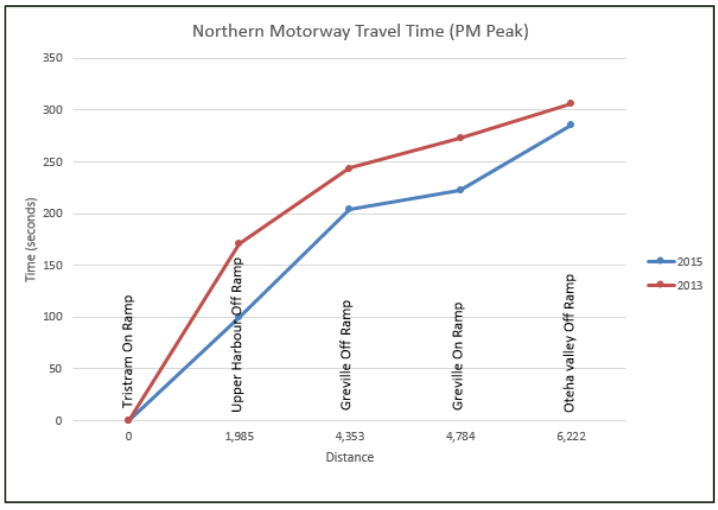
The information highlights the increase in travel times experienced on the Northwestern Motorway as a result of the temporary arrangements currently in place.

4.2 Northern Motorway Northbound Auxiliary Lane

The northbound auxiliary lane between the Upper Harbour and Greville interchanges has recently opened. While the auxiliary lane does not remove the northbound constraint between the Upper Harbour northbound off ramp and on ramp, it has provided additional capacity along the merge and weave section between the Upper Harbour and Greville interchanges.

Figure 2 shows the improvements observed in the corridor performance, by comparing the 2013 travel times against those observed in 2015. While there has been an increase in traffic exiting the Northern Motorway at the Upper Harbour interchange (as a response to the construction works on the Northwestern Motorway and growth at Hobsonville), the impacts of this reassignment on the northbound travel time between the Upper Harbour and Greville interchanges are likely to be minor, given that the Auckland Harbour Bridge controls the amount of traffic entering the North Shore.

Figure 2: Northbound Travel Times (Tristram to Oteha Valley Interchanges) – PM Peak (Average 4-6pm)



5 COMPARISON AGAINST MODEL DEVELOPMENT GUIDELINES

As noted within Section 1, the Upper Harbour SATURN traffic model was originally calibrated and validated against criteria defined in the NZ Transport Agency Economic Evaluation Manual (EEM). During 2014, the NZ Transport Agency, in conjunction with the NZ Modelling User Group (NZMUGS) published a new document "Transport Model Development Guidelines" (July 2014).

As the 2015 traffic demands have been derived by applying growth to the validated 2008 model, and with the challenges associated with updating the model, due to the major construction works on the Northwestern Motorway, the performance of the model has been compared against both sets of validation criteria. While there has been an objective of adhering to the latest guideline, where this has been problematic given the update approach applied, there has been a focus on (as a minimum) achieving the EEM criteria which the original model was measured against.

6 TRAFFIC DATA COLLETION

Traffic information has been obtained from a number of sources to assist with the update of the model. All data collection has relied on electronic information, including state highway automatic traffic counts, intersection SCATS traffic counts and TomTom data (as sourced through the NZ Transport Agency specifically for NZ Transport Agency projects).

6.1 State Highway Counts

State Highway traffic count data has been provided by the Transport Agency. These include traffic counts on SH1 and SH18, including on and off-ramp counts, collected in March 2015.

6.2 SCATS Data

Intersection traffic counts have been extracted from the SCATS system on a Tuesday, Wednesday and Thursday in March 2015, including intersections located within the core area of the model. Signal phasing data recorded on a neutral Wednesday has also been obtained, to assist the calibration of signal timings within the model.

6.3 Journey Time Information

Three-day-average journey time data obtained from the TomTom March 2015 database has been provided by the Transport Agency. The following eight journey time routes have been used:

- Route 1 and 2: between the SH18 Albany Highway interchange and the SH1 Oteha Valley Road interchange, via SH18 and SH1
- Route 3 and 4: between the Oteha Valley Road/Albany Highway intersection and the SH1 Tristram Avenue interchange, via Albany Expressway (SH17) and SH1
- Route 5 and 6: SH1 between the Tristram Avenue interchange and the Oteha Valley Road interchange
- Route 7 and 8: between the SH18 Albany Highway Interchange and the SH1 Tristram Avenue interchange, via SH18 and SH1

Figure 3below illustrates each of the journey time routes.

Figure 3: TomTom Journey Time Routes

It should be noted that due to data rights and privacy, individual travel time data from TomTom along each of the above routes has not been made available. However the statistical travel time data between the starting point and each "check point" along these routes has been provided, in terms of average travel times and 5 to 95 percentile travel time data. This may result in some inaccuracies in the journey times at some check points, however the general journey times along the whole routes are considered to be appropriate for the purpose of updating the model validation.

In addition to the key routes within the core study area, point to point travel time data has been provided for the following state highway corridors:

- Northern Motorway (SH1) between the Oteha Valley Interchange and the SH16 Port Connection
- Upper Harbour Corridor (SH18) between the Hobsonville Interchange and the Upper Harbour Interchange
- Northwestern Motorway (SH16) between the Hobsonville Interchange and the Newton Interchange.

Data for the state highway corridors has been obtained for 2013 and 2015 in order to review how the network operation compares, for scenarios without and with construction works along the Northwestern Motorway. This data has been compared by running a sensitivity test in the Upper Harbour SATURN model, again noting however that the traffic demands in SATURN (as sourced from the ART model) assume that there are no roadworks on the Northwestern Motorway.

7 TRAFFIC DEMAND UPDATE

7.1 Zone Structure

Traffic demands for 2013 and beyond have been obtained from the ART model, version 3.2. The subtle differences between ART3.0 and ART3.2 relate to the zone structure applied across the network. As a

response to regional growth in the Future Urban Zones, the zone structure in the fringes of the region has been refined in ART 3.2.

With regard to the North Shore, the changes to zone boundaries are minimal, given that the detail of the North Shore (the location of the NCI project) already has a refined zone structure. The zone structure within the northwest has been amended slightly, but the changes within the boundary of the SATURN model are again minimal, so much so, that a simple cross reference table was used to place ART 3.2 zones back into ART 3.0 zones for the purposes of carrying forward the forecast demands.

The majority of the changes in zone definition between ART3.0 and ART3.2 occur in the northern, western and southern areas of the region, which sit outside the Upper Harbour SATURN model boundaries.

7.2 Traffic Demands

During the model development in 2010, the model was validated to represent 2008 traffic conditions, with traffic demands being obtained from the Auckland Regional Model (ART3.0). The ART model reflects 2006 traffic conditions based on the census data and observed data collected in 2006.

A comparison of 2008 validated SATURN traffic demands and the 2015 traffic counts within the core study area indicates that growth has occurred. As such, growth has been applied to the 2008 validated SATURN traffic demands.

The ART3.2 model continues to have a 2006 base validated model, with the 2013 model being a forecast year, which has been cross checked against the 2013 Census information. To increase the level of traffic in the SATURN model, five out of seven years growth forecasting according to the 2006 and 2013 ART model traffic demands and two out of three years growth forecast between the 2013 and 2016 ART traffic demands have been applied, to bring the Upper Harbour SATURN traffic demands up to 2015 levels.

The updated 2015 traffic demands have increased the level of traffic within the modelled area, and the majority of traffic counts align well. However, some pockets of the network presented traffic demands that were either light or heavy when compared to the 2015 traffic counts. While noting that the traffic volumes around the State Highway network are affected by the construction works on the Northwestern Motorway, some areas of the network have been accepted as being light, or heavy in the model. Corrections have not been applied, as the differences are considered temporary and to include any correction would artificially inflate or reduce traffic flows along the corridor.

In order to better align traffic demands with observed counts, the following key corrections have been applied to the traffic demands:

- Demands have been added at Albany Senior High School, as the base model does not include the new school
- The 2015 demand update aligns well on the State Highways during the morning and evening peaks. However the SH1 traffic demands from the north remain low during the inter peak. As such, the zone demands associated with the Northern Motorway (SATURN Zone 1401) have been increased for the inter peak, based on traffic count data obtained at the SH1 Oteha Valley Road interchange. This increase will be checked when moving forward to forecast years

- Traffic demands associated with the Hobsonville Peninsula development appear to be underestimated. Therefore the demands associated with ART zone 126 and 127 have been increased, on the assumption that 40% of the total Hobsonville Peninsula development is already in place
- There was an imbalance in traffic demands between East Coast Road and the Northern Motorway, at the northern boundary of the model. While the total demand was right, the balance in flows between the two routes in the ART model was not right. The traffic demands have been adjusted based on traffic counts
- The westbound traffic demands on SH18 during the morning peak appear to be too high. This relates to the high left turning flows from Albany Highway south, at the Albany Highway/SH18 interchange. A select link analysis has been undertaken and the left turn demands have been reduced by 40%
- The southbound traffic demand crossing Auckland Harbour Bridge during the evening peak has been reduced, as the demand was in the order of 6,900 vehicles per hour. The observed count sits at about 4,900 vehicles per hour (noting that this is an "actual flow", ie the low able to reach the Bridge). As such, the demand was reduced by 20%, resulting in a demand of some 5,600 vehicles per hour. The modelled delay at the foot of the bridge (some 5.5 minutes) matches the observed travel times.

Table 3 below summarises the trip totals before and after the demand calibration described above.

Table 3: Matrix Totals, Before and After 2015 Update

Process	Morning Peak Period	Inter Peak Period	Evening Peak Period
2006 ART (1hr)	86,210	74,960	93,550
Previously Validated Matrix (2008)	84,070	72,350	94,660
2013 ART (1hr)	89,050 (0.5% pa)	79,420 (0.8% pa)	97,810 (0.7% pa)
Growth (5/7 ART 2006 to ART 2013)	2,130	3,185	3,040
2016 ART (1hr)	90,890	81,810	100,170
Growth (2/3 ART 2013 to ART 2016)	1,220	1,590	1,600
2015 Revised Total	87,420	77,125	99,300
Manual Corrections (to align with 2015 traffic counts)	380	1,295	-340
Final Updated Matrix (2015)	87,800 (0.6% pa)	78,420 (1.2% pa)	98,960 (0.6% pa)

The above table indicates a small amount of growth in 2015 during the morning and evening peak periods, relative to the modelled 2013 demands, with the inter peak period showing the highest amount of growth. Similar trends exist with the ART model.

8 MODEL DEVELOPMENT TARGETS

As mentioned earlier, the Upper Harbour SATURN traffic model was originally calibrated and validated against criteria defined in the NZ Transport Agency Economic Evaluation Manual (EEM). During 2014, the NZ Transport Agency, in conjunction with the NZ Modelling User Group (NZMUGS) published a new document "Transport Model Development Guidelines". Reference has been made to the 2014 Guideline in the first instance, with the EEM criteria also being referred to.

The targets within the 2014 Guidelines for large NZ Transport Agency projects (Category D) have been referred to.

8.1 Link Flows

The coefficient of determination (R-square) values for each model are provided in Table 4. The results are provided in terms of total traffic flows.

Ideally these coefficients should satisfy an R-square of 95% in the vicinity of the project, with the target in the 2014 Model Development Guideline being the same as that previously set out in the EEM.

Table 4: Coefficient of Determination (R^2) Results for Updated 2015 Model (Link Counts)

Time Period	Number of Link Counts	R^2	Line of Best Fit
Morning Peak Period	70	98%	1.048
Inter Peak Period	71	98%	1.022
Evening Peak Period	70	97%	1.055

Table 4 indicates that R-square values of over 95% are achieved for all time periods. The lines of best fit are within the targets in the 2014 Model Development Guideline for all three modelled periods. As mentioned above, a shift in traffic flows has been observed during the evening peak period, between SH1 and SH18, possibly due to the temporary construction works on SH16. This has made it extremely difficult to validate the westbound traffic demands on SH18, which has reduced the R-square value for the evening peak model.

Figure 4 to Figure 6 show plots of the observed versus modelled link counts for the three modelled time periods. The plots show a good correlation between observed and modelled counts.

Appendix A shows the locations of all link counts used in the model update.

Figure 4: Observed Versus Modelled Link Counts – Morning Peak Period

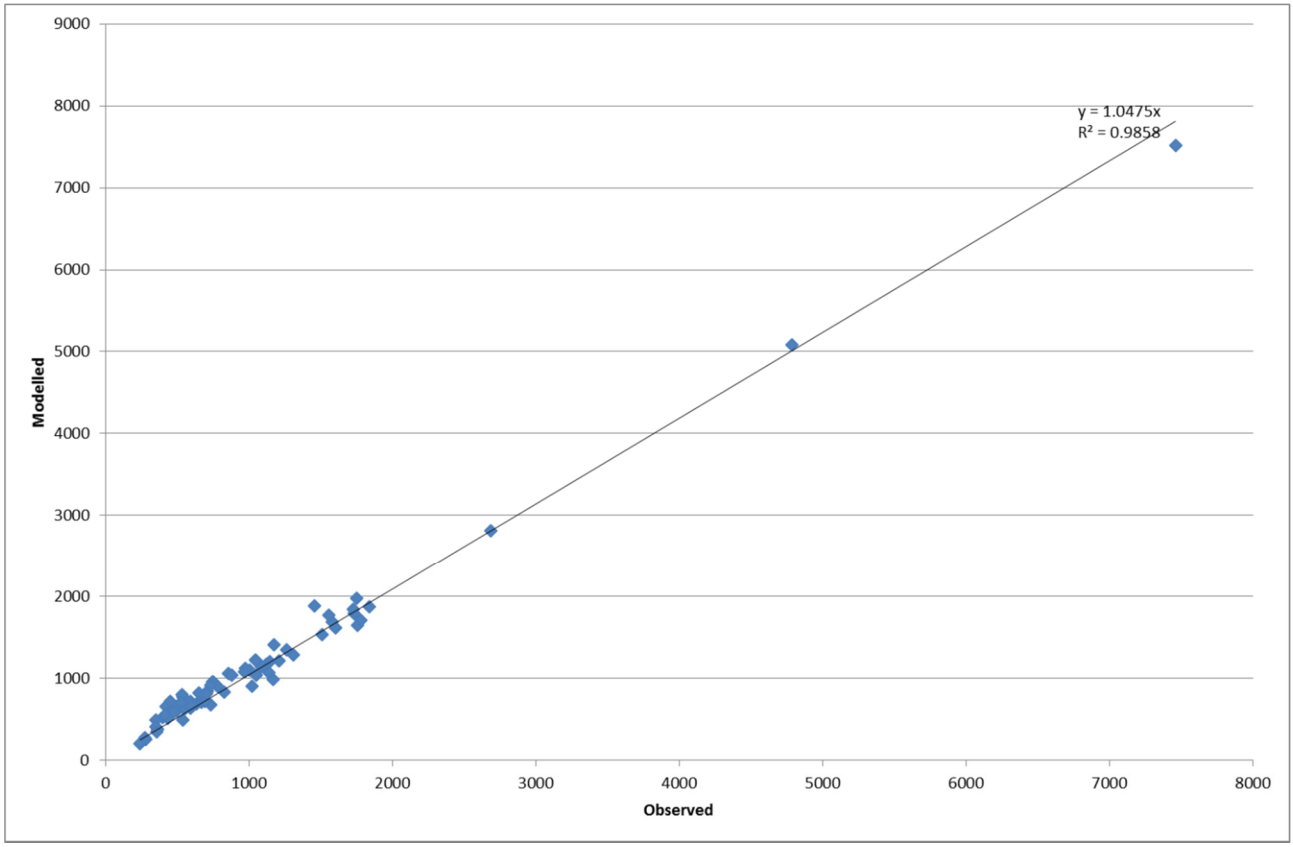


Figure 5: Observed Versus Modelled Link Counts – Inter Peak Period

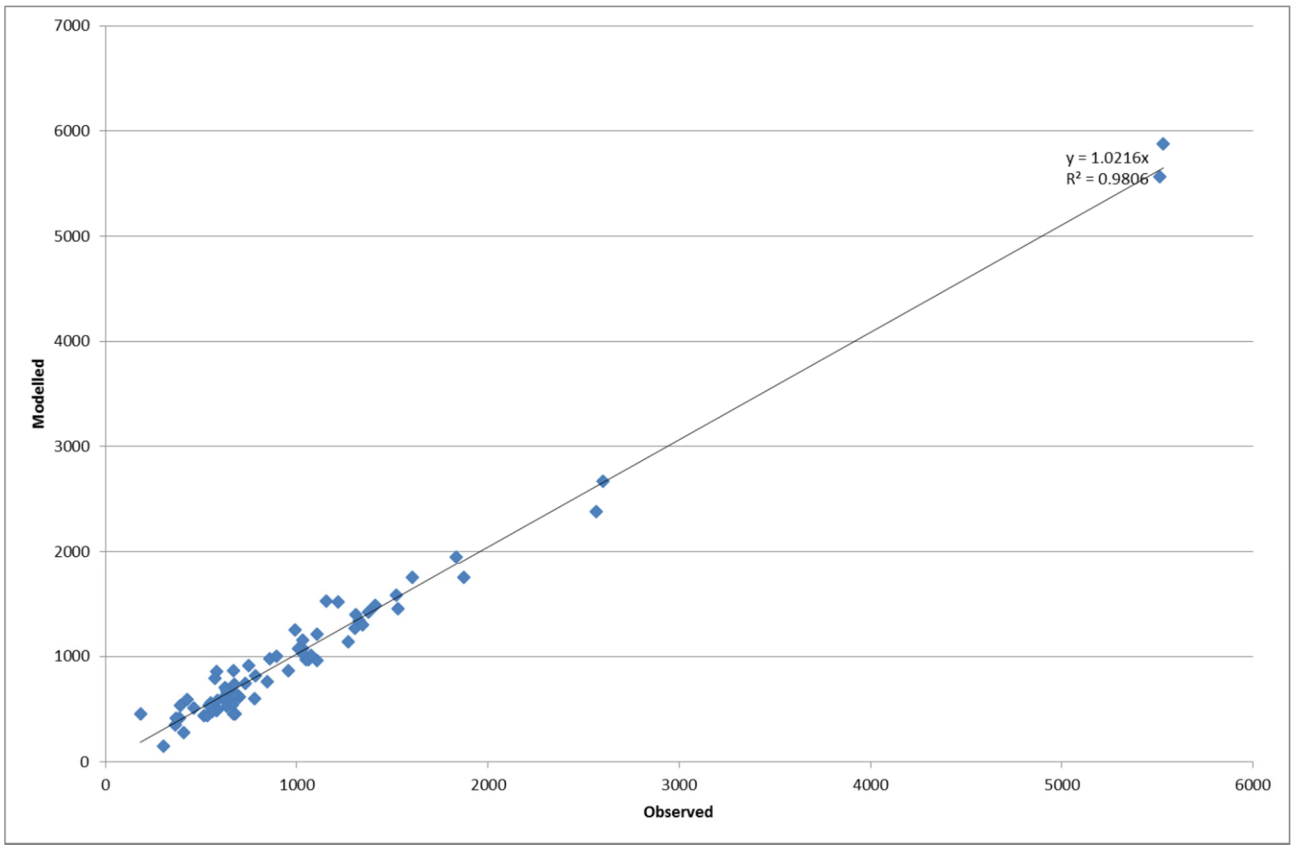
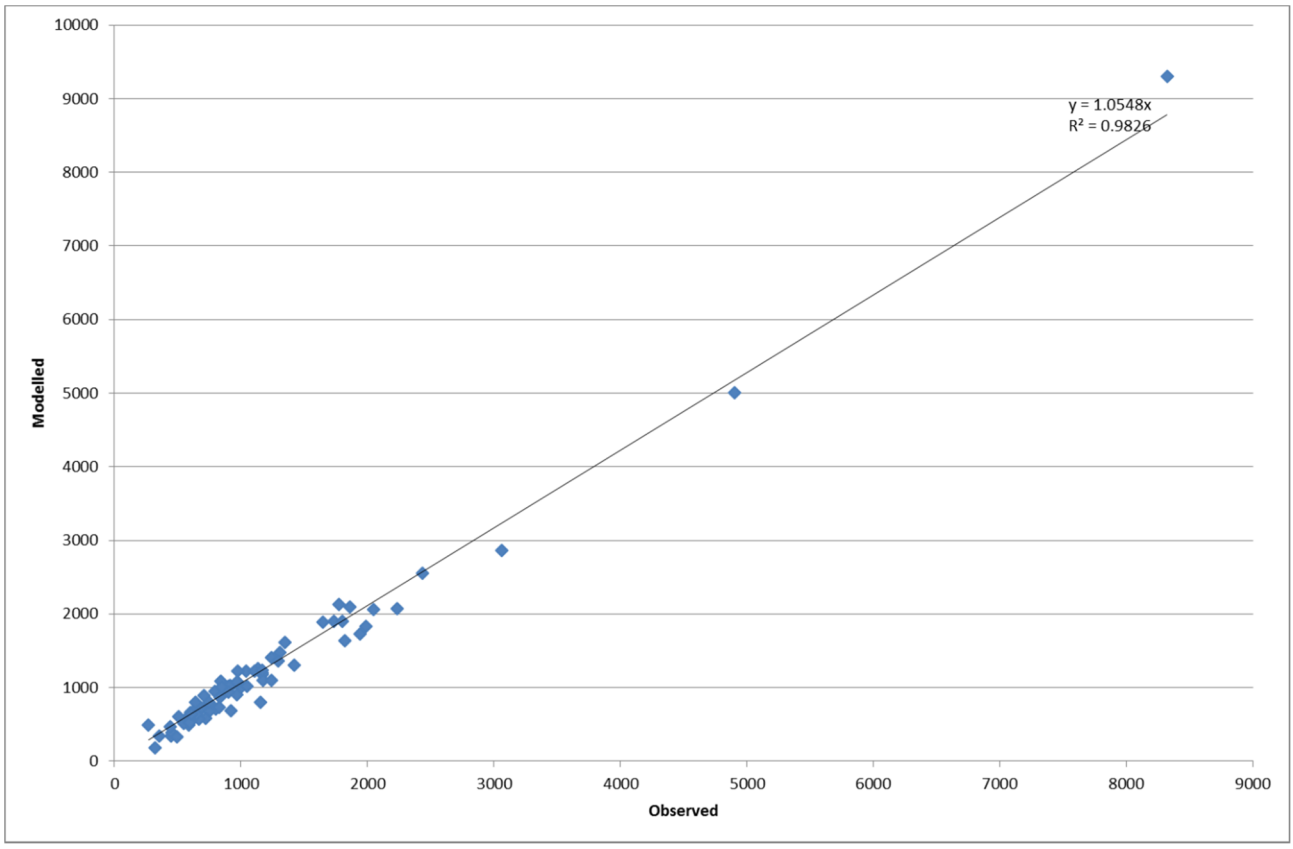


Figure 6: Observed Versus Modelled Link Counts – Evening Peak Period



8.1.1 Percentage Root-Mean-Square-Error (RMSE)

The RMSE percentage is calculated for every count within the model (link and turning counts), and is provided as one value for each modelled time period. The 2014 Model Development Guideline states that the RMSE should be less than 17.5%, with a value less than 27.5% being acceptable, subject to clarification. The target in the EEM is less stringent.

Table 5 outlines the RMSE results for all counts used in the update of the model. The table shows that the inter peak RMSE percentage values are within the recommended target of 17.5%, while the morning and evening peak values are slightly higher than the recommended value. However, they are well within the acceptable value of 27.5%.

Table 5: Percentage Root Mean Square Error Results for Model Update (Link Counts)

Time Period	Number of Counts	%RMSE
Morning Peak Period	161	18.7
Inter Peak Period	162	17.3
Evening Peak Period	161	19.9

8.1.2 GEH Statistic for Link Flows

The GEH statistics for link flows are shown in Table 6.

Table 6: Link Count GEH Statistics

Targets in 2014 Guideline	Time Period	Number of Counts	% of Counts
82.5% GEH < 5	Morning Peak Period	49	70%
	Inter Peak Period	55	77%
	Evening Peak Period	52	74%
87.5% GEH < 7.5	Morning Peak Period	66	94%
	Inter Peak Period	63	89%
	Evening Peak Period	64	91%
92.5% GEH < 10	Morning Peak Period	67	96%
	Inter Peak Period	69	97%
	Evening Peak Period	68	97%

The table indicates that the GEH targets for link flows are met for the GEH values of less than 7.5 (87.5% of counts) and 10 (92.5% of counts) while the percentage of links with GEH values of less than 5 are less than the target (82.5%) in all peaks. However, the level of validation achieved in terms of the percentage of counts with a GEH of less than 5, exceeds the previous EEM criteria of 60%.

Tables providing all traffic counts and GEH values are included in Appendix B.

8.1.3 Link Count Percentage Differences

As a means to determine the model's accuracy, the 2014 Model Development Guideline requires an assessment of individual link counts, whereby the volume of traffic on the link sets the required accuracy. The guideline concentrates on link volumes of:

1. 400 vehicles per hour or less
2. Between 400 and 2,000 vehicles per hour
3. More than 2,000 vehicles per hour

At least 87.5% of counts should achieve the criteria. No such criteria were included in the EEM. Table 7 summarises the percentages achieved.

Table 7: Link Count Differences

Targets in 2014 Guideline	Period	Number of Counts	%
87.5% of links < 400 vph to be within 50 vph	Morning Peak Period	5 of 7	71%
	Inter Peak Period	3 of 6	50%
	Evening Peak Period	2 of 3	66%
87.5% of links 400 vph to 2,000 vph to be within 12.5%	Morning Peak Period	27 of 60	45%
	Inter Peak Period	38 of 61	62%
	Evening Peak Period	38 of 61	62%
87.5% of links > 2,000 vph to be within 250 vph	Morning Peak Period	2 of 3	67%
	Inter Peak Period	3 of 4	75%
	Evening Peak Period	5of 6	83%

As matrix estimation has not been undertaken in this assessment, and with the original traffic model being developed according to the EEM criteria, meeting the newer 2014 Model Development Guideline targets set for count percentage differences is difficult to achieve.

The previous measure for link counts was to summarise the percentage of counts within 20% on links with more than 500 vehicles per hour. The model results in 81%, 84% and 90% of model volumes being within 20% of the count, where data is available.

8.2 Turn Flows

8.2.1 GEH Statistic for Turn Flows

The GEH statistics for the turn counts used within the model update are shown in Table 8. The targets set in the 2014 Model Development Guideline require a high level of accuracy and are difficult to achieve, given the scope and the challenges noted earlier with this particular model update.

Table 8: Turn Count GEH Statistics

Targets in 2014 Guideline	Time Period	Number of Counts	% of Counts
82.5% GEH < 5	Morning Peak Period	55	60%
	Inter Peak Period	65	71%
	Evening Peak Period	55	60%
87.5% GEH < 7.5	Morning Peak Period	76	84%
	Inter Peak Period	75	82%
	Evening Peak Period	71	78%
92.5% GEH < 10	Morning Peak Period	84	92%
	Inter Peak Period	86	95%
	Evening Peak Period	82	90%

The targets in the 2014 Model Development Guideline for links with GEH values of under 5 or 7.5 have not been met. The model performs better for those links with GEH values under 10, with the morning and inter peak period models meeting the criteria and the evening peak period being relatively close.

Table 9 summarises the percentages achieved for absolute turning flow differences for the updated SATURN model.

Table 9: Turn Count Differences

Targets in 2014 Guidelines	Period	Number of Counts	%
87.5% of turns < 400 vph to be within 50 vph	Morning Peak Period	40 of 65	62%
	Inter Peak Period	40 of 64	63%
	Evening Peak Period	31 of 60	52%
87.5% of turns 400 vph to 2,000 vph to be within 12.5%	Morning Peak Period	12 of 26	46%
	Inter Peak Period	19 of 27	70%
	Evening Peak Period	17 of 31	55%

8.3 Journey Time Comparisons

8.3.1 Core Area

Table 10 to Table 12 summarise the absolute and percentage differences between observed and modelled journey times, and whether the modelled journey times fall within the criteria set out in the 2014 Guideline.

Table 10: Journey Time Comparison – Morning Peak Period

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	450	435	-15	-3.5%	Yes
Route 2	Southbound	1305	655	-650	-49.8%	No
Route 3	Northbound	465	505	40	8.1%	Yes
Route 4	Southbound	1405	1305	-100	-7.2%	Yes
Route 5	Northbound	285	305	20	6.6%	Yes
Route 6	Southbound	1635	1035	-600	-36.6%	No
Route 7	Northbound	430	435	5	1.7%	Yes
Route 8	Southbound	1090	1150	55	5.2%	Yes

Table 11: Journey Time Comparison - Inter Peak Period

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	345	295	-50	-13.8%	Yes
Route 2	Southbound	380	415	35	9.1%	Yes
Route 3	Northbound	470	455	-15	-3.0%	Yes
Route 4	Southbound	455	415	-40	-8.5%	Yes
Route 5	Northbound	290	245	-45	-15.4%	No
Route 6	Southbound	275	280	5	2.6%	Yes
Route 7	Northbound	335	330	-10	-2.3%	Yes
Route 8	Southbound	340	390	45	13.6%	Yes

Table 12: Journey Time Comparison – Evening Peak Period

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	390	425	35	8.7%	Yes
Route 2	Southbound	540	580	40	6.5%	Yes
Route 3	Northbound	745	780	35	5.0%	Yes
Route 4	Southbound	735	735	0	0.0%	Yes
Route 5	Northbound	485	540	55	10.5%	Yes
Route 6	Southbound	435	375	-60	-14.6%	Yes
Route 7	Northbound	675	690	15	2.6%	Yes
Route 8	Southbound	555	575	20	4.2%	Yes

The above tables indicate that the results of the journey time comparisons are generally very good, with the inter peak and evening peak periods meeting the guideline criteria of 87.5% (at least 7 out of 8 routes).

During the morning peak period, the observed travel time along the two southbound routes (starting at the SH1 Oteha Valley Road interchange) is much longer than the model predicted time. However, the traffic demands along this section of motorway are found to be similar to the observed data, and the high journey time observed between Oteha Valley Road and Greville Road is most likely due to queues blocking back into the corridor as a result of downstream constraints.

A queue of this nature is difficult to replicate in a SATURN model, given SATURN's inability to simulate long distance queues. The journey time could be reduced by including an isolated speed flow curve for this segment, which would need to be added to the morning peak model only. It is noted that once passed the section north of Greville Road, the predicted journey times fit well with the observed travel times. In addition to this, an assessment of the whole of route has been compared as summarised below, and the journey time from Oteha Valley Road to the City Centre validates well.

In addition to the percentage and actual difference comparisons, journey times versus travel distance plots have also been produced, with the plots being presented in Appendix C. The red line represents the modelled journey time, with the black line representing the observed journey time.

In general, the travel time versus travel distance plots indicate that the model replicates existing travel times to an acceptable level. In noting this, the following comments are made:

- As mentioned above, modelled travel times along Route 2 and Route 6, after the Greville Road on ramp, correlate well with the observed times during the morning peak period
- Most of the inter peak period plots show good correlation along the routes. The northbound journey time along SH1 appears to be low, but the difference between the observed and modelled time is under 1 minute.

8.3.2 State Highway Journey Times

As a result of the construction works along the Northwestern Motorway, travel time data has been collected for 2013 (when effects due to construction are considered minimal) and 2015 (when the full extent of construction is in place).

To recap, the traffic demands received from the ART model (for 2013 and 2016) assume no operational constraints (ie no construction works). The SATURN model update concentrates on 2015, in order to include the northbound auxiliary lane on the Northern Motorway. In reviewing the 2013 and 2015 data, there are some noticeable changes in the performance of the network.

Summarised below are the travel times on the State Highways, as observed in 2013 and 2015.

Table 13: Journey Time Comparison – State Highways

Route Description	Morning (7-9am)		Midday (12-2pm)		Evening (4-6pm)	
	2013	2015	2013	2015	2013	2015
SH1 Oteha to City Centre	36:40	42:45 (17%)	10:35	11:30 (9%)	15:50	26:50 (70%)
SH1 City Centre to Oteha	12:10	13:15 (9%)	11:30	12:30 (9%)	18:30	21:00 (14%)
SH16 Hobsonville to Newton	24:00	28:30 (19%)	9:45	12:20 (27%)	9:45	17:00 (74%)
SH16 Newton to Hobsonville	12:15	15:05 (23%)	11:55	14:25 (21%)	29:45	33:00 (11%)
SH18 Upper Harbour to Hobsonville	8:40	9:50 (14%)	8:35	10:00 (17%)	8:45	10:35 (22%)
SH18 Hobsonville to Upper Harbour	17:50	17:40 (-1%)	9:25	10:15 (9%)	10:05	11:05 (10%)

The comparisons highlight an increase in journey times, generally of 10% to 15%, except for those which are expected to be slower as a result of construction works on the Northwestern Motorway (SH16). Journey times which increase in time by some 20% are those along the Northwestern Motorway, as well as SH1 citybound in the morning and evening peaks, and SH18 towards Hobsonville during the evening peak period.

The northbound auxiliary lane on the Northern Motorway and the SH18 widening on the approach to the Upper Harbour interchange have resulted in improved travel times. As such, the Northern Corridor Improvements, coupled with growth and construction traffic patterns, do need to be considered carefully when assessing the above information.

The performance of the Upper Harbour SATURN model has been compared against the 2015 journey time information as presented in Table 14. The results show that the modelled time is too fast along the Northwestern Motorway, which is to be expected.

Table 14: Journey Time Comparison – State Highways (Based on 2015 data)

Route Description	Morning (7-9am)			Midday (12-2pm)			Evening (4-6pm)		
	2013	2015	Model	2013	2015	Model	2013	2015	Model
SH1 Oteha to City Centre	36:40	42:45	39:30 (-8%)	10:35	11:30	12:45 (10%)	15:50	26:50	22:10 (17%)
SH1 City Centre to Oteha	12:10	13:15	12:15 (-8%)	11:30	12:30	10:50 (-13%)	18:30	21:00	16:45 (-20%)
SH16 Hobsonville to Newton	24:00	28:30	27:35 (-3%)	9:45	12:20	10:25 (-16%)	9:45	17:00	12:30 (-26%)
SH16 Newton to Hobsonville	12:15	15:05	12:10 (-20%)	11:55	14:25	11:05 (-23%)	29:45	33:00	25:10 (-24%)
SH18 Upper Harbour to Hobsonville	8:40	9:50	10:20 (5%)	8:35	10:00	9:50 (-1%)	8:45	10:35	10:00 (4%)
SH18 Hobsonville to Upper Harbour	17:50	17:40	14:30 (-18%)	9:25	10:15	9:20 (-9%)	10:05	11:05	11:00 (-1%)
Criteria	4 out of 6			4 out of 6			2 out of 6		

The results indicate that the model does not meet industry guidelines along the Northwestern Motorway, as well as a couple of other routes, being SH18 towards Upper Harbour during the morning peak period.

A sensitivity test was therefore carried out to see how the model reacts when the speed and capacity of the Northwestern Motorway are reduced (to reflect the current construction works). For the sections of the motorway where major road works are in place, the capacity has been reduced by 10% (a reduction typically applied to reflect temporary traffic management on highways) and the speed has been reduced to that currently signposted, being 80km/hr. The modelled journey times are presented in Table 15.

Table 15: Journey Time Comparison – State Highways (Sensitivity Test – Construction Works)

Route Description	Morning (7-9am)			Midday (12-2pm)			Evening (4-6pm)		
	2015	Model	Test	2015	Model	Test	2015	Model	Test
SH1 Oteha to City Centre	42:45	39:30 (-8%)	40:55 (-4%)	11:30	12:45 (10%)	12:45 (10%)	26:50	22:10 (17%)	22:10 (17%)
SH1 City Centre to Oteha	13:15	12:15 (-8%)	12:40 (-5%)	12:30	10:50 (-13%)	11:50 (-5%)	21:00	16:45 (-20%)	19:25 (-8%)
SH16 Hobsonville to Newton	28:30	27:35 (-3%)	39:05 (37%)	12:20	10:25 (-16%)	14:25 (17%)	17:00	12:30 (-26%)	14:50 (-12%)
SH16 Newton to Hobsonville	15:05	12:10 (-20%)	13:40 (-9%)	14:25	11:05 (-23%)	15:30 (7%)	33:00	25:10 (-24%)	31:30 (-5%)
SH18 Upper Harbour to Hobsonville	9:50	10:20 (5%)	10:05 (3%)	10:00	9:50 (-1%)	9:50 (-1%)	10:35	10:00 (-4%)	10:55 (3%)
SH18 Hobsonville to Upper Harbour	17:40	14:30 (-18%)	15:55 (-10%)	10:15	9:20 (-9%)	9:25 (-8%)	11:05	11:00 (-1%)	11:30 (3%)
Criteria	4 out of 6 (Base) 5 out of 6 (Test)			4 out of 6 (Base) 5 out of 6 (Test)			2 out of 6 (Base) 5 out of 6 (Test)		

The sensitivity test improves the level of validation across the network. The one time which stands out is the SH16 Hobsonville to Newton route during the morning peak period. This is a result of the sensitivity test in SATURN applying the ART demand which does not reflect construction works to a SATURN network with construction works. The coding along the SH16 corridor in the SATURN network only includes the motorway, and not the alternative parallel routes. As such, vehicles that are able to make local trips on local routes are likely to do so in reality, but cannot do so in the model. While the 37% difference is high, the coding of the network in the sensitivity test (being the reduced capacity and speed) has led to a reasonable response by the model, during the other time periods and directions. As such, we are generally satisfied with how the model has reacted.

9 PEER REVIEW

A preliminary version of this report was provided for peer review by TDG.

Flow has reviewed the peer review report and we generally agree with the findings of the peer review completed. However, there are a number of matters that Flow would like to respond to, in order to clarify points, or provide confidence that the model and assessment methodology for the NCI project is robust.

Matters raised by TDG that Flow would like to provide comment on are discussed below.

9.1 Effects of Construction Works

- **TDG Section 3.1, Bullet 2**

  I do not support the statement in the fourth paragraph that the "construction works on the North Western Motorway prevent[ing] the model from being revalidated". I wholeheartedly agree that the roadworks make the process significantly more complicated, but it would still have been possible to validate the model. In fact I suggest you have validated the traffic model in the core area.

Flow partially agrees that a model could have been validated. The language within this report has been changed, to reflect the fact that the construction works have inhibited rather than prevented 2015 validation.

9.2 Assessment of Queues

- **Section 3.1, Bullet 4**

  It is noted that the new guidelines have more stringent targets than the Economic Evaluation Manual (EEM), and without applying further matrix estimation, the new targets will be difficult to achieve. While I agree with the problem, and depending on what level of validation is achieved, it suggests that the Upper Harbour SATURN Traffic Model needs recalibration or replacement with a new tool that can replicate the queuing that occurs in reality and is difficult to reflect in SATURN.

The NCI project makes use of various traffic modelling packages to inform the project design. The SATURN model is informing the economic evaluation of the project, with travel times around the wider network comparing well against observed information, while noting that the extent of the queue does not. For example, on the Northern Motorway southbound, the queue in SATURN does not extend for the length of the corridor, but the travel time (from which a large portion of benefits are based) between Oteha Valley Road and the Port, as issued in supplementary information during the peer review, had travel times within 8%.

As well as the SATURN Model, the assessment of project options is also utilising a PARAMICS micro-simulation traffic model for the core strategic links, namely along the SH1 and SH18 corridors. The PARAMICS model has also been validated and forecast demands are being sourced from the SATURN model.

The PARAMICS model is used to inform the design of the NCI project and it is providing the detailed analysis required by the network operations and safety audit teams. The PARAMICS models and SATURN models are being used iteratively, with details of speeds predicted in PARAMICS being fed back into SATURN.

As such, we are of the opinion that the NCI project is being appropriately assessed using a range of traffic modelling tools, allowing a robust design and evaluation to be completed.

9.3 Source of Benefits

- **Section 3.8.1, Bullet 3**

  We would suggest that given there are fewer checks on model performance outside of the core study area that it would be advantageous to confirm that any calculated benefits from new schemes are primarily derived within the core area. For example, further checks on model performance may be warranted if significant benefits are estimated for SH16, where fewer checks on the model have been carried out.

As a means to confirm that the traffic model provides a stable and robust platform from which to evaluate the project benefits of the NCI project, a fixed trip matrix assessment will be completed, with the project benefits being derived for the wider network, as well as the core study area. This information will be included in the economic analysis section of the DBC.

9.4 Other Issues

The peer review of the SATURN model also notes the following points:

- It supports the base year (2015) and the traffic demand methodology used for updating the model
- It suggests that the checks applied to the base model to confirm its ability to replicate observed traffic information is comprehensive
- It acknowledges the challenges associated with updating a base model which includes a fluid situation, with roadworks on the Northwestern Motorway
- It suggests that the model generally meets the targets in the EEM and mostly achieves the link based targets in the new 2014 Model Development guideline.

10 SUMMARY

This report has outlined that the update of the Upper Harbour SATURN traffic model, which is to be used to inform the Northern Corridor Improvements Detailed Business Case. The model generally satisfies the criteria that are generally consistent between the older NZ Transport Agency Economic Evaluation Manual (which the original Upper Harbour SATURN model was validated to) and the 2014 Model Development Guideline.

The performance of each of the three updated base models is summarised in Table 16. The table indicates that the key targets in the 2014 Model Development Guideline have mostly been achieved. Those that have not been achieved relate to turning count validation, and the percentages of links within 50 vph or 12.5% on roads. It is concluded that the performance of the updated Upper Harbour SATURN model adequately represents the base year 2015.

Table 16: Transport Modelling Criteria – Model Update

Criteria	Sub criteria	Description	2014 Model Development Guideline Criteria Satisfied			EEM Criteria
			Morning	Inter	Evening	
Link Flows	Coefficient of determination (R^2)	A minimum of 95% in vicinity of project	Yes	Yes	Yes	95%

Table 16: Transport Modelling Criteria – Model Update

	Line of best fit	Y = 0.925x to 1.075x	Yes	Yes	Yes	-
	Screenlines	90% of screenlines with GEH < 5.0	-	-	-	-
	GEH statistic (Link Counts)	82.5% GEH less than 5	No (70%)	No (77%)	No (74%)	60%
		87.5% GEH less than 7.5	Yes	Yes	Yes	-
		92.5% GEH less than 10	Yes	Yes	Yes	90%
	Percentage-Root-Mean-Square Error (RMSE)	Acceptable: <17.5% Requires Classification: 17.5-27.5%	Yes	Yes	Yes	<30%
	Link Count Differences	87.5% of links <400vph within 50vph	No (71%)	No (50%)	No (66%)	Within 20% of Links >500 vph AM-81% INT-84% PM-90%
		87.5% of links 400-2000vph within 12.5%	No (45%)	No (62%)	No (62%)	
		87.5% of links >2,000vph within 250vph	No (67%)	No (75%)	No (83%)	
Turning Flows	GEH statistic (Turn Counts)	82.5% GEH less than 5	No (60%)	No (72%)	No (60%)	60%
		87.5% GEH less than 7.5	No (84%)	No (84%)	No (78%)	-
		92.5% GEH less than 10	No (92%)	Yes	No (90%)	90%
	Turn Counts Differences	87.5% of turns <400 vph within 50 vph	No (62%)	No (63%)	No (52%)	-
		87.5% of turns 400-2000 vph within 12.5%	No (46%)	No (70%)	No (55%)	
		87.5% of turns >2,000 vph within 250 vph	-	-	-	
Journey Times	Difference Comparison	87.5% or more of the modelled travel times should fall within 15% (or 1 minute, if 1 minute is greater than 15% of the travel time).	No (6 of 8 or 75%)	Yes (7 of 8 or 87.5%)	Yes (8 of 8 or 100%)	85% or more of the modelled travel times

Table 16: Transport Modelling Criteria – Model Update

	Plots	Distance / Time	Mostly good	Mostly good	All good	should fall within 15%, or 1 minute

10.1 Sensitivity Test Summary

The results table has been repeated below for the scenario whereby construction works on the Northwestern Motorway have been tested.

Table 17: Transport Modelling Criteria – Model Update

Criteria	Sub criteria	Description	2014 Model Development Guideline Criteria Satisfied			EEM Criteria
			Morning	Inter	Evening	
Link Flows	Coefficient of determination (R^2)	A minimum of 95% in vicinity of project	Yes	Yes	Yes	95%
	Line of best fit	Y = 0.925x to 1.075x	Yes	Yes	Yes	-
	Screenlines	90% of screenlines with GEH < 5.0	-	-	-	-
	GEH statistic (Link Counts)	82.5% GEH less than 5	No (61%)	No (77%)	No (77%)	60%
		87.5% GEH less than 7.5	Yes	Yes	Yes	-
		92.5% GEH less than 10	Yes	Yes	Yes	90%
	Percentage-Root-Mean-Square Error (RMSE)	Acceptable: <17.5% Requires Classification: 17.5-27.5%	Yes	Yes	Yes	<30%
	Link Count Differences	87.5% of links <400vph within 50vph	No (57%)	No (50%)	No (66%)	Within 20% of Links >500 vph AM-79% INT-84% PM-87%
		87.5% of links 400-2000vph within 12.5%	No (45%)	No (62%)	No (64%)	
		87.5% of links >2,000vph within 250vph	Yes	No (75%)	No (83%)	
Turning Flows	GEH statistic	82.5% GEH less than 5	No (62%)	No (73%)	No (64%)	60%

Table 17: Transport Modelling Criteria – Model Update

	(Turn Counts)	87.5% GEH less than 7.5	No (86%)	No (84%)	No (79%)	-
		92.5% GEH less than 10	No (92%)	Yes	No (89%)	90%
	Turn Counts Differences	87.5% of turns <400 vph within 50 vph	No (60%)	No (64%)	No (52%)	-
		87.5% of turns 400-2000 vph within 12.5%	No (46%)	No (63%)	No (52%)	
		87.5% of turns >2,000 vph within 250 vph	-	-	-	
Journey Times	Difference Comparison	87.5% or more of the modelled travel times should fall within 15% (or 1 minute, if 1 minute is greater than 15% of the travel time).	No (5 of 8 or 62.5%)	Yes (8 of 8 or 100%)	Yes (7 of 8 or 87.5%)	85% or more of the modelled travel times should fall within 15%, or 1 minute
	Plots	Distance / Time	Mostly good	Mostly good	All good	

Table 18: Journey Time Comparison – Morning Peak Period – Sensitivity Test

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	450	465	15	2.6%	Yes
Route 2	Southbound	1305	645	-660	-50.6%	No
Route 3	Northbound	465	515	50	9.9%	Yes
Route 4	Southbound	1405	1360	-45	-3.3%	Yes
Route 5	Northbound	285	315	30	9.4%	Yes
Route 6	Southbound	1635	1060	-575	-35.1%	No
Route 7	Northbound	430	420	-10	-1.5%	Yes
Route 8	Southbound	1090	1300	210	19.2%	No

Table 19: Journey Time Comparison - Inter Peak Period – Sensitivity Test

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	345	295	-50	-13.7%	Yes
Route 2	Southbound	380	415	35	9.1%	Yes
Route 3	Northbound	470	475	5	1.7%	Yes
Route 4	Southbound	455	420	-35	-8.2%	Yes
Route 5	Northbound	290	270	-20	-6.9%	Yes
Route 6	Southbound	275	280	5	3.1%	Yes
Route 7	Northbound	335	345	10	2.5%	Yes
Route 8	Southbound	340	390	50	14.5%	Yes

Table 20: Journey Time Comparison – Evening Peak Period – Sensitivity Test

Route Description		Observed Time (seconds)	Modelled Time (seconds)	Difference	Percent Difference	Criteria
Route 1	Northbound	390	450	60	14.5%	Yes
Route 2	Southbound	540	575	35	6.4%	Yes
Route 3	Northbound	745	845	100	13.8%	Yes
Route 4	Southbound	735	725	-10	-1.8%	Yes
Route 5	Northbound	485	610	125	25.1%	No
Route 6	Southbound	435	375	-60	-14.1%	Yes
Route 7	Northbound	675	735	60	8.8%	Yes
Route 8	Southbound	555	625	70	12.7%	Yes

APPENDIX A Traffic Count Locations

Figure A1: Traffic Count Location – Morning Peak

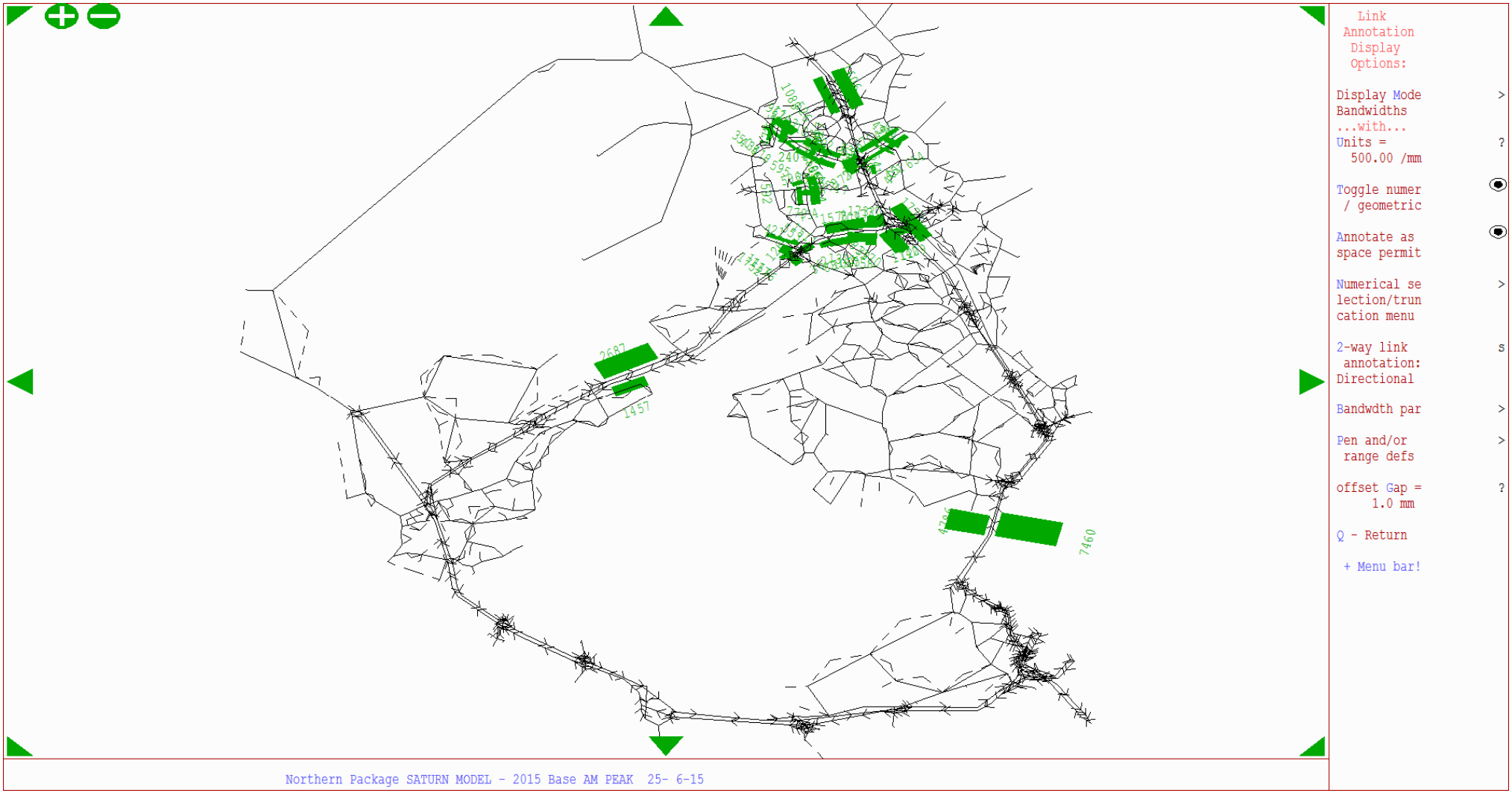


Figure A2: Traffic Count Location – Inter Peak

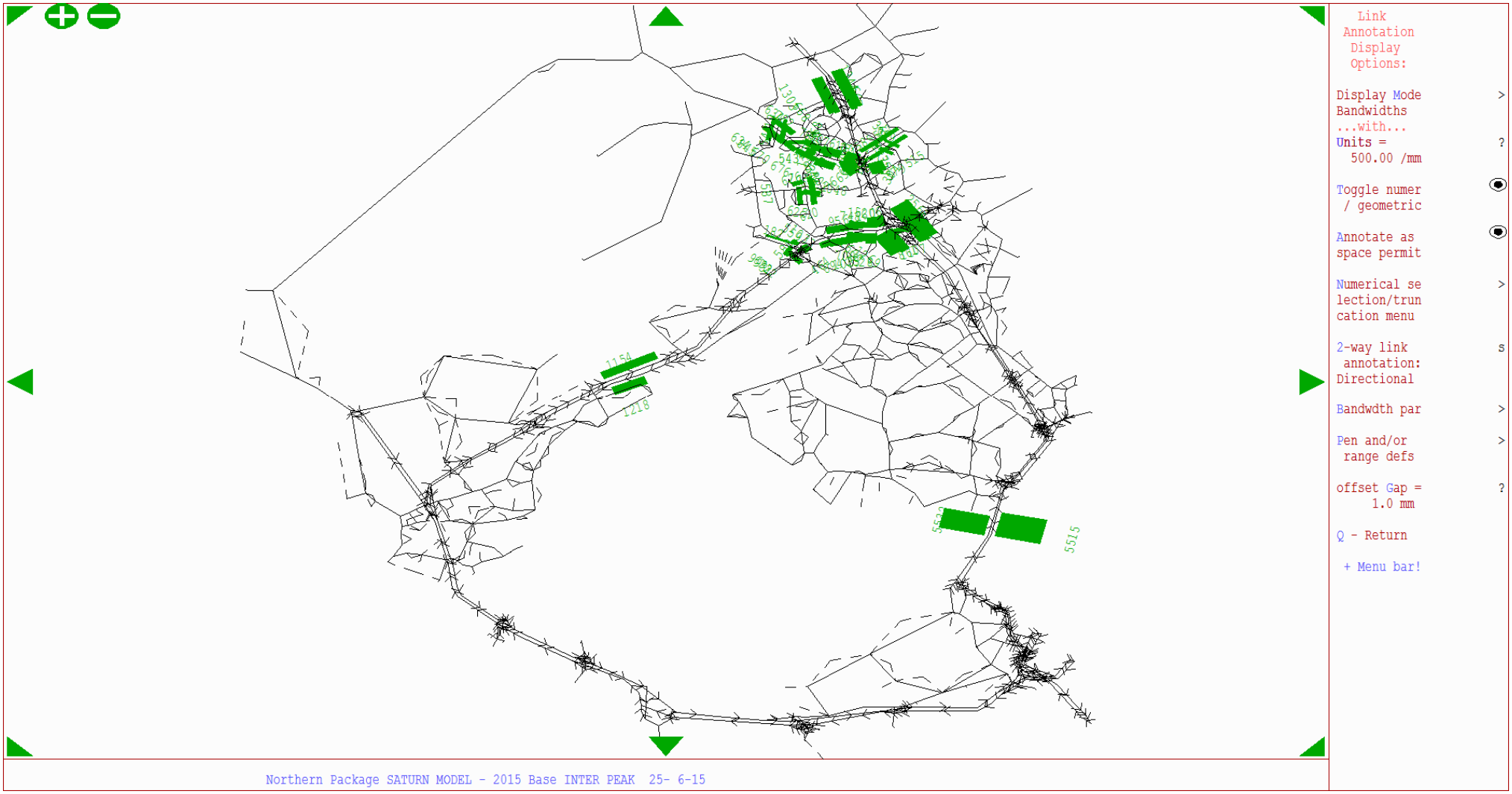
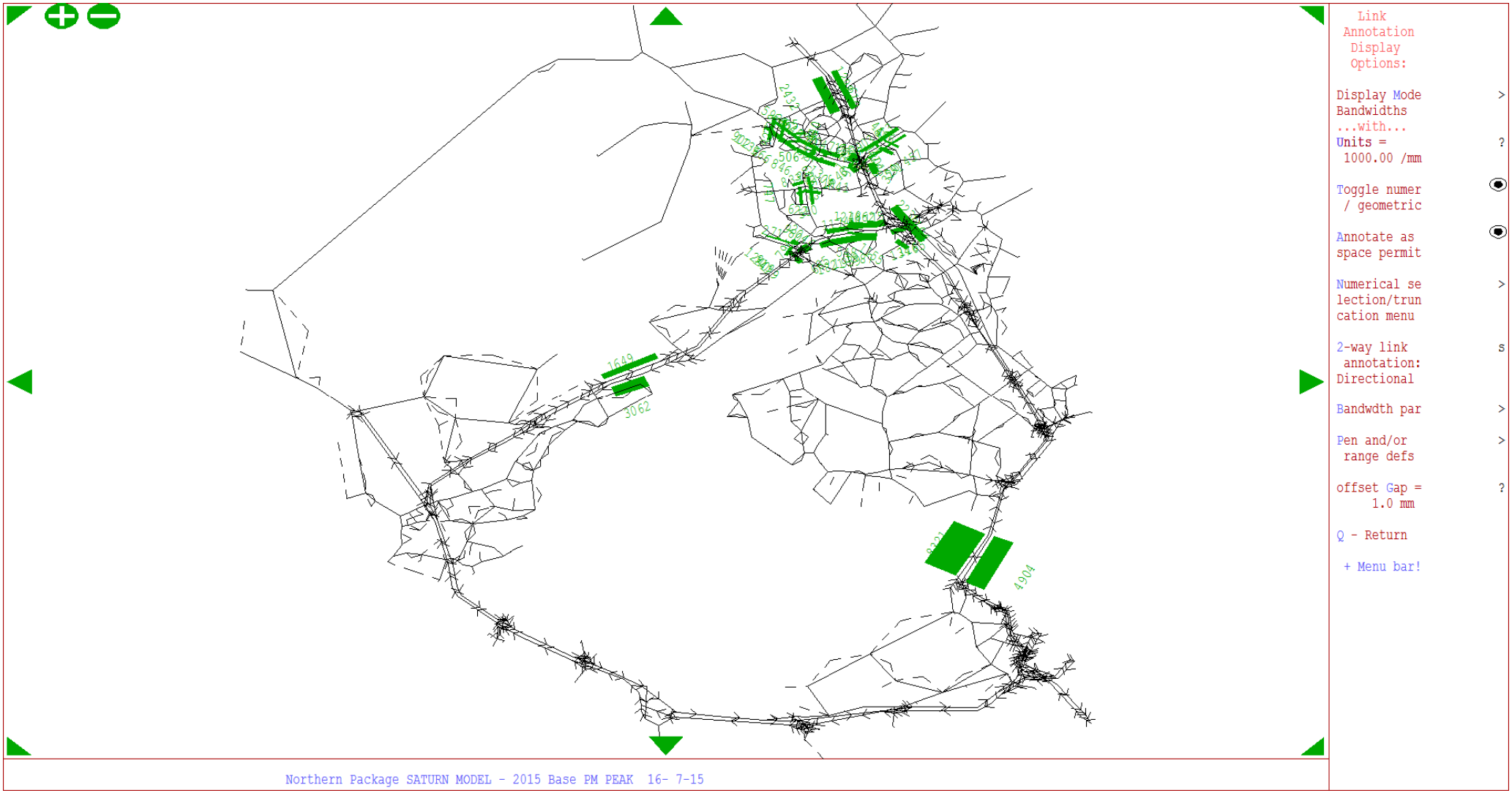


Figure A3: Traffic Count Location – Evening Peak



APPENDIX B Traffic Count GEH Tables

Northern Package SATURN Traffic Model - Link Flow Validation
2015 AM Peak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP NB	1	1306	1024	0	1045	1225	1800	180	1723%	5.34	32400	0
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE EB	2	1305	1024	0	279	260	990	-18	-685%	1.16	361	585837
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 SB	3	961	1024	0	631	693	2725	62	976%	2.39	3844	170900
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD WB	4	960	1024	0	401	527	606	126	3153%	5.87	15876	413964
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 NB	5	1024	961	0	747	956	3600	209	2792%	7.15	43681	88447
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD EB	6	1024	960	0	608	668	1227	60	984%	2.37	3600	190445
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH NB	7	8711	8712	0	276	278	1620	2	89%	0.15	4	590439
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST EB	8	643	8712	0	670	713	2422	43	640%	1.63	1849	140175
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH SB	9	8718	8712	0	435	546	1796	111	2541%	4.99	12321	371368
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST WB	10	1444	8712	0	654	826	1800	172	2631%	6.33	29584	152412
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH SB	11	8712	8711	0	734	679	1250	-54	-756%	2.09	3025	96348
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST WB	12	8712	643	0	451	582	1800	131	2895%	5.75	17161	352124
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH NB	13	8712	8718	0	354	493	1800	139	3913%	6.73	19321	476652
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST EB	14	8712	1444	0	496	610	1800	114	2304%	4.86	12996	300743
SH1/SH18 INTERCHANGE WEST INTERSECTION UNDERPASS WB	15	1702	1701	0	1142	1072	2098	-69	-609%	2.09	4900	9526
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST WB	16	1711	1702	0	1209	1211	1551	-15	-134%	0.47	4	27093
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST EB	17	1712	1710	0	1732	1791	2718	59	343%	1.41	3481	472794
SH1/SH18 INTERCHANGE WEST INTERSECTION SH18 TH	18	1710	1701	0	1730	1846	1839	116	670%	2.74	13456	470047
SH18 WEST OF PAUL MATHEWS RD EB	19	8705	1712	0	1578	1694	2332	116	737%	2.87	13456	284729
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE SB	20	2587	1712	0	709	840	1201	131	1854%	4.72	17161	112493
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST WB	21	1710	1712	0	1758	1646	3000	-111	-637%	2.72	12544	509225
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST WB	22	1712	8705	0	1005	1100	1700	95	950%	2.94	9025	1552
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE NB	23	1712	2587	0	1311	1289	1700	-21	-169%	0.61	484	71076
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH NB	24	1563	947	0	1176	1411	2280	235	1994%	6.52	55225	17319
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION OVERBRIDGE NB	25	947	7600	0	1119	1174	1879	55	487%	1.61	3025	5565
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP EB	26	7601	7600	0	1264	1348	1706	84	667%	2.33	7056	48224
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION OVERBRIDGE SB	27	7600	947	0	1511	1537	1522	26	174%	0.67	676	217716
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH NB	28	7600	1051	0	1752	1977	3238	225	1282%	5.20	50625	500698
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION SCHNAPPER ROACK ROAD EB	29	1075	1051	0	421	663	523	65	1555%	3.07	58564	388628
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH SB	30	893	1051	0	553	629	1970	76	1379%	3.14	5776	241474
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD WB	31	1056	1051	0	362	379	1329	17	482%	0.91	289	465670
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD NB	32	861	1414	0	541	768	1364	227	4193%	8.87	51529	253412
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST EB	33	1059	1414	0	1019	908	2123	-110	-1085%	3.56	12321	645
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY SB	34	2562	1414	0	477	638	1278	161	3378%	6.82	25921	321943
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST WB	35	1413	1414	0	754	956	1913	202	2673%	6.89	40804	84332
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD SB	36	1414	861	0	972	1119	1777	147	1513%	4.55	21609	5242
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST WB	37	1414	1059	0	595	633	2795	38	632%	1.52	1444	201960
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY NB	38	1414	2562	0	532	801	3200	269	5052%	10.41	72361	262554
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST EB	39	1414	1413	0	692	724	1700	32	468%	1.22	1024	124186
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH NB	40	2214	1027	0	592	717	1500	125	2103%	4.87	15625	204666
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST EB	41	1720	1027	0	596	671	913	75	1261%	2.99	5625	201063
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH SB	42	645	1027	0	1053	1214	2128	161	1525%	4.77	25921	74
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST WB	43	8402	1027	0	779	909	1700	130	1663%	4.46	16900	70437
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH SB	44	1027	2214	0	1054	1041	1500	-12	-126%	0.41	169	92
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST WB	45	1027	1720	0	734	912	1500	178	2426%	6.21	31684	96348
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH NB	46	1359	1022	0	477	585	2013	108	2260%	4.68	11664	321943
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY EB	47	1358	1022	0	967	1085	2365	118	1221%	3.69	13924	5991
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD SB	48	887	1022	0	827	836	1751	9	110%	0.32	81	47263
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 WB	49	8703	1022	0	435	517	2706	82	1874%	3.74	6724	371368
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH SB	50	1022	1359	0	859	1056	2318	197	2291%	6.36	38809	34373
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY WB	51	1022	1358	0	350	413	3542	63	1795%	3.22	3969	482191
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD NB	52	1022	887	0	355	346	5300	-8	-260%	0.49	81	475272
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 EB	53	1022	8703	0	1143	1209	3200	66	577%	1.92	4356	9722
SH17/COLISEUM DRIVE INTERSECTION COLISEUM DRIVE SB	54	9	8703	0	240	201	1236	-38	-1607%	2.60	1521	647059
SH17/MASSEY ENTRANCE INTERSECTIN SH17 WEST WB	55	1059	8703	0	418	554	3200	136	3252%	6.17	18496	392377
SH18 UPPER HARBOUR BRIDGE EB	56	4052	7624	0	2687	2814	6000	127	471%	2.41	16129	2698135
SH18 UPPER HARBOUR BRIDGE WB	57	883	3501	0	1457	1884	4000	427	2927%	10.44	182329	170239
SH18 WEST OF UNSWORTH DR WB	58	8705	1700	0	881	1043	3000	162	1837%	5.22	26244	26700
SH1 OTEHA VALLEY RD OFF RAMP NB (N10	59	2068	2069	0	526	711	1800	185	3510%	7.43	34225	268739
SH1 OTEHA VALLEY RD ON RAMP SB (N10	60	8023	2055	0	453	720	1650	267	5888%	11.02	71289	349754
SH1 UPPER HARBOUR HWY OFF RAMP NB (N8	61	1041	8742	0	1170	989	1800	-180	-1550%	5.52	32761	15775
SH1 UPPER HARBOUR HWY ON RAMP SB (N8	62	8026	1040	0	706	809	1650	103	1455%	3.73	10609	114515
SH1 UPPER HARBOUR HWY INTERCHANGE NB (N8	63	1041	4104	0	1839	1879	6100	40	218%	0.93	1600	631389
SH1 UPPER HARBOUR HWY INTERCHANGE SB (N8	64	1151	1040	0	1778	1709	3600	-68	-387%	1.65	4761	538169
SH1 OTEHA VALLEY RD INTERCHANGE NB (N10	65	2068	2090	0	1088	1145	4100	57	523%	1.70	3249	1901
SH1 GREVILLE RD ON RAMP SB (N9	66	3335	1307	0	541	491	2000	-49	-926%	2.21	2500	253412
SH1 GREVILLE RD INTERCHANGE NB (N9	67	8727	2051	0	1556	1774	4100	218	1402%	5.35	47524	261735
SH1 OTEHA VALLEY RD INTERCHANGE SB (N10	68	2089	2055	0	1606	1615	4100	9	55%	0.22	81	315395
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - SB	69	371	440	0	7460	7514	9500	54	72%	0.62	2916	41159923
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - NB	70	466	333	0	4786	5080	5700	294	614%	4.18	86436	13999571

Results Summary	Total	%		Target
GEH <5	49	70%		58
GEH <7.5	66	94%		61
GEH <10	67	96%		65
GEH >12	0	0%		
Total	**70**			
Average Count	1044			
Sum Count	73193543			
Sum Diff	1396985			
R Squared	**0.981**			
Total no. of Counts	70		161	
Summation Observed Flows	73108		105486	
Summation (Modelled Flows - Observed Flows)^2	1396985		2401937	
% RMSE	**14**		**18.7**	

Northern Package SATURN Traffic Model - Turning Flow Validation
2015 AM Peak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP LT	1	1306	1024	1305	353	273	848	-79	-2269%	4.53	6400	7.85
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP TH	2	1306	1024	961	524	611	847	87	1664%	3.66	7569	28290.50
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP RT	3	1306	1024	960	168	341	776	173	10296%	10.84	29929	35269.67
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE LT	4	1305	1024	961	108	112	383	4	406%	0.42	16	61405.93
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE TH	5	1305	1024	960	108	62	296	-45	-4286%	5.02	2116	61405.93
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE RT	6	1305	1024	2050	64	86	311	22	3404%	2.52	484	85148.52
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 LT	7	961	1024	960	332	265	1447	-66	-2013%	3.87	4489	566.54
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 TH	8	961	1024	2050	11	2	424	-8	-7734%	3.28	81	118888.56
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 RT	9	961	1024	1305	289	425	854	136	4704%	7.19	18496	4462.53
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH LT	10	8711	8712	643	71	29	1149	-41	-5875%	5.89	1764	81112.29
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH TH	11	8711	8712	8718	164	181	235	17	1033%	1.29	289	36788.08
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH RT	12	8711	8712	1444	40	68	235	28	7058%	3.84	784	99731.03
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST LT	13	643	8712	8718	67	104	1124	37	5593%	4.05	1369	83406.71
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST TH	14	643	8712	1444	352	344	1026	-7	-226%	0.43	64	14.46
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST RT	15	643	8712	8711	251	264	271	13	532%	0.83	169	10983.50
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH LT	16	8718	8712	1444	104	198	1217	94	9039%	7.65	8836	63404.35
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH TH	17	8718	8712	8711	271	271	289	0	-11%	0.02	0	7191.41
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH RT	18	8718	8712	643	60	77	289	17	2802%	2.03	289	87498.94
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST LT	19	1444	8712	8711	212	143	997	-68	-3233%	5.14	4761	20679.07
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST TH	20	1444	8712	643	320	475	1026	155	4859%	7.80	24025	1281.80
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST RT	21	1444	8712	8718	123	207	271	84	6838%	6.55	7056	54196.86
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH1 NORTHBOUND OFF RAMP RT	22	8742	1701	1702	410	515	698	105	2554%	4.87	11025	2937.40
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH18 TH	23	1710	1701	1702	1074	1016	1016	-57	-538%	1.79	3364	515808.08
SH1/SH18 INTERCHANGE EAST INTERSECTION SH1 SOUTHBOUND OFF RAMP RT	24	1117	1702	1701	140	277	537	137	9770%	9.47	18769	46570.59
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST LT	25	1711	1702	8050	642	415	761	-226	-3534%	9.87	51529	81909.18
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST TH	26	1711	1702	1701	568	778	790	210	3692%	8.08	44100	45027.91
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON CARRIBEAN DRIVE RT	27	724	1710	1701	348	378	392	30	863%	1.58	900	60.87
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST TH	28	1712	1710	1701	1383	1468	2245	85	614%	2.25	7225	1055135.32
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST RT	29	1712	1710	724	349	323	473	-25	-733%	1.39	676	46.27
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 EAST TH	30	1701	1710	1712	1271	1086	1163	-184	-1456%	5.39	34225	837587.02
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST LT	31	8705	1712	2587	346	487	1052	141	4088%	6.93	19881	96.08
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST TH	32	8705	1712	1710	1231	1207	1280	-23	-197%	0.69	576	765971.19
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE LT	33	2587	1712	1710	498	585	916	87	1738%	3.72	7569	20220.21
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE RT	34	2587	1712	8705	211	256	284	45	2127%	2.94	2025	20967.68
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST TH	35	1710	1712	8705	793	845	2000	52	650%	1.80	2704	191141.92
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST RT	36	1710	1712	2587	965	801	1024	-163	-1695%	5.50	26896	371121.96
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH LT	37	631	1049	890	138	91	1529	-46	-3401%	4.39	2209	47437.80
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH TH	38	610	1049	1563	976	1222	1393	246	2520%	7.42	60516	384645.31
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE LT	39	890	1049	1563	200	201	716	1	28%	0.04	1	24274.32
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE RT	40	890	1049	610	352	381	409	29	831%	1.53	841	14.46
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH RT	41	1563	1049	890	73	70	221	-2	-441%	0.38	9	79977.08
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION ALBANY HWY STH TH	42	1563	947	7600	920	1055	1269	135	1472%	4.31	18225	318319.16
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION WESTBOUND OFF RAMP RT	43	7603	947	7600	199	118	645	-80	-4064%	6.42	6561	24586.93
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP LT	44	7601	7600	1051	697	813	829	116	1664%	4.22	13456	116415.94
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP RT	45	7601	7600	947	567	546	877	-20	-378%	0.91	441	44604.51
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION ALBANY HWY NORTH TH	46	1051	7600	947	944	992	1055	48	506%	1.54	2304	345976.65
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH LT	47	7600	1051	1075	175	199	1469	24	1383%	1.77	576	32689.43
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH TH	48	7600	1051	893	828	1002	1002	174	2095%	5.74	30276	222970.76
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH RT	49	7600	1051	1056	750	767	767	17	226%	0.61	289	155391.91
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH LT	50	893	1051	1056	46	117	930	71	15400%	7.85	5041	95977.40
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH TH	51	893	1051	7600	500	512	758	12	249%	0.55	144	20793.01
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH RT	52	893	1051	1075	8	0	282	-7	-10000%	4.00	64	120966.37
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD LT	53	1056	1051	7600	332	337	1024	5	148%	0.27	25	566.54
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD LT	54	861	1414	1059	191	290	862	99	5165%	6.36	9801	27159.76
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD TH	55	861	1414	2562	242	349	360	107	4407%	6.21	11449	12950.94
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD RT	56	861	1414	1413	108	130	143	22	1995%	1.98	484	61405.93
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST LT	57	1059	1414	2562	41	93	603	52	12801%	6.40	2704	99100.42
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST TH	58	1059	1414	1413	532	391	1423	-140	-2654%	6.57	19881	31045.67
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST RT	59	1059	1414	861	446	425	425	-20	-471%	1.01	441	8135.64
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY LT	60	2562	1414	1413	52	204	776	152	29243%	13.44	23104	92295.78
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY TH	61	2562	1414	861	372	360	360	-11	-333%	0.65	144	262.37
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY RT	62	2562	1414	1059	53	81	143	28	5189%	3.37	784	91689.17
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST LT	63	1413	1414	861	154	334	540	180	11717%	11.55	32400	40724.13
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST TH	64	1413	1414	1059	350	262	961	-87	-2501%	5.00	7744	33.67
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST RT	65	1413	1414	2562	249	359	413	110	4404%	6.29	12100	11406.71
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH LT	66	2214	1027	1720	85	0	756	-84	-9991%	13.02	7225	73333.83
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH TH	67	2214	1027	645	313	464	495	151	4828%	7.67	22801	1832.03
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH RT	68	2214	1027	8402	194	248	318	54	2804%	3.66	2916	26179.95
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST RT	69	1720	1027	2214	80	1	205	-78	-9821%	12.31	6241	76066.85
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH LT	70	645	1027	8402	139	119	822	-19	-1448%	1.77	400	47003.19
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH TH	71	645	1027	2214	628	785	989	157	2498%	5.90	24649	74091.64
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH RT	72	645	1027	1720	286	310	318	24	833%	1.38	576	4872.35
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST LT	73	8402	1027	2214	346	250	907	-95	-2762%	5.53	9216	96.08
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST TH	74	8402	1027	1720	363	602	712	239	6590%	10.89	57121	51.81
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST RT	75	8402	1027	645	70	56	205	-13	-2018%	1.78	196	81682.90
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH LT	76	1359	1022	1358	95	160	1215	65	6839%	5.75	4225	68017.79
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH TH	77	1359	1022	887	261	293	621	32	1222%	1.92	1024	8987.46
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH RT	78	1359	1022	8703	122	132	176	10	814%	0.88	100	54663.47
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY LT	79	1358	1022	887	32	6	1205	-25	-8198%	6.04	676	104847.86
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY TH	80	1358	1022	8703	708	809	887	101	1431%	3.68	10201	124043.29
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY RT	81	1358	1022	1359	227	271	273	44	1927%	2.77	1936	16590.01
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD LT	82	887	1022	8703	313	268	953	-44	-1448%	2.66	2025	1832.03
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD TH	83	887	1022	1359	484	515	621	31	634%	1.37	961	16434.68
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD RT	84	887	1022	1358	30	54	176	24	7926%	3.67	576	106147.07
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 LT	85	8703	1022	1359	147	270	960	123	8392%	8.54	15129	43598.36
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 TH	86	8703	1022	1358	225	199	1353	-25	-1152%	1.78	676	17109.21
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 RT	87	8703	1022	887	62	47	393	-14	-2403%	2.02	225	86319.73
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION SH1 NB OFF RAMP RT	88	2069	2070	2000	279	317	560	38	1378%	2.23	1444	5898.58
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION OTEHA VALLEY ROAD WEST TH	89	202	2070	2000	301	216	491	-84	-2816%	5.27	7225	3003.28
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION SH1 SB OFF RAMP RT	90	2089	2000	2070	862	444	865	-417	-4853%	16.37	174724	256236.21
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION OTEHA VALLEY ROAD EAST TH	91	876	2000	2070	1010	810	1178	-199	-1980%	6.63	40000	427974.76

Results Summary	Total	%	Target
GEH <5	55	60%	75
GEH <7.5	76	84%	80
GEH <10	84	92%	84
GEH >12	4	4%	
Total	**91**		
Average Count	356		
Sum Count	9135068		
Sum Diff	1004952		
R Squared	**0.890**		
Total no. of Counts	91		
Summation Observed Flows	32378		
Summation (Modelled Flows - Observed Flows)^2	1004952		
% RMSE	**30**		

Northern Package SATURN Traffic Model - Link Flow Validation
2015 Interpeak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP NB	1	1306	1024	0	1307	1395	1800	88	673%	2.39	7744	79572
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE EB	2	1305	1024	0	643	551	1260	-91	-1435%	3.78	8464	145859
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 SB	3	961	1024	0	1032	1070	2754	38	371%	1.18	1444	50
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD WB	4	960	1024	0	304	148	689	-155	-5130%	10.37	24336	519719
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 NB	5	1024	961	0	1048	969	3600	-78	-751%	2.48	6241	533
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD EB	6	1024	960	0	1409	1485	1990	76	540%	2.00	5776	147521
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH NB	7	8711	8712	0	426	594	2138	168	3954%	7.46	28224	358700
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST EB	8	643	8712	0	585	493	1963	-91	-1567%	3.95	8464	193526
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH SB	9	8718	8712	0	365	355	1780	-9	-269%	0.52	100	435488
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST WB	10	1444	8712	0	515	441	1800	-73	-1442%	3.40	5476	260014
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH SB	11	8712	8711	0	389	418	1250	29	754%	1.46	841	404389
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST WB	12	8712	643	0	579	484	1800	-94	-1640%	4.12	9025	198841
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH NB	13	8712	8718	0	393	538	1800	145	3696%	6.73	21025	399317
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST EB	14	8712	1444	0	531	443	1800	-87	-1655%	3.98	7744	243953
SH1/SH18 INTERCHANGE WEST INTERSECTION UNDERPASS WB	15	1702	1701	0	861	974	1487	113	1311%	3.73	12769	26868
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST WB	16	1711	1702	0	1107	964	1731	-142	-1294%	4.45	20449	6738
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST EB	17	1712	1710	0	1520	1580	2418	60	392%	1.52	3600	245109
SH1/SH18 INTERCHANGE WEST INTERSECTION SH18 TH	18	1710	1701	0	1606	1749	2560	143	888%	3.48	20449	337659
SH18 WEST OF PAUL MATHEWS RD EB	19	8705	1712	0	956	867	2504	-88	-929%	2.94	7921	4749
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE SB	20	2587	1712	0	748	911	1235	163	2177%	5.65	26569	76682
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST WB	21	1710	1712	0	1528	1449	3023	-78	-519%	2.06	6241	253094
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST WB	22	1712	8705	0	1033	1029	1700	-3	-37%	0.12	16	65
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE NB	23	1712	2587	0	700	618	1700	-81	-1173%	3.20	6724	105570
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH NB	24	1563	947	0	732	744	2120	12	163%	0.44	144	85799
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION OVERBRIDGE NB	25	947	7600	0	692	632	1998	-59	-862%	2.32	3600	110833
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP EB	26	7601	7600	0	580	859	1506	279	4810%	10.40	77841	197950
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION OVERBRIDGE SB	27	7600	947	0	1033	1154	1218	121	1171%	3.66	14641	65
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH NB	28	7600	1051	0	993	1252	2796	259	2603%	7.72	67081	1019
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION SCHNAPPER ROACK ROAD EB	29	1075	1051	0	182	459	493	78	4308%	5.27	76729	710507
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH SB	30	893	1051	0	559	477	2259	-81	-1469%	3.61	6724	217077
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD WB	31	1056	1051	0	464	510	1452	46	985%	2.07	2116	314626
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD NB	32	861	1414	0	672	736	1473	64	946%	2.40	4096	124549
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST EB	33	1059	1414	0	781	604	1529	-176	-2268%	6.73	31329	59495
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY SB	34	2562	1414	0	1011	1076	1406	-1	-24%	0.08	4225	194
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST WB	35	1413	1414	0	1063	969	2221	-93	-881%	2.94	8836	1450
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD SB	36	1414	861	0	669	644	1770	-24	-374%	0.98	625	126676
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST WB	37	1414	1059	0	676	454	2922	-221	-3285%	9.34	49284	121742
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY NB	38	1414	2562	0	1106	1213	3200	107	968%	3.14	11449	6575
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST EB	39	1414	1413	0	1076	1007	1700	-68	-646%	2.15	4761	2610
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH NB	40	2214	1027	0	587	588	1250	1	10%	0.02	1	191770
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST EB	41	1720	1027	0	626	589	975	-36	-595%	1.51	1369	159134
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH SB	42	645	1027	0	648	669	1982	21	326%	0.82	441	142065
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST WB	43	8402	1027	0	625	706	1700	81	1293%	3.13	6561	159932
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH SB	44	1027	2214	0	641	573	1250	-67	-1061%	2.76	4624	147391
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST WB	45	1027	1720	0	620	615	1250	-4	-85%	0.21	25	163957
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH NB	46	1359	1022	0	548	558	1696	10	184%	0.43	100	227448
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY EB	47	1358	1022	0	634	675	2716	41	654%	1.62	1681	152815
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD SB	48	887	1022	0	368	417	1507	49	1326%	2.46	2401	431538
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 WB	49	8703	1022	0	845	764	2584	-80	-960%	2.86	6561	32370
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH SB	50	1022	1359	0	570	789	2271	219	3844%	8.41	47961	206948
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY WB	51	1022	1358	0	634	524	3583	-109	-1743%	4.59	12100	152815
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD NB	52	1022	887	0	410	282	5300	-127	-3122%	6.88	16384	378121
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 EB	53	1022	8703	0	782	820	3200	38	481%	1.33	1444	59008
SH17/COLISEUM DRIVE INTERSECTION COLISEUM DRIVE SB	54	9	8703	0	543	536	1829	-6	-125%	0.29	49	232243
SH17/MASSEY ENTRANCE INTERSECTIN SH17 WEST WB	55	1059	8703	0	670	458	3200	-211	-3157%	8.90	44944	125965
SH18 UPPER HARBOUR BRIDGE EB	56	4052	7624	0	1154	1523	6000	369	3198%	10.09	136161	16663
SH18 UPPER HARBOUR BRIDGE WB	57	883	3501	0	1218	1511	4000	293	2405%	7.93	85849	37282
SH18 WEST OF UNSWORTH DR WB	58	8705	1700	0	894	1005	3600	111	1247%	3.62	12321	17139
SH1 OTEHA VALLEY RD OFF RAMP NB (N10	59	2068	2069	0	668	868	1800	200	2995%	7.22	40000	127389
SH1 OTEHA VALLEY RD ON RAMP SB (N10	60	8023	2055	0	667	540	1650	-126	-1909%	5.18	16129	128104
SH1 UPPER HARBOUR HWY OFF RAMP NB (N8	61	1041	8742	0	1269	1134	1800	-134	-1065%	3.90	18225	59577
SH1 UPPER HARBOUR HWY ON RAMP SB (N8	62	8026	1040	0	1325	1338	1650	13	100%	0.36	169	90051
SH1 UPPER HARBOUR HWY INTERCHANGE NB (N8	63	1041	4104	0	2600	2666	6100	66	255%	1.29	4356	2480891
SH1 UPPER HARBOUR HWY INTERCHANGE SB (N8	64	1151	1040	0	2568	2384	4200	-183	-717%	3.70	33856	2381110
SH1 OTEHA VALLEY RD INTERCHANGE NB (N10	65	2068	2090	0	1303	1264	4100	-38	-301%	1.09	1521	77331
SH1 GREVILLE RD ON RAMP SB (N9	66	3335	1307	0	1377	1421	2000	44	322%	1.19	1936	123964
SH1 GREVILLE RD INTERCHANGE NB (N9	67	8727	2051	0	1835	1945	4100	110	598%	2.52	12100	656237
SH1 GREVILLE RD INTERCHANGE SB (N9	68	5207	1307	0	1875	1745	4200	-129	-693%	3.06	16900	722644
SH1 OTEHA VALLEY RD INTERCHANGE SB (N10	69	2089	2055	0	1344	1297	4100	-46	-353%	1.31	2209	101815
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - SB	70	371	440	0	5515	5565	8200	50	90%	0.67	2500	20160859
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - NB	71	466	333	0	5532	5876	8200	344	622%	4.56	118336	20313811

Results Summary	Total	%		Target
GEH <5	55	77%		59
GEH <7.5	63	89%		62
GEH <10	69	97%		66
GEH >12	0	0%		
Total	**71**			
Average Count	1025			
Sum Count	56983565			
Sum Diff	1252337			
R Squared	**0.978**			
Total no. of Counts	71		162	
Summation Observed Flows	72769		101879	
Summation (Modelled Flows - Observed Flows)^2	1252337		1909850	
% RMSE	**13**		**17.3**	

Northern Package SATURN Traffic Model - Turning Flow Validation
2015 Interpeak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP LT	1	1306	1024	1305	338	378	784	40	1197%	2.14	1600	327.97
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP TH	2	1306	1024	961	681	715	1099	34	501%	1.29	1156	130400.35
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP RT	3	1306	1024	960	289	301	568	12	427%	0.72	144	954.20
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE LT	4	1305	1024	961	248	208	527	-39	-1614%	2.65	1600	5168.19
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE TH	5	1305	1024	960	303	225	455	-77	-2585%	4.82	6084	285.28
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE RT	6	1305	1024	2050	93	118	278	25	2698%	2.44	625	51479.12
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 LT	7	961	1024	960	818	959	1579	141	1724%	4.73	19881	248113.46
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 TH	8	961	1024	2050	31	11	549	-19	-6372%	4.30	400	83457.50
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 RT	9	961	1024	1305	183	100	625	-82	-4537%	6.98	6889	18738.90
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH LT	10	8711	8712	643	140	137	1256	-2	-246%	0.29	9	32360.45
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH TH	11	8711	8712	8718	214	353	441	139	6513%	8.28	19321	11212.72
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH RT	12	8711	8712	1444	72	105	441	33	4515%	3.46	1089	61449.51
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST LT	13	643	8712	8718	86	112	1089	26	2999%	2.59	676	54704.58
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST TH	14	643	8712	1444	360	285	586	-74	-2082%	4.17	5625	1608.80
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST RT	15	643	8712	8711	140	96	288	-43	-3108%	4.00	1936	32360.45
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH LT	16	8718	8712	1444	99	54	1243	-44	-4590%	5.20	2025	48792.44
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH TH	17	8718	8712	8711	188	186	269	-1	-129%	0.18	4	17395.00
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH RT	18	8718	8712	643	78	116	269	38	4879%	3.86	1444	58510.83
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST LT	19	1444	8712	8711	61	136	1219	75	12337%	7.58	5625	67024.09
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST TH	20	1444	8712	643	361	231	586	-129	-3590%	7.53	16900	1690.02
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST RT	21	1444	8712	8718	93	73	288	-19	-2145%	2.19	400	51479.12
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH1 NORTHBOUND OFF RAMP RT	22	8742	1701	1702	541	493	603	-47	-896%	2.13	2304	48889.58
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH18 TH	23	1710	1701	1702	1140	1221	1587	81	708%	2.35	6561	672580.23
SH1/SH18 INTERCHANGE EAST INTERSECTION SH1 SOUTHBOUND OFF RAMP RT	24	1117	1702	1701	357	564	666	207	5811%	9.66	42849	1377.14
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST LT	25	1711	1702	8050	603	554	1281	-48	-806%	2.02	2401	80151.21
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST TH	26	1711	1702	1701	505	409	450	-95	-1893%	4.47	9216	34265.67
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON CARRIBEAN DRIVE RT	27	724	1710	1701	249	339	408	90	3603%	5.23	8100	5025.41
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST TH	28	1712	1710	1701	1357	1410	2156	53	390%	1.42	2809	1075596.92
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST RT	29	1712	1710	724	163	170	261	7	412%	0.52	49	24614.51
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 EAST TH	30	1701	1710	1712	1349	1133	1470	-215	-1600%	6.13	46656	1059067.17
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST LT	31	8705	1712	2587	87	27	1151	-59	-6946%	8.02	3600	54237.80
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST TH	32	8705	1712	1710	869	841	1353	-27	-326%	0.97	784	301521.67
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE LT	33	2587	1712	1710	630	739	1021	109	1731%	4.17	11881	96168.14
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE RT	34	2587	1712	8705	118	172	215	54	4561%	4.47	2916	40759.62
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST TH	35	1710	1712	8705	915	857	2000	-57	-630%	1.94	3364	354155.78
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST RT	36	1710	1712	2587	612	591	1023	-20	-337%	0.84	441	85328.19
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH LT	37	631	1049	890	95	101	1510	6	632%	0.61	36	50575.56
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH TH	38	610	1049	1563	673	671	1089	-1	-24%	0.06	4	124686.59
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE LT	39	890	1049	1563	59	73	985	14	2307%	1.68	196	68063.65
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE RT	40	890	1049	610	76	93	388	17	2188%	1.81	289	59482.39
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH RT	41	1563	1049	890	59	89	305	30	5009%	3.44	900	68063.65
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION ALBANY HWY STH TH	42	1563	947	7600	511	504	1024	-6	-142%	0.32	49	36522.99
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION WESTBOUND OFF RAMP RT	43	7603	947	7600	180	129	765	-50	-2854%	4.14	2601	19569.24
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP LT	44	7601	7600	1051	382	623	942	241	6299%	10.74	58081	3857.64
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP RT	45	7601	7600	947	198	236	563	38	1939%	2.60	1444	14857.20
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION ALBANY HWY NORTH TH	46	1051	7600	947	835	918	922	83	989%	2.79	6889	265338.20
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH LT	47	7600	1051	1075	168	221	1468	53	3128%	3.77	2809	23070.61
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH TH	48	7600	1051	893	506	560	765	54	1059%	2.32	2916	34636.89
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH RT	49	7600	1051	1056	320	471	563	151	4731%	7.61	22801	0.01
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH LT	50	893	1051	1056	45	77	1213	32	7165%	4.12	1024	75564.57
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH TH	51	893	1051	7600	504	400	765	-103	-2070%	4.91	10816	33896.45
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH RT	52	893	1051	1075	9	0	281	-8	-10000%	4.24	81	96652.66
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD LT	53	1056	1051	7600	416	467	1137	51	1227%	2.43	2601	9237.11
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD LT	54	861	1414	1059	156	185	870	29	1859%	2.22	841	26859.97
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD TH	55	861	1414	2562	404	399	417	-4	-130%	0.26	25	7074.47
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD RT	56	861	1414	1413	112	152	186	40	3556%	3.47	1600	43218.30
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST LT	57	1059	1414	2562	116	128	482	12	992%	1.04	144	41571.18
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST TH	58	1059	1414	1413	468	281	794	-186	-4000%	9.68	34969	21936.54
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST RT	59	1059	1414	861	197	196	400	0	-71%	0.10	1	15101.98
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY LT	60	2562	1414	1413	495	574	804	79	1594%	3.41	6241	30663.47
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY TH	61	2562	1414	861	386	359	417	-26	-696%	1.39	729	4370.52
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY RT	62	2562	1414	1059	130	76	186	-53	-4188%	5.37	2916	36058.25
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST LT	63	1413	1414	861	87	89	651	2	254%	0.24	4	54237.80
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST TH	64	1413	1414	1059	390	193	794	-196	-5042%	11.51	38809	4915.40
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST RT	65	1413	1414	2562	586	687	776	101	1719%	3.99	10201	70814.47
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH LT	66	2214	1027	1720	93	4	667	-88	-9518%	12.68	7921	51479.12
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH TH	67	2214	1027	645	297	324	383	27	917%	1.55	729	523.96
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH RT	68	2214	1027	8402	197	259	383	62	3141%	4.10	3844	15101.98
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST RT	69	1720	1027	2214	52	0	128	-51	-9988%	10.18	2704	71765.11
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH LT	70	645	1027	8402	89	128	835	39	4337%	3.71	1521	53310.24
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH TH	71	645	1027	2214	339	316	765	-22	-677%	1.27	529	365.19
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH RT	72	645	1027	1720	221	225	383	4	201%	0.30	16	9779.25
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST LT	73	8402	1027	2214	250	257	1062	7	273%	0.43	49	4884.63
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST TH	74	8402	1027	1720	306	385	855	79	2575%	4.24	6241	192.94
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST RT	75	8402	1027	645	69	64	128	-4	-701%	0.59	25	62945.85
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH LT	76	1359	1022	1358	93	32	1086	-60	-6535%	7.68	3721	51479.12
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH TH	77	1359	1022	887	229	242	280	13	580%	0.86	169	8261.01
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH RT	78	1359	1022	8703	226	284	330	58	2549%	3.61	3364	8815.35
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY LT	79	1358	1022	887	62	5	1245	-56	-9135%	9.76	3249	66507.31
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY TH	80	1358	1022	8703	437	476	1160	39	887%	1.81	1521	13714.73
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY RT	81	1358	1022	1359	136	194	311	58	4289%	4.54	3364	33815.57
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD LT	82	887	1022	8703	119	60	897	-58	-4937%	6.21	3481	40356.84
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD TH	83	887	1022	1359	179	215	280	36	2003%	2.56	1296	19850.02
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD RT	84	887	1022	1358	71	142	330	71	9955%	6.85	5041	61946.29
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 LT	85	8703	1022	1359	256	380	1130	124	4841%	6.95	15376	4081.95
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 TH	86	8703	1022	1358	470	350	1160	-119	-2562%	5.95	14400	22532.98
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 RT	87	8703	1022	887	120	34	293	-85	-7136%	9.75	7396	39956.06
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION SH1 NB OFF RAMP RT	88	2069	2070	2000	467	386	923	-80	-1730%	3.91	6561	21641.32
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION OTEHA VALLEY ROAD WEST TH	89	202	2070	2000	684	403	890	-280	-4105%	12.04	78961	132576.01
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION SH1 SB OFF RAMP RT	90	2089	2000	2070	208	325	431	117	5617%	7.16	13689	12519.40
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION OTEHA VALLEY ROAD EAST TH	91	876	2000	2070	506	348	712	-157	-3121%	7.64	24964	34636.89

Results Summary	Total	%
GEH <5	65	71%
GEH <7.5	75	82%
GEH <10	86	95%
GEH >12	2	2%
Total	**91**	
Average Count	320	
Sum Count	7095189	
Sum Diff	657513	
R Squared	**0.907**	
Total no. of Counts	91	
Summation Observed Flows	29110	
Summation (Modelled Flows - Observed Flows)^2	657513	
% RMSE	**27**	

Target
75
80
84

Northern Package SATURN Traffic Model - Link Flow Validation
2015 PM Peak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP NB	1	1306	1024	0	1309	1475	1800	166	1271%	4.46	27556	11376
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE EB	2	1305	1024	0	917	1012	1895	95	1031%	3.04	9025	81421
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 SB	3	961	1024	0	1166	1199	2536	33	280%	0.95	1089	1321
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD WB	4	960	1024	0	320	186	897	-133	-4179%	8.40	17956	778529
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 NB	5	1024	961	0	1041	1219	3600	178	1712%	5.30	31684	26032
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION GREVILLE ROAD EB	6	1024	960	0	1732	1905	1826	173	1001%	4.06	29929	280537
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH NB	7	8711	8712	0	800	712	1882	-87	-1101%	3.20	7744	161880
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST EB	8	643	8712	0	903	1018	2129	115	1277%	3.72	13225	89606
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH SB	9	8718	8712	0	449	336	1892	-112	-2520%	5.71	12769	567525
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST WB	10	1444	8712	0	457	390	1800	-66	-1475%	3.28	4489	555536
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH SB	11	8712	8711	0	496	330	1250	-165	-3355%	8.19	27556	498920
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST WB	12	8712	643	0	591	485	1800	-105	-1792%	4.57	11236	373740
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH NB	13	8712	8718	0	608	617	1800	9	147%	0.36	81	353243
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST EB	14	8712	1444	0	913	1024	1800	111	1216%	3.57	12321	83719
SH1/SH18 INTERCHANGE WEST INTERSECTION UNDERPASS WB	15	1702	1701	0	1346	1613	2010	267	1984%	6.94	71289	20637
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST WB	16	1711	1702	0	1165	1179	1125	14	124%	0.42	196	1394
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST EB	17	1712	1710	0	1862	2095	2778	233	1250%	5.23	54289	435148
SH1/SH18 INTERCHANGE WEST INTERSECTION SH18 TH	18	1710	1701	0	1775	2125	2197	350	1974%	7.94	122500	327936
SH18 WEST OF PAUL MATHEWS RD EB	19	8705	1712	0	1174	1103	2256	-70	-604%	2.10	5041	803
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE SB	20	2587	1712	0	1240	1407	1399	167	1345%	4.59	27889	1418
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST WB	21	1710	1712	0	1987	1837	2990	-149	-756%	3.43	22500	615687
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST WB	22	1712	8705	0	1939	1728	1700	-210	-1089%	4.93	44521	542664
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE NB	23	1712	2587	0	548	513	1700	-34	-640%	1.52	1225	428165
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH NB	24	1563	947	0	1419	1307	1894	-111	-788%	3.03	12544	46940
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION OVERBRIDGE NB	25	947	7600	0	919	690	1651	-228	-2493%	8.08	52441	80283
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP EB	26	7601	7600	0	796	954	1586	158	1986%	5.34	24964	165115
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION OVERBRIDGE SB	27	7600	947	0	2046	2065	2031	19	91%	0.41	361	711757
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH NB	28	7600	1051	0	1240	1099	3424	-140	-1134%	4.11	19881	1418
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION SCHNAPPER ROACK ROAD EB	29	1075	1051	0	271	490	227	-39	-1483%	2.54	47961	867400
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH SB	30	893	1051	0	980	1065	2601	85	864%	2.65	7225	49436
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD WB	31	1056	1051	0	685	725	815	40	586%	1.51	1600	267644
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD NB	32	861	1414	0	965	907	1468	-57	-596%	1.88	3364	56332
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST EB	33	1059	1414	0	750	672	1559	-77	-1044%	2.94	6084	204614
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY SB	34	2562	1414	0	844	1088	1507	202	2395%	6.57	59536	128410
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST WB	35	1413	1414	0	972	1219	2016	247	2543%	7.47	61009	53058
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD SB	36	1414	861	0	640	804	1728	164	2569%	6.12	26896	316229
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST WB	37	1414	1059	0	846	1012	2860	166	1964%	5.45	27556	126980
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY NB	38	1414	2562	0	998	1010	3200	12	119%	0.38	144	41756
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST EB	39	1414	1413	0	1047	1020	1700	-26	-261%	0.85	729	24131
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH NB	40	2214	1027	0	747	801	1248	54	717%	1.93	2916	207337
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST EB	41	1720	1027	0	833	873	1002	40	480%	1.37	1600	136414
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH SB	42	645	1027	0	603	663	1935	60	992%	2.38	3600	359212
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST WB	43	8402	1027	0	622	672	1700	50	803%	1.96	2500	336798
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH SB	44	1027	2214	0	593	632	1250	39	665%	1.59	1521	371299
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST WB	45	1027	1720	0	580	599	1250	19	330%	0.79	361	387311
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH NB	46	1359	1022	0	827	730	1655	-96	-1173%	3.48	9409	140882
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY EB	47	1358	1022	0	593	524	3038	-68	-1156%	2.90	4761	371299
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD SB	48	887	1022	0	440	467	1707	27	608%	1.26	729	581167
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 WB	49	8703	1022	0	1136	1264	2493	128	1129%	3.70	16384	4401
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH SB	50	1022	1359	0	706	894	2072	188	2666%	6.65	35344	246356
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY WB	51	1022	1358	0	902	935	3594	33	366%	1.09	1089	90206
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD NB	52	1022	887	0	722	588	5300	-133	-1858%	5.24	17956	230729
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 EB	53	1022	8703	0	666	571	3200	-94	-1426%	3.82	9025	287664
SH17/COLISEUM DRIVE INTERSECTION COLISEUM DRIVE SB	54	9	8703	0	506	601	1817	95	1871%	4.02	9025	484893
SH17/MASSEY ENTRANCE INTERSECTIN SH17 WEST WB	55	1059	8703	0	966	1072	3200	106	1092%	3.31	11236	55858
SH17/COLISEUM DRIVE INTERSECTION COLISEUM DRIVE NB	56	8703	9	0	355	344	2222	-10	-308%	0.58	121	717990
SH17/MASSEY ENTRANCE INTERSECTIN SH17 WEST EB	57	8703	1059	0	649	635	3022	-13	-217%	0.56	196	306188
SH18 UPPER HARBOUR BRIDGE EB	58	4052	7624	0	1649	1888	6000	239	1448%	5.68	57121	199503
SH18 UPPER HARBOUR BRIDGE WB	59	883	3501	0	3062	2861	4000	-200	-655%	3.69	40401	3458325
SH18 WEST OF UNSWORTH DR WB	60	8705	1700	0	1821	1631	3600	-189	-1046%	4.58	36100	382737
SH1 OTEHA VALLEY RD ON RAMP SB (N10	61	8023	2055	0	610	639	1650	29	470%	1.15	841	350870
SH1 UPPER HARBOUR HWY OFF RAMP NB (N8	62	1041	8742	0	1155	795	1800	-359	-3118%	11.53	129600	2241
SH1 UPPER HARBOUR HWY ON RAMP SB (N8	63	8026	1040	0	1106	1225	1650	119	1073%	3.48	14161	9282
SH1 UPPER HARBOUR HWY INTERCHANGE SB (N8	64	1151	1040	0	2235	2070	4200	-164	-738%	3.56	27225	1066381
SH1 OTEHA VALLEY RD INTERCHANGE NB (N10	65	2068	2090	0	2432	2555	4100	123	506%	2.47	15129	1512057
SH1 GREVILLE RD ON RAMP SB (N9	66	3335	1307	0	1168	1233	2000	65	555%	1.87	4225	1179
SH1 GREVILLE RD INTERCHANGE SB (N9	67	5207	1307	0	1801	1899	4200	98	544%	2.28	9604	358390
SH1 OTEHA VALLEY RD INTERCHANGE SB (N10	68	2089	2055	0	1298	1361	4100	63	485%	1.72	3969	9150
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - SB	69	440	2551	0	4904	5000	5000	96	196%	1.36	9216	13702266
AUCKLAND HARBOUR BRIDGE - CLASSIFIER SITE NO 1 - NB	70	2530	466	0	8321	9301	300	980	1178%	10.44	960400	50675280

Results Summary	Total	%		Target
GEH <5	52	74%		58
GEH <7.5	64	91%		61
GEH <10	68	97%		65
GEH >12	0	0%		
Total	**70**			
Average Count	1202			
Sum Count	86422404			
Sum Diff	2344170			
R Squared	**0.973**			
Total no. of Counts	70		161	
Summation Observed Flows	84164		121060	
Summation (Modelled Flows - Observed Flows)^2	2344170		3569653	
% RMSE	**15**		**19.9**	

Northern Package SATURN Traffic Model - Turning Flow Validation
2015 PM Peak - All Vehicles

DESCRIPTION	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFF	GEH	DIFF SQ	MOD-AVE SQ
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP LT	1	1306	1024	1305	192	227	544	35	1819%	2.41	1225	45561.14
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP TH	2	1306	1024	961	669	833	890	164	2450%	5.98	26896	69458.31
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH1 NB OFF RAMP RT	3	1306	1024	960	449	415	415	-33	-751%	1.62	1156	1896.55
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE LT	4	1305	1024	961	260	331	950	71	2718%	4.11	5041	21155.86
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE TH	5	1305	1024	960	390	500	537	110	2819%	5.21	12100	238.72
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION TAWA DRIVE RT	6	1305	1024	2050	268	181	408	-86	-3248%	5.81	7569	18892.65
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 LT	7	961	1024	960	894	990	1629	96	1075%	3.13	9216	238680.57
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 TH	8	961	1024	2050	105	18	445	-86	-8262%	11.05	7569	90270.53
SH 1 RAMPS/GREVILLE ROAD/TAWA DRIVE/SH17 INTERSECTION SH17 RT	9	961	1024	1305	167	190	461	23	1396%	1.74	529	56858.66
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH LT	10	8711	8712	643	259	210	1306	-48	-1908%	3.23	2401	21447.76
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH TH	11	8711	8712	8718	375	284	288	-90	-2427%	5.01	8281	927.24
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGHGREEN DRIVE SOUTH RT	12	8711	8712	1444	166	218	288	52	3155%	3.78	2704	57336.57
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST LT	13	643	8712	8718	115	251	1157	136	11827%	10.05	18496	84361.52
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST TH	14	643	8712	1444	587	715	837	128	2177%	5.01	16384	32960.20
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD WEST RT	15	643	8712	8711	202	52	134	-149	-7402%	13.26	22500	41392.13
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH LT	16	8718	8712	1444	161	91	971	-69	-4357%	6.25	4900	59756.07
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH TH	17	8718	8712	8711	227	178	460	-48	-2167%	3.46	2401	31844.60
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION HUGH GREEN DRIVE NORTH RT	18	8718	8712	643	61	67	460	6	1016%	0.77	36	118646.18
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST LT	19	1444	8712	8711	67	99	1268	32	4826%	3.55	1024	114548.77
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST TH	20	1444	8712	643	272	208	837	-63	-2341%	4.11	4096	17809.05
GREVILLE ROAD/HUGH GREEN DRIVE INTERSECTION GREVILLE ROAD EAST RT	21	1444	8712	8718	119	82	134	-36	-3117%	3.70	1369	82053.92
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH1 NORTHBOUND OFF RAMP RT	22	8742	1701	1702	397	244	516	-152	-3864%	8.57	23409	71.41
SH16 GREAT NTH RD INTERCHANGE EB (NW2 SH18 TH	23	1710	1701	1702	1124	1257	1289	133	1187%	3.87	17689	516313.31
SH1/SH18 INTERCHANGE EAST INTERSECTION SH1 SOUTHBOUND OFF RAMP RT	24	1117	1702	1701	582	928	928	346	5947%	12.60	119716	31169.71
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST LT	25	1711	1702	8050	402	478	478	76	1894%	3.63	5776	11.91
SH1/SH18 INTERCHANGE EAST INTERSECTION CONSTELLATION EAST TH	26	1711	1702	1701	763	647	647	-115	-1522%	4.37	13456	127841.61
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON CARRIBEAN DRIVE RT	27	724	1710	1701	264	288	289	24	899%	1.43	576	20008.26
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST TH	28	1712	1710	1701	1511	1838	2448	327	2162%	7.98	106929	1222239.59
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 WEST RT	29	1712	1710	724	351	257	330	-93	-2674%	5.38	8836	2964.86
CONSTELLATION DRIVE/CARRIBBEAN DRIVE INTERSECITON SH18 EAST TH	30	1701	1710	1712	1656	1306	1650	-349	-2115%	9.10	122500	1563873.93
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST LT	31	8705	1712	2587	105	8	1156	-96	-9204%	12.84	9409	90270.53
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 WEST TH	32	8705	1712	1710	1069	1095	1100	26	241%	0.78	676	440297.87
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE LT	33	2587	1712	1710	844	1000	1000	156	1848%	5.14	24336	192325.62
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON PAULMATHEWS DRIVE RT	34	2587	1712	8705	395	396	399	1	14%	0.03	1	109.21
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST TH	35	1710	1712	8705	1544	1332	2000	-211	-1371%	5.58	44944	1296294.85
CONSTELLATION DRIVE/PAUL MATHEWS DRIVE INTERSECITON SH18 EAST RT	36	1710	1712	2587	443	505	990	62	1390%	2.83	3844	1409.96
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH LT	37	631	1049	890	306	483	1469	177	5772%	8.90	31329	9890.41
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY SOUTH TH	38	610	1049	1563	1367	1255	1652	-111	-818%	3.09	12544	924577.35
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE LT	39	890	1049	1563	52	62	634	10	1839%	1.27	100	124927.29
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON UPPER HARBOUR DRIVE RT	40	890	1049	610	91	125	131	34	3694%	3.24	1156	98879.15
ALBANY HIGHWAY/UPPER HARBOUR DRIVE INTERSECITON ALBANY HWY NORTH RT	41	1563	1049	890	80	159	296	79	9932%	7.26	6241	105918.06
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION ALBANY HWY STH TH	42	1563	947	7600	714	630	998	-83	-1179%	3.25	7056	95202.76
SH18 ALBANY HIGWAY INTERCHANGE SOUTH INTERSECTION WESTBOUND OFF RAMP RT	43	7603	947	7600	206	60	537	-145	-7084%	12.65	21316	39780.52
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP LT	44	7601	7600	1051	418	413	1004	-4	-120%	0.25	25	157.49
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION EASTBOUND OFF RAMP RT	45	7601	7600	947	378	541	582	163	4314%	7.61	26569	753.53
SH18 ALBANY HIGWAY INTERCHANGE NORTH INTERSECTION ALBANY HWY NORTH TH	46	1051	7600	947	1667	1524	1524	-142	-860%	3.59	20449	1591507.02
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH LT	47	7600	1051	1075	313	284	1427	-28	-911%	1.65	841	8547.10
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH TH	48	7600	1051	893	651	505	1359	-145	-2243%	6.07	21316	60294.53
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY SOUTH RT	49	7600	1051	1056	275	310	637	35	1268%	2.04	1225	17017.35
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH LT	50	893	1051	1056	16	60	1288	44	27726%	7.18	1936	151671.73
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH TH	51	893	1051	7600	956	995	995	39	405%	1.24	1521	303104.70
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION ALBANY HWY NORTH RT	52	893	1051	1075	8	0	319	-7	-9957%	3.97	64	157966.94
ALBANY HIGHWAY/SCHNAPPER ROCK ROAD/BUSH ROAD INTERSECTION BUSH ROAD LT	53	1056	1051	7600	624	561	561	-62	-1014%	2.60	3969	47763.86
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD LT	54	861	1414	1059	276	330	768	54	1941%	3.08	2916	16757.44
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD TH	55	861	1414	2562	466	413	413	-52	-1129%	2.51	2809	3666.24
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION BUSH ROAD RT	56	861	1414	1413	223	166	287	-56	-2547%	4.07	3249	33288.20
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST LT	57	1059	1414	2562	110	145	575	35	3193%	3.11	1225	87291.03
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST TH	58	1059	1414	1413	453	304	868	-148	-3280%	7.63	22201	2260.95
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 WEST RT	59	1059	1414	861	187	222	266	35	1880%	2.46	1225	47720.64
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY LT	60	2562	1414	1413	372	549	807	177	4761%	8.25	31329	1118.94
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY TH	61	2562	1414	861	358	408	413	50	1410%	2.58	2500	2251.55
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION MERCARI WAY RT	62	2562	1414	1059	115	89	287	-25	-2296%	2.62	676	84361.52
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST LT	63	1413	1414	861	96	174	633	78	8104%	6.70	6084	95759.64
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST TH	64	1413	1414	1059	455	594	868	139	3055%	6.07	19321	2455.15
BUSH ROAD/ ALBANY EXPRESSWAY INTERSECTION SH17 EAST RT	65	1413	1414	2562	422	451	516	29	697%	1.41	841	273.88
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH LT	66	2214	1027	1720	82	0	453	-81	-9997%	12.80	6724	104620.26
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH TH	67	2214	1027	645	428	455	455	27	625%	1.27	729	508.48
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD SOUTH RT	68	2214	1027	8402	236	338	340	102	4318%	6.02	10404	28713.49
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD WEST RT	69	1720	1027	2214	63	0	143	-62	-10000%	11.22	3969	117272.38
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH LT	70	645	1027	8402	110	61	685	-48	-4458%	5.30	2401	87291.03
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH TH	71	645	1027	2214	315	383	909	68	2174%	3.66	4624	8181.30
BUSH ROAD/ ROSEDALE ROAD INTERSECTION BUSH ROAD NORTH RT	72	645	1027	1720	178	218	340	40	2269%	2.87	1600	51733.75
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST LT	73	8402	1027	2214	215	245	1036	30	1395%	1.98	900	36271.41
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST TH	74	8402	1027	1720	320	381	909	61	1898%	3.25	3721	7301.80
BUSH ROAD/ ROSEDALE ROAD INTERSECTION ROSEDALE ROAD EAST RT	75	8402	1027	645	86	46	143	-39	-4625%	4.89	1600	102048.65
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH LT	76	1359	1022	1358	141	0	923	-140	-9996%	16.78	19881	69934.09
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH TH	77	1359	1022	887	471	482	482	11	237%	0.51	121	4296.73
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION ALBANY HWY SOUTH RT	78	1359	1022	8703	215	250	250	35	1649%	2.32	1225	36271.41
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY LT	79	1358	1022	887	63	7	1119	-55	-8822%	9.37	3136	117272.38
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY TH	80	1358	1022	8703	370	306	1607	-63	-1734%	3.49	4096	1256.74
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION DAIRY FLAT HWY RT	81	1358	1022	1359	160	211	313	51	3198%	3.76	2601	60245.97
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD LT	82	887	1022	8703	81	15	974	-65	-8181%	9.58	4356	105268.16
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD TH	83	887	1022	1359	251	371	482	120	4794%	6.82	14400	23854.97
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION OTEHA VALLEY ROAD RT	84	887	1022	1358	107	81	250	-25	-2459%	2.72	676	89072.73
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 LT	85	8703	1022	1359	294	312	1060	18	604%	1.02	324	12421.22
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 TH	86	8703	1022	1358	653	854	1286	201	3082%	7.33	40401	61280.73
SH17/ALBANY HWY/OTEHA VALLEY ROAD INTERSECTION SH17 RT	87	8703	1022	887	189	98	147	-90	-4802%	7.57	8281	46850.84
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION SH1 NB OFF RAMP RT	88	2069	2070	2000	862	743	743	-118	-1386%	4.22	14161	208437.40
SH1 OTEHA VALLEY ROAD INTERCHANGE WEST INTERSECTION OTEHA VALLEY ROAD WEST TH	89	202	2070	2000	1168	1086	1086	-81	-699%	2.43	6724	581481.66
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION SH1 SB OFF RAMP RT	90	2089	2000	2070	163	162	589	0	-48%	0.06	1	58782.27
SH1 OTEHA VALLEY ROAD INTERCHANGE EAST INTERSECTION OTEHA VALLEY ROAD EAST TH	91	876	2000	2070	565	167	790	-397	-7040%	20.79	158404	25456.03

Results Summary	Total	%	Target
GEH <5	55	60%	75
GEH <7.5	71	78%	80
GEH <10	82	90%	84
GEH >12	7	8%	
Total	**91**		
Average Count	405		
Sum Count	12872591		
Sum Diff	1225483		
R Squared	**0.905**		
Total no. of Counts	91		
Summation Observed Flows	36896		
Summation (Modelled Flows - Observed Flows)^2	1225483		
% RMSE	**29**		

APPENDIX C Journey Time – Time Distance Plots

Figure C1: Journey Time Distance-Time Plots – Morning Peak Period - Route 1, Northbound

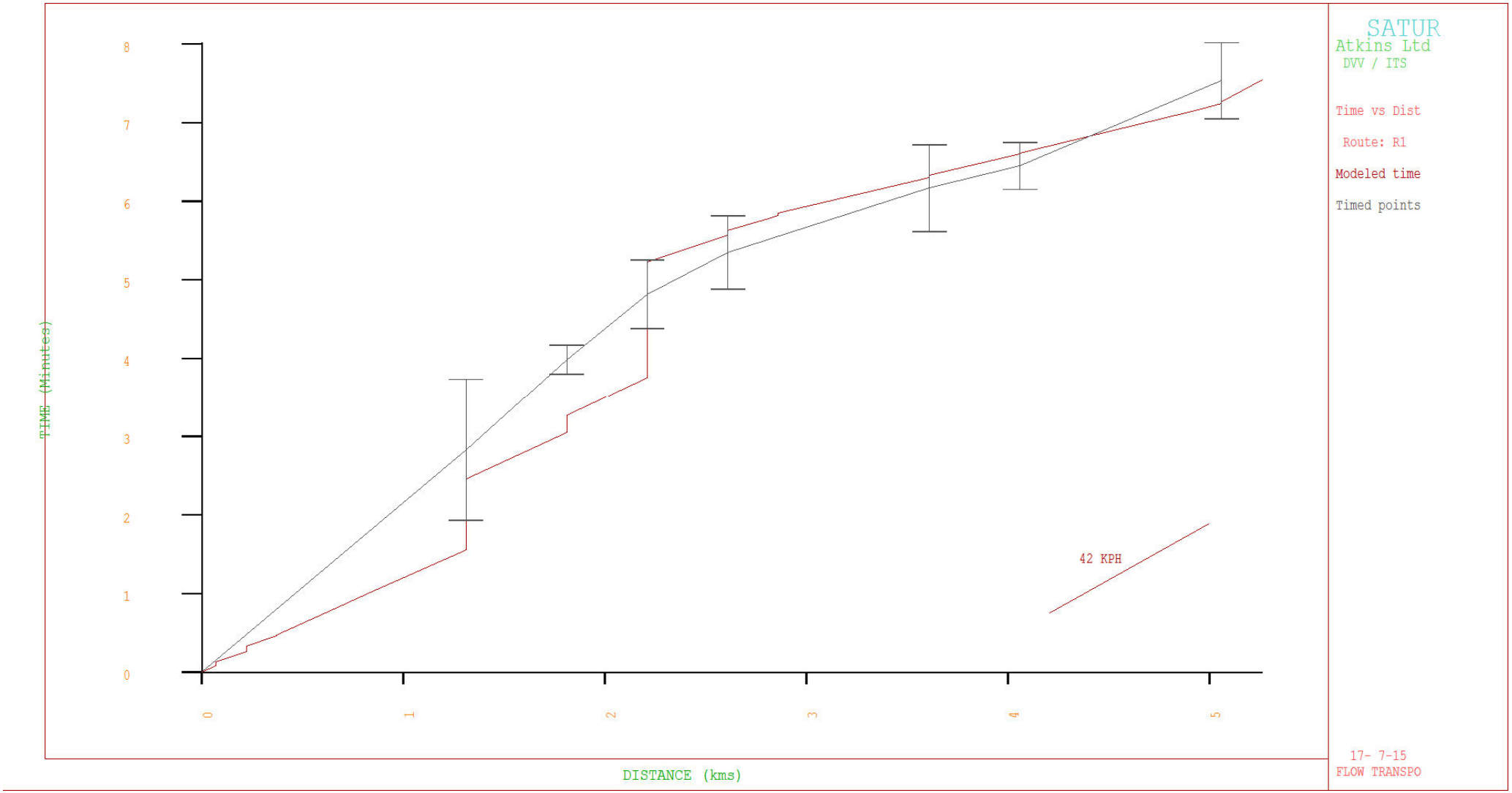


Figure C2: Journey Time Distance-Time Plots – Morning Peak Period - Route 2, Southbound

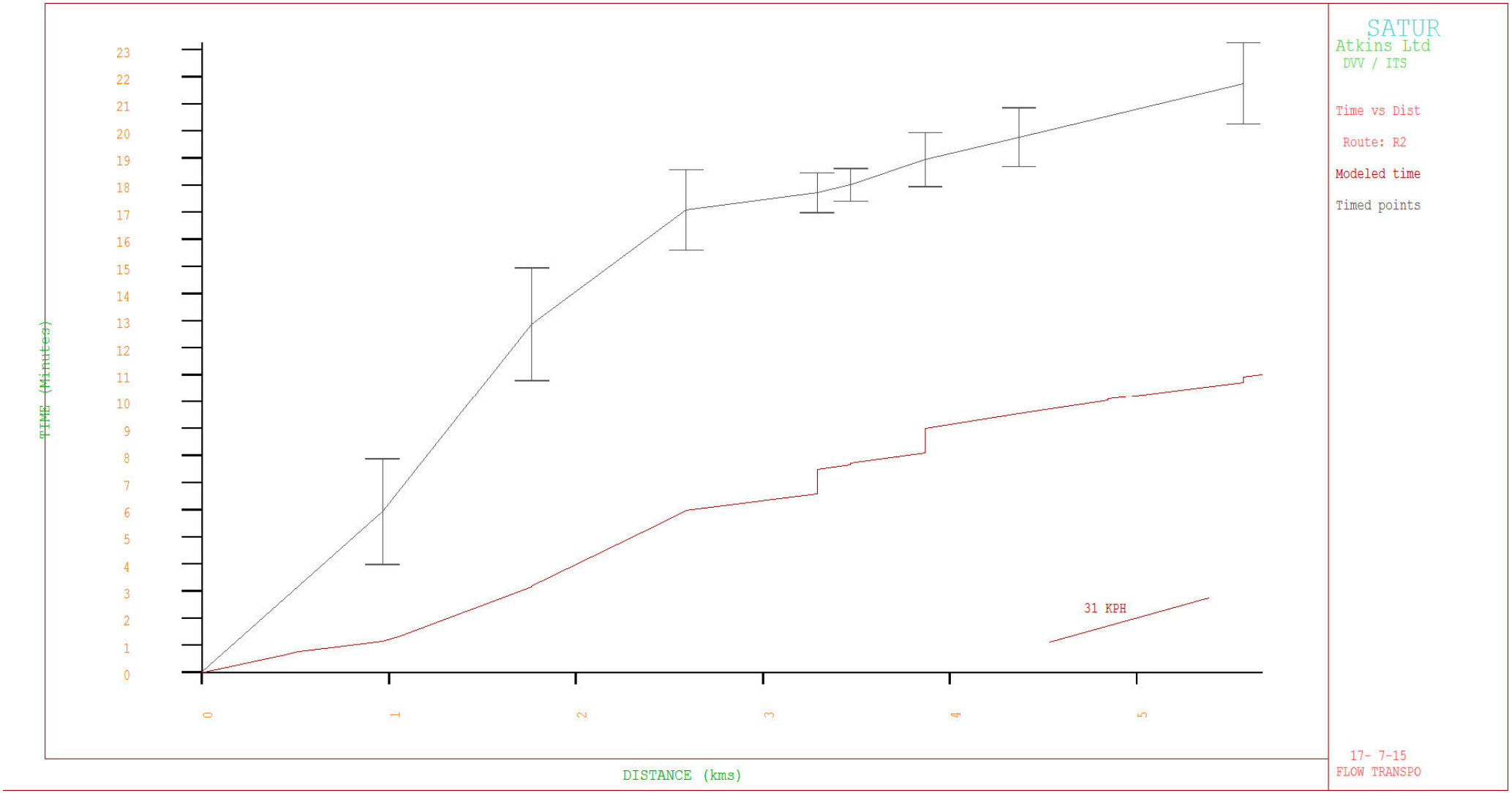


Figure C3: Journey Time Distance-Time Plots – Morning Peak Period - Route 3, Northbound

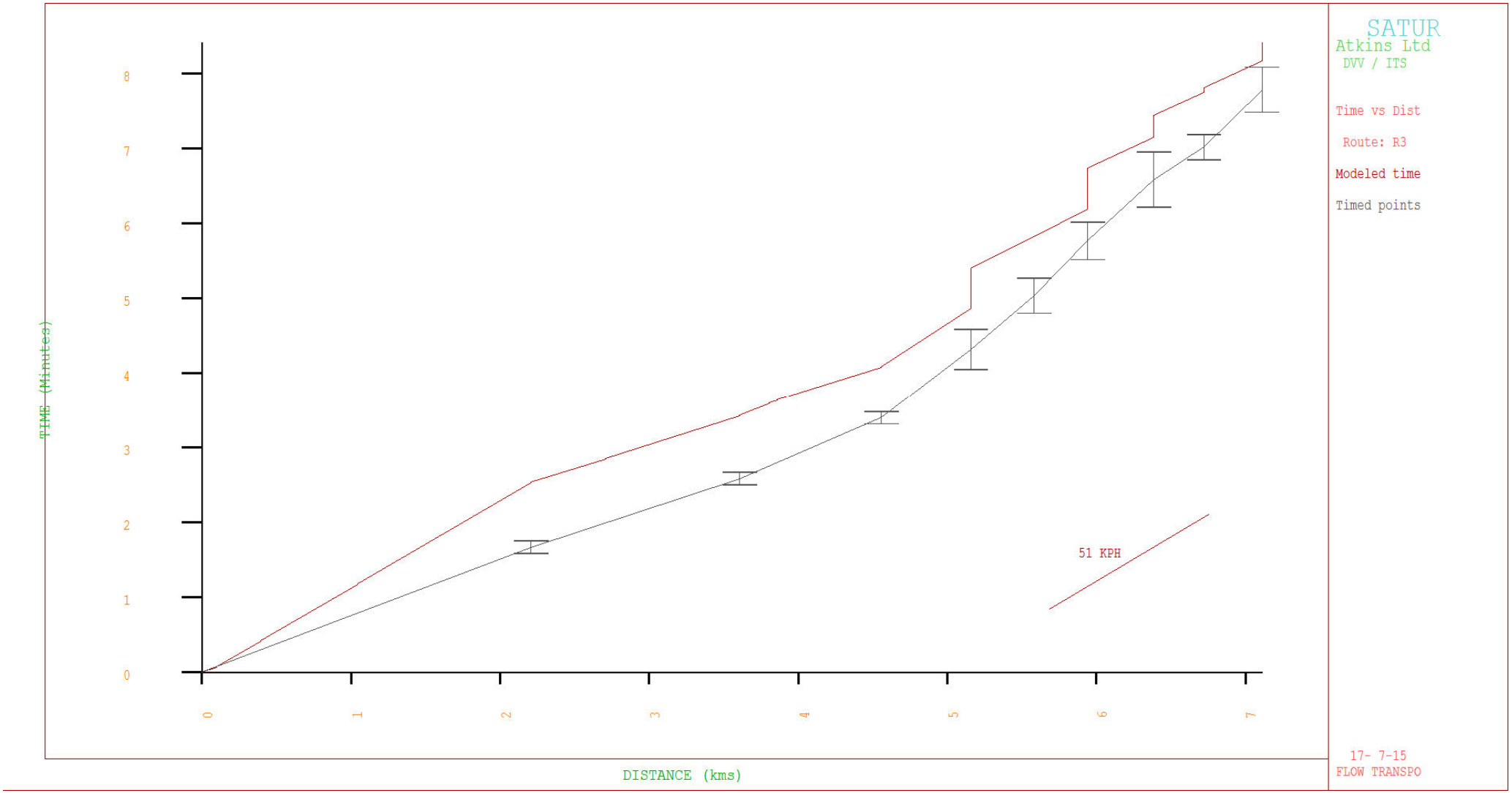


Figure C4: Journey Time Distance-Time Plots – Morning Peak Period - Route 4, Southbound

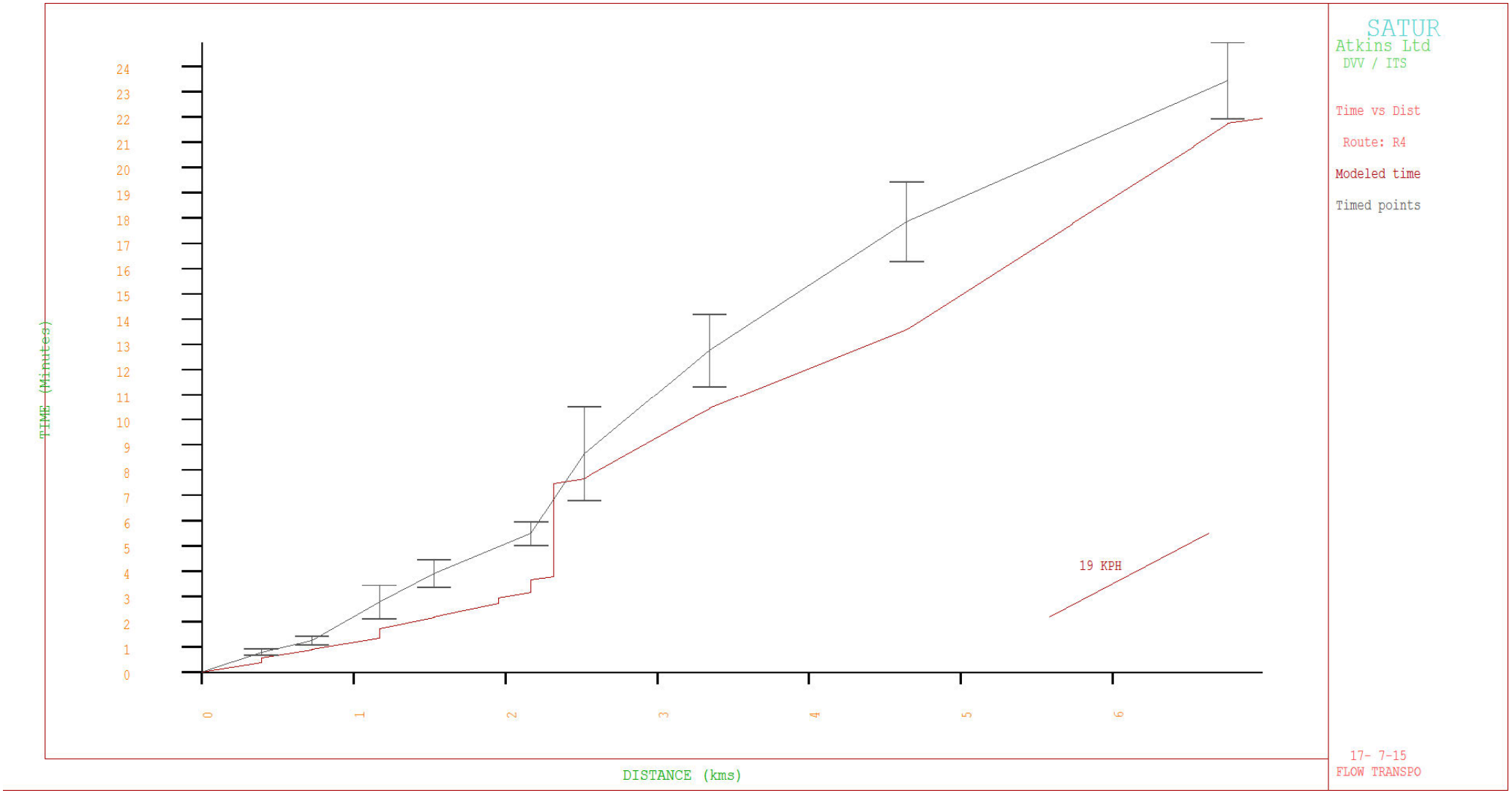


Figure C5: Journey Time Distance-Time Plots – Morning Peak Period - Route 5, Northbound

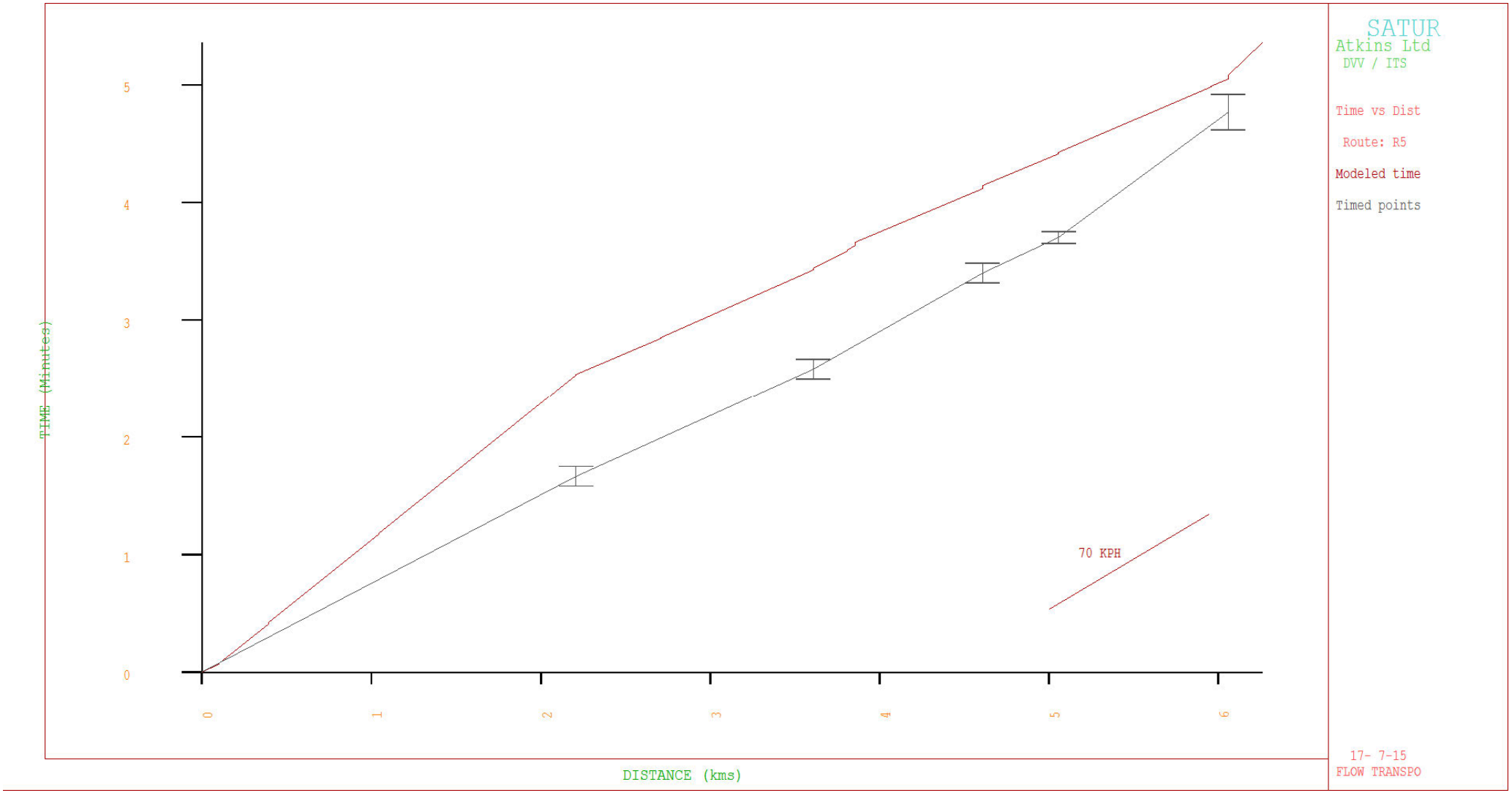


Figure C6: Journey Time Distance-Time Plots – Morning Peak Period - Route 6, Southbound

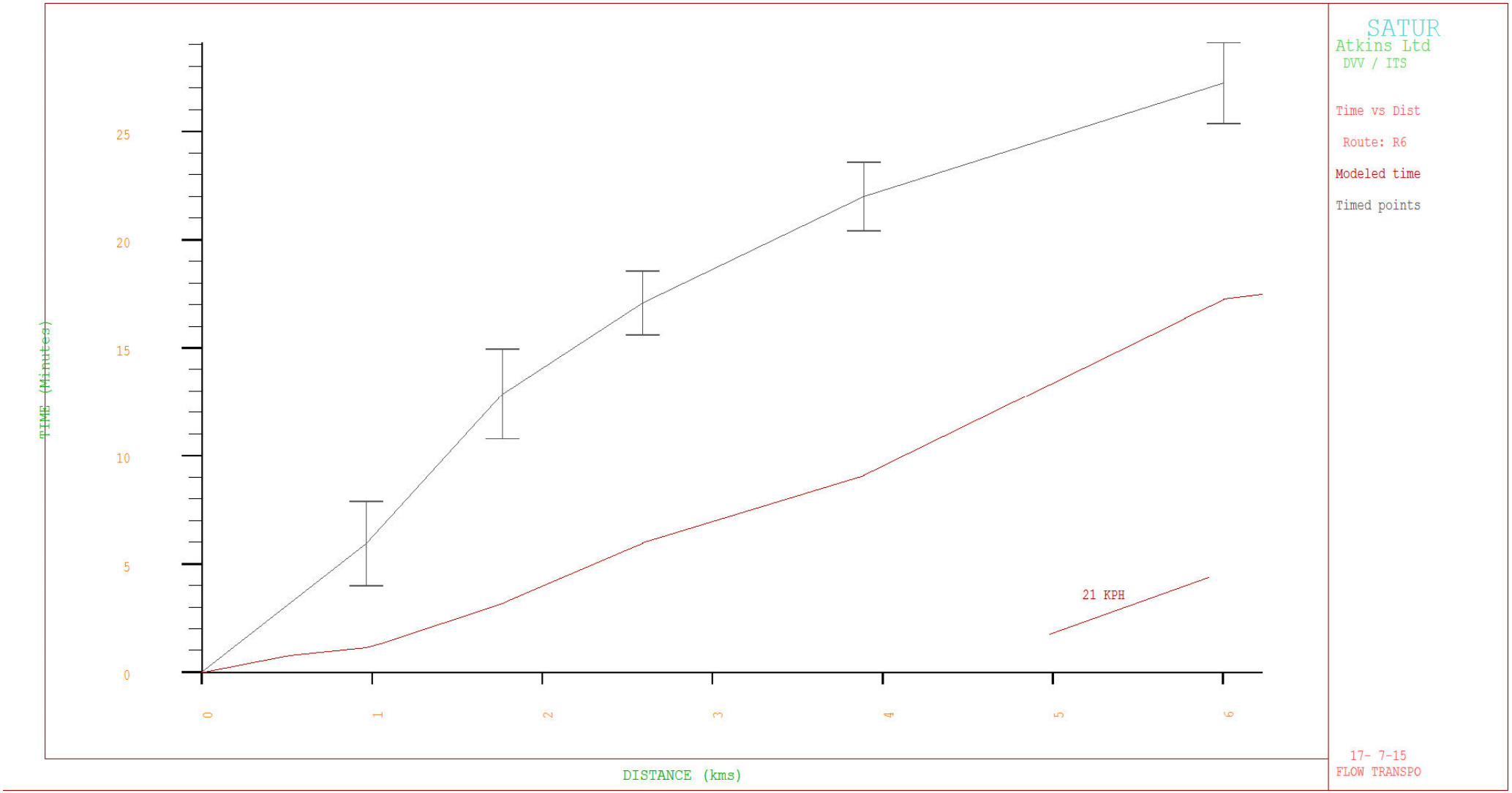


Figure C7: Journey Time Distance-Time Plots – Morning Peak Period - Route 7, Northbound

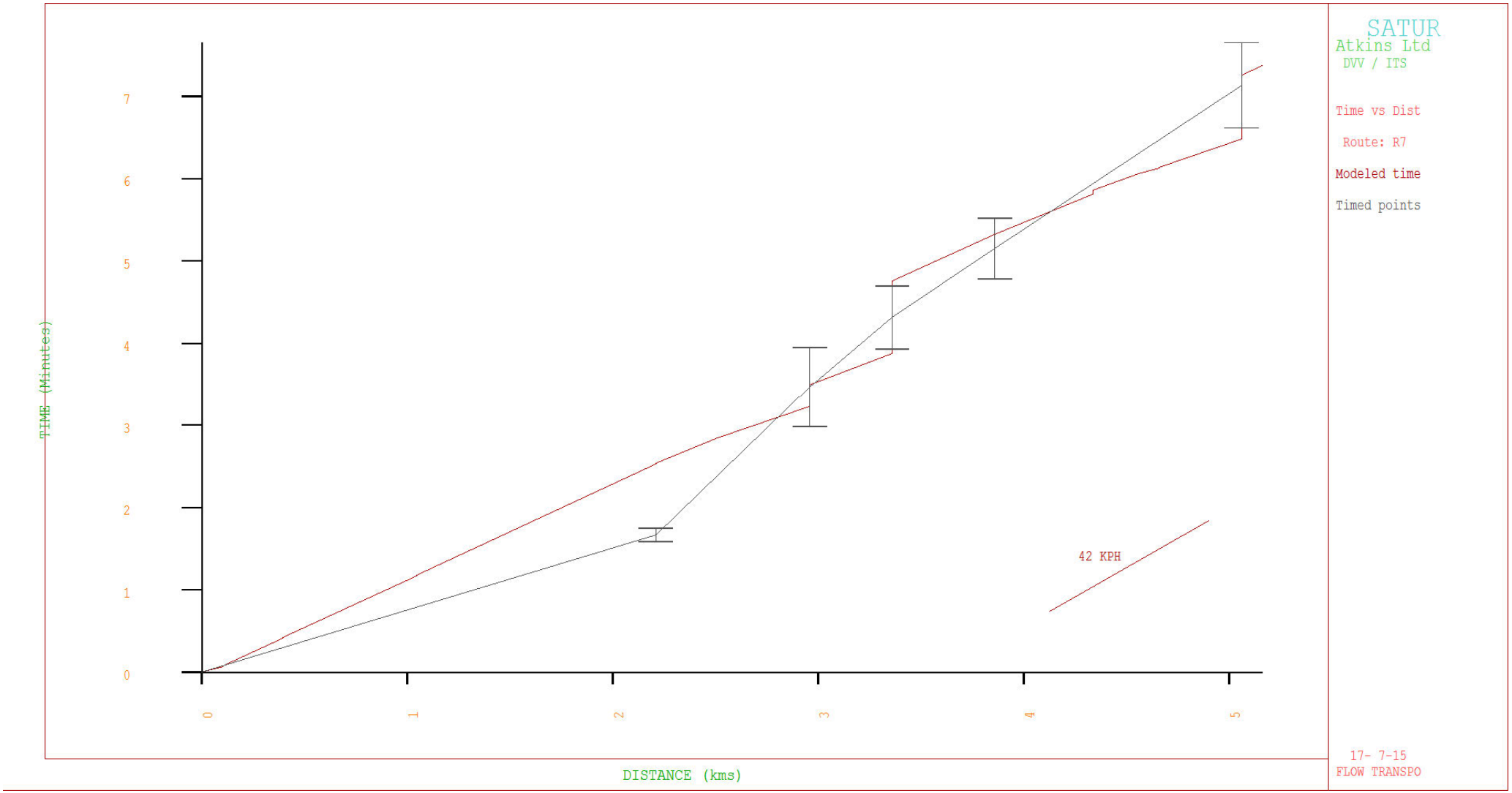


Figure C8: Journey Time Distance-Time Plots – Morning Peak Period - Route 8, Southbound

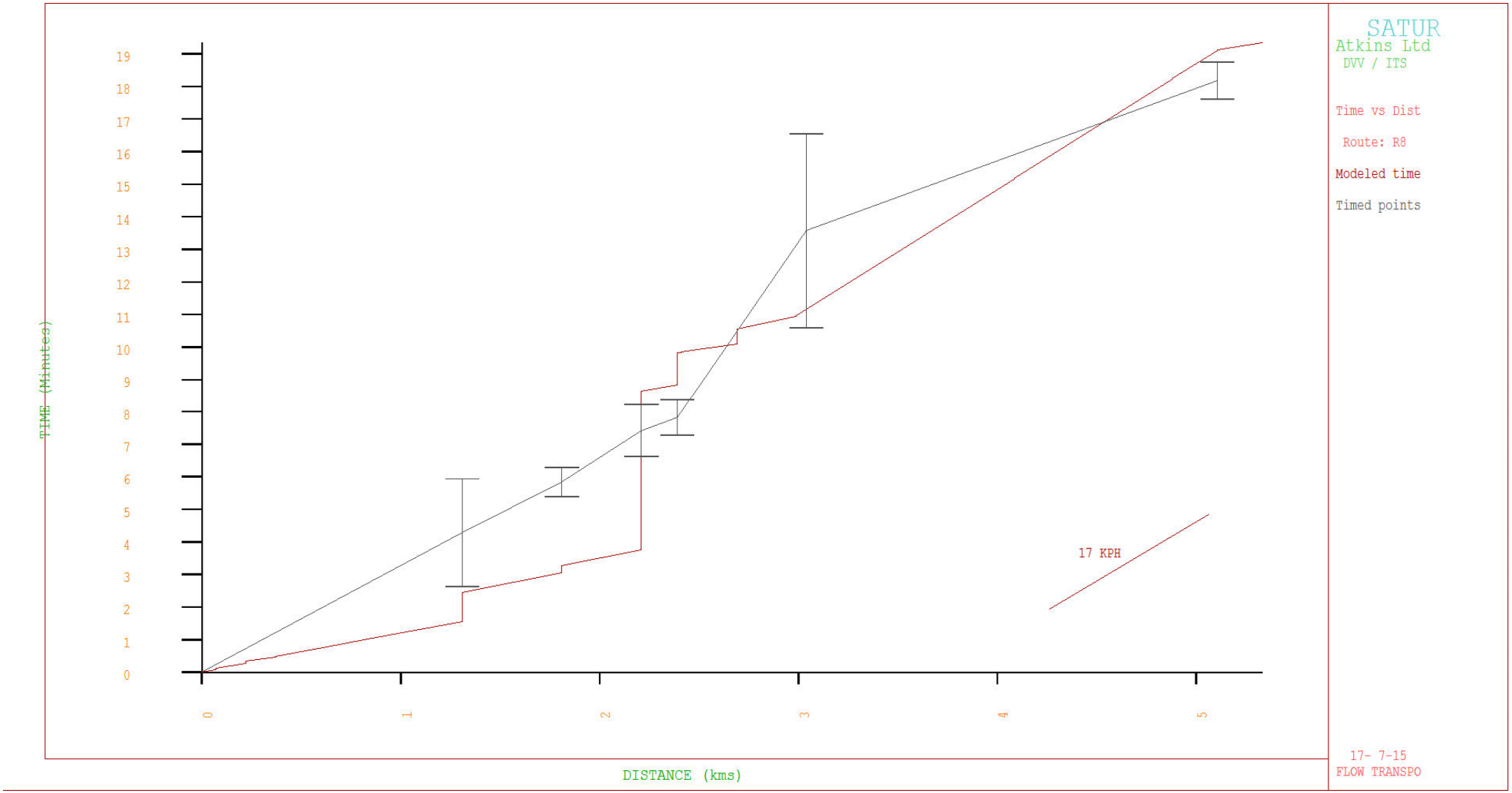


Figure C9: Journey Time Distance-Time Plots – Inter Peak Period - Route 1, Northbound

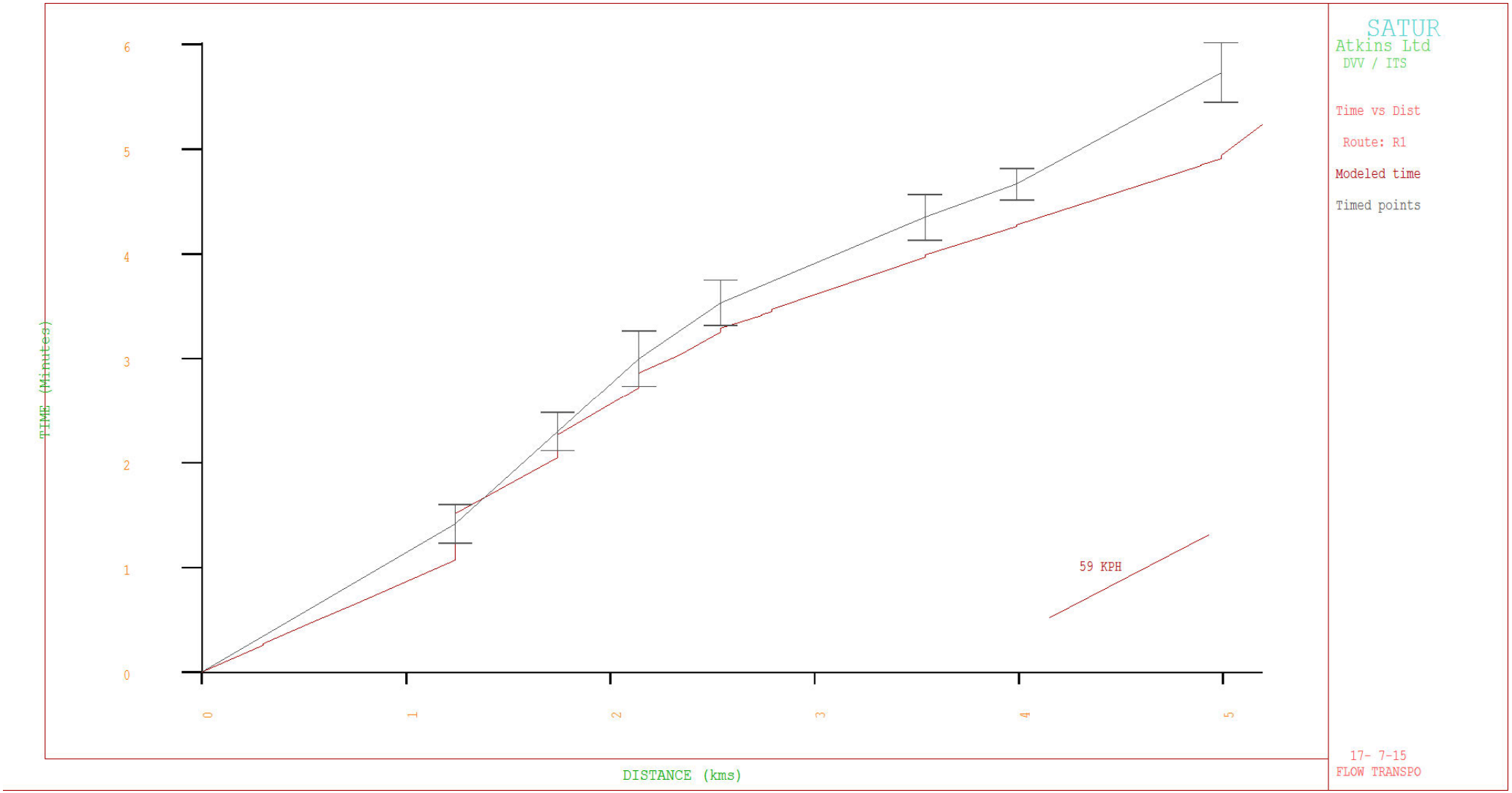


Figure C10: Journey Time Distance-Time Plots – Inter Peak Period - Route 2, Southbound

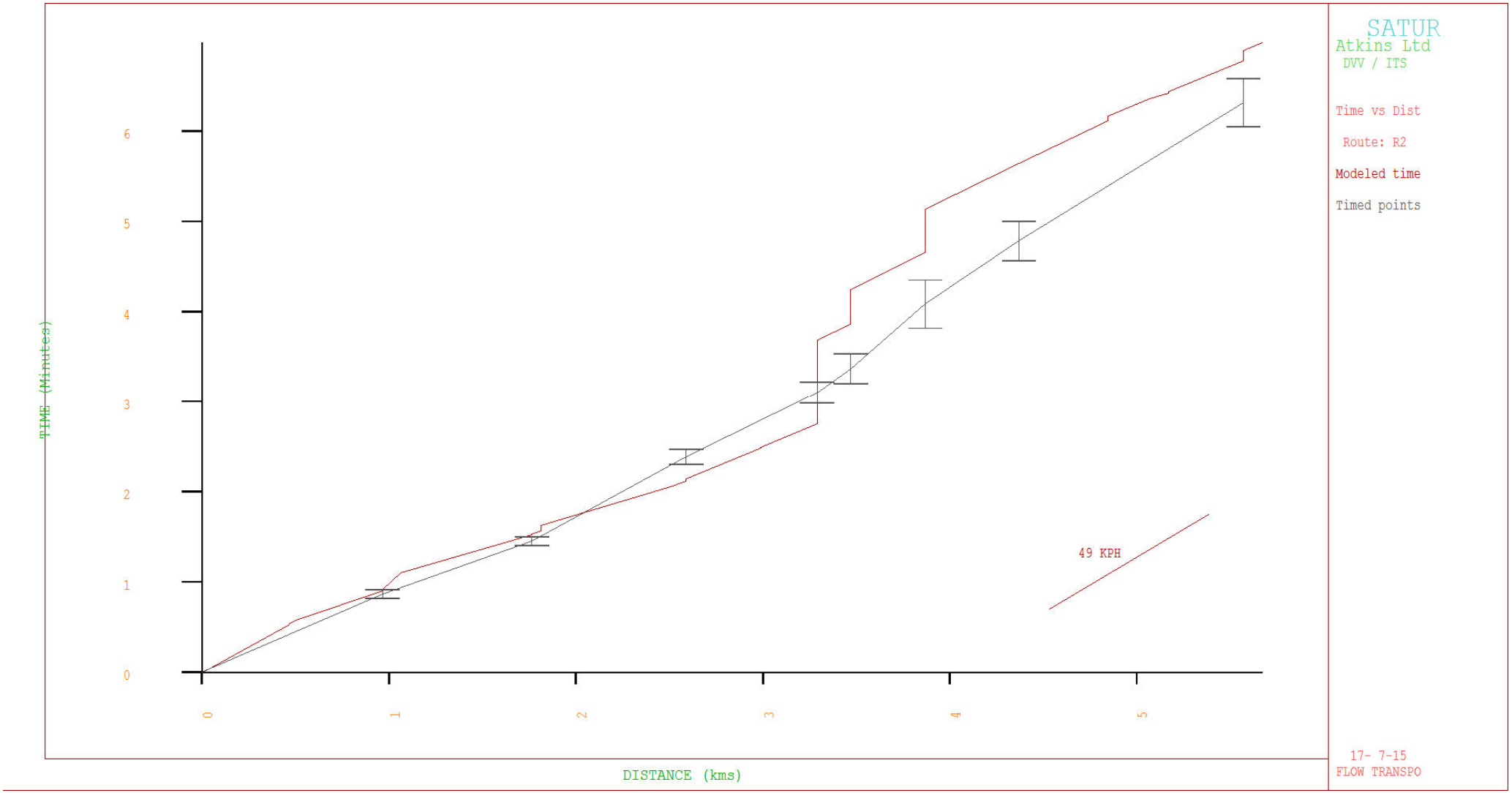


Figure C11: Journey Time Distance-Time Plots – Inter Peak Period - Route 3, Northbound

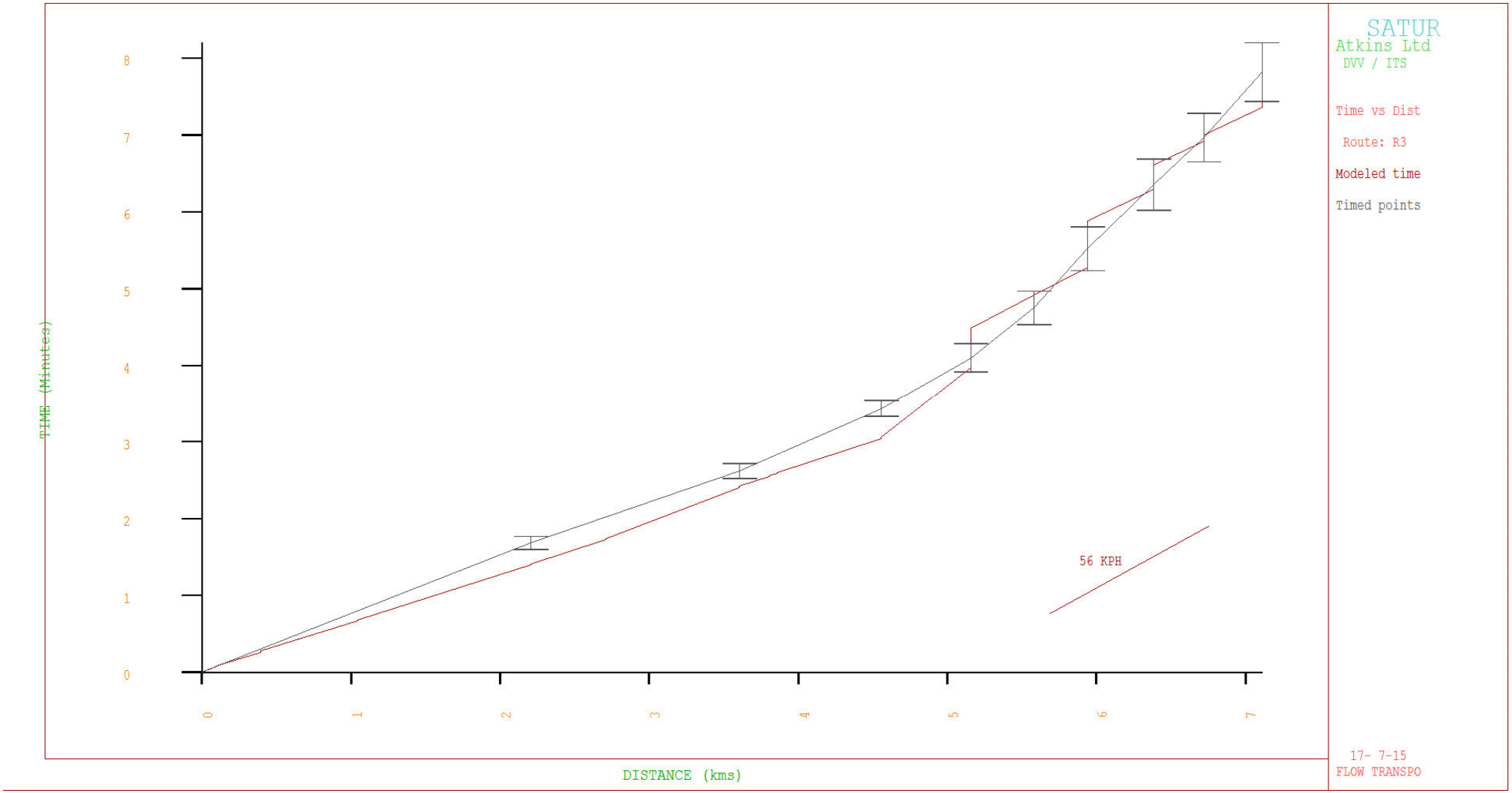


Figure C12: Journey Time Distance-Time Plots – Inter Peak Period - Route 4, Southbound

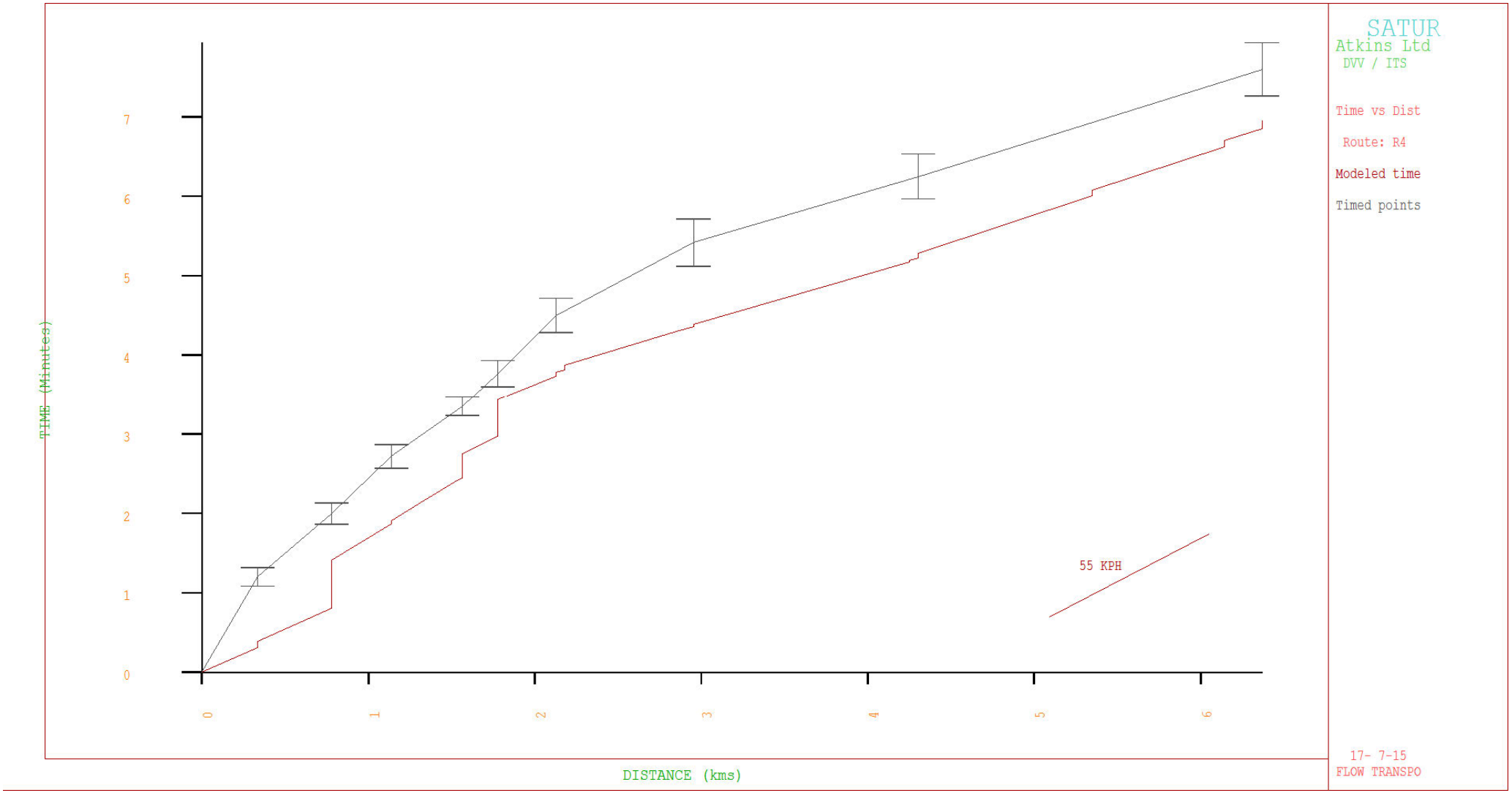


Figure C13: Journey Time Distance-Time Plots – Inter Peak Period - Route 5, Northbound

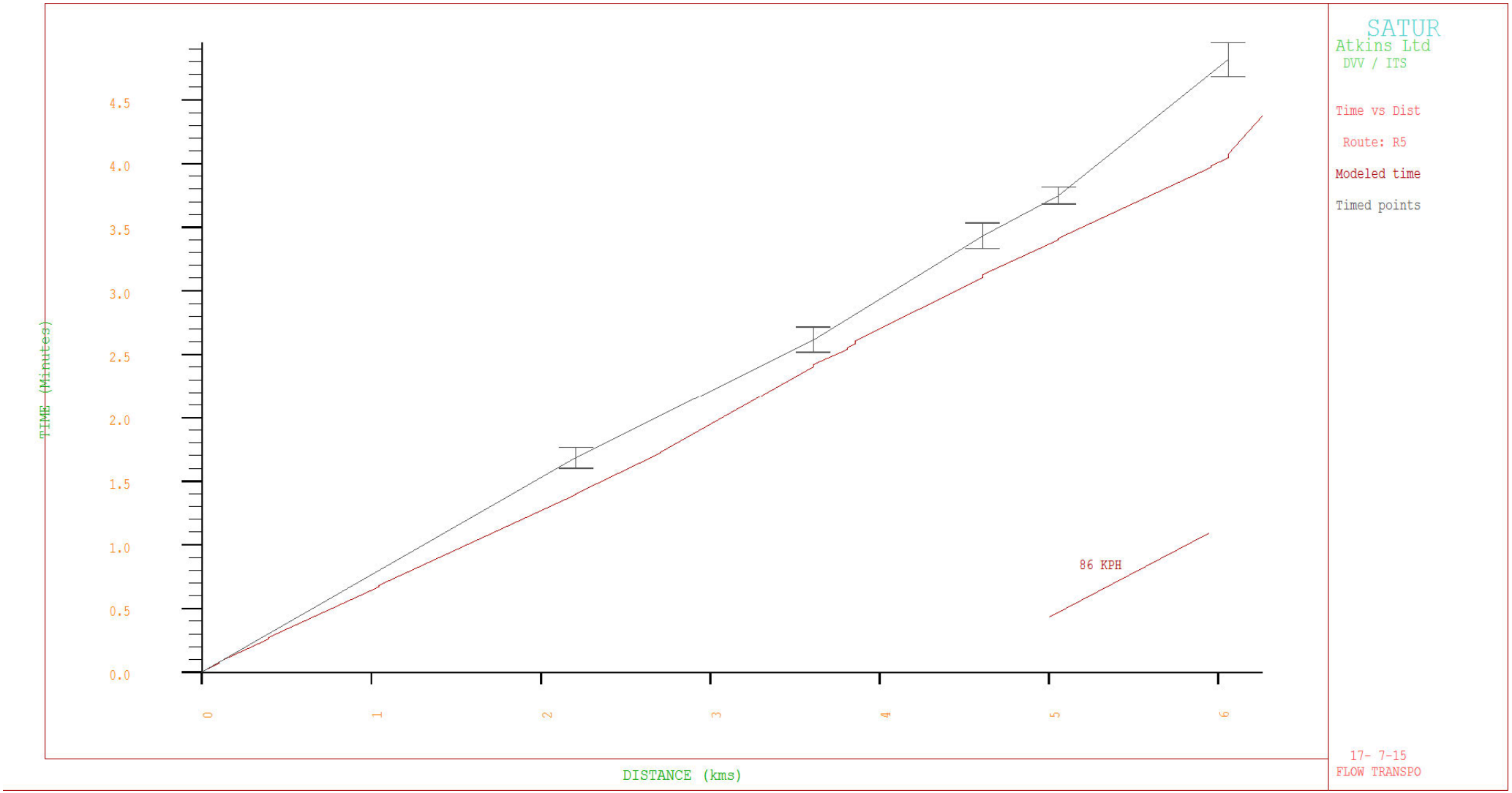


Figure C14: Journey Time Distance-Time Plots – Inter Peak Period - Route 6, Southbound

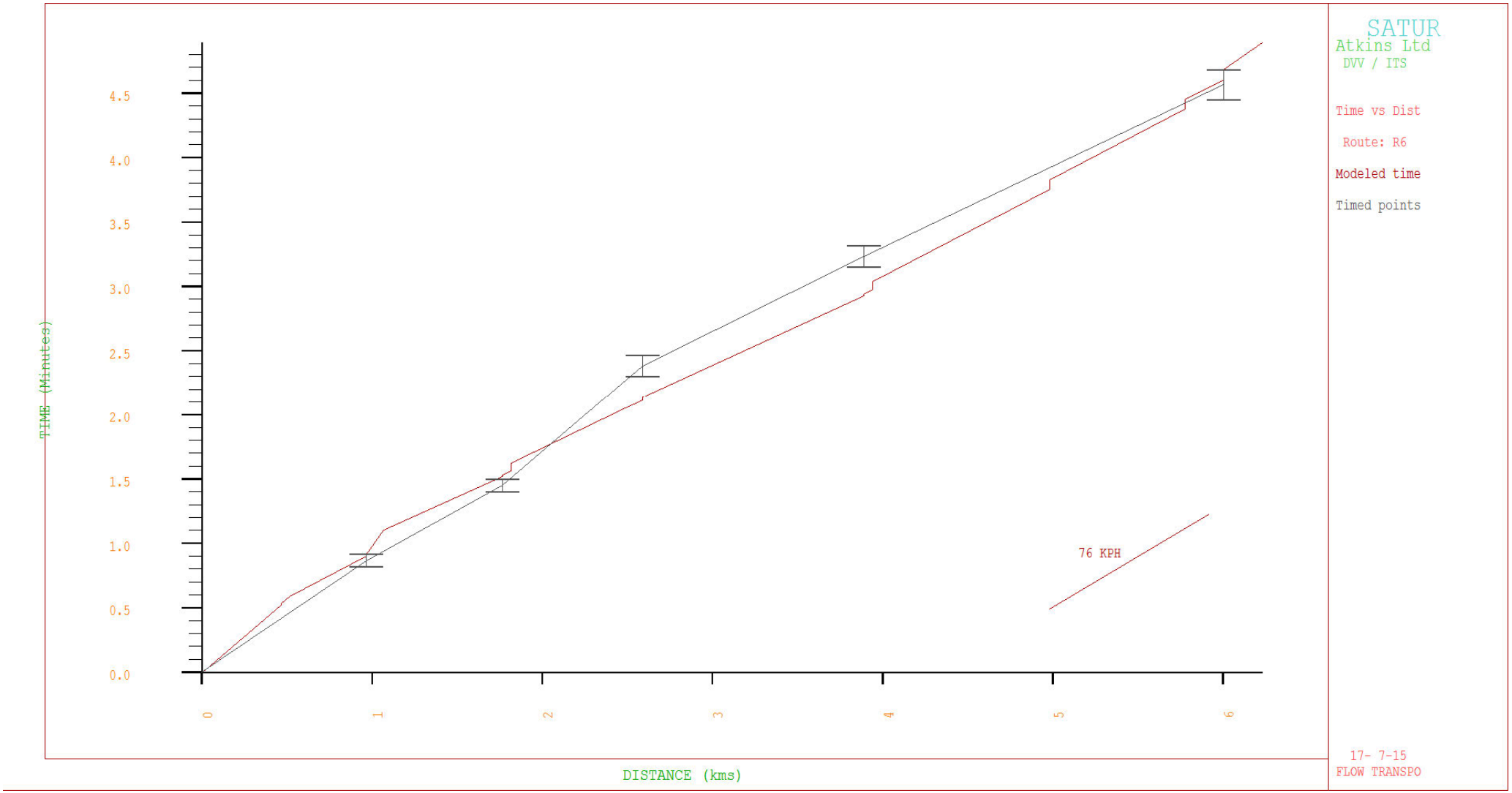


Figure C15: Journey Time Distance-Time Plots – Inter Peak Period - Route 7, Northbound

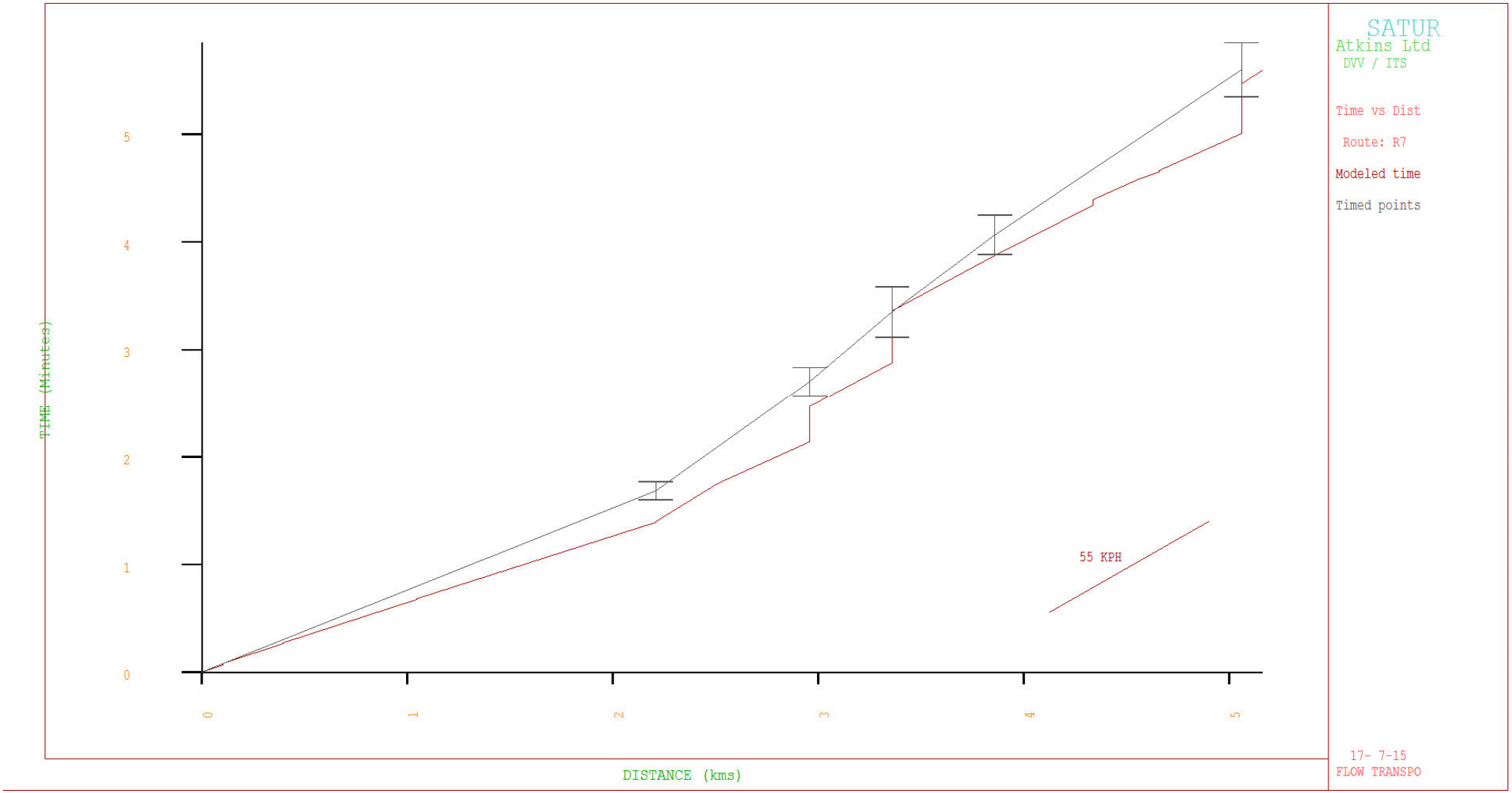


Figure C16: Journey Time Distance-Time Plots – Inter Peak Period - Route 8, Southbound

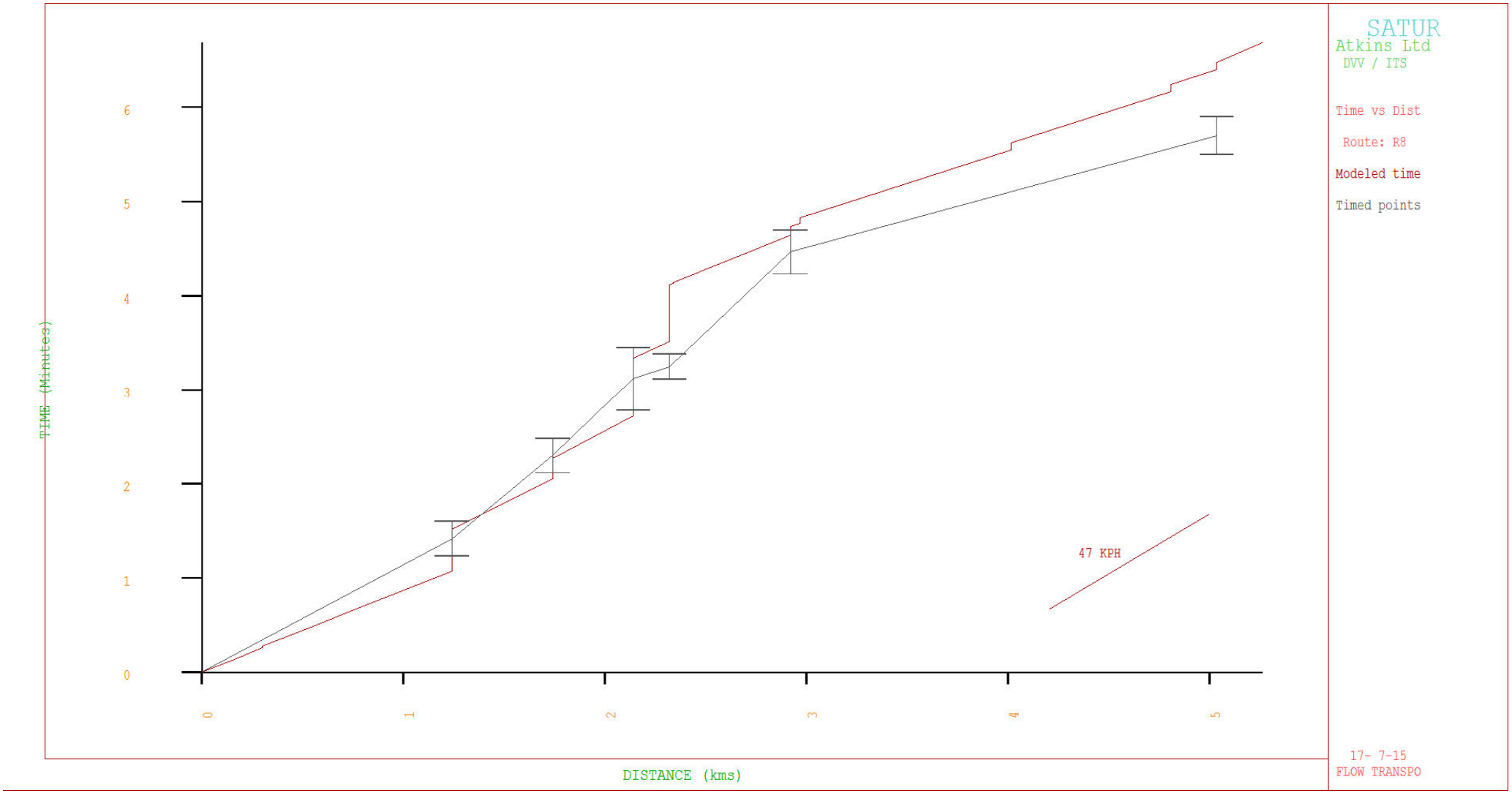


Figure C17: Journey Time Distance-Time Plots – Evening Peak Period - Route 1, Northbound

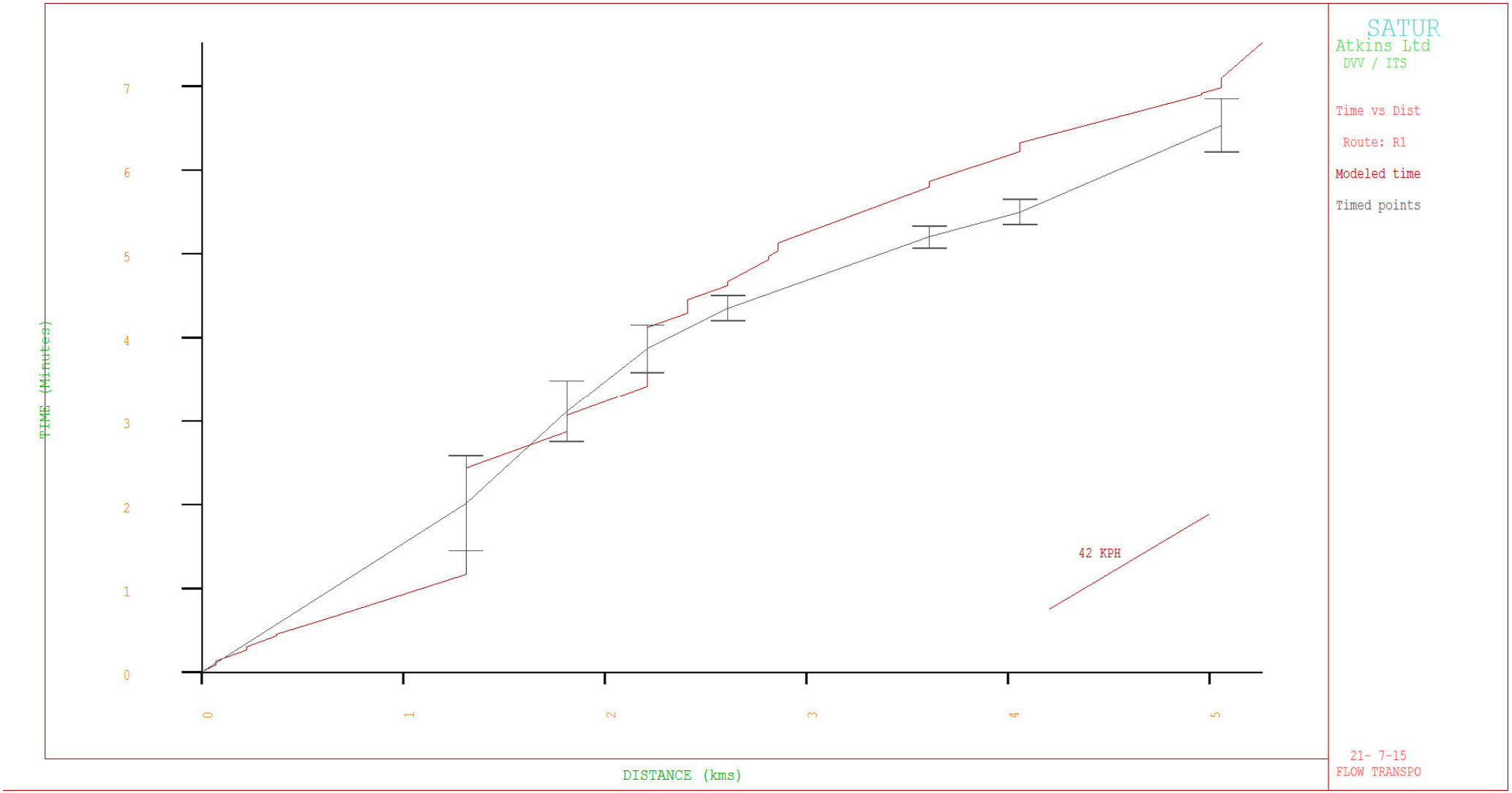


Figure C18: Journey Time Distance-Time Plots – Evening Peak Period - Route 2, Southbound

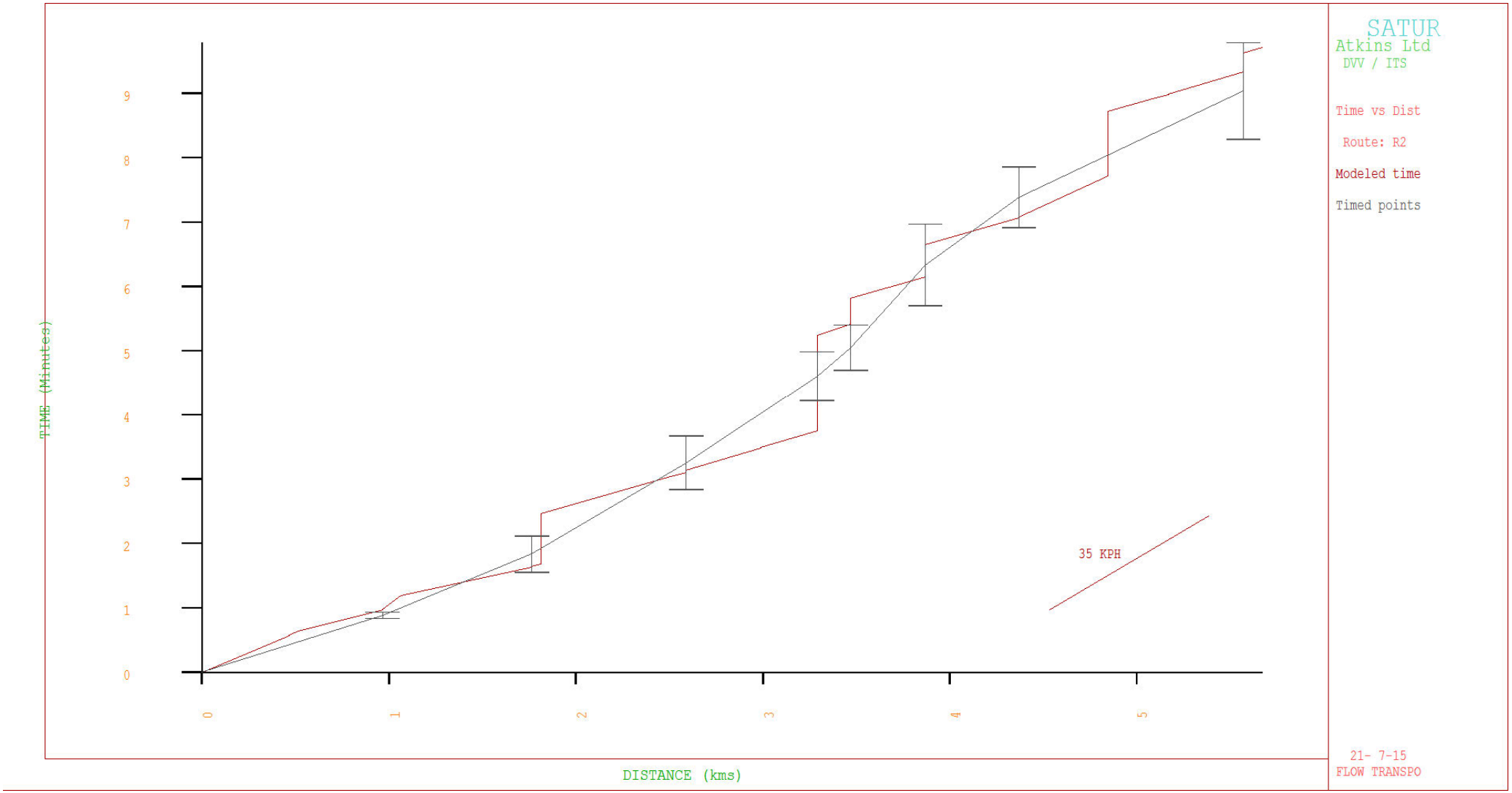


Figure C19: Journey Time Distance-Time Plots – Evening Peak Period - Route 3, Northbound

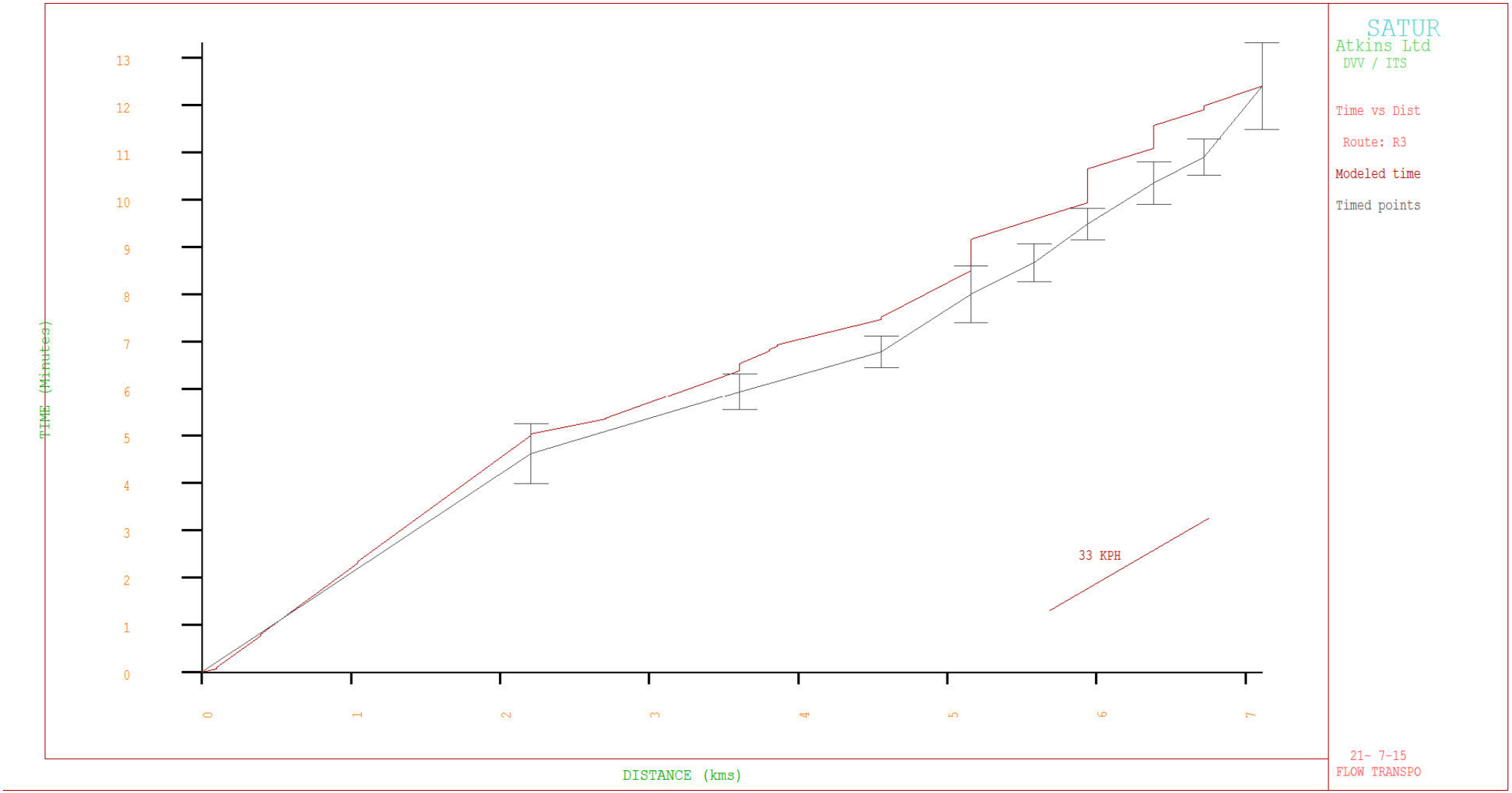


Figure C20: Journey Time Distance-Time Plots – Evening Peak Period - Route 4, Southbound

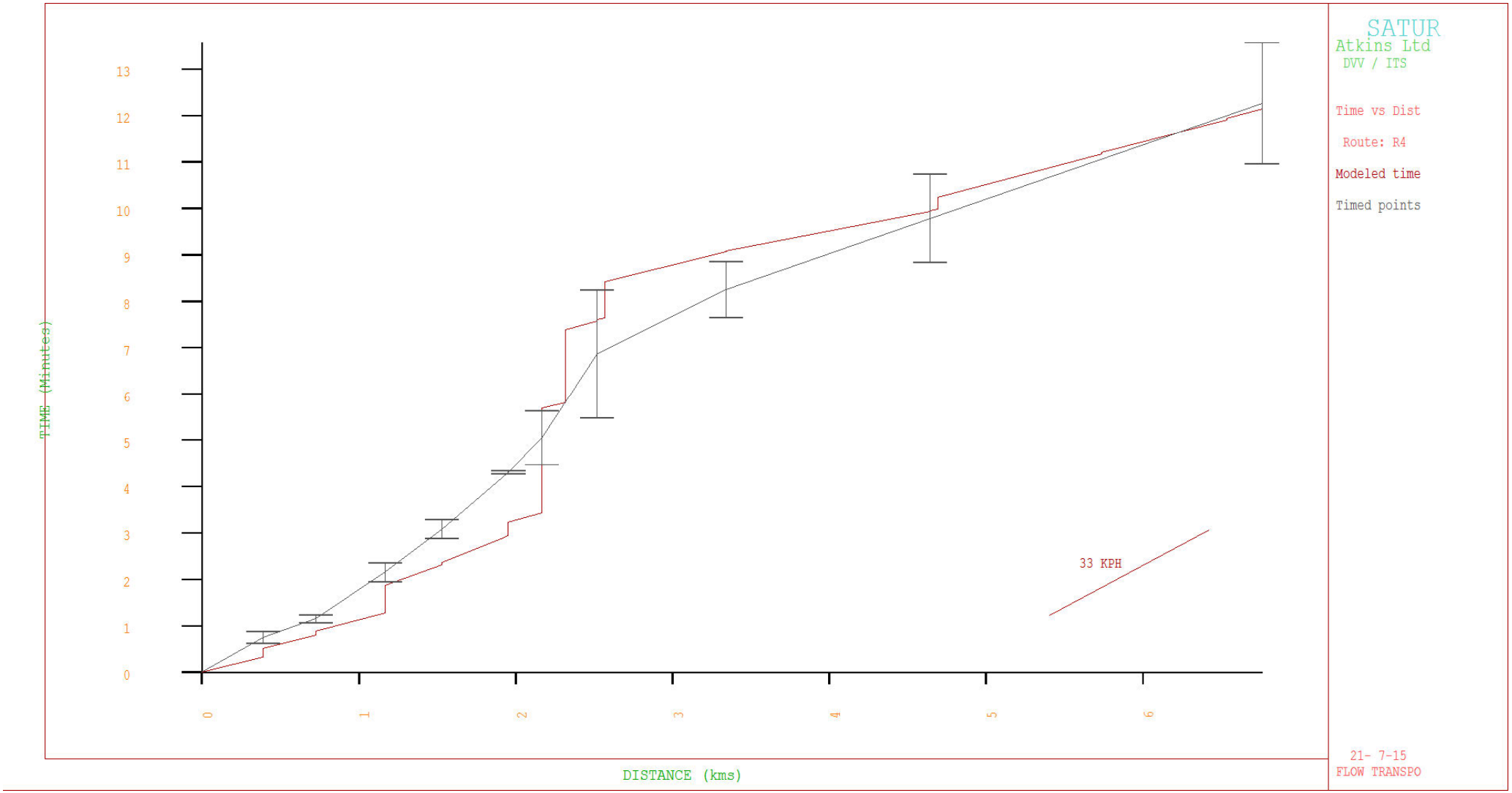


Figure C21: Journey Time Distance-Time Plots – Evening Peak Period - Route 5, Northbound

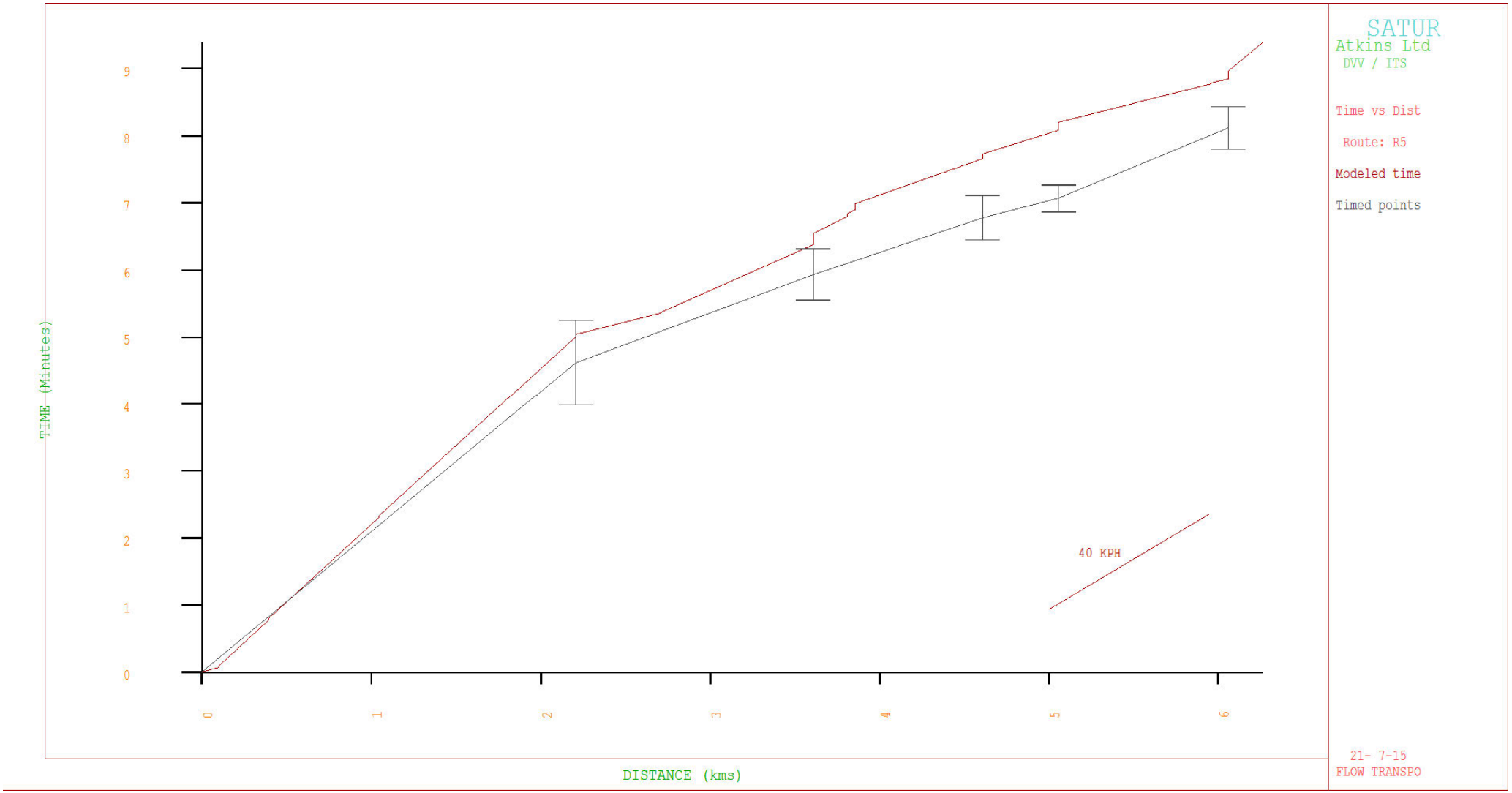


Figure C22: Journey Time Distance-Time Plots – Evening Peak Period - Route 6, Southbound

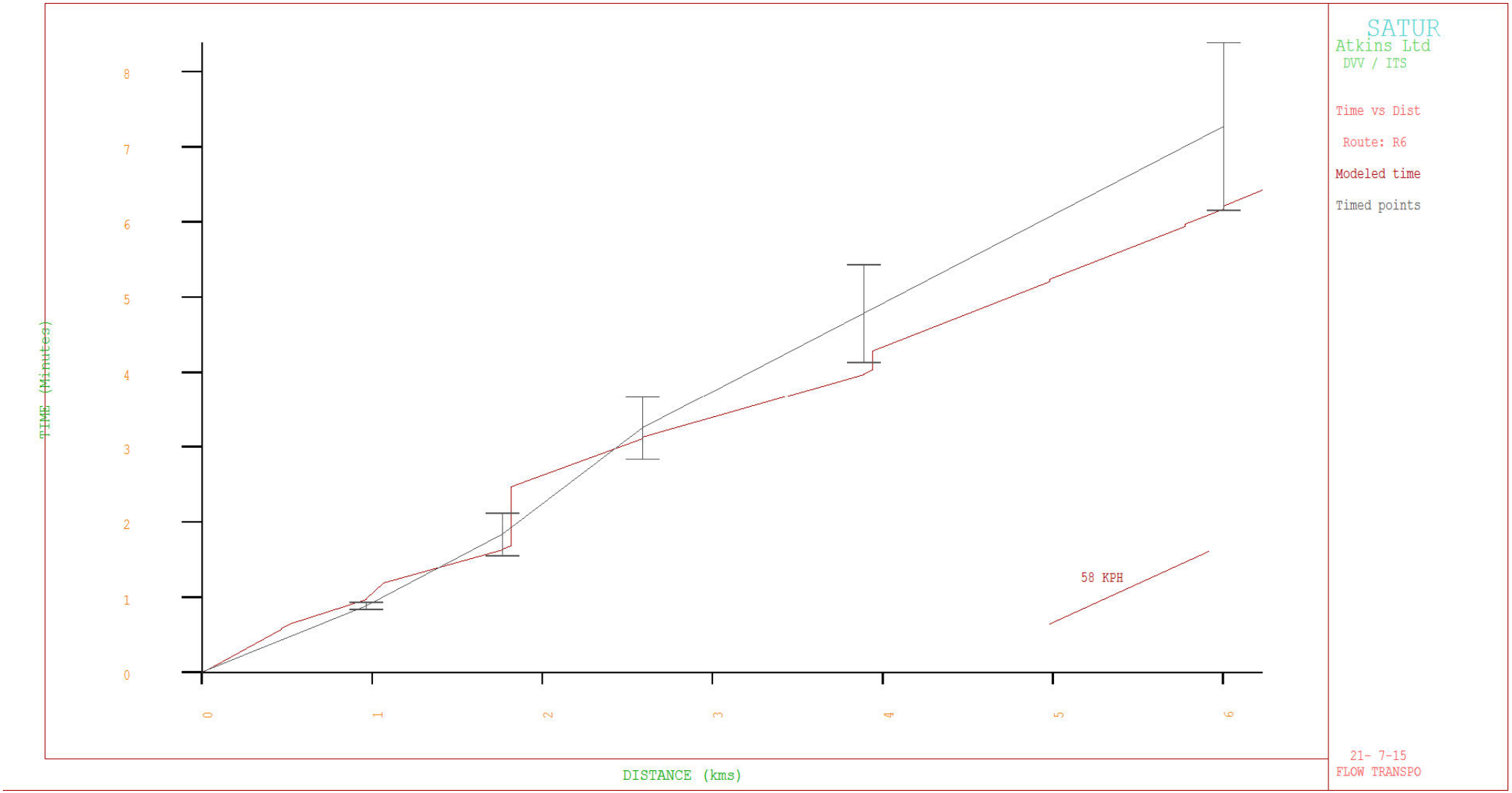


Figure C23: Journey Time Distance-Time Plots – Evening Peak Period - Route 7, Northbound

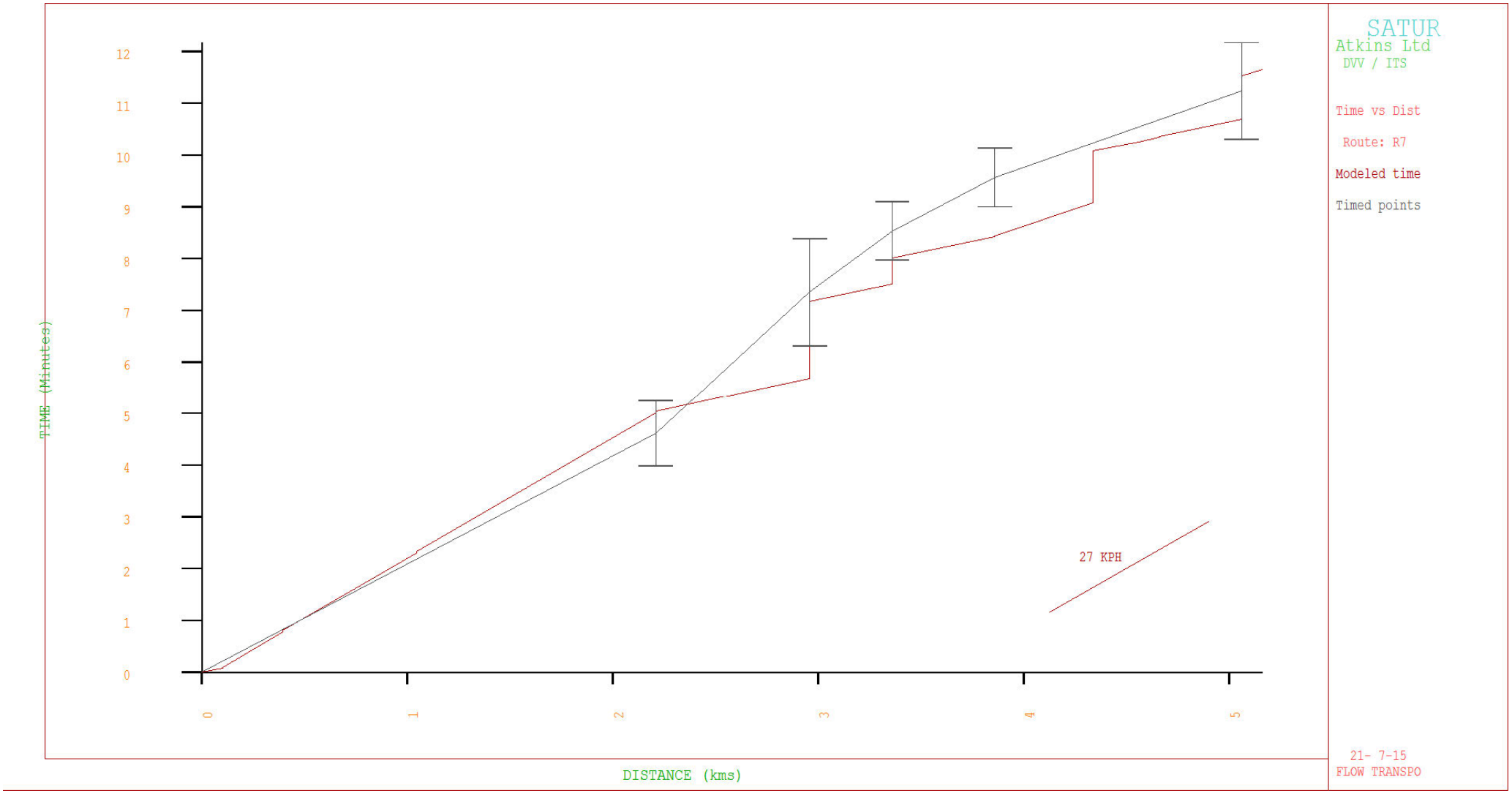
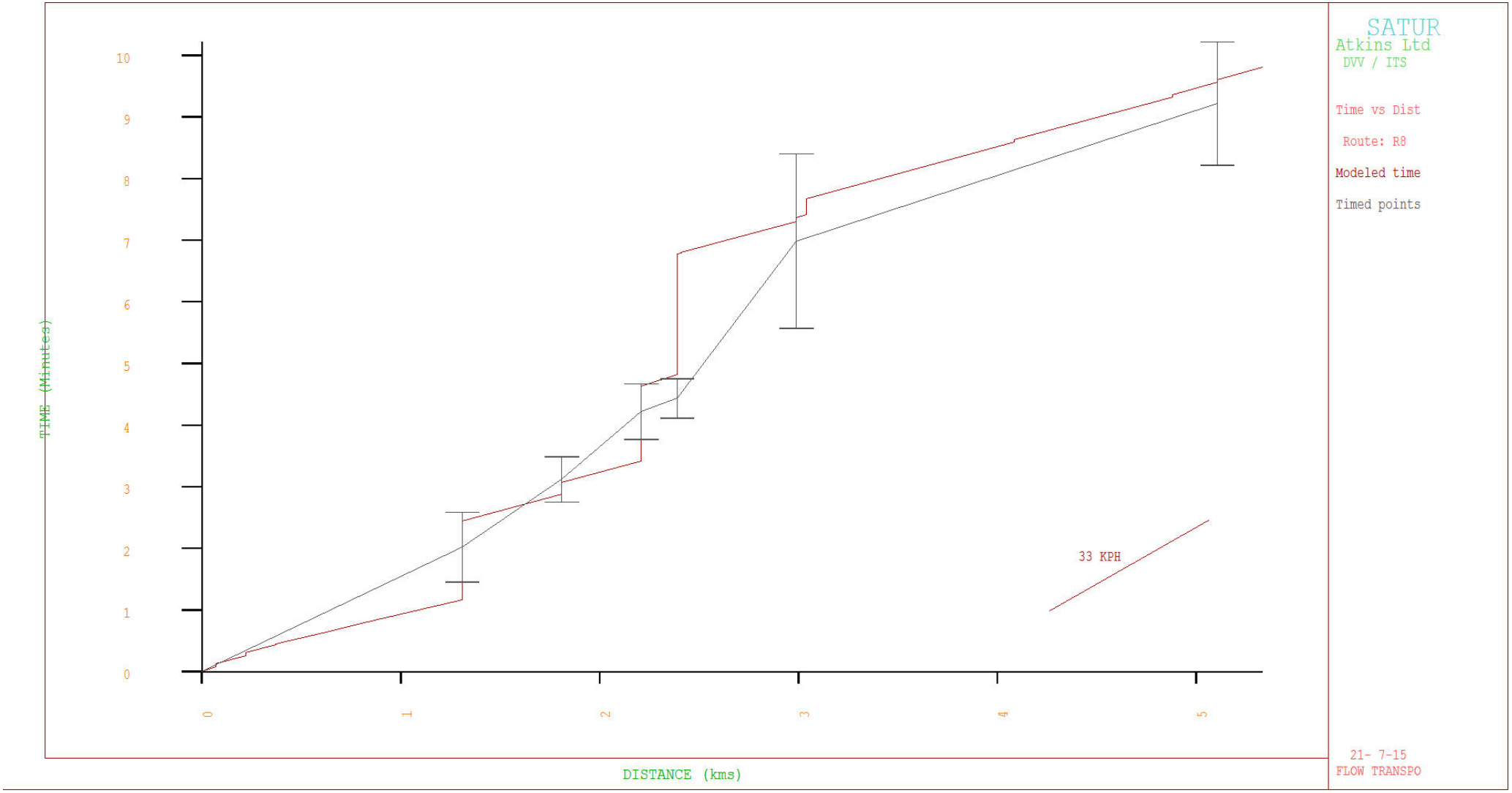


Figure C24: Journey Time Distance-Time Plots – Evening Peak Period - Route 8, Southbound



Appendix D
North Shore Network Plan – Post Consultation

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North Shore New Network Map

All current bus services are changing. Ferries and school buses are not part of this consultation

The route numbers used are for consultation purposes only, and may not be the final numbers. Bus stop locations will be reviewed once the New Network is finalised. All routes travel in both directions except where arrows indicate.

Get to know the new service types

Frequent services
Operate on key routes across Auckland. Run at least every 15 mins during the day (7am – 7pm, 7 days a week), and may run less frequently outside of these times. In some cases run more often at peak times.

Connector services
Run at least every 30 mins during the day (7am – 7pm, 7 days a week), and may run less frequently outside of these times. Generally run every 10 – 15 mins at peak.

Local services
Frequency and days of week vary. Please see Proposed Frequencies and Hours of Service table for details about each service.

Peak period services
Services that only operate during weekday peak periods. Generally run 7am – 9am, and 4pm – 6pm.

N78 will be extended when area develops

NX to be extended to Hibiscus Coast Station in the future

Albany services: NX, N6, N62, N63, N66, N74, N78, N79, N82

Massey University services: N6, N78, N82

Refer to map key for NX service details

W5 continues to Henderson via Hobsonville Rd, Westgate and Don Buck Rd: W5

N9 splits at Verrans Corner: N9a and N9b continue at the same frequency, but in alternating directions around the Beach Haven loop: N9

Onewa Rd services: N8, N9, N25, N81, N91, N92, N93

Services to City: NX, N4, N4a, N8, N9, N11, N23, N81, N91, N92, N93

Takapuna to Smales Farm services: N6, N25, N30, N31, N32

Right turn from Esmonde Rd into Akoranga Station to be investigated: N4, N4a

All services to and from the city via Sylvan Ave, except for morning peak services to the city via College Rd and Akoranga Station: N23

Refer to map key for NX service details

PROPOSED SERVICES

BUSWAY SERVICES

- NX1 Albany to Britomart (Lower Albert St), at least every 10 – 15 mins, 7 days a week, more often during peak
- NX2 Albany to City universities, at least every 10 – 15 mins, 7 days a week, more often during peak
- NX3 Albany to Newmarket, Mon to Fri only at least every 30 mins and every 10 mins at peak

FREQUENT SERVICES

At least every 15 minutes, 7am – 7pm, 7 days a week.

- N4/N4a Milford to City universities via Takapuna
- N6 Massey University to Takapuna via Albany Station, Browns Bay, Mairangi Bay Constellation Station and Smales Farm Station
- N8 Glenfield to Britomart (Lower Albert St) via Onewa Rd (made up of N8a and N8b)
- N9 Beach Haven to Britomart (Lower Albert St) via Onewa Rd (made up of N9a and N9b)

CONNECTOR SERVICES

At least every 30 minutes, 7am – 7pm, 7 days a week.

- N4a Constellation Station to City universities via Sunnynook, East Coast Rd, Milford and Takapuna
- N8a Constellation Station to Britomart (Lower Albert St) via Glenfield Rd and Onewa Rd
- N8b Bayview to Britomart (Lower Albert St) via Glenfield Rd and Onewa Rd
- N9a Beach Haven to Britomart (Lower Albert St) via Rangatira Rd and Onewa Rd
- N9b Beach Haven to Britomart (Lower Albert St) via Birkdale Rd and Onewa Rd
- N23a Smales Farm Station to City universities via Hillcrest and Sylvan Ave
- N25 Beach Haven to Takapuna - clockwise via Glenfield and Smales Farm Station: anti-clockwise via Highbury, Northcote and Akoranga Station
- N30 Devonport to Smales Farm Station via Takapuna
- N31 Constellation Station to Bayswater via East Coast Rd, Forrest Hill Rd, Smales Farm Station and Takapuna
- N41 Constellation Station to Smales Farm Station via Mairangi Bay, Beach Rd and Milford
- N62 Albany Station to Constellation Station via East Coast Rd
- N78 Long Bay to Albany Station via Torbay, Glamorgan Dr and Oteha Valley Rd, with weekday extension to Massey University
- N79 Torbay to Albany Station via Fitzwilliam Dr or Oaktree Ave
- W5 Henders on to Constellation Station via Westgate and Greenhithe

LOCAL SERVICES

- N12 Stanley Point to Devonport Ferry Terminal
- N13 Devonport Ferry Terminal to Mt Victoria/Cheltenham
- N21a Northcote Point to Smales Farm Station via Northcote and North Shore Hospital
- N21b Birkenhead Wharf to Smales Farm Station via Highbury, Northcote and North Shore Hospital
- N24 Smales Farm Station to Akoranga Station via Hillcrest West
- N32 Milford to Takapuna via Nile Rd, North Shore Hospital, Smales Farm Station and Karaka St
- N45 Smales Farm Station to Constellation Station via Wairau Rd and Unsworth Dr
- N49 Windy Ridge to Constellation Station via Kaipatiki Rd, Glenfield, Diana Dr and Link Dr
- N63 Albany Station to Constellation Station via Hugh Green Dr and Apollo Dr
- N65 Schnapper Rock to Constellation Station via Rosedale Rd
- N66 Albany Station to Constellation Station via Albany Highway and William Pickering Dr
- N74 Albany to Fairview Heights circuit
- N82 Highbury to Albany via Glenfield Rd, Constellation Station and Massey University
- N92 Beach Haven wharf to City universities via Lauderdale Rd, Verbena Rd and Onewa Rd
- N93 Highbury to Newmarket via Onewa Rd, Ponsonby Rd, K'Rd and Auckland Hospital

PEAK PERIOD SERVICES

- W5c Greenhithe to Constellation Station
- N11 Belmont to City universities via Esmonde Rd
- N23b Hillcrest to City universities via Akoranga Station (morning peak only)
- N43 Crown Hill to Smales Farm Station via East Coast Rd and Shakespeare Rd
- N81 Windy Ridge to City universities via Glenfield Rd and Onewa Rd
- N91 Chatswood to Auckland University via Onewa Rd

EXISTING SERVICES (no changes)

- Existing services (no changes as part of this consultation)

KEY SYMBOLS

- Interchange
- Ferry Terminal - connects to bus services
- Ferry Terminal - does not connect to bus services
- Services in this direction only

NZ TRANSPORT AGENCY WAKA KOTAHI · aurecon · KensingtonSwan LAWYERS

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Appendix E
Predicted Hourly Traffic Data

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Table E1 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Morning Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	1,300	1,940	1,990	2,080	3,170	3,250
Oteha Valley Rd IC	1,150	1,600	1,660	1,630	2,240	2,430
Greville Rd to Oteha Valley Rd	1,870	2,640	2,680	2,360	2,820	3,200
Greville Rd Interchange	1,780	2,470	2,590	1,850	2,030	2,770
Greville Rd to Upper Harbour	3,020	3,860	4,810	2,310	3,160	4,530
Upper Harbour Interchange	1,900	2,620	2,450	1,720	2,090	2,040
Upper Harbour to Tristram Ave	2,890	3,620	3,810	2,550	2,870	2,800
SH18						
Tauhinu Rd to Greenhithe Rd	2,560	3,490	3,660	1,630	2,530	3,120
Greenhithe Rd to Albany Hwy	2,820	4,010	4,210	1,770	2,820	3,480
Albany Highway Interchange	1,480	2,380	2,500	890	1,440	2,130
East of Albany Highway	1,700	2,390	2,740	1,000	1,480	2,530

Table E2 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Morning Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	1,330	2,000	2,030	2,080	3,170	3,250
Oteha Valley Rd IC	1,170	1,650	1,700	1,630	2,240	2,430
Greville Rd to Oteha Valley Rd	1,910	2,730	2,740	2,360	2,820	3,200
Greville Rd Interchange	1,820	2,550	2,650	1,860	2,040	2,770
Greville Rd to Upper Harbour	3,080	3,990	4,930	2,330	3,170	4,540
Upper Harbour Interchange	1,930	2,690	2,510	1,740	2,100	2,040
Upper Harbour to Tristram Ave	2,930	3,730	3,920	2,590	2,890	2,820
SH18						
Tauhinu Rd to Greenhithe Rd	2,680	3,640	3,770	1,660	2,640	3,160
Greenhithe Rd to Albany Hwy	2,940	4,150	4,320	1,800	2,940	3,530
Albany Highway Interchange	1,550	2,460	2,560	900	1,490	2,150
East of Albany Highway	1,760	2,480	2,800	1,020	1,530	2,550

Table E3 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Inter Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	1,660	2,680	2,720	1,650	2,660	2,720
Oteha Valley Rd IC	1,260	1,870	1,940	1,300	1,910	1,980
Greville Rd to Oteha Valley Rd	2,130	3,290	3,340	1,840	2,610	2,860
Greville Rd Interchange	1,940	3,010	3,150	1,750	2,250	2,710
Greville Rd to Upper Harbour	3,340	4,700	5,270	3,170	3,850	4,920
Upper Harbour Interchange	2,670	3,580	3,580	2,380	2,840	2,860
Upper Harbour to Tristram Ave	3,800	4,770	5,000	3,720	4,080	4,080
SH18						
Tauhinu Rd to Greenhithe Rd	1,350	2,430	2,570	1,350	2,480	2,750
Greenhithe Rd to Albany Hwy	1,530	2,740	2,980	1,560	2,900	3,220
Albany Highway Interchange	670	1,280	1,680	870	1,190	1,910
East of Albany Highway	870	1,370	1,910	1,010	1,230	2,070

Table E4 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Inter Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	1,660	2,680	2,720	1,650	2,660	2,720
Oteha Valley Rd IC	1,260	1,870	1,950	1,300	1,910	1,980
Greville Rd to Oteha Valley Rd	2,130	3,290	3,340	1,840	2,610	2,860
Greville Rd Interchange	1,940	3,020	3,150	1,750	2,250	2,710
Greville Rd to Upper Harbour	3,340	4,710	5,280	3,170	3,850	4,920
Upper Harbour Interchange	2,670	3,580	3,580	2,380	2,840	2,860
Upper Harbour to Tristram Ave	3,800	4,770	5,000	3,720	4,080	4,090
SH18						
Tauhinu Rd to Greenhithe Rd	1,350	2,430	2,570	1,350	2,480	2,750
Greenhithe Rd to Albany Hwy	1,530	2,750	2,980	1,560	2,900	3,220
Albany Highway Interchange	670	1,280	1,680	870	1,190	1,910
East of Albany Highway	870	1,370	1,910	1,010	1,230	2,070

Table E5 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Evening Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	3,350	4,320	4,570	1,620	2,330	2,400
Oteha Valley Rd IC	2,560	3,030	3,350	1,360	1,840	1,900
Greville Rd to Oteha Valley Rd	4,140	4,550	5,080	2,000	2,510	2,870
Greville Rd Interchange	3,850	4,040	4,800	1,900	2,150	2,720
Greville Rd to Upper Harbour	5,320	5,440	7,220	3,120	3,770	4,690
Upper Harbour Interchange	4,250	4,260	4,970	2,070	2,540	2,340
Upper Harbour to Tristram Ave	5,040	5,310	5,840	3,290	3,720	3,650
SH18						
Tauhinu Rd to Greenhithe Rd	1,570	2,480	2,900	2,600	2,660	3,350
Greenhithe Rd to Albany Hwy	1,820	2,820	3,290	2,980	3,110	4,010
Albany Highway Interchange	870	1,180	1,920	1,560	1,670	2,570
East of Albany Highway	1,100	1,220	2,080	1,630	1,680	2,870

Table E6 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Evening Peak

	Northbound/Eastbound			Southbound/Westbound		
Road	**2015**	**2031 Reference Case**	**2031 Project**	**2015**	**2031 Reference Case**	**2031 Project**
SH1						
North of Oteha Valley Rd	3,460	4,790	4,750	1,620	2,330	2,400
Oteha Valley Rd IC	2,660	3,470	3,510	1,360	1,840	1,900
Greville Rd to Oteha Valley Rd	4,310	5,210	5,330	2,010	2,520	2,880
Greville Rd Interchange	4,010	4,690	5,040	1,910	2,160	2,740
Greville Rd to Upper Harbour	5,550	6,320	7,580	3,210	3,860	4,770
Upper Harbour Interchange	4,420	4,790	5,210	2,130	2,590	2,380
Upper Harbour to Tristram Ave	5,250	5,520	6,120	3,440	3,830	3,730
SH18						
Tauhinu Rd to Greenhithe Rd	1,650	2,670	3,090	2,750	3,010	3,440
Greenhithe Rd to Albany Hwy	1,910	3,010	3,480	3,150	3,520	4,110
Albany Highway Interchange	910	1,260	2,040	1,670	1,930	2,620
East of Albany Highway	1,150	1,300	2,200	1,740	1,930	2,930

Table E7 Predicted Local Arterial Weekday Actual Flows (two way, vehicles per hour) – Morning Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	1,190	1,260	1,080
Constellation Drive (east of Apollo Dr)	2,000	2,170	2,180
Rosedale Road (west of Tawa Dr)	1,790	1,650	1,170
Rosedale Road (west of Apollo Dr)	1,000	1,120	830
McClymonts Road (west of Medallion Dr)	1,690	1,960	2,080
Oteha Valley Road (east of SH1)	2,030	2,170	2,500
Oteha Valley Road (west of Munroe Ln)	1,270	1,210	1110
Greville Road (east of SH1)	1,320	1,920	2,180
Albany Highway (south of Wharf Rd)	1,530	2,140	1,540
Albany Highway (south of Rosedale Rd)	1,570	1,850	1,380
Albany Highway (south of Upper Harbour Dr)	2,620	3,510	3,990
Albany Expressway (west of SH1)	1,670	2,170	2,720
Albany Expressway (west of Bush Rd)	1,550	1,900	2,270
William Pickering Drive (north of Piermark Dr)	1,300	1,330	960
Bush Road (north of Piermark Dr)	2,290	2,240	1,950
Tawa Drive (north of Rosedale Rd)	1,250	1,330	980
Apollo Drive (north of Constellation Dr)	1,850	1,990	1,710
East Coast Road (north of Greville Rd)	1,620	1,980	2,040
East Coast Road (north of Browns Bay Rd)	1,820	1,660	1,820
East Coast Road (north of Constellation Dr)	2,810	3,120	2,950
Unsworth Drive (north of Albany Hwy)	350	500	500
Unsworth Drive (south of Barbados Dr)	300	390	300
Paul Matthews Road (east of Bush Rd)	2,070	2,310	1590
Caribbean Drive (North of Goldfinch Rise)	990	1,260	1,240

Table E8 Predicted Local Arterial Weekday Demand Flows (two way, vehicles per hour) – Morning Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	1,220	1,290	1,090
Constellation Drive (east of Apollo Dr)	2,020	2,230	2,200
Rosedale Road (west of Tawa Dr)	1,820	1,670	1,170
Rosedale Road (west of Apollo Dr)	1,030	1,140	830
McClymonts Road (west of Medallion Dr)	1,690	1,960	2,100
Oteha Valley Road (east of SH1)	2,040	2,190	2,520
Oteha Valley Road (west of Munroe Ln)	1,280	1,210	1120
Greville Road (east of SH1)	1,330	1,930	2,190
Albany Highway (south of Wharf Rd)	1,530	2,190	1,550
Albany Highway (south of Rosedale Rd)	1,590	1,880	1,400
Albany Highway (south of Upper Harbour Dr)	2,650	3,720	4,030
Albany Expressway (west of SH1)	1,690	2,210	2,760
Albany Expressway (west of Bush Rd)	1,550	1,930	2,290
William Pickering Drive (north of Piermark Dr)	1,320	1,340	970
Bush Road (north of Piermark Dr)	2,320	2,280	1,970
Tawa Drive (north of Rosedale Rd)	1,260	1,350	990
Apollo Drive (north of Constellation Dr)	1,890	2,030	1,730
East Coast Road (north of Greville Rd)	1,630	1,980	2,060
East Coast Road (north of Browns Bay Rd)	1,830	1,680	1,830
East Coast Road (north of Constellation Dr)	2,830	3,200	2,970
Unsworth Drive (north of Albany Hwy)	350	520	510
Unsworth Drive (south of Barbados Dr)	300	400	300
Paul Matthews Road (east of Bush Rd)	2,100	2,360	1620
Caribbean Drive (North of Goldfinch Rise)	1,020	1,310	1,260

Table E9 Predicted Local Arterial Weekday Actual Flows (two way, vehicles per hour) – Inter Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	690	930	770
Constellation Drive (east of Apollo Dr)	920	1,390	1,320
Rosedale Road (west of Tawa Dr)	1,600	1,480	1,260
Rosedale Road (west of Apollo Dr)	1,050	800	850
McClymonts Road (west of Medallion Dr)	1,930	2,430	2,500
Oteha Valley Road (east of SH1)	1,620	2,500	2,640
Oteha Valley Road (west of Munroe Ln)	1,130	1,190	1230
Greville Road (east of SH1)	970	1,650	1,760
Albany Highway (south of Wharf Rd)	940	1,250	1,030
Albany Highway (south of Rosedale Rd)	1,230	1,240	1,030
Albany Highway (south of Upper Harbour Dr)	1,490	2,220	2,360
Albany Expressway (west of SH1)	2,040	2,560	2,840
Albany Expressway (west of Bush Rd)	1,050	1,790	1,820
William Pickering Drive (north of Piermark Dr)	760	980	760
Bush Road (north of Piermark Dr)	1,680	2,000	1,740
Tawa Drive (north of Rosedale Rd)	1,060	870	860
Apollo Drive (north of Constellation Dr)	1,480	1,570	1,430
East Coast Road (north of Greville Rd)	860	1,350	1,300
East Coast Road (north of Browns Bay Rd)	730	1,240	1,240
East Coast Road (north of Constellation Dr)	1,630	2,160	2,010
Unsworth Drive (north of Albany Hwy)	330	410	460
Unsworth Drive (south of Barbados Dr)	170	130	90
Paul Matthews Road (east of Bush Rd)	1,460	1,240	1,270
Caribbean Drive (North of Goldfinch Rise)	810	1,020	920

