Appendix D Contents

Appendix D includes:

- the latest Transport Modelling Report
- peer review of the recommended option modelling and economics.

The following modelling reports completed earlier in the NFAP project are held on file:

- NTSM Traffic Modelling Report for Draft Proposal
- Nelson Tasman Saturn Model Peer Review v1 Sep 19
- NTSM Forecast Report Rev C
- NTSM forecast model peer review v3

Prepared for
Waka Kotahi NZTA
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Transport Modelling - Preferred Option

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Nelson Future Access ProgrammeNelson Future Access Programme

Transport Modelling - Preferred Option

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Quality Information

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Reviewed by Dirk du Preez

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	08-Jun-2021	Internal Review	Adam Ashford Associate Director	
B	21-Jun-2021	Draft for TKTPL review	Adam Ashford Associate Director	
C	02-Jul-2021	Final for Waka Kotahi	Adam Ashford Associate Director	

Table of Contents

List of figures:

List of tables:

Executive Summary

New Zealand Transport Agency (NZTA), Nelson City Council (NCC) and Tasman District Council (TDC) are in the process of developing a detailed multi-modal transport system investment programme which supports the aspirations of the local Nelson and Tasman communities.

As part of the evidence base for the DBC, a more detailed traffic model than the existing regional strategic Nelson-Tasman TRACKS Transportation Model (NTTTM) model was required. The model is a key deliverable to understand the consequences of changes to the current network as proposed in the Nelson Future Access Plan programme.

This report documents the development, methodology and key findings of the modelling of the preferred option which consists of bus priority treatments along SH6 Tahunanui Road and Waimea Road, active mode route improvements and local treatments along lower order roads to minimise rat-runs, was assessed against the Do Minimum using a combination of SATURN modelling and out of model spreadsheet assessments. The model ignores any mode shift effect from changing community behaviours as e bikes and scooters become more affordable and seen as a socially responsible way to travel, or any other travel demand activities such as work place travel planning, peak spreading through changed school start times and an increase in work from home. It also ignores any active mode share impact from the city-wide speed review and thus could be viewed as a conservative assessment.

The results of the modelling assessment forecast that:

- Providing active mode travel facilities will increase the walking and cycling mode shares by between 1% and 4% depending on the peak hour and model year. The largest shift is forecast for the 2048 AM peak hour where the combined walking and cycling mode share is forecast to shift from 33% to 37%.
- Bus travel times with the Do Minimum are forecast to increase significantly from 2018 to 2048 with PM peak southbound (outbound from the city centre) forecast to more than double in travel time.
- Providing safety and bus priority improvements measures along SH6 Tāhunanui Drive and Waimea Road is forecast to improve bus travel times and therefore bus travel mode shares
- Providing safety and bus priority improvements along SH6 Tāhunanui Drive and Waimea Road will increase the travel time for general traffic along these routes.
- The treatment of local roads within Nelson to minimise rat-run behaviour is forecast to reduce the travel along these local roads and increase demand on the SH6 and Waimea Road arterials;
- Increased parking costs, are forecast to:
  - Reduce the demand on private vehicle travel into the Nelson City Centre; and
  - Increase the attractiveness of the bus and therefore bus mode shares could eb expected to increase;

At the wider network level, the modelling summary statistics forecast that:

- For the 2028 model year, the Preferred Option is forecast to reduce the total network travel distances as some trips are forecast to be shifted to public transport and active modes, but increase travel times due to the proposed safety and bus priority measures along the two main arterials into the Nelson City Centre;
- The 2048 model year shows that the Preferred Option is forecast to reduce both the network travel distances and travel times compared to the Do Minimum as the forecast congestion in the Do Minimum scenario is relieved by a combination of the forecast shift from private vehicle trips to other modes, and the improved level of service.

Given the high level of uncertainty and as travel time and parking cost elasticities were central assumptions in the assessment, sensitivity testing around these assumptions were undertaken to determine how sensitive the outcomes are against these assumptions, and to present an indicative range of potential outcomes.

In general, apart from bus mode shares, the modelling forecasts that car travel times, mode shares and average daily traffic volumes are relatively insensitive to these parameters.

1.0 Introduction

1.1 Background

New Zealand Transport Agency (NZTA), Nelson City Council (NCC) and Tasman District Council (TDC) are in the process of developing a detailed multi-modal transport system investment programme which supports the aspirations of the local Nelson and Tasman communities.

These aspirations include:

- A thriving central business district (CBD);
- A world-class waterfront area;
- A healthy environment; and
- A safe, resilient and accessible transport system.

Currently journeys between Nelson's CBD, the waterfront, the port, airport and Richmond are mostly via arterial routes SH6 (Rocks Road) or Waimea Road. Higher than anticipated population growth observed over the last few years and forecasts exceeding previous outlooks are putting these routes, and the transport network under pressure. Constraints on the transport network result in conflict between modes such as trucks and cyclists and increased risks of crashes, rat-running through residential areas to avoid the main routes, and an overall decrease in journey reliability.

These needs resulted in the NZTA putting out a request for tenders (RFT) for the Rocks Road Single Stage Business Case (SSBC) and Nelson Future Access Plan Detailed Business Case (DBC).

As part of the evidence base for the DBC, a more detailed traffic model than the existing regional strategic Nelson-Tasman TRACKS Transportation Model[1] (NTTTM) model was required. The model is a key deliverable to understand the consequences of changes to the current network operating hierarchy and was also required as evidence for Richmond Network Operating Framework (NOF) also being carried out by AECOM.

[1] Nelson-Tasman Model Build and Validation Report 2018 by Abley dated 5 November 2018.

1.2 Study Area

The study area of the NFAP project is shown in red in

Figure 1. The area of influence shown in blue covers the rest of Nelson City as well as Richmond and some of the wider Tasman area.

Figure 1: Project Study Area[2]

1.3 Purpose

The purpose of this report is to document the modelling approach and summarise the results of the modelling of the NFAP preferred option.

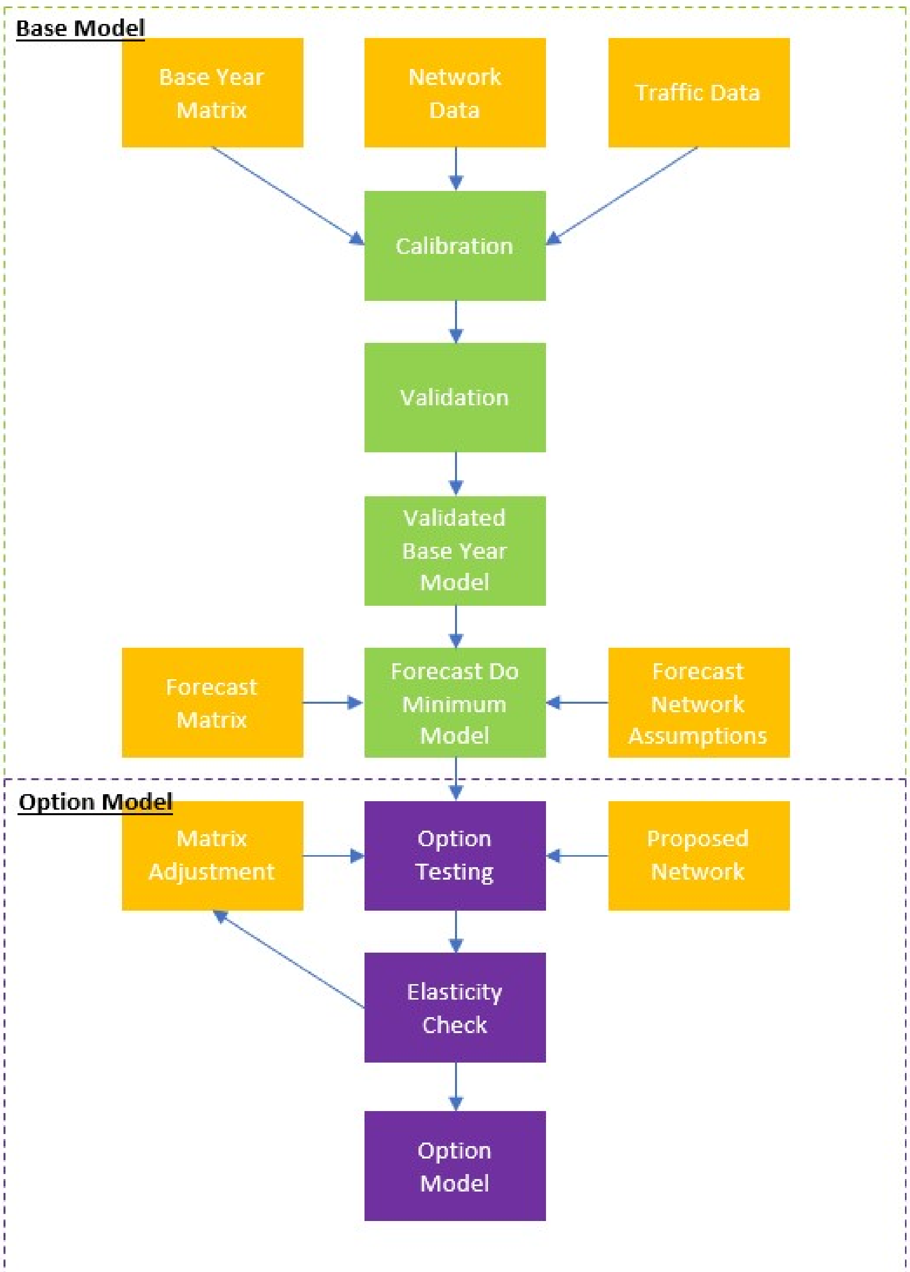
[2] Source: NZTA RFT Contract 2018830 Nelson Future Access – Detailed Business Case)

2.0 Methodology

2.1 Model development approach

The underlying process of building the model and improving the comparison between observed and modelled traffic data (Base Year Model) and using this as a basis for the development of the future year models (Forecast Model) is shown in Figure 2.

Figure 2: Modelling process flowchart



This report covers the options testing and refinement of the preferred option steps as shown in Figure 2.

2.2 Base model

The base year Nelson Tasman SATURN Model (NTSM) was peer reviewed by Tim Kelly Transportation Planning Ltd (TKTPL) with the final changes to the original peer review report and acceptance of all resolutions issued and received on 1 October 2019[3].

2.3 Forecast model

The forecast modelling report[4] was also peer reviewed by TKTPL with final acceptance of resolutions received on 21 April 2020[5].

The forecast modelling considers the growth forecast as part of the Nelson Tasman Future Development Strategy (FDS) adopted by Nelson City Council (NCC) and Tasman District Council (TDC) in July 2019.

From a modelling and travel demand perspective, the demand matrices based on these land use forecasts are 5% and 24% larger than the previous demand matrices (from the original NTTTM) for the 2028 and 2048 model years respectively.

2.4 Modelled peak hours and years

As discussed in the NTSM Base Model development report, the modelled peak hours are:

- The morning peak hour (8-9:00);
- The afternoon peak hour (17-18:00); and
- An inter-peak which represents the average of the two busiest hours in the middle of the day (11-13:00).

The model years are 2018 (base model), 2028 and 2048. The choice of these future years was to be consistent with the land-use forecasts carried out by the Nelson Infrastructure Strategy 2018 – 2048. This land use was subsequently updated with the FDS.

2.5 Do Minimum option

The Do Minimum option to which all options were tested is based on the NTSM Forecast model discussed in 2.3.

2.6 Public transport modelling approach

The NTSM, which was developed to scope, does not have the capability of directly assessing the impact of changes in public transport (PT) services. Public Transport interventions are however being proposed with the Nelson Future Access Project (NFAP) as part of the package of improvements, and therefore modelling the PT response is required to assess the project outcomes.

As agreed with the client Waka Kotahi and later confirmed as an appropriate approach with the Investment Assurance team representative of Waka Kotahi, we addressed this constraint by a SATURN + Spreadsheet modelling approach that builds on the existing NTSM using an elasticity of demand approach. It was agreed that the uncertainty around forecasting mode shift behaviour should be sensitivity tested using a range of elasticity values.

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[3] Base Year Model Development and Validation Report dated 19 September 2019 (AECOM) and Peer Review report by Tim Kelly Transportation Planning dated 1 October 2019.
[4] Nelson-Tasman SATURN Model – Forecast Model Development Report dated 28 February 2020.
[5] Nelson-Tasman SATURN Model – Peer Review of Forecast Model Development Report dated 21 April 2020.

2.7 Options testing – package option modelling memorandum

AECOM prepared a technical file note / memorandum[6] for the purpose of providing an initial brief to the traffic model and economics peer review for the testing of options for the NFAP business case.

This memorandum and supporting material were provided to TKTPL to provide high-level peer review comments received on 1 October 2020[7].

Key findings in this review include the limitations of the modelling approach with respect to:

- Trip retiming: optional retiming of trips to avoid congestion by traveling earlier or later than the peak periods;
- Trip redistribution: the feedback between transport provisions and land use where individuals or business may opt to relocate as accessibility to employment and education changes; and
- Mode transfer/shift: the shift to/from a different more of transport in response to the project interventions making specific modes of travel relatively more attractive than another compared to the existing situation.

The refinement of the modelling approach discussed in Section 4.0 seeks to address some of the trip retiming and mode shift inadequacies inherent to the use of a SATURN traffic model.

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[6] Nelson Future Access Project - Package option modelling and indicative economic assumptions dated 28 September 2020
[7] Nelson Future Access Project: Package Modelling Peer Review Notes

3.0 Preferred Option

3.1 Preferred option description

The emerging preferred option consists of:

1. **Near-term (Years 0-3)**

Investment in network optimisation to improve the user experience and access to active modes.

- Focussed on the area ~5km around the CBD where most of the mode shift to active modes will occur, and for which most of the local trips (~60%) originate.

2. **Short-term (Years 4-10)**

- Investment in transferring more people to Public Transport, complementing the investment and changes in the Regional Public Transport Plan;
- Active Mode improvements including upgraded facilities along SH6 Rocks Road to increase LoS;
- Extends the scope of investment beyond ~5km of the CBD where the transfer of people from car to Public Transport will most likely occur; and
- Reinforces the road hierarchy to remove rat-running from suburban streets.

3. **Medium and Long-term (Years 11-30)**

- Investment to accommodate the increased demand for active modes through new and upgraded crossing points, corridor and project area upgrades;
- Provides an enhanced streetscape and level of service for active modes, and closes gaps identified in the network hierarchy;
- Public transport improved further through the provision of priority lanes on SH6 and Waimea Road;
- Corridor widening and road space reallocation to accommodate shared path improvements, and to further close gaps in the network hierarchy.

3.2 Active Modes

The location and type of active modes facilities proposed as part of the preferred option are shown in Figure 3.

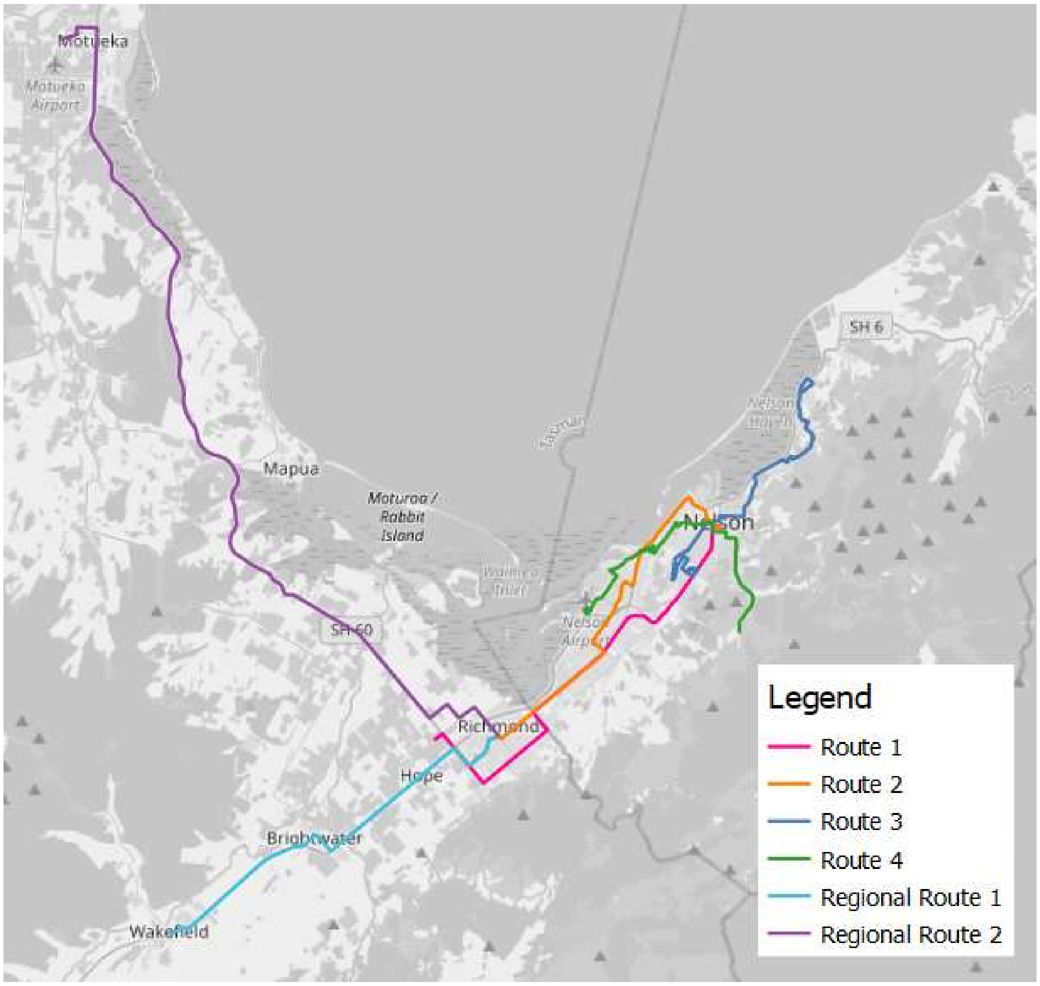
Figure 3: Active Mode Facilities

3.3 Public transport

3.3.1 RPTP update

The bus routes in the NTSM were adjusted to represent the six bus routes shown in Figure 4 as proposed in the latest RPTP.

Figure 4: RPTP Bus Routes



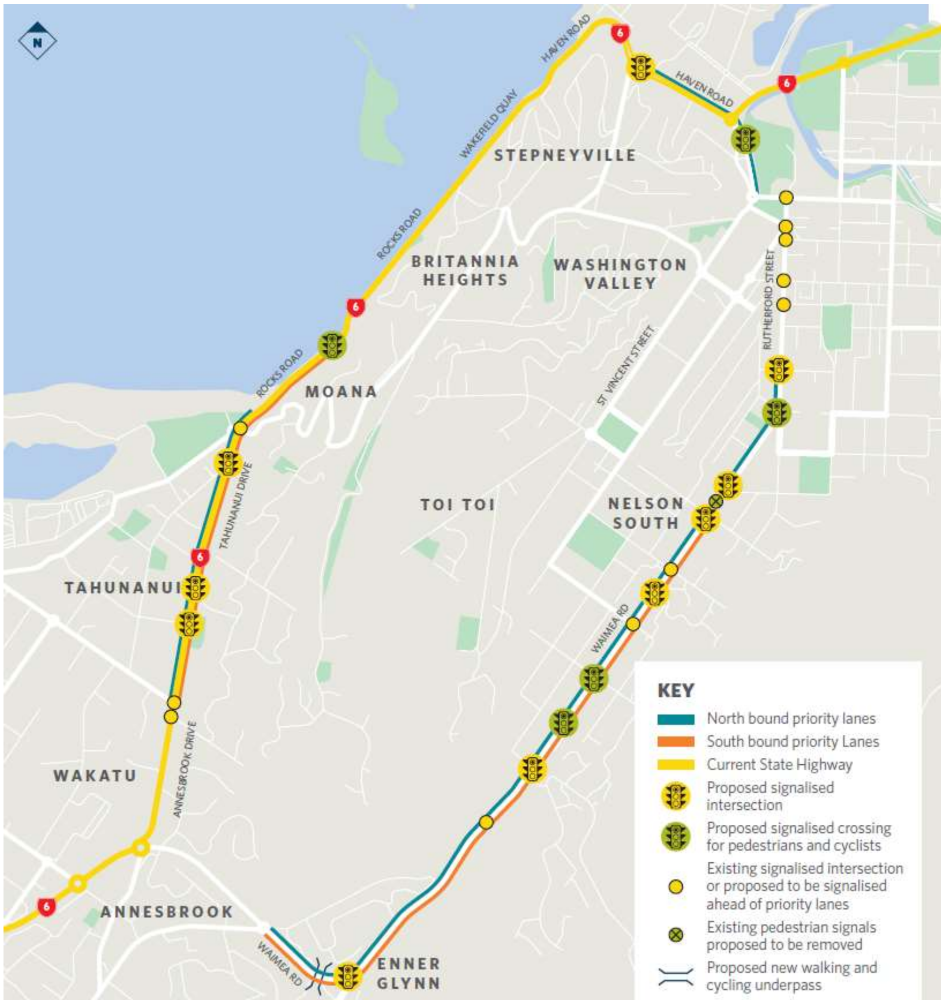
In terms of service levels, the RPTP update proposes:

- July 2023: New urban routes, all urban routes run half hourly at peak and hourly off-peak/weekend, from 7AM to 7PM. This assume a 2-hour AM peak (7AM-9AM) and a 3-hour PM peak (3PM-6PM). New Stoke Link on-demand service between 9AM and 3PM. Regional routes are single inbound AM trip and single outbound PM trip on each route (Motueka/Wakefield), which is an extension of an urban route.
- July 2026: All urban routes move to a 30-minute headway between 7AM and 7PM, seven days a week. Previous regional route extensions replaced by two new regional routes on the same corridors, with 4 return weekday trips from Motueka and 6 return weekday trips from Wakefield. All services will have evenly spaced headways, and run a limited stop pattern between Richmond and Nelson (same corridors as the Route 1 and Route 2 - two intermediate stops at key nodes).
- July 2029: Route 1 and Route 2 services move to a 15-minute headway at peak. Weekday regional service pattern extended to the weekend.

3.3.2 Long term package bus priority upgrades

As part of the NFAP preferred long-term programme, bus priority infrastructure along SH6 Tāhunanui Drive and Waimea Road are being proposed. Figure 5 shows the extent of the bus priority along the two main arterial road and Appendix A shows the proposed concept design of these changes.

Figure 5: Bus Priority



4.0 Preferred Option Model

4.1 Base Year Public Transport and Active Modes

The NTSM does not contain active mode or public transport matrices, so these matrices were obtained from the NTTTM. However, the active model and public transport matrices from the NTTTM are only available for the AM peak hour period, being the only peak period for which the NTTTM is a four-stage model.

Therefore, the origins and destinations of the inter and PM peak active and PT matrices were calculated based on the AM peak matrices with the PM being a transpose of the AM peak, and the IP being an average of the AM and PM peaks.

Bus patronage data, and pedestrian and cyclist counts were then used to scale the respective inter and PM peak matrices to the observed counts. Table 1 shows the summary of the process.

Table 1: Base Year Public Transport and Active Mode Matrix Process

Peak Hour	Original Matrix	Public Transport	Active Modes
AM	NTTTM	The number of trips from the AM peak was scaled to inter and PM peak according to the bus patronage counts.	The number of trips from the AM peak ws scaled to inter and PM peak according to the pedestrian and cyclist counts.
IP	Average of AM and PM matrices		
PM	Transpose of NTTTM AM peak matrices		

Table 2 shows the hourly patronage information, from November 2020, provided by NCC and used to proportion the AM peak hour patronage into inter and PM peak numbers.

The data provided:

- Does not include school holidays;
- Was for the Nelson-Tasman region under COVID19 alert level 1;
- Divided the hourly patronage for weekday by 21 days; and
- Divided the hourly patronage for weekend by 9 days.

Table 2: Weekday Average Bus Patronage

Bus Route	Starting Time														Total
	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	
4901	0	43	106	33	42	36	38	37	41	118	45	38	13	12	601
4902	8	66	55	30	34	36	39	31	34	70	48	36	14	0	500
4903	0	7	4	5	5	7	6	6	6	6	10	9	3	0	73
4904	0	2	1	2	2	2	2	2	2	2	3	3	0	0	23
4905	0	3	1	4	2	3	2	4	2	2	5	3	1	0	31
4906	0	0	0	1	0	2	0	1	0	0	0	0	0	0	3
4917	0	0	0	0	1	1	0	1	0	0	0	0	0	0	3
4927	0	0	0	1	1	1	0	1	1	0	0	0	0	0	5
4937	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
4980	1	1	0	1	2	2	1	0	2	2	1	0	0	0	12

Bus Route	Starting Time														Total
	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	
4981	0	1	0	1	0	0	1	0	1	1	1	0	0	0	6
Total	9	122	168	78	88	89	89	82	89	201	111	88	32	12	1258

Table 3 shows the 2018 average active mode counts for the following three locations:

- Bishopdale shared path;
- Waimea Road, Bishopdale; and
- Rocks Road (Wakefield Quay).

These active mode counts were used to proportion the AM peak hour active mode numbers into inter and PM peak numbers.

Table 3: Average Active Model Counts

Type	Cyclist	Pedestrian	Cyclist	Pedestrian
Month	February	February	July	July
7:30 AM to 9:00 AM	115	23	76	16
10:00 AM to 11:00 AM	24	19	12	13
12:00 PM to 13:45 PM	38	18	29	24
14:45 PM to 17:30 PM	173	67	107	55
Total	350	127	225	108

4.2 Active modes demand estimates

The active mode demand estimation for the proposed walking and cycling path along Rocks Road is based on a comparison study methodology[8].

A geographic information system (GIS) methodology, according to the Monetised Benefits and Costs Manual[9] (MBCM), was conducted to estimate the active mode demand for the other facilities.

The NTSM matrices used in the option model were adjusted to account for the mode shift to active modes – i.e. short distance car trips were assumed to shift to active modes.

4.3 Public transport

4.3.1 Nelson Regional Public Transport Plan – Network Patronage

The PT review carried out by Stantec has projected a network patronage increase from 2021 to 2031 based on changes in bus service routes, reduced fares and more frequent buses.

This patronage projection has been further projected to 2048 to account for the effects of the new patronage level into the 2048 models. Table 4 shows the assumptions made for the patronage forecast.

[8] https://www.nzta.govt.nz/assets/planning-and-investment/docs/health-and-active-modes-impacts-march-2020.pdf
[9] https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

Table 4: RPTP Network Patronage Forecast

Year Period	Network Patronage Growth
2021 – 2031	From RPTP, patronage growth based on changes to bus routes, bus schedule and bus fares.
2031 – 2041	Same as first 10 years, patronage growth based on changes to bus routes, bus schedule and bus fares.
2041 – 2048	No further changes to the bus services after 2031 which is assumed to generate no further uplift, and patronage assumed to grow based on FDS population growth rate beyond 2031.

The projected network patronage level is:

- 488,000 bus trips per year for 2028; and
- 1,656,000 bus trips per year for 2048.

The hourly patronage information from Table 2 were used to proportion the annual patronage level into hourly peak numbers.

A key point observed from the hourly patronage information is that roughly 90% of the existing patronage is on route 1 and 2 via Rocks Road and Waimea Road respectively. For the purposes of this study, therefore, the assumption was made that all patronage changes applied to these two routes only.

Table 5 shows the estimated peak hour bus patronage changes between the NTTTM and the RPTP patronage.

Table 5: Peak Hour Patronage (pax/hour)

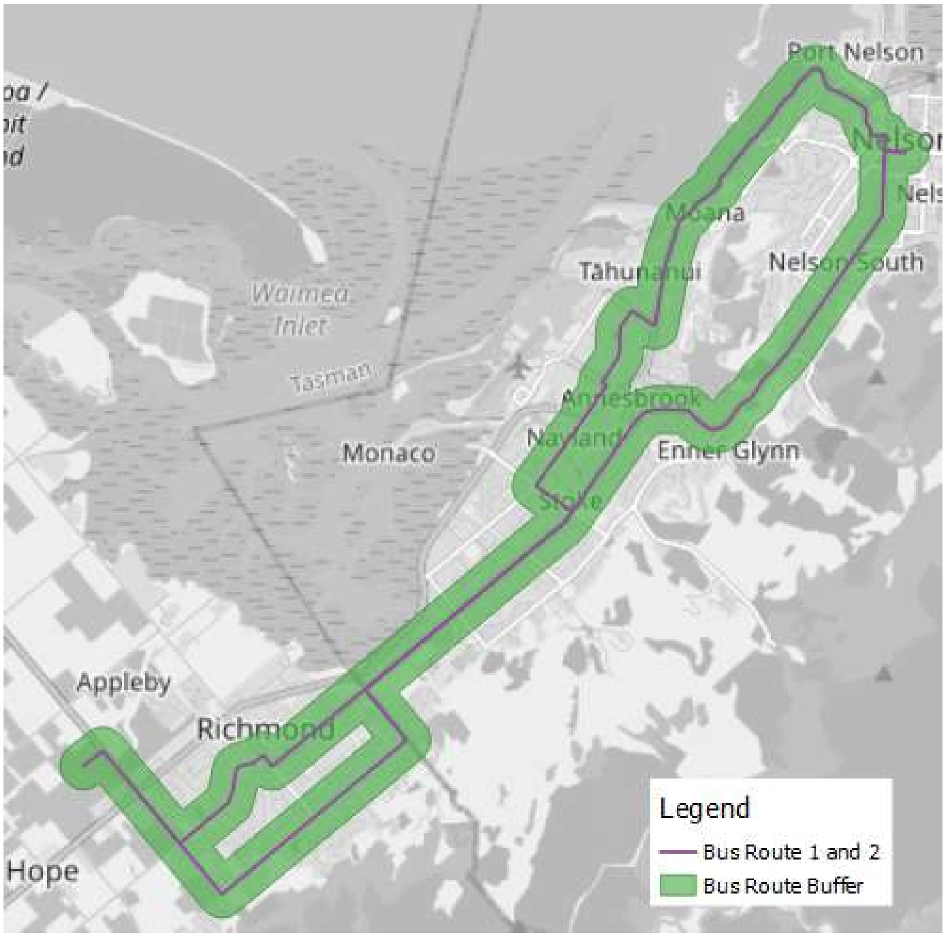
	AM Peak			Inter Peak			PM Peak		
Year	2018	2028	2048	2018	2028	2048	2018	2028	2048
NTTTM	247	259	290	131	138	154	295	310	346
RPTP forecast interpolations	247	441	701	131	234	372	295	528	838
Additional bus patronage (RPTP – NTTM)	0	182	411	0	97	218	0	218	491

For this purpose of the NFAP option assessment modelling, it was assumed that the increase in bus patronage would be trips transferred from private vehicle travel based on the RPTP service improvements as these routes represent longer distance trips with much of the patronage between Richmond and Nelson.

The light vehicle demand matrices used for the option model were therefore adjusted accordingly – i.e. the light vehicle matrix for the 2048 AM peak hour was reduced by 411 vehicle trips.

The matrix adjustments were made to model zones within an 400m buffer of the two main bus routes only to account for acceptable walking distances to stops along the two main routes as shown in Figure 6. This was considered a conservative approach as it largely ignores the effect of the additional route from Atawhai to the airport servicing the City Centre and Port Hills.

Figure 6: 400m bus route buffer for mode shift estimates



4.3.2 Bus priority improvements – network modelling

The layout of the NTSM model network was updated to best reflect geometry of the bus priority improvements shown in Appendix A.

The proposed bus priority improvements include several short exit merge lanes at signalised intersections which is not a standard layout option in SATURN.

Updated capacity indexes were applied to the links downstream of the intersections, with short merge lanes to reflect the delay caused by the downstream merge movement. The downstream capacity at these intersections, representing the merges, were assumed to have less capacity than a full lane and were modelled with 1400 vehicles/hour capacity whereas a standard lane capacity along these corridors was assumed to have a 1900 vehicles/hour capacity.

4.3.3 Bus priority improvements – demand uplift (travel time elasticities)

Over and above the forecast patronage uplifts from the proposed RPTP updates to the bus services, the NFAP preferred option proposes bus priority measures along Rocks Road and Waimea Road with the intent of further increasing bus patronage and to decrease the reliance on the private vehicle.

These measures, described in Section 3.3.2, are forecast to improve the journey time of bus passengers with respect to car travel resulting in a further shift to public transport.

As the SATURN model does not have the ability to estimate mode shift, an iterative elasticity of demand approach was used to estimate how many light vehicle trips would shift to bus trips based on the respective mode travel time changes due to these priority measures.

Two elasticities were applied; the 1st of which is bus travel time elasticity which estimates the percentage change in bus demand caused by a 1% change in the bus travel time. A bus in-vehicle time elasticity of -0.40[10] was used from the Waka Kotahi Monetised Benefits and Costs Manual (MBCM). This implies that for every 1% improvement in travel time, the patronage will be uplifted by 0.4%.

The 2nd elasticity; private vehicle trip cross elasticity, estimates the percentage change in the demand of alternative transport modes caused by a 1% change in vehicle car travel time.

The MBCM does not recommend an appropriate cross elasticity for this purpose and therefore, the cross elasticities from Victoria Transport Policy Institute[11] were used.

The cross elasticities for private vehicle travel time are shown in Table 6

Table 6: Cross Elasticities of private vehicle travel time

	Car Driver	Public Transport (bus)	Active Modes
Elasticity	-0.76	0.39	0.19

The car driver elasticity of -0.76 implies that a 1% increase in car travel times results in a 0.76% decrease in car (light vehicle) travel. The associated increases in PT and active mode travel are 0.39% and 0.19% respectively. This represents

There is therefore a deficit of 0.18% which refers to the suppression of travel or re-timing of light vehicle travel outside of the peak hours. There is not a commensurate increase in PT and active mode travel with the reduction in light vehicle travel when travel times increase – i,e. car travel within the peak hours decreases by 0.76% but other modes only increase by 0.58%.

This cross elasticity with respect to car travel time was applied to the car totals i.e. if car travel time increased by 1%, 1000 car trips would be assumed to be reduced by 0.76% to 992 trips whereas bus patronage would then be assumed to increase by 1000 x 0.39%, roughly 4 trips.

The bus travel time elasticity was however applied to the base bus patronage, i.e. if absolute bus travel time improved by 1%, the assumption is that this would increase bus patronage by 0.4%, 4 trips.

For the purposes of the assessment, the relative increase in travel times along the two major arterials was assumed to also apply to the demand for travel via the alternative routes through the study area – meaning that increases in travel times along the two main arterials were assumed to affect the overall demand for private car travel in the study area.

4.3.4 Elasticity check process

Bus travel times for the RPTP route 1 and route 2, and vehicle travel time along the respective arterial routes, were used as an “elasticity check” to determine the relative change in travel times in consecutive network assignments.

In an iterative process of reassigning an adjusted matrix to the network, the difference in light vehicle and bus travel times between the current and the previous model runs was checked to see if the difference was greater than 1.5%. When the difference was greater than 1.5%, the car matrix was adjusted accordingly.

This iterative process was terminated when the travel times for each of the modes in the current and previous model runs converged to within 1.5%.

[10] https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

[11] https://www.vtpi.org/tranelas.pdf

4.4 Rat-run treatments

To address existing rat-run behaviour to avoid the delays at intersections along the arterials, and to minimise additional rat-run trips due to further intersection restrictions along the arterials, several routes were reduced in terms of capacity and speed in the model to reflect proposed treatments.

The network of the Option model has been adjusted according to the rat running routes shown in Appendix B. The capacity and speed limit along these routes have been reduced to 350pcu/hr and 25 km/hr to simulate the effects of the rat running treatments.

The same rat running treatments has also been applied on Russell Street and Toi Toi Street as initial results suggest that these two roads are potential rat running routes:

- Toi Toi Street as it is proposed to be connected to Princes Drive and the modelling suggested it could be used to avoid delays on Rocks Road whereas; and
- Russell Street since the modelling suggested it could be used to bypass delays forecast at the port and at the SH6 / Haven roundabout.

5.0 Parking management assessment

Given the competing objectives of a) maintaining private vehicle car travel times along the two arterial routes at current levels, and b) uplifting public transport patronage, it was proposed that parking management measures be investigated as a potential measure by which to reduce the reliance on private vehicle travel into the Nelson City Centre.

AECOM proposed a high-level elasticity of demand assessment method to estimate an indicative reduction in private vehicle travel demand due to an increase in parking costs in and around the city centre.

5.1 Methodology

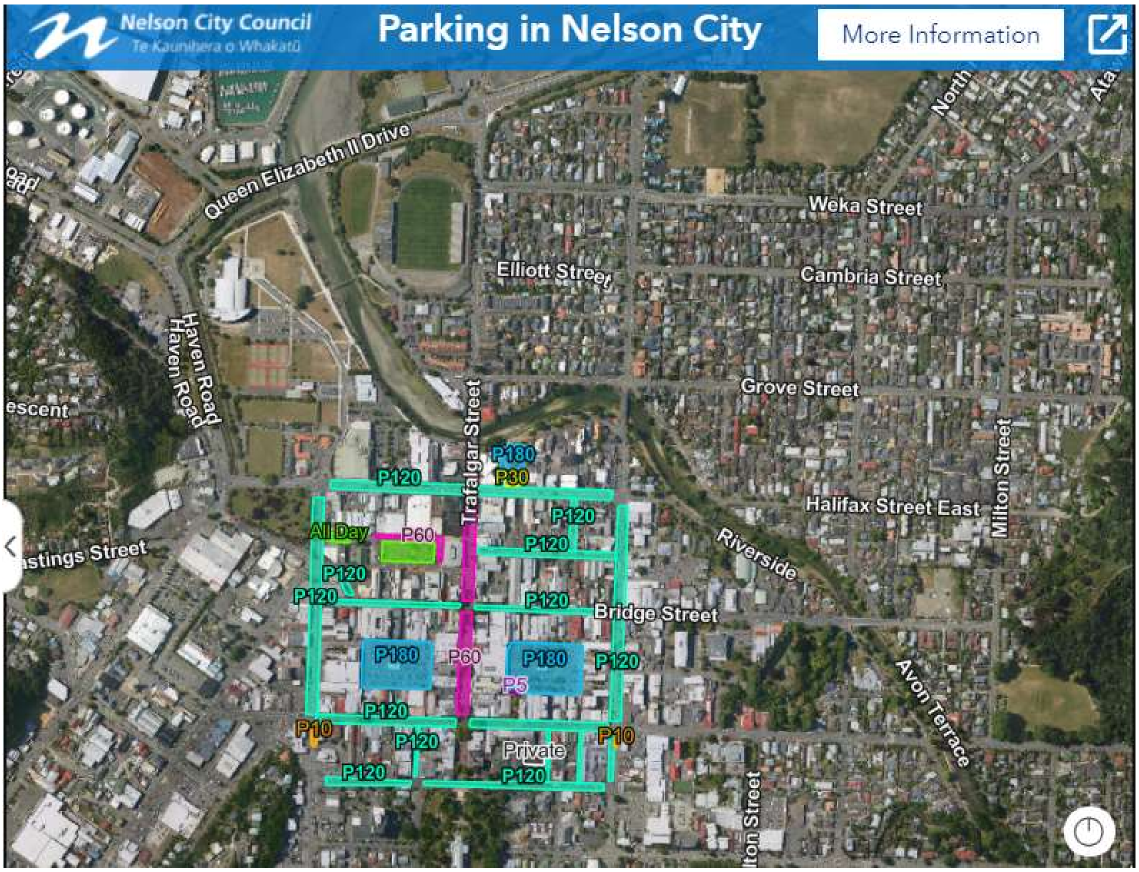
The methodology employed consisted of:

1. Assessing the current parking provisions in the Nelson City Centre – this consisted of determining the supply and cost of public parking to determine the parking base which would be affected by parking price changes;
2. Assessing the average normal weekday parking utilisation in the area of influence determined in step 1;
3. Determining the number of private vehicle trips, based on parking utilisation numbers and city centre bound car trips (from the forecast modelling), to apply an elasticity of demand factor to – inbound and outbound sub-matrices were created based on the area of influence in step 1 to determine the number of trips into and out of the city centre during the morning, mid-day and afternoon peak hours;
4. Determining an appropriate elasticity of demand factor to apply to the city centre bound origin-destination trip pairs. The MBCM was consulted and a weighted average elasticity value was determined based on Census 2018 city centre bound Journey to Work (JTW) and Journey to Education (JTE) numbers in;
5. A nominal increase in average daily parking costs were determined and a weighted percentage increase in parking costs were calculated;
6. The factor by which to reduce the size of the city centre bound (AM peak) or city centre originating (PM peak) trips was determined by multiplying the elasticity value by the percentage increase in parking costs
7. The trips in the sub-matrices were reduced by the factor determined in step 6;
8. The adjusted matrices were assigned to the model network to determine the impact on trip patterns and travel times into and out of the city centre;

5.2 Area of influence

The existing paid public parking in the Nelson City Centre was confirmed through the Nelson City Council Website[12] - excerpt shown in

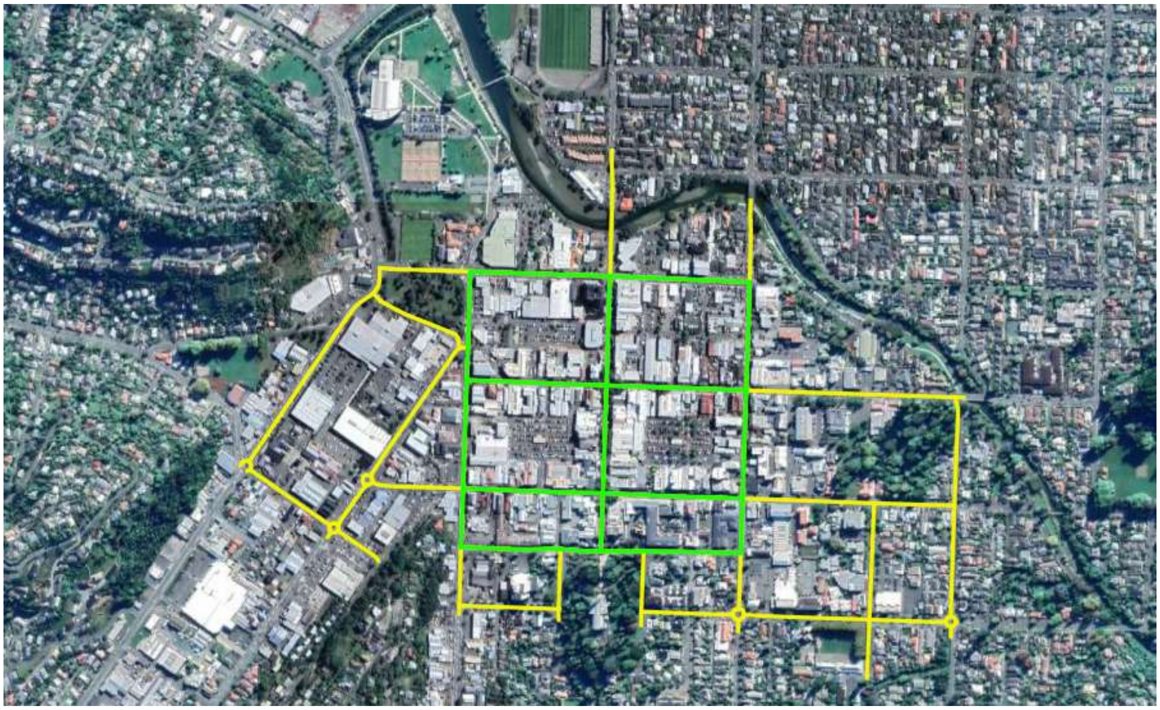
Figure 7: Current paid parking.



A desktop study was undertaken to determine the supply of paid parking in these streets and parking lots, and the extent of free but limited time parking around the city centre. Figure 8 shows the existing paid on-street parking in green and the assumed extent of limited time in the city centre fringe.

[12] http://www.nelson.govt.nz/services/transport/parking/where-to-park-in-nelson/

Figure 8: Extent of assumed parking management area



5.3 Parking supply, turn-over and costs

5.3.1 Supply

No official numbers on parking supply were received from NCC but a desktop study was undertaken to quantify the number of paid and free limited time parking within the area of influence.

Table 7: Parking supply

Type	Paid	Free limited time	Total
Parking lot	857	0	857
On-street	599	922	1,521
Total	1,456	922	2,378

5.3.2 Turn-over and utilisation

Of the parking lots, one is an all-day parking with capacity of 180 parks. The rest are all P180 limited time meaning patrons can park for a maximum of 180 minutes (3 hours). The paid on-street parking varies between P10 and P120, but the vast majority are P120.

NCC has a policy which allows everyone in the city to park for free for an hour every day. this means people visiting the city centre can park for free if their visit is less than one hour, but this also means that for the paid P180 parking, patrons only pay for 2 hours even if they park for 3 hours.

The paid parking time for all paid parking therefore, theoretically, implies that the average payment is for 1 hour shorter than the limited time. For this reason, it was assumed that the all-day parking would be paid for 7 hours.

For the free but limited time on-street parking, an assumption was made that the parking duration would be in line with the time restrictions.

It was assumed that the parking supply in this area is well utilised based on a 2018 article[13] which estimated that "Occupancy rates at city centre car parks were consistently above 95 per cent". A 75% occupancy rate, based on an assessment of aerial photography, was assumed for the on-street parking which results in a weighted average occupancy/utilisation rate for the study area of 82%.

5.3.3 Parking costs

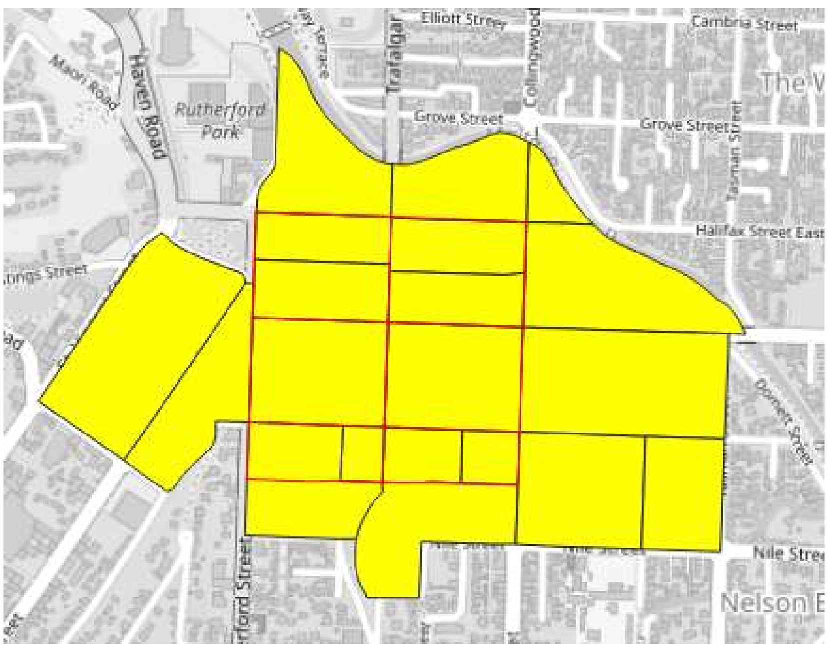
Currently parking is paid at $2/hour. While there may be more complexities around the pricing structure, it was assumed for the purpose of this assessment that this applies to all paid parking.

Given the respective numbers of paid and free parking, and assumed parking durations and utilisation, this equates to an average daily parking cost of $8.

5.4 Parking Demand

Sub-matrices representing the city centre area in Figure 8 were extracted from the light vehicle matrices for the AM, Inter and PM peak hour matrices for the 2028 and 2048 model years. Figure 9 shows the assumed parking managed zones for this assessment.

Figure 9: Parking managed zones



The parking demand was assumed to apply to the AM inbound, PM outbound and for the Inter peak the average of in- and- outbound traffic from the model demand matrices.

Table 8: Peak hour traffic volumes into the City Centre

Peak hour direction	2028	2048
AM In	3,639	3,933
IP In/out	2,836	3,312
PM Out	3,094	3,671

[13] https://www.stuff.co.nz/nelson-mail/121671018/council-to-clamp-down-on-car-parking-overstayers

The trips into the city centre area during the respective model peak periods exceed the assumed public car park capacity of 2,378.

With car parking assumed to be 82% full as per the utilisation assessment, the parking demand to which the elasticity can be applied was assumed to be 82% of the parking capacity – 1,955 trips.

This was applied to each peak period for the 2028 and 2048 model years.

5.5 Increased parking cost scenario

5.5.1 Increased Cost

A hypothetical scenario was tested where the cost of parking in the city centre and city centre fringe is increased. The central scenario tested assumed the cost in the city centre is increased from $2/hr to $4/hr whereas the cost in fringe, which is currently free, is $2/hr.

The nett effect of this across the area of influence is that the daily average parking cost increases from $8/day to $17/day – a 124% increase in cost.

5.5.2 Parking elasticity

A literature review was conducted to determine appropriate elasticity values to estimate change in travel demand in response to an increase in parking costs.

The following documents were consulted:

- Monetised Benefits and Costs Manual (MBCM)[14] – diversion rates to/from PT based on parking charge changes;
- Understanding Transport Demands and Elasticities – Victoria Transport Policy Institute (VPTI)[15];
- Land Transport New Zealand Research Report 331 - Impacts of fuel price changes on New Zealand Transport[16]; and
- Transfund New Zealand (now Waka Kotahi NZTA) Research report No. 248 - Review of Passenger Transport Demand Elasticities[17]; and
- Temporal Variance of Revealed Preference On-Street Parking Price Elasticity - Peter J. Clinch and Andrew Kelly (2003).

The review found that motorists tend to be particularly sensitive to parking price because it is such a direct charge. Compared with other out-of-pocket expenses, parking fees are found to have a greater effect on vehicle trips, typically by a factor of 1.5 to 2.0 (VPTI).

Clinch and Kelly (2003) find that the elasticity of parking frequency is smaller (–0.11) than the elasticity of vehicle duration (-0.20), indicating that some motorists respond to higher fees by reducing how long they stay[18].

The central assumption for the travel time elasticity, -0.3, was based on the VPTI recommended range -0.1 to -0.4 and a diversion rate to public transport was based on recommended values of CBD-bound trips by trip purpose of 75% for Journey to Work (JTW) and 50% for Journey to Education. Weighted by the Census 2018 trip purposes, the resultant diversion rate is 69%.

Sensitivity tests with respect to the impact on travel demand and mode share based on these assumptions were conducted using lower and higher bound values for the elasticities and diversion rates.

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14 https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf
15 https://www.vtpi.org/elasticities.pdf
16 https://www.nzta.govt.nz/resources/research/reports/331
17 https://www.nzta.govt.nz/assets/resources/research/reports/248/248-Review-of-passenger-transport-demand-elasticities.pdf
18 Peter J. Clinch and Andrew Kelly (2003), *Temporal Variance of Revealed Preference On-Street Parking Price Elasticity*, Department of Environmental Studies, University College Dublin (www.environmentaleconomics.net).

5.6 Estimated impact of increased parking costs

5.6.1 Reduction in travel demand

The assumed parking demand being 1,955 trips as discussed in Parking Demand.

The assumed increase in parking costs was from $8/day to $17/day which is an increase of 124%.

The appropriate elasticity determined to estimate the response in demand for travel due to parking cost increases was -0.3 which implies a 1% increase in costs would result in a -0.3% decrease in travel.

This results in reduction of travel into the city centre of 124% x 0.3 x 1,955 = 725 trips.

5.6.2 Model application

The sub-matrices representing the study area were factored to account for this reduction for each peak period and model year and then re-assigned to the model network.

6.0 Results

6.1 Mode Share

Table 9 to Table 14 shows the mode share summary within the study area for the following three scenarios:

- Do Minimum;
- Preferred Option; and
- Preferred Option with parking charges – based on the assessment done in Section 5.0.

Table 9 to Table 11 shows the demand of the trips by modes whereas Table 12 to Table 14 shows the mode share by percentage. These figures are reporting the travel statistics for the project study area.

Table 9: Do Minimum Mode Share Summary

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048
Light Vehicle	12,449	13,296	15,864	11,139	12,588	15,727	13,153	14,779	18,413
Heavy Vehicle	804	1,025	1,405	902	1,166	1,609	387	486	653
Bus	221	233	260	118	124	138	265	278	311
Active Mode	5,122	5,869	8,658	2,084	2,388	3,523	4,858	5,567	8,211
Total	18,597	20,423	26,186	14,243	16,265	20,997	18,663	21,110	27,588

Table 10: Preferred Option Mode Share Summary

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048
Light Vehicle	12,449	12,960	14,481	11,139	12,433	14,919	13,153	14,425	17,057
Heavy Vehicle	804	1,025	1,405	902	1,166	1,609	387	486	653
Bus	221	374	646	118	199	475	265	447	726
Active Mode	5,122	6,064	9,627	2,084	2,468	3,965	4,858	5,751	9,121
Total	18,597	20,423	26,159	14,243	16,265	20,968	18,663	21,110	27,556

Table 11: Preferred Option with Parking Restriction Mode Share Summary

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048

	AM			IP			PM		
Light Vehicle	12,449	12,234	13,755	11,139	11,708	14,194	13,153	13,700	16,331
Heavy Vehicle	804	1,025	1,405	902	1,166	1,609	387	486	653
Bus	221	877	1,149	118	702	978	265	951	1,229
Active Mode	5,122	6,064	9,627	2,084	2,468	3,965	4,858	5,751	9,121
Total	18,597	20,201	25,937	14,243	16,043	20,746	18,663	20,888	27,334

Table 12: Do Minimum Mode Share Summary (%)

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048
Light Vehicle	67%	65%	61%	78%	77%	75%	70%	70%	67%
Heavy Vehicle	4.3%	5.0%	5.4%	6.3%	7.2%	7.7%	2.1%	2.3%	2.4%
Bus	1.2%	1.1%	1.0%	0.8%	0.8%	0.7%	1.4%	1.3%	1.1%
Active Mode	28%	29%	33%	15%	15%	17%	26%	26%	30%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 13: Preferred Option Mode Share Summary (%)

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048
Light Vehicle	67%	63%	55%	78%	76%	71%	70%	68%	62%
Heavy Vehicle	4.3%	5.0%	5.4%	6.3%	7.2%	7.7%	2.1%	2.3%	2.4%
Bus	1.2%	1.8%	2.5%	0.8%	1.2%	2.3%	1.4%	2.1%	2.6%
Active Mode	28%	30%	37%	15%	15%	19%	26%	27%	33%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 14: Preferred Option with parking charges Mode Share Summary (%)

	AM			IP			PM		
Years	2018	2028	2048	2018	2028	2048	2018	2028	2048

	AM			IP			PM		
Light Vehicle	67%	61%	53%	78%	73%	68%	70%	66%	60%
Heavy Vehicle	4.3%	5.1%	5.4%	6.3%	7.3%	7.8%	2.1%	2.3%	2.4%
Bus	1.2%	4.3%	4.4%	0.8%	4.4%	4.7%	1.4%	4.6%	4.5%
Active Mode	28%	30%	37%	15%	15%	19%	26%	28%	33%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

The model forecast a small growth in bus patronage for the Preferred Option before 2028 due to the implementation of the RPTP and a significate growth between 2028 to 2048 due to the completion of the bus priority lanes, changes in forecast land use patterns and total number of trips generated increases[19].

For the purposes of the modelling, it has been assumed that the bus priority infrastructure has been introduced by 2034 with no further changes beyond 2034. The highest shift to PT therefore reflects in the 2048 model outputs.

The 2028 modelling of the Preferred Option outputs suggest that bus patronage increases as follows:

- AM peak:
    - 221 bus trips in 2018 increase to 374 bus trips in 2028;
    - 1.2% bus mode share in 2018 increase to 1.8% in 2028;
- Inter peak:
    - 118 bus trips in 2018 increase to 199 bus trips in 2028;
    - 0.8% bus mode share in 2018 increase to 1.2% in 2028;
- PM peak:
    - 265 bus trips in 2018 increase to 447 bus trips in 2028; and
    - 1.4% bus mode share in 2018 increase to 2.1% in 2028.

In summary, the change in modelled bus patronage from 2028 to 2048 is forecast as:

- AM peak:
    - 374 bus trips in 2028 increase to 646 bus trips in 2048;
    - 1.8% bus mode share in 2028 decrease to 2.5% in 2048;
- Inter peak:
    - 199 bus trips in 2028 increase to 475 bus trips in 2048;
    - 1.2% bus mode share in 2028 decrease to 2.3% in 2048;
- PM peak:
    - 475 bus trips in 2028 increase to 726 bus trips in 2048; and

[19] The elasticity calculations for the 2028 and 2048 forecast years are independent and based only on the relative travel times in the respective model years. i.e. there are different travel time baselines in each forecast year so the relative change in car and bus travel times for each year determine the shift to/from PT/active modes to/from car trips and vice versa.

  - 1.2% bus mode share in 2028 decrease to 2.6% in 2048.

A similar trend can be found in the modelling of the Preferred Option with parking price increases. However, the mode share of buses is forecast to increase, and the mode share of light vehicles is forecast to decrease compared with the preferred option without parking price increases.

The forecast increases in modelled bus patronage of the Preferred Option with and without parking price increases for 2028:

- AM peak:
  - 374 bus trips increase to 877 bus trips;
  - 1.8% bus mode share increase to 4.3% bus mode share;
- Inter peak:
  - 199 bus trips increase to 702 bus trips;
  - 1.2% bus mode share increase to 4.4% bus mode share;
- PM peak:
  - 447 bus trips increase to 951 bus trips; and
  - 2.1% bus mode share increase to 4.6% bus mode share.

The increase in modelled bus patronage of the Preferred Option with and without parking restriction for 2048:

- AM peak:
  - 646 bus trips increase to 1,149 bus trips;
  - 2.5% bus mode share increase to 4.4% bus mode share;
- Inter peak:
  - 475 bus trips increase to 978 bus trips;
  - 2.3% bus mode share increase to 4.7% bus mode share;
- PM peak:
  - 726 bus trips increase to 1,229 bus trips; and
  - 2.6% bus mode share increase to 4.5% bus mode share.

6.2 Average Annual Daily Traffic

Figure 10 shows the location of the AADT counts from the models. Table 15 to

Table 17 shows the forecast average annual daily traffic (AADT) along roads of interests for the three scenarios.

Figure 10: Location of AADT

Table 15: Do Minimum AADT

Road	2018	2028	2048
Rocks Road	18,200	23,100	25,900
Waimea Road	28,800	32,500	36,900
Motueka Street	8,500	9,300	12,400
Tipahi Street	200	400	800
Kawai Street	500	700	1,000
Brougham Street	1,000	1,200	2,000
Van Diemen Street	7,600	8,500	10,200
Vanguard Street	6,500	7,200	9,400
Washington Road	9,700	10,700	13,100
Bisley Avenue	2,700	2,600	3,500
Tosswill Road	2,500	3,300	4,200

Road	2018	2028	2048
Maire Street	500	700	1,100

Table 16: Preferred Option AADT

Road	2018	2028	2048
Rocks Road	18,200	23,600	28,600
Waimea Road	28,800	31,600	34,100
Motueka Street	8,500	9,000	10,800
Tipahi Street	200	400	1,100
Kawai Street	500	700	1,400
Brougham Street	1,000	1,100	2,900
Van Diemen Street	7,600	8,400	8,200
Vanguard Street	6,500	7,000	11,600
Washington Road	9,700	10,400	7,200
Bisley Avenue	2,700	2,500	2,900
Tosswill Road	2,500	3,000	1,100
Maire Street	500	600	2,400

Table 17: Preferred Option with parking charges AADT

Road	2018	2028	2048
Rocks Road	18,200	22,700	27,900
Waimea Road	28,800	30,200	33,500
Motueka Street	8,500	8,400	10,500
Tipahi Street	200	300	1,000
Kawai Street	500	500	1,400
Brougham Street	1,000	1,100	2,700
Van Diemen Street	7,600	8,000	8,000
Vanguard Street	6,500	6,300	11,100
Washington Road	9,700	9,600	7,000
Bisley Avenue	2,700	2,400	2,700
Tosswill Road	2,500	2,900	1,100
Maire Street	500	500	2,300

These results forecast that there will be a reduction in the AADT along the Waimea Road route and an increase along Rocks Road in the Preferred Option model compared with the Do Minimum model. This appears reasonable as several intersections along Waimea Road are proposed to be signalised and traffic will likely avoid Waimea Road and reroute via Rocks Road to avoid the additional signal delays.

Comparing the Preferred Option model with the Do Minimum model, In 2048, the AADT:

- Along Rocks Road is forecast to increase by 2,700, from 25,900 to 28,600; and
- Along Waimea Road is forecast to decrease by 2,800, from 36,900 to 34,100.

The proposed bus priority infrastructure along the two main arterial roads, including the introduction of bus priority signals, is expected to reduce the capacity for light vehicles and therefore, light vehicles are forecast to continue to use the rat run routes despite the proposed capacity and speed reduction treatments on these routes.

For example, in 2048 the AADT:

- Along Maire Street is forecast to increase by 1,300, from 1,100 to 2,400;
- Along Tipahi Street is forecast to increase by 300, from 800 to 1,100;
- Along Kawai Street is forecast to increase by 400, from 1,000 to 1,400; and
- Along Vanguard Street is forecast to increase by 2,200, from 9,400 to 11,600.

The modelling suggests that by applying a parking restriction with combination to the Preferred Option models will result in further decrease in traffic.

For example, the forecast decrease in AADT of the Preferred Option with and without parking restriction in 2048:

- Along Rocks Road is forecast to decrease by 700, from 28,600 to 27,900;
- Along Waimea Road is forecast to decrease by 600, from 34,100 to 33,500;
- Along Maire Street is forecast to decrease by 100, from 2,400 to 2,300;
- Along Tipahi Street is forecast to decrease by 100, from 1,100 to 1,000; and
- Along Vanguard Street is forecast to decrease by 500, from 11,600 to 11,100

6.3 Peak hour volumes

Figure 11 to Figure 13 shows the demand difference from the 2048 Preferred Option model - 2048 Do Minimum model.

The blue banded links show the roads on which volumes are forecast to reduce while the green banded links show the roads on which volumes are expected to increase.

Figure 11: 2048 AM Preferred Option Demand Flow - 2048 AM Do Minimum Demand Flow

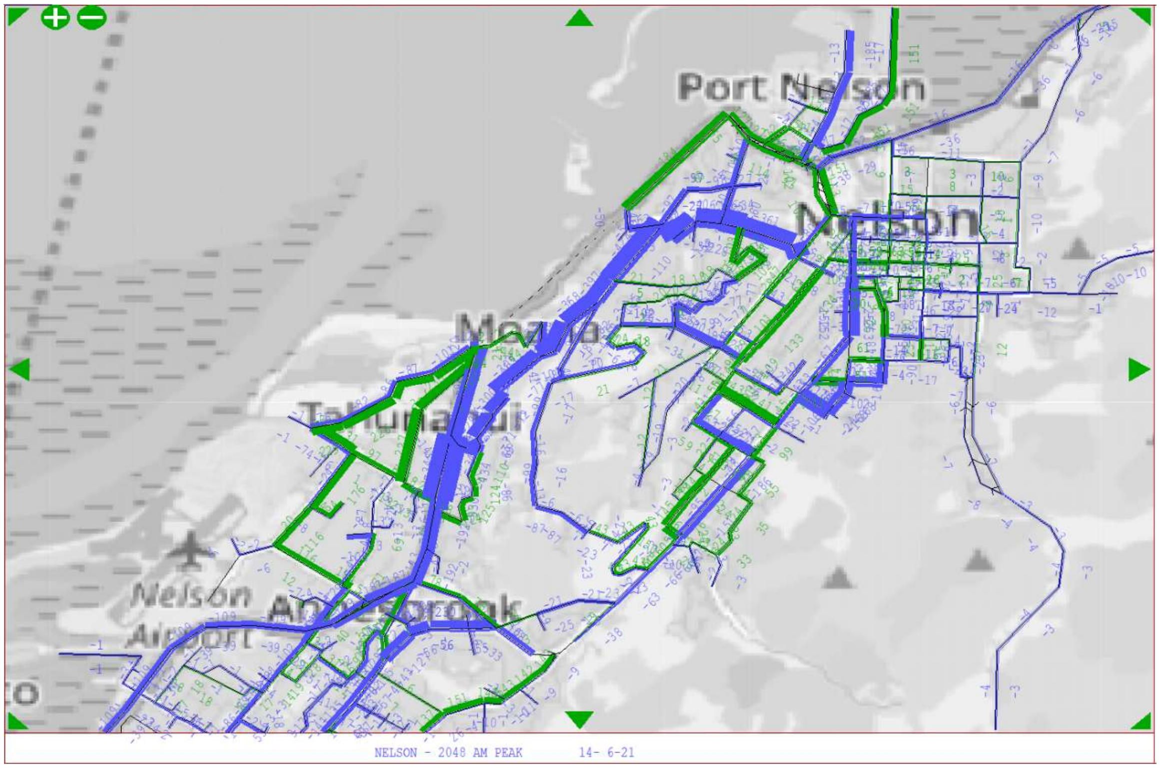


Figure 12: 2048 IP Preferred Option Demand Flow - 2048 IP Do Minimum Demand Flow

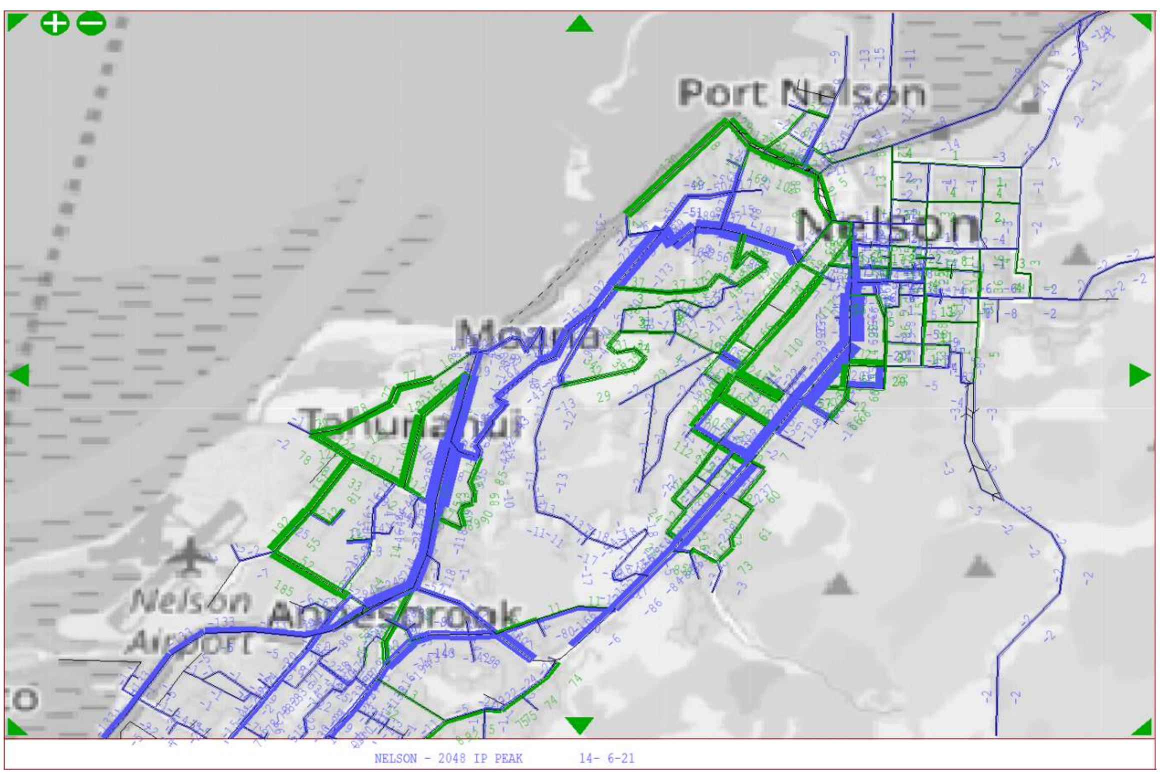
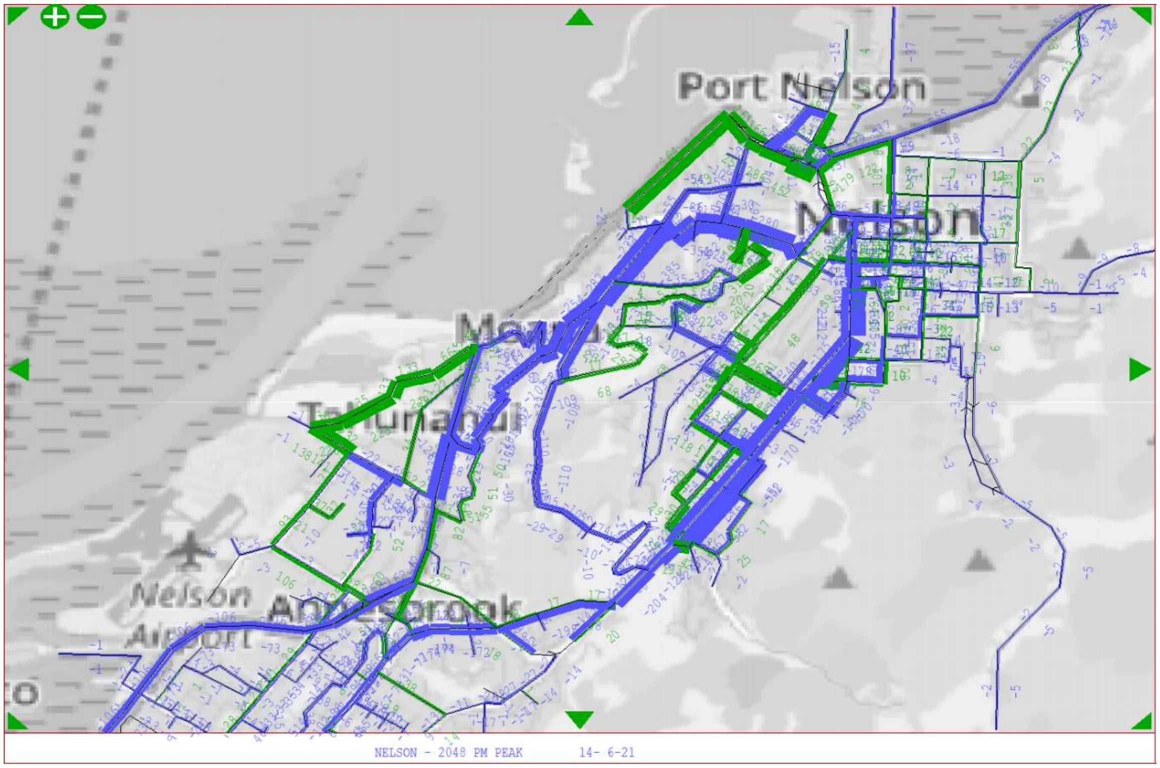


Figure 13: 2048 PM Preferred Option Demand Flow - 2048 PM Do Minimum Demand Flow



The flow difference plots show the decrease in traffic along Waimea Road and the increase in traffic along Rocks Road identified in the section 0. The plots also show that Maire Street is forecast to be used as a rat run route to avoid Rocks Road while Tipahi Street and Kaiwai Street is forecast to be used to avoid delays on Waimea Road.

Figure 14 to Figure 16 shows the demand difference from the 2048 Preferred Option with parking charges model - 2048 Do Minimum model.

Figure 14: 2048 AM Preferred Option with parking charges Demand Flow - 2048 AM Do Minimum Demand Flow

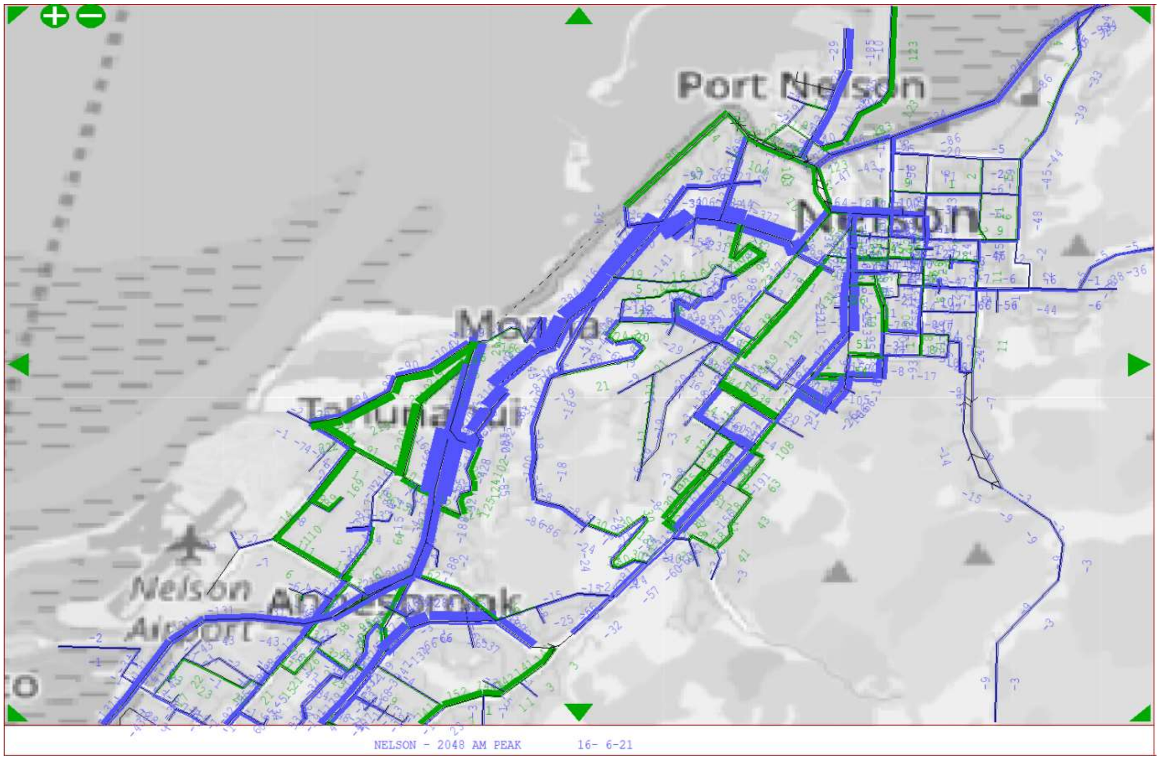


Figure 15: 2048 IP Preferred Option with Parking Price Increases Demand Flow - 2048 IP Do Minimum Demand Flow

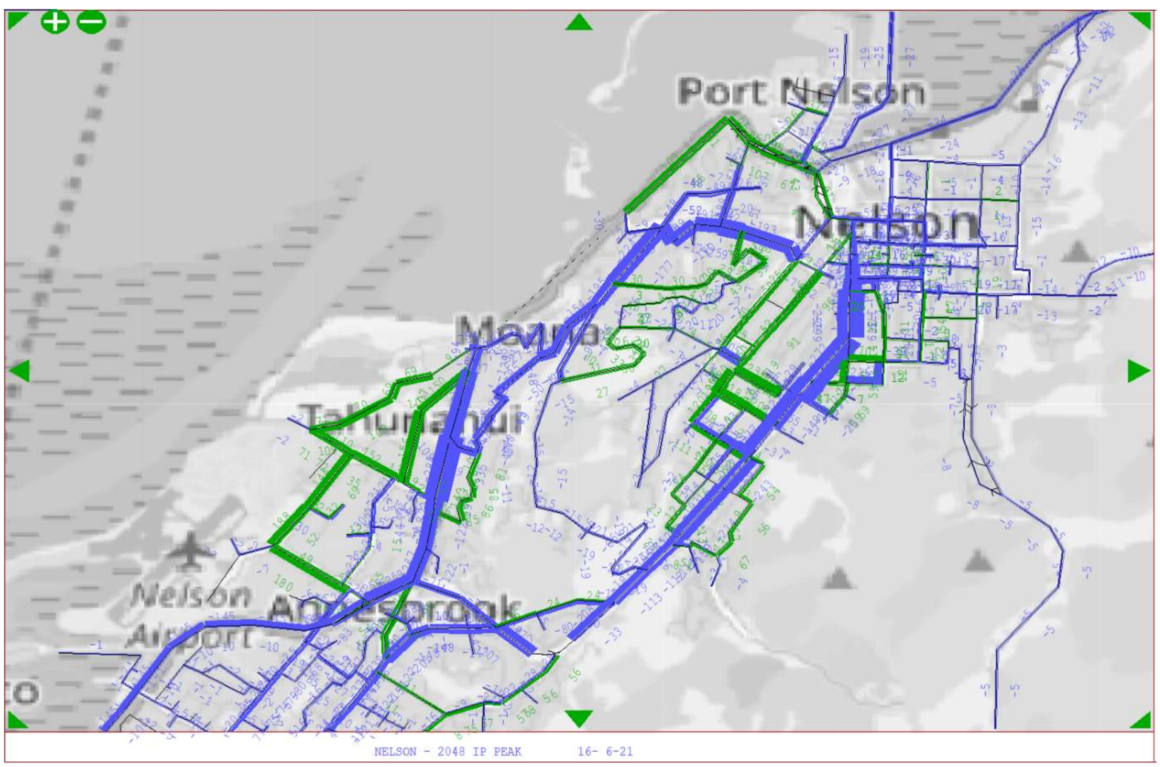
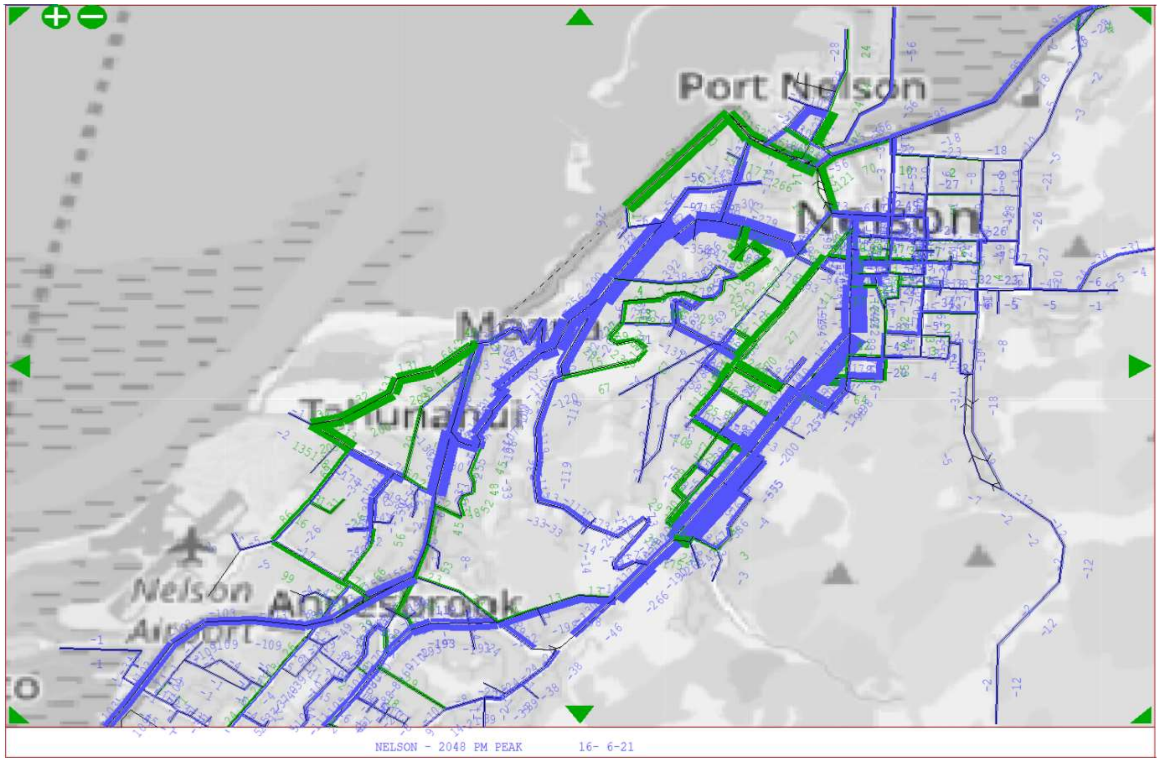


Figure 16: 2048 PM Preferred Option with Parking Price Increases Demand Flow - 2048 PM Do Minimum Demand Flow



6.4 Travel time – general traffic

Table 18 to Table 20 shows the general traffic travel time in minutes along Rocks Road and Waimea Road for the three scenarios.

Table 18: Do Minimum Travel Time along Rocks Road and Waimea Road (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Annesbrook roundabout to Haven roundabout via Rocks Road	11.6	8.3	8.7	12.9	9.2	9.5	14.1	10.0	10.6
Haven roundabout to Annesbrook roundabout via Rocks Road	8.5	8.3	9.9	8.8	8.6	9.4	9.6	9.5	13.9
Annesbrook roundabout to Haven roundabout via Waimea Road	12.3	8.1	8.7	13.5	8.8	9.4	15.6	9.9	10.2
Haven R/A to Annesbrook roundabout via Waimea Road	9.7	8.3	10.0	10.2	8.9	12.1	11.4	10.3	20.2

Table 18 shows that with the Do Minimum, travel times are forecast to increase from 2018 to 2028 and 2048. The PM travel time southbound along Waimea Road in 2048 is forecast to double from 10 minutes to 20 minutes.

Table 19: Preferred Option Travel Time Along Rocks Road and Waimea Road (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Annesbrook roundabout to Haven roundabout via Rocks Road	11.6	8.3	8.7	9.4	9.1	9.4	18.9	12.2	13.1
Haven roundabout to Annesbrook roundabout via Rocks Road	8.5	8.3	9.9	9.4	8.5	9.4	11.9	13.3	19.3
Annesbrook roundabout to Haven roundabout via Waimea Road	12.3	8.1	8.7	9.3	8.8	9.3	19.3	12.1	12.4
Haven R/A to Annesbrook roundabout via Waimea Road	9.7	8.3	10.0	11.3	8.8	11.3	13.4	13.8	25.1

Table 20: Preferred Option with parking charges Travel Time Along Rocks Road and Waimea Road (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Annesbrook roundabout to Haven roundabout via Rocks Road	11.6	8.3	8.7	11.8	8.9	9.4	16.3	12.0	13.3
Haven roundabout to Annesbrook roundabout via Rocks Road	8.5	8.3	9.9	8.8	8.4	9.2	12.6	12.5	17.1
Annesbrook roundabout to Haven roundabout via Waimea Road	12.3	8.1	8.7	11.5	8.5	9.2	16.0	11.8	12.4
Haven R/A to Annesbrook roundabout via Waimea Road	9.7	8.3	10.0	9.7	8.6	10.3	13.4	13.4	22.8

Table 21 shows the change in travel time along Rocks Road and Waimea Road between the Preferred Option and the Do Minimum scenario.

Table 21: Travel times of Preferred Option minus Do Minimum (min)

Route	2028			2048		
	AM	IP	PM	AM	IP	PM
Annesbrook roundabout to Haven roundabout via Rocks Road	-3.4	0.0	0.0	4.7	2.3	2.5
Haven roundabout to Annesbrook roundabout via Rocks Road	0.5	0.0	0.0	2.3	3.8	5.4
Annesbrook roundabout to Haven roundabout via Waimea Road	-4.2	-0.1	-0.1	3.7	2.2	2.2

Route	2028			2048		
	AM	IP	PM	AM	IP	PM
Haven R/A to Annesbrook roundabout via Waimea Road	1.1	-0.2	-0.8	2.1	3.6	4.9

The travel time differences shown in Table 21 shows that the proposed changes along the two corridors will increase average travel times along these sections by between 2 and 5 minutes in 2048. These increases can largely be attributed to the additional delay incurred by having to stop at several traffic signals.

Table 22 shows the change in travel time along Rocks Road and Waimea Road between the Preferred Option with parking charges and the Do Minimum scenario.

Table 22: Travel times of Preferred Option with parking charges minus Do Minimum (min)

Route	2028			2048		
	AM	IP	PM	AM	IP	PM
Annesbrook roundabout to Haven roundabout via Rocks Road	-1.0	-0.2	-0.1	2.2	2.1	2.8
Haven roundabout to Annesbrook roundabout via Rocks Road	-0.1	-0.1	-0.1	3.0	3.0	3.2
Annesbrook roundabout to Haven roundabout via Waimea Road	-2.0	-0.3	-0.3	0.4	1.9	2.3
Haven R/A to Annesbrook roundabout via Waimea Road	-0.4	-0.4	-1.8	2.0	3.1	2.7

Table 22 shows that with increased parking charges in the Nelson City Centre, travel times into and out of the city centre are forecast to decrease as private vehicle travel demand into city centre are forecast to be reduced in response to higher parking costs. This effect is forecast to be more marked for Rocks Road than for Waimea Road.

6.5 Travel time – bus routes

Table 23 to Table 25 shows the forecast travel time for buses and light vehicles along bus route 1 and 2 for the three scenarios. (note: these travel times are between Richmond and Nelson).

Table 23: Do Minimum Bus Route Travel Time (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Bus - Route 1 - Northbound	29.3	24.4	25.5	34.0	26.3	29.5	46.9	32.8	34.5
Bus - Route 1 - Southbound	25.3	22.6	25.1	28.0	24.6	30.7	36.9	29.2	52.1
Bus - Route 2 - Northbound	32.4	27.1	27.9	35.3	28.7	29.6	44.3	34.8	33.6
Bus - Route 2 - Southbound	27.3	26.4	28.8	29.7	28.1	33.0	34.2	33.7	62.7

Table 23 shows that bus travel times with the Do Minimum are forecast to increase significantly from 2018 to 2048 with PM peak southbound (outbound from the city centre) forecast to more than double in travel time.

Table 24: Preferred Option Bus Route Travel Time (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Bus - Route 1 - Northbound	29.3	24.4	25.5	29.2	26.2	29.2	38.9	30.8	34.6
Bus - Route 1 - Southbound	25.3	22.6	25.1	29.3	24.5	29.3	34.9	30.4	40.5
Bus - Route 2 - Northbound	32.4	27.1	27.9	29.4	28.5	29.4	39.5	33.9	31.8
Bus - Route 2 - Southbound	27.3	26.4	28.8	31.9	28.0	31.9	33.0	34.0	58.1

Table 25: Preferred Option with parking charges Bus Route Travel Time (min)

Route	2018			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Bus - Route 1 - Northbound	29.3	24.4	25.5	31.3	25.9	28.7	38.6	30.6	34.9
Bus - Route 1 - Southbound	25.3	22.6	25.1	27.6	24.2	27.7	35.3	30.1	39.8
Bus - Route 2 - Northbound	32.4	27.1	27.9	33.5	28.1	29.0	38.9	33.5	32.1
Bus - Route 2 - Southbound	27.3	26.4	28.8	29.4	27.7	30.5	33.2	33.5	54.9

Table 24 and Table 25 show that with the proposed priority treatments, bus travel times along these routes are forecast to improve.

Table 26 shows the change in travel time forecast along the bus routes between the Preferred Option and the Do Minimum scenario.

Table 26: Preferred Option - Do Minimum (min)

Route	2028			2048			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
1 north	-4.8	-0.1	-0.3	-8.0	-2.0	0.1	-14%	0%	-1%	-17%	-6%	0%
1 south	1.3	-0.1	-1.5	-1.9	1.3	-11.6	5%	0%	-5%	-5%	4%	-22%
2 north	-5.9	-0.2	-0.2	-4.8	-1.0	-1.8	-17%	-1%	-1%	-11%	-3%	-5%
2 south	2.2	-0.1	-1.1	-1.1	0.3	-4.6	7%	0%	-3%	-3%	1%	-7%

Table 27 shows the change in travel time along the bus routes between the Preferred Option with parking charges and the Do Minimum scenario.

Table 27: Preferred Option with parking charges - Do Minimum (min)

Route	2028			2048			2028			2048		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
1 north	-2.7	-0.4	-0.8	-8.3	-2.2	0.4	-8%	-2%	-3%	-18%	-7%	1%
1 south	-0.3	-0.4	-3.1	-1.6	1.0	-12.3	-1%	-1%	-10%	-4%	3%	-24%
2 north	-1.8	-0.6	-0.6	-5.4	-1.4	-1.5	-5%	-2%	-2%	-12%	-4%	-4%
2 south	-0.3	-0.4	-2.5	-1.0	-0.3	-7.8	-1%	-1%	-7%	-3%	-1%	-12%

Table 26 and Table 27 show that with the proposed priority treatments, bus travel times along these routes are forecast to improve by up to 11.6 minutes (22%), and 12.3 minutes (24%) if parking charges are introduced. On average bus travel times are forecast to improve by 1 around minutes (2028) and 4 minutes (2048).

6.6 Summary statistics

Table 28: Summary modelling statistics

Year, peak	Total Travel Distance (veh-km)			Total Travel Time (veh-hr)			Average Speed (kph)		
	Do Min	Option	Option + parking charges	Do Min	Option	Option + parking charges	Do Min	Option	Option + parking charges
2018 AM	121710	121710	121710	2906	2906	2906	42	42	42
2018 IP	97324	97324	97324	2109	2109	2109	46	46	46
2018 PM	123747	123747	123747	2835	2835	2835	44	44	44
2028 AM	146547	144875	140230	3760	3661	3412	39	40	41
2028 IP	122096	121200	117914	2790	2762	2642	44	44	45
2028 PM	154370	151901	147307	4003	3841	3593	39	40	41
2048 AM	205953	199797	196814	8562	8381	8003	24	24	25
2048 IP	169282	164315	162259	5643	5010	4867	30	33	33
2048 PM	212901	205415	202381	11064	10938	10413	19	19	27

Table 28 shows that with the Do Minimum scenario, total travel on the network is forecast to increase from 2018 through to 2048. Travel times are forecast to increase more rapidly than travel distances as the network is forecast to become more congested. This is especially true for the 2048 PM peak for which the light vehicle demand matrix is 20% larger than the 2048 AM peak.

For a detailed discussion on this, please refer to the forecast modelling report discussed/referenced in Section 2.3.

Table 28 also shows that for 2028 model year, the Preferred Option is forecast to reduce the total network travel distances as some trips are forecast to be shifted to public transport and active modes, but increase travel times due to the proposed safety and bus priority measures along the two main arterials into the Nelson City Centre.

For the 2048 model year it shows that the Preferred Option is forecast to reduce both the network travel distances and travel times compared to the Do Minimum as the forecast congestion in the Do Minimum scenario is relieved by a combination of the forecast shift from private vehicle trips to other modes, and the improved level of service to traffic from the side roads along the two arterials, even with the increase in travel times along these arterials routes.

Table 29 presents the percentage change in network travel statistics shown in Table 28 compared to the Do Minimum scenario.

Table 29: Change in network travel statistics compared to the Do Minimum scenario

Year	Total Travel Distance (veh-km)		Total Travel Time (veh-hr)		Average Speed (kph)	
	Option	Option + parking charges	Option	Option + parking charges	Option	Option + parking charges
2028 AM	-2.0%	-3.8%	6.8%	-0.2%	1.5%	5.4%
2028 IP	-1.3%	-2.9%	4.2%	1.4%	0.2%	1.8%
2028 PM	-2.1%	-3.8%	4.4%	-0.8%	2.3%	6.2%
2048 AM	-3.0%	-4.4%	-2.1%	-6.5%	-1.2%	2.1%
2048 IP	-2.9%	-4.1%	-11.2%	-13.8%	10.0%	11.0%
2048 PM	-3.5%	-4.9%	-1.1%	-5.9%	-2.1%	38.5%

7.0 Sensitivity testing

7.1 Travel time elasticities

Sensitivity testing was carried out around the central assumptions for elasticity of demand.

Table 30 shows the base elasticity assumptions along with the lower and upper bounds tested.

Table 30: Sensitivity test parameter assumptions (preferred option)

Assumption	Cross Elasticity			Bus Elasticity
	Car Driver	Public Transport	Active Modes	
Base	-0.76	0.39	0.19	-0.4
Lower bound (-50%)	-0.38	0.195	0.095	-0.2
Upper bound (+50%)	-1.14	0.585	0.285	-0.6

Figure 17,Figure 18, and Figure 19 shows the total network trips based on the elasticity assumptions for the light vehicle, bus patronage and active mode trips respectively.

Figure 17: Light vehicle mode share range based on elasticity assumptions sensitivity testing

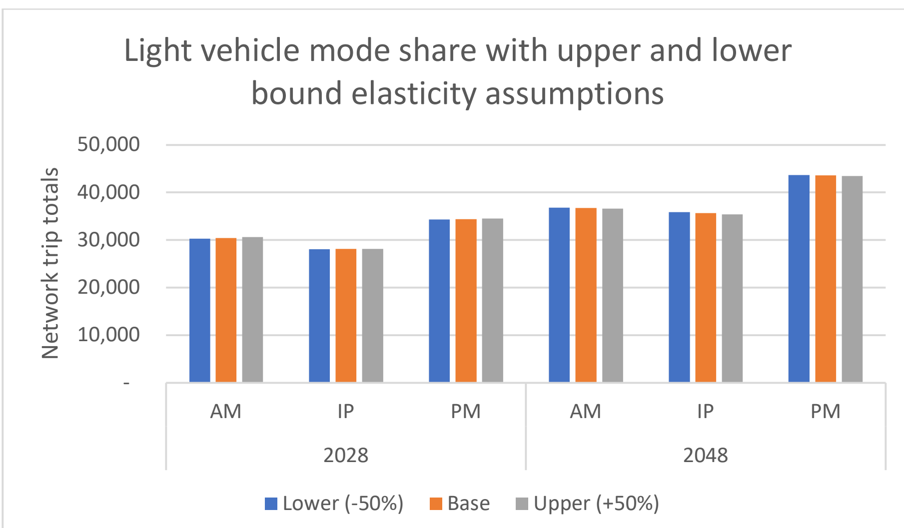


Figure 18: Active modes mode share range based on elasticity assumptions sensitivity testing

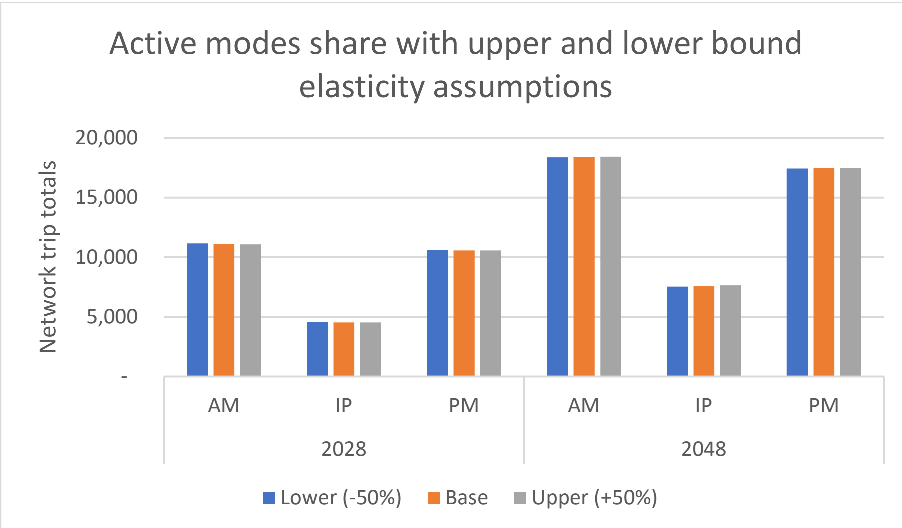


Figure 19: Bus mode share range based on elasticity assumptions sensitivity testing

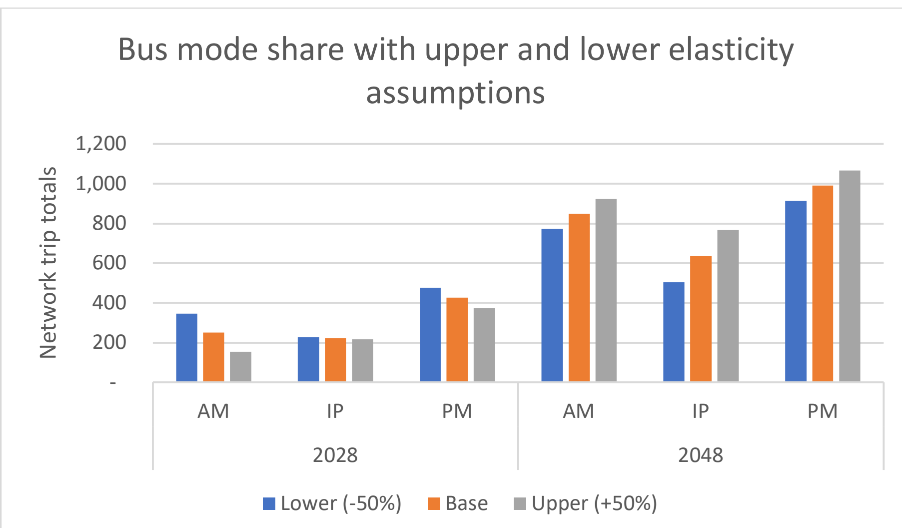


Figure 17 through Figure 18 shows that the light vehicle and active mode totals are generally insensitive to the elasticity assumptions, with the totals for the lower and upper bound tests varying by less than 2% for any of the peaks and model years.

Figure 19 shows that the bus patronage is more sensitive to these parameter assumptions. This is to be expected however given the low base patronage against which the assumptions were tested. Figure 20 shows the bus patronage mode share percentage with respect to the lower, base and upper bound elasticity parameters tested.

Figure 20: Bus mode share percentage range based on elasticity assumptions sensitivity testing

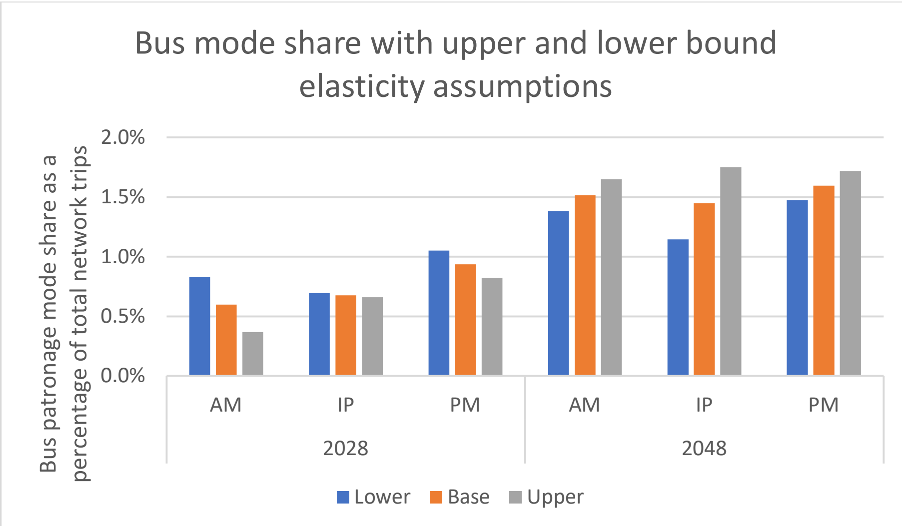


Figure 20 shows that while the bus mode share is relatively sensitive to the elasticity assumptions, and a large mode shift is forecast when comparing to the central assumption, when comparing to the total network trips and bus more share as a percentage of all network trips, the relative difference is small.

The elasticity parameters with respect to travel time used in the assessment are therefore considered to be appropriate for this indicative level of assessment.

7.2 Parking cost elasticities

Sensitivity tests were also conducted around the central parking cost elasticity assumptions. Two parameters were changed and tested; the elasticity parameter and the daily parking cost (based on weighted average hourly parking costs for city centre and fringe).

The central assumption for the parking cost elasticity used was -0.3, implying that car travel into the city centre will reduce by 0.3% for every 1% increase in parking costs.

Table 31 shows tested scenarios and the respective forecast impacts on private vehicle trip reduction and bus patronage

Table 31: Parking cost elasticity sensitivity test

Assumption	Parking elasticity / parking cost	Private vehicle trip demand reduction	Bus patronage increase
Base	-0.30	772 (39%)	535
Lower bound (-50%)	-0.15	386 (20%)	268
Upper bound (+50%)	-0.45	1,158 (59%)	803
Base parking costs	$17/day	772 (39%)	535
Lower bound parking cost (-50%)	$13/day	432 (22%)	300
Upper bound parking costs (+50%)	$27/day	1,451 (74%)	1,006

Table 31 shows the range of outputs based on the parking elasticity parameter sensitivity test. This shows a direct relationship between the parameter assumed and the reduction in car travel demand into the city centre. This shows that the assessment is relatively sensitive to the elasticity and cost assumptions and that the outputs are very indicative – i.e. a range of potential outcomes should be considered when assessing likely impacts of parking cost changes.

8.0 Conclusion & recommendation

8.1 Summary

The Preferred Option, which consists of bus priority treatments along Rocks and Waimea Road, active mode route improvements and local treatments along lower order roads to minimise rat-runs, was assessed against the Do Minimum using a combination of SATURN modelling and out of model spreadsheet assessments.

The results of the modelling assessment forecast that:

- Providing active mode travel facilities will increase the walking and cycling mode shares by up to 4% depending on the peak hour and model year. The largest shift is forecast for the 2048 AM peak hour where the combined walking and cycling mode share is forecast to shift from 33% to 37%.
- Bus travel times with the Do Minimum are forecast to increase significantly from 2018 to 2048 with PM peak southbound (outbound from the city centre) forecast to more than double in travel time.
- Providing safety and bus priority improvements measures along Rocks Road and Waimea Road is forecast to improve bus travel times and therefore bus travel mode shares:
    - Bus travel times along these routes are forecast to improve by up to 11.6 minutes (22%), and 12.3 minutes (24%) if parking charges are introduced (PM peak 2048);
    - On average bus travel times are forecast to improve by 2 around minutes (2028) and 4 minutes (2048). With increased parking costs, this is forecast to improve slightly;
    - The bus mode shares in 2028 are forecast to increase from around 1% (Do Minimum) to roughly 2% (Preferred Option);
    - The bus mode shares in 2048 are forecast to increase from around 1% (Do Minimum) to roughly 2.5% (Preferred Option);
- Providing safety and bus priority improvements along Rocks Road and Waimea Road will increase the travel time for general traffic along these routes:
    - The proposed changes along the two corridors will increase average travel times along these sections by between 2 and 5 minutes. These increases can largely be attributed to the additional delay incurred by having to stop at several traffic signals;
    - With increased parking costs in the Nelson City Centre, the increase in general traffic travel times along the two corridors are forecast to increase less severely – introducing parking charges is forecast to reduce travel times by roughly 1 minute on both routes;
- The treatment of local roads within Nelson to minimise rat-run behaviour is forecast to reduce the travel along these local roads and increase demand for the Rocks Road and Waimea Road arterials;
- Increased parking costs are forecast to:
    - Reduce the demand on private vehicle travel into the Nelson City Centre; and
    - Increase the attractiveness of alternative modes and therefore bus and active mode travel mode shares;
- At the network level, the modelling summary statistics suggest that:
    - For 2028 model year, the Preferred Option is forecast to reduce the total network travel distances as some trips are forecast to be shifted to public transport and active modes, but maintain a similar travel times along the two main arterials into the Nelson City Centre;

- For the 2048 model year it shows that the Preferred Option is forecast to reduce both the network travel distances and travel times compared to the Do Minimum as the forecast congestion in the Do Minimum scenario is relieved by a combination of the forecast shift from private vehicle trips to other modes, and the improved level of service to traffic from the side roads along the two arterials, even with the increase in travel times along these arterials routes.

While the modelling results are considered a conservative forecast of future travel behaviour, given the high level of uncertainty and as travel time and parking cost elasticities were central assumptions in the assessment, sensitivity testing around these assumptions were undertaken to determine how sensitive the outcomes are against these assumptions, and to present an indicative range of potential outcomes.

In general, apart from bus mode shares, the modelling forecasts that car travel times, mode shares and average daily traffic volumes are relatively insensitive to these parameters.

8.2 Recommendations

Forecasting future travel behaviour and land use patterns is based on several assumptions and extrapolations, so the results presented in this report represent one possible scenario.

The results were sensitivity tested against several assumed parameters to account for some of this uncertainty, so decision makers can be confident that the preferred option is robust and relatively insensitive to these changes.

The results provide an indication of the forecast network operations as well as the modal response to the proposed network changes, including improved active mode travel and bus priority investments.

It is recommended that when the projects are considered in more detail at the next stage of investigation, more detailed assessments should be conducted to provide more confidence in the forecast outcomes.

It is also recommended that, to support these assessments, for example the effect of parking cost changes, detailed surveys be carried out to estimate the potential impact on aspects that were not considered within scope of this assessment. These aspects could include potential spill-over parking into suburbs close to the city centre, relocation of businesses or reduction in economic activity in the city centre.

Do you want to recommend a different model should be built that provides for active and PT modes?

14 July 2021

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Rhys

Nelson Future Access Programme: Transport Modelling & Economic Analysis Peer Review

Background

The Waka Kotahi NZ Transport Agency (**WK-NZTA**), Nelson City Council (**NCC**) and Tasman District Council (**TDC**) are jointly developing a multi-modal transport system investment programme to support the aspiration of the local communities.

Previously, a SATURN traffic model has been developed and applied, to inform both the Detailed Business Case (**DBC**) for the Nelson Future Access Project (**NFAP**) and the Richmond Network Operating Framework (**NOF**).

This model has been validated to conditions observed in 2018 and was subsequently used for forecasting purposes. Both the base-year validation and the forecasting stages of the model development process were subject to peer review processes in 2019 and confirmed to be 'fit-for-purpose'.

Since this time, consultant Aecom has been commissioned to utilise the model for the specific purpose of assessing the impacts of a package of measures including bus priority, active mode promotion and minor changes to the roading network.

The purpose of this document is to report a peer review of the methodology used to apply the model for these assessments. This includes a review of the subsequent economic analysis which was based upon the outputs of the transportation modelling.

Transportation Modelling

Available Documentation

The document which formed the basis of the review is:

- Nelson Future Access Programme: Transport Modelling – Preferred Option (Rev B, 21 June 2021).

Subsequent to the review and discussion, this document was updated to Rev C, dated 2 July 2021.

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Derivation of Existing Bus Patronage and Active Mode Uptake

Existing bus patronage and active mode numbers and patterns were taken from the weekday AM peak TRACKS model, reversed for the PM peak and averaged for the inter-peak, before adjustment to the available observed data. This approach is logical and makes the best use of the available data. Seasonal variability in active mode data was accounted for with the use of data for both February (summer) and July (winter).

Bus Patronage and Active Mode Forecasting

The uptake of active modes in response to the proposed walking and cycling path along Rocks Road was based upon an accepted methodology and the scale of the change appears reasonable in the context of the facilities proposed.

The vehicle-trip matrices in the SATURN model were then adjusted to account for the assumed modal shift from private vehicles to active modes, taking account of the likely trip-distances and origin-destination pairs involved.

> Issue & discussion: the approach presumes that all of the new active mode trips come from existing private vehicle trips. In practice, some of the active mode trips may be truly 'new', may be transfers from the bus service or transfers from being passengers in private cars. While this might result in some over-estimation of private vehicle reductions, the numbers involved are small and would have little bearing on the overall results or conclusions.

The bus patronage improvements were supplied to Aecom by Stantec, which had been separately commissioned to undertake a PT Review (a review of this work was outside the scope of this review). Again, it was assumed that all of the new bus passengers are transfers from private vehicles.

> Issue & discussion: the approach assumes that all of the new bus passengers are transfers from existing private vehicle trips. In practice, some may be truly 'new' trips, may be transfers from active modes or transfers from being passengers in private cars. While this might result in some over-estimation of private vehicle reductions, the numbers involved are small and would have little bearing on the overall results or conclusions.

The associated reductions made to the private vehicle matrices appear reasonable, in that these reflect the likely origin-destination pairs and were only applied to zones within 400m of the two main bus routes.

Further increases to bus patronage were assumed to derive from bus priority measures, which would reduce bus travel times while also increasing private vehicle travel times. Elasticity approaches were used to determine the likely resulting transfer of trips from private vehicles to buses, using published elasticity values. It is reasonable to expect such transfers to take place and the use of such elasticity values is common practice.

Rat-Run Treatments

It is well-known that use is currently made of a number of 'rat-run' routes to avoid actual or perceived congestion on the main routes. Such activity could be expected to intensify, both over time as traffic demands increase and further with measures to intentionally prioritise bus movements.

Controls on the known ‘rat-run’ routes were reasonably simulated in the model by the application of lower capacities and speeds.

> Issue & discussion: the report noted that the level of control originally assumed for the rat-runs was possibly insufficient to deter ‘rat-run’ activity when further delays arise to private vehicle travel on the main routes. It would be possible to simply reduce the capacity and/or speeds of the relevant routes even further, although as noted by Aecom this would require policy decisions and the approval of residents whose access would become impaired with tighter controls.

Parking Management

An elasticity approach was adopted to quantify the effects upon private vehicle use of increasing the costs of public parking within the Nelson CBD. The methodology used and assumptions made all appear reasonable, particularly in relation to drivers being more sensitive to parking charges than other costs of vehicle operation because of their immediacy.

> Issue & discussion: the overall approach presumes that the effect of the parking charge increases will be to encourage some drivers to change their mode of travel to bus or active mode. While this would undoubtedly occur to some degree, these are not the only behavioural responses that drivers might make. For example, for more ‘discretionary’ trips, drivers may travel to the Nelson CBD less often, or not at all. A proportion who are travelling for work purposes (and so can reclaim the parking charges) would be unlikely to change their behaviour. It is unlikely that the complexity of such response could be comprehensively captured by the approach used.

> Issue & discussion: the approach used only relates to the public parking within the Nelson CBD area. There is no indication of the extent of privately-operated parking, which is beyond any controls imposed through charging. Aecom has reasonably responded that the analysis is only intended to assess the effects upon the public parking stock.

Despite the approach used being reasonable, the overall forecasts of reductions in private vehicle use in response to increased parking charges do not feel totally plausible. For example, a 124% increase in parking charges is forecast to lead to a reduction of 725 vehicle trips. This issue appears to be have been identified by the sensitivity testing and a recognition that this aspect of the modelling requires more work to firm up the underlying assumptions and variables.

Overall Results

The report summarises the modal forecasts by year for the package of changes proposed. All of the forecasts look reasonable in the context of the methodology used and accord with the expected effects of such changes.

Sensitivity Testing

The assessment has acknowledged that the methodologies used are necessarily reliant upon a significant number of assumptions and variables, all of which are subject to levels of uncertainty.

For the bus and active mode measures, sensitivity testing has been used to vary the core elasticity values by +/-50%, but the results are not significantly affected by this variability.

This indicates that the results are robust despite the known uncertainties in the key variables.

For the parking analysis, the forecast levels of private vehicle reductions are sensitive to variability in the elasticity and parking costs values. This indicates that care is required in the application or use of these results for any further analysis or policy development.

Overall Conclusion

The methodology adopted and assumptions made within the analysis are reasonable and the resulting forecasts are considered to be robust in the context of the assumed changes. The issues identified during the review process are generally minor in nature or simply identify much wider contextual matters which only need to be acknowledged rather than addressed by the approach used.

Uncertainty inherent in the process has been acknowledged and addressed through sensitivity testing – this flags that care is needed in the application of the effects of the parking charges and further information should be collected to provide more confidence in these particular results.

Economic Analysis

Available Documentation

The information which formed the basis of the review is a set of spreadsheets supplied by email on 18 June 2021. A revised version of the central spreadsheet (NFAP Indicative Package BCRs Network V6) was supplied on 30 June 2021.

General Methodology

The approach used is conventional, in that the relevant economic benefits associated with the proposed package have been quantified for each model year (using outputs from the traffic modelling described above), interpolation used to determine values for intermediate years and discounting applied to derive net present values. The discounted benefit streams have then been compared to the discounted costs to determine overall Net Present Values.

Costs

A review of the underlying project cost estimates is beyond the scope of this review. The allocation of the costs to years and the associated discounting to present values appears reasonable and correct.

Benefits

As expected the majority of the benefits are travel time reductions. Benefits arise because the travel time increases (due to the additional intersections and rat-run measures) are out-weighed by the travel time reductions resulting from the removal of vehicle trips (due to transfers to bus or active modes).

> Issue & discussion: the replacement of each vehicle trip with a bus or active mode trip will result in the removal of a vehicle from the road network, with associated travel time, VoC and other benefits, which have been properly quantified. But each person making such a transfer is likely to incur a significantly increased travel time, and it is unclear to what extent this effect has been allowed for within the economic analysis. In response, Aecom has calculated the additional bus travel time costs for the 'new'

passengers, and this results in a small deterioration in the overall level of assessed benefits and the BCR. For the transfers to active mode trips, Aecom reasonably considers that this would only apply to short distance trips, for which the change in overall journey time would be small (with some trips possibly being even quicker by active mode).

Issue & discussion: travel time, VoC and other costs have been derived from the traffic model for the modelled years (2018, 2028 and 2048). Values for the years between 2018 and 2028 have been calculated using linear interpolation. For the package, this process has involved linear interpolation between the Do-Minimum values for 2018 and the package values for 2028. But account should be made for the year in which the package is assumed to be implemented, when a 'step-change' in costs would be expected. It is unclear whether allowance has been made for this effect.

In response, Aecom has included allowance for the step change in such costs at the opening date, but the overall effect upon the assessed economic benefits and BCR is small.

Issue & discussion: the VoC have been calculated by the multiplication of distances travelled by the unit costs of vehicle operation in cents/km. An adjustment has been made to convert this to $, but the divisor used is 1000, rather than 100. It is unclear why this value has been used.

Aecom has confirmed that this was a calculation error. Correction results in an increase in the assessed VoC and CO_2 benefits.

Issue & discussion: the values of travel times, VoC etc relate to specific time periods and are factored to annual totals using peak to AADT factors. The annualised benefits will be sensitive to these factors, but no information was originally available regarding their derivation.

In response, Aecom supplied a spreadsheet ('AADT.xlsx') used for the specific purpose of calculating these factors. The factors (3.93, 3.67 and 4.76 for the AM/IP/PM peak periods respectively) were calculated by reference to observed traffic volumes for these periods for a number of representative road sections.

Concerns were raised with these factors, on the basis that:

- the factors should only take account of the duration of each modelled period vs the number of times the period occurs during a year – they do not need to take account of the traffic volumes within each period since this is already reflected in the unit travel times, VoC etc;
- the PM peak factor should be the same as the AM peak factor, given that these periods are both represented by a one hour modelled period and the same number of peak periods should occur in a year;
- the IP factor should generally be much higher than those for the AM/PM peaks, because the number of hours in a year is greater; and
- the application of a 75% adjustment to factor from conditions on weekdays to those on 'other days' is incorrect in the context of a relationship between traffic delays and volumes not being linear (i.e. if traffic volumes for 'other days' are 75% of those on weekdays, delays can be expected to be much less than 75% of those on weekdays).

Aecom has revisited this aspect, with a recalculation of the factors to 1.87, 10.0 and 1.87 for the AM/IP/PM peak periods respectively. The claimed benefits for the ‘other periods’ has been reduced to zero. The overall effect upon the calculated BCRs is slightly positive, because the higher relative factoring of the IP period outweighs the reduced factoring of the AM/PM peak periods and the removal of ‘other period’ benefits.

It is agreed that these factors now appear more reasonable. Also the analysis is conservative in that legitimate benefits will occur in the ‘other’ periods, which are not now being claimed.

Issue & discussion: the CO_2 costs for the Do-Minimum in 2028 and 2048 appear much lower than expected and it appears these have not been annualised using the peak to AADT factors.

Aecom has now calculated the CO_2 costs by the application of a factor on the VoC, which in turn do reflect the annualization factors.

Issue & discussion: it is understood that the unit CO_2 costs to be applied in the analysis are likely to be significantly increased to reflect current policy positions. If this is the case, the assessed CO_2 benefits could be significantly higher, although these form a small proportion of the overall benefits. It would be helpful if Aecom could advise on this.

Aecom has advised that the unit CO_2 values remain subject to review. As a result, the forecasts of these benefits may be considered to be conservative.

Overall Conclusion

The approach used to calculate the discounted costs and benefits is now robust and the results can be considered to be both reliable and conservative.

Yours sincerely,

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