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VIASTRADA
TRANSPORT PLANNING AND DESIGN

MEMORANDUM

To: New Plymouth District Council

Attn: Liz Beck

Date: 7 September 2023

Re: Cycle demand estimation for Transport Choices – both network and route demand methods

Quality Assurance Statement		
This document has been prepared for the benefit of New Plymouth District Council. No liability is accepted by ViaStrada Ltd, or any of its employees or sub-consultants with respect to its use by any other person.	Prepared by:	Megan Gregory, BE, MET Senior Transportation Engineer [redacted] Pim van den Top, BUrbPlan Transport Planner [redacted]
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	Project Number:	1047-19
	Project Name:	New Plymouth Transport Choices
	Version:	03 – third draft

1 Introduction

New Plymouth District have received funding from Waka Kotahi – NZ Transport Agency to deliver the "Transport Choices" programme, a series of corridor improvements to make walking and cycling safer and more attractive.

This document outlines the application of:

- a **network**-based model that compares average cycling Quality of Service (based on cycle facility type and ONRC road classification by length of road) with cycling mode share, for comparative cities from across New Zealand. This is a new modelling approach, developed as an alternative to the SP11 method, which is for analysing individual routes. The method was originally developed and applied for Dunedin City's Strategic Cycling Network in July 2023 by ViaStrada.

- A **route**-based model that uses Quality of Service and jobs data to estimate demand, as per the Waka Kotahi Monetised Benefits and Costs Manual

The models estimate the uptake in cycling from completion of:

- Project 1 Devon Street West (SH45) only
- Project 1 plus Project 2 (Mangorei Road)
- Projects 1, 2 and 3 (SH44)
- Projects 1, 2, 3 and 4 (Devon Street East)

The route-based model omits project 4 Devon Street East as it has not progressed to consultation phase as of August 2023. The designs consulted on provide predominantly separated cycling facilities along the full length of each route and include other safety features such as raised pedestrian crossings. These routes are shown in Figure 1-1.

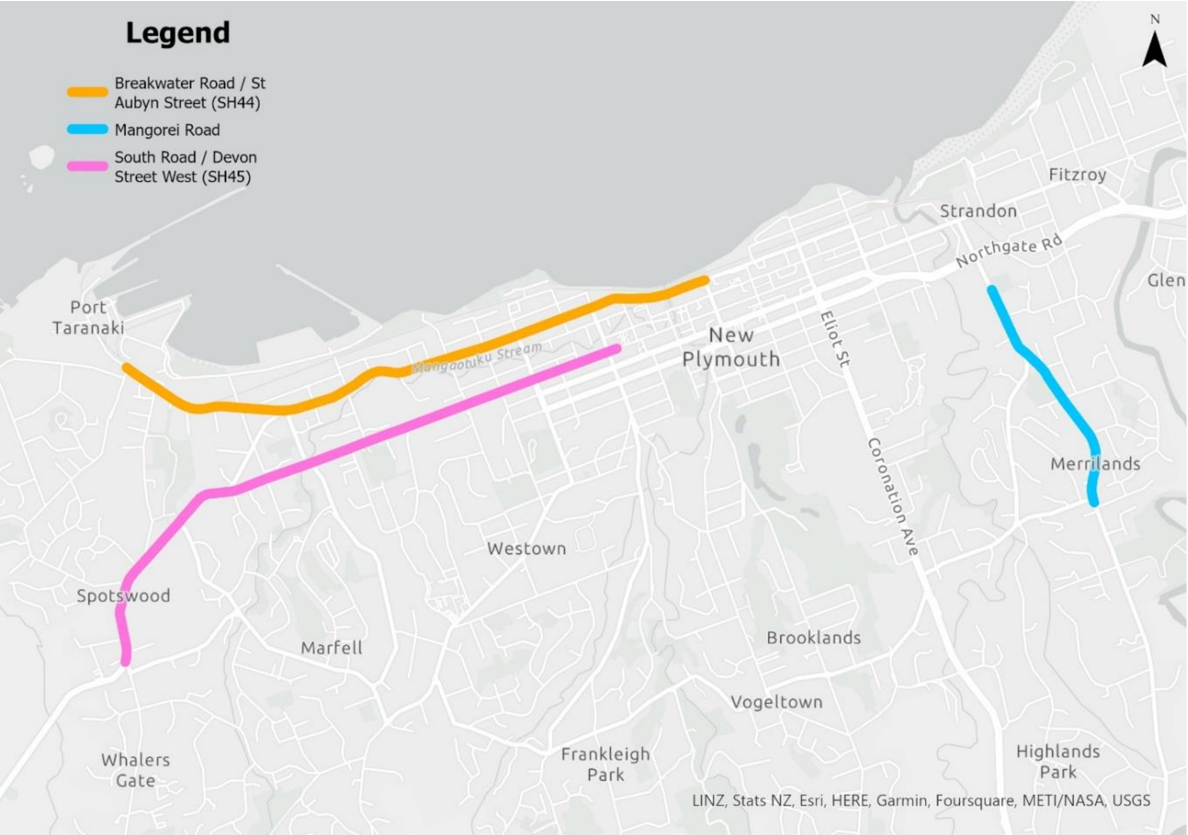


Figure 1-1: Proposed cycleway routes

2 Network modelling approach

A model was developed to determine the relationship between average cycling Quality of Service for cycling based on cycle facility type and road classification and cycling mode share.

2.1 Modelling approach background

Waka Kotahi Research Report 676 *Latent Demand for Walking and Cycling* (WSP, 2021) summarises the range of methods used within New Zealand and internationally for estimating walking and cycling latent demand. It includes a decision tree that is intended to help analysts determine the right method for demand forecasting based on the project scale, cost, risks, and other factors. Figure 2-1 represents the decision tree graphically.

Method 1:	**Method 2:**	**Method 3:**	**Method 4:**	**Method 5:**
Sketch plan equation (cycling). Informed expert estimation (walking).	Sketch plan equation with informed expert calibration (cycling). Informed expert estimation (walking).	Comparison approach combined with an evaluation of level of service and potential use. Employ modifying factors based on the local context.	Geospatial assessment combined with an evaluation of level of service and potential use. Employ modifying factors based on the local context.	Transport model with locally specific data and factors.

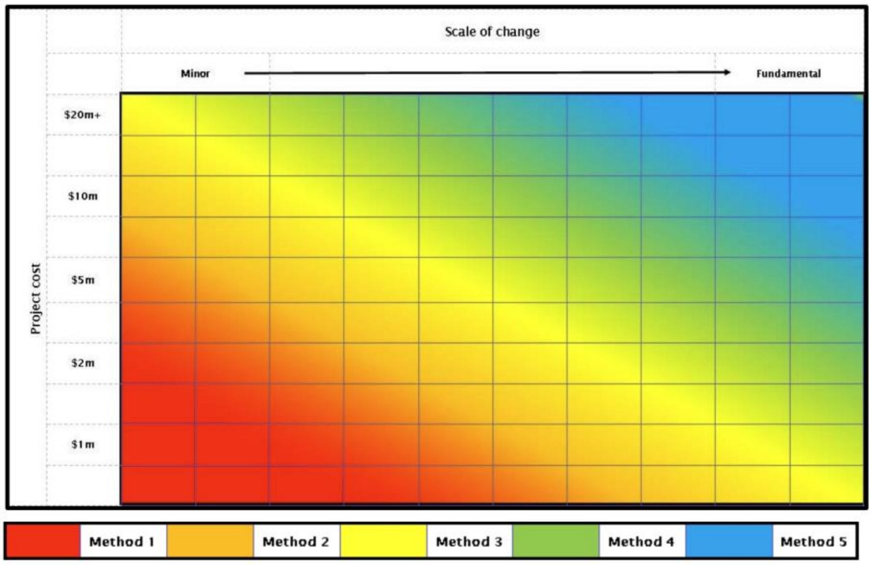


Figure 2-1: Walking and cycling demand methods and selection matrix (extract of Table 4.1 and Figure 4.1 in RR676)

The model developed and employed in this work for New Plymouth falls in the "Method 3" category with some Method 4 geospatial analysis.

2.2 Quality of Service for cycling for cycle facility – road category combinations

The Auckland Transport Cycling Quality of Service (QoS) tool was used to determine the typical quality of service expected for various types of cycling provision combined with the One Network Road Classification (ONRC) categories.

The cycling provisions considered were:

- Separated cycleway
- Shared path
- Cycle lane
- Mixed traffic (i.e. speed and volume depend on the typical characteristics of the road classification, with no additional measures) – this is the default where no specific provision is made for cycling
- Neighbourhood greenway (<2,000 vpd and <30 km/h, as per CNG standards)

The ONRC categories were:

- National
- Regional
- High volume
- Arterial
- Primary Collector
- Secondary Collector
- Low Volume
- Access

The AT QoS tool has five principles (subsets of criteria) for evaluating cycle provision; only the three principles directly relating to safety were evaluated. The other two principles, directness and comfort, were assumed to be consistent across facility types for a given locality.

In evaluating the safety criteria, some assumptions were made. For example, it was assumed that facility dimensions would be reasonable but not generally within the "gold-plated" i.e. highest-scoring category. Note that, for the neighbourhood greenway scores, it was assumed that traffic volumes and speeds would be reduced to levels appropriate for neighbourhood greenways, making this a very unlikely category to be applied on roads with currently high volumes and high speeds.

The possible QoS scores from the AT tool range from 1 (best) to 4 (worst). Table 2-1 shows the typical Quality of Service scores derived from this method.

Table 2-1: Typical Quality of Service scores for cycle facility – road category combinations

ONRC category	Cycle facility type				
	Separated cycleway	Shared path	Cycle lane	Mixed traffic	Neighbourhood Greenway
National	1.67	1.67	3.50	4.00	1.33
High Volume	1.67	1.67	3.50	4.00	1.33
Regional	1.67	1.67	3.50	4.00	1.33
Arterial	1.67	1.67	3.00	4.00	1.33
Primary Collector	1.67	1.67	2.00	3.00	1.33
Secondary Collector	1.67	1.67	2.00	3.00	1.33
Access	1.67	1.67	2.00	3.00	1.33
Low Volume	1.67	1.67	2.00	3.00	1.33

2.3 Selection of comparison cities

2.3.1 Long-list

A long list of potential comparison cities was developed, based on population and having some existing cycling provision. The long-listed cities were:

- Auckland
- Christchurch
- Dunedin
- Hamilton
- Invercargill
- Nelson
- Napier
- New Plymouth
- Palmerston North
- Rotorua
- Tasman
- Taupō
- Tauranga
- Wellington
- Whanganui
- Whangārei

Invercargill was soon discarded when it was discovered that the NZ cycle facility dataset incorrectly recorded most streets as having cycle lanes.

2.3.2 Urban areas

The extents of the comparison cities were based on the urban areas from a Statistics NZ dataset. These are smaller than the territorial authority (TA) units and just encompass city boundaries, not entire districts or rural components. For example, the boundary of Christchurch City Council includes all of Banks Peninsula, whereas the urban area of Christchurch City is much smaller.

2.3.3 Selection criteria

To select the most appropriate comparison cities for New Plymouth (the study city), the long list cities were evaluated based on four key criteria:

- Factors included in the regression modelling (but not ultimately included in the final models) for the SP11 (route) model:
    - Parking charges
    - Population or population density
- Additional factors considered relevant by the SP11 working group in development:
    - Hilliness - several metrics were investigated. The chosen metric calculated the number of contours (at 10 m intervals) intersecting each census SA1 unit, divided by the SA1 area and weighted all of these according to population. This was considered to give a good indication of the amount “ups and downs” in the general topography, and was more accurate than simply using the change in elevation.
    - Weather – mean annual total hours of sunshine

The degree of difference of each comparison city compared with New Plymouth was calculated and divided by the mean, for each criterion. Table 2-2 shows the difference scores for each city for each criterion, plus the total and average scores for each city, ranked to show the cities starting with the most similar city (Tauranga) in descending order.

Table 2-2: Long list cities compared with New Plymouth

	(City score – New Plymouth score) / mean					
	Parking	**Population density**	**Hilliness**	**Sunshine**	**total**	**average**
Tauranga	0.17	0.29	0.07	0.08	0.62	0.15
Christchurch	0.26	0.48	0.22	0.03	0.99	0.25
Hamilton	0.43	0.69	0.13	0.09	1.35	0.34
Napier	1.04	0.09	0.31	0.03	1.47	0.37
Palmerston North	1.04	0.28	0.09	0.24	1.65	0.41
Nelson	0.09	0.17	1.65	0.14	2.05	0.51
Rotorua	0.78	0.40	0.95	0.04	2.17	0.54
Whangārei	0.61	0.19	0.98	0.47	2.24	0.56
Dunedin	0.78	0.37	0.83	0.27	2.25	0.56
Whanganui	1.48	0.27	0.47	0.07	2.30	0.57
Auckland	0.61	1.38	0.61	0.10	2.70	0.67
Taupō	1.48	0.12	0.35	1.10	3.05	0.76
Wellington	0.87	1.00	3.52	0.05	5.43	1.36

2.4 Evaluation of existing quality of service for study and comparison cities

For each study and comparison city (within the Statistic NZ urban areas) the length of road segments with the various cycle facility – road category combinations was computed, using GIS. The datasets involved were:

- New Zealand Road Centreline dataset provided by Waka Kotahi, accessed July 2023
    - Including the ONRC categories
- NZ Cycle Facility dataset 2021 published via ArcGIS Online by Abley

- o With categories for separated cycleway, shared path and cycle lane.

The lines of the datasets did not coincide perfectly and the segments of the cycle facility dataset were generally much longer than the segments of the road dataset.

The cycle facilities were joined to adjacent / corresponding roads by creating buffers around the cycle facilities and joining these to the road segments that lay within them. This avoided the possibility of assigning a cycle facility type to a road that only crossed or intersected the cycle facility. In cases where there were multiple facilities, e.g. a road with an on-road cycle lane plus a shared path running alongside, the "better" provision, i.e. the one most likely to yield a higher QoS, was selected.

For each city, the length of road for each cycle facility – road category combinations was computed; the typical QoS scores (see Table 2-1) were applied, and the sum of all was divided by the total length for the city, to give an average QoS score.

2.5 Mode share for study and comparison cities

Journey to work cycling mode share for the cities was taken from the 2018 Census. For New Plymouth, the 2018 cycling mode share is reported to be 1.7%.

2.6 Relationship between mode share and average quality of service

Using the inputs as described above, cities were added to the model starting with the most similar to New Plymouth and successively decreasing in similarity (i.e. in the order shown in Table 2-2) until a suitable R-squared was achieved.

The relationships between average Quality of Service and cycling mode share are shown in Figure 2-2.

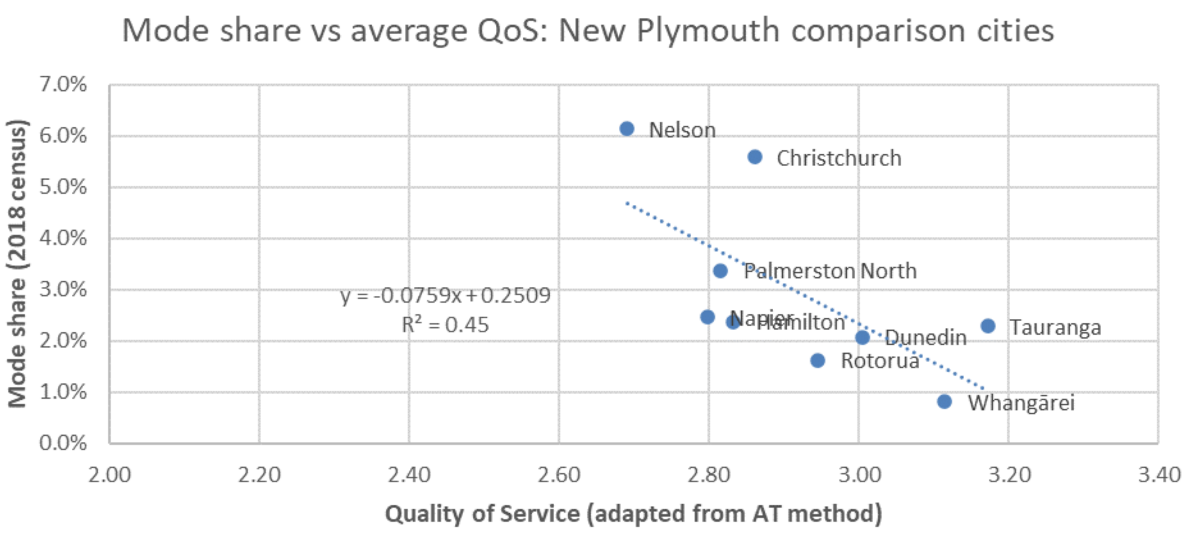


Figure 2-2: New Plymouth mode share vs QoS model 1: comparable cities

The R-squared values for the model is considered to be acceptable, given the broad-level approach applied in calculating average QoS and selecting the comparison cities.

2.7 Evaluate future provision scenarios

The New Plymouth Transport Choices routes were added to the GIS and the resulting cycle facility – road network combinations for each scenario were evaluated in the same way as for the study and comparison cities previously.

Four different scenarios were evaluated:

- Project 1 (Devon St West / SH45) only
- Project 1 plus Project 2 (Mangorei Road)
- Projects 1, 2 and 3 (SH44)
- Projects 1, 2, 3 and 4 (Devon St East)

The resulting cycling mode share prediction for the New Plymouth cycle network once the Transport Choices corridors have been upgraded is illustrated in Figure 2-3. Given a baseline of 1.7% cycling mode share (journeys to work), all scenarios show a substantial uptake. This is intuitive, given the large scale each project as in "backbones" of the New Plymouth transport network. Even completing just Devon Street West (SH45) is estimated to make up the bulk of the mode shift.

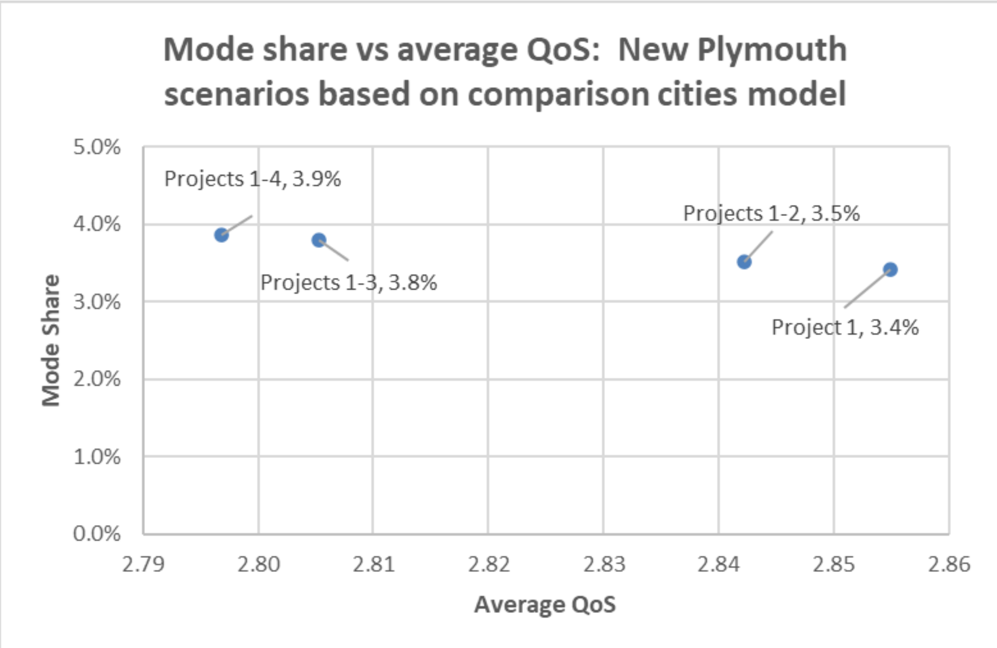


Figure 2-3: cycling JTW mode share vs average quality of service for New Plymouth cycle network future scenarios

2.8 Sensitivity testing

It is believed that there will be a step-change in cycling volumes when a comprehensive network without gaps is developed, and therefore the model presented in Figure 2-3 may not be adequate.

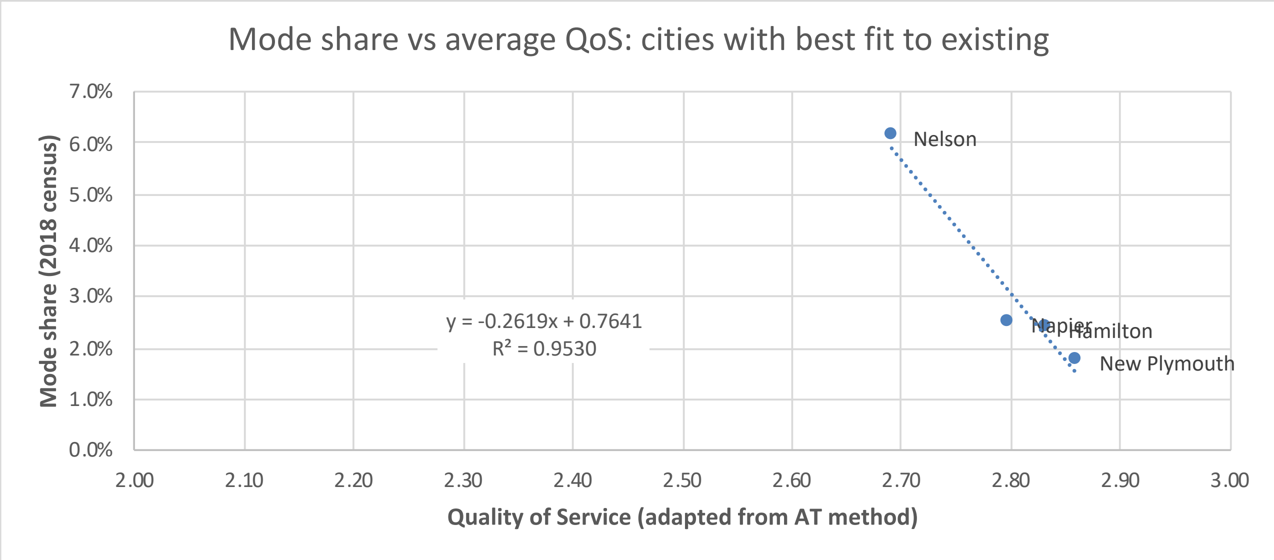
No other NZ cities currently have a complete cycle network, but some do have extensive routes and connections (for example, Christchurch city with its "Major Cycle Routes" and historic dedication to cycle lanes). Therefore, various other models have been developed using the cities with the highest proportion of roads that have either separated cycleways, shared paths, or cycle lanes (noting that neighbourhood greenways and low speed commercial zones would come under "mixed traffic" in this classification, and therefore not contribute to the cycle facilities tally, however this is not expected to affect the overall ranking). Table 2-3 shows the proportions for each city.

Table 2-3: Proportion of road length with cycle facilities by city

City	Proportion cycle facilities	City	Proportion cycle facilities
Christchurch	0.22	Auckland	0.06
Hamilton	0.21	Whanganui	0.05
Napier	0.17	Rotorua	0.04

Nelson	0.13	Whangārei	0.04
Wellington	0.08	Tauranga	0.03
Dunedin	0.07		

A second model, with the steepest slope, was created using Hamilton, Napier, and Nelson. This provides a strong r-squared but is based on relatively few data points. It also provides the greatest differentiation between mode share as more routes are completed. This is worthwhile using as it may better represent connectivity or "network completion" effect.



For the third model, Christchurch, Hamilton, Napier, and Nelson were chosen, plus the existing New Plymouth provisions; this is shown in Figure 2-4.

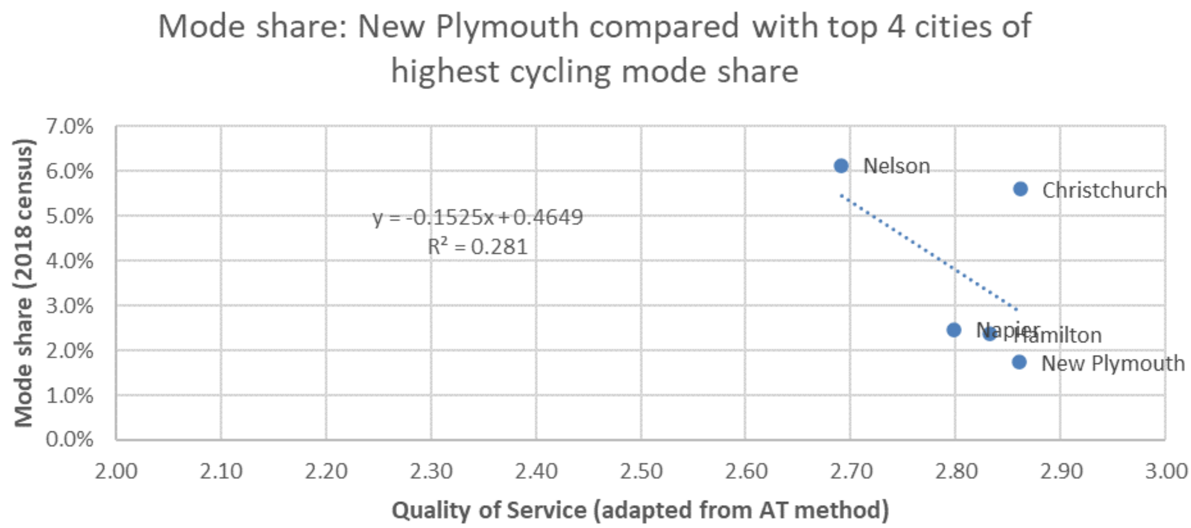


Figure 2-4: New Plymouth cycling JTW mode share vs QoS model 2: cities with high proportion of cycling facilities

A fourth model was created using only Christchurch, Nelson, and the existing New Plymouth provision:

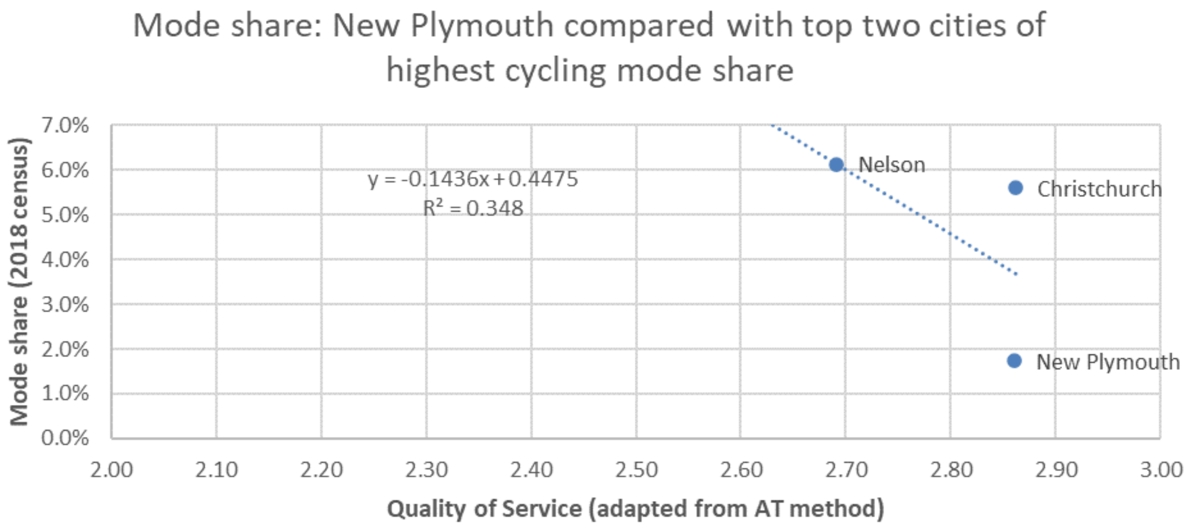


Figure 2-5: New Plymouth cycling JTW mode share vs QoS model 3: cities with highest proportion of cycling facilities

Thus, applying all four models with the various scenarios of provision gives the estimated cycling mode share values shown in Figure 2-6.

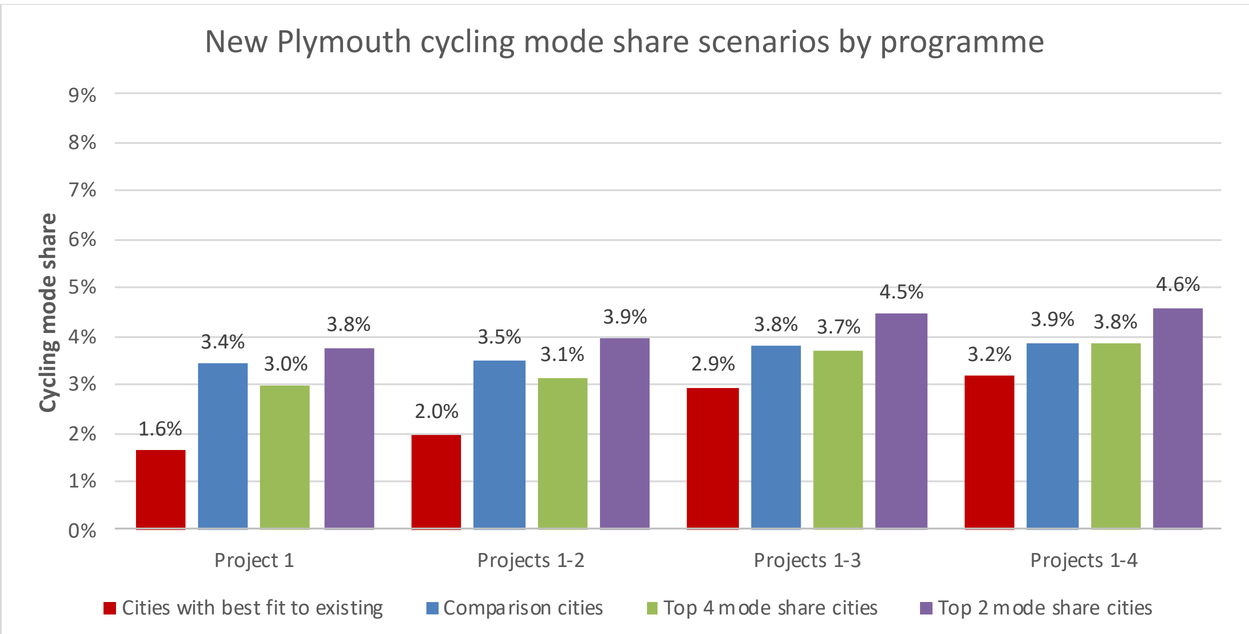


Figure 2-6: cycling JTW mode share predictions for three models and various provision scenarios

2.9 Mode shift and uptake based on comparison cities model

Mode shares (and consequent mode shifts from the existing 1.7% journey to work by bicycle) are estimated absent any other interventions that might be made including parking pricing, public transport service changes, integrated land use and transport planning, and travel behaviour change programmes such as Lets Go! The actual mode shift may be greater.

When translated into cycling for all trip purposes, the daily number of additional people on bikes[1] is estimated to be over 3,680 per day with an annual social benefit of over $22M (Table 2-4) using values from page 55 of the MBCM (Waka Kotahi 2023). This table is for only the comparison and best fit models. When comparing with the route-based estimation in the next section, use only the Projects 1, 2, 3 rows.

Table 2-4: daily cycling demand based upon network estimation

Projects	Mode share	Net gain in cyclists (new riders)	Capped annual benefit	Total annual benefits (undiscounted)
Model 1: comparison cities				
1, 2, 3	3.8%	3,680	$6,200	$22,818,079
1, 2, 3, 4	3.9%	4,360	$6,200	$27,004,764
Model 2: best fit to existing conditions of New Plymouth				
1, 2, 3	2.9%	6,310	$6,200	$39,113,973
1, 2, 3, 4	3.2%	6,500	$6,200	$40,327,296

3 Route-based model

The SP11 cycle demand modelling approach and tool developed by ViaStrada has been used to estimate demand for each route. This tool utilises the Auckland Transport Cycleway Quality of Service Tool (AT QoS) and NZ census employment data to estimate demand levels.

3.1 Auckland Transport Cycleway Quality of Service Tool (AT QoS)

The AT QoS tool evaluates the safety, directness, comfort, coherence and attractiveness of intersections and midblock segments along a route depending on the facility type and other key criteria. QoS is scored from 1 to 4 and relates to the type(s) of users expected to find it appropriate, as shown in Table 3-4. Note that lower QoS scores are better.

Table 3-1: AT QoS score definitions

AT QoS score	Design	Anticipated users
1	Consistent with or exceeds best practice design guidance.	Suitable for a very wide range of users.
2	Meets best practice design guidance.	Suitable for a wide range of users, including the 'interested but concerned'.
3	Does not meet best practice design guidance and may introduce safety concerns for users.	Likely to only be attractive for confident cyclists.
4	Presents shortcomings in design that are likely to introduce major safety concerns for most users or other quality problems.	Will detract many potential users.

The approach to using this tool was right-sized for its application within SP11 for this project. Each corridor has been sectioned into intersections, and midblock sections between each intersection. Where normally

[1] Additional or new riders are typically reported for economic purposes as this is where the greatest health benefits are to be realised in an investment. The maximum annual benefit per new cyclist is assumed due to the facility lengths.

each side of the corridor is assessed separately, for the purposes of this assessment each side of the road is assessed together. Assumptions and limitations of this approach are given in section 5.

3.2 SP11 cycle demand modelling

SP11-7 is a cycle demand model that estimates trips generated by a new or improved cycling facility. This method is based on the number of jobs in a series of buffer zones around the cycling routes; from 0–0.4 km, 0.4–0.8 km, and 0.8–1.6 km. This is combined with the assessment results from the AT QoS tool to estimate the demand along each route. This cycling demand model is part of the Monetised Benefits and Costs Manual (Waka Kotahi).

For the purposes of this assessment, the optional "directness" measure has been included. Additionally, all three routes have been treated independently, with employment data being calculated from full buffers for all routes. While there may be some overlap, this is accounted for through the "network effect" increasing the overall demand if multiple routes are implemented at once.

Due to the GIS buffer method only including employment data, journeys to school by students are not automatically counted. In accordance with the method, these additional trips have been estimated based on a combination NZ 2018 census data and school roll data from the Ministry of Education, with assumed increases in cycling mode share of 5–10%.

To provide a range of possible values, an upper and lower bound was calculated. The parameters for these bounds are in Table 3-2.

Table 3-2: Upper and lower bound parameters

	Lower Bound	Upper Bound
AT QoS	Upper quartile QoS value along route	Lower quartile QoS value along route
School Demand Estimation	*High Schools:* A mode share increase of 5% *Intermediates:* No increase	*High Schools:* A mode share increase of 10% *Intermediates:* A mode share increase of 10%

Where available, existing count data have been used in the model. Where direct counts are the only counts available, these have been calibrated and normalised against a comparison of real and automatic counts in locations where both are available. This resulted in a factor of 3.6 being used to convert a manual peak-2-hour count to a daily count for use in the model.

3.3 Cycling Quality of Service

The results for the AT QoS assessment of the three corridors (as per proposed designs for consultation) are summarised in Table 3-3. These results show that the facilities on all three routes generally meet best practice guidelines, and at times exceed them.

Table 3-3: AT QoS assessment results (rating scale: 1 is best, 4 is worst)

Corridor	Proposed facility		Existing facility	
	Average QoS score	Worst segment QoS score	Average QoS score	Worst segment QoS score
Breakwater Road / St Aubyn Street (SH44)	1.80	2.50	2.68	3.00
South Road / Devon Street West (SH45)	1.85	2.50	2.65	3.25
Mangorei Road	1.85	2.50	2.73	3.00

The resulting upper and lower quartile scores for all three routes were 2.0 and 1.6 respectively.

The worst segment score was reached a limited number of times, and only at intersections, as below:

- Breakwater Road / St Aubyn Street (SH44): **2x intersections**
- South Road / Devon Street West (SH45): **5x intersections**
- Mangorei Road: **2x intersections**

In all cases, these 'worst-case' results were all characterised by having high vehicle volumes at side roads and wide turn radii enabling high speeds. No midblock sections had scores higher than 2.

3.4 SP11 cycle demand modelling

The results of the SP11 cycle demand modelling are summarised in Table 3-4, showing a modest, but significant increase in the number of people cycling along the proposed routes.

Table 3-4: SP11 cycle demand modelling results

Corridor	Modelled existing cyclists (daily)	Counted existing cyclists (daily)	Predicted new cyclists (daily)	Predicted total cyclists (daily)
Breakwater Road / St Aubyn Street (SH44)	60	50*	170 – 350	230 – 400
South Road / Devon Street West (SH45)	50	70	260 – 520	320 – 590
Mangorei Road	10	40	380 – 680	420 – 720
Total	**120**	**160**	**810 – 1,550**	**970 – 1,710**

**Extrapolated from 2-hour-peak count*

As this method is intended to assess individual routes rather than networks, implementing multiple connected routes is likely to yield results better than those indicated above due to the "network effect". For further analysis and discussion on the potential impacts of implementing combinations of these projects to form a network, refer to section 2.

Comparing to the 3,000+ new riders shown in Table 2-4, the route-based model shows a lower total of up to 1,550 new riders. One could be considered a conservative estimate and the other one that reflects what happens when networks reach a level of connectedness and usefulness that enables a step-change in behaviour.

4 Conclusion

The network modelling approach used here is considered to be “right sized” to the level of investment and given the limitation in data availability and resources for modelling. The approach is based upon a regression model of New Plymouth compared to other cities in New Zealand where the variables are network coverage and Quality of Service from a large dataset of cycling networks nationwide and the Census 2018 Journey to Work cycling mode share.

The route modelling approach is the Monetised Benefits and Costs Manual Simplified Procedure 11 based upon a Waka Kotahi research project that used the before and after cycle counts at 22 sites around New Zealand.

Both models have a range of assumptions and limitations (as all models do), documented in section 5.

Based on these simple models, if projects 1, 2, and 3 were implemented as currently being consulted upon, the network model suggests an uptake of between 3,600 and 6,300 riders per day and annual (undiscounted) benefits of between $23 and 40 million. The route model suggests an uptake of up to 1,500 new riders per day, which still yields up to $9 million in annual benefits (undiscounted).

The differences are likely due to the model structures but intuitively make sense as well – the more of a connected network the people of New Plymouth have, the more likely it is that they will get on their bikes for more trips, more often.

5 Assumptions and limitations

Some assumptions have been made to right-size the approach to this assessment, with limitations also acknowledged.

5.1 Network model

The **NZ Cycle Facilities dataset**:

- Was produced in 2021 and therefore does not contain facilities installed or upgraded in the last 2 years. This is not considered to be a significant limitation given the size of the dataset.
- The network for Invercargill was shown to be inaccurate and therefore excluded.
- For New Plymouth, the NZ Cycle Facilities dataset excluded many cycle lanes (some of these may have been introduced since the dataset was produced). An updated dataset based on NPDC records was used, however the comparison cities used in the model development may still be affected by the limitations.
- Only includes separated cycleways, shared paths and cycle lanes; doesn't include on-road provisions such as neighbourhood greenways, low speed commercial zones etc which are distinct from riding in general traffic. This was addressed by scoring the QoS based on the anticipated speeds and motor vehicle volumes that would be achieved if such facilities were installed, regardless of their current ONRC category.

Roads-based methodology, i.e. connecting the cycle provisions to the road network, doesn't account for completely off-road alternative links e.g. not all of New Plymouth's shared paths would be included, even though they offer a high standard of provision and significant advantages to cyclists compared to motorists travelling in this area. It was decided that attempting to merge the cycle facility and road datasets, and identify which cycle facilities were completely separate from the road as opposed to adjacent to the road on a nationwide level (or at least for multiple cities) would be highly time-intensive yet only yield a very small improvement in the data quality.

Auckland Transport QoS tool:

- The tool is intended to be applied to specific road segments, and does not provide any means of combing the QoS scores for multiple segments to give an average score. The method of weighting the various QoS scores by length seems to be a reasonable approach to producing an average score.
- The use of the tool was based on assumptions to create typical road segments, e.g. by assuming the typical characteristics (e.g. width, interaction with bus stops, motor vehicle speed etc). In reality, these would vary from one facility to another, and different localities have different minimum standards and typical profiles that mean typical QoS could vary between cities.
- The method focused on midblock facility type but did not consider intersections, which is generally more difficult to design and is where the biggest risks to cycling safety can occur. It was assumed that, if midblock facilities are provided, intersection provision will be at least to the same safety standard.

Hilliness as for the other comparison measures was calculated on a broad, city-wide level to enable a comparison between cities. The hilliness measure was weighted by population at a census SA1 unit level to account in part for the effects of areas with extreme hilliness within a city, which generally have a lower population density and therefore less potential for cycling. However, the hilliness of an actual route will depend on the route alignment, which generally coincides with the road alignment and may have been chosen to avoid large gradients or frequent undulations.

5.2 Route-based model

Auckland Transport QoS tool

- Turn radii at intersections have been assumed to be greater than 6.1m, except in cases where notable and significant narrowing is proposed. In these cases, the turn radius was assumed to be the next category down (5.1-6m).
- The AT QoS tool recommends that cycling facilities on both sides of the road are scored separately. For the purposes of this analysis, opposite sides of the road have been scored together in all cases – most sections have similar facility attributes on both sides.
- Full signal phasing analysis has not been completed. Wait times at signalised intersections have been estimated at an average of >20 seconds in most cases, with one intersection having a slightly higher assumed average wait time at the recommendation of the designer
- Where the width of the separated cycleway reduces to below 1.8m for short sections (e.g. at bus stops), this has assumed to be acceptable and has been marked as above 1.8m for the midblock section, except in cases where the narrowing is for a significant length (e.g. multiple bus stops in sequence with cycleway narrowing).
- AT QoS does not provide a suitable method of combining the QoS of various elements to give an overall segment or route score. The premise of this is that every category needs to be suitable to a particular cycling audience, and the audience will work to the lowest common denominator. However, in practice most people will be willing to accept a few undesirable features if they perceive most other aspects to be of a suitable standard. This is particularly true for the proposed designs for this project, where no section falls to a highly poor standard for any section of the routes.
- The use of the tool was based on assumptions to create typical road segments, e.g. by assuming the typical characteristics (e.g. width, interaction with bus stops, motor vehicle speed etc). These would vary from one facility to another, and different localities have different minimum standards and typical profiles that mean typical QoS could vary between cities.

SP11 cycleway demand modelling

- To account for school traffic not measured in SP11 through employment census data, increases of 5–10% have been assumed for schools adjacent to the corridors based on Ministry of Education school roll data. This is a conservative estimate – where separated cycling facilities are provided near schools, mode share can increase to as high as 29% in a New Zealand context (Christchurch Boy's High School).
    - For the lower bound model, a mode share increase of 5% was estimated for *High School students only*
    - For the upper bound model, a mode share increase of 10% was estimated for *High School AND Intermediate School students*
- The primary land use input into the SP11 model is employment data from the 2018 NZ census. Any changes to employment patterns since then is therefore not accounted for in the model.
- The SP11 method is based only on the individual proposed route, and does not consider the quality or extent of adjacent cycling networks (new or proposed).