TE MANATŪ WAKA
MINISTRY OF TRANSPORT

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Section	Description of ground
6(a)	as release would be likely to prejudice the security or defence of New Zealand or the international relations of the New Zealand Government
6(b)	as release would be likely to prejudice the entrusting of information to the Government of New Zealand on a basis of confidence by (i) the Government of any other country or any agency of such a Government; or (ii) any international organisation
6(c)	prejudice the maintenance of the law, including the prevention, investigation, and detection of offences, and the right to a fair trial
9(2)(a)	to protect the privacy of natural persons
9(2)(b)(ii)	to protect information where the making available of the information would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information
9(2)(ba)(i)	to protect information which is subject to an obligation of confidence or which any person has been or could be compelled to provide under the authority of any enactment, where the making available of the information would be likely to prejudice the supply of similar information, or information from the same source, and it is in the public
9(2)(ba)(ii)	to protect information which is subject to an obligation of confidence or which any person has been or could be compelled to provide under the authority of any enactment, where the making available of the information would be likely otherwise to damage the public interest
9(2)(f)(ii)	to maintain the constitutional conventions for the time being which protect collective and individual ministerial responsibility
9(2)(f)(iv)	to maintain the constitutional conventions for the time being which protect the confidentiality of advice tendered by Ministers of the Crown and officials
9(2)(g)(i)	to maintain the effective conduct of public affairs through the free and frank expression of opinions by or between or to Ministers of the Crown or members of an organisation or officers and employees of any public service agency or organisation in the course of their duty
9(2)(h)	to maintain legal professional privilege
9(2)(i)	to enable a Minister of the Crown or any public service agency or organisation holding the information to carry out, without prejudice or disadvantage, commercial activities
9(2)(j)	to enable a Minister of the Crown or any public service agency or organisation holding the information to carry on, without prejudice or disadvantage, negotiations (including commercial and industrial negotiations)

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Transport Modelling Results Sensitivity Review

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Security Classification

This deliverable has not been informed by mana whenua and Māori engagement at this time due to TOC1a being a close-out phase at ALRL's direction; further engagement will be required before this deliverable is endorsed by mana whenua. Please refer to the Document Review Record for relevant feedback relating to this deliverable.

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1. Introduction

Patronage forecasts are a foundation of the design, operation planning and business case for the Auckland Light Rail (ALR) project. Forecasting is necessary yet inherently uncertain. The process essentially tries to predict future human responses to a wide range of factors, often 30-40 years in the future.

The ALR project has used the Auckland Macro Strategic Model (MSM) which is a multimodal model (car, public transport, walking and cycling) that forecasts average weekday travel demand, to generate patronage forecasts. This is the same model that is used by all transport projects in Auckland.

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While the MSM is a universally applied tool in Auckland, there are a number of variables that ALR has tested that influence the forecasts. Tests like these are commonly carried out by projects using the MSM model and are used to simulate potential future outcomes.

The ALR project has used various combinations of these factors to reflect "high" and "low" forecasts. While using "high" and "low" forecasts has been useful in showing the potential range of patronage outcomes, given the significance of the ALR project and a desire to be transparent with forecasting, it was decided to understand the variable factors underpinning the forecasts and assess their consequence or significance and their likelihood to enable the project, partners and stakeholders understand the levels of certainty relating to the forecasts.

Feedback from Board's Independent Advisory Panel, Transport for London (TfL) and Business Case Huihuinga has suggested that there should be testing of sensitivities to variables that underpin the forecasts. All variables tested have been included in some model runs carried out. Some are included in the forecast used in the business case, while others have not been assumed in this forecast.

This process is to identify the levels of confidence in the forecasts, specifically:

- The factors that are influential on the forecast – and how influential they are
- The likelihood of those factors being eventuating or not in the future
- The future conditions that would change these factors eventuating or not
- Controls and mitigations that can be included to influence and reduce the risk of factors assumed not holding "true"

1.1 Purpose

ALR is a very large, complex project with considerable interest from partners, funders, and stakeholders. It is also a project that is intentionally attempting to shape future travel behaviour and urban/investment responses in line with the agreed project objectives. Creating change and trying to forecast the extent to which this change will occur is inherently uncertain.

Given the scale and levels of interest in ALR and a desire to be transparent about the analysis carried out in support of the business case, it was decided to carry out this assessment of the risks relating to patronage forecasts. This assessment is intended to provide insight into the factors that have been most influential in the demand forecasts and the levels of certainty that the assumptions made can be expected to hold true.

The purpose of this work is also to respond to specific comments made by reviewers.

ALR's Board Assurance Panel has raised questions about the need for a "higher capacity system" (segregation) and has noted that the demand forecasts play a key role in this. Specifically:

"The Panel has expressed a view that the demand forecasts, and therefore the Project's design capacity, appear high for existing and future corridor catchment population projections. I think they need to substantiate this. MSM model delivers the demands. The input assumptions (land use) and things like pricing deserve scrutiny – not the pure "projections"."

In addition, feedback via the CBC Huihuinga has been supportive of developing sensitivities and assessment of risk in forecasting so that they can understand the risk in various investment strategies.

A full analysis of the risks and levels of certainty would take some time and could be significant. The MSM model is comprehensive, the best available, fully reviewed and approved. The MSM model itself is not reviewed in this paper. This assessment reviews the impact (consequence) and likelihood of some of the variables that were tested in the MSM runs for ALR in a way that is transparent and easily understood. It is intended to provide an initial view of their influence and likelihood, noting that the work has been carried out within a short timeframe and scope.

1.2 Background to modelling approach

1.2.1 MSM and key attributes

Details of the MSM model and the forecasting methodology can be found in ALR's Travel Demand Forecasting Technical Note (Appendix E-E).

The Auckland Macro Strategic Model (MSM) is a multimodal model (Car, public transport (PT), active modes) that forecasts average weekday travel demand. Based on 2006 data initially, it is updated partially every time census data is made available. The model is also continuously improved to enhance specific elements or to represent changes (e.g., work from home post-Covid). Use of this model is advantageous because in covers both car and public transport responses in an integrated manner, suitable for economic analytics. The model development has been peer reviewed at all update stages. This is the main model used by ALR.

1.2.2 Attributes tested by ALR

The ALR project elected to use the MSM for estimating travel demands because it includes both Car and PT trips in an integrated manner and it is used for all major transport projects in Auckland. The MSM baseline models maintained by Auckland Forecasting Centre (AFC) are the starting point from which alternative schemes are tested and compared. The MSM parameters or variables that have been used to test scheme proposals and to carry out sensitivity testing (and are considered in this paper) are briefly noted below.

Networks: Different ALR and connecting networks are constructed to reflect route alternatives, station locations, and connections to stations. ALR services are also tested (train size, service patterns, speeds, system type). This process also includes related to changes in road networks and other PT services to support ALR options. Specific network changes that were reflected in the MSM modelling were:

1. Testing with and without proposed additional light rail lines, specifically lines to the North Shore and Northwest,

2. Improved access links to LRT stations due to development intensifying close to stations,
3. Improved active mode speeds due to provision of active and micro modes (walk, cycle, scooters) infrastructure at and around major stations,
4. Reducing car access speeds along zone centroid connectors reflecting slow zones and that travel to and from zones in the model is more constrained than the model reflects,
5. LRT stations quality would be high quality and thus attractive to users,
6. Transferring between PT services would be as easy as possible.

Land Use: The principal input driving travel demand is the amount of daily activity households generate, driven by population and employment growth. Future estimates of regional growth and the locations of growth are thus critical inputs to the option tests. The inclusion of the ALR project is expected to increase growth along the corridor relative to other areas. Note the regional total future growth is held constant, which is the 2021 Stats NZ medium growth forecast used by the Auckland Council

Public Transport Crowding: Crowding disutility on PT vehicles increases as the vehicles fill up, eventually resulting in travellers using an alternative. ALR has conducted tests switching crowding on or off to understand upper levels of demand i.e., demand without crowding penalties on ALR.

Public Transport standing density: Crowding disutility on PT vehicles increases as the vehicles fill up, eventually resulting in travellers using an alternative. This is dependent on the type of PT vehicle, in particular the number of seated and standing passengers per vehicle. ALR has conducted sensitivity tests to understand upper and lower levels of demand for the LRT services.

Car travel disincentives: Car travel to major centres was assumed to become disincentivised over time, reflecting changes such as increased car parking fees, reduced parking supply, constrained car supply, pedestrian priority, removal of minimum parking provision development rules, and possible other policy interventions in future. Not all of these are parameters in the MSM model that can be modified so a simple process was applied that modified the MSM parking cost parameters. These values were factored by 2 as a proxy for the expected changes.

Working from home (WFH): While the long-term impacts of COVID-19 on demand are not yet fully understood, there is evidence that for certain work categories (such as office workers), there is likely to be an increase in working from home, which reduces travel demand.

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The baseline assumption in the MSM model is that on average 7% of home-based work trips work from home during an average workday. This proportion is based on census journey to work information. To take the likelihood of an increase in future WFH into account, it was decided to increase the regional working-from-home average for home-to-work trips by 7%, i.e., overall, 14%.

Congestion pricing. A joint investigation into congestion pricing in Auckland by the Ministry of Transport (MoT), Waka Kotahi, Auckland Council, and Auckland Transport recommended congestion pricing should be introduced. The cabinet adopted these recommendations in 2022.

1.2.3 Peer reviews and benchmarking

In addition to the extensive peer review and approvals applied to the MSM model, TfL have reviewed the appropriateness of the model system used in the assessment, as well as the reasonableness of the project demand estimates for ALR specifically.

In summary, TfL see a progressive agenda around mode shift and land use change that will change the market for public transport in Auckland - they see no flaws in the modelling approach and no reason to doubt the long-term forecasts and need for additional capacity.

What they are saying is that if a city takes a highly integrated approach to the planning of new transport systems - looking beyond just existing and future demand in the corridor and factoring in:

- Changes in land use that generate additional demand over and above in the catchment of new stations.
- The introduction of other policies that seek to restrain traffic (or re-balance traffic and public transport demand across the city) through mechanisms such as parking controls, pricing and other policies that seek to encourage greater use of public transport.

Then more optimistic demand scenarios should be considered - because the experience from other global cities is that when these policies are deployed in an integrated manner, the upside impact on public transport demand can be significant.

What TfL are seeing in ALR is an ambition set through the Investment Logic Map (ILM) and policy to do just this in Auckland, so they are flagging the possibility of more, not less, demand occurring.

They are also acknowledging the fact that the policy levers that will be most influential in driving this outcome, are in the control of the agencies and authorities who are all part of the sponsorship of ALR - i.e., if they want it to happen, they control the levers.

The flip side of this is, if they don't want to pull the policy levers, then the demand effect will be less.

These are not generic comments they are making that could be applied to any city - but are unique to the circumstances in Auckland and the way ALR is being planned.

2. Methodology

2.1 Using standard risk assessment processes

Carrying out a risk assessment of this nature is not a usual practice in developing business cases for transport projects in New Zealand. With this in mind, and with limited time and resources, it was decided to leverage risk assessment practice commonly applied and accepted in transport projects at business case stage. While there are some issues with direct applicability of the process, there are the following advantages:

- The methodology is known and relied upon by the same set of partners and stakeholders for cost and other risks in the project.
- It is possible to leverage the ALR Board's risk threat matrix for assessment, creating consistence and alignment with other risks assessed.
- There are ready templates that can be utilised to reduce effort and time.

The process used was similar to a normal risk assessment. Where possible, quantitative measures were used. As described in Section 2.2, the consequence (impact on patronage) of each of the variables assessed has been assessed quantitatively. These results were used to provide a "consequence rating" based on the levels of impact they have on the patronage forecasts.

As is the case with most risk assessments, the "likelihood rating" was carried out using a workshop of experienced people providing qualitatively assessed likelihood, recorded transparently.

The work used ALR's agreed risk threat matrix (Table 2.1) below to generate the assessed level of risk for each variable factor.

Note that in the "Consequence Descriptions" table below, there was not a descriptor for patronage. For the purposes of this work, one was added using the same percentage measures as "cost" as this was considered most closely aligned. Note that this particular element of the Risk Threat Matrix has not been approved by the ALR Board. Further work may elect to amend this.

Table 2.1 Risk matrix – note "Patronage" line added for this paper

Risk Threat Matrix 5x5						
Matrix						
	Likelihood percent	Consequence				
	NA	Insignificant	Minor	Moderate	Severe	Extreme
Almost Certain	>85%	Low	Medium	High	Critical	Critical
Likely	>55% - 85%	Low	Medium	High	Critical	Critical
Possible	>30% - 55%	Low	Medium	Medium	High	Critical
Unlikely	>5% - 30%	Low	Low	Medium	Medium	High
Rare	<5%	Low	Low	Low	Low	High
		Consequence Descriptions				
Rating Scale:		Insignificant	Minor	Moderate	Severe	Extreme
Reputation	Stakeholders	Disruption to	Disruption to	Disruption to	Disruption to	Disruption to
	Public/Media	Local media	Local media coverage	Short term (days)	Sustained media	Sustained national
	Legal/Compliance	Breach managed at a	Breach with letter	Breach with legal	Individual prosecution	High profile
Performance	Delivery (TOC1)	Programme slippage	Programme slippage	Programme slippage	Programme slippage	Programme slippage
	Cost (% of Phase)	Negative financial impact of less than 0%	Negative financial impact between 0% and 0%	Negative financial impact between 0% and 0%	Negative financial impact between 0% and 0%	Negative financial impact of more than 0%
	Patronage	Less than 2.5% impact on patronage (+ or -)	2.5% - 5% impact on patronage (+ or -)	5% - 10% impact on patronage (+ or -)	10 - 25% impact on patronage (+ or -)	>25% impact on patronage (+ or -)
	Cost (TOC1)	Negative financial	Negative financial	Negative financial	Negative financial	Negative financial
	Health & Safety	Injury requiring	Injury requiring short	Injury requiring	Serious injury	Loss of life,
	Environmental	Small scale pollution	Minimum pollution or	Pollution or other	Significant and	Permanent pollution
	Environmental Sus	Embodied Carbon:	Embodied Carbon:	Embodied Carbon:	Potential to contribute	Potential to contribute
	Social Sustainabili	Māori Outcomes:	Māori Outcomes:	Māori Outcomes:	Māori Outcomes:	Māori Outcomes:
	Customer Experie	Insignificant	Minor interruption to	Moderate	Major interruption to	Extreme interruption

2.2 Statistical analysis of influencing factors

In order to understand what the significant factors affecting patronage are, a linear regression analysis was carried out. Linear regression is generally used to explain or predict the value of a variable (dependent variable), based on the value of other variable/s (independent variables). In this case, the dependent variables are AM boardings and peak load demand, and the independent variables are shown in Table 2.2 below.

Table 2.2 Independent variables for regression

Independent variables	Description
CC2MMaxCap	CC2M Max Capacity (pax/hr/direction)
CC2MEmployment & Population	Land use – CC2M Population & Employment Average
CC2MFrequency	CC2M Frequency (trains / hr)
WFH	Working from home percentage (7% or 14%)
Crowding Parameter	Standing density parameter for crowding (ppl per sqm) 4, 7, 12, 21
Congestion Pricing	Congestion Pricing (Yes or No)
Parking Pricing	Double in Parking Pricing (Yes or No)
Mangere Wynyard Travel Time	CC2M Wynyard to Mangere Travel Time (min)
Network integration **NS** **NW**	Integration North Shoreline (Yes or No) Northwest line (Yes or No)

The methodology of the regression analysis is as follow:

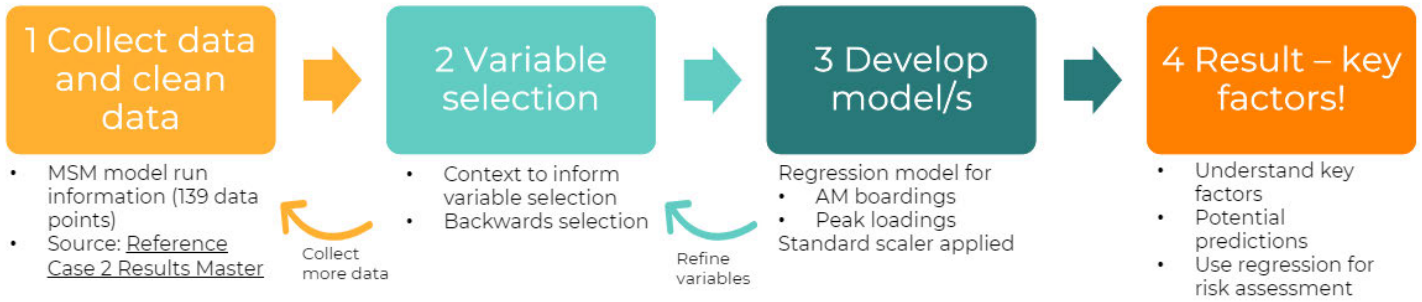

Figure 2.1 Factors affecting patronage regression analysis steps

3. Findings

3.1 Quantified consequence assessment

The regression for both AM boardings and peak load demands enable us to understand which are the most important factors that influence patronage. Figure 3.1 below shows the statistically significant factors that affects AM boardings and peak load.

For both AM boardings and peak load, the top three factors are land use (CC2M population and employment), Mangere to Wynyard travel time and parking pricing.

Interestingly, congestion pricing as a variable is significant for AM boardings, but it is not significant for peak load.

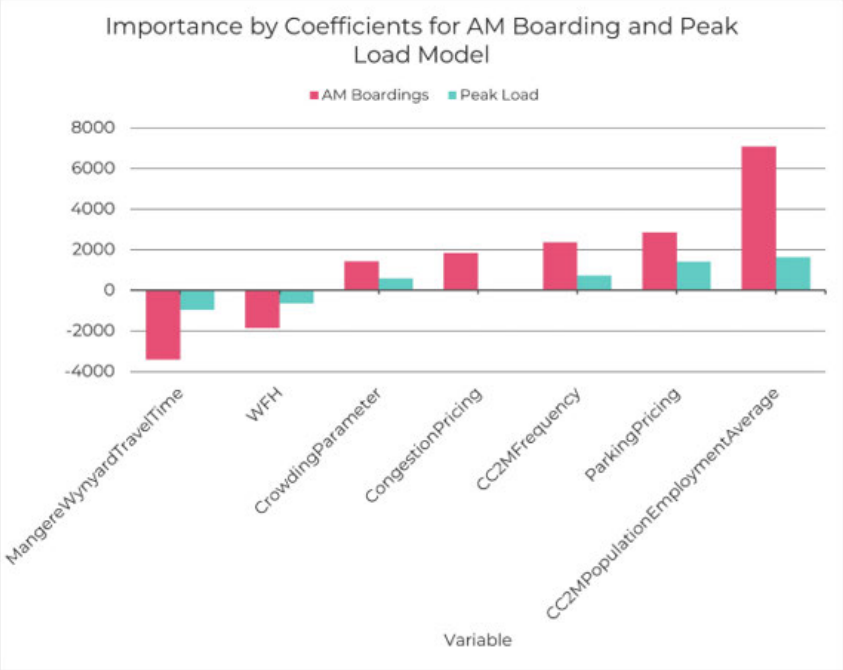

Figure 3.1 Importance by coefficients for the scaled variables (exclude y-intercept)

With considerations for the variables that we have control and influence over, Table 3.1 below highlights the key variables for risk analysis, which are congestion pricing, parking pricing, working from home and land use. The colour in the table indicates the importance of the variables by coefficient, and the percentage is the percentage change in boardings and peak load when the value of a factor is alternated from Option 78 (central forecast).

Table 3.1 Importance by coefficients, with % change on patronage from Option 78 2051, and variables selected for risk analysis

Factor/variable	AM 2-hour boardings	Peak load demand	Within control	Risk analysis
Land Use	**-13%**	**-10%**	No	**Yes**
Congestion pricing	-6%	NA – not in model	No	**Yes**
Parking proxy	-9%	**-15%**	No	**Yes**
Frequency	-12% (frequency = 15) to 8% (frequency = 30)	-12% to 8%	**Yes**	
Capacity	NA – not in model	NA – not in model	**Yes**	
Crowding	-2% to 11%	-3 to 15%	**Yes**	
Work From Home	14%	15%	No	**Yes**
Travel time	-28%	-25%	**Yes**	
Network integration	NA – not in model	NA – not in model	Yes - Some control	

3.2 Qualitative likelihood assessment

The likelihood of a variable being present or not, depending on the assumptions in Option 78, was carried out using a process similar to a "normal" risk assessment exercise. This was largely qualitative involving a workshop of experienced people with the logic recorded for transparency. Table 3.2 summarises the assessed likelihood of each risk factor.

The most likely factor to vary from that assumed is land use forecasts. This factor is a key driver and one of the core benefits of the ALR project, however, it is a dynamic that is subject to a wide range of influences, many of which are outside the direct control of the project. Of note, a large proportion of the work carried out by ALR in the current phase of work, for example, the urban workstream and its influence on alignment, stations, and design options have been focused on realising these benefits. In risk terms, this work is a mitigation to the risk that the forecast land use does not eventuate.

Table 3.2 Likelihood rating summary

Variable	Rating	Notes
Land use	Possible	Likelihood of the forecast being **lower** than forecast (the risk) is assessed as "Possible, 30% - 55%". There is uncertainty in the scale and timing of a land use response, however the extensive work carried out to support this response (the urban workstream, its influence on options and urban business case) increases confidence in the forecast.

Congestion charging	Unlikely	Likelihood of the TCQ **not** being introduced by 2051 (the risk) is assessed as "Unlikely, 5% - 30%". There is some uncertainty as congestion charging is politically difficult and NZ does not have a precedent for such a scheme. Providing certainty is that the TCQ Study provides a sound case for such a scheme and the strategy has been adopted by Cabinet in 2022, providing some commitment from Government. Overall, it was considered unlikely not to occur in the next 30 years.
Parking restrictions	Unlikely	Likelihood of the parking restrictions **not** being introduced by 2051 (the risk) is assessed as "Unlikely, 5% - 30%". The NPS-UD and Auckland's Unitary Plan already mandates parking minimums and traffic management in the city centre is already in progress and forms the Council's adopted Access for Everyone Strategy. There is some risk that the measures are implemented in a less effective manner than assumed and this has meant it was not rated "Rare".
Working from home	Unlikely	Likelihood of working from home being **less** than 14% (i.e., greater patronage) was assessed as "Unlikely, 5% - 30%". Trends in this area are still evolving and long-term post-Covid data does not exist. A conservative assumption has been made in the model and an equally conservative likelihood of this being a lower rate than assumed.

3.3 Monte Carlo Simulation

Monte Carlo simulation is used understand the risks around the patronage forecast given inputted risks around the factors. Appendix B shows the probability distribution of the input factors used in the Monte Carlo simulation.

The Monte Carlo simulation has the following assumptions:

- The variables network integration, crowding, travel time and frequency are assumed to be the same as Option 78. Hence, the variables simulated with Monte Carlo are land use, congestion pricing, parking proxy, and working from home.
- Congestion pricing is assumed to be more likely to be true in the earlier years, and the likelihood increases further towards the later years.

- Parking proxy is assumed to have a low likelihood of being true in the early years and high likelihood of being true in the later years.
- Working from home percentage is assumed to have high likelihood of being 14%, and this likelihood increases further in the later years.

The Monte Carlo simulated range of patronage for year 2051 is indicated in Table 3.3 below. In 2051, there is a 79% chance that the AM boardings figure is higher than the Option 78 patronage, and there is around a 50% chance that the peak load will be higher than that in Option 78.

Table 3.3 Monte Carlo result vs Option 78

	Monte Carlo			Option 78 – central forecast	Probability of patronage higher than Option 78
	Low (10th percentile)	Median	Higher (90th percentile)		
AM Boardings	30,500	35,700	40,900	32,346	79%
Peak Load	8,700	10,200	11,700	10,131	53%

Figure 3.2 shows the AM peak boardings percentile and Figure 3.3 shows the AM peak boardings vs result from Option 78 for the different years. Figure 3.3 shows that, given the input factors' risks, Option 78 sits on the lower side of the simulated results for year 2031, 2041 and 2051, and on the higher side of the simulated results in year 2065. This suggest, in the earlier years up to 2051, the upside risk for patronage is higher.

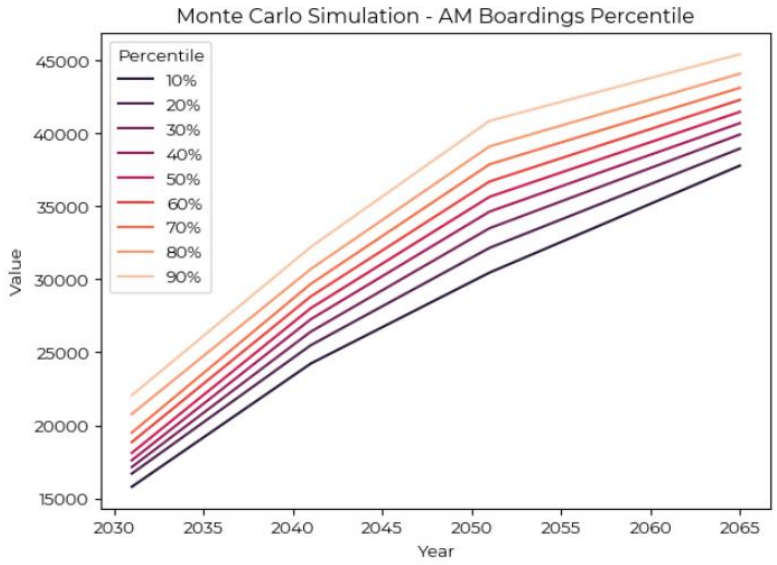

Figure 3.2 Monte Carlo – AM Boarding percentile

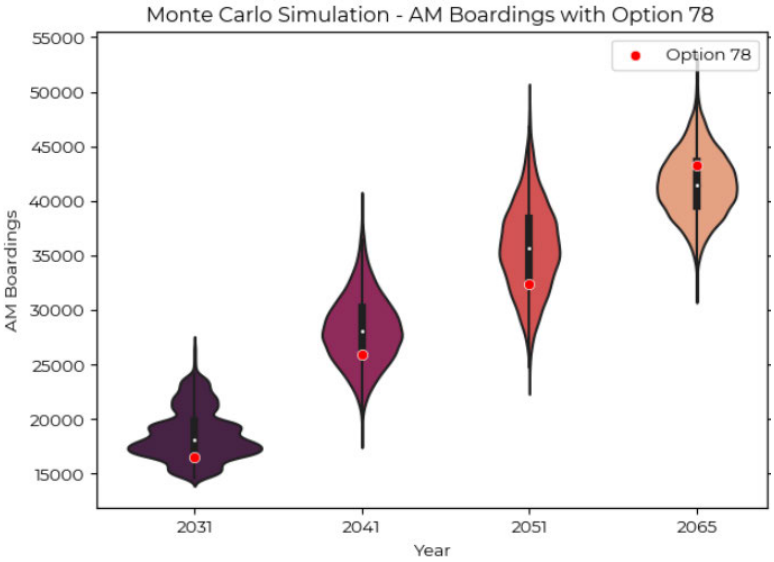

Figure 3.3 Monte Carlo – AM Boarding vs Option 78

Similarly, Figure 3.4 shows the AM peak load percentile, and Figure 3.5 shows the AM peak load vs result from Option 78 for the different years. Figure 3.5 shows that, for year 2051, Option 78 appears to be around the median of the simulated results, suggesting similar upside and downside risks.

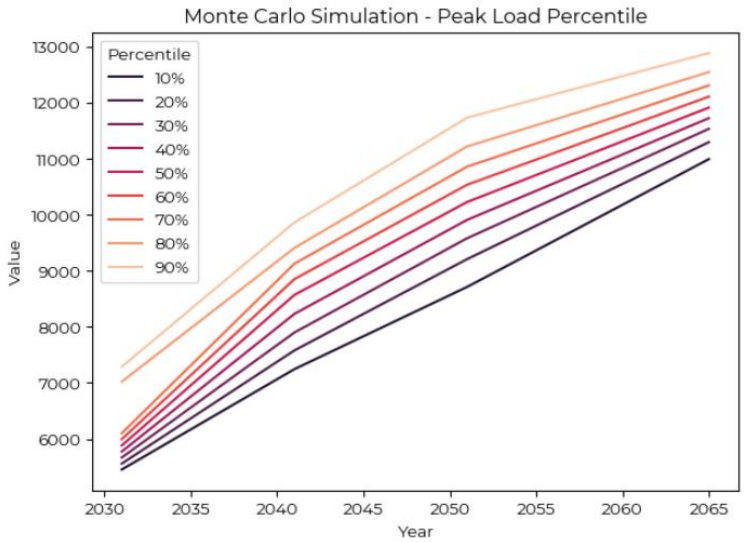

Figure 3.4 Monte Carlo – Peak load percentile

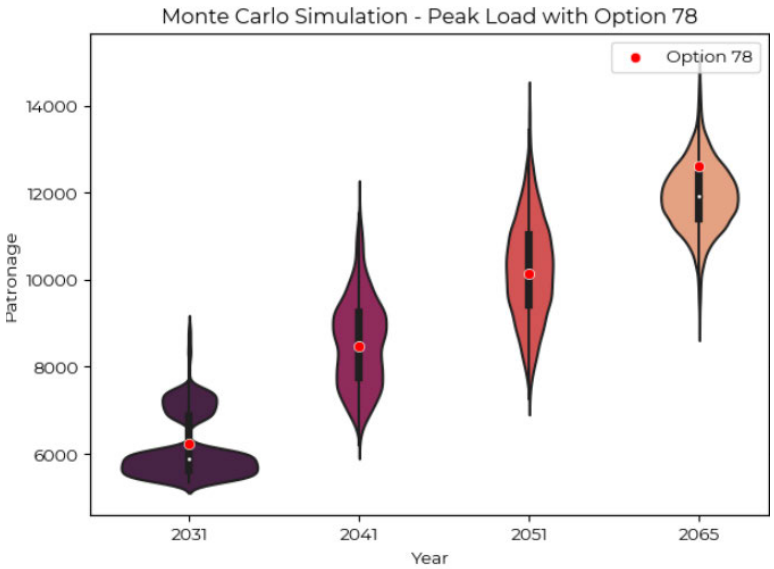

Figure 3.5 Monte Carlo – Peak load vs Option 78

3.4 Summary of key factors affecting patronage

The Patronage Risk Register v1 spreadsheet in Appendix A includes the results of the risk assessment. Some key observations are:

- No factors were assessed as “critical” risk using ALR’s Risk Threat Matrix
- The Monte Carlo assessment indicates that the collective risk to patronage has greater upside risk than downside risk for peak boardings and a similar upside and downside risk for peak load demand.
- Most of the assessed risks are within the control of the project partners, although few are in the direct control of ALR.
- Land use inputs were assessed to have “high” risk.
- Land use was assessed as a “downside” risk. This means that as the ALR forecasts include assumptions for land use change, the risk of land use being lower than Option 78 was assessed. Notes on land use:
  - Land use outcomes had a relatively high effect on forecast demand for CC2M, with 10%-13% patronage difference compared to do min land use in 2051 (other variables constant). This is expected as influencing land use is a key project objective.
  - The project would need to rely on the market and other partners to deliver the bulk of the forecast land use outcomes and there is some uncertainty in its realisation.
  - The project has implemented a significant urban workstream which has influenced the project’s route and design to optimise urban outcomes as a key mitigating control for this risk.

  - Note that, while not assessed here, as per TfL's advice, there is also potential upside risk on this factor. This assessment has also been simplified and there are many potential outcomes including slower or lower, but still effective land use outcomes.

- Parking restrictions (parking pricing as a proxy in the MSM model) was rated a "Medium" risk. It is assumed to be in place in the forecasts and the risk considered was that of parking restrictions not being implemented in the next 30 years. Many of the mechanisms that would create the effects on vehicle access and parking to key centres are planned or form part of Council and Auckland Transport policies. This means that the risk of measures not being implemented in the next 30 years was considered "unlikely".
- Congestion charging as an assumption has been the subject of some discussion and was rated a "Medium" risk. It is assumed to be in place in the forecasts and the risk considered was that of a congestion charging regime not being implemented in the next 30 years. The report titled "The Congestion Question (TCQ)", has been delivered to, and adopted by Government in 2022 and is reflected in the model runs used by the project. This means that the risk of TCQ not being implemented in the next 30 years was considered "unlikely".

4. Limitations

Table 4.1 below highlights the limitation of the risk analysis and their potential implications.

Table 4.1 Limitations

Limitation	Explanation
Risk assessment is high level.	Given time and resource constraint, the risk workshop is held with a small group of people, focusing on the key risks. Further work can be done to fully understand the risks around input factors and refine the implications on patronage.
Regression analysis is a simplification of the MSM model.	Regression is used as an 'approximation' of the more complex MSM model. This is helpful to understand key variables, however, there will still be some residual variations not explained.
There are some correlations between the independent variables, including WFH with parking proxy, WFH with congestion pricing, and congestion pricing with parking pricing.	This is likely to be a result of the input MSM data used, where the sample (i.e., MSM runs) caused the data to show a statistical correlation between independent variables, however, it is likely they are not actually correlated. (Risk of Type 1 error).

Appendix A Risk Spreadsheet

Out of Scope

Appendix B Probability for Input into Monte Carlo Simulation

<table>
<tr><th>Variable</th><th>Description</th><th>Distribution</th><th>Notes</th></tr>
<tr><td>Land Use</td><td>CC2M Population
<table>
<tr><th></th><th>Low (Ref 2 Do min)</th><th>High (IBC Very High Accelerated)</th><th>Mode</th></tr>
<tr><td>2031</td><td>249996</td><td>251512</td><td>250754</td></tr>
<tr><td>2041</td><td>275435</td><td>336442</td><td>305939</td></tr>
<tr><td>2051</td><td>303937</td><td>412722</td><td>358330</td></tr>
<tr><td>2065</td><td>351100</td><td>427137</td><td>389119</td></tr>
</table>
Employment: Calculated as a factor of population with some randomness, based on 2021 proportion, as population and employment within the CC2M corridor are highly correlated.</td><td>Triangular</td><td>-</td></tr>
<tr><td>Congestion pricing</td><td>
<table>
<tr><th></th><th colspan="2">Chance of congestion pricing happening</th></tr>
<tr><th></th><th>Not happening</th><th>Happening</th></tr>
<tr><td>2031</td><td>40%</td><td>60%</td></tr>
<tr><td>2041</td><td>15%</td><td>85%</td></tr>
<tr><td>2051</td><td>5%</td><td>95%</td></tr>
<tr><td>2065</td><td>5%</td><td>95%</td></tr>
</table></td><td>Discrete</td><td>-</td></tr>
<tr><td>Parking proxy</td><td>
<table>
<tr><th></th><th colspan="2">Chance of parking proxy happening</th></tr>
<tr><th></th><th>Not happening</th><th>Happening</th></tr>
<tr><td>2031</td><td>95%</td><td>5%</td></tr>
<tr><td>2041</td><td>50%</td><td>50%</td></tr>
<tr><td>2051</td><td>50%</td><td>50%</td></tr>
<tr><td>2065</td><td>5%</td><td>95%</td></tr>
</table></td><td>Discrete</td><td>-</td></tr>
<tr><td>Frequency</td><td>Assumed to be 24 trains/hour</td><td>Fixed value</td><td>Within control</td></tr>
</table>

<table>
<tr><th>Variable</th><th>Description</th><th>Distribution</th><th>Notes</th></tr>
<tr><td>Crowding</td><td>Assumed to be 7 people per sqm</td><td>Fixed value</td><td>Within control</td></tr>
<tr><td>Work From Home</td><td><table>
<tr><th></th><th colspan="2">Working from home chance of proportion</th></tr>
<tr><th></th><th>7%</th><th>14%</th></tr>
<tr><td>2031</td><td>25%</td><td>75%</td></tr>
<tr><td>2041</td><td>15%</td><td>85%</td></tr>
<tr><td>2051</td><td>5%</td><td>95%</td></tr>
<tr><td>2065</td><td>5%</td><td>95%</td></tr>
</table></td><td>Discrete</td><td>-</td></tr>
<tr><td>Travel time</td><td>Assumed to be 29 min</td><td>Fixed value</td><td>Within control</td></tr>
<tr><td>Network integration</td><td>Assumed no integration with Northshore and Northwest</td><td>Fixed value</td><td>Within control</td></tr>
</table>