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AJM Joint Venture

Project name	Suburban Rail Loop East				
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Reviewer	**Gillian Austin**			Date	**27 January 2022**

1 Introduction

1.1 Background

For the Environmental Effects Statement (EES), the Aurecon-Jacobs-Mott MacDonald Joint Venture (henceforth AJM) have developed a suite of transport models including mesoscopic and microsimulation models to assess local traffic impacts in the Suburban Rail Loop (SRL) East precincts in more detail.

For the microsimulation modelling, AJM have developed small area models for five SRL East precincts as follows:

- Box Hill;
- Burwood;
- Glen Waverley;
- Clayton; and
- Cheltenham

Each model covers several hours in the morning and afternoon/evening periods, for a 2021 base-year plus a number of future years. These models encompass the core area of each precinct and are intended to be used to assess the road user impacts within these areas in detail. The models are being developed using the PTV VISSIM microsimulation modelling software. A VISSIM model has been developed for SRL East that covers the Box Hill precinct. A detailed account of the microscopic base year model development and calibration and validation performance is documented in the report Box Hill Precinct VISSIM Base Model Report[1].

1.2 Purpose

This Technical Advice Note (TAN) provides a detailed description of the development of the future year microsimulation traffic models for testing the Rail Day 1 and Construction Impacts scenarios for application in the SRL East Traffic and Transport Impact Assessment[2] (TTIA). The TAN outlines the model development process along with the assumptions, inputs and approach. As such it covers various technical aspects of model development in greater detail than is provided in the Transport Modelling Appendix accompanying the main Traffic and Transport Impact assessment Report for the EES. It is intended to be a background report for technical stakeholders and is recommended to be read in parallel with the TTIA Modelling Appendix so the reader is aware of the context of the Box Hill VISSIM and how it is applied in the overall modelling and assessment framework.

[1] Report no. SRL-AJM-RAI-PWD-REP-XTE-NAP-0001503
[2] Report no. SRL-AJM-PWD-PWD-REP-XTR-NAP-0001222

2 Scope of TAN

The scope of this TAN is to provide details on the application of the Box Hill microsimulation model in terms of the overall approach undertaken to develop it including assumptions, demand inputs, traffic signal coding, risks, limitations and recommendations. This TAN also intends to outline anticipated future network issues and constraints for stakeholders to consider in future network planning. The scenarios coded and run are detailed herein, along with their definitions and processes behind building them. The scope of this TAN does not include presenting model outputs, which are reported directly in the Traffic and Transport Assessment Report (TTIA) (and its associated appendices). However, the inputs, assumptions and approach outlined in this TAN correspond to these outputs directly in the TTIA[1] (and its associated appendices).

This TAN is structured in the following manner:

Section 3: Documents the future year network supply inputs, approach and assumptions. This includes description of the surface transport infrastructure changes, general model parameters and operational inputs such as speed limits and public transport

Section 4: Outlines the approach and parameters that underpin the traffic signal operation of the model

Section 5: Documents the methodology and logic under-pinning the future year demand forecasting

Section 6: Conclusion and next steps.

3 Future Year Network Summary

For the purposes of forecasting traffic conditions and volumes in the Box Hill area, the future years of 2031 and 2041 were selected. These years accord with the highest intensity of activity in the precinct area for the construction works and project operation (SRL East) respectively. Base Case networks were produced first to represent the road network in these future years without the SRL East project in place. Following this, Rail Day 1 and Construction Impacts networks were then coded. The future year scenarios modelled and discussed throughout the report are outlined in Table 3.1. The future year scenarios were modelled across an AM and PM peak period, defined as:

AM Peak Period – 7:00AM – 10:00AM, inclusive of a 30-minute warm-up period between 7:00AM – 7:30AM and a 30-minute cool down period between 9:30AM – 10:00AM.

PM Peak Period – 3:00PM – 7:00PM, inclusive of a 30-minute warm-up period between 3:00PM – 3:30PM and a 30-minute cool down period between 6:30PM – 7:00PM.

All traffic modelling documented in the TTIA reflects a core 1-hour peak period, defined for Box Hill based on the highest sum of 2021 traffic volumes across 4 consecutive 15-min intervals as:

1-hour AM Peak Period – 8:00AM – 9:00AM

1-hour PM Peak Period – 4:45PM – 5:45PM

Table 3.1 Future year scenarios

Model Scenario	Description	Years Modelled	Land Use Scenario
Base Case Models	No SRL models, where the SRL East project is not in place	2031, 2041	ViF18
Construction Impact Models	No SRL models, with the inclusion of SRL East transport construction measures	2031	ViF18
Rail Day 1 Models	Rail Day 1 models, where the SRL East project is built as per Rail Day 1 land use and transport assumptions	2041	CityPlan Round 5 C1d

The future year changes adopted for each scenario are provided in Table 3.4 and the future year street network layout for the 2041 Rail Day 1 scenario is shown in Figure 3.1. Street network changes related to the 2031 Construction Impact scenario are shown in Figure 3.2. The Victorian Department of Transport (DoT) and Whitehorse City Council were consulted on committed future network changes within the model area which apply to both the Base Case and Rail Day 1 scenarios. This includes future year public transport service frequencies. No additional network changes were noted by these stakeholders on top of the existing 2021 conditions within the modelling horizon and boundary. However, AJM have incorporated two additional changes to the road network, No. 13 and No. 14 in Table 3.4, as follows:

No. 13 – A right-turn ban has been enforced in all future year scenarios from Elland Avenue and Hiltons Lane. The 2021 turning count survey data (see Table 3.2) showed a very low right-turning movement count from both streets. The right-turn bans are introduced to reduce queueing on side streets in future year scenarios.

No. 14 – No-parking restrictions have been extended to cover the entirety of the modelled peak periods in all future year scenarios along Station Street (north and south of Whitehorse Road) and Elgar Road (south of Whitehorse Road only). This is to provide additional capacity to the road network to carry the increased private vehicle trip demand during the peak periods. The changes are summarised in Table 3.3

Table 3.2 Right turn turning count volume at Elland Avenue and Hiltons Lane

Movement	AM 1-hour peak period (8:00 – 9:00) – 2021 Turning Count	PM 1-hour peak period (4:45 – 5:45) – 2021 Turning Count
Right turn from Elland Avenue	10	8
Right turn from Hiltons Lane	1	5

Table 3.3 Change in parking restrictions in the Box Hill microsimulation model

Street	Location	2021 Base Year Parking Restrictions	2031 and 2041 Parking Restrictions (Base Cases & Rail Day 1 scenarios)
Station St	South of Whitehorse Road – West side of street	No Parking: 5:30AM – 6:30AM No Stopping: 7:00AM – 7:00PM	No Parking – 5:30AM – 10:00AM No Stopping – 7:00AM – 7:00PM
	South of Whitehorse Road – East side of street	No Stopping: 7:00AM – 9:00AM & 4:00PM – 6:00PM 1P Ticket: 9:00AM – 4:00PM (Mon – Fri)	No Stopping: 7:00AM – 10:00AM & 3:00PM – 7:00PM 1P Ticket: 10:00AM – 3:00PM (Mon – Fri)
	North of Whitehorse Road – West side of street	Clearway (Tow Away zone): 7:00AM – 9:00AM & 4:00PM – 6:00PM 2P: 9:00AM – 4:00PM (Mon – Fri)	Clearway (Tow Away zone): 7:00AM – 10:00AM & 3:00PM – 7:00PM 2P: 10:00AM – 3:00PM (Mon – Fri)
	North of Whitehorse Road – West side of street	Clearway (Tow Away zone): 7:00AM – 9:00AM & 4:00PM – 6:00PM 2P: 9:00AM – 4:00PM (Mon – Fri)	Clearway (Tow Away zone): 7:00AM – 10:00AM & 3:00PM – 7:00PM 2P: 10:00AM – 3:00PM (Mon – Fri)
Elgar Road	South of Whitehorse Road – West and east side of street	Clearway: 6:30AM – 9:30AM & 4:00PM – 6:30PM (Mon – Fri) 2P: 9:30AM – 4:00PM (Mon – Fri)	Clearway: 6:30AM – 10:00AM & 3:00PM – 7:00PM (Mon – Fri) 2P: 10:00AM – 3:00PM (Mon – Fri)

It is noted that these minor changes were made to both the future Base Case and Rail Day 1 models to represent more realistic traffic operation in the network. Part of the scope of this application report is to highlight issues and constraints in the network for stakeholders, such as DoT and Whitehorse City Council in this instance, to consider potential solutions to these.

Table 3.4 Summary of future year network changes by scenario - Box Hill Microsimulation Model

No	Location	Concerning	Future Year Base Case		Construction	Rail Day 1
			2031	2041	2031	2041
1	Whitehorse Road between Linsley Street and Nelson Rd	Realignment of the westbound carriageway to north of the existing median. Reduction of 1 traffic lane in both directions.	✗	✗	✗	✓
2	Whitehorse Road between Linsley Street and Nelson Road	New cycle path on the south side of Whitehorse Road.	✗	✗	✗	✓
3	Whitehorse Road between Linsley Street and Nelson Road	New permanent speed limit of 40 km/hr in both directions.	✗	✗	✗	✓
4	Whitehorse Road / Nelson Road	Tram crossover from the west approach and traffic lane cross over from the east approach intersection geometry modifications.	✗	✗	✗	✓
5	Whitehorse Road / Clisby Ct	New signalised intersection.	✗	✗	✗	✓
6	Whitehorse Road / Station Street	Right turn ban from the east and north approach and other intersection geometry modification.	✗	✗	✗	✓
7	Whitehorse Road / Watts Street	New signalised intersection.	✗	✗	✗	✓
8	South approach of Station Street / Whitehorse Road	New mid-block pedestrian and bicycle crossing.	✗	✗	✗	✓
9	Whitehorse Road between Station Street and Bruce St	Cross-section modification. Realignment of both eastbound and westbound directions. Reduction of 1 traffic lane in both directions.	✗	✗	✓	✗
10	Whitehorse Road between Station Street and Bruce St	Minor changes to intersection layout of Whitehorse Road/Station Street intersection- westbound departure leg and eastbound departure leg.	✗	✗	✓	✗
11	Irving Ave	Closure of Irving Avenue between Station Street and basement car park access of 5-7 Irving Avenue (residential apartment block) to general traffic. Note, basement car park access to general traffic is retained.	✗	✗	✓	✗
12	Whitehorse Road between Bruce Street and Station St	Reduced speed limit of 40 km/h in both directions.	✗	✗	✓	✗
13	Elland Avenue and Hiltons Ln	Ban right-turn to Station Street South.	✓	✓	✓	✓
14	Station Street (north and south side of Whitehorse Road) and Elgar Road (south of Whitehorse Road only)	Extension of “no parking” restrictions to cover the entirety of the modelled AM and PM peak periods on both sides of the roads.	✓	✓	✓	✓
15	Network wide	Revised future public transport frequencies for buses and trams across all time periods.	✓	✓	✓	✓

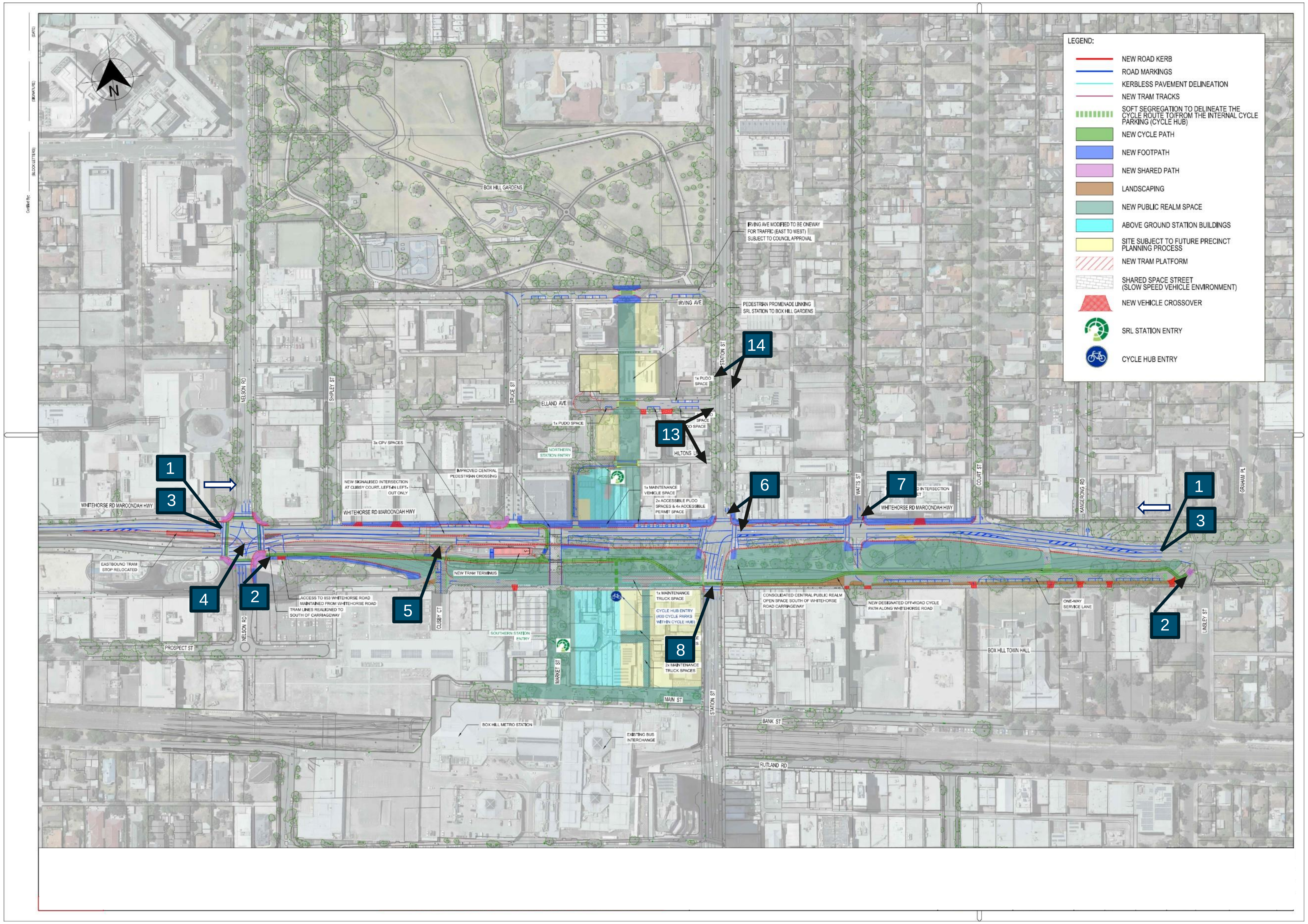


Figure 3.1 Box Hill 2041 SRL East Street network layout

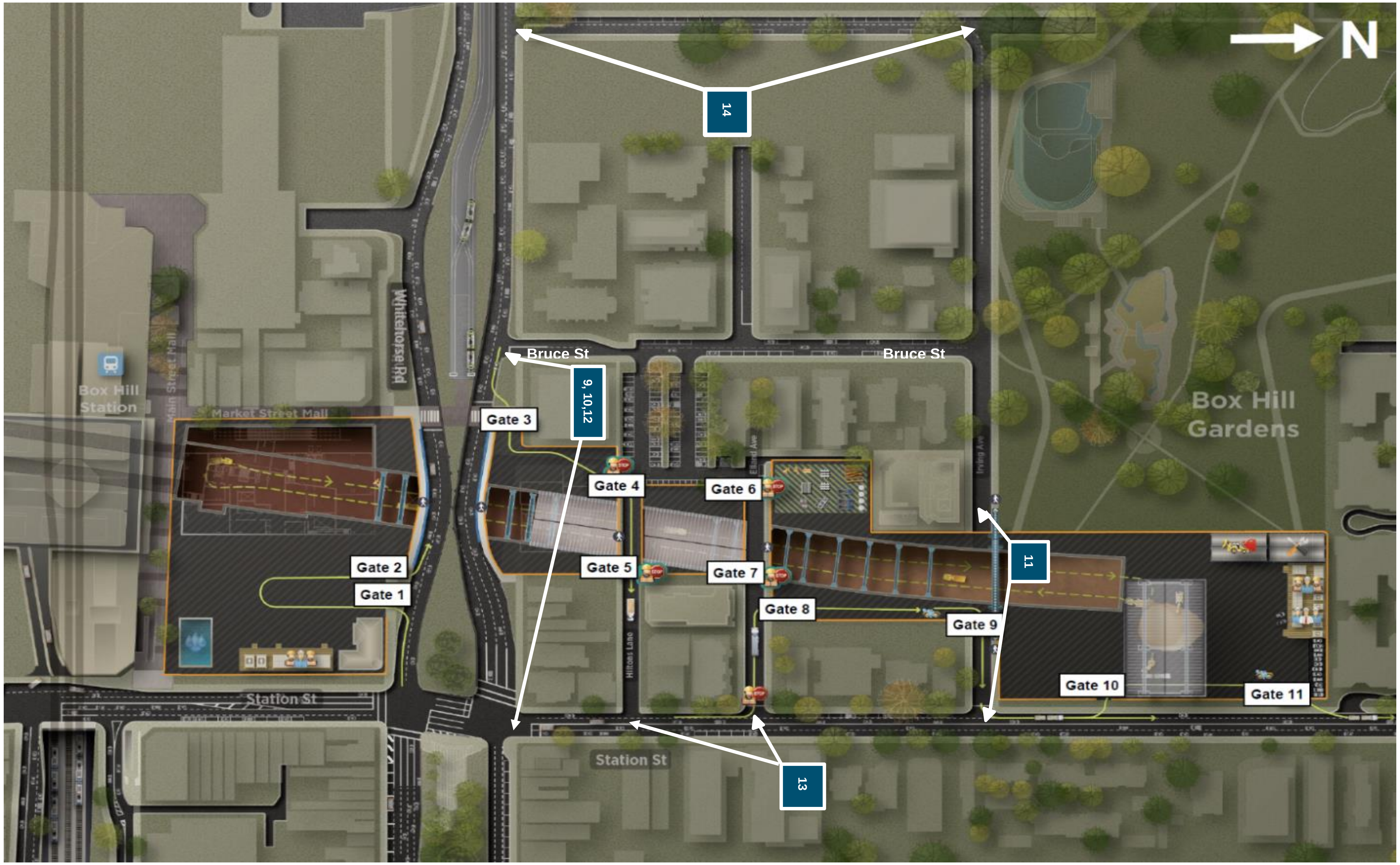


Figure 3.2 Box Hill 2031 construction site layout

3.1 **Public Transport Services**

For the future year scenarios, all bus and tram services retain their existing 2021 routes except for Bus route 201 Box Hill Station – Deakin University in the 2041 Rail Day 1 scenario. In this scenario Route 201 which is a direct limited stopping service is considered likely to become redundant following the opening of SRL East and has therefore been excluded.

For all 2031 and 2041 scenarios, Table 3.5 outlines the bus and tram service frequency for each of the routes in the Box Hill model area. The extent of the tram route in the Box Hill model can be seen in Figure 3.3 and the bus routes can be seen in Figure 3.4. An indicative SRL bus network used for inclusion in the microsimulation model for the Box Hill SRL Precinct has been sourced from DoT.

Table 3.5 Box Hill public transport service frequency in the AM and PM peak periods

Mode	Route	Description	Modelled Headway (minutes)	
			AM Peak (7:00-10:00)	PM Peak (15:00-19:00)
Bus	**270**	Box Hill – Mitcham via Blackburn North	15	15
	271	Box Hill – Ringwood via Park Orchards	15	15
	279	Box Hill - Doncaster SC via Middleborough Road	15	15
	281	Templestowe – Deakin University	15	15
	284	Doncaster Park & Ride – Box Hill via Union Road	30	30
	293	Box Hill – Greensborough via Doncaster SC	15	15
	302	Box Hill Station via Belmore Road and Eastern Freeway	15	15
	612	Chadstone via Surrey Hill & Camberwell & Glen Iris	15	15
	733	Box Hill via Clayton & Monash University & Mt Waverley	15	15
	765	Chirnside Park – Mooroolbark via Manchester Road	15	15
	903	Altona – Mordialloc (SMARTBUS Service)	5	5
Tram	**109**	Box Hill to Port Melbourne	8	8

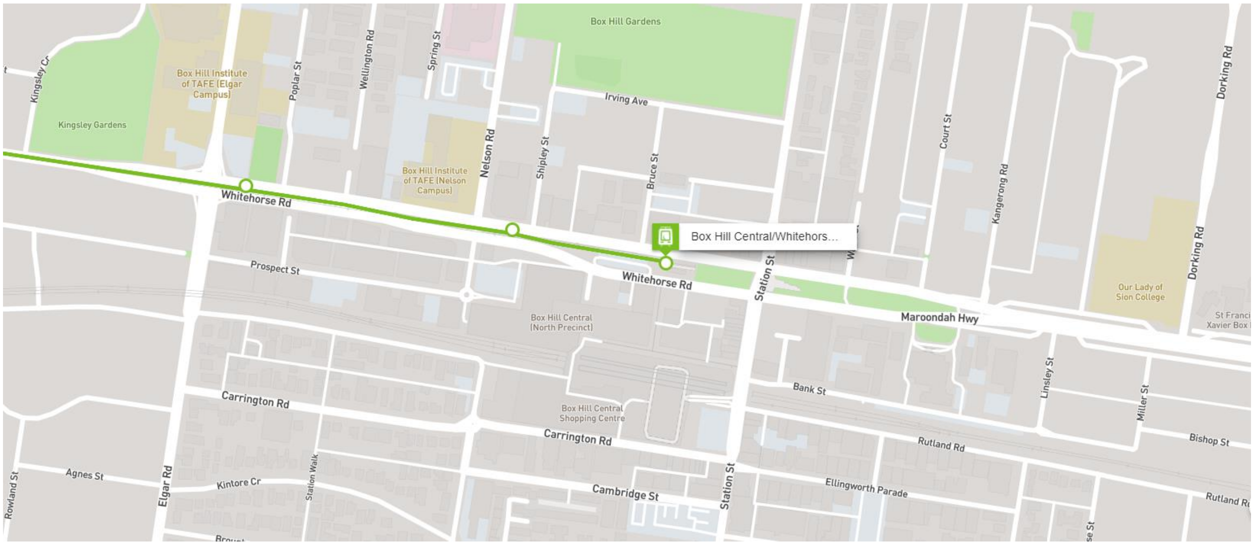


Figure 3.3 109 Tram route extents in the Box Hill microsimulation model

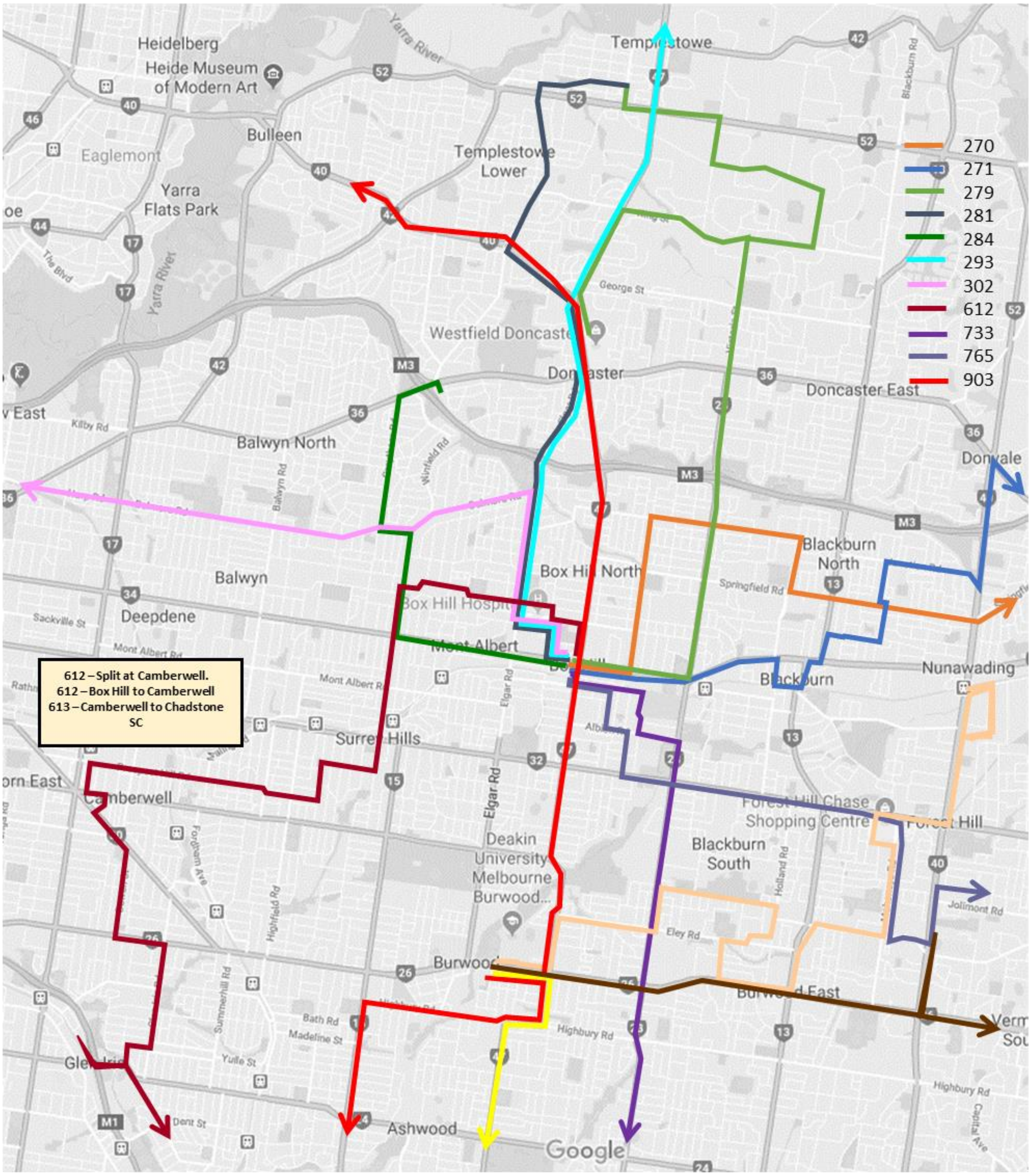


Figure 3.4 **Box Hill 2041 Rail Day 1 proposed bus routes**

4 Traffic Signals

4.1 Introduction

This section sets out the details of the future-year signal modelling for the Box Hill precinct microsimulation model.

Traffic signals in Melbourne operate under the Sydney Coordinated Adaptive Traffic System (SCATS) control, where phase sequences and green splits are dynamically adjusted according to traffic demands. Replicating this operation in a micro-simulation model can be a major challenge, especially for intersections with complex control logic.

VISSIM provides a mechanism for modelling traffic signals with its Vehicle Actuated Programming (VAP) module, and this has been used to mimic the control logic for traffic signals within the Box Hill study area.

For the base year models, where the objective is to calibrate the signals against observed operations, all the required operational data is available from the SCATS operations sheets.

For the future-year models, operations sheets were unavailable, and it was usually required to adopt default timing parameters and make simplifying assumptions, especially for new or changed/upgraded signal sites. Where the nature of the intersection site was complex, consultation with DoT was undertaken to seek advice on optimising signal timing, phasing and site coordination. This is noted under the relevant intersections below.

4.2 General signal timings

For any new phase associated with new or upgraded intersections, a starting minimum green time has been adopted in line with the Austroads Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations, Appendix G - Signal Timings, Section G.3.3 Actuated Controller Settings, Table G1 – see extract in Table 4.1 below. All other signal parameters including late starts, early cut-offs, gap times and yellow times were also adopted from this table. AJM notes that the source of these timings date to 1995 and since then, late start times can be programmed to be as low as 0 seconds (i.e. no late start).

A starting maximum phase time was assumed with reference to the expected demand for that movement. From here, if the maximum phase times were not adequate, adjustments were made to service the demand whilst keeping the average cycle time below an acceptable limit. Once the performance of the approach or movement were deemed to be satisfactory (or optimised), the phase timings were locked.

Table 4.1 Typical traffic signal controller settings (Austroads Guide to Traffic Management Part 9: Table G1)

Setting	Vehicle Settings (Seconds)		Pedestrian Setting (Seconds)
	Through (and left turn) Movements	Arrow Controlled Right-Turn Movements	
Late Start	2 - 5	0 - 6	
Minimum Green	5 - 10	5 - 6	
Maximum Extn. Green	10 - 85	5 - 25	
Gap	2.5 – 4.0	2.0 – 3.0	
Early Cut-Off Green	0 - 8	0	
Yellow Time	3.0 – 5.0	3.0 – 6.0	
All-Red Time	1.0 – 3.0	1.0 – 3.0	
Walk Time			5 - 16
Clearance Time			6 - 20

It is also noted that the VAP file inputted into the VISSIM traffic model was coded in a manner such as to replicate real world signal logic as closely as possible for all future year scenarios. This includes the ability to replicate a gap-out operation (referenced as the Gap time in Table 4.1) that can terminate a phase early between the minimum and maximum phase times due to a sufficiently low rate of vehicles calling a detector for a particular movement.

4.3 Signalised Pedestrian Crossings

The timings governing the pedestrian crossings have been based with reference to the *Austroads Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations, Appendix G.5 Pedestrian Settings (2020).* The following guidelines are used to calculate the pedestrian time settings for each modified or proposed pedestrian crossings.

- Walk Time (Green Display), $W = 2 + d/1.2$

  Inclusive of a 2 second reaction time *plus* time to walk distance ‘d’ at 1.2 m/s, where d is the kerb-to-kerb crossing distance for single carriageway and larger of the two carriageway widths plus median width for divided carriageway

- Clearance Time (Flashing Red Display), $C = d/1.5$

Inclusive of a time to walk distance ‘d’ at 1.5 m/s, where d is the kerb-to-kerb crossing distance for single carriageway and larger of the two carriageway widths for divided carriageway.

4.4 2031 Construction Case Scenario

Site 2206 Whitehorse Road / Station Street is modified from the existing operation in the construction case in response to the required realignment and lane reduction of Whitehorse Road between Bruce Street and Station Street for construction works. This involves:

- The east and west approach of Whitehorse Road being reduced from three through lanes to two through lanes;
- The east approach kerb-side shared left-turn / through lane will be converted to a left-turn only lane with detector No. 1 being retained;
- The west approach dedicated short left-turn lane will be removed and the outside through lane will be converted to a shared left-turn / through lane. Detector no. 4 will be retained;
- The existing kerb-side parallel parking spaces on the west approach of Whitehorse Road will be removed; and
- The phase sequence will remain unchanged from the existing condition.

The annotated detector and lane assignment map in Figure 4.1 illustrate the lane reductions, changed lane arrangements and corresponding detectors. The annotated detector and lane assignment map in Figure 4.1 illustrates the lane reductions, changed lane arrangements and corresponding detectors.

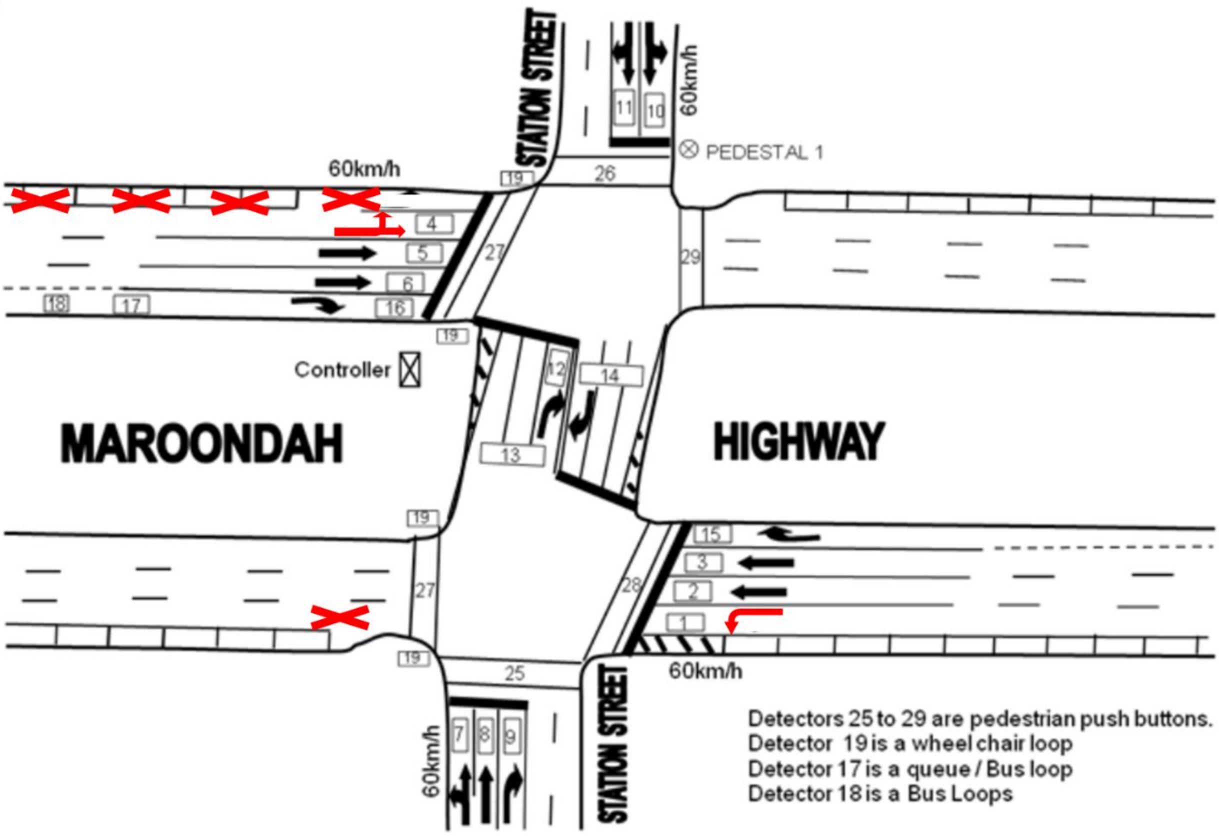


Figure 4.1 Whitehorse Road (Maroondah Highway) / Station Street intersection lane assignment for the 2031 Construction Case scenario

4.5 2041 Rail Day 1 Scenario

Several sites will be modified from their existing operation in the Rail Day 1 scenario due to the realignment of Whitehorse Road between Nelson Road and Watts Street. These modifications apply to:

- SCATS Site 2204 Whitehorse Road / Nelson Road;
- SCATS Site 2205 Whitehorse Road NR Market Street to be coordinated with the proposed signalised intersection at Whitehorse Road / Clisby Court;
- SCATS Site 2206 Whitehorse Road / Station Street; and
- SCATS Site 2010 Whitehorse Road NR Watts Street

The sections below summarise the proposed changes at these sites for the Rail Day 1 scenario. It is noted that these proposed changes should be subjected to review and detailed design by DoT Network Operations if implemented.

4.5.1 Approach to Optimisation

For all modelled signal operations, a single phasing arrangement has been adopted, based on engineering judgement given traffic volumes, pedestrian volumes and geometric conditions.

Alternative timings were then tested by trial and error, where alternative maximum extension green times were adjusted based on the observation of the simulation, successively adding, or reducing the green time allocations as dictated by queues and delays.

AJM notes that the signal modelling would be subjected to further optimisation as part of detailed design stages and this is likely to enhance the operation of the ultimate intersection.

4.5.2 Whitehorse Road / Clisby Court / Market Street (SCATS Site 2205)

The proposed signalised intersection of Whitehorse Road with Clisby Court will be coordinated with the existing pedestrian crossing near Market Street (SCATS site 2005) as per received advice from DoT. A standard phase sequence A-B-C is implemented and is detailed below:

- Phase A facilitates the eastbound and westbound through movements on Whitehorse Road, the left-tun into Clisby Court and pedestrians and cyclists across Clisby Court (P1). Tram movements are not permitted in Phase A due to the conflict with the left-turn movement into Clisby Court.
- Phase B facilitates the eastbound and westbound tram movements and is only activated on tram demand (Detector 4). The through traffic movements continue on Whitehorse Road and run in Phase B where it overlaps with Phase A.
- Phase C facilitates the pedestrian movements across Whitehorse Road at Market Street (P3) and at Clisby Court West (P2).

Additionally:

- Vehicles can access Clisby Court via a left-turn movement from Whitehorse Road east. This movement runs in Phase A and C; and
- Vehicles can exit Clisby Court onto Whitehorse Road via a left or right-turn movement. These movements are facilitated in Phase C together with the left turn movement into Clisby Court and the pedestrian phase at Market Street.

A map of detectors placed on the intersection approaches and the SIDRA intersection layout and phasing arrangements are shown in Figures 4.2 to Figures 4.4. Timing parameters for general traffic and pedestrians are shown in Table 4.2 and Table 4.3 respectively. Regarding the pedestrian timings, AJM notes that the walk time when combined with the clearance time for movements P2 and P3 is sufficient to service the pedestrian demands. However, the final walk times programmed for these crossings should be subjected to further detailed testing prior to implementation by the DoT Network Operations.

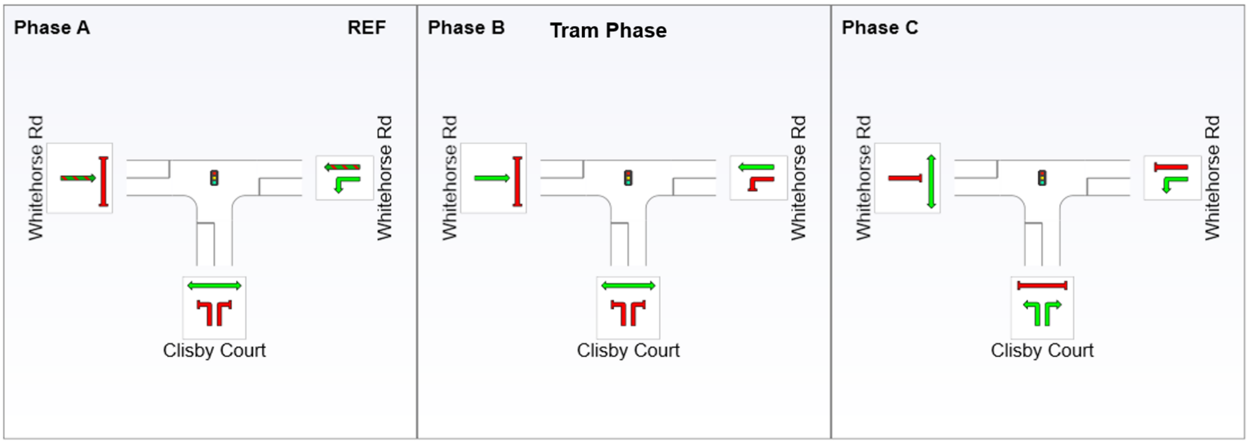


Figure 4.2 SIDRA Phasing Diagram for Whitehorse Road / Clisby Court / Market Street

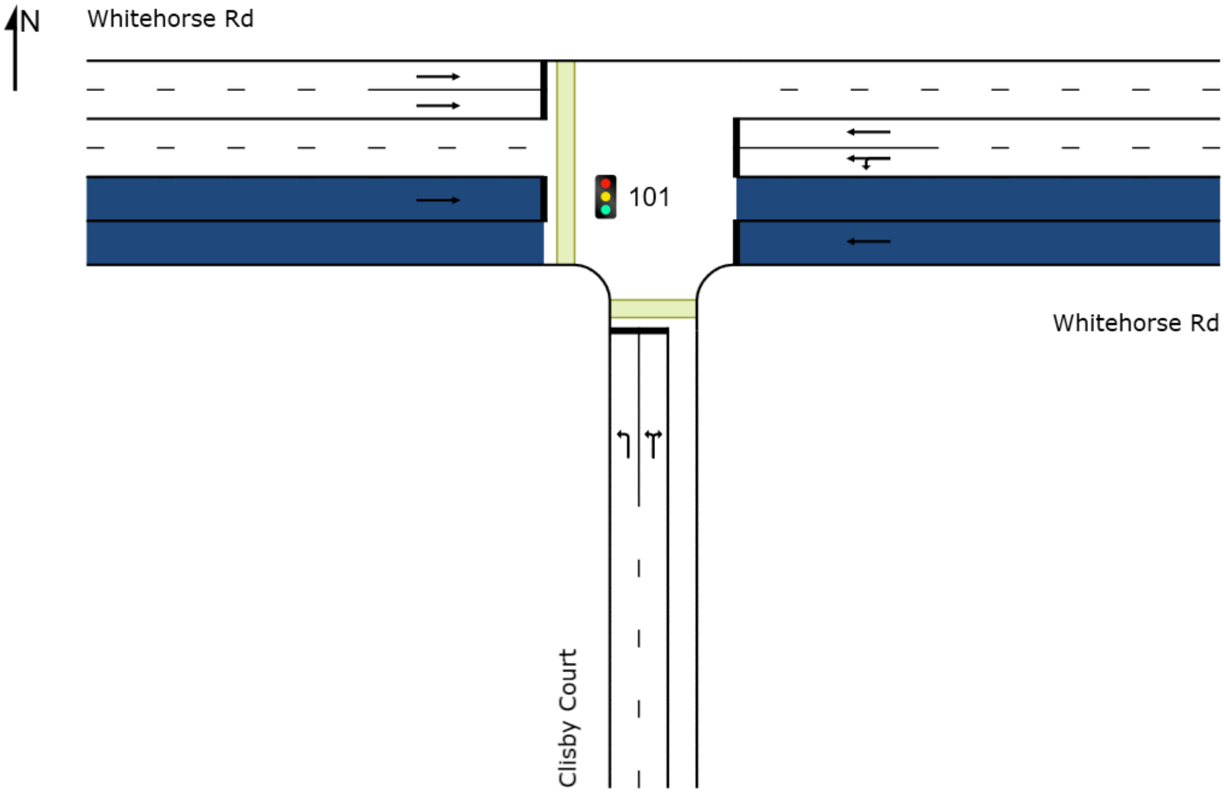


Figure 4.3 SIDRA intersection layout for Whitehorse Road / Clisby Court

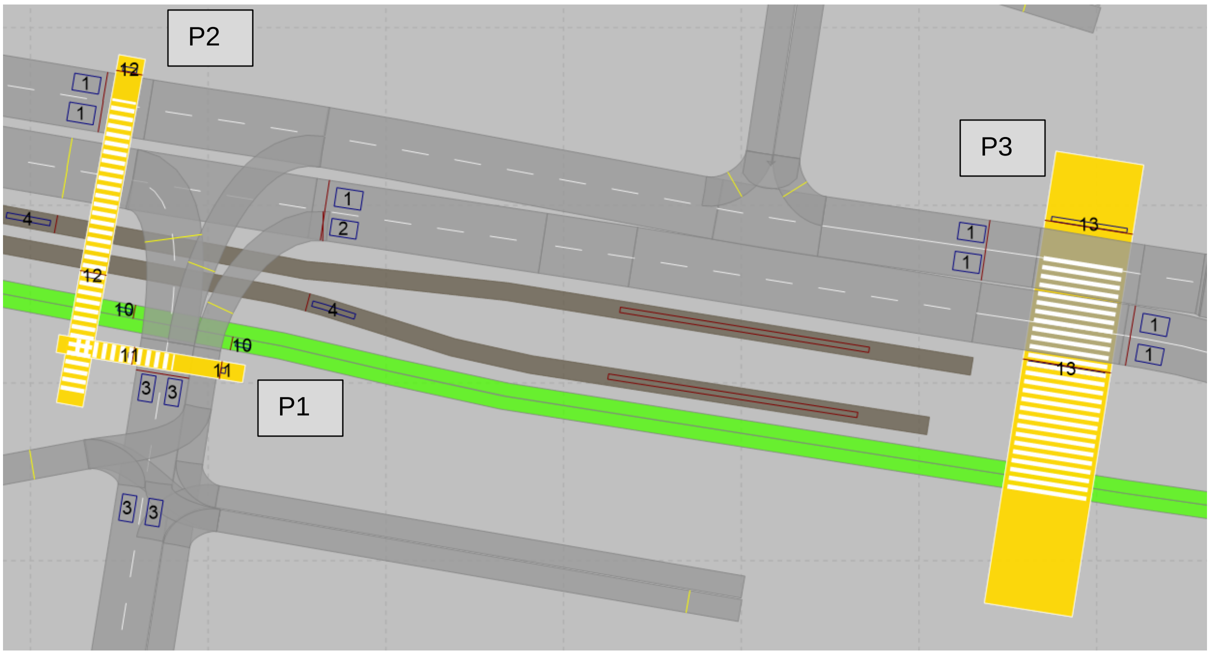


Figure 4.4 Detector Map for Whitehorse Road / Clisby Court / Market Street

Table 4.2 2041 SRL signal timing parameters for Whitehorse Road / Clisby Court

Parameter	Phase		
	A	B	C
Inter-green (yellow/all-red)	4.0 / 2.0	4.0 / 2.0	4.0 / 2.0
Minimum green (s)	16	6	6
Gap (s)	2.5	2.5	2.5
Early cut-off (s)	-	-	-
Max. Extn. Green, Plan 1: 7:00-10:00 (s)	120	6	8
Max. Extn. Green, Plan 2: 15:00-19:00 (s)	120	6	8

Table 4.3 2041 SRL pedestrian timing parameters for the Market Street POS

Parameter	Pedestrian Movement		
	P1	P2	P3
Walk Time (s)	8	6	6
Clearance Time (s)	8	12	12

4.5.3 Whitehorse Road / Nelson Road (SCATS Site 2204)

The intersection control at the intersection of Whitehorse Road with Nelson Road changes significantly. This is due to the proposed tram track crossover on the east approach and the requirement to signalise the development ingress and egress access point at 852 Maroondah Highway located south-east of the intersection. Generally speaking, the ingress and egress access point is a dummy link that connects slightly further east and does not link directly into the intersection as seen in Figure 4.6. Phase H is run on demand and is a variable phase which could also run at the same time as Phase F.

Feedback received from DoT and incorporated into the operation of this intersection includes:

- Switching the order of Phase A and Phase B, such that the existing (2021) Phase B now runs as Phase A;
- Switching the order of Phase E and Phase F, such that the existing (2021) Phase F now runs as Phase E.

The proposed phase sequence is described below, and it is acknowledged that 8 phases are proposed. DoT have advised that SCATS is limited to running 7 phases, as such the operation of this intersection should be subjected to further optimisation and detailed design by DoT Network Operations. A detailed review may consider eliminating the filtered right turn movement from Whitehorse Road east to Nelson Road north in Phase B if the pedestrian crossing is activated. When testing the model, the removal of this filtered right turn didn't show any noticeable difference in intersection performance. Currently, the proposed phase sequence is as follows:

- Phase A facilitates the Whitehorse Road east approach movements to clear the right-turn pocket into Nelson Road north. In addition, the left-turn from Nelson Road north into Whitehorse Road east and the left-turn movement into the development also run in phase A.

- Phase B facilitates the Whitehorse Road through and left-turn movements from the east and west approaches together with the pedestrian movement P1 and the left-turn into the development. The east approach right-turn into Nelson Road north is a filtered movement in this phase (overlap from Phase A).
- Phase C facilitates the Whitehorse Road west approach movements together with pedestrian movements P2 and P7.
- Phases D and G facilitate the eastbound and westbound tram movements along Whitehorse Road together with the west approach through and left-turn movements and pedestrian movement P4.
- Phase E facilitates all Nelson Road south approach movements together with pedestrian movements P3, P4, P5 and P7.
- Phase F facilitates all Nelson Road north and south approach movements together with pedestrian movements P3, P4, P5, P6 and P7. The right-turn is filtered.
- Phase H facilitates the development egress (852 Maroondah Highway) which is activated on demand only (Detector 3) together with the Nelson Road north approach left turn and pedestrian movements P1 and P3 (overlap into Phase A).

A map of detectors placed on the intersection approaches and the SIDRA intersection layout and phasing arrangements are shown in Figures 4.5 to Figures 4.7. Timing parameters are shown in Table 4.4 and Table 4.5.

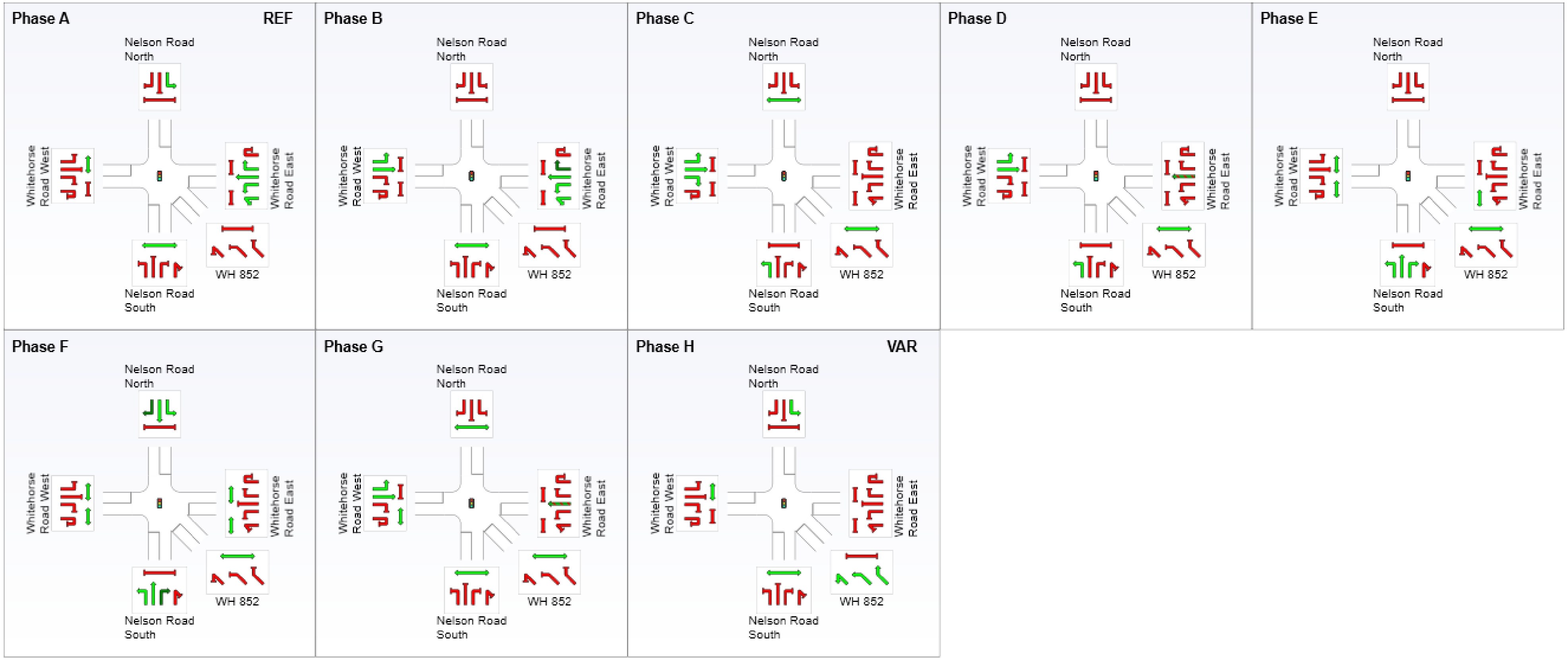


Figure 4.5 **SIDRA intersection layout for Whitehorse Road / Nelson Road**

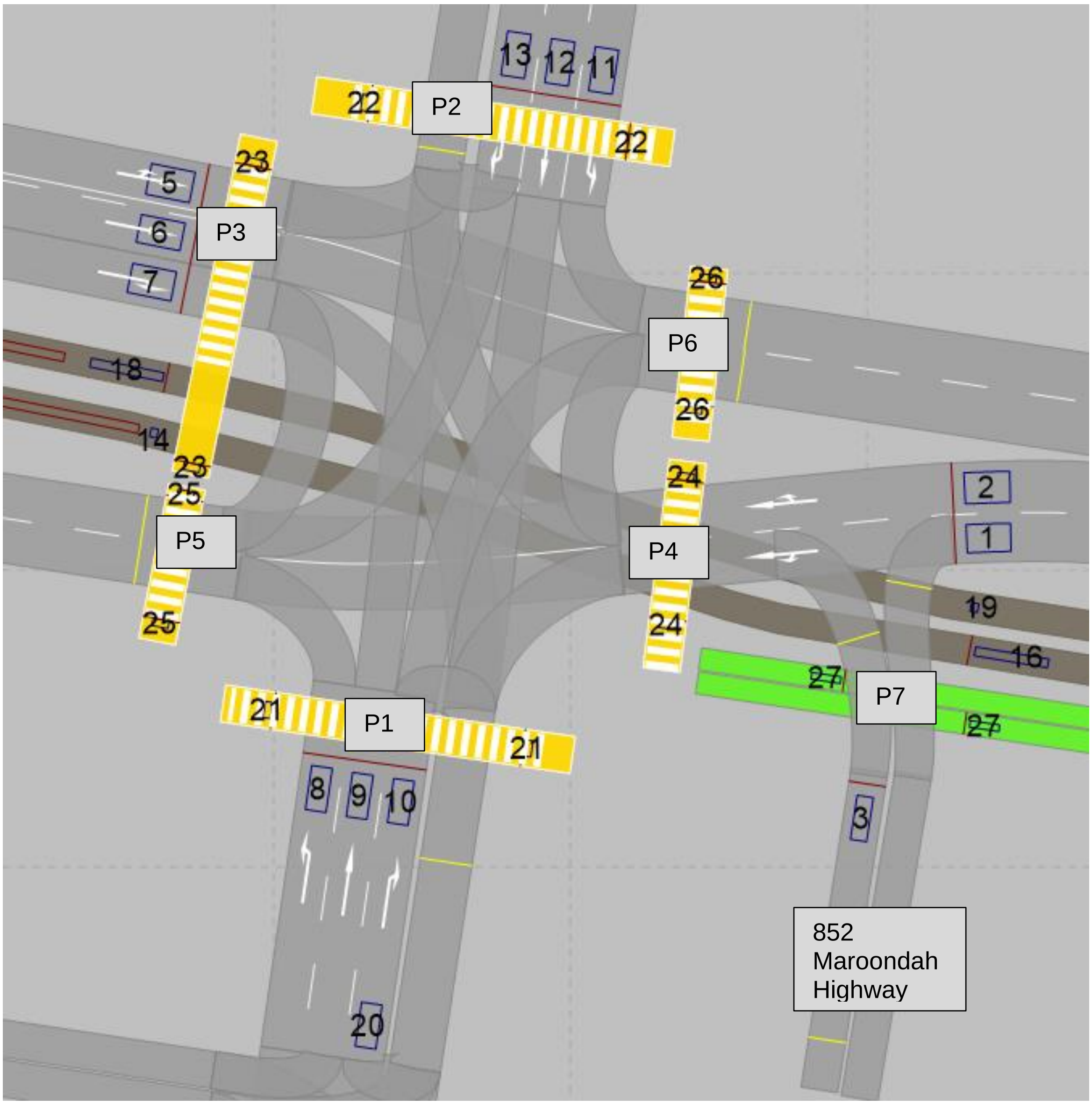


Figure 4.6 **Detector Map for Whitehorse Road / Nelson Road**

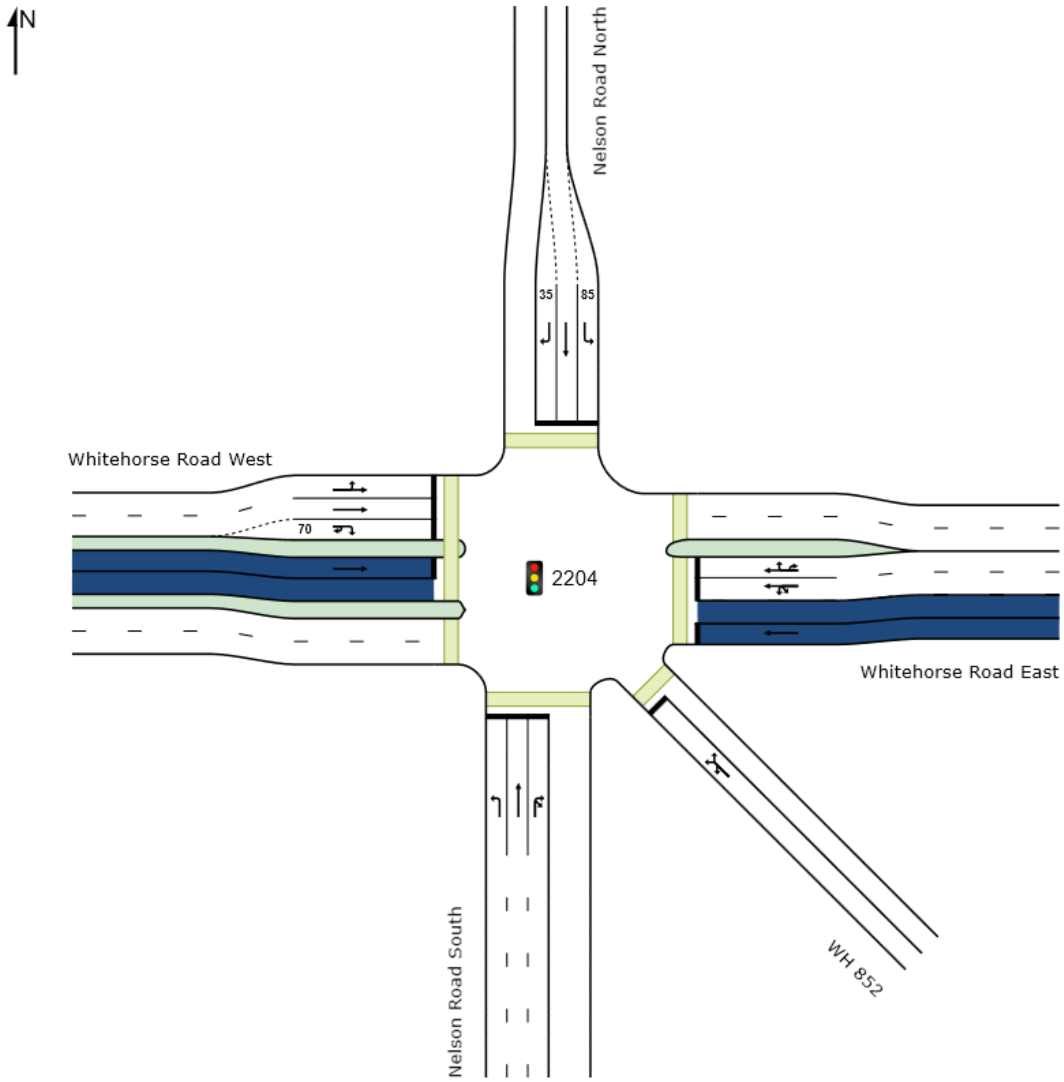


Figure 4.7 SIDRA intersection layout for Whitehorse Road / Nelson Road

Table 4.4 2041 Rail Day 1 general traffic signal timing parameters for Whitehorse Road / Nelson Road

Parameter	Phase							
	A	B	C	D	E	F	G	H
Inter-green (yellow/all-red)	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5	4.5 / 2.5
Minimum green (s)	10	6	8	6	6	6	6	6
Gap (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Early cut-off (s)	-	-	-	-	-	-	-	-
Max. Extn. Green, Plan 1: 7:00-10:00 (s)	38	28	12	8	8	34	8	8

Parameter	Phase							
	A	B	C	D	E	F	G	H
Max. Extn. Green, Plan 2: 15:00-19:00 (s)	12	50	20	8	20	24	8	8

Table 4.5 2041 Rail Day 1 pedestrian timing parameters for Whitehorse Road / Nelson Road

Parameter	Pedestrian Movement						
	P1	P2	P3	P4	P5	P6	P7
Walk Time (s)	8	8	10	10	9	9	16
Clearance Time (s)	12	13	8	8	7	7	6

4.5.4 Whitehorse Road / Station Street (SCATS Site 2206)

The intersection control at the intersection of Whitehorse Road with Station Street changes significantly due to the realignment of the corridor in the Rail Day 1 scenario. The median is removed and the right turn movements from the north and east approach are banned. The pedestrian and cycle path crossing on the Station Street south approach is also set back. The new proposed phase sequence is A1-B-C-D or A2-B-C-D and is described below:

- Phase A1 facilitates the Whitehorse Road east and west approach's left-turn and through movements together with the pedestrian / cyclist movement across Station Street south (P1) and Station Street north (P2). Phase A1 is activated on pedestrian / cyclist demand at pedestrian crossing P1 (Detector 25).
- Phase A2 runs as an alternative phase to A1 in the event there is no pedestrian / cyclist demand at P1.
- Phase B facilitates the Station Street south movements together with the Whitehorse Road east approach left turn and pedestrian movement P3.
- Phase C facilitates the Station Street north and south approaches left turn and through and pedestrian movements P3 and P5.
- Phase D facilitates all Whitehorse Road west approach movements and the Station Street south approach left turn and pedestrian movement P2.

A map of detectors placed on the intersection approaches and the SIDRA phasing arrangements are shown in Figures 4-8 to Figures 4-9. Timing parameters are shown in Table 4.6 and Table 4.7.

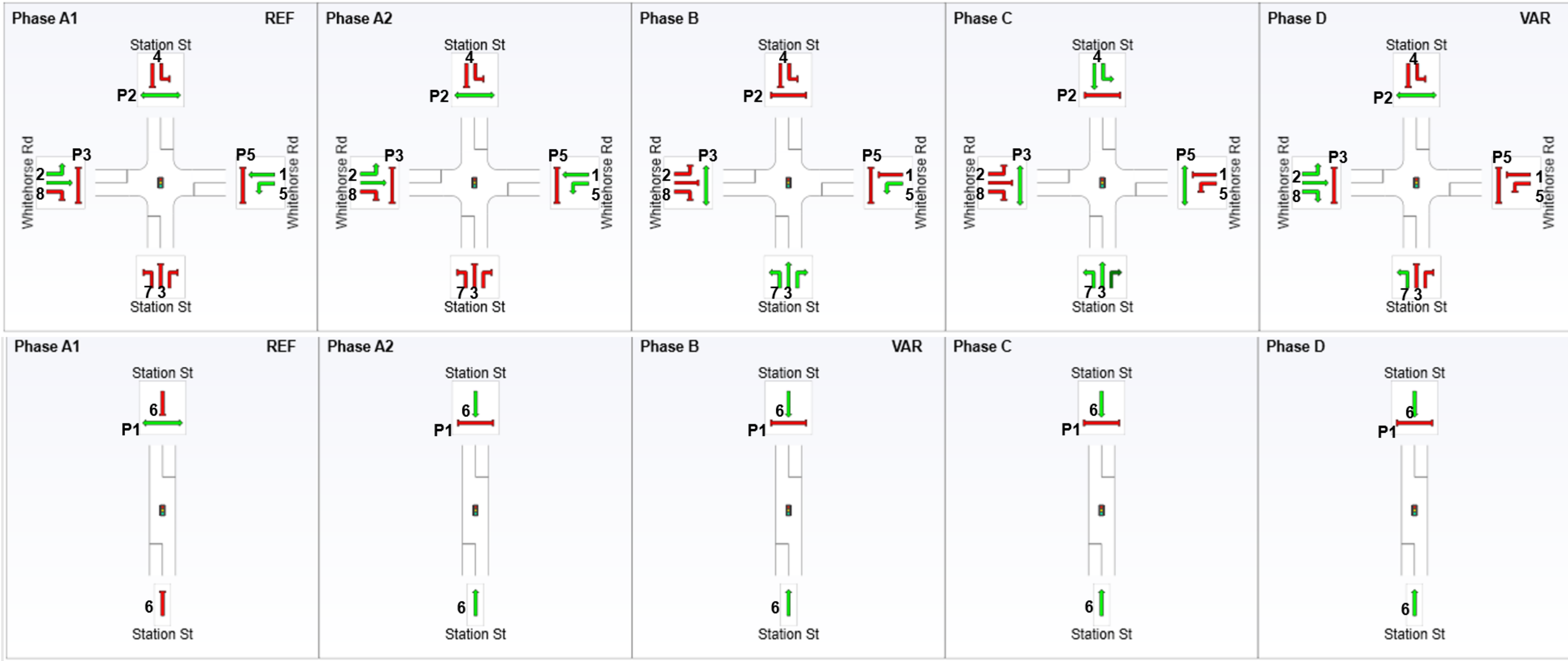


Figure 4.8 **SIDRA intersection layout for Whitehorse Road / Station Street**

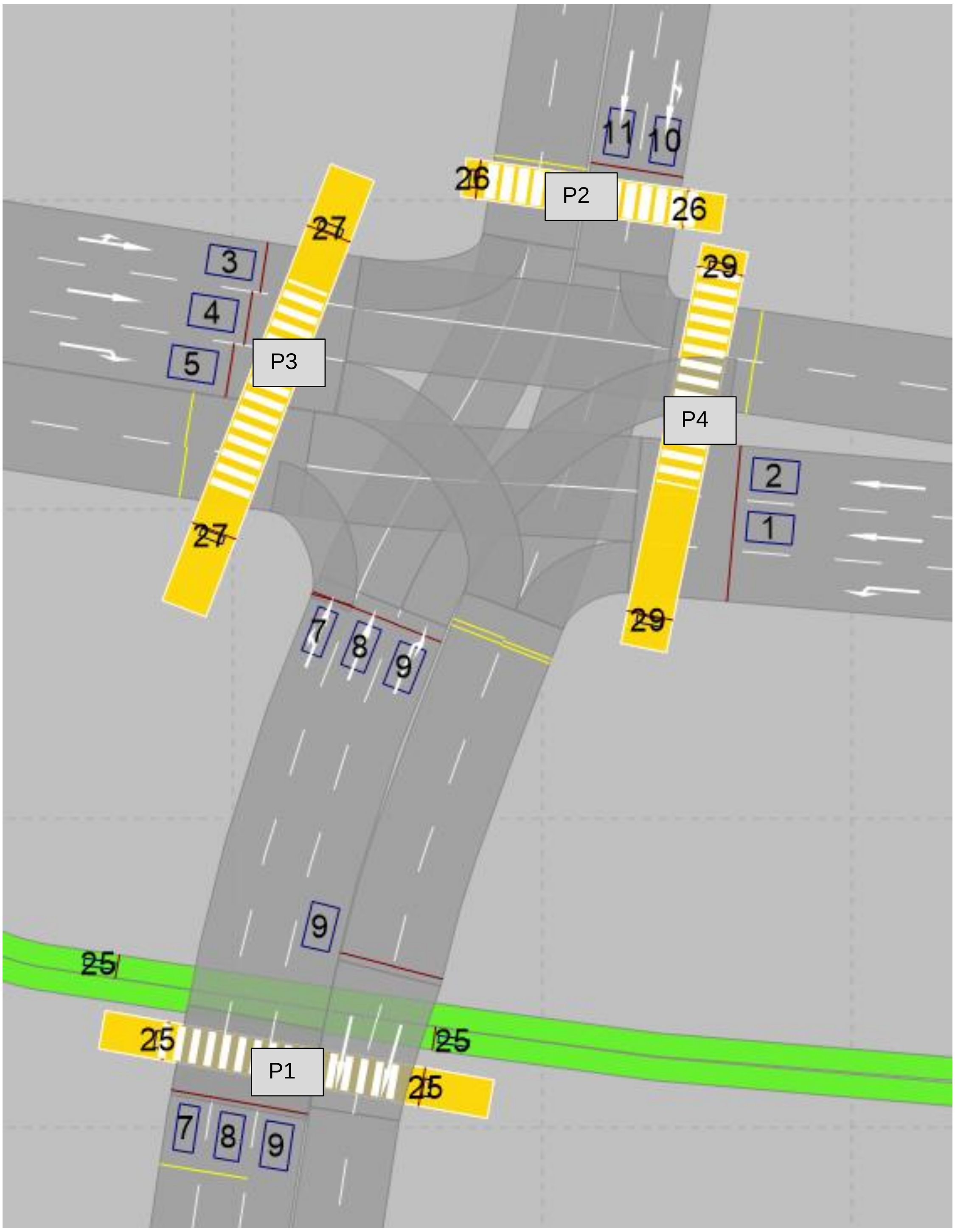


Figure 4.9 **Detector Map for Whitehorse Road / Station St**

Table 4.6 2041 Rail Day 1 general traffic Signal Timing Parameters for Whitehorse Road / Station Street

Parameter	Phase			
	A	B	C	D
Inter-green (yellow/all-red)	4.0 / 2.0	4.5 / 2.5	4.0 / 2.0	4.0 / 2.0
Minimum green (s)	10	8	8	8
Gap (s)	2.5	2.5	2.5	2.5
Early cut-off (s)	-	-	-	
Max. Extn. Green, Plan 1: 7:00-10:00 (s)	40	15	36	16
Max. Extn. Green, Plan 2: 15:00-19:00 (s)	29	19	35	24

Table 4.7 2041 SRL Pedestrian Timing Parameters for Whitehorse Road / Station Street

Parameter	Pedestrian Movement			
	P1	P2	P3	P5
Walk Time (s)	12	12	12	12
Clearance Time (s)	8	8	8	8

Whitehorse Road / Watts Street (SCATS Site 2010)

The existing POS at Watt Street will be converted to a four-arm signalised intersection allowing:

- Full movements from Watts Street south approach
- Left-turn movement only from Watts Street north approach to Whitehorse Road eastbound
- Standard phase sequence is A-B

A map of detectors placed on the intersection approaches and the SIDRA intersection layout and phasing arrangements are shown in Figures 4.8 to Figures 4.9. Timing parameters are shown in Table 4.8 and Table 4.9.

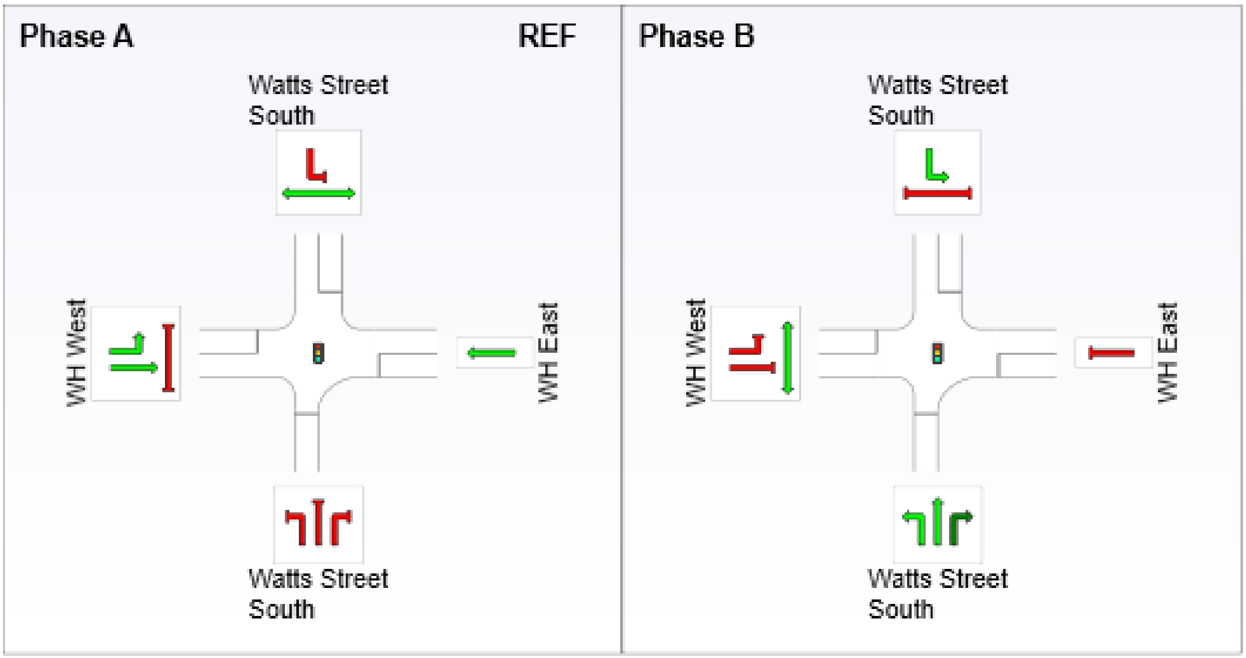


Figure 4.10 **SIDRA intersection layout for Whitehorse Road / Watts Street**

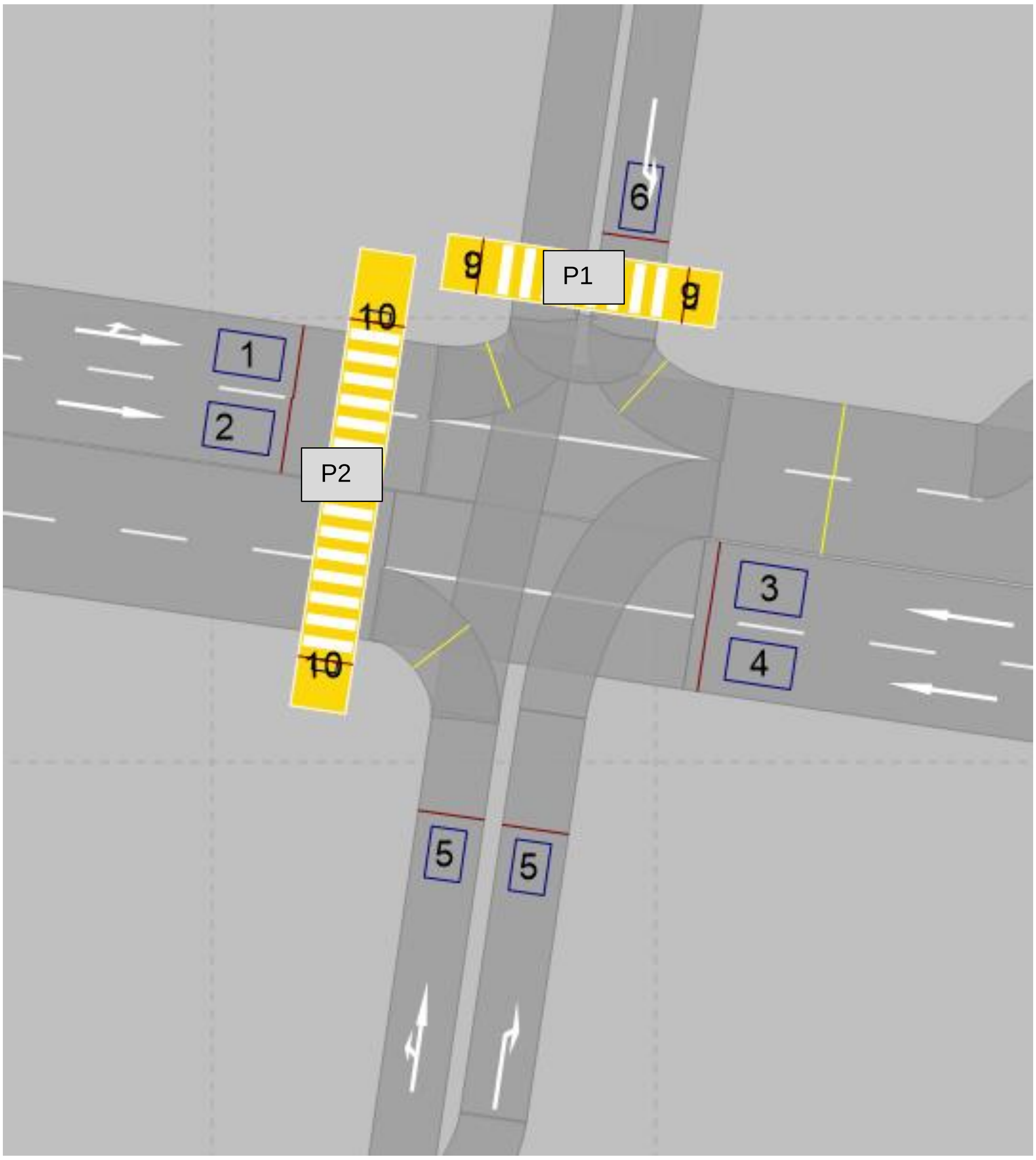


Figure 4.11 Detector Map for Whitehorse Road / Watts Street

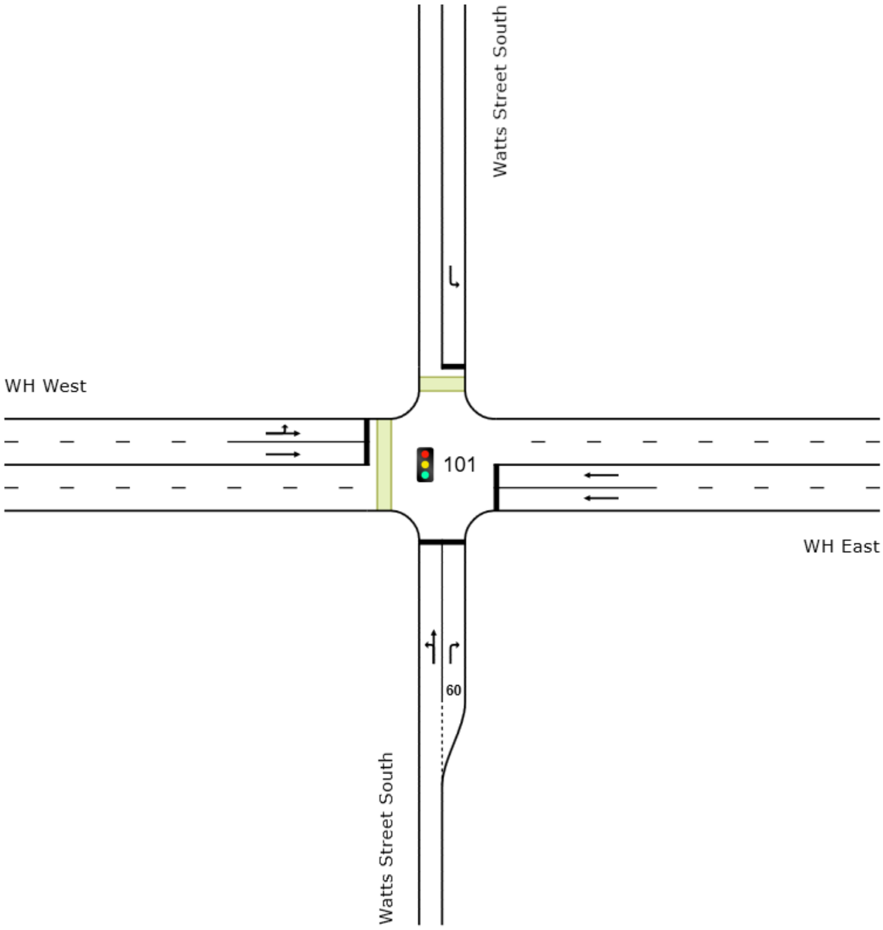


Figure 4.12 SIDRA intersection layout for Whitehorse Road / Watts Street

Table 4.8 2041 Rail Day 1 signal timing parameters for Whitehorse Road / Watts St

Parameter	Phase	
	A	B
Inter-green (yellow/all-red)	4.0 / 2.0	4.5 / 2.5
Minimum green (s)	12	6
Gap (s)	2.5	2.5
Early cut-off (s)	-	-
Max. Extn. Green, Plan 1: 7:00-10:00 (s)	120	16
Max. Extn. Green, Plan 2: 15:00-19:00 (s)	120	16

Table 4.9 2041 Rail Day 1 pedestrian timing parameters for Whitehorse Road / Watts St

Parameter	Pedestrian Movement

	P1	P2
Walk Time (s)	8	8
Clearance Time (s)	10	12

4.5.5 Other Intersections

The remaining intersection sites will not be modified from their existing operations in the Rail Day 1 Scenario. These include:

- SCATS Site 2203 Whitehorse Road / Elgar Road;
- SCATS Site 2209 Whitehorse Road / Linsley Road; and
- SCATS Site 3939 Station Street / Rutland Road

The tables below illustrate how the signals at these intersection sites perform in the 2041 Rail Day 1 scenario (Model) against the 2021 SCATS data in terms of actuations and phase times.

SCATS Site 2203 Whitehorse Road / Elgar Road

The minimum phase times all increase (except for Phase E) in the 2041 Rail Day 1 scenario. And the 2041 Rail Day 1 average cycle time in the AM and PM peak period exceed 160 seconds. The model indicates confirmation from experienced network operation engineers is required to confirm that the intersection requires this length of cycle time to service the volume of traffic. However, it is noted that in Victoria, congested intersections can require and operate satisfactorily with cycle lengths between 140 seconds and up to 180 seconds in the peak hours. According to DoT's Movement and Place framework, this correlates to the intersection of two GT2 classification roads. While the section of Elgar Road within the Box Hill microsimulation network is not strictly GT2, a section slightly south between Canterbury Road and Whitehorse Road is GT2. For legibility and coordination with adjacent intersections such as Station Street / Whitehorse Road, a higher cycle time was applied than the suggested Movement and Place framework.

Table 4.10 AM peak period signal comparison results - Whitehorse Road / Elgar Road

Signal Calibration Results - 7:30-9:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	56	45	21	30	57	38	36	37	28%	23%	2,032	1,667	-18.0%
B	8	22	0	14	13	15	12	15	1%	5%	96	330	243.8%
C	52	44	13	13	14	14	13	13	9%	8%	676	572	-15.4%
D	56	45	15	29	48	48	30	45	23%	28%	1,688	2,030	20.3%
E	56	45	15	12	24	25	22	23	17%	14%	1,221	1,017	-16.7%
F	12	18	0	11	11	11	11	11	2%	3%	132	198	50.0%
G	56	45	14	16	44	44	24	32	19%	20%	1,365	1,436	5.2%
									Total (s)		7,210	7,250	0.6%
									Average Cycle Time(s)		129	161	25.1%

Table 4.11 PM peak period signal comparison results - Whitehorse Road / Elgar Road

Signal Calibration Results - 15:30-18:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	84	65	19	30	54	43	32	39	25%	23%	2,681	2,518	-6.1%
B	38	36	0	13	14	17	13	17	5%	6%	503	602	19.7%
C	81	63	13	13	14	13	13	13	10%	8%	1,053	819	-22.2%
D	84	65	14	28	50	48	27	43	21%	26%	2,233	2,804	25.6%
E	84	65	12	21	24	23	22	22	17%	13%	1,876	1,451	-22.7%
F	18	24	0	0	11	11	11	11	2%	2%	198	264	33.3%
G	84	65	16	24	43	39	27	36	21%	22%	2,247	2,333	3.8%
										Total (s)	10,791	10,791	0.0%
										Average Cycle Time(s)	128	166	29.2%

SCATS Site 2209 Whitehorse Road / Linsley Road

This intersection demands similar average cycle timings in the 2041 Rail Day 1 scenario compared to the 2021 Base Year for both the AM and PM peak periods. The maximum phase times for Phase A are a result of low demand from Linsley Road whereby the controller is permitted to rest on Phase A (pivot phase) until a vehicle calls a detector on the south approach (Linsley Road).

Table 4.12 AM peak period signal comparison results - Whitehorse Road / Linsley Road

Signal Calibration Results - 7:30-9:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	54	56	83	79	243	176	108	107	82%	81%	5,832	5,969	2.3%
B	55	56	13	14	41	28	23	24	18%	19%	1,271	1,355	6.6%
C													
D													
E													
F													
G													
										Total (s)	7,103	7,324	3.1%
										Average Cycle Time(s)	129	131	1.3%

Table 4.13 PM peak period signal comparison results - Whitehorse Road / Linsley Road

Signal Calibration Results - 15:30-18:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	84	92	24	27	239	127	107	93	83%	79%	9,013	8,540	-5.2%
B	82	93	13	13	41	30	22	24	17%	21%	1,794	2,242	25.0%
C													
D													
E													
F													
G													
										Total (s)	10,807	10,782	-0.2%
										Average Cycle Time(s)	129	117	-8.9%

SCATS Site 3939 Station Street / Rutland Road

This intersection demands a lower average cycle length in the AM peak period but a higher average cycle length in the PM peak period. Overall, however, the results show a similar average signal timings in the 2041 Rail Day 1 scenario compared to the 2021 Base Year for both the AM and PM peak periods.

Table 4.14 AM peak period signal comparison results - Station Street / Rutland Road

Signal Calibration Results - 7:30-9:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	56	66	46	41	94	67	79	60	61%	55%	4,423	3,962	-10.4%
B	56	60	12	12	13	17	12	16	10%	13%	687	961	39.9%
C	56	66	11	12	30	30	17	21	14%	19%	978	1,390	42.1%
D	23	28	11	11	19	19	17	13	5%	5%	381	363	-4.7%
E	56	37	11	11	23	23	13	15	10%	8%	748	572	-23.5%
F													
G													
										Total (s)	7,217	7,248	0.4%
										Average Cycle Time(s)	129	110	-14.8%

Table 4.15 PM peak period signal comparison results - Station Street / Rutland Road

Signal Calibration Results - 15:30-18:30

Phase	Frequency		Minimum (s)		Maximum (s)		Average (s)		Average (%)		Total (s)		
	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	SCATS	Model	% Error
A	84	78	33	39	79	57	60	56	46%	40%	5,019	4,355	-13.2%
B	84	74	12	12	12	21	12	19	9%	13%	1,008	1374	36.3%
C	84	77	11	15	30	25	16	23	13%	16%	1,372	1768	28.9%
D	84	77	11	11	34	31	24	26	19%	18%	2,037	1997	-2.0%
E	84	71	11	11	22	23	16	19	13%	12%	1,379	1333	-3.3%
F													
G													
										Total (s)	10,815	10,827	0.1%
										Average Cycle Time(s)	129	139	7.8%

5 Demand

The demand forecasting applied to all the micro-simulation models generally take a three-step approach. The process is summarised by Figure 5.1 below.

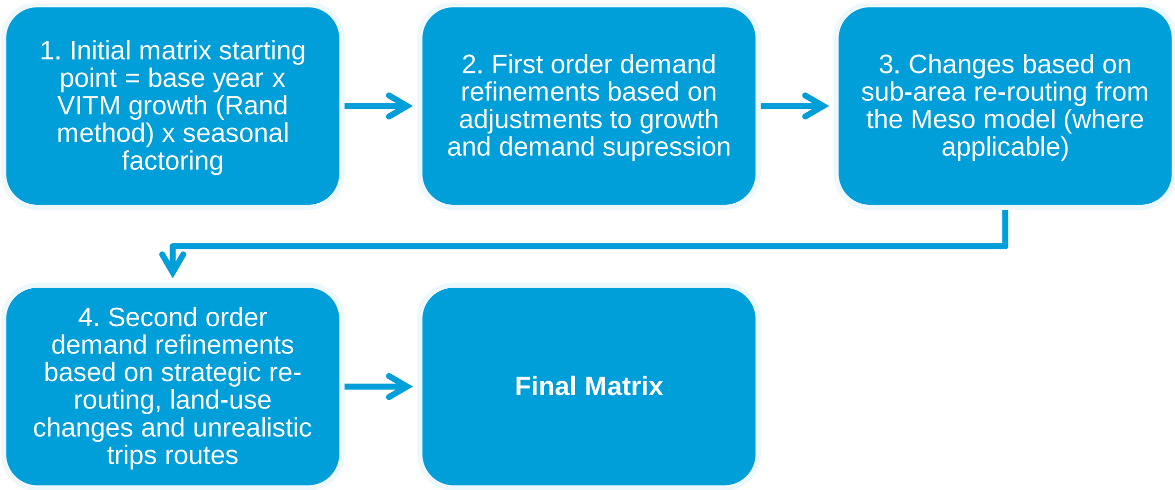


Figure 5.1 Microsimulation model general demand forecasting methodology

The zone system for the Box Hill micro-simulation model is shown below by Figure 5.2 to aid the reader understand some of the changes to the demand matrix. Also, the VITM to micro-simulation zone concordance tables are provided in Appendix B.

Figure 5.2 **Box Hill Micro-simulation Zone System**

5.1 Step 1

The general approach to preparing the future forecast traffic demands for the micro-simulation models has been to develop zonal growth rates between the base year and future years from the corresponding VITM strategic models. These growth rates are then applied to the micro-simulation year trip matrices (in a method known as pivoting) using matrix balancing techniques to produce the future year trip matrices. Further seasonality factoring has also been considered in this step to account for the 90 percentile busiest AM/PM periods. This is described further in Section 5.1.1 below.

It is important to emphasise that the method uses VITM solely for the purpose of extracting the changes in vehicle trip generation in each zone between the base year and forecast year. The trip distributions (O-D matrices) produced by the VITM are not considered because while the VITM generally validates well at the aggregate trip generation level, the validation tends to become progressively worse following each successive step in the process through trip distribution/mode choice and traffic assignment. The VITM cannot be expected to produce reliable estimates of individual zone-to-zone trips.

Applying the zonal-level growth factors to the locally calibrated year matrix for each model has the advantages of:

- Preserving the general trip patterns inherent in the calibrated local area model year matrix; and
- Utilising data from VITM at the highest possible level of aggregation - and reliability - consistent with data requirements.

5.1.1 Seasonality Factoring

Seasonality factoring has been incorporated as a global factor adjustment (whereby all origin and destination pairs have been factored consistently) to account for the 90 percentile busiest AM/PM periods. Whilst the 90 percentile AM and PM period within the data provided fall on the 37 busiest day it is noted that there is little material difference in daily volumes between the 37 and the 30 day which is suggested in the modelling guidelines. Irrespective of the percentile day the peak hour volumes relate to, it is noted that the base model volumes are only exceeded on 10% of days of the year and therefore are acceptable for the purpose of the report to support planning approval.

To develop a future demand model representing the 90 percentile annual period this factor has been applied where necessary to the initial demand forecasts. It has been calculated from an analysis of historic SCATS detector actuations for all signalised intersections within each of the model areas. Specifically, total detector actuations for the morning model period (07:00-10:00) and afternoon model period (15:00-19:00) were extracted from the SCATS detector records for each day of 2019 and ranked in descending order. The 90 percentile busiest period (rank no. 37) was then compared to the relevant 2021 survey day, and the ratio of detector actuations between the two used to calculate a design day factor.

As such, the seasonality scaling factor which was applied, scales the demand from the survey day to the 90th percentile busiest period. The ratio of the 90th percentile actuations to the survey period actuations is taken as the scaling factor. Therefore, in summary the seasonality factor has been calculated separately for the AM and PM periods and comprises the ratio of the sum of the network movements from the 90 percentile day peak period divided by the sum of the network movements as surveyed.

The resultant factors are set out in Table 5.1 for the Box Hill micro-simulation model, and these were applied as a single factor across all 15-minute demand matrices over the entire model period.

Because all detector actuations have been used – including vehicle, pedestrian and special vehicle detectors – the design day factor is based on what may be termed a total road user activity indicator rather than being based on private vehicle traffic alone.

By using the ratio of survey day traffic to 2019 90 percentile traffic, it is implicitly assumed that traffic volumes will, over the forecast period, return to pre-COVID levels and seasonal patterns. This is considered a conversative approach particularly around rail stations, with a likely increased propensity for people to adopt a hybrid working model (i.e. part time at home, part time at a workplace office).

Table 5.1 **Seasonality factors**

Precinct Model	Survey Date	Survey Day SCATS Actuations		2019 90th Percentile SCATS Actuations		90^{th} Percentile Busiest Period Factor	
		AM (7-10)	PM (3-7)	AM (7-10)	PM (3-7)	AM (7-10)	PM (3-7)
Box Hill	Tue 23/2/2021	68,720	106,793	77,588	114,697	1.129	1.074

5.1.2 Adjusted Growth

A summary of the final total trip growth for each future scenario is presented in Table 5.2. This provides a quick snapshot of the trip growth in each period, relative to the 2021 observed trips, across all precinct models and scenarios, used to produce the design day traffic demands.

Table 5.2 **Total matrix trip growth factors from 2021 observed base, all vehicles, model evaluation period**

Precinct Model and Time Period		Scenario				
		1 (2031 Base Case)	2 (2036 Base Case)	3 (2036 SRL)	4 (2041 Base Case)	5 (2041 Rail Day 1)
Box Hill	AM (07:30-09:30)	1.22*	1.26	1.23	1.30	1.28
	PM (15:30-18:30)	1.17	1.21	1.19	1.25	1.23

*Note: Trip growth factors are **not** annual growth rates. i.e. 1.22 is the total growth rate between 2021 and 2031.

5.2 Step 2

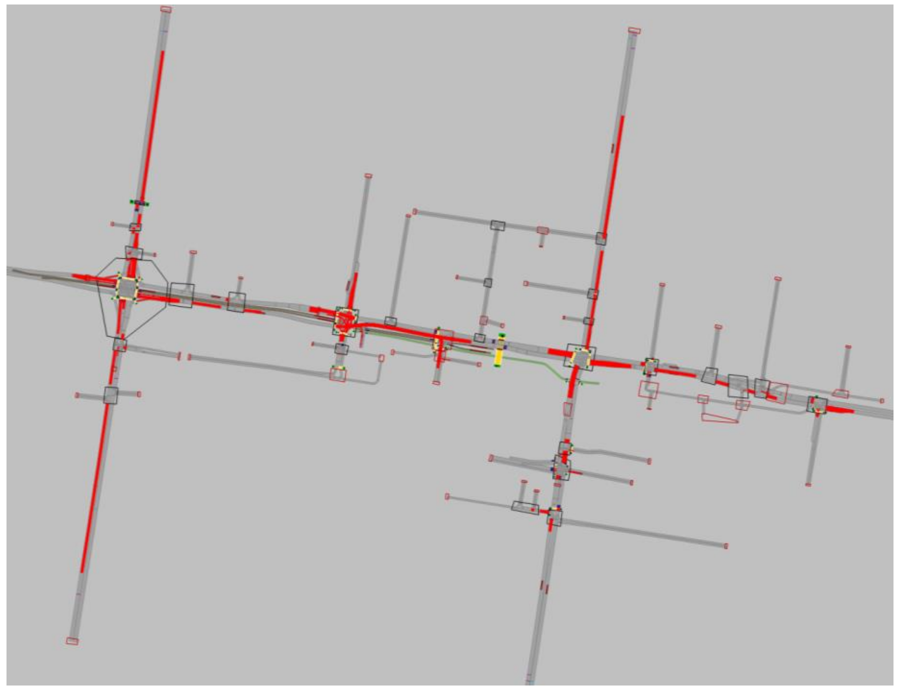
After having adopted the demand produced for the micro-simulation models from step 1, initial model runs for the 2041 Rail Day 1 Scenario showed that the Box Hill network was significantly over capacity in the AM and PM peak periods. Furthermore, the model outputs showed substantial queueing at select intersections representing impractical travel times and producing significant latent demand, as seen in Table 5.3.

This can also be seen in Table 5.4 which shows a clear change in average queue length in the AM and PM peak periods against both a full demand and reduced demand input. This includes improvements in queue length along Elgar Road and Station Street (both north of Whitehorse Road), as well as the section of Whitehorse Road approaching Elgar Road from the west. This led to a review of the VITM based “unconstrained” demand from VITM, which does not have a demand ceiling based on network capacity and other factors (further discussed in Appendix A).

Table 5.3 Comparison of network statistics between full 2041 Rail Day 1 demand and refined demand

Network Statistics	2041 Rail Day 1 Full Demand		2041 Rail Day 1 Reduced Demand	
	AM	PM	AM	PM
Total Travel time (hours)	820	724	668	644
Total Delay (hours)	548	445	392	369
Average Delay (Secs)	199	162	142	136
Average Speed (kph)	13	14	16	16
Latent demand (number of vehicles)	286	673	36	116

Table 5.4 **Comparison of 2041 Rail Day 1 full demand average queue length and 2041 Rail Day 1 refined demand average queue length**

AM PEAK HOUR PERIOD	
Full Demand – Average Queue	Refined Demand – Average Queue
	
PM PEAK HOUR PERIOD	
Full Demand – Average Queue	Refined Demand – Average Queue
	

As described earlier, for simplicity and in order to develop a timely model sufficient for adoption as part of the planning approval processes, blanket growth factors were applied based on network surveys and SCATS data. In reality, growth around a network is more organic and different links and movements within links may well be subject to different rates of change over time.

Where the network as a whole responded reasonably, the blanket growth factor approach for the purpose of planning was considered acceptable and provided sufficient confidence that the project would be able to manage impacts to the road network adequately.

However, where initial performance of the network was more constrained, further consideration of the broad growth factors was warranted. For example, across all of Greater Melbourne, a moderate annual increase in traffic volumes is observed, however for selected sites within the inner south/east areas of Melbourne, the data shows a moderate decrease in traffic volumes. This is at odds with the VITM data which shows continual traffic growth over time. Given the roads and surrounding land use at the SRL East precincts are likely to more closely resemble that of inner south/east areas, there is justification to potentially restrict future traffic growth in the SRL East precincts. This is expanded on further in Appendix A.

Individual movement growth is influenced by:

- Constraints on up and downstream links
- Type of trips and whether they are local, sole purpose, pass by or through trips
- Localised densification and growth compared to state-wide growth

In addition, growth is unlikely to be constant over longer horizons as networks demands increase. It is widely accepted that as networks become more congested, human nature, advances in technology, as well as greater awareness of outside factors such as the environment, result in individuals making choices to avoid congestion. These choices include:

- Peak spreading, where drivers choose to travel earlier or later to avoid congested periods
- Change of mode, trips changing to modes less subject to queuing and congestion such as car to bike / electric bike / scooter
- Adoption of flexible working practices

While full analysis of all the highway links in VITM in terms of key influences and adopted growth was not a viable model refinement stage given the constraints of the project's timeline, the highway links corresponding to the major VISSIM model entry zones were considered.

In general, it was considered that the primary entry zones into the network would in practice be likely to have reduced growth from the base model due to the inclusion of through traffic unlikely to be subject to the same level of growth as local highway links where growth would be associated with the densification of the area and change in path choice which triggers increased trip generation.

Slightly higher growth discrepancies were anticipated in the PM peak hour as a result of the significant queuing observed as drivers take up personal travel choices including peak spreading, journey route changes and mode changes to avoid unreasonable delays.

Instead of reducing the global factor, that was applied matrix wide (discussed in Section 5.1.1 and which may overestimate the volumes on major roads, it was determined to reduce the individual VITM growth factors at the highway links applied at the VISSIM zones of concern. This was determined through a trial and error process to identify an overall network demand that would realistically be expected to be accommodated. At an aggregate level, VITM has been used to extract these growth rates for each microsimulation (VISSIM) zone based on growth in what was by inspection judged the most representative VITM zone or link to that VISSIM zone (refer to Figure B.1 in Appendix B). For microsimulation external model entry and exit zones (such as VISSIM zones 1, 3, 15, 20, 26 and 36), this corresponds to the arterial road access points to the wider network. Here, growth rates were based on traffic growth on the link from VITM. Engineering judgement was exercised to inform the extent to which the VITM growth factors were reduced by and was generally kept to within the typical daily fluctuations of +/- 10%.

The review found that external to external trips from Elgar Road, Whitehorse Road and Station Street on particular movements were well over capacity and required demand adjustments. (For the purposes of the EES modelling work, SRLA instructed AJM that network capacity changes were out of scope other than future reference case improvements as agreed with DoT and Whitehorse City Council.)

Table 5.5 and Table 5.6 summarise the manual adjustments made to the future year demand matrices with respect to trip suppression for the AM and PM peak hour periods respectively. They were made to the Base Case, Construction Impact and Rail Day 1 scenario matrices.

These changes were made only between external zones, that is zones which start or end at the edge of the network.

Table 5.5 2031 and 2041 AM peak period vehicle trip demand suppression adjustments

Trip	Origin Zone	Destination Zone	% of trips removed
Right turn from Whitehorse Road West to Elgar Road South	1	36	9.5%
Eastbound trip along full length of Whitehorse Road	1	20	4%
Southbound trip along full length of Elgar Road	3	36	5%
Northbound trip along full length of Elgar Road	36	3	9.5%
Northbound trip along full length of Station St	26	15	8.6%

Table 5.6 2031 and 2041 PM peak period vehicle trip demand suppression adjustments

Trip	Origin Zone	Destination Zone	% of trips removed
Right turn from Whitehorse Road West to Elgar Road South	1	36	15.5%
Eastbound trip along full length of Whitehorse Road	1	20	7.5%
Southbound trip along full length of Elgar Road	3	36	5%
Northbound trip along full length of Elgar Road	36	3	11.5%
Northbound trip along full length of Station St	26	15	5%

Trip	Origin Zone	Destination Zone	% of trips removed
Southbound trip along full length of Station St	15	26	5%

These factors were applied for the 2041 Base Case initially, the same reductions factors were adopted for the 2041 Rail Day 1, 2031 Construction Impact and 2031 Base Case scenarios. Both the AM peak period and PM peak period were adjusted. This makes the comparison between the Base Case and Rail Day 1 scenarios and different time periods consistent.

The application of this demand suppression at the key model entry and exit points does not skew project outcomes and offers realistic representation of the future network performance for the following reasons:

- The demand suppression only applies to trips between external zones;
- There is still a degree of latent demand present in the AM and PM peak periods (as seen in Table 5.3) even after demand suppression;
- The improvements in average speed are, for all intents and purposes, indistinguishable between the full demand and reduced demand scenarios; and
- All other OD zone pair combinations (excluding those starting or ending at 1, 8, 15 and 20) remain broadly the same in their volumes

Note, due to time limitations AJM acknowledge this is a simplistic approach and further assessments can be undertaken to model alternative adjustments. However, the same VITM growth limitations are present in all the other traffic models.

5.3 Step 3

As the microsimulation models are confined to a limited area proximate to the SRL East stations, they do not capture any wider area re-routing of traffic expected to occur from the Project's impact. To capture the effects of expected re-routing, the Box Hill mesoscopic (SRL VISUM) model has been used to feedback changes in the micro-simulation demand matrix as a result of traffic re-routing.

For Box Hill, the model hierarchy and relationship between the models in terms of traffic demand is summarised in Figure 5.3. These precincts utilise strategic, mesoscopic and microsimulation models. This methodology has been applied because these are localities where re-routing is a key impact of the 2031 Construction and 2041 Project scenarios. It is important, therefore, that the mesoscopic model is utilised to fully capture traffic re-routing in sufficient detail for impacts to be properly captured and assessed in the more detailed microsimulation models.

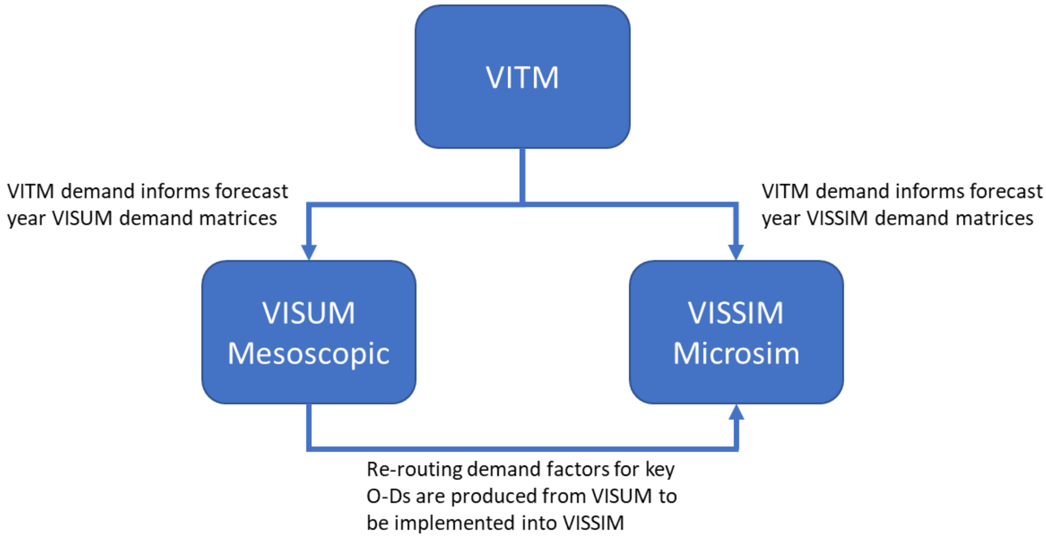


Figure 5.3 **Model Relationships**

5.3.1 Incorporating Re-routing

The basic approach has been to adjust the through-traffic trips between the major road access points to/from the microsimulation model, based on the percentage changes in these trips obtained from the corresponding SRL Box Hill VISUM model.

Stage 1 - Zonal Reassignment Factors from Mesoscopic Models

The first stage was to derive a series of zonal growth factors which reflected the change in trips arising from the traffic reassignment effects of the SRL East project. The following procedure was adopted:

1. From the corresponding SRL East mesoscopic model, a sub-area matrix corresponding to the microsimulation model area was extracted for selected forecast scenarios.
2. The reassignment was assumed to be significant only for trips between the major arterial road access points to/from each model area. The zones corresponding to these points are set out in Table 5.7.
3. For the identified external zones, an external-external (EE) trip matrix was extracted from the mesoscopic sub-area matrix for each future scenario.
4. For each identified zone, calculate the change in trips by comparing the Base Case with Rail Day 1 trips (i.e. row and column totals from mesoscopic EE matrices) to obtain a re-assignment factor for inbound and outbound trips separately. The resultant zonal growth factors are shown in Table 5.8.

At this point, no further use was made of the mesoscopic model results in this demand forecasting – instead, the derived factors were used in a pivoting process as explained below.

It is noted that the reassignment was limited to external-to-external major (arterial road) trips for two reasons:

a. These are the trips that have the greatest discretion in route choice – if they are not destined to or originating from the precinct, one could circumvent them i.e. it is these trips that will most likely be sensitive to reassignment; and
b. The mesoscopic models are based on VITM-sized zones, and as such lack the fine zonal definition to credibly reassign local trips within a relatively small study area such as those for the micro-simulation models. Using the mesoscopic models to reassign local traffic would likely

produce spurious results which within the timeline of the project would eb unable to be investigated further.

Table 5.7 **Reassignment zones for Box Hill model**

Reassignment Zone No	Description
1	Whitehorse Road west model access point
3	Elgar Road north model entry point
15	Station Street north model access point
20	Whitehorse Road east model access point
26	Station Street south model access point
36	Elgar Road south model access point

Table 5.8 **Box Hill 2041 (Scenario 5) Reassignment Factors for Selected External Zones**

Vehicle Type	Time Period	Trip Direction	External Zones Reassignment Factor					
			Z1	Z3	Z15	Z20	Z26	Z36
LV	AM	In	1.00	0.99	0.76	0.86	0.90	0.99
		Out	1.00	0.95	1.39	0.54	0.99	0.98
	PM	In	0.94	1.02	0.95	0.71	0.97	1.06
		Out	1.00	0.96	0.95	0.60	0.99	1.08
HV	AM	In	0.99	1.12	1.12	0.48	1.22	1.15
		Out	1.11	0.82	1.33	0.76	1.70	1.02
	PM	In	1.02	1.17	1.28	0.98	1.24	1.14
		Out	1.01	1.12	1.48	0.58	1.08	1.37

Stage 2 – Identify Peak Period Matrices

Traffic reassignment is expected to be associated with the congestion during peak period traffic conditions, so it was not deemed appropriate to apply the reassignment changes to all 15-minute time periods over the model period.

To account for this, an extended peak period was identified, corresponding to all contiguous time periods where the 15-minute matrix demand was within (a somewhat arbitrary) 90% of the highest 15-minute demand. The reassignment factors were then applied to these matrices only.

Stage 3 –Pivoting

Standard pivoting methods were used to apply the meso-based reassignment factors as follows:

1. For each selected future SRL East scenario, the EE matrix from the corresponding base case was extracted for each 15-minute matrix within the extended peak period;
2. The reassignment factors were applied to the row and column totals of each EE matrix, then factored to a common control total;
3. Each EE matrix was then balanced using the standard furness method; and
4. Each EE matrix was then substituted into the corresponding Rail Day 1 matrix to yield the reassignment-adjusted matrix.

5.4 Step 4

Once the raw VITM demands are produced and any re-routing had been incorporated, the final step in the demand forecasting process was the refinement and sense checking of the trip matrices. This step utilised manual adjustments to cater for a range of things for the future No SRL and Rail Day 1 scenarios, including:

1. Adjustment and/or removal of demands between zone pairs that are not realistic or would not exist based on future land-uses;
2. Adjustment and/or removal of demands between zone pairs that are not possible in the future due to a feasible route not being available in the model; and
3. Refinement of trip demands based on realism checks (and limitations) of the raw unconstrained VITM growth and consequent unrealistic network operation.

Table 5.9 summarises the matrix adjustments implemented due to infrastructure and movement changes resulting in infeasible trips in the matrix vis-à-vis Point 1 above.

Table 5.9 Turning movement changes in the 2041 Rail Day 1 scenario

Trips from Zones	Trips to Zones	Matrix Modification	Reason
16,17,18,19,20,21,22,39	9,10,11,12,13,14,15	All trips to be removed from the model	Banned right turn from Whitehorse Road East to Station Street North makes the trip infeasible. Rerouting of trips are incorporated in Step 2 to account for re-assigned movements
9,10,11,12,13,14,15	1,2,3,4,5,6,7,8,30,31,32,33,34,35,36,37	All trips to be removed from the model	Banned right turn from Whitehorse Road East to Station Street North makes the trip infeasible. Rerouting of trips are incorporated in Step 2 to account for re-assigned movements
1,3,7,33,36	30	Rerouted to approach from Station Street South	Banned right turn into Clisby Court makes the trip infeasible
8	1-7,30-37	All trips to be removed from the model	No U-turn at Station Street from Whitehorse Road West making the trip infeasible
12	1-8,16-39	Rerouted to Station Street Northbound	Banned right turn from Hiltons Lane (blocking left turn due to queueing on SB Station - rerouting to Station NB)
13	1-8,16-39	Rerouted to Station Street Northbound	Ban RT from Elland Avenue (blocking left-turn due to queueing on SB Station - rerouting to Station NB)

5.5 Construction Case demand summary

To develop the demand for the Construction Impacts scenario, the 2031 Base Case demand was used. In addition to the 2031 demand, an additional heavy vehicle volume and workforce trip volume was added to the model to reflect construction-related traffic to the site. As the details on their arrival and departure patterns are not known, the construction vehicles accessing the site were assigned 15-minute headways in the AM period and 6-minute headways in the PM period. The details of construction vehicle volumes are shown in Table 5.10. AJM notes that construction trip volumes were inputted into the model through route assignment, that is, creating custom routes and assigning a demand on them. This was because it was deemed a more efficient way to introduce unique construction vehicle trips into the model without creating additional zones in the network for every entry/exit site access gate. While they do not correspond to specific origin-destination (OD) pairings, the table below shows the approximate origin and destination zone these trips are directed to in the network.

The inbound and outbound haulage routes are shown in Figure 5.4 and Figure 5.5 respectively.

Table 5.10 Box Hill Construction Volumes

ROUTES	VISSIM MODEL ZONES (APPROX.)		AM PEAK (8:00-9:00AM)	PM PEAK (4:45-5:45PM)
	ORIGIN	DESTN.	VEHICLES	VEHICLES
To Gate 1 from M3 via Middleborough Road and Whitehorse Road	20	30	4	10
To Gate 3 from M3 via Whitehorse Road	20	11	4	9
To Gate 8 from Eastlink via Station Street	26	13	4	9
To Gate 10 from Eastlink via Station Street	26	15	4	9
From Gate 2 to M3 via Whitehorse Road and Elgar Road	30	3	4	10
From Gate 5 to M3 via Station St	12	15	4	9
From Gate 9 to M3 via Station Street	14	15	4	9
From Gate 11 to M3 via Station Street	14	15	4	9

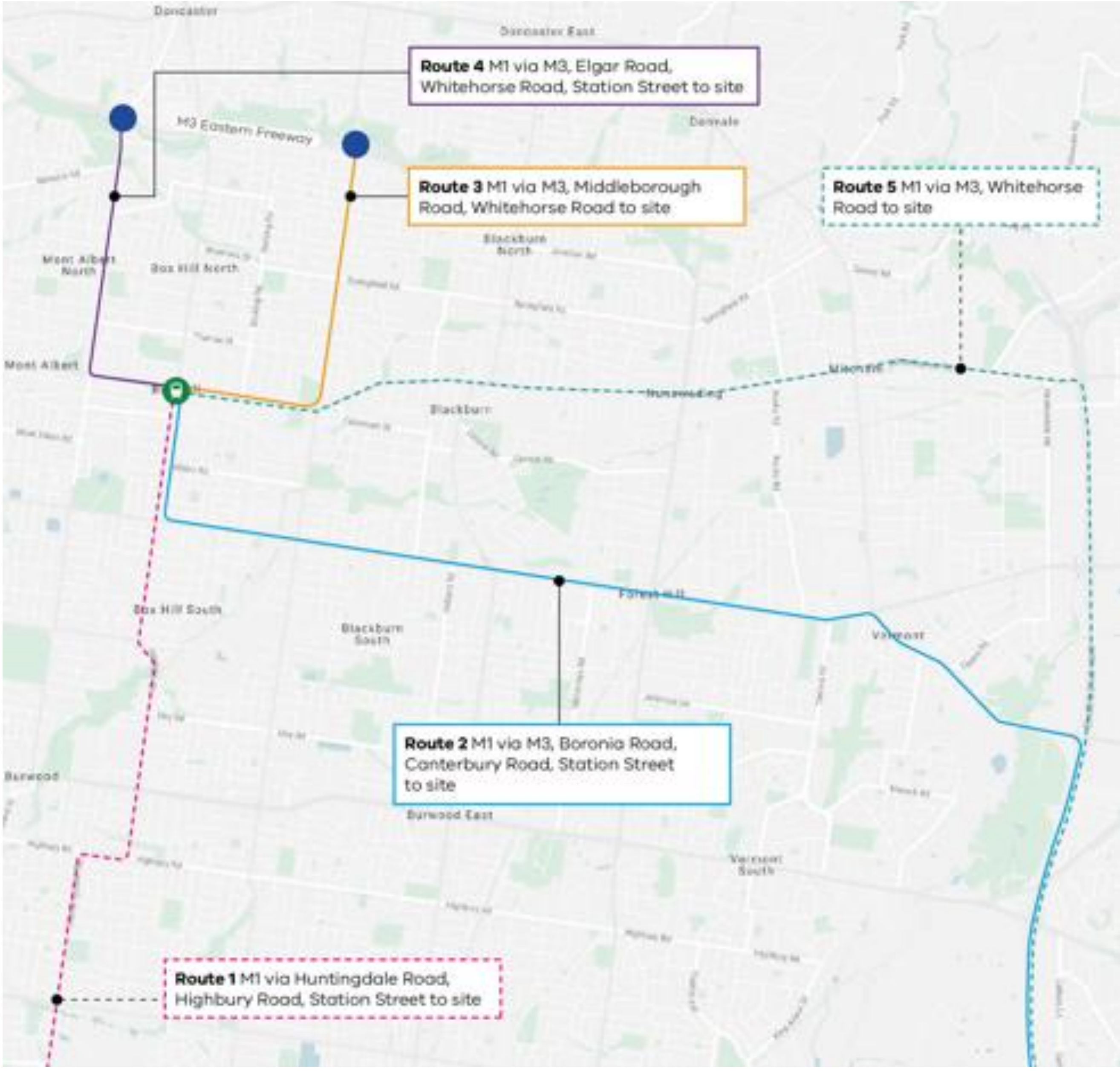


Figure 5.4 **Inbound Box Hill construction haulage routes**

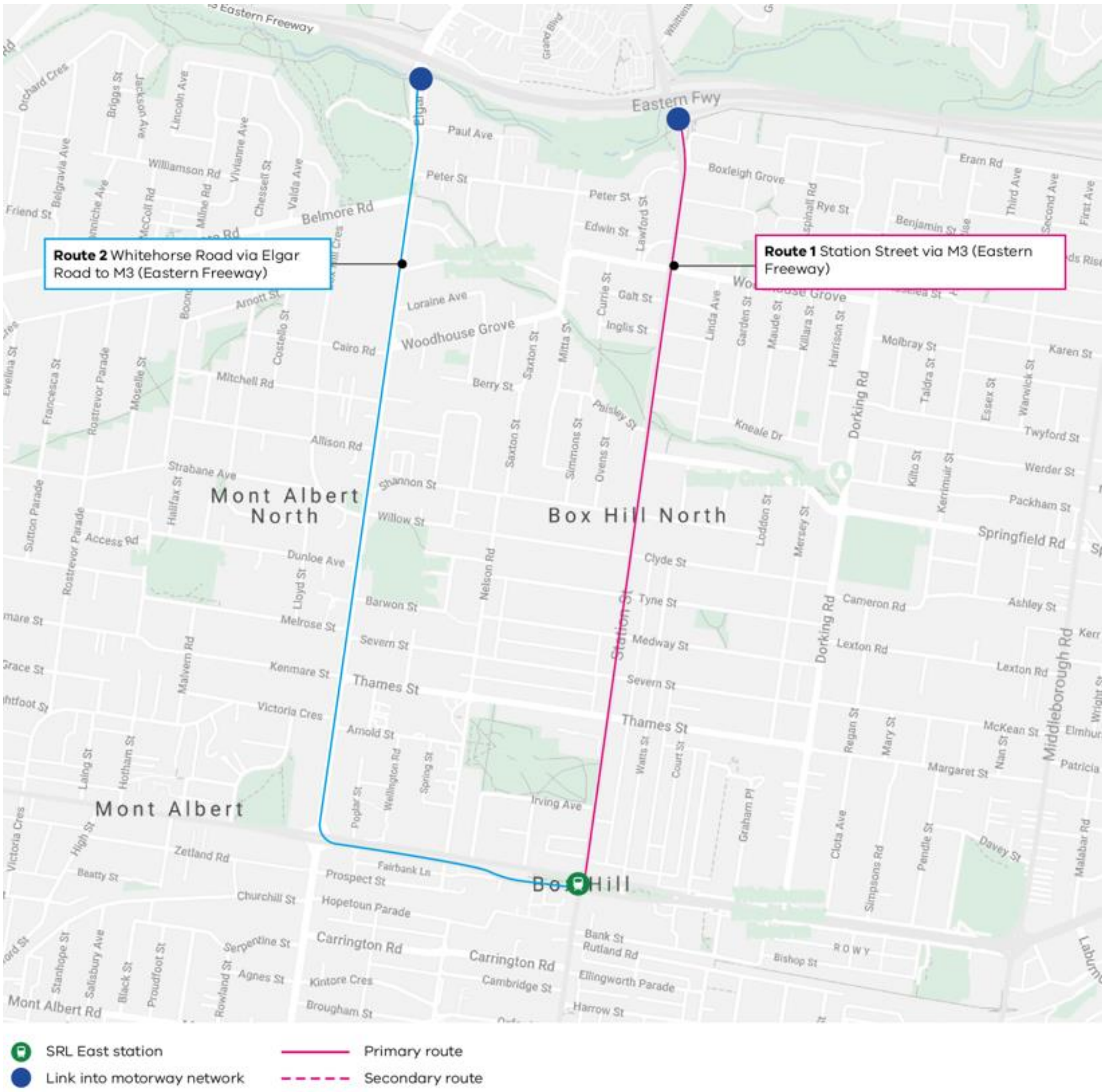


Figure 5.5 Outbound Box Hill construction haulage routes

5.6 Pedestrian Demands

Pedestrian demands were surveyed by 15-minute intervals and implemented into the 2021 Base Year model. At the time of model application however, precinct pedestrian forecasting and analysis were not ready to be implemented into the micro-simulation models for future year scenarios.

AJM in this instance assumed future pedestrian volumes for the 2031 and 2041 model scenarios to be 50% higher than the surveyed volumes at key signalised intersections and pedestrian operated signalised (POS) crossings where it is likely to impact vehicle traffic operations. The locations are shown in Table 5.11.

Table 5.11 Locations where pedestrian demands were inflated in future year scenarios

SCATS Site	Intersection
2203	Whitehorse Road / Elgar Road
2204	Whitehorse Road / Nelson Road
2205	Maroondah Highway nr Market Street (POS)
2206	Maroondah Highway / Station Street
2209	Maroondah Highway / Linsley Street
2210	Maroondah Highway nr Market Street
2219	Elgar Road NR Maroondah Highway (POS)
3939	Station Street / Rutland Road

AJM have undertaken some cross checks to confirm that the assumptions above are broadly in line with the forecasted precinct pedestrian movements. Further additional model checks were undertaken to ensure that pedestrian actuations were reasonable during the model simulation period at the critical intersections. It is the actuations rather than demand which are more likely to impact vehicle traffic operations hence the relevance of this check.

6 Conclusions

This technical note provides a summary of the Box Hill model application specific to the Traffic and Transport Impact Assessment as part of the SRL East EES. The following conclusions are highlighted regarding the application of the Box Hill micro-simulation model:

- The application of the Box Hill model makes assumptions which are documented throughout this report around future network operation, especially in terms of signal operations. It is recommended these assumptions and application within the model are further considered by relevant stakeholders as the design process progresses;
- Key constraints in the model are the Elgar/Whitehorse and Station/Whitehorse intersections. It is recommended that further signal optimisation by an experienced SCATS engineer is considered to evaluate how future operations can be improved (including coordination of the corridor); and
- The application of the Box Hill model incorporates reasonable re-routing and trip suppression to more closely resemble the expected level of traffic activity the SRL East precincts are likely to stimulate.

It is intended that the application of the Box Hill model will continue as the design evolves. All aspects of the model as outlined in this report can be re-examined as this process continues.

Joint Venture

Appendix A: Demand Forecasting

Traffic growth rates have been developed from the strategic VITM model. Broadly speaking, VITM is likely to forecast increasing traffic growth since traffic volumes are correlated with land-use (which increases over time) as well as increasing car ownership over time (since the model makes some broad assumptions such as annual income growth of 1.5% per annum every year until 2056).
Figure 6.1 shows a selection of inner-city count sites. Sites coinciding with freeways or toll roads have been removed, and for the remaining sites, the annual growth in private vehicle (PV) volumes between the years 2011 and 2018 is shown in Table A.1 for the AM (07:00-10:00), PM (15:00-19:00) and daily (24 hours) periods.

In terms of a growth comparison, in the Greater Melbourne statistics, daily growth is always higher compared to the AM and PM peak hour growth. Furthermore, in the inner south/east site statistics, the AM and PM peak period (negative) change in growth is larger compared to the daily growth.

Across all of Greater Melbourne, a moderate annual increase in traffic volumes is observed, however for selected sites within the inner south/east areas of Melbourne, the data shows a moderate decrease in traffic volumes. This is at odds with the VITM data which shows continual traffic growth over time. Therefore, there is justification to potentially restrict future traffic growth in the SRL East precincts at the microsimulation level as the roads and surrounding land use will closely resemble that of inner south/east sites.

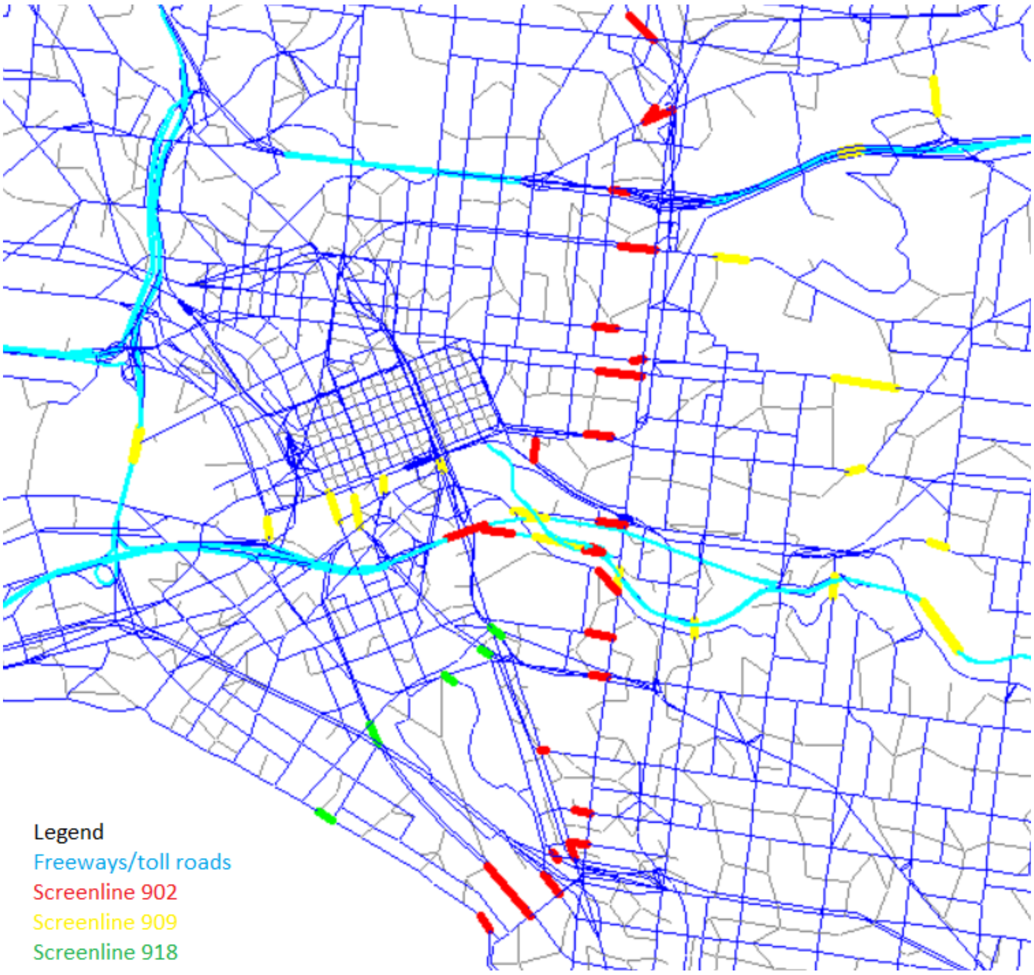


Figure 6.1: Selected inner-city count sites

Table A.1 VITM screenline data - traffic growth across Greater Melbourne and selected inner-city sites

Greater Melbourne Traffic Growth– VITM Screenline Data								
2011 AM PV	**2018 AM PV**	**AM PV CAGR**	**2011 PM PV**	**2018 PM PV**	**PM PV CAGR**	**2011 Daily PV**	**2018 Daily PV**	**Daily PV CAGR**
2,405,922	2,624,379	+1.25%	3,446,012	3,712,390	+1.07%	11,679,751	12,957,123	+1.49%
Inner-City Traffic growth – VITM Screenline Data								
2011 AM PV	**2018 AM PV**	**AM PV CAGR**	**2011 PM PV**	**2018 PM PV**	**PM PV CAGR**	**2011 Daily PV**	**2018 Daily PV**	**Daily PV CAGR**
264,795	250,389	-0.80%	347,712	329,500	-0.77%	1,355,631	1,321,081	-0.37%

Strategic models such as VITM will often produce levels of traffic that cannot be realistically accommodated on the network, as it allows for volume-capacity ratios that can sometimes far exceed what is realistically possible[3]. Furthermore, the VITM does not explicitly model intersections and only considers mid-block link characteristics as capacity constraint. As intersection capacity is typically the primary cause of capacity constraint, this means that VITM will often over-estimate the traffic capacity of roads. Another simplification in most transport models, including VITM, is the omission of a consideration of increased peak spreading trends over time. Evidence shows that as congestion on a network increases, the length of the peak period increases as road users strive to avoid the worst delays and minimise their travel times[4]. The analysis of arterials in inner city precincts above (similar to that in terms of the characteristics of the future SRL East precincts such as Box Hill) demonstrates little growth (in fact, negative growth) in typical arterial roads.

Due to these limitations with the strategic model, it was deemed necessary to undertake further demand refinements on the Box Hill micro-simulation matrices to take account of the likely over-estimation of demand from the VITM. It is also reasonable to expect that traffic conditions would not, in reality, reach the initial modelled levels of network breakdown as under these conditions people will reassess their behaviour and do a range of things to avoid congestion, such as shifting modes, changing the time that they travel or not travelling at all.

[3] Thompson, P; ‘Link Capacity and Strategic Modelling’, Jacobs/DEDJTR (2015)

[4] Camargo, P, Spalding, T and Alaimo, A; ‘Improving a traditional 4-step transport model with a Departure Time Choice model component’, Veitch Lister Consulting (2017)

Appendix B: Box Hill VITM Zone Concordance

Table B.1 VITM Zone/Link Concordance for Box Hill Microsimulation Model

VISSIM Zone	Zone Type	VITM Zone / Link	VITM Park 'n' Ride Zone	Description
1	External	Link 10068-28426	✗	Whitehorse Road west model access point
2	Internal	No Growth	✗	Box Hill Institute carpark
3	External	Link 25098-10084	✗	Elgar Road north model entry point
4	Internal	No Growth	✗	Box Hill Institute carpark
5	Internal	Zone 581	✗	Poplar Street
6	Internal	Zone 581	✗	Wellington Road
7	Internal	Zone 581	✗	Nelson Road
8	Internal	Zone 581	✗	Shipley Street
9	Internal	Zone 581	✗	Irving Avenue
10	Internal	No Growth	✗	Archibald Street
11	Internal	Zone 581	✗	Public carpark
12	Internal	Zone 581	✗	Hiltons Lane
13	Internal	Zone 581	✗	Eland Avenue
14	Internal	No Growth	✗	Irving Avenue office development
15	External	Link 25044-9374	✗	Station Street north model access point
16	Internal	Zone 582	✗	Watts Street
17	Internal	No Growth	✗	Court Street
18	Internal	Zone 579	✗	Kangerong Road
19	Internal	Zone 579	✗	Graham Place
20	External	Link 28508-28487	✗	Whitehorse Road east model access point
21	Internal	Zone 584	✗	Linsley Street
22	Internal	Zone 584	✗	City of Whitehorse offices carpark
23	Internal	Zone 584	✗	Bank Street
24	Internal	Zone 588	✗	Rutland Road
25	Internal	Zone 588	✗	Ellingworth Parade
26	External	Link 28587-9478	✗	Station Street south model access point
27	Internal	No Growth	✗	Development Access
28	Internal	Zone 584	✗	Carrington Road (exit)
29	Internal	Zone 584	20015, 20375	Box Hill Central SC carpark
30	Internal	Zone 584	✗	Clisby Court
31	Internal	Zone 584	✗	Box Hill Central SC carpark
32	Internal	No Growth	✗	Fairbank Lane parking
33	Internal	Zones 583, 584	✗	Prospect Street (east)
34	Internal	Zones 583, 584	✗	Prospect Street (west)
35	Internal	Zones 583, 584	20015, 20375	Hopetoun Parade
36	External	Link 28564-9477	✗	Elgar Road south model access point
37	Internal	Zone 585	✗	Churchill Street
38	Internal	No Growth	✗	Development Access
39	Internal	No Growth	✗	Ace Parking

Figure B.1 **VITM zones overlayed on VISSIM network zones**

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