WAKA KOTAHI
NZ TRANSPORT AGENCY

PAPAKURA TO BOMBAY STAGE 2

ASSESSMENT OF TRANSPORT AND TRAFFIC EFFECTS

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Abbreviations

Abbreviation	Term
AEE	Assessment of Effects on the Environment
ASP	Auckland Strategic Planning
AUPOP	Auckland Unitary Plan (Operative in Part 2016)
CoPTTM	Code of Practice for Temporary Traffic Management
CTMP	Construction Traffic Management Plan
EPA	Expert Consenting Panel
FTA	Covid 19 Recovery (Fast Track Consenting) Act 2020
FTN	Frequent Transit Network
GPS	Government Policy Statement 2018
HCV	Heavy Commercial Vehicle
LVA	Landscape, Visual and Natural Character Effects Assessment
HCV	Heavy Commercial Vehicle
NIMT	North Island Main Trunk
NoR	Notice of Requirement
NoR 1	Alteration to the SH1 Designation 6706
NoR 2	Alteration to the SH1 Designation 6700
NoR 3	Alteration to the SH1 Designation 6701
NoR 4	Shared User Path between Quarry Road and Bombay Interchange
NoR 5	Drury South Interchange Connections
NZTA	NZ Transport Agency Waka Kotahi
ONRC	One Network Road Classification
P2B project	SH1 Upgrades Project between Papakura to Bombay
P2DS	Papakura to Drury South project
PCU	Passenger Car Unit
RMA	Resource Management Act 1991
SGA	The Te Tupu Ngātahi Supporting Growth Alliance
SH1	State Highway 1 Motorway

SH22	State Highway 22
SUP	Shared Use Path
TMS	Traffic Monitoring System
vpd	Vehicles Per Day

Glossary of Acronyms / Terms

Acronym/Term	Description
Auckland Council	Means the unitary authority that replaced eight councils in the Auckland Region as of 1 November 2010.
the Project	Stages 2 of the P2B project between Drury to Bombay
Project Area	Area of land that is within the proposed designation boundary.

EXECUTIVE SUMMARY

This report provides an Assessment of Transport Effects to support Stage 2 of the Papakura to Bombay (P2B project) Project.

Project Background

P2B project is a NZTA led project to improve the transport capacity and functionality of the State Highway network and provide for long term growth in the South of Auckland. Stage 1 has consent and was divided into sub-sections which are either constructed or construction is underway.

Stage 2 is for route protection and NZTA is seeking five NoRs, three of which alter the existing SH1 designation, one covers the provision of a Shared Use Path (SUP) and the remaining NoR is for the connections into the local road network at the new Drury South Interchange.

Stage 2 incorporates the remaining portion of the P2B project area south of Quarry Road to approximately 600 meters (m) south of the existing Bombay/Mill Road Interchange. The following is a description of the planned works:

- An additional lane in each direction along SH1;
- A new interchange constructed at Drury South;
- Upgrades to the existing Ramarama and Bombay Interchanges;
- Continuation of a Shared User Path (SUP) from Quarry Road near its intersection with Great South Road to Bombay Interchange; and,
- Stormwater management devices.

Assessment Methodology

To assess the traffic effects of the Project, the Southern Sector SATURN traffic model was used. The traffic models used are for the years 2038 and 2048 and are described as follows:

- Future Reference Case. The Supporting Growth Southern Sector forecast models (existing environment plus one additional traffic lane in each direction on SH1 from Papakura to Drury, as consented under Stage 1 works, with 2038 and 2048 predicted traffic demands); and,
- The Project (Future Reference Case, plus the Project).

Both the Future Reference Case and Project models assume investment in a range of other transport projects. The most notable projects include investment in rail, and the implementation of the Mill Road and Pukekohe Arterials projects, although the effects of these two roading projects not proceeding have also been assessed.

Assessment of operational effects

The traffic modelling predicts significant travel time reductions on SH1 in comparison to the Future Reference Case. This will result in more efficient and reliable journeys. These efficiency and reliability benefits will make a valuable contribution to the efficient movement of freight.

The positive traffic and transportation effects of Project include:

- Improved efficiency and effectiveness of travel along SH1. The reduced travel times will make journey times along SH1 shorter which will benefit a significant volume of traffic, including freight movements;

- Improved safety. The Project will include safety upgrades that will make SH1 a safer and more resilient route;
- Provision of upgraded pedestrian and cycle facilities through the SUP and at the existing interchanges will improve pedestrian and cyclist connectivity and safety;
- Reduced traffic volumes on local roads. This will result in less delays for public transport and freight vehicles that will be using these routes. Pedestrians and cyclists that use these roads will benefit from the reduced traffic volumes, providing them with a safer and more pleasant environment; and,
- Improved connectivity between Pukekohe and Drury via the new Drury South interchange which will support growth in these areas.

Assessment of construction effects

The delivery of Stage 2 is anticipated to involve a range of temporary traffic management techniques commonly utilised across the wider Auckland motorway network, with some of these techniques already being used on Stage 1 of the P2B project.

The Site access points and temporary traffic management controls will be in accordance with the NZTA code of practice for temporary traffic management (CoPTTM), and Temporary Traffic Management Plans will be developed by the contractor for the various stages and requirements of each of the Projects construction activities.

It is expected that contractors engaged in the Project will employ a range of traffic management approaches to minimise traffic disruption and enhance the efficiency of construction. Consequently, selecting a specific traffic management arrangements or techniques for the construction phase is not possible at this early stage of the process.

It is recommended that a Construction Traffic Management Plan (CTMP) is required, to ensure that the adverse traffic effects of the Project are managed during the construction stage.

Conclusion

The Project will improve the efficiency, effectiveness and safety of travel, along the strategically significant SH1 route.

- The additional lanes along the motorway will ensure effective continuity of capacity from previous P2B project stages and will reduce travel times. These improvements will offer efficiency gains throughout the project area, which will benefit a significant volume of traffic, including freight movements, particularly southbound in the evening peak;
- Safety will be improved the provision of wider shoulders and improved median and side barrier protection, making SH1 more resilient and less susceptible to closures due to serious crashes. However, it needs to be acknowledged that these safety benefits will be offset to an extent by the provision of additional traffic lanes which will increase average speeds and increase the possibility of additional weaving movements; and,
- Provision of upgraded pedestrian and cycle facilities through the SUP and existing interchanges will improve pedestrian and cyclist connectivity and safety.

1 INTRODUCTION

This Assessment of Transport and Traffic Effects Report (Report) has been prepared to inform the Assessment of Environmental Effects (AEE) for five Notices of Requirements (NoR) being sought by New Zealand Transport Agency Waka Kotahi (referred herein as 'NZTA) under the Resource Management Act 1991 (RMA).

1.1 Purpose and Scope of this Report

This Report considers the potential transport effects associated with the construction and operation of the project on the existing and likely future environment, and recommends measures that may be implemented to avoid, remedy, and/or mitigate these effects.

This Report should be read alongside the Assessment of Effects on the Environment (AEE), which contains further details on the history and context of the Project. The AEE also contains a detailed description of works to be authorised within each of the five NoRs, and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this Report and have been considered as part of this assessment of transport effects. As such, they are not repeated here. Where a description of an activity is necessary to understand the potential effects, it has been included in this Report for clarity.

1.2 Report Structure

To provide a clear assessment of each NoR, this Report follows the structure set out in the AEE. That is, each notice has been separated out into its own section, and each section contains an assessment of the actual and potential effects for the specific NoR. Where appropriate, measures to avoid, remedy or mitigate effects are recommended.

Table 1-1 below describes the extent of each section, and where the description of effects can be found in this Report.

Table 1-1: Summary of the Report Sections

Sections	Section number
Overview of the Project	2
Overview of the methodology used for the assessment, identification of the assessment criteria and any relevant standards or guidelines	3
Overall assessment of general transport matters for all Stage 2 NoRs	4
Assessment of specific transport matters for Stage 2 NoR 1 to NoR 3: Alteration to SH1 Designations, and NoR 4: SUP between Quarry Road and Bombay Interchange	5
Assessment of specific transport matters for Stage 2 NoR 5: Drury South Connections	6
Overall conclusion of the level of potential adverse transport effects of the Stage 2 P2B project Project.	7

2 PROJECT DESCRIPTION

2.1 Papakura to Bombay (P2B project) Project

The Papakura to Bombay Project (P2B project) is a NZTA led project to improve the transport capacity and functionality of the State Highway network and provide for long term growth

in the South of Auckland. An indicative location plan of the P2B project area is illustrated in Figure 2-1 (below).

For clarity and by way of summary we note that:

- The previous stages of the P2B project, were approved under the Covid 19 Recovery (Fast Track Consenting) Act 2020 (FTA), as part of the Papakura to Drury South project (P2DS), this includes: Stage 1B1 and Stage 1B2; and,
- Stage 1B1 of the P2DS, was approved by the Expert Consenting Panel (EPA) in November 2022, Stage 1B2 was approved by the EPA in July 2023, both applications altered the existing SH1 Designation 6706 (Takanini to Drury Interchange), which is the subject of NoR 1.

Further discussion of the different stages of the P2B project is contained in the AEE (**Appendix A**), Design Report (**Appendix C**) and legal submissions supporting this application.

2.2 Stage 2

NZTA is seeking five NoRs for Stage 2 of the P2B project, which are summarised in Table 2-1 (below).

For clarity and by way of summary we note that:

- The Project area, which was formally known as Stages 2 and 3 under the P2B project, is now to be referred to as a single stage for route protection only, this is referred herein as ‘Stage 2’ or ‘the Project’;
- Stage 2 incorporates the remaining portion of the P2B project area south of Quarry Road to the existing Bombay/Mill Road Interchange; and
- Stage 2 will protect land required to authorise the future upgrades of the SH1 corridor.

NZTA is seeking to protect adequate land to accommodate the following planned works:

- A new interchange constructed at Drury South (one additional lane in both directions of the proposed interchange);
- Upgrades to existing Ramarama Interchange;
- Upgrades to existing Bombay Interchange;
- Continuation of a Shared User Path (SUP) from Quarry Road near its intersection with Great South Road to Bombay Interchange; and,
- Stormwater management devices.

SH1 Papakura to Bombay project

October 2023

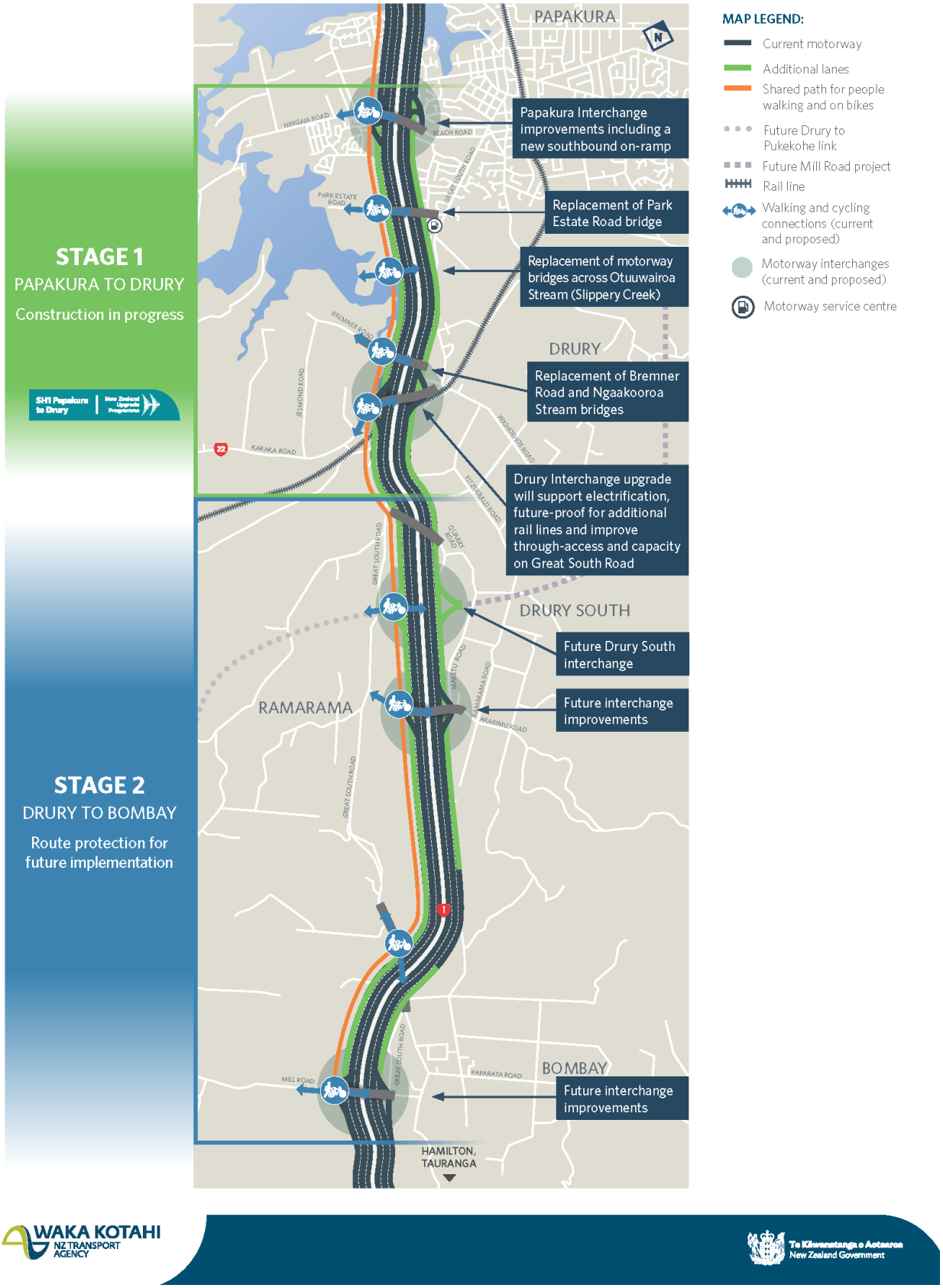

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Figure 2-1: Indicative location plan showing Stage 2 of the NZTA Project

Table 2-1: Summary of the Project NoR Package

Notice	Requiring Authority	Project	Purpose	Extent	Lapse Period
NoR 1	NZTA	Alteration to SH1 Designation 6706	Motorway between Takanini and Hamilton	SH1 CH 15160 to CH 15500 State Highway 1 from north of Takanini Interchange to south of Quarry Road, Drury	Given effect (ie. no lapse date)
NoR 2		Alteration to SH1 Designation 6700	Motorway	SH1 CH 15500 to CH 22740 State Highway 1 from south of Quarry Road, Drury to Bombay Road, Bombay	
NoR 3		Alteration to SH1 Designation 6701	Motorway	SH1 CH 22740 to CH 24600 State Highway 1 from Bombay Road to Mill Road, Bombay	
NoR 4		Shared User Path	Designation for the construction, operation and maintenance of a shared path and associated infrastructure.	SH1 CH 15160 to CH 24580 State Highway 1 from Quarry Road, Drury to Bombay Interchange/Mill Road.	20 years
NoR 5		Drury South Interchange Connections	Designation for the construction, operation and maintenance of a new link road and associated infrastructure.	CH 300 to CH 1750 Adjacent State Highway 1 at Drury South Interchange, linking to Quarry Road to the east, and Great South Road to the west.	20 years

3 ASSESSMENT APPROACH AND METHODOLOGY

This chapter outlines the approach to the assessment of the construction and operational transport effects of the Project within the altered and SUP designation areas.

3.1 Transport Modelling methodology overview

To assess the traffic effects of the Project, we have used the Southern Sector SATURN traffic model. This was developed several years ago for Auckland Transport, and it has been used for the assessment of many land use developments and transport investment proposals throughout South Auckland. Notably it is one of the transport modelling tools accepted by the Auckland Forecasting Centre, and it has been used recently by the Supporting Growth Alliance (SGA). For this assessment we have used the version of the models provided in September 2023, which relate to the years 2038 and 2048.

The forecast 2038 and 2048 traffic demands are based on outputs from Auckland Forecasting Centre's Macro Strategic Model (MSM), which in turn uses land use inputs from the Auckland Strategic Planning (ASP) model. The area is subject to significant land use changes and Appendix A summarises these changes.

This report refers to traffic models for the years 2038 and 2048 as follows:

- Future Reference Case. The Supporting Growth Southern Sector forecast models (existing environment plus one additional traffic lane in each direction on SH1 from Papakura to Drury, as consented under Stage 1 works, with 2038 and 2048 predicted traffic demands); and,
- The Project (Future Reference Case with the Project).

Table 3-1 shows the number of traffic lanes on SH1 for each of the models.

Table 3-1 Modelled scenarios: Summary of number of traffic lanes on SH1

Lane allocation on SH1	NORTHBOUND		SOUTHBOUND	
	FUTURE REF CASE 2038/2048	THE PROJECT 2038/2048	FUTURE REF CASE 2038/2048	THE PROJECT 2038/2048
Papakura to Drury	3	3	3	3
Drury to Bombay	2	3	2[1]	3

The Future Reference Case includes Stage 1 of the P2B project, which will provide three lanes along SH1 in each direction between the Papakura and Drury interchanges.

The Future Reference Case and the Project scenarios differ in that the Project will extend the additional lanes through from Drury to the Bombay Interchange and will include upgrades at the Ramarama and Bombay Interchanges, and a new interchange south of Drury Interchange.

Both the Future Reference Case and Project models assume investment in a range of other transport projects. At a regional level, the most notable projects include investment in rail, and the implementation of the Mill Road and Pukekohe Arterials projects.

[1] Plus existing southbound climbing lane between south of Ramarama and north of Bombay

Our assumptions regarding these projects are based on whether they are likely to be completed in the 2038 or 2048 model periods. The timing and staging of these projects is based on discussions with NZTA and the Supporting Growth Alliance.

Parts of the Mill Road project and the Pukekohe Arterials are not yet committed. Therefore, this report assesses this uncertainty by considering the medium term (2038) scenario both without and with these projects, while the longer term (2048) scenario assumes that the projects have progressed.

We should stress that while the report refers to future transport conditions in two specific years, these scenarios should be assumed to relate to the year in which the various assumptions are actually achieved. For example, the 2038 scenario could relate to 2035 or 2040, if for example land use changes occur faster or slower than currently anticipated. The issue of the uncertainty of forecasts is addressed in Section 6 below.

Further details of the assumptions included in the traffic models are provided in **Appendix A**.

4 ASSESSMENT OF TRANSPORT EFFECTS ACROSS ALL PROJECT NORS

This chapter assesses the cumulative transport effects, benefits and generic construction effects which are applicable to the entire Stage 2 Project (i.e. all five NoRs) and recommends measures to avoid, remedy, or mitigate actual or potential adverse effects.

4.1 Positive Transport Effects

Stage 2 of the Project will:

- Improve the safety, efficiency, and effectiveness of travel, along SH1, which is a strategically significant route. The additional lanes along the motorway will ensure effective continuity of capacity from Stage 1. These improvements will offer efficiency gains through reduced travel times in the Project area, which will benefit a significant volume of traffic, including freight movements.
- Include safety upgrades that will make SH1 a safer and more resilient route.
- Provide dedicated pedestrian and cycle infrastructure through the provision of the SUP and improved facilities at the existing interchanges which will improve pedestrian and cyclist connectivity and safety.
- Reduce traffic volumes on local roads. This will result in less delays for public transport and freight vehicles that will be using these routes.
- Provide improved connectivity between Pukekohe and Drury via the new Drury South interchange which will support growth in these areas.

4.2 Assessment of construction effects

The delivery of Stage 2 is anticipated to involve a range of temporary traffic management techniques commonly utilised across the wider Auckland motorway network, with some of these techniques already visible in Stage 1 of the P2B project.

Site access points and temporary traffic management controls will be in accordance with the NZTA code of practice for temporary traffic management (CoPTTM), and Temporary Traffic Management Plans will be developed by the contractor for the various stages and requirements of each of the Projects construction activities

It is expected that contractors engaged in the Project will employ a range of traffic management approaches to minimise traffic disruption and enhance the efficiency of construction. Consequently, selecting a specific traffic management arrangements or techniques for the construction phase is not possible at this early stage of the process.

We expect that the traffic management details will be developed through the project delivery phase and will be subject to further assessment, at the time of detailed construction planning, noting that the details should be consistent with the principles to be defined within a Construction Transport Management Plan (CTMP).

4.3 Assessment of operational effects

The delivery of Stage 2 is anticipated to involve a range of operational effects.

The Project will improve pedestrian and cyclist facilities by providing a SUP and upgrading existing interchanges, such as Ramarama and Bombay interchanges, and providing high standard facilities at the proposed new Drury South Interchange. These improvements wo;; improve safety and connectivity.

The traffic modelling predicts significant travel time reductions in comparison to the Future Reference Case on SH1. This will result in more efficient and reliable journeys. These efficiency and reliability benefits will make a valuable contribution to the efficient movement of freight.

The Project will enhance the safety and resilience of SH1 and its interchanges within the Project area. Various measures will be implemented along SH1, including wider shoulders, improved median barriers, additional traffic lanes, and improved road alignment. Furthermore, the improvements at the Ramarama and Bombay interchanges will improve safety and efficiency at the local road connections. However, it needs to be acknowledged that these safety benefits will be offset to an extent by the provision of additional traffic lanes, which will increase average speeds and increase the potential for weaving movements.

The redesign of the Ramarama Interchange to a roundabout between the northbound off and on ramps and Ararimu Road aims to improve operational efficiency and safety. This roundabout layout will reduce conflict for merging traffic, reduce delays, have a lower crash rate and reduce crash severity.

Traffic signals are to be installed at the Bombay Interchange by NZTA during 2024. The longer term layout proposed as part of this P2B project Stage 2 project will include provision for pedestrians and cyclists, plus additional traffic lanes to ensure that the interchange can better accommodate future traffic demands.

Provision of the Drury South Interchange will provide improved connectivity between the future growth areas around Pukekohe and Drury areas and will improve these areas connectivity with SH1. The interchange will provide connectivity benefits for pedestrians and cyclists by providing a connection east-west through the motorway corridor.

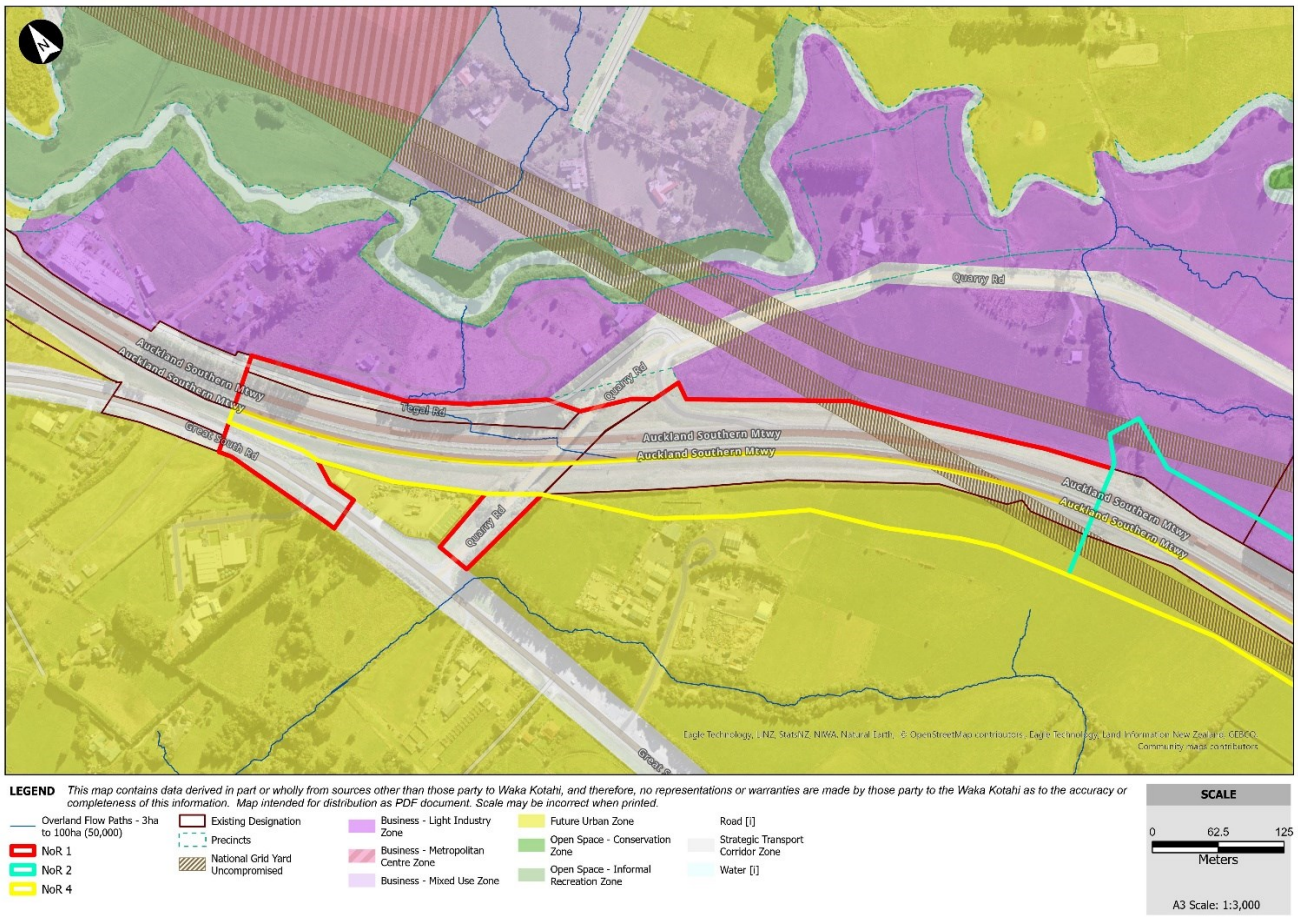
5 ASSESSMENT OF TRANSPORT EFFECTS NOR 1-3 ALTERATION TO SH1 DESIGNATIONS AND NOR 4 SHARED USER PATH

This section assesses the specific transport matters relation to NoRs 1-3: Alterations to the existing SH1 Designations 6706, 6700, and 6701, and NoR 4: Shared User Path from the Quarry Road SH1 overbridge to the Bombay Interchange.

5.1 Overview and description of works

As set out in Table 5-1 to Table 5-3 below, the proposed alterations to the existing SH1 Designations to provide widening of the existing SH1 corridor and accommodate the future upgrades to the SH1 network, and Table 5-4 sets out the proposal for the SUP.

Table 5-1: Overview of the alteration to SH1 Designation 6706

NoR 1 – Alteration to SH1 Designation 6706	
	
Key features	
Overview	▪ Six general traffic lanes (4.3m shoulders) on State Highway 1. ▪ Safety improvements include upgrading interchanges, wider shoulders, new barriers, and improved lighting along the full extent of the Project.
Structures	▪ Upgrades to existing Quarry Road over-bridge

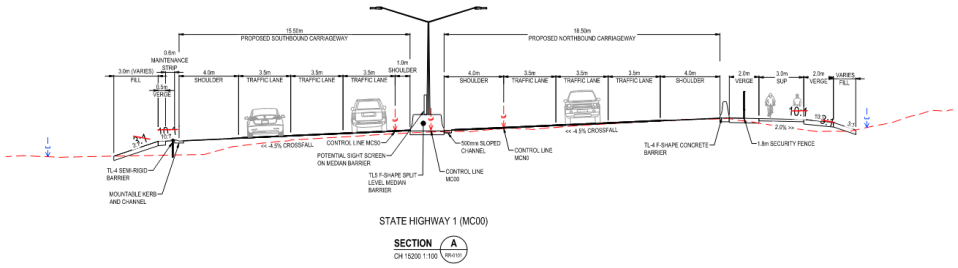
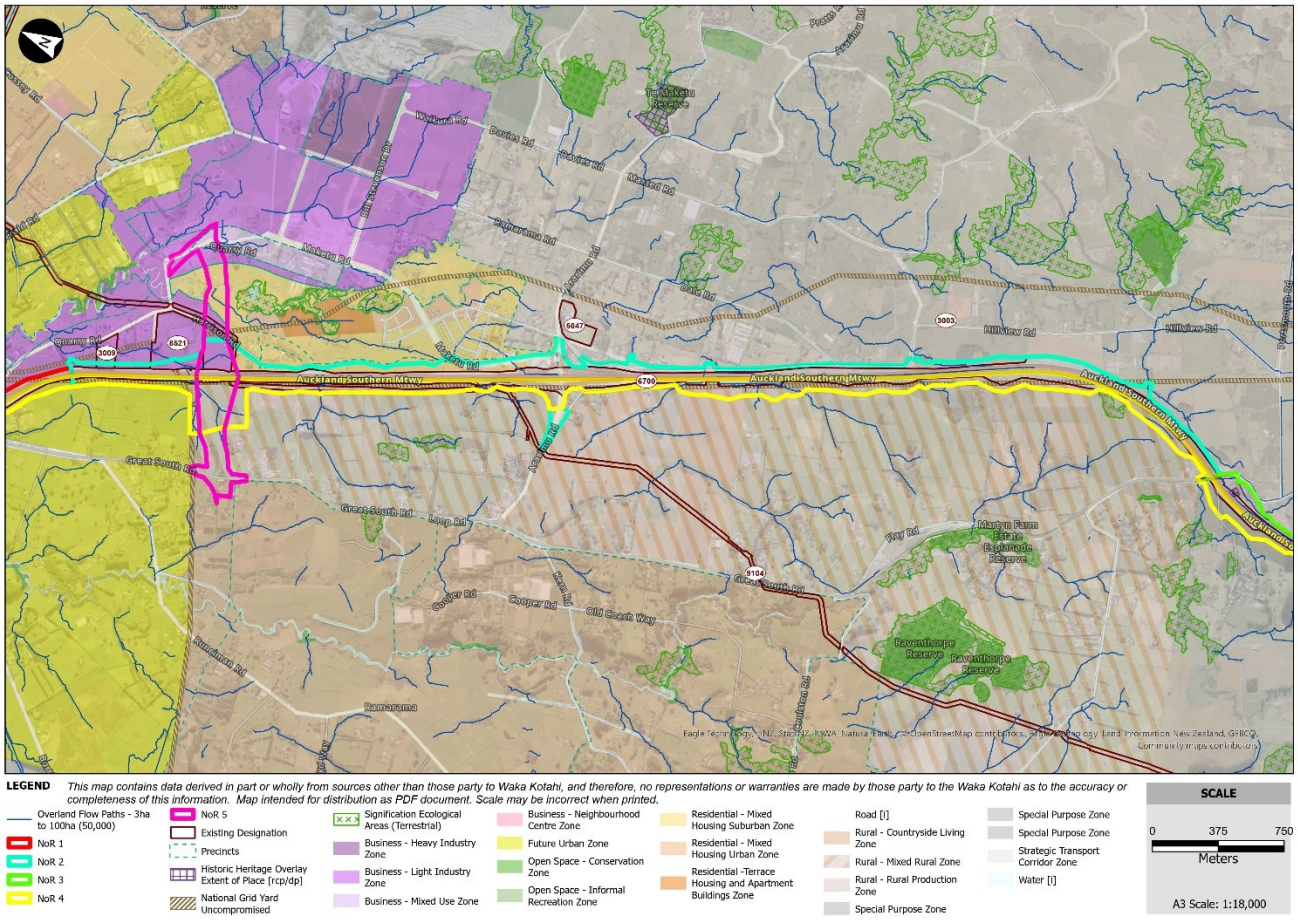
Speed Environment	▪ Design to accommodate 110km/h on State Highway 1
Access Lanes	▪ Designed to accommodate special vehicle lane within the 4m shoulder
Intersections	▪ N/A
Stormwater Infrastructure	▪ Swales and wetland treatment train (100% treatment of impervious surfaces and full scale wetland)
Typical cross sections	

