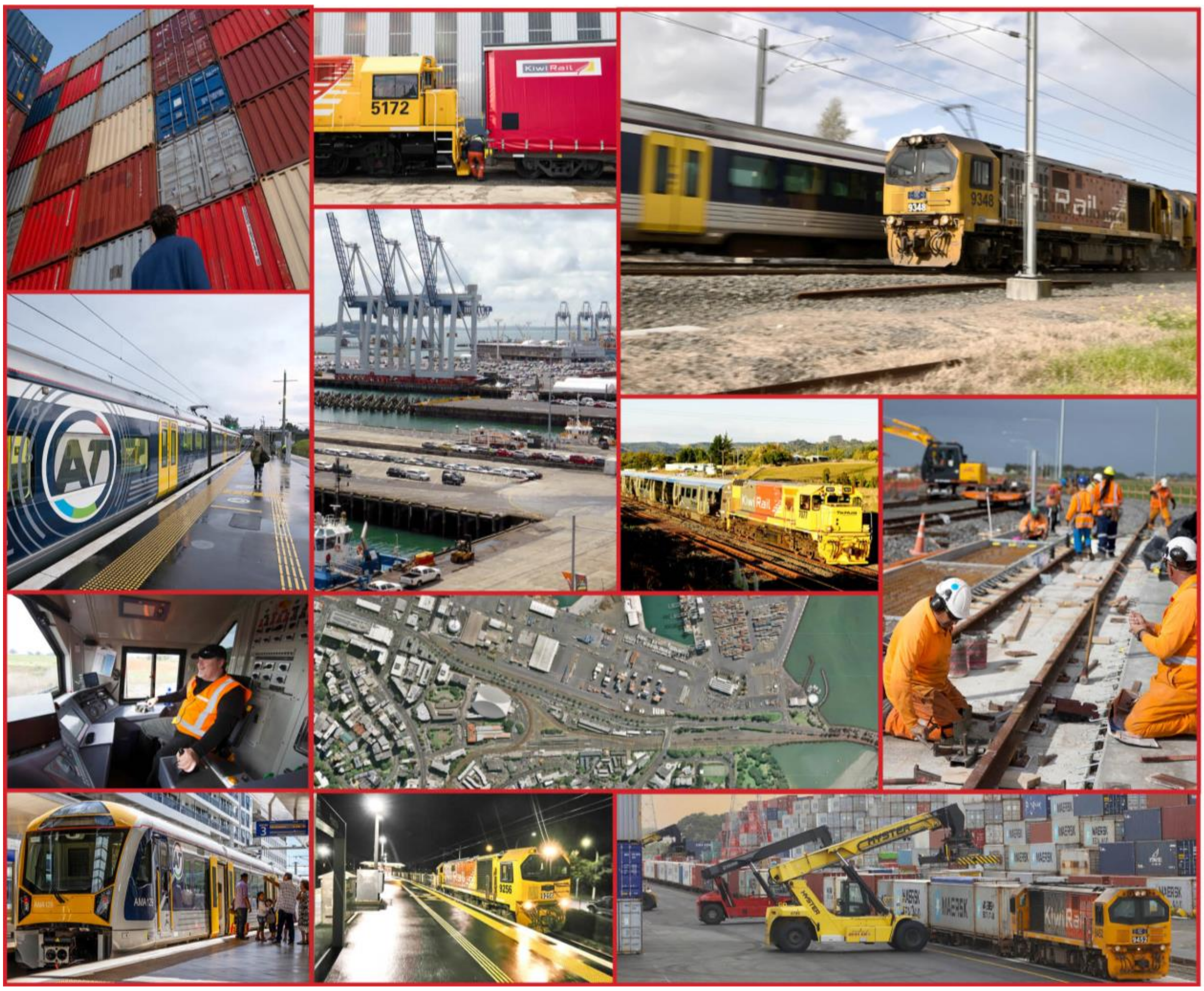
AUCKLAND RAIL PROGRAMME BUSINESS CASE

FINAL REPORT

11 DECEMBER 2023



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AUCKLAND RAIL PROGRAMME BUSINESS CASE

FINAL REPORT

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This report is the combination of five separate business case reports (Strategic Case, Economic Case, Financial Case, Commercial Case, Management Case) which have been brought together to create this Programme Business Case. Many people contributed to the development and review of these cases, with the primary consultant authors and reviewers listed in the table above. Furthermore, KiwiRail and Auckland Transport project team members contributed meaningfully to the development of the cases with valuable edits and review comments throughout the process. The collaboration between client and consultant teams is acknowledged.

EXECUTIVE SUMMARY

This Auckland Rail Programme Business Case (PBC) has been prepared by WSP for Auckland Transport (AT) and KiwiRail Holdings Limited (KiwiRail) . It builds upon and replaces the 2015 Auckland Rail Development Plan and sets out the 30-year pipeline of investment required in Auckland's rail network to support the local, regional, and national long-term vision for rail set out in the New Zealand Rail Plan.

BACKGROUND

RAIL NETWORK CONTEXT

The Auckland rail network is part of the wider national rail network which accommodates:

- intra-Auckland metro passenger services, primarily focused on Auckland's city centre; the backbone of the Rapid Transit Network (RTN) for New Zealand's largest city, with around one third of the national population,
- inter-regional commuter and tourism services to and from Hamilton and Wellington, and
- inter-regional/national rail freight, a critical component of the national freight supply chain, imports, exports, and the national economy.

These services connect the nation's ports, industry, and population centres. Consequently, the service level and capacity of the rail network in Auckland is of significant national importance.

The network is currently undergoing a major transformation, with the addition of the City Rail Link (CRL), a project that will resolve the existing network bottleneck at Britomart Station by creating a direct connection between the existing Eastern and Western corridors. The network, following CRL construction (along with other enabling network upgrades), is taken as a starting point for this PBC. This is illustrated in Figure 0-1.

The Auckland rail network is a mixed-use railway where metro, freight and inter regional services operate on the same tracks. Mixed use railways are complicated to operate and plan for, and inherently less efficient and reliable than dedicated mode networks. Most countries solve this problem by segregating service types ('all-stop' versus 'non-stop' services) as their railways become busier. Segregation improves efficiency, utilisation, and reliability and therefore greater segregation is a strategic goal for the future development of the rail network in Auckland.

The CRL is designed to enable significantly higher train volumes than current day levels and Auckland Transport has plans to increase metro service frequencies accordingly. However, the capacity of the wider network will effectively be fully utilised soon after the opening of the CRL, as the capacity of the CRL is higher than that of the outer network, which operates as a mixed mode facility.

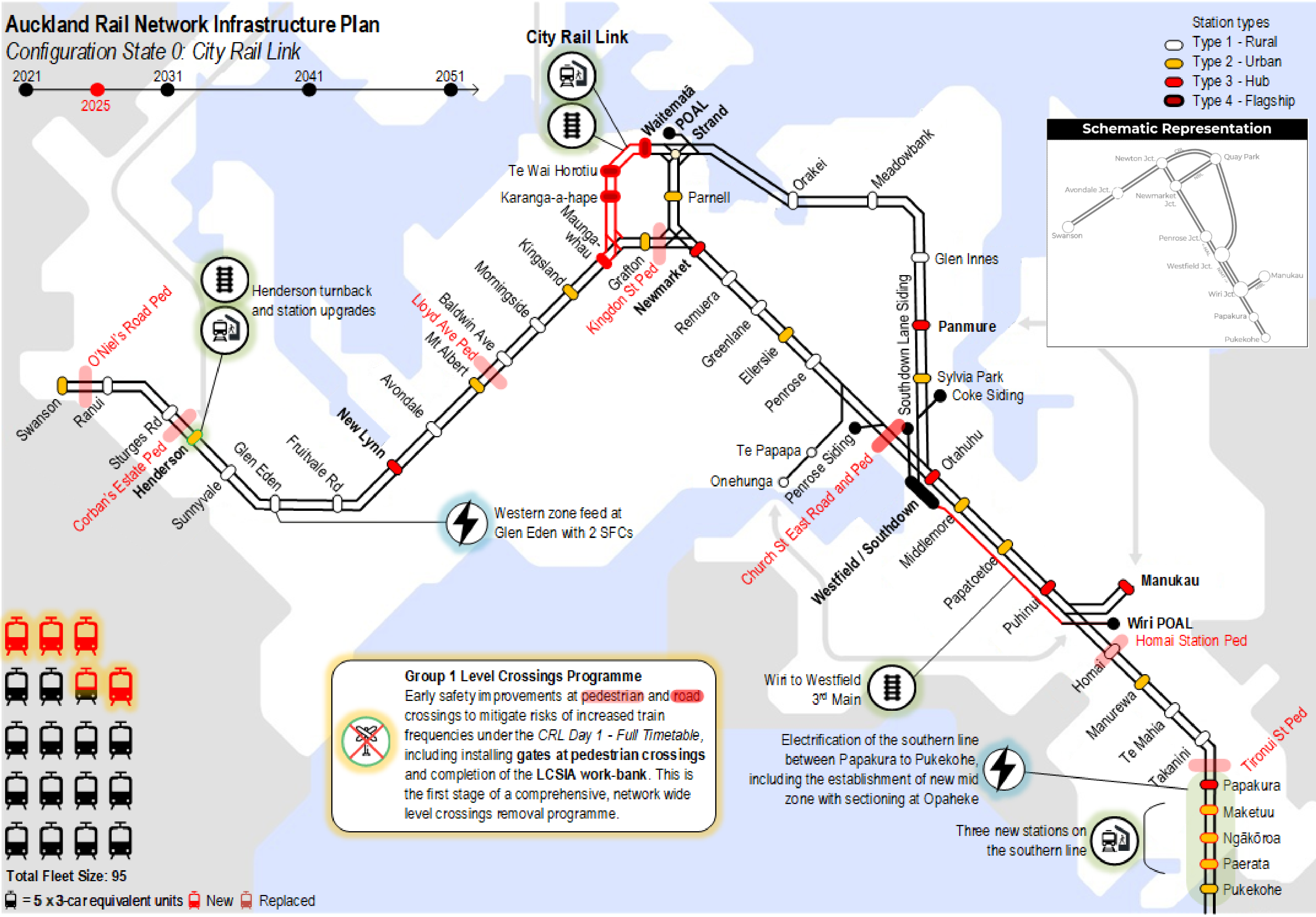

Figure 0-1: Auckland rail network (following completion of the CRL)

RELIABILITY AND RESILIENCE CONTEXT

Investment in the New Zealand rail network has been insufficient over the past several decades, and critical physical assets such as track, signalling, and level crossing systems, have become increasingly unreliable. Failures of network assets result in an unreliable service for heavy rail customers, with speed restrictions, cancellations, and poor levels of punctuality becoming more frequent.

The degree of underinvestment has been highlighted in the extreme by the current Rail Network Rebuild (RNR) programme. The RNR has required full closures of large segments of the Auckland rail network over a three-year period to restore the basic foundations of the network – the track formation – to modern standard. In some cases, upgrades have not been made for over 100 years.

The significant increase in metro services planned from the opening of the CRL will require, more than ever, that network assets be maintained to high standards of reliability and availability. However, the RNR represents only a portion of the investment required to achieve these standards. A programme of investment is needed to establish a proactive asset management and maintenance system. Requisites include sufficient track maintenance access time, modern equipment, and flexible infrastructure to support efficient work practices.

Establishing a reliable network is a pre-requisite to any further service expansion on the network and has emerged as the highest-ranked priority of the PBC.

GROWTH CONTEXT

Historically, New Zealand has developed and grown around the rail network with the transport of goods and people between ports and cities relying heavily on rail. As in the past, a combination of Auckland's geography, transport and land use decisions will influence the future growth context for rail in New Zealand's largest city.

Auckland's population has doubled over the last four decades to approximately 1.7 million people in 2022 and is projected to grow by 47% to 2.3m by 2051. This population growth will significantly increase travel demand over the next 30 years, potentially resulting in an extra 400,000 peak time trips and 2 million more daily trips across all modes.

From a planning perspective, to respond to continued growth, the Auckland Plan 2050 and Auckland Unitary Plan recommend most growth occurs within the existing urban areas. This approach to growth will enable an expanded public transport (PT) network to serve a denser urban population more effectively, rather than forcing people to drive long distances to access services and opportunities. As Auckland's only mass transit system, rail is an essential mode to accommodate growth and support future urban development around existing station catchments. It is also essential to encourage mode shift from private vehicles, especially for long trips such as to/from the south, where three new stations are being built to support future urbanisation.

The PBC has taken current Auckland transport planning policy as an input. That is, it has assumed no further extensions to urban limits and is aligned with current policy on recommended PT modes.[1] However, this does not preclude further expansion of the rail network in the future, as populations expand further, or change occurs to currently assumed modes.

Growth in Auckland's rail network cannot solely be determined by PT priorities within the region, as rail's national role is much wider than this. The rail network must also accommodate the movement of people and goods in, out and through Auckland's urban limits, or Auckland will become a bottleneck for the country.

Inter-regional rail travel is a growing market. KiwiRail operates tourism passenger rail services between Auckland and Wellington. The Te Huia Hamilton – Auckland passenger service began in April 2021 and is performing well. A 2022 parliamentary inquiry on inter-regional rail has recommended scoping studies for new Auckland-Tauranga and Auckland – Wellington services[2].

Rail freight is an important part of New Zealand's freight and logistics supply chain and needs to improve its productivity to ensure it can facilitate the efficient flow of imports, exports, and domestic goods. Freight tonnage is forecast to increase by 40 million annual tonnes to, from and through the region over the next 25 years[3]. The rail network needs to carry its share, as the alternative is that freight will instead be forced onto New Zealand's roads. Goods that start their journey by road will most likely stay on-road to their destination, so consequently rail capacity and access in Auckland determines the mode of travel far beyond the Auckland boundary.

In developing this PBC it has been recognised that freight flows for imports (and to a lesser extent exports) are strongly influenced by the competitive positions of the Auckland, Tauranga, and Northland ports. This PBC tests the rail network requirements to accommodate growth across a range of realistic port scenarios, and the resilience of the recommended programme to those scenarios.

Importantly, any growth from these three key markets that cannot be accommodated on rail, will primarily spill to roads[4]. Over long distances, this will increase costs for road maintenance, due to the large numbers of heavy trucks increasing wear and tear on national road networks. These costs will ultimately be passed on to the public.

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[1] Southern and northern extensions to the network have been considered as a sensitivity and are not expected to materially change the investment requirements within the RTN bounds. Investment to support such extensions has not been provisioned in the PBC. However, current policy recommends light rail as the mode between the city centre and Auckland Airport. In that context the continued heavy rail to bus connections at Puhinui Station remain a key input assumption. Should that change, minor modifications to PBC recommendations may be required.

[2] Inquiry into the Future of Inter-Regional Passenger Rail, October 27, 2022.

[3] This growth comes from underlying demand, modal shift of freight from roads to rail and changes in freight flows.

[4] For example, in the short-term Ports of Auckland is seeking to grow its use of rail transport from 100,000 to 250,00 TEU annually, which would take at least 75,000 heavy truck trips per annum off Auckland's roads.

ENVIRONMENTAL CONTEXT

New Zealand's Government has recognised the need to decarbonise our transport system in support of the increasing urgency of emissions reduction and its commitment to the Paris Agreement, a legally binding United Nations Treaty[5]. Government has set out transport emissions reduction targets for both freight and passenger transport in its Emissions Reduction Plan (ERP). A core objective of this PBC is to develop a programme that responds to this requirement and helps to reduce net carbon emissions from transport activities and support sustainable growth in Auckland and nationally. It does this by stimulating mode shift from vehicles to rail for both freight and passenger services and providing the required levels of capacity to meet ERP targets as part of a broader programme of policy and infrastructure improvements.

The 30-year vision for the Auckland rail network is to provide a reliable and resilient transport system, which enables growth, integrates with other transport planning strategies and policies, and provides capacity and appropriate service levels for all users. Efficiency, reliability, and resilience are maintained or enhanced as use of the network intensifies, by upgrading critical systems to modern standards, adding new infrastructure and equipment to increase capacity, and reducing complexity by maximising segregation between different traffic types on the network.

If this vision is not achieved, rail, continuing to operate at current levels of service quality, will not be sufficiently attractive to *induce* mode shift, nor have sufficient capacity to *support* mode shift generated by exogenous factors. As a critical part of the national supply chain, and the spine of Auckland's PT network, the investment in Auckland's rail system set out in this PBC is critical.

FUNDING CONTEXT

New Zealand faces a material infrastructure deficit and will need to find new ways to drive value for money outcomes, build on what it has and prioritise the multiple demands it has for finite funding. Traditional funding sources such as the National Land Transport Fund (NLTF) are diminishing.

The New Zealand Infrastructure Commission – Te Waihanga, recently noted that New Zealand's future welfare and livelihoods depend increasingly on maintaining and improving existing infrastructure. Its New Zealand Infrastructure Strategy outlines that for every $40 spent on new infrastructure, $60 should be put towards maintenance and renewals of existing assets.

Importantly, this PBC sets out a holistic programme, which includes overall system costs, including necessary maintenance and renewals investments. It improves the existing system by building new capacity and new corridors to reach additional markets, whilst improving efficiency across local, multi-regional and national markets. This investment programme supports Auckland growth but is not just about Auckland – it is also an investment that has direct value for other regions and the overall national economy.

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[5] https://unfccc.int/process-and-meetings/the-paris-agreement

INVESTMENT NEED, BENEFITS AND OBJECTIVES

The existing state (infrastructure and services) of the Auckland rail network (problems), and desired strategic outcomes (benefits, investment objectives and KPIs) have been agreed by Auckland Transport, KiwiRail, Auckland Council, and Waka Kotahi to guide the required investment in rail to 2051. The problems, benefits, investment objectives, and their respective weightings are outlined in Figure 0-2.

There are interdependencies between the problems and addressing only one or two problems would prevent the rail system from achieving the benefits sought and fail to fulfil the enabling role of rail in regional and national policies.

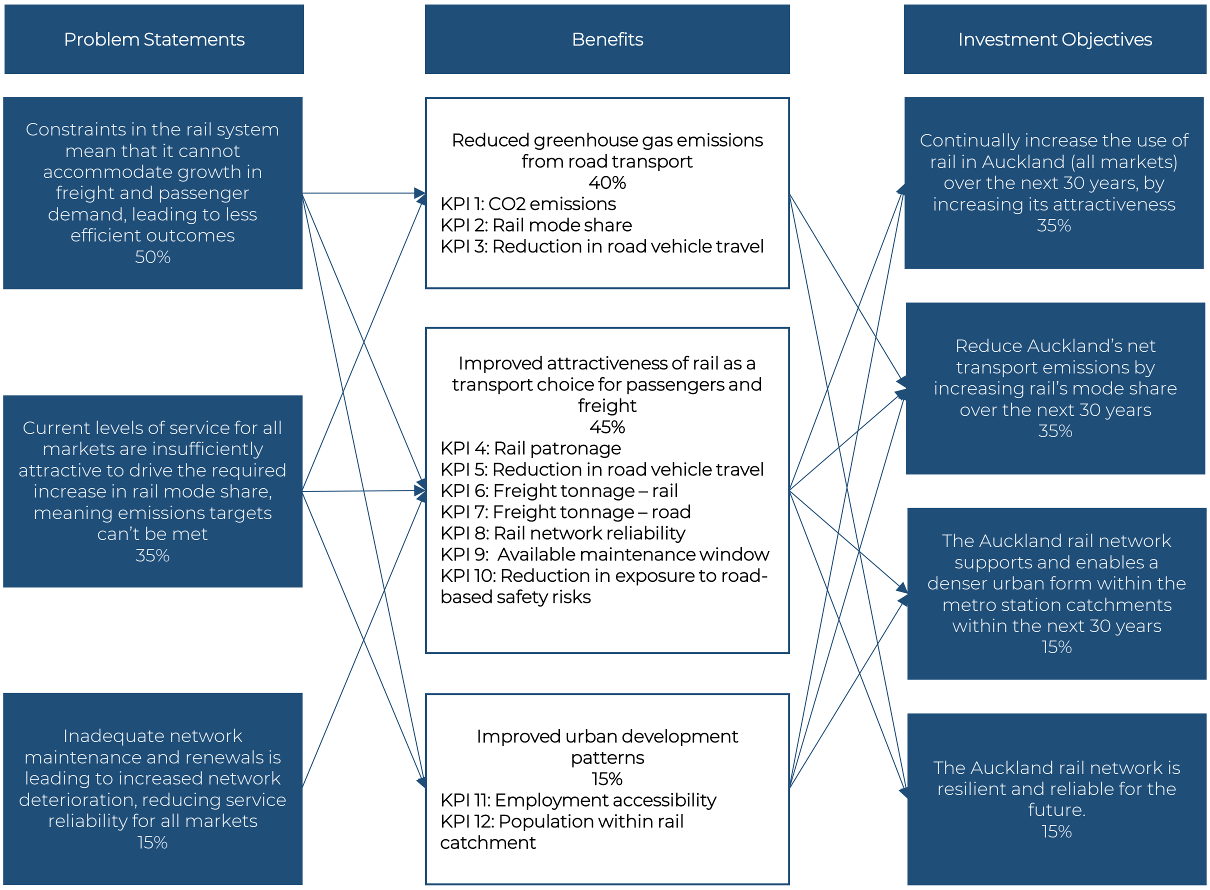

Figure 0-2: Problem statements, benefits, investment objectives and outcomes

NEED FOR INVESTMENT

In summary, the three agreed problems are:

1. **Capacity constraints.** A range of constraints, predominantly related to infrastructure, limit the capacity of the rail network. Required growth in freight and passenger rail travel cannot be accommodated on the existing network, meaning that neither forecast growth nor target mode shift to rail will be achieved and the Government's committed emission reduction targets will not be met (50% weighting).
2. **Poor level of service.** Many passengers and freight customers are deterred from choosing rail because of inadequate levels of service. Contributing factors include

reliability and punctuality, frequency, service timing, service travel time, directness, metro station and overall network accessibility and safety concerns. This results in less efficient outcomes including increased road-based travel, congestion and higher carbon emissions, and poorer productivity because the rail network is insufficiently attractive to drive the required increase in rail mode share, meaning emissions targets can't be met (35% weighting).

3 **Inadequate network maintenance and renewals.** Service reliability and punctuality problems are typically related to maintenance issues that, without intervention, will worsen as train volumes increase and assets continue to age and deteriorate. These issues are compounded when capacity is constrained as there is little to no redundancy within the system to respond to or recover from these issues, (15% weighting).

Table 0-1 summarises key outcomes sought from investment in Auckland's rail network.

Table 0-1: Summary outcomes sought from investment

Metro Passenger		Provide peak period capacity for base demand (metro passenger).
		Maximum length of standing (target <15mins).
		Enable incremental journey time improvements. This is particularly relevant programme phasing as it establishes the principle that journey times for all trips should not worsen when moving from one configuration state to another.
		Point-to-point journey time comparable to off-peak car trips.
	45min	Journey time to city centre should not be more than 45mins. This has been defined as a trip from anywhere on the network to Aotea and vice versa.
	RTN	Comply with 2018 Regional Public Transportation Plan (RPTP) Rapid Transit Network (RTN) aspirations for services of 10 minutes (or better) minimum frequency between 6am and midnight.
Freight		Provide peak period capacity for base demand (per forecasts provided).
		Provide optimal timetabling with freight destinations (i.e., ports, ferries, logistic industries etc.)
	1500m	Enable transition to 1,500m freight trains from south of Auckland to Westfield / Southdown.
Interregional		Provide peak period capacity for base services (inter-regional passenger; # slots).
		Enable incremental journey time improvements.
Reliability	6hrs	Enable 6 hours of productive maintenance per night (on average)[6].

[6] Maintenance access requirements are expected to reduce across time as renewals improve the state of the network and maintenance plant, equipment and methodologies are improved.

		Enable 30-minute evening service with one main closed (for maintenance).
	75%	Peak network capacity utilisation (target <75%). Utilisation refers to the percentage of available capacity allowed by infrastructure, utilised by rail services. A 75% target provides future planning flexibility and allows for growth beyond that predicted in the inputs to the PBC

ECONOMIC CASE – PROGRAMME DEVELOPMENT

The PBC optioneering process followed Waka Kotahi's Business Case Approach including idea generation, assessment of alternatives and options, and option short-listing, to identify a preferred option. These steps were undertaken through a series of partner workshops and evaluated using multi-criteria analysis (MCA). A dedicated project space was established to promote a collaborative approach. The more traditional linear sifting approach of the Waka Kotahi framework was supplemented by elements of the Long-Term Planning Process (LTPP) used by Network Rail (United Kingdom) to ensure a holistic, system-wide view of the rail system was considered in developing and evaluating options.

LONG LIST ASSESSMENT

The long list assessment identified 291 distinct network improvements, which were distilled to core service elements including running longer trains (both freight and passenger), increased freight access by removing metro peak exclusion periods, more frequent services to meet peak demands, and create an all-day, frequent timetable, providing new routes, provisioning for car competitive faster services, and mode segregation of all-stops and limited stop services.

Subsequently nine differentiating infrastructure options for the 2051 end state network were developed.[7] These represented varying degrees and combinations of these service elements, and the infrastructure required to support them, across a range of investment levels.

The analysis identified several core constraints on the network which were central to the value for money assessments made to sieve options to a short list of three. The primary areas of constraint were:

- Southern corridor capacity: The Southern corridor will see the most demand growth in the network across all markets; freight, metro and inter regional. Even running with a modernised and fully optimised signalling system, the existing two track railway was found to provide inadequate capacity to accommodate all demands. Four-tracking this corridor is therefore a critical requirement, and a first priority in the broader strategic goal of creating a segregated network.
- Wiri to Westfield capacity: The short segment of track between Wiri and Westfield was found to experience the highest train volumes within the Southern corridor, not only in the context of Auckland, but also the entire New Zealand rail network. This is due to the merging of Southern and Eastern passenger lines, and freight on the North Island Main

[7] Referred to as the 'Provisional Short List'

Trunk (NIMT) and to and from the Port of Auckland (POAL). Three solutions were considered; a do-minimum four track option, additional duplication of tracks to further expand capacity, and modifications to the metro network service structure to reduce train volumes. All three solutions were taken forward to the short-list.

- Metro and freight conflicts on the inner network: Freight services on the North Auckland Line (NAL) traverse the entire metro Western Line, and inner portion of the Southern Line between Westfield junction and Maungawhau. Status quo is for these services to be restricted to off peak metro periods[8]. This simultaneously limits the capacity and reliability of freight services (resulting in freight being forced onto the national road network under any scenario in which there is growth in Northland) and restricts metro services from expanding outside of the currently planned 2-hour peak period on the Western and Southern lines. A range of solutions were identified to resolve this constraint including use of a dedicated Avondale – Southdown corridor to decant freight from the inner Auckland network, construction of a shorter by-pass tunnel around Newmarket (ultimately rejected due to significant uncertainties around feasibility and because it did not offer the optionality for passenger services gained from Avondale - Southdown), four-tracking the entire Western and Inner Southern corridors to segregate metro and freight (rejected due to poor value for money proposition), and a do-minimum option with no infrastructure intervention but potential mitigations through enhanced signalling and network control.
- Journey time competitiveness: It was identified that while the CRL greatly improves journey times for some customers, particularly on the Western and Eastern lines where rail is expected to be highly competitive with private car trips from opening day[9], services on the Southern Line would be much less attractive, particularly to/from the outer areas. Duplication of mains on the Southern corridor to Westfield provides a means for selected metro trains to pass slower, all-stop trains, thereby creating a competitive express service (with equal benefit to inter regional trains from Hamilton.) Options for further travel time improvement were also considered by four-tracking the inner Southern Line, and the Eastern Line (ultimately rejected given risks around corridor width restrictions, environmental risks, and marginally fewer travel time benefits).
- Insufficient maintenance access: All options considered maintenance enhancements as a minimum requirement and were therefore not generally differentiated by such considerations. However, the duplication of mains, and alternative routes through the network, are highly beneficial for maintenance as they enable maintenance access with minimal compromise to train services. The maintenance benefits of the various track expansion options were considered in the option selection, including one option to duplicate track over the entire network (ultimately rejected due to value of money considerations).

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[8] The metro peak is a defined period of time in the Auckland Network Access Agreement.

[9] On the Western Line this is due to eliminating the need to route through Newmarket, and on the Eastern Line it is primarily due being comparatively proximate to the city centre.

SHORT LIST ASSESSMENT

At the conclusion of the long list assessment workshop, three options were taken forward for further detailed analysis as summarised in Figure 0-3 below, which also summarises the MCA and indicative cost and benefit assessments.

To differentiate between options, Indicative Benefit Cost Ratios (IBCRs) were calculated. The use of an IBCR acknowledges some of the limitations with the short list analysis (e.g., omission of operating costs and certain benefit categories and, simplified, non-optimised phasing of each option).

Note that the economic analysis undertaken in the short list phase was further refined for the final preferred programme per Monetised Benefits and Costs Manual (MBCM) guidance[10]. This refinement resulted in an increase to the IBCR values shown below, as:

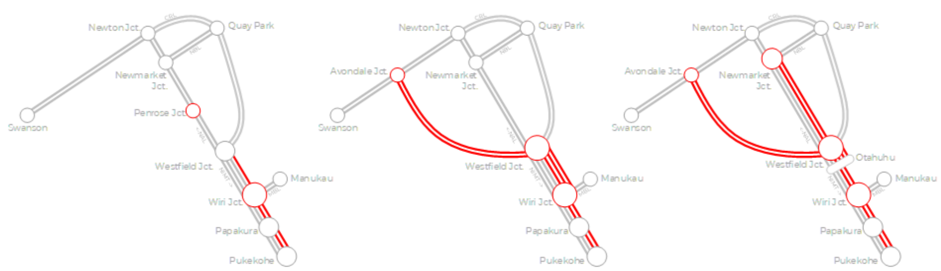
- elements of the programme were optimised (reduced or deferred), through refinements to the programme phasing and scope[11];
- costs and benefits were quantified more accurately based on a greater level of detail in analysis;
- updates to the MBCM made in April 2023 were accounted for (which resulted in certain benefits increasing in the preferred programme).

As will be discussed in the Economic assessment section below, the BCR of the final preferred programme (a refinement of short list option Ciii) is 1.0.

It is also worth noting that subsequent analysis carried out on the final preferred programme, also indicated that the IBCR for Option Ai was likely overstated. This was because the assessment of freight benefits for this option did not account for operating constraints that were not well understood at the time of the short list assessment and were therefore optimistic. Those same constraints do not apply to Options Ciii and Di.

[10] Per MBCM Optioneering Overview page "At the shortlist stage, more detailed assessment is carried out. It is important that economic assessment is included as part of the multi-criteria analysis (MCA) at the shortlist stage. This will enable robust comparison across options. Decision makers should consider both monetised and non-monetised benefits and costs to make an informed choice between options. The rationale for the methodology used and decisions made should be clearly articulated and documented. At the preferred option stage, further detailed economic assessment should be carried out."

[11] See Options Development Report Part 2 (Appendix H), Section 7.2 for a full accounting of the refinements made between the Initial and Final Preferred Programme's.



	Ai		Ciii		Di	
	Minimum investment option: - Southern corridor four tracking - Maint. enhancements - Signalling enhancements - Level crossing removals - New metro fleet, depot and stabling - Station upgrades - Power upgrades		Minimum investment option plus… - Avondale Southdown resolving inner network conflicts - Wiri to Westfield capacity issues resolved via track duplication		Minimum investment option plus… - Avondale Southdown resolving inner network conflicts - Wiri to Westfield capacity issues resolved via metro service restructuring - Four tracking of the inner southern corridor for express benefits.	
MCA Summary Score	**13.8**		**27.0**		**20.3**	
Total Capital Costs	lower	upper	lower	Upper	lower	upper
	$17bn	$25bn	$25bn	$35bn	$26bn	$37bn
Indicative Benefit Cost Ratio	lower	upper	lower	upper	lower	upper
	0.76	1	0.58	0.84	0.55	0.80

Figure 0-3: Summary of short list options and assessment

Option Ai was included in the assessment as a minimum investment package and did not include Avondale-Southdown or additional capacity between Westfield – Wiri. This was a lower cost option, with a potentially higher benefit-cost ratio (indicating better value for money). However, analysis found that by late in the programme period, the Ai network would be operationally constrained, lacked resilience to future changes such as higher passenger or freight service growth (potentially triggered by policy changes), and did not allow for freight growth patterns different to those in the base case, which may arise from ports competition or changing import/export patterns (that are not within the control of the rail network, but which it must respond to).

Subsequent analysis during the refinement of the preferred option reinforced these points and meant that the expected constraints associated with Option Ai would occur earlier than previously anticipated and be more restrictive in achieving both the investment objectives and desired outcomes, than assumed during the short-list assessment. With the benefit of this additional information, the summarised MCA scores and IBCR for Option Ai are considered to overstate its performance relative to Options Ciii and Di.

It was evident from the short-list assessment that the shortcomings of Option Ai meant it was not a long-term end state option for Auckland's rail network. The analysis showed that a further step change would be required beyond Option Ai for the rail network to continue to deliver its required role in the future transport system.

While the incremental economic benefits of Options Ciii and Di estimated in the short-list assessment appear to be modest, they did not adequately reflect the material shortcomings of Option Ai (e.g., its inability to accommodate freight demands once detailed timetabling constraints were included) that were identified during the subsequent refinement of the preferred option. This means the initial indicative economic performance conclusions for Options Ciii and Di are somewhat misleading.

Options Ciii and Di are both viable long-term solutions that deliver the step change needed to overcome the operational constraints evident in Option Ai, setting the Auckland rail network up for continued success further into the future. Both options are also robust across a variety of likely future scenarios. Therefore, the substantial limitations associated with Option Ai meant that it was discounted, as it lacked the ambition required to achieve the overall Investment Objectives of the PBC in the long term.

Option Ciii was then preferred over Option Di with the highest overall MCA score, lower cost, and slightly higher IBCR and incremental BCR. This reflected the inadequate performance of the service-based solution to the Wiri to Westfield bottleneck adopted in Di, and the low value-for-money proposition of 4-tracking the Inner Southern corridor (between Westfield and Newmarket) given its small incremental travel time benefit over Ciii at a substantial additional cost.

Thus, Option Ciii was recommended as the Initial Preferred 2051 End State.

For these reasons, the more aspirational and resilient option – ultimately refined into the preferred programme – was chosen as it:

- delivered all the components of the smaller investment package,
- incorporated important provisions for a more future proofed, resilient long-term solution,
- provided additional flexibility to respond to different future scenarios (e.g., changing demand patterns),
- delivered against all the investment objectives, with residual capacity for longer term growth, and
- would be subject to future decisions on components scheduled for implementation later in the programme horizon (i.e., third decade), meaning their inclusion also ensured they would not be precluded in the future.

PHASING

Having confirmed a preferred end state option for the network, significant further analysis was undertaken to assess the phasing of this infrastructure over time. This assessment showed that while the 2051 Configuration State[12] provides an appropriate level of capacity and service quality ultimately, the timeline to implement it is highly likely to lag demand.

Development of the final preferred programme was completed in two iterations:

[12] Terminology adopted from the LTPP. A Configuration State is a set of infrastructure interventions that enable one or more major service improvement.

- Iteration 1: Develop infrastructure and service intervention phasing to meet projected growth under the base demand scenario for all markets, and their various service objectives (aka conditional outputs), culminating in the refined 2051 end state; and
- Iteration 2: Adjust demand-led phasing to reflect practical deliverability constraints including planning, consenting, and funding considerations. A key component of this phase was to assess the range of potential trade-offs that may be required during periods where the required infrastructure-enabled capacity lags demand.

The 'constrained' phasing plan produced in the Iteration 2 analysis was then stress-tested against three scenarios representing a combination of port outcomes and policy settings. The analysis considered the effects of the POAL being closed completely (with freight volumes redistributed across the network), capped at existing volumes, and unconstrained (resulting in significant growth on the Eastern corridor), in combination with the potential effects of strong policy interventions to achieve the targets set out in the Emissions Reduction Pathway. The analysis allowed for further refinement of the phasing (Iteration 3) to ensure robustness of the programme. This is presented in Figure 0-4 below as a series of indicative Configuration States (CS).

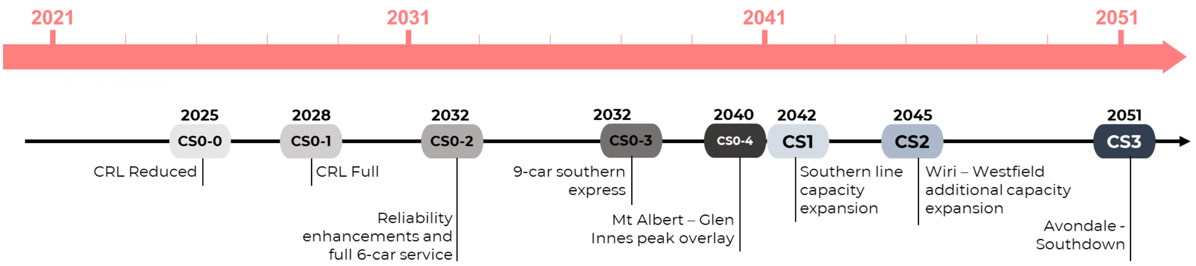


Figure 0-4: Final prefered programme phasing

The critical finding from this analysis was that under all realistic scenarios, to meet the demands of all markets, four tracking of the Southern corridor will be required by the early 2030s. However, given the extent and complexity of the works in a brownfield environment, the long lead times for planning and consenting, and the currently constrained funding environment, a more plausible delivery date for the infrastructure is 2042. This means that for more than a decade, growth on the Southern corridor will be constrained, and compromises required.

There is therefore urgency to pursue this work as early as possible, and to consider ways to minimise the implementation timeline (which may include for example, starting with the relatively less complex greenfield section between Pukekohe and Papakura, for which designation planning for four-tracking is already underway).

Furthermore, the phasing analysis:

- Tested and recommended four tracking of the full Southern corridor: Cost optimisation was considered to limit four-track to Papakura rather than Pukekohe. However, analysis demonstrated material trade-offs for all markets. In one extreme, this would involve passenger services running with 15-minute headway gaps between Papakura and Pukekohe resulting in high levels of crowding, or in another extreme, a freight service restricted to current max train lengths, resulting in between 270 – 540 heavy truck trips worth of demand forced onto the roading network each day between Auckland and other regions (principally Waikato and Bay of Plenty).

- **Introduced targeted 9 car extensions and an inner East – West overlay:** Based on a value for money assessment, the preferred programme ultimately plans only for Southern Line express services to run at 9-car lengths within the 30-year timeframe, these being the highest demand services on the network. This drives the need to extend selected platforms on the Southern Line to 9-car lengths. However, given 9-car train lengths will be needed shortly after 2051 for all metro services (or earlier in high growth scenarios) the PBC takes as a principle that futureproofing for 9-car operations should be planned network-wide where practical.
- **Assessed the triggers for Wiri to Westfield capacity expansion:** Scenario analysis indicates that the need for additional capacity expansion between Wiri and Westfield is heavily dependent on the future of POAL. If growth from POAL is unconstrained, this infrastructure becomes critical, however conversely if POAL is closed, it is likely not justifiable. This infrastructure element has been planned in the late stages of the programme, to be reviewed when the future of the POAL is known with greater certainty.

ECONOMIC CASE – RECOMMENDED PROGRAMME

The recommended 30-year plan for Auckland's rail network is shown in Figure 0-5.

This is a comprehensive transport package that aims to get the most out of the existing network, to improve customer experiences, and to deliver on significant forecast growth. Its development has included detailed consideration of options to maximise the efficiency and effectiveness of the rail network, factoring in forecast future demand for both freight and passenger journeys, and the imperative to prioritise reliability and resilience in future network planning.

Building on current network improvements underway by KiwiRail and the addition of the CRL (completion expected end of 2025), the recommended programme aims to ensure a fit-for-purpose rail network throughout Auckland, taking Aucklanders where they need to go and moving freight efficiently to and through the city.

The recommended Auckland rail network provides:

- An efficient, reliable, transport system that supports future forecast passenger and freight demand and the long-term development of a more efficient and low carbon transport system.
- An integrated transport system that complements the existing network and facilitates mode shift from private passenger and freight vehicles to rail, to reduce greenhouse gas emissions and road congestion and consequent increased road costs and capacity requirements.
- The flexibility to extend the network should the Rapid Transport Strategy change in future, and to facilitate ongoing growth across the long term.