Table E10 Predicted Local Arterial Weekday Demand Flows (two way, vehicles per hour) – Inter Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	690	930	770
Constellation Drive (east of Apollo Dr)	920	1,400	1,320
Rosedale Road (west of Tawa Dr)	1,600	1,480	1,260
Rosedale Road (west of Apollo Dr)	1,050	800	850
McClymonts Road (west of Medallion Dr)	1,930	2,440	2,510
Oteha Valley Road (east of SH1)	1,620	2,500	2,640
Oteha Valley Road (west of Munroe Ln)	1,130	1,200	1230
Greville Road (east of SH1)	970	1,650	1,760
Albany Highway (south of Wharf Rd)	940	1,250	1,030
Albany Highway (south of Rosedale Rd)	1,230	1,240	1,030
Albany Highway (south of Upper Harbour Dr)	1,490	2,220	2,360
Albany Expressway (west of SH1)	2,040	2,570	2,840
Albany Expressway (west of Bush Rd)	1,050	1,790	1,820
William Pickering Drive (north of Piermark Dr)	760	980	760
Bush Road (north of Piermark Dr)	1,680	2,000	1,740
Tawa Drive (north of Rosedale Rd)	1,060	870	860
Apollo Drive (north of Constellation Dr)	1,480	1,570	1,430
East Coast Road (north of Greville Rd)	860	1,360	1,300
East Coast Road (north of Browns Bay Rd)	730	1,240	1,240
East Coast Road (north of Constellation Dr)	1,630	2,160	2,010
Unsworth Drive (north of Albany Hwy)	330	420	460
Unsworth Drive (south of Barbados Dr)	170	130	90
Paul Matthews Road (east of Bush Rd)	1,460	1,240	1,270
Caribbean Drive (North of Goldfinch Rise)	810	1,020	920

Table E11 Predicted Local Arterial Weekday Actual Flows (two way, vehicles per hour) – Evening Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	1,280	1,470	1,220
Constellation Drive (east of Apollo Dr)	1,410	1,750	2,010
Rosedale Road (west of Tawa Dr)	1,890	1,870	1,490
Rosedale Road (west of Apollo Dr)	960	1,080	1,070
McClymonts Road (west of Medallion Dr)	1,790	2,030	2,010
Oteha Valley Road (east of SH1)	2,480	2,980	3,060
Oteha Valley Road (west of Munroe Ln)	1,860	1,600	1,160
Greville Road (east of SH1)	1,510	2,230	2,530
Albany Highway (south of Wharf Rd)	1,450	2,410	1,830
Albany Highway (south of Rosedale Rd)	1,810	2,250	1,660
Albany Highway (south of Upper Harbour Dr)	3,020	3,620	3,670
Albany Expressway (west of SH1)	2,420	2,560	2,670
Albany Expressway (west of Bush Rd)	1,680	2,000	2,100
William Pickering Drive (north of Piermark Dr)	840	1,190	940
Bush Road (north of Piermark Dr)	1,770	1,960	1,610
Tawa Drive (north of Rosedale Rd)	1,450	1,240	1,110
Apollo Drive (north of Constellation Dr)	1,840	2,150	1,930
East Coast Road (north of Greville Rd)	1,420	1,800	1,870
East Coast Road (north of Browns Bay Rd)	1,360	1,480	1,360
East Coast Road (north of Constellation Dr)	2,540	2,720	2,520
Unsworth Drive (north of Albany Hwy)	540	560	570
Unsworth Drive (south of Barbados Dr)	280	270	250
Paul Matthews Road (east of Bush Rd)	2,030	2,200	1,720
Caribbean Drive (North of Goldfinch Rise)	1,240	1,280	1,280

Table E12 Predicted Local Arterial Weekday Demand Flows (two way, vehicles per hour) – Evening Peak

	2015	2031 Reference Case	2031 Project
Sunset Road (near SH1)	1,310	1,530	1,250
Constellation Drive (east of Apollo Dr)	1,440	1,830	2,040
Rosedale Road (west of Tawa Dr)	1,940	1,940	1,500
Rosedale Road (west of Apollo Dr)	990	1,110	1,080
McClymonts Road (west of Medallion Dr)	1,830	2,060	2,050
Oteha Valley Road (east of SH1)	2,610	3,140	3,140
Oteha Valley Road (west of Munroe Ln)	1,890	1,660	1,170
Greville Road (east of SH1)	1,590	2,320	2,610
Albany Highway (south of Wharf Rd)	1,480	2,460	1,850
Albany Highway (south of Rosedale Rd)	1,830	2,340	1,680
Albany Highway (south of Upper Harbour Dr)	3,130	3,840	3,740
Albany Expressway (west of SH1)	2,470	2,700	2,730
Albany Expressway (west of Bush Rd)	1,720	2,080	2,140
William Pickering Drive (north of Piermark Dr)	860	1,210	960
Bush Road (north of Piermark Dr)	1,800	2,040	1,630
Tawa Drive (north of Rosedale Rd)	1,490	1,290	1,120
Apollo Drive (north of Constellation Dr)	1,870	2,260	1,950
East Coast Road (north of Greville Rd)	1,480	1,860	1,910
East Coast Road (north of Browns Bay Rd)	1,420	1,540	1,390
East Coast Road (north of Constellation Dr)	2,590	2,850	2,570
Unsworth Drive (north of Albany Hwy)	570	600	590
Unsworth Drive (south of Barbados Dr)	300	280	250
Paul Matthews Road (east of Bush Rd)	2,070	2,300	1,750
Caribbean Drive (North of Goldfinch Rise)	1,320	1,420	1,340

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Appendix F
Volume/Capacity Ratio Plots

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2015 Base - Weekday Morning Peak Volume/Capacity Plot

2015 Base - Weekday Inter Peak Volume/Capacity Plot

2015 Base - Weekday Evening Peak Volume/Capacity Plot

2031 Reference Case - Weekday Morning Peak Volume/Capacity Plot

2031 Reference Case - Weekday Inter Peak Volume/Capacity Plot

2031 Reference Case - Weekday Evening Peak Volume/Capacity Plot

2031 Project - Weekday Morning Peak Volume/Capacity Plot

2031 Project - Weekday Inter Peak Volume/Capacity Plot

2031 Project - Weekday Evening Peak Volume/Capacity Plot

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Appendix G
Predicted Volume/Capacity Ratios at Key Intersections

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Table G1 Predicted Intersection Volume/Capacity Ratios – SH1/Greville Road/Tawa Drive Interchange, Morning Peak

Road	2015	2031 Reference Case	2031 Project
SH1 Northbound Ramps Intersection			
SH17 West Left Turn	19%	29%	57%
SH17 West Through	1%	2%	1%
SH17 West Right Turn	47%	70%	80%
Tawa Drive Left Turn	28%	28%	19%
Tawa Drive Through	26%	15%	13%
Tawa Drive Right Turn	28%	30%	14%
SH1 Off Ramp Left Turn	33%	53%	32%
SH1 Off Ramp Through	72%	95%	87%
SH1 Off Ramp Right Turn	45%	57%	89%
Greville Road Left Turn	100%	95%	67%
Greville Road Through	100%	85%	60%
Greville Road Right Turn	93%	101%	77%
SH1 Southbound Ramps Intersection			
Greville Road East Left Turn	57%	60%	70%
Greville Road East Through	82%	84%	45%
SH1 Off Ramp Left Turn	24%	58%	30%
SH1 Off Ramp Right Turn	37%	100%	61%
Greville Road West Through	58%	22%	44%
Greville Road West Right Turn	32%	22%	72%

Table G2 Predicted Intersection Volume/Capacity Ratios – SH1/Greville Road/Tawa Drive Interchange, Inter Peak

Road	2015	2031 Reference Case	2031 Project
SH1 Northbound Ramps Intersection			
SH17 West Left Turn	61%	68%	91%
SH17 West Through	2%	9%	5%
SH17 West Right Turn	16%	18%	11%
Tawa Drive Left Turn	39%	25%	17%
Tawa Drive Through	49%	37%	63%
Tawa Drive Right Turn	43%	36%	50%
SH1 Off Ramp Left Turn	48%	34%	30%
SH1 Off Ramp Through	65%	83%	85%
SH1 Off Ramp Right Turn	53%	79%	72%
Greville Road Left Turn	31%	65%	65%
Greville Road Through	11%	27%	13%
Greville Road Right Turn	17%	99%	93%
SH1 Southbound Ramps Intersection			
Greville Road East Left Turn	81%	58%	75%
Greville Road East Through	19%	70%	26%
SH1 Off Ramp Left Turn	4%	24%	10%
SH1 Off Ramp Right Turn	21%	53%	41%
Greville Road West Through	51%	43%	48%
Greville Road West Right Turn	86%	43%	98%

Table G3 **Predicted Intersection Volume/Capacity Ratios – SH1/Greville Road/Tawa Drive Interchange, Evening Peak**

Road	2015	2031 Reference Case	2031 Project
SH1 Northbound Ramps Intersection			
SH17 West Left Turn	61%	96%	104%
SH17 West Through	4%	26%	24%
SH17 West Right Turn	41%	48%	87%
Tawa Drive Left Turn	35%	101%	100%
Tawa Drive Through	93%	97%	100%
Tawa Drive Right Turn	44%	93%	61%
SH1 Off Ramp Left Turn	42%	13%	17%
SH1 Off Ramp Through	94%	43%	53%
SH1 Off Ramp Right Turn	102%	67%	96%
Greville Road Left Turn	42%	98%	58%
Greville Road Through	9%	82%	19%
Greville Road Right Turn	14%	100%	81%
SH1 Southbound Ramps Intersection			
Greville Road East Left Turn	57%	53%	84%
Greville Road East Through	22%	74%	38%
SH1 Off Ramp Left Turn	5%	25%	18%
SH1 Off Ramp Right Turn	25%	60%	46%
Greville Road West Through	104%	58%	82%
Greville Road West Right Turn	104%	58%	64%

Table G4 Predicted Intersection Volume/Capacity Ratios – SH1/Constellation Drive Interchange, Morning Peak

Road			
SH1 Northbound Ramps Intersection			
SH18 Left Turn	101%	102%	33%
SH18 Through	104%	98%	93%
SH1 Off Ramp Left Turn	73%	90%	58%
SH1 Off Ramp Right Turn	73%	81%	84%
Constellation Drive Through	45%	76%	60%
Constellation Drive Right Turn	67%	100%	74%
SH1 Southbound Ramps Intersection			
Constellation Drive East Left Turn	98%	100%	86%
Constellation Drive East Through	39%	50%	65%
SH1 Off Ramp Left Turn	12%	63%	N/A
SH1 Off Ramp Through (Buses Only)	48%	106%	61%
SH1 Off Ramp Right Turn	81%	85%	83%
Constellation Drive West Through	82%	68%	65%
Constellation Drive West Right Turn	98%	100%	86%

Table G5 Predicted Intersection Volume/Capacity Ratios – SH1/Constellation Drive Interchange, Inter Peak

Road			
SH1 Northbound Ramps Intersection			
SH18 Left Turn	53%	94%	34%
SH18 Through	77%	85%	74%
SH1 Off Ramp Left Turn	96%	100%	48%
SH1 Off Ramp Right Turn	82%	90%	88%
Constellation Drive Through	65%	74%	55%
Constellation Drive Right Turn	69%	92%	86%
SH1 Southbound Ramps Intersection			
Constellation Drive East Left Turn	91%	96%	83%
Constellation Drive East Through	26%	33%	50%
SH1 Off Ramp Left Turn	0%	14%	N/A
SH1 Off Ramp Through (Buses Only)	85%	95%	71%
SH1 Off Ramp Right Turn	87%	96%	80%
Constellation Drive West Through	96%	98%	84%
Constellation Drive West Right Turn	91%	96%	83%

Table G6 Predicted Intersection Volume/Capacity Ratios – SH1/Constellation Drive Interchange, Evening Peak

Road			
SH1 Northbound Ramps Intersection			
SH18 Left Turn	95%	108%	66%
SH18 Through	98%	101%	99%
SH1 Off Ramp Left Turn	102%	98%	47%
SH1 Off Ramp Right Turn	47%	50%	39%
Constellation Drive Through	83%	80%	76%
Constellation Drive Right Turn	58%	104%	88%
SH1 Southbound Ramps Intersection			
Constellation Drive East Left Turn	105%	57%	41%
Constellation Drive East Through	109%	106%	101%
SH1 Off Ramp Left Turn	12%	22%	20%
SH1 Off Ramp Through (Buses Only)	3%	26%	N/A
SH1 Off Ramp Right Turn	100%	107%	88%
Constellation Drive West Through	98%	93%	88%
Constellation Drive West Right Turn	102%	96%	98%

2015 Existing Layout

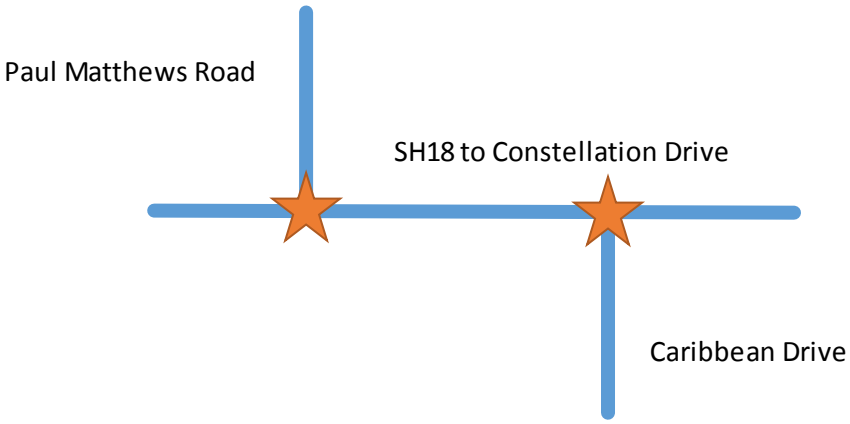

Table G7 Predicted Weekday Traffic Flows at Paul Matthews Road/SH18 intersection and Caribbean Drive/SH18 intersection, 2015 Base

	Morning Peak	Inter Peak	Evening Peak
Paul Matthews Road/SH18 Intersection			
Paul Matthews Road Left Turn into SH18 East	62%	72%	103%
Paul Matthews Road Right Turn in to SH18 West	90%	80%	99%
SH18 West Left Turn into Paul Matthews Road	47%	2%	1%
SH18 West Through to SH18 East	47%	2%	1%
SH18 East Through to SH18 West	42%	43%	67%
SH18 East Right Turn into Paul Matthews Road	78%	58%	51%

Caribbean Drive/SH18 Intersection			
SH18 West Through to SH18 East	64%	65%	75%
SH18 West Right Turn into Caribbean Drive	73%	65%	78%
Caribbean Drive Left Turn into SH18 West	66%	35%	66%
Caribbean Drive Right Turn into SH18 East	95%	83%	100%
SH18 East Left Turn into Caribbean Drive	14%	25%	52%
SH18 East Through to SH18 West	91%	77%	79%

2031 Reference Case Layout

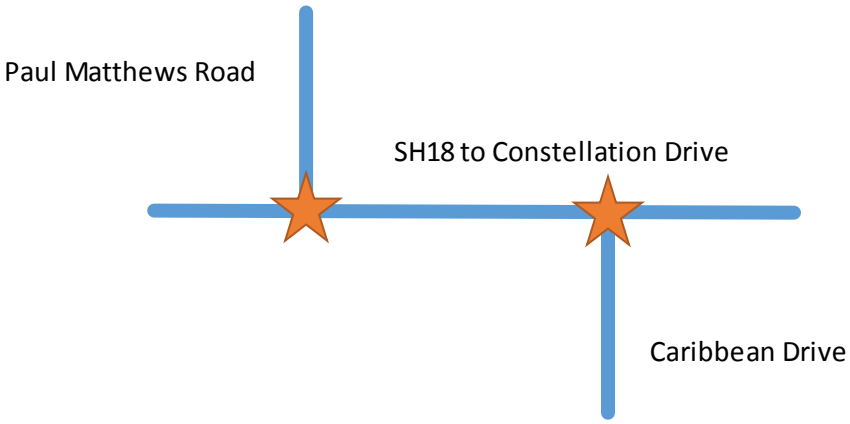

Table G8 Predicted Weekday Traffic Flows at Paul Matthews Road/SH18 intersection and Caribbean Drive/SH18 intersection, 2031 Reference Case

	Morning Peak	Inter Peak	Evening Peak
Paul Matthews Road/SH18 Intersection			
Paul Matthews Road Left Turn into SH18 East	83%	79%	102%
Paul Matthews Road Right Turn in to SH18 West	107%	44%	102%
SH18 West Left Turn into Paul Matthews Road	70%	3%	6%
SH18 West Through to SH18 East	70%	3%	6%
SH18 East Through to SH18 West	61%	60%	65%
SH18 East Right Turn into Paul Matthews Road	84%	61%	85%

Caribbean Drive/SH18 Intersection			
SH18 West Through to SH18 East	80%	85%	75%
SH18 West Right Turn into Caribbean Drive	107%	64%	100%
Caribbean Drive Left Turn into SH18 West	67%	45%	64%
Caribbean Drive Right Turn into SH18 East	98%	82%	86%
SH18 East Left Turn into Caribbean Drive	39%	24%	53%
SH18 East Through to SH18 West	100%	91%	90%

2031 With Project

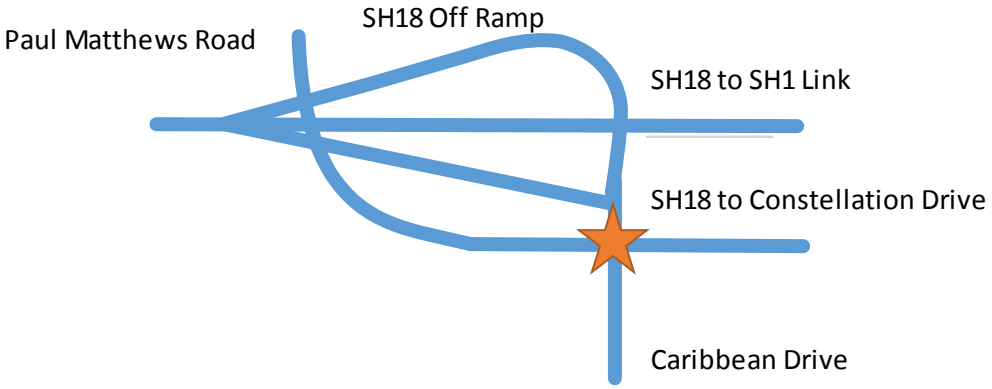

Table G9 Predicted Weekday Traffic Flows at Paul Matthews Road/SH18/Caribbean Drive intersection, 2031 Project

	Morning Peak	Inter Peak	Evening Peak
Paul Matthews Road Left Turn into SH18 Ramps	20%	0%	12%
Paul Matthews Road Through to Constellation Drive	39%	66%	95%
Paul Matthews Road Right Turn into Caribbean Drive	85%	69%	102%
Caribbean Drive Left Turn into Paul Matthews Drive	66%	29%	40%
Caribbean Drive Through to SH18 Ramps	42%	13%	76%
Caribbean Drive Right Turn into Constellation Drive	92%	76%	99%
Constellation Drive Left Turn into Caribbean Drive	37%	28%	52%
Constellation Drive Through to SH18 Ramps	93%	64%	42%
Constellation Drive Right Turn into Paul Matthews Drive	97%	77%	81%
SH18 Ramps Left Turn into Constellation Drive	85%	75%	45%
SH18 Ramps Through to Caribbean Drive	97%	31%	68%
SH18 Ramps Right Turn into Paul Matthews Drive	93%	0%	0%

Appendix H
Predicted Hourly Traffic Data – 2031 Sensitivity Tests

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Table H1 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Morning Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	1,520	1,550	1,940	1,990	2,070	2,140
Oteha Valley Rd IC	1,310	1,360	1,600	1,660	1,700	1,790
Greville Rd to Oteha Valley Rd	2,400	2,420	2,640	2,680	2,780	2,780
Greville Rd Interchange	2,300	2,350	2,470	2,590	2,600	2,680
Greville Rd to Upper Harbour	3,560	4,340	3,860	4,810	4,050	5,220
Upper Harbour Interchange	2,320	2,300	2,620	2,450	2,820	2,440
Upper Harbour to Tristram Ave	3,320	3,640	3,620	3,810	3,920	3,960
SH1 Southbound						
North of Oteha Valley Rd	2,380	2,480	3,170	3,250	3,480	3,580
Oteha Valley Rd IC	1,830	1,970	2,240	2,430	2,470	2,650
Greville Rd to Oteha Valley Rd	2,510	2,840	2,820	3,200	3,200	3,550
Greville Rd Interchange	1,790	2,450	2,030	2,770	2,400	3,100
Greville Rd to Upper Harbour	2,950	4,110	3,160	4,530	3,720	5,030
Upper Harbour Interchange	1,910	1,840	2,090	2,040	2,370	2,250
Upper Harbour to Tristram Ave	2,570	2,510	2,870	2,800	3,260	3,220
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	3,000	3,040	3,490	3,660	3,990	4,150
Greenhithe Rd to Albany Hwy	3,510	3,590	4,010	4,210	4,540	4,830
Albany Highway Interchange	1,930	1,970	2,380	2,500	2,780	3,200
East of Albany Highway	2,020	2,250	2,390	2,740	2,790	3,390
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	2,420	2,810	2,530	3,120	2,740	3,460
Greenhithe Rd to Albany Hwy	2,750	3,180	2,820	3,480	3,000	3,790
Albany Highway Interchange	1,370	1,860	1,440	2,130	1,560	2,350
East of Albany Highway	1,420	2,270	1,480	2,530	1,620	2,640

Table H2 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Morning Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	1,550	1,580	2,000	2,030	2,280	2,290
Oteha Valley Rd IC	1,340	1,390	1,650	1,700	1,910	1,940
Greville Rd to Oteha Valley Rd	2,450	2,480	2,730	2,740	3,120	3,010
Greville Rd Interchange	2,350	2,400	2,550	2,650	2,930	2,910
Greville Rd to Upper Harbour	3,640	4,430	3,990	4,930	4,560	5,670
Upper Harbour Interchange	2,360	2,330	2,690	2,510	3,160	2,680
Upper Harbour to Tristram Ave	3,370	3,690	3,730	3,920	4,390	4,360
SH1 Southbound						
North of Oteha Valley Rd	2,380	2,480	3,170	3,250	3,480	3,580
Oteha Valley Rd IC	1,830	1,970	2,240	2,430	2,470	2,650
Greville Rd to Oteha Valley Rd	2,510	2,840	2,820	3,200	3,210	3,560
Greville Rd Interchange	1,790	2,450	2,040	2,770	2,410	3,110
Greville Rd to Upper Harbour	2,960	4,120	3,170	4,540	3,790	5,110
Upper Harbour Interchange	1,910	1,840	2,100	2,040	2,400	2,280
Upper Harbour to Tristram Ave	2,580	2,520	2,890	2,820	3,390	3,330
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	3,160	3,200	3,640	3,770	4,360	4,530
Greenhithe Rd to Albany Hwy	3,680	3,750	4,150	4,320	4,920	5,220
Albany Highway Interchange	2,020	2,050	2,460	2,560	3,010	3,460
East of Albany Highway	2,110	2,340	2,480	2,800	3,030	3,650
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	2,480	2,830	2,640	3,160	3,130	3,590
Greenhithe Rd to Albany Hwy	2,810	3,200	2,940	3,530	3,430	3,940
Albany Highway Interchange	1,400	1,870	1,490	2,150	1,790	2,430
East of Albany Highway	1,440	2,280	1,530	2,550	1,850	2,730

Table H3 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Inter Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	1,780	1,820	2,680	2,720	2,940	2,990
Oteha Valley Rd IC	1,350	1,400	1,870	1,940	2,060	2,120
Greville Rd to Oteha Valley Rd	2,710	2,840	3,290	3,340	3,530	3,550
Greville Rd Interchange	2,500	2,680	3,010	3,150	3,190	3,340
Greville Rd to Upper Harbour	4,110	4,580	4,700	5,270	5,090	5,660
Upper Harbour Interchange	3,130	3,100	3,580	3,580	3,950	3,900
Upper Harbour to Tristram Ave	4,330	4,400	4,770	5,000	5,160	5,400
SH1 Southbound						
North of Oteha Valley Rd	1,780	1,800	2,660	2,720	2,930	2,990
Oteha Valley Rd IC	1,390	1,420	1,910	1,980	2,120	2,190
Greville Rd to Oteha Valley Rd	2,150	2,300	2,610	2,860	2,920	3,150
Greville Rd Interchange	1,960	2,230	2,250	2,710	2,520	2,970
Greville Rd to Upper Harbour	3,520	4,260	3,850	4,920	4,000	5,280
Upper Harbour Interchange	2,620	2,720	2,840	2,860	2,970	2,890
Upper Harbour to Tristram Ave	3,850	3,890	4,080	4,080	4,100	4,080
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	1,850	1,930	2,430	2,570	2,580	2,860
Greenhithe Rd to Albany Hwy	2,250	2,350	2,740	2,980	2,880	3,250
Albany Highway Interchange	1,020	1,310	1,280	1,680	1,260	1,840
East of Albany Highway	1,140	1,590	1,370	1,910	1,370	2,110
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	1,830	1,920	2,480	2,750	2,770	3,190
Greenhithe Rd to Albany Hwy	2,310	2,400	2,900	3,220	3,230	3,700
Albany Highway Interchange	940	1,350	1,190	1,910	1,400	2,210
East of Albany Highway	990	1,450	1,230	2,070	1,450	2,450

Table H4 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Inter Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	1,780	1,820	2,680	2,720	2,970	3,020
Oteha Valley Rd IC	1,350	1,400	1,870	1,950	2,090	2,150
Greville Rd to Oteha Valley Rd	2,710	2,840	3,290	3,340	3,580	3,600
Greville Rd Interchange	2,500	2,680	3,020	3,150	3,240	3,390
Greville Rd to Upper Harbour	4,110	4,580	4,710	5,280	5,160	5,740
Upper Harbour Interchange	3,130	3,110	3,580	3,580	4,010	3,950
Upper Harbour to Tristram Ave	4,340	4,400	4,770	5,000	5,230	5,480
SH1 Southbound						
North of Oteha Valley Rd	1,780	1,800	2,660	2,720	2,930	2,990
Oteha Valley Rd IC	1,390	1,420	1,910	1,980	2,120	2,190
Greville Rd to Oteha Valley Rd	2,150	2,300	2,610	2,860	2,920	3,150
Greville Rd Interchange	1,960	2,230	2,250	2,710	2,520	2,970
Greville Rd to Upper Harbour	3,530	4,260	3,850	4,920	4,040	5,310
Upper Harbour Interchange	2,620	2,720	2,840	2,860	2,990	2,900
Upper Harbour to Tristram Ave	3,850	3,890	4,080	4,090	4,140	4,100
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	1,850	1,930	2,430	2,570	2,630	2,920
Greenhithe Rd to Albany Hwy	2,250	2,350	2,750	2,980	2,940	3,310
Albany Highway Interchange	1,020	1,310	1,280	1,680	1,290	1,870
East of Albany Highway	1,140	1,590	1,370	1,910	1,400	2,140
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	1,830	1,920	2,480	2,750	2,840	3,210
Greenhithe Rd to Albany Hwy	2,310	2,400	2,900	3,220	3,320	3,730
Albany Highway Interchange	940	1,350	1,190	1,910	1,440	2,220
East of Albany Highway	1,000	1,450	1,230	2,070	1,480	2,470

Table H5 Predicted Motorway Weekday Actual Flows (vehicles per hour) – Evening Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	3,670	3,840	4,320	4,570	4,410	4,770
Oteha Valley Rd IC	2,760	2,930	3,030	3,350	3,130	3,580
Greville Rd to Oteha Valley Rd	4,270	4,660	4,550	5,080	4,670	5,300
Greville Rd Interchange	3,870	4,480	4,040	4,800	4,100	4,820
Greville Rd to Upper Harbour	5,440	6,960	5,440	7,220	5,440	7,280
Upper Harbour Interchange	4,320	4,760	4,260	4,970	4,240	5,030
Upper Harbour to Tristram Ave	5,200	5,670	5,310	5,840	5,370	6,000
SH1 Southbound						
North of Oteha Valley Rd	1,940	1,980	2,330	2,400	2,570	2,640
Oteha Valley Rd IC	1,630	1,680	1,840	1,900	1,990	2,090
Greville Rd to Oteha Valley Rd	2,250	2,600	2,510	2,870	3,080	3,160
Greville Rd Interchange	1,970	2,490	2,150	2,720	2,720	2,990
Greville Rd to Upper Harbour	3,580	4,380	3,770	4,690	3,760	5,040
Upper Harbour Interchange	2,390	2,190	2,540	2,340	2,560	2,530
Upper Harbour to Tristram Ave	3,560	3,460	3,720	3,650	3,810	3,910
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	2,280	2,530	2,480	2,900	2,690	3,080
Greenhithe Rd to Albany Hwy	2,630	2,950	2,820	3,290	3,090	3,510
Albany Highway Interchange	1,030	1,800	1,180	1,920	1,360	2,070
East of Albany Highway	1,110	1,980	1,220	2,080	1,390	2,270
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	2,660	3,260	2,660	3,350	2,680	3,500
Greenhithe Rd to Albany Hwy	3,120	3,930	3,110	4,010	3,120	4,190
Albany Highway Interchange	1,680	2,490	1,670	2,570	1,680	2,750
East of Albany Highway	1,680	2,780	1,680	2,870	1,680	3,090

Table H6 Predicted Motorway Weekday Demand Flows (vehicles per hour) – Evening Peak

	2021 Demands		Default 2031 Demands		2031 Demands + 10%	
Road	**Reference Case**	**With Project**	**Reference Case**	**With Project**	**Reference Case**	**With Project**
SH1 Northbound						
North of Oteha Valley Rd	3,940	3,950	4,790	4,750	5,450	5,300
Oteha Valley Rd IC	3,010	3,040	3,470	3,510	4,070	4,020
Greville Rd to Oteha Valley Rd	4,660	4,830	5,210	5,330	6,070	5,960
Greville Rd Interchange	4,270	4,650	4,690	5,040	5,450	5,470
Greville Rd to Upper Harbour	6,000	7,220	6,320	7,580	7,240	8,260
Upper Harbour Interchange	4,620	4,930	4,790	5,210	5,500	5,700
Upper Harbour to Tristram Ave	5,360	5,870	5,520	6,120	6,140	6,800
SH1 Southbound						
North of Oteha Valley Rd	1,940	1,980	2,330	2,400	2,570	2,640
Oteha Valley Rd IC	1,630	1,680	1,840	1,900	1,990	2,090
Greville Rd to Oteha Valley Rd	2,260	2,610	2,520	2,880	3,150	3,220
Greville Rd Interchange	1,980	2,510	2,160	2,740	2,810	3,050
Greville Rd to Upper Harbour	3,640	4,430	3,860	4,770	4,260	5,290
Upper Harbour Interchange	2,420	2,220	2,590	2,380	2,900	2,650
Upper Harbour to Tristram Ave	3,620	3,500	3,830	3,730	4,340	4,170
SH18 Eastbound						
Tauhinu Rd to Greenhithe Rd	2,340	2,570	2,670	3,090	3,070	3,440
Greenhithe Rd to Albany Hwy	2,690	2,990	3,010	3,480	3,490	3,870
Albany Highway Interchange	1,050	1,830	1,260	2,040	1,540	2,290
East of Albany Highway	1,140	2,010	1,300	2,200	1,570	2,490
SH18 Westbound						
Tauhinu Rd to Greenhithe Rd	2,930	3,340	3,010	3,440	3,470	3,730
Greenhithe Rd to Albany Hwy	3,440	4,010	3,520	4,110	4,040	4,470
Albany Highway Interchange	1,900	2,530	1,930	2,620	2,210	2,930
East of Albany Highway	1,900	2,820	1,930	2,930	2,210	3,290