Table 5-2: Overview of the alteration to SH1 Designation 6700

NoR 2 – Alteration to SH1 Designation 6700	
	
Key features	
Overview	▪ Six general traffic lanes (4.3m shoulders) on State Highway 1. ▪ Safety improvements include upgrading interchanges, wider shoulders, new barriers, and improved lighting along the full extent of the Project.
Structures	▪ Drury South Interchange ▪ Ramarama Interchange
Speed Environment	▪ Design to accommodate 110km/h on State Highway 1
Access Lanes	▪ Designed to accommodate special vehicle lane within the 4m shoulder
Intersections	▪ Drury South Interchange – new over-pass with roundabouts ▪ Ramarama Interchange – modified Stevensons roundabout with ramp signals and off-line bridge
Stormwater Infrastructure	▪ Swales and wetland treatment train (100% treatment of impervious surfaces and full scale wetland)

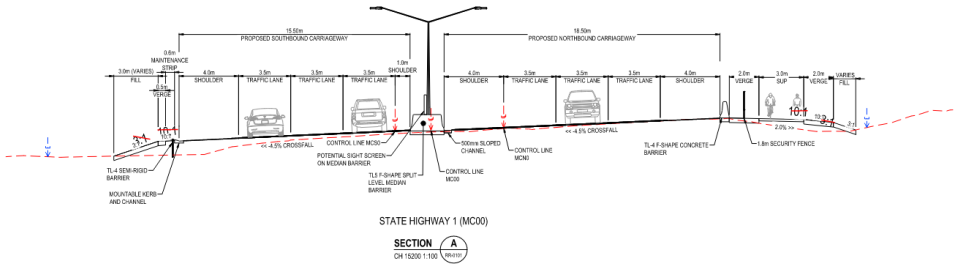
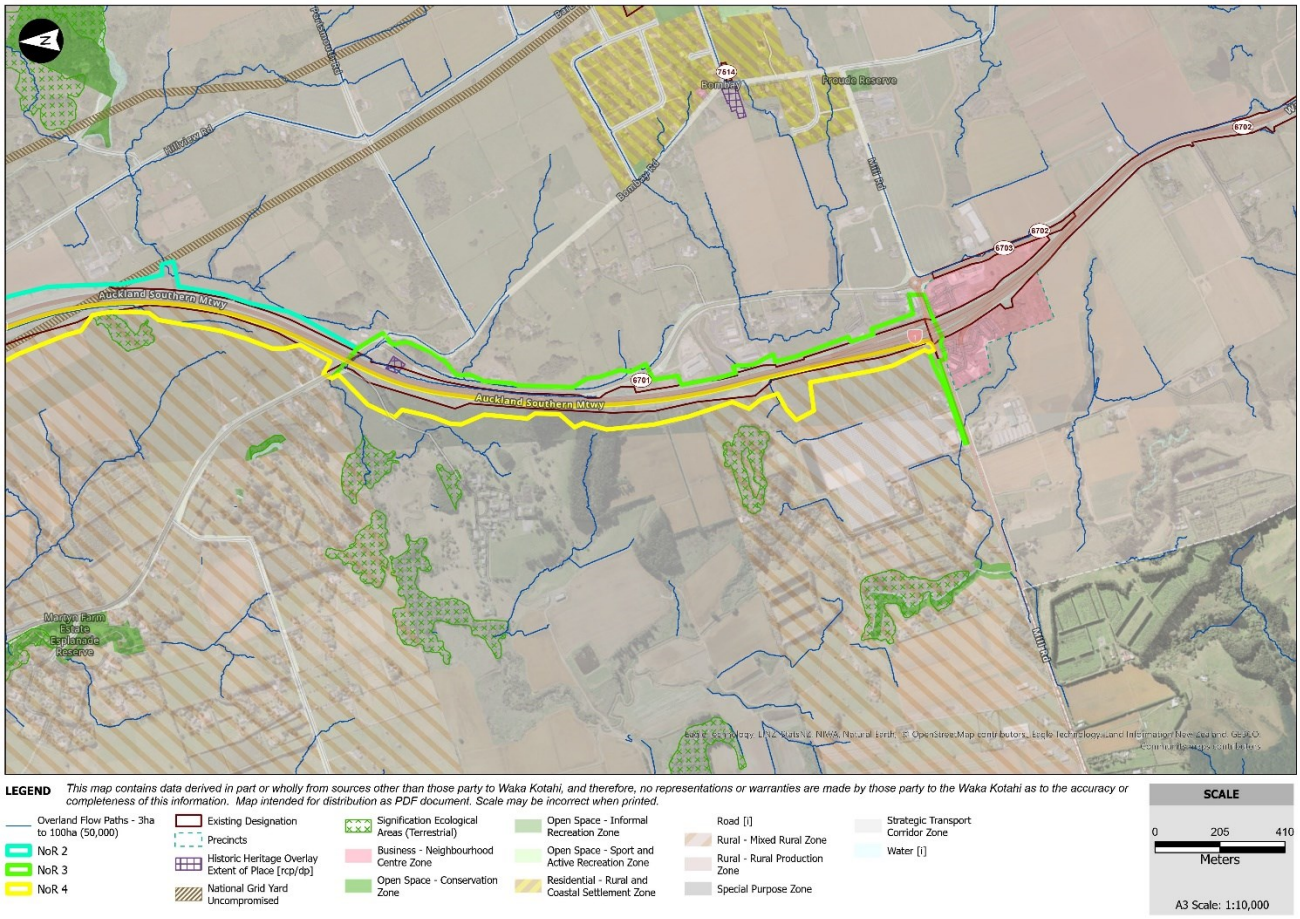
Typical cross sections	

Table 5-3: Overview of the alteration to SH1 Designation 6701

NoR 3 – Alteration to SH1 Designation 6701	
	
Key features	
Overview	▪ Six general traffic lanes (4.3m shoulders) on State Highway 1. ▪ Safety improvements include upgrading interchanges, wider shoulders, new barriers, and improved lighting along the full extent of the Project.
Structures	▪ Upgrades to the existing Mill Road/Bombay Interchange ▪ Mill Road over-bridge and abutments ▪ SH1 Great South Road Bridge
Speed Environment	▪ Design to accommodate 110km/h on State Highway 1
Access Lanes	▪ Designed to accommodate special vehicle lane within the 4m shoulder
Intersections	▪ Bombay Interchange – northbound signals ▪ Mill Road Bridge – altering both abutments to allow realignment of the road beneath Bombay Interchange
Stormwater Infrastructure	▪ Swales and wetland treatment train (100% treatment of impervious surfaces and full-scale wetland)

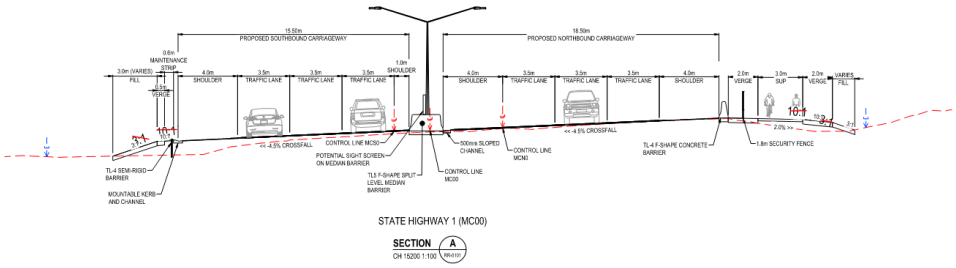
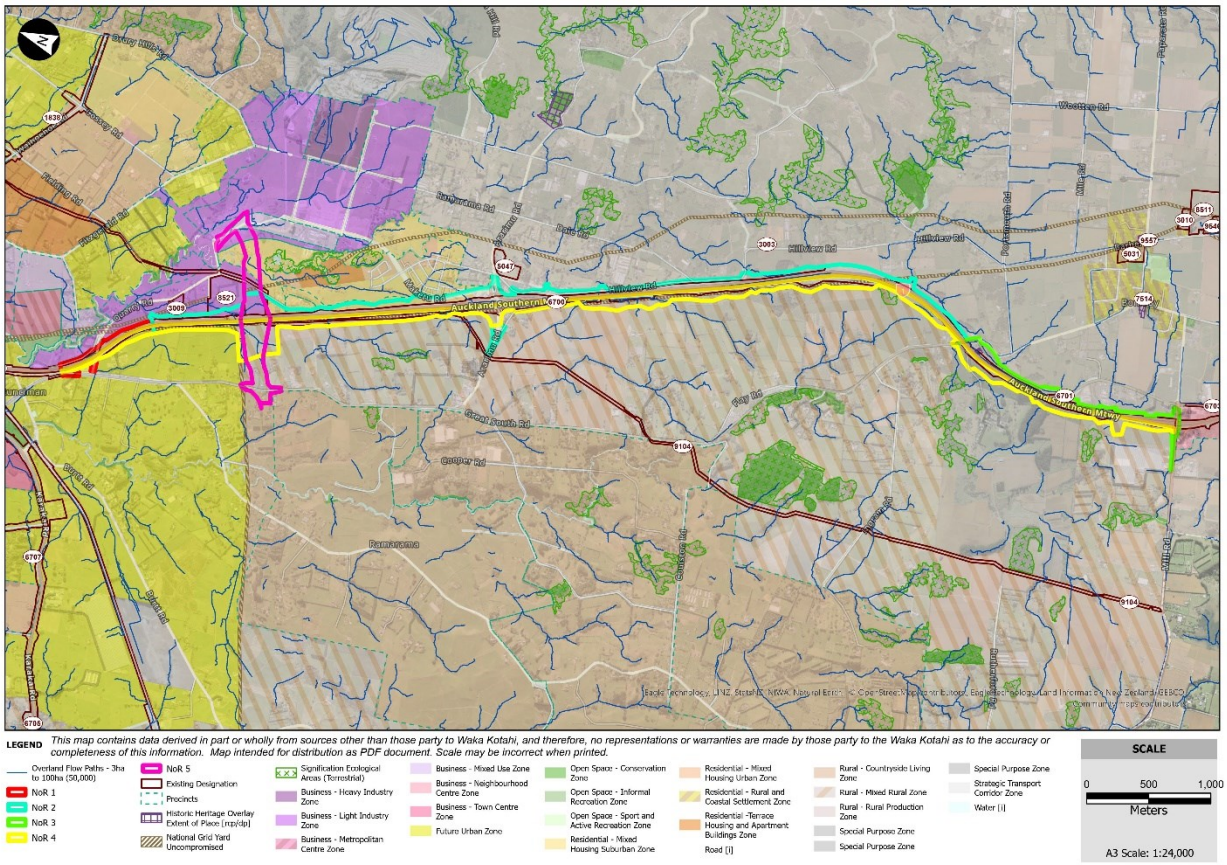
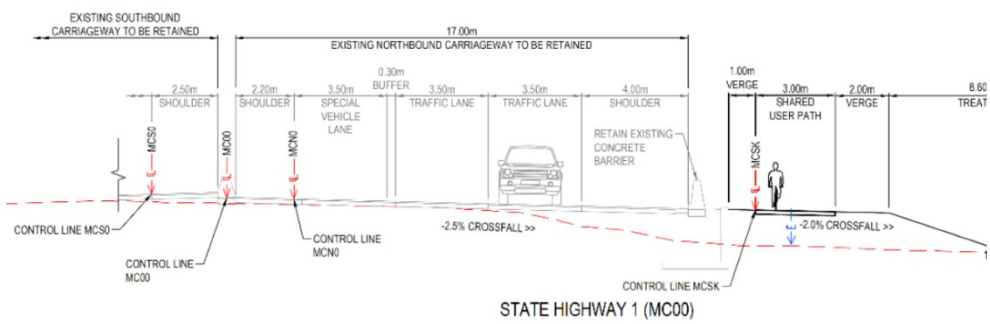
Typical cross sections	

Table 5-4: Overview of the SUP

NoR 4 – Construction, operation and maintenance of a new SUP	
	
Key features	
Overview	▪ Requires a new designation between 200m north of Quarry Road to 600m south of the existing Mill Road/Bombay Interchanges, with some locations overlapping the existing SH1 Designations 6706, 6700 and 6701. ▪ 3.0m wide SUP continuing from 200m north Quarry Road to 600m south of the existing Bombay/Mill Road Interchange. ▪ Located on the western side of the motorway.
Structures	▪ Tie-ins to all new and upgraded motorway interchange (ie. Drury South, Ramarama and Bombay) ▪ New bridge at Great South Road
Speed Environment	▪ N/A
Access Lanes	▪ N/A
Intersections	▪ Grade separated tie-in at all interchanges
Stormwater Infrastructure	▪ Swales and wetland treatment train (100% treatment of impervious surfaces and full scale wetland)

Typical cross sections	

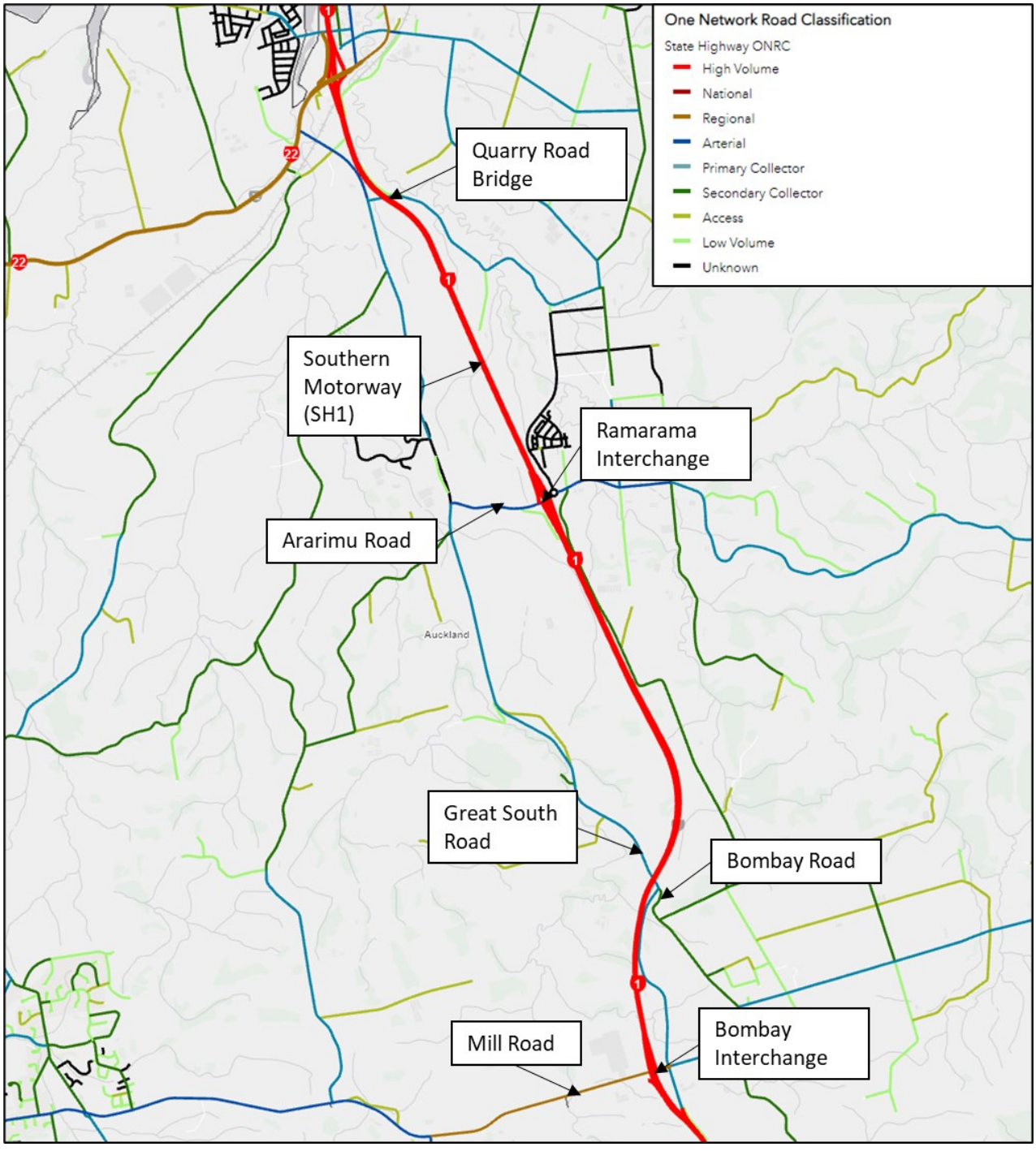
5.2 Existing environment

This section summarises the existing transport environment of the Project area. Further details are contained in **Appendix B**.

5.2.1.1 Surrounding road network hierarchy

Figure 5-1 below shows the road hierarchy in the vicinity of Stage 2 using the One Network Road Classification (ONRC).

Figure 5-1: Road Hierarchy



The main north-south route within the vicinity of the Project is:

- Great South Road predominantly located to the west of the project area with a section to the east of SH1 between Bombay Road and Mill Road. Classified as an Arterial by the ONRC, it provides a major road connection from Takanini to Papakura, Drury and joining SH1 at the Bombay Interchange. Great South Road also extends further north through to Manukau, Penrose and Newmarket, which provides an alternative non-State Highway route to SH1.

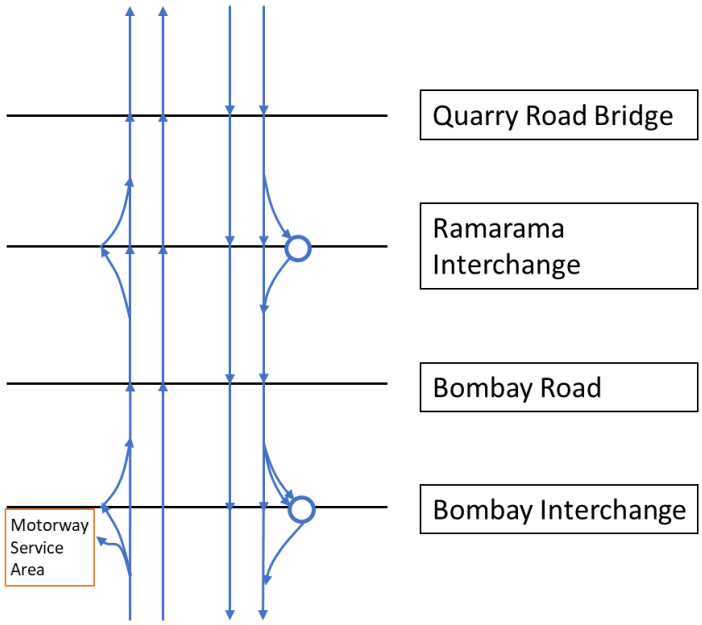
The main east-west routes within the vicinity of the Project are as follows:

- Quarry Road and the Quarry Road bridge provides a connection from Great South Road on the west of SH1 to the industrial areas on the east, north of Ramarama. Quarry Road is classified as a Primary Collector Road by the ONRC.
- Ararimu Road is an east-west route which intersects with the Ramarama interchange. Ararimu Road provides a connection from Great South Road to Ramarama Road. This road is the main corridor access to and from Ramarama primary school. Ararimu Road is classified as an Arterial Road by the ONRC.
- Mill Road is an east-west route which intersects with the Bombay interchange.

5.2.1.2 Existing layout of SH1

The existing layout of SH1 for the Project area from south of Drury Interchange is shown indicatively in Figure 5-2 below.

Figure 5-2: Existing SH1 Lane Arrangement[2]



From south of Drury Interchange, the southbound layout of SH1 is:

- 2 lanes from Quarry Road overbridge to Bombay Interchange, although there is a climbing lane for slow moving traffic, between south of the Ramarama interchange and the bridge over Bombay Road/Great South Road
- at the Ramarama Interchange, 1 lane for the on and off ramps, connected at a roundabout
- at the Bombay Interchange, 2 lanes for the off-ramp and 1 lane for the on-ramp, connected at a roundabout.

[2] Plus the southbound climbing lane between south of the Ramarama interchange and north of the Bombay interchange

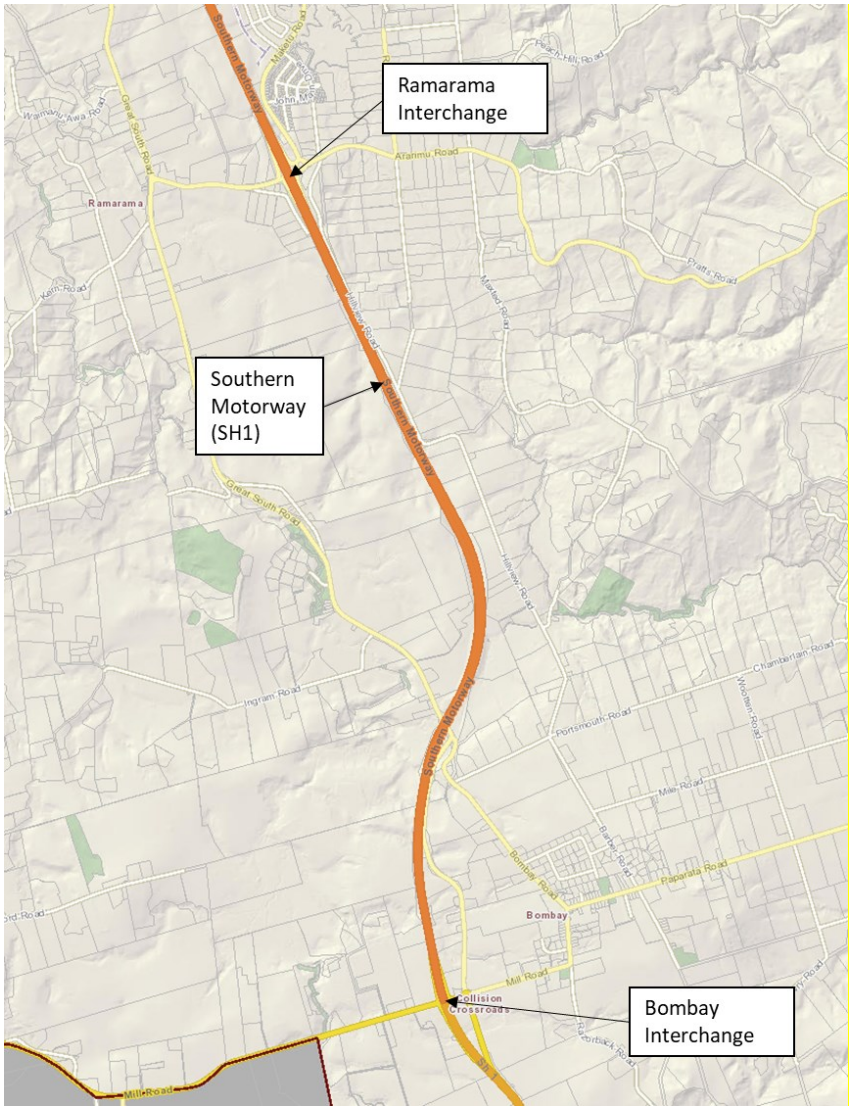
From the Bombay Interchange, the northbound layout is:

- 2 lanes from Bombay Interchange to Quarry Road overbridge
- at the Ramarama Interchange, 1 lane for the on and off-ramps
- at Bombay Interchange, 1 lane diverging to 2 lanes on the off-ramp with the left lane serving a motorway service area.

5.2.2 Current SH1 Interchanges

The Ramarama and Bombay interchanges are the two existing interchanges within the Project area. The locations of these interchanges are shown in Figure 5-3.

Figure 5-3: Existing Interchanges along SH1



5.2.2.1 Ramarama Interchange

The existing layout of the Ramarama interchange in shown in Figure 5-4-4 below. The interchange has the following features:

- Both north and south facing ramps.
- Ararimu and Maketu roads have two lanes, one lane in each direction. The roundabout is also a single-lane roundabout.

- The speed limit on Ararimu and Maketu Road is 60km/h. The on-ramps and off-ramps transition to/from 100km/h speed limit to align with SH1.
- A footpath is provided only on the southern side of the bridge segment of Ararimu Road over SH1. This provides pedestrian connectivity with the footpaths on the eastern side of Ararimu Road. However, there are no footpaths on the eastern side of Ararimu Road.
- The southbound on-ramp and off-ramp form a roundabout intersection with Ararimu and Maketu Road.
- The southbound on-ramp is a high angle left turn slip lane immediately after the exit from the Ararimu Road/Maketu Road roundabout.
- The southbound off-ramp has a single lane splitting into two lanes at the roundabout. The left lane is exclusive for left turn movement onto Maketu Road as the first exit
- The northbound off-ramp and on-ramp form a priority-controlled intersection with Ararimu Road.
- traffic exiting the off-ramp is controlled by a stop-controlled intersection.
- Right turn movement onto the on-ramp is given by a right turn bay

Figure 5-4: Existing Layout at Ramarama Interchange

5.2.2.2 Bombay Interchange

Figure 5-5 shows the existing layout of the Bombay interchange. It includes the following features:

- Both north and south facing ramps are provided.
- Mill Road and Great South Road have two lanes, one lane in each direction. The Mill Road bridge segment and west side of Mill Road has the two lanes separated by a relatively large flush median.
- Mill Road and Great South Road have a posted speed limit of 60km/h near the interchange. The speed limit on Great South Road increases to 80km/h approximately 250m north of the roundabout. The speed limit on Mill Road increases to 80km/h soon after the northbound ramps. The on-ramps and off-ramps transition to/from 100km/h speed limits to align with SH1.

- The southbound on-ramp and off-ramp intersect with Mill Road
- The southbound off-ramp has a single lane splitting into two lanes at the stop-controlled intersection. Immediately left of the off-ramp is the Mill Road/Great South Road single-lane roundabout.
- The southbound on-ramp is off the Mill Road/Great South Road roundabout. The on-ramp is a segment of Great South Road.
- The northbound off-ramp and on-ramp form a stop-controlled intersection with Mill Road.
- The northbound off-ramp starts off as a single lane then splits into two lanes separated by a flush median taper. The left lane serves a rest stop/motorway service area which has a number of food and service facilities including a McDonalds and a BP service station. The right lane on the onramp continues and splits again to form the stop-controlled intersection with Mill Road.
- Left turn movement onto the on-ramp is given by a high angle slip lane
- Right turn movement onto the on-ramp is given by a right turn bay
- A footpath is provided on both sides of the bridge segment of Mill Road over SH1. However, there is no pedestrian connectivity as the footpath does not connect pass the on and off ramps.

Figure 5-5: Existing Layout at Bombay Interchange

5.2.3 SH1 existing traffic volumes

According to data from NZTA's Traffic Monitoring System (TMS), the existing daily traffic volumes along SH1 (two-way) are summarised below (for the year 2022):

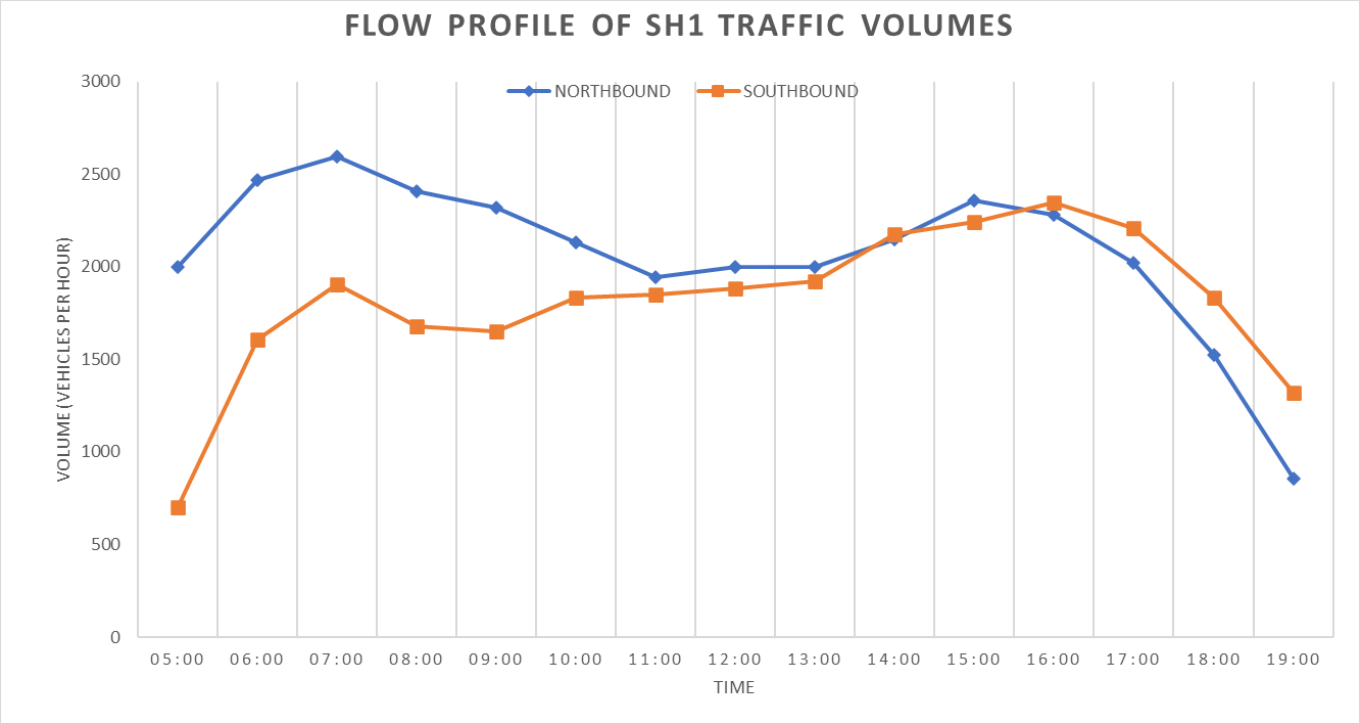
- Approximately 56,200 vehicles per day (vpd) between the Drury Interchange (Quarry Road overbridge) and Ramarama Interchange and;
- 49,900 vpd between the Ramarama and Bombay Interchanges.

The above figures indicate that the traffic volumes on the motorway are increasing from south to north as the motorway gets closer to Auckland.

5.2.4 Existing operation of SH1

Currently, traffic flows on the Southern Motorway follow a commuter traffic "tidal" pattern, with heavier northbound flows during the weekday morning peak and southbound in the evening peak. This pattern is shown in Figure 5-6 where the traffic flows are derived from TMS actual count data.

Figure 5-6: Flow profile of northbound and southbound traffic on SH1 between Drury and Ramarama Interchange



Figures 5-7 and 5-8 below indicate existing speeds along SH1, based on TomTom's speed data.

Figure 5-7: TomTom map showing average speeds northbound on SH1

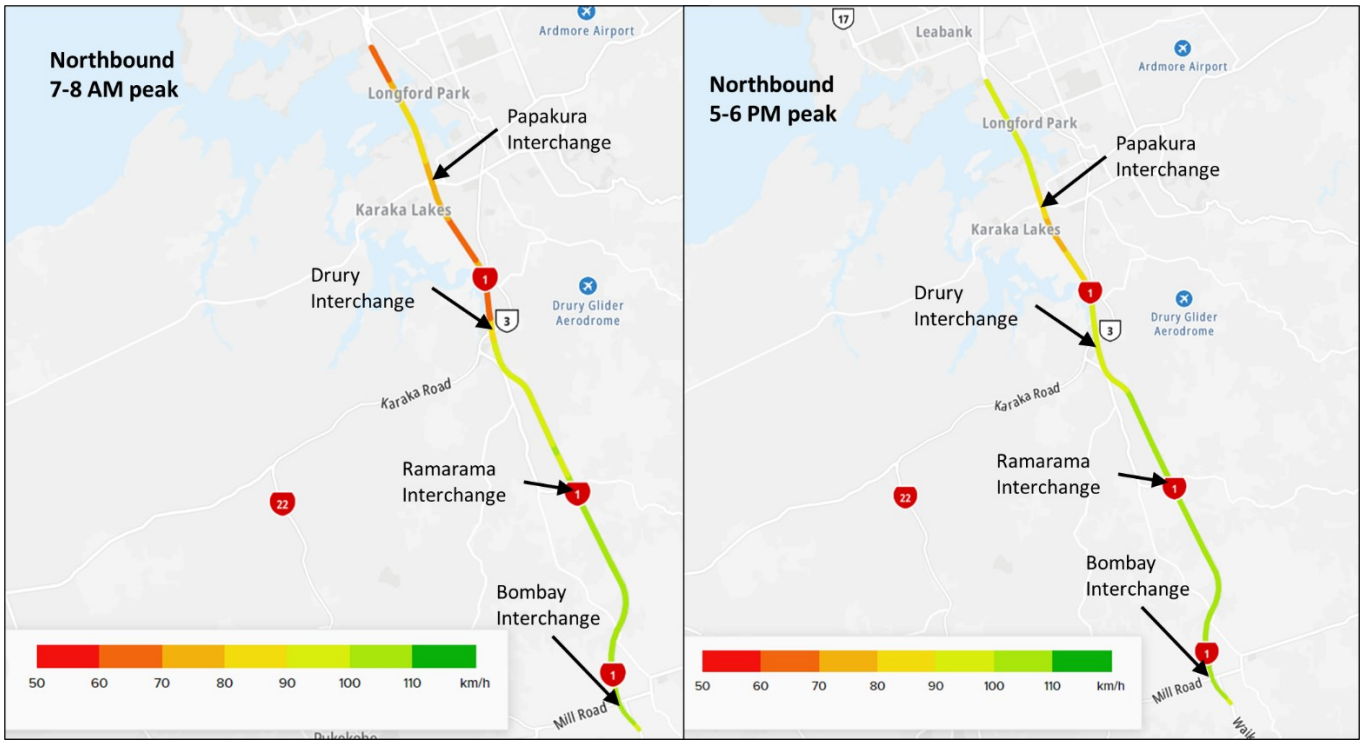
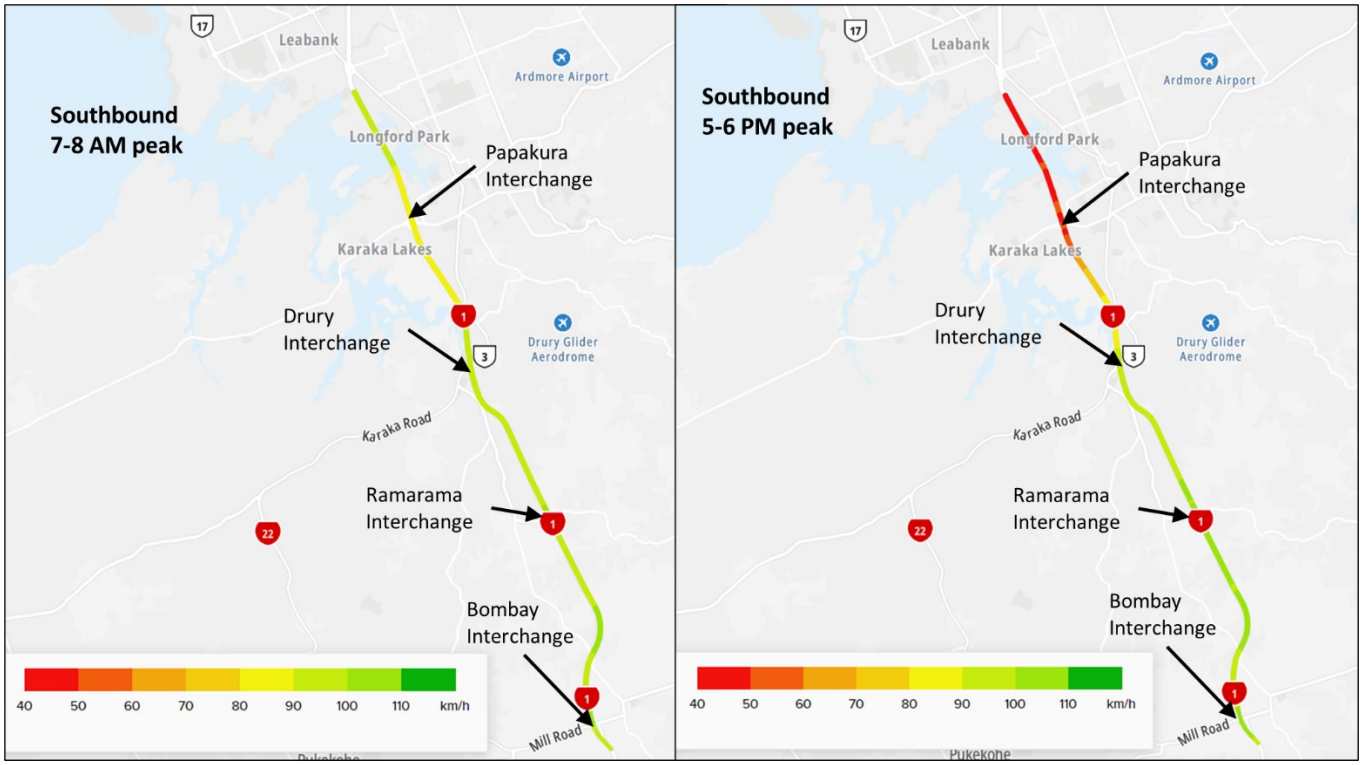


Figure 5-8: TomTom map showing average speeds southbound on SH1



In the weekday morning peak period, congestion usually extends back from north of the Project area around the Papakura/Takanini area towards the Drury interchange. Congestion is worse further north on SH1 as it gets closer to Auckland city centre.

During the evening peak period, southbound congestion occurs mainly north of the Papakura Interchange with no significant congestion reported throughout the remainder of Project area. Indeed, the section of motorway south from

Drury is “sheltered” from severe congestion by the capacity bottlenecks to the north. However, SH1 to the north of the Bombay Interchange can experience congestion at times.

Through traffic on Mill Road at the Bombay Interchange currently has priority over the on/off ramp movements. This results in vehicles queuing on the off ramps and queues extends back toward SH1 at times.

5.2.5 Crashes within the project area

We have undertaken a high-level crash assessment for the Project area for the time periods between 2016 to 15th February 2020 and for 2023 up to 15th August (16th February 2020-2022 was avoided due to COVID-19)[3]. Our crash analysis included the area SH1 south of the Drury interchange (by Pitt Road) to the SH1 / Mill Road Bombay Interchange. A summary of the assessment is detailed below, with further details provided in **Appendix B**.

The key findings of the crash assessment are:

- A total of 193 recorded crashes
- Crash numbers by severity:
- 0 fatal crashes.
- 6 (3%) serious injury crashes.
- 45 (23%) minor injury crashes.
- 142 (74%) non-injury crashes.
- Crash numbers by crash type:
- 38 (20%) overtaking crashes.
- 64 (33%) straight road lost control / head on crashes.
- 20 (10%) bend – lost control / head on crashes.
- 52 (27%) rear end / obstruction crashes.
- 17 (9%) crossing / turning crashes.
- 2 (1%) miscellaneous crashes.
- 0 pedestrian related crashes.

The safe system approach acknowledges that people make mistakes and are vulnerable in a crash. While mistakes are inevitable, deaths and serious injuries from road crashes are not. Notably, the majority of the crashes (97%) did not result in serious injuries or deaths.

Two out of the six serious crashes occurred along Mill Road at the Bombay Interchange and involved turning and failing to give way to straight oncoming vehicle. Three of the six crashes occurred along SH1 between Ramarama and Bombay and the remaining serious crashes occurred along SH1 just south of Quarry Road. Two crashes involved motorcyclists, which are a vulnerable road user type and more susceptible to serious injuries compared to other private vehicles.

Most crashes were loss of control or head-crashes on straight sections of road which is not unexpected for the Auckland Motorway network environment due to the high-speed environment. The low number of losing control at a bend, turning or crossing related is expected as SH1 is mostly straight. There are no pedestrian crashes recorded as pedestrians are not permitted on the motorway.

[3] Two serious crashes are reported during this period one northbound and one southbound, north of the Bombay interchange where a significant grade change is present. The northbound incident involved a motorbike losing control into the central median barrier. The southbound incident involved a car being side swiped by a truck changing lanes.

Furthermore, a relatively significant proportion of crashes have occurred at the Ramarama and Bombay interchanges with 12% and 27% of total crashes respectively. This is relatively large percentage considering the search area covered a large area.

The location of the highest number of crashes other than at the Bombay Interchange is along SH1 to the south of the Quarry Road overbridge to the Ramarama Interchange, with a total of 51 crashes (26% of total).

5.2.6 Pedestrian and cycle facilities

There are no pedestrians and cyclist facilities along the SH1 corridor within the Project area. Pedestrian and cycle movements within the Project area are concentrated on a few local roads in the vicinity of the interchanges. The facilities that do exist include:

- Ramarama Interchange: Limited footpaths with no pedestrian connectivity over the Ararimu overbridge and no cycle facilities.
- Bombay Interchange: Limited footpaths with no pedestrian connectivity over the Mill Road overbridge and no cycle facilities.

Overall, there are currently very limited pedestrian amenities and connectivity in the project area.

5.2.7 Public transport facilities

There are currently no public transport facilities along the motorway in the vicinity of the Stage 2 Project area. The closest bus routes to the Project area are route 376 that travels between Papakura to Drury and route 394 which is the replacement bus service for the Papakura to Pukekohe rail service.

The Southern Rail Line passes through the Project area en route from Drury to Pukekohe. The line is currently closed due to being upgraded to electrification.

5.2.8 Freight

The Southern Motorway serves as a crucial corridor for freight traffic moving between Auckland and the Waikato (and further south). According to data from NZTA's Traffic Monitoring System (TMS) for the year 2022, Heavy Commercial Vehicles (HCV)s were approximately 13 percent of the total vehicles on the motorway between Drury and Ramarama interchanges, with a slightly lower proportion of around 12 percent between Ramarama and Bombay interchanges. Consequently, this translates to an average annual daily two-way traffic volume of approximately 7,300 HCVs between Drury and Ramarama interchanges and 6,000 between Ramarama and Bombay interchanges.

There are key freight generators near the Project area, that include

- Quarries at
- Hunua Road east of SH1 north of Drury
- Quarry Road east of SH1 in between Drury and Ramarama
- Ridge Road west of SH1, south of Bombay
- McPherson Road on SH2, southeast of Bombay.
- Industrial areas in the vicinity of Quarry Road between Drury and Ramarama (light and heavy industry zone)

5.3 Future Transport Network (without Project)

The Te Tupu Ngātahi Supporting Growth Alliance (SGA) is a collaboration between NZTA and Auckland Transport to investigate and plan transport projects needed to support Auckland's future urban growth areas over the next 30 years[4].

South Auckland has been earmarked for future urban growth, and it is expected that the population could increase by 120,000 people by 2046[5] in communities in Takaanini, Ōpāheke, Drury, Paerata and Pukekohe. Further details on the location of future land use changes are provided within **Appendix A.**

Growth in South Auckland will be enabled by the Drury-Opaheke Structure Plan released in April 2019. The plan outlines Council's strategic direction for growth in the area, which will occur when Future Urban Zone land will become urbanised. The plan shows the arrangement of various land uses and infrastructure. Accordingly, it is heavily interlinked with the SGA.

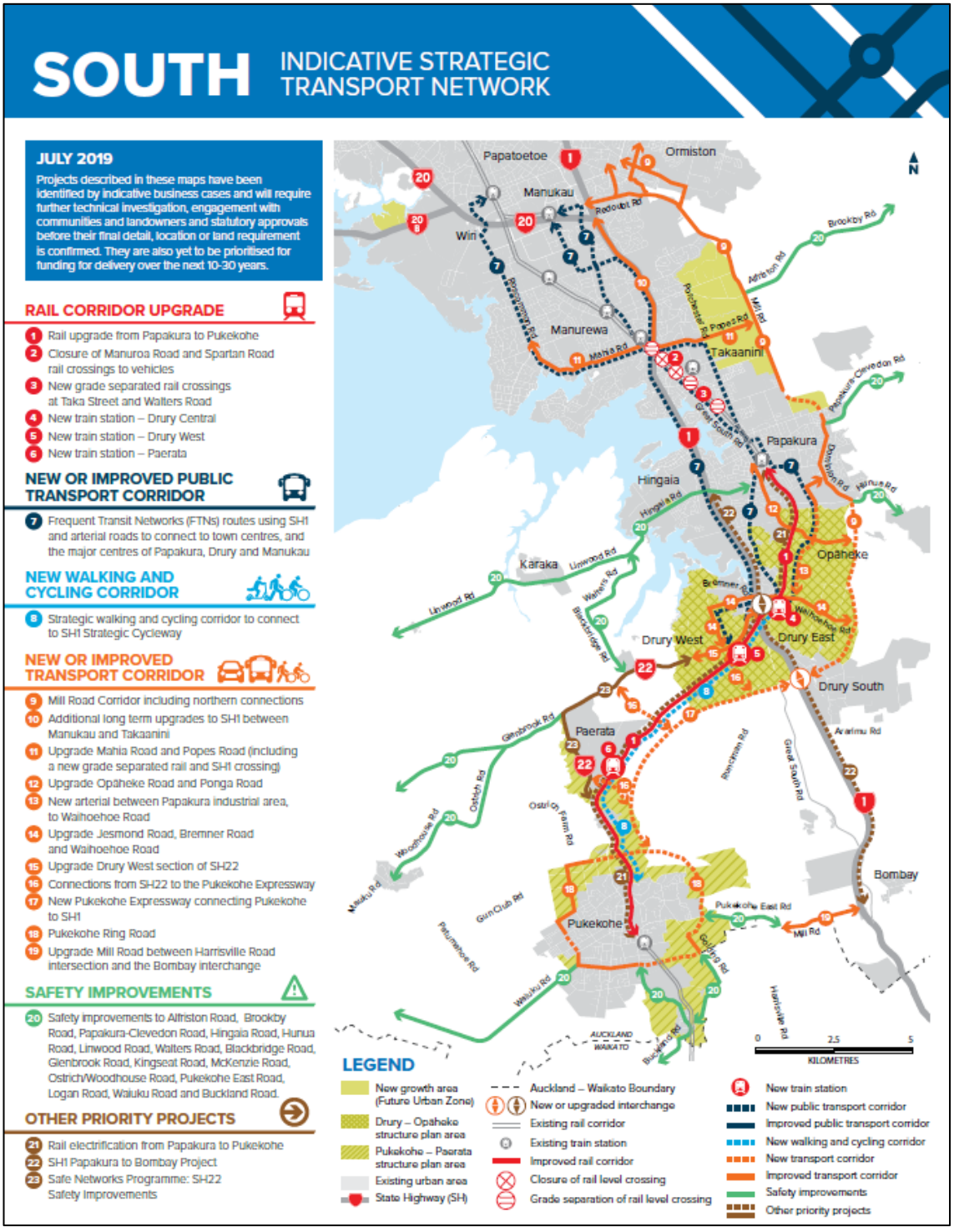
An indicative strategic transport network to support South Auckland (SGA Network) has been released by Auckland Transport and NZTA[6]. The network includes

- Ongoing investment in the rail network and Frequent Transit Networks (FTN)
- A walking and cycling network
- Safety upgrades and improvements to the roading network, including on key rural routes
- Proposed new strategic routes including the Mill Road Corridor and an alternative route to Pukekohe, alongside other state highway upgrades

A map of the proposed SGA Network is shown in Figure 5-9.

[4] https://www.supportinggrowth.govt.nz
[5] https://www.supportinggrowth.govt.nz/growth-areas/pukekohe-paerata-and-south-drury/
[6] https://www.supportinggrowth.govt.nz/assets/supporting-growth/docs/South-Auckland/Indicative-Network-2019-Maps-South.pdf

Figure 5-9: Supporting Growth Alliance – Proposed South Auckland Network



5.3.1 Road Network Upgrades

A series of upgrades to the road network is proposed in South Auckland. The majority of these are part of the SGA Network. The projects that have direct linkages to the Project include:

- South Drury Connection linking in with the South Drury Interchange, which is part of this Stage 2 P2B project. It will connect with the Drury West Arterial and the Drury to Paerata Link to the west.
- Mill Road (Drury Section). This will extend from Hunua Road in the north to the new Drury South Interchange.

- Mill Road (Bombay)

The series of upgrades will provide increased connectivity of the road network, which will help accommodate the future growth anticipated in the area. These upgrades will also enable improvements to the public transport and walking and cycling networks.

At a more local level, NZTA is planning to introduce traffic signals at the existing Bombay interchange in 2024. Initial traffic modelling tests indicate that these signals (without extra lanes) will have limited capacity, but they will enable the queues at the interchange to be managed, with greater priority to be given to vehicles exiting the northbound off ramp, which is predicted to be an issue in the weekday evening peak.

5.3.2 Public Transport Upgrades

5.3.2.1 Rail Network

Upgrades to the rail network are proposed as part of the SGA Network[7]. These changes include

- Electrification and capacity upgrades of the Southern Line between Papakura and Pukekohe.
- Three new railway stations at Drury East, Drury West and Paerata.
- Grade separation of existing level rail crossing at Taka Street and Walters Road.
- Closure of existing level rail crossings at Manuroa Road and Spartan Road.

The upgrades aim to increase the capacity and efficiency of the rail network. They also aim to provide opportunities for freight and passenger rail to operate more independently from each other. The new stations will provide future residents and commuters in Drury with rail connectivity to areas north of Auckland.

5.3.2.2 Frequent Transit Networks

An FTN is proposed as part of the SGA Network[8]. FTNs include public transport routes with minimum frequencies of 15 minutes in both directions between 7am and 7pm, seven days a week. Priority measures are usually implemented to ensure that FTN routes are not prone to congestion. The FTN that is nearest to the Project is the Ōpāheke North-South FTN Arterial which is from Hunua Road in the north to Waihoehoe Road in the south.

In addition to rail, the proposed FTN routes will aim to provide passengers with the choice to travel to reach a wide range of destinations without needing to plan connections in advance.

5.3.3 Walking and Cycling Upgrades

A new strategic walking and cycling corridor is proposed as part of the SGA Network. The corridor is proposed to connect Drury with Pukekohe alongside the alignment of the railway corridor. At Drury, this new walking and cycling corridor will connect with the proposed shared path along SH1.

New walking and cycling connections are likely to be provided as part of the arterial road improvements proposed for Drury, including Bremner Road. Furthermore, on-road cycle lanes and shared path facilities are proposed as part of the Mill Road corridor upgrade[9]. These facilities will enable active mode trips to be made within the local Papakura and Drury networks.

[7] https://www.supportinggrowth.govt.nz/assets/supporting-growth/docs/South-Auckland/Southern-Stations-and-Electrification-to-Pukekohe.pdf
[8] https://findoutmore-supportinggrowth.nz/south-frequent-transit-network/great-south-road-frequent-transit-network-ftn
[9] https://www.nzta.govt.nz/planning-and-investment/nz-upgrade/nzup-regional-projects/auckland-package/nzup-south-auckland-projects/mill-road/

5.3.4 Future Traffic Demands

Forecast daily traffic flows, for the Base (2016) traffic model and the 2038 and 2048 Future Reference Case, are summarised in Table 5-5. The locations of the roads outlined in the table are depicted in Figure 5-10, with Figure 5-11 showing a more detailed map around Drury and Ramarama.

Table 5-55: Base (2016) and 2038, 2048 forecast daily traffic flows, without Project (two way, vehicles/day)

ROAD	2016, BASE	2038, FUTURE REF CASE	DIFFERENCE from 2016	2048, FUTURE REF CASE	DIFFERENCE from 2016
1. SH1 (north of Papakura Interchange)	67,500	154,500	+87,000	159,000	+91,500
2. SH1 (south of Park Estate Road)	55,750	128,000	+72,250	135,250	+79,500
3. SH1 (south of Drury Interchange)	40,000	90,250	+50,250	100,750	+60,750
4. SH1 (south of New Drury South Interchange)	40,000	90,250	+50,250	100,750	N/A
5. SH1 (south of Ramarama Interchange)	36,750	90,250	+53,500	104,250	+67,500
6. Great South Road (south of Park Estate Road)	11,000	18,000	+7,000	20,500	+9,500
7. Great South Road (west of Pitt Road)	2,000	10,500	+8,500	14,250	+12,250
8. Great South Road (south of Quarry Road)	1,750	6,500	+4,750	9,500	+7,750
9. Great South Road (south of Waimanu Awa Road)	750	7,500	+6,750	11,250	+10,500
10. Mill Road extension (south of Hunua Road)	N/A	15,500	N/A	22,500	N/A
11. Mill Road extension (south of Waihoehoe Road)	N/A	10,250	N/A	18,500	N/A
12. Pukekohe Arterials (west of New Drury South Interchange)	N/A	N/A	N/A	N/A	N/A
13. SH22 (west of Drury Interchange)	20,750	33,750	+13,000	37,750	+17,000
14. SH22 (west of Oira Road)	19,000	23,000	+4,000	25,000	+6,000
15. SH22 (north of Heights Road)	14,750	20,250	+5,500	24,000	+9,250
16. Bremner Road (east of Victoria Street)	1,000	16,500	+15,500	19,250	+18,250
17. Bremner Road (west of Victoria Street)	1,000	18,000	+17,000	20,500	+19,500
18. Mill Road extension (at Drury South Interchange)	N/A	N/A	N/A	N/A	N/A
19. Quarry Road (east of Great South Road)	1,500	9,500	+8,000	12,750	+11,250
20. Mill Road (Pukekohe, west of Bombay Interchange)	16,000	31,250	+15,250	30,250	+14,250
21. Maketu Road (north of Ararimu Road)	0	19,500	+19,500	23,250	+23,250
22. Pukekohe Arterials (west of Burtt Road)	N/A	15,250	N/A	20,750	#N/A
23. Burtt Road (east of SH22)	3,000	6,500	3,500	9,500	6,500
24. Linwood Road (east of Hingaia Road)	10,750	24,500	13,750	28,750	18,000

Figure 5-10: Wider Southern Network SATURN model Map from Papakura to Bombay Interchange

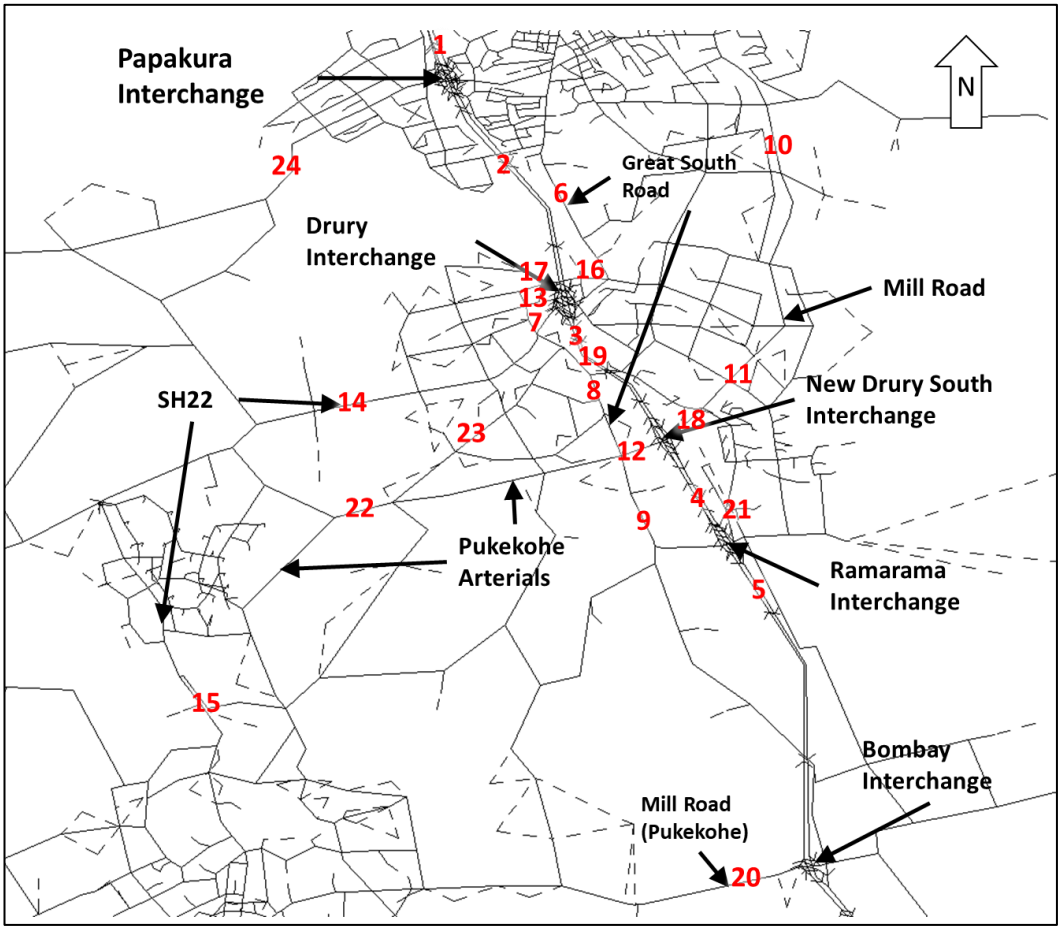
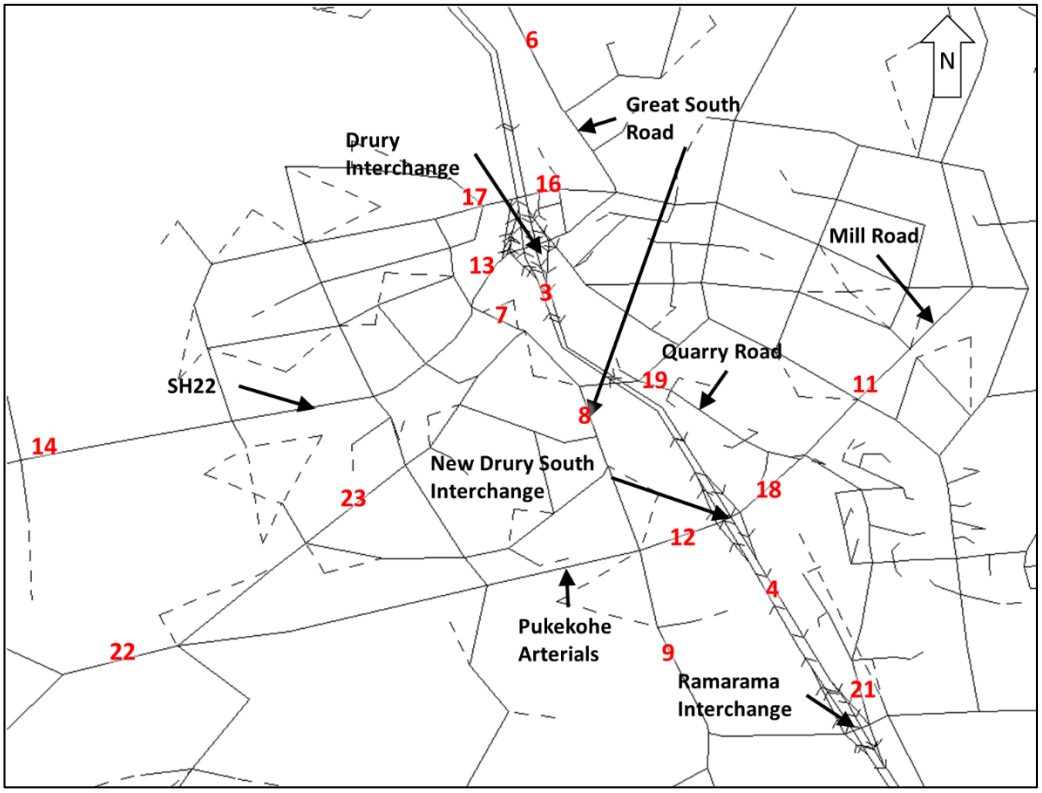


Figure 5-11: Zoomed in SATURN model Map around Drury and Ramarama Interchange



These forecasts indicate significant increases in flows, due to the anticipated land use changes. For example, the two way flow on SH1 south of Drury is predicted to increase from 40,000 vehicles/day in 2016 to around 90,000 by 2038.

The above increases in flows are predicted to have the following effects on travel times along SH1.

Table 5-66: Modelled travel times on SH1, Base (2016) model and Future Reference Cases (2038) (mm:ss), between south of Papakura Interchange and south of Bombay Interchange

TIME PERIOD AND DIRECTION	NORTHBOUND			SOUTHBOUND		
	2016	2038 FUTURE REF CASE	CHANGE	2016	2038 FUTURE REF CASE	CHANGE
Morning Peak	10:45	15:30	+4:45	10:30	11:40	+01:10
Inter Peak	10:45	14:25	+03:40	10:40	13:30	+02:50
Evening Peak	10:55	14:50	+03:55	11:45	19:20	+7:35

The above table indicates that travel times along the motorway are generally predicted to increase when compared to the 2016 base model, particularly northbound in the morning peak and southbound in the evening peak. It should be acknowledged that the 2016 Base model reflects the situation prior to the provision of the additional capacity offered by the SCI project, and these works are now complete.

The above changes in travel times can be explained by examining the base and forecast hourly traffic flows along SH1, as shown in 5-7 and Table 5-88-8 below. These tables provide both the demand and arrival flows:

- The demand flows reflect the numbers of vehicles that wish to pass along the route, per hour
- The arrival flows represent the flows that can actually get through. Where there is congestion, these arrival flows are lower than the demand flows

The traffic model assumes a capacity of about 2,000 vehicles per lane per hour. Therefore, where the arrival flows are greater than 4,000 vehicles/hour on a two lane section of the motorway, or 6,000 vehicles/hour on a three lane section, this indicates that demand has reached or exceeded capacity. The extent to which capacity is predicted to be exceeded can be derived from the demand flows.

Table 5-77: 2016 and 2038 Forecast Peak Hour Demand and Arrival Traffic Flows for Future Reference Case

		Demand Flows				Arrival Flows			
	ROAD	2016 BASE CASE		2038 FUTURE REFERENCE CASE		2016 BASE CASE		2038 FUTURE REFERENCE CASE	
		NORTHBOUND	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**
Morning Peak	Takanini to Hill Road	4,000	2,900	6,900	5,300	3,800	2,900	6,000	5,300
	Papakura to Takanini	3,800	2,700	6,400	5,400	3,600	2,700	6,400	5,300
	Drury to Papakura	2,400	2,300	5,000	4,600	2,400	2,300	5,000	4,500
	South of Drury to New Drury South Interchange	1,900	1,600	3,400	3,200	1,900	1,600	3,400	3,200
	New Drury South Interchange to Ramarama Interchange	1,900	1,600	3,400	3,200	1,900	1,600	3,400	3,200
	Ramarama to Bombay	1,700	1,500	3,500	3,100	1,700	1,500	3,500	3,100
	South of Bombay Interchange	1,400	1,300	2,600	2,500	1,400	1,300	2,600	2,500
Evening Peak	Takanini to Hill Road	3,100	4,500	5,000	8,100	3,100	4,200	4,800	6,600
	Papakura to Takanini	2,900	4,000	5,300	8,200	2,900	3,800	5,100	6,600
	Drury to Papakura	2,400	3,400	3,500	4,800	2,400	3,200	3,400	3,900
	South of Drury to New Drury South Interchange	1,700	2,400	4,900	6,500	1,700	2,300	4,700	5,200
	New Drury South Interchange to Ramarama Interchange	1,700	2,400	3,500	4,800	1,700	2,300	3,400	3,900
	Ramarama to Bombay	1,600	2,300	3,400	4,800	1,600	2,200	3,400	4,000
	South of Bombay Interchange	1,600	1,900	2,900	4,100	1,600	1,900	2,900	3,500

Table 5-88: 2038 and 2048 Forecast Peak Hour Demand and Arrival Traffic Flows for Future Reference Case

		Demand Flows				Arrival Flows			
	ROAD	2038 FUTURE REFERENCE CASE		2048 FUTURE REFERENCE CASE		2038 FUTURE REFERENCE CASE		2048 FUTURE REFERENCE CASE	
		NORTHBOUND	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**
Morning Peak	Takanini to Hill Road	6,900	5,300	8,500	6,000	6,000	5,300	6,000	5,900
	Papakura to Takanini	6,400	5,400	7,000	6,100	6,400	5,300	5,100	6,000
	Drury to Papakura	5,000	4,600	4,700	5,200	5,000	4,500	4,500	5,000
	South of Drury to New Drury South Interchange	3,400	3,200	3,700	3,800	3,400	3,200	3,700	3,700
	New Drury South Interchange to Ramarama Interchange	3,400	3,200	3,700	3,800	3,400	3,200	3,700	3,700
	Ramarama to Bombay	3,500	3,100	3,900	3,800	3,500	3,100	3,900	3,700
	South of Bombay Interchange	2,600	2,500	3,100	3,200	2,600	2,500	3,100	3,100
Evening Peak	Takanini to Hill Road	5,000	8,100	5,800	9,300	4,800	6,600	5,600	6,600
	Papakura to Takanini	5,300	8,200	5,900	9,200	5,100	6,600	5,600	6,600
	Drury to Papakura	4,900	6,500	5,500	7,500	4,700	5,200	5,200	5,400
	South of Drury to New Drury South Interchange	3,500	4,800	4,000	5,700	3,400	3,900	3,900	4,100
	New Drury South Interchange to Ramarama Interchange	3,500	4,800	4,000	5,700	3,400	3,900	3,900	4,100
	Ramarama to Bombay	3,400	4,800	4,000	5,700	3,400	4,000	4,000	4,200
	South of Bombay Interchange	2,900	4,100	3,600	5,100	2,900	3,500	3,600	3,700

The above tables indicate that parts of the motorway between the Bombay and Drury interchanges are predicted to be operating at capacity by 2038 in the evening peak and by 2048 in the morning peak.

5.4 Assessment of construction effects

We expect that the traffic management details will be developed through the project delivery phase and will be subject to further assessment, at the time of detailed construction planning. However, we have considered three types of effects during construction:

- Temporary works within the new SUP designation.
- Temporary works along the motorway.
- Construction related traffic.

It is considered that there are available techniques to maintain the safety, efficiency and convenience of road users during the construction period, including

- Physical temporary traffic management devices (e.g. signs and barriers), and
- Traffic demand management strategies, including providing general traveller information and public notifications in advance of the construction period, may encourage motorists to consider alternative routes and bypass the construction zone.

5.4.1 Temporary works within the new SUP designation

We have assumed that:

- The SUP can be constructed without affecting the operation of traffic lanes on the motorway.
- The SUP works at interchanges/overbridges will be either undertaken consecutively with the Project construction works or undertaken separately with a lesser degree of disruption to traffic lanes than what will occur during the Project construction works.

Based on these assumptions, we consider that there will be negligible traffic effects resulting from the construction of the new SUP, beyond what we have identified during the construction within the altered area of Designations 6706, 6700 and 6701.

5.4.2 Temporary works along the motorway

Temporary traffic management will be required on the motorway along the affected sections, this could include narrowing of the existing traffic lanes and reduction in the speed limit. These measures are commonly applied during motorway construction works and these are currently being used during the ongoing Stage 1 works of the P2B project.

5.4.3 Other Temporary works

5.4.3.1 Effects on Motorway Interchanges

At the Ramarama Interchange the existing priority intersection between the northbound onramp, offramp and Ararimu Road will be converted to a roundabout. Minor effects on Ararimu Road can be expected whilst the roundabout is constructed, with temporary traffic management measures being in place and potentially comprising of a reduced 30km/h speed limit and narrower lanes.

To allow the road widening associated with the longer term signalised layout at the Bombay Interchange, temporary traffic management measures can be expected to control traffic. Measures may include a reduced speed limit to 30km/h, narrower lanes or lane closures. Minor delays can be expected during the construction of this improved layout.

5.4.3.2 Effects on Motorway Bridges

The Stage 2 works will require works at three bridges, one which carries Quarry Road over SH1 and the other two that carry the split northbound and southbound SH1 carriageways over Great South Road. The Design and Construction report states that movement across these bridges is to be retained during the construction period. However, the effects on road users can be better understood when details of the construction techniques and activities are determined, later in the project delivery phase.

5.4.4 Construction related traffic

5.4.4.1 Site Office and Construction Yards

The location of the main construction site office and the construction yards are not yet determined.

It is likely that some site accesses will be required from the motorway. This is quite normal for projects of this nature (indeed Stage 1 of the P2B project includes such access points). The location of these access points will need to enable the project construction but will also need to be located in a manner that minimises adverse operational and particularly safety effects.

5.4.4.2 Truck Routing

Heavy commercial vehicle deliveries will predominantly be concentrated on the construction yards, although as noted above, the location of these yards, and therefore the location of the site accesses, are not yet known.

The routing of trucks will need to be considered once the yards have been identified.

5.4.5 Mitigation

The above issues can be expected to form part of a Construction Transport Management Plan, which will seek to minimise the potential adverse effects during the construction of the Project.

5.5 Assessment of operational effects

As outlined above we have developed two traffic models to assess the effects of Stage 2, these are:

- Future Reference Case (Existing Case including Stage 1 consented works, with 2038 and 2048 predicted traffic demands).
- The Project.

The expected performances of the new Drury South, Ramarama and Bombay interchanges has been assessed using SIDRA Intersection and Networks modelling software. We have assessed and modelled the 2048 forecast year with the Project and the detailed outputs are provided in **Appendix C**.

5.5.1 Traffic Effects

5.5.1.1 State Highway traffic volumes

Tables 5-9 and 5-10 below set out the predicted daily flows along the Southern Motorway between the Drury and Bombay interchanges at the years 2038 and 2048.

Table 5-99: 2038 Forecast Daily Traffic Flows, Future Reference Case and with Project (vehicles per day)

ROAD	FUTURE REFERENCE CASE		WITH PROJECT	
	NORTHBOUND	SOUTHBOUND	NORTHBOUND	SOUTHBOUND
South of Drury to New Drury South Interchange	44,900	45,400	53,200	56,100
New Drury South Interchange north facing ramps	N/A	N/A	8,800	10,800
New Drury South Interchange south facing ramps	N/A	N/A	5,500	4,400
New Drury South Interchange to Ramarama Interchange	44,900	45,400	49,900	49,700
Ramarama Interchange north facing ramps	6,100	5,600	5,600	5,200
Ramarama Interchange south facing ramps	6,100	5,600	2,000	2,900
Ramarama to Bombay	44,900	45,300	46,400	47,300
Bombay Interchange north facing ramps	10,400	9,800	11,500	11,100
Bombay Interchange south facing ramps	3,800	3,800	4,300	3,000
South of Bombay Interchange	38,300	39,300	39,100	39,300

Table 5-1010: 2048 Forecast Daily Traffic Flows, Future Reference Case and with Project (vehicles per day)

ROAD	FUTURE REFERENCE CASE		WITH PROJECT	
	NORTHBOUND	SOUTHBOUND	NORTHBOUND	SOUTHBOUND
South of Drury to New Drury South Interchange	50,000	50,700	58,700	62,800
New Drury South Interchange north facing ramps	N/A	N/A	6,900	9,000
New Drury South Interchange south facing ramps	N/A	N/A	6,900	5,600
New Drury South Interchange to Ramarama Interchange	50,000	50,700	58,700	59,300
Ramarama Interchange north facing ramps	4,400	5,200	4,700	5,700
Ramarama Interchange south facing ramps	6,500	6,800	3,200	3,900
Ramarama to Bombay	52,100	52,100	57,200	57,500
Bombay Interchange north facing ramps	9,200	9,300	12,100	12,600
Bombay Interchange south facing ramps	3,900	3,900	4,000	2,800
South of Bombay Interchange	46,800	46,700	49,000	47,700

The above forecasts relate to the scenario with the Pukekohe Arterials. The models have also been run for a 2038 scenario without these arterials, with forecasts set out in **Appendix D**.

The Project is generally predicted to increase daily traffic volumes on SH1 when compared to the Future Reference Case.

5.5.1.2 Travel Times along SH1

The forecast travel times along the motorway in 2038 and 2048, without and with the Project, are summarised in Table 5-11 and Table 5-12.

To ensure comprehensive coverage of the assessment, the analysis extends north of the Project area, capturing the section from the Takanini Interchange to just beyond the Bombay Interchange. This extended scope is designed to effectively capture the primary traffic bottlenecks north of the Drury Interchange as these will impact the Stage 2 Project area.

Table 5-1111: 2038 Forecast SH1 Travel Times, Future Reference Case and with Project (mm:ss), between north of Takanini Interchange and south of Bombay Interchange

TIME PERIOD AND DIRECTION	NORTHBOUND			SOUTHBOUND		
	REF CASE	WITH PROJECT	CHANGE	REF CASE	WITH PROJECT	CHANGE
Morning Peak	27:30	25:47	-01:43	16:20	14:29	-01:51
Inter Peak	18:25	16:13	-02:12	18:43	15:46	-02:57
Evening Peak	17:14	14:27	-02:47	24:57	19:29	-05:58

Table 5-1212: 2048 Forecast SH1 Travel Times, Future Reference Case and with Project (mm:ss), between north of Takanini Interchange and south of Bombay Interchange

TIME PERIOD AND DIRECTION	NORTHBOUND			SOUTHBOUND		
	REF CASE	WITH PROJECT	CHANGE	REF CASE	WITH PROJECT	CHANGE
Morning Peak	47:04	45:43	-01:21	20:18	16:22	-03:56
Inter Peak	25:08	20:50	-04:18	23:12	18:20	-04:52
Evening Peak	22:49	17:34	-05:15	27:42	21:17	-06:25

Cumulative travel time plots are provided in the Figures 5-12 to 5-15 below, covering the 20km from south of the Bombay interchange through to the Takanini interchange.

Figure 5-12: Cumulative Travel Time plot for 2038 Northbound on SH1

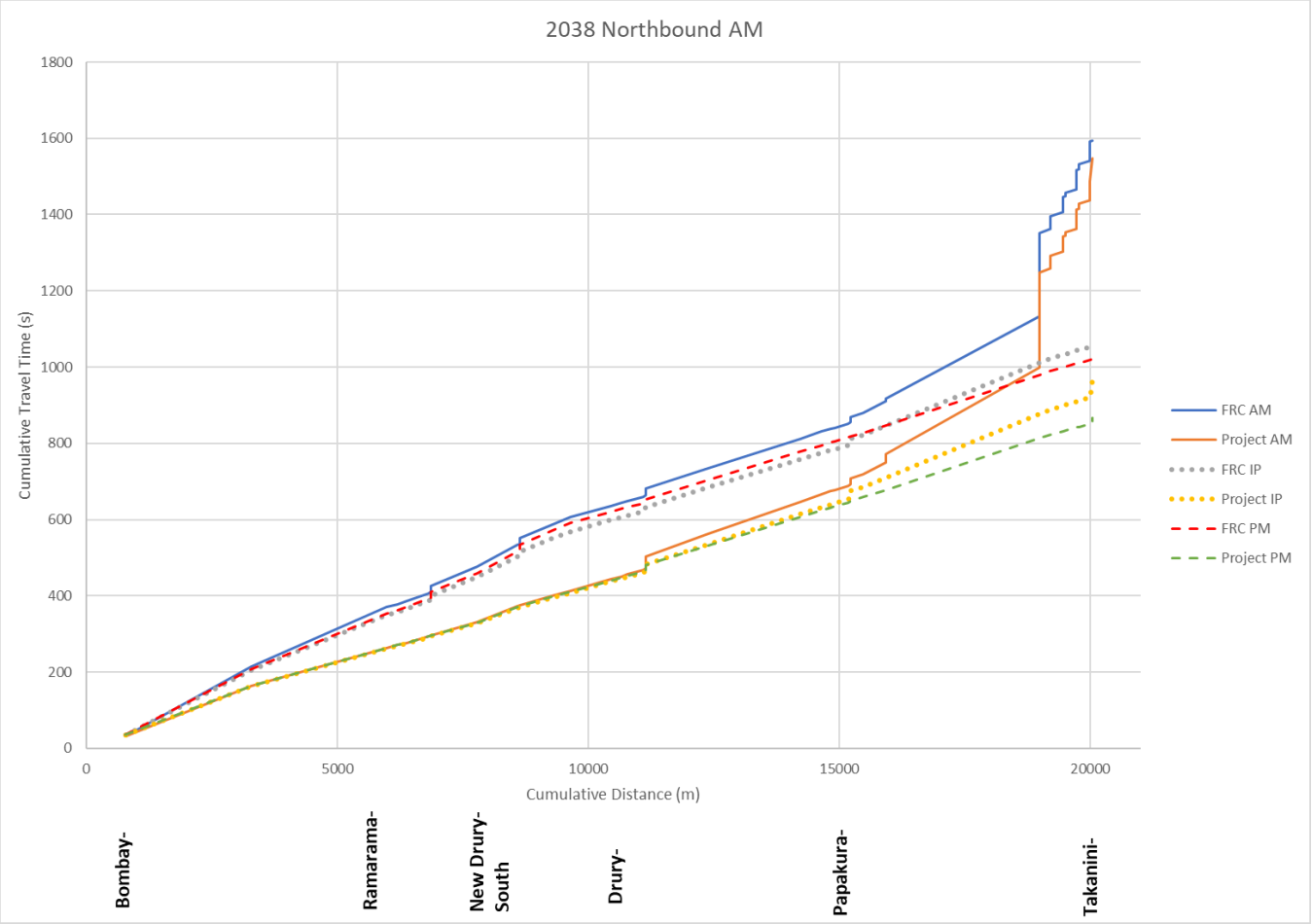


Figure 5-13: Cumulative Travel Time plot for 2038 Southbound on SH1

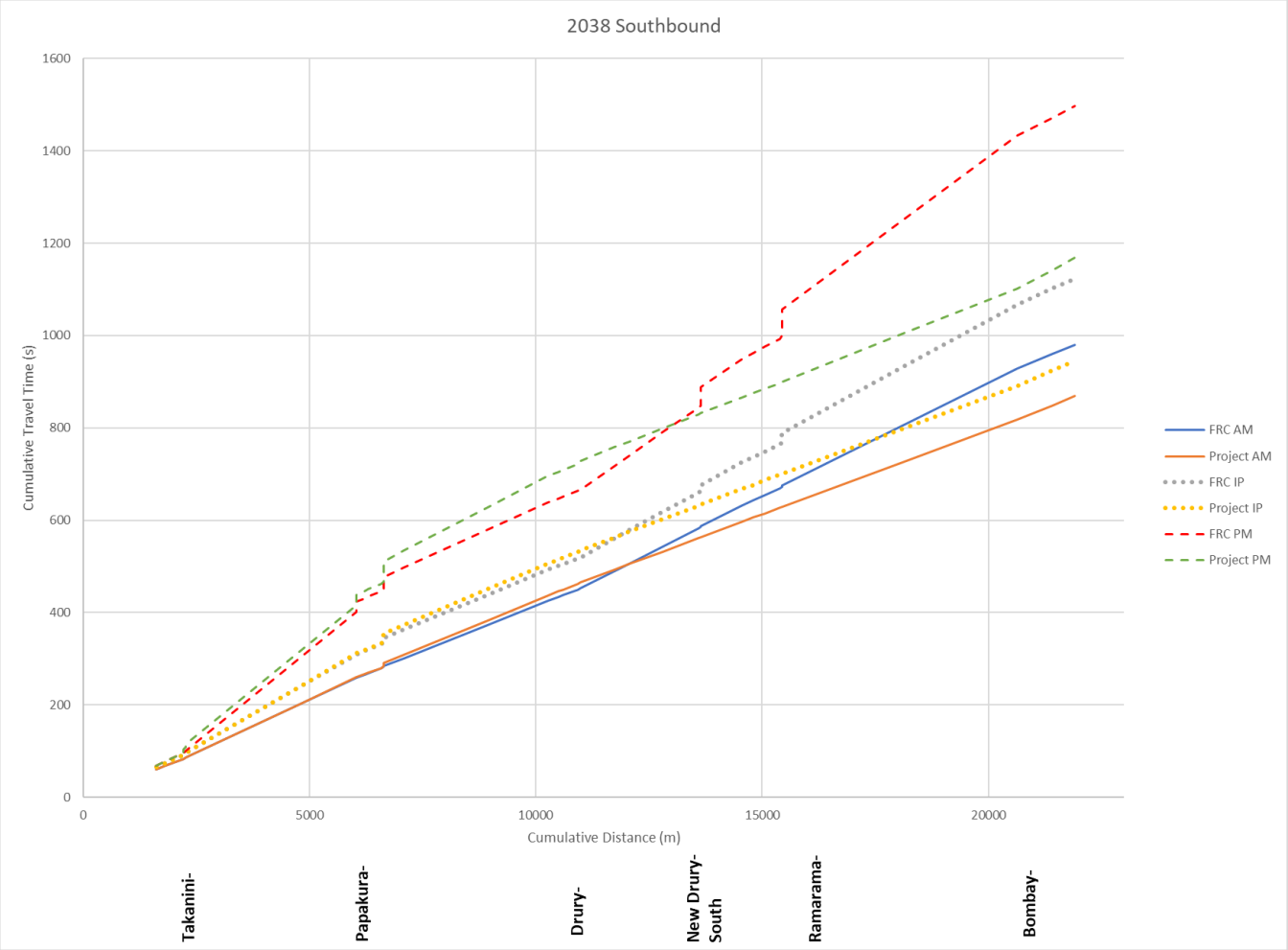


Figure 5-14: Cumulative Travel Time plot for 2048 Northbound on SH1

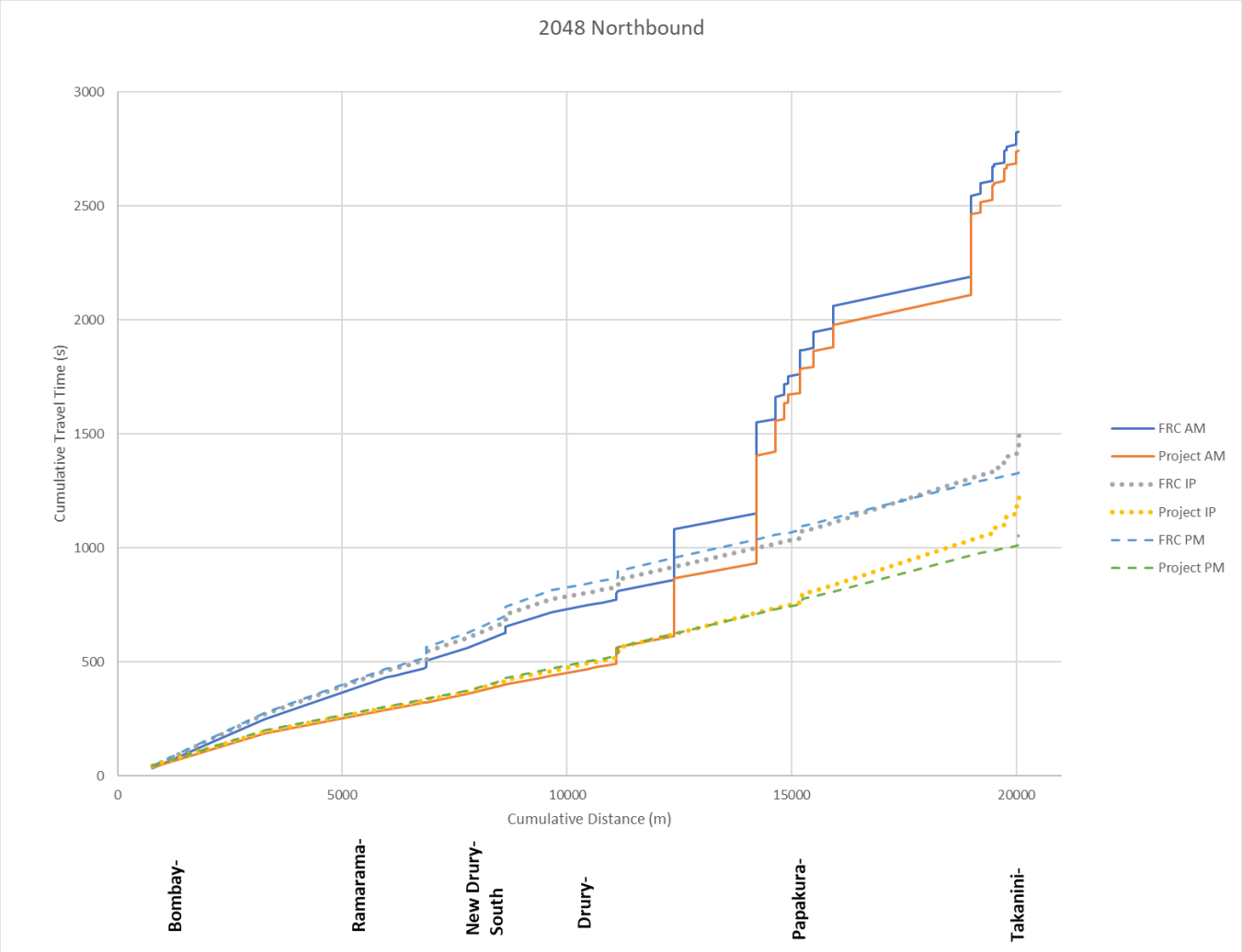
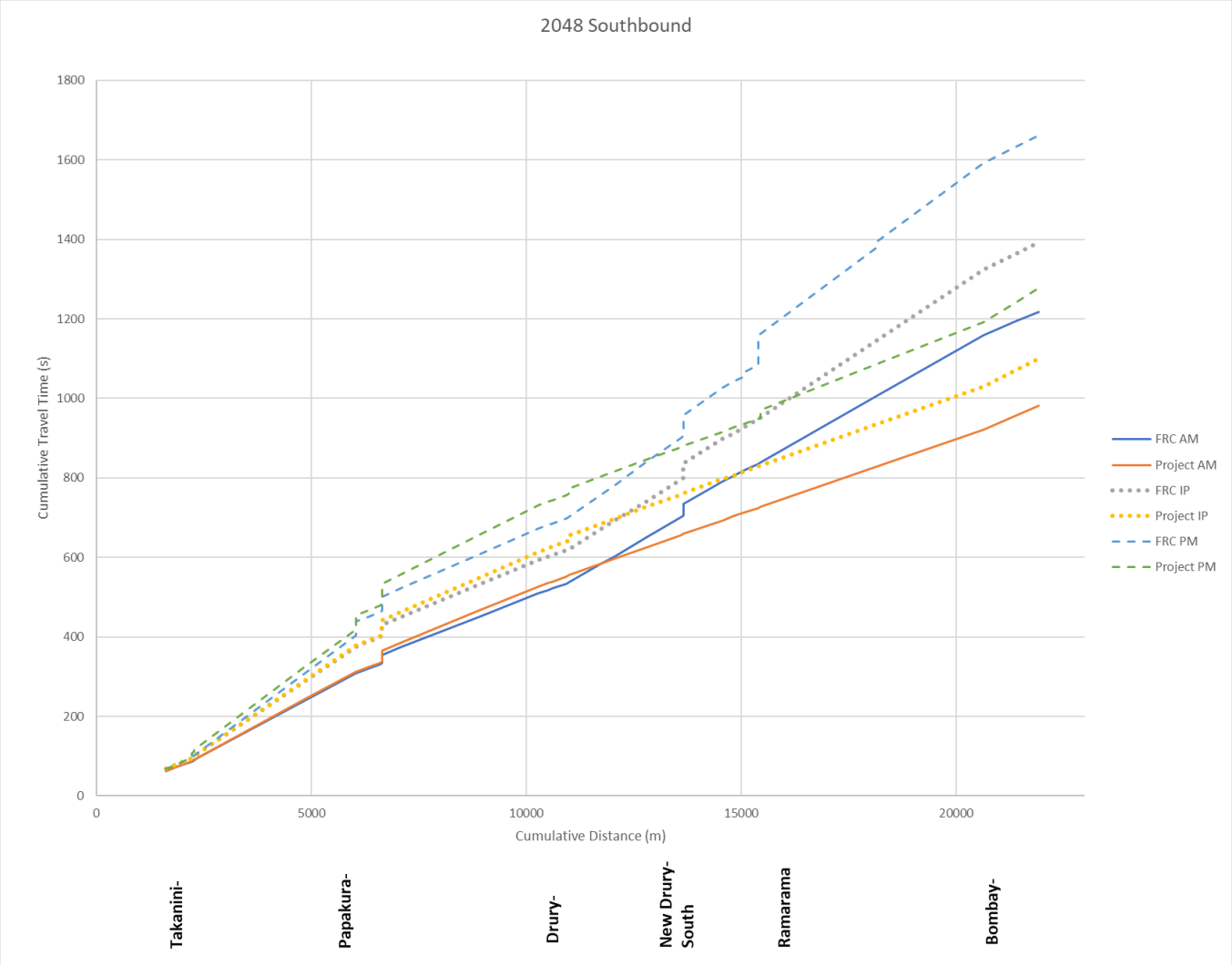


Figure 5-15: Cumulative Travel Time plot for 2048 Southbound on SH1



The above tables and figures indicate reductions in travel times between the Future Reference Case and the Project.

- In 2038, northbound travel time reductions approaching 2 minutes are predicted in the morning peak, with reductions approaching 3 minutes in the evening peak.
- For 2038 southbound similar reductions of almost 2 minutes are predicted in the morning peak, with larger reductions of nearly 6 minutes in the evening peak.
- In 2048, the predicted travel time savings are predicted to be slightly lower southbound in the morning peak, but a larger reduction of around 4 minutes is predicted southbound.
- For the evening peak period, a larger reduction of over 5 minutes is predicted northbound, with a slightly greater reduction of 6 and a half minutes southbound.

The cumulative travel time plots are useful in that they indicate that travel time savings are predicted mainly along the length of the Project from Bombay to Drury, northbound in the morning peak, but the increase in capacity along this section will increase pressure further to the north, where increased congestion is predicted. The net effect is still predicted to be positive.

An explanation for the travel times can be provided via the following tables (Table 5-13 and Table 5-14) which set out the predicted demand flows and arrival flows (vehicles/hour).

The greatest travel times are predicted in the evening peak. The traffic flows able to reach the southbound section of SH1 south from Drury will be sheltered by the capacity bottlenecks to the north, while the increased capacity south from Drury to Bombay will lead to travel time savings, without downstream effects.

The magnitude of travel time savings can be further explained by simple extrapolation of speeds:

- The project covers a length of the motorway of approximately 10km.
- The model predicts average speeds southbound in the evening peak to be about 40kph with the Future Reference Case, and roughly 80 kph with the Project.

The above points indicate that peak travel time savings of over 6 minutes are reasonable.

The lower flows in the inter peak period are predicted to lead to travel time savings of two to three minutes in 2038, increasing to between 4 and 5 minutes by 2048.

Table 5-1313: 2038 Forecast Peak Hour Demand and Arrival Traffic Flows, Future Reference Case and with Project

		Demand Flows				Arrival Flows			
	ROAD	FUTURE REFERENCE CASE		WITH PROJECT		FUTURE REFERENCE CASE		WITH PROJECT	
		NORTHBOUND	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**	**NORTHBOUND**	**SOUTHBOUND**
Morning Peak	Takanini to Hill Road	6,900	5,300	7,000	5,300	6,000	5,300	6,000	5,300
	Papakura to Takanini	6,400	5,400	6,500	5,400	6,400	5,300	6,500	5,300
	Drury to Papakura	5,000	4,600	5,400	4,800	5,000	4,500	5,400	4,700
	South of Drury to New Drury South Interchange	3,400	3,200	4,300	4,000	3,400	3,200	4,200	3,900
	New Drury South Interchange to Ramarama Interchange	3,400	3,200	4,000	3,400	3,400	3,200	4,000	3,300
	Ramarama to Bombay	3,500	3,100	3,700	3,200	3,500	3,100	3,600	3,100
	South of Bombay Interchange	2,600	2,500	2,800	2,600	2,600	2,500	2,800	2,600
Evening Peak	Takanini to Hill Road	5,000	8,100	5,000	8,100	4,800	6,600	4,800	6,600
	Papakura to Takanini	5,300	8,200	5,300	8,300	5,100	6,600	5,200	6,600
	Drury to Papakura	4,900	6,500	5,400	7,100	4,700	5,200	4,900	5,700
	South of Drury to New Drury South Interchange	3,500	4,800	4,100	5,700	3,400	3,900	4,000	4,600
	New Drury South Interchange to Ramarama Interchange	3,500	4,800	3,600	5,200	3,400	3,900	3,600	4,300
	Ramarama to Bombay	3,400	4,800	3,500	5,300	3,400	4,000	3,500	4,400
	South of Bombay Interchange	2,900	4,100	3,100	4,200	2,900	3,500	3,000	3,600

Table 5-1414: 2048 Forecast Peak Hour Demand and Arrival Traffic Flows, Future Reference Case and with Project

		Demand Flows				Arrival Flows			
	ROAD	FUTURE REFERENCE CASE		WITH PROJECT		FUTURE REFERENCE CASE		WITH PROJECT	
		NORTHBOUND	SOUTHBOUND	NORTHBOUND	SOUTHBOUND	NORTHBOUND	SOUTHBOUND	NORTHBOUND	SOUTHBOUND
Morning Peak	Takanini to Hill Road	8,500	6,000	8,400	6,000	6,000	5,900	6,000	5,900
	Papakura to Takanini	7,000	6,100	6,900	6,200	5,100	6,000	5,100	6,000
	Drury to Papakura	4,700	5,200	4,200	5,400	4,500	5,000	4,000	5,200
	South of Drury to New Drury South Interchange	3,700	3,800	3,700	4,600	3,700	3,700	3,700	4,500
	New Drury South Interchange to Ramarama Interchange	3,700	3,800	4,100	4,400	3,700	3,700	4,100	4,300
	Ramarama to Bombay	3,900	3,800	4,300	4,100	3,900	3,700	4,300	4,000
	South of Bombay Interchange	3,100	3,200	3,400	3,300	3,100	3,100	3,400	3,200
Evening Peak	Takanini to Hill Road	5,800	9,300	5,800	9,300	5,600	6,600	5,600	6,600
	Papakura to Takanini	5,900	9,200	5,900	9,300	5,600	6,600	5,700	6,600
	Drury to Papakura	5,500	7,500	5,600	8,100	5,200	5,400	5,400	5,800
	South of Drury to New Drury South Interchange	4,000	5,700	4,800	6,600	3,900	4,100	4,700	4,800
	New Drury South Interchange to Ramarama Interchange	4,000	5,700	4,400	6,100	3,900	4,100	4,400	4,600
	Ramarama to Bombay	4,000	5,700	4,400	6,500	4,000	4,200	4,400	5,000
	South of Bombay Interchange	3,600	5,100	3,800	5,200	3,600	3,700	3,800	4,100

5.5.1.3 Area wide traffic effects of the Project

Figure 5-16 and Figure 5-17 illustrate the forecast changes in daily traffic flows across the wider network resulting from the Project compared to the Future Reference Case. Increases in flows are shown as green bands while decreases are shown as blue bands.

Table 5-151515 below summarises the key forecast differences illustrated in these figures (with flows rounded to the nearest 100 vehicles/day). (The locations of the roads listed in this table were shown on Figure 5-10 and Figure 5-11 earlier in this report).

For the 2038 forecast year, the Project is generally predicted to have the following effects on daily traffic volumes when compared to the Future Reference Case:

- Increases in volumes on SH1 along the Stage 2 Project area due to providing improvements along SH1 and the interchanges.
- Decreases in volumes on SH22 due to users rerouting and using the new Pukekohe Arterials to access the Drury South interchange.
- Decreases in volumes on the parallel Great South Road route due to increases in trips on SH1.
- Increases in volumes on Mill Road parallel to SH1. This is a result of the increases on the new Pukekohe Arterials which will be connected to and beyond the new Drury South Interchange.
- Relatively small increases in volumes on Mill Road (Pukekohe) as a result of the Mill Road and Bombay Interchange upgrades.
- Decreases in volumes on Quarry Road as a result of a decrease in Great South Road as well as the increase on Mill Road.
- Decreases in volumes on Burtt Road as users are using Pukekohe Arterials to access the new Drury South Interchange instead of onto SH22 and Drury Interchange.
- Decreases in volumes on Linwood Road due to decreases on SH22.

For the 2048 forecast year, the notable differences between the Project and the Future Reference Case when compared to 2038 are the following:

- A relatively larger Increase in volumes along the SH1 Stage 2 Project area.
- A relatively larger increase along the Mill Road and Pukekohe Arterials links to the new Drury South interchange.
- A small relative increase in volumes on Mill Road from south of Hunua road and not just near the new Drury South interchange.
- SH22 volume changes are predicted to stay relatively similar.
- A lower increase in volumes is predicted on the Pukekohe Arterials.
- Volumes are predicted to be similar on Great South Road north of Drury. However, a larger decrease is anticipated south of Drury.
- A slight increase in volumes is predicted on Mill Road, Pukekohe, extending towards the Pukekohe town centre in the 2048 model.

Figure 5-16: 2038 daily traffic flow difference plot, Project vs Reference Case

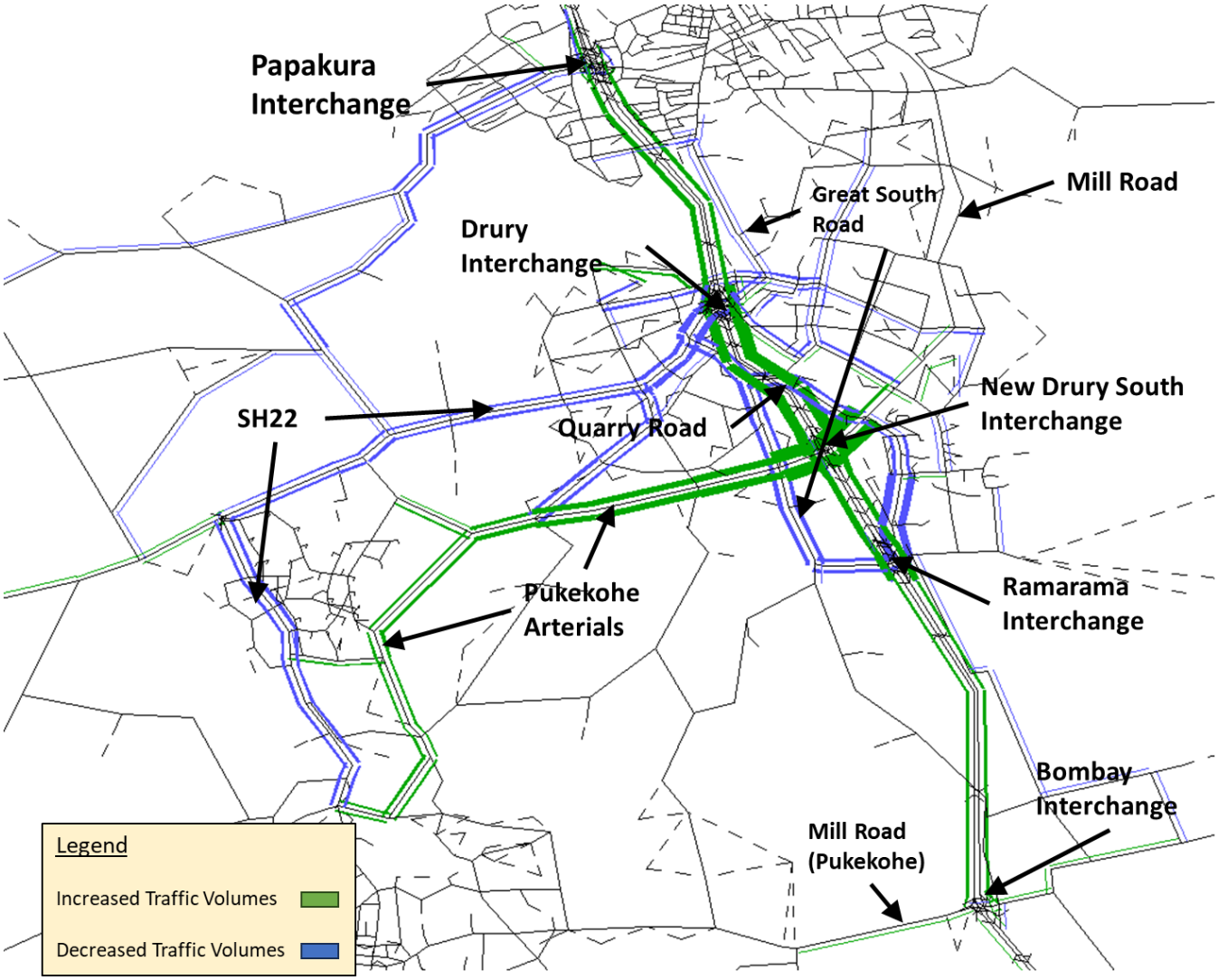


Figure 5-17: 2048 daily traffic flow difference plot, Project vs Reference Case

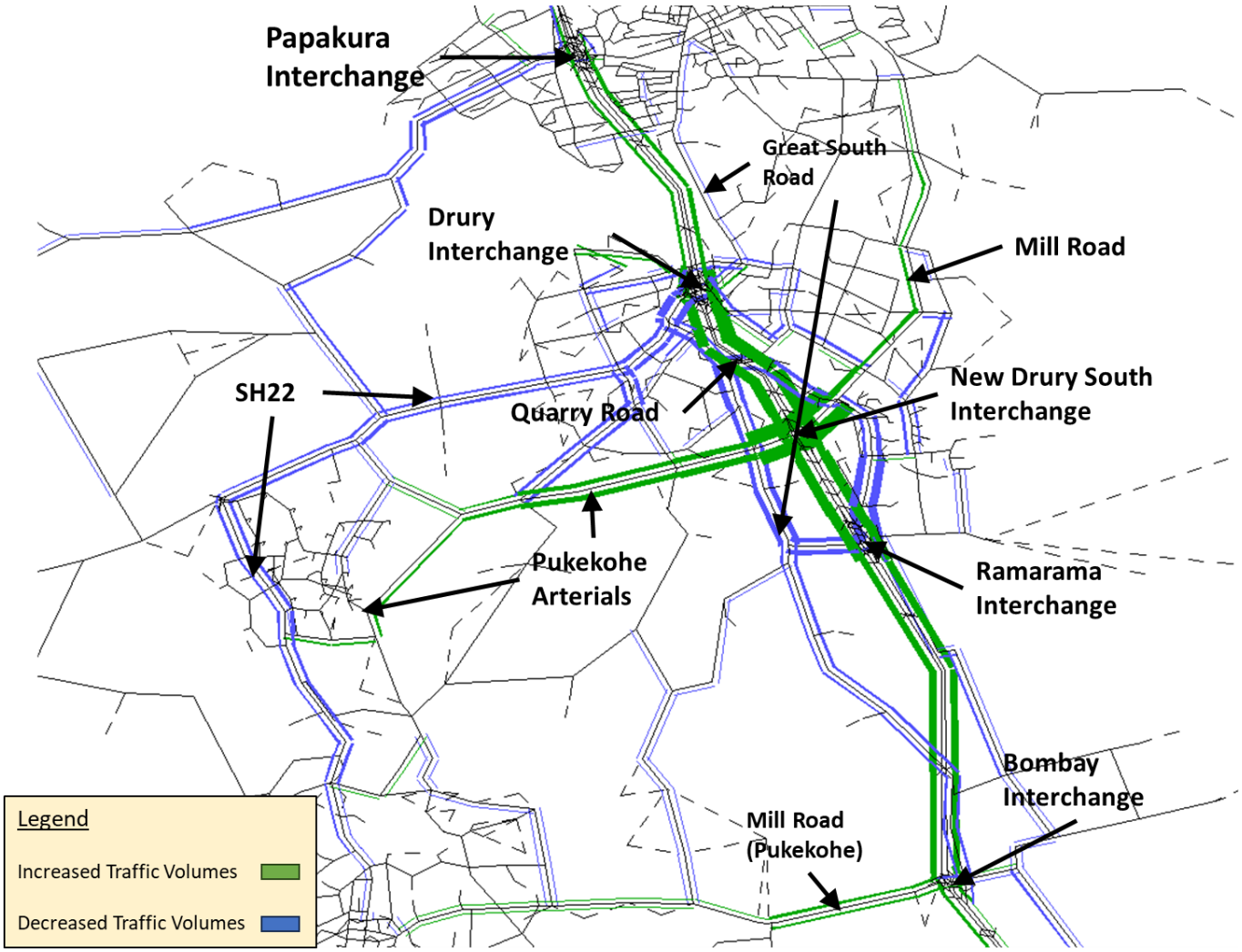


Table 5-1515: 2038 and 2048 forecast daily traffic flows (two way), Project vs Future Reference Case

2038 REF CASE	2038 REF CASE	2038 WITH PROJECT	DIFFERENCE	2048 REF CASE	2048 WITH PROJECT	DIFFERENCE
1. SH1 (north of Papakura Interchange)	154,500	155,250	+750	159,000	160,000	+1,000
2. SH1 (south of Park Estate Road)	128,000	134,750	+6,750	135,250	140,500	+5,250
3. SH1 (south of Drury Interchange)	90,250	109,250	+19,000	100,750	121,500	+20,750
4. SH1 (south of New Drury South Interchange)	90,250	99,500	+9,250	100,750	118,000	+17,250
5. SH1 (south of Ramarama Interchange)	90,250	93,750	+3,500	104,250	114,750	+10,500
6. Great South Road (south of Park Estate Road)	18,000	16,250	-1,750	20,500	19,500	-1,000
7. Great South Road (west of Pitt Road)	10,500	5,250	-5,250	14,250	9,000	-5,250
8. Great South Road (south of Quarry Road)	6,500	1,500	-5,000	9,500	3,250	-6,250
9. Great South Road (south of Waimanu Awa Road)	7,500	2,250	-5,250	11,250	3,750	-7,500
10. Mill Road extension (south of Hunua Road)	15,500	15,500	+0	22,500	23,000	+500
11. Mill Road extension (south of Waihoehoe Road)	10,250	13,500	+3,250	18,500	21,000	+2,500
12. Pukekohe Arterials (west of New Drury South Interchange)	0	24,500	+24,500	0	27,750	+27,750
13. SH22 (west of Drury Interchange)	33,750	22,500	-11,250	37,750	26,500	-11,250
14. SH22 (west of Oira Road)	23,000	19,500	-3,500	25,000	22,000	-3,000
15. SH22 (north of Heights Road)	20,250	17,000	-3,250	24,000	20,750	-3,250
16. Bremner Road (east of Victoria Street)	16,500	15,000	-1,500	19,250	17,500	-1,750
17. Bremner Road (west of Victoria Street)	18,000	18,000	+0	20,500	20,000	-500
18. Mill Road extension (at Drury South Interchange)	0	25,500	+25,500	0	29,500	+29,500
19. Quarry Road (east of Great South Road)	9,500	3,250	-6,250	12,750	5,000	-7,750
20. Mill Road (Pukekohe, west of Bombay Interchange)	31,250	32,250	+1,000	30,250	34,000	+3,750
21. Maketu Road (north of Ararimu Road)	19,500	7,500	-12,000	23,250	10,750	-12,500
22. Pukekohe Arterials (west of Burtt Road)	15,250	21,250	+6,000	20,750	24,500	+3,750
23. Burtt Road (east of SH22)	6,500	2,000	-4,500	9,500	4,000	-5,500
24. Linwood Road (east of Hingaia Road)	24,500	21,250	-3,250	28,750	25,250	-3,500

Appendix D includes a sensitivity test on the effects of excluding the Pukekohe Arterials upgrades and the completed Mill Road route in 2038, as these are projects that are proposed but not yet committed.

5.5.1.4 Operation of Motorway Interchanges

The future operation of the three motorway interchanges covered by the Project has been assessed using SIDRA, taking the forecast flows from the 2048 SATURN models with the Project.

The following paragraphs refer to the maximum degree of saturation at each of the three intersections. An intersection predicted to be operating with a degree of saturation of 100% is said to be operating at theoretical capacity. However, conditions tend to deteriorate before this figure is reached, and an intersection operating at around 85% to 90% is said to be at practical capacity.

It should be noted from the earlier sections of this report that the 2048 scenario assumed for these SIDRA models include significant land use change and therefore significant traffic growth in South Auckland. Therefore, an upgraded layout that is predicted to be operating at or around practical capacity should not necessarily be seen as unacceptable, particularly as NZTA does not adopt a "predict and provide" approach to "resolve" areas of predicted congestion.

5.5.1.4.1 Drury South Interchange:

The proposed layout of the interchange will be a typical dumbbell layout with the on and off ramps intersecting at two roundabouts on the new Drury South Connections as detailed in Section 7. The east approach will be a new connection to Mill Road, while the west approach will connect to Great South Road. Each roundabout will incorporate two circulating lanes and two lanes on each approach.

Grade separated pedestrian and cyclist facilities will be provided throughout the interchange, including connections with the SUP.

The modelling indicates that the operation of the New Drury South Interchange with the Project will have the following outcomes:

- The Great South Road/Pukekohe Arterials roundabout is predicted to operate well within capacity. In the morning peak period, the worst approach is predicted to be the Pukekohe Arterials west approach with a Degree of Saturation of 47%. For the evening peak period, the roundabout is predicted to perform slightly worse, with the worst movement being the right turn from the Great South Road southern approach, with a Degree of Saturation of 54%.
- The interchange roundabouts are predicted to be approaching capacity by 2048. In the morning peak period, the worst performing location is predicted to be traffic coming from the Great South Road/Pukekohe Arterials roundabout on the western approach at the northbound roundabout. This approach is predicted to be operating with a Degree of Saturation of 85%. Similarly for the evening peak period, the worst congestion is predicted to be for traffic coming from the new Mill Road link, at the southbound roundabout on the east approach. This approach is predicted to be operating with a Degree of Saturation of 86%.
- Queues are not predicted to extend back onto SH1, nor to the Great South Road/Pukekohe Arterials roundabout or Mill Road in all cases.

5.5.1.4.2 Ramarama Interchange

A number of changes are proposed for the Ramarama Interchange. Specifically, the existing northbound on and off-ramps, which currently form a priority-controlled intersection with Ararimu Road, will be replaced with a roundabout with one lane on each approach.

The existing southbound on and off-ramps will remain largely unchanged. Grade separated pedestrian and cyclist facilities will be provided throughout the interchange and linking with the SUP. A new pedestrian and cyclist crossing provided on the Maketu Road.

The modelling indicates that the operation of the Ramarama Interchange with the Project will have the following outcomes:

- During the morning peak period, the interchange is expected to operate efficiently with adequate capacity. In the morning peak period, the worst approach is predicted to be the SH1 northbound off-ramp with a Degree of Saturation of 55%.
- The situation differs during the evening peak period, where the interchange is predicted to be nearing capacity by 2048, At the eastern roundabout the Ararimu Road east approach is predicted to operate with a Degree of Saturation of 78%, while the north Maketu Road approach is predicted to operate with a Degree of Saturation of 93%. This is mainly due to the relatively high volumes from the large industrial area in-between Ramarama and Drury. These users will head onto SH1 southbound via Maketu Road.
- Queues are not predicted to extend back onto SH1 in all cases.

5.5.1.4.3 Bombay Interchange

The Project introduces a number of modifications to the Bombay Interchange:

- Currently, the off ramp intersections at the interchange are priority controlled and adjacent to the interchange there are motorway service areas on both the east and west side of the interchange also with priority control.
- It is proposed to convert these priority-controlled intersections to traffic signal control during 2024. This will largely be signalisation of the existing layout, with no additional traffic lanes. This interim layout will allow queues to be managed, particularly those on the southbound off ramp, but the layout will not be sufficient to accommodate future traffic demands.
- As part of Stage 2 of the P2B project, the Mill Road overbridge will be widened to two lanes in each direction. Also, the southbound off ramp will be widened to provide two right turn lanes. Signalised pedestrian crossings will also be incorporated at the signalised approaches which will provide connectivity with the new SUP, and the Great South Road/Mill Road roundabout immediately to the east will have lane modifications to accommodate the widening of the Mill Road bridge.

The modelling indicates that the operation of the Bombay Interchange with the Project will have the following outcomes:

- The interchange is predicted to be approaching capacity by 2048 during the morning peak period. The worst movements are predicted to be the southbound right turn from the SH1 off-ramp and the eastbound through movement on Mill Road from Pukekohe, with Degrees of Saturation of 85% and 87%, respectively,
- During the evening peak period, the Interchange is expected to operate with a Degree of Saturation of 82% on the southbound right turn from SH1 off-ramp, with a maximum Degree of Saturation of 83% on the northbound off ramp.
- The Mill Road/Great South Road roundabout is predicted to operate efficiently with low delay times and essentially no queues.

5.5.2 Property Access

The project will generally not affect property access, although the Landscape, Visual and Natural Character Effects Assessment (LVA) and Arboricultural Report refer to the need to realign an internal road within the Stephens site.

5.5.3 Effects on Pedestrians and Cyclists

The Project will provide enhanced pedestrian and cycle facilities by providing a SUP alongside the western side of SH1 with connections through the new Drury South, Ramarama and Bombay interchanges to the local road network.

The new SUP and grade separated facilities will improve accessibility at these interchanges for pedestrians and cyclists. At the new Drury South and Ramarama interchanges, grade separated pedestrian and cycle facilities will provide connections to the local road network on both sides of SH1. At the Bombay Interchange the at-grade SUP will be controlled by traffic signals.

A reduction in traffic volumes has a positive effect on pedestrians and cyclists as it will reduce the likelihood of pedestrian and cycle crashes. It is predicted that several adjacent local roads will experience decreases in traffic volumes because of the Project; most notably on SH22, Quarry Road and Great South Road. The specific segments and reductions on the roads are outlined in Section 6.5.

We consider that the traffic effects of the operation of the SUP will be positive by providing existing and future communities along the corridor with additional safe and efficient active mode transport options. The provision of improved facilities for active mode users will also benefit other road users (for example persons in cars and trucks), by reducing demand for private vehicles. Furthermore, it should be noted that more reductions in traffic flows are predicted on the local roads than increases. Ultimately the SUP will allow pedestrians and cyclists to make north-south trips separated from traffic. This in turn will offer health benefits, and decongestion benefits for those trips that change mode (from cars to active modes), and road safety benefits.

Improvements at local roads and SH1 Interchanges

This section provides an overview of the pedestrian and cyclist improvements that will be provided at the SH1 Interchanges and at local road locations as part of the Project.

- Quarry Road Link

A link will be provided between the SUP and Quarry Road. At this location Quarry Road has an intersection with Great South Road immediately to the west of the SUP and to the east Quarry Road passes under SH1 giving access to destinations to the east of SH1. This gives pedestrians and cyclists good access both east and west of SH1 via Great South Road and Quarry Road and in particular will give good access to the southern area of the future growth area in Drury.

- New Drury South Interchange:
  - The new Drury South Interchange will include high levels of accessibility at the interchange for active modes by providing grade separated facilities. This will allow travel by these modes to be carried out safely, with crossing facilities separate from traffic. Linkages between the SUP and the local road network will be provided with a link to Great South Road to the west of SH1 and to the east to the future Mill Road extension.
- Ramarama Interchange

  The project will improve the accessibility at the interchange for active modes by providing new and upgraded facilities. Grade separated facilities will be provided between the SUP on the west side of SH1 to the existing facilities on Ararimu Road on the east side of SH1 and the continuation of the SUP through the interchange will also be grade separated. The SUP connection to Ararimu Road will enable access to Great South Road particularly for cyclists.
- Bombay Interchange
  - The SUP will terminate at the Bombay interchange. The project will improve the accessibility at the interchange for active modes by providing new and upgraded facilities on Mill Road through the intersection.

In summary, the Project will significantly improve facilities for pedestrians and cyclists at Ramarama and Bombay Interchanges as well as provide new facilities at New Drury South Interchange.

5.5.4 Effects on Public Transport

The widening of motorway shoulder will accommodate of potential future buses.

Future buses that use SH1 will experience less delays, improved travel times and overall safer journeys through the Project area. There will be benefits from the project on the future public transport network where traffic volumes are predicted to reduce.

A significant reduction in traffic volumes on SH22 is predicted and buses using this route will benefit from less delays and improved journey time reliability. Currently, there is one bus route (service 394) using SH22 which is a replacement for the rail service between Papakura and Pukekohe. However as future development occurs in the areas between Pukekohe and Drury then there will likely be an increased demand for further bus services to use SH22, and to serve the new rail stations in the area.

The shoulder lanes proposed along SH1 as part of the Project will provide the opportunity for these to be used by buses in the future. This would potentially provide more reliable journey times during times of congestion for any future bus routes that may be part of the bus network along the motorway.

5.5.5 Effects on Freight

The Southern Motorway is one of the Auckland region's primary freight routes, with an average annual daily two-way traffic volume of approximately 7,300 HCVs between Drury and Ramarama interchanges and 6,000 between Ramarama and Bombay interchanges. As such, the Project will provide direct benefits to freight movements by reducing motorway travel times in both directions.

Benefits will also be gained by freight movements on nearby routes that will experience a reduction in traffic volumes, especially SH22 and Great South Road which are predicted to experience reductions in traffic volumes.

The new Drury South interchange will give freight movements an increased route choice and potentially reducing journey times that will be particularly beneficial in the future when future growth occurs around Pukekohe and Drury.

Overall, SH1 will be safer, more resilient, and more efficient for the movement of freight.

5.5.6 Effects on safety

As noted previously, the Project is expected to result in an increase in traffic on SH1 and local arterials leading to the motorway, with corresponding reductions in traffic on parts of the local network. If all other factors are equal, the crash rate could be expected to increase where traffic volumes increase and, decrease where traffic volumes reduce.

Any influence on crash risk on SH1 from the increase in traffic volumes will be offset by the improved geometric layout. The crash risk and level of severity of crashes is expected to reduce, as the Project includes improved safety elements compared to the Reference Case, by:

- Provision of a new 4.0m wide bus shoulder for both directions.
- Replacing the grass median with a fully paved median with 2.5m wide shoulders.
- Improving existing median barriers and edge protection.

The Project is expected to generally reduce traffic volumes on the local road network. This is expected to generally reduce the rate of crashes occurring on the local road network. Reduced traffic congestion can lead to fewer rear-end collisions, which are common in stop-and-go traffic. This decrease in congestion can also result in a safer environment for all road users, including pedestrians and cyclists as mentioned previously.

Conversely, it's important to note that a reduction in congestion, while generally beneficial, may inadvertently lead to higher speeds on the road. This increase in speed carries the risk of more accidents, which may be of higher severity.

- New Drury South Interchange
    - Since the Drury South Interchange is an addition to the road network then it can be expected that the risk of crashes will be greater than the existing environment where the interchange does not exist.
    - The crash risk can be considered to increase due to the presence of the interchange. However, the risk of crashes occurring, and the level of severity are expected to be minimal due to the use of the latest geometric

design standards and the use of a safe systems approach to reduce the severity of crashes when they do occur.

- The roundabout intersections at the end of the off-ramps are predicted to operate within capacity which reduces any likelihood of vehicles queuing on the off-ramps extending back onto the motorway and causing a safety hazard.

- Ramarama Interchange
  - The conversion of the priority-controlled intersection to signal control for the northbound off ramp will improve the safety at the intersection. The roundabout can be expected to have a lower crash rate than the priority control which has a crash history of 3 crashes that were minor and non-injury crashes. The slower speed environment created by the roundabout will reduce the severity of crashes.
  - The crash rate at the intersection will be influenced by the traffic volumes using the intersection. The traffic volumes on Ararimu Road are predicted to decrease which will mean a corresponding decrease in the risk that crashes will occur.
  - Pedestrian and cycle safety will be improved at the interchange with the provision of grade separated facilities resulting in the segregation of pedestrians and cyclists from vehicles and eliminating the risk of crashes between these modes.
- Bombay Interchange
  - This section of Mill Road has a poor crash history with 30 crashes recorded between 2016 to 15th February 2020 and to 2023 up to 15th August. Of the crashes at the interchange 15 crashes were associated with turning manoeuvres and these types of crashes will be reduced by the proposed interim traffic signals which are to be implemented during 2024.

5.5.7 Effects on Emissions

The effects on emissions are assessed within the air quality report and in the overall AEE.

5.5.8 Sensitivity Tests

5.5.8.1 Alternative road network

As stated earlier, the traffic modelling results referred to in this report primarily relate to a scenario that includes the completion of the Pukekohe Arterials and Mill Road projects, and a traffic model run has also been carried out that excludes these two projects.

5.5.8.2 Alternative Growth Scenario

Section 6.3.4 above set out the rate of change in traffic flows, which is predicted to be around 5% per year. This is higher than would normally be expected for many parts of New Zealand, but it reflects the significant land use change that is expected to take place in South Auckland.

The traffic forecasts are based on the most recent version of the MSM, using a land use scenario referred to as I11.6.

Auckland Council has recently approved the Future Development Strategy (FDS, in November 2023). The FDS reconfirmed development in the Paerata and Pukekohe areas, but it removed the Opaheke area from the list of future urban areas.

The MSM has not yet been updated to reflect the recent approval of the FDS, meaning that scenario I11.6 remains the most current modelled forecast. However, clearly the precision of the forecasts for 2038 and 2048 is open to question at this point in time and given the significance of the increases due to land use changes, it should not be

assumed that the forecasts will be achieved within the two specific calendar years of 2038 and 2048, but broadly when the land use forecasts are reached.

5.5.8.3 Induced traffic

The SATURN modelling has assessed fixed vehicle matrices for the without and with Project scenarios, meaning that an assessment of the effects of this single Project in inducing traffic have not been assessed. However, the induced traffic effects of the Project can be expected to be minor, given the capacity bottlenecks on SH1, further to the north.

5.5.8.4 Road pricing

A further uncertainty in the traffic forecasts relates to the possibility of road pricing. This is not a confirmed project at this time, and if it proceeds, it could take place in a variety of formats. Therefore it has not be assumed within the core assumptions. However, if pricing proceeds it could reduce the rate of growth in demands along the motorway corridor.

5.6 Summary and conclusions

In terms of traffic and transport impacts, the Project will bring about positive operational effects. These effects are largely related to travel time reductions and associated reliability benefits along SH1 and a safer and more resilient transport network for vehicle drivers, pedestrians and cyclists.

The transport effects include:

- Safer and better-connected walking and cycling routes by providing new and upgraded facilities for pedestrians and cyclists.
    - A new off-road SUP continuing from Stage 1 (South of Drury Interchange) to Bombay Interchange, which will contain multiple local connection points to new and existing communities.
    - Upgraded facilities at the existing and Ramarama and Bombay Interchanges as well as new facilities as part of the new Drury South Interchange.
    - The enhancements will improve accessibility and safety for active mode users, addressing the current lack of such facilities in the Project area and promoting a shift towards walking and cycling as preferred modes of transport. Furthermore, this will provide more support for future development in the local area.

- Significant improvements in travel times due to the Project, compared to the Future Reference Case. The predicted reductions in travel times on SH1 indicate quicker and more efficient journey times for both northbound and southbound users during peak hours in the years 2038 and 2048.
- Improving the safety and resilience of SH1 through the provision of a range of improvements along SH1, including wider shoulders, enhanced median barriers, wider traffic lanes, and an improved alignment. However, reducing congestion is generally positive but may inadvertently lead to higher speeds, increasing the risk and severity of accidents. However this increase in crash risk will be offset by the improved geometric layout provided by the Project.
- Improved safety through upgrades at the Bombay Interchange. The proposed layout will make the area safer by providing safe footpaths and crossing points for pedestrians and cyclists and improving connectivity. The new layouts will accommodate growing traffic demands, contributing to long-term sustainability.
- Improved safety and efficiency at the Ramarama Interchange. Northbound ramps will intersect at a new roundabout intersection, allowing the interchange to operate more efficiently and safely. This design will reduce conflict areas in terms of merging traffic, reducing delays. Furthermore, roundabouts are associated with lower

crash rates and reduced severity of accidents, as they eliminate high-speed, T-bone collisions typical at stop-controlled intersections.

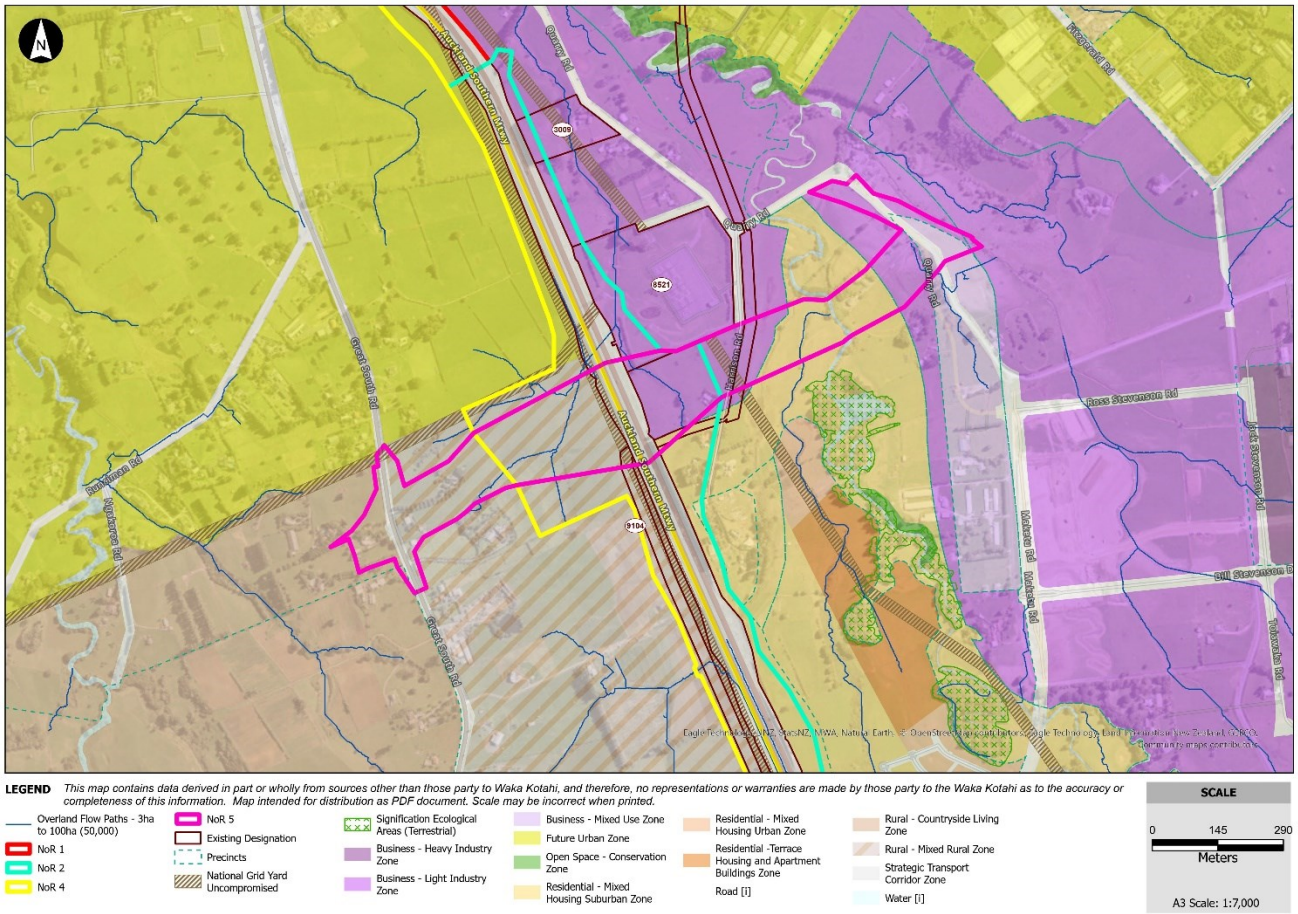
6 ASSESSMENT OF TRANSPORT EFFECTS NOR 5 DRURY SOUTH INTERCHANGE CONNECTIONS

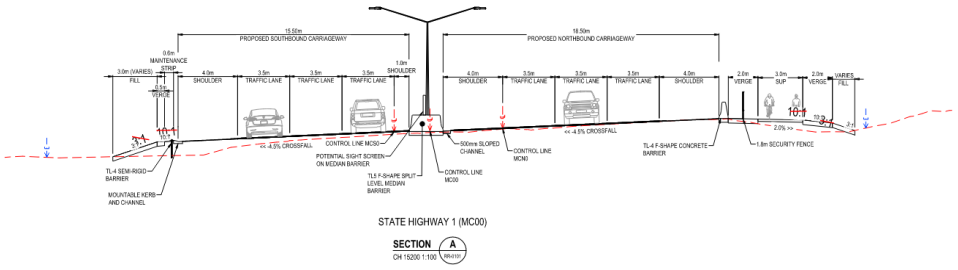
This section assesses the specific transport matters relation to NoR 5: Drury South Interchange Connections.

6.1 Overview and description of works

As set out in Table 6-1 below, the proposed designation to accommodate the construction, operation, and maintenances of a new link road between Maketu Road and Great South Road.

Table 6-1: Overview of the Drury South Interchange Connections

NoR 5 – Drury South Interchange Connections	
	
Key features	
Overview	▪ New link roads to the adjacent network (Maketu Road and Great South Road) to tie-into the proposed Drury South Interchange. ▪ Four traffic lanes, cycle lanes and footpaths on either side.
Structures	▪ Raised viaduct across the Hinagaia reserve area.
Speed Environment	▪ N/A
Access Lanes	▪ Accommodation for a special vehicle lane or bus lane within the 4m shoulder
Intersections	▪ Signalised intersection at Maketu Road

	▪ Round-about intersection tie-in to Great South Road
Stormwater Infrastructure	▪ Swales and wetland treatment train (100% treatment of impervious surfaces and full scale wetland)
Typical cross sections	

6.2 Existing environment

The proposed Drury South interchange will be a new interchange on SH1 located approximately 1.4 kms south of the Quarry Road Bridge. The connections will link the interchange with the local road network at Great South Road to the west and Quarry Road to the east.

Approximately 500m to the west of the interchange location is Great South Road which runs parallel to SH1 at this location.

6.3 Assessment of construction effects

It is expected that the contractors engaged to deliver the Project will adopt a range of traffic management approaches to minimise disruption to traffic movement, as well as to assist with the efficient construction of the improvements themselves. In this regard, it may be inappropriate at this stage of the process to select any particular or specific arrangement or technique of traffic management for the construction period.

We expect that the traffic management details will be developed through the project delivery phase and will be subject to further assessment, at the time of detailed construction planning.

6.4 Assessment of operational effects

6.4.1 Traffic Effects

The volumes for the Future Reference Case and with the Project for the new Drury South connections are shown in Table 6-2 below.

Table 6-22: Volumes (VPD) for roads related to the New Drury South connections

ROAD	Vehicles per day (vpd)					
	2038 REF CASE	2038 WITH PROJECT	DIFFERENCE	2048 REF CASE	2048 WITH PROJECT	DIFFERENCE
Great South Road northbound	4,000	1,500	-2,500	6,000	3,000	-3,000
Great South Road eastbound	5,750	11,500	+5,750	8,500	13,750	+5,250
Great South Road southbound	2,250	750	-1,500	3,250	1,200	-2,050
Great South Road westbound	0	12,500	+12,500	0	13,400	+13,400
West RAB NB	0	5,500	+5,500	0	6,900	+6,900

West RAB EB	0	12,000	+12,000	0	14,400	+14,400
West RAB WB	0	15,000	+15,000	0	15,200	+15,200
East RAB EB	0	11,500	+11,500	0	16,200	+16,200
East RAB SB	0	10,750	+10,750	0	9,000	+9,000
East RAB WB	0	11,250	+11,250	0	12,600	+12,600

6.4.1.1 Effects on Connections

The following section assesses the expected performances of the New Drury South connections using the SIDRA Intersection and Networks modelling software. Results are provided at Section 6.5.1.4 above.

6.4.1.2 Local Road traffic volumes

6.4.2 Effects on pedestrians and cyclists

The connections between Great South Road and Quarry Road to the Drury South interchange will include shared use paths for pedestrians and cyclists which will link in with the SUP located alongside SH1.

As future development occurs to the east of Pukekohe and to the south of Drury these connections combined with the Drury South Interchange will give good east-west connections between these two areas especially for cyclists. The connections will also enable and maximise access to the SUP from future development areas.

6.4.3 Effects on public transport users

The Drury South interchange connections will have limited benefits to existing public transport users. However, the connections will provide future opportunities for public transport connectivity between Pukekohe and Drury especially once future development occurs in these areas and the Pukekohe Arterials project progresses.

6.4.4 Effects on Freight

The new Drury South interchange and its connections will give freight movements an increased route choice, potentially reducing journey times by enabling shorter routes to be taken especially east-west. This will be particularly beneficial in the future when future growth occurs around Pukekohe and Drury and the Pukekohe Arterials project progresses.

The proposed connections are planned to link in with the south Drury connection of the Pukekohe Arterials project. The connections will provide the future opportunity to link in with Pukekohe Arterials project, which will reduce congestion and delays caused by traffic resulting from future urban growth in north Pukekohe and Paerata. The proposed connections and the Pukekohe Arterials project will provide an alternative route to SH22 for freight.

Reduced congestion, delays and increased route choice will be beneficial for the efficient movement of freight.

6.4.5 Effects on safety

Since the two east and west connections and the associated intersections with Great South Road and Quarry Road are additions to the road network then it can be expected that the risk of crashes will be greater than the existing environment where they do not exist.

The crash risk can be considered to increase due to the increase in exposure. However, the crash risk and the level of severity are expected to be reduced due to the use of the latest geometric design standards and the use of a safe systems approach to reduce the severity of crashes when they do occur.

6.5 Summary and conclusions

The traffic and transport impacts of the connections will bring about positive operational effects. These effects are largely related to the improved connectivity that the interchange will provide with the Pukekohe Arterials to the west and the Mill Road extension to the east.

The interchange and the associated connections will provide an alternative to SH22 as an access between Pukekohe and SH1. The increase in future development in the area will increase demand for access to SH1 and the new connections will contribute to the efficient movement of vehicles and freight between Pukekohe and SH1.

The connections at the interchange will improve the connectivity for pedestrian and cyclists between the SUP, Pukekohe and Drury particularly for cyclists.

7 CONCLUSION

We conclude that the Project will deliver positive traffic and transportation effects. These effects are related to the reduced travel time savings and improved safety along SH1 and the provision of improved pedestrian and cycle facilities. Wider effects of the Project will include reduction of traffic volumes on local roads and enhanced connectivity for all modes that will support future growth in the Pukekohe and Drury areas.

The positive traffic and transportation effects of Project include:

- Improve efficiency and effectiveness of travel along SH1. The reduced travel times will make journey times along SH1 shorter which will benefit a significant volume of traffic, including freight movements.
- Improve safety. Safety will be improved through a reduction in crash severity through safety upgrades that will make SH1 a safer and more resilient route.
- Provision of upgraded pedestrian and cycle facilities through the SUP and existing interchanges will improve pedestrian and cyclist connectivity and safety.
- Improved pedestrian and cycle facilities will make these modes more attractive modes of travel and enabling improved transport choices and promoting these modes of transport.
- Reduce traffic volumes on local roads. This will result in less delays on these routes for public transport and freight that are using them. Pedestrians and cyclists that use these roads will benefit from the reduced traffic volumes and providing them with as safer and more pleasant environment.
- Provide improved connectivity between Pukekohe and Drury via the new Drury South interchange which will support growth in these areas.

This report has also considered the adverse traffic effects. It is recommended that a Construction Traffic Management Plan (CTMP) is required, to ensure that these adverse effects are managed during the construction stage.

APPENDICES

APPENDIX A – TRAFFIC AND TRANSPORT MODELLING METHODOLOGY OVERVIEW

Modelling approach

This transport assessment primarily uses outputs from the Southern Sector SATURN model. The model covers a wide area, between Pukekohe and the SH1 Interchange at Bombay in the south, through to north of the interchange at Te Irirangi Road, and it has been used to assess several projects within South Auckland.

Base model

The base Southern Sector SATURN model was originally validated by Beca to base year (2011) conditions. These conditions included the completion of the SH20 Manukau Extension, and the model validation included traffic flows and travel times along the SH1, at a broad level. This base model was subsequently updated in mid-2019 to reflect 2016 traffic conditions, as part of the Supporting Growth (South Auckland) Detailed Business Case study. Demands within the base model have been updated using cordon demands obtained from the 2016 Macro Strategic Model (MSM) and the volumes and travel times have been checked against the observed data to make sure the model reasonably reflects 2016 traffic conditions. It should be noted that in 2016, construction work was occurring on SH1 between SH20 and the Papakura Interchange. This affected the SH1 capacity north of the Papakura Interchange in 2016 and this has been reflected in the base model.

The Southern Sector SATURN model has separate vehicle matrices for light and heavy vehicles. The combination of these demands leads to outputs in the form of passenger car units (PCUs), whereby one light vehicle is given a value of one PCU, but one heavy vehicle is assigned a value of two PCUs. The traffic flows set out in this report have been converted back to vehicles, except where specifically stated otherwise.

We have assessed the predicted peak hour traffic flows of the base 2016 model and the 2023 'do minimum' model used in Stage 1 for our Stage 2 area. For this assessment, we have analysed the segment of SH1 between Drury Interchange and Ramarama Interchange. We have used linear interpolation of the traffic flows from these two years to compare with the current 2023 TMS peak volumes.

The peak hour traffic flows for the 2016 base model, the 2028 'do minimum' model and the current (2023) TMS traffic counts are set out in Table A1 below.

Table A1: Traffic flow comparison between 2016, 2028 and current (2023) flows, SH1 between Drury and Ramarama

Road and Year	2016		2028		2023 (Current TMS count)	
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Morning Peak Hour	1900	1570	2900	2570	2600	1910
Evening Peak Hour	1730	2330	2540	3080	2280	2350

New and improved road corridors

The SGA Network includes several new and improved transport corridors. Table A2 below summarises the main road upgrades that are proposed near the project area.

While the staging and timeframes of these projects are not fully certain, we have considered assumptions on whether these projects will be completed based on historic discussions with NZTA and the Supporting Growth Alliance. We have made assumptions on whether these projects will be completed by 2038 or 2048. The table below indicates whether the upgrades have been included in the 2038 and 2048 Future Reference Case and the Project transport models for our assessment.

Table A2: Proposed Road Network Upgrades

Proposed Road Upgrade	Description	Included in 2038 Model?	Included in 2048 Model?
Mill Road Corridor[10]	Upgrade and extend Mill Road to provide an alternative route between Manukau and Drury. This will likely be a limited access urban arterial road.	Yes (but excluded as a sensitivity test)	Yes
SH22 Upgrades[11]	Upgrade SH22 between Oira Road and SH1 Drury Interchange to accommodate growth, and better accommodate freight, public transport and general traffic. It will also provide walking and cycling connections.	Yes	Yes
Drury Arterial Road Improvements[12]	Upgrades to several roads in Drury to elevate them to urban standards by accommodating walking, cycling and public transport modes. This includes Jesmond Road, Bremner Road, Waihoehoe Road, Croskery Road and Hunua Road. A new arterial connection through Opaheke from Croskery Road to Waihoehoe Road will also be developed.	Yes	Yes
Pukekohe Arterials and Connections[13]	A proposed road which will provide an alternative route between SH1 and Pukekohe to the existing SH22 route. The road will likely be a limited access road and will have multiple connections to SH22.	Yes (but excluded as a sensitivity test)	Yes
Drury South SH1 Interchange	A new interchange on SH1 is proposed at Drury South, which will connect with the extended Mill Road corridor in the east and the Pukekohe Arterials in the west.	Yes	Yes

Discussions around the timeframe of Pukekohe Arterials and its connections to the SH1 Drury South Interchange have previously been held with the Supporting Growth Alliance. We concluded that it was unclear whether the Arterials would be completed in 2038 with the current funding programme. As such, we have assumed that the Arterials will be completed in 2038 and 2048 for our core tests, but sensitivity tests have been completed to understand its effects in 2038 if excluded. This is assessed in Appendix D.

[10] https://www.supportinggrowth.govt.nz/assets/2019-Launch-Website/Project-Profiles/South-PPs/dbe91d4121/South-Mill-Road-Corridor.PDF
[11] https://www.supportinggrowth.govt.nz/assets/2019-Launch-Website/Project-Profiles/South-PPs/a5878881d2/South-Upgrade-to-Drury-West-Section-of-SH22.pdf
[12] https://www.supportinggrowth.govt.nz/assets/2019-Launch-Website/Project-Profiles/South-PPs/158cf42b2f/South-Drury-Arterial-Road-Improvements.PDF
[13] https://www.supportinggrowth.govt.nz/assets/2019-Launch-Website/Project-Profiles/South-PPs/d232118e4c/South-Pukekohe-Arterials-and-Connections.PDF

The project network model assumptions are outlined in Table A3 below. The Sensitivity test reflects the partial network assumptions whilst the Future Reference Case and the Project reflect the Full Network assumptions.

Table A3: Network Project Assumptions

Key	
√	Included
x	Excluded
-	Minimal Network Change
*	Partially included (as per Pukekohe NOR Future ref case)

Package	Project(s)	2038 Partial Network	2038 Full Network	2048 Full Network
Rail DBC package	Additional rail capacity between Pukekohe and Papakura (and associated grade separations at road/rail crossings)	√	√	√
	New rail stations at Drury Central, Drury West and Paerata	√	√	√
	Regional north-south cycle route between Drury and Pukekohe, with grade-separated active mode crossings of SH1 and NIMT	√	√	√
South Strategic DBC package	Mill Road Corridor – a new and upgraded strategic transport corridor from Manukau to Drury, including upgrades to Redoubt Road, Mill Road and Dominion Road and a new section connecting to SH1 in Drury South	x	√	√
	FTN on Porchester / Mahia / Roscommon Roads and Great South Road from Drury to Manukau	√	√	√
SH1 Papakura-to-Bombay	Stage 1 of the P2B project includes an upgrade to the existing Drury interchange, which connects to and is interdependent with the SH22 upgrade project. The Interchange upgrade will also need to provide for proposed rail upgrades. There is also a direct inter-relationship with the Bremner Upgrade/FTN project, as P2B project will necessitate an upgrade/replacement of the existing Bremner Road crossing of SH1.	√	√	√
SH22 Drury-to-Paerata (Safe Network Programme)	The Safe Network Programme is in the funding application process for short-term safety improvements in the SH22 area. Parts of this programme are being prioritised including a roundabout at the intersection of SH22 and Glenbrook Road, and the recently completed right-turn bay into Jesmond Road.	√	√	√

	Longer term upgrades on SH22 between SH1 and Oira Road are being looked at by SGA as part of this Drury Local package. These upgrades are proposed to improve safety, amenity and capacity along the route to enable urbanisation of the area and are envisaged to ultimately be supplemented by a new route in the long term (the proposed Pukekohe Arterials).	x	√	√
Drury Strategic Transport Network	State Highway 22 Arterial Upgrade (NoR D1)	√	√	√
	Jesmond to Waihoehoe East FTN Arterial upgrade (NoR D2)	√	√	√
	Waihoehoe Road East Arterial Upgrade (NoR D3)	x	√	√
	Opāheke North-South FTN Arterial (NoR D4)	√	√	√
	Ponga Road / Opāheke Road Arterial Upgrade (NoR D5)	√	√	√
Mill Road	Mill Road Corridor – a new and upgraded strategic transport corridor from Manukau to Drury, including upgrades to Redoubt Road, Mill Road and Dominion Road and a new section connecting to SH1 in Drury South (4 lanes with lower speeds)	x	√	√
Takaanini DBC Package (FTN & level crossing closures)	GSR FTN (2 General Traffic Lanes and 2 Bus Lanes)	√	√	√
	Takaanini FTN (Alfriston and Porchestor Rd)		√	√
	Level Crossing at grade- Manuia, Taka, Walters	√	√	√
	Level Crossing Closure - Spartan, Manuroa, Rangi	√	√	√
	Wastney Road upgrades	x	√	√
	Popes Road urbanisation (however no change to coding)	-	√	√
	Mahia Rd and Roscommon Rd (2 General Traffic Lanes)	√	√	√
	Takaanini Interchange (as per the 2022 Google Map)	√	√	√
	Croskery Road urbanisation (however no change to coding)	-	√	√
Pukekohe General	Indicative New Collector Roads		√	√
	Crown Road closure	√	√	√
	Speed limit changes in Auckland (arcgis.com) (only for Puke study area)	√	√	√
Pukekohe DBC Packages	Drury West Arterial	x	√	√
	South-Drury Arterial	x	√	√
	Drury Paerata Link	x	√	√
	Paerata Arterials upgrades and new connection	x	√	√
	Sim-Sim connection over Paerata rail	x	√	√
	Pukekohe Arterials	*	√	√
	Pukekohe East road upgrades for active modes	x	√	√
	Mill Road Bombay- upgrades (4-lanes upto Harrisville Rd)	x	√	√
Growth	Land Use Assumptions	2038	2038	up to 2048+

Future Reference Case modelling overview

It is normal practice to compare the effects of a project against a future Do Minimum scenario. In this instance, the term "Do Minimum" may be somewhat misleading, as it represents a scenario which includes quite significant change, both in the form of changes in travel demands and in transport investment. As a result, this assessment compares the Stage 2 project against a "Future Reference Case", which represents the consented Stage 1B of the Project and the projects described above.

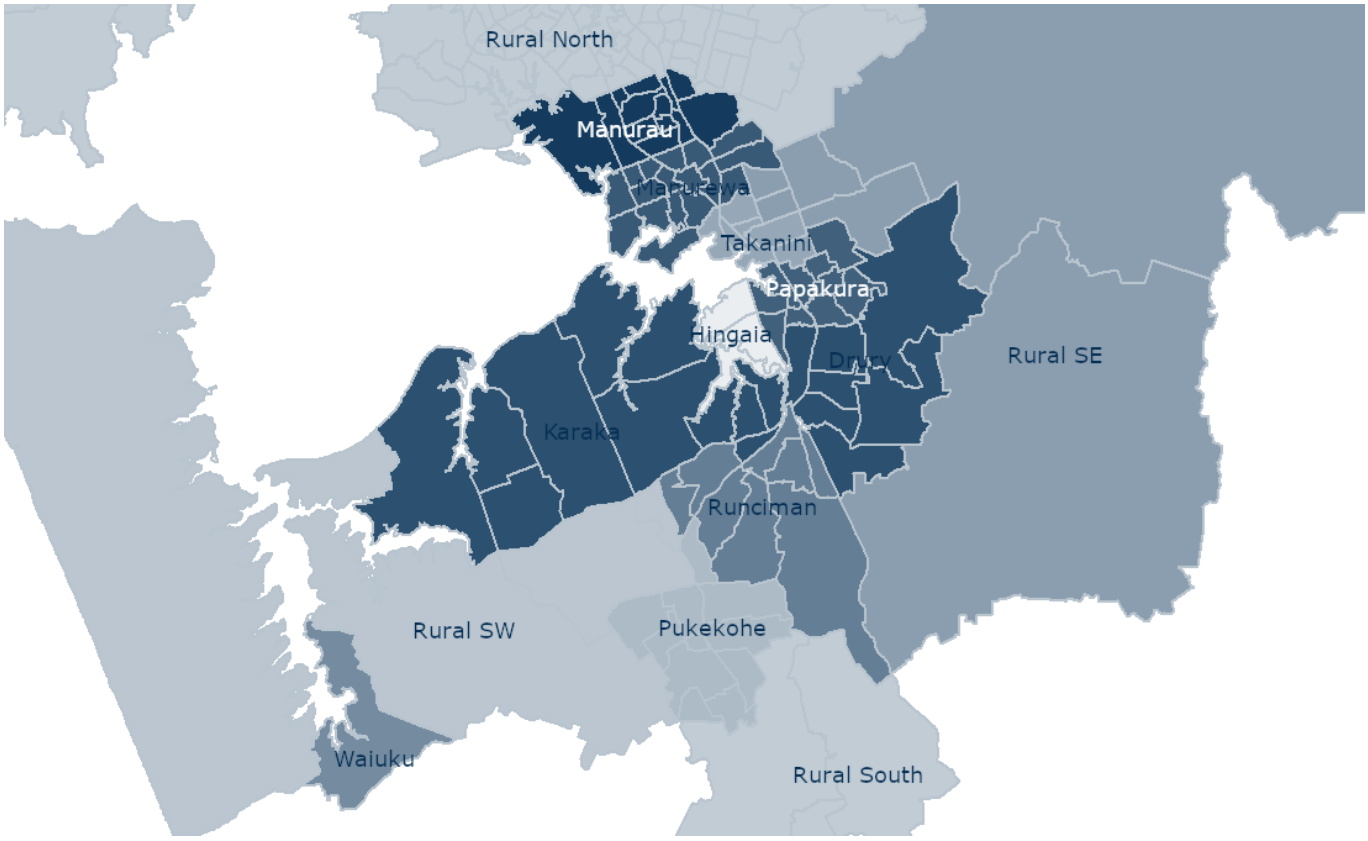
Changes in land uses

The Southern Sector SATURN traffic model derives traffic forecasts from the MSM. As a result, the forecasts represent the effects of any land use changes at a macro level.

The MSM contains some 100 zones in south Auckland. To simplify the analysis, these zones have been grouped into 13 urban and rural districts, as listed below and shown in Figure A1:

- Manukau.
- Manurewa.
- Takanini.
- Papakura.
- Drury.
- Hingaia.
- Karaka.
- Runciman/Ramarama.
- Pukekohe.
- Waiuku.
- Rural Southeast.
- Rural South.
- Rural Southwest.

Figure A1: MSM Southern Districts



Tables A4 and A5 document the population and employment forecasts for the south of Auckland. In summary:

- An additional 119,950 residents are anticipated between 2016 and 2038, representing a 54% increase.
- A further 31,350 residents are anticipated between 2038 to 2048, representing a 9% increase from 2038.
- Much of this growth is forecast for areas in the vicinity of the Papakura to Bombay Improvements, such as Drury, Karaka, Runciman and Pukekohe.
- Approximately 37,050 new jobs are forecast from 2016 to 2038, representing a 53% increase.
- A further 12,750 new jobs are anticipated between 2038 to 2048, representing a 12% increase from 2038.

Table A4: Predicted population in South Auckland14

LOCATION	MSM Forecast (Scenario I11)			Growth	
Manukau	19,150	29,000	32,800	+9,850	+3,800
Manurewa	79,200	93,750	95,300	+14,550	+1,550
Takanini	13,200	16,650	16,900	+3,450	+250
Papakura	33,800	41,900	44,000	+8,100	+2,100
Hingaia	2,550	16,050	15,300	+13,500	-750
Drury	4,550	17,850	24,200	+13,300	+6,350
Karaka	4,350	22,500	34,000	+18,150	+11,500

[14] Note that these numbers differ from those in Section 3 due to the difference in the boundaries used for South Auckland in MSM vs. Supporting Growth's transport assessments.

Runciman	2,550	13,200	15,700	+10,650	+2,500
Pukekohe	22,600	39,300	41,100	+16,700	+1,800
Waiuku	9,500	9,950	9,900	+450	-50
Rural SE	10,550	11,350	11,500	+800	+150
Rural SW	10,450	13,100	13,900	+2,650	+800
Rural South	7,650	15,450	16,800	+7,800	+1,350
Total	**220,100**	**340,050**	**371,400**	**+119,950**	**+31,350**

Table A5: Predicted employment in South Auckland

LOCATION	MSM Forecast (Scenario I11)			Growth	
Manukau	23,650	34,400	38,500	+10,750	+4,100
Manurewa	8,700	9,550	9,800	+850	+250
Takanini	4,950	12,000	14,750	+7,050	+2,750
Papakura	7,700	9,100	9,600	+1,400	+500
Hingaia	550	1,450	1,400	+900	-+50
Drury	1,900	9,250	11,100	+7,350	+1,850
Karaka	1,550	3,350	4,600	+1,800	+1,250
Runciman	1,000	2,500	3,150	+1,500	+650
Pukekohe	8,700	12,550	13,500	+3,850	+950
Waiuku	3,100	3,300	3,300	+200	+0
Rural SE	3,050	4,450	4,950	+1,400	+500
Rural SW	2,950	2,600	2,600	-+350	+0
Rural South	2,000	2,350	2,350	+350	+0
Total	**69,800**	**106,850**	**119,600**	**+37,050**	**+12,750**

APPENDIX B – EXISTING ENVIRONMENT AND CRASH HISTORY

This Appendix provides additional information on the existing environment in the vicinity of the Project area as well as the crash history results.

Existing traffic volumes on key local roads

The existing 7-day average daily traffic volumes on the key local roads within the vicinity of the SH1 in the Project area is summarised in Table B1 below.

Table B7-1: Daily Traffic Flows on key local roads (vehicles per day) [15]

ROAD	SECTION OF ROAD	DAILY FLOWS[16]	DATE OF DATA
Quarry Road	Between Maketu Road and Ramarama Road roundabout	990	Apr 2019
Ararimu Road	Between SH1 overbridge 1st Abutment and 2nd Abutment	4,290	Dec 2019
Ararimu Road	Between Mceldownie Road and Ramarama Road	2,570	Mar 2022
Maketu Road	N/A	N/A	N/A
Mill Road	Between SH1 Overbridge 2nd Abutment and Great South Road Roundabout	14,380	Nov 2022
Mill Road	Between BP gas station exit and SH1 Overbridge 1st Abutment	21,370	Sep 2022
Mill Road	Between Great South Road Roundabout and Bombay Rd (T-intersection)	4,460	Sep 2022
Great South Road	Between Mill Road Roundabout and Lums Access Rd (On-ramp)	6,480	May 2021
Great South Road	Between Bombay Road and Mill Road Roundabout	1,461	Mar 2018

[15] Sourced from Auckland Transport website https://at.govt.nz/about-us/reports-publications/traffic-counts/
[16] Seven-day average daily volumes

This Appendix provides additional information on the existing environment in the vicinity of the Project area as well as the crash history results.

Existing traffic volumes on key local roads

The existing 7-day average daily traffic volumes on the key local roads within the vicinity of the SH1 in the Project area is summarised in **Error! Reference source not found.** below.

Table B2: Daily Traffic Flows on key local roads (vehicles per day) [17]

ROAD	SECTION OF ROAD	DAILY FLOWS[18]	DATE OF DATA
Quarry Road	Between Maketu Road and Ramarama Road roundabout	990	Apr 2019
Ararimu Road	Between SH1 overbridge 1st Abutment and 2nd Abutment	4,290	Dec 2019
Ararimu Road	Between Mceldownie Road and Ramarama Road	2,570	Mar 2022
Maketu Road	N/A	N/A	N/A
Mill Road	Between SH1 Overbridge 2nd Abutment and Great South Road Roundabout	14,380	Nov 2022
Mill Road	Between BP gas station exit and SH1 Overbridge 1st Abutment	21,370	Sep 2022
Mill Road	Between Great South Road Roundabout and Bombay Rd (T-intersection)	4,460	Sep 2022
Great South Road	Between Mill Road Roundabout and Lums Access Rd (On-ramp)	6,480	May 2021
Great South Road	Between Bombay Road and Mill Road Roundabout	1,461	Mar 2018

[17] Sourced from Auckland Transport website https://at.govt.nz/about-us/reports-publications/traffic-counts/
[18] Seven-day average daily volumes

Crashes within the Project area

We have undertaken a high-level crash assessment for the Project area between 2016 – 15th February 2020 and for 2023 up to 15th August (16th February 2020-2022 was avoided due to COVID-19). Our crash search areas included SH1 south of the Drury interchange (by Pitt Road) to the SH1 / Mill Road Bombay interchange. A summary of the assessment is detailed below, with further details provided in Table B3.

Table B3: Crash Summary Table – Number of Crashes and Percentage of Total by Crash Type and Crash Severity

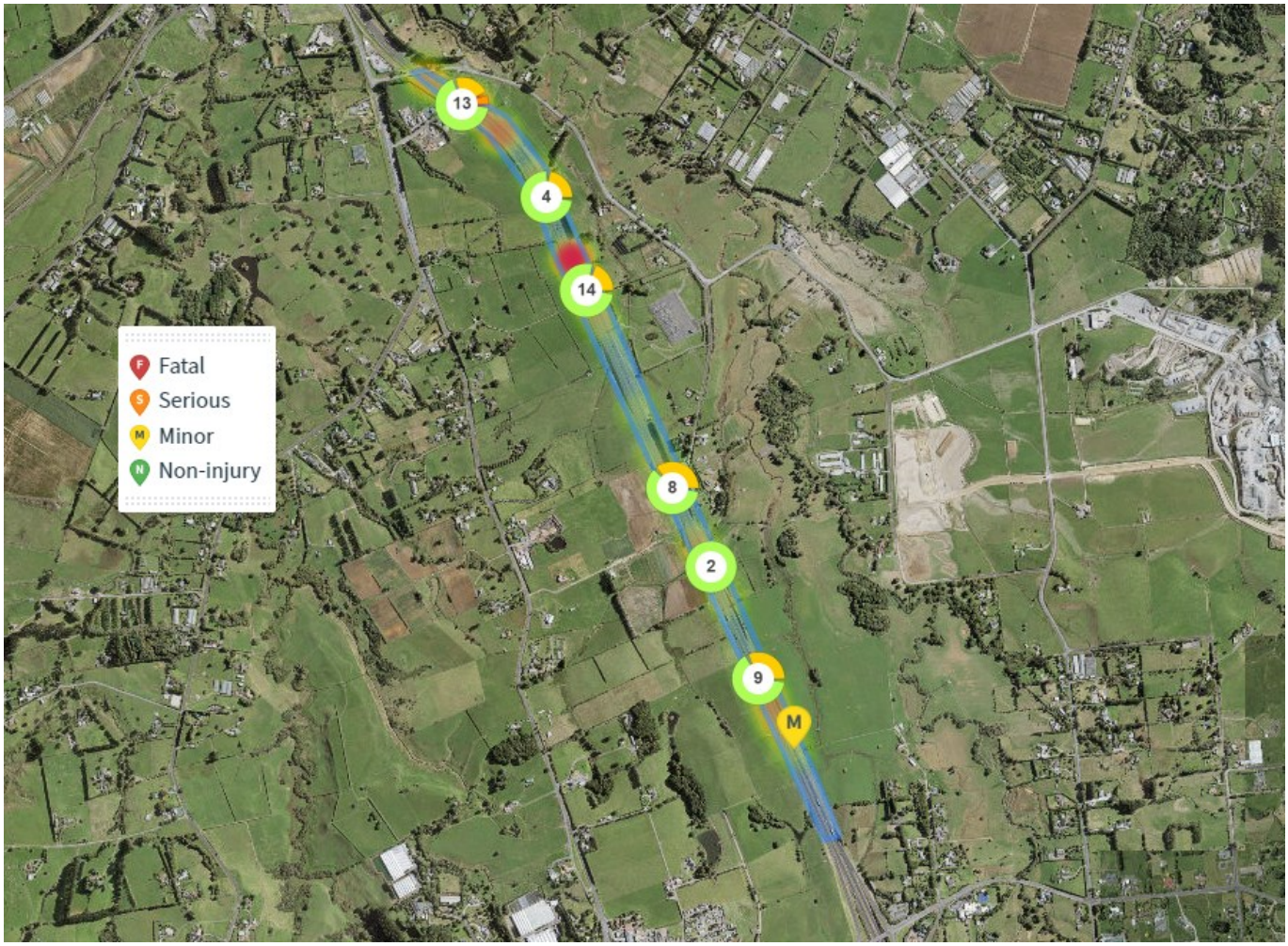
LOCATION	CRASH TYPE							CRASH SEVERITY			
	CHANGING LANES/OVER TAKING/ MERGING	LOSS-OF-CONTROL (Straight and bend road)	REAR-END/ OBSTRUCTION	CROSSING/ TURNING	PEDESTRIAN/ CYCLIST	OTHER	TOTAL	FATAL	SERIOUS	MINOR	NON-INJURY
SH1: South of Drury Interchange to Quarry Road Bridge	3 (33%)	2 (22%)	4 (45%)	0 (0%)	0 (0%)	0 (0%)	9 (5%)	0 (0%)	0 (0%)	2 (22%)	7 (78%
SH1: South of Quarry Road Bridge to North of Ramarama Interchange	13 (25%)	25 (50%)	13 (25%)	0 (0%)	0 (0%)	0 (0%)	51 (26%)	0 (0%)	1 (2%)	14 (27%)	36 (71%
Ramarama Interchange including interchange ramps	1 (4%)	11 (48%)	8 (35%)	2 (9%)	0 (0%)	1 (4%)	23 (12%)	0 (0%)	0 (0%)	7 (30%)	16 (70%
SH1: South of Ramarama Interchange to Bombay Road	6 (15%)	25 (61%)	10 (24%)	0 (0%)	0 (0%)	0 (0%)	41 (21%)	0 (0%)	2 (5%)	6 (15%)	33 (80%
SH1: South of Bombay Road to North of Bombay Interchange	6 (35%)	9 (53%)	1 (6%)	0 (0%)	0 (0%)	1 (6%)	17 (9%)	0 (0%)	1 (6%)	6 (35%)	10 (59%
Bombay Interchange including interchange ramps	9 (17%)	12 (23%)	16 (31%)	15 (29%)	0 (0%)	0 (0%)	52 (27%)	0 (0%)	2 (4%)	10 (19%)	40 (77%
Total Study Area	**38 (20%)**	**84 (43%)**	**52 (27%)**	**17 (9%)**	**0 (%)**	**2 (1%)**	**193**	**0 (0%)**	**6 (3%)**	**45 (23%)**	**142 (74%**

Crashes Search Area and Diagrams

A summary of the crash search areas and outputs are provided below.

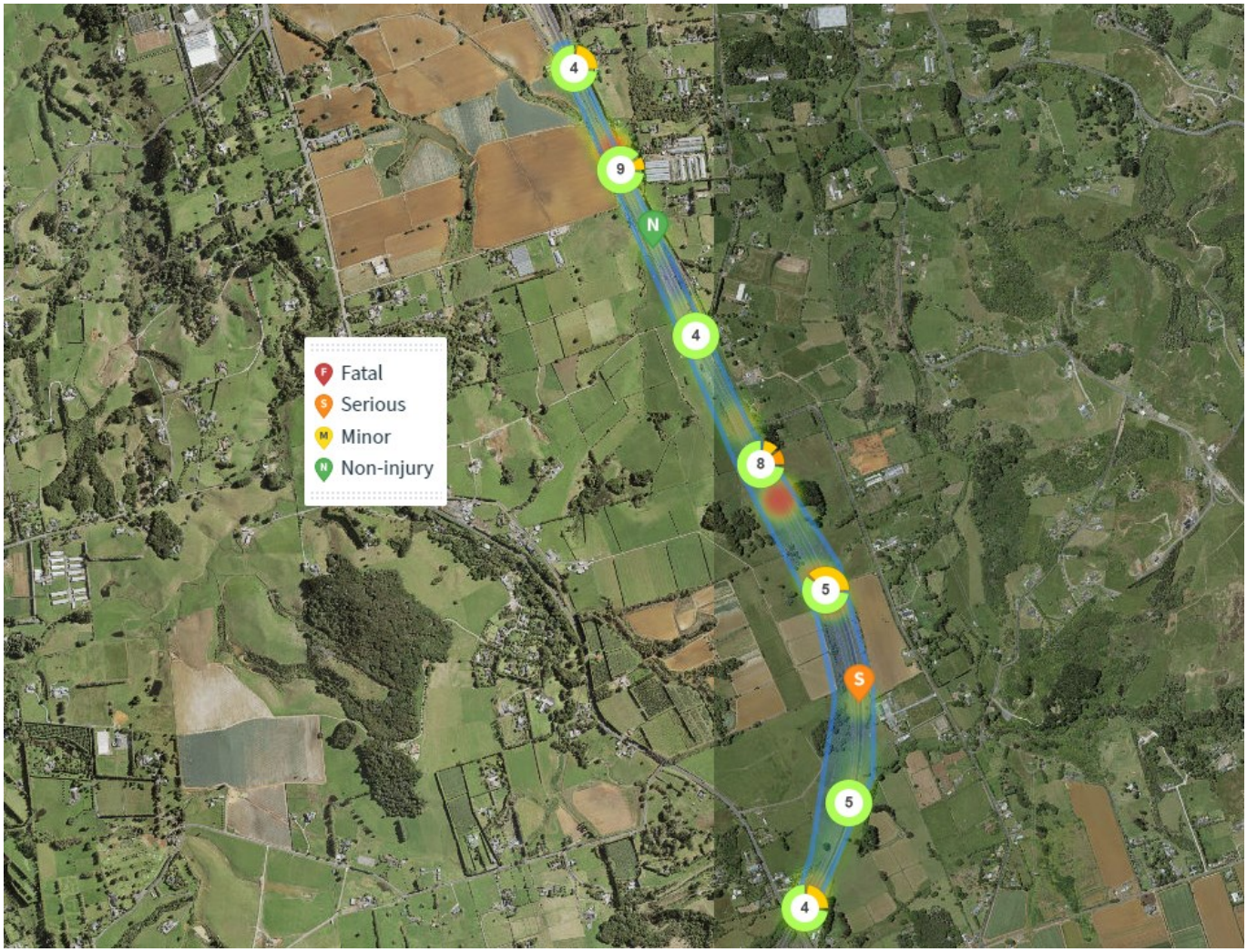
Section 1: SH1 – South of Drury Interchange to Quarry Road Bridge

Section 2: SH1 – South of Quarry Road Bridge to North of Ramarama Interchange

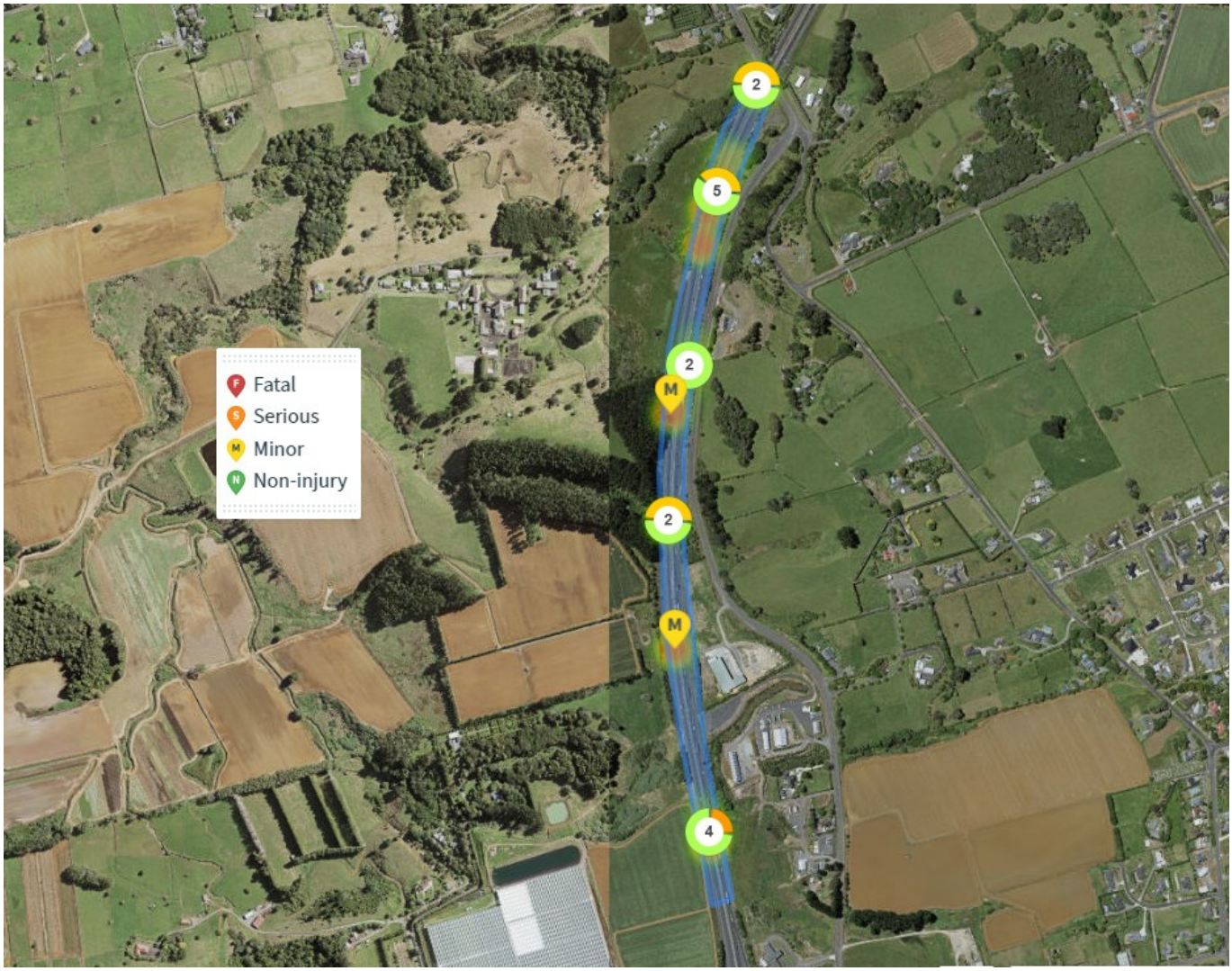


Section 3: Ramarama Interchange including interchange ramps

Section 4: SH1 – South of Ramarama Interchange to Bombay Road



Section 5: SH1 – South of Bombay Road to North of Bombay Interchange



Section 6: Bombay Interchange including interchange ramps

APPENDIX C – SIDRA RESULTS

Operation of SH1 Interchanges with the Project

The following are the SIDRA Intersection modelling outputs of the New Drury South, Ramarama and Bombay Interchanges with the Project.

New Drury South Interchange SIDRA Results

Figure C1: SIDRA layout of New Drury South Interchange with the Project

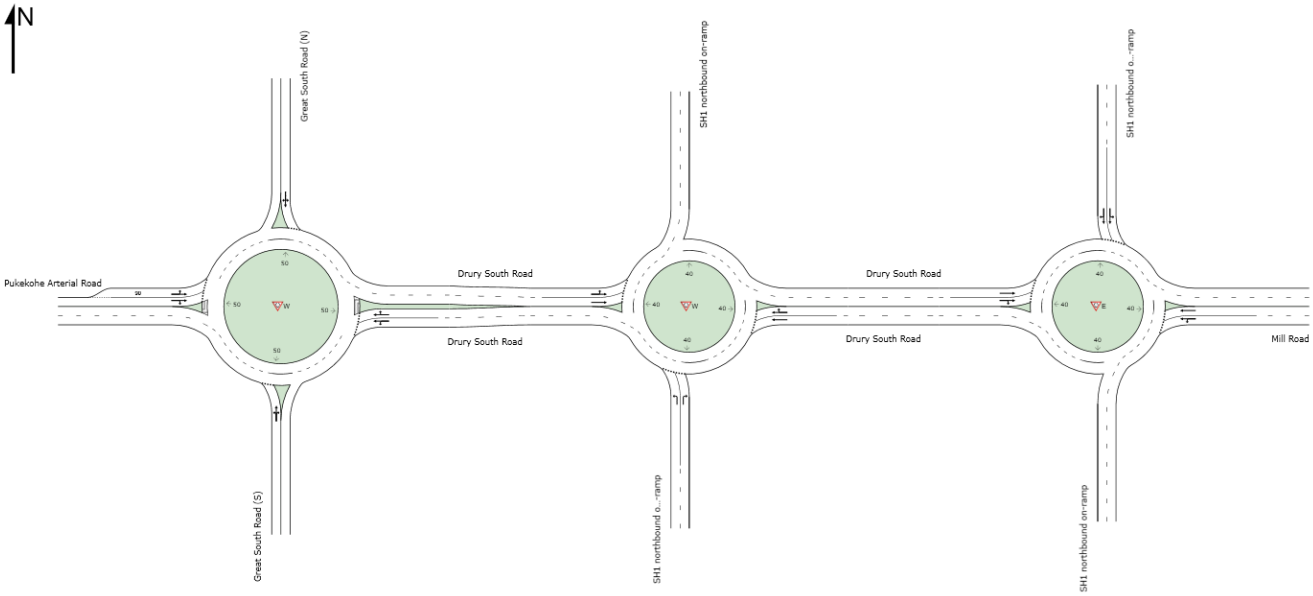


Figure C2: 2048 forecast Morning peak SIDRA results at New Drury South Interchange with Project (GSR/Pukekohe Arterial Roundabout, Western Interchange Roundabout and Eastern Interchange Roundabout).

MOVEMENT SUMMARY

Site: W [2048 AM GSR RAB (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Great South Road (S)														
1	L2	131	2.3	131	2.3	0.345	5.1	LOS A	1.6	11.6	0.61	0.75	0.61	53.4
2	T1	40	2.5	40	2.5	0.345	4.5	LOS A	1.6	11.6	0.61	0.75	0.61	55.6
3	R2	130	9.2	130	9.2	0.345	12.3	LOS B	1.6	11.6	0.61	0.75	0.61	48.0
Approach		301	5.3	301	5.3	0.345	8.1	LOS A	1.6	11.6	0.61	0.75	0.61	52.1
East: Drury South Road														
4	L2	78	5.1	78	5.1	0.262	3.6	LOS A	1.7	12.6	0.40	0.33	0.40	55.9
5	T1	611	7.9	611	7.9	0.262	2.9	LOS A	1.7	12.6	0.41	0.36	0.41	58.0
6	R2	63	1.6	63	1.6	0.262	10.5	LOS B	1.6	12.0	0.43	0.41	0.43	58.6
Approach		752	7.0	752	7.0	0.262	3.6	LOS A	1.7	12.6	0.41	0.36	0.41	57.8
North: Great South Road (N)														
7	L2	98	3.1	98	3.1	0.315	6.9	LOS A	1.5	10.8	0.75	0.84	0.78	47.4
8	T1	49	2.0	49	2.0	0.315	6.2	LOS A	1.5	10.8	0.75	0.84	0.78	55.2
9	R2	54	1.9	54	1.9	0.315	13.7	LOS B	1.5	10.8	0.75	0.84	0.78	56.3
Approach		201	2.5	201	2.5	0.315	8.5	LOS A	1.5	10.8	0.75	0.84	0.78	52.7
West: Pukekohe Arterial Road														
10	L2	27	3.7	27	3.7	0.470	3.9	LOS A	3.8	28.0	0.52	0.34	0.52	55.4
11	T1	1189	6.7	1189	6.7	0.470	3.3	LOS A	3.8	28.0	0.54	0.39	0.54	50.7
12	R2	104	2.9	104	2.9	0.470	11.0	LOS B	3.6	26.6	0.56	0.45	0.56	58.0
Approach		1320	6.4	1320	6.4	0.470	3.9	LOS A	3.8	28.0	0.54	0.39	0.54	51.7
All Vehicles		2574	6.1	2574	6.1	0.470	4.7	LOS A	3.8	28.0	0.53	0.46	0.53	54.0

MOVEMENT SUMMARY

Site: W [2048 AM West (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 northbound off-ramp														
1	L2	96	4.2	96	4.2	0.139	6.4	LOS A	0.5	3.6	0.52	0.70	0.52	49.8
3	R2	621	0.3	621	0.3	0.539	12.3	LOS B	3.2	22.3	0.61	0.89	0.72	44.3
Approach		717	0.8	717	0.8	0.539	11.5	LOS B	3.2	22.3	0.60	0.87	0.69	44.9
East: Drury South Road														
5	T1	657	7.6	657	7.6	0.213	2.5	LOS A	0.0	0.0	0.00	0.29	0.00	50.8
6	R2	34	11.8	34	11.8	0.213	9.5	LOS A	0.0	0.0	0.00	0.32	0.00	59.6
Approach		691	7.8	691	7.8	0.213	2.8	LOS A	0.0	0.0	0.00	0.29	0.00	51.8
West: Drury South Road														
10	L2	214	0.9	214	0.9	0.854	17.4	LOS B	15.5	114.2	1.00	1.30	1.79	46.7
11	T1	1219	7.6	1219	7.6	0.854	17.9	LOS B	15.5	114.2	1.00	1.32	1.82	37.4
Approach		1433	6.6	1433	6.6	0.854	17.9	LOS B	15.5	114.2	1.00	1.32	1.81	39.4
All Vehicles		2841	5.5	2841	5.5	0.854	12.6	LOS B	15.5	114.2	0.66	0.96	1.09	42.3

MOVEMENT SUMMARY

Site: E [2048 AM East (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Mill Road														
4	L2	182	0.5	182	0.5	0.286	4.9	LOS A	1.7	12.1	0.56	0.55	0.56	54.8
5	T1	412	8.3	412	8.3	0.286	4.5	LOS A	1.7	12.1	0.57	0.52	0.57	50.5
Approach		594	5.9	594	5.9	0.286	4.6	LOS A	1.7	12.1	0.57	0.53	0.57	52.4
North: SH1 northbound off-ramp														
7	L2	181	9.9	181	9.9	0.333	11.6	LOS B	1.5	11.5	0.75	0.88	0.86	50.4
8	T1	1	0.0	1	0.0	0.333	10.2	LOS B	1.5	11.5	0.75	0.88	0.86	52.3
9	R2	286	7.0	286	7.0	0.348	15.3	LOS B	1.8	13.3	0.75	0.94	0.83	41.9
Approach		468	8.1	468	8.1	0.348	13.8	LOS B	1.8	13.3	0.75	0.92	0.84	46.0
West: Drury South Road														
11	T1	1691	5.2	1691	5.2	0.559	2.5	LOS A	0.0	0.0	0.00	0.31	0.00	59.4
12	R2	144	4.9	144	4.9	0.559	9.4	LOS A	0.0	0.0	0.00	0.36	0.00	59.4
Approach		1835	5.2	1835	5.2	0.559	3.0	LOS A	0.0	0.0	0.00	0.31	0.00	59.4
All Vehicles		2897	5.8	2897	5.8	0.559	5.1	LOS A	1.8	13.3	0.24	0.45	0.25	55.3

Figure C3: 2048 forecast Evening peak SIDRA results at New Drury South Interchange with Project (GSR/Pukekohe Arterial Roundabout, Western Interchange Roundabout and Eastern Interchange Roundabout).

MOVEMENT SUMMARY

Site: W [2048 PM GSR RAB (Site Folder: 2048)]

Network: N101 [PM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Great South Road (S)														
1	L2	203	2.5	203	2.5	0.540	8.2	LOS A	3.2	23.0	0.78	0.95	1.00	52.1
2	T1	62	3.2	62	3.2	0.540	7.6	LOS A	3.2	23.0	0.78	0.95	1.00	54.1
3	R2	119	3.4	119	3.4	0.540	15.2	LOS B	3.2	23.0	0.78	0.95	1.00	45.9
Approach		384	2.9	384	2.9	0.540	10.3	LOS B	3.2	23.0	0.78	0.95	1.00	51.1
East: Drury South Road														
4	L2	92	6.5	92	6.5	0.438	3.5	LOS A	3.3	23.7	0.40	0.31	0.40	55.9
5	T1	1170	1.5	1170	1.5	0.438	2.8	LOS A	3.3	23.7	0.41	0.34	0.41	58.1
6	R2	87	1.1	87	1.1	0.438	10.5	LOS B	3.2	23.0	0.43	0.38	0.43	58.9
Approach		1349	1.8	1349	1.8	0.438	3.3	LOS A	3.3	23.7	0.41	0.34	0.41	58.0
North: Great South Road (N)														
7	L2	109	1.8	109	1.8	0.211	5.3	LOS A	0.9	6.6	0.62	0.68	0.62	49.7
8	T1	39	2.6	39	2.6	0.211	4.7	LOS A	0.9	6.6	0.62	0.68	0.62	56.9
9	R2	23	4.3	23	4.3	0.211	12.3	LOS B	0.9	6.6	0.62	0.68	0.62	58.0
Approach		171	2.3	171	2.3	0.211	6.1	LOS A	0.9	6.6	0.62	0.68	0.62	53.4
West: Pukekohe Arterial Road														
10	L2	64	1.6	64	1.6	0.309	3.8	LOS A	2.2	15.9	0.49	0.35	0.49	55.7
11	T1	700	4.4	700	4.4	0.309	3.2	LOS A	2.2	15.9	0.50	0.39	0.50	50.8
12	R2	92	2.2	92	2.2	0.309	10.9	LOS B	2.1	14.9	0.52	0.46	0.52	57.9
Approach		856	4.0	856	4.0	0.309	4.0	LOS A	2.2	15.9	0.50	0.40	0.50	52.5
All Vehicles		2760	2.6	2760	2.6	0.540	4.7	LOS A	3.3	23.7	0.50	0.46	0.53	55.3

MOVEMENT SUMMARY

Site: W [2048 PM West (Site Folder: 2048)]

Network: N101 [PM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 northbound off-ramp														
1	L2	26	0.0	26	0.0	0.041	8.3	LOS A	0.2	1.1	0.64	0.75	0.64	47.4
3	R2	263	0.4	263	0.4	0.286	13.6	LOS B	1.3	9.3	0.69	0.89	0.69	43.3
Approach		289	0.3	289	0.3	0.286	13.1	LOS B	1.3	9.3	0.69	0.88	0.69	43.6
East: Drury South Road														
5	T1	1324	1.9	1324	1.9	0.499	2.4	LOS A	0.0	0.0	0.00	0.34	0.00	49.1
6	R2	333	5.7	333	5.7	0.499	9.4	LOS A	0.0	0.0	0.00	0.48	0.00	57.2
Approach		1657	2.7	1657	2.7	0.499	3.8	LOS A	0.0	0.0	0.00	0.37	0.00	52.3
West: Drury South Road														
10	L2	254	0.8	254	0.8	0.490	6.8	LOS A	3.6	26.1	0.73	0.74	0.79	53.6
11	T1	674	5.2	674	5.2	0.490	6.7	LOS A	3.6	26.1	0.74	0.77	0.81	48.2
Approach		928	4.0	928	4.0	0.490	6.7	LOS A	3.6	26.1	0.73	0.76	0.80	50.4
All Vehicles		2874	2.9	2874	2.9	0.499	5.7	LOS A	3.6	26.1	0.31	0.55	0.33	50.2

MOVEMENT SUMMARY

Site: E [2048 PM East (Site Folder: 2048)]

Network: N101 [PM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Mill Road														
4	L2	248	0.0	248	0.0	0.857	20.1	LOS C	15.8	113.0	1.00	1.39	1.96	45.6
5	T1	1122	3.2	1122	3.2	0.857	20.8	LOS C	15.8	113.0	1.00	1.39	1.99	36.6
Approach		1370	2.6	1370	2.6	0.857	20.6	LOS C	15.8	113.0	1.00	1.39	1.99	38.9
North: SH1 northbound off-ramp														
7	L2	140	11.4	140	11.4	0.225	7.6	LOS A	0.8	6.3	0.59	0.76	0.59	53.3
8	T1	1	0.0	1	0.0	0.225	6.3	LOS A	0.8	6.3	0.59	0.76	0.59	55.5
9	R2	552	1.4	552	1.4	0.510	12.9	LOS B	2.9	20.5	0.64	0.92	0.78	43.9
Approach		693	3.5	693	3.5	0.510	11.8	LOS B	2.9	20.5	0.63	0.89	0.74	46.4
West: Drury South Road														
11	T1	725	4.3	725	4.3	0.286	2.5	LOS A	0.0	0.0	0.00	0.34	0.00	58.7
12	R2	218	2.3	218	2.3	0.286	9.4	LOS A	0.0	0.0	0.00	0.51	0.00	56.7
Approach		943	3.8	943	3.8	0.286	4.1	LOS A	0.0	0.0	0.00	0.38	0.00	58.2
All Vehicles		3006	3.2	3006	3.2	0.857	13.4	LOS B	15.8	113.0	0.60	0.96	1.08	45.9

Operation of the Ramarama Interchange

Figure C4: SIDRA layout of Ramarama Interchange with the Project

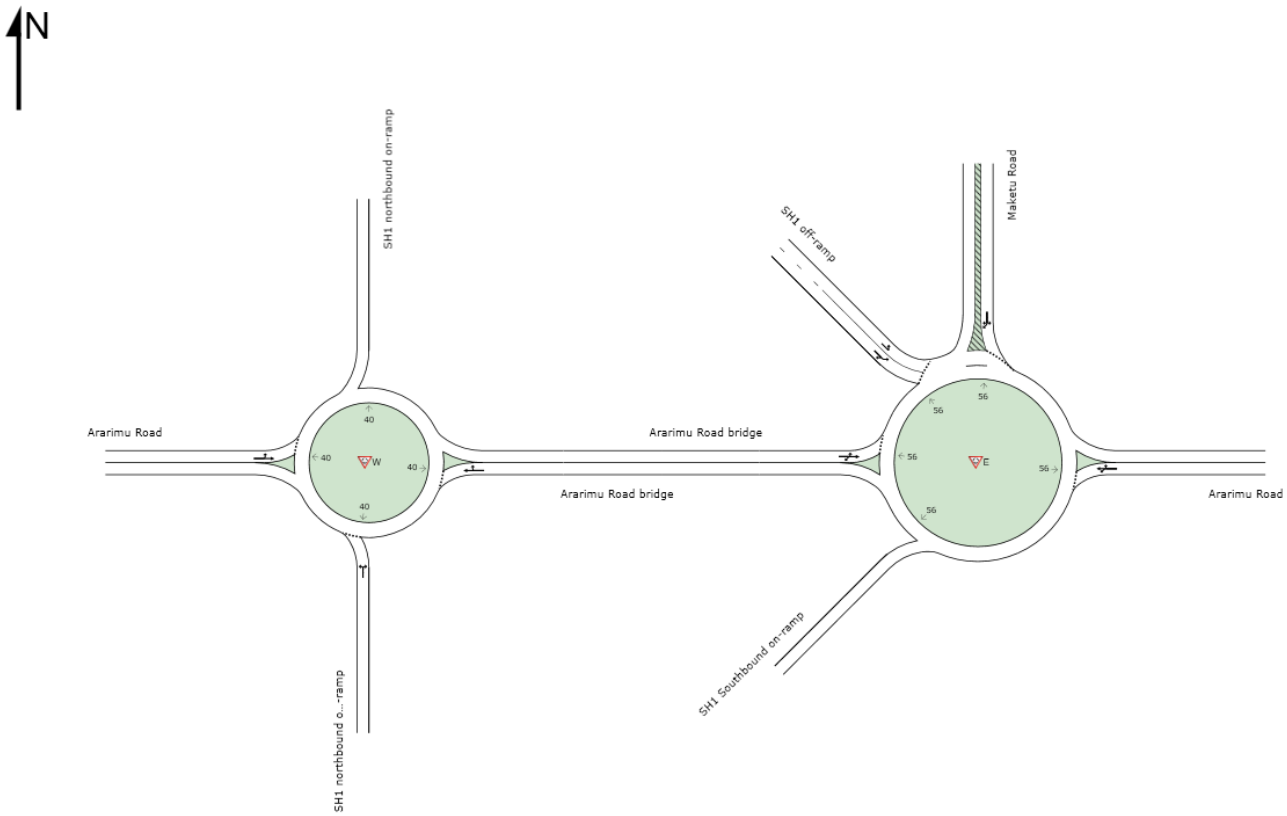


Figure C5: 2048 forecast Morning peak SIDRA results at Ramarama Interchange with Project (Western Interchange Roundabout and Eastern Interchange Roundabout).

MOVEMENT SUMMARY

Site: W [2048 AM West (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 northbound off-ramp														
1	L2	25	4.0	25	4.0	0.550	7.4	LOS A	4.6	34.9	0.73	0.85	0.83	49.7
3	R2	531	11.5	531	11.5	0.550	14.0	LOS B	4.6	34.9	0.73	0.85	0.83	43.2
Approach		556	11.2	556	11.2	0.550	13.7	LOS B	4.6	34.9	0.73	0.85	0.83	43.7
East: Ararimu Road bridge														
5	T1	132	9.8	132	9.8	0.273	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	53.6
6	R2	353	1.4	353	1.4	0.273	9.4	LOS A	0.0	0.0	0.00	0.59	0.00	54.6
Approach		485	3.7	485	3.7	0.273	7.5	LOS A	0.0	0.0	0.00	0.59	0.00	54.4
West: Ararimu Road														
10	L2	62	11.3	62	11.3	0.197	9.5	LOS A	1.4	10.4	0.85	0.81	0.85	52.3
11	T1	63	9.5	63	9.5	0.197	8.8	LOS A	1.4	10.4	0.85	0.81	0.85	46.8
Approach		125	10.4	125	10.4	0.197	9.1	LOS A	1.4	10.4	0.85	0.81	0.85	50.2
All Vehicles		1166	8.0	1166	8.0	0.550	10.6	LOS B	4.6	34.9	0.44	0.74	0.49	48.8

MOVEMENT SUMMARY

Site: E [2048 AM East (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Ararimu Road														
4a	L1	91	2.2	91	2.2	0.408	3.9	LOS A	3.0	21.2	0.63	0.54	0.63	55.4
5	T1	247	2.4	247	2.4	0.408	4.2	LOS A	3.0	21.2	0.63	0.54	0.63	48.6
6	R2	153	3.9	153	3.9	0.408	11.7	LOS B	3.0	21.2	0.63	0.54	0.63	57.6
Approach		491	2.9	491	2.9	0.408	6.5	LOS A	3.0	21.2	0.63	0.54	0.63	53.6
North: Maketu Road														
7	L2	40	12.5	40	12.5	0.320	4.6	LOS A	1.9	14.3	0.58	0.71	0.58	51.7
9a	R1	111	22.5	111	22.5	0.320	10.6	LOS B	1.9	14.3	0.58	0.71	0.58	53.6
9	R2	157	0.6	157	0.6	0.320	11.5	LOS B	1.9	14.3	0.58	0.71	0.58	45.7
Approach		308	10.1	308	10.1	0.320	10.3	LOS B	1.9	14.3	0.58	0.71	0.58	50.1
NorthWest: SH1 off-ramp														
27b	L3	233	0.9	233	0.9	0.282	7.6	LOS A	2.0	14.0	0.80	0.79	0.80	53.1
27a	L1	227	6.6	227	6.6	0.271	5.5	LOS A	2.2	16.4	0.81	0.69	0.81	54.7
29b	R3	82	12.2	82	12.2	0.271	14.8	LOS B	2.2	16.4	0.81	0.69	0.81	47.5
Approach		542	5.0	542	5.0	0.282	7.8	LOS A	2.2	16.4	0.81	0.73	0.81	53.2
West: Ararimu Road bridge														
10	L2	514	12.3	514	12.3	0.427	3.4	LOS A	3.4	26.0	0.46	0.43	0.46	54.2
11	T1	62	3.2	62	3.2	0.427	2.9	LOS A	3.4	26.0	0.46	0.43	0.46	58.2
12b	R3	18	5.6	18	5.6	0.427	11.8	LOS B	3.4	26.0	0.46	0.43	0.46	62.6
Approach		594	11.1	594	11.1	0.427	3.6	LOS A	3.4	26.0	0.46	0.43	0.46	54.8
All Vehicles		1935	7.1	1935	7.1	0.427	6.6	LOS A	3.4	26.0	0.62	0.59	0.62	53.2

Figure C6: 2048 forecast Evening peak SIDRA results at Ramarama Interchange with Project (Western Interchange Roundabout and Eastern Interchange Roundabout).

MOVEMENT SUMMARY

Site: W [2048 PM West (Site Folder: 2048)] — **Network: N101 [PM (Network Folder: 2048)]**

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 northbound off-ramp														
1	L2	56	8.9	56	8.9	0.308	5.6	LOS A	1.8	14.3	0.59	0.72	0.59	51.3
3	R2	257	16.3	257	16.3	0.308	12.2	LOS B	1.8	14.3	0.59	0.72	0.59	45.6
Approach		313	15.0	313	15.0	0.308	11.0	LOS B	1.8	14.3	0.59	0.72	0.59	47.1
East: Ararimu Road bridge														
5	T1	203	4.9	203	4.9	0.247	2.5	LOS A	0.0	0.0	0.00	0.52	0.00	55.3
6	R2	234	3.4	234	3.4	0.247	9.4	LOS A	0.0	0.0	0.00	0.52	0.00	56.2
Approach		437	4.1	437	4.1	0.247	6.2	LOS A	0.0	0.0	0.00	0.52	0.00	55.7
West: Ararimu Road														
10	L2	65	7.7	65	7.7	0.118	5.6	LOS A	0.7	5.0	0.59	0.58	0.59	54.7
11	T1	52	1.9	52	1.9	0.118	4.8	LOS A	0.7	5.0	0.59	0.58	0.59	50.5
Approach		117	5.1	117	5.1	0.118	5.2	LOS A	0.7	5.0	0.59	0.58	0.59	53.4
All Vehicles		867	8.2	867	8.2	0.308	7.8	LOS A	1.8	14.3	0.29	0.60	0.29	52.2

MOVEMENT SUMMARY

Site: E [2048 PM East (Site Folder: 2048)] — **Network: N101 [PM (Network Folder: 2048)]**

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Ararimu Road														
4a	L1	74	2.7	74	2.7	0.780	28.8	LOS C	11.9	86.5	1.00	1.32	1.79	41.9
5	T1	242	2.9	242	2.9	0.780	29.1	LOS C	11.9	86.5	1.00	1.32	1.79	31.8
6	R2	85	8.2	85	8.2	0.780	36.9	LOS D	11.9	86.5	1.00	1.32	1.79	43.1
Approach		401	4.0	401	4.0	0.780	30.7	LOS C	11.9	86.5	1.00	1.32	1.79	37.0
North: Maketu Road														
7	L2	78	1.3	78	1.3	0.929	17.2	LOS B	23.9	174.1	1.00	1.26	1.81	45.0
9a	R1	775	5.4	775	5.4	0.929	23.1	LOS C	23.9	174.1	1.00	1.26	1.81	46.6
9	R2	146	4.1	146	4.1	0.929	24.4	LOS C	23.9	174.1	1.00	1.26	1.81	36.6
Approach		999	4.9	999	4.9	0.929	22.9	LOS C	23.9	174.1	1.00	1.26	1.81	45.4
NorthWest: SH1 off-ramp														
27b	L3	134	2.2	134	2.2	0.117	4.7	LOS A	0.7	4.7	0.52	0.56	0.52	55.1
27a	L1	254	3.5	254	3.5	0.201	3.3	LOS A	1.3	9.3	0.52	0.45	0.52	56.8
29b	R3	50	8.0	50	8.0	0.201	12.4	LOS B	1.3	9.3	0.52	0.45	0.52	50.5
Approach		438	3.7	438	3.7	0.201	4.7	LOS A	1.3	9.3	0.52	0.48	0.52	55.8
West: Ararimu Road bridge														
10	L2	245	16.7	245	16.7	0.216	2.9	LOS A	1.5	12.1	0.31	0.37	0.31	54.6
11	T1	42	4.8	42	4.8	0.216	2.5	LOS A	1.5	12.1	0.31	0.37	0.31	58.7
12b	R3	22	4.5	22	4.5	0.216	11.3	LOS B	1.5	12.1	0.31	0.37	0.31	63.3
Approach		309	14.2	309	14.2	0.216	3.5	LOS A	1.5	12.1	0.31	0.37	0.31	55.7
All Vehicles		2147	5.8	2147	5.8	0.929	17.8	LOS B	23.9	174.1	0.80	0.98	1.33	46.6

Operation of the Bombay Interchange

Figure C7: SIDRA layout of Bombay Interchange with the Project

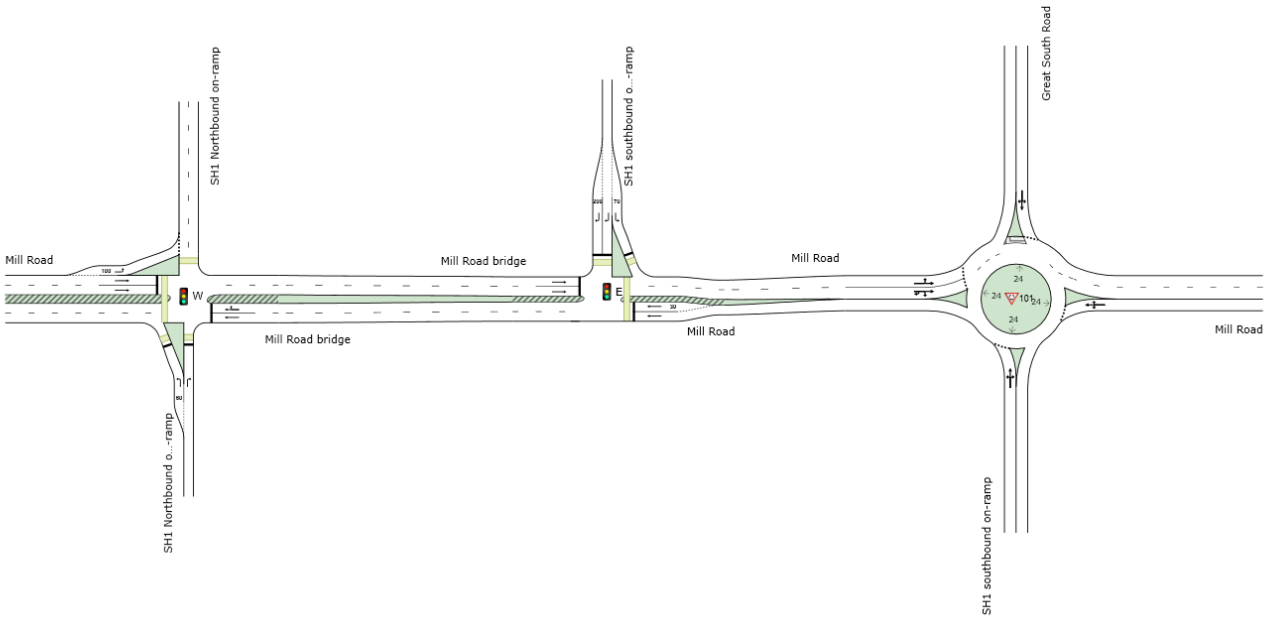


Figure C8: 2048 forecast Morning peak SIDRA results at Bombay Interchange with Project (Coordinated Signals, Pedestrian Crossing and Mill Road/GSR Roundabout Summary).

CCG MOVEMENT SUMMARY

Common Control Group: CCG1 [CCGName] — **Network: N101 [AM (Network Folder: 2048)]**

EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Network Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance (CCG)

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
Site: W [2048 AM West]														
South: SH1 Northbound off-ramp														
1	L2	352	6.0	352	6.0	*0.850	61.3	LOS E	22.1	162.5	1.00	0.95	1.19	29.8
3	R2	5	20.0	5	20.0	0.008	28.4	LOS C	0.2	1.4	0.62	0.65	0.62	31.3
Approach		357	6.2	357	6.2	0.850	60.9	LOS E	22.1	162.5	0.99	0.95	1.19	29.8
East: Mill Road bridge														
5	T1	1063	6.4	1063	6.4	0.635	4.9	LOS A	11.2	82.4	0.22	0.20	0.22	52.4
6	R2	24	0.0	24	0.0	0.635	14.6	LOS B	11.2	82.4	0.44	0.40	0.44	43.7
Approach		1087	6.3	1087	6.3	0.635	5.1	LOS A	11.2	82.4	0.22	0.20	0.22	52.1
West: Mill Road														
10	L2	1168	4.1	1168	4.1	0.753	6.5	LOS A	12.3	89.5	0.32	0.63	0.32	53.0
11	T1	355	5.6	355	5.6	*0.871	67.3	LOS E	11.7	85.6	1.00	1.01	1.38	18.8
Approach		1523	4.5	1523	4.5	0.871	20.6	LOS C	12.3	89.5	0.48	0.72	0.57	42.7
All Vehicles		2967	5.3	2967	5.3	0.871	19.8	LOS B	22.1	162.5	0.45	0.56	0.52	41.9
Site: E [2048 AM East]														
East: Mill Road														
5	T1	216	2.8	216	2.8	0.199	17.7	LOS B	3.8	27.3	0.74	0.59	0.74	15.5
Approach		216	2.8	216	2.8	0.199	17.7	LOS B	3.8	27.3	0.74	0.59	0.74	15.5
North: SH1 southbound off-ramp														
7	L2	80	0.0	80	0.0	0.207	48.1	LOS D	3.9	27.3	0.87	0.75	0.87	23.7
9	R2	873	7.1	873	7.1	*0.848	51.7	LOS D	29.7	220.5	0.97	0.93	1.13	22.4
Approach		953	6.5	953	6.5	0.848	51.4	LOS D	29.7	220.5	0.96	0.92	1.10	22.5
West: Mill Road bridge														
11	T1	360	5.8	360	5.8	0.174	0.6	LOS A	0.2	1.8	0.03	0.02	0.03	52.5
Approach		360	5.8	360	5.8	0.174	0.6	LOS A	0.2	1.8	0.03	0.02	0.03	52.5
All Vehicles		1529	5.8	1529	5.8	0.848	34.7	LOS C	29.7	220.5	0.71	0.66	0.80	22.7

Pedestrian Movement Performance (CCG)

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
Site: W [2048 AM West]											
South: SH1 Northbound off-ramp											
P1	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.7	25.3	0.34
P1B	Slip/Bypass	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.0	24.3	0.33
North: SH1 Northbound on-ramp											
P3	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	76.3	28.6	0.38
West: Mill Road											
P4	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	83.6	38.2	0.46
All Pedestrians		200	54.3	LOS E	0.2	0.2	0.95	0.95	76.6	29.1	0.38
Site: E [2048 AM East]											
East: Mill Road											
P2	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	82.9	37.2	0.45
North: SH1 southbound off-ramp											
P3	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	76.3	28.6	0.38
P3B	Slip/Bypass	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.0	24.3	0.33
All Pedestrians		150	54.3	LOS E	0.2	0.2	0.95	0.95	77.4	30.0	0.39

MOVEMENT SUMMARY

Site: 101 [2048 AM Mill Road/GSR RAB (Site Folder: 2048)]

Network: N101 [AM (Network Folder: 2048)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 southbound on-ramp														
1	L2	1	0.0	1	0.0	0.003	4.5	LOS A	0.0	0.1	0.37	0.49	0.37	49.3
2	T1	1	0.0	1	0.0	0.003	4.5	LOS A	0.0	0.1	0.37	0.49	0.37	54.7
3	R2	1	0.0	1	0.0	0.003	9.7	LOS A	0.0	0.1	0.37	0.49	0.37	54.7
Approach		3	0.0	3	0.0	0.003	6.2	LOS A	0.0	0.1	0.37	0.49	0.37	53.5
East: Mill Road														
4	L2	1	0.0	1	0.0	0.163	4.9	LOS A	0.9	6.2	0.41	0.49	0.41	54.1
5	T1	182	1.6	182	1.6	0.163	4.8	LOS A	0.9	6.2	0.41	0.49	0.41	50.5
6	R2	2	0.0	2	0.0	0.163	10.0	LOS B	0.9	6.2	0.41	0.49	0.41	55.5
Approach		185	1.6	185	1.6	0.163	4.9	LOS A	0.9	6.2	0.41	0.49	0.41	50.7
North: Great South Road														
7	L2	1	0.0	1	0.0	0.040	5.4	LOS A	0.2	1.5	0.47	0.63	0.47	51.2
8	T1	5	20.0	5	20.0	0.040	5.8	LOS A	0.2	1.5	0.47	0.63	0.47	52.0
9	R2	34	5.9	34	5.9	0.040	10.7	LOS B	0.2	1.5	0.47	0.63	0.47	46.0
Approach		40	7.5	40	7.5	0.040	10.0	LOS A	0.2	1.5	0.47	0.63	0.47	47.3
West: Mill Road														
10	L2	71	5.6	71	5.6	0.134	3.8	LOS A	0.7	5.0	0.03	0.40	0.03	53.0
11	T1	182	1.6	182	1.6	0.134	3.4	LOS A	0.7	5.0	0.03	0.42	0.03	55.3
12	R2	187	7.0	187	7.0	0.134	8.8	LOS A	0.7	5.1	0.04	0.63	0.04	49.8
12u	U	1	100.0	1	100.0	0.134	10.8	LOS B	0.7	5.1	0.04	0.63	0.04	30.1
Approach		441	4.8	441	4.8	0.134	5.8	LOS A	0.7	5.1	0.04	0.51	0.04	52.4
All Vehicles		669	4.0	669	4.0	0.163	5.8	LOS A	0.9	6.2	0.17	0.51	0.17	51.6

Figure C9: 2048 forecast Evening peak SIDRA results at Bombay Interchange with Project (Coordinated Signals, Pedestrian Crossing and Mill Road/GSR Roundabout Summary).

CCG MOVEMENT SUMMARY

Common Control Group: CCG1 [CCGName] **Network: N101 [PM (Network Folder: 2048)]**

EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Network Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance (CCG)

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
Site: W [2048 PM West]														
South: SH1 Northbound off-ramp														
1	L2	244	7.4	244	7.4	*0.830	65.0	LOS E	15.3	113.7	1.00	0.94	1.21	28.9
3	R2	1	0.0	1	0.0	0.002	33.3	LOS C	0.0	0.3	0.68	0.60	0.68	28.8
Approach		245	7.3	245	7.3	0.830	64.9	LOS E	15.3	113.7	1.00	0.93	1.21	28.9
East: Mill Road bridge														
5	T1	1344	3.6	1344	3.6	0.608	0.8	LOS A	1.9	13.9	0.05	0.05	0.05	58.6
6	R2	1	0.0	1	0.0	0.608	5.1	LOS A	1.9	13.8	0.05	0.05	0.05	55.1
Approach		1345	3.6	1345	3.6	0.608	0.8	LOS A	1.9	13.9	0.05	0.05	0.05	58.6
West: Mill Road														
10	L2	811	8.0	811	8.0	0.533	6.1	LOS A	4.2	31.6	0.18	0.59	0.18	53.3
11	T1	435	4.6	435	4.6	*0.811	59.7	LOS E	13.4	97.8	1.00	0.94	1.19	20.3
Approach		1246	6.8	1246	6.8	0.811	24.8	LOS C	13.4	97.8	0.47	0.71	0.53	39.7
All Vehicles		2836	5.3	2836	5.3	0.830	16.9	LOS B	15.3	113.7	0.32	0.42	0.36	42.9
Site: E [2048 PM East]														
East: Mill Road														
5	T1	165	2.4	165	2.4	0.139	19.0	LOS B	2.5	17.8	0.76	0.59	0.76	14.7
Approach		165	2.4	165	2.4	0.139	19.0	LOS B	2.5	17.8	0.76	0.59	0.76	14.7
North: SH1 southbound off-ramp														
7	L2	17	5.9	17	5.9	0.039	42.8	LOS D	0.8	5.6	0.79	0.68	0.79	25.4
9	R2	1183	3.7	1183	3.7	*0.824	43.8	LOS D	33.2	239.5	0.96	0.91	1.02	24.7
Approach		1200	3.8	1200	3.8	0.824	43.8	LOS D	33.2	239.5	0.96	0.90	1.02	24.7
West: Mill Road bridge														
11	T1	436	4.8	436	4.8	0.223	0.7	LOS A	0.3	2.3	0.03	0.02	0.03	51.8
Approach		436	4.8	436	4.8	0.223	0.7	LOS A	0.3	2.3	0.03	0.02	0.03	51.8
All Vehicles		1801	3.9	1801	3.9	0.824	31.1	LOS C	33.2	239.5	0.71	0.66	0.76	24.9

Pedestrian Movement Performance (CCG)

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
Site: W [2048 PM West]											
South: SH1 Northbound off-ramp											
P1	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.7	25.3	0.34
P1B	Slip/Bypass	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.0	24.3	0.33
North: SH1 Northbound on-ramp											
P3	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	76.3	28.6	0.38
West: Mill Road											
P4	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	83.6	38.2	0.46
All Pedestrians		200	54.3	LOS E	0.2	0.2	0.95	0.95	76.6	29.1	0.38
Site: E [2048 PM East]											
East: Mill Road											
P2	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	82.9	37.2	0.45
North: SH1 southbound off-ramp											
P3	Full	50	54.3	LOS E	0.2	0.2	0.95	0.95	76.3	28.6	0.38
P3B	Slip/Bypass	50	54.3	LOS E	0.2	0.2	0.95	0.95	73.0	24.3	0.33
All Pedestrians		150	54.3	LOS E	0.2	0.2	0.95	0.95	77.4	30.0	0.39

MOVEMENT SUMMARY

Site: 101 [2048 PM Mill Road/GSR RAB (Site Folder: 2048)] **Network: N101 [PM (Network Folder: 2048)]**

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: SH1 southbound on-ramp														
1	L2	1	0.0	1	0.0	0.003	4.4	LOS A	0.0	0.1	0.33	0.48	0.33	49.5
2	T1	1	0.0	1	0.0	0.003	4.3	LOS A	0.0	0.1	0.33	0.48	0.33	54.8
3	R2	1	0.0	1	0.0	0.003	9.5	LOS A	0.0	0.1	0.33	0.48	0.33	54.9
Approach		3	0.0	3	0.0	0.003	6.1	LOS A	0.0	0.1	0.33	0.48	0.33	53.7
East: Mill Road														
4	L2	1	0.0	1	0.0	0.111	5.1	LOS A	0.6	4.0	0.43	0.51	0.43	53.9
5	T1	113	0.9	113	0.9	0.111	5.0	LOS A	0.6	4.0	0.43	0.51	0.43	50.2
6	R2	6	16.7	6	16.7	0.111	10.6	LOS B	0.6	4.0	0.43	0.51	0.43	54.6
Approach		120	1.7	120	1.7	0.111	5.3	LOS A	0.6	4.0	0.43	0.51	0.43	50.6
North: Great South Road														
7	L2	6	0.0	6	0.0	0.072	5.7	LOS A	0.4	2.6	0.51	0.67	0.51	51.0
8	T1	4	25.0	4	25.0	0.072	6.3	LOS A	0.4	2.6	0.51	0.67	0.51	51.8
9	R2	59	5.1	59	5.1	0.072	11.0	LOS B	0.4	2.6	0.51	0.67	0.51	45.7
Approach		69	5.8	69	5.8	0.072	10.3	LOS B	0.4	2.6	0.51	0.67	0.51	47.0
West: Mill Road														
10	L2	37	5.4	37	5.4	0.138	3.8	LOS A	0.8	5.6	0.06	0.38	0.06	53.0
11	T1	205	1.5	205	1.5	0.138	3.4	LOS A	0.8	5.6	0.06	0.38	0.06	55.7
12	R2	213	7.5	213	7.5	0.145	8.8	LOS A	0.8	6.1	0.07	0.63	0.07	49.2
12u	U	1	0.0	1	0.0	0.145	10.9	LOS B	0.8	6.1	0.07	0.63	0.07	29.4
Approach		456	4.6	456	4.6	0.145	6.0	LOS A	0.8	6.1	0.06	0.50	0.06	52.2
All Vehicles		648	4.2	648	4.2	0.145	6.3	LOS A	0.8	6.1	0.18	0.52	0.18	51.3

APPENDIX D – SENSITIVITY TEST

Sensitivity test, Pukekohe Arterials and Mill Road inclusion

As outlined in the main report, there are several new and improved transport corridors in the SGA Network that are included in Future Reference Case and the Project models.

Two of the future projects in the SGA Network are the Pukekohe Arterials and Mill Road corridor. These projects include the following infrastructure relevant to the Project:

- A proposed road which will provide an alternative route between SH1 and Pukekohe to the existing SH22 route. It would connect to SH1 at the Project's new Drury South Interchange. The road will have several connections to SH22.
- Upgrades to Mill Road and Pukekohe East Road from a single carriageway to a dual carriageway between Bombay interchange and Harrisville Rd.
- Upgrade and extension of Mill Road to provide an alternative route between Manukau and Drury. This will likely be a limited-access urban arterial road.

Due to the uncertainty over whether the Pukekohe Arterials or Mill Road will be completed by 2038, while we have included it in our Future Reference Case, and the Project models, we have undertaken this sensitivity test without the Pukekohe Arterials and Mill Road in 2038 to assess the possible effects.

Area-wide effects

Figure D1 and FigureD2 illustrate the daily flow differences with and without the proposed completion/upgrades of Mill Road and Pukekohe Arterials, for both the Future Reference Case and the Project. Increases in traffic flows are shown as green bands while decreases are shown as blue bands.

Table below summarises the key forecast differences illustrated in these figures (with flows rounded to the nearest 100 vehicles/day).

Figure D1: 2038 Daily traffic flow difference, with vs without complete Mill Road & Pukekohe Arterials, for Future Reference Case

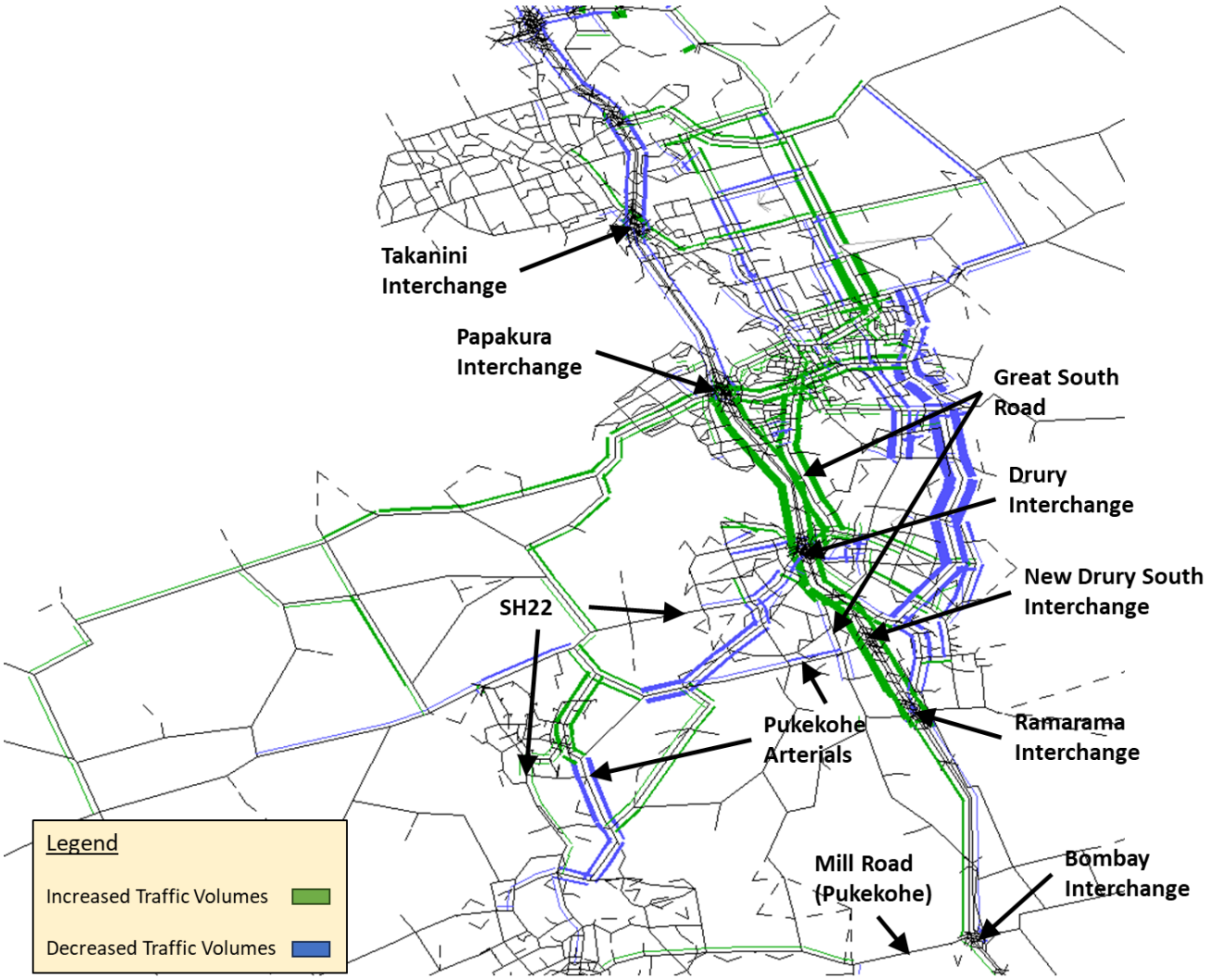


Figure D2: 2038 Daily traffic flow difference, with vs without complete Mill Road & Pukekohe Arterials, with the Project

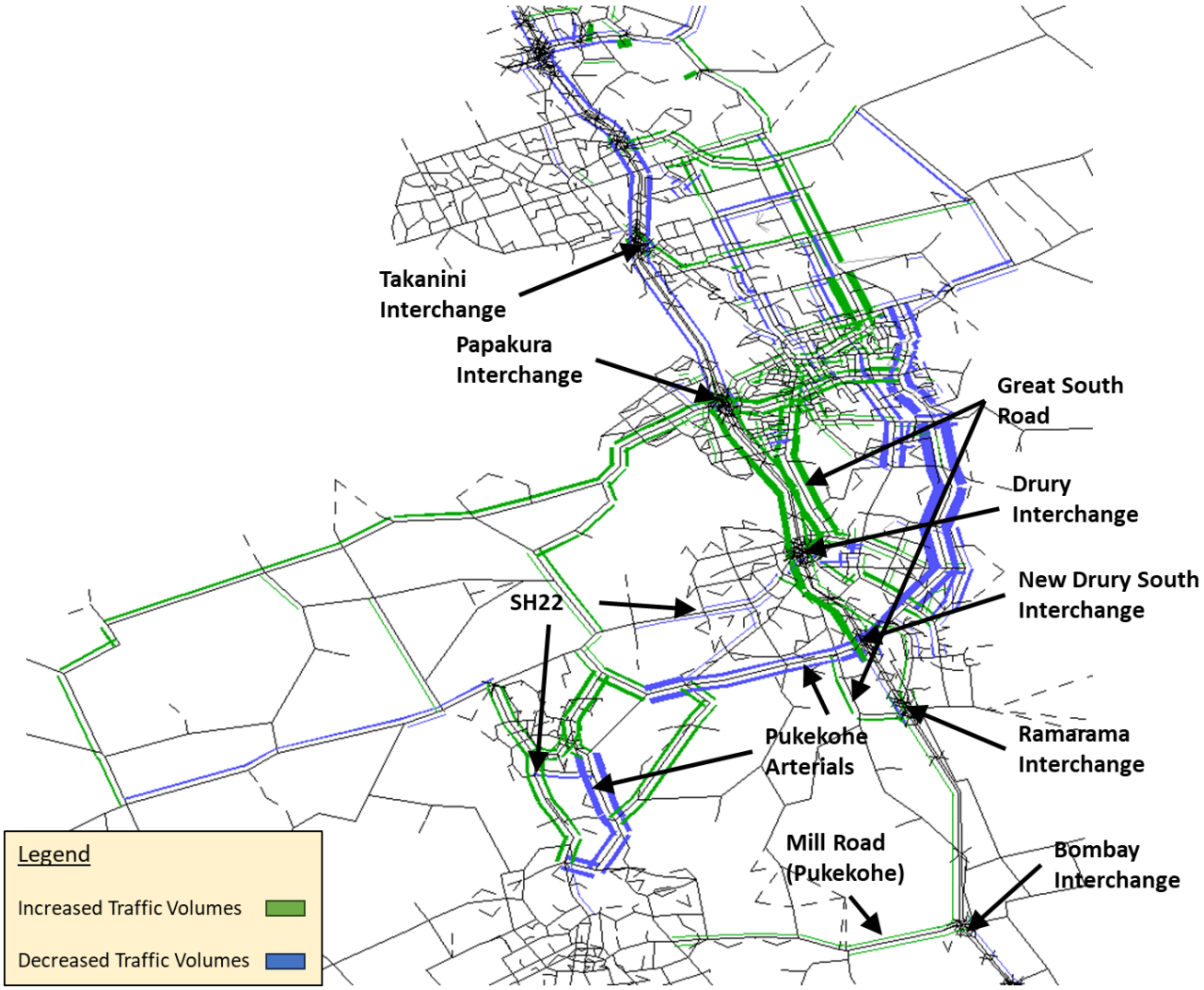


Table D1: 2038 Forecast Daily Traffic Flows with and without Mill Road and Pukekohe Arterials comparison (two way, vehicles per day)

ROAD	Future Reference Case			The Project		
	With Mill Road & Completed Pukekohe Arterials	Without Mill Road & Completed Pukekohe Arterials	DIFFERENCE	With Mill Road & Completed Pukekohe Arterials	Without Mill Road & Completed Pukekohe Arterials	DIFFERENCE
1. SH1 (north of Papakura Interchange)	154,500	152,500	-2,000	155,250	153,500	-1,750
2. SH1 (south of Park Estate Road)	128,000	138,500	+10,500	134,750	141,750	+7,000
3. SH1 (south of Drury Interchange)	90,250	100,500	+10,250	109,250	116,250	+7,000
4. SH1 (south of New Drury South Interchange)	90,250	100,500	+10,250	99,500	99,000	-500
5. SH1 (south of Ramarama Interchange)	90,250	91,000	+750	93,750	94,000	+250
6. Great South Road (south of Park Estate Road)	18,000	26,500	+8,500	16,250	25,500	+9,250
7. Great South Road (west of Pitt Road)	10,500	11,750	+1,250	5,250	6,750	+1,500
8. Great South Road (south of Quarry Road)	6,500	5,750	-750	1,500	1,750	+250
9. Great South Road (south of Waimanu Awa Road)	7,500	7,000	-500	2,250	3,500	+1,250
10. Mill Road extension (south of Hunua Road)	15,500	0	-15,500	15,500	0	-15,500
11. Mill Road extension (south of Waihoehoe Road)	10,250	1,250	-9,000	13,500	1,500	-12,000
12. Pukekohe Arterials (immediately west of New Drury South Interchange)	0	0	+0	24,500	16,750	-7,750
13. SH22 (west of Drury Interchange)	33,750	31,500	-2,250	22,500	21,500	-1,000
14. SH22 (west of Oira Road)	23,000	22,500	-500	19,500	18,500	-1,000
15. SH22 (north of Heights Road)	20,250	21,250	+1,000	17,000	21,000	+4,000
16. Bremner Road (east of Victoria Street)	16,500	15,500	-1,000	15,000	15,000	+0
17. Bremner Road (west of Victoria Street)	18,000	16,500	-1,500	18,000	16,750	-1,250
18. Mill Road extension (at Drury South Interchange)	0	0	+0	25,500	22,000	-3,500
19. Quarry Road (east of Great South Road)	9,500	12,000	+2,500	3,250	5,000	+1,750
20. Mill Road (Pukekohe, west of Bombay Interchange)	31,250	31,500	+0	32,250	33,500	+1,250
21. Maketu Road (north of Ararimu Road)	19,500	18,250	-1,250	7,500	9,750	+2,250
22. Pukekohe Arterials (west of Burtt Road)	15,250	7,000	-8,250	21,250	11,000	-10,250
23. Burtt Road (east of SH22)	6,500	1,500	-5,000	2,000	750	-1,250
24. Linwood Road (east of Hingaia Road)	27,500	27,500	+3,000	25,750	25,750	+4,500

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