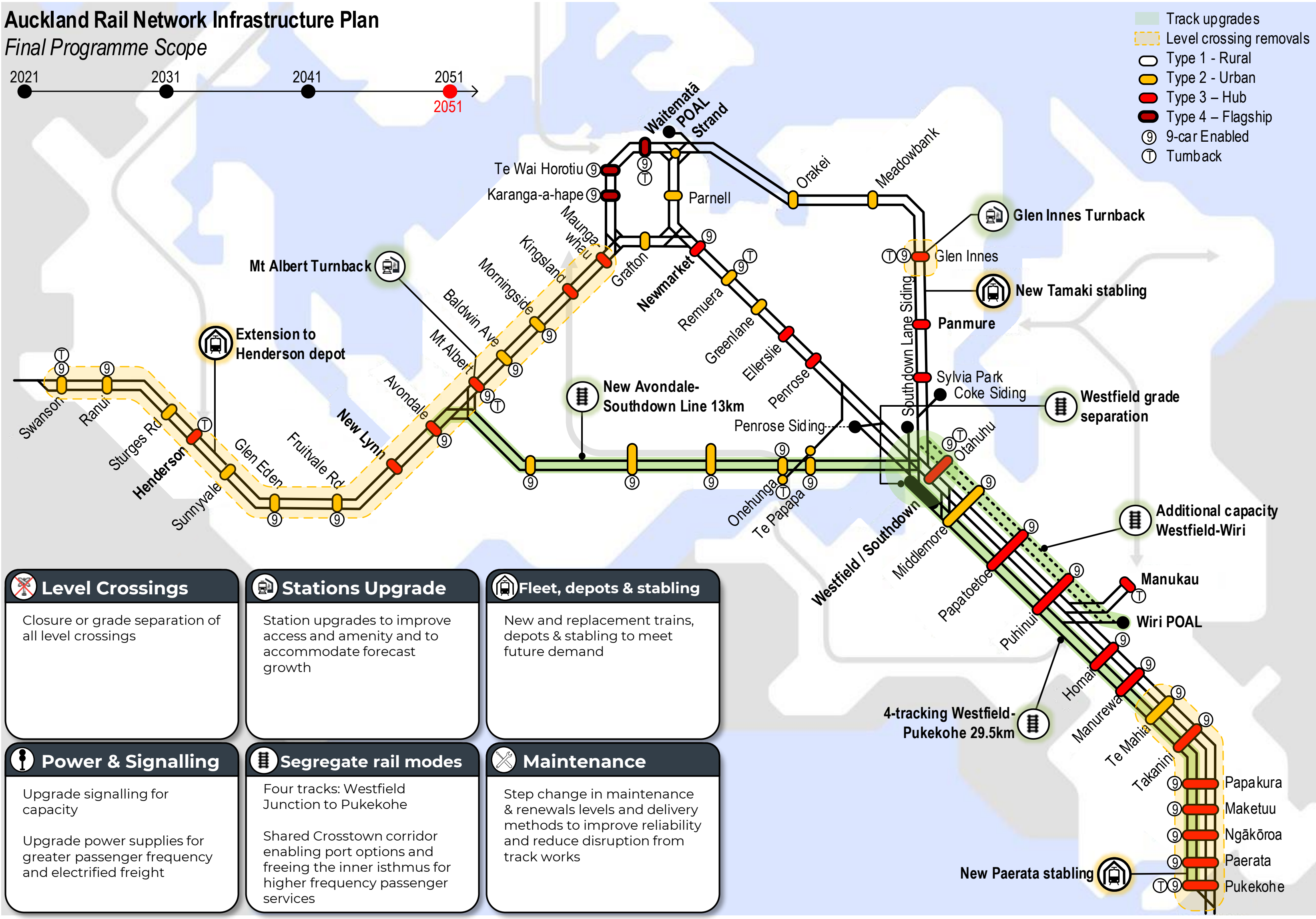


Figure 0-5: 30-year rail investment plan

The outcomes will be achieved by targeted investment in six key areas:

- Maintenance and renewals: A step change in maintenance and renewals levels and delivery methods, improved reliability, and reduced disruption from track works. New high-capacity maintenance and renewals plant and equipment. Elements include a heavy maintenance facility, three satellite stabling yards and two maintenance sidings for plant and equipment (locations not yet confirmed).
- Level crossing removal 34[13] (road and pedestrian) crossings to be grade separated or closed. For the network to operate at maximum efficiency and for optimum safety outcomes, rail needs to be separated from roads and active mode facilities.
- Station upgrades: Rail stations upgraded to Auckland Transport's Transport Design Manual standard, including platform fitout and amenities, new platforms for new tracks and turn-backs at strategic locations. Platform extensions to support 9-car services and future proofing for full 9-car operations beyond 2051.
- Signalling and power: upgrades including two new power feeds, ETCS2, ATO, traffic management systems and signal block enhancement.
- Fleet, depots and stabling: 72 new 3-car EMU and associated stabling requirements to meet increased demand.
- Segregate rail modes as much as possible:
  - 4 tracking the North Island Main Trunk (NIMT) between Westfield Junction and Pukekohe (29.5km), including Westfield Junction grade separation and consideration of further additional capacity between Westfield and Wiri Junctions. Rail is a national and local system, with significant demands across all customer markets. Four tracking is required to allow freight, metro, and inter-regional passenger services to be separated, to enable more express services and faster, more frequent journeys.
  - Avondale – Southdown completes a long planned crosstown rail corridor (13km). It enables more flexible, efficient freight operations including for rail to be able to respond to growth at upper North Island ports and allows the inner-city track network to provide more frequent, faster journeys, as well as enabling all day express services on the Southern line. It will reduce freight movements in the inner city by more efficient routing of Northland services to Southdown (NZ's third largest port) without needing to pass through the inner Auckland network where capacity is limited, and complex operations have impacts on reliability. It will also enable new transport and urban development opportunities across the isthmus from Avondale to Glen Innes.

Together these key initiatives will significantly increase the capacity, service levels and resilience of the rail network. In particular, the programme maximises the separation of all-stops and non-stop services, thereby enhancing the capacity and reliability of the existing network as well as providing significant new capacity. The individual elements of the rail programme are highly interdependent. The programme delivers significant local, regional, and national outcomes, but

[13] This number excludes the 8 level crossings on the Onehunga Branch Line (OBL). There are 42 road and pedestrian level crossing sites in total on the Auckland electrified rail network. The level crossings on the OBL were assessed and were phased outside the PBC horizon of 2051 due to low train volumes. This phasing of the OBL level crossings will be assessed further during the Level Crossing SSBC currently in development.

the full realisation of these benefits depends on the integrity of the overall programme and investment in all system elements to a level commensurate with the level of service required.

The ultimate aim for the recommended investment programme is that rail remains an integral part of an effective public transport and freight system, with increased capacity, connectivity and optionality that offers New Zealanders attractive, reliable and efficient travel solutions. It also enables more sustainable growth by taking cars and trucks off roads, thereby reducing carbon emissions, and helping to meet New Zealand's climate change obligations.

PERFORMANCE AGAINST INVESTMENT OBJECTIVES

Table 0-2 summarises the performance of the programme against the investment objectives.

Table 0-2 Investment objectives performance summary

INVESTMENT OBJECTIVE (AND KPIS)	PREFERRED PROGRAMME PERFORMANCE SUMMARY
Continually increase the use of rail in Auckland (all markets) over the next 30 years, by increasing its attractiveness	
Extent to which the option increases rail's attractiveness for metro passengers (i.e. service offering characteristics)	Provides capacity to meet demand with standing times of 15min or less on all lines (with some minor exceptions in the AM peak on the Southern line). Delivers RTN frequency at all stations, all day, with trains running at 7.5min (avg.) headway. The Southern line also has express services all day. Improves peak frequencies for 44 out of 45 stations[14] on the network with up to 270% increases in frequency at key stations. Delivers improved travel times for all lines for local and express services with up to 10 min travel time saved on the Southern line, 8min on the Eastern line, and 5 min on the Western line. Inclusion of Avondale-Southdown metro service opens new catchment and can link to Auckland Light Rail (ALR) if it proceeds for Mangere and airport precinct access.
Extent to which the option increases metro passenger rail patronage	Annual heavy rail boardings are expected to increase to over 76 million by 2051 (+38.5% compared to do-min). This represents a 3.6-fold increase over pre-COVID patronage the next 30 years. Passenger-km travelled across all PT modes increases to 3.44 billion km in 2051 (+8% compared to do-min).
Extent to which the option increases metro passenger rail mode share	Rail mode share based on Auckland Forecasting Centre's Macro Strategic Model (MSM) (2051) AM peak outputs is 25% from the

[14] The only station to not receive frequency upgrades is Manukau as it is already well served on CRL Day 1

INVESTMENT OBJECTIVE (AND KPIS)	PREFERRED PROGRAMME PERFORMANCE SUMMARY
	addressable market[15] (acknowledging rail is not a viable option for large parts of Auckland). In context of the overall transport network: • PT mode share (2051): 15.1% (+3% compared to do-min), • Rail mode share (2051): 4.4% (+38% compared to do-min).
Extent to which the option increases the share of freight moved by rail	The increase in freight moved by rail is substantial over the programme horizon because of its increased capacity and improved network reliability. In 2051, rail freight outcomes are expected to be: • 3.9 billion net tonne-km (NTK) on rail (+63% compared to do-min), under the base demand scenario (B1), • 17.9 million tonnes moved by rail (+44% compared to do-min). Rail freight mode share (by NTK) increases from 16% in the do-min to 26% under the preferred programme in 2051, across the addressable market (extends beyond Auckland, principally to/from Wellington, and Waikato and the Bay of Plenty). The preferred programme provides flexibility to accommodate different freight growth scenarios (e.g., if Ports of Auckland moves).
Reduce Auckland's net transport emissions by increasing rail's share of Auckland's transport task over the next 30 years	
Extent to which the option reduces Auckland's net CO_2 emissions from transport	In 2051, compared to the do-min, road vehicle CO_2 emissions are projected to reduce by some 8,000 tonnes, with a further 65,000 tonnes of CO_2 removed from freight (due to mode shift from truck to rail). Over the 30-year programme horizon, a total of 2.1 million tonnes of CO_2 will be avoided (even when allowing for road fleet decarbonisation assumptions). Freight contributes about 95% of this reduction.
Extent to which the option reduces on road VKT	81 million vehicle-km are removed from the Auckland road network in 2051 (-0.6% reduction on do-min VKT), based on MSM modelling. A further 100 million km (estimated) are removed from the Auckland and national road networks because of freight mode shift from road to rail.
The Auckland rail network supports and enables a denser urban form within the metro station catchments within the next 30 years	
Extent to which the option increases	#Jobs accessible within 30min PT (2051): 60,341 (+6.6% compared to do-min).

[15] The addressable market is defined as those trips to/from zones where rail is deemed as being a viable transport mode. This is defined as any zone where a rail trip occurs (regardless of origin or destination).

INVESTMENT OBJECTIVE (AND KPIS)	PREFERRED PROGRAMME PERFORMANCE SUMMARY
employment accessibility by PT (within 30 and 45 minutes travel)	#Jobs accessible within 45min PT (2051): 204,342 (+10.3% compared to do-min).
The Auckland rail network is resilient and reliable for the future. Achieved by increasing the available window for productive maintenance to 6 hours per day (on average) and keeping network utilisation below UIC (International Union of Railways) 406 planning limits for utilisation.	
Extent to which the option improves rail network reliability	Following the opening of the CRL, the main capacity constraint on the rail network will be mixed use areas on the Southern line where the Outer Southern is estimated to be at 101% capacity on CRL opening day (whereas the ultimate target for resilient and reliable operation is 75%). The preferred programme enables significant growth in train (metro and freight) volumes while progressively reducing / maintaining reliable levels of utilisation across the network. By 2051 end state, it achieves the following utilisation by section: • West: 75% • East: 83% • Inner South: 75% • Outer South: 58% Four-tracking and network sectionalisation will also enable 6-hour productive maintenance windows to deliver the necessary level of maintenance to sustain reliable operations, while minimising the impact on passengers. The preferred programme adds some 117km of new track over the 30 years, taking the network length from 189km to 306km (+62%). This helps separate all-stop metro services and non-stop freight and express services, which in turn reduces utilisation to manageable and reliable levels and improves the ability to deliver required maintenance.

The carbon emissions avoided by the PBC-recommended investment programme are expected to be significantly greater if policy levers are put in place to accelerate shift to more sustainable modes (both in passenger and freight) or if slower fleet decarbonisation (private and heavy vehicles) occurs than assumed by MoT's fleet composition forecasts in Waka Kotahi's Vehicle Emission Prediction Model (VEPM). It is also noted that without the investment recommended by the PBC, the potential for these policy levers to be effective, with equitable outcomes, will be limited. As such investment in the Auckland rail network provides a more resilient approach to mitigating the impacts of climate change.

This highlights the need for a broader system of investments and policy levers external to the PBC to achieve emissions reduction goals – improvements to the heavy rail network alone will not be sufficient. However, scenario analysis indicates that the recommended rail network largely has capacity to accommodate required ERP target volumes (passenger and freight) if a broader system of initiatives does eventuate (though not on the targeted timescales unless investment were also accelerated).

PERFORMANCE AGAINST STRATEGIC OBJECTIVES

Maximising segregation of traffic types on the rail network directly improves efficiency, utilisation, and reliability and therefore is a strategic goal for the Auckland rail network. The recommended programme achieves this through the provision of four tracks on the Southern corridor (two for all-stops services and two for non-stop services (express and inter-regional passenger and freight)), and the provision of the crosstown Avondale – Southdown corridor. This allows intense passenger services to operate on dedicated tracks from the southern end of the network and through most of the inner network, whilst simultaneously enabling a much more efficient freight supply chain. Achieving this level of network segregation will enable greater system reliability and resilience and support wider public policy initiatives such as increased inter-regional rail travel and expanded Northland freight options. It will also preserve future options in relation to POAL (which might otherwise be precluded).

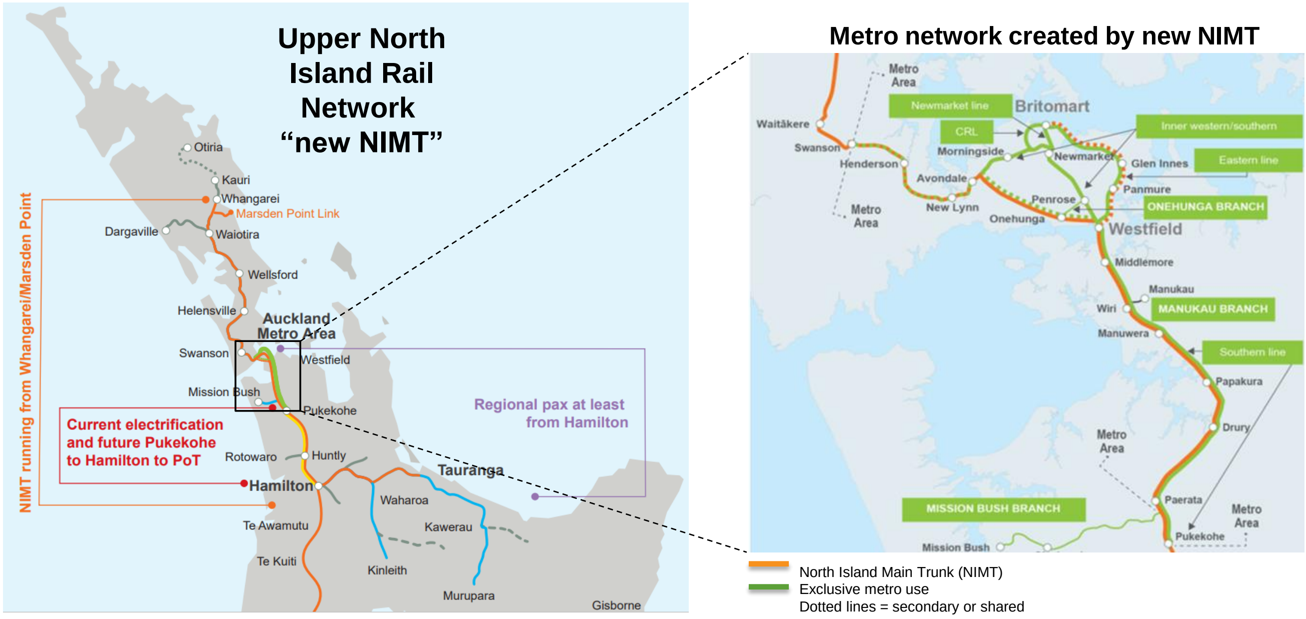


Figure 0-6: Strategic segregation of upper North Island rail network

ECONOMIC ASSESSMENT

The recommended programme has a **BCR of 1.0** when the estimate for Wider Economic Benefits (WEBs) is excluded, or 1.2 when they are included. When WEBs are excluded, the positive NPV shows that the estimated benefits of the programme are slightly higher than the estimated costs. When WEBs are included, or an allowance is made for likely areas of conservatism, the positive NPV increases further.

The recommended programme BCR reflects, in part, the major investment and long delivery time required to achieve the desired step change in rail infrastructure and services. This means that while the step change is large, benefits can only start to build after key elements of the programme are delivered – they do not immediately jump to a high value. This means there will be a long period before the return on investment is realised, however it is also important to recognise that rail assets have a very long useful life (some 150 years) and therefore benefits are able to be realised over an equally long time.

A summary of the economic assessment is provided in Table 0-3 and Figure 0-7 presents the costs and benefits over time to illustrate this point.

Table 0-3 Recommended programme economic assessment summary (2022$, millions)

	TOTAL		PRESENT VALUE	
Benefits				
Metro	$	40,000	$	9,700
Freight	$	21,400	$	5,800
Inter-regional	$	8,000	$	1,700
Residual value	$	5,900	$	600
WEBs	$	10,000	$	2,400
TOTAL (excl. WEBs)	$	75,300	$	17,800
TOTAL (incl. WEBs)	$	85,300	$	20,300
Costs				
Capex	-$	19,700	-$	11,900
Renewals	-$	1,400	-$	200
Opex	-$	19,300	-$	5,100
TOTAL	-$	40,400	-$	17,200
NPV (excl. WEBs)			$	600
NPV (incl. WEBs)			$	3,000
BCR (excl. WEBs)				1.0
BCR (incl. WEBs)				1.2

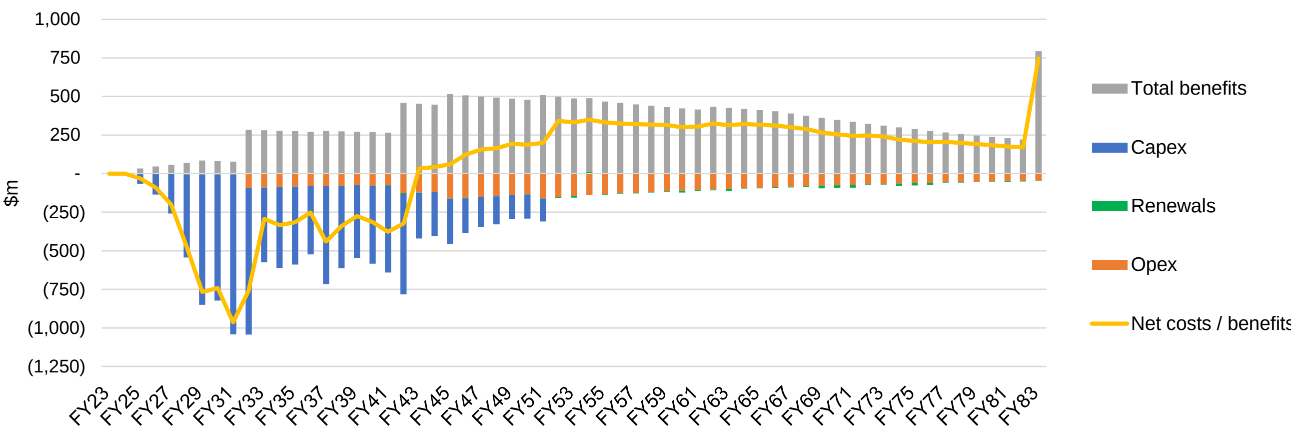


Figure 0-7: Programme discounted costs and benefits over time (2022$, millions)

Waka Kotahi's Investment Prioritisation Method (IPM) for the 2021–24 National Land Transport Programme (NLTP) has been used to determine the overall assessment profile for the recommended programme:

- GPS alignment: Very high
- Scheduling: Medium

- Efficiency: Low

Based on Figure 3 in the IPM document, this assessment profile leads to a priority order rating of 3.

FINANCIAL CASE

This PBC describes:

- the do-minimum, system wide investment funding forecast required to maintain, operate and renew the existing rail network in Auckland, as well as,
- the pipeline of growth projects to build on and maintain the existing network to meet forecast service levels and demand to 2051.

The overall funding required between FY2025 – FY2051 to deliver the recommended programme is summarised in Table 0-4. This reflects all costs that are currently not committed. The funding requirement includes renewals and operating costs that are expected to be included in a 'minimum investment programme' as part of continuous programmes, regardless of whether additional capital investment is made. The forecast cashflow over time is shown in Figure 0-8. Note that this chart excludes escalation.

Table 0-4 Programme cost summary

	COST ESTIMATE ($M)
Capital costs (P50)	20,700
Renewals	2,600
Operating costs	13,300
Total cost (real)	36,600
Escalation	*17,400*
Total cost (nominal)	54,100

Figure 0-8: Recommended programme cashflow (P50 capital costs, real)

A breakdown of the capital investment programme by asset category is included in Table 0-5. Totals may not add precisely owing to rounding.

Table 0-5 Capital cost estimate by asset category (P50)

9(2)(i) - Commercial activities

Capex funding required ($m) By asset category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Maintenance plant and equipment	[redacted]															
Stations (new)	[redacted]															
Platforms	[redacted]															
Signalling, Telecomms, Network Control	[redacted]															
Traction power system	[redacted]															
EMU rolling stock	[redacted]															
EMU depots and stabling	[redacted]															
Regional Services stabling	[redacted]															
Level crossing removal	[redacted]															
Station improvement	[redacted]															
Maintenance depots and access	[redacted]															
Track	[redacted]															
Disruption management charges	[redacted]															
Programme level studies and investigations	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	**80**	**170**	**400**	**820**	**1,300**	**1,400**	**1,800**	**1,800**	**950**	**1,100**	**6,000**	**13,600**	**11,000**	**30,600**	**650**	**9,900**

The recommended programme represents a considerable investment over the next 30 years and will place pressure on both traditional and potential funding sources. In developing the phasing for the programme, affordability constraints have been considered, informed by the project partners' views on likely funding constraints, particularly in the first decade.

The funding requirement in the next 3-4 years is critical to enable a lift in productivity for maintenance and renewals activity as demands on the network post-CRL opening grow, and to secure designations for critical programme elements such as 4-tracking between Westfield and Pukekohe and a new EMU depot. The early funding for these investigations and planning activities is necessary and represents 'no regret' as putting in place the appropriate planning protections will ensure these programme components are not precluded in the future, even if implementation funding is unconfirmed.

The immediate funding requirement to progress business cases, assess different options, secure long-term designations, and progress strategic property acquisition is low. The substantial cost associated with bulk property acquisition and construction occurs much later (for most of the programme). This may help mitigate some near-term affordability challenges.

NEXT STEPS FOR THE PROGRAMME

The long-term vision for Auckland's rail network is a comprehensive programme to be delivered in its entirety over a 30-year period. The PBC has identified a significant package of benefits at local, regional, and national levels that will result from the successful delivery of the recommended programme. These benefits arise from the interactions of the whole programme, not its separate component parts and are therefore reliant on the delivery of the whole programme. The same range of benefits will not arise if elements within the programme are not delivered.

It is therefore the view of the joint KiwiRail and Auckland Transport team that the programme ideally be considered, funded, and delivered as the holistic package. Both organisations are committed to working together to develop more efficient ways of delivering the programme. This would enable many projects within the programme to be delivered under a collaborative structure and create a level of funding certainty that is not currently afforded to these projects.

The relative priorities to progress individual projects within the recommended programme vary, subject to a range of matters, including:

- Urgency – demand pressure (both freight and passenger), central Government climate change commitments, or the time to deliver related projects can influence the urgency of delivery. Additional track capacity and level crossing removal projects are relevant in this regard.
- Contribution to programme outcomes – The extent to which a project contributes to the overall programme benefits including dependencies with other projects, accessibility, resilience etc.
- Financial and delivery benefits – route protection can reduce property and construction costs and support early discussions with affected landowners. Benefits achieved can be significant if protection is obtained prior to development. This is particularly relevant for the additional capacity projects that could have significant impacts on privately owned property.

Projects within the Auckland rail network recommended programme have been grouped primarily by geographic location and will be progressed as packages of work according to the following considerations:

- Project type, e.g., physical footprint required, has property and consenting considerations,
- Complex scope and risk,
- Nature of interdependency between elements and customer outcomes,
- Time period to deliver and demand triggers for implementation, and
- High stakeholder interest / need to earn social licence.

Figure 0-9 summarises the indicative project phasing and approach to delivery of the next phases of the programme.

It is important to recognise that although the programme elements themselves are resilient to a range of different futures, a range of future uncertainties could influence the grouping, prioritisation, and delivery timing of projects within the programme. Uncertainties could include decisions about the future location of the Port of Auckland and emissions reduction priorities and timing.

KiwiRail and Auckland Transport are committed to ensuring that the programme continues to meet the identified needs and timeframes and will regularly review the overall programme prioritisation.

A key imperative for both Auckland Transport and KiwiRail is to identify opportunities to reduce the lead time to construction. A collaborative programme delivery mechanism would provide options for both organisations to deliver projects of the size, complexity, geographical spread, and multiple interfaces (social, economic, environmental, technical, operation) of those recommended for the Auckland rail network over the next 30 years. It may also help to facilitate optimal approaches to ongoing change management and managing the impacts on existing services.

Projects with high complexity, high consenting risk, large footprint requirements, and urgency in terms of delivery to meet demand, require rapid progress of next stages (e.g., business cases and NoRs). These projects have significant cost requirements and consequently have long lead times to secure funding, and prompt progress of these planning phases is intended to reduce the lead time to construction.

It is noted that maintenance plant and equipment, maintenance depots and OLE sectioning business cases and their subsequent implementation are urgent and underpin the strategy to reduce operational disruption by improving maintenance and renewals productivity as soon as possible.

In the next five years, following the endorsement of this PBC, the following outcomes are sought:

- Business cases undertaken to confirm the recommended rail network and enable investors to make decisions on whether projects will proceed directly to the implementation phase or alternatively to route protect corridors for longer term projects.
- Projects that are required to improve maintenance productivity and support operational efficiency are implemented.
- Projects that require an increased designation footprint for implementation are route protected.
- Consenting, detailed design and construction procurement begins for projects that have a confirmed designation or that do not require significant additional footprint outside the existing designation.
- Programme optimisation - considers minimum technical requirements, the nature of interdependencies and how the programme of indicative projects is best structured to balance time, cost, and quality.

Swimlanes focus on the largest most complex elements of the programme items, not exhaustive

Project	Y0				Y1				Y2				Y3				Y4				Y5			
	FY 23/24				FY 24/25				FY 25/26				FY 26/27				FY 27/28				FY 28/29			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Southern Corridor																								
Westfield (Penrose) to Pukekohe: 4 track includes Westfield Junction	PBC		Procure		IBC				Procure		DBCs (scope TBC after IBC)				AEE / NOR								Procure	
Westfield to Wiri: Additional track capacity									DBC and further work to be progressed as required															
Westfield to Papakura Stations	PBC		Procure		IBC				Procure		DBC (Route Protection or In				AEE / NOR								Procure	
Level Xings - Takaanini - Group 2	AEE/NOR						Procure		Consents, Property Acquisition, Design						Construction									
Papakura to Pukekohe: 4 track	AEE / NOR																							
					Procure		Imp. BC + Design			Procure		Consents, Property Acquisition, Design							Construction					
Papakura to Pukekohe Level crossings removal group 5	AEE / NOR									Procure		Consents, Property Acquisition, Design												
Depot Stabling (South)	PBC		Procure		SSBC**				AEE / NOR or extension of 4 tracking NOR				Procure		Consents, Property Acquisition, Design						Construction			
Station upgrades - Southern stations not on four track sections (ie on NAL)	PBC		Procure		SSBC#				AEE / NOR								Design and Construction							
Crosstown Corridor																								
Avondale Southdown Corridor including new stations & tie-ins	PBC		Procure		SSBC, Design##												Consenting, property acquisition, NoR lapse date extended							
Onehunga connectivity study*			Procure*		Study																			
Western and Eastern Corridor																								
Level Xings West Inner and Mid, Glen Innes - Group 3 including connected station upgrade	LX SSBC Groups 2-5		Procure		AEE / NOR								Scope/Procur		Consents, Property Acquisition, Design								Construction	
Level Xings Outer West - Group 4 including connected station upgrades													Designations secured. Timing for consenting, property acquisition, construction to fit funding availability and demand triggers											
Station upgrades - Western and Eastern	PBC		Procure		SSBC#				AEE / NOR						Procure		Design and Construction							
Depot Stabling (East,West)	PBC		Procure		SSBC**				AEE / NOR				Procure		Consents, Property Acquisition, Design						Construction			
EMU																								
EMU Fleet (inc. Driver assist) - linked to depot and stabling	PBC		Scope/Procur		SSBC**				Scope / procure								Staged construction and delivery							
Signalling, Telecoms and Network Control																								
ETCS Level 2	PBC		Procur	DBC							Procure		Implementation											
Traction power and OLE																								
Sectioning, Power study, Power feed	PBC		Studies** / Procure			DBCs###					Procure		Implementation											
Maintenance plant, depots/satellite, sidings																								
First decade productivity priorities (plant, equipment, depot/satellites)	PBC		Procure		DBCs ###				Procure		Build and Deliver													
Renewals (Catch up renewals network completion)	Procure		DBC		Continuous renewals programme																			

*Study timing ideally has certainty around Light Rail decisions.
** Within one SSBC. Note interdependency to be managed with power study and approach to depot backup power feeds
# Within one SSBC
Extent of design will be influenced by ALR.
If Southern requirements confirmed in W-Pukekohe alignment, interdependencies with Group 1 to be managed

Figure 0-9: Indicative project phasing and approach– Auckland Rail Network Recommended Programme

RECOMMENDATIONS AND APPROVALS SOUGHT

The Auckland Rail Network PBC seeks the following support from the KiwiRail, Auckland Transport and Waka Kotahi Boards:

- Endorsement of the PBC including the recommended 30-year Auckland rail network investment programme.

It is recommended that the 30-year Auckland rail network investment programme is endorsed at this time because:

- Extensive analysis and strategic guidance have confirmed the robustness of the approach to the base case and scenario projections for freight, metro, and inter-regional passenger services. Therefore, there is confidence that the recommended investments will be required in the long-term.
- Rail infrastructure has long lead times and takes many years to deliver. Planning needs to begin in the short-term to ensure that the future rail network can be implemented when required and the infrastructure pipeline managed. This planned approach is necessary to support better infrastructure outcomes and the achievement of emissions reduction, mode shift, land-use integration, and accessibility goals. The alternative is disconnected, reactive infrastructure improvements that lag demand and do not meet the level of service expectations of rail customers.
- An endorsed 30-year Auckland rail network investment programme provides increased certainty for owner organisations, investors, affected landowners and other key stakeholders. It also allows for opportunities to integrate more efficiently with other transport projects and to attract and extract value from better planned adjacent development.
- Next steps:
- No funding is requested for the remainder of the 2021-24 National Land Transport Programme (NLTP) and no funding approvals are being sought as part of the endorsement of the PBC.
- KiwiRail and Auckland Transport have submitted cashflows for the next phases of the strategic rail programme through the draft 2024-33 Rail Network Improvement Programme (RNIP) and Regional Land Transport Programme (RLTP) respectively. This is a necessary step for inclusion in the 2024-27 NLTP.
- Funding would be sought during the 2024-27 NLTP period for next stage business cases and early investment priorities. Standard KiwiRail, Auckland Transport, and Waka Kotahi processes, such as Point of Entry submission, would be followed prior to seeking funding approvals.

TABLE OF CONTENTS

APPENDICES

FIGURE

TABLES

1 INTRODUCTION

1.1 BACKGROUND

Railways are a climate-friendly and efficient way to move people and freight. They are a clean and compact way to move millions of passengers and millions of tons of goods across cities, regions, countries, and continents., thereby offering a route to sustainable growth.

Historically, New Zealand developed and grew around the rail network with goods and services being transported between ports and cities, and more recently within our largest cities. Currently, cities across Aotearoa are growing faster than ever before and this is particularly evident in Auckland where Auckland Council have been releasing additional planning capacity[16] and have set a clear direction of growth for the next three decades. This direction will enable an unprecedented greenfield expansion of the city mainly towards the north-west and the south. Combined with other brownfield and inner-city densification allowances this has resulted in infrastructure providers scrambling to stay relevant and keep up.

Urban growth is not only limited to Auckland; similar trends also exist in other major cities across New Zealand, albeit at different scales. Housing demand, compounded by aging infrastructure and the lack of investment over many decades has widened the funding gap and Auckland has become the epicentre of development pressure and investment.

Yet, over the last couple of decades, rail has constituted a shrinking share of our transport solution, mainly as the railway service was uncompetitive and poorly integrated with other forms of transport. Yet, an efficient mixed-mode rail network can play a critical, catalytic, role for economic growth and development through stimulating trade, linking production sites to regional and international markets, promoting national and cross-border integration of regions, and facilitating access to jobs, education, and health services.

Rail transport provides a more energy efficient alternative to road or air transport. Investment in rail transport is therefore an important element of a low carbon transport strategy. Rail transport is also an energy efficient way to move high volumes of bulk commodities from centres of production, such as mining and agricultural areas, to ports and airports. Government has recognised the need to decarbonise our transport system in support of the increasing urgency of emissions reduction.

Responding to the New Zealand Government's commitment to the Paris Agreement, a legally binding United Nations Treaty[17], a core purpose of this Auckland Rail Network Programme Business Case (PBC) is to develop a programme that helps to reduce net carbon emissions from transport activities and support sustainable growth in Auckland by stimulating mode shift to rail for both freight and passenger services.

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[16] Auckland Plan 2050

[17] https://unfccc.int/process-and-meetings/the-paris-agreement

The **Auckland rail network**[18] is a mixed-use railway where passenger (metro and inter-regional) and freight services operate on the same tracks and must be timetabled to allow fair, reasonable, and safe access for all users. Investment in the rail network is required to address all markets.

There is an important relationship between the services, infrastructure, and performance of the rail network. Freight and passenger customers experience the services operating on the rail network every day. Services need the right level of well-maintained infrastructure to operate effectively. If the underlying infrastructure is poorly maintained and therefore unreliable, customers will experience a poor outcome and will not choose rail transport. This relationship is important in that issues or constraints within any one element (including maintenance faults) can contribute towards the perception that rail is a less attractive choice than private vehicles for passenger and freight travel.

As such, investment needs to move beyond just the traditional rail network, that being track, fleet and services, to encompass the full rail system. An appropriate maintenance and renewal programme, including associated depot, plant, and equipment, is essential to ensure the ongoing reliable operation of the rail system in Auckland.

1.2 PURPOSE

This PBC aims to:

- Seek agreement and support from Auckland Transport, KiwiRail and Waka Kotahi NZ Transport Agency (Waka Kotahi) on the strategic investment programme to 2051 for the Auckland rail network.
- Develop a justified and prioritised programme of interventions that best delivers the required changes over time to 2051.
- Support alignment with future Rail Network Investment Programmes (RNIPs) and underpin a joint investment programme.

1.3 PEER REVIEW

This PBC has been peer reviewed by Allard Transport and Management Consulting (ATMC). The peer reviewer was provided with drafts of each of the five cases within the PBC for review as they were prepared. Formal feedback was received from the peer reviewer and the project team incorporated the recommended changes (where appropriate) or provided a formal response through that process where necessary to address any misunderstandings.

The final peer review report (dated 5 October 2023) of the completed draft PBC identified a small number of residual recommended actions for consideration, primarily in the Executive Summary. All of those recommendations have been incorporated in the finalisation process of this document by the project team. This means that there are no outstanding items from the final peer review report and therefore no specific responses required throughout this PBC.

[18] The programme recommends investments to be implemented beyond 2025, following the completion of the City Rail Link (CRL)

2 STRATEGIC CASE

The Strategic Case outlines the existing state (infrastructure and services) of the Auckland rail network and identifies the desired strategic outcomes to guide the required investment in rail to 2051.

It assesses alignment with the policies, strategies, and plans of partners (KiwiRail and Auckland Transport) and stakeholders (including Waka Kotahi as the regulator and key funding provider). It also identifies and describes linked or dependent projects, and the main uncertainties that could influence the programme and benefits realisation.

2.1 THE AUCKLAND RAIL NETWORK

The Auckland network is a critical part of the wider national rail network. It comprises approximately 90km of rail corridor and 190km of track extending between Pukekohe and Swanson[19] and includes the following[20]:

- Network infrastructure to enable the running of trains including the track system, signalling and train control system, Overhead Line Electrification (OLE) and traction power system.
- Rail stations
- Level crossings
- Bridge and tunnel structures
- Rolling stock: Auckland Transport's electric multiple unit (EMU) fleet, plus rolling stock related infrastructure (e.g. stabling yards and the Wiri depot)
- Maintenance equipment and regimes

The whole rail system is underpinned by its maintenance regime and its ability to deliver and sustain high levels of reliability.

Figure 2-1 shows the Auckland rail network following the completion of CRL[21].

[19] Note this is the current extent of the Auckland electrified network, which is the focus for this PBC.

[20] Freight rolling stock (locomotives and wagons) and commercial freight operational areas (such as within Southdown terminal) are beyond the scope of this PBC.

[21] This PBC uses the CRL-enabled network as its base case.

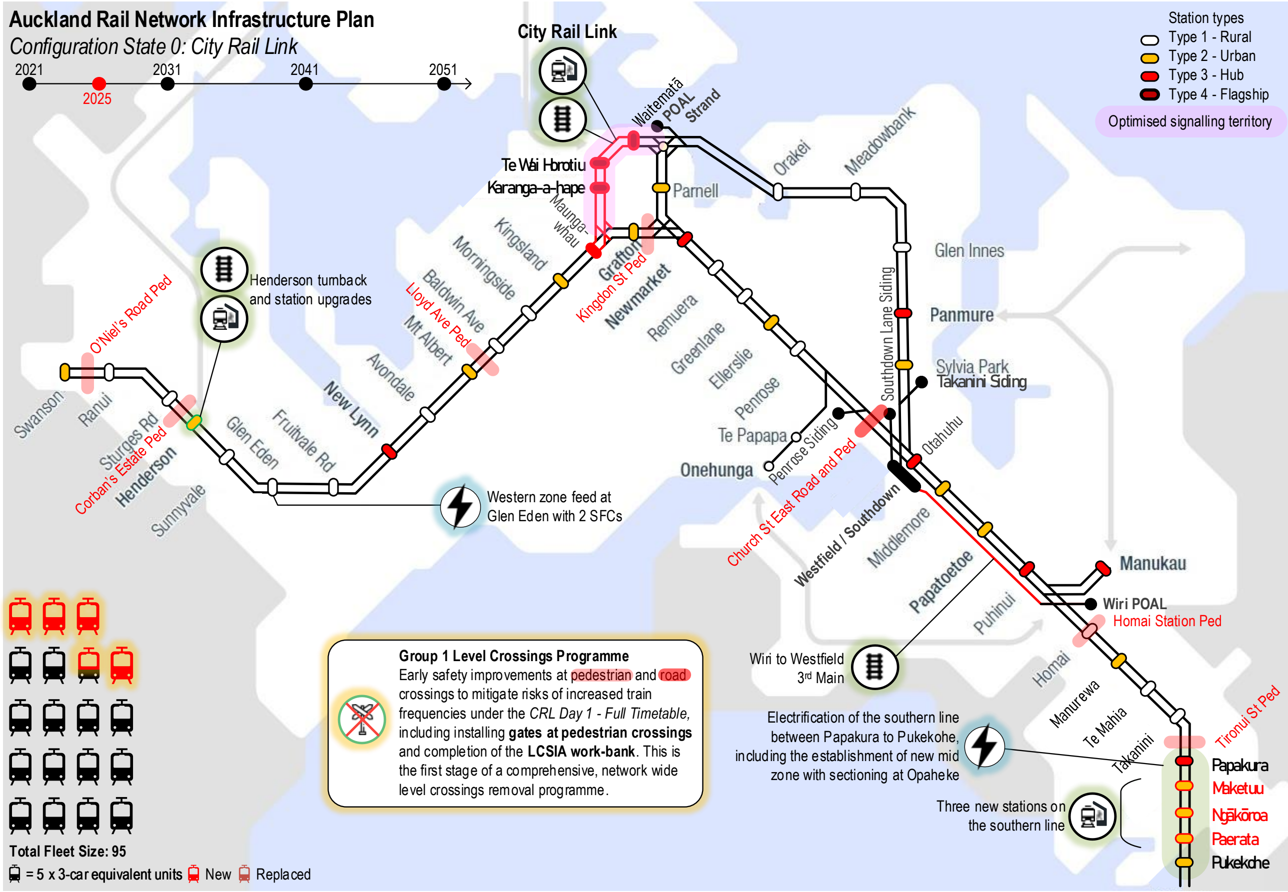

Figure 2-1: Auckland rail network (following completion of the CRL)

2.1.1 EXISTING NETWORK DESCRIPTION

This section provides a description of Auckland's rail network. It is broken down into the physical network (comprising both 'below track' infrastructure (e.g., tracks, signalling etc) and 'above track' assets (e.g., metro stations and rolling stock)). It acknowledges that the infrastructure must accommodate the mixture of services that operate on it.

The post-CRL opening Auckland rail network is the base case for this PBC. All investments and improvements recommended in this PBC are in addition to pre-CRL investment. The descriptions below therefore treat CRL as existing.

2.1.1.1 PHYSICAL NETWORK

The Auckland rail network comprises approximately 90km of rail corridor and 190km of track. It is used by the three markets of freight, inter-regional and metro passenger services.

The network includes the following lines:

- North Island Main Trunk (NIMT) – connects Auckland to the Southern part of the North Island, and to the South Island via a roll-on/roll-off ferry connection across Cook Strait. Within Auckland, the NIMT connects Pukekohe in the south to Westfield Junction, where it diverts eastward to connect to the Ports of Auckland (POAL) and the junction at Quay Park. This corridor provides critical access for freight, and passenger services with the metro Southern and Eastern lines following portions of the corridor as well as the Te Huia and Northern Explorer inter-regional services, which terminate at The Strand Station in Quay Park.

- North Auckland Line (NAL) – connects Auckland to Northland, starting at Westfield Junction (where it meets the NIMT) and following the path of SH1 to Newmarket where it deviates westward to Swanson. The metro Southern and Western lines follow segments of this corridor (Western line services terminate at Swanson), and Northland freight trains travel along it from Westfield to Swanson and beyond to Northland.
- Onehunga Branch Line (OBL) – a branch line connecting the NAL at Penrose to Onehunga town centre. This line is used for passenger services only and unlike other lines, is primarily single tracked, which limits its capacity.
- Newmarket Branch Line (NBL) – connects the NAL and the NIMT between Newmarket and Quay Park. This segment of the network is an important link for the metro Southern, Western, and Onehunga services to access Britomart, however its use will change significantly on opening of the CRL.
- Manukau Branch Line (MBL) – a branch line connecting the NIMT at Wiri Junction (just south of Puhinui Station) to Manukau city centre. This branch line is currently the terminus of the metro Eastern line service that continues along the NIMT to Britomart.
- Glenbrook Branch Line (GBL) – a branch line connecting the NIMT at Paerātā Junction (just north of Pukekohe) to Glenbrook and Waiuku, for freight service to and from the Glenbrook Steel Mill. There is no Auckland metro passenger service on this line, but it is used by the Glenbrook vintage railway. It is not considered as part of this PBC.
- City Rail Link (CRL) – when complete, the CRL will connect the NAL at the redeveloped Maungawhau Station (Mt Eden) to Waitematā Station (Britomart) via twin 3.5km tunnels, adding two new stations (Karanga a Hape at Karangahape Road and Te Wai Horotiu at Aotea) that are being future proofed for 9-car trains. It removes the current terminus constraint at Britomart and is expected to be complete in 2024/25.

Other key physical features of the Auckland rail network, including committed investments to be in place by CRL opening, include:

- 33[22] vehicle level crossings and 9 pedestrian level crossings within the Auckland electrified rail network, with most of the vehicle level crossings being on the NAL between Newmarket and Swanson, OBL and NIMT south of Takanini.
- 41[23] metro passenger stations that are serviced by the four metro passenger services.
- Auckland Transport's fleet of 72 EMUs (with each unit being a 3-car train) that operate the metro passenger services in either 3-car or 6-car trains along the electrified portions of the network from Swanson in the west to Papakura in the south (extending to Pukekohe as part of the Papakura to Pukekohe electrification project (P2P)). These are maintained at the Wiri depot, with stabling around the network at Wiri, Quay Park, Henderson, and Papakura. A further 23 units are currently being manufactured for delivery by CRL opening, which will take the fleet to 95 units (95x 3-car trains) in total.

[22] Assumes that Church Street East road crossing and 7 pedestrian crossings on the NAL and Southern Line are closed as required for CRL opening.

[23] The Strand station is excluded from this number as it services inter-regional passenger services only - Te Huia and Northern Explorer

- Auckland Transport's fleet of 10 diesel multiple units (DMUs) that operate the shuttle service between Pukekohe and Papakura were recently (July 2022) removed from service to allow for the Papakura to Pukekohe and Southern Stations projects, which are underway. A bus service will replace the DMU shuttle service until P2P is completed.
- Signalling for the network, except for Papakura to Pukekohe, is based on the European Train Control System (ETCS) Level 1 standard, a widely adopted standard for railway signalling systems. The system was brought in for the introduction of electrified services with traction power supply of 25kV AC. P2P includes upgrading the signals on that section to the ETCS Level 1 standard.
- Network Control, for rail traffic (freight and passenger) management and control of the various rail systems, is based in Wellington. There is a project underway to create a purpose-built facility in Auckland, the Auckland Integrated Rail Management Centre (IRMC), that will combine signalling, network and station control within the Auckland area and improve national resilience (by having two control centres).
- There are two feeder stations that provide traction power for EMUs, located at Westfield and Penrose. A third feed will be in place for CRL day one (discussed below). There are four track sectioning cabins (TSCs) located around the network. These works are part of the Additional Western Power Feed Single-Stage Business Case (SSBC), which details these power feeds and are required as part of the implementation for CRL.
- KiwiRail own and manage the freight rolling stock (locomotives and wagons) nationally and within Auckland utilise the Auckland rail network for operating the various freight services (described below).
- The key freight facilities are at POAL Ltd, Southdown, Westfield, Otahuhu and Wiri POAL. There are also several rail connections to the Auckland rail network from commercial properties (e.g. Coca-Cola Amatil in Mt Wellington)
- Interregional trains operate primarily on the NIMT and terminate at The Strand station. There is no additional specific physical network infrastructure associated with these services.

2.1.1.2 COMMITTED IMPROVEMENTS

The most significant of committed Auckland rail network improvements (in addition to the CRL) are discussed below. Completion is expected (for all projects) in 2024 or 2025. These committed and funded improvements form the starting point for any investment programme recommended by this PBC and are included in the 'base case' of this PBC.

Auckland Metro Programme – This programme includes five major projects, representing some $1.5 billion of investment to ease network congestion, cater for southern growth and modernise the underlying track infrastructure to improve reliability and resilience and make the network ready for the CRL.[24] The five projects are:

1. Wiri to Quay Park (W2QP) – W2QP includes track reconfiguration in Quay Park to allow for better freight train movements to/from Ports of Auckland, junction reconfiguration at Westfield and Wiri and the addition of some sections of a third main line between Westfield and Wiri.

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[24] https://www.kiwirail.co.nz/what-we-do/projects/amp/

2 **Papakura to Pukekohe Electrification** – P2P extends network electrification south to Pukekohe to enable electrified services to start/finish in Pukekohe, removing the need for customers to interchange to the diesel shuttle service.

3 **Southern Stations** – Three new stations at Drury, Ngākōroa (Drury West) and Paerātā -are being delivered and funded by the NZ Upgrade Programme (NZUP).

4 **Rail Network Growth Impact Management (RNGIM) / Rail Network Rebuild (RNR)**[25] – This programme seeks to resolve historical under-investment and enable a programme of catch-up track renewal work across Auckland's network.[26] The RNR aims to improve the operation, resilience, and maintenance of the network in advance of CRL opening by addressing the 55 recommendations made in the High-Level Rail Infrastructure Review (HLRIR) undertaken by Auckland Transport and KiwiRail in 2019. RNR includes major track and formation replacement for old sections of track where there are currently speed restrictions for trains, and modernising equipment so it is less prone to failures that interrupt services. Initial funding of $184 million was secured from Waka Kotahi for the programme, which is currently in progress[27]. Early indications are that additional funding will be required to complete the entire programme.

5 **Western Power Feed** – An additional power feed on the Western line is being delivered to upgrade the overall traction power supply system (TPSS) in advance of CRL. The project consists of a new Vector feed from the Transpower substation at Hepburn Road, a double static frequency converter system at 337 West Coast Road, and an additional power feed at Glen Eden.

2.2 STRATEGIC CONTEXT

2.2.1 DECARBONISING NEW ZEALAND'S TRANSPORT SYSTEM

The global climate is getting warmer because of rising greenhouse gas emissions. Extreme weather events are becoming more severe and more common and sea levels are rising. To reduce these global and local risks, the New Zealand Government has committed to the Paris Agreement. In 2021, New Zealand confirmed its Nationally Determined Contribution (NDC) to reduce net greenhouse gas emissions to 50% below gross 2005 levels by 2030.[28]

In its Emissions Reduction Plan (ERP) the Government has set out its plans to meet this obligation. The Government is committed to four national transport targets in ERP:

1 Reduce total vehicle kilometres travelled (VKT) by the light fleet by 20% below projected growth levels, by 2035 through improved urban form and providing better travel options, particularly in our largest cities.

2 Increase zero-emissions vehicles to 30% of the light fleet by 2035.

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[25] For ease of public communication, the catch-up renewals / service disruption activities of the RNGIM programme has publicly been called the RNR.

[26] https://www.kiwirail.co.nz/what-we-do/projects/amp/auckland-work/

[27] Noting RNIGM is in progress but will not be fully delivered prior to the opening of CRL.

[28] https://unfccc.int/sites/default/files/NDC/2022-06/New%20Zealand%20NDC%20November%202021.pdf

3 Reduce emissions from freight transport by 35% by 2035.

4 Reduce the emissions intensity of transport fuel by 10% by 2035.

Targets 1 and 3 are most relevant for this PBC.

Regional targets are yet to be formalised, but the draft ERP targets for Auckland are:

1 8% reduction in VKT on the 2019 baseline.

2 29% reduction in VKT on the 2035 baseline.

There is an acknowledgement within the draft targets that the 2035 baseline is a 30% increase in VKT over the 2019 baseline.

Further to ERP, Auckland Council has adopted Te Tāruke-ā-Tāwhiri (Auckland's Climate Plan)[29], which sets out Auckland's long-term approach to climate change in response to the more frequent and extreme weather events the city is facing. It commits to reduce Auckland's transport emissions by 64% by 2030. The Transport Emissions Reduction Pathway (TERP)[30] provides direction that Auckland Council and Auckland Transport are required to follow in all their activities to achieve this target. Figure 2-2 summarises the TERP targets and benefits.

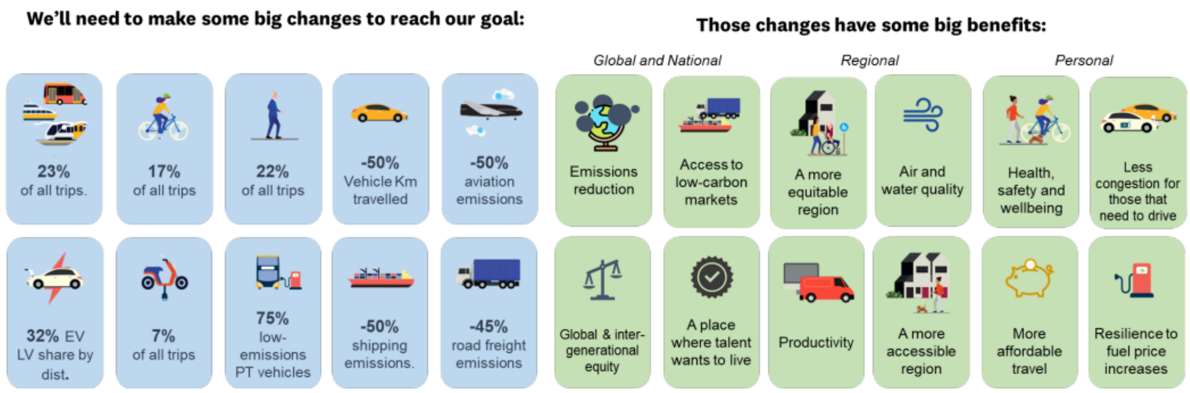

Figure 2-2: Auckland TERP – targets and benefits

Figure 2-3 shows the breakdown of Auckland's greenhouse gas emissions. The transport system accounts for just over 40% of Auckland's total emissions[31]. Within transport emissions, 95% come from road transport (almost 38% of Auckland's total emissions),[32] with rail's contribution being negligible (0.1% of total emissions).

[29] Te Tāruke-ā-Tāwhiri, Auckland Council, 2020

[30] Transport Emissions Reduction Pathway, Auckland Council 2020

[31] Auckland's Greenhouse gas emissions profile

[32] Transport Emissions Reduction Pathway, Auckland Council 2020

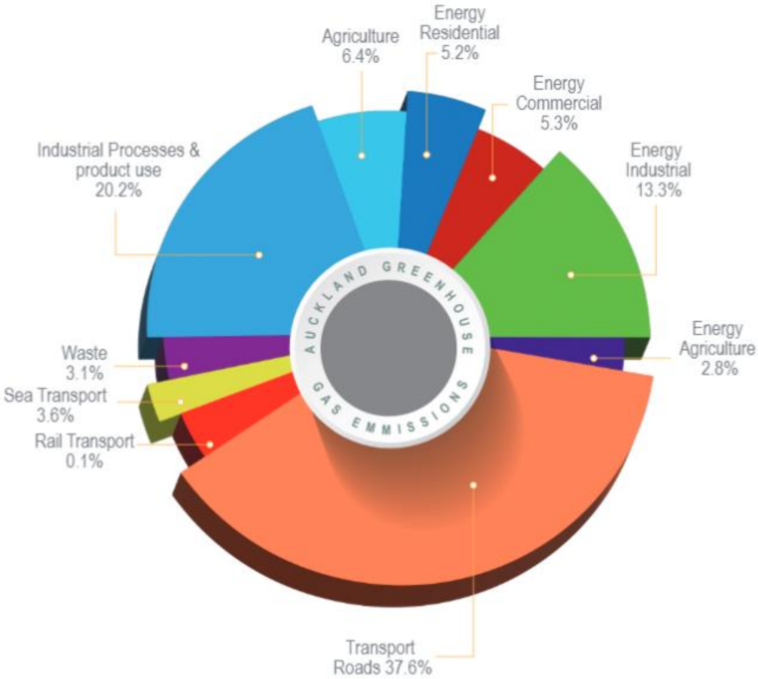

Figure 2-3: Auckland greenhouse gas emissions by market

The indicative Government Policy Statement on Land Transport 2024/2025 – 2033/34 (GPS 2024) elevates emissions reduction to become an overarching focus. This is to ensure that the implications for emissions reduction are a core consideration for all investment decisions.

2.2.1.1 DECARBONISING PASSENGER TRAVEL

The average occupancy of private vehicles in Auckland is 1.05[33], therefore, a single passenger rail service (3-car EMU) can carry the equivalent of 357 private vehicles and reduce CO_2 emissions by up to 1029kg[34], making a significant contribution to Auckland's emission reduction targets. This is shown in Figure 2-4.

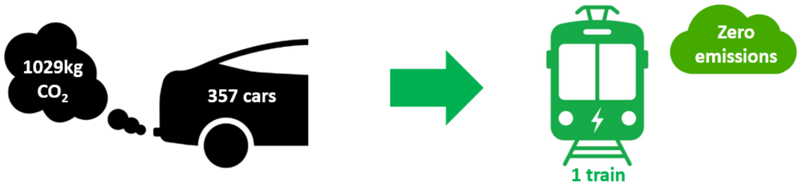

Figure 2-4: Public transport efficiency

Auckland has a current estimated population of 1.59 million people[35]. This population is projected to grow by 27% to 2.02 million by 2035. Employment is forecast to grow by 24% from 680,000 to 842,000 by 2035[36].

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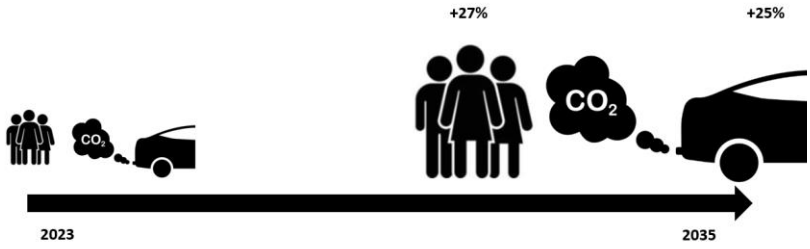
[33] Analysis of 2018 Census data. Travel to work and education in Auckland, Auckland Transport, October 2020.

[34] A full 3-car EMU carries 375 passengers (all seats and standing room occupied). This is divided by average vehicle occupancy of 1.05 to get to the equivalent number of private vehicles. The average rail journey is 16km, and vehicle emission rate is 0.18kg/km (2018 fleet statistics). 357 x 16 x 0.18 = 1,029kg CO_2

[35] 2018 Census.

[36] Household, employment, and population data for 2018, 2031, 2041, and 2051 is drawn from Auckland Council's land use scenario I11.6, the current agreed land use scenario for future planning purposes.

To meet emission reduction targets, and allow Auckland to grow in a sustainable way, the transport system must respond to this increase in travel demand by providing attractive incentives for customers to choose rail over higher-emission road-based travel. This is reinforced in ERP target 1.



Despite more recent and planned investment in active modes and PT that is forecast to deliver an increase of more than 120% in PT boardings, a **27%** increase in population is expected to drive a **25%** increase in VKT across the region by 2035[37].

To meet the ERP target for Auckland, acknowledging it remains in draft, VKT needs to reduce some 10% from current levels, despite a continuing period of growth in population.

Beyond these high-level draft ERP targets, no further breakdowns currently exist for Auckland (e.g., mode-specific targets). As part of the analysis undertaken in this PBC, a methodology has been developed to estimate the likely level of annual rail patronage that would be required if Auckland's draft ERP targets were achieved[38]. This process leads to an estimated target of:

- **86 million rail passenger boardings in 2035.**

This level of patronage results in some **1.4 billion passenger-km on rail**. In terms of rail's mode share of PT under ERP, this represents a:

- **23% mode share of PT by boardings**
- **40% mode share of PT by distance travelled.**

For comparison, there were approximately 22 million annual passenger boardings pre-COVID and the Rail Network Rebuild, so the estimated ERP target is four-fold increase in patronage by 2035 on pre-COVID levels.

Achieving this level of growth in patronage will require a substantial shift in passenger behaviour if passenger rail's share of the overall ERP target is to be met.

The targets set by TERP are much higher. Auckland Council estimates that there would need to some **550 million trips on PT** to achieve the TERP targets. Using the PT mode share methodology developed for this PBC, achieving TERP targets would require approximately **126 million rail passenger boardings** in 2030, a **47% increase over the ERP target**, also occurring five years earlier.

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[37] Note that this does not mean a 47% increase in CO_2 as it is assumed that the fleet will decarbonise over this timeframe.

[38] The methodology requires a number of assumptions to be made to ultimately estimate an overall target for PT boardings across the region. Beyond that, PT mode share is informed by several transport modelling scenarios. Different assumptions will lead to a different target for rail boardings being generated.

Modelling associated with TERP's development estimated that achieving the PT targets in TERP would require PT systems to operate at close to 100% capacity and at peak time frequencies across the whole day[39]. Were metro passenger services to increase to that level, it would consume all rail capacity leaving none for rail freight, which would in turn prevent the national freight mode shift and overall national transport emissions reduction targets being met. Hence, this level of emissions reduction, both in Auckland and nationally, is not achievable without investment to address capacity constraints in the Auckland rail network.

Addressing many of these capacity constraints will require considerable physical works that take time to plan, design, consent and deliver. This means there is considerable urgency to immediately proceed with the next steps to increase service and network capacity if the rail network is to make a meaningful contribution to Auckland's ERP targets (noting that these are 'lower and longer' than TERP).

2.2.1.2 DECARBONISING NEW ZEALAND'S FREIGHT SUPPLY CHAIN

Rail plays a key part in New Zealand's freight supply chain system and supports distribution of goods between key transport nodes. Rail brings economies of scale, enabling the efficient movement of large volumes of goods. It connects our ports and regions, allowing goods to reach international markets. This contributes to both national economic productivity and regional economic growth, supporting people, businesses, producers, and tourism.

Figure 2-5 shows the density of freight movement on New Zealand's rail network. It highlights that the freight corridors connecting to and from Auckland carry by far the greatest density of freight in the country: nearly half of all rail freight in New Zealand is on the 'golden triangle' Auckland-Hamilton-Tauranga, and a large amount also travels domestically between Auckland, Wellington, and Christchurch. This also means that Auckland plays a very significant role in New Zealand's freight supply chain – both for international imports and exports and domestically, and constraints in Auckland have wide impacts.

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[39] Transport Emissions Reduction Pathway, Auckland Council 2020

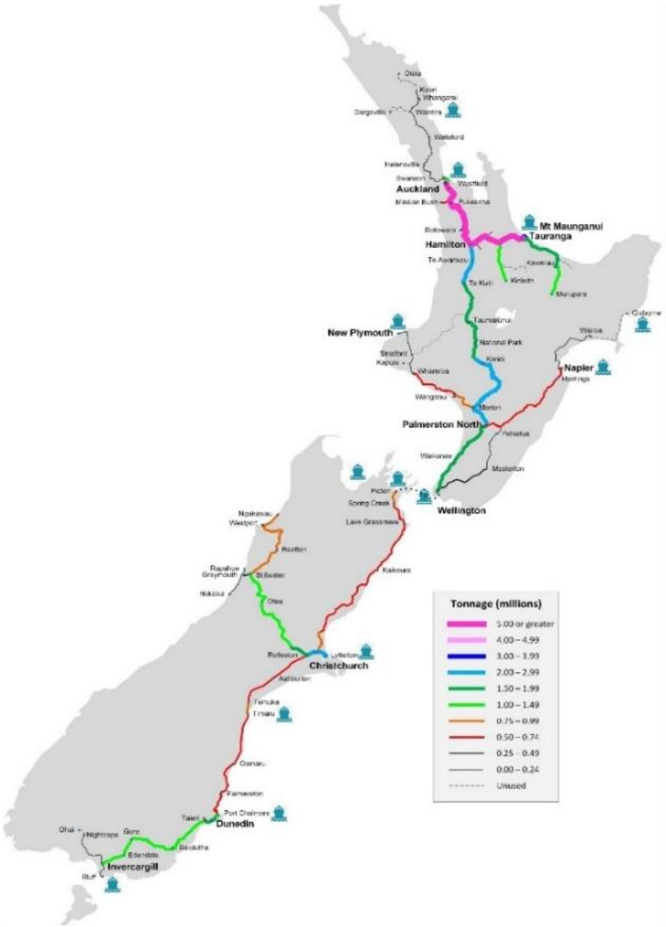

Figure 2-5: Density of freight movement on the New Zealand rail network[40]

To meet New Zealand's Paris Agreement NDC (and New Zealand's Emissions Reduction Plan targets), national emissions from freight transport need to reduce by 35% by 2035. In this context it is important to note that *rail freight is a national network connecting ports and cities.* If there is no slot for a freight train in Auckland (New Zealand's biggest freight market), that means that freight between Auckland and e.g., Tauranga or Christchurch must travel by road – effectively, a bottleneck in one location dictates to the wider national supply chain.

This matters because rail freight is significantly more emission-efficient than carriage by road, with every tonne of freight moved by rail today producing 70% less carbon emissions than the equivalent carried by road.[41] Furthermore, that carriage is long distance (i.e., determining freight emissions right across the country). A single 750m freight rail service carries a freight load equivalent to approximately 54 heavy trucks[42]. This is illustrated in Figure 2-6. KiwiRail currently operates seven such services per day in each direction between Auckland and Tauranga, approximately 209km. This equates to approximately 12% of the freight market between these locations. Were the equivalent freight task carried by road instead, this would require an additional 749 truck trips covering more than 155,000km on Auckland, Waikato, and Bay of Plenty roads every single day, along with the corresponding emission load on the environment.

[40] KiwiRail Decarbonisation Indicative Business Case, 2023

[41] NZ Rail Plan 2021

[42] Assumes 2 TEU (2x20' or 1x40' containers) per heavy truck. KiwiRail Metroport trains carry, per contract, 107 TEU. In the future, longer trains will carry even greater loads per journey.

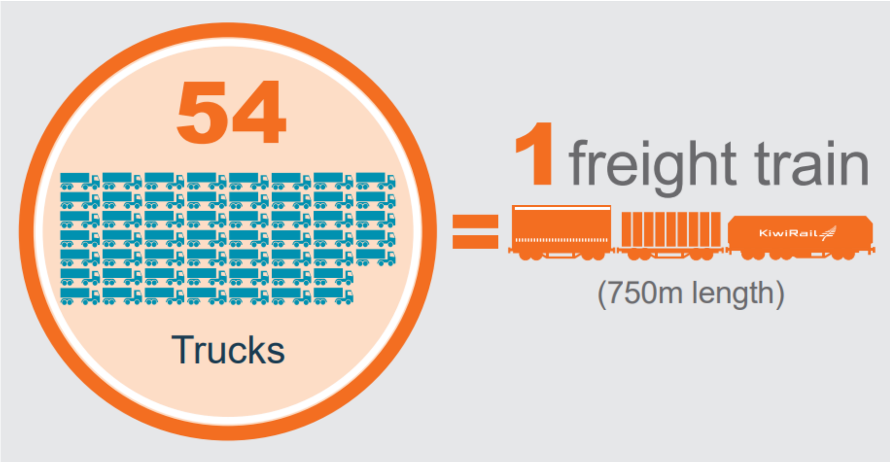

Figure 2-6: Rail freight efficiency

Since rail freight trips are typically over long distances, their potential contribution to reduce emissions is significant. KiwiRail's modelling as part of its Decarbonisation Indicative Business Case (IBC) indicates that some 460,000 tonnes of carbon would be avoided if 21% of the (rail accessible) national freight task in 2035 was carried by rail rather than road (up from the 13% currently). This amount of carbon is equivalent to 4% of New Zealand's current **total transport CO_2 emissions**.[43] This implies that the potential for emissions reduction that could be achieved by rail freight is extremely significant.

Rail freight is therefore a national and inter-regional story rather than a local one, and the ability for freight to access rail in one location affects its ability to serve a much wider national catchment.

Despite an industry shift to decarbonise freight (both road and rail) through fleet changes - for example KiwiRail plans to introduce battery electric locomotives progressively from 2027 to 2041[44] - substantial increases in mode share for freight moved by rail will be needed to help achieve the Government's 35% target reduction in New Zealand's freight emissions.

2.2.1.2.1 THE FREIGHT TASK IS GROWING AND THE POTENTIAL FOR EMISSIONS REDUCTION IS HIGH

Approximately 130 freight trains per day operate on KiwiRail's 3500km national network[45], transporting import-export freight to and from major ports, domestic freight between major cities and bulk commodities for processing or export, such as logs, dairy products, steel, and coal.

Not all freight markets across New Zealand are accessible to rail. For example, rail is not suited to competing with couriers to carry packages across town (first mile, last mile services) and it cannot provide services where there are no rail tracks. Rail is best suited to carrying freight over longer distances, between regions, or to carrying larger volumes over shorter distances, such as between seaports and inland freight distribution centres. These kinds of movements make up the addressable market for rail freight in New Zealand, and for the purposes of this PBC it has been assumed that the growth of rail freight occurs only in markets where these services already exist.

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[43] https://www.stats.govt.nz/indicators/new-zealands-greenhouse-gas-emissions and https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/transport/.

[44] KiwiRail Decarbonisation IBC, 2022.

[45] https://www.kiwirail.co.nz/what-we-do/freight/.

The transport sector's total contribution to greenhouse gas emissions is documented in the Ministry of Transport's Green Freight Strategic Working Paper (2020), which projects that trucks will overtake cars and account for the largest share of greenhouse emissions in coming decades.

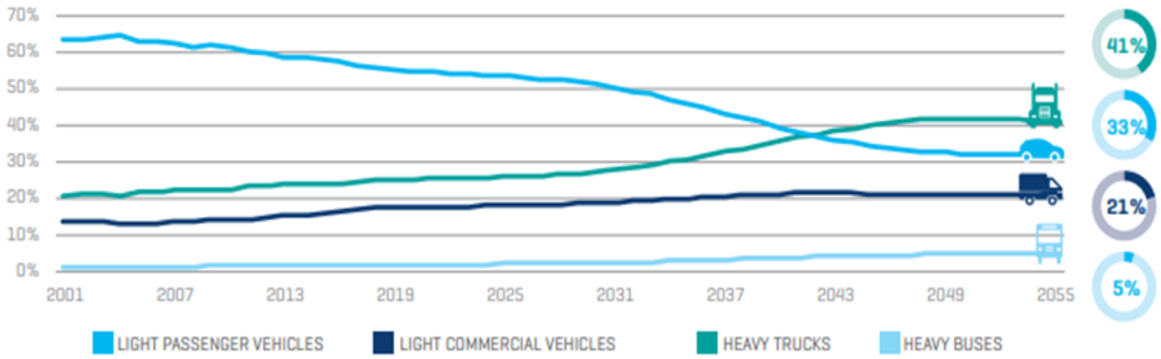

Figure 2-7: Projected percentage of emissions from road transport

KiwiRail data shows that in 2020/21 298 million tonnes of freight moved around the country, leading to approximately 28 billion tonne-km (net tonne km (NTK)) of goods moved nationally. Of the total national freight task, rail moved:

- 5% of freight tonnage
- 13% of freight NTK

For freight with origins or destinations in Auckland, rail carries 6% by weight and 17% by NTK. Increasing rail's share of the freight task above these current levels presents an opportunity to remove the equivalent number of heavy vehicles from the national road network. Modelling for KiwiRail's concurrent Decarbonisation IBC indicates that the potential for mode shift from road to rail is high.

In the Auckland context, the Decarbonisation IBC estimates mode shift in its B1 Scenario (which is the base case for this PBC) to 26% (NTK) of the addressable Auckland freight market (i.e., freight that already exists but travels by road alongside existing rail services and is suitable to be carried by rail[46]). In 2051, the equivalent of 3,780 heavy truck trips *daily* could instead travel by 35 rail journeys between the ports of Auckland and Tauranga[47]. The opportunity to reduce NTK by road increases even further when longer distances are involved – for example between Auckland and South Island destinations. This will consequently make a significant contribution to the national 35% freight emissions reduction target.

This level of mode shift will require a significant increase in freight train volumes and can only be achieved with adequate and right-timed access to the rail network. To be efficient, longer freight trains (up to 1,500m) are expected to be required in the early 2030s to meet forecast demand.

Nationally since 2019, Government has invested more than $8.5bn in KiwiRail and the national rail network, including investments in freight locomotives and wagons as well as infrastructure improvements aimed at restoring and enabling the growth of rail freight, as well as metro services.

[46] This mode shift is predicated on a scenario that assumes funding for KiwiRail initiatives, but no significant changes to Government policies. With policy changes, mode share of around 31% of addressable market is expected to be achievable.

[47] There would be fewer rail journeys using longer trains, but for comparative purposes train length has been held at 750m.

However, further investment is required to accommodate the level of demand required to meet these emission reduction targets.

2.2.2 AUCKLAND'S URBAN FORM CONTRIBUTES TO HIGH ROAD TRANSPORT DEPENDENCY

A core purpose of this PBC is to develop a programme that reduces net carbon emissions from transport activities to achieve sustainable growth in Auckland by stimulating mode shift to rail for both freight and passenger services.

Auckland is set to grow by 47% to 2.33 million people by 2051. To meet its emission reduction and housing supply targets, Auckland must grow in a sustainable way and travel behaviours for people and goods will be required to undergo a substantial shift away from higher-emission road-based travel and toward lower emission modes such as rail. The location of growth is important in determining the efficiency with which the transport system can cater for people's travel needs in the future.

A combination of Auckland's geography and historical transport and land-use decisions has greatly influenced current travel behaviour. Major decision-making in the 1950s centred Auckland's transport system around a network of motorways, rather than an emphasis on PT networks, fundamentally shaping the nature of urban development across the city. The development and expansion of the motorway network combined with New Zealand's preference for building detached houses on large plots of land has led to the rapid outward expansion of cities and the urban sprawl experienced today.[48]

These decisions have shaped Auckland's urban form, with the Auckland region being dominated by a pattern of lower density suburbs between Warkworth in the north and Pukekohe in the south. This spread in population and centres is shown in the extent of the Auckland boundary in Figure 2-8, with the urban areas shown within the black dashed lines (future urban areas are highlighted in yellow).

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[48] Auckland Regional Council, 2010

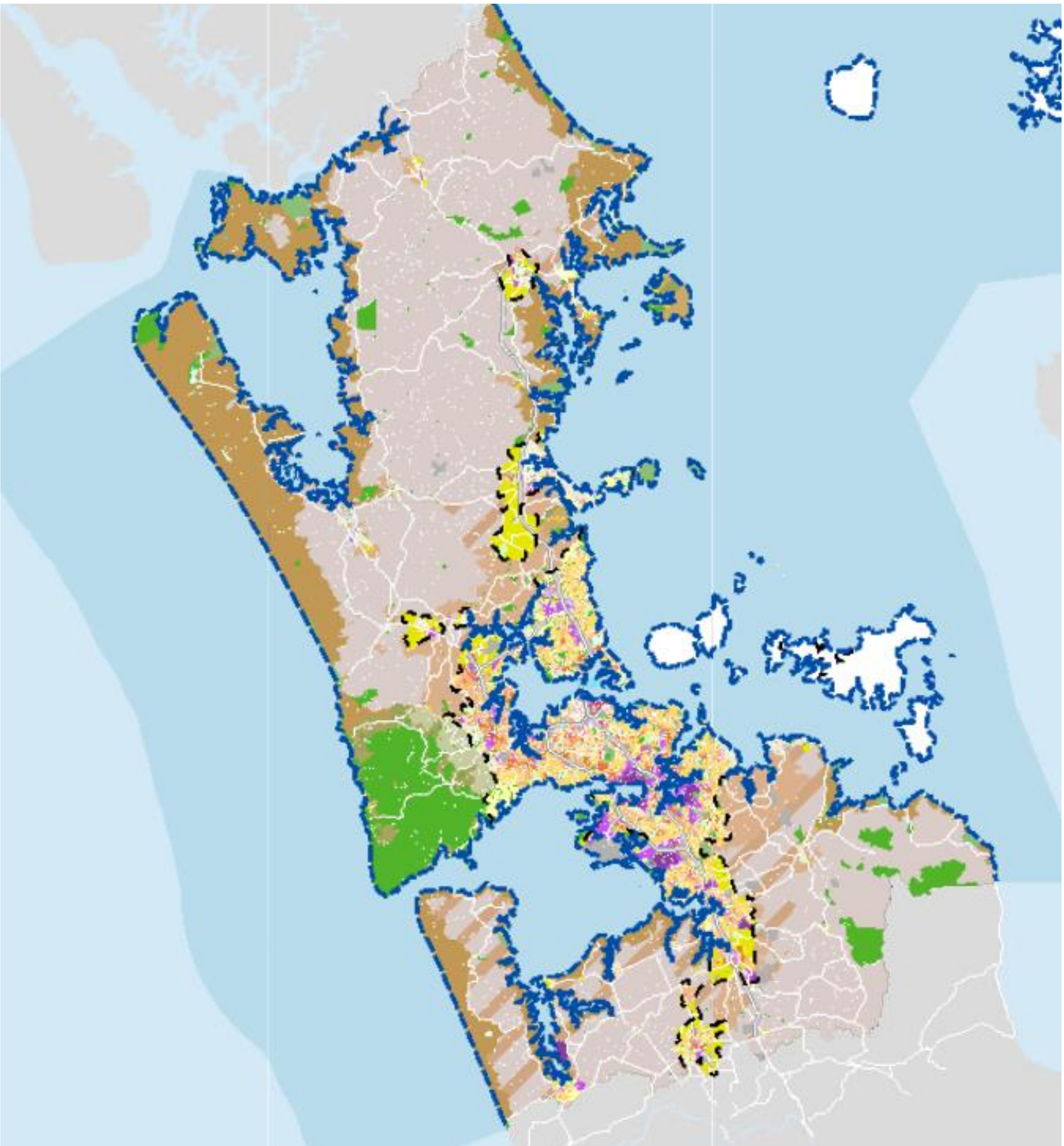

Figure 2-8: Auckland boundary[49]

This legacy of outward expansion into greenfield areas and the development of many satellite suburbs, combined with relatively little past investment in multi-modal networks (e.g. PT, walking, and cycling) has resulted in some of the highest rates of car ownership in the world (0.76 vehicles per capita[50], with 93.6% of households having 1 or more vehicles[51]) and a corresponding high dependence on, and preference for, private vehicle travel (94% of trips (by distance) were made by

[49] Source: Auckland Unitary Plan

[50] https://www.ehinz.ac.nz/indicators/transport/motor-vehicles-2/

[51] https://figure.nz/chart/ip6SOAB4VnTQVOuQ

car, 4% by PT and 2% by active modes, with heavy rail accounting for 20% of PT boardings in 2018 (Pre-Covid)).

Rail is well-placed to support mode shift for some of these greenfield areas through existing corridors and land ownership. This is particularly prominent in the south, where committed projects include three new stations and electrification of the line between Papakura and Pukekohe. However, given the distance and travel time from these greenfield areas to the city centre, express services are an opportunity to provide an attractive alternative to car travel.

Additionally, Auckland's urban area is shaped by natural features such as its harbours, central isthmus, maunga and beaches, and large areas of rural land that help define the character and attractiveness of the region, but also notably constrain development locations and accessibility.

Physical pinch points, including where the isthmus is narrowest, add significant constraints and complexity to land-use development and expansion of the transport network. In addition, the flow of people, goods and services becomes more complex due to the limited alternative access points caused by these geographic restrictions. This means Auckland's road-centric transport system is significantly constrained.

Future improvements to the transport network now prioritise a more balanced, less road-centric investment approach, acknowledging the historical underinvestment in public and active transport networks.

Auckland's geography also constrains freight movements. Auckland is one of the largest and busiest seaports in New Zealand and serves as a key gateway for goods arriving at and departing from New Zealand, making it a critical component of the country's import and export industries. The central city location of Ports of Auckland means that it has limited space for expansion and is constrained by transport infrastructure, which can result in congestion and delays in moving freight in and out of the port. Therefore, substantial volumes of freight traffic are required to travel through the city centre, competing for space with passengers and other users on already congested rail and road corridors.

Currently, only 12% (approximately 100,000 TEU[52] per annum) of Ports of Auckland volumes moves by rail. Ports of Auckland have asked for this to increase to 30%, or around 250,000 TEU. However, doing so would require right timed, and reliable access for freight trains on the Auckland rail network. In context, carrying 100,000 TEU by road requires 50,000 truck trips capable of carrying two 20' containers (or a higher number of trucks, if only one container can be carried). If the increase to 30% could be achieved, an additional 75,000 truck trips (150,000 TEU) could be removed from the Auckland Road network each year and will have scaled-up impacts nationally as the mode by which freight leaves the port is more likely to carry to final destination (e.g., Tauranga, Wellington, etc) than to incur double-handling costs by switching modes later.

Land use policy and controls are beginning to respond to the need for transport and land use to be better integrated to improve the efficiency of both systems. The National Policy Statement on Urban Development 2020 (NPS-UD) provides for considerably more capacity around the rapid transit network (RTN), focused on increasing development capacity for housing within RTN station catchments. The Manukau Central area is a particular area of opportunity for intensification, given its location in proximity to Manukau station. This is positive for rail's mode share; in that it will concentrate a greater proportion of growth into rail's immediate catchment. At the same time,

[52] TEU is a twenty-foot equivalent unit, meaning one 20' container of freight.

care should be taken to ensure housing development accounts for potential expansion of the rail corridor to accommodate long-term demand.

Well designed, attractive stations, connected to a reliable, frequent rail system will encourage higher density developments in station locations, encouraging walking and cycling and less car dependence.

In a future where rail will be required to undertake a greater proportion of Auckland's transport task, the intensification around the RTN corridors, and particularly at rail stations, is a positive step towards enabling that outcome.

2.2.3 MARKETS FOR AUCKLAND'S RAIL DEMAND

The rail network plays a key part in shaping Auckland and has national impacts for the connectivity of people, goods, and services. The rail network is utilised by three markets, all three of which are forecast to grow substantially over the next 30 years:

- **Metro passenger rail services**, connecting people to employment, education, and leisure activities within the Auckland region.
- **Rail freight services**, transporting freight goods via rail into, out of, within and through Auckland.
- **Inter-regional passenger and tourist services**, connecting Auckland to other parts of New Zealand.

2.2.3.1 METRO PASSENGER DEMAND

Rapid transit is an important part of Auckland's PT network. It provides fast, frequent, and high-capacity services along corridors that are separated from general traffic and therefore not affected by road congestion.[53] The attractiveness of the rapid transit network is critical to Auckland's ability to continue to grow while reducing vehicle emissions.

Auckland's rapid transit network utilises a range of modes and connections to achieve wide network coverage. Mode allocation is based on customer types, forecast demands and location context. Rail has the highest capacity of all rapid transit modes and is used as a spine to convey high volumes to and from the highest demand locations. The influence and interdependency from an urban development point of view is discussed in Section 6.7 below.

Rail is particularly attractive for longer distance travel, such as from growth areas in southern Auckland where longer car trips contribute to already significant congestion on the Southern Motorway and associated high vehicle emissions.

Over the last 10 years, investment in rail electrification, new trains, track, and station upgrades led to approximately 22 million annual passenger trips by rail in 2020: by far the greatest proportion of rapid transit journeys in Auckland.

Figure 2-9 shows that Auckland passenger rail patronage increased by some 17 million annual passenger trips between 2008 and 2020.

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[53] Auckland Transport Rapid Transit Plan,

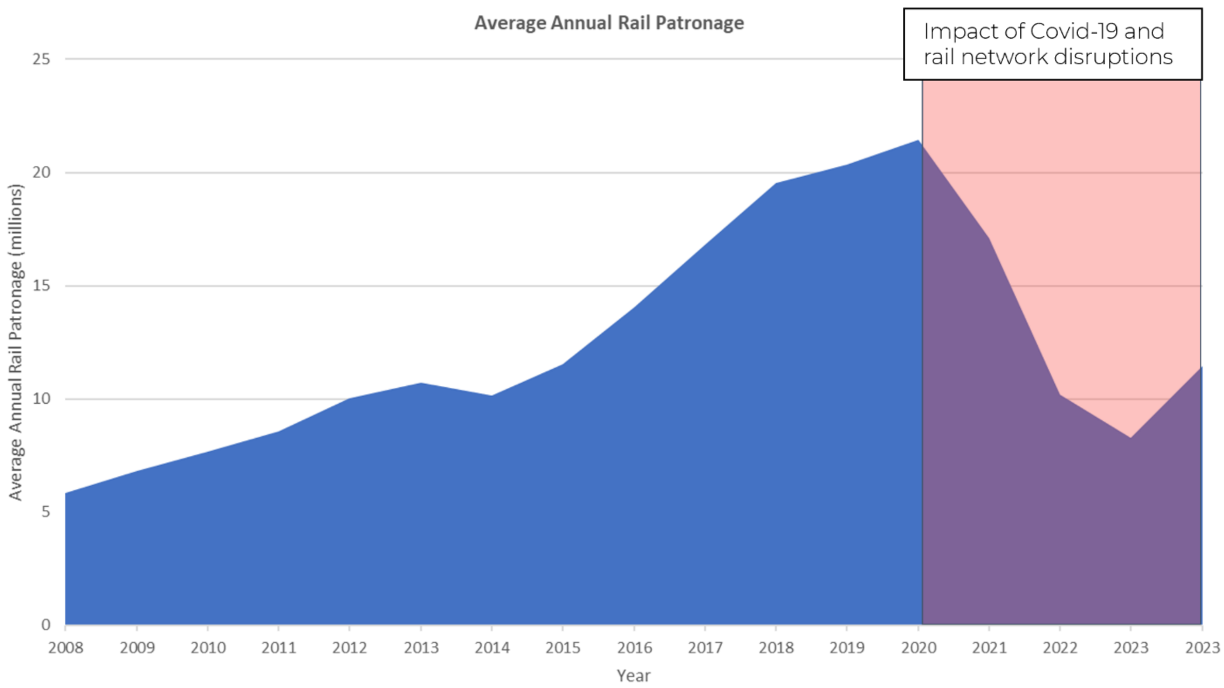

Figure 2-9: Auckland rolling annual passenger patronage (all rail lines)

Once CRL opens, nearly 35 million **weekday** trips per annum are expected on the rail network (pre-COVID estimates). Figure 2-10 shows that by 2051, this is forecast to increase to approximately **62 million weekday trips per annum**[54], more than double the rail boardings per capita, from 10.9 in 2018 to 26.7 in 2051. Figure 2-11 shows an expansion of weekday boardings to estimate total annual boardings for comparison to the weekday boarding totals, which are a standard transport modelling output. ERP (2035) and TERP (2030) estimated[55] rail boarding target lines are also added for comparison. In 2051, congestion charging (but not road pricing) is included in the Do Minimum (Do Min).

The base case forecast of 62m trips is unconstrained, to provide an estimate of the required target level of capacity and service. Unconstrained demand has been used to enable a move away from 'predict and provide', to achieve the scale of behaviour change required to make meaningful progress towards ERP and TERP targets.

To cater only for the Do Min level of demand would sell the programme short, and eventually require further iteration, as when the induced demand from proposed improvement eventuates, the Do Min network and services would perform poorly with high levels of crowding etc. Therefore, a higher 'unconstrained' base case has been used for planning and design to ensure that the 2051 system continues to function well. Monitoring plays an important role in this 30-Year programme, enabling the exact timing of each implementation phase to move relative to observed demand patterns.

For these demand levels to eventuate, there needs to be sufficient capacity available on metro passenger services to accommodate passengers and provide an adequate level of service so that those passengers continue to make an increasing number of journeys by rail. Service capacity will

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[54] MSM RefDM_TCQ_CS4SL, Auckland Forecasting Centre, 2023

[55] ERP and TERP do not specifically provide weekday boarding volumes. These have been interpolated from available data.

continue to be one of the major influences on the ability of the rail network to fulfil its transport task (and how attractive it is from a customer perspective).

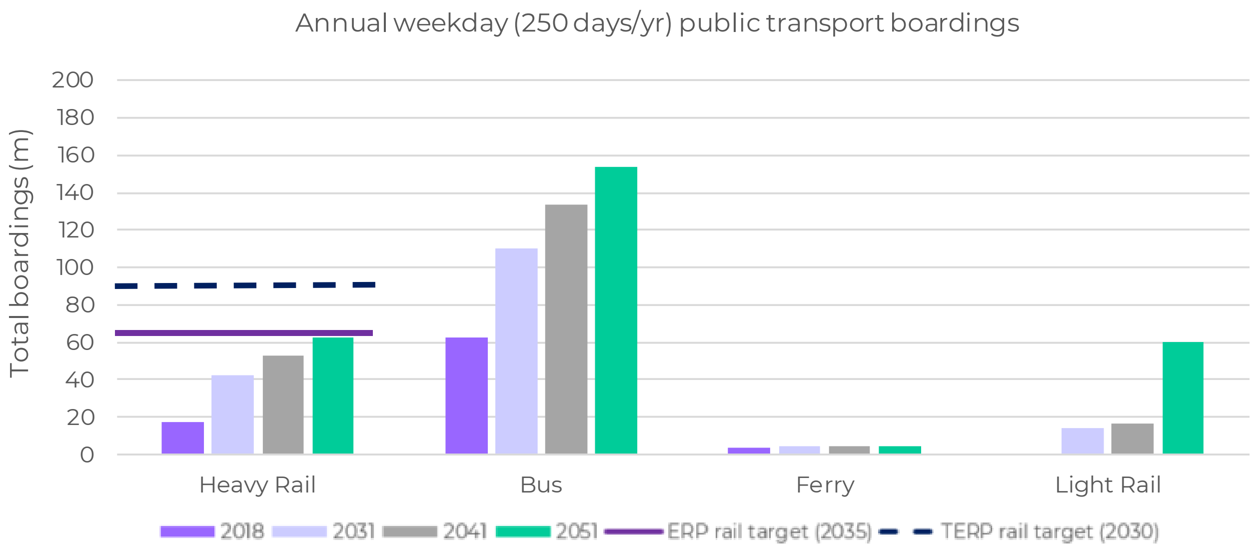

Figure 2-10: Annual estimated weekday boardings

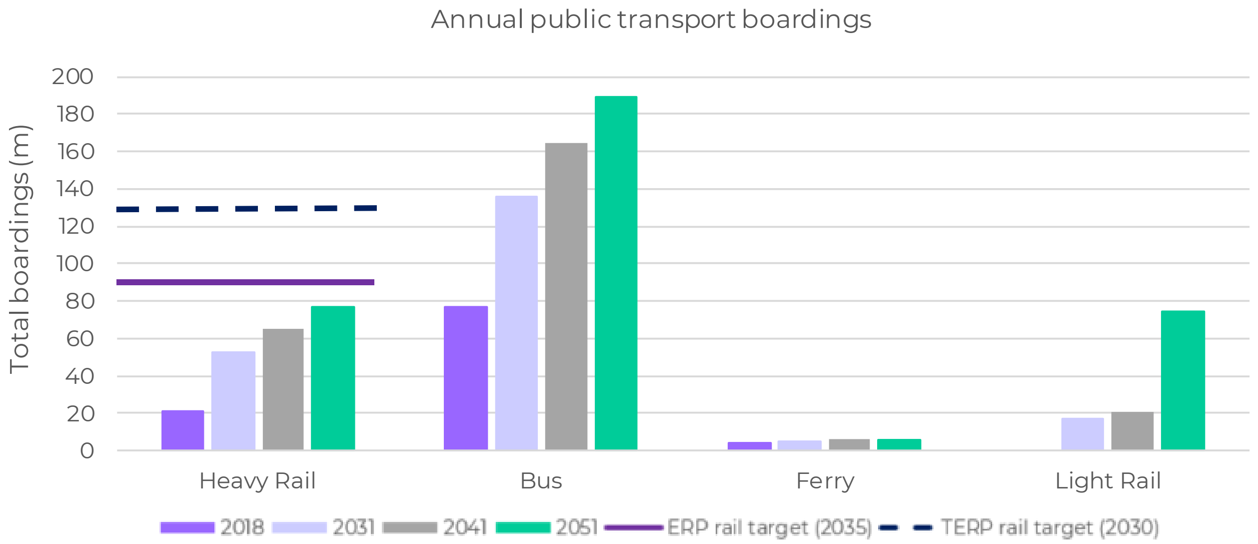

Figure 2-11: Annual estimated boardings overall (weekdays and weekends)

2.2.3.2 FREIGHT DEMAND

A functioning and efficient freight network is critical to the productivity of the nation's supply chain. The NZ Rail Plan 2021 identifies two rail investment priorities, and investing in rail in Auckland aligns with both:

- restore a resilient, reliable, and safe rail network for New Zealand over the next decade to restore rail freight and provide a platform for future investments for growth.
- invest in the metropolitan rail networks to support growth and productivity in our largest cities.

As NZ's biggest city, Auckland contributes to a large part of the national freight requirement. In 2020/21, Auckland accounted for nearly 33% of all freight (by tonnage). Of these 99 million tonnes, KiwiRail analysis indicates that some 5.7 million tonnes (approximately 6%) is moved by rail.

Movements between Auckland and Tauranga make up around 17% (by tonnage) of national freight flows[56], which highlights the critical importance of the Auckland rail network to the national rail freight task. Auckland's current rail freight network consists of the NIMT and the NAL.

In line with a growing population, the freight task in New Zealand has been growing steadily. The Ministry of Transport's freight model forecasts that freight tonnage in New Zealand will increase by almost 40 percent by 2052/53 from that in 2017/18. This will impact all transport modes, including rail, and the rail network needs to have sufficient capacity to accommodate forecast growth.

In absolute terms, Auckland will continue to experience New Zealand's highest population growth in the future, and it is therefore likely to generate the greatest increase in freight tonnage; an increase of some 40 million tonnes over 25 years, as shown below in Figure 2-12. This level of growth for Auckland will mean a considerable increase in freight flows on Auckland's rail network even if the rail freight mode share is static.

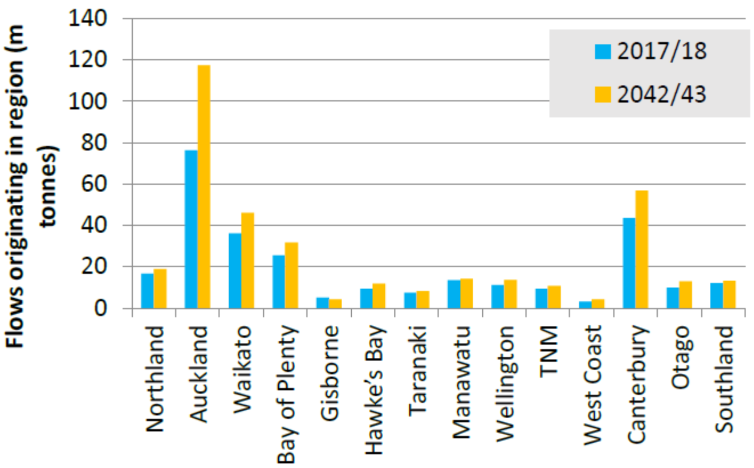

Figure 2-12 Freight tonnage forecast growth, by origin, 2017/18 – 2042/43[57]

A 2018 Productivity Commission report[58] on rail freight concludes that "if New Zealand is to achieve a worthwhile mode shift from road haulage, rail will need to offer significantly lower freight rates, faster delivery times and easier access to rail services – because without these freight customers will not consider using rail". This indicates that unless rail becomes much more productive, enabling it to offer competitive domestic freight rates, the desired level of mode shift is unlikely to be achievable. This means that the rail network must develop in a way that enables more freight to be moved on rail, more reliably.

At the highest level, demand for rail freight using the Auckland network will be a function of:

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[56] Source: Top Freight Flows by Tonnage KiwiRail Freight Data for Year Ending 30 June 2021

[57] Update of the National Freight Demands Study (2017/18), Ministry of Transport (MoT) Transport Knowledge Conference 2019, retrieved from https://www.knowledgehub.transport.govt.nz/assets/TKH-Uploads/TKC-2019/Update-of-the-National-Freight-Demands-Study_Paling.pdf

[58] https://www.productivity.govt.nz/assets/Submission-Documents/7c9fe0016d/Sub-002-Target-Railway-Progress-The-Role-of-Rail-in-NZ-Transport-Strategy.pdf

- national freight demands,
- the addressable market for import / exports,
- the relative competitiveness of rail vs road haulage for the addressable market, and
- the paths taken for North Island port import and export flows.

In terms of the long-term competitiveness of rail, there has been positive shifts. Nationally since 2019, Government has invested more than $8.5bn in KiwiRail and the national rail network, including investments in freight locomotives and wagons as well as infrastructure improvements aimed at restoring and enabling the growth of rail freight, as well as metro services. Support for rail is a present priority - in its 2023 Budget, Government has committed $569.2m[59] in KiwiRail. This includes $10 million funding to look in detail at how best to electrify more North Island rail lines – such as the Golden Triangle (Tauranga – Hamilton – Auckland), which carries around half of all rail freight in New Zealand. This recognises that further investment is required to accommodate the level of demand required to meet emission reduction targets and New Zealand Rail Plan priorities.

Yet on the other hand policy initiatives like the recent road user charge (RUC) subsidy (a COVID initiative) have provided a further subsidy to road haulage.

2.2.3.2.1 THE ROLE OF PORTS

Port policy and strategy is beyond the influence of the Auckland Rail PBC yet has profound effects on the demand for, and timing of, rail freight services both within Auckland and nationally. Accordingly, this PBC applies a scenario approach to reveal the extent of consequences of potential ports-driven futures on the rail network, recognising that the eventual outcome is likely to be somewhere in between.

The underlying freight demand projections in this PBC are based on the Ministry of Transport's 2017/18 freight demand model, which is continually updated.[60] The forecast has been overlaid with scenarios that consider different port futures and/or policy approaches that impact the rate of freight demand growth and modal share conversion from road to rail. A key differentiator between scenarios is the long-term role of POAL in New Zealand's supply chain. The scenarios set out the implications of potential decisions around the port and a continuation of the policy intent to support rail's role in emissions reduction.

Figure 2-13 summarises how a range of scenarios affect the upper North Island freight market and how variations in port activity drive rail freight demand patterns and the required rail network response. Table 2-1 sets out the highest-level implications of the scenarios for the Auckland network[61]. More detailed discussion of these scenarios is provided in Appendix C.

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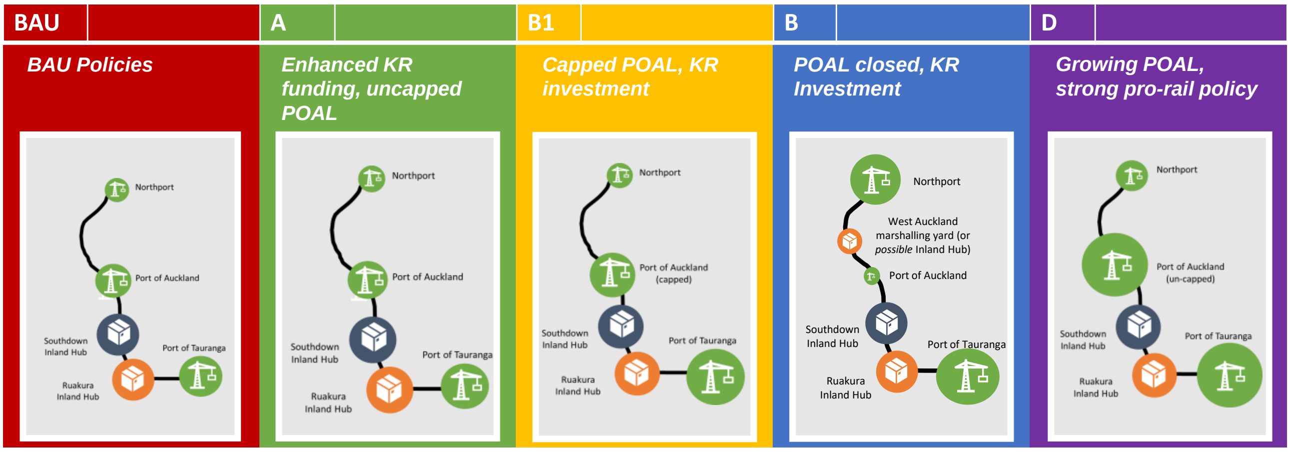
[59] The $569.2 million Budget investment includes $10 million to take further rail electrification in the North Island to a detailed business case stage, with initial design and engineering to scope the work, enabling funding on major decisions to be considered within this decade:

[60] This model built upon the Ministry of Transport 2017/2018 model and has continued to be updated with new information including consideration of the Auckland Port Relocation Study,

[61] The scenarios were developed outside of the PBC, as part of the Freight Decarbonisation DBC.



BAU: No cap on POAL, but no enhanced investment. Assumes Marsden link built

- Moderate- growth all lines
- No significant change to current distribution

A: Enhanced KiwiRail investment to support faster growth, but BAU for government policies

- Moderate+ growth all lines
- No significant change to current distribution

B1: POAL restricted and all growth goes south to Metroport:

- Big PoT & NIMT-S demand
- Med POAL & NIMT-E demand
- Modest Northport & NAL demand

B: POAL closed - volumes and growth split between Northport and PoT

- Big PoT and NIMT-S demand
- Big Northport and NAL demand
- Minor or nil NIMT-E demand.

D: Strong pro-rail policy drives higher national rail freight growth (but POAL uncapped is biggest driver in Auckland)

- Big POAL and POT
- Moderate NIMT-S demand
- Increased NIMT-E demand

Figure 2-13: Port scenarios summary

Table 2-1: Port Scenarios

IF	THEN	SCENARIO
Business as usual – plus known schemes / policy changes	Moderate growth, but no significant changes to distribution except plans to increase the share of containers moved on and off the port via rail. The rail network in Auckland will need to respond to increased demand on the Southern line (Western line demand comparable to today, uncapped POAL means resilience on Eastern line is needed to cope with potential increases)	BAU
Releasing constraints	At present rail is constrained by bottlenecks in its operations, as well as limits on track capacity. Scenario A assumes these constraints would largely be overcome, allowing rail to better compete for traffic nationally. POAL would be uncapped, and the Eastern and Southern lines will need to be resilient to growth.	A
Ports of Auckland capped at existing limits and Tauranga most successful competitor for “spilt” import / exports	Growth bound for POAL will spill predominantly to Tauranga, the rail network needs to provide for significant growth on the Southern line. The spilled volume is all assumed to travel on rail as it is uneconomic to travel on road between Auckland and Tauranga, adding to growth on the Southern line.	B1

IF	THEN	SCENARIO
Ports of Auckland closed	There is a fundamental shift in flows now needing to make their way to Auckland. The level of displaced volumes is so material there is likelihood that Tauranga and Northport will both change materially. The rail network needs be resilient to growth on the Southern line and from Northport to Southdown on the Western line.	B
Ports of Auckland's capacity is uncapped, and Government adopts "pro-rail" policies to encourage mode shift nationally	In this scenario POAL would need to increase its rail handling capacity to enable rail to play a bigger role than it does currently. Rail will need access to more pathways.	D

The current state constraints assessments and medium-term implications of Scenario B1 (POAL capped) is illustrated by Figure 2-14 below. Under Scenarios A & D, the graphic would look more congested, particularly on the Eastern line. Under Scenario B, if the POAL was closed, the graphic would look significantly more congested, North, and South.

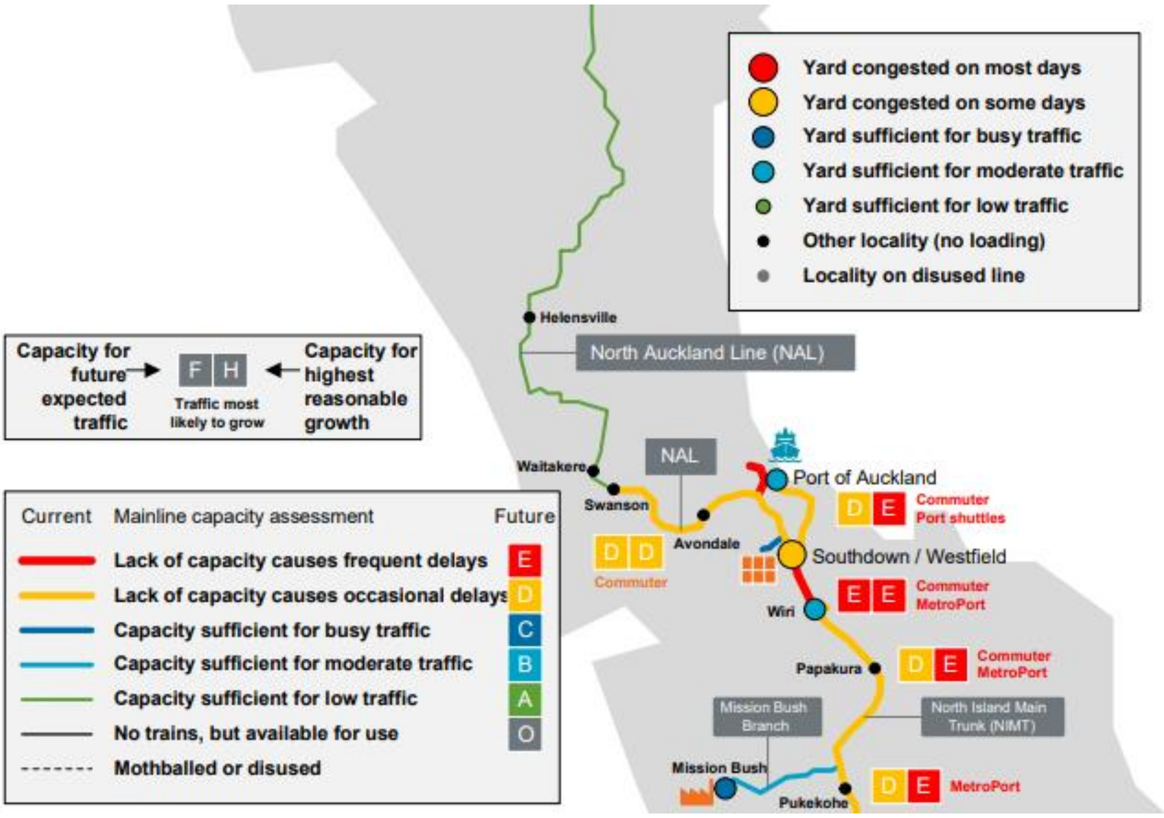


Figure 2-14: Rail capacity in the Auckland isthmus

In summary:

- Ports of Auckland is reaching the limits of growth and could potentially face some level of reduction,
- Metroport will continue to play a significant role, but will also reach limits over 30 years, and
- Northport's role will grow from its small base.

In this context, it is important that this PBC makes a reasonable assessment of how the long- term port capacity in the North Island will be serviced, and what that means for the future distribution of freight flows.

2.2.3.3 INTER-REGIONAL PASSENGER DEMAND

There are currently two inter-regional services that use the NIMT to connect into Auckland, as described in Table 2-2.

Table 2-2: Inter-regional services

NAME	ROUTE		DESCRIPTION
Te Huia – Hamilton to Auckland inter-regional service	Frankton (Hamilton) to The Strand (Auckland), stopping at Rotokauri, Huntly, Papakura and Puhinui	NIMT	Daily commuter service that consists of two Hamilton to Auckland services (one in the morning peak and one in the afternoon) and two Auckland to Hamilton services (one in the morning and one in the early evening). A Saturday service operates from Hamilton to Auckland in the morning and Auckland to Hamilton in the early evening. Journey time is approximately 150 mins (2.5 hours).
Northern Explorer – Auckland to Wellington	Auckland's The Strand Station and Wellington railway station, stopping at Paraparaumu, Palmerston North, Ohakune, National Park, Otorohanga (summer only), Hamilton and Papakura	NIMT	Long-distance passenger train operated by The Great Journeys of New Zealand division of KiwiRail. Three services operated per week in each direction.

Te Huia has been acknowledged as a key inter-regional PT project identified in the Waikato Regional Land Transport Plan and Regional Public Transport Plan, aiming to provide long-term efficient and reliable PT connections between Hamilton and Auckland. This service is currently operated as a five-year trial to run from 2019-2024, after which a long-term model is anticipated.

The service terminates at The Strand calling at Papakura and Puhinui within the Auckland rail network. Its business case identified that there would be significant connectivity benefits if it were able to operate instead to Newmarket (terminating) or to Britomart and this remains an aspiration.

The trial service was paused from September 2021 until April 2022 due to Covid. Despite this break in service, patronage is growing steadily.

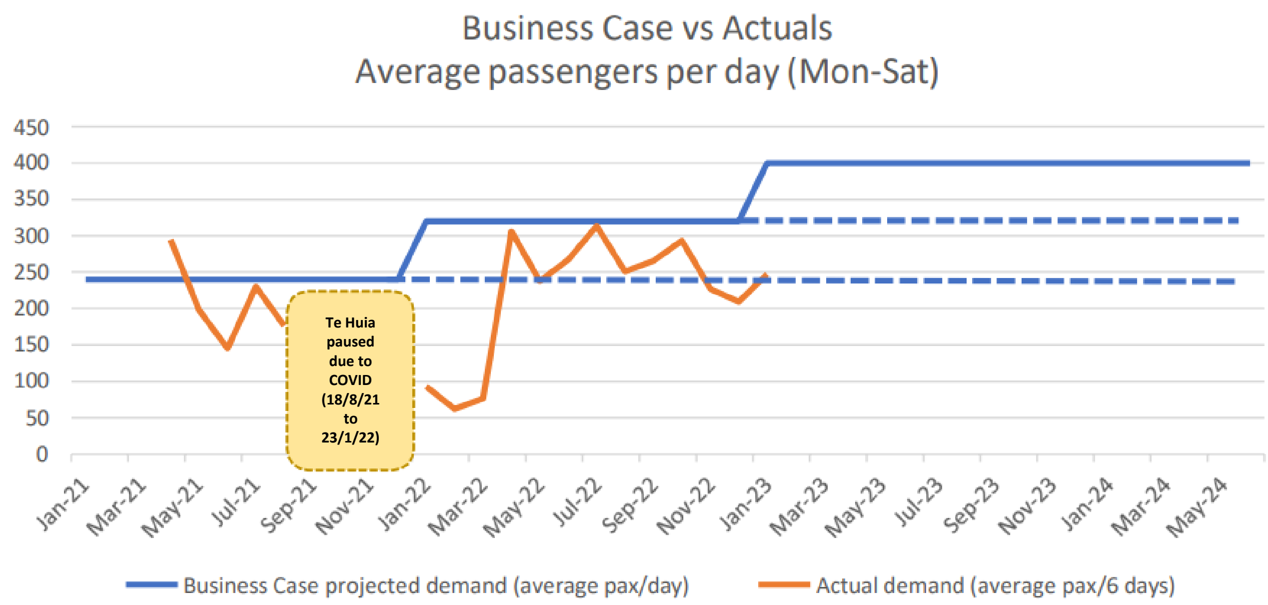


Figure 2-15: Te Huia patronage[62]

The Waikato Regional Transport Committee notes that Te Huia has achieved its' year one Business Case patronage targets (average of 250 passengers per day).

Consumer groups are advocating for a revival of regional services (once prolific in the country):

- particularly in the Golden Triangle linking Auckland, Hamilton, and Tauranga, with some aspirations of connecting to Whangārei,[63]
- overnight trains,[64] and
- consideration of regional passenger rail as alternatives to short length domestic air travel.

The results of the parliamentary enquiry into inter-regional passenger services in 2022 indicate that if this emerging market for regional services is to be grown, it will be important to:

- provide services that operate at appropriate times and frequencies to be attractive,
- make interchanging easy (including through more seamless ticketing) and transfer points to the RTN, and
- ensure the underlying service is comfortable and time competitive with the alternatives (private vehicle travel or air travel).

[62] Source: Waikato RTC
[63] https://www.railconference.info/blog/modern-passenger-rail-for-new-zealand-part 1-3
[64] Auckland to Wellington has been identified as an almost ideal distance/time travelled for night train operation.

2.2.3.4 OVERALL NETWORK DEMAND

As Auckland and New Zealand continue to grow over the next 30 years, freight and both inter-regional and metro passenger rail demand is expected to grow significantly and is required to do so if New Zealand is to meet its international emission reduction targets.

The subsequent sections of this PBC describe the challenges to accommodating this level of future demand. From CRL Day 1, the network is forecast to operate with very high network utilisation and limited redundancy. This will constrain its ability to accommodate future growth in any market. These capacity constraints will require trade-offs to be made between markets to the extent that no market can grow without trading-off capacity against another market.

2.3 PROBLEMS, BENEFITS, CONSTRAINTS AND OPPORTUNITIES

An Investment Logic Mapping (ILM) workshop was held on 10th March 2022 with Auckland Transport, KiwiRail, Auckland Council, and Waka Kotahi. Three problems (and weightings) were agreed by the project partners:

1. Constraints in the rail system mean that it cannot accommodate growth in travel demand for freight and passengers, leading to less efficient outcomes. (50% weighting)
2. Current customer levels of service for all markets are insufficiently attractive to drive the required increase in rail mode share, meaning emissions targets can't be met. (35% weighting)
3. Inadequate network maintenance and renewals is leading to increased network deterioration, reducing service reliability for all markets[65]. (15% weighting)

The ILM is outlined in Figure 2-16 and evidence supporting each problem is presented in the following sections.

[65] Problem 3 focus has evolved since 2022, and revised wording was agreed in March 2023.

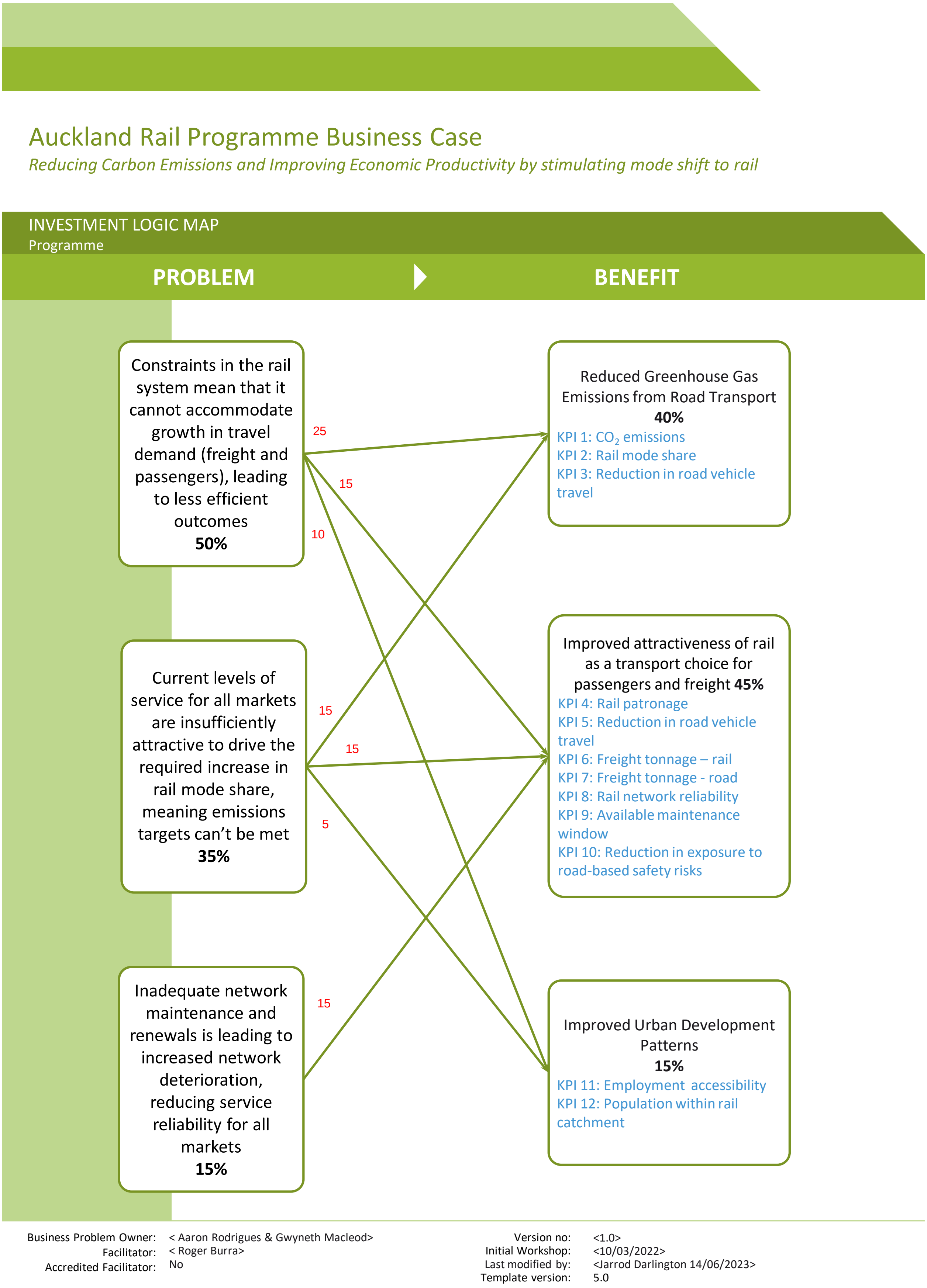


Figure 2-16: Auckland rail investment logic map

2.3.1 PROBLEM ONE – CAPACITY CONSTRAINTS

Constraints in the rail system mean that it cannot accommodate growth in travel demand for freight and passengers, leading to less efficient outcomes.

The evidence for Problem One is presented under three areas that contribute to system constraints:

- Physical infrastructure.
- Metro service capacity.
- Freight capacity.

2.3.1.1 PHYSICAL INFRASTRUCTURE CONSTRAINTS

Physical infrastructure constraints restrict the number or size of services that can be operated. Customers experience the effects of these constraints on their services (e.g. an overcrowded train or a wrong-timed freight slot), but the underlying cause is network infrastructure capacity.

Operating rail services with infrastructure constraints can result in:

- Service frequencies, operating times and/or train lengths cannot increase to accommodate growing patronage or freight demand, resulting in constrained growth and productivity.
- Available time slots for freight services are limited, resulting in more freight being carried by road, increasing Auckland and national transport emissions.
- Limited inter-regional service frequencies undermine the ability to provide a viable alternative to car (or air) travel for longer distance trips and are therefore less attractive for customers.
- Reduced service frequencies or operating times mean customers cannot travel when they need to.
- Lower frequencies and/or restricted train lengths cause crowding on existing services.
- Limited stop services (metro and inter-regional passenger) either cannot be operated or are constrained and therefore unable to achieve the journey time benefits that would attract customers for medium to long journeys (typically longer than 45 minutes for metro journeys)

The post-CRL Auckland rail network infrastructure capacity constraints are described below and summarised in Figure 2-17.

Physical system constraints are discussed at a component level, but the complex nature of the rail system means that overall network capacity is governed by the relationships between some of the components. For example, the current signalling system can accommodate 12 trains per hour per direction (tphpd) on the Western line, but in practice level crossings may restrict this to a lower train frequency due to safety mitigations.

The component that dictates overall system capacity can be thought of as the 'weakest link in a chain'. Once the capacity constraint associated with the critical component is addressed, a different component then governs overall system capacity, and so on. Post-CRL, other areas that will constrain capacity include level crossings, Southern line track and signalling constraints, flat junctions at Westfield, Wiri and Newmarket, fleet and stabling.

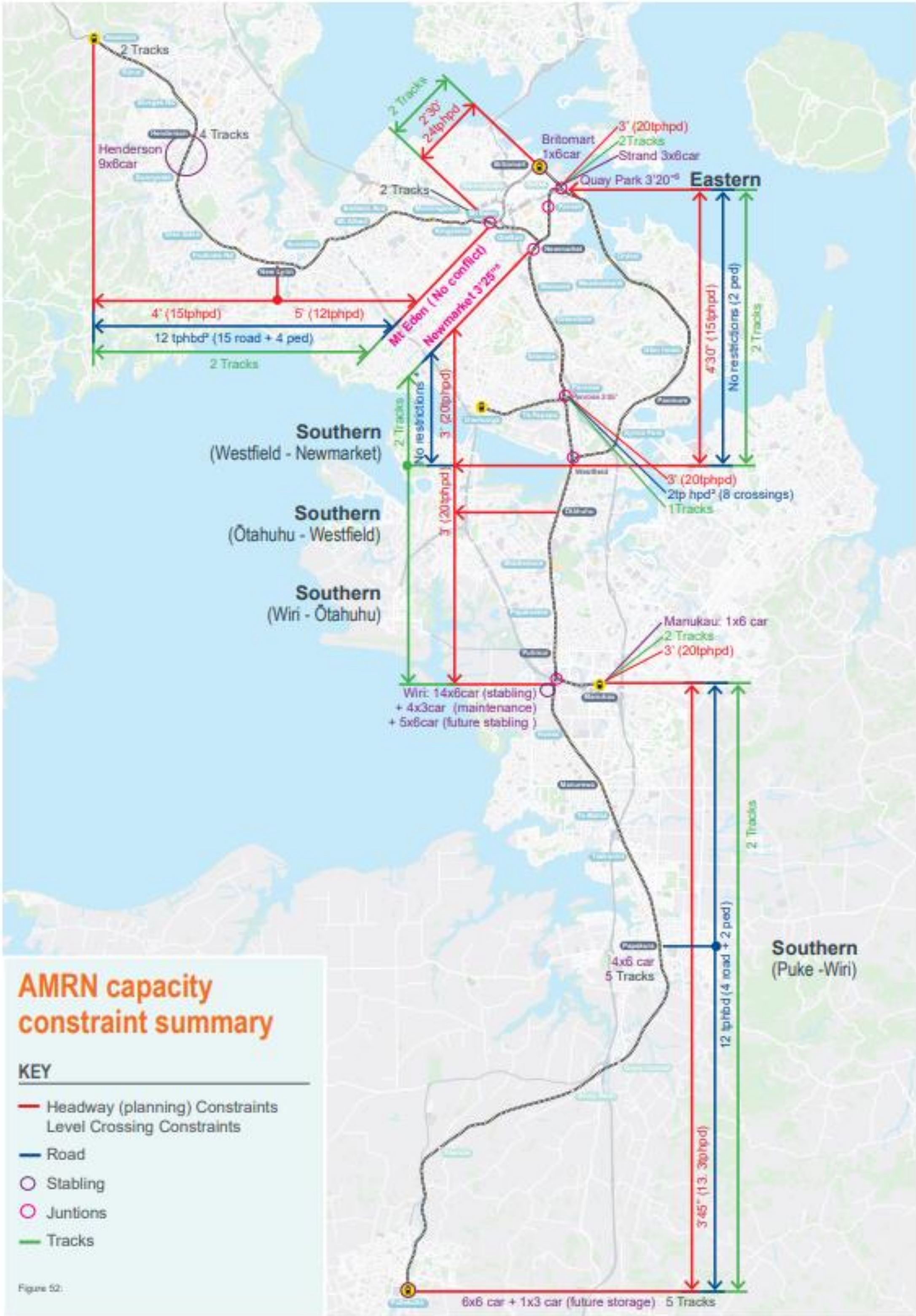


Figure 2-17: Auckland rail network capacity constraint summary[66]

[66] Headway constraints represent the minimum separation time that two metro trains can be scheduled. Wider headways may be required for different train types. 3'45" headway on southern corridor has been updated to 3'40" in the final analysis

INFRASTRUCTURE/ COMPONENT	CURRENT CAPACITY DISCUSSION
Number of tracks	Except for the OBL, the Auckland rail network is double tracked (i.e. two tracks) between Swanson and Pukekohe and will have a third track between Wiri and Westfield by 2025. This means that all services are in mixed operation (i.e., metro and freight services, mixed together) and overall capacity of the tracks is dependent on the signalling system. The major limitation of the double track configuration is its ability to operate diverse services with differing stopping patterns, average speed and rolling stock performance characteristics, within a single corridor. The third track between Wiri and Westfield will effectively be a single-track section for freight.
Track layout (e.g. junctions, turnbacks)	The 2025 base network includes 5 major junctions; Quay Park, Newmarket, Wiri, and Westfield that are level crossings (aka flat junctions) and Mt Eden that is fully grade separated. The movement of trains through these junctions imposes a capacity limit on the network where train paths cross or merge with one another through them. Availability of turnback sidings (or turn backs) provides a constraint on where services can terminate. These provide a place off the main line where a train can wait before its re-entry into service. They do not restrict capacity per se, but rather inform train planning and timetabling for the Auckland rail network. There are turn backs at Swanson, Henderson, New Lynn (emergency), Mt Eden, Britomart, Parnell, Onehunga, Otahuhu, Manukau, Puhinui, Papakura, and Pukekohe. Potential for additional turn backs also exist at Newmarket, Manurewa and Drury has also been identified if investment in the infrastructure is made.
City Rail Link	The CRL has similar capacity constraints to the rest of the network, however the tunnel introduces some unique considerations with respect to ventilation, and limited potential for future expansion. The design capacity for CRL is 24 tphpd, though this requires several system upgrades to be achieved. Analysis prepared as part of CRL operational modelling notes that to enable train frequencies greater than 20 tphpd, signalling and rolling stock upgrades will be required (e.g. automatic train operation (ATO)). The CRL is being future proofed for 9-car EMU (equivalent length) platforms following a decision in 2018 to extend the stations during construction.
Track dimension constraints	All track is 3.6 ft / 1.067m narrow gauge, and max speed is limited to 110 km/hr, which is reflective of the gauge and alignment on the Auckland rail network.

INFRASTRUCTURE/ COMPONENT	CURRENT CAPACITY DISCUSSION
	Narrow gauge track is typically limited to a maximum operational speed of 160km/hr. Queensland Rail operates tilting trains on a narrow-gauge network and currently holds the record for maximum speed on narrow gauge at 210 km/hr. However, given geometry constraints along most of the network (particularly presence of horizontal curves), close platform spacing, and mixed mode nature of the operation, there is limited scope for significant track speed improvements within Auckland.
Signalling	The signalling system dictates the minimum distance / time between two trains following one another in the same direction. The signalling across the Auckland rail network is ETCS Level 1, which is essentially a conventional fixed block signalling system with elements of speed control (automatic train protection). The Auckland rail network's current signalling system was designed for an operational headway of 3-minutes in the inner core (20 tph), and 4-minutes further out (15 tph), but higher than anticipated train dwell times mean this level of capacity cannot be achieved. For timetabling and planning purposes, a margin is added to the operational headway capacity to give a planning headway. Planning headways on the Auckland rail network are shown in Figure 2-17, and are generally: • 5 mins on the NAL N (West of Mt Eden) – or 12 tphpd • 3 mins on the NAL S (Westfield – Newmarket) – or 20 tphpd • Between 3 and 4 mins on the NIMT (varies by section) – or 15 – 20 tphpd
Freight paths	During peak periods, freight paths on the NIMT are scheduled in the network timetable. This requires two 10 min paths each hour, being provided for scheduled freight trains and late running contingency. Freight access to the Auckland Port and Northland, as well as shunting moves in and out of smaller freight sidings requiring mainline access, is restricted to inter-peak and off peak only, given high peak metro train volumes along these routes. During inter-peak and off-peak periods, train frequencies are sufficiently low across the network that freight can be manually dispatched without need for specific scheduled paths. With the introduction of RTN frequencies over the next 30 years, this will no longer be possible, and specific paths will need to be planned throughout the day.
Power system	The 2025 base network assumes the entire Auckland rail network is electrified (i.e. Papakura to Pukekohe electrification is completed), with the new Western Power Feed also in place.

INFRASTRUCTURE/ COMPONENT	CURRENT CAPACITY DISCUSSION
	Analysis has been undertaken during the PBC to inform the need for additional power feeds on the network, including consideration for electrification of the freight fleet.
Level crossings	The 33 road level crossings do not physically impact train throughput capacity (besides the constraints they place on signal positions and behaviour - e.g. overrun protection). However, as train volumes increase, the barrier down time increases, leading to delays on the wider road and active mode network, and growing safety concerns where the likelihood of dangerous driver and pedestrian behaviour increases. The PBC has assumed that post CRL opening, increases in train volumes on segments of the network that contain level crossings will be constrained until the safety risks can be mitigated. The road level crossings are therefore a critical capacity constraint to increasing train volumes.
Station platform length	Apart from stations on the OBL[67], all metro stations on the Auckland rail network have platforms that can accommodate 6-car EMU trains (AM class). This currently limits the metro services that can operate to 6-car EMU trains. As noted above, the CRL is being future proofed for 9-car EMU (equivalent length) platforms that effectively provides the ultimate limit for platform lengths (assuming all door boarding operations at stations).
Network control	Efficient network control is important for maximising the capacity of the infrastructure and ensuring a reliable operation. The main constraint for efficient network control is the Traffic Management System (TMS) which is currently based on Siemens Control guide OCS Rail9000 software (known as R9K). This system has several limitations compared to more modern TMS solutions, including lack of effective automatic dispatching and conflict resolution function, limited capability to make live schedule adjustments, and limited capability to manage work zones. With significantly increased traffic on the network post CRL, the need for a modernised traffic management system to provide precise, reliable operations will be critical.
Timetabling / Service Structure	The major constraint imposed by the metro timetable/service structure is the interlining of services (merging of two or more services together along the same corridor) which effectively constrains the maximum frequency that can be run on each interlined route to the capacity of the shared

[67] Penrose Platform 3 (OBL) can accommodate 6-car sets. Te Papapa and Onehunga can only accommodate 3-car trains.

INFRASTRUCTURE/ COMPONENT	CURRENT CAPACITY DISCUSSION
	corridor segment. The CRL and Wiri to Westfield segments of the network are particularly significant in this respect. To resolve these capacity bottlenecks, an alternative to building additional tracks is therefore to eliminate interlining from the service structure in these areas. However, this results in addition timetable constraints and disbenefits to users.
Metro service rolling stock	Auckland Transport will have 95x 3-car EMUs for CRL opening. The passenger capacity delivered by the train plan is a function of the service headway (restricted in part by signalling and level crossings) and the length of each service (i.e. 3-car or 6-car trains on the current network). Stabling for the EMUs is provided around the network and is required for the fleet. That is, the fleet can't be expanded without expanding stabling. Stabling for CRL opening is delivered as follows: • Henderson: 18 • Strand: 8 • Wiri: 50 (includes potential for stabling 4 x 3-car units on maintenance roads) • Papakura: 8 • Pukekohe: 13 • Total: 97[68] The homogenous fleet of AM Class EMUs was manufactured by CAF and is maintained at Auckland Transport's depot facility in Wiri. Repairs, maintenance, and periodic overhaul of the fleet occurs at the depot. It will be upgraded (layout changes and additional stabling) by 2025 to accommodate the new 23 units and will be able to maintain the full fleet of 95x 3-car EMUs, but with extremely limited potential for any additional maintenance capacity, meaning that new fleet beyond the planned 95, will require additional stabling and maintenance facilities.
Freight and interregional rolling stock	KiwiRail own the rolling stock that operate inter-regional passengers into and out of Auckland and the locomotives and wagons that are used to operate the local and domestic freight services. Funding for new rolling stock has been committed gradually since 2017.

[68] The 97 figure includes 4x3-car stabling positions on maintenance roads which is not ideal. There is also potential for overnight stabling at Britomart (4) and Manukau (2) stations but this is not intended for permanent stabling and has not been included above. The 50x3-car stabling stabling positions at Wiri includes 18x3-car units of new stabling which is still in development and needs to be revisited in future phases of the programme.

<table>
<tr><th>INFRASTRUCTURE/ COMPONENT</th><th>CURRENT CAPACITY DISCUSSION</th></tr>
<tr><td>Staffing</td><td>From a network maintenance perspective, KiwiRail's Auckland asset management team has 74 staff across three teams of Production, Site and Asset. KiwiRail has identified deficiencies in staffing levels in all teams against future asset management workload requirements. The current and future staffing levels are summarised below, highlighting the significant increase in staffing that will be required to maintain the Auckland rail network at the necessary standard in the future:
<table>
<tr><th>TEAM</th><th>CURRENT (FY19)</th><th>ADDITIONAL STAFF REQUIRED</th><th>FUTURE</th></tr>
<tr><td>Production</td><td>25</td><td>27.5</td><td>52.5</td></tr>
<tr><td>Site</td><td>41</td><td>35</td><td>76</td></tr>
<tr><td>Asset</td><td>8</td><td>6</td><td>14</td></tr>
<tr><td>TOTAL</td><td>74</td><td>68.5</td><td>142.5</td></tr>
</table>
Numbers of train drivers for passenger and freight services can also be a constraint on overall service capacity. From a passenger service perspective, Auckland One Rail has a training and recruitment plan in place to grow the number of drivers to meet metro service requirements at CRL opening, suggesting this is not an immediate constraint.</td></tr>
<tr><td>Auckland rail network maintenance equipment</td><td>Much of KiwiRail's maintenance equipment is aging and not as efficient as more modern equipment. This compounds the problem of short maintenance windows as once on site, processes are not as efficient as they otherwise could be. As part of the AMTP, KiwiRail is progressing a modernisation and efficiency programme to procure the tools and equipment to make its workforce more productive. This PBC includes these indicative budgets to ensure the assumed level of service for operations can be achieved.</td></tr>
</table>

2.3.1.2 METRO SERVICE CONSTRAINTS

Metro service capacity is a combination of service frequency and seat availability, and both these factors influence the attractiveness of rail from a customer perspective and therefore the patronage on these services., i.e., people will choose a rail journey if it is right-timed, and it is not too crowded.

Approximately **62 million weekday metro passenger trips per annum** are forecast on the Auckland rail network by 2051.[69] This is more than triple 2018 demand levels. Metro service capacity constraints must be addressed to accommodate this considerable growth in demand. Some service capacity upgrades are already underway on the Auckland rail network, including delivery of the CRL, expanding the EMU fleet from 72 to 95 units, extending electrification south to Pukekohe and a new western power feed to increase the power to the system (to allow more units to be in service at the same time). These items all form part of the base case on which the investment programme will build.

The proposed metro passenger service base case train plan (at CRL opening) that can operate within the infrastructure constraints summarised above is shown below in Figure 2-18.

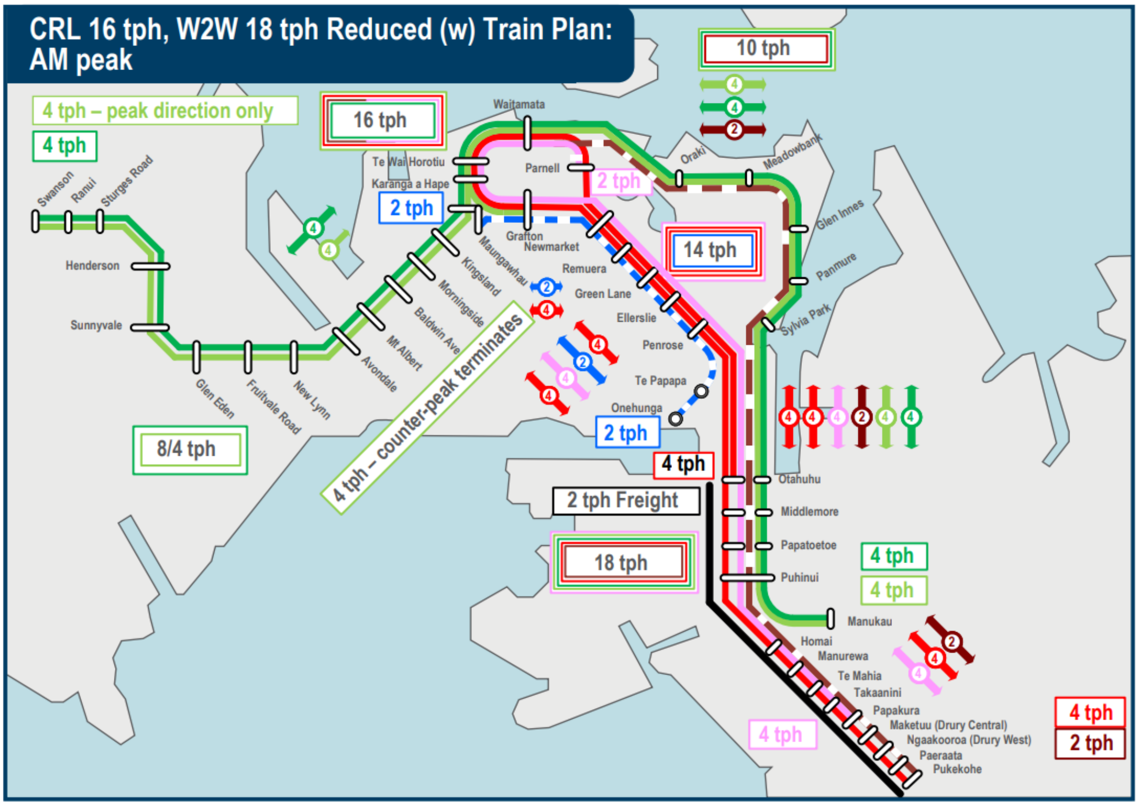


Figure 2-18: Proposed CRL opening metro passenger train plan

Train service length is the one variable that is not depicted in the train plan, but using the fleet of 95 units, the peak hour can operate as 6-car trains and the shoulder peak hour operates mainly as 3-car trains. To operate all services across the morning peak as 6-car trains (except the Onehunga service), a fleet of about 120 units would be required.

Figure 2-19 and Figure 2-20 summarise passenger capacity issues on the Auckland rail network for the 2031 and 2051 morning peak periods respectively, based on the train plan above[70].. Over-

[69] MSM output mode share using 2051 Base Case network and services. Note that the 62M figure is the total number of weekday trips, whereas the total number of annual trips (including weekends and holidays) is 76M.

[70] Freight scenario B1 and RTN metro scenario applied. MSM crowding module on, increasing generalised cost when seated capacity is over 80%. No explicit capacity constraints modelled.

capacity issues are highlighted in black (i.e. volume / capacity ratio (v/c) is greater than 1), where capacity is total capacity (seated and standing). A more detailed description by service follows.

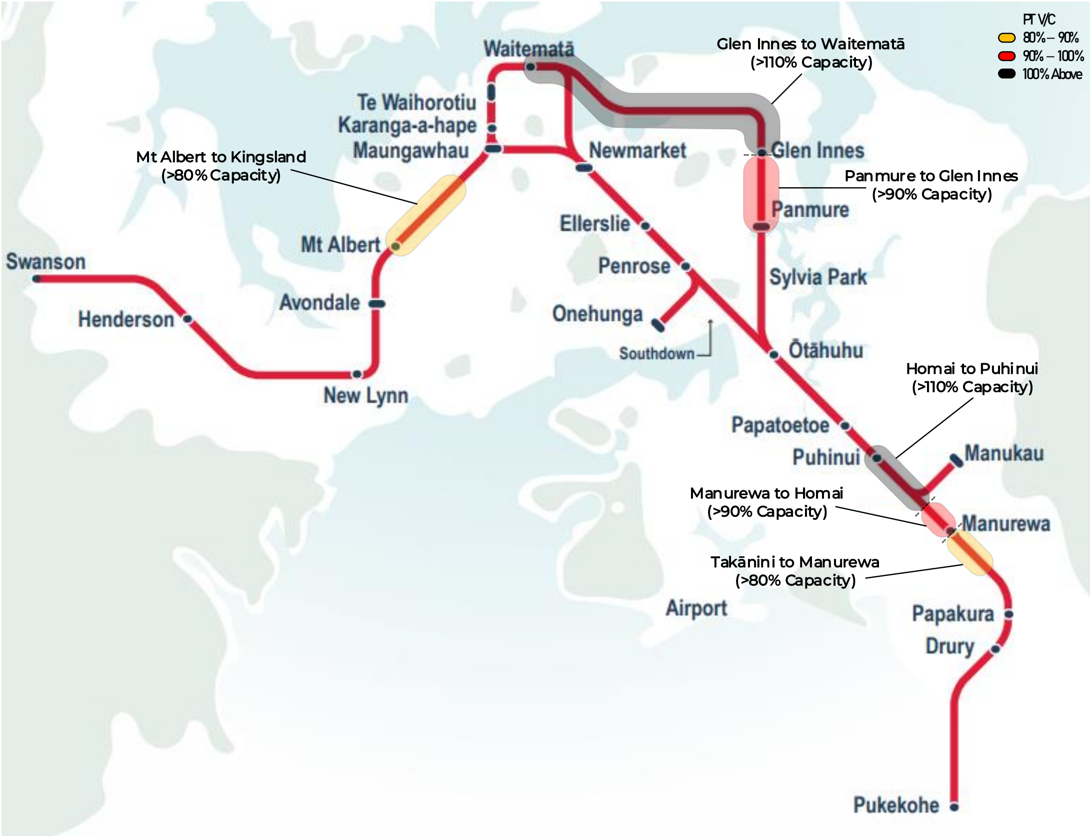


Figure 2-19: Summary of passenger service capacity issues, 2031 morning peak

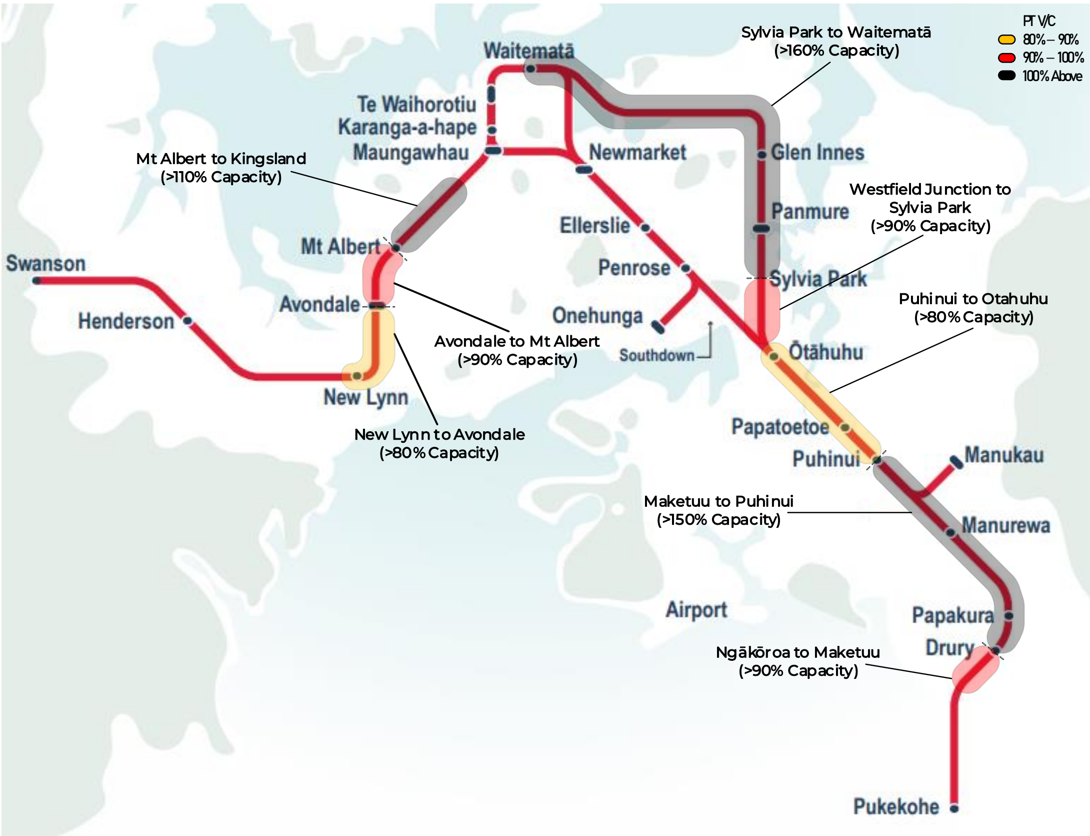


Figure 2-20: Summary of passenger service capacity issues, 2051 morning peak

Appendix A contains a summary of the initial demand / capacity analysis undertaken for the network, with full results in Appendix B, including service-by-service capacity analysis along each line for the 2031 and 2051 morning peak period base case demands. This analysis highlights the following capacity constraints that inhibit the Auckland rail network's ability to accommodate forecast metro passenger demand:

- On the Western Line:
  - Additional capacity will be needed in the early 2030s to avoid passengers standing from New Lynn (an approximately 24-minute journey to Aotea once CRL opens).
  - Total capacity is not expected to be exceeded until the late 2040s, with only the inner section east of Morningside over capacity in 2051.
- On the Southern Line:
  - Substantial additional capacity will be needed soon after CRL opening to avoid excessively long standing (over 35 minutes to Newmarket) times from the outer southern stations.
  - The limited stop service is extremely attractive to customers from the outer south, resulting in significant capacity problems that will need to be considered in planning the service mix for the Southern line.
- On the Eastern Line:
  - By the 2030s, passengers boarding at Panmure will have standing room only, although the journey time to Britomart is only 15 minutes, which is at the upper end of Auckland Transport's acceptable standing times on PT. As demand increases over time, standing journeys will become longer as the point at which seated capacity is exceeded moves further out.
  - Total capacity is exceeded on some services at Orakei by 2031, highlighting the need for additional service capacity early in the second decade.

Investing to address capacity constraints also addresses other level of service factors that influence the overall attractiveness of rail (e.g. service frequency, reliability etc). This creates a self-reinforcing cycle where good levels of service attract more passengers to rail, thereby requiring additional capacity.

2.3.1.3 FREIGHT SERVICE CONSTRAINTS

The rail network in New Zealand was built to move people and goods over long distances between towns and ports, providing international and domestic linkages. The role of rail freight today remains the same – efficiently moving our imports, exports, and domestic goods to and from New Zealand's ports, manufacturing sites and distribution and storage facilities.

New Zealand's ports operate in a competitive market, and this means that, to be competitive, rail freight needs to be able to provide productive (including being right-timed and right priced) services to and from ports (for import / export product) and logistics operators (distributing freight nationally).

Access to right timed and reliable capacity in Auckland is a present-day constraint that will worsen as demands on the network (from both freight, regional and metro) increase. This increases the risk that Auckland will become a bottleneck on the national supply chain. Rail freight planning must also anticipate material shifts in port strategy, or rail will be prevented from playing its full part in the New Zealand supply chain and its decarbonisation.

Rail freight needs to grow to meaningfully contribute to freight and logistics productivity, the wider New Zealand economy and the Government's emission reduction commitments (freight transport emissions must reduce by 35% by 2051). It needs to cater for probable port strategy scenarios and the impacts that these scenarios might have on freight flows and the overall cost effectiveness of the supply chain.

To achieve these national goals, there must be increased availability for freight services within the Auckland network and connecting to its destinations. The allocation of today's fixed physical network capacity across all customer segments currently constrains the necessary service availability and therefore the potential growth in rail freight. There are three principal elements that have a detrimental impact on freight service capacity:

- Mixed network capacity and past prioritisation of metro services,
- Network redundancy affecting reliability of services,
- Physical and operational constraints limiting frequency and size of trains (both metro and freight).

2.3.1.3.1 MIXED NETWORK CONSTRAINTS

Due to the mixed-use nature of Auckland's rail network, passenger (metro and inter-regional) and freight services must share track space and a balanced approach is required to accommodate all markets.

Figure 2-21: Source of demands for track access

A mixed-mode network is less 'capacity-efficient' than a dedicated network for a single mode would be. This is because the operational characteristics of all-stops metro and freight services are fundamentally different. Metro trains are comparatively lightweight, nimble vehicles that accelerate and decelerate quickly between stops. They also stop often, to pick up and discharge passengers. Conversely, freight trains are very long and heavy vehicles that take a long time to speed up and slow down, and which aim to traverse long distances without stopping. When freight trains are forced to speed up and slow down behind all-stops metro trains, they become very slow, and more space is needed between services to avoid complete stops with subsequent slow restarts. Long distance passenger trains tend to share much of the nimbleness of metro services, but operationally (i.e., no or few stops) are more akin to the freight pattern of operation.

This combination of different types of services reduces the overall capacity of the network by approximately 10%, as shown in Table 2-3, compared to networks where freight and passenger services run on separate tracks.

Table 2-3: Network utilisation planning maximum operational ability[71]

Type of line	Peak hour	Daily period
Dedicated suburban passenger traffic	85 %	70 %
Dedicated high-speed line	75 %	60 %
Mixed-traffic lines	75 %	60 %

Table 2-4 illustrates the practical constraints of the Auckland rail network when freight and passenger services are required to share track space – i.e., when either additional metro services are introduced to a freight pattern, or additional freight into a metro pattern. There are further dimensions to this such as the introduction of express metro passenger services, or inter-regional services. Effectively, the time between trains, train length, and the volume of different service types affects complexity. The Auckland rail network is complex and as demand increases, major conflicts will not be resolvable within a two-track network.

Table 2-4: Auckland mixed-use network capacity (freight and metro)

	PASSENGER SERVICES PER HOUR		
Freight trains	**4-6**	**6-10**	**10+**
900m, 30 minute headway, off-peak	No conflicts on 2 tracks	Moderate conflicts. Loss of resilience. Operations compromised. Strong case for additional capacity/ passing opportunities	Major conflicts. Unworkable with 2 tracks. 4 tracks required
900m, 30-minute headway, all day	Moderate conflicts. Loss of resilience. Operations compromised. Strong case for additional capacity/ passing opportunities	Major conflicts. Unworkable with 2 tracks. 4 tracks required	More than 4 tracks required
1,500m, 30-minute headway, off-peak	Moderate conflicts. Loss of resilience. Operations compromised. Strong case for additional capacity/ passing opportunities	Major conflicts. Unworkable with 2 tracks. 4 tracks required	Major conflicts. Unworkable with 2 tracks. 4 tracks required

[71] International Union of Railways, Capacity Guide, 2013

	PASSENGER SERVICES PER HOUR		
1,500m, 30-minute headway, all day	Major conflicts. Unworkable with 2 tracks. 4 tracks required	Major conflicts. Unworkable with 2 tracks. 4 tracks required	More than 4 tracks required

In addition to this overall mixed-use network capacity reduction, as demand for metro passenger services has increased over time, metro network access has historically been prioritised over freight service access, especially during peak periods – which has limited the ability of freight to grow. This is even though freight has great potential for commercially viable use, and to lower New Zealand's transport emissions.

Figure 2-22 shows the split between metro passenger (Auckland Transport) and freight services (KiwiRail) in terms of distance travelled[72] for FY2020. The numbers in brackets are from the previous three-year period and show the shift, even in recent years, in dominance of metro passenger services on the Auckland rail network. From CRL opening, the proportion of freight services will diminish even further.

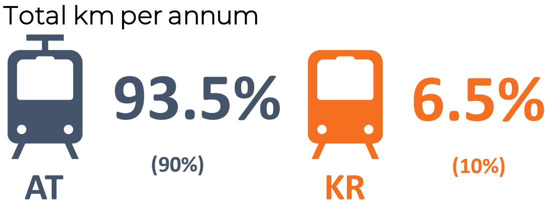


Figure 2-22: Auckland network – metro / freight split

The prioritisation of metro passenger services means that there is insufficient capacity for freight services during peak demand periods and there are clashes in the morning and evening peaks, especially on the NIMT. This means freight services have been restricted to off peak times and are unable to easily respond to customer needs. Just like passengers, freight customers send their freight when it needs to go – they have integrated supply chain elements, of which rail freight is one key element (others include their pickup and delivery fleet, processing sites, etc).

Restricting freight services in this way means that it is less attractive for freight customers to use rail freight in Auckland rather than roads, as the required productivity by rail cannot be achieved with wrong-timed services.

Freight that starts its journey by road in Auckland typically continues on-road all the way to its destination in Northland, Tauranga, Palmerston North, Wellington, or Christchurch (or vice versa) - even if there is capacity on the rail network outside of Auckland – because imposing double-handling costs to shift goods onto rail would erode the potential productivity of rail transport. This means not only extra trucks on Auckland roads, but also on the national road network. Therefore, insufficient access to right-timed freight services in Auckland affects the entire national rail freight chain and underutilises the national rail network.

[72] Distance travelled within the Auckland network, not nationally.

As Auckland Transport's aspiration for metro passenger services includes expanding peaks in the future, the exclusion problem for freight services would worsen substantially (before even considering the need for freight to be able to grow). Furthermore, there is a limit to usable operating hours. Overnight operation has practical limits due to community acceptance of effects such as noise – and there is limited freight customer demand during night hours (e.g., the Port of Auckland is not permitted to be a 24-hour operation). In addition, maintenance is prioritised during the overnight window, further reducing available freight operating windows.

For freight customers, right-timed, reliable, punctual, and cost-effective services are the critical factors that determine the level of service and influence freight's rail mode share[73].

The impacts of wrong-timed freight services extend well beyond rail operations and can require entire freight and logistics chains to extend or alter their hours of operation. Optimising productivity at freight and logistic hubs is critical for freight customers. Wrong-timed deliveries can compromise businesses' ability to deliver for their subsequent customers, including meeting ships in port and meeting the Inter-Island ferry sailing times. The ability to be competitive depends on highly productive capital and labour, therefore wrong-timed freight services that lead to staffing challenges, such as odd-timed shifts, can be impactful in a competitive market, adding significantly to the overall cost of rail freight, affecting its ability to be competitive versus road.

More detailed examples are provided in Appendix D.

These capacity restrictions and the side effects they cause (combined with reliability issues) mean that moving freight by rail is not as attractive as it otherwise could be. If rail services are unreliable, wrong-timed, unable to flex to meet customer needs and unable to deliver sufficient productivity, then freight customers more often choose trucks travelling on the road network to complete the freight task., resulting in the following adverse outcomes:

- Increased greenhouse gas and other air polluting emissions
- wear and tear on the roads that adds to ongoing maintenance costs.
- congestion, particularly during peak periods, with the associated negative economic impacts
- exposure to road-based harm for road users.

To address the inherent inefficiencies of mixed mode operations, most large cities opt to separate freight and passenger networks. In the long term, and as the network in Auckland gets busier for longer, **segregation of traffic types will need to be a strategic aim in Auckland.**

2.3.1.3.2 LACK OF REDUNDANCY

Most rail freight services cover long distances (apart from local shuttles such as between the Port and Wiri yard). This means that they are exposed to many potential sources of delays across the wider, national rail network. The timing of freight services can also be impacted by changes in ship arrivals and departures, which are often subject to change. This means that freight services into and out of Auckland are susceptible to delays and reliability impacts because of issues on the wider network or outside KiwiRail's control.

These factors, external to the Auckland rail network, can cause freight services to miss their allocated slot within Auckland. In the worst-case scenario, a freight train that misses an allocated slot just before the start of a metro peak period will be delayed and eventually dispatched (after 30

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[73] Mainfreight and Port of Auckland customer surveys, August 2022

minutes or more, according to network access agreement protocols) directly into peak metro frequency traffic, causing major disruptions that can affect the whole network and all markets. This impact manifests itself as a large delay to the freight service, but it is caused by the lack of available redundant capacity within the Auckland rail network to respond to or recover from a delay and cater for the different operational characteristics[74] of its users. This is compounded by the fact that much of the Auckland network operates as a single track per direction. Once a rail segment is blocked, there are no alternative routes available.

2.3.1.3.3 FREIGHT-SPECIFIC INFRASTRUCTURE CONSTRAINTS

Most import and export (IMEX) freight services starting or terminating in Auckland do so from Southdown. Westfield caters to the building and distribution of all types of freight and is also a marshalling yard for all types of services.

If rail is to meet addressable market demand for growth and under a range of port scenarios, then the volume of freight tonnage and trains is forecast to rise materially. Lengthening trains is a key method of increasing throughput / capacity and there will be a trigger point where it becomes efficient to increase the size of trains rather than just respond with greater volumes.

Freight decarbonisation forecasts indicate that by 2030 the volume of trains using the Southern line will start testing this threshold and there will either be a very high demand scenario or the need to extend trains (incrementally up to 1,500m) particularly between Auckland and Tauranga. Under a high-volume scenario, the number of turns could become problematic. Alternatively new methods would be required to turn longer trains around more efficiently.

Nevertheless, network and key hub upgrades would still be required to support longer train lengths of up to 1,500m[75]. Constraints that currently prevent up to 1,500m trains from operating from Auckland include:

- Southdown is currently limited to 750m trains, whilst Westfield can cater to 900m.
- Arrival and departure tracks (for rail services) at the Auckland depots are too short to receive/depart a 1,500m train without blocking other rail services, which would disrupt passenger, inter-regional operations, and other freight services.
- Freight services on the NIMT between Wiri and Pukekohe (where services are not segregated) will need to be extended to a 15-minute headway vis a vis metro trains.
- Port of Tauranga's Sulphur Point rail terminal would also need to be upgraded to take longer trains.

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[74] The characteristics of a metro service are short journeys, with the ability to make up time by skipping stations if necessary to recover delays. Freight services by contrast cover long distances on a speed-restricted network and require more flexibility in scheduling: it is unrealistic to expect a 13-hour service to present itself at the Auckland boundary within +/- 2 minutes of a required time, every single time (notwithstanding that there may also be metro delays to account for).

[75] Running more freight services will likely require additional locomotives and freight wagons in the coming decades. Investment in freight rolling stock is outside the scope of this PBC, however we note that Government has made significant investments in KiwiRail (including new locomotives and wagons) since 2018 as well as signalling its intent to restore rail freight in the NZ Rail Plan.

Investing to address capacity constraints for freight movements would increase rail's attractiveness to freight customers, and reduce reliance on road-based freight, enabling productivity benefits and substantial progress towards meeting Government's 35% emission reduction target for freight.

2.3.1.4 INTER-REGIONAL-SPECIFIC INFRASTRUCTURE CONSTRAINTS

The range of services that can be operated by inter-regional rail to/from Auckland are limited by infrastructure constraints within Auckland that put these services into competition with metro for capacity. This is a problem that will worsen after the opening of CRL and planned increase in the number of metro services operated, which claim priority over inter-regional.

This conflict has been recognised and to meet Waikato Regional Council's strategic and operational targets set out in the original Single Stage Business Case (2018), an addendum to the original business case was commissioned in early 2022 to confirm that the rail network can cater for inter-regional rail post-CRL and can identify any additional infrastructure required. The addendum detailed options identification and modelling assessment to consider how Te Huia can operate in Auckland after the opening of CRL and a reassessment of constraints at Puhinui Station.

A review of problems, benefits and Investment Objectives identified within the original Single Stage Business Case (2018) identified that these all remained valid. An additional problem was identified by the Te Huia Governance Working Group in 2021 and agreed by Waikato Regional Council and Waka Kotahi via a Point of Entry statement. This identified problem was that *Te Huia's level of service* ***may not be able to be maintained after the opening of the CRL due to the significant uplift in Metro service level and corresponding network and rail infrastructure restrictions for Te Huia.***

Notably, it was concluded that "*while termination at Newmarket offers significant transport connectivity benefits for passengers (compared to Strand), this option presented significant risks for a timetable resilience perspective. Termination at Mount Eden or Parnell were both found to be inoperable due to the inability to path Auckland metro services. Termination at Pukekohe was concluded to offer poor connectivity for inter-regional passengers compared to Strand*."

Ultimately the addendum notes that "as a result of the modelling work, the preferred option recommended is to operate Te Huia services between Hamilton Frankton and Strand (via the NIMT-E in Auckland) after the opening of the Auckland Post-City Rail Link". It is clear, however, that the recommendation is based on **avoidance of risk of not being able to operate at all** where Auckland's rail infrastructure is insufficient to provide for the needs of this market as well as the aspirations of metro services. Were the infrastructure not so constrained, the Te Huia service would choose to operate to Newmarket, which offers significantly greater connectivity benefits.

2.3.2 PROBLEM TWO – POOR LEVEL OF SERVICE

Current customer levels of service for all markets are insufficiently attractive to drive the required increase in rail mode share, meaning emissions targets can't be met.

Level of service is a term used to describe network performance measures that could influence customer willingness and/or barriers to choosing rail over other transport modes. To meet the Government's committed emission reduction targets, rail needs to be sufficiently attractive to retain existing customers and to encourage more customers to choose rail in the future.

Metro rail customer level of service is based on a range of factors as follows:

- Getting where they want to go, when they want to travel,
- Journey time,
- Service frequency,
- Service reliability (i.e., is the service running?),
- Service punctuality (i.e., is the service running on time?),
- Right timed (i.e., is the service arriving when it is needed)
- Safety (on and off the train),
- Service amenity and quality of experience on the train (e.g., access to a seat, cleanliness and extra features like air conditioning, Wi-Fi etc),
- Service capacity (discussed in problem one), and
- Access to and amenity at stations

All factors except service amenity are identified as areas where improvements are required.

Current and future passengers were surveyed to understand the current market attractors and barriers. The top areas that require improvement are summarised in Figure 2-23.

For metro passengers, the perception of level of service is often relative to alternative modes (e.g. bus or car), meaning changes in those modes (for example increased levels of congestion reduce the level of service experienced when travelling by car) will increase the attractiveness of rail relative to that mode.

While both bus and rail patronage respond to service improvements, as income improves, and car ownership levels increase bus patronage falls away dramatically whereas rail patronage is retained. This suggests that bus passengers more frequently catch the bus due to limited choice. By comparison, train passengers may be doing so by choice.[76]

For the freight & logistics industry, productivity is the key driver. According to freight customers[77] the critical factors that determine the level of service and their willingness to use rail are whether services are:

- right-timed,
- right-sized,
- reliable,
- punctual, and
- cost-effective

Rail freight is a 24-hour operation, but it does not follow that all (or even most) demand exists during the night. Domestic rail freight services need to be timed to meet ferries, and to arrive at destination in time for distribution. International imports and exports need to arrive and depart in time to meet ships and operate cyclically. If a slot is missed, time often cannot be made up, which leads to cancellation of a "pair" of services - and that capacity is lost from the supply chain. This is turn means the efficiency of the ports and entire wider supply chain is impacted.

As set out in earlier sections, the lack of available capacity and historical prioritisation of metro services (which means that freight services can be held up to 30-45 minutes to enable late running metro services to return to timetable) has made it difficult for freight services to operate at the times and with the reliability required by the freight and logistics industry. This makes rail freight insufficiently productive to compete with roads, leading to inefficient outcomes and increases the use of national road infrastructure by heavy trucks carrying freight that could more efficiently and sustainably have moved by rail.

[76] https://www.nzta.govt.nz/assets/resources/research/reports/434/docs/434.pdf

[77] Freight customers consulted during this PBC include Toll, Mainfreight and Ports of Auckland.

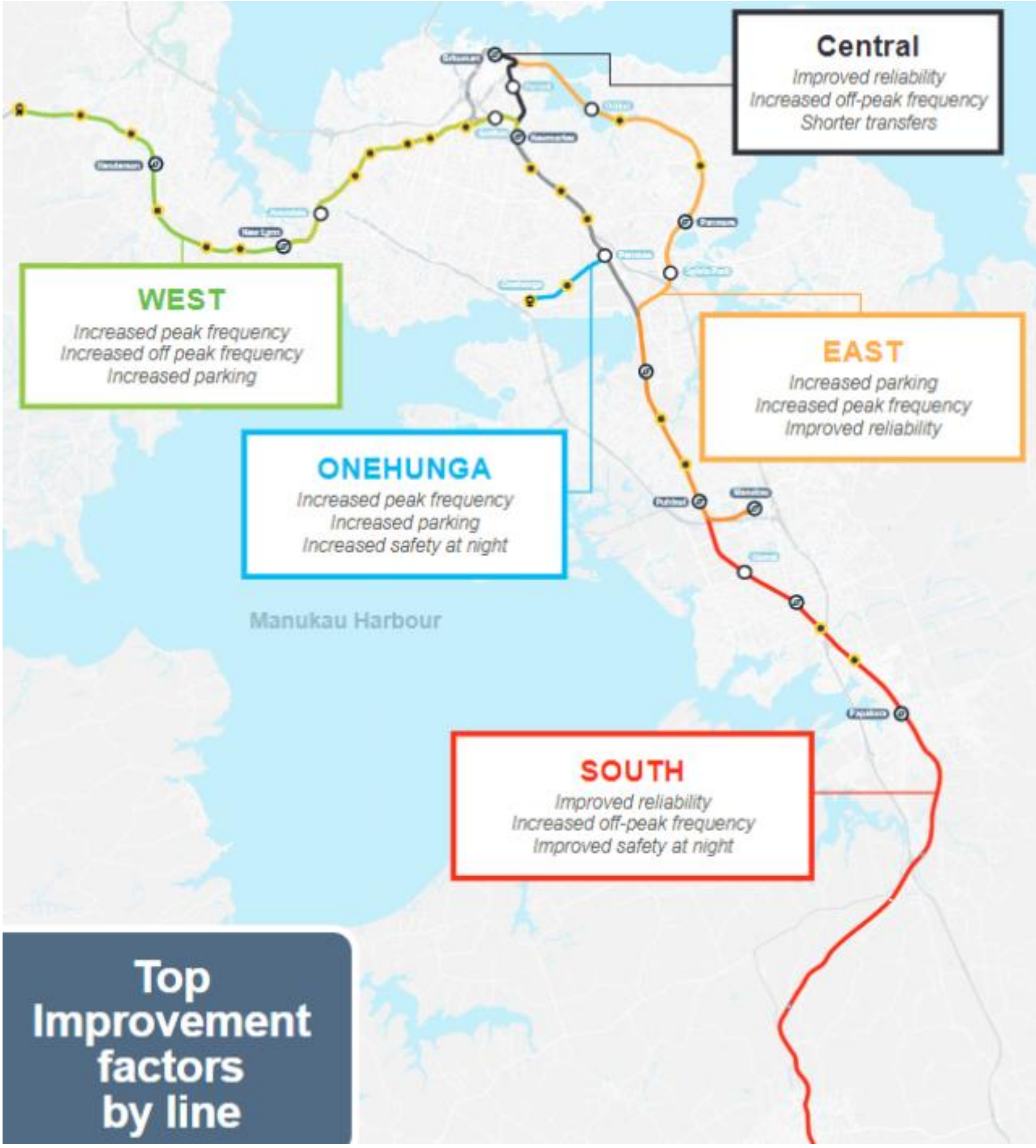

Figure 2-23: Customer market improvement factors summary

2.3.2.1 SERVICE RELIABILITY AND PUNCTUALITY

Reliability is the measure of completed services against scheduled services, effectively measuring the proportion of cancelled services. Auckland Transport and KiwiRail have a reliability target of 95% for both metro and freight services.

Metro service reliability by line over the last 10 years is shown in Figure 2-24, with KiwiRail's service reliability from 2013-2019 shown in Figure 2-25.

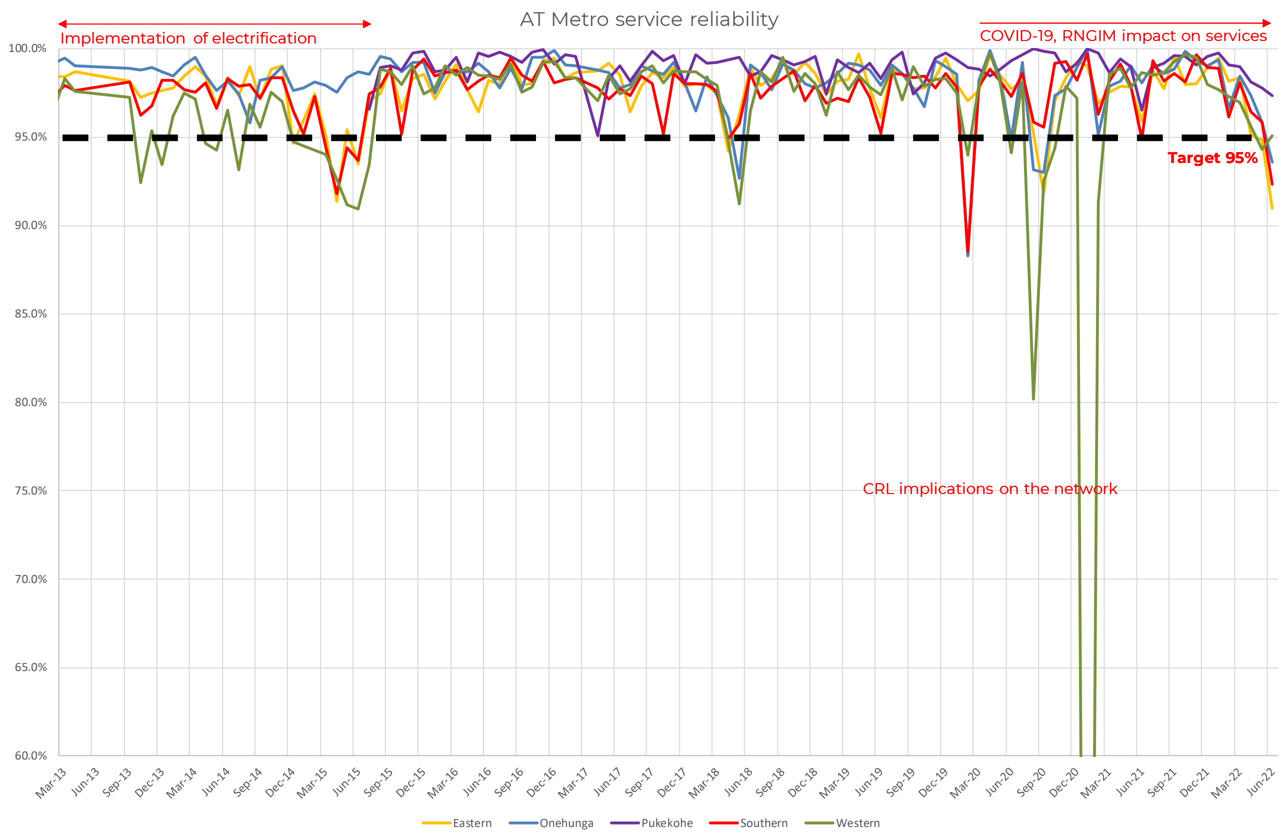

Figure 2-24: Reliability of service line (2012-2022)[78]

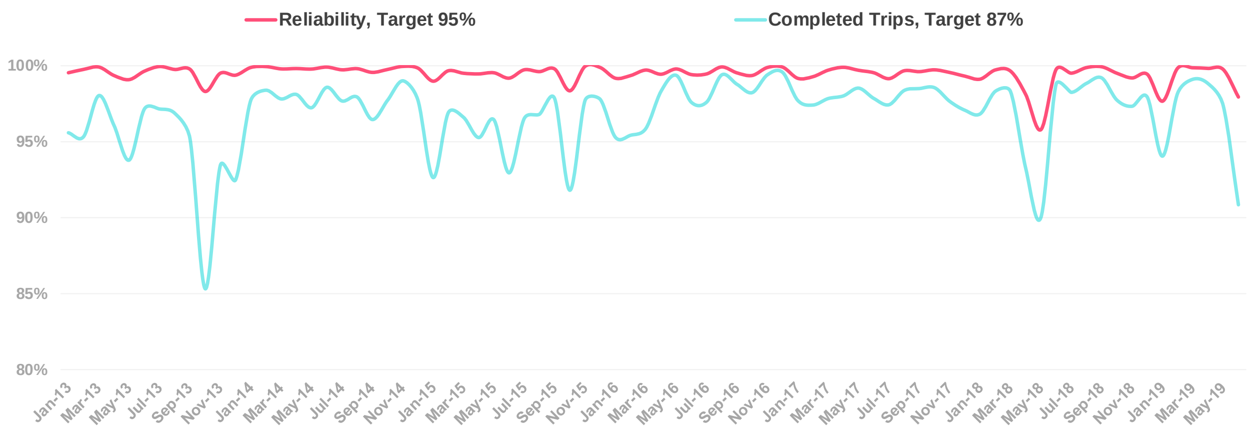

Figure 2-25: Reliability of KiwiRail operated services on the Auckland rail network, 2013-2019.[79]

To put the percentages into perspective, pre-COVID, Auckland Transport operated around 15,000 services each month, with average reliability of approximately 98.5%. However, this means that around 250 services were cancelled each month, or approximately 10 services per day.

The reliability data for KiwiRail's services is similar, with actual reliability of approximately 99% and completed trips of approximately 97%. Interviews with Auckland rail freight customers indicate

[78] Source: Auckland Transport

[79] Source: KiwiRail

that further improving confidence in service arrival times would encourage them to increase their use of rail freight services.[80]

Punctuality is the measure of services arriving at their destination no more than one minute early or five minutes later than the scheduled arrival time for metro passenger services, and within 30 minutes for freight services. Customers experience this as travel time reliability – confidence the service will get them (or their freight) to the destination on time. Auckland Transport and KiwiRail both have a punctuality target of 95% for their metro and freight services.

Metro service punctuality over the last 10 years is shown in Figure 2-26 and freight service punctuality between 2013-2019 is shown in Figure 2-27.

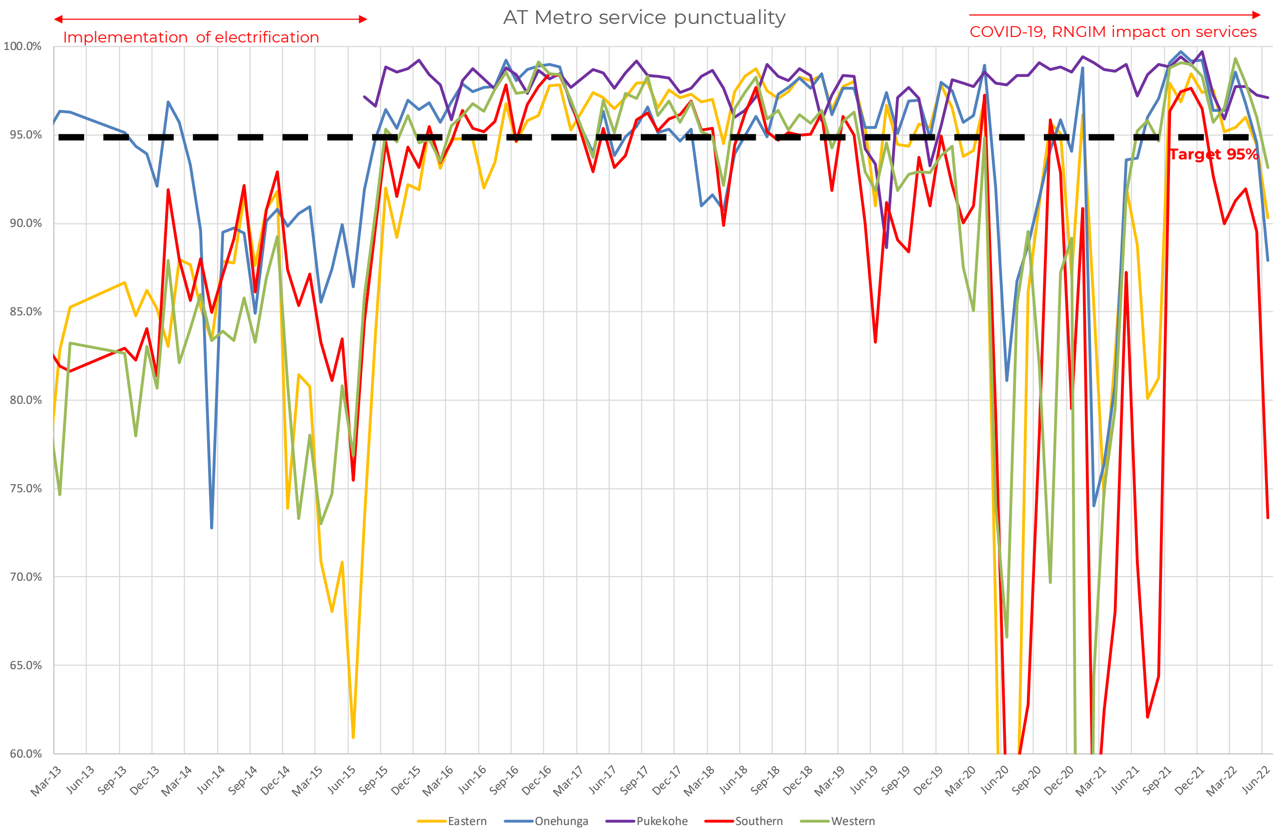

Figure 2-26: Punctuality of passenger rail (2012-2022)[81]

Prior to COVID and the disruptions caused by the RNR programme, metro services typically met the target, with the Southern line service being the poorest and most variable performer. As this is the longest service, this is not a surprising result. Unfortunately, this data doesn't differentiate between a service that is 6 minutes late and one that is 30 minutes late, so the magnitude of poor punctuality is unknown.

Some punctuality issues arise from day-to-day variability in operations (for example, passengers holding doors open longer, differences in train operator behaviour), but are often as a result Temporary Speed Restrictions (TSRs) being imposed on operations to maintain a safe service speed while infrastructure repairs or improvements are made.

[80] WSP Rail Freight Customer Interviews. August 2022

[81] Source: Auckland Transport

Punctuality since March 2020 has been severely affected by the TSRs put in place while a specific track quality issue (rolling contact fatigue) was resolved (as part of the RNR programme). The overall poor performance of services since then is contributing to rail patronage's poor recovery (relative to PT overall) following the impacts of COVID-19.

It is noted that reliability (measured as punctuality) was the factor that people valued the most to get them to travel by rail more often. The data presented in Figure 2-26 suggests that there is room to improve punctuality, to improve the overall level of service for metro passengers and create a more attractive option such that rail passengers choose rail over other modes.

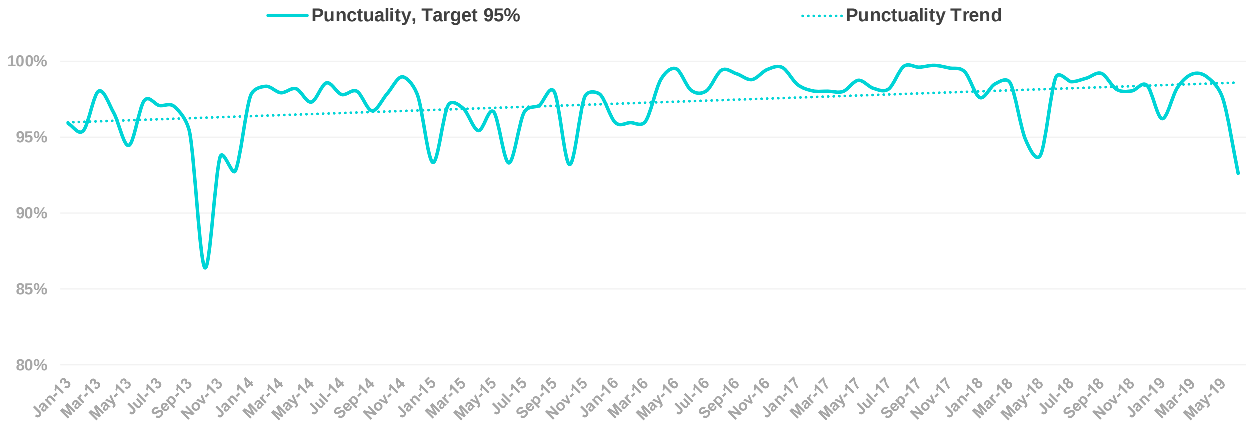

Figure 2-27: Punctuality of KiwiRail operated services on the Auckland rail network (2013-2019)[82]

Reliability and punctuality are critical factors for freight services as they are often timed to meet a ship departure (Port of Tauranga or Centerport or the Interislander in Wellington) or for goods to be available for a freight forwarder to distribute the next day; failure to meet these timings has consequential delays that can be costly to freight customers.

The punctuality data for KiwiRail's services show an improving trend over time, with the target of 95% generally being met, especially since 2016. However, feedback from rail freight customers surveyed in August 2022[83] suggested punctuality and reliability were areas that required improvement if they were to consider greater use of rail to move freight. They noted considerable variation in actual and scheduled arrival/departure times as being one of their main frustrations as well as frequent cancellations. For example, POAL noted its freight operation currently moves about 12% of containers by rail. If the required level of service could be delivered reliably, this could increase to approximately 30%.

2.3.2.2 JOURNEY TIME

Journey times are an important issue particularly for metro services[84]. Competitive journey times were highlighted by a third of customers surveyed as being an important area to increase rail's

[82] Source: KiwiRail

[83] WSP Rail Freight Customer Surveys, August 2022

[84] Whist freight services can also benefit from journey time improvements, these would need to be across much longer sections of the network than the short distance travelled inside Auckland (i.e., ~35km out of a 200-1,000 km journey) to significantly improve performance, and hence are largely beyond the scope of this PBC. Within Auckland, capacity, slot timings, reliability and prioritization issues are far more significant for freight.

attractiveness for metro passengers. The geographic segmentation further highlighted this being more important for longer journeys.

To understand the relative performance of metro rail (post-CRL opening) to car travel times in both the peak and inter-peak periods, a sample of potential journeys is presented in Table 2-5. For peak period car travel, the travel time range is presented to highlight the variability and uncertainty in travel time due to congestion. The purpose of this analysis is to benchmark the expected base case rail travel times and provide a guide as to the level of travel time reduction that would be required to provide better parity to car usage throughout the day. Journey times between rail stations are used, as these journeys are within the influence of this PBC, noting that a much wider range of journeys are possible, where rail is used for a partial journey.

There are practical limits to how much rail travel times can be reduced as they are constrained by stopping patterns, station dwell times and track speed limits. It is also noted that in uncongested conditions, car travel times will almost always be faster than rail, as other than intersection delay, there is no need to stop between the start and finish points of the journey.

Table 2-5: Car and rail travel times across Auckland

ROUTE	CAR TRAVEL TIME (2022)		RAIL TRAVEL TIME (POST CRL OPENING)[85]
	PEAK[86]	INTER-PEAK[87]	
Pukekohe – Britomart	60 – 120 min	48 min	62 – 72 min (ltd stop vs all stops)
Henderson – Manukau	40 – 75 min	30 min	80 min
Swanson – Britomart	40 – 80 min	30 min	44 min
Papakura – Sylvia Park	30 – 60 min	25 min	32 – 40 min (peak vs off-peak, incl. transfer)
Panmure – Newmarket	22-45 min	21 min	35 min (incl. transfer)
Manurewa – Middlemore	20 – 40 min	19 min	13 min
Drury (central) – Manukau	18 – 35 min	15 min	36 – 45 min (peak vs off-peak, incl. transfer)

The sample of journeys shown in Table 2-5 highlights that during peak periods, rail can be competitive for some journeys shown, even those that include a transfer.

During the inter-peak period, rail's competitiveness reduces as underlying road congestion is reduced (reducing car travel times). Most rail travel times remain 10-15 minutes longer during the inter-peak period than their car equivalent. This provides a target travel time reduction across the rail network, which would dramatically lift rail's attractiveness and viability as a mode of travel for

[85] Provided by AT
[86] Based on morning peak, arrival at 8:30am, Google 2022.
[87] Based on average inter-peak time, Google 2022.

more journeys across the day. Increasing the ability to operate express services could make rail travel times more comparable on some corridors.

As described earlier there are limitations to rail's ability to achieve a direct link in a competitive fashion. Some journeys will simply never be as competitive on the existing network, especially in the inter-peak (such as Henderson – Manukau, which remains 50 minutes longer by rail in the inter-peak) no matter the improvements delivered for rail, given the road connection is far more direct, and in this example, via the motorway at high speed for most of the journey.

Despite these limitations, the Transport Capacity and Quality of Service Manual[88] outlines that a PT travel time up to 25% longer than car is considered comparable by passengers, although this is likely to depend on the total travel time of the trip and the trip purpose. This is shown in Figure 2-28 below.

Transit–Auto Travel Time Ratio	Passenger Perspective	Operator Perspective
≤1	• Faster trip by transit than by auto	• Feasible when transit operates in a separate right-of-way and the roadway network is congested
>1–1.25	• Comparable in-vehicle travel times by transit and auto • For a 40-min commute, transit takes up to 10 min longer	• Feasible with express service • Feasible with limited-stop service in an exclusive lane or right-of-way
>1.25–1.5	• Tolerable for choice riders • For a 40-min commute, transit takes up to 20 min longer	
>1.5–1.75	• Round trip up to 1 h longer by transit for a 40-min one-way trip	
>1.75–2	• A trip takes up to twice as long by transit than by auto	• May be best possible result for mixed traffic operations in congested downtown areas
>2	• Tedious for all riders	• May be best possible result for small city service that emphasizes coverage over direct connections

Figure 2-28: Passenger and operator perspectives of transit to car travel time ratios

2.3.2.3 SERVICE FREQUENCY

Service frequency is an important contributor to overall level of service and productivity for both passenger and freight services.

2.3.2.3.1 PASSENGER SERVICE FREQUENCY

In respect of passengers, Auckland Transport's Regional Public Transport Plan (RPTP) has an RTN service frequency aspiration of 10-minute frequency or better, with a service spanning most of the day (6am and 12am).

The United States National Academies of Sciences, Engineering and Medicine Transportation Research Board, Transit Capacity and Quality of Service Manual (2017)[89] provides a summary of passenger and operator perspectives for different transit system headways. It indicates that a 15-minute headway is the maximum desirable wait time for passengers. Wait times longer than 15

[88] United States of America Transportation Research Board, Transport Capacity and Quality of Service Manual, Third Edition, 2017

[89] https://www.trb.org/Main/Blurbs/169437.aspx

minutes mean passengers must adapt their travel to the train schedule, often resulting in less-than-optimal arrival or departure times. It also states that frequencies of 10 minutes or less are considered a frequent service that allows passengers to 'turn up and go'. This is shown in Figure 2-29.

Average Headway	Passenger Perspective	Operator Perspective
≤5 min	• Very frequent service, no need for passengers to consult schedules • Bus bunching more likely, which can result in longer-than-planned waits for a bus and more variable passenger loads	• Feasible for bus or rail service in very high-density (high-ridership) corridors, and where routes converge to serve a major activity center • Exclusive right-of-way highly desirable to reduce external impacts on transit operations and to keep operating speeds high (minimizing operating costs) • In mixed traffic, bus and streetcar headways approach traffic signal cycle lengths: bunching can easily occur • Adding more frequency to add capacity may not be feasible or effective due to (*a*) minimum train spacing requirements or (*b*) unused capacity due to bus bunching • Using larger or longer vehicles, or replacing seats with standing area, may be options for adding capacity short of upgrading transit modes
>5–10 min	• Frequent service, no need for passengers to consult schedules • Bus bunching possible, which can result in longer-than-planned waits for a bus and more variable loads	• Feasible on high-density corridors with bus or rail service, and where routes converge to serve a major activity center • Short headways needed for circulator routes to be able to compete with walking and bicycling (*2*) • Exclusive right-of-way desirable to reduce external impacts on transit operations and to keep operating speeds high (minimizing operating costs) • Traffic congestion, dwell time variability, and differences in bus operator driving styles may result in bus bunching • Increasing frequency to add capacity usually feasible (budget permitting) when exclusive right-of-way provided in congested areas
11–15 min	• Relatively frequent service, but passengers will usually check scheduled arrival times to minimize their waiting time at the stop or station • Maximum desirable wait time for the next service if a bus or train is missed	• Often branded as "frequent service" in conjunction with long service hours, including weekends • Feasible in higher-density corridors (e.g., 15 dwelling units/net acre for bus service [*3*]), routes with strong anchors on both ends, and park-and-ride–based peak-period commuter bus service • Typically the longest feasible off-peak headway that would justify light rail or BRT service
16–30 min	• Passengers will check scheduled arrival times to minimize their waiting time • Passengers must adapt their travel to the transit schedule, often resulting in less-than-optimal arrival or departure times for them	• Typically provided as 20- or 30-min headways (e.g., 3 or 2 buses per hour) • Other headways can also be seen when traffic congestion increases bus running time, but budget not available to add service • Feasible in moderate-density corridors (e.g., 7 dwelling units/net acre for bus service [*3*]) • Typical commuter rail headway; longest commuter bus headway
31–59 min	• Non-clockface headways require passengers to check scheduled arrival times • Passengers must adapt their travel to the transit schedule, usually resulting in less-than-optimal arrival and/or departure times for them • Provides more bus departures per day than hourly service over the same service span	• Typically provided as 40- or 45-min headways • Other headways can also be seen when traffic congestion increases bus running time, but budget not available to add service • Feasible in low-to-moderate density corridors (e.g., 5–6 dwelling units/net acre [*3*])
60 min	• Provides a minimal service level to meet basic travel needs • Passengers must adapt their travel to the transit schedule, usually resulting in less-than-optimal arrival and departure times for them	• Typical maximum headway for fixed-route bus service • Potentially feasible at densities as low as 4 dwelling units/net acre, depending on ability to subsidize service (*3*) • May be provided to meet a service coverage standard
>60 min	• Undesirable for urban transit service due to typical long waits for return trips and when a bus is missed	• May wish to consider some form of demand-responsive transit to provide service that better meets passengers' travel needs

Figure 2-29: Passenger and operator perspectives of average headway

2.3.2.3.2 FREIGHT SERVICE FREQUENCY

Freight service frequency needs manifest differently from passenger services. For freight, the Auckland network is just one section of a wider national network. Freight services need to have sufficient access to this part of the rail network to run at the times they are needed (not just when there is a space *not* needed by a metro service). They also require sufficient resilience to service a competitive ports market and to respond to environmental changes and short notice needs. This means that regular and sufficient frequency train slots are required for freight services to do their job within New Zealand's economy. For example:

- Rail freight needs the ability to be competitive and productive. Service frequency is an important part of this, as customers require frequency (as well as overall capacity, reliability, etc) for rail services to provide a service comparably productive versus road.
- Rail freight services between ports tend to be contracted services (i.e., X number per day or week, providing Y volumes per train). These services need to run at times that enable international cargo ships to be efficiently unloaded and not force double-handling costs onto exporters and importers. They also need to run at a frequency that enables the schedule of ships to be handled by the port and avoids having ships backed up, unable to enter ports because wharves are unable to be freed up.
- New Zealand has an open economy in which its ports are free to compete for custom (in turn enabling the shipping industry to obtain competitive rates). A ship that is contracted to call at Tauranga might alternatively become a customer at Auckland or at Northport, with consequential change in the rail freight service pattern required to move containerised freight around. There needs to be sufficient rail capacity and frequency to enable (and not obstruct) the efficient operation of this competitive market.

New Zealand's freight and logistics supply chain need sufficient capacity and service frequency to be able to cope with unforeseen events and changes. For example, in mid-2021, productivity and congestion issues at Ports of Auckland meant that many container ships had to be handled at Tauranga instead. This created a "mountain[90]" of containers in backlog, and an urgent need for additional rail services to be created. Responding to these sorts of urgent requirements is only possible if the underlying frequency already exists to be moved around, and when there is sufficient capacity and resilience in the overall network to enable it. From around 2030, there will be no spare capacity on the Auckland network, and unless new capacity is created, maintenance and/or other services (including metro services) would need to be cancelled to be able to respond to unplanned events as no resilience capacity will by then exist. Lastly, it is important to recognise that the impact of insufficient service frequency in Auckland has broad reach. Like the rail network, Auckland's ports are part of the wider national freight and logistics chain. When one part of this system is not working or is constrained, the impacts are felt throughout the economy. The Nov 2022 article[91] headlined below illustrates the sorts of reactions this causes throughout the supply chain – forcing up costs across the board.

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[90] See e.g.: https://www.nzherald.co.nz/bay-of-plenty-times/news/port-of-tauranga-congestion-extra-rail-services-to-move-container-mountain/EKNOLCY55XBCQJMM6TE7FYNL3U/

[91] https://www.stuff.co.nz/business/130327977/shipping-woes-push-up-prices-in-shops-as-ships-queue-to-offload-at-our-main-ports

Shipping woes push up prices in shops, as ships queue to offload at our main ports

All eyes on Auckland

Ports of Auckland, which is usually the first stopping point for international vessels, remains a major pinch point, and holdups there have a domino effect on other ports around the country.

2.3.2.4 ACCESS TO AND AMENITY AT STATIONS

Rail stations are the access points to the metro passenger network. Mode of transport to/from stations influence accessibility to and willingness to use the rail network, summarised in Figure 2-30.

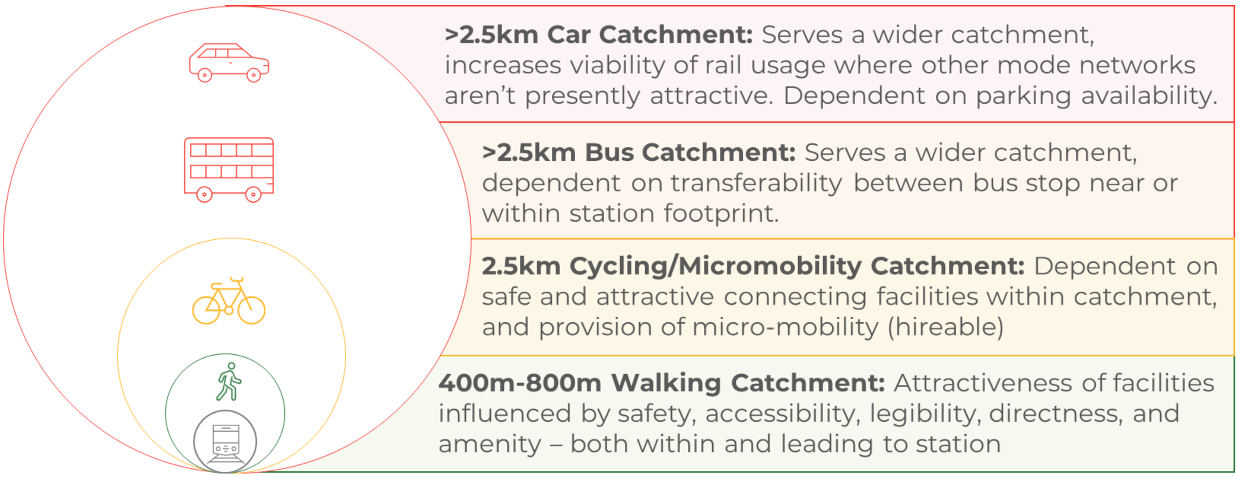

Figure 2-30: Catchments by mode for access to rail stations

Across Auckland many metro rail stations have access deficiencies, plus deficiencies in the first and last mile connections, which limits the attractiveness of transfer between rail and other modes (and vice versa). Providing efficient connections will encourage more customers to choose rail for their journey.

The connectivity of the surrounding network e.g., safety getting to/from, or within the rail network and appropriate facilities, such as cycle or car parking can enhance or limit station accessibility.

Auckland Transport recently undertook a deficiency analysis of existing station accessibility and highlighted current deficiencies, which act as a barrier (to varying degrees) to choosing rail as a transport option.[92]

One common deficiency to address will be walking access to stations, with Auckland Transport's work identifying potential additional active mode connections (such as the current work being undertaken around Glen Innes Station) that could expand the walkable/rideable catchment and remove a major physical barrier. Improving deficient active mode access was the second highest access improvement identified by customers when surveyed about factors that would encourage more travel by train, with around a quarter of respondents highlighting it in their top three factors overall.

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[92] First and Final Legs SSBC, 2023, Auckland Transport

Feedback received across the different geographic segments of the rail network also found that limited parking is a barrier for a lot of customers. This is unsurprising given the limited active mode connections to Auckland's train stations coupled with Auckland's higher rate of car dependency. Typically, there is a strong relationship between park and rides and the number of passengers at a PT station. Stations with more parking spaces have higher ridership.

Addressing first mile / last mile rail network access deficiencies can increase the number of opportunities people have access to by PT, improving the attractiveness of rail, influencing customer mode shift, and delivering demonstrable reductions in vehicle emissions.

2.3.2.5 SAFETY AND SECURITY

Perceived and actual safety risk is another major influence on the level of service that customers experience. Data provided by the rail operator for the five-year period Jan 2017- Nov 2021 indicates customer-related elements that may influence security or safety perceptions. This is summarised in Table 2-6.

Table 2-6 shows that on-train assaults, vandalism and passenger injuries have been worsening over time, indicating specific safety issues that are contributing to a less attractive service for passengers.

Table 2-6: Rail operator data passenger incidents over a five-year period (Jan 2017- Nov 2021)

INCIDENT CODE RELATING TO PERCEPTION OF SAFETY / SECURITY	FREQUENCY (OVER 5 YEARS)	ANNUAL AVERAGE	ANNUAL TREND IMPROVING / DETERIORATING[93]
Assault on train	65	13	Deteriorating
At platform / station	*17*	*3*	*Improving*
On train	*48*	*10*	*Deteriorating*
Passenger Issue	1706	341	Improving
Drunk / vomit	*336*	*67*	*Improving*
Robbery / criminal activity	*47*	*9*	*Improving*
Disorderly behaviour (includes verbal abuse / assault)	*665*	*133*	*Improving*
Fare evasion	*106*	*21*	*Improving*
On-board vandalism	*14*	*3*	*Deteriorating*
Passenger alarm activated (including false alarm events from children)	*65*	*13*	*Deteriorating*
Other	*473*	*95*	*Improving*
Trespasser (including potential self-harm)	656	131	Improving
Vandalism / Graffiti	713	143	Improving
Injury event (most common was fall)	23	5	Deteriorating

[93] Weighted per 100K Passenger Trip

2.3.3 PROBLEM THREE – INADEQUATE NETWORK MAINTENANCE AND RENEWALS

Rail maintenance requires constant balancing of cost (or funding), performance (or level of service) and risk (asset or network infrastructure condition). To deliver an acceptable level of service, KiwiRail requires:

- access to the asset or network for maintenance,
- experienced resources (people, plant, and materials),
- asset management and maintenance capability (including technical standards and safety compliance and appropriate methodologies for repair), and
- cost efficient work productivity (short and reactive maintenance is more expensive than planned larger scale work).

The Auckland rail network is in the process of being upgraded from a freight standard to that of a network suitable for metro services. It does not include many of the requirements described above. Historical lack of Government investment in infrastructure maintenance and renewal, expected increases in levels of service from CRL and other Auckland metro projects, reduced maintenance access time to the network, and a lack of current funding available to implement modern maintenance practices prevent an acceptable level of service from being delivered for customers.

Asset maintenance and renewal activities are essential to enable the rail network to deliver the desired level of service, including timetabled services, safety, reliability, network availability, punctuality, and frequency of services. Without investment to resolve the existing backlog of renewals, and adequate funding to maintain and renew the network into the future, any investment in additional capacity or increased level of service would be severely undermined.

The expected lifecycle of an asset relies on the ability to proactively maintain it; failing to do so will result in more frequent catch-up renewals being required. These are highly disruptive and are poor value for money due to premature asset deterioration. The ability to fund the ongoing maintenance and renewals of the asset has a direct impact on level of service, meaning constrained funding will result in a lower level of service (fewer trains, reduced punctuality, etc.). Due to historical under-funding, a multi-year catch-up renewals programme is currently underway in Auckland to address the backlog renewals. This programme has meant that customers experience a much lower level of service than they expect, including multi-month line closures, more frequent weekend closures and speed restrictions.

Figure 2-31 shows the relationship between maintenance and renewals and reliability, services, and infrastructure, with the customer experience at the centre. A well-maintained rail network, supported by strong asset management processes, will have more resilient infrastructure that enables the operation of safer, more reliable, and more effective services.

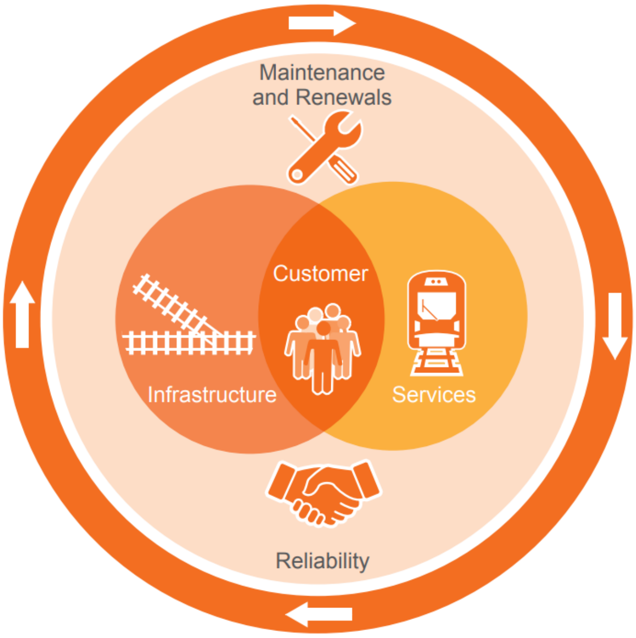


Figure 2-31: Relationship of services, infrastructure, and reliability

Freight customers and passengers use train services because they offer a safer, cheaper, more environmentally friendly, and more convenient mode of transport. At the core, users expect trains to depart and arrive on time, offer a reasonable service frequency, and have travel times comparable to other modes of transport. To deliver these service levels, infrastructure needs to be maintained regularly and renewed before the condition of the assets deteriorates to such an extent that the train service become unreliable. Failing to do so means that users do not choose or trust rail as a viable transport option.

As with all PT modes, rail provides a critical service to those who do not have another travel choice, and it is critical that a good level of service is maintained through regular maintenance and asset renewals.

2.3.3.1 NETWORK DETERIORATION REDUCES SERVICE RELIABILITY

Inadequate network maintenance and renewals has led to network deterioration, reducing service reliability for all markets.

Level of service is typically measured by the ability of the infrastructure to support frequent and on time passenger services. Asset resilience and reliability, and network control operations, are critical to level of service. Figure 2-32 shows the incidents affecting passenger services (a proxy for deterioration of the level of service) for the period 2013 to 2021, noting that the data quality in early years may be less reliable while the reporting system was being set up.[94]

[94] These records have been extracted from Compass, the incident management tool used by Auckland One Rail, the metro operator to apportion delays.   This is jointly agreed daily between the operators (passenger and freight) and infrastructure provider (KiwiRail). These records are also used in the calculation of train service KPIs.

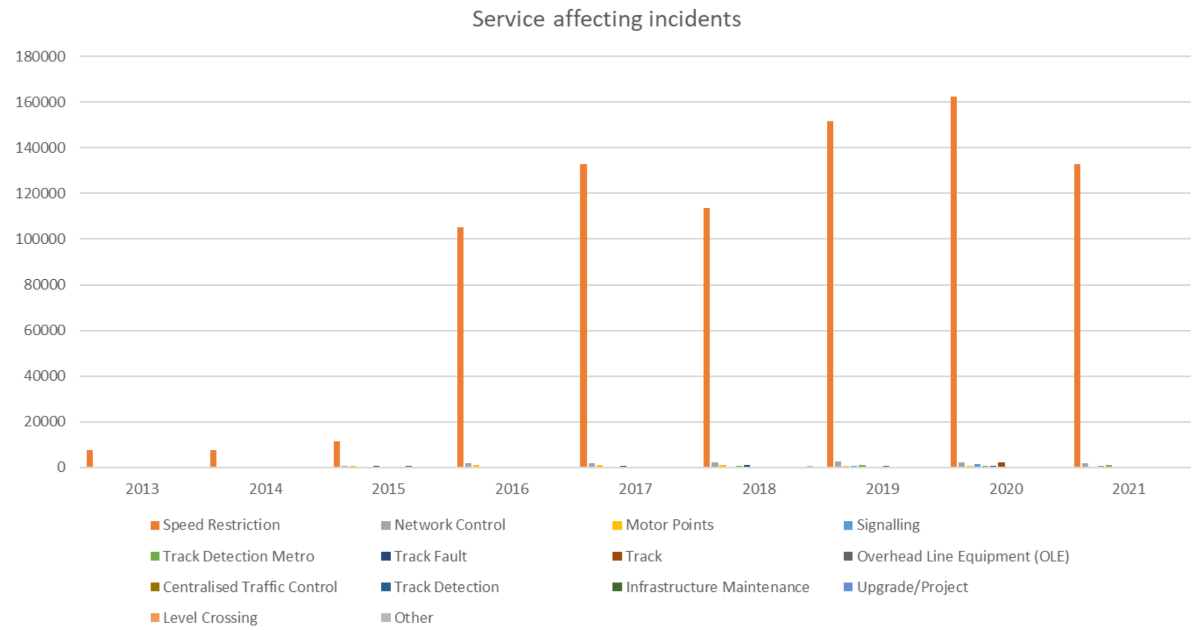


Figure 2-32: Incidents affecting services

Speed restrictions are the main contributors to a lower level of service. Figure 2-33 shows reasons for the speed restrictions:

- TSR based on daily bulletins are planned and are required for a wide variety of operational and infrastructure (project, maintenance, changes to network, etc.) reasons,
- TSRs caused by consequential delays caused by other incidents,
- Heat40 – TSRs are a proactive management response to track faults caused by high temperature (greater than 40 degrees)

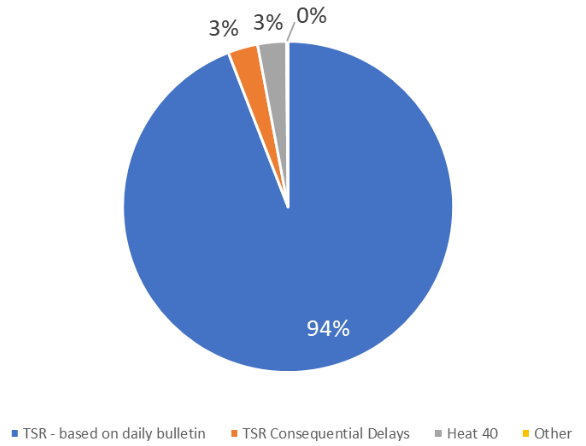


Figure 2-33: Temporary speed restriction causes (2013-2021)

The following charts exclude the TSR data.

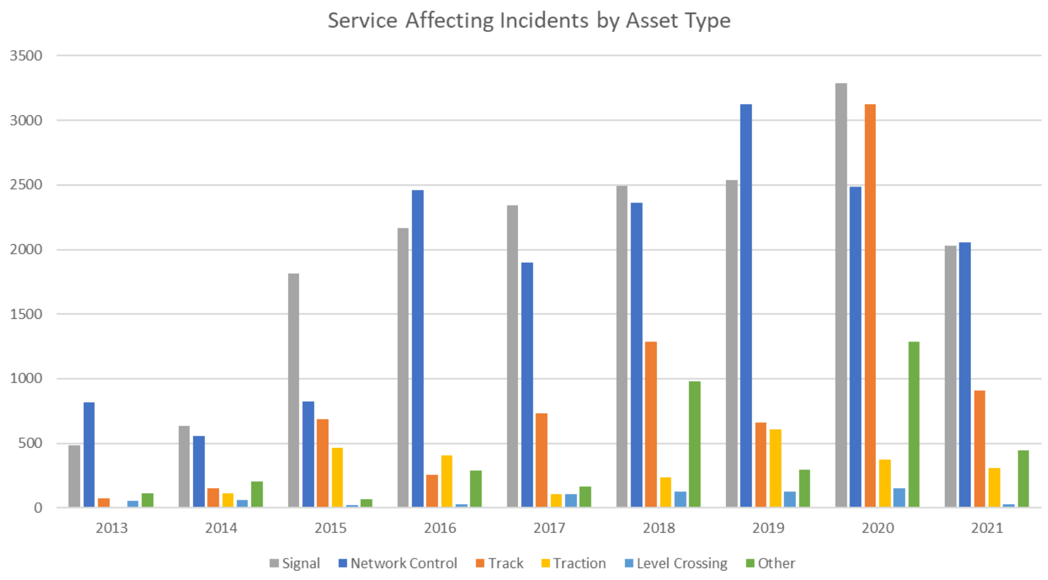


Figure 2-34: Service affecting incidents by asset type (excluding TSRs)

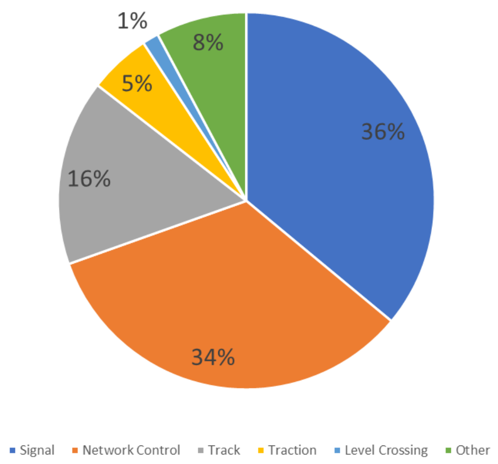


Figure 2-35: Comparative service affecting incidents by asset type, excluding TSRs

36% of recorded incidents, signal incidents include points, detection, and signalling incidents. Network control incidents are related to human factors (train controllers, controllers to drivers, controllers to protection, projects, early or delayed trains).

Track faults, although identified the most through regular inspections, only contribute to 16% of service affecting incidents. However, due to their inherent lack of "fail safe" mechanisms these faults are riskier than signals and network controls issues.

Other factors include a wide variety of reasons such as derailment, adverse weather, fleet allocation, line side fire, animals, etc.

2.3.3.2 FAULTS PROVIDE EVIDENCE OF INADEQUATE MAINTENANCE AND RENEWALS

Faults are an indicator of asset condition and age. The Auckland rail network is subject to more faults than in 2014, but more proactively identified and lower risk faults have been identified than in the past. This shows that there is more work to do before the Auckland rail network is resilient and reliable enough for the services contemplated post CRL opening and beyond.

Track faults are collated from the following sources:

- EM80 – track geometry faults,
- MANUAL or M125 faults identified by track inspectors,
- NDT – faults identified with non-destructive testing (ultrasonic, ECSM, ACFM, PAUT), and
- M155 and 346– faults identified by third parties (train drivers or the public).

Other assets such as signalling, traction, drainage and structures are inspected periodically to ensure compliance with engineering standards and codes.

The graphs below indicates that:

- When Rolling Contact Fatigue (RCF) cracks were properly identified and diagnosed in 2019, the number of active faults increased dramatically.
- Once the Auckland Metro Recovery Programme was set up and funded by the Rail Network Growth Impact Management (RNGIM) project, the worst affected sections were addressed by 2021.
- The network has not fully recovered from RCF, with active faults remaining above 2019 levels, and more repairs still being completed including proactive grinding and polishing.
- The distribution of total faults remains skewed towards:
  - the NIMT – the longest, oldest, and busiest part of the Auckland network
  - the biggest body of asset - track.

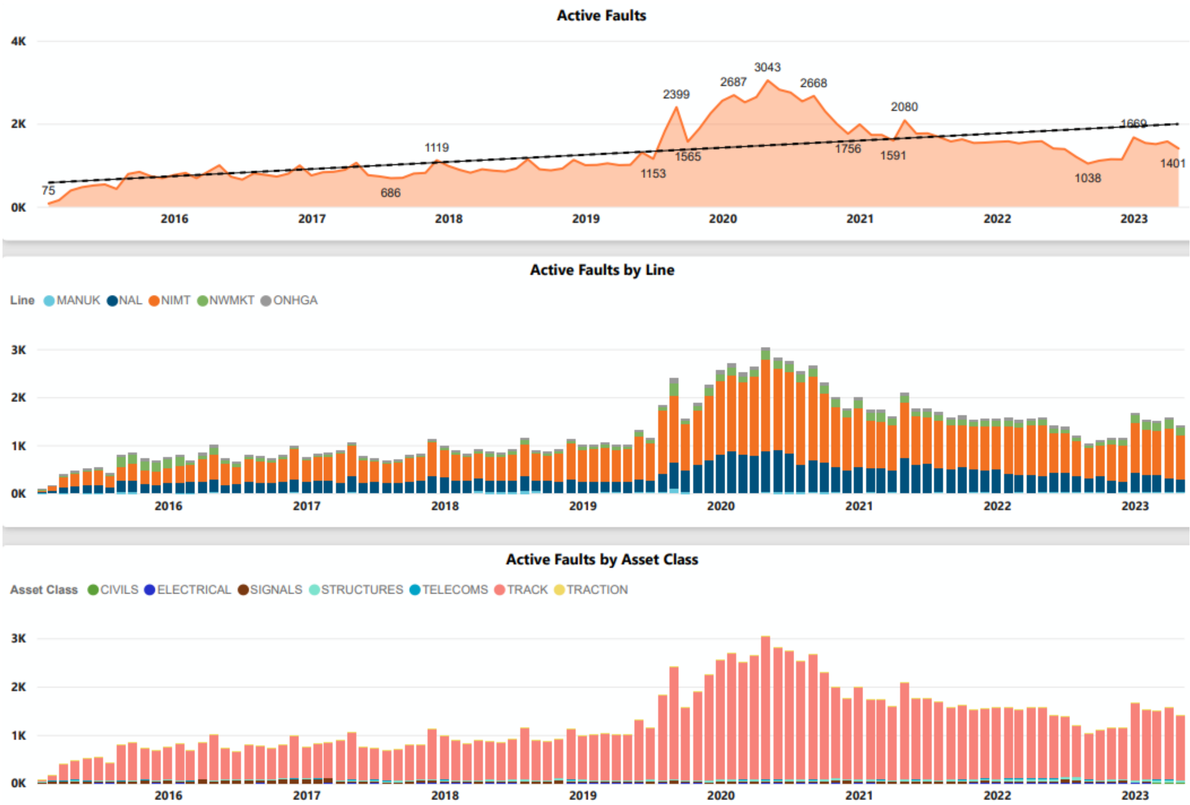


Figure 2-36: Total monthly faults, (excluding RCF) priority ratings 1-20[95]

[95] Source: Faults are recorded in Maximo. Note – Maximo does not record RCF. We note that COVID did not materially affect the fault recordings (except those recorded by third parties).

Faults are assigned a priority rating of 1-20. Priority 1-12 faults, carry the highest safety risk, while Priority 13-20 faults carry a lower risk.

Figure 2-37 shows a noticeable reduction in Priority 1-12 faults in recent years. This is consistent with work programmes focussed on remedying faults with the greatest risk.

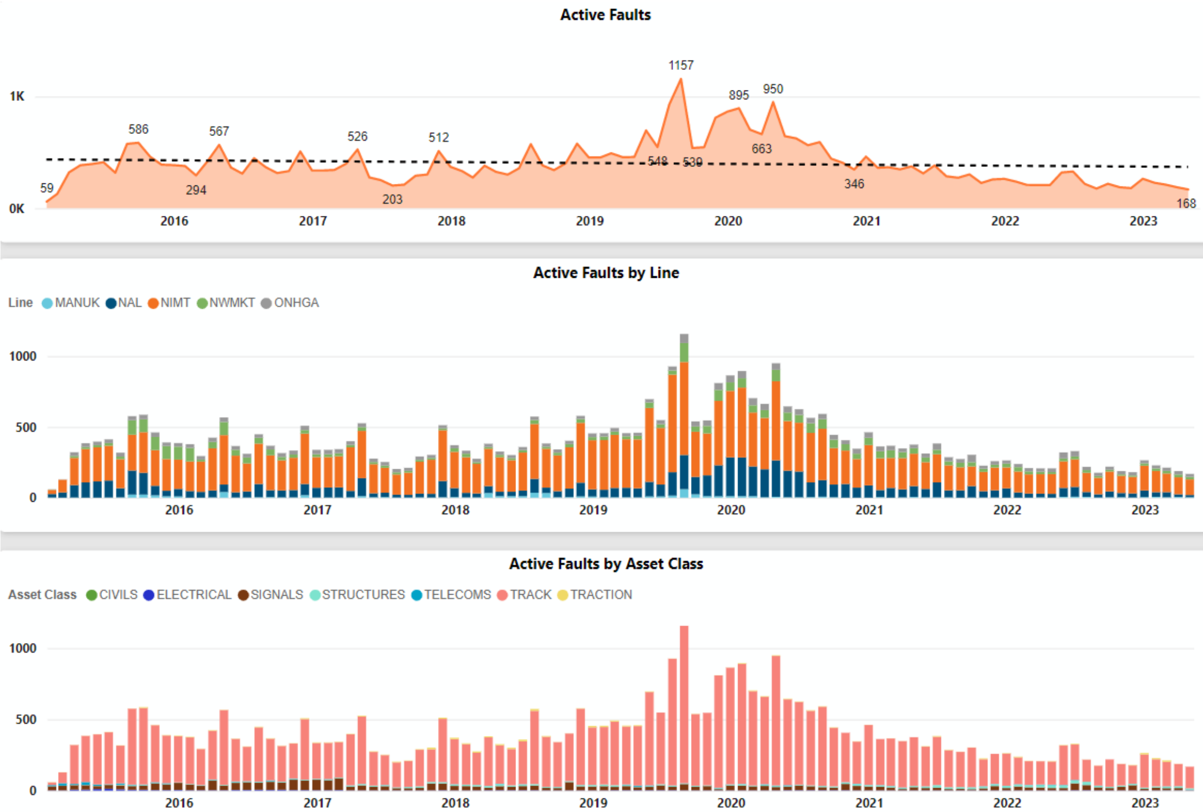


Figure 2-37: Total monthly faults, (excluding RCF) priority ratings 1-12[96]

However, Figure 2-38 indicates that a steady tail of more than 1,000 lower priority track faults remain that have not yet been addressed. The shift from higher priority faults (1-12) to less critical faults (13-20) since the Auckland Metro Recovery programme's establishment in mid-2020 provides some evidence that the recovery programme has made a difference and that a transition to a less reactive maintenance regime is occurring. However, the relatively steady volume of maintenance or renewal works backlog remains a concern. Failure to address this backlog could lead to premature asset degradation that prompts the need for another recovery programme in future years.

[96] Source: Faults are recorded in Maximo. Note – Maximo does not record RCF. We note that COVID did not materially affect the fault recordings (except those recorded by third parties).

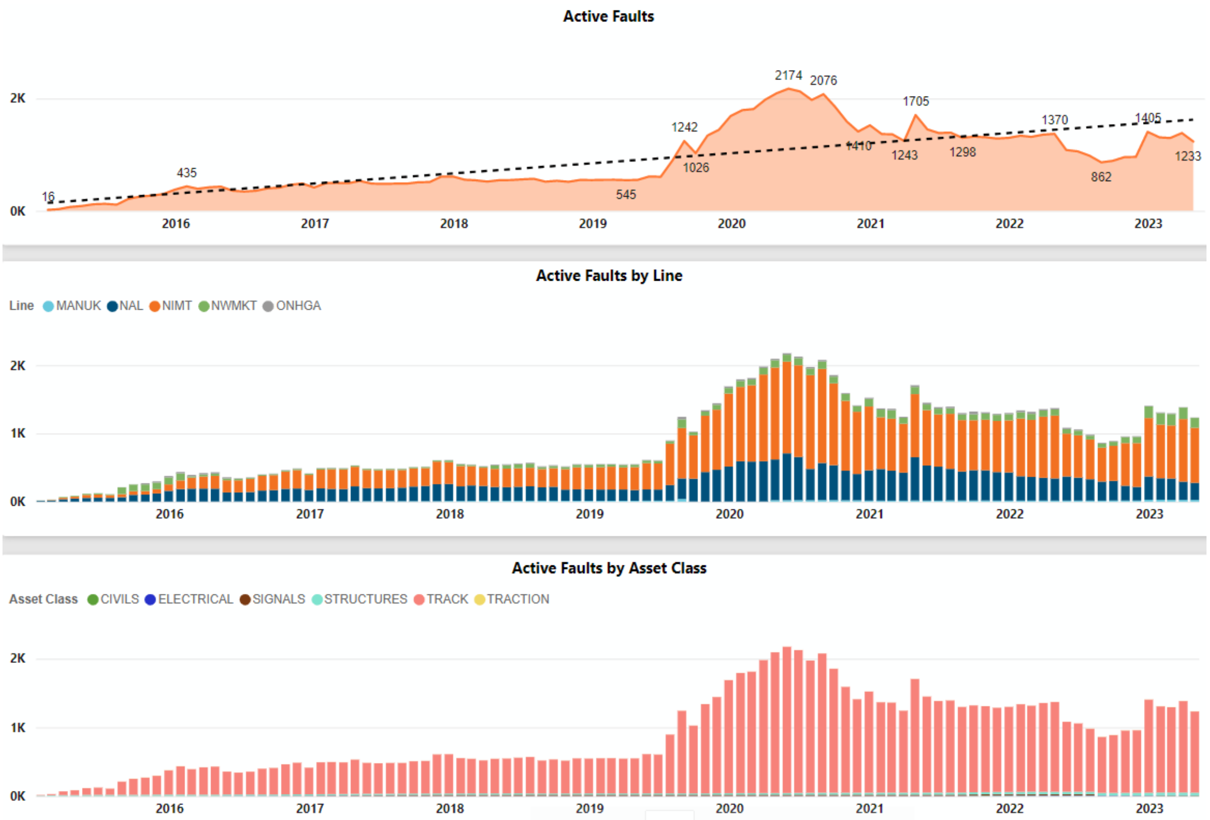


Figure 2-38: Total monthly faults (excluding RCF) PRIORITY RATINGS 13-20

Existing levels of network maintenance and renewals are inadequate and have led to a backlog that has not been fully addressed.

Best practice asset management requires infrastructure replacement through a continuous renewals programme before the assets reach the end of their economic or operational useful life. This timely intervention is to ensure that the level of service is maintained, as waiting to replace the assets at end of economic life can result in more frequent and unpredictable failures and therefore a reduced level of service. Timely intervention also provides a time buffer to plan disruptions and optimise the renewals of the assets (for example geographical grouping of renewal activities).

By contrast, a catch-up renewals programme is a discrete package of works, that is entirely reactive, in that it addresses assets renewal backlog, where renewal is already overdue. Typically, more frequent, unplanned, repetitive, and recurring failures in level of service are experienced by the users because assets have reached the end of their useful life. Reactive repairs are typically costly, which significantly erodes annual maintenance budgets and disrupts preventative maintenance plans, which leads to a vicious circle whereby new assets deteriorate at an accelerated rate, adding to further renewals backlog.

A High-Level Rail Infrastructure Review (HLIR) in 2020 identified a range of weaknesses in asset management of the heavy rail network in Auckland. Contributing factors included lack of resources, inadequate practices, procedures, and insufficient productive time available to undertake maintenance activities.

The HLIR review concluded that a significantly increased level of investment was required to ensure that Auckland's rail network infrastructure is capable of safely and reliably supporting the anticipated growth in rail demand. This review indicated that the current network can only just be maintained and renewed at a minimal acceptable standard with current funding and methods.

Any further increase to metro or freight services, without a consequent increase to maintenance and renewal, is likely to cause the network to deteriorate below a reliable or acceptable level of service.

As described in the next section, the deterioration of levels of service has consequential impacts on customers of the rail network. These effects would only be exacerbated were more line closures required for catch-up renewals and maintenance post-CRL opening.

2.3.3.3 ASSET FAILURES LEAD TO OPERATIONAL RESTRICTIONS WITH MATERIAL CUSTOMER IMPACTS

The most obvious example of customer disruption due to insufficient maintenance and renewals is the rolling closure of lines on the Auckland rail network due to the RNGIM project. The RNGIM project is replacing degraded track and addressing catch-up renewals related to track drainage, formation, ballast, and sleepers across approximately a third of the network. The sheer volume of the backlog of work required to bring the network up to a resilient and reliable state for CRL opening would have meant that it would have taken more than 20 years to complete had it needed to be undertaken during overnight and weekend maintenance windows. Figure 2-39 outlines the degree of catch-up renewals being undertaken through RNGIM.

Western Line:

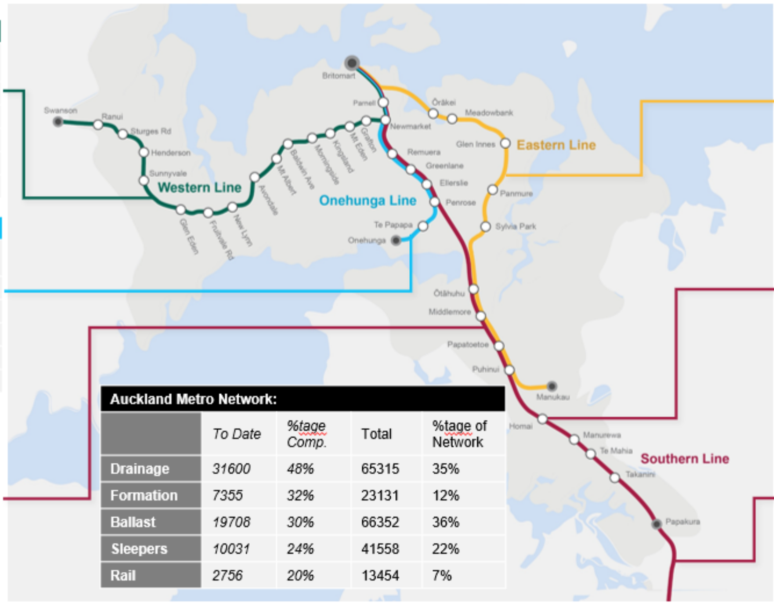
	To Date	Total	%tage of Route
Drainage	4484	10330	22%
Formation	201	3195	15%
Ballast	466	8337	17%
Sleepers	740	1573	3%
Rail	196	2624	5%

NAL South (INCL Newmarket):

	To Date	Total	%tage of Route
Drainage	3597	5491	20%
Formation	3019	4995	18%
Ballast	5834	10828	40%
Sleepers	5067	5067	19%
Rail	1309	1309	5%

NIMT South (Westfield – Wiri):

	To Date	Total	%tage of Route
Drainage	0	3811	22%
Formation	227	1775	10%
Ballast	230	4537	27%
Sleepers	0	4972	29%
Rail	0	2049	12%



Auckland Metro Network:

	To Date	%tage Comp.	Total	%tage of Network
Drainage	31600	48%	65315	35%
Formation	7355	32%	23131	12%
Ballast	19708	30%	66352	36%
Sleepers	10031	24%	41558	22%
Rail	2756	20%	13454	7%

NIMT East (INCL Britomart):

	To Date	Total	%tage of Route
Drainage	15084	24942	77%
Formation	3423	6876	22%
Ballast	12744	21424	67%
Sleepers	418	2806	9%
Rail	1251	2095	7%

NIMT South (Wiri – Papakura):

	To Date	Total	%tage of Route
Drainage	7463	11380	50%
Formation	0	2265	10%
Ballast	0	5200	23%
Sleepers	0	11504	50%
Rail	0	3806	17%

NIMT South (Papakura – Pukekohe):

	To Date	Total	&tage of Route
Drainage	972	9361	27%
Formation	485	4025	11%
Ballast	434	16026	45%
Sleepers	3806	15636	44%
Rail	0	1571	4%

Figure 2-39: Extent of RNGIM project catch-up renewals

Since the start of 2023, the Southern and Onehunga lines between Westfield Junction and Britomart were closed from January to March, followed by the closure of the Eastern line in March, which will remain closed until January 2024. The remainder of the Southern line, the Manukau branch, and the Western line will be closed in stages from 2024 through 2025. While lines are closed, passenger rail services that would normally operate on those sections of the network are cancelled and replaced with limited peak direction services that operate via alternative routing and much slower rail replacement bus services. For people who continue to use the PT system this results in a much slower and less reliable journey. The alternative sees people resorting to driving in place of PT contributing to increased greenhouse gas emissions and congestion.

Data from Auckland Transport's metro patronage report[97] indicates that the severe disruption faced by rail passenger customers is hampering efforts to lift rail patronage back up to pre-COVID levels. Figure 2-40 demonstrates that rail patronage recovery is lagging that of bus patronage by a significant margin[98]. This is despite publicised widespread bus cancellations due to driver shortages and funding constraints.

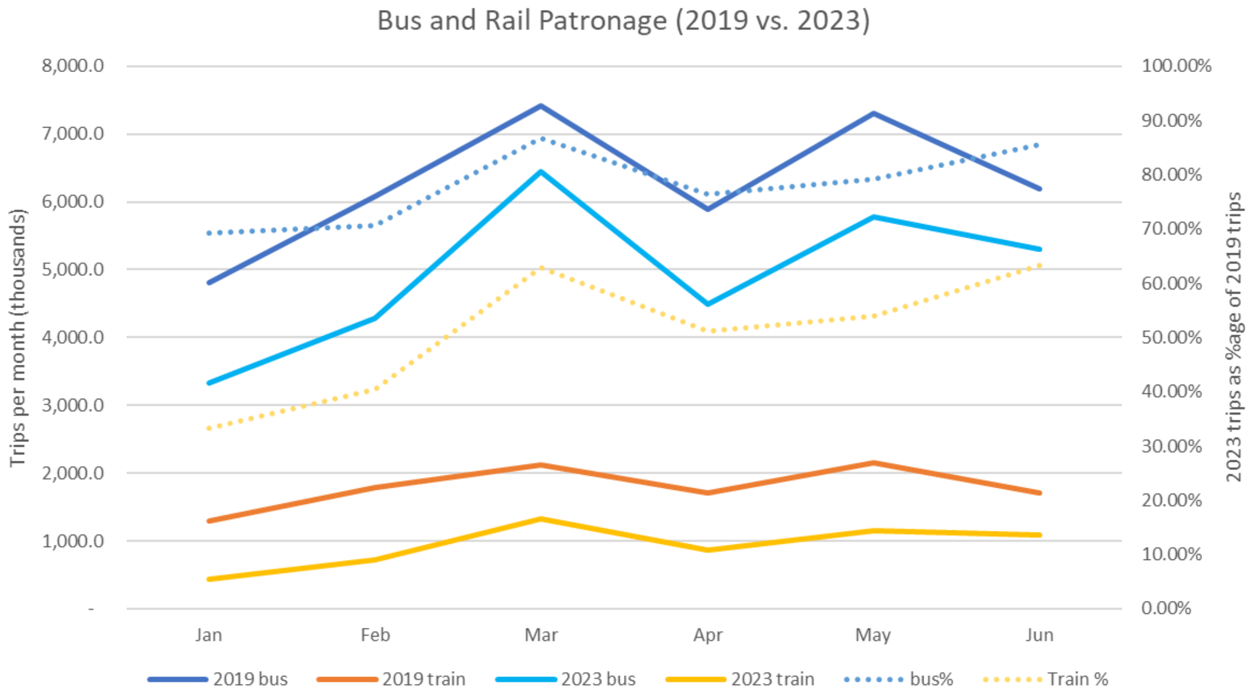


Figure 2-40: Comparison of bus and rail patronage recovery post-COVID

The RNGIM related closures follow network shutdowns in 2020 and 2021 when KiwiRail undertook urgent renewals on the most worn parts of the network over eight months in response to the discovery of RCF. These network shutdowns largely coincided with COVID lockdowns thereby allowing the widespread cancellation of passenger services with minimal impact (see Figure 2-26 and Figure 2-27). However, outside of the lockdown periods, rail passenger services still experienced higher than normal service cancellations and longer journey times due to restrictions placed on the network to ensure customer safety. These measures and their impacts are explored in more detail below.

Even if services can be operated, customer levels of service are materially impacted by faults caused by degraded infrastructure.

Critical faults requiring urgent repairs can cause closure. Lower severity faults typically lead to network capacity restrictions (e.g., TSRs or reduced axle loads) until the fault is resolved. Cancellations and capacity restrictions result in delays, reducing productivity, economic benefits (especially for freight) and the confidence of customers in rail reliability.

[97] https://at.govt.nz/about-us/reports-publications/at-metro-patronage-report/

[98] On the 19th of July 2023, bus patronage was recorded as being higher than the same date in 2019: https://www.stuff.co.nz/national/politics/local-government/132591006/bus-patronage-blips-above-precovid-levels-in-auckland

In addition to KiwiRail's fault reporting, the metro operator also records incidents and their effect on level of service. The following charts show overall and signal related incidents:

- reliability – percentage of timetabled services run (not cancelled) due to KiwiRail attributable incidents,
- punctuality – on time services as a percentage of actual services, and
- completed trips – similar to reliability but also considers the fact that the operator must manage returning services when a train is cancelled.

Total incidents recorded by the operator include track and signal faults primarily. Figure 2-42 indicates that signal incidents play a critical role in the on-the-day service, leading to cancellations of some services, reduced punctuality (delays) and completed trips.

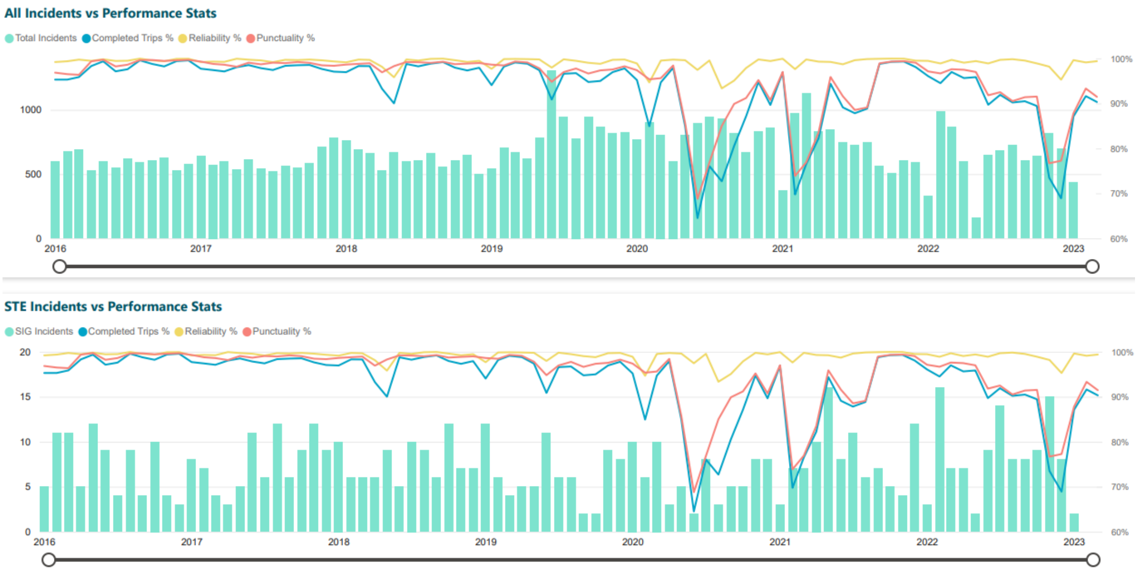


Figure 2-41: Metro operator reported incidents and network performance

The key difference between the charts above are whether TSRs are imposed. TSRs are safety mitigations taken by KiwiRail that enable services to continue running, albeit in a degraded state with reduced punctuality. TSRs are less likely to lead to a cancellation or reduced service reliability, but still have customer impacts because services take longer than they otherwise should. Figure 2-41 shows that punctuality is materially affected by TSRs imposed due to signal faults.

Further analysis of TSRs is available from the network operating management system. Figure 2-42 shows that RCF is another ongoing source of TSRs.

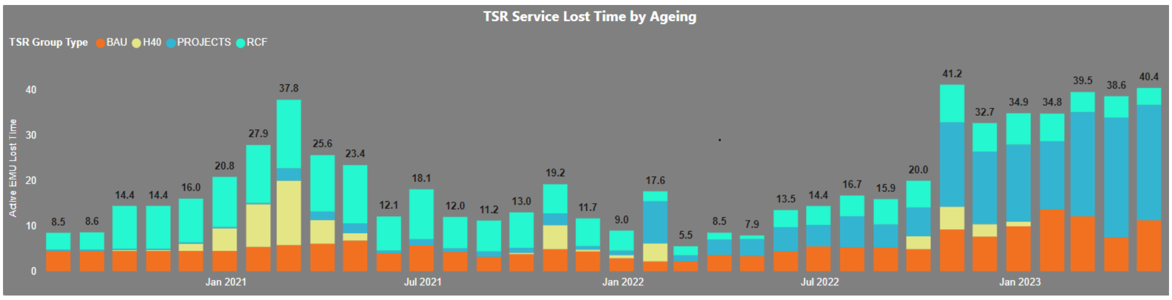


Figure 2-42: Temporary speed restriction service lost time

Since 2022 there has been a significant increase in TSRs, introduced to maintain the safety of the corridor. There is also evidence of seasonally introduced TSRs when the temperature of the track reaches 40 degrees, generating a H40 warning, typically in the spring or summer months, although this has reduced between 2021 and 2023.

The consequence of TSRs is slower train services for passengers. Since 2013 on average there have been 89 service cancellations per month. Overall, this is 0.7% - 1% of timetabled services. Note some cancellations are due to TSRs (i.e., the decision is made to cancel delayed services).

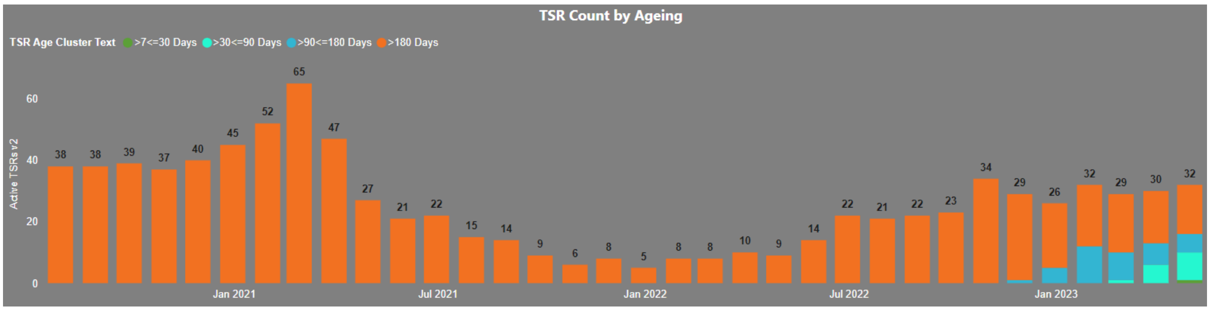
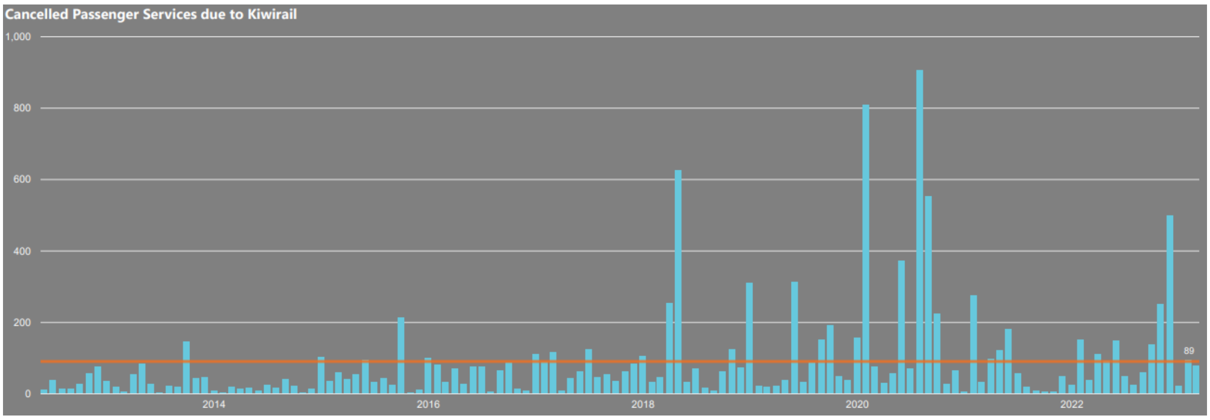


Figure 2-43: TSR Count



Cancelled passenger services data are extracted from Compass, used by Auckland One Rail (Network Operator).

Figure 2-44: Cancelled passenger services

Whilst some TSRs may have a short effect, track related TSRs have long lead times and prolonged lower service levels for customers. The average length of TSRs is lower than its peak in 2021, yet in 2023, half of the TSRs have been in place for more than 180 days.

Apart from H40 TSRs, other TSRs are heavily dependent on the state of the asset. Provided safety is not compromised, over time customers would receive a better level of service if the level and length of TSRs could be reduced. Increased maintenance and renewals would both reduce delays due to infrastructure failure and the need for TSRs once the maintenance and renewal backlog has been addressed.

2.3.3.4 PRODUCTIVE MAINTENANCE ACCESS TIME IS INADEQUATE

Productive maintenance access time is inadequate; more maintenance time and productivity improvements are required.

Regular rail infrastructure inspection, maintenance and renewals are required to support reliability.   There are fewer impacts on customers if maintenance and renewals can be scheduled overnight. The alternative to overnight maintenance is line closure during daytime operation; known as a block of line (BoL). Currently due to the backlog of renewals activity there is a heavy reliance on extended BoLs. In a normal year, there are 26 days of BOL[99], which is insufficient to meet renewals requirements[100]. Furthermore, Auckland Transport has requested a future model with less reliance on BoLs due to the material customer impacts these have. This would require more access time be made available for overnight maintenance than is currently available.

Figure 2-45 shows, by line, the limited amount of time available each day for maintenance access on the Auckland rail network with existing timetables. On average the productive time available for maintenance is three hours per night - an hour less than the times shown because of set up and pack down requirements. With current maintenance practices, six hours of productive maintenance time are required which means lines must be free of train movements for at least seven hours to enable the safe set up and pack down of the sites. The existing traction and OLE configuration partially drives this by requiring power to be isolated to both lines for long sections of track.

Under an overnight maintenance model, a 6-hour productive window is targeted. An example of a typical overnight maintenance activity such as sleeper replacement, destressing, switch replacement, rail, and turnout repair, is as follows:

- rail changing requires a minimum of two welds per activity, and
- each weld takes 2.5 hours.

This leaves little time to remove and replace the rail.

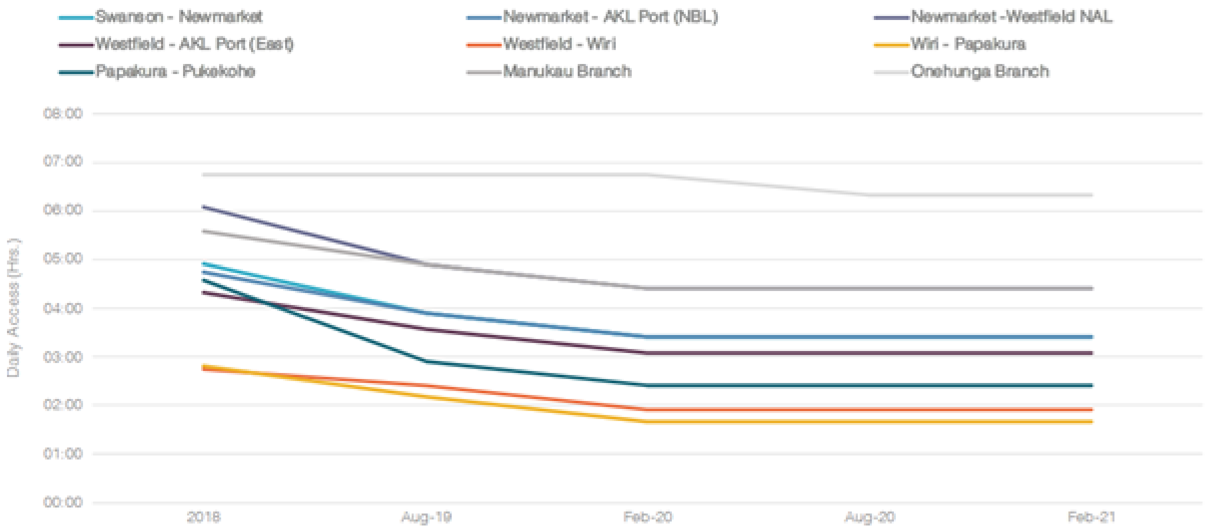


Figure 2-45: Maintenance access across lines

Figure 2-45 shows that the necessary time for maintenance is currently only available on the OBL, the least busy line of the network. For all other lines, there is insufficient productive maintenance time. On the Westfield to Papakura section, available maintenance access is only two hours per night, due to its critical role for all-day freight movements as well as heavy daytime use by metro. It is also important to note that the desire to encourage mode shift by meeting demand

[99] Made up of public holiday length weekends/periods in any given year and Christmas shutdown.

[100] Formation renewals productivity is currently ~ 40m per day, with variation materially impacted by conditions. If KiwiRail were 100% reliant on block of lines, to renew 100km of formation would take approximately 2,500 days or 7 years working every day with at least one line blocked.

with a more frequent service throughout the day and later into the night is a direct challenge to increasing available maintenance windows.

If sufficient access for maintenance and renewals is not available, then continued safety risks and declining levels of service (such as service cancellations and poor travel time reliability) for rail passenger and freight customers can be expected, as discussed in relation to Problem Two.

Once backlogs have been addressed a smoothed renewal programme would need to be implemented to remove the reliance on block of line renewals.

Changes required include:

- protecting a 6-hour overnight productive maintenance window (for works or non-destructive testing). This is currently problematic for metro operations, however, RNGIM is currently delivering crossovers that will enable single line running with a 30-minute timetable.
- ensuring there is sufficient plant and equipment for inspection and maintenance, as well as highly productive renewal equipment appropriate for the busiest part of New Zealand's rail system. Currently, specialised track maintenance work trains are continuously rotated around New Zealand based on a time-based intervention. To achieve the desired maintenance outcomes, plant, and equipment critical to the operation of the Auckland network needs to be prioritised at a local level, within the context of the national plant and equipment strategy. Alternatively, additional equipment is required to be dedicated to the Auckland network.
- rail mounted equipment such as work trains, ballast trains, grinders, etc. require stabling and depot/workshop space in proximity to the Auckland network and its associated maintenance facilities (mechanics, spares, specialised tools, etc.). In addition, extra operators are required, and special training programmes funded.
- protecting shoulder periods to enable productivity increases and completion of the required works. For example, completing work that can be carried out under live lines and next to open lines outside of night-time windows. These works include non-destructive testing, automated track inspection, re-sleeper, ballast drop, geometry repair, destress, rail changing, weld repair, inspection, tamping, grinding, stone blowing, polishing, milling, rail delivery, drainage repair, bridge maintenance, civil works, vegetation, graffiti. These works need to be supported by improved warning systems (ATWS is currently being trialled).
- maintenance risks will increase in a future state with very high utilisation of track. Additional tracks are a key intervention to improve resilience and allow critical renewals to occur. As the network grows beyond two tracks in some sections, there is a case to target lower peak capacity utilisation and take the opportunity to address any renewals gaps for those sections of the network.

2.3.3.5 ASSET MANAGEMENT MATURITY IS INCREASING BUT WILL NOT BE RESOLVED OVERNIGHT

KiwiRail has a national Strategic Asset Management Plan[101] that sets out the approach to asset management by asset class. The baseline condition assessment has been completed for Auckland and the final 30 Year Asset Management Plan for Auckland is scheduled to be complete in early 2024.

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[101] KiwiRail Strategic Asset Management Plan – Rail Network 31 January 2023

Key challenges anticipated in the Auckland Asset Management Plan are:

- Meeting concurrent needs of metro and freight trains.
- Expected growth in passenger numbers and metro trains "post CRL".
- Changes to the Metro fleet to 9 car operation.
- Expectations for higher LoS for metro passengers.
- Freight trains volume growth.
- Additional assets created as part of CAPEX (e.g., CRL, P2P, W2QP, AMP).
- Constrained corridor access for delivery of essential work.
- Expectations for increased environmental protection.
- Impacts of climate change and the level of resilience to natural hazards.
- Historical under-funding and reduced risk tolerance to asset failure.
- New technologies and local requirements.
- Experience and maturity in asset management resources.

Key long term lifecycle Investment Objectives are to:

- Enhance network safety.
- Improve asset reliability.
- Move to a preventative maintenance model which considers network expansion and the wear and tear caused by increasing train volumes.
- Enhance resilience to natural hazards and climate change.
- Provide adequate track access times.
- Optimise whole of life costs.

KiwiRail is in the process of addressing the HLIR recommendations. Key interventions underway or complete are:

- Significant change to codes, standards, development and maintenance and asset management process training and practices to enable a step change in maintenance delivery.
- Accelerated investment in renewals to address historical formation, drainage, and track issues, to bring the network up to a modern metro standard. The initial priority (that is funded) is to address pre-1986 era assets via the RNGIM project.[102]
- Improved network resilience with new crossovers and signalling upgrades to allow single line running; on-tracking pads and faster isolation of traction wires to allow earlier start and later demobilisation for night works.
- Increasing available productive maintenance access hours.

[102] The initial Rail Network Growth Impact Management project scope was $181m. It is subject to cost scope adjustment in FY23. This programme of work needs to be delivered prior to CRL opening.

Figure 2-46 illustrates the transition required to move from a rail network initially built and maintained for freight services, to one suitable for mixed metro services serving metro, freight, and regional customers, that is also capable of being maintained to a reliable standard. The colour coding indicates the capability at the end of the currently funded rail programmes.

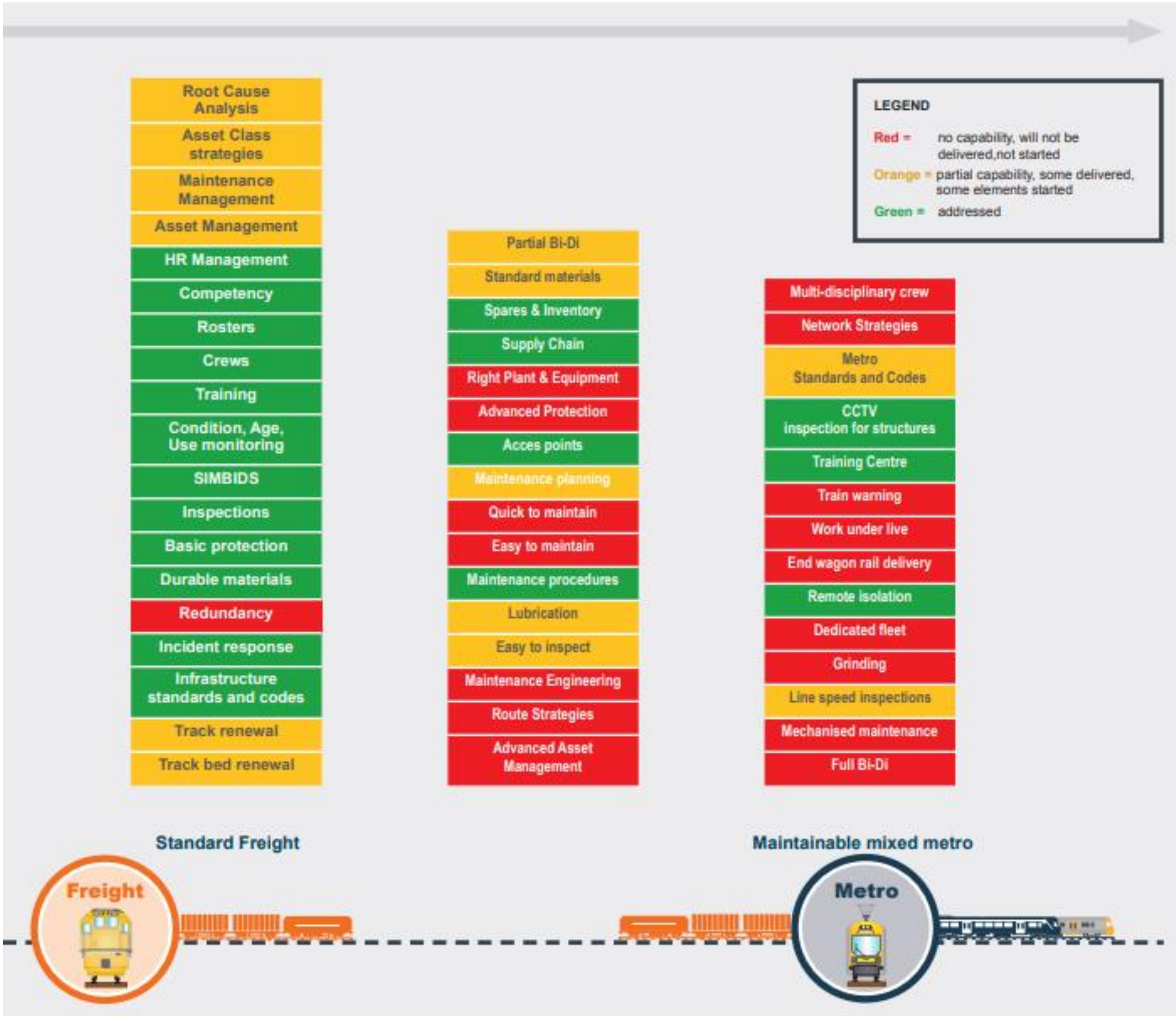


Figure 2-46: Estimated capability state (2025)

Because the asset has been in a state of managed decline it won't reach steady state overnight. Despite the significant investment and change underway at present, it is anticipated that changes in inspection with Auckland Track Inspection System (ATIS) and non-destructive testing (NDT) and increasing service volumes will lead to high maintenance and renewal workload levels going forward. As such, the need for continued focus in this area will remain critical.

A turnaround requires both a step-change in maintenance and renewals practices and the funding to enable it.

Since the revitalisation of Auckland's rail system, and especially since the electrification of the network, there has been continued increases in the number of rail PT services operated. The wear and tear of these services on the rail network was underestimated and the growth in services has not been matched by sufficient funding for backlog renewals and proactive maintenance.

Increasing the annual maintenance and renewal spend means Auckland Transport needs to increase their share of the funding, however they face severe funding constraints. As a result, funding for maintenance and renewals has been capped since the start of the ANAA, thereby creating a progressive buildup of backlog in both maintenance and renewals. The level of renewals Auckland Transport has been able to fund over the past 2 years is approximately $6M/yr.

It is noted that a reduction in level of service will gradually lead to less rail use, which in turn affects Auckland Transport's farebox revenue and therefore its ability to fund KiwiRail for maintenance and renewals. This vicious circle will worsen the deficit if unaddressed.

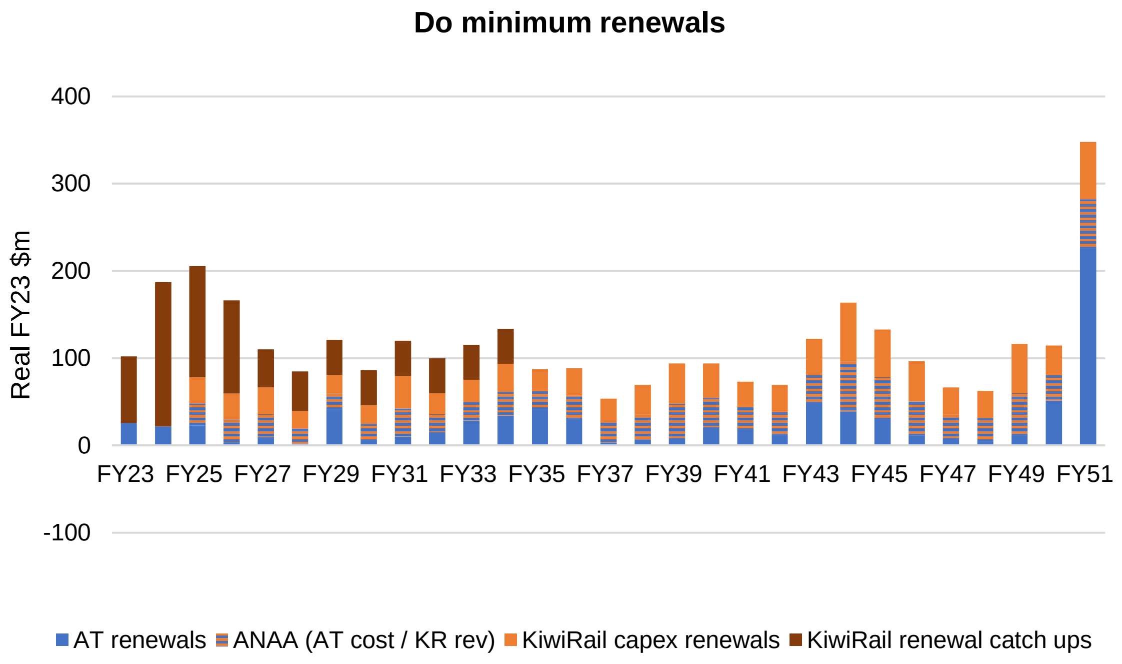
Going forward the sector will also need to transition to new methodologies with different plant and equipment requirements and a programme that renews life expired assets before they deteriorate, rather than through one-off, exceptional, programmes. At present, due to funding constraints at a local level, metro services are not able to fully contribute to the annual ongoing renewals requirements – the shortfall is estimated to be between $40M to $60M, which includes OPEX and CAPEX. In FY23 few of the KiwiRail requested renewals priorities were funded within the allocated Auckland Transport user contribution value meaning the maintenance budget was reduced and RCF remediation, preventative grinding and non-destructive testing had to be fully deferred.

Continuing to maintain a life expired asset is uneconomical and increases the risk of in-service failure. The imbalance between affordability and level of service is being exacerbated by the need to allow more trains to run on the tired network, leading to increasingly frequent network disruptions.

This is concerning because:

- in the face of insufficient funding availability, maintenance and renewals are de-prioritised by the user and KiwiRail is left with a funding gap,
- the imminent opening of CRL will bring with it a step change in service levels. A step change in maintenance and renewals is required to maintain the network in a resilient and reliable state for current services, and to manage the growth that will occur in the near future, and
- a higher maintenance standard, preventative maintenance and associated enhanced inspections are expected to lead to a higher workbank. Proactive polishing, grinding or milling programmes are recommended to preserve rail life and prevent RCF. Ultimately while this ought to improve whole of life cost it will crystallise costs earlier in some instances.

Figure 2-47 shows the scale of annual forecast costs, under an illustrative Do Min scenario for a CRL Day 1 reduced timetable, and the forecast cost share based on current approaches.



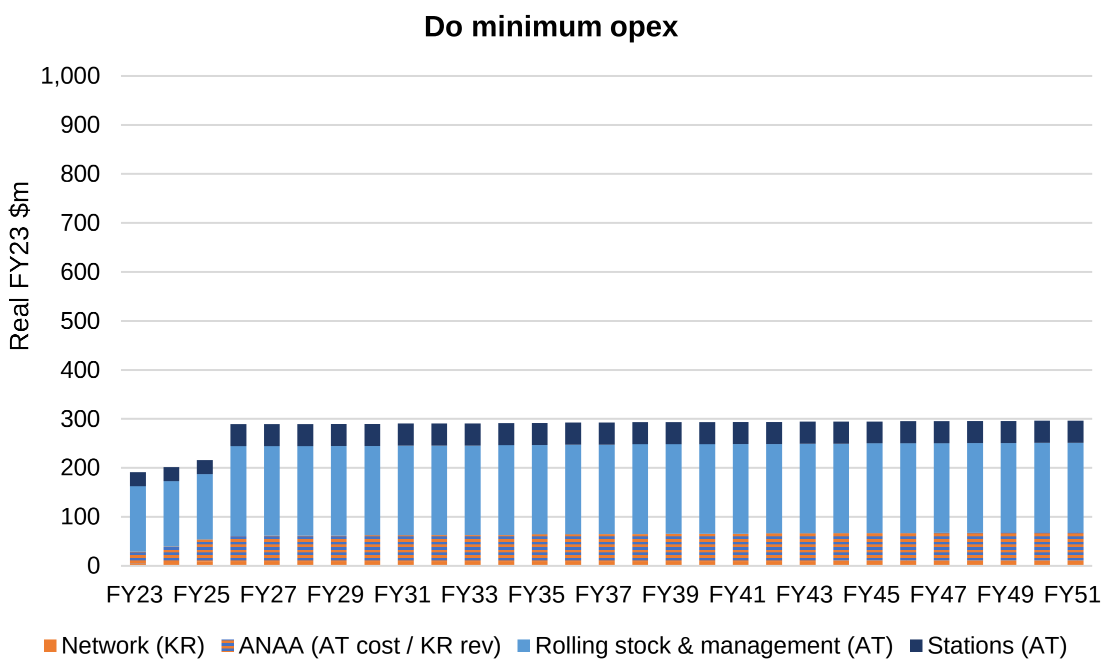


Figure 2-47: Do Min renewal and opex costs (escalation is excluded)

Currently, business as usual maintenance and renewals needs cannot be met with current funding. Therefore, with material growth in services expected, affordability will continue to worsen.

Failure to address affordability challenges and stop this vicious cycle will lead to more rapid deterioration of network assets and could substantially add to the existing renewals backlog. Mitigation strategies, such as temporary speed restrictions or service restrictions, will increasingly impact customer levels of service given the expected increase in patronage post-CRL opening, undermining the potential for mode-shift. Furthermore, a failure to adequately maintain the network would undermine the effectiveness of recent catch-up renewals and new infrastructure investment.

Further investment is also required to address the current and growing renewals backlog. The RNGIM project only addresses pre-1986 era assets, leaving renewals for assets from 1986 (and sometimes earlier) to 2000 unfunded. This also assumes that post-1986 assets have been well maintained over their lifespan. However, the previous lack of funding for long-term proactive maintenance means that post-1986 asset lifespan will have reduced from the 20-25 years that could be expected in ideal conditions. Therefore, more post-2000 assets are also likely to need renewal. KiwiRail estimates that post-RNGIM there will remain up to 33% of the rail network that is past the end of its economic life, therefore meeting the definition of backlog renewal.

An extension of the Rail Network Rebuild[103] is required to remedy this renewals backlog. This cannot feasibly be delivered prior to CRL opening and therefore:

- some level of trade-off is likely to be required for a period after CRL opening where either:
  - fewer services than desired are run (e.g., services capped to the maximum that the network could take without accelerated degradation), or
  - there remains some level of accelerated wear on the network.
- maintenance and renewal productivity will need to be improved to ensure that the backlog renewals can be addressed without the full line closures required by the RNGIM project, and
- a more sustainable / affordable funding solution will need to be developed.

All other things equal, if the Auckland network does not receive sufficient planned maintenance and renewal funding on an ongoing basis:

- reliability is expected to worsen. This will continue to undermine mode shift goals and the infrastructure provider's reputation, and
- it will not be prudent to accommodate the forecast increase in services from CRL Day 1.

The consequence is that recent rail investment will not deliver the expected benefits, including mode shift, if services are not able to operate at the expected frequency and capacity.

It is recommended that consideration be given to whether changes are required to the user pays funding model, given the inherent risk that:

- the current model of 49% local user pays and 51% taxpayer funding is insufficient,
- there will be ongoing deferral of maintenance and renewals given local funding constraints, and
- without a more reliable service, mode shift aspirations will not be met.

It is not for the PBC to address this, but it is noted that a range of views have been expressed on the incentives:

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[103] For ease of public communication, the catch renewals / service disruption activities of the Rail Network Growth Impact Management (RNGIM) programme has publicly been called the Rail Network Rebuild (RNR).

- From the Crown perspective, it may appear that it is in the users' financial interest to maintain the current approach of limited continuous maintenance and renewals because the Crown pays for catch-up renewals.
- From a KiwiRail perspective, a model which continues to incentivise underinvestment in maintenance and renewals is suboptimal and perpetuates lower levels of service than desirable and with reputational risks for KiwiRail.
- From an Auckland Transport perspective, its funding constraints do not enable it to fully support the level of maintenance and renewals forecast by KiwiRail.

To support the 30-Year Auckland Rail PBC, it is critical for the sector to work with the Crown to resolve the affordability challenges associated with the funding model for ongoing maintenance and renewals and produce the right size services costs and benefits to Auckland.

2.3.4 PROBLEMS SUMMARY

As outlined in the sections above, the supporting evidence for the problem statements shows that:

- A range of constraints, predominantly related to infrastructure, limit the capacity of the rail network. Required growth in freight and passenger rail travel cannot be accommodated meaning that target mode shift to rail will not be achieved and the Government's committed emission reduction targets will not be met.
- Many passengers and freight customers are deterred from choosing rail because of inadequate level of service. Contributing factors include metro station accessibility, service travel time, directness, frequency, reliability and punctuality, safety concerns and overall accessibility. This results in less efficient outcomes including increased road-based travel, congestion and emissions and poorer productivity.
- Service reliability and punctuality problems are typically related to maintenance issues that, without intervention, will worsen as train volumes increase and assets continue to age and deteriorate. These issues are compounded when capacity is constrained as there is little to no redundancy within the system to respond to or recover from these issues.

2.3.5 BENEFITS OF INVESTING

Benefits for investing in the Auckland rail network over the next 30 years were identified and agreed following the ILM workshop on 10th March 2022 and reviewed on 16th January 2023. The benefits, their respective weightings and KPIs are:

Figure 2-48: Weighting of investment objectives

- Reduced greenhouse gas emissions from road transport 40%

  Addressing network constraints and poor levels of service will shift travel demand away from road transport and onto rail, a more sustainable, efficient mode. This will reduce private VKT and contribute to the Government's committed emission reduction targets.

  - KPI 1: CO2 emissions
  - KPI 2: Rail mode share
  - KPI 3: Reduction in road vehicle travel

- Improved attractiveness of rail as a transport choice for passengers and freight 45%

  Addressing network constraints and poor levels of service and maintaining the network well will enable a greater range of reliable passenger and freight services. This improved service offering will promote rail as a viable transport choice, encourage mode shift and allow rail to deliver a greater share of the transport task for Auckland into the future.

  - KPI 4: Rail patronage
  - KPI 5: Reduction in road vehicle travel
  - KPI 6: Freight tonnage – rail
  - KPI 7: Freight tonnage - road
  - KPI 8: Rail network reliability
  - KPI 9: Available maintenance window
  - KPI 10: Reduction in exposure to road-based safety risks

- Improved Urban Development Patterns 15%

  Policy changes like the NPS-UD support a more intensive, integrated (transport and land use) approach to urban growth. Addressing network constraints and poor levels of service will make it more attractive to live close to rail stations and to use a better performing rail network, therefore helping to deliver on the outcomes sought by the NPS-UD and improving the sustainability of Auckland's urban growth into the future.

  - KPI 11: Employment accessibility
  - KPI 12: Population within rail catchment

2.3.5.1 BENEFITS MAP

Table 2-7 outlines the benefits and measures of successfully investing to address the identified issues and opportunities. Measures have been chosen using the Waka Kotahi Land Transport Benefits Framework and Management Approach, August 2020 (LTBMF).

Table 2-7: Benefits, Key Performance Indicators (KPIs) and measures

BENEFIT	KPI NO.	KPI	MEASURE REF (LTBMF)	MEASURE	BASELINE (METRICS INFORMATION TBC)
Reduced greenhouse gas emissions from road transport (40%)	1	CO_2 emissions	8.1.1	Tonnes of CO_2 equivalent emitted from road transport (AKL region, all trip purposes) Net CO_2 equivalent emitted for inter-regional freight with origin/destination in Auckland	Council TERP team, Auckland Transport for regional transport emissions total, or MSM KiwiRail (addressable freight analysis)
	2	Rail mode share	10.2.1 5.2.3	Metro passenger rail trips as a portion of all non-freight trips Freight tonnage moved on rail as a portion of addressable freight tonnage	Auckland Transport - observed or 2018 model run. KiwiRail
	3	Reduction in road vehicle travel	8.1.2	Road VKT (by vehicle class e.g. car, HCV)	Model (AFC) or Observed (Ministry of Transport (MoT)/WK)
Improved attractiveness of rail as a transport choice for	4	Rail patronage	10.1.1	Annual metro passenger rail boardings Annual interregional passenger rail boardings	Auckland Transport rail service data
	5	Reduction in road vehicle travel	8.1.2	Road VKT (By vehicle class, e.g., car, HCV)	Model (AFC) or Observed (MoT/WK)

BENEFIT	KPI NO.	KPI	MEASURE REF (LTBMF)	MEASURE	BASELINE (METRICS INFORMATION TBC)
passengers and freight (45%)	6	Freight tonnage - rail	5.2.3 / 5.2.5	Annual freight tonnage moved on rail as a percentage of total freight; and/or Annual freight tonnage moved on rail	KiwiRail
	7	Freight tonnage - road	5.2.3 / 5.2.5	Annual freight tonnage moved on road as a percentage of total freight; and/or Annual freight tonnage moved on road	KiwiRail
	8	Rail network reliability	4.1.2	Rail network utilisation (%age against UIC 406 planning limits) Number and duration of service disruptions because of network faults Number and duration of temporary speed restrictions (TSRs) imposed.	KiwiRail KiwiRail / AOR
	9	Available maintenance window	4.1.2	Productive maintenance availability (average hours per day)	2-2.5hours (KiwiRail TBC)
	10	Reduction in exposure to road-based safety risks	1.1.3	Number of deaths and serious injuries on the road network (annual)	Auckland regional DSIs per million VKT (annual)
Improved Urban Development Patterns (15%)	11	Employment accessibility	5.2.6	Number of job opportunities accessible within 30 min and 45 min by PT in the AM peak	AFC - MSM output (for 2018)
	12	Population within rail catchment	10.2.6	Number of people residing within 1km of a rail station	Either Census SA2 analysis or MSM output (for 2018)

2.3.6 *OUTCOMES*

2.3.6.1 INVESTMENT OBJECTIVES

Investment objectives were developed based on the identified problems and benefits as part of the ILM workshop, with project partners and key stakeholders, as follows:

Investment Objective One – Continually increase the use of rail in Auckland (all markets) over the next 30 years, by increasing its attractiveness*

**attractiveness factors include reliability, frequency, capacity, and travel time*

Investment Objective Two - Reduce Auckland's net transport emissions by increasing rail's mode share over the next 30 years.

Investment Objective Three - The Auckland rail network supports and enables a denser urban form within the metro station catchments within the next 30 years.

Investment Objective Four - The Auckland rail network is resilient and reliable for the future.

- Achieved by increasing the available window for productive maintenance to 6 hours per day (on average[104]) and keeping network utilisation below UIC (International Union of Railways) 406 planning limits for utilisation[105].

These Investment Objectives were identified as the primary reasons for investment and have been used as key criteria to be met by the preferred programme. The Investment Objectives are measured through the KPIs as previously outlined in Table 2-7, with further line of sight summarised below in Figure 2-49.

[104] Maintenance access requirements are expected to reduce across time as renewals improve the state of the network and maintenance plant, equipment and methodologies are improved. Initially, the need is for an 8hr maintenance window and 6hr average productive window on average, per line per night. By 2051, the investment (including 4 tracks, and to a level of predictive maintenance) is expected to require an 8hr maintenance window and 6hr average productive window in at least two sections of the network per night

[105] UIC 406 recommends planning utilisation limits to ensure network operations can be sustained at reliable levels. These planning limits are percentage limits of theoretical capacity, which depend on the nature of operations on the network. For example, under a passenger-only network, the planning limit is 85% of theoretical capacity in the peak hour (70% across the day); for mixed operations (passenger and freight), such as is the case in Auckland, the planning limit is lower, at 75% of theoretical capacity in the peak hour (60% across the day). These lower values reflect the issues associated with the different operating characteristics of the two rail modes (passenger and freight).

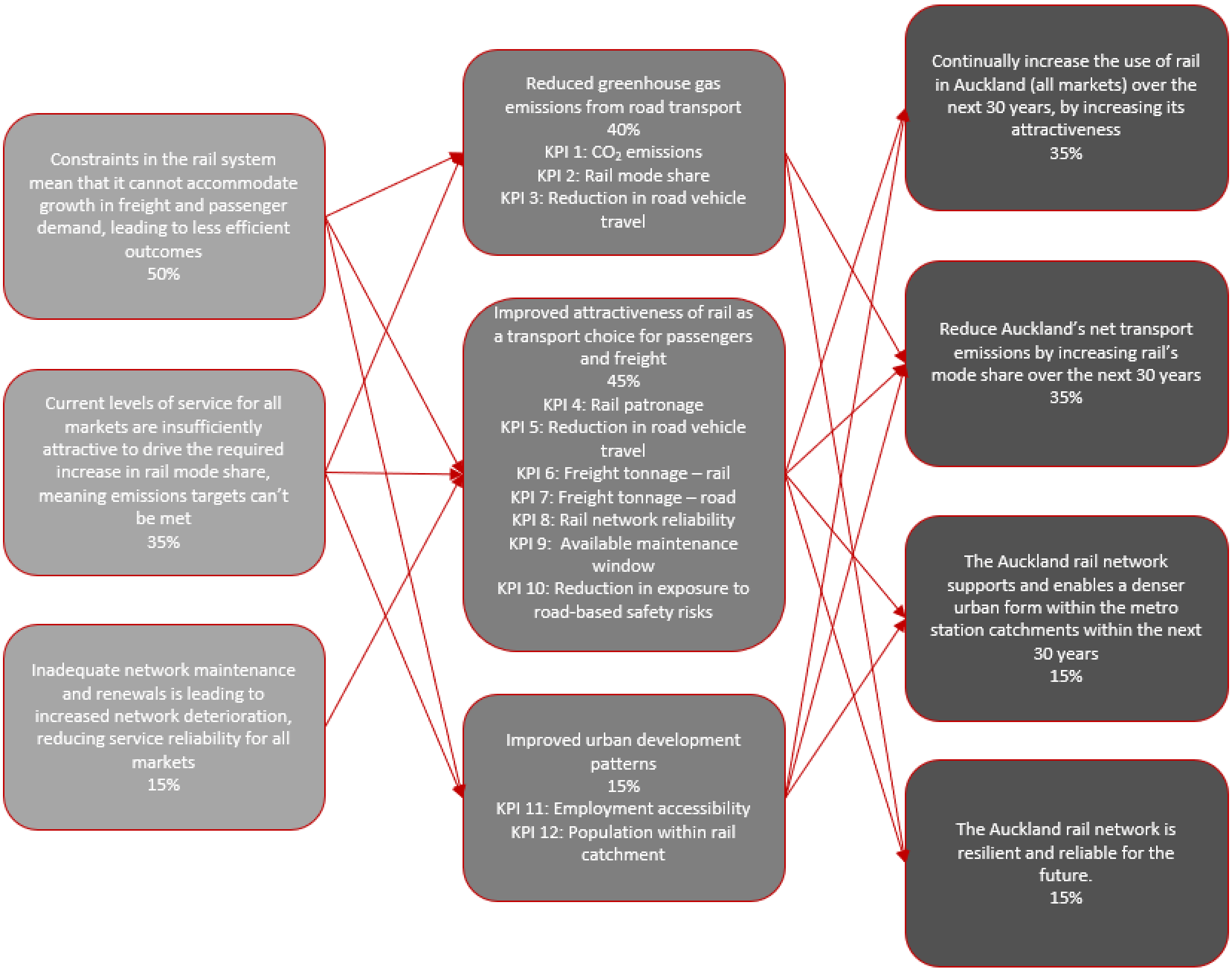

Figure 2-49: Problem statements, benefits, and Investment Objectives

2.3.6.2 STRATEGIC ALIGNMENT

The Investment Objectives and outcomes identified for the Auckland rail network will directly deliver on Government's strategic direction as set out in the Government Policy Statement for Land Transport 2024[106]:

- Emissions reduction: transport related greenhouse gas emissions will fall significantly, while providing a more sustainable. Inclusive, safe, and accessible transport system for all New Zealanders
- Safety: develop a transport system where no-one is killed or seriously injured
- Sustainable urban development: People living in our towns and cities can readily access places to work, study, shop, and access other amenities nearby and through a variety of transport options. The transport system enables more people to live and travel in urban areas by prioritising space-efficient modes such as PT, walking and cycling.

[106] https://www.transport.govt.nz/area-of-interest/strategy-and-direction/government-policy-statement-on-land-transport-2024/

- **Integrated freight system:** well-designed transport corridors with efficient, reliable, and resilient connections will support productive economic activity.
- **Maintaining and operating the system**: the condition of the existing transport system is efficiently maintained at a level that meets the current and future needs of users.
- **Resilience**: minimising and managing the risks from natural and human-made hazards, anticipating, and adapting to emerging threats, and ensuring the transport system recovers effectively from disruptive events.

More detail on specific strategic documentation is provided in Appendix E.

2.3.7 INTERDEPENDENCIES

Interdependencies are external factors that the 30-Year investment programme may be dependent on, or that may be reliant on the outputs from this PBC. Management strategies have been put in place to record how potential issues will be monitored through the programme.

There are numerous existing projects that have direct interfaces and relationships with the Auckland Rail PBC which are discussed further in Appendix F. Some of the most significant interdependencies – urban development, Northland rail development, upper North Island electrification and the Auckland Light Rail project – are discussed briefly below.

2.3.7.1 URBAN DEVELOPMENT

Cities across Aotearoa are growing faster than ever before. This is particularly evident in Auckland, where Auckland's housing supply and demand is well documented. Both private and public sector agencies have been grappling to provide a sustainable supply solution for many decades. With the Urban Development Act coming into effect in 2020, coupled with the Urban Growth Agenda, which establishes urban growth partnerships in five growth areas - i.e., infrastructure funding, financing and delivery, urban planning, integrated transport, and system coherence - the groundwork is laid for moves toward an integrated future ready state.

The Auckland 2050 plan sets the scene and framework for urban development across the city.

In its simplest form, urban density is a product of and spatially realised through a series of nodal hierarchies where these intersect with transport choices of people and goods. This hierarchy in the Auckland sense allows for rail stations and precincts to act like beads on a string. Figure 2-50 below illustrates the rail network capacity pressure points in 2031 overlaid by urban densification nodes.

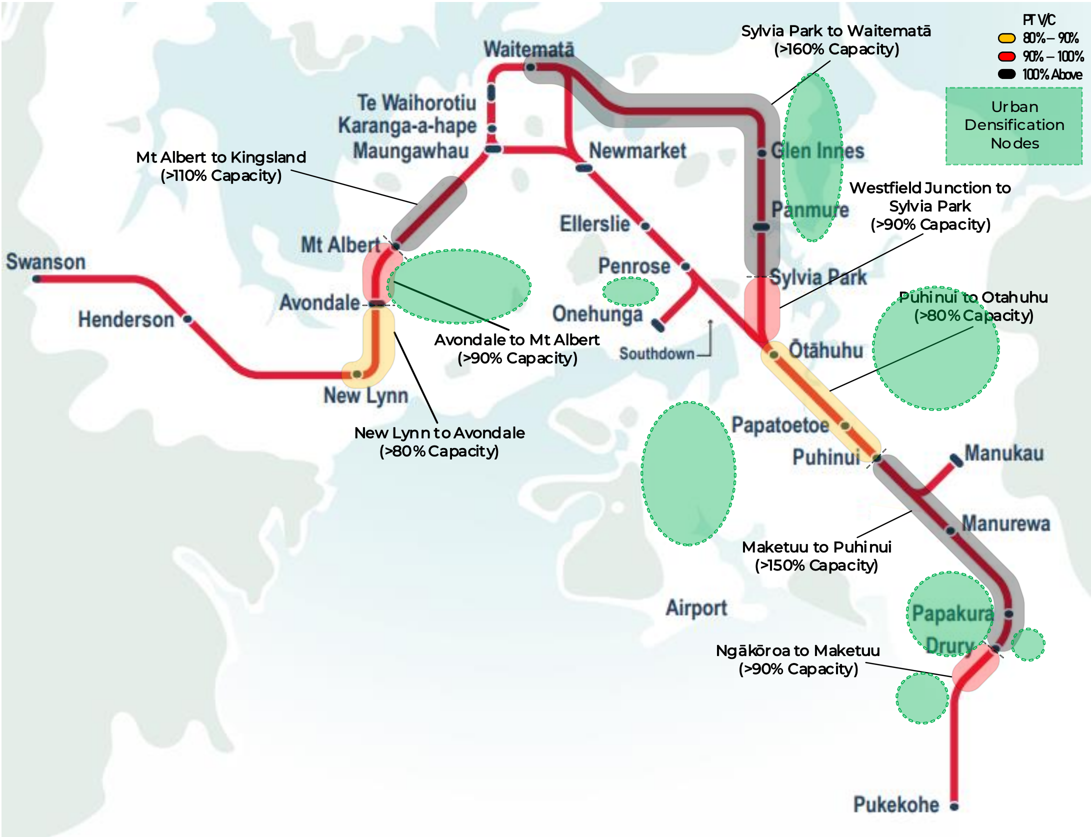

Figure 2-50: Urban densification nodes and rail network

The broader precincts around transport nodes are great locations for future housing, jobs, and community services. These precincts typically fulfill different functions in the urban landscape, by way of example Waitematā/Britomart (Commerce), Grafton (Education), Middlemore (Healthcare), etc. These functions tie into the wider urban fabric of the city, wider neighbourhoods, and communities. Stations and station precincts are also gateways into the wider city transport network, and its modal interchanges.

Stations in suburban locations around the city do not inherently boast the same development potential (and take-up) as the primary nodes. Hence not all stations will have the same development potential as for example Waitemata/Britomart. Generally, the opportunity for increased housing density declines the further out you move from the city centre or metropolitan centres. However, the greater value is almost certainly in the development potential in the *vicinity* of rail stations, supporting wider urban development needs, rather than on the station precinct itself. Rail stations are, therefore, the enablers or facilitators of urban development around them principally by the private sector[107], or in a few cases by public sector entities. Other ways in which rail improvements affect urban development includes:

- Affordability - Public transport fulfills a critical role in the overall affordability and cost of living envelope. Moving economic activity across the city (and beyond) in an affordable and efficient

[107] The attractiveness of urban development around rail stations arises principally from the services offered, which act as “seeding” activities for private sector investment. Capital efficiency will drive Crown investment targeted at enabling services with the private sector leveraging the benefits created.

way also contribute to better community outcomes as well as a healthy, vibrant, and equitable Auckland, same of which is recognised as a major objective in the Auckland 2050 plan.

- Railway stations (and other transport nodes) also fulfills a very important role from a **wayfinding** and **sense of place** and **urban regeneration** point of view, further contributing and strengthening and connecting our communities around the city.

Some of the major urban regeneration & large-scale housing projects: underway across Auckland include:

- The public sector (Kainga Ora and Tamaki Regeneration) will deliver in excess of 40,000 new warm dry homes across the city in regeneration areas (also referred to as LSP's and more recently SDP's). