Stantec

TUUMATA PLAN CHANGE
Traffic Modelling Report

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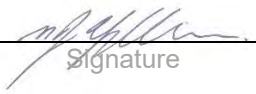
Approved by: 
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Acronyms / Abbreviations

AM	Morning (peak period)
EB	Eastbound
ETC	Eastern Transport Corridor (ETC)
GFA	Gross Floor Area
HCC	Hamilton City Council
hh	Household
ITA	Integrated Transportation Assessment
LASS	Local Authority Shared Services
MDR	Medium Density Residential
NB	Northbound
NC	Neighbourhood Centre
ODP	Operative District Plan
PM	Evening (peak period)
RSP	Ruakura Structure Plan
RR453	Waka Kotahi Research Report 453
SB	Southbound
vpd	Vehicles per day
Vph	Vehicles per hour
WB	Westbound
WEX	Waikato Expressway
WRTM	Waikato Regional Transportation Model

1 Executive Summary

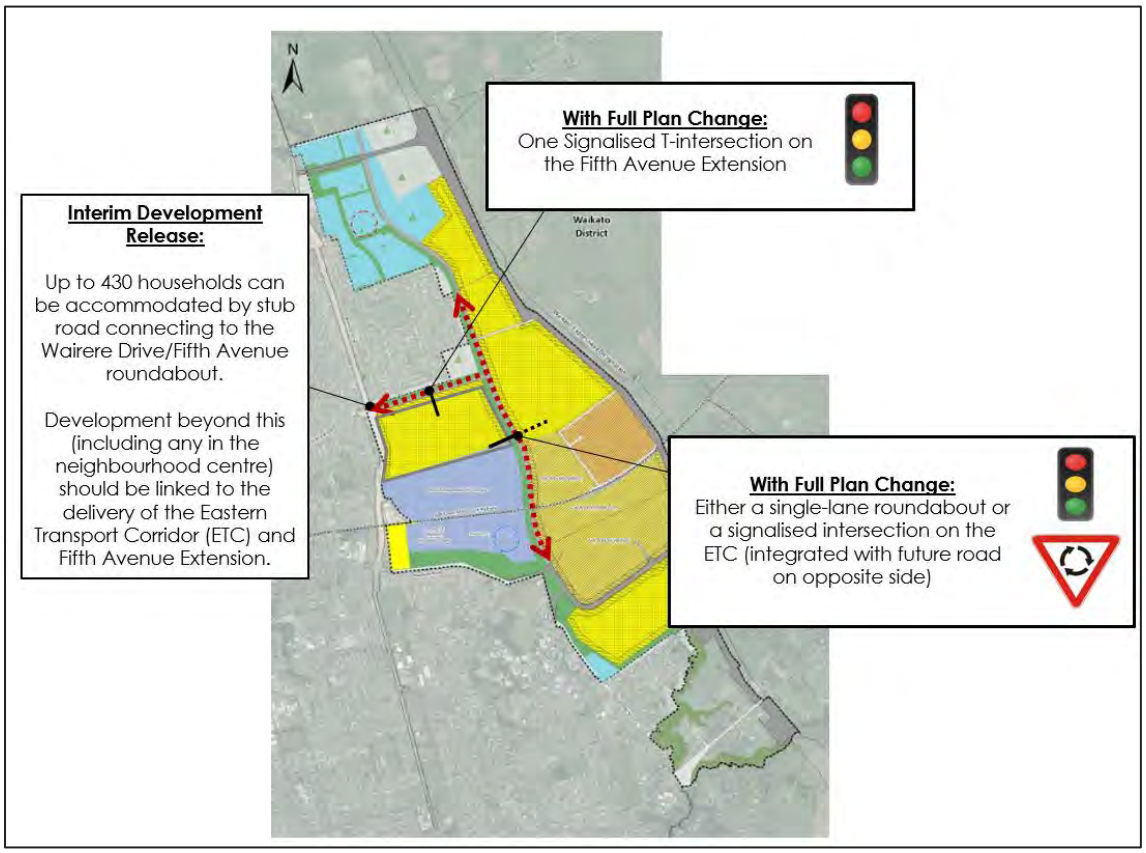
This report describes modelling of the proposed Tuumata Plan Change, comprising the Tuumata Residential Zone and Tuumata Neighbourhood Centre, using the Waikato Regional Transportation Model (WRTM).

The Plan Change area includes approximately 1,269 residential households and a neighbourhood centre of approximately 6,000m^2 gross floor area (GFA).

The key conclusions of this report, which are also summarised on Figure 1, are:

- Up to 430 households can be accommodated by the existing transport network ahead of delivery of the Eastern Transport Corridor (ETC) and Fifth Avenue Extension;
- When fully developed, the Plan Change area has two connections to the arterial transport network, one on the Fifth Avenue Extension and one on the ETC. The following layouts provide appropriate capacity:
  - A signalised T-intersection on the Fifth Avenue Extension; and
  - Either a single lane roundabout or a signalised crossroad intersection on the ETC, both integrated with a future Structure Plan Road as the eastern leg.
- If a school were to be designated in the Plan Change area in future, the above intersections forms can operate appropriately. The right turn lane approaching the Plan Change area on the Fifth Avenue Extension (from the city side) would need to be around 20m longer however will remain well clear of the Wairere Drive intersection.

Figure 1 – Summary Findings



2 Introduction

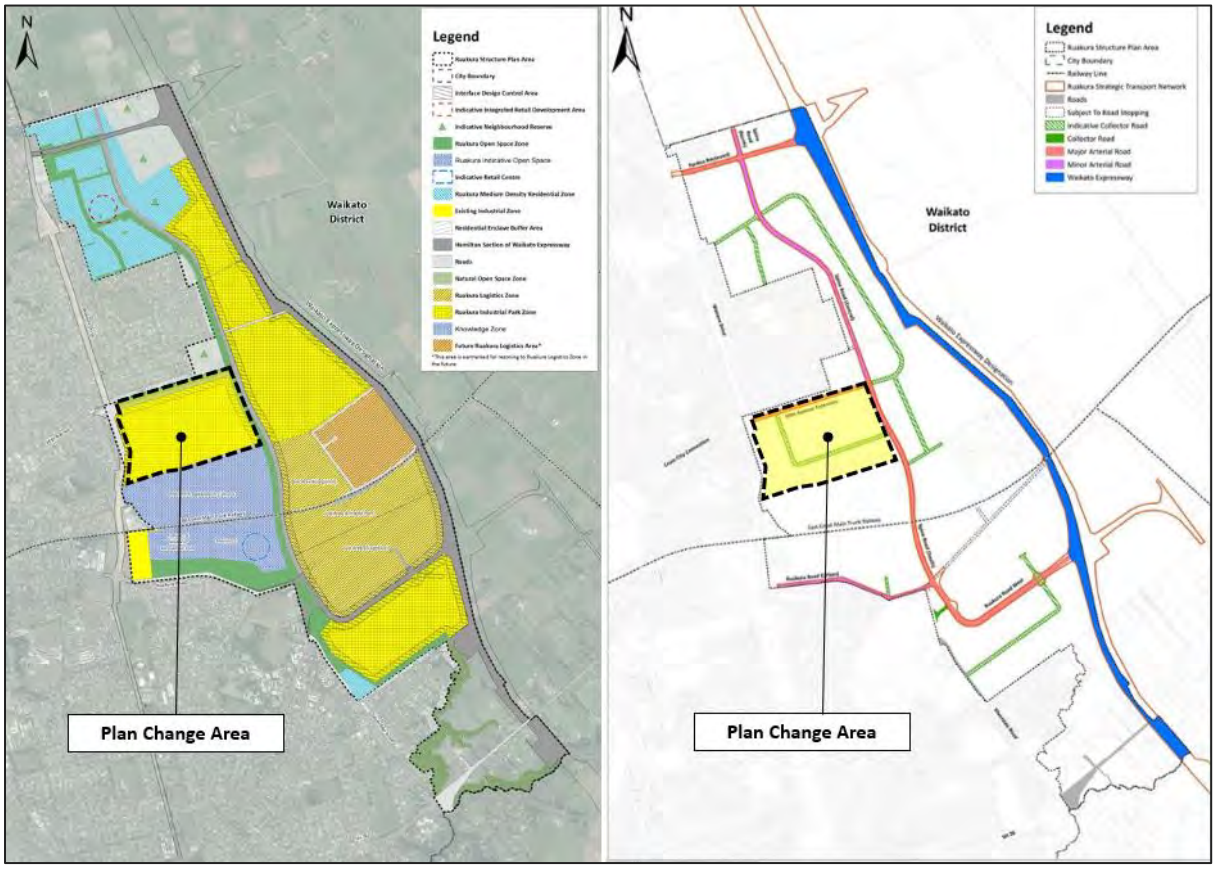
Stantec has been appointed by Tainui Group Holdings (TGH) to examine and describe the traffic and transportation effects of the proposed Tuumata Plan Change that seeks to rezone land in the Ruakura-Tuumata Structure Plan Area from its existing Industrial Park Zoning to Residential, with an integrated Neighbourhood Centre.

This report focusses on traffic modelling using the Waikato Regional Transportation Model (WRTM) and SIDRA isolated intersection modelling, which is integrated into the WRTM.

It is intended to be read in conjunction with the Integrated Transportation Assessment (ITA) report that has also been prepared by Stantec to accompany the Plan Change Application.

The location of the Tuumata Plan Change area in the context of the existing Ruakura Structure Plan (RSP) land use and strategic transport infrastructure maps is shown below as Figure 2.

Figure 2 – Plan Change Area Location (Base Maps from HCC ODP Figure 2-14 and 2-15A)



3 Modelling Approach

3.1 Overview

The WRTM modelling was completed as a third-party engagement through Local Authority Shared Services (LASS), as the model manager. One round of modelling was completed in June 2022 and a further round was run in October 2022. Copies of the model briefing documents are included as Appendix A.

The modelling approach and trip generation inputs were developed in consultation with Hamilton City Council (HCC) Officers and their technical advisors (Gray Matter).

The modelling assessment included six scenarios that can be summarised as:

Scenarios used to assess an interim release of development (residential only), ahead of delivery of the Eastern Transport Corridor (ETC):

- **Scenario 1**: 2018 base model with no development in the Plan Change area and the Waikato Expressway (WEX) assumed to be completed.
- **Scenario 2:** 2018 base model as above with 430 dwellings added in the Plan Change area[1].
- **Scenario 3:** 2031 base model with no development in the Plan Change area and Eastern Transport Corridor (ETC) assumed not to be in place.
- **Scenario 4:** 2031 base model as above with 430 dwellings in the Plan Change area.

Scenarios used to assess full development of the Plan Change area (residential and neighbourhood centre) at the year 2041:

- **Scenario 5:** 2041 base with no development in the Plan Change area.
- **Scenario 6[2]:** 2041 base with full development of the Plan Change area.

The purpose of Scenarios 1 to 4 is to assess the level of development that can be accommodated in the Plan Change area ahead of the delivery of the ETC. The years 2018 and 2031 are used because they are the available model years. If needed, they can be interpolated between to assess different potential delivery years for the ETC, which does not have a committed timeframe at this stage.

Scenarios 5 and 6 provide the 'with Plan Change' and 'without Plan Change comparisons at the future year 2041, with the Tuumata Plan Change area developed to its intended potential.

It is noted that when the Ruakura Structure Plan was adopted and incorporated in the HCC Operative District Plan (ODP), the Tuumata Plan Change area was assumed to include around 50 hectares (gross) of industrial land use.

For the purpose of this analysis, all previously zoned and/or assumed land use activities in the Tuumata Plan Change area have been removed from the WRTM. As such, all the analyses in this report compare the land uses that are now proposed with a zero baseline.

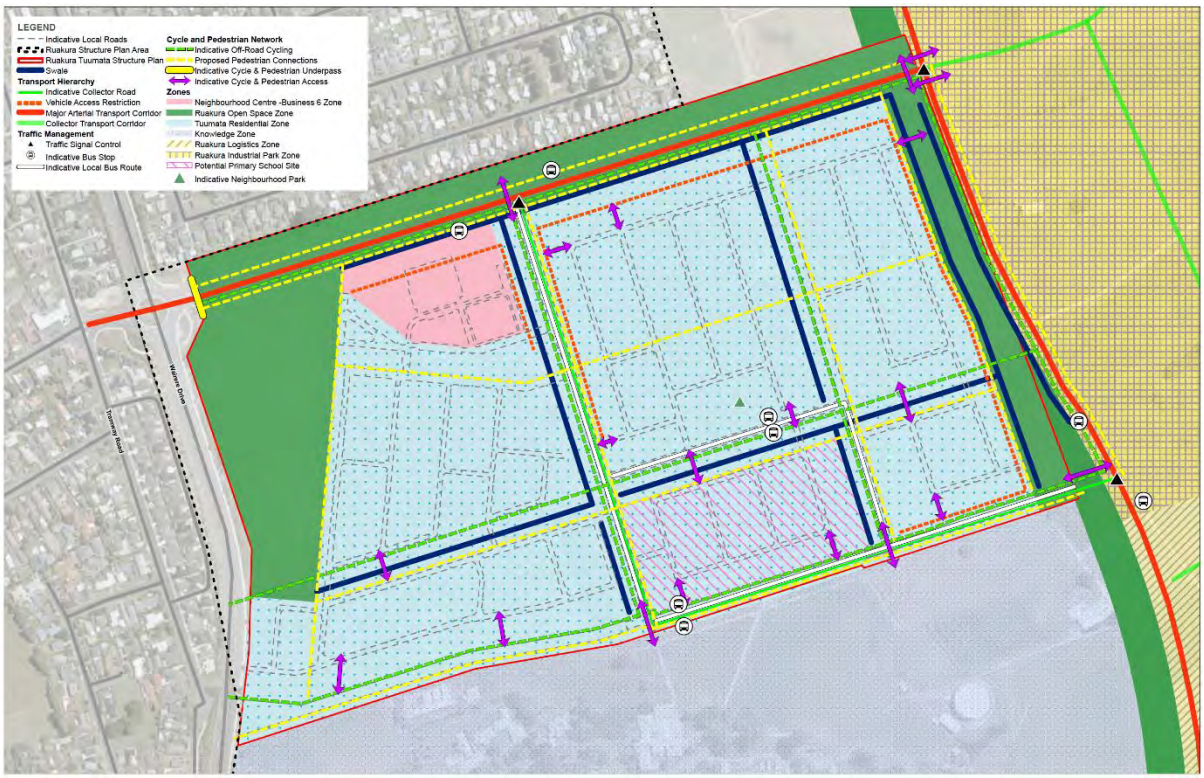
[1] In this scenario the development would be accessed via an unsignalised connection to the Fifth Avenue Extension, which in the absence of the ETC, would be a stub road from the Wairere Drive roundabout.
[2] Scenario 6 is the scenario that was re-run with a different land use mix in October 2022. It is referred to as Scenario 6a in some of the raw model output files.

3.2 Plan Change Land Use

The Tuumata Plan Change includes two land use types, the Tuumata Residential Zone and the Tuumata Neighbourhood Centre (NC). The masterplan is shown as Figure 3.

The Plan Change area is expected to yield approximately 1,269 dwellings (including 100 apartments in the NC) and approximately 6,000m^2 gross floor area (GFA) of NC. For the purposes of the analysis that follows, the HCC ODP definition[3] of GFA will be adopted for reference to the gross floor area of development.

Figure 3 – Ruakura Tuumata Structure Plan (Prepared by Boffa Miskell)



[3] **Gross Floor Area (GFA):** Means the sum of the gross floor area of all floors of all buildings on a site measured from the exterior faces of the exterior walls or from the centrelines of walls separating two buildings. Gross floor area shall include elevator shafts, stairwells and lobbies at each floor and mezzanine floors and balconies, and exclude any provided car-parking, loading and servicing areas and access thereto and building service rooms containing equipment such as lift machinery, tanks, air conditioning and heating plants.

3.3 Trip Generation

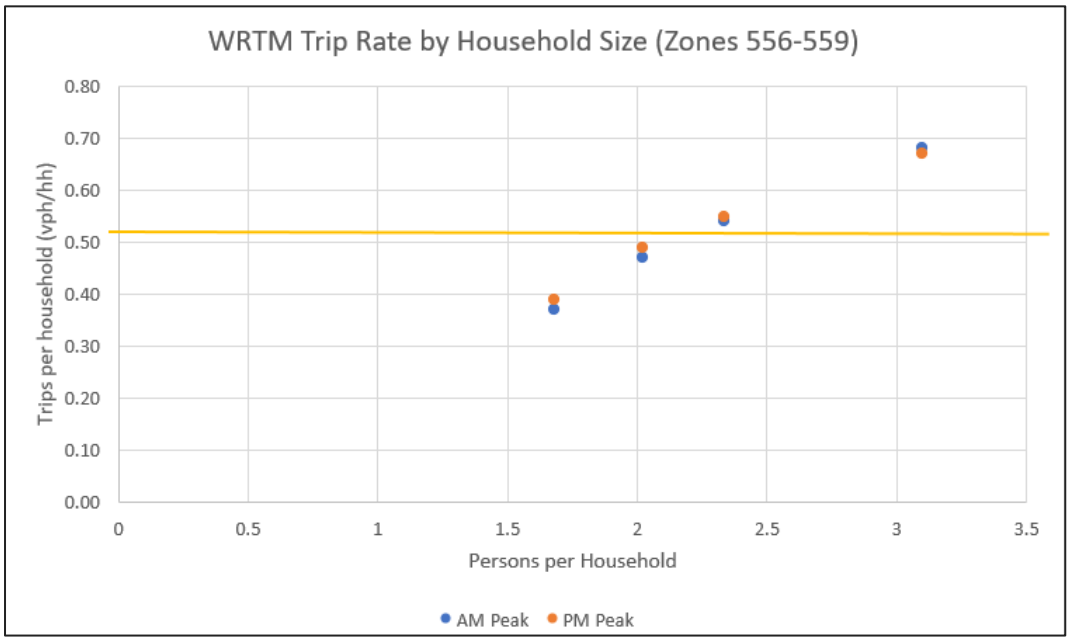
Trip generation rates were developed in consultation with HCC and with reference to the RMS Guide to Traffic Generating Developments (New South Wales) and associated studies[4], the New Zealand guidance document RR453 (Trips and Parking Related to Land Use), as well as the existing characteristics of the WRTM in comparable land use zones.

The adopted rates are:

- 0.53 vehicles per hour (vph)/residential unit during the AM and PM peaks;
- 7.76 vph/100m^2 GFA during the AM peak; and
- 10.41 vph/100m^2 GFA during the PM peak.

Review of WRTM trip generation characteristics for other residential zones around the Plan Change area (zones 556 to 559) shows that 0.53 vph/hh aligns approximately with existing WRTM trip rates for an average household size of two people, in this part of Hamilton. This data is summarised on Figure 4 below.

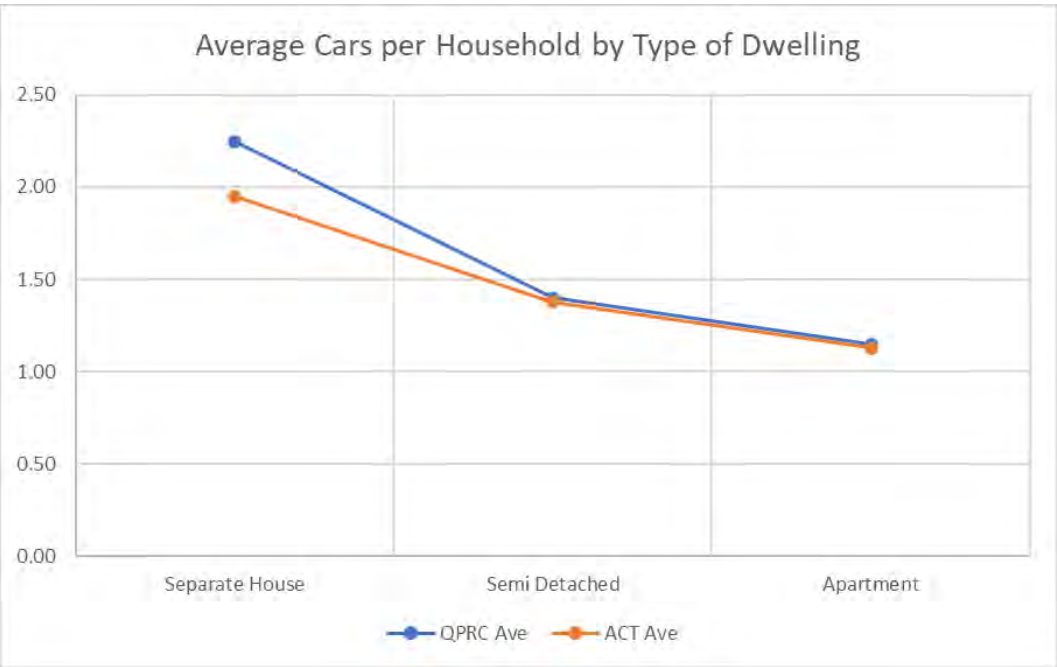
Figure 4 – WRTM Trip Rates, Other Eastern Residential Zones



It is well established by this and other sources that car availability (and consequently trip generation), reduces with household size. There is also a relationship between the physical form of the dwelling and car ownership, as illustrated below on Figure 5 using Australian Census data extracted by Stantec for a strategic transport model in the Australian Capital Territory (ACT), that is of a similar nature to the WRTM.

[4] Trip Generation Surveys Small Suburban Shopping Centres Analysis Report, Bitzios Consulting for Roads and Maritime Services NSW (November 2018)

Figure 5 – Queanbeyan and ACT Car Ownership Trends



Logically, when there are more smaller format dwellings like apartments and attached houses, car ownership and trip rates are lower than what is typically seen in lower density residential areas.

Given the high residential density proposed in the Tuumata Residential Zone (compared to typical residential areas in Hamilton), the expectation of these smaller format housing typologies, together with the site's urban context, access to local employment, commercial, and retail services, and further having regard for the planned high-frequency rapid transit public transport service routes along Fifth Avenue and on the ETC, alongside extensive pedestrian/cycle networks, it is assessed as appropriate to progress the evaluations based on both the AM and PM peak periods with a rate of 0.53 trips/unit.

The expected trip generation of the Plan Change area is summarised in Table 1. The table shows one-hour and two-hour volumes, since the WRTM represents two-hour peak periods. The expected generation of the interim stage of development is also shown.

Table 1: Plan Change Trip Generation

Land Use	AM Peak		PM Peak	
	One Hour	Two Hour	One Hour	Two Hour
Full Development				
Neighbourhood Centre	466	815	625	1,093
Residential	673	1,177	673	1,177
TOTAL	1,138	1,992	1,297	2,270
Interim Stage (Pre-ETC)				
Residential	228	399	228	399

4 Model Validation

4.1 Validation Report

The modelling was undertaken in a subarea model windowed from the main WRTM. A model validation report that describes the subarea model and its validation checks is included as Appendix B.

The model validation exercise included comparisons to 350 individual traffic counts in the subarea. Following consulting with HCC, reference as also made to SCATS detector count data extracted from the HCC traffic signal control system. Detector counts were extracted for the intersections of:

- Wairere Drive/Powells Road;
- Wairere Drive/Bisley Road (AgResearch); and
- Wairere Drive/Ruakura Road.

As summarised in Appendix B, the base model achieved a very good level of correlation with the turning movement counts at these intersections, which surround the Plan Change area.

4.2 Land Use Adjustments

The starting point for the WRTM 2041 models (Scenarios 5 and 6) is a land use file supplied to the model operator by the model partners (HCC, Waka Kotahi, and other Council partners). This file includes the expected number of households and jobs in each model zone, based on the partners best understanding of development intentions, District Plan zoning and other factors.

Following the initial review of model results some changes were made to model land use inputs in zones around the Plan Change area, to bring them into better alignment with what is now known about these areas.

The number of jobs in the Ruakura inland port and logistics zones (south of the railway and west of the Ruakura interchange) was increased. These areas have approved Land Development Plan consents and/or known future plans. The number of jobs in the model was increased until the combined trip generation from these zones approximately matched the combined trip generation totals given in the ITA reports prepared for these areas.

4.3 Future Network Assumptions

The form of the future 2041 network (irrespective of the Plan Change) was agreed with HCC and was based on the existing 2041 WRTM base network.

It was agreed that the ETC corridor should be modelled as four lanes (two each way), between Ruakura Road and the Fifth Avenue Extension, to ensure that it attracted traffic in an unconstrained

manner. This ensures that Plan Change intersections and other intersections in the area are assessed with maximum practical traffic volumes.

In relation to the 2018 network, it was agreed that the Waikato Expressway (WEX) Hamilton Section should be assumed to be open, as its completion was imminent at the time the first round of modelling was run (June 2022)

5 Pre-ETC Model Results

5.1 Base Network Waikato Expressway Effects

The ‘existing’ network for the pre-ETC tests is the validated 2018 base model with the Hamilton Section of the WEX added. The WEX opened in mid-2022 and as such, the effects of the Plan Change do not need to be assessed on a pre-Expressway network as any land use changes caused by the Plan Change cannot occur ahead of the WEX.

As the WEX was not open at the time this work commenced, conditions in the ‘existing’ networks will be different to what is seen and experienced on the network today. To assist with understanding and quantifying these the effects of the WEX, Figure 6 and Figure 7 present volume difference plots for the AM and PM peak periods, respectively.

On these plots the thickness of the line represents the scale of the change. Red represents an increase and green represents a decrease.

Figure 6 – AM Peak Volume Changes due to WEX (2018 Network)

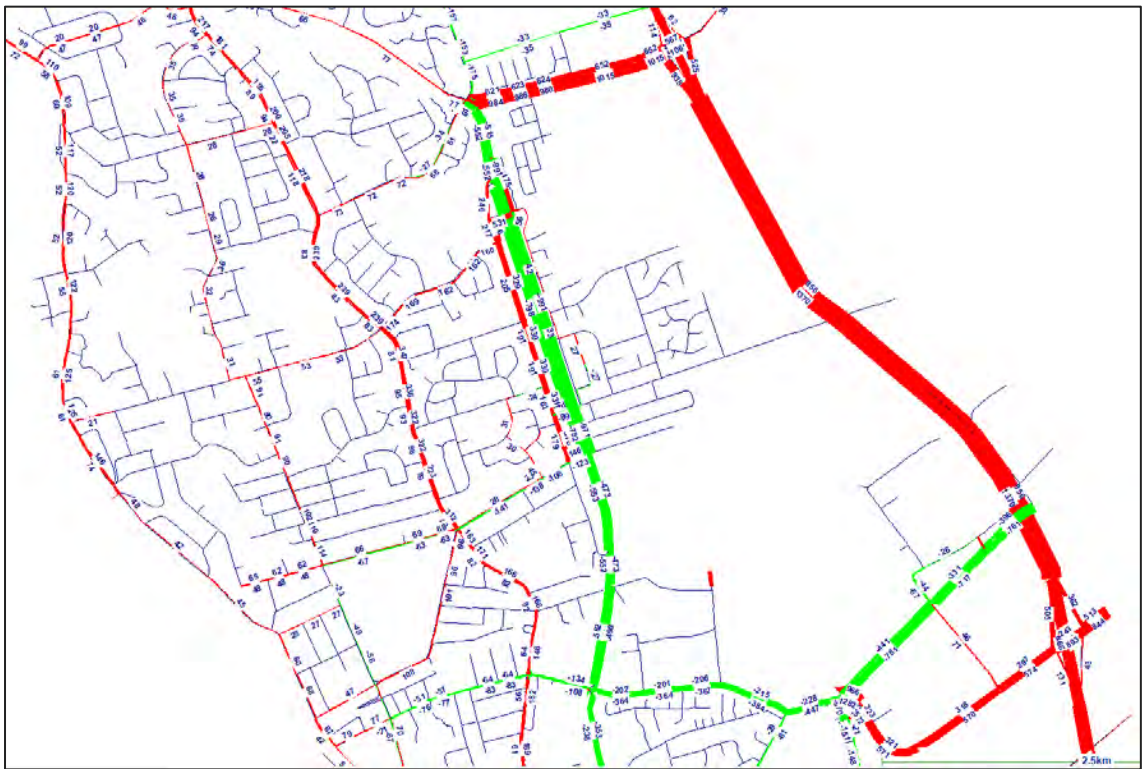
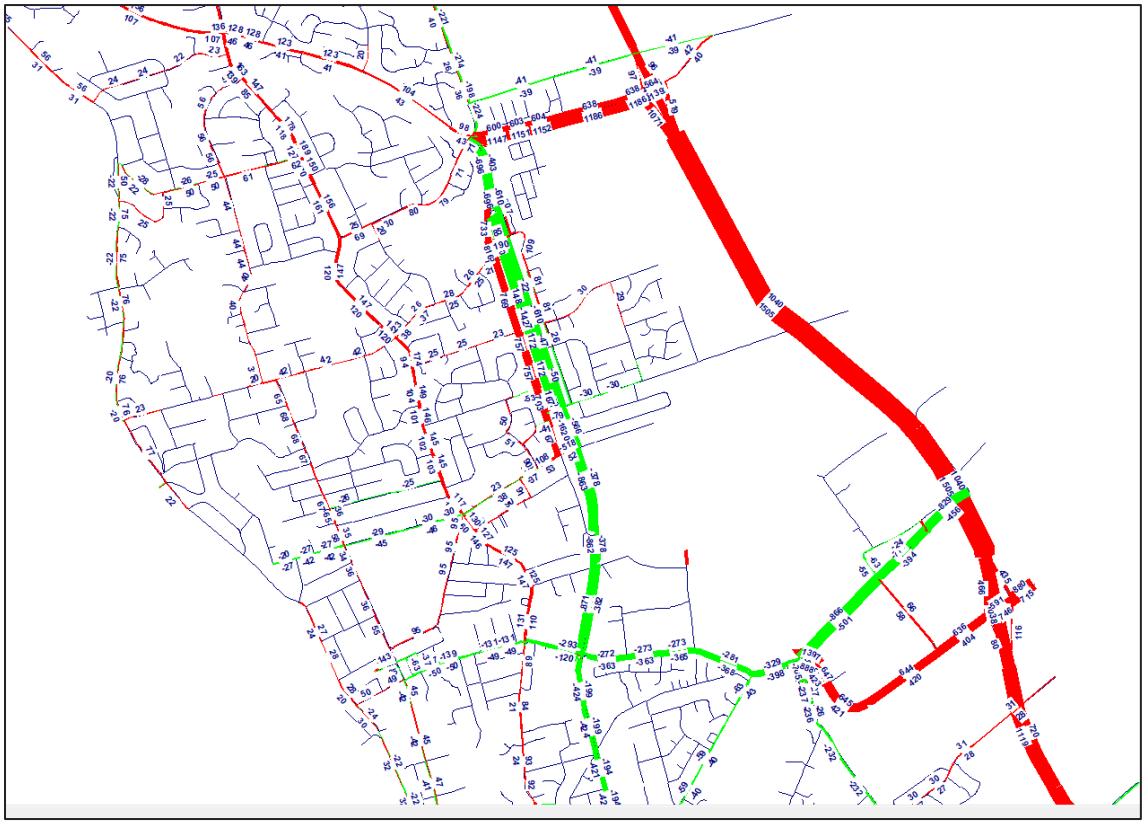


Figure 7 – PM Peak Volume Changes due to WEX (2018 Network)



The Figures show that the opening of the WEX draws traffic from the Wairere Drive and Ruakura Road corridors. Corridors including Pardoa Boulevard and Realigned Ruakura Road see increases as traffic redistributes around the network in response to interchange placement and associated local road connectivity changes.

In the vincinity of the Plan Change, the model is predicting the following changes in daily two-way traffic volumes[5]:

- Wairere Drive, north-west of Gordonton Road +560 vpd (+4%)
- Gordonton Road, north of Wairere Drive -1,020 vpd (-6%)
- Pardoa Boulevard, east of Wairere Drive +8,380 vpd (+800%)
- Wairere Drive, north of Powells Road -9,570 vpd (-41%)
- Wairere Drive, north of Ruakura Road -5,760 vpd (-26%)
- Ruakura Road, east of Wairere Drive -3,000 vpd (-19%)
- Wairere Drive, north of Clyde Street -3,020 vpd (-27%)
- Fifth Avenue, west of Wairere Drive -1,110 vpd (-13%).

[5] Estimated from the average of the AM and PM peak two-hour totals, multiplied by five.

At intersections around the Plan Change area, the model is predicting the following changes in peak period volumes:

- Wairere Drive/Fifth Avenue roundabout -24% (AM), -32% (PM)
- Five Cross Roads roundabout +7% (AM), +4% (PM)
- Wairere Drive/Powells Road traffic signals -33% (AM), -36% (PM)
- Wairere Drive/Pardoa Boulevard/Gordonton Road roundabout +4% (AM), +5% (PM)
- Wairere Drive/Ruakura Road traffic signals -19% (AM), -21% (PM)

5.2 Area of Influence

The area of influence of the Plan Change in both the interim and full development scenarios has been defined for the purpose of this assessment as where it causes a change in total intersection volume of 5% or more. Below this level, the effects can be considered as being minimal and within the normal range of day-to-day variation.

Table 2 and Table 3 present the comparisons for the years 2018 and 2031. In 2018, Scenario 2 includes 430 households in the Plan Change area compared to none in Scenario 1. In 2031, Scenario 4 includes 430 households in the Plan Change area compared to none in Scenario 3.

In both cases, the interim development stage is assumed to connect to the (formed but currently unused) eastern leg of the Wairere Drive/Fifth Avenue roundabout.

The Tables also present intersection level of service (LOS). The definitions used to assess intersection LOS are included in Appendix C. Intersections that meet or exceed the 5% threshold are highlighted.

Table 2: Area of Influence (Scenario 2 v Scenario 1)

Period	Intersection	Intersection Volume (2 Hours)			LOS	
		Scenario 2	Scenario 1	% Change	Scenario 2	Scenario 1
AM	Fifth Avenue/Wairere Roundabout	4,607	4,307	7%	A	A
	Five Cross Roads Roundabout	4,943	4,895	1%	A	A
	Wairere Drive/Powells Road Signals	3,738	3,749	0%	F	F
	Wairere Drive/Pardoa Boulevard Roundabout	6,242	6,375	-2%	A	A
	Wairere Drive/Bisley Road Signals (AgResearch)	3,489	3,477	0%	A	A
	Wairere Drive/Ruakura Road Signals	5,080	5,151	-1%	C	C
PM	Fifth Avenue/Wairere Roundabout	4,172	4,549	9%	A	A
	Five Cross Roads Roundabout	5,427	5,516	2%	B	B
	Wairere Drive/Powells Road Signals	3,838	3,859	1%	E	E
	Wairere Drive/Pardoa Boulevard Roundabout	6,853	6,886	0%	D	D
	Wairere Drive/Bisley Road Signals (AgResearch)	3,539	3,665	4%	A	A
	Wairere Drive/Ruakura Road Signals	5,483	5,570	2%	C	C

Table 3: Area of Influence (Scenario 4 v Scenario 3)

Period	Intersection	Intersection Volume (2 Hours)			LOS	
		Scenario 4	Scenario 3	% Change	Scenario 4	Scenario 3
AM	Fifth Avenue/Wairere Roundabout	6,717	6,350	6%	C	B
	Five Cross Roads Roundabout	5,224	5,699	2%	A	A
	Wairere Drive/Powells Road Signals	5,896	5,970	1%	E	E
	Wairere Drive/Pardoa Boulevard Roundabout	7,891	7,790	0%	C	C
	Wairere Drive/Bisley Road Signals (AgResearch)	5,107	4,920	2%	A	A
	Wairere Drive/Ruakura Road Signals	7,073	7,013	1%	B	B
PM	Fifth Avenue/Wairere Roundabout	6,350	5,985	6%	A	A
	Five Cross Roads Roundabout	5,699	5,618	1%	B	B
	Wairere Drive/Powells Road Signals	5,970	5,935	1%	D	D
	Wairere Drive/Pardoa Boulevard Roundabout	7,790	7,755	0%	E	E
	Wairere Drive/Bisley Road Signals (AgResearch)	4,920	4,800	3%	A	A
	Wairere Drive/Ruakura Road Signals	7,013	6,901	2%	C	C

The Tables show that the Plan Change causes a 7% to 9% increase in intersection volume in the 2018 scenarios. By 2031, when background volumes are higher, the change reduces to 6%. Moving outward from the site, no other intersections see changes of more than 4%.

Some intersections see a decrease, which is a result of rerouting in the model. The WRTM is a dynamic model and when there are changes in delay, for example as a result of new activity on the eastern leg of the Wairere Drive/Fifth Avenue roundabout, travel times are recalculated, and some trips assign to different routes.

Review of the LOS data shows that the Wairere Drive/Fifth Avenue roundabout operates acceptably in both 2018 and 2031, with and without development in the Plan Change area. On that basis, the interim release of 430 households can be accommodated on the existing network (with WEX).

The intersection of Wairere Drive/Powells Road it is operating at LOS D/E/F during the various periods. Although it does not meet the volume change threshold to be considered an effect of the Plan Change, the intersection is discussed further at Section 9.1.

6 2041 Model Results

6.1 Link Volumes

When fully developed, the Plan Change is expected to generate some 1,138 vph during the AM peak hour (or 1,992 vehicles in two hours) and 1,297 vph during PM peak hour (or 2,270 vehicles in two hours). The modelled distribution of these trips is summarised below on Figure 8 and Figure 9.

These are volume difference plots for the AM and PM peak periods, respectively. They show the difference between Scenario 6 (with development) and Scenario 5 (without development). Red is an increase in volume, green is a decrease.

The plots show the combined effects of new trips generated by the Plan Change area and redistributions of other trips around the network, in response to volume and network changes made by the Plan Change. One example of this is along the eastern section of the Fifth Avenue Extension, where there is a reduction. The reasons for this are explained below.

Figure 8 – 2041 AM Link Difference Plot (Scenario 6 – Scenario 5)

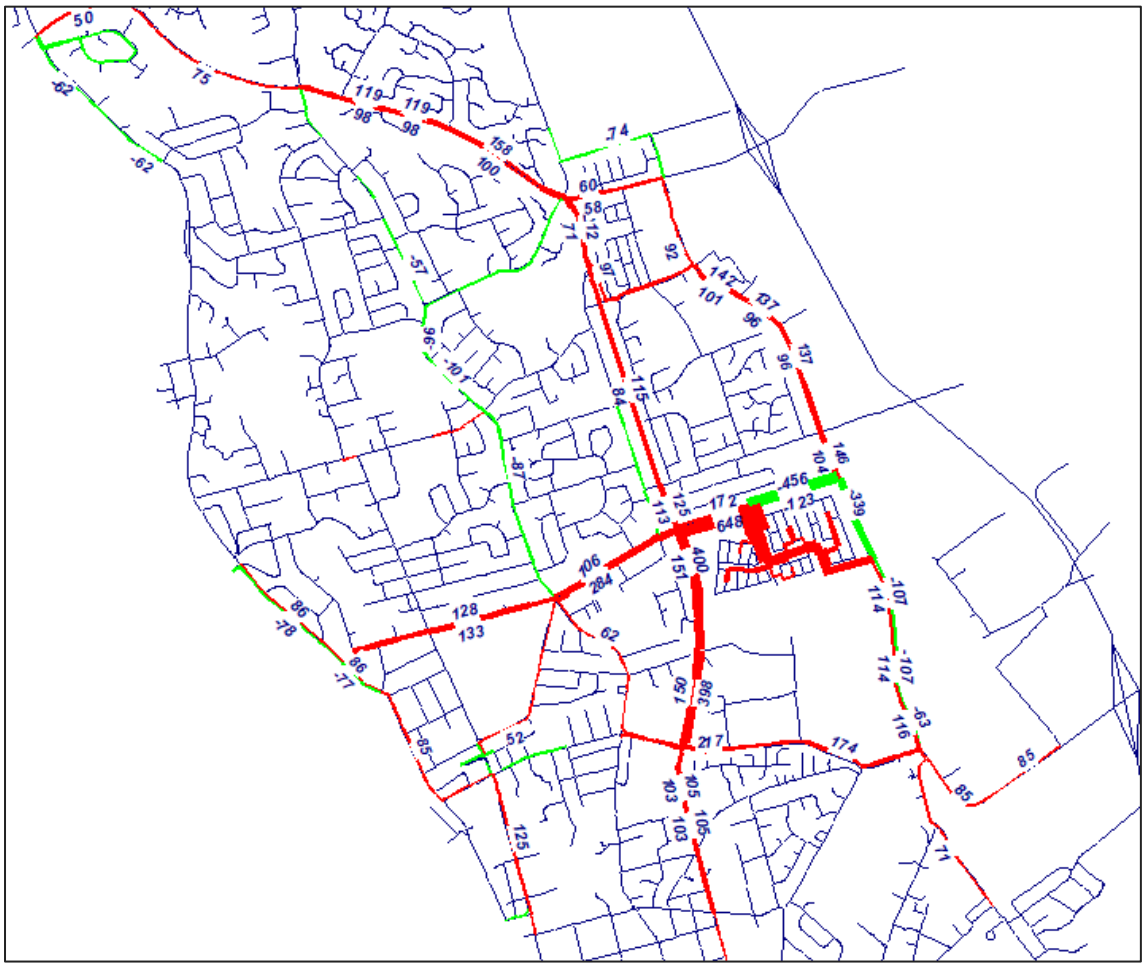
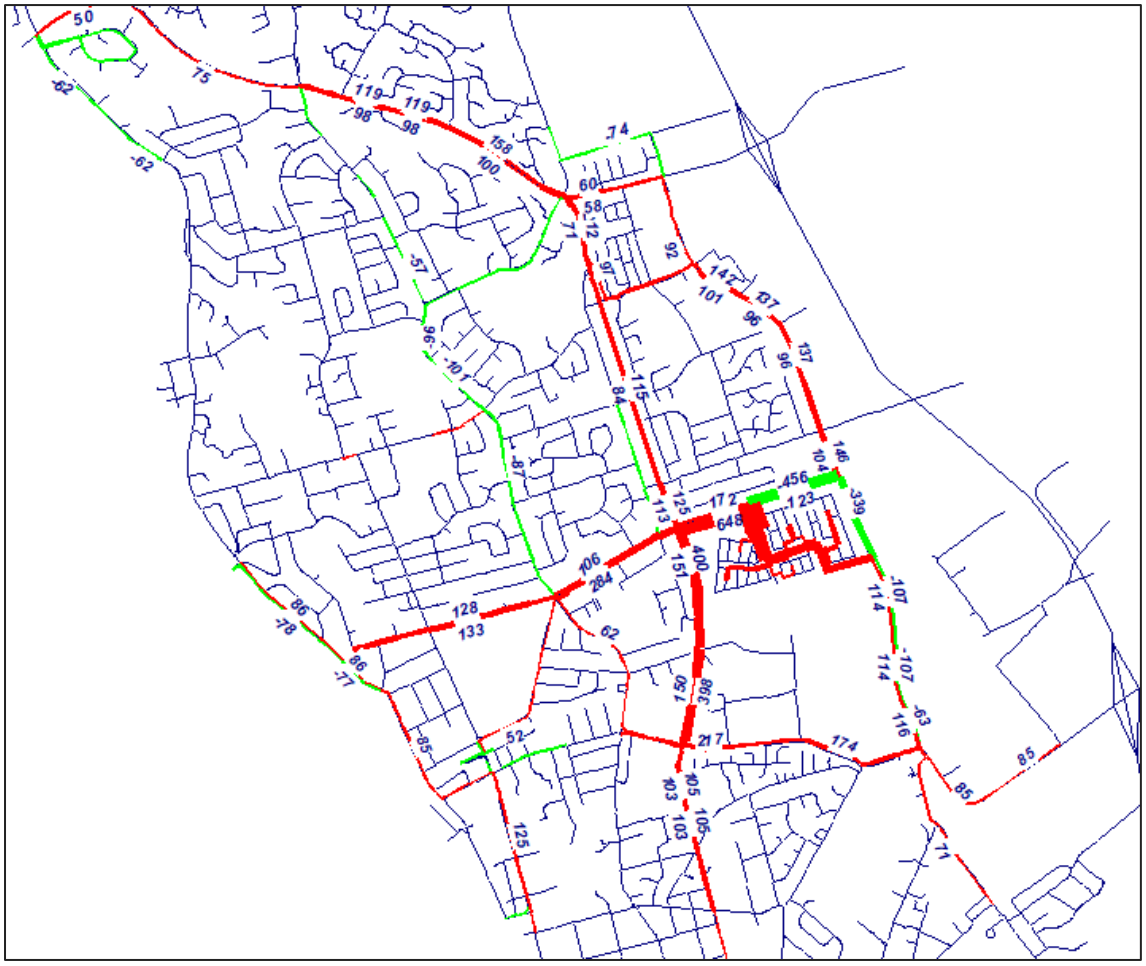


Figure 9 – 2041 PM Link Difference Plot (Scenario 6 – Scenario 5)



Overall, the distribution of trips from the Plan Change area is approximately 33% to/from the north (via either the ETC or Wairere Drive), 24% to/from the west and 43% to/from the south (via either the ETC or Wairere Drive).

In relation to the reductions on the eastern section of the Fifth Avenue Extension and Wairere Drive north of Fifth Avenue, in Scenario 5 there is no land use activity in the Plan Change area and no intersections to it. In Scenario 6, the land use is added and so is a new signalised intersection. This intersection introduces delay to the through movements along the Fifth Avenue Extension. This, combined with increases in delay at the intersections at either end of this link (Wairere Drive/Fifth Avenue and Fifth Avenue Extension/ETC) is enough to cause some vehicles to reassign, for example by staying on the ETC and using the Carrs Road interchange instead.

Table 4 below summarises some of the expected daily[6] changes in link volumes around the Plan Change area.

[6] Daily volumes estimated from the average of the AM and PM two-hour totals multiplied by five.

Table 4: Daily Link Volume Changes

Road Section	Daily Two-Way Link Volume (vpd)			
	Scenario 6	Scenario 5	Change	% Change
Wairere Drive, south of Pardoa Boulevard	25,100	23,800	1,300	5%
Fifth Avenue, east of Five Cross Roads	10,800	9,100	1,700	19%
ETC, north of Fifth Avenue Extension	6,100	5,000	1,100	22%
ETC, south of Plan Change intersection	8,200	7,500	700	9%
Wairere Drive, north of Ruakura Road	19,600	17,200	2,400	14%

The Plan Change generates changes of up to 14% on Wairere Drive, 9% to 22% on the ETC and 19% on Fifth Avenue.

On Wairere Drive, overall daily volumes in Scenario 6 remain within the practical carrying of a four-lane arterial road (two lanes each way). This is typically around 36,000 vpd. On Fifth Avenue and the ETC, the daily volumes are well within the practical carrying capacity of two-lane roads (one lane each way), which is typically around 18,000 vpd.

6.2 Link Level of Service

Figure 10 and Figure 11 show link level of service (LOS) diagrams for Scenario 5 (no Plan Change) and Scenario 6 (fully developed Plan Change), for the AM and PM peak respectively.

The Figures show LOS D (green), LOS E (blue) and LOS F (red) only. Links with LOS A, B or C have no colour. The criteria used to describe link LOS are included in Appendix C.

Figure 10 – 2041 Link LOS AM

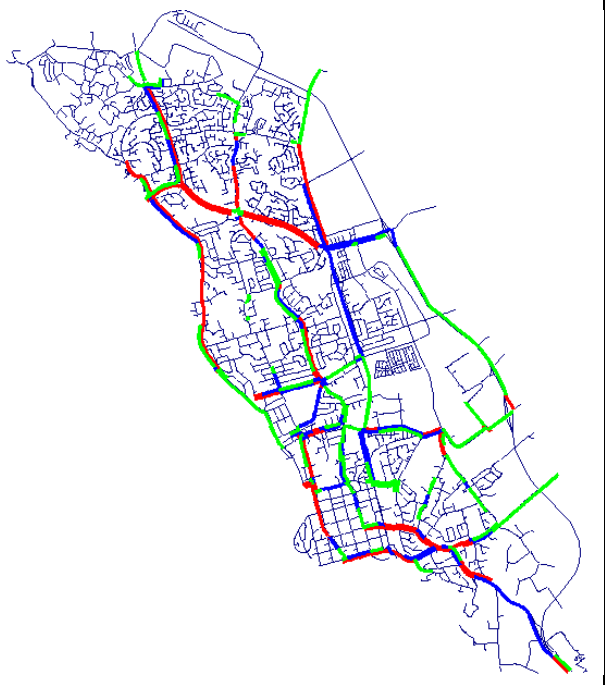
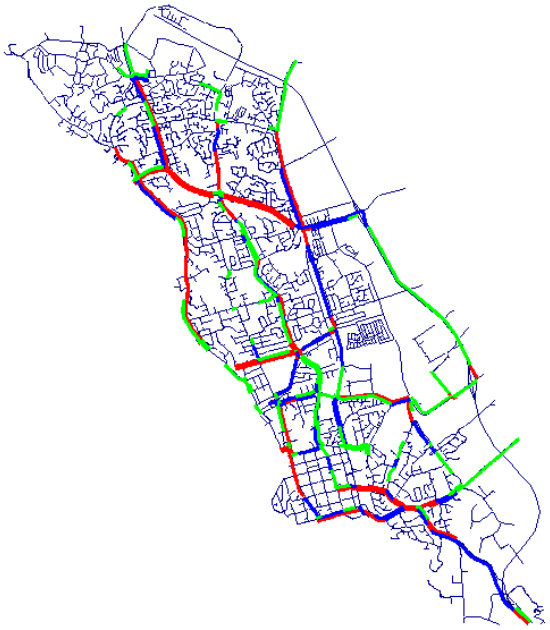
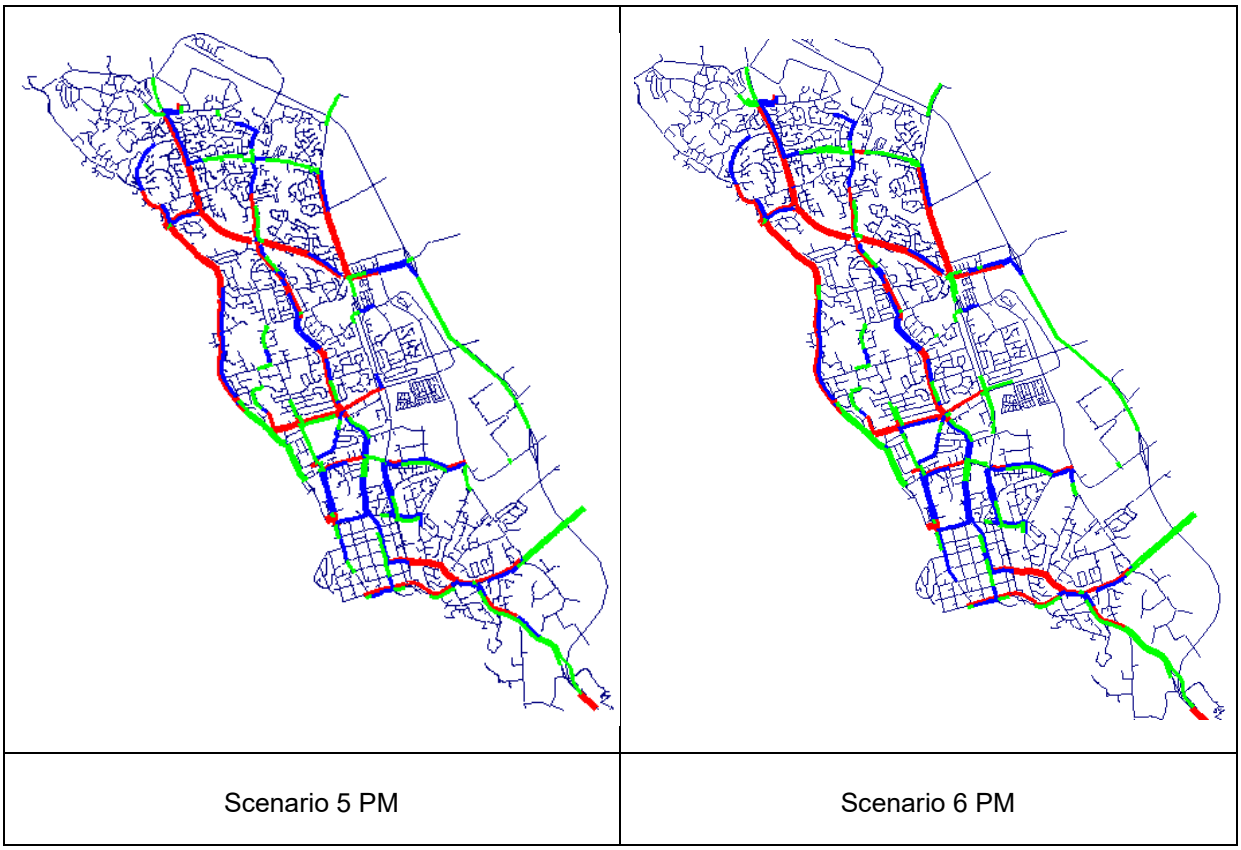
	
Scenario 5 AM	Scenario 6 AM

Figure 11 – 2041 Link LOS PM



Scenario 5 PM	Scenario 6 PM

The diagrams show that by 2041, with no development in the Plan Change area, LOS F is expected on roads including:

- Wairere Drive north-west of Gordonton Road, extending up Resolution Drive;
- Gordonton Road, north of Wairere Drive;
- River Road and Hukanui Road, from where they meet Wairere Drive to approximately in line with Fifth Avenue/Boundary Road;
- The cross-city connector route (Fifth Avenue and Boundary Road);
- Some sections of Ruakura Road; and
- Cambridge Road and Cobham Drive in the south of the city.

Comparing the left and right side of these Figures shows that the Plan Change makes little difference to link LOS across the network.

A more detailed analysis of incremental changes at intersection level is provided in Section 6.4.

6.3 Intersection Level of Service

Figure 12 and Figure 13 show intersection level of service (LOS) diagrams for Scenario 5 (no Plan Change) and Scenario 6 (fully developed Plan Change), for the AM and PM peak respectively.

The Figures show LOS D (green), LOS E (blue) and LOS F (red) only. Intersections with LOS A, B or C have no colour. The criteria used to describe intersection LOS are included in Appendix C.

Figure 12 – 2041 Intersection LOS AM

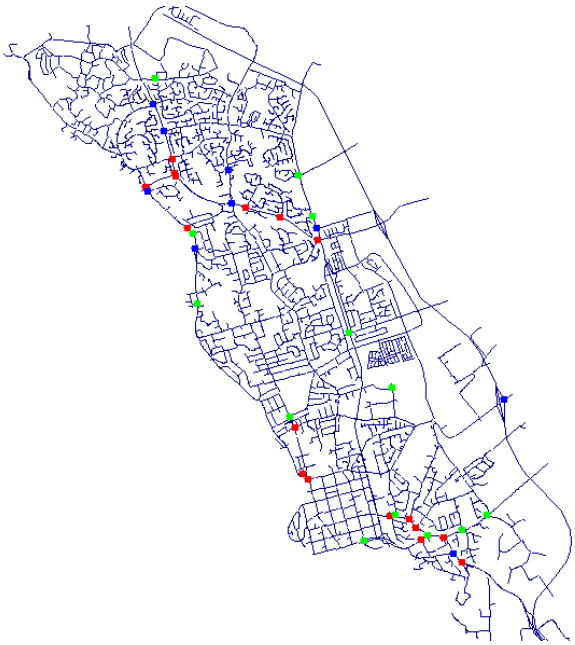
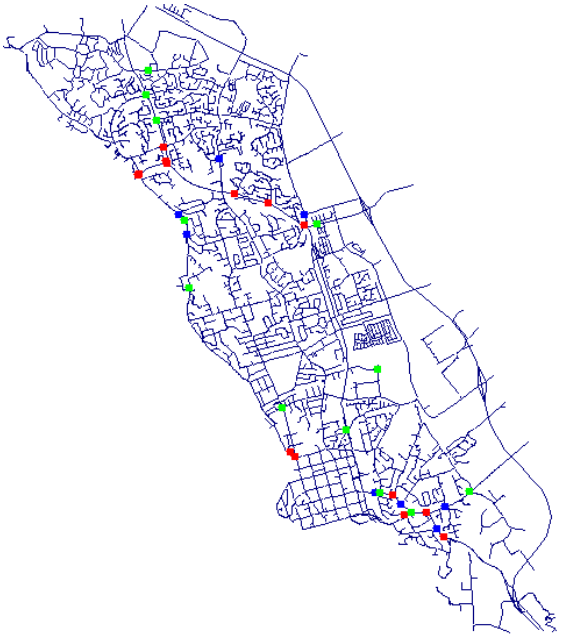
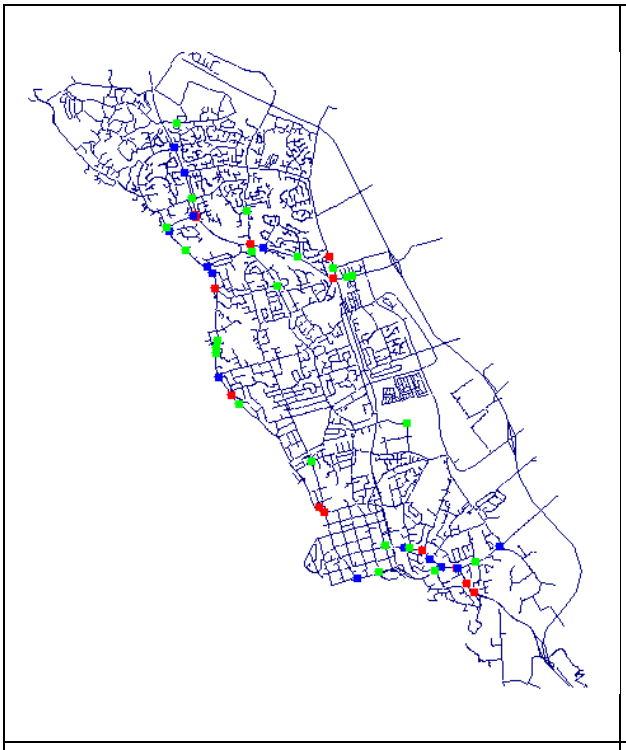
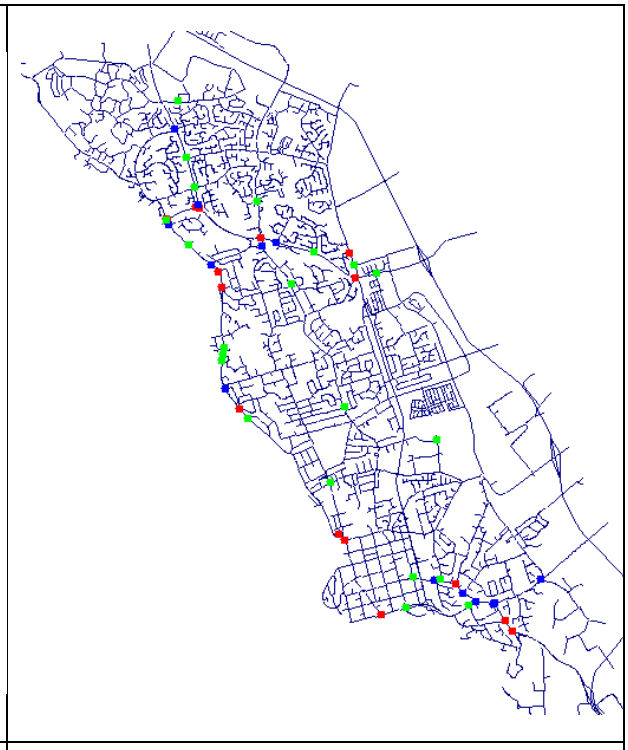
	
Scenario 5 AM	Scenario 6 AM

Figure 13 – 2041 Intersection LOS PM



Scenario 5 PM



Scenario 6 PM

The diagrams show that by 2041, with no development in the Plan Change area, LOS F is expected at some intersections along corridors including:

- Wairere Drive (Waikato River to Gordonton Road);
- River Road around Fairfield Bridge;
- Grey Street/Clyde Street in Hamilton East; and
- Cambridge Road and Cobham Drive in the south of the city.

Comparing the left and right side of these Figures shows that the Plan Change makes little difference to intersection LOS around the network. Further analysis of individual intersections is provided in the following section.

Additional comments about the Wairere Drive/Powells Road intersection are included in Section 9.

6.4 Area of Influence

The area of influence of the Plan Change in both the interim and full development scenarios has been defined for the purpose of this assessment as where it causes a change in total intersection volume of 5% or more. Below this level, the effects can be considered as being minimal and within the normal range of day-to-day variation.

Table 5 and Table 6 present the comparison between Scenario 6 (fully developed Plan Change) and Scenario 5 (no development in the Plan Change area) for the AM and PM periods, respectively. The same information is presented diagrammatically under each Table as Figure 14 and Figure 15.

The Tables also present intersection LOS. The definitions used to assess intersection LOS are included in Appendix C. Intersections that meet or exceed the 5% threshold are highlighted.

Table 5: Area of Influence (Scenario 6 v Scenario 5), AM

Intersection	Intersection Volume (2 Hours)			LOS	
	Scenario 6	Scenario 5	% Change	Scenario 6	Scenario 5
Fifth Avenue/Wairere Roundabout	6,940	5,961	16%	B	A
Fifth Avenue Extension/ETC Signals	1,461	1,815	-20%	A	B
Five Cross Roads Roundabout	5,704	5,377	6%	B	B
Wairere Drive/Powells Road Signals	5,489	5,235	5%	C	D
Wairere Drive/Pardoa Boulevard Roundabout	9,232	8,908	4%	F	F
Gordonton Road/Thomas Road Signals	3,153	3,153	0%	B	C
Wairere Drive/Hukanui Road Roundabout	8,069	7,950	1%	C	E
Boundary Road/Heaphy Terrace Roundabout	5,095	4,832	5%	A	A
Hukanui Road/Clarkin Road Roundabout	3,859	3,936	-2%	A	C
Wairere Drive/Bisley Road Signals (AgResearch)	4,382	3,831	14%	A	A
Wairere Drive/Ruakura Road Signals	6,676	6,095	10%	B	B
Ruakura Road/Te Aroha Street Signals	5,175	5,047	3%	C	C
Wairere Drive/Clyde Street Signals	4,126	3,959	4%	C	C
Ruakura Road/Ruakura Lane Signals	2,333	2,177	7%	A	A
Powells Road/ETC Roundabout	1,450	1,205	20%	A	A
Pardoa Boulevard/ETC Signals	3,303	3,240	2%	B	B
Realigned Ruakura Road/ETC Signals	3,980	3,816	4%	C	C
ETC/Chedworth Roundabout	1,183	936	26%	A	A

Figure 14 – Area of Influence, AM 2041

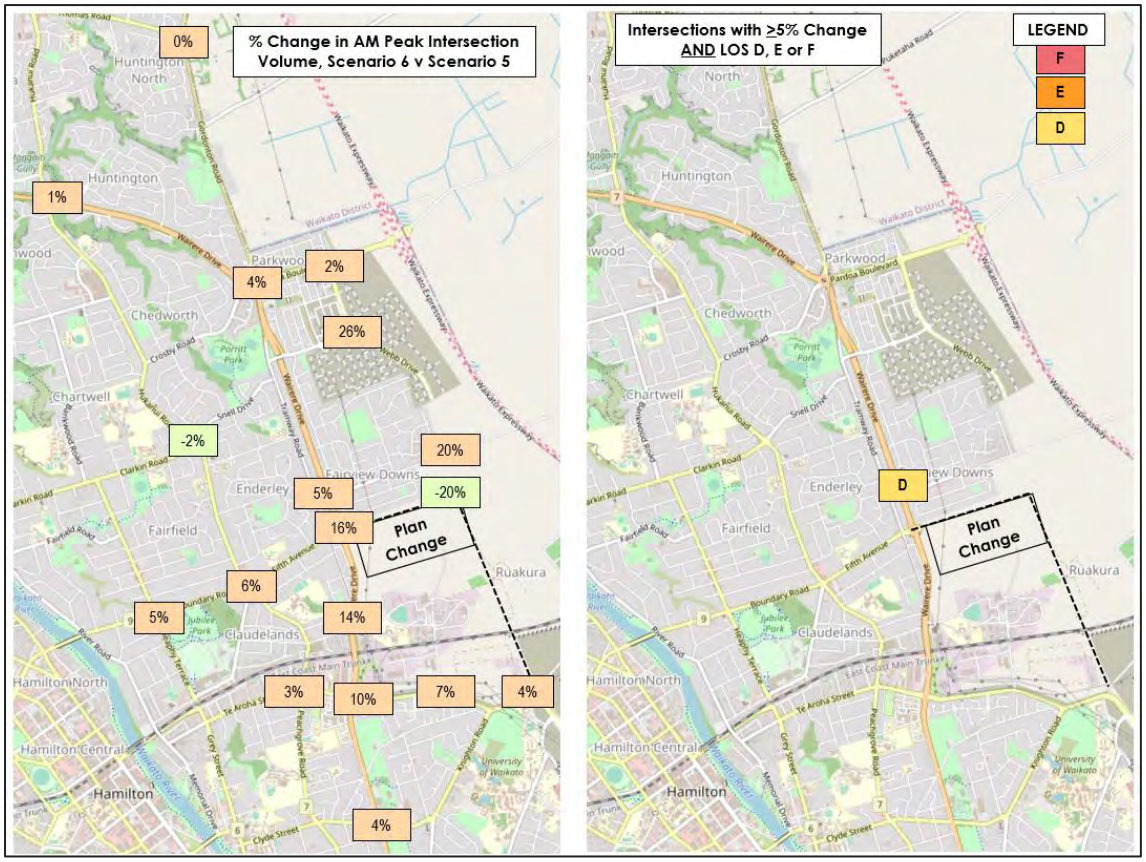
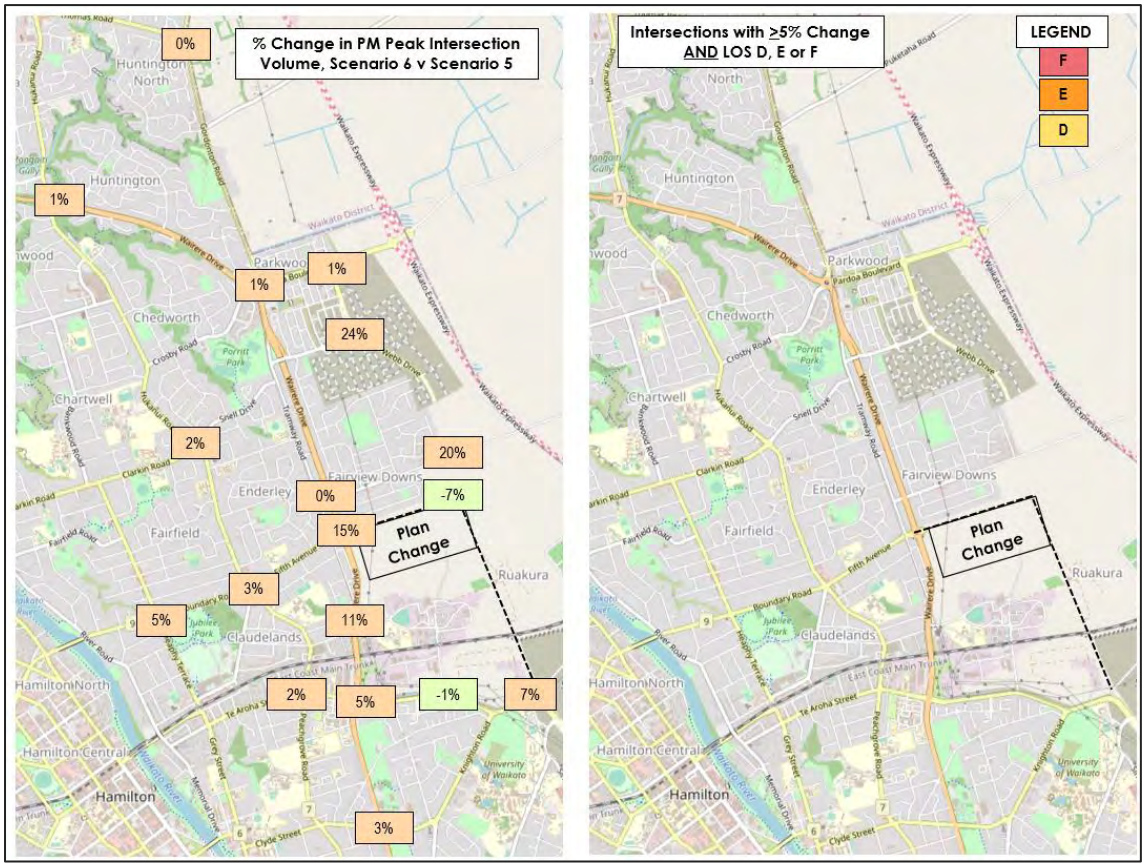


Table 6: Area of Influence (Scenario 6 v Scenario 5), PM

Intersection	Intersection Volume (2 Hours)			LOS	
	Scenario 6	Scenario 5	% Change	Scenario 6	Scenario 5
Fifth Avenue/Wairere Roundabout	6,468	5,621	15%	A	B
Fifth Avenue Extension/ETC Signals	1,453	1,560	-7%	B	A
Five Cross Roads Roundabout	6,059	5,881	3%	C	C
Wairere Drive/Powells Road Signals	4,890	4,876	0%	C	C
Wairere Drive/Pardoa Boulevard Roundabout	8,329	8,214	1%	F	F
Gordonton Road/Thomas Road Signals	3,503	3,492	0%	C	C
Wairere Drive/Hukanui Road Roundabout	8,187	8,107	1%	F	F
Boundary Road/Heaphy Terrace Roundabout	5,921	5,639	5%	B	C
Hukanui Road/Clarkin Road Roundabout	4,186	4,090	2%	B	B
Wairere Drive/Bisley Road Signals (AgResearch)	4,033	3,628	11%	A	A
Wairere Drive/Ruakura Road Signals	6,480	6,195	5%	C	B
Ruakura Road/Te Aroha Street Signals	5,762	5,673	2%	C	C
Wairere Drive/Clyde Street Signals	4,130	4,003	3%	C	C
Ruakura Road/Ruakura Lane Signals	2,214	2,242	-1%	B	B
Powells Road/ETC Roundabout	1,296	1,082	20%	A	A
Pardoa Boulevard/ETC Signals	3,471	3,452	1%	C	C
Realigned Ruakura Road/ETC Signals	3,970	3,716	7%	C	C
ETC/Chedworth Roundabout	1,113	896	24%	A	A

Figure 15 – Area of Influence, PM 2041



The Tables and Figures show that there are nine intersections in the AM peak and seven in the PM peak that are expected to see volume changes of 5% or more. All these intersections are operating at LOS D or better during both peak periods.

On that basis, the Plan Change does not generate any intersection LOS issues that are not already present without the Plan Change. Further comments on specific intersections are provided in Section 9.1.

7 Select Link Analyses

7.1 Introduction

A select link analysis identifies a specific link in the network and maps the origins and destinations of all trips that use that link. Select link plots assist in understanding how a section of road is being used and what sort of trips are being made on it.

The following select link locations were included in the model brief following consultation with HCC. The select link plots presented in this section were run on Scenario 6 (2041 with Tuumata Plan Change).

7.2 Tuumata Plan Change Area Access

Figure 16 and Figure 17 show select link plots for the Plan Change area access road, immediately south of the Fifth Avenue Extension.

Figure 16 – AM Select Link, Tuumata Access (Fifth Avenue Extension)

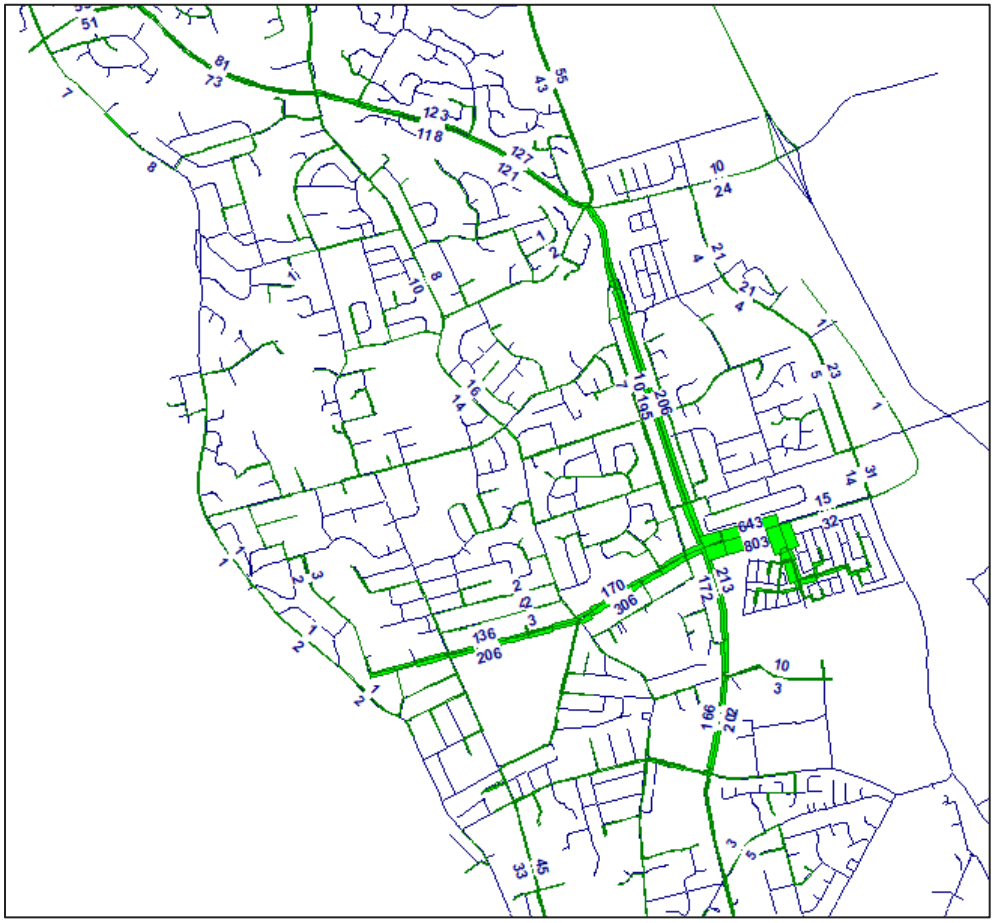
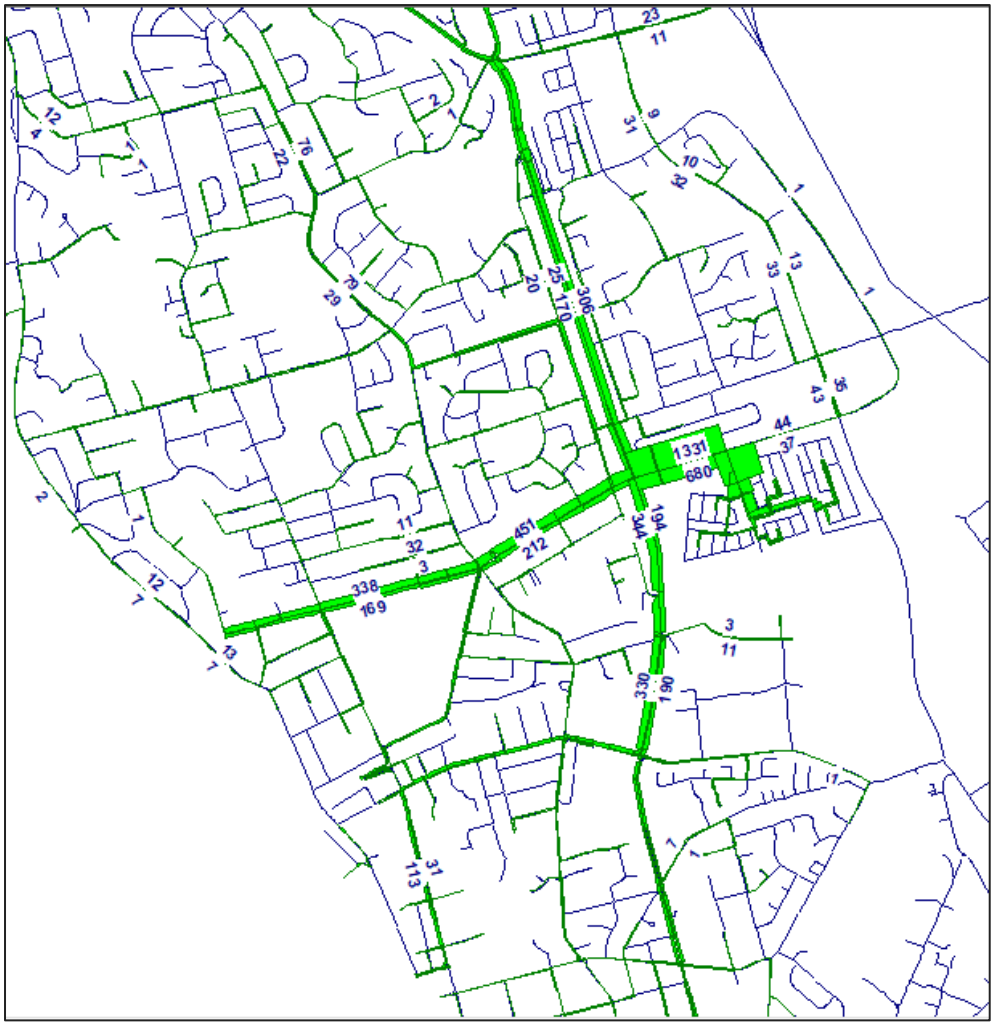


Figure 17 – PM Select Link, Tuumata Access (Fifth Avenue Extension)



These plots show trips to and from the Plan Change area distributing north, west, and south on the arterial network. There is no interaction with the ETC south of Fifth Avenue because the Plan Change area has another access point to the ETC, which provides for all turning movements.

7.3 Fifth Avenue Extension

Figure 18 and Figure 19 show the AM and PM select link plots for the Fifth Avenue Extension, to the east of the proposed access to the Plan Change area.

Figure 18 – AM Select Link, Fifth Avenue Extension, east of Tuumata Access

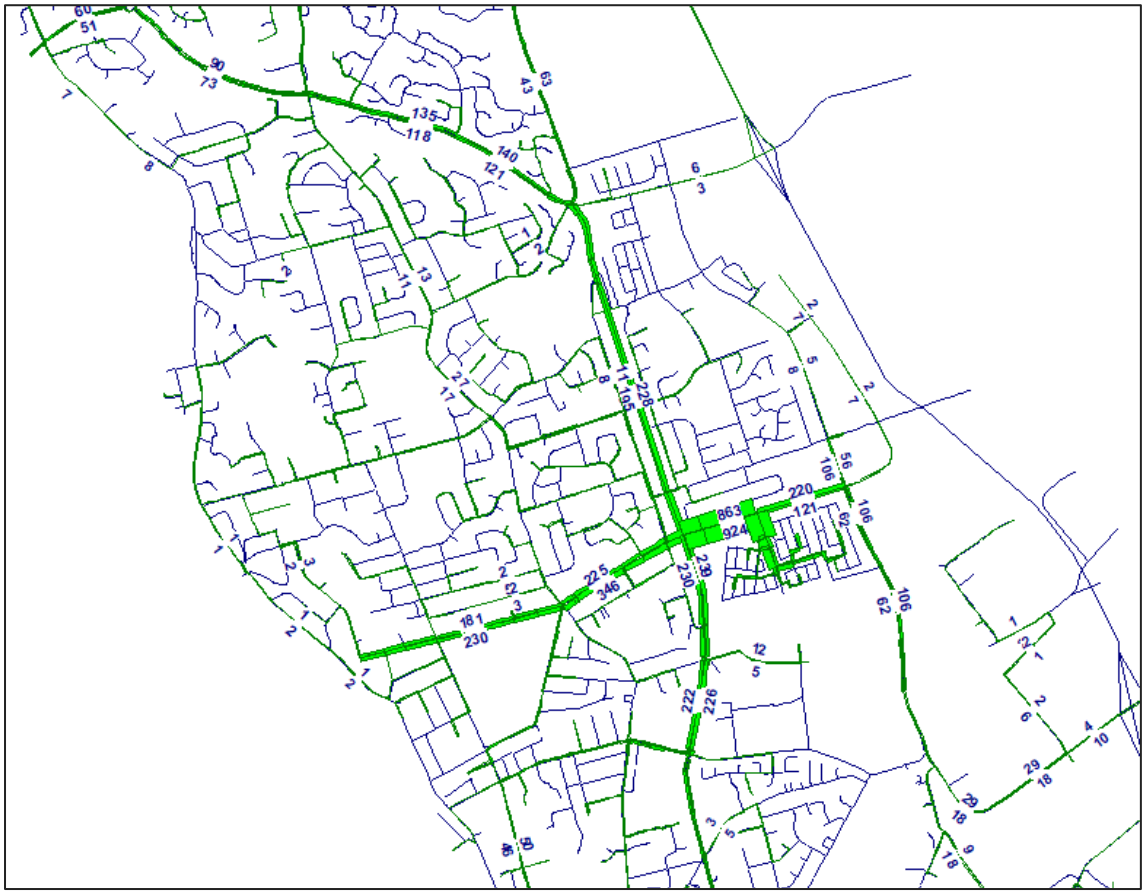


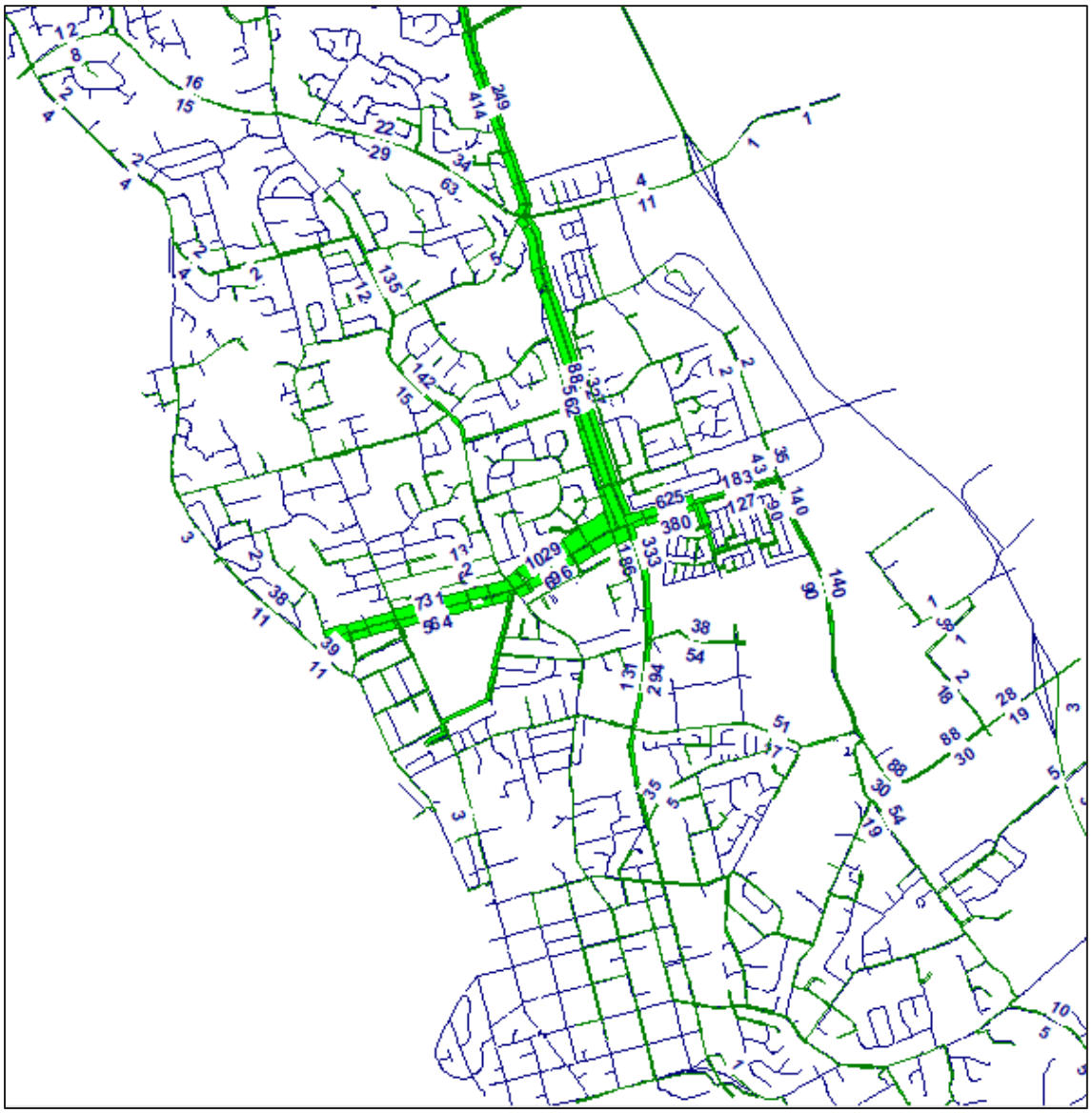
Figure 19 – PM Select Link, Fifth Avenue Extension, east of Tuumata Access

These plots show that this section of road is being used as a connection from north to south (and vice versa) linking the Rototuna and Huntington areas with the University and Silverdale areas in the south. It is also playing a role linking the Plan Change area and other Ruakura Structure Plan areas with the cross-city connector corridor along Fifth Avenue and Boundary Road.

Figure 20 and Figure 21 show the AM and PM select link plots for the Fifth Avenue Extension, to the west of the proposed access to the Plan Change area.

Figure 20 – AM Select Link, Fifth Avenue Extension, west of Tuumata Access

Figure 21 – PM Select Link, Fifth Avenue Extension, west of Tuumata Access



These plots show two dominant movements for this section of road, one being to and from the west (the CBD) and the other to and from the north (Wairere Drive and Gordonton Road). This is expected as this section of road connects the primary access point to the Plan Change area with the city and the arterial network. The north-west to south-east through function is also evident but makes up a smaller proportion compared to the eastern section.

7.4 ETC

Figure 22 and Figure 23 show the AM and PM select link plots for the ETC, to the north of the Fifth Avenue Extension.

Figure 22 – AM Select Link, ETC North of Fifth Avenue Extension

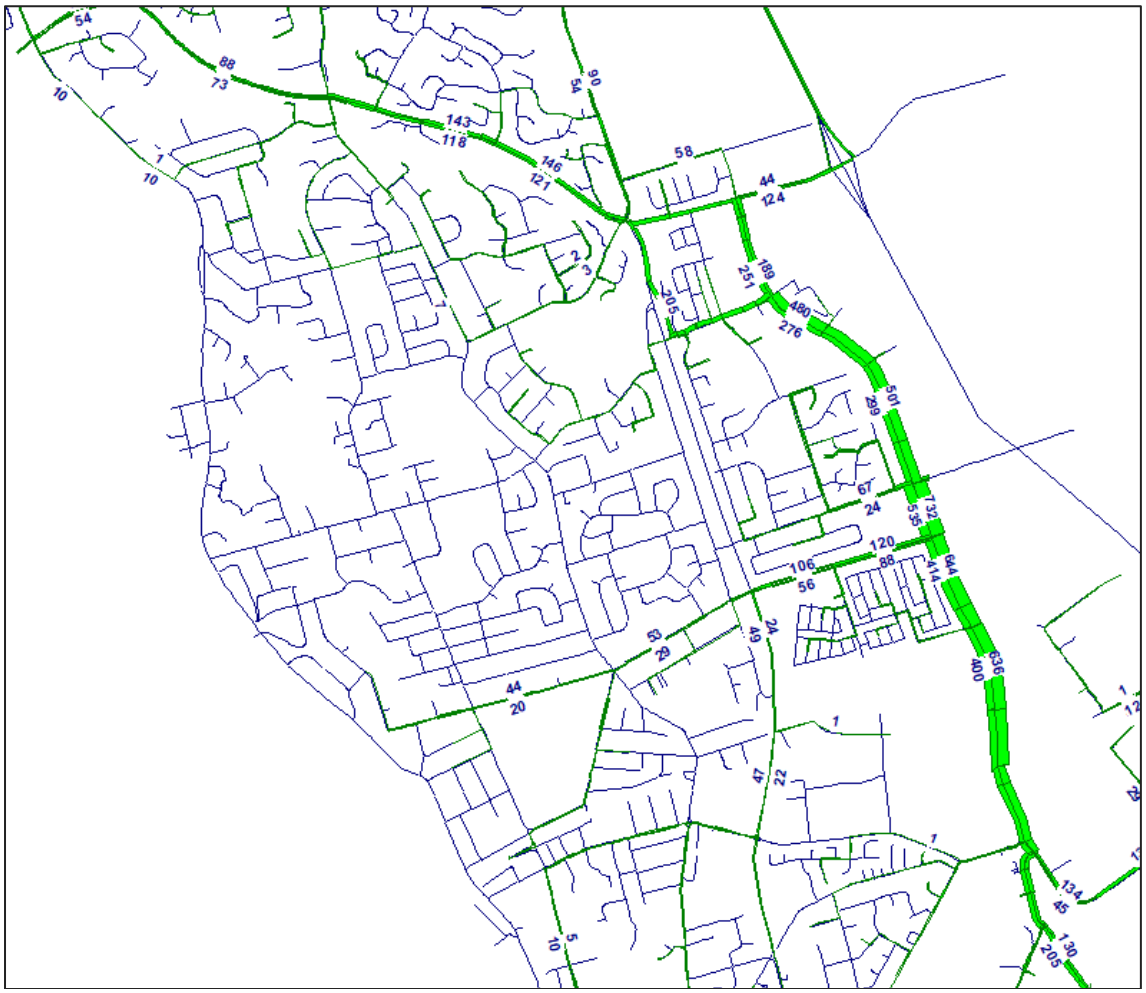
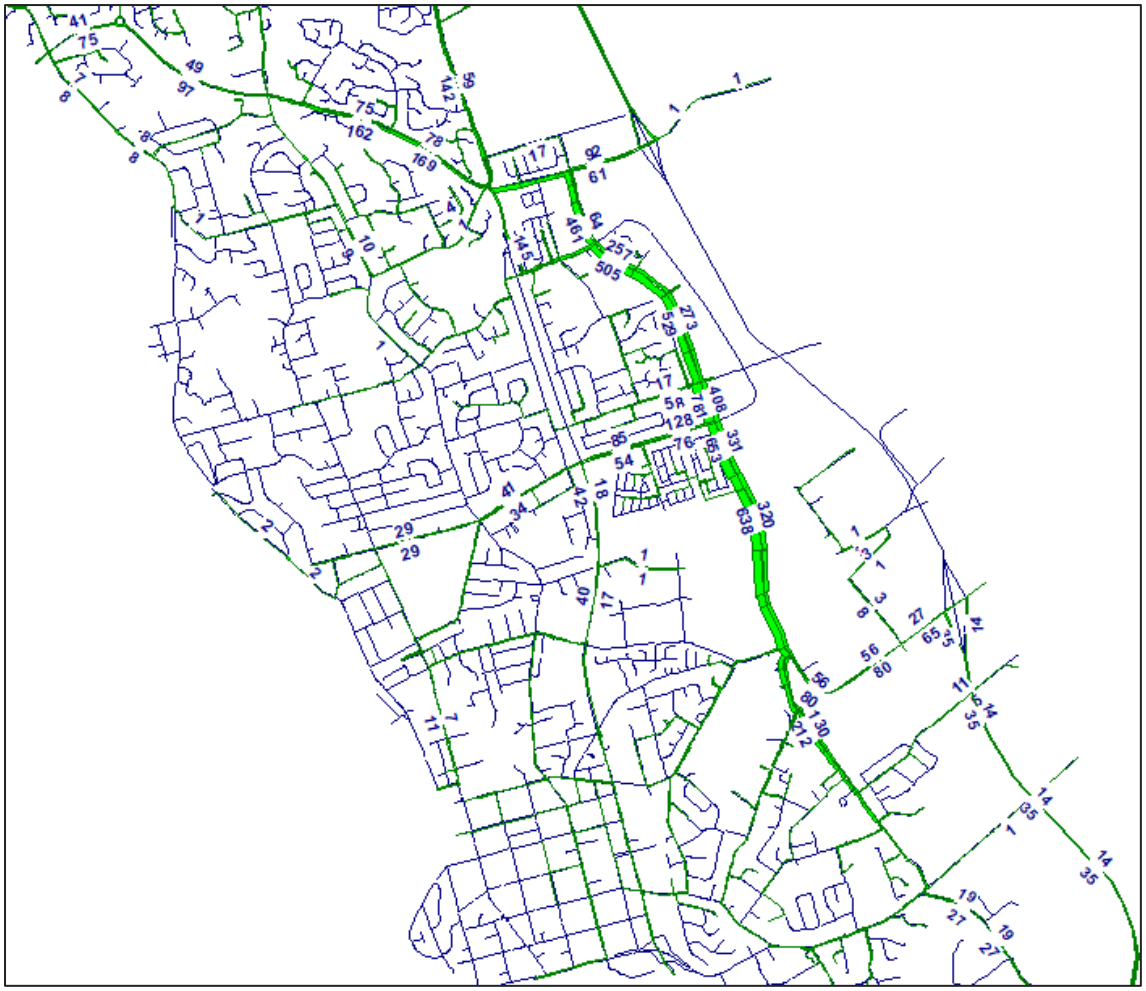


Figure 23 – PM Select Link, ETC North of Fifth Avenue Extension



These plots show that the northern section of the ETC is performing multiple roles. It is distributing traffic to and from the Greenhill Interchange on the WEX and providing an alternative north/south connection parallel to the Wairere Drive Ring Road. It is also providing access to various areas in the Ruakura Structure Plan area and the established area of Fairview Downs.

Figure 24 and Figure 25 show the AM and PM select plots for the section of the ETC to the south of the Fifth Avenue Extension.

Figure 24 – AM Select Link, ETC South of Fifth Avenue Extension

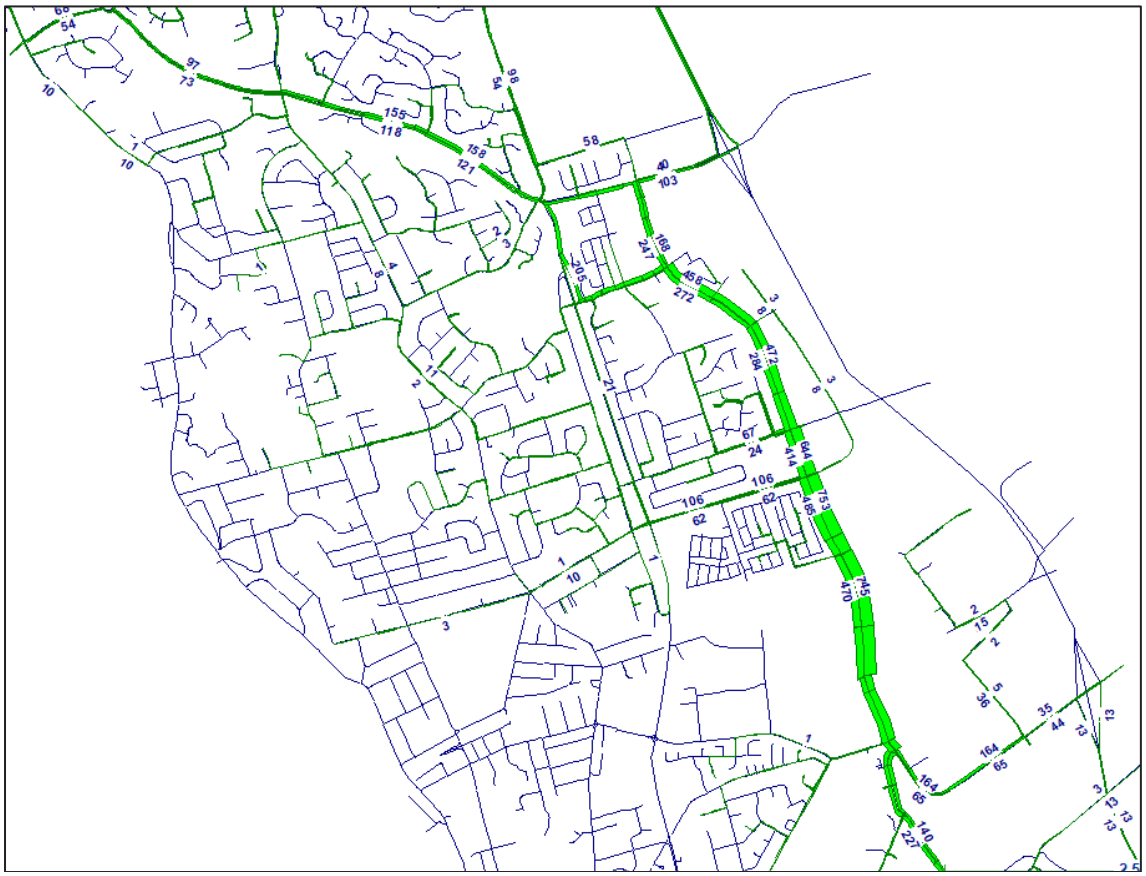
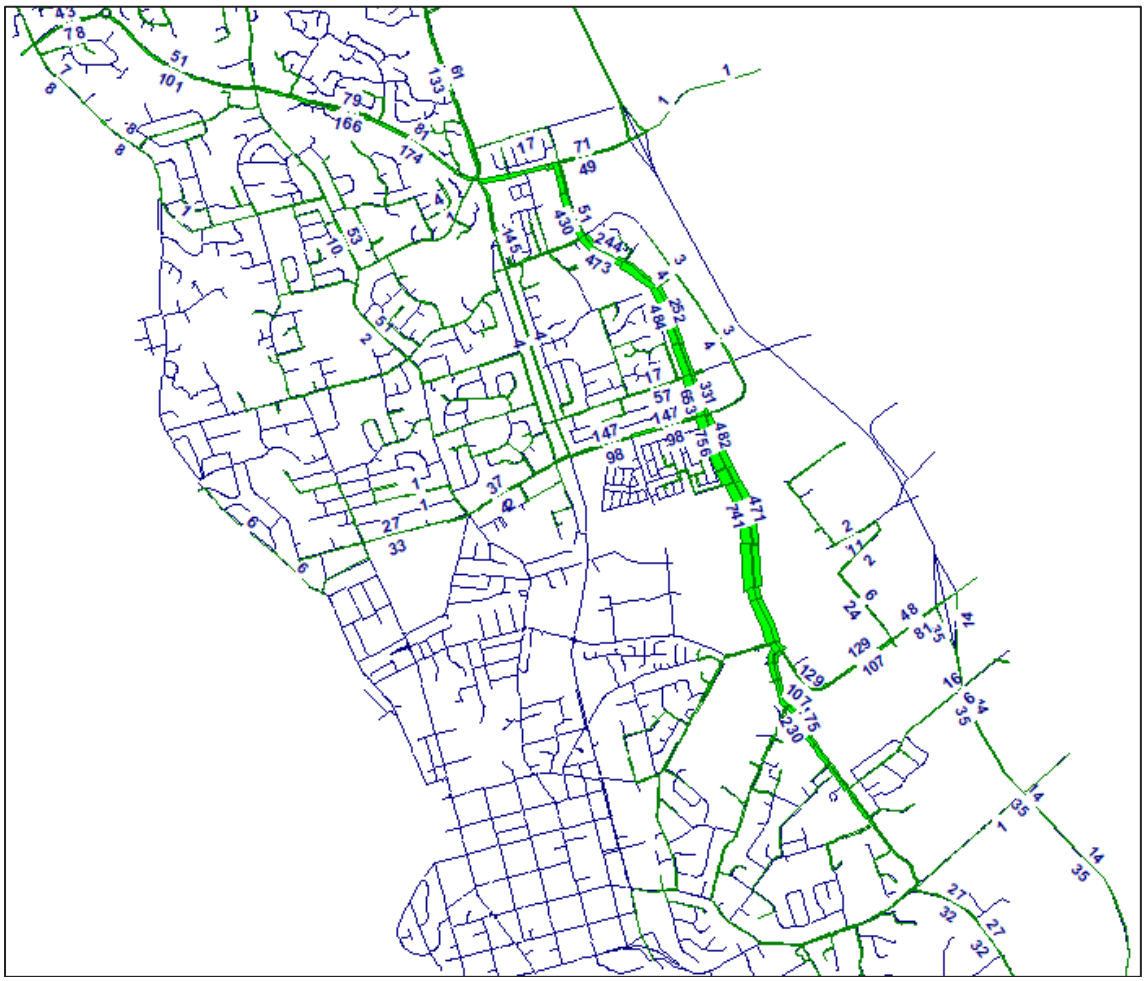


Figure 25 – PM Select Link, ETC South of Fifth Avenue Extension



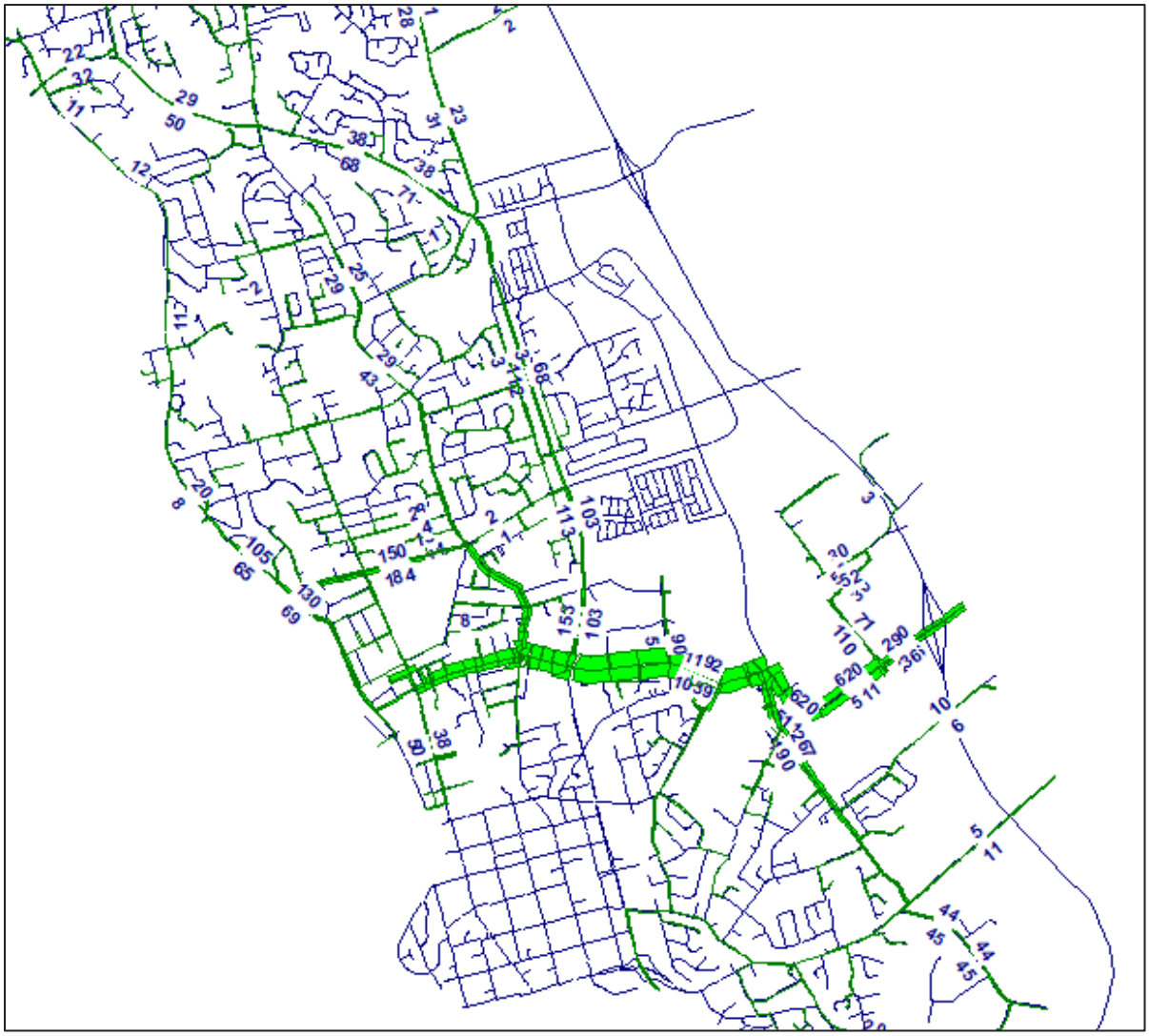
These plots also show multiple roles being performed by the ETC on the southern section also. The pattern indicates that trips to and from Silverdale, the University and the Inland Port/Logistics areas are using this section of the ETC to access the northern sections of Wairere Drive, the WEX interchanges, and the cross-city connector (to a lesser extent). The road is also playing a local function, providing access to the Plan Change area and other areas in the Ruakura Structure Plan area.

7.5 Ruakura Road

Figure 26 and Figure 27 show the AM and PM select link plots for Ruakura Road, on the section to the east of Ruakura Lane

Figure 26 – AM Select Link, Ruakura Road East of Ruakura Lane

Figure 27 – PM Select Link, Ruakura Road East of Ruakura Lane



These plots show that the dominant function on this part of Ruakura Road is east-west movement along the corridor. The road also plays a distribution function, connecting Peachgrove Road, Wairere Drive and Silverdale Road.

7.6 Travel Times

Two travel time routes were assessed and compared for Scenario 5 (no Plan Change) and Scenario 6 (fully developed Plan Change). The routes were:

- Wairere Drive, between Pardoa Boulevard and Cobham Drive (total length 6km); and
- Cross-city connector (Fifth Avenue & Boundary Road), between the ETC and the Boundary Road Bridge (total length 3km).

The routes were assessed in both directions, northbound and southbound on Wairere Drive and eastbound and westbound on the cross-city connector. The results are summarised in Table 7 and Table 8.

Table 7: Travel Time Comparisons (AM Peak)

Route	Travel Time (s)				Travel Speed (km/h)			
	S6	S5	Change	%	S6	S5	Change	%
Wairere Drive, Pardoa to Cobham (SB)	509	523	-14	-3%	43	42	1.1	3%
Wairere Drive, Cobham to Pardoa (NB)	605	608	-4	-1%	36	36	0.2	1%
Cross-City Connection, ETC to River (WB)	452	404	48	12%	29	32	-3.5	-11%
Cross-City Connector, River to ETC (EB)	368	351	16	5%	36	37	-1.7	-4%

Table 8: Travel Time Comparisons (PM Peak)

Route	Travel Time (s)				Travel Speed (km/h)			
	S6	S5	Change	%	S6	S5	Change	%
Wairere Drive, Pardoa to Cobham (SB)	539	528	12	2%	40	41	-0.9	-2%
Wairere Drive, Cobham to Pardoa (NB)	778	757	21	3%	28	29	-0.8	-3%
Cross-City Connection, ETC to River (WB)	383	349	34	10%	34	38	-3.3	-9%
Cross-City Connector, River to ETC (EB)	548	487	61	13%	24	27	-3.0	-11%

On Wairere Drive, the northbound direction is most critical in the PM peak when the average travel speed (Scenario 5) is 29 km/h. Development in the Plan Change area reduces this by 1 km/h, which adds another 21 seconds to the journey.

On the cross-city connector route, westbound travel towards the CBD is most critical in the AM peak. During this period, the expected average travel speed (Scenario 5) is 32 km/h. Development in the Plan Change area reduces this by 3 km/h, which adds another 48 seconds to the journey.

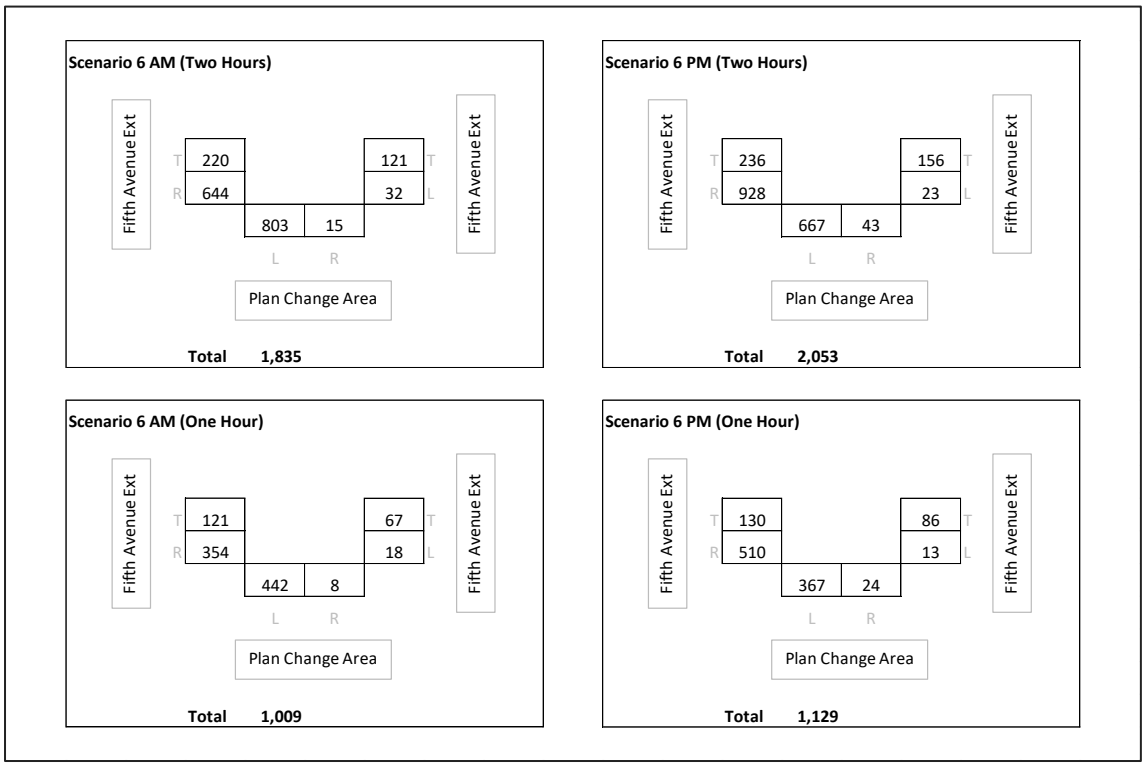
In the PM peak, the expected travel speed eastbound away from the CBD (Scenario 5) is 27 km/h. The addition of the Plan Change area reduces this by 3 km/h, adding another 61 seconds to the journey.

8 Plan Change Intersections

8.1 Tuumata/Fifth Avenue Extension Access

The modelled two-hour and one-hour[7] AM and PM peak turning movements at the proposed access to the Tuumata Plan Change area (Scenario 6) are shown below as Figure 28.

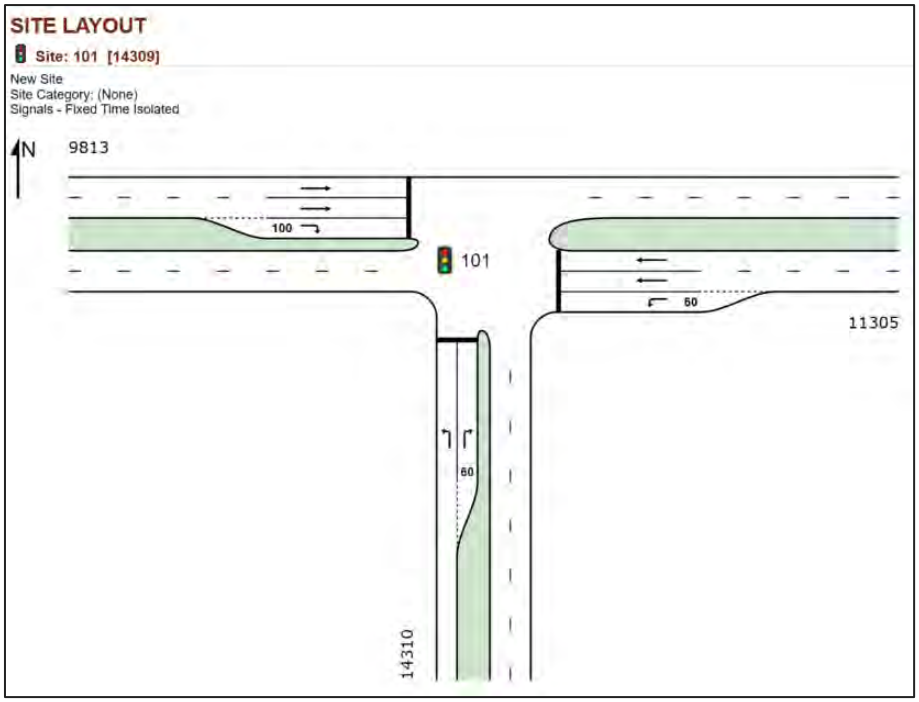
Figure 28 – Tuumata Access Turning Movements (Fifth Avenue Extension)



The layout adopted for this intersection in the SIDRA model (that is part of the WRTM model) is shown below as Figure 29.

[7] Converted from two-hour volumes using a factor of 0.55

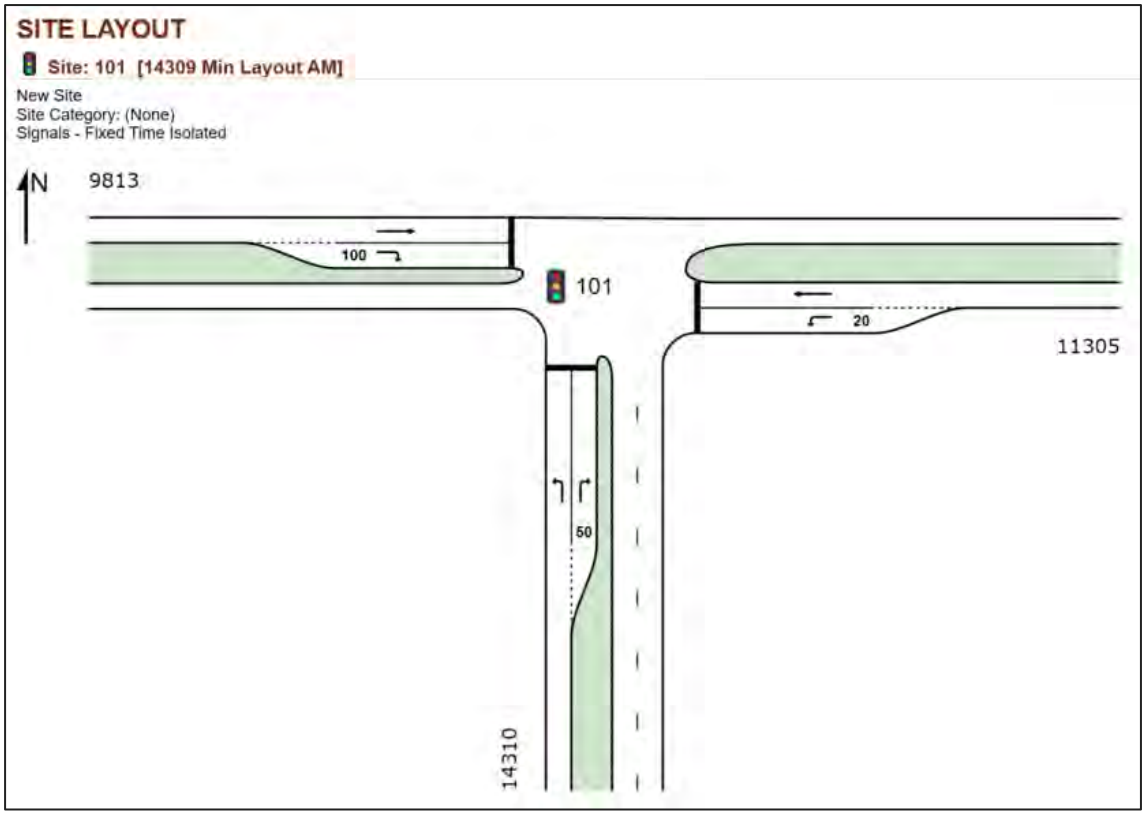
Figure 29 – WRTM Fifth Avenue Extension/Tuumata Intersection Layout



This intersection layout operated with an average intersection delay of 16.5 seconds/vehicle during the AM peak and 17 seconds/vehicle during the PM peak. Volume and delay summaries by turning movement are included in Appendix D.

Further tests were run in SIDRA to establish the minimum intersection layout that would provide for no worse than LOS D on any individual turning movement and maintain the 95th percentile queue lengths within each storage lane. That layout is shown as Figure 30 below.

Figure 30 –Fifth Avenue Extension/Tuumata Intersection Layout – Minimum Required



The analysis shows that the general arrangement above (with pedestrian crossing facilities and other features to be added) can provide appropriate vehicle capacity at the year 2041. The modelled 95th percentile queue lengths in the right turn bay on the Fifth Avenue Extension (West) approach were:

- 63m (9 vehicles) in the AM peak; and
- 92m (13 vehicles) in the PM peak

These are well within the available 420m midblock distance back towards Wairere Drive, indicating negligible risk of the proposed signals affecting the operating of the Wairere Drive/Fifth Avenue roundabout.

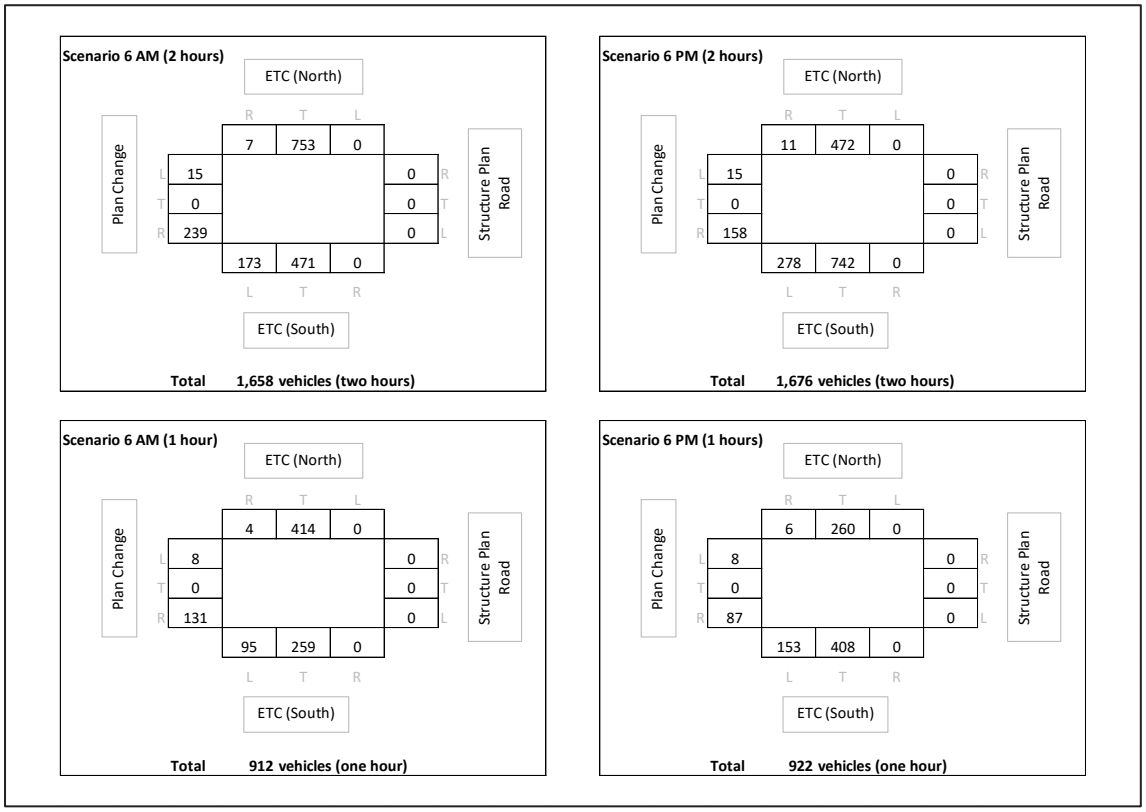
Generally, on the arterial network HCC has been constructing these sorts of intersections with two through lanes on the major road approaches (as indicated on Figure 29). If the corridor is two lanes (one lane each way), the lanes are built as short lanes with localises widening provided around the intersection. This provides a more efficient layout for vehicles but increases pedestrian crossing distance if there are at-grade crossings.

The analysis above shows that either layout can appropriately accommodate the expected vehicle demands in 2041. The intersection design can be developed at a later stage, in consultation with the relevant stakeholders and considering the needs of all transport modes.

8.2 Tuumata/ETC Access

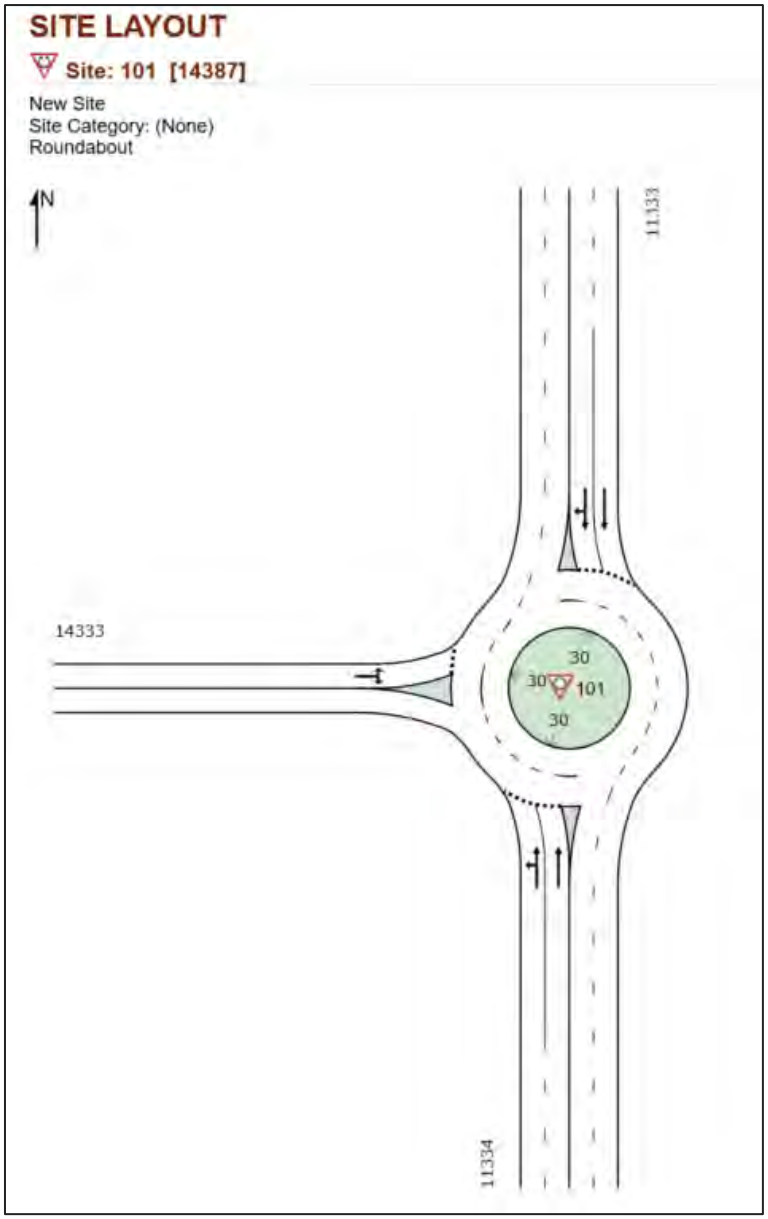
The modelled two-hour and one-hour AM and PM peak turning movements at the proposed access to the Plan Change area on the ETC (Scenario 6) are shown below as Figure 31.

Figure 31 – Tuumata Access Turning Movements (ETC)



The layout adopted for this intersection in the SIDRA model (that is part of the WRTM model) is shown below as Figure 32.

Figure 32 – WRTM ETC/Tuumata Intersection Layout



This intersection layout operated with an average intersection delay of 5 seconds/vehicle during the AM and PM peaks. Volume and delay summaries by turning movement are included in Appendix D.

Further tests were run in SIDRA to investigate options for this intersection. These tests included consideration of a fourth intersection leg to the east, into a future industrial area on the opposite side of the ETC. A nominal allowance of 100 vph on each turn into and out of this intersection leg was included, with a smaller 20 vph assumed to move across to and from the Plan Change area.

The analysis showed that either a single lane roundabout or a simple signalised layout would provide appropriate capacity. These layouts are shown below as Figure 33 and Figure 34. Further SIDRA outputs are included in Appendix E.

Figure 33 –ETC/Tuumata Block Intersection Roundabout Layout – Minimum Required

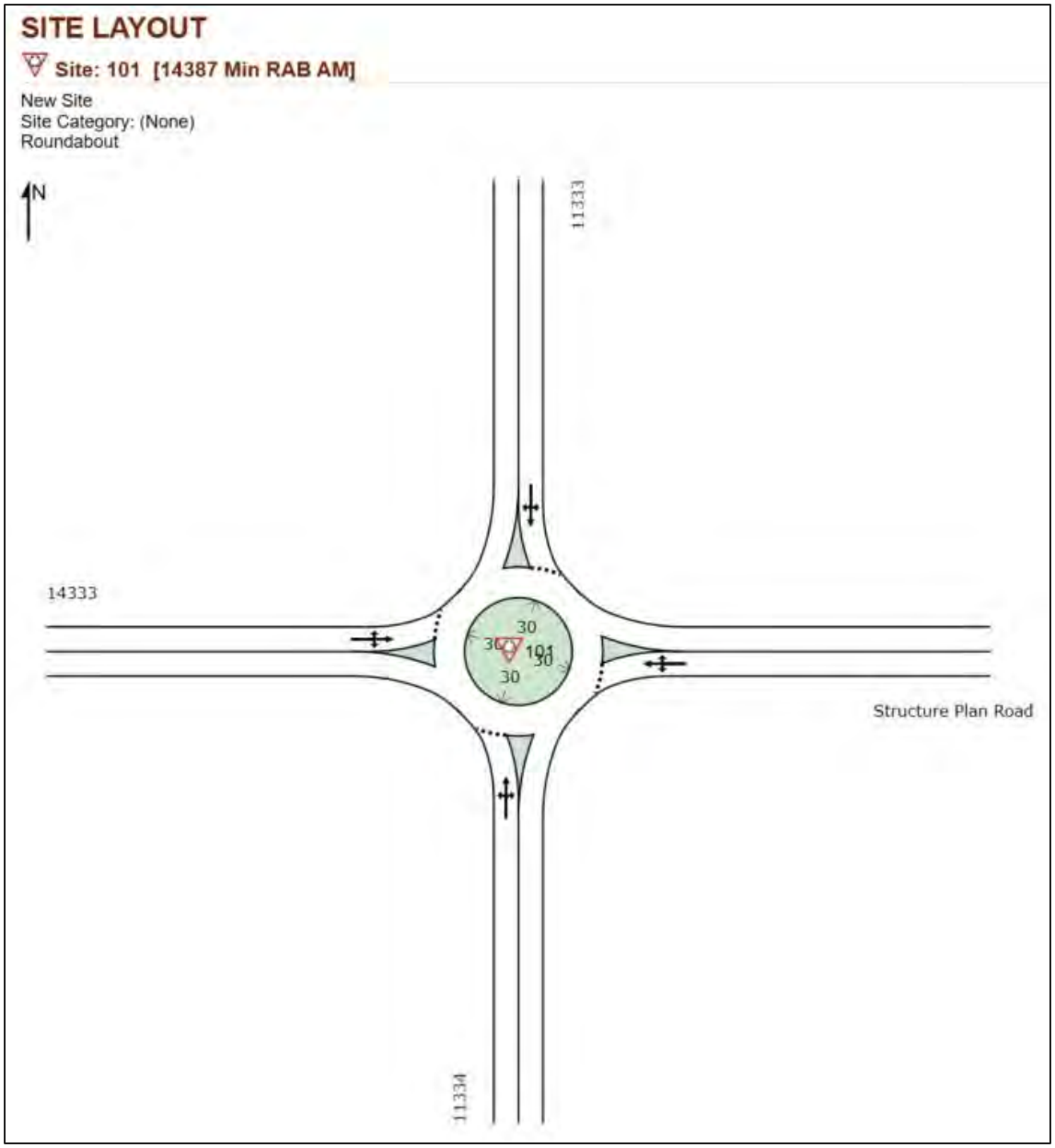
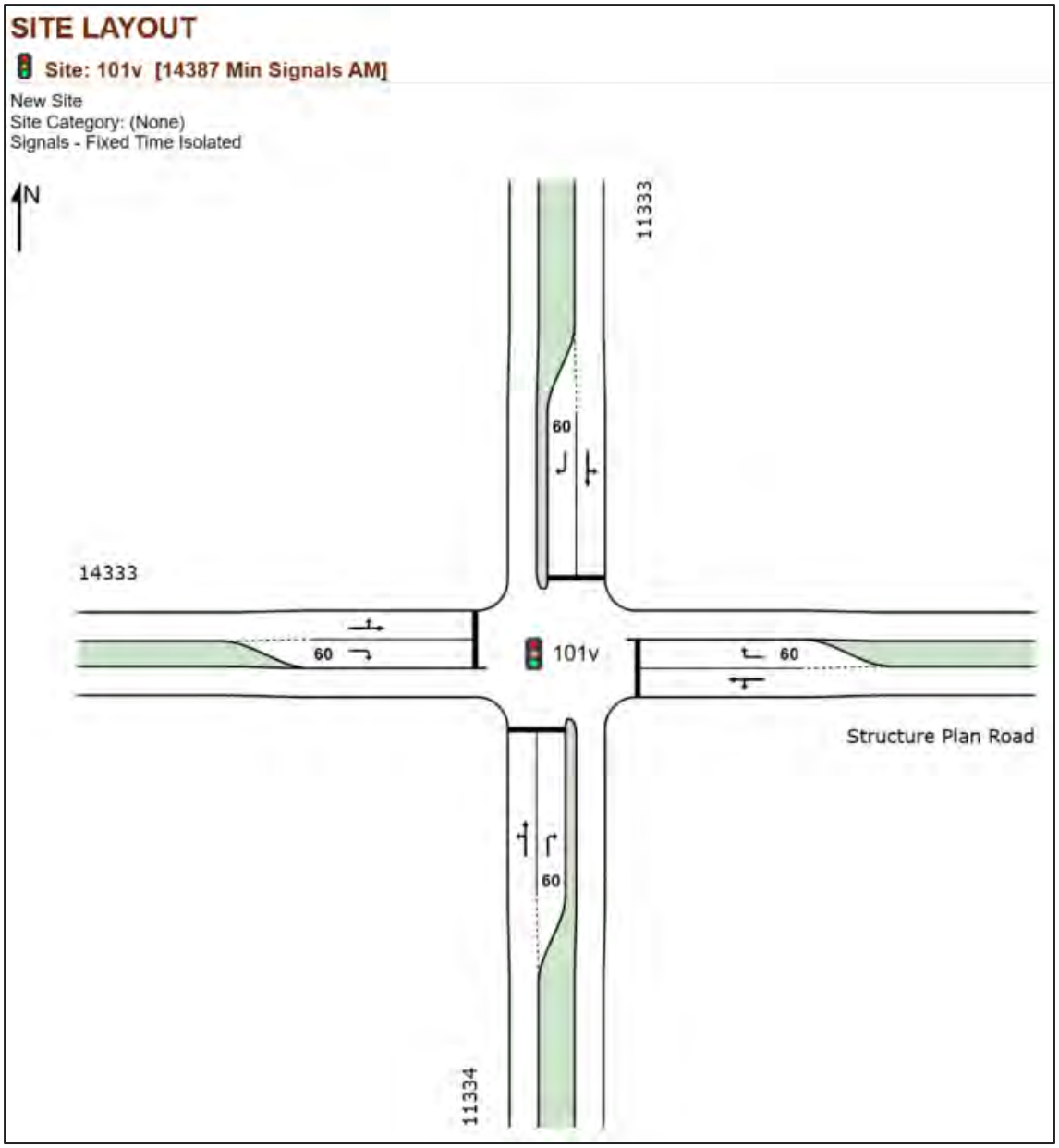


Figure 34 –ETC/Tuumata Block Intersection Signalised Layout – Minimum Required



The analysis shows that the general arrangements above (with pedestrian crossing facilities and other features to be added) can provide appropriate capacity at the year 2041. The ETC corridor was deliberately modelled as a four-lane road (two lanes in each direction) to ensure that it attracted an unconstrained volume of traffic.

The volumes described earlier in Table 4 (6,100 – 8,200 vpd) and the above intersection analyses indicate that two lanes (one each way) provide adequate traffic capacity at 2041. The corridor does however have the width to accommodate more lanes if required.

The analysis above indicates that either a roundabout or a signalised intersection can provide appropriate capacity in 2041. The intersection design can be developed at a later stage, in consultation with the relevant stakeholders and considering the needs of all transport modes.

8.3 School Sensitivity Test

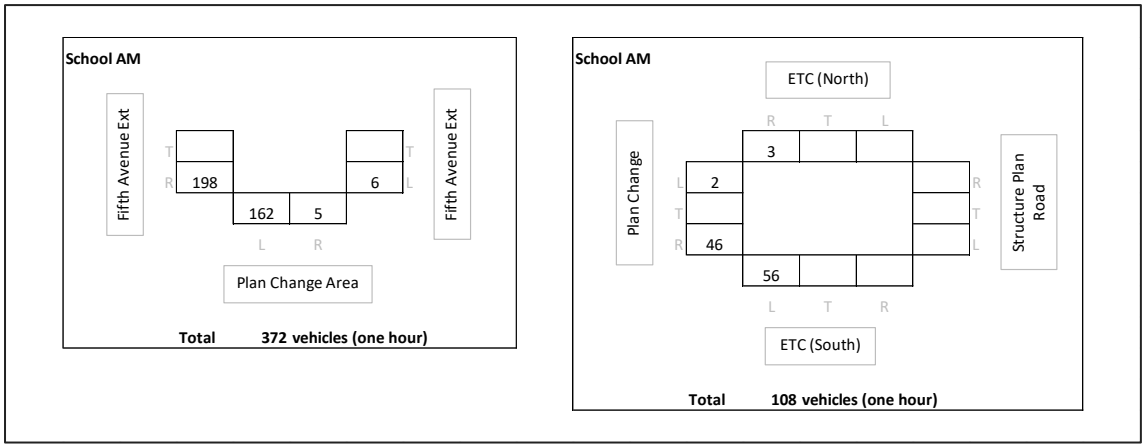
TGH has had initial discussions with the Ministry of Education (MoE) regarding the opportunity to protect a site for a future school in the southern part of the Plan Change area. Steps have been taken to ensure that the lot layout and surrounding roads can appropriately provide for a school around 4 ha in size. The MoE is not able to provide any certainty regarding plans for the site and as such it does not form part of the Plan Change.

A sensitivity test was undertaken to assess the ability of the Plan Change intersections to accommodate the change to a school, which would replace some residential lots. The assumptions used in this analysis are:

- The school is a primary school with a roll of 800 students and 40 staff;
- Using the 50th percentile trip rate from RR453, the school generates 480 vph (IN+OUT);
- Trips are distributed to the two Plan Change intersections in proportion to the volumes in Scenario 6 (78% use the Fifth Avenue Extension access, 22% use the ETC access);
- At the Fifth Avenue access, trips are split 96% west and 4% east, in accordance with the Scenario 6 patterns;
- At the ETC access, trips are split 95% south and 5% north, in accordance with the Scenario 6 patterns;
- Conservatively, no trips are removed to account for the residential land use that would replaced by the school;
- Only the AM peak period is modelled as a school's afternoon peak does not overlap with the PM commuter peak; and
- 55% of trips are inbound towards the school and 45% are outbound.

The resultant turning movement estimates are shown below as Figure 35.

Figure 35 –Estimated School Trip Generation at Plan Change Intersections



These movements were added to the SIDRA models for these intersections in Scenario 6, using the minimum footprint options shown above as Figure 30, Figure 33 and Figure 34.

SIDRA outputs are included in Appendix E. They illustrate that the ETC intersection, whether formed as a roundabout or signals, is not materially affected by the additional movements associated with the school. The signalised intersection continues to operate at LOS C and the roundabout intersection continues to operate at LOS A.

The Fifth Avenue Extension intersection continues to operate at LOS B. The increase in right turn demand increases the 95th percentile queue length on the western approach from 63m to 110m in the AM Peak. This makes the AM the more critical scenario for the design of this lane, as this is longer than the predicted PM queue of 92m. This is well clear of potential interaction with the Wairere Drive/Fifth Avenue roundabout but may warrant provision of a longer right turn bay. The Fifth Avenue Extension corridor has ample width to accommodate a longer right turn lane if it was required.

It is also noted that the above analysis assumes a roll size and adopts a typical rate of private car travel. No allowance has been made for trip capture within the Plan Change area (people living in the area and attending the school), for greater than typical uptake of active modes and public transport, or for attraction of trips that would otherwise be made to other schools. These factors, which would all reduce the volume of traffic using surrounding intersections, would be expected to be considered in detail at the time a Designation is sought.

The above analysis confirms that the proposed form of intersections serving the Plan Change area, and the available transport corridors, are able to accommodate the potential future inclusion of a school. There could be some minor differences in specific features of the intersection designs to consider, if and when plans for a school are advanced.

9 Non-Plan Change Related Issues

9.1 Wairere Drive/Powells Road

This section provides commentary on the Wairere Drive/Powells Road intersection, which has been identified as having LOS issues in some scenarios, albeit not generated or materially affected by the proposed Plan Change.

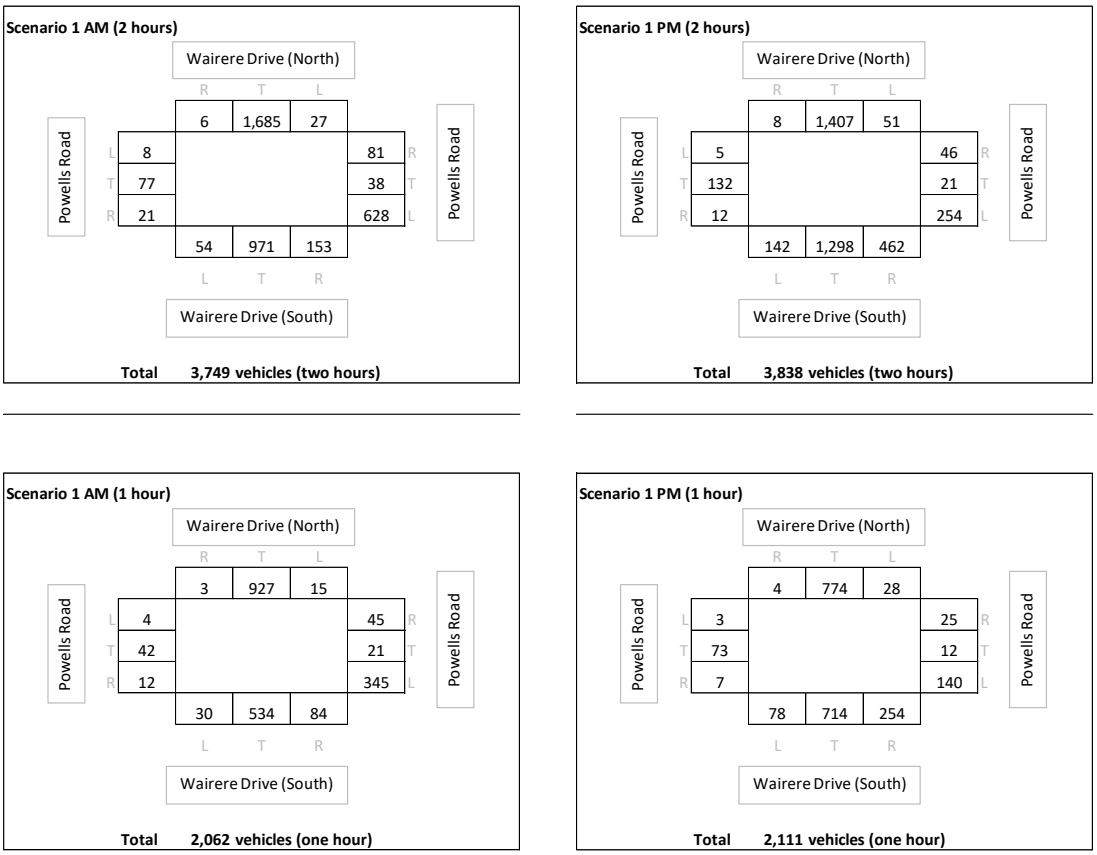
The intersection operates at LOS E and LOS F in the pre-ETC scenarios (Scenario 1 to 4). The development of the Plan Change area generates a change in total volume of between 0.3% and 0.6% at this interchange and as such, does not materially affect the existing issue here.

Intersection operation improves in the 2041 scenarios (Scenario 5 and 6) when the eastern end of Powells Road is connected to the ETC at a roundabout. This provides new access options for people living in Fairview Downs and reduces reliance on the Wairere Drive/Powells Road intersection.

The existing layout of the intersection is shown below as Figure 36. Modelled turning movements in Scenario 1 (2018 with no Plan Change) are shown as Figure 37, for two-hour and one-hour peak periods.

Figure 36 – Wairere Drive/Powells Road Intersection (Source: HCC GIS Maps)

Figure 37 – Wairere Drive/Powells Road Turning Movements (Scenario 1)



The intersection has been modelled to reflect its on-street operation, which involves drivers queueing side by side over a short length on the Powells Road (East) approach. This approach is line marked as a single lane but in practice operates as two, as can be seen above on Figure 36.

In Scenario 1 (no Plan Change), this intersection has modelled average delays of 110 seconds/vehicle in the AM peak and 71 seconds/vehicle in the PM peak.

In the AM peak, the modelled 95th percentile queue lengths are 430m on Wairere Drive (North), 330m on Powells Road (East), 140m on Wairere Drive (South) and 30m on Powells Road (West).

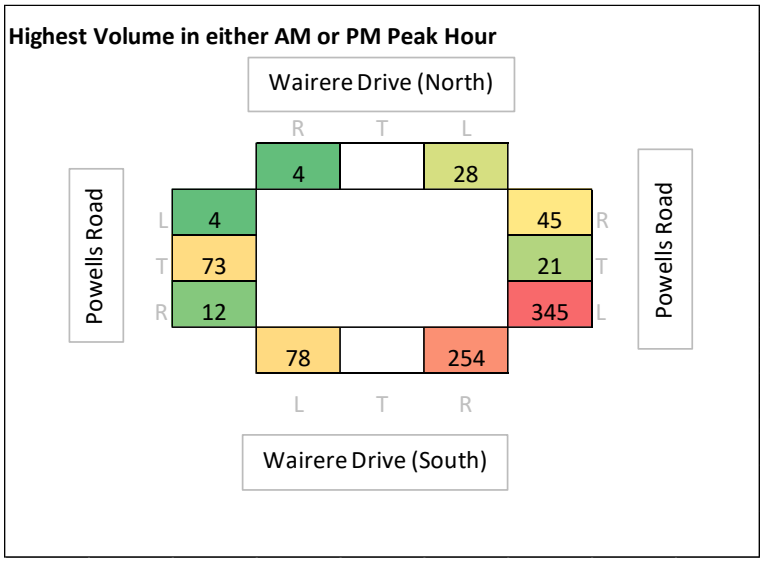
In the PM peak, the modelled 95th percentile queue lengths are 240m on Wairere Drive (North), 70m on Powells Road (East), 216m on Wairere Drive (South) and 50m on Powells Road (West).

The LOS issues arise because of the phase time that is taken by the Powells Road approaches, when the intersection is allowed to optimise its cycle and phase times across all approaches. One option for managing this would be to limit the phase time given to these minor road approaches, regardless of the delays and queues that eventuate. This would protect the functioning of Wairere Drive but would

not assist road users travelling to and from Fairview Downs. Other options are explored in the following section.

Figure 38 shows the maximum peak hour turning movements at the intersection in either the AM or PM peak. Movements are colour coded based on their relative scale.

Figure 38 – Wairere Drive/Powells Road Peak Hour Turning Movements (Either Period)



Review the turning movements above shows that there is minimal demand (<15 vph) in either peak period for:

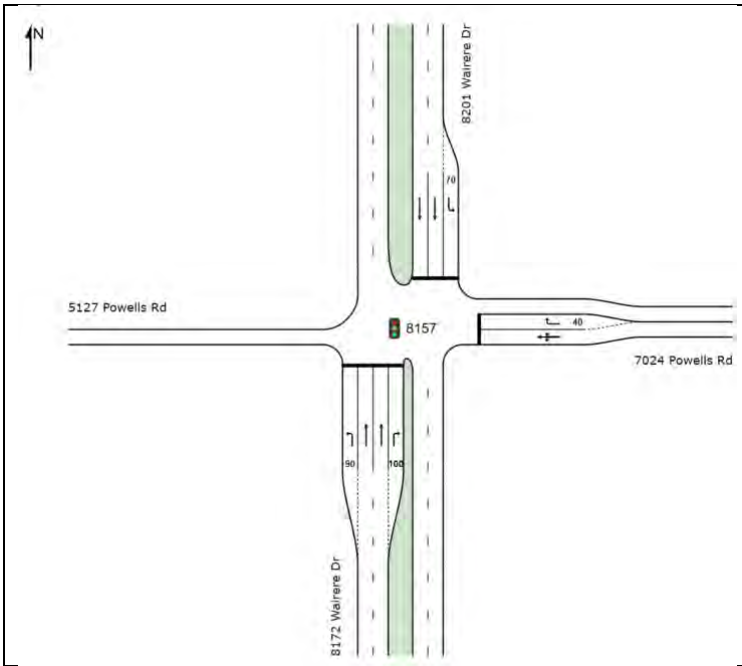
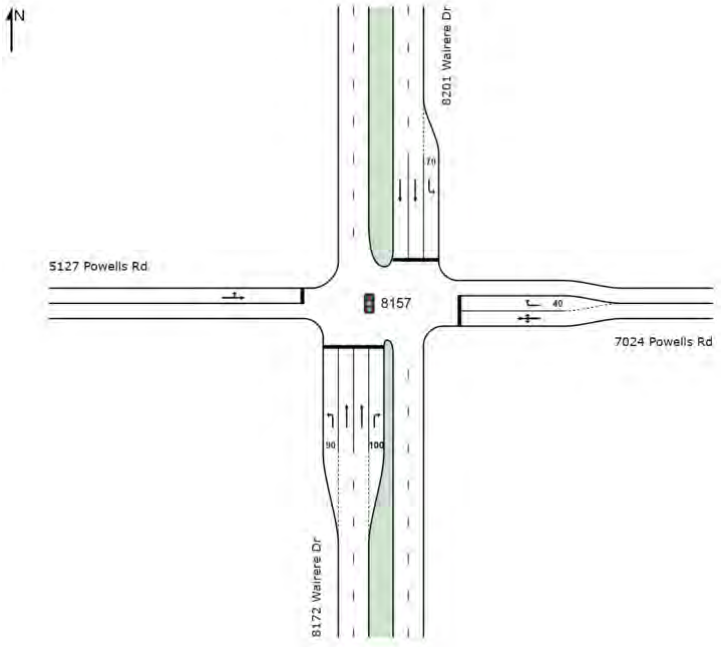
- Right turns into Powells Road (West) from Wairere Drive (North);
- Left turns out of Powells Road (West) to Wairere Drive (North); and
- Right turns out of Powells Road (West) to Wairere Drive (South).

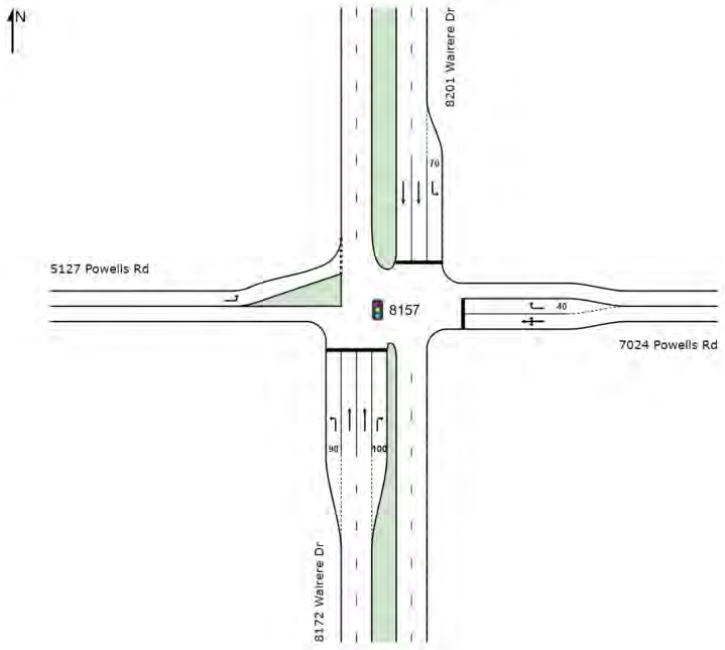
These turns all have reasonable (and potentially more attractive) alternatives available, for example via the Carrs Road interchange, or using Tramway Road to travel south and access the Wairere Drive/Fifth Avenue roundabout.

There are moderate demands for through movements east to west and vice versa, with 20-70 vph crossing either way. The highest demands are on the right turn into Powells Road from the south and the corresponding left turn out to the south. These movements have no convenient alternative until the ETC is delivered.

A more efficient intersection layout and signal phasing could be achieved by removing the turning movements that have low to moderate demand and reasonable available alternatives. The three indicative layouts below are all able to achieve LOS C or better during both peaks.

Figure 39 – Indicative Wairere Drive/Powells Road Intersection Layouts

	**Test 1 Notes:** No right turn from Wairere Drive (North). Powells Road (West) converted to entry only from Wairere Drive. Volume that was moving through from Powells Road West to East transferred to right turn into Powells East from the south.
	**Test 2 Notes:** No right turn from Wairere Drive (North). No right turn out of Powells Road West.

	**Test 3 Notes:** No right turn from Wairere Drive (North). Left turn out of Powells Road (West) is Give Way controlled.

SIDRA outputs including layouts, movement summaries and phasing information are included in Appendix E.

Overall, this analysis demonstrates that there are options available to improve the performance of this intersection, should that be the desired outcome.

10 Summary and Conclusions

The following key conclusions can be made based on the assessments described in this report:

- The proposed Tuumata Plan Change, comprising the Tuumata Residential Zone and Neighbourhood Centre has been modelled in the WRTM using a subarea model, validated to 2018 conditions.
- The Plan Change area includes approximately 1,269 residential households and a neighbourhood centre of approximately 6,000m^2 GFA.
- The Plan Change area is expected to generate approximately 1.138 vehicle movements per hour (vph) during the morning peak hour and 1,297 vph during the evening peak hour.
- Analysis using models for the years 2018 and 2031 shows that an initial release of 430 households can be accommodated by the network, ahead of delivery of the Eastern Transport Corridor (ETC).
- The critical corridor that would support this stage of development is Wairere Drive, which is expected to see a reduction in traffic volume following the opening of the WEX.
- The peak period volume through the Wairere Drive/Fifth Avenue roundabout is expected to reduce by 25-35%.
- The initial development release is expected to generate some 230 vph, which represents a change of between 7% and 9% in peak hour volume at the roundabout. The model indicates that the roundabout can accommodate this change and maintain an acceptable level of service.
- The Wairere Drive/Powells Road intersection to the north of this roundabout operates with a poor level of service irrespective of the Plan Change, and the Plan Change adds a negligible volume of traffic to it.
- Reliance on this intersection will reduce when Powells Road is eventually connected east, to the ETC. In the interim, there are options (explained in Section 9.1 of this report) to improve the function of this intersection by removing some lower volume movements.
- When fully developed, the Plan Change area is expected to increase link volumes on the existing arterial network by between 5% and 22%. All roads continue to operate with daily volumes that are within their practical carrying capacities.
- At 2041 the city network has various areas that are expected to operate at LOS F. This includes the northern section of Wairere Drive, Resolution Drive, River Road, Hukanui Road. Cambridge Road and Cobham Drive, and parts of the cross-city connector and Ruakura Road.
- The Plan Change does not make link performance around the study area materially worse.
- Travel times with and without the Plan Change were assessed for two routes, one along Wairere Drive from Pardoa Boulevard to Cobham Drive and the other along the cross-city connector from the ETC to the Boundary Road Bridge.
- The travel time comparisons show that the Plan Change is expected to increase journey times on these routes by up to 13% (up to one minute). This corresponds to a reduction in average speed of up to 3.5km/h.
- Analysis of intersection volumes shows that the Plan Change causes nine intersections in the AM peak and seven intersections in the PM peak to see volume increases of 5% or more.

- These intersections all operate at LOS D or better and therefore no changes are required to the network beyond the Plan Change area's immediate access points.
- The Plan Change area is proposed to have two access points, one on the Fifth Avenue Extension and one on the ETC.
- The Fifth Avenue Extension intersection can operate appropriately as a signalised intersection with either a two-lane or four-lane configuration of through lanes along the Fifth Avenue Extension.
- If a school is to be designated in the Plan Change area in future, initial analysis (assuming a primary school with 800 students) indicates that the intersection can accommodate increases in demand, with some potential changes to storage lane lengths. Specifically, the right turn approaching the Plan Change area on the Fifth Avenue Extension would need to be around 20m longer.
- The ETC intersection can operate acceptably as either a single-lane roundabout or a signalised intersection. Either treatment can accommodate the increases associated with a future school.

APPENDICES

Appendix A - Model Briefing Documents

Stantec

Memo

To:	HCC/WLASS	From:	Mark Apeldoorn/Anna Wilkins Hamilton
Project/File:	310205113	Date:	13 May 2022

Reference: 310205113

1 Introduction

The purpose of this memo is to describe the testing sought in the Waikato Regional Transportation Model (WRTM) for the Tramway Block Plan Change. The memo outlines the proposed masterplan, expected trip generation, model scenarios and requested outputs from the model, which will be shared with the HCC and Tainui Group Holdings (TGH) teams.

Based on prior WLASS approval a sub-area model has been extracted and local area validation progressed. The validation report is attached as Appendix A.

2 Masterplan

2.1 Proposed Layout

The Tramway block includes two land use types, medium density residential (MDR) and suburban centre (SC). The latest masterplan is shown as Figure 1. Density calculations are presented as Figure 2.

Reference: 310205113

Figure 1 Tramway Block Masterplan

Figure 2 Tramway Block Areas & Densities

Stage 01 - TRAMWAY BLOCK (Includes 5th Avenue Extension)				
DEVELOPABLE LAND - Med Density	21.09	31%	Dwellings @net 50p/ha	1,054.50
DEVELOPABLE LAND - Suburban **(3.26ha Gross, 1ha net)**	3.26	5%		
SCHOOL (4ha min)	-	0%		
ROAD, FOOTPATH, CYCLEPATH, BERMS, ON STREET PARKING	20.94	31%		
ROAD RESERVE - OPEN SPACE (includes space for future roads)	7.57	11%		
OPEN SPACE	4.47	7%		
STORMWATER	4.00	6%		
SWALE	6.64	10%		
TRAMWAY BLOCK - TOTAL (Gross Area)	**67.97**	**100%**		

The Tramway block is expected to yield approximately 1,054 dwellings and approximately 10,000m^2 gross floor area (GFA) of SC. The GFA to be tested will be confirmed by TGH following the receipt of an economics report. For the purposes of the analysis that follows, the Hamilton City Council (HCC) Operative District Plan (ODP) definition[1] of GFA will be adopted for reference to the gross floor area of development. With the RMS trip rates being developed and referenced to a different (GLFA) basis, a corresponding calculation adjustment may be warranted to properly reflect the differing basis of determination. This will be assessed once the indicative form of the development described in the

[1] **Gross Floor Area (GFA):** Means the sum of the gross floor area of all floors of all buildings on a site measured from the exterior faces of the exterior walls or from the centrelines of walls separating two buildings. Gross floor area shall include elevator shafts, stairwells and lobbies at each floor and mezzanine floors and balconies, and exclude any provided car-parking, loading and servicing areas and access thereto and building service rooms containing equipment such as lift machinery, tanks, air conditioning and heating plants.

economics report is determined. By way of information, the RMS GLFA definition is included below.[2] Provisionally and for the purposes of this brief, the HCC GFA has been assessed as broadly represented by the RMS GLFA, without adjustment, for the purposes of estimating trip generation.

2.2 Potential School

The masterplan has been prepared to protect the opportunity for the Ministry of Education (MoE) to designate a school in the southern part of the Tramway block (in subarea 5 as shown on Figure 3 below). This includes ensuring that the proposed road network in this area can accommodate school buses and public transport routes.

At this stage, it is understood that the MoE is not able to provide any certainty about these plans or any information about the form that a future school may take.

A school is therefore not included in the masterplan land use assumptions. It has however been included as a sensitivity test, as described later in this memo.

3 WRTM Land Use Inputs

The proposed zoning of the Tramway block for the purpose of modelling it in the WRTM is shown below as Figure 3. Modelling the block at this level of disaggregation is consistent with the representation of other residential areas across Hamilton.

It enables the interaction (internal trip making) between residential and commercial areas to be captured, and assists with a reasonable representation of route choice, given the two connection points that are available to the network.

[2] Gross leasable floor area: the sum of the area of each floor of a building where the area of each floor is taken to be the area within the internal faces of the walls, excluding stairs, amenities, lifts corridors and other public areas but including stock storage area.

Figure 3 Proposed Zone Structure in WRTM

Trip generation rates have been developed with reference to the RMS Guide to Traffic Generating Developments (New South Wales) and associated studies[3], as well as the existing characteristics of the WRTM The RMS rates are:

High Density Residential Flat Buildings in Regional Centres:

- 0.53 trips/unit during the AM peak
- 0.32 trips/unit during the PM peak (Note: proposal is to adopt 0.53 trips in the PM peak hour assessment as described below)
- 4.58 trips/unit over the day

These rates are broadly consistent with the HCC Operative District Plan rates for apartments.

Shopping Centres with GLFA <10,000m^2

- 7.76 trips/100m^2 GLFA during the AM peak
- 10.41 trips/100m^2 GLFA during the PM peak

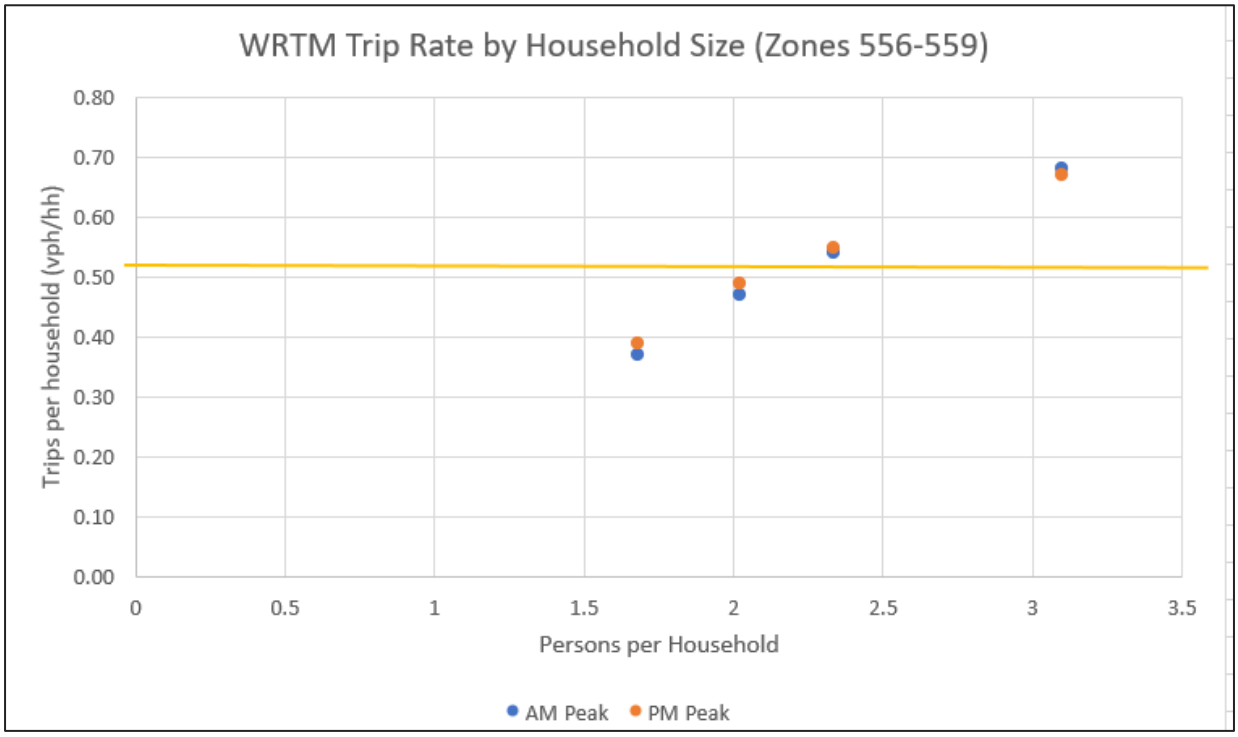
[3] Trip Generation Surveys Small Suburban Shopping Centres Analysis Report, Bitzios Consulting for Roads and Maritime Services NSW (November 2018)

A daily rate is not given for shopping centres so a factor of 10 has been adopted and applied to the average AM and PM rates, which gives an estimated daily rate of 91 vpd/100m^2 GFLA).

The above rates are proposed to be adopted in the assessment, except for the PM peak residential rate which is recommended to be increased to match the AM peak (0.53 trips/unit).

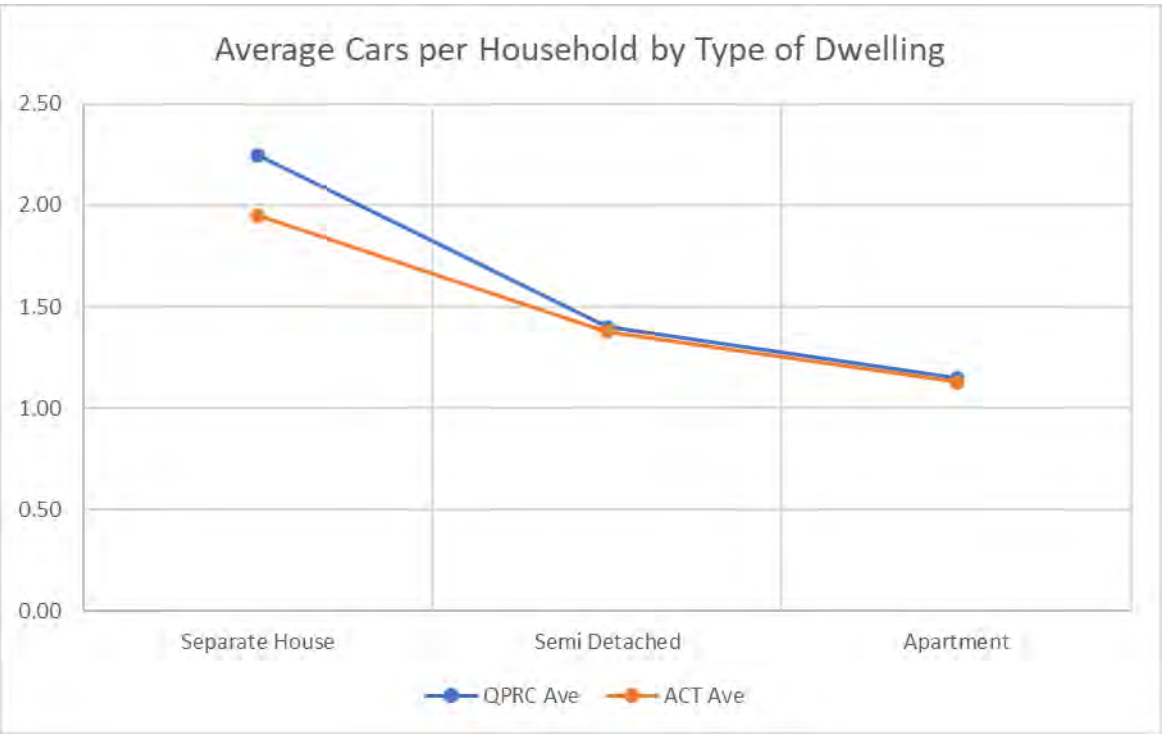
Review of WRTM trip generation characteristics for other residential zones around the Tramway block (zones 556 to 559) shows that 0.53 trips/hh aligns approximately with existing WRTM trip rates for an average household size of two people. This is shown on Figure 4 below.

Figure 4 WRTM Trip Rates, Other Eastern Residential Zones



It is well established by this and other sources that car availability (and consequently trip generation), reduces with household size. There is also a relationship between the physical form of the dwelling and car ownership, as illustrated below using Australian Census data extracted by Stantec for a different model.

Figure 5 Queanbeyan and ACT Car Ownership Trends



Logically, when there are more smaller-format dwellings like apartments and attached houses, car ownership and trip rates fall.

Given the high density proposed in the Tramway block, the expectation of these smaller format housing typologies together with the site's urban context, access to local employment, commercial, and retail services, the provisioning for a local school activity outcome; and further having regard for the planned high-frequency rapid transit public transport service routes along Fifth Ave and on the Eastern Transport Corridor (ETC) alongside extensive pedestrian/cycle networks, it is assessed as appropriate to progress the evaluations based on both the AM and PM peak periods with a rate of 0.53 trips/unit.

The resulting trip generation assessment for the block (using the subareas shown on Figure 3) is shown in Table 1 below. The number of dwellings in each area has been estimated in proportion to the relative size of these areas.

Table 1 – Trip Generation Assessment

Sub-Area	Type	Size	Unit	AM Peak Hour			PM Peak Hour			Daily		
				Trips	IN	OUT	Trips	IN	OUT	Trips	IN	OUT
1	SC	10,000	sqm GFA	**776**	427	349	**1,041**	521	521	**9,100**	4,550	4,550
2	MDR	266	Dwellings	**141**	42	99	**141**	92	49	**1,220**	610	610
3	MDR	219	Dwellings	**116**	35	81	**116**	76	41	**1,004**	502	502
4	MDR	145	Dwellings	**77**	23	54	**77**	50	27	**662**	331	331
5	MDR	124	Dwellings	**65**	20	46	**65**	43	23	**566**	283	283
6	MDR	90	Dwellings	**48**	14	34	**48**	31	17	**414**	207	207
7	MDR	210	Dwellings	**111**	33	78	**111**	72	39	**961**	481	481
TOTAL	-	-	-	**1,335**	**594**	**740**	**1,600**	**884**	**716**	**13,927**	**6,964**	**6,964**

The land use parameters in these zones in the WRTM should be applied to match these trip generation characteristics as closely as possible.

The WRTM inherently accounts for pass-by and diverted trip impacts, for example people who call into the commercial area as part of an existing trip on the network, being made for another purpose.

4 Model Scenarios

The starting point for the modelling is the recently validated 2018 base model (AM and PM). This has been windowed to a smaller subarea to enable efficient running time when investigating network changes within a scenario, but the full model needs to be run for each new land use scenario.

The validation of this network and the assessment of the appropriate area to window is reported separately and is included as **Attachment 1**.

The proposed model scenarios are as follows. All scenarios are proposed to be run in the AM and PM peaks.

Year 2018 and 2031

The purpose of these scenarios is to assess the effects of an initial release of residential development in the area ahead of delivery of the Eastern Transport Corridor (ETC).

No commercial development is proposed prior to the ETC being in place and 2031 is used as a nominal year to assess the early development stage with an allowance for other background growth.

The assumed land use pattern and network assumptions (beyond the Plan Change area) for 2031 need to be agreed with HCC.

- Scenario 1: 2018 base with no development in Tramway block (i.e.: remove the 16ha industrial activity, if any, on the basis there is no permitted basis for this and it will be replaced by the proposal in any event). Add the Waikato Expressway Hamilton Section.
- Scenario 2: 2018 base (with the Waikato Expressway Hamilton Section) with circa 400 dwellings (threshold to be tested) in Tramway block[4].
- Scenario 3: 2031 base with no development in Tramway block (remove the 16ha industrial activity as above), no ETC.
- Scenario 4: 2031 base with 430 dwellings in Tramway block, no ETC.

Year 2041

The purpose of these scenarios is to assess the effects of full development of the Tramway block. An industrial use scenario is included for comparison.

The assumed land use pattern and network assumptions (beyond the Plan Change area) for 2041 need to be agreed with HCC.

- Scenario 5: 2041 base with no development in Tramway block.
- Scenario 6: 2041 base with full development of Tramway block (Table 1)[5].

Year 2041 with Other Development Areas

The purpose of this scenario is to consider the potential rezoning of land to the south of the Tramway block (on the AgResearch/Knowledge zone sites), that could share some of the Tramway block's transport connections. This will inform an assessment of the corridor widths that are required to be protected (in and abutting the Tramway block) to not preclude these opportunities for other parties.

- Scenario 7: 2041 base with full development of Tramway block (Table 1) plus development/rezoning of AgResearch, using the land use assumptions outlined in Figure 6.

It was acknowledged in the methodology workshop meeting that any evaluation involving consideration of effects potentially due to NPS-UD intensification outcomes, for which there is no relevant land use

[4] In this scenario the development would be accessed via an unsignalised connection to the Fifth Avenue Extension, which in the absence of the ETC, would be a stub road from the Wairere Drive roundabout.
[5] In this scenario (and in Scenario 7) the Tramway block should be modelled with two access points, one being a signalised T-intersection on the Fifth Avenue Extension and the other a left-in, left-out only access on the ETC.

information able to be applied, will be considered outside of and following the WLASS modelling, and through sensitivity evaluations at corridor/intersection level where needed.

Figure 6 Indicative AgResearch & Knowledge Zone Densities

	67.96503819			
Stage 02 - AG RESEARCH BLOCK				
DEVELOPABLE LAND - Medium - High Density	31.33	54%	Dwellings @60p/ha	1,879.89
TOWN CENTRE - MIXED USE / APTS	3.00	5%	Dwellings @90p/ha	270.00
WARTER RESERVOIR (Section 2 SO519316)	1.50	3%		
TRANSPORT HUB (North of rail corridor)	0.75	1%		
ROAD	10.00	17%		
OPEN SPACE	5.25	9%		
STORMWATER (apprx. 10% requirement)	5.76	10%		
AG RESEARCH BLOCK - TOTAL (Gross Area)	**57.59**	**100%**		

In all scenarios, the assumed base case land use pattern and network assumptions (beyond the Plan Change area) for 2031 and 2041 need to be agreed with HCC.

School Sensitivity Test

If a school were to replace residential development in Subarea 5, it would be expected to generate more trips in the weekday morning peak hour, a similar number of trips in the weekday evening peak hour (because the school peak occurs earlier in the afternoon), and approximately 20% more trips across the day.

The inbound/outbound split would be different during the morning, with the school having a more even directional distribution compared to the mostly outbound pattern of a residential area. The school would also have a greater level of internal trip making, capturing trips that would otherwise be made to other schools.

A check is proposed to be undertaken at the Tramway block/Fifth Avenue Extension intersection to confirm that this change could be accommodated by the available intersection footprint. The check will be undertaken in SIDRA, using output volumes from the WRTM with adjustments to remove the residential generation associated with Subarea 5 and replace it with estimated school traffic generation, in the AM peak.

5 Model Outputs

The following outputs are requested.

For all scenarios (Scenario 1 to Scenario 7):

- Loaded network files.
- Volume plots (area in and around the Tramway block).

- Intersection turning movements plots at:
    - Tramway block intersection (if included);
    - Left in left out intersection on ETC (if included); and
    - Wairere Drive/Fifth Avenue roundabout.
- Level of service (LOS) plots (area in and around Tramway block).

For Scenarios 2, 4, 6 and 7 select link plots on:

- Connection into Tramway block (south of signalised intersection);
- Fifth Avenue Extension (between Wairere Drive and new Tramway block intersection);
- Fifth Avenue (west of Wairere Drive);
- The ETC (north of the Fifth Avenue Extension); and
- The ETC (south of the Fifth Avenue Extension).

Volume difference plots for:

- Scenario 2 minus Scenario 1
- Scenario 4 minus Scenario 3
- Scenario 6 minus Scenario 5

Reference: 310205113

Appendix A – Proposed Model Sub-Area Validation Report

Stantec

Memo

To:	Mark Apeldoorn, Anna Wilkins Hamilton	From:	Grant Smith Addington
Project/File:	TGH Tramway (310205113)	Date:	21 April 2022

Reference: 2018 Model Validation Check

The Tramway Plan change analysis depends to some extent on traffic modelling of the surrounding network to assess the effects of the development. Intersection performance will be an important part of the analysis.

The Waikato Regional Transportation Model (WRTM) is to be used for this work. In its current form, it includes intersection delays using the algorithms built into Tracks. These calculate intersection delays at the turn level and are, in summary:

- **Signals:** Algorithms based on ARR123 which was the theory on which SIDRA was initially based;
- **Roundabouts**: Algorithms based on a simplified version of the equations published in the Sidra 5.1 User Manual, (in turn based on work by Troutbeck); and
- **Priority Intersections:** Algorithms based on Tanner's queueing theory, extended by Fisk and Tan for four turn types, and later by Gabites Porter for all 23 turn types.

In the last two-three years, Tracks has been significantly extended to integrate Sidra into the road assignment. Traffic is loaded in increments which simulate the build-up of traffic during the peak periods. At each increment of loading, traffic flow is passed to Sidra, which is run, and the resulting delays passed back to Tracks for the next path build. This can occur for each and every intersection. In uncongested networks, flows and delays are identical in Tracks and the Sidra Sip file, in congested networks, the delays in Tracks are average delays over the hour – in the Sidra Sip file the delays are calculated from the flows at the last increment.

The disadvantage of integrating Sidra into a large model is that run times balloon out. Using the inbuilt algorithms an assignment takes around 13 minutes. When Sidra is integrated for signals only (121 sets) the run time is 79 minutes. When roundabouts (273) and signals are integrated, the run time was 318 minutes. This is not feasible.

Accordingly, the decision was taken to cut down the full WRTM into a subarea for the purposes of the Tramway analysis. The model was run at 2041 with and without Tramway at full development to determine the area of influence of the development. crossings.

The development assumptions were from an early iteration of the Plan Change – a level of development that is unlikely to occur, but it does maximise the likely area of influence.

For the record, the assumptions behind this run were

- 1,096 dwellings
- 17,850 m^2 GLFA
- 0.32 trips per hour (PM peak)
- 6.2 trips per hour /100 m2 Commercial (PM Peak)
- 1707 trips per hour (PM Peak)

The land use inputs to the WRTM were adjusted to reflect this level of generation.

The full model and the subarea is shown on Figure 1, but effectively Tramway effects are confined to the east of the river, with almost no change to the river crossings. There is some model 'noise' in the CBD but that is not a result of the plan change.

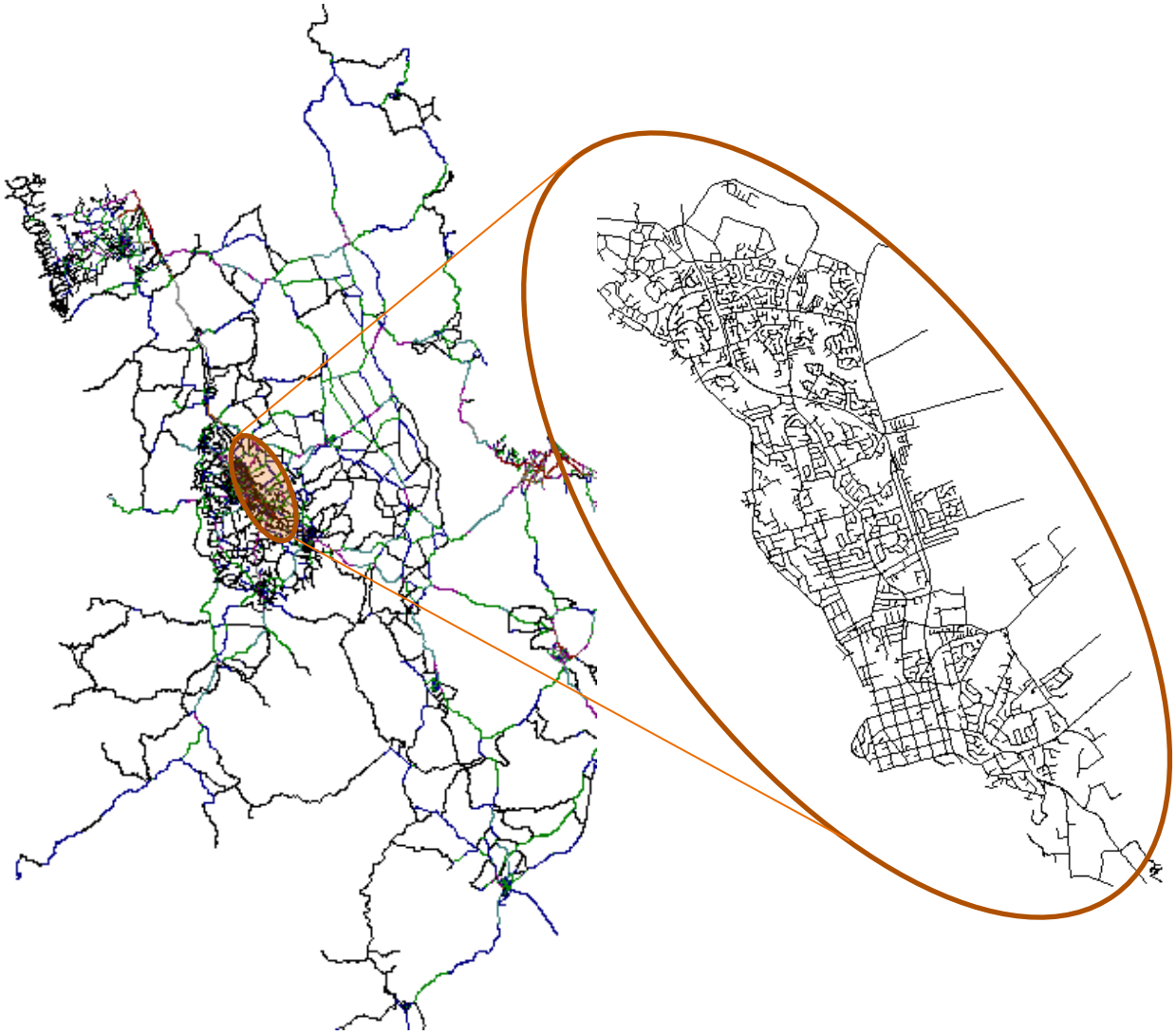


Figure 1 – Tramway Model Sub Area

Reference: 2018 Model validation check

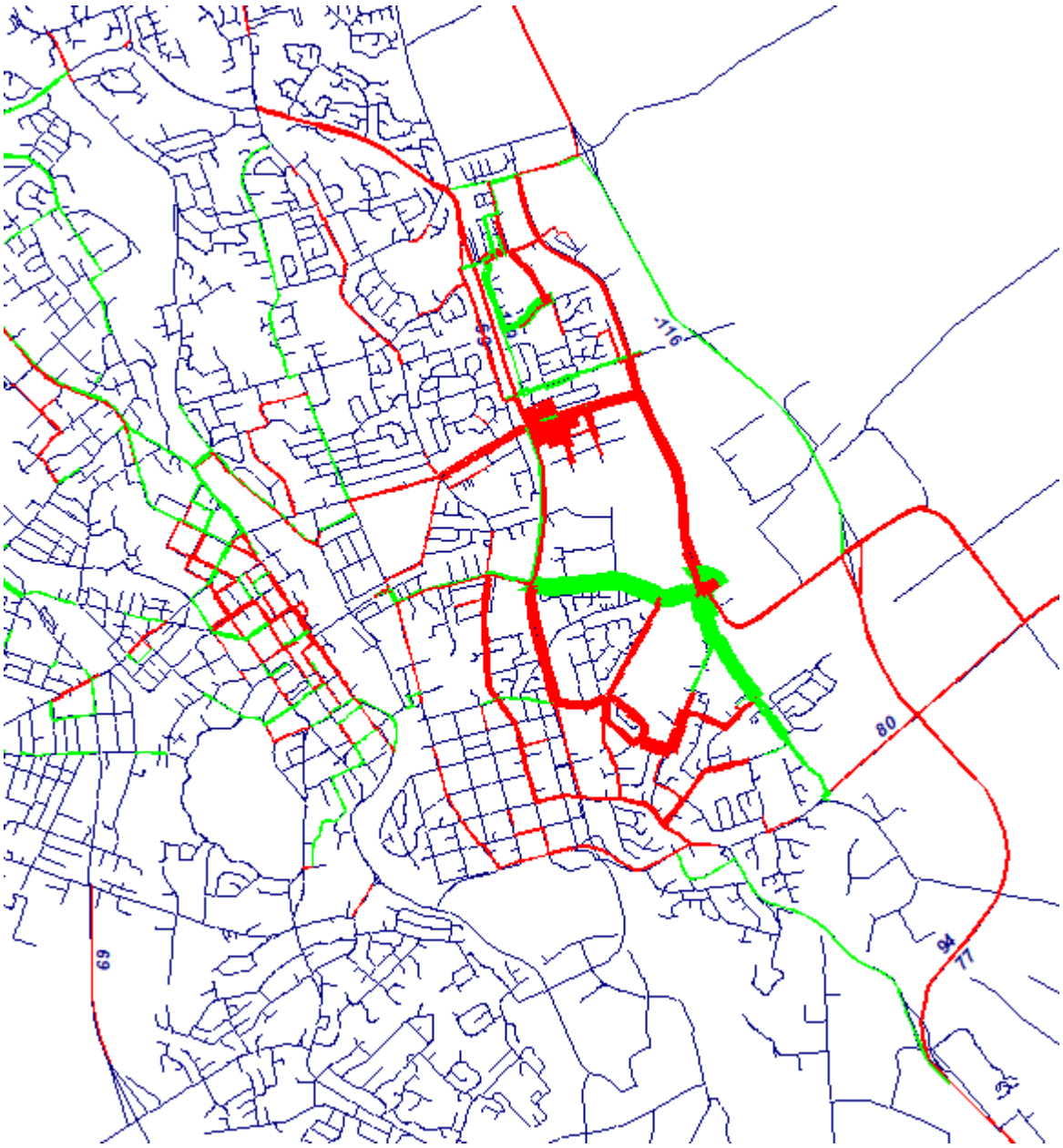
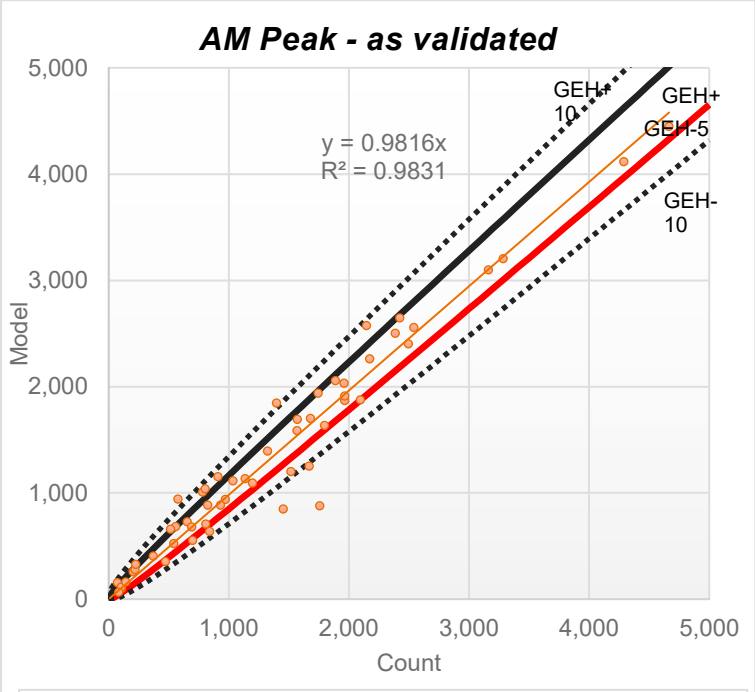
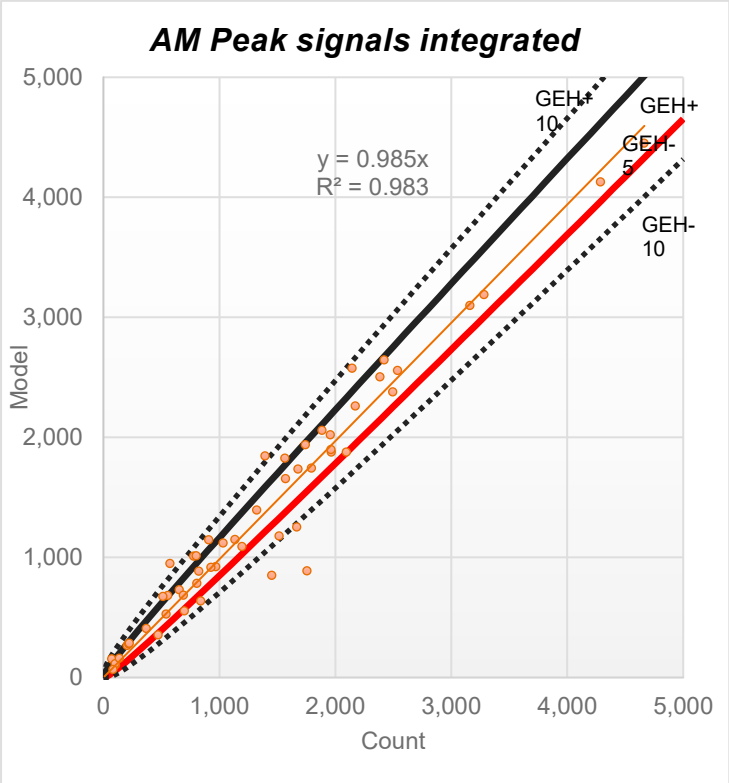


Figure 2 – Change in Flow – PM Peak

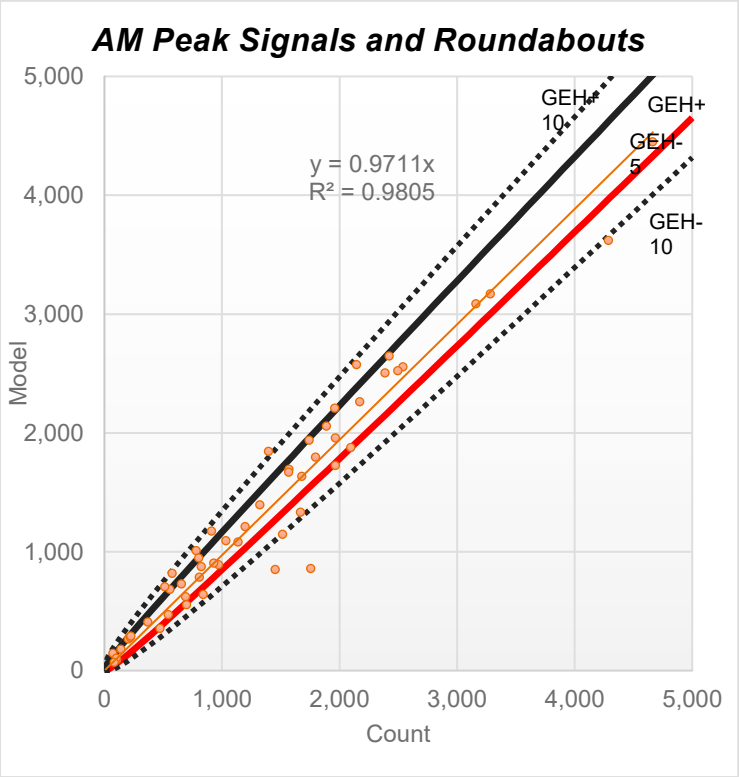
This provides a model that has 278 zones. It has been set up to be an assignment model only with the subarea matrix required to be formed from the full WRTM if a land use change is required. The assignment runs in 42 seconds without Sidra integration, 3.8 minutes with signals integrated, and 21 minutes with roundabouts and signals integrated.

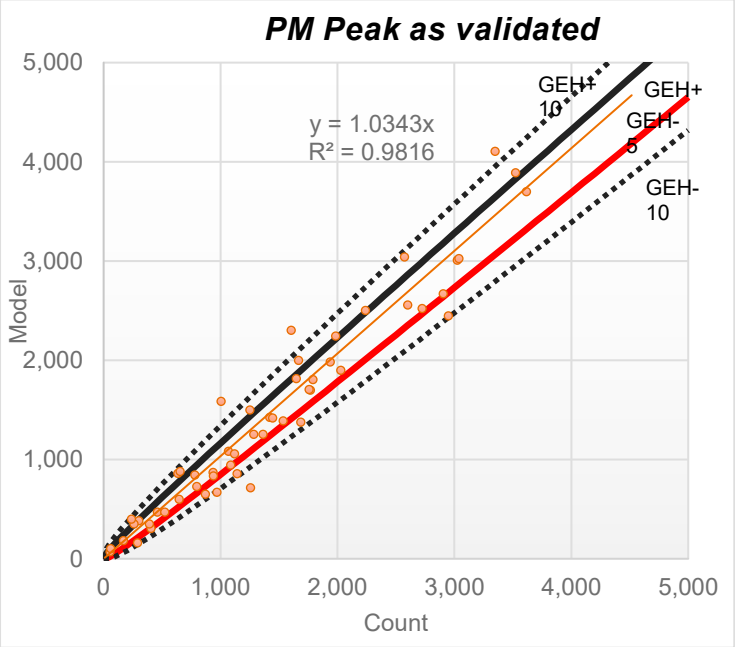
Because the delay calculations are different a check was made to ensure that the validation of the model has been maintained. There are limited screenlines in the sub-area model, but there are 350 individual traffic counts in the sub-area from the 1,107 that have been used in the full model validation. A comparison of the three runs is shown for the AM and PM peaks is shown below, with a summary of the GEH values in Table 1.



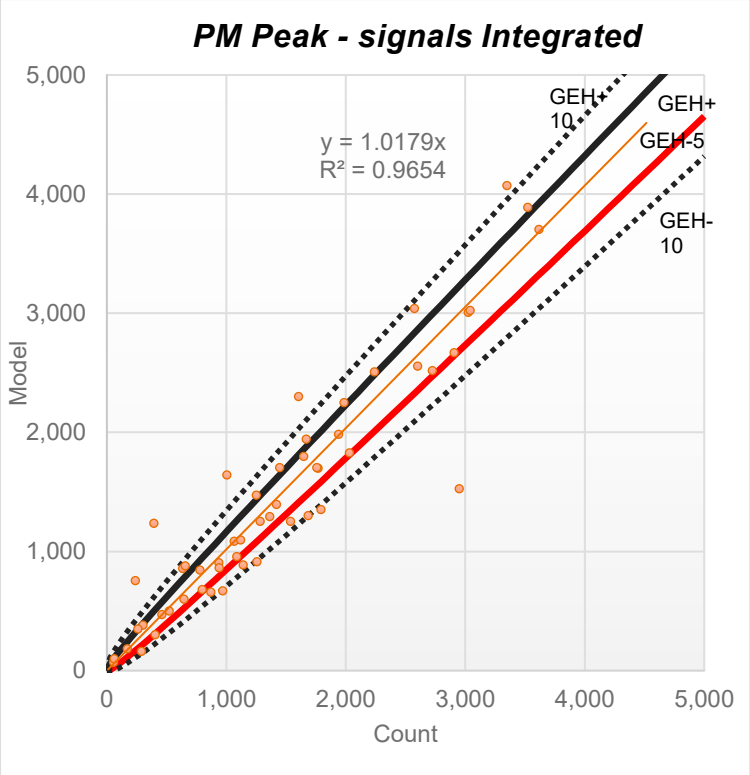


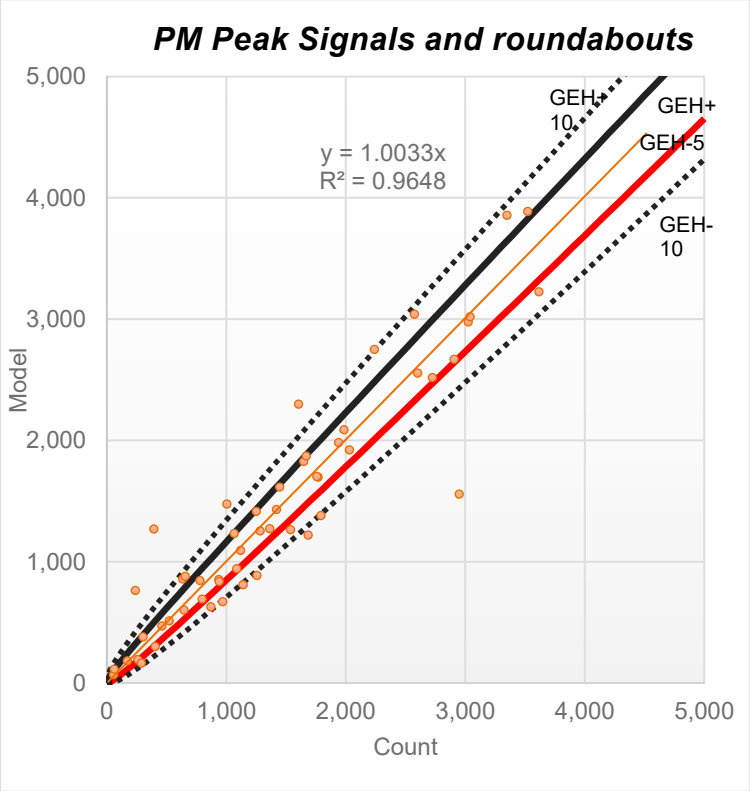
Reference: 2018 Model validation check





Reference: 2018 Model validation check





Reference: 2018 Model validation check

	AM Peak			PM Peak		
	As validated	*Sidra signals*	*Sidra signals & Roundabouts*	*As validated*	*Sidra signals*	*Sidra signals & Roundabouts*
GEH Less than 5.0	65.4%	65.4%	65.1%	50.6%	50.6%	51.7%
GEH Less than 7.5	80.6%	80.6%	80.6%	69.4%	69.4%	69.6%
GEH Less than 10.0	88.9%	88.9%	89.7%	80.9%	80.9%	79.5%
GEH more than 10.0	11.1%	11.1%	10.3%	19.6%	19.6%	20.5%

Integrating Sidra gives a slightly better validation in both periods when signals are integrated when looking at the slopes and r^2 of the scatter plots but does not significantly affect the distribution of GEH values.

The full WRTM has been validated to NZTA Transport Model Development Guidelines for a Category A (Regional) models. Given that validation was acceptable, and was peer reviewed, it follows that the sub-area with improved intersection modelling and a slightly better validation performance, will also be acceptable and within the NZTA guidelines.

Accordingly, there is no need to attempt to improve the validation in the sub-area model, which means that the future models can be used without change, apart from forming the subarea and integrating Sidra calculated delays for signals and roundabouts into the assignment.

Stantec New Zealand

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grant.smith@stantec.com

Attachment: Nil

Stantec

Memo

To:	HCC/WLASS	From:	Mark Apeldoorn/Anna Wilkins Hamilton
Project/File:	310205113	Date:	10 October 2022

Reference: 310205113

1 Introduction

The purpose of this memo is to describe a revised set of land use inputs for the Tramway Block Plan Change that are to be tested in further runs of the Waikato Regional Transportation Model (WRTM).

The Plan Change has already been modelled once in the WRTM, in a previously approved third party engagement between Tainui Group Holdings (TGH), Hamilton City Council (HCC) and Waikato Local Authority Shared Services (WLASS).

That exercise included local area validation of the model and agreement of parameters such as Plan Change trip rates and wider network assumptions. These inputs and assumptions are documented in the previous model brief (13 May 2022) and will remain unchanged in this further run.

This memo focusses on the Plan Change land use inputs, which have changed following further consultation with HCC and other stakeholders. The broad nature of the changes is to reduce the size of the Suburban Centre (SC) and increase the density of residential areas.

2 WRTM Land Use Inputs

At the time of writing this brief, TGH was in the process of preparing a full new set of Plan Change drawings.

The updated drawings will show the following expected yields:

- 51.7 hectares (ha) of gross developable residential land, yielding 1,129 dwellings; and
- 6,000m^2 of suburban centre (across approximately 2.1 ha), including 100 apartments.

The land use drawings will change but not in a way that materially affects how the Plan Change is modelled in the WRTM.

Therefore, the next model run will retain the internal zone structure that is shown indicatively on Figure 1 below (noting that the underlying land use drawing will be updated in due course).

Reference: 310205113

Figure 3 Proposed Zone Structure in WRTM

The trip generation assessment for Plan Change is shown in Table 1 below. The number of dwellings in each area has been estimated in proportion to the relative size of these areas. The trip generation totals of the previously modelled version of the Plan Change are also presented for comparison.

Reference: 310205113

Table 1 – Trip Generation Assessment

Sub-Area	Type	Size	Unit	AM Peak Hour			PM Peak Hour			Daily		
				Trips	IN	OUT	Trips	IN	OUT	Trips	IN	OUT
1	SC	6,000	sqm GFA	**466**	256	210	**625**	312	312	**5,460**	2,730	2,730
1	SC (Res)	100	Apartments	**53**	16	37	**53**	34	19	**458**	229	229
2	MDR	280	Dwellings	**148**	44	104	**148**	96	52	**1,281**	640	640
3	MDR	230	Dwellings	**122**	37	85	**122**	79	43	**1,055**	527	527
4	MDR	152	Dwellings	**80**	24	56	**80**	52	28	**695**	348	348
5	MDR	130	Dwellings	**69**	21	48	**69**	45	24	**594**	297	297
6	MDR	95	Dwellings	**50**	15	35	**50**	33	18	**435**	218	218
7	MDR	242	Dwellings	**128**	39	90	**128**	84	45	**1,110**	555	555
TOTAL	-	-	-	**1,117**	**451**	**665**	**1,276**	**736**	**540**	**11,089**	**5,544**	**5,544**
PREVIOUS VERSION OF PLAN CHANGE				**1,335**			**1,600**			**13,977**		

The land use parameters in these zones in the WRTM should be applied to match these trip generation characteristics as closely as possible.

In the previous modelling, commercial GFA in the adjacent Knowledge Zone was reduced from 9,000 sqm to 3,000 sqm. For this new testing, this GFA needs to be reverted to the original 9,000 sqm GFA.

3 Model Scenarios

Two scenarios are requested, and both are to be run in the AM and PM peaks. The scenario numbering picks up from the previous model brief.

- Scenario 5: 2041 base with no development in Tramway block; and
- Scenario 6: 2041 base with full development of Tramway block (Table 1).

4 Model Outputs

The following outputs are requested.

For both scenarios:

- Loaded network files.
- Volume plots (area in and around the Tramway block).
- Intersection turning movements plots at:

  - Tramway block intersection (if included);
  - Left in left out intersection on ETC (if included); and
  - Wairere Drive/Fifth Avenue roundabout.
- Level of service (LOS) plots (area in and around Tramway block).

For Scenario 6, select link plots on:

- Connection into Tramway block (south of signalised intersection);
- Fifth Avenue Extension (between Wairere Drive and new Tramway block intersection);
- Fifth Avenue (west of Wairere Drive);
- The ETC (north of the Fifth Avenue Extension); and
- The ETC (south of the Fifth Avenue Extension).

Volume difference plots for:

- Scenario 6 minus Scenario 5

Appendix B – Model Validation Report

Stantec

Memo

To:	Mark Apeldoorn, Anna Wilkins Hamilton	From:	Grant Smith Addington
Project/File:	TGH Tramway (310205113)	Date:	21 June 2022

Reference: 2018 Model validation check

The Tramway Plan change analysis depends to some extent on traffic modelling of the surrounding network to assess the effects of the development. Intersection performance will be an important party of the analysis.

The Waikato Transportation model is to be used for this work. In its current form, it includes intersection delays using the algorithms built into Tracks. These calculate intersection delays at the turn level and are, in summary

- **Signals**. Algorithms based on ARR123 which was the theory on which SIDRA was initially based
- **Roundabouts**. Algorithms based on a simplified version of the equations published in the Sidra 5.1 User Manual, (in turn based on work by Troutbeck)
- **Priority Intersections**. Algorithms base on Tanner's queueing theory, extended by Fisk and Tan for four turn types, and later by Gabites Porter for all 23 turn types.

In the last two-three years, Tracks has been significantly extended to integrate Sidra into the road assignment. Traffic is loaded in increments which simulate the build-up of traffic during the peak periods. At each increment of loading, traffic flow is passed to Sidra, which is run, and the resulting delays passed back to Tracks for the next path build. This can occur for each and every intersection. In uncongested networks, flows and delays are identical in Tracks and the Sidra Sip file, in congested networks, the delays in Tracks are average delays over the hour – in the Sidra sip file the delays are calculated from the flows at the last increment.

The disadvantage of integrating Sidra into a large model is that run times balloon out. Using the inbuilt algorithms an assignment takes around 13 minutes. When Sidra is integrated for signals only (121 sets) the run time is 79 minutes. When roundabouts (273) and signals are integrated, the run time was 318 minutes. This is not feasible.

Accordingly, the decision was taken to cut down the full WRTM into a subarea for the purposes of the Tramway analysis. The model was run at 2041 with and without Tramway at full development to determine the area of influence of the development. The

The full model and the subarea is shown on Figure 1, but effectively Tramway effects are confined to the east of the river, with almost no change to the river crossings. There is some model ‘noise’ in the CBD but that is not a result of the plan change

The change in flow is shown on Figure 2 for the PM peak.

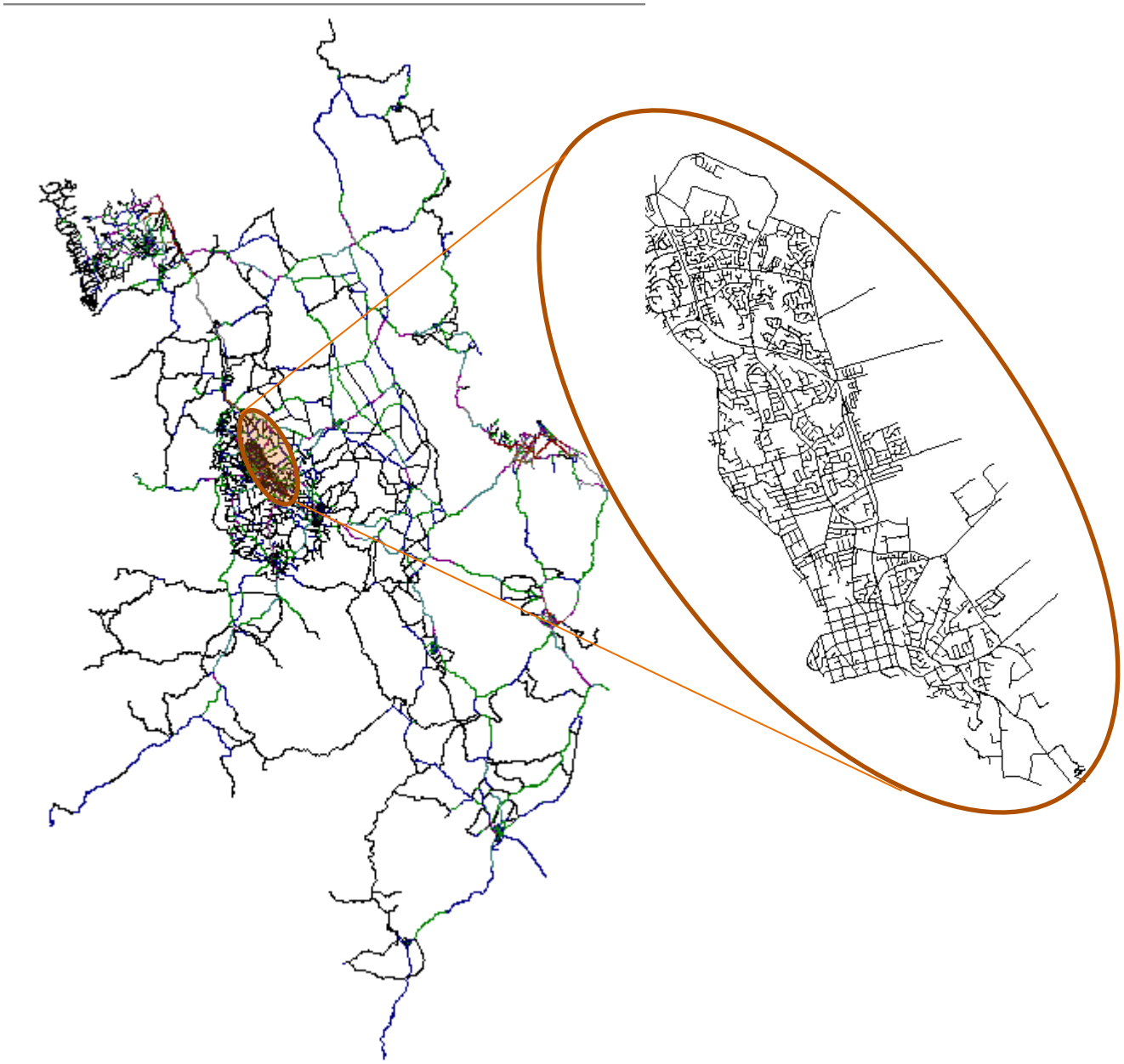


Figure 1 – Tramway Model Sub Area

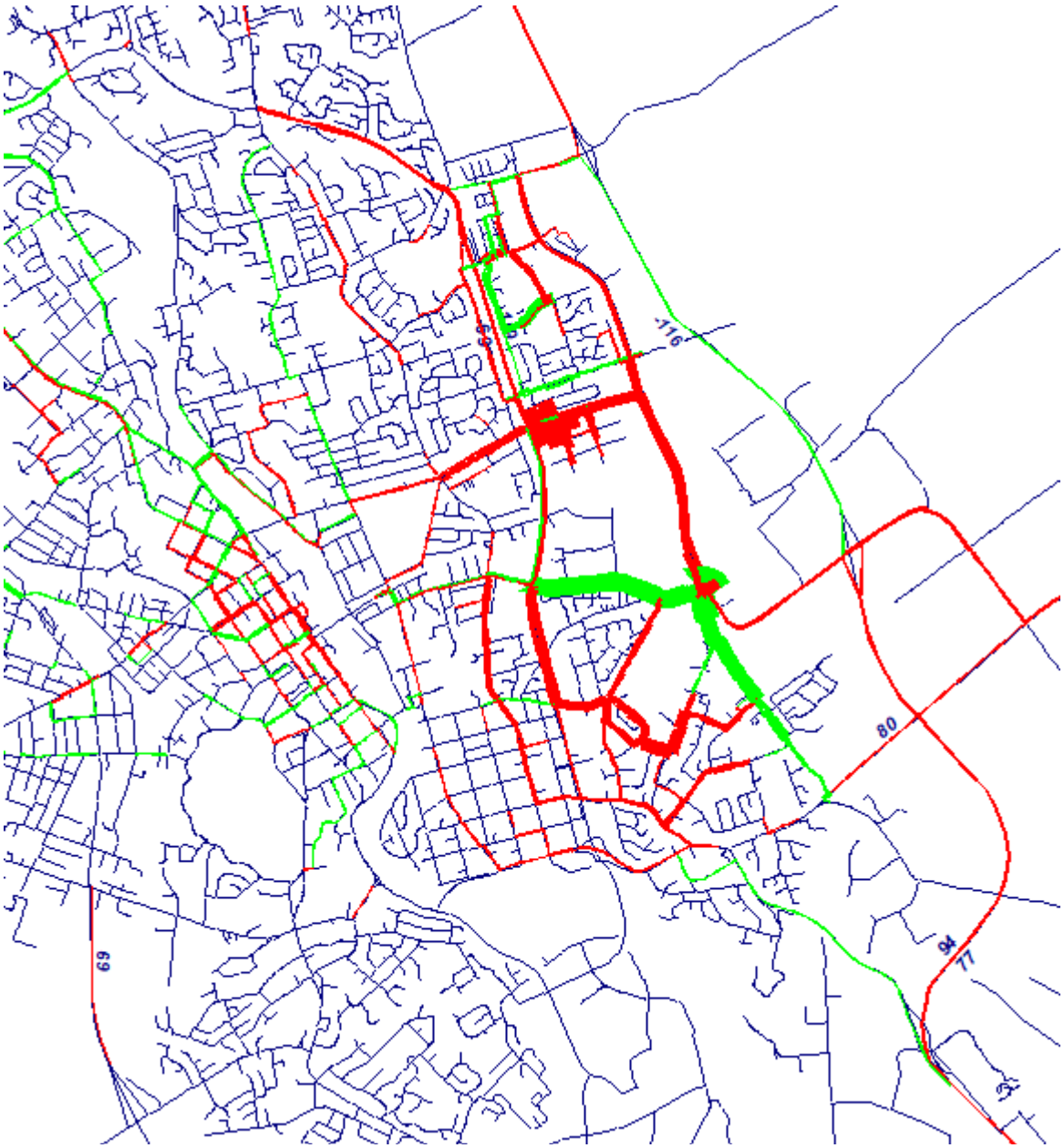
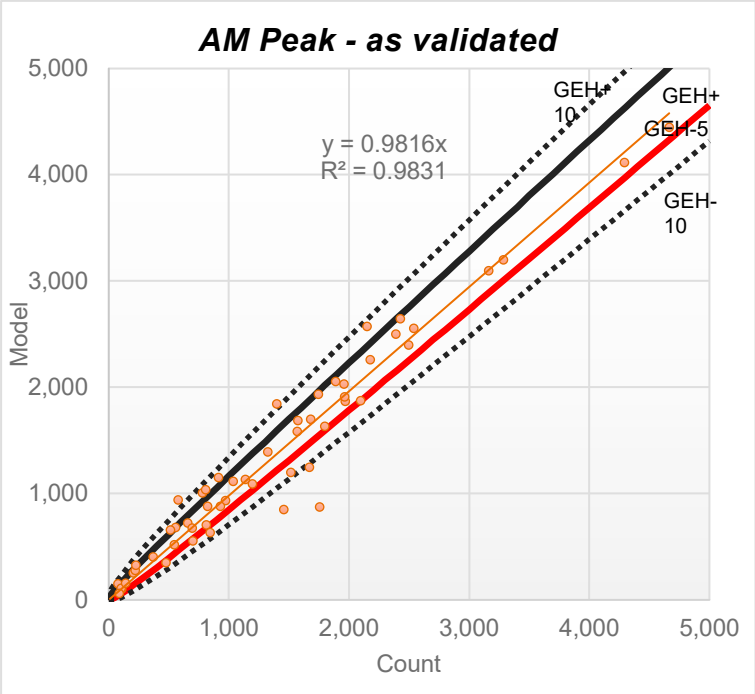


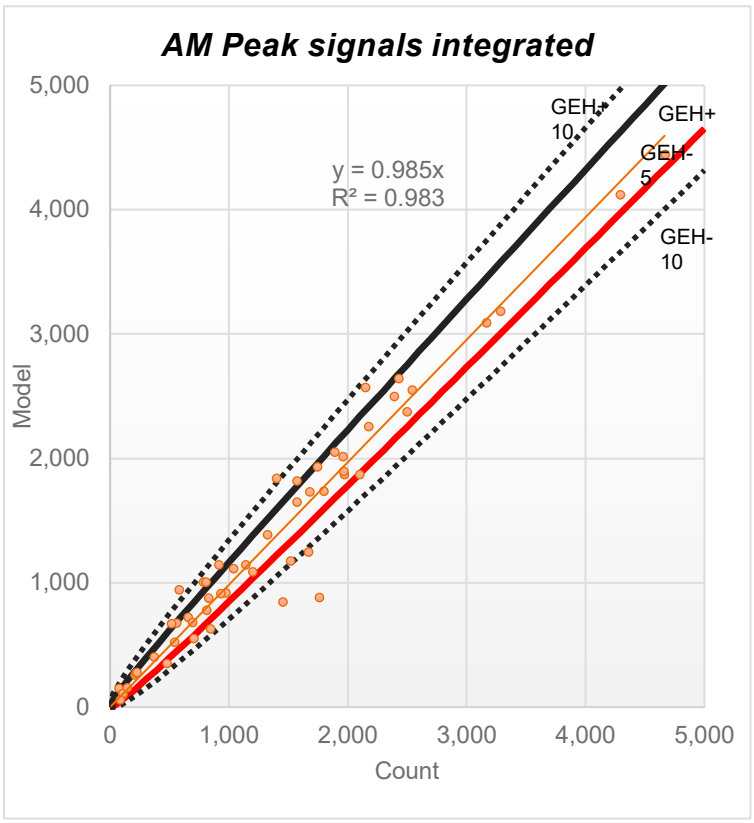
Figure 2 – Change in Flow – PM Peak

This provides a model that has 278 zones. It has been set up to be an assignment model only with the subarea matrix required to be formed from the full WRTM if a land use change is required. The assignment runs in 42 seconds without Sidra integration, 3.8 minutes with signals integrated, and 21 minutes with roundabouts and signals integrated.

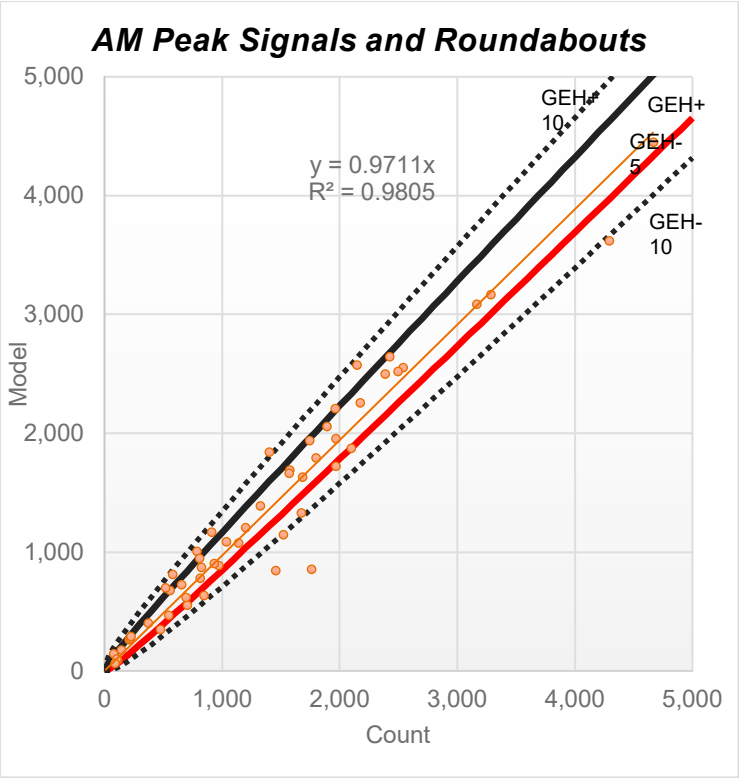
Because the delay calculations are different a check was made to ensure that the validation of the model has been maintained. There is no screenline in the sub-area model, but there are 350 individual traffic counts from the 1107 that have been used in the full model validation. A comparison of the three runs is shown for the Am and PM peaks is shown below, with a summary of the GEH values in Table 1.

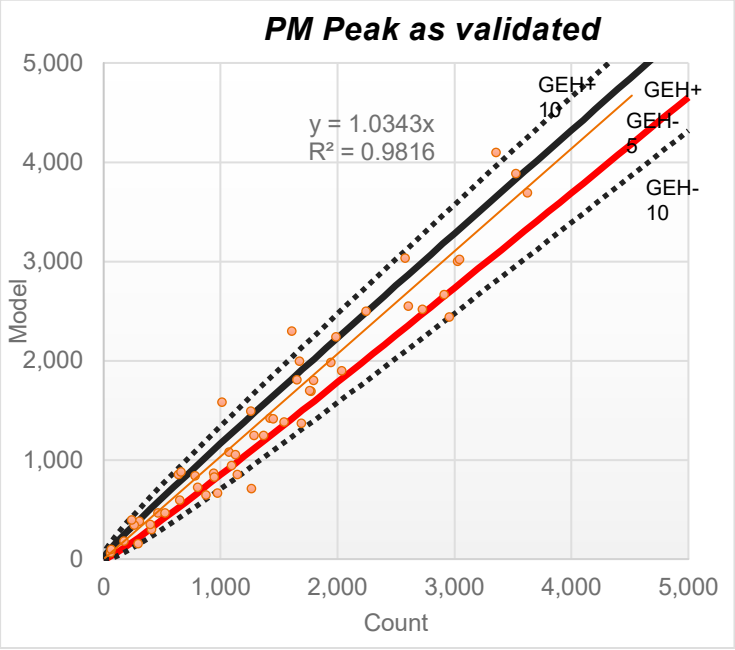


Reference: 2018 Model validation check

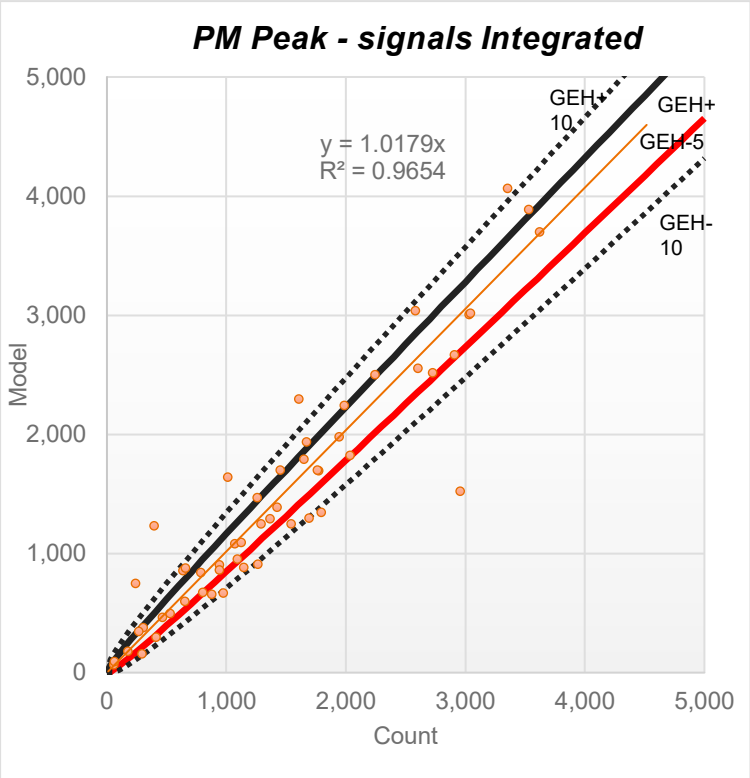


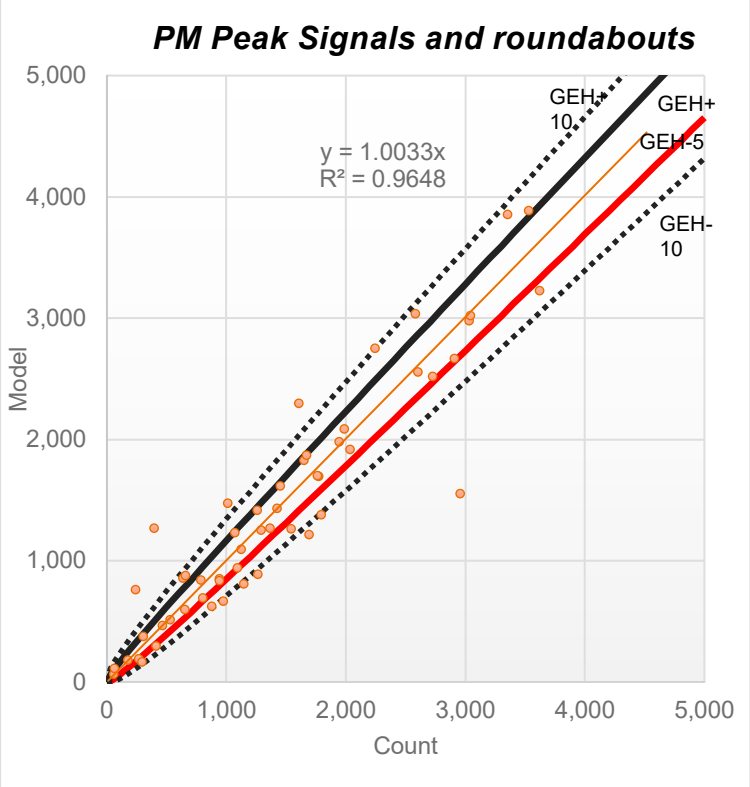
Reference: 2018 Model validation check





Reference: 2018 Model validation check





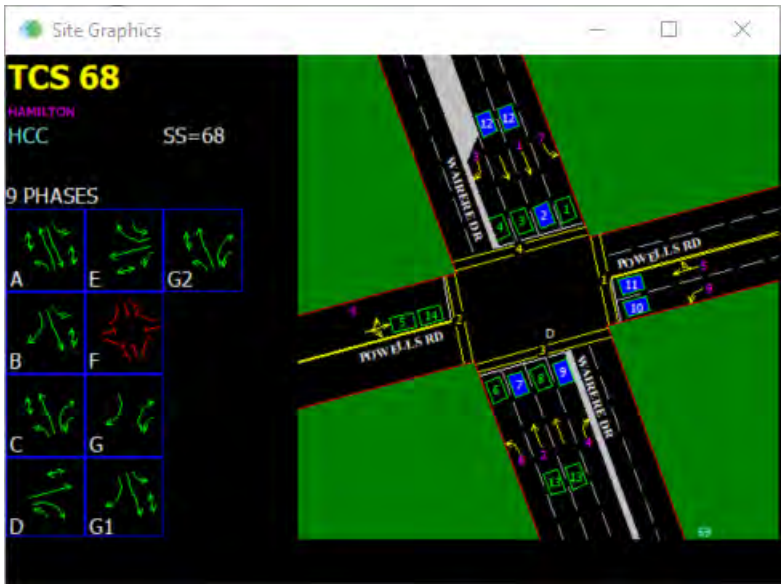
	AM Peak			PM Peak		
	As validated	*Sidra signals*	*Sidra signals & Roundabouts*	*As validated*	*Sidra signals*	*Sidra signals & Roundabouts*
GEH Less than 5.0	65.4%	65.4%	65.1%	50.6%	50.6%	51.7%
GEH Less than 7.5	80.6%	80.6%	80.6%	69.4%	69.4%	69.6%
GEH Less than 10.0	88.9%	88.9%	89.7%	80.9%	80.9%	79.5%
GEH more than 10.0	11.1%	11.1%	10.3%	19.6%	19.6%	20.5%

Integrating Sidra gives a slightly better validation in both periods when signals are integrated when looking at the slopes and r^2 of the scatter plots but does not significantly affect the distribution of GEH values.

Accordingly, there is no need to attempt to improve the validation in the sub-area model, which means that the future models can be used without change, apart from forming the subarea and integrating Sidra into the assignment.

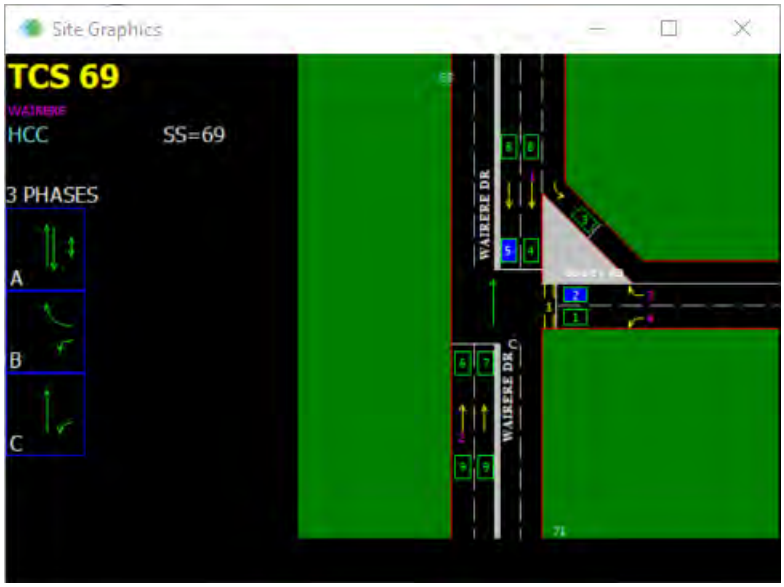
Local area validation

There are three sets of signals in the locality of the plane change, Namely the intersections of Wairere Drive and Powells Road, The entrance to the Ag Research campus, and the intersection of Wairere Drive and Ruakura Road.
Traffic volumes from Scats detectors were obtained for each of these intersections, with detector locations shown on the following diagrams.

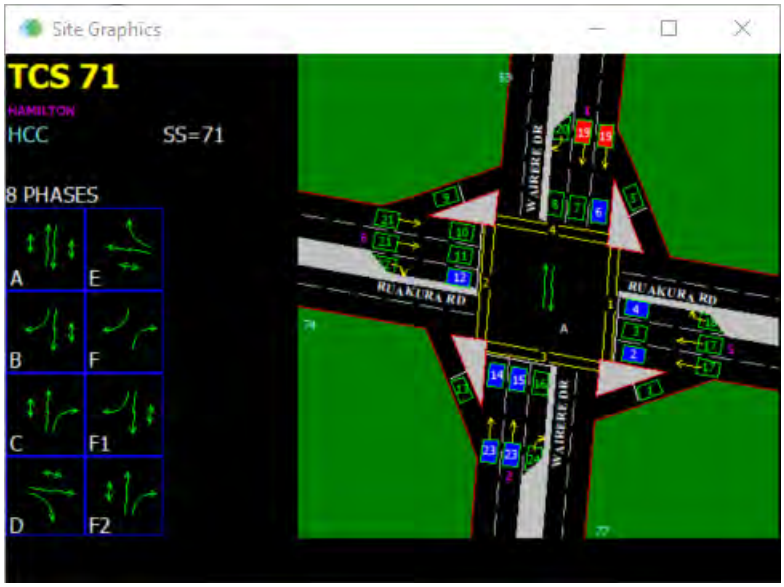


Wairere Drive/Powells Road

Reference: 2018 Model validation check



Ag Research Entrance



Wairere Drive/Ruakura Road

On these three intersections the detector locations are such that in every case (except the east and west approaches at Powells Road) individual turn volumes are isolated.

The tables below show the am and PM modelled vs counted turns at each of the intersections.

Reference: 2018 Model validation check

Morning peak comparisons

Wairere Drive /Powells Road							
Approach	***Detectors***	***Turn***	***700***	***800***	***Total***	***Model***	***GEH***
North	1	L	29	24	53	29	2.7
	2	T	544	645	2488	2658	2.4
	3	T	618	681			
	4	R	16	27	43	22	2.6
East	11	RT				175	
	10	L	280	316	596	626	0.9
South	6	L	49	66	115	126	0.7
	7	T	389	385	1607	1694	1.5
	8	T	402	431			
	9	R	79	88	167	140	1.5
West	5	LTR	42	96	138	153	0.9
					5207	**5623**	**4.0**

Ag Research Entrance							
Approach	***Detectors***	***Turn***	***700***	***800***	***Total***	***Model***	***GEH***
North	3	L	98	278	376	184	8.1
	4	T	609	772	2673	2449	3.1
	5	T	562	730			
East	1	L	12	32	44	31	1.5
	2	R	17	62	79	54	2.2
South	6	T	441	460	1809	1783	0.4
	7	T	438	470			
					4981	***4501***	***4.9***

Wairere Drive/Ruakura Road							
Approach	***Detectors***	***Turn***	***700***	***800***	***Total***	***Model***	***GEH***
North	5	L	302	515	817	749	1.7
	6	T	340	333	1454	1059	7.9
	7	T	394	387			
	8	R	138	251	389	672	8.7
East	1	L	12	10	22	0	4.7
	2	T	190	261	693	1016	7.8
	3	T	95	147			
	4	R	262	289	551	692	4.0
South	13	L	168	240	408	252	6.1
	14	T	241	217	1065	810	5.9
	15	T	315	292			
	16	R	17	39	56	14	5.0
West	9	L	82	140	222	281	2.6
	10	T	65	128	485	615	3.9
	11	T	114	178			
	12	R	116	208	324	217	4.6
					6486	***6377***	***1.0***

Evening Peak Comparisons

Wairere Drive /Powells Road							
Approach	***Detectors***	***Turn***	***1600***	***1700***	***Total***	***Model***	***GEH***
North	1	L	73	84	157	60	6.6
	2	T	416	441	1703	1972	4.4
	3	T	422	424			
	4	R	33	40	73	43	2.8
East	11	RT				71	
	10	L	158	184	342	254	3.6
South	6	L	71	91	162	181	1.0
	7	T	624	697	2747	2721	0.4
	8	T	683	743			
	9	R	210	227	437	620	5.6
West	5	LTR	214	267	481	94	16.1
					6102	**6016**	**0.8**

Reference: 2018 Model validation check

Ag Research Entrance							
Approach	***Detectors***	***Turn***	***1600***	***1700***	***Total***	***Model***	***GEH***
North	3	L	49	37	86	67	1.5
	4	T	576	604	2149	1971	2.8
	5	T	482	487			
East	1	L	57	57	114	61	4.0
	2	R	227	270	497	125	14.9
South	6	T	623	671	2705	2554	2.1
	7	T	681	730			
					5551	***4778***	***7.6***

Wairere Drive/Ruakura Road							
Approach	***Detectors***	***Turn***	***1600***	***1700***	***Total***	***Model***	***GEH***
North	5	L	309	328	637	678	1.1
	6	T	328	332	1355	963	8.1
	7	T	344	351			
	8	R	116	127	243	391	5.9
East	1	L	16	15	31	0	5.6
	2	T	159	166	594	686	2.6
	3	T	132	137			
	4	R	318	322	640	648	0.2
South	13	L	166	174	340	152	8.5
	14	T	292	335	1429	1232	3.8
	15	T	390	412			
	16	R	9	7	16	3	3.0
West	9	L	315	328	643	675	0.9
	10	T	192	251	935	1194	5.6
	11	T	229	263			
	12	R	321	369	690	322	11.6
					7553	***6944***	***5.1***

Given that the counted movements are taken in May 2022, and the model has been validated to March 2018[1], the correspondence between counted and modelled movements and the GEH statistics are very good.

[1] In particular, the extension of Wairere Drive to Cobham Drive is not open in the model, but is open in the counts.

Reference: 2018 Model validation check

There are some movements where the GEH is greater than 5, particularly at the Wairere Drive/ Ruakura Road intersection but in general, a high degree of confidence can be placed on the modelled results.

Stantec New Zealand

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Attachment: [Attachment]

Appendix C – Level of Service Criteria

Intersection Level of Service

Signals (average for the intersection)
D: Delay between 35 and 55 seconds
E: Delay between 55 seconds and 80 seconds
F: Delay greater than 80 seconds

Roundabouts (average for the intersection)
D: Delay between 35 and 55 seconds
E: Delay between 55 seconds and 80 seconds
F: Delay greater than 80 seconds

Priority intersections (worst approach)
D: Delay between 25 and 35 seconds
E: Delay between 35 seconds and 50 seconds
F: Delay greater than 50 seconds

Link Level of service

C: stable flow, at or near free flow. The ability to manoeuvre through lanes is noticeably restricted and lane changes require more driver awareness.

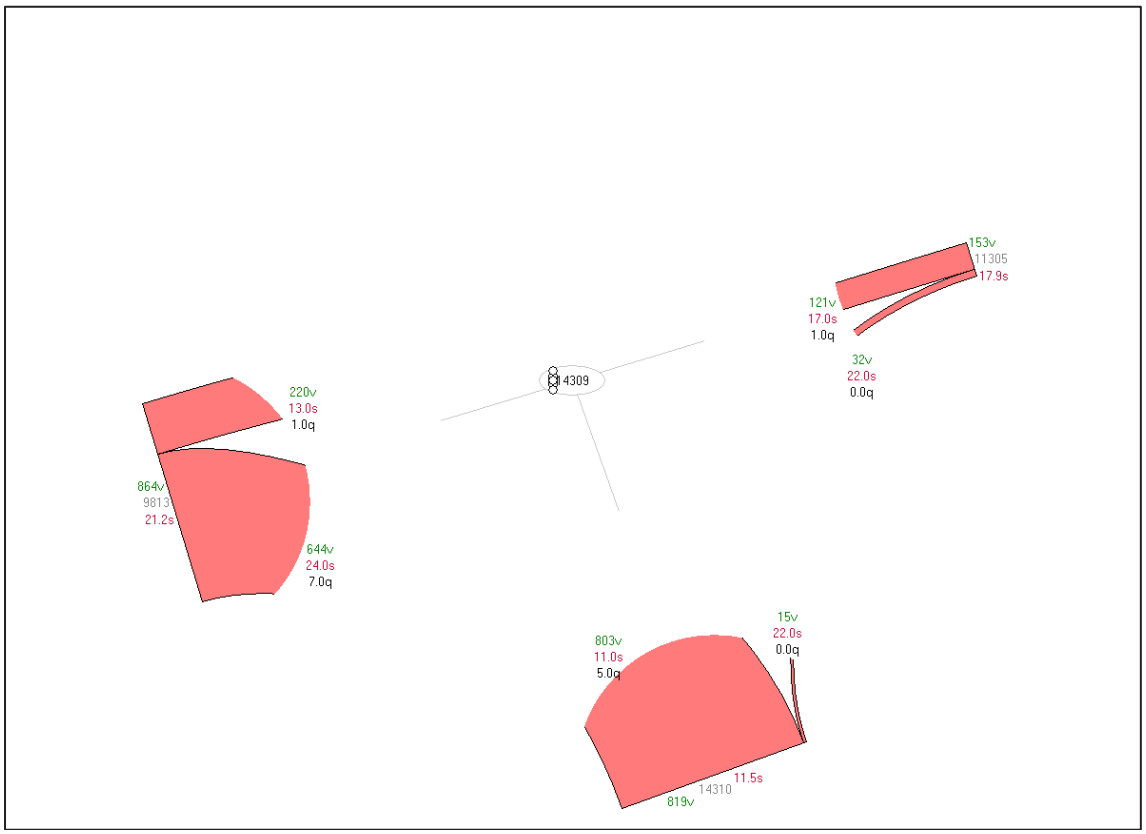
D: approaching unstable flow. Speeds slightly decrease as traffic volume slightly increases. Freedom to manoeuvre within the traffic stream is much more limited and driver comfort levels decrease.

E: unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to manoeuvrein the traffic stream and speeds rarely reach the posted limit

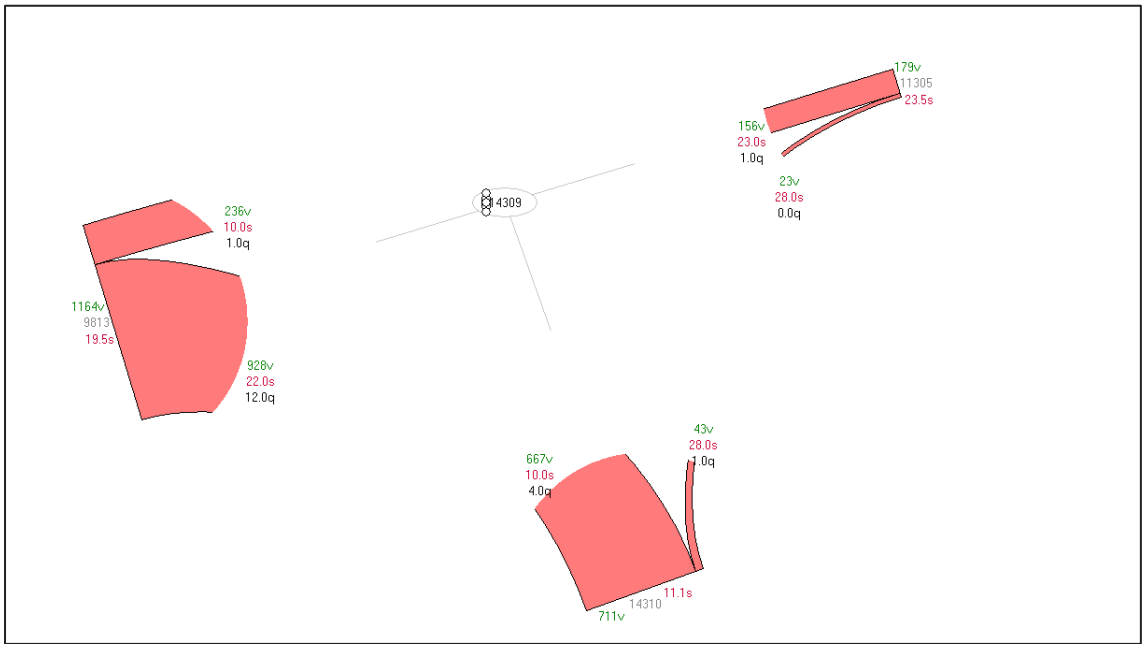
F: forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS

Appendix D – WRTM Intersection Outputs

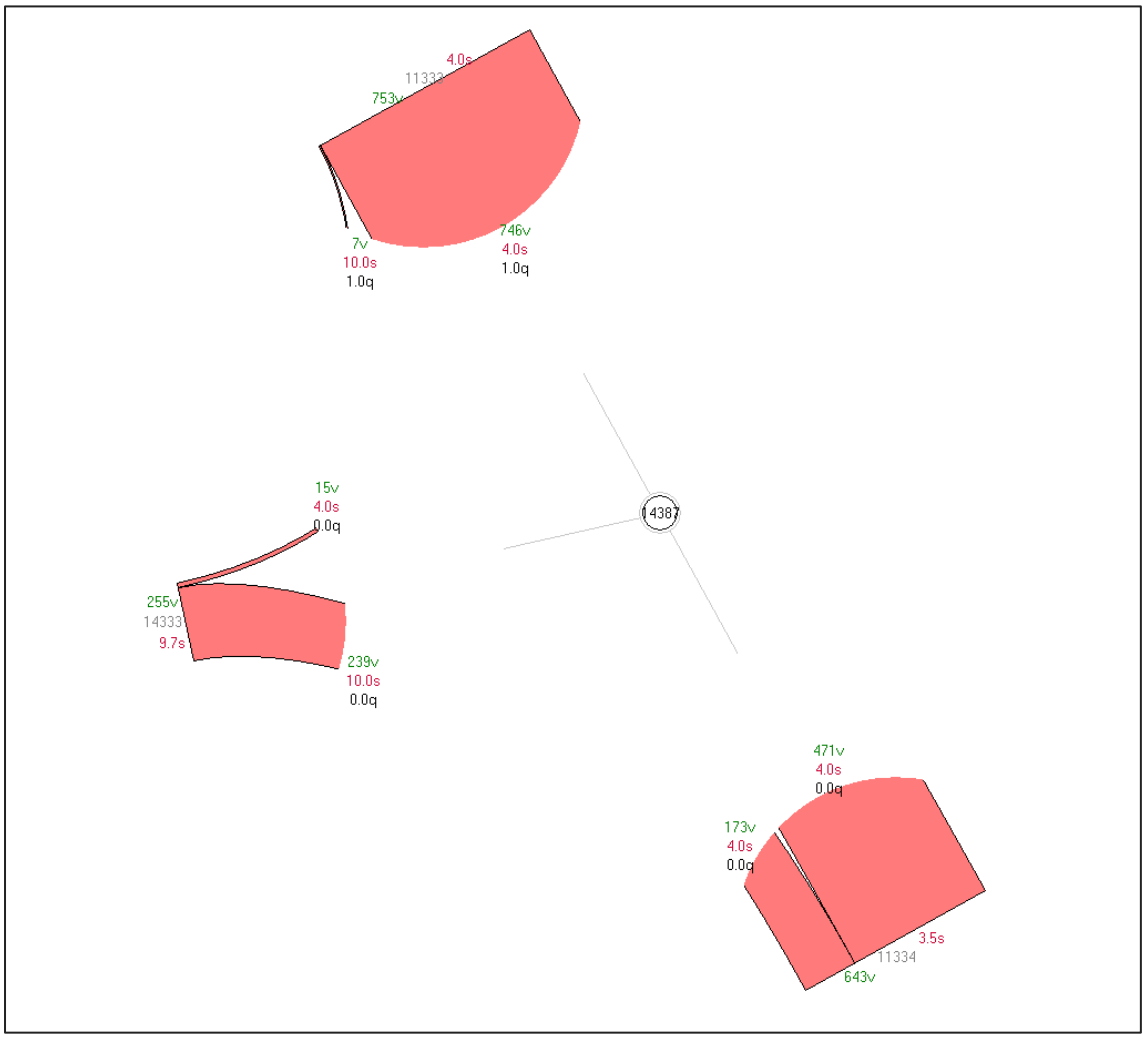
Fifth Avenue Extension/Tuumata Access, Scenario 6 AM



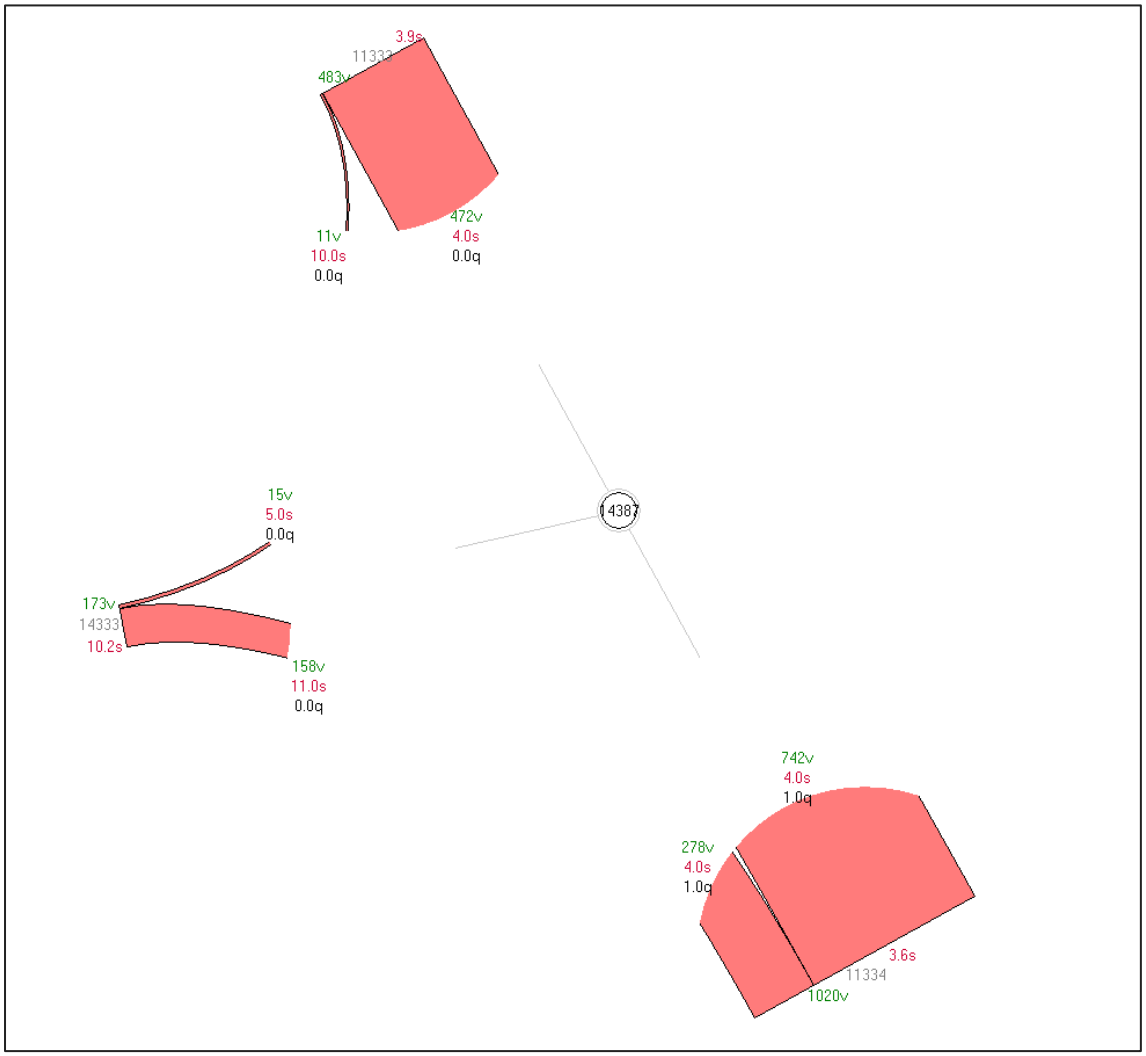
Fifth Avenue Extension/Tuumata Access, Scenario 6 PM



ETC/Tuumata Access, Scenario 6 AM



ETC/Tummata Access, Scenario 6 PM



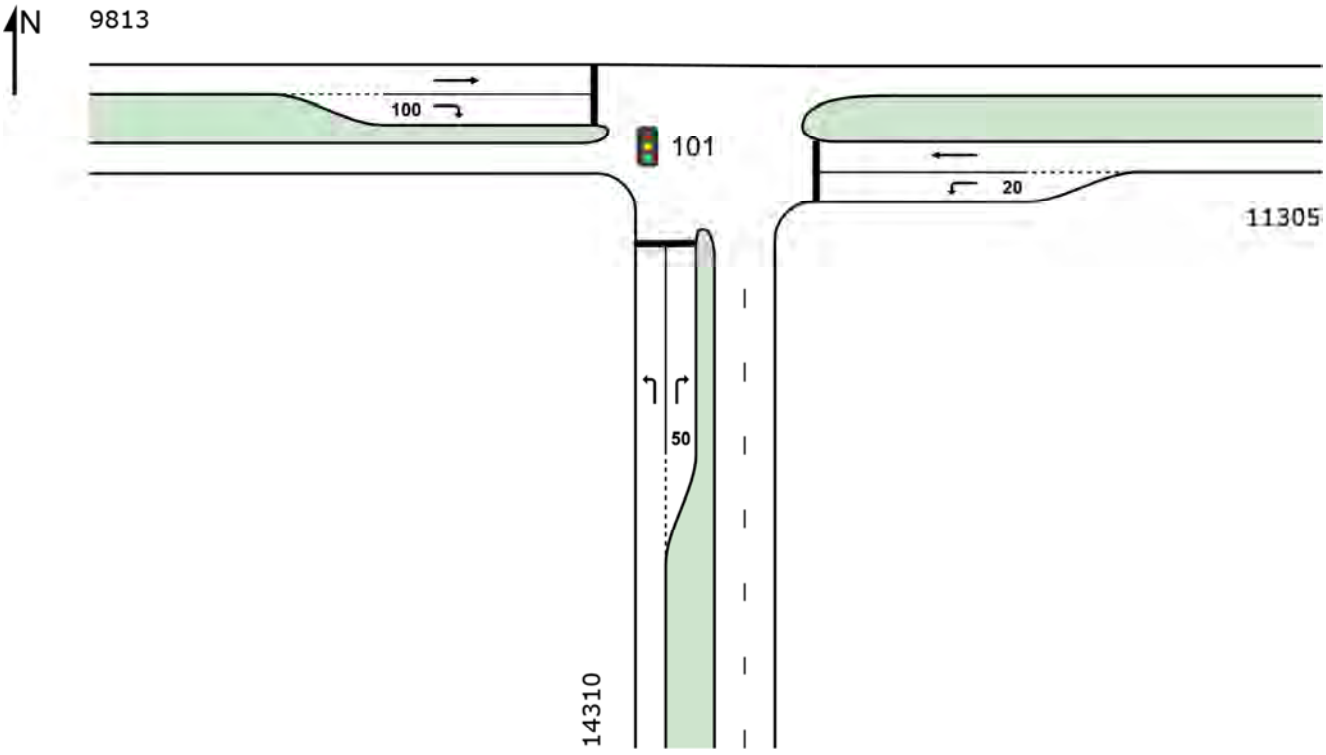
Appendix E – SIDRA Test Outputs

SIDRA Outputs – Tuumata Access Points

SITE LAYOUT

Site: 101 [14309 Min Layout AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



Organisation: STANTEC NEW ZEALAND | Created: Monday, October 31, 2022 4:46:31 PM
Project: \\Nz4118-ppfss01\shared_projects\310205113\7_technical\Model results\Scenario 6a - 27_10\AMP\TRAM2041_Extra Tests.sip8

MOVEMENT SUMMARY

Site: 101 [14309 Min Layout AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 14310												
1	L2	465	5.0	0.472	11.6	LOS B	5.7	41.4	0.65	0.77	0.65	49.1
3	R2	8	5.0	0.031	22.1	LOS C	0.1	1.1	0.88	0.66	0.88	43.0
Approach		474	5.0	0.472	11.8	LOS B	5.7	41.4	0.65	0.76	0.65	49.0
East: 11305												
4	L2	19	5.0	0.023	12.2	LOS B	0.2	1.5	0.58	0.66	0.58	48.7
5	T1	71	5.0	0.249	17.4	LOS B	1.3	9.6	0.92	0.69	0.92	46.7
Approach		89	5.0	0.249	16.3	LOS B	1.3	9.6	0.85	0.69	0.85	47.1
West: 9813												
11	T1	127	5.0	0.123	4.7	LOS A	1.2	8.9	0.51	0.41	0.51	55.7
12	R2	373	5.0	0.831	26.9	LOS C	8.6	63.0	1.00	1.01	1.42	40.6
Approach		500	5.0	0.831	21.2	LOS C	8.6	63.0	0.87	0.86	1.19	43.6
All Vehicles		1063	5.0	0.831	16.6	LOS B	8.6	63.0	0.77	0.80	0.92	46.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [14309 Min Layout PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

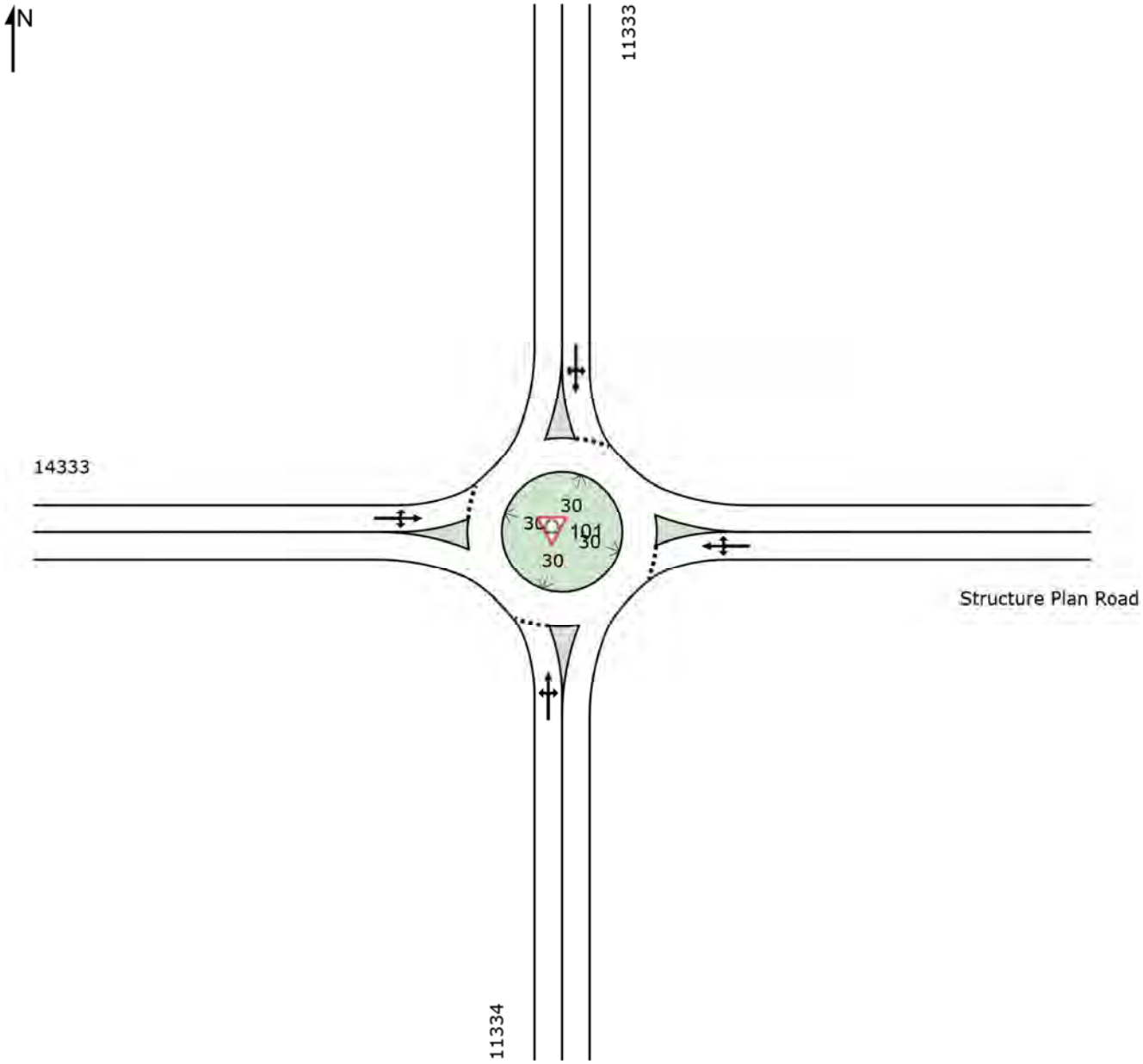
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 14310												
1	L2	386	5.0	0.337	10.1	LOS B	4.4	31.9	0.49	0.72	0.49	50.1
3	R2	25	5.0	0.117	28.2	LOS C	0.6	4.3	0.92	0.70	0.92	40.1
Approach		412	5.0	0.337	11.2	LOS B	4.4	31.9	0.52	0.72	0.52	49.4
East: 11305												
4	L2	14	5.0	0.021	16.8	LOS B	0.2	1.6	0.67	0.66	0.67	45.9
5	T1	91	5.0	0.399	23.7	LOS C	2.2	16.1	0.96	0.74	0.96	43.2
Approach		104	5.0	0.399	22.8	LOS C	2.2	16.1	0.92	0.73	0.92	43.5
West: 9813												
11	T1	108	5.0	0.090	3.7	LOS A	1.0	7.4	0.40	0.32	0.40	56.6
12	R2	537	5.0	0.748	21.9	LOS C	12.6	91.6	0.92	0.90	1.03	42.9
Approach		645	5.0	0.748	18.9	LOS B	12.6	91.6	0.83	0.80	0.92	44.7
All Vehicles		1161	5.0	0.748	16.5	LOS B	12.6	91.6	0.73	0.76	0.78	46.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [14387 Min RAB AM]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: 101 [14387 Min RAB AM]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	100	5.0	0.352	4.2	LOS A	2.6	19.0	0.40	0.49	0.40	53.9
2	T1	273	5.0	0.352	4.3	LOS A	2.6	19.0	0.40	0.49	0.40	55.6
3	R2	105	5.0	0.352	10.0	LOS A	2.6	19.0	0.40	0.49	0.40	55.8
Approach		478	5.0	0.352	5.5	LOS A	2.6	19.0	0.40	0.49	0.40	55.3
East: Structure Plan Road												
4	L2	105	5.0	0.255	6.7	LOS A	1.7	12.1	0.70	0.75	0.70	52.0
5	T1	21	5.0	0.255	6.8	LOS A	1.7	12.1	0.70	0.75	0.70	53.6
6	R2	105	5.0	0.255	12.5	LOS B	1.7	12.1	0.70	0.75	0.70	53.8
Approach		232	5.0	0.255	9.4	LOS A	1.7	12.1	0.70	0.75	0.70	52.9
North: 11333												
7	L2	105	5.0	0.453	5.1	LOS A	3.3	24.2	0.57	0.53	0.57	53.7
8	T1	436	5.0	0.453	5.2	LOS A	3.3	24.2	0.57	0.53	0.57	55.4
9	R2	4	5.0	0.453	10.9	LOS B	3.3	24.2	0.57	0.53	0.57	55.7
Approach		545	5.0	0.453	5.3	LOS A	3.3	24.2	0.57	0.53	0.57	55.1
West: 14333												
10	L2	8	5.0	0.167	5.9	LOS A	1.0	7.2	0.60	0.71	0.60	51.1
11	T1	21	5.0	0.167	6.0	LOS A	1.0	7.2	0.60	0.71	0.60	52.6
12	R2	138	5.0	0.167	11.7	LOS B	1.0	7.2	0.60	0.71	0.60	52.8
Approach		167	5.0	0.167	10.7	LOS B	1.0	7.2	0.60	0.71	0.60	52.7
All Vehicles		1422	5.0	0.453	6.7	LOS A	3.3	24.2	0.54	0.57	0.54	54.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [14387 Min RAB PM]

New Site
Site Category: (None)
Roundabout

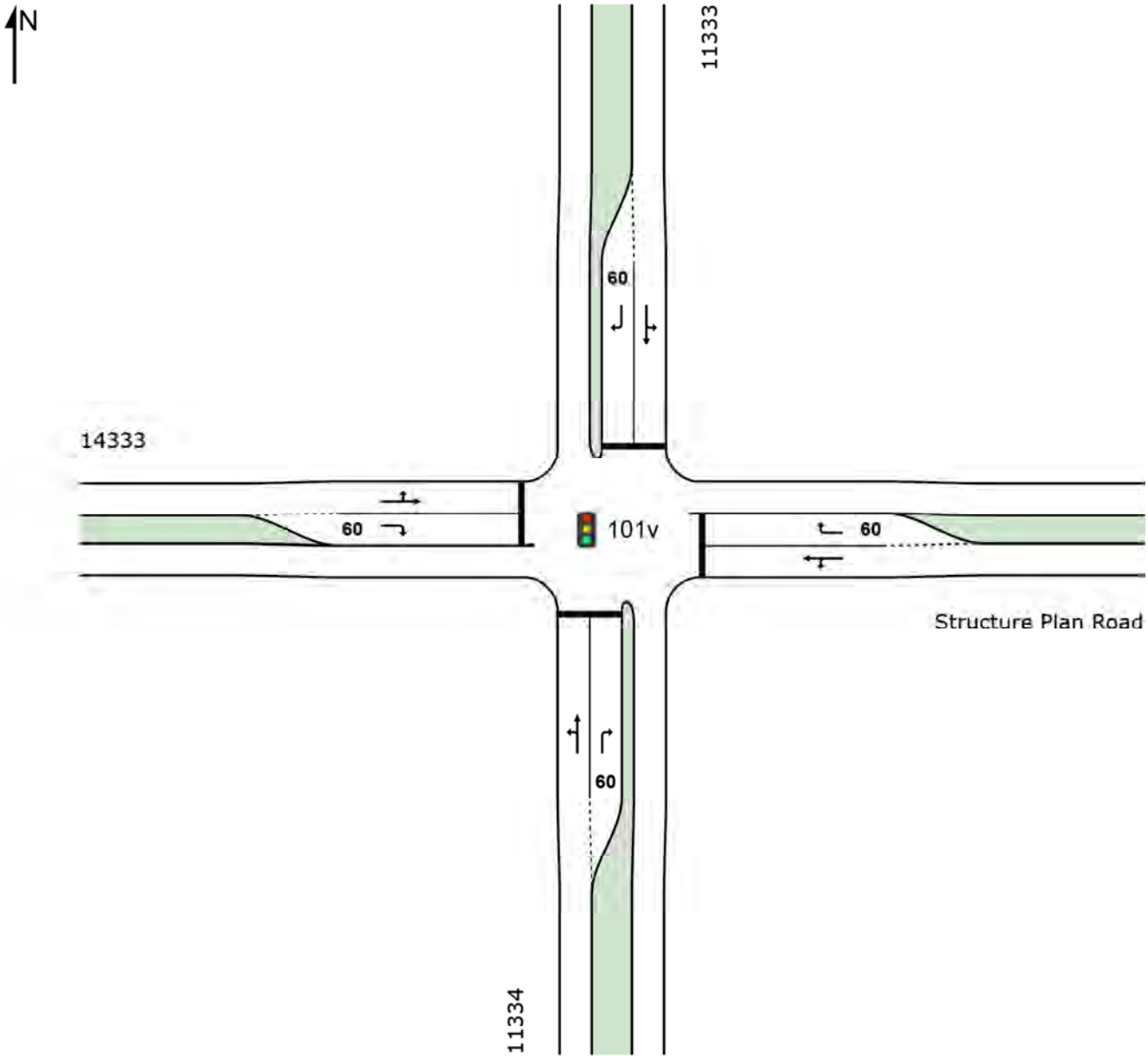
Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	161	5.0	0.503	4.3	LOS A	4.3	31.3	0.46	0.48	0.46	53.8
2	T1	429	5.0	0.503	4.4	LOS A	4.3	31.3	0.46	0.48	0.46	55.5
3	R2	105	5.0	0.503	10.1	LOS B	4.3	31.3	0.46	0.48	0.46	55.8
Approach		696	5.0	0.503	5.3	LOS A	4.3	31.3	0.46	0.48	0.46	55.2
East: Structure Plan Road												
4	L2	105	5.0	0.213	5.3	LOS A	1.3	9.3	0.55	0.65	0.55	52.7
5	T1	21	5.0	0.213	5.4	LOS A	1.3	9.3	0.55	0.65	0.55	54.3
6	R2	105	5.0	0.213	11.1	LOS B	1.3	9.3	0.55	0.65	0.55	54.6
Approach		232	5.0	0.213	8.0	LOS A	1.3	9.3	0.55	0.65	0.55	53.7
North: 11333												
7	L2	105	5.0	0.311	4.6	LOS A	2.0	14.5	0.46	0.49	0.46	54.3
8	T1	274	5.0	0.311	4.7	LOS A	2.0	14.5	0.46	0.49	0.46	56.0
9	R2	6	5.0	0.311	10.4	LOS B	2.0	14.5	0.46	0.49	0.46	56.3
Approach		385	5.0	0.311	4.8	LOS A	2.0	14.5	0.46	0.49	0.46	55.5
West: 14333												
10	L2	8	5.0	0.139	6.9	LOS A	0.9	6.3	0.69	0.74	0.69	50.7
11	T1	21	5.0	0.139	7.0	LOS A	0.9	6.3	0.69	0.74	0.69	52.2
12	R2	92	5.0	0.139	12.7	LOS B	0.9	6.3	0.69	0.74	0.69	52.4
Approach		121	5.0	0.139	11.3	LOS B	0.9	6.3	0.69	0.74	0.69	52.3
All Vehicles		1434	5.0	0.503	6.1	LOS A	4.3	31.3	0.50	0.53	0.50	54.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [14387 Min Signals AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 101v [14387 Min Signals AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	100	5.0	0.536	19.7	LOS B	7.4	54.2	0.84	0.74	0.84	46.6
2	T1	273	5.0	0.536	14.1	LOS B	7.4	54.2	0.84	0.74	0.84	47.8
3	R2	105	5.0	0.472	29.6	LOS C	2.6	19.0	0.97	0.77	0.97	39.6
Approach		478	5.0	0.536	18.7	LOS B	7.4	54.2	0.87	0.75	0.87	45.5
East: Structure Plan Road												
4	L2	105	5.0	0.421	27.3	LOS C	3.0	21.6	0.94	0.77	0.94	41.0
5	T1	21	5.0	0.421	21.7	LOS C	3.0	21.6	0.94	0.77	0.94	41.9
6	R2	105	5.0	0.390	27.4	LOS C	2.5	18.0	0.94	0.77	0.94	40.5
Approach		232	5.0	0.421	26.8	LOS C	3.0	21.6	0.94	0.77	0.94	40.9
North: 11333												
7	L2	105	5.0	0.776	24.2	LOS C	13.4	97.5	0.95	0.93	1.10	44.3
8	T1	436	5.0	0.776	18.6	LOS B	13.4	97.5	0.95	0.93	1.10	45.3
9	R2	4	5.0	0.019	27.4	LOS C	0.1	0.7	0.90	0.63	0.90	40.5
Approach		545	5.0	0.776	19.8	LOS B	13.4	97.5	0.95	0.92	1.10	45.1
West: 14333												
10	L2	8	5.0	0.096	25.8	LOS C	0.6	4.7	0.88	0.66	0.88	43.2
11	T1	21	5.0	0.096	20.2	LOS C	0.6	4.7	0.88	0.66	0.88	44.2
12	R2	138	5.0	0.681	32.1	LOS C	3.7	26.7	1.00	0.85	1.20	38.5
Approach		167	5.0	0.681	30.3	LOS C	3.7	26.7	0.98	0.82	1.14	39.4
All Vehicles		1422	5.0	0.776	21.8	LOS C	13.4	97.5	0.92	0.83	1.00	43.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [14387 Min Signals PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	161	5.0	0.765	22.4	LOS C	14.0	102.3	0.93	0.90	1.05	45.0
2	T1	429	5.0	0.765	16.8	LOS B	14.0	102.3	0.93	0.90	1.05	46.1
3	R2	105	5.0	0.472	29.6	LOS C	2.6	19.0	0.97	0.77	0.97	39.6
Approach		696	5.0	0.765	20.0	LOS C	14.0	102.3	0.93	0.88	1.04	44.8
East: Structure Plan Road												
4	L2	105	5.0	0.562	30.1	LOS C	3.2	23.3	0.99	0.80	1.04	39.7
5	T1	21	5.0	0.562	24.5	LOS C	3.2	23.3	0.99	0.80	1.04	40.6
6	R2	105	5.0	0.486	29.7	LOS C	2.6	19.1	0.98	0.77	0.98	39.5
Approach		232	5.0	0.562	29.4	LOS C	3.2	23.3	0.98	0.79	1.01	39.7
North: 11333												
7	L2	105	5.0	0.491	18.0	LOS B	7.1	51.7	0.79	0.71	0.79	47.6
8	T1	274	5.0	0.491	12.4	LOS B	7.1	51.7	0.79	0.71	0.79	48.9
9	R2	6	5.0	0.028	27.5	LOS C	0.1	1.0	0.91	0.65	0.91	40.5
Approach		385	5.0	0.491	14.1	LOS B	7.1	51.7	0.80	0.71	0.80	48.3
West: 14333												
10	L2	8	5.0	0.127	28.1	LOS C	0.7	5.0	0.92	0.68	0.92	42.0
11	T1	21	5.0	0.127	22.5	LOS C	0.7	5.0	0.92	0.68	0.92	43.0
12	R2	92	5.0	0.605	33.4	LOS C	2.4	17.9	1.00	0.79	1.13	38.0
Approach		121	5.0	0.605	31.1	LOS C	2.4	17.9	0.98	0.76	1.08	39.1
All Vehicles		1434	5.0	0.765	20.9	LOS C	14.0	102.3	0.91	0.81	0.97	44.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SIDRA Outputs – Tuumata Access Points with School

MOVEMENT SUMMARY

Site: 101 [14309 Min Layout AM_School]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 14310												
1	L2	636	5.0	0.554	11.1	LOS B	8.8	64.0	0.60	0.77	0.60	49.5
3	R2	15	5.0	0.068	27.9	LOS C	0.3	2.5	0.91	0.68	0.91	40.3
Approach		651	5.0	0.554	11.5	LOS B	8.8	64.0	0.61	0.76	0.61	49.2
East: 11305												
4	L2	25	5.0	0.039	16.9	LOS B	0.4	3.0	0.67	0.68	0.67	45.8
5	T1	71	5.0	0.311	23.4	LOS C	1.7	12.4	0.95	0.72	0.95	43.4
Approach		96	5.0	0.311	21.7	LOS C	1.7	12.4	0.88	0.71	0.88	44.0
West: 9813												
11	T1	127	5.0	0.105	3.7	LOS A	1.2	8.7	0.41	0.33	0.41	56.5
12	R2	581	5.0	0.810	24.9	LOS C	15.1	110.1	0.95	0.95	1.16	41.5
Approach		708	5.0	0.810	21.1	LOS C	15.1	110.1	0.85	0.84	1.02	43.6
All Vehicles		1455	5.0	0.810	16.8	LOS B	15.1	110.1	0.74	0.80	0.83	46.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [14387 Min RAB AM_School]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	160	5.0	0.396	4.2	LOS A	3.1	22.5	0.43	0.49	0.43	53.9
2	T1	273	5.0	0.396	4.3	LOS A	3.1	22.5	0.43	0.49	0.43	55.6
3	R2	105	5.0	0.396	10.0	LOS B	3.1	22.5	0.43	0.49	0.43	55.9
Approach		538	5.0	0.396	5.4	LOS A	3.1	22.5	0.43	0.49	0.43	55.1
East: Structure Plan Road												
4	L2	105	5.0	0.268	7.2	LOS A	1.8	13.1	0.74	0.77	0.74	51.7
5	T1	21	5.0	0.268	7.3	LOS A	1.8	13.1	0.74	0.77	0.74	53.2
6	R2	105	5.0	0.268	13.0	LOS B	1.8	13.1	0.74	0.77	0.74	53.5
Approach		232	5.0	0.268	9.8	LOS A	1.8	13.1	0.74	0.77	0.74	52.6
North: 11333												
7	L2	105	5.0	0.479	5.5	LOS A	3.6	26.3	0.63	0.57	0.63	53.4
8	T1	436	5.0	0.479	5.6	LOS A	3.6	26.3	0.63	0.57	0.63	55.1
9	R2	7	5.0	0.479	11.3	LOS B	3.6	26.3	0.63	0.57	0.63	55.3
Approach		548	5.0	0.479	5.7	LOS A	3.6	26.3	0.63	0.57	0.63	54.7
West: 14333												
10	L2	12	5.0	0.220	6.0	LOS A	1.3	9.8	0.62	0.73	0.62	50.9
11	T1	21	5.0	0.220	6.1	LOS A	1.3	9.8	0.62	0.73	0.62	52.4
12	R2	187	5.0	0.220	11.8	LOS B	1.3	9.8	0.62	0.73	0.62	52.6
Approach		220	5.0	0.220	11.0	LOS B	1.3	9.8	0.62	0.73	0.62	52.5
All Vehicles		1538	5.0	0.479	7.0	LOS A	3.6	26.3	0.58	0.59	0.58	54.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [14387 Min Signals AM_School]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 11334												
1	L2	160	5.0	0.663	21.7	LOS C	9.5	69.3	0.91	0.82	0.94	45.1
2	T1	273	5.0	0.663	16.1	LOS B	9.5	69.3	0.91	0.82	0.94	46.2
3	R2	105	5.0	0.472	29.6	LOS C	2.6	19.0	0.97	0.77	0.97	39.6
Approach		538	5.0	0.663	20.4	LOS C	9.5	69.3	0.92	0.81	0.95	44.4
East: Structure Plan Road												
4	L2	105	5.0	0.374	26.2	LOS C	2.9	21.0	0.92	0.77	0.92	41.5
5	T1	21	5.0	0.374	20.6	LOS C	2.9	21.0	0.92	0.77	0.92	42.5
6	R2	105	5.0	0.358	26.3	LOS C	2.4	17.6	0.92	0.77	0.92	41.0
Approach		232	5.0	0.374	25.7	LOS C	2.9	21.0	0.92	0.77	0.92	41.4
North: 11333												
7	L2	105	5.0	0.821	27.2	LOS C	14.5	105.9	0.98	1.00	1.22	42.7
8	T1	436	5.0	0.821	21.6	LOS C	14.5	105.9	0.98	1.00	1.22	43.7
9	R2	7	5.0	0.033	27.6	LOS C	0.2	1.2	0.91	0.65	0.91	40.5
Approach		548	5.0	0.821	22.8	LOS C	14.5	105.9	0.98	1.00	1.22	43.5
West: 14333												
10	L2	12	5.0	0.094	24.8	LOS C	0.7	5.1	0.86	0.66	0.86	43.5
11	T1	21	5.0	0.094	19.2	LOS B	0.7	5.1	0.86	0.66	0.86	44.5
12	R2	187	5.0	0.821	34.4	LOS C	5.4	39.2	1.00	0.99	1.47	37.6
Approach		220	5.0	0.821	32.4	LOS C	5.4	39.2	0.98	0.94	1.38	38.5
All Vehicles		1538	5.0	0.821	23.8	LOS C	14.5	105.9	0.95	0.89	1.10	42.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

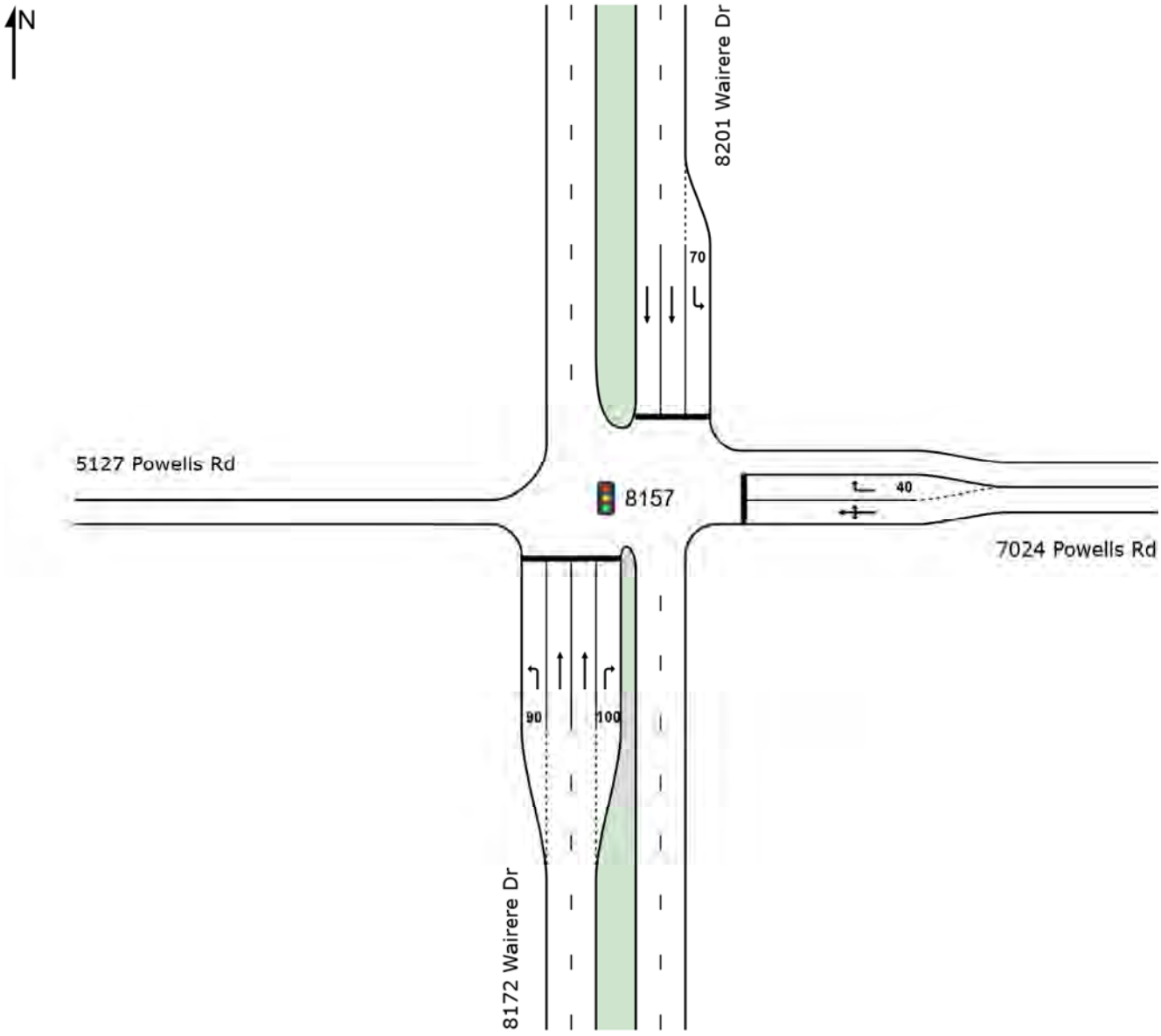
SIDRA Outputs – Wairere Drive/Powells Road

SITE LAYOUT

Site: 8157 [8157 - Test 1 AM]

WAIRERE RD POWELLS RD
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated

* 8157 *



MOVEMENT SUMMARY

Site: 8157 [8157 - Test 1 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 96 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	36	5.0	0.033	13.5	LOS B	0.7	4.7	0.40	0.65	0.40	47.9
2	T1	588	5.0	0.253	9.3	LOS A	6.2	45.2	0.47	0.41	0.47	52.0
3	R2	143	5.0	0.289	19.9	LOS B	2.9	20.9	0.77	0.76	0.77	44.2
Approach		768	5.0	0.289	11.5	LOS B	6.2	45.2	0.53	0.49	0.53	50.2
East: 7024 Powells Rd												
4	L2	381	5.0	0.555	27.6	LOS C	13.9	101.7	0.76	0.79	0.76	40.6
5	T1	27	5.0	0.555	22.0	LOS C	13.9	101.7	0.76	0.79	0.76	41.5
6	R2	56	5.0	0.120	35.9	LOS D	2.0	14.7	0.78	0.72	0.78	37.1
Approach		464	5.0	0.555	28.3	LOS C	13.9	101.7	0.76	0.79	0.76	40.2
North: 8201 Wairere Dr												
7	L2	21	5.0	0.035	28.5	LOS C	0.7	4.8	0.67	0.68	0.67	40.0
8	T1	949	5.0	0.733	31.1	LOS C	19.7	143.7	0.92	0.80	0.92	39.7
Approach		970	5.0	0.733	31.1	LOS C	19.7	143.7	0.91	0.80	0.91	39.7
All Vehicles		2201	5.0	0.733	23.7	LOS C	19.7	143.7	0.75	0.69	0.75	42.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 1 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 96 seconds (Site Practical Cycle Time)

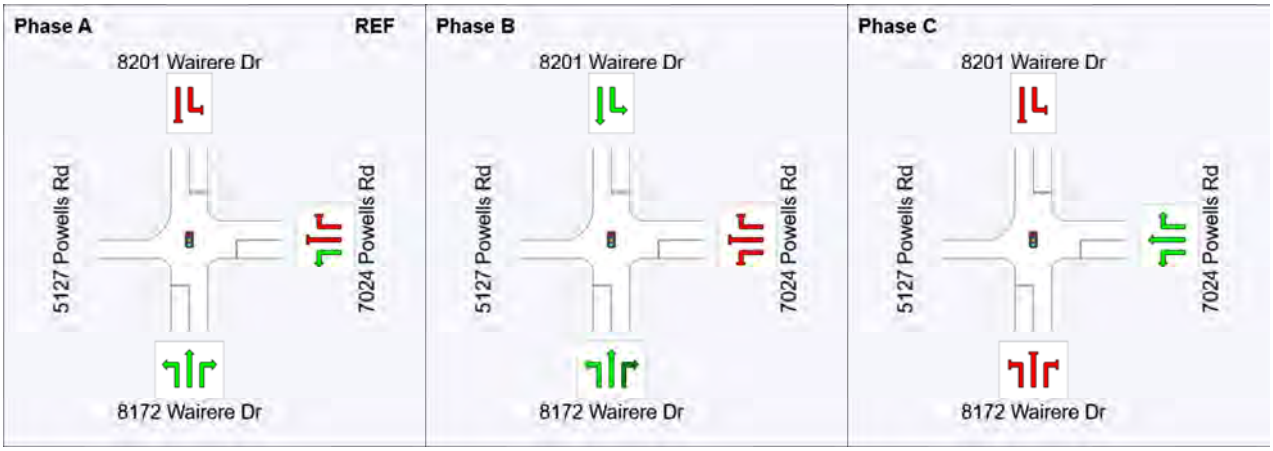
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	26	65
Green Time (sec)	20	33	25
Phase Time (sec)	26	39	31
Phase Split	27%	41%	32%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 8157 [8157 - Test 1 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 68 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	76	5.0	0.057	8.3	LOS A	0.7	5.0	0.28	0.64	0.28	51.4
2	T1	802	5.0	0.289	3.4	LOS A	4.4	32.4	0.35	0.31	0.35	56.9
3	R2	346	5.0	0.496	13.6	LOS B	5.3	38.5	0.77	0.80	0.77	47.8
Approach		1224	5.0	0.496	6.6	LOS A	5.3	38.5	0.47	0.47	0.47	53.6
East: 7024 Powells Rd												
4	L2	152	5.0	0.279	24.3	LOS C	4.0	29.4	0.75	0.75	0.75	42.2
5	T1	12	5.0	0.279	18.7	LOS B	4.0	29.4	0.75	0.75	0.75	43.1
6	R2	29	5.0	0.186	39.5	LOS D	1.0	7.1	0.94	0.71	0.94	35.7
Approach		193	5.0	0.279	26.3	LOS C	4.0	29.4	0.78	0.74	0.78	41.1
North: 8201 Wairere Dr												
7	L2	31	5.0	0.048	21.7	LOS C	0.7	4.9	0.67	0.69	0.67	43.2
8	T1	861	5.0	0.646	21.1	LOS C	12.2	89.1	0.87	0.76	0.87	44.6
Approach		892	5.0	0.646	21.1	LOS C	12.2	89.1	0.87	0.75	0.87	44.5
All Vehicles		2308	5.0	0.646	13.8	LOS B	12.2	89.1	0.65	0.60	0.65	48.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 1 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 68 seconds (Site Practical Cycle Time)

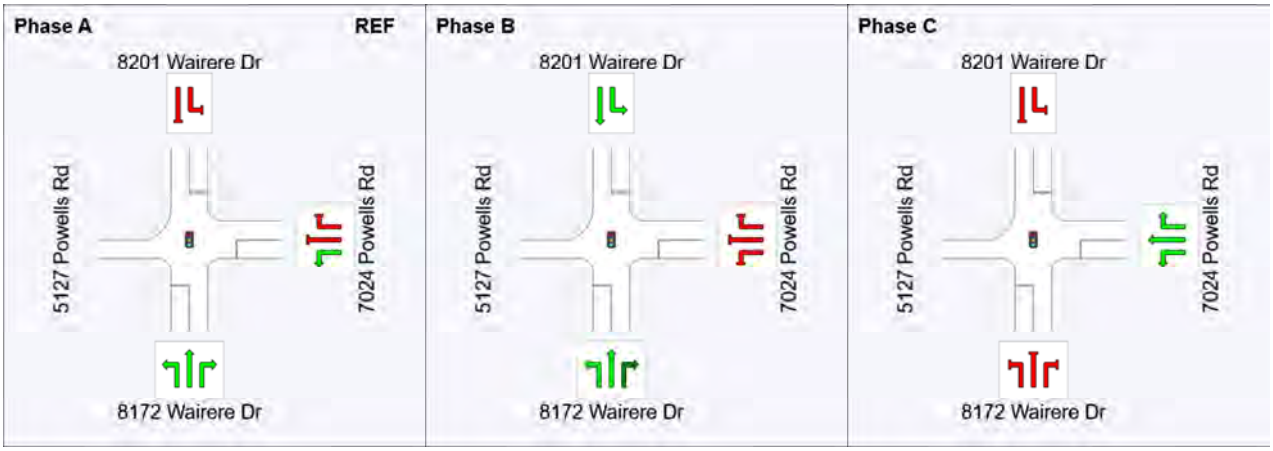
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	26	56
Green Time (sec)	20	24	6
Phase Time (sec)	26	30	12
Phase Split	38%	44%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

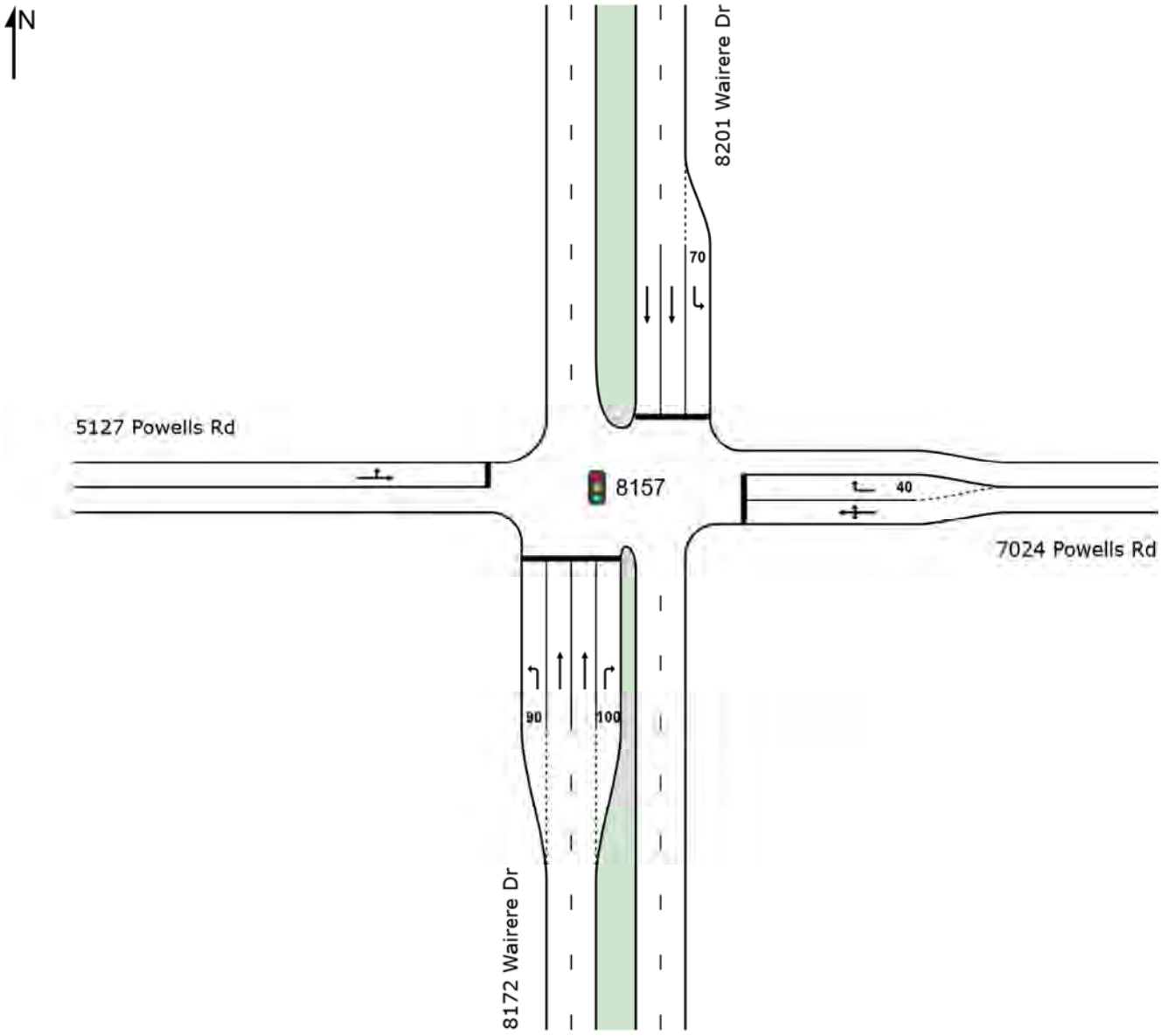
Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

SITE LAYOUT

Site: 8157 [8157 - Test 2 AM]

WAIRERE RD POWELLS RD
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated

* 8157 *



Organisation: STANTEC NEW ZEALAND | Created: Thursday, June 16, 2022 1:42:26 PM
Project: \\Nz4118-ppfss01\shared_projects\310205113\7_technical\Model results\Scenario 1\Extra Sidra Tests AM TRAM2021.sip8

MOVEMENT SUMMARY

Site: 8157 [8157 - Test 2 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 91 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	31	5.0	0.029	13.9	LOS B	0.6	4.0	0.42	0.65	0.42	47.6
2	T1	583	5.0	0.260	9.8	LOS A	6.1	44.8	0.50	0.43	0.50	51.7
3	R2	91	5.0	0.209	19.3	LOS B	1.8	12.9	0.75	0.74	0.75	44.5
Approach		704	5.0	0.260	11.2	LOS B	6.1	44.8	0.53	0.48	0.53	50.4
East: 7024 Powells Rd												
4	L2	376	5.0	0.529	25.4	LOS C	12.5	91.3	0.74	0.79	0.74	41.6
5	T1	22	5.0	0.529	19.8	LOS B	12.5	91.3	0.74	0.79	0.74	42.5
6	R2	51	5.0	0.137	34.6	LOS C	1.7	12.8	0.78	0.73	0.78	37.6
Approach		448	5.0	0.529	26.2	LOS C	12.5	91.3	0.74	0.78	0.74	41.1
North: 8201 Wairere Dr												
7	L2	16	5.0	0.025	26.0	LOS C	0.5	3.3	0.65	0.67	0.65	41.2
8	T1	943	5.0	0.689	27.8	LOS C	17.9	130.9	0.89	0.78	0.89	41.2
Approach		959	5.0	0.689	27.8	LOS C	17.9	130.9	0.88	0.78	0.88	41.2
West: 5127 Powells Rd												
10	L2	4	5.0	0.100	33.0	LOS C	1.7	12.5	0.76	0.59	0.76	40.4
11	T1	47	5.0	0.100	27.4	LOS C	1.7	12.5	0.76	0.59	0.76	41.3
Approach		51	5.0	0.100	27.8	LOS C	1.7	12.5	0.76	0.59	0.76	41.2
All Vehicles		2163	5.0	0.689	22.1	LOS C	17.9	130.9	0.74	0.68	0.74	43.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 2 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 91 seconds (Site Practical Cycle Time)

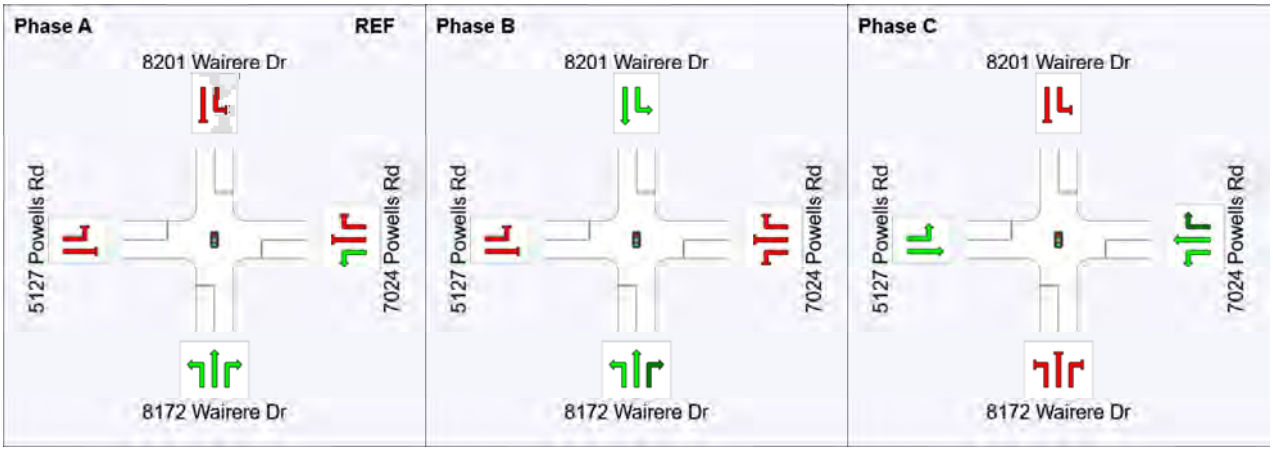
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	21	60
Green Time (sec)	15	33	25
Phase Time (sec)	21	39	31
Phase Split	23%	43%	34%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 8157 [8157 - Test 2 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 72 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	76	5.0	0.060	9.1	LOS A	0.8	5.8	0.31	0.64	0.31	50.8
2	T1	802	5.0	0.300	4.3	LOS A	5.2	37.7	0.39	0.34	0.39	56.0
3	R2	269	5.0	0.408	14.0	LOS B	3.8	28.0	0.73	0.78	0.73	47.6
Approach		1147	5.0	0.408	6.9	LOS A	5.2	37.7	0.46	0.46	0.46	53.4
East: 7024 Powells Rd												
4	L2	152	5.0	0.260	23.9	LOS C	4.1	29.9	0.72	0.74	0.72	42.3
5	T1	12	5.0	0.260	18.3	LOS B	4.1	29.9	0.72	0.74	0.72	43.3
6	R2	29	5.0	0.192	41.8	LOS D	1.0	7.5	0.94	0.71	0.94	35.0
Approach		193	5.0	0.260	26.3	LOS C	4.1	29.9	0.76	0.74	0.76	41.1
North: 8201 Wairere Dr												
7	L2	31	5.0	0.049	22.9	LOS C	0.7	5.2	0.67	0.69	0.67	42.6
8	T1	861	5.0	0.657	22.7	LOS C	13.0	95.0	0.88	0.76	0.88	43.7
Approach		892	5.0	0.657	22.7	LOS C	13.0	95.0	0.87	0.76	0.87	43.7
West: 5127 Powells Rd												
10	L2	3	5.0	0.402	39.6	LOS D	3.2	23.6	0.94	0.73	0.94	37.7
11	T1	92	5.0	0.402	34.0	LOS C	3.2	23.6	0.94	0.73	0.94	38.5
Approach		95	5.0	0.402	34.2	LOS C	3.2	23.6	0.94	0.73	0.94	38.5
All Vehicles		2326	5.0	0.657	15.7	LOS B	13.0	95.0	0.66	0.61	0.66	47.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 2 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 72 seconds (Site Practical Cycle Time)

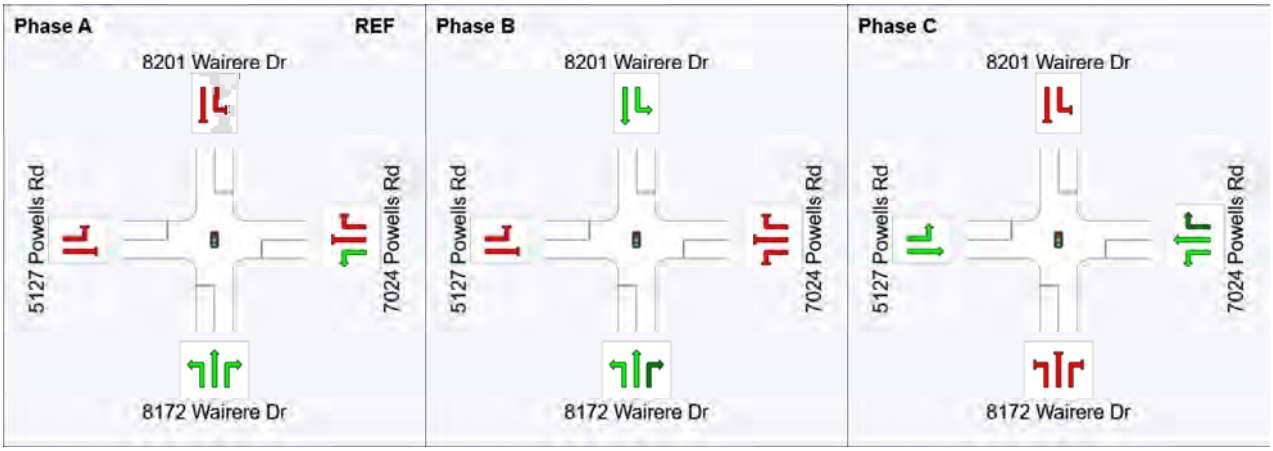
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	26	57
Green Time (sec)	20	25	9
Phase Time (sec)	26	31	15
Phase Split	36%	43%	21%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



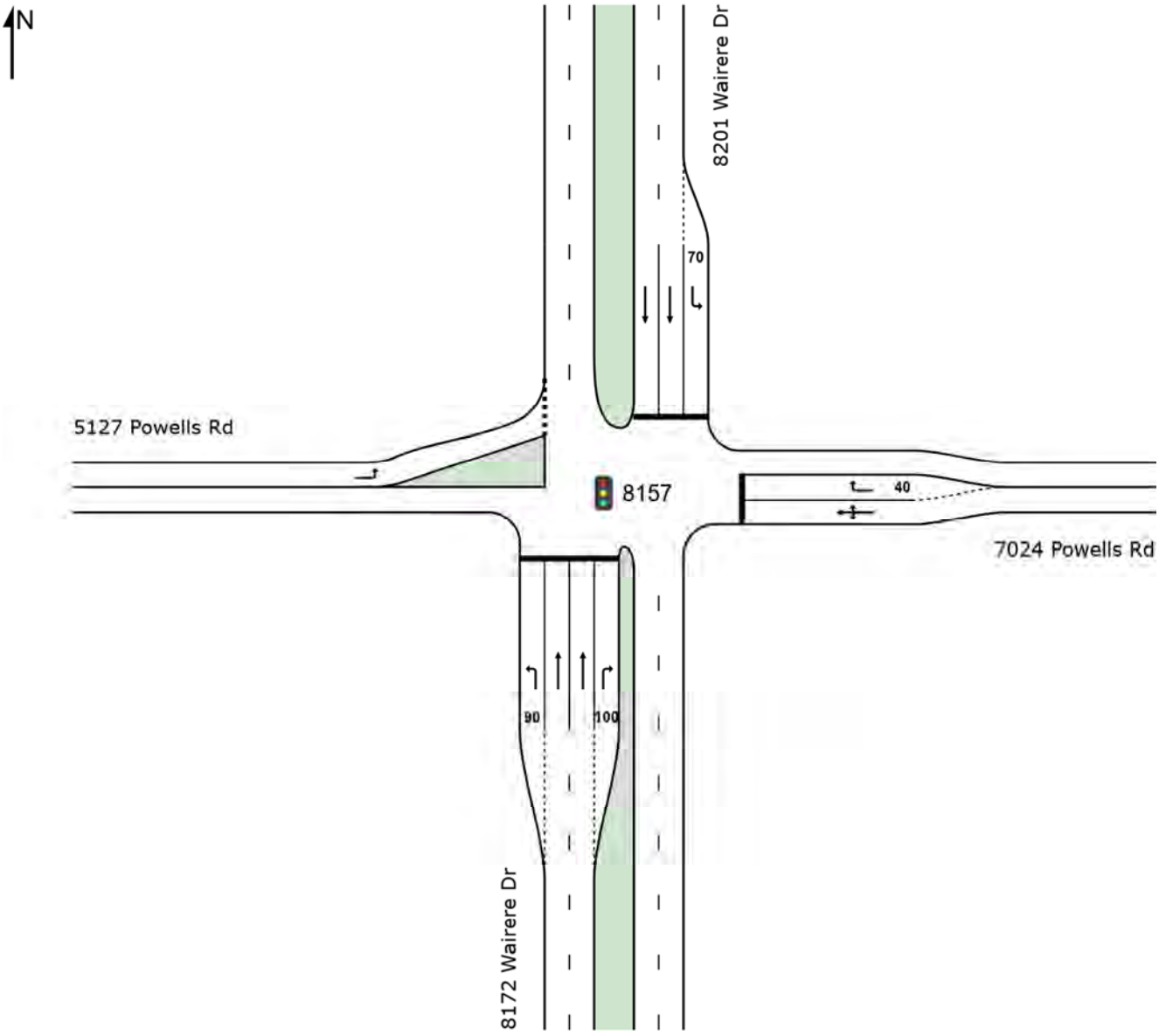
REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

SITE LAYOUT

Site: 8157 [8157 - Test 3 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated



MOVEMENT SUMMARY

Site: 8157 [8157 - Test 3 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 93 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	31	5.0	0.028	12.9	LOS B	0.5	3.8	0.39	0.64	0.39	48.3
2	T1	583	5.0	0.247	8.6	LOS A	5.8	42.3	0.46	0.40	0.46	52.6
3	R2	138	5.0	0.270	18.9	LOS B	2.6	19.0	0.75	0.75	0.75	44.7
Approach		752	5.0	0.270	10.6	LOS B	5.8	42.3	0.51	0.47	0.51	50.8
East: 7024 Powells Rd												
4	L2	376	5.0	0.529	26.5	LOS C	12.9	94.5	0.75	0.79	0.75	41.1
5	T1	22	5.0	0.529	20.9	LOS C	12.9	94.5	0.75	0.79	0.75	42.0
6	R2	51	5.0	0.114	36.0	LOS D	1.8	13.1	0.79	0.72	0.79	37.0
Approach		448	5.0	0.529	27.3	LOS C	12.9	94.5	0.75	0.78	0.75	40.6
North: 8201 Wairere Dr												
7	L2	16	5.0	0.026	27.7	LOS C	0.5	3.5	0.67	0.67	0.67	40.4
8	T1	943	5.0	0.727	30.1	LOS C	18.9	138.0	0.91	0.80	0.91	40.1
Approach		959	5.0	0.727	30.1	LOS C	18.9	138.0	0.91	0.80	0.91	40.1
West: 5127 Powells Rd												
10	L2	4	5.0	0.004	6.9	LOS A	0.0	0.2	0.22	0.57	0.22	53.1
Approach		4	5.0	0.004	6.9	LOS A	0.0	0.2	0.22	0.57	0.22	53.1
All Vehicles		2163	5.0	0.727	22.7	LOS C	18.9	138.0	0.74	0.68	0.74	43.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 3 AM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 93 seconds (Site Practical Cycle Time)

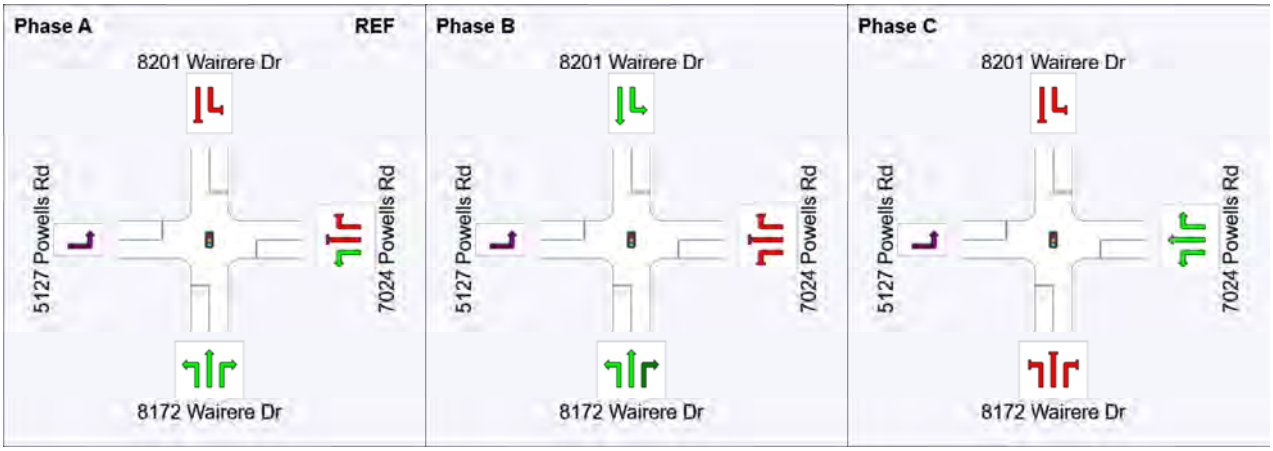
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	26	64
Green Time (sec)	20	32	23
Phase Time (sec)	26	38	29
Phase Split	28%	41%	31%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 8157 [8157 - Test 3 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 68 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: 8172 Wairere Dr												
1	L2	76	5.0	0.057	8.3	LOS A	0.7	5.0	0.28	0.64	0.28	51.4
2	T1	802	5.0	0.289	3.4	LOS A	4.4	32.4	0.35	0.31	0.35	56.9
3	R2	269	5.0	0.385	12.9	LOS B	3.6	26.5	0.70	0.77	0.70	48.3
Approach		1147	5.0	0.385	5.9	LOS A	4.4	32.4	0.43	0.44	0.43	54.2
East: 7024 Powells Rd												
4	L2	152	5.0	0.279	24.3	LOS C	4.0	29.4	0.75	0.75	0.75	42.2
5	T1	12	5.0	0.279	18.7	LOS B	4.0	29.4	0.75	0.75	0.75	43.1
6	R2	29	5.0	0.186	39.5	LOS D	1.0	7.1	0.94	0.71	0.94	35.7
Approach		193	5.0	0.279	26.3	LOS C	4.0	29.4	0.78	0.74	0.78	41.1
North: 8201 Wairere Dr												
7	L2	16	5.0	0.025	21.5	LOS C	0.3	2.5	0.66	0.67	0.66	43.4
8	T1	861	5.0	0.646	21.1	LOS C	12.2	89.1	0.87	0.76	0.87	44.6
Approach		877	5.0	0.646	21.1	LOS C	12.2	89.1	0.87	0.76	0.87	44.5
West: 5127 Powells Rd												
10	L2	3	5.0	0.003	6.9	LOS A	0.0	0.1	0.25	0.57	0.25	53.1
Approach		3	5.0	0.003	6.9	LOS A	0.0	0.1	0.25	0.57	0.25	53.1
All Vehicles		2220	5.0	0.646	13.7	LOS B	12.2	89.1	0.63	0.59	0.63	48.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 8157 [8157 - Test 3 PM]

WAIRERE RD POWELLS RD * 8157 *
2013 WAIKATO MODEL
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 68 seconds (Site Practical Cycle Time)

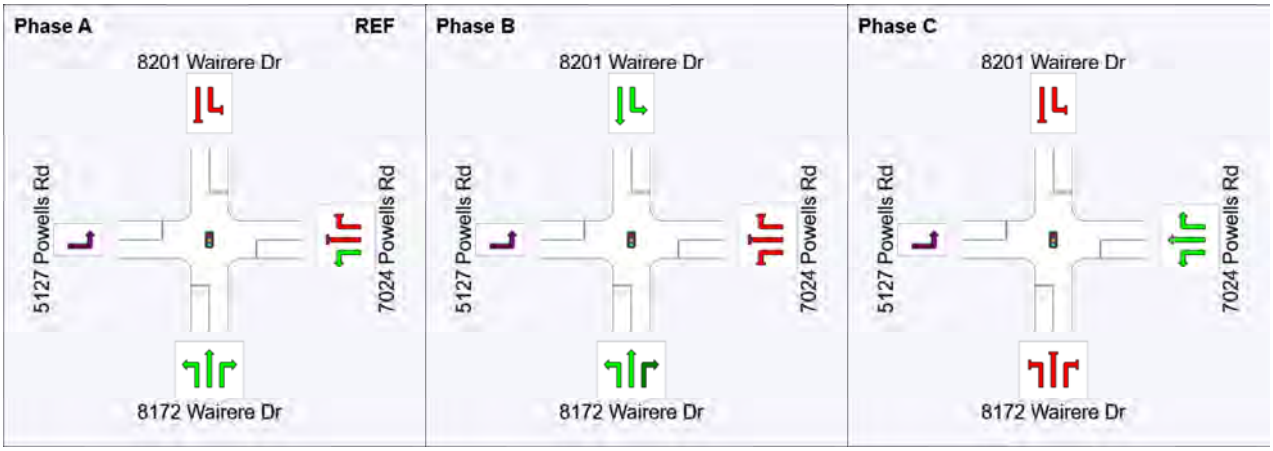
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Sequence 1
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	26	56
Green Time (sec)	20	24	6
Phase Time (sec)	26	30	12
Phase Split	38%	44%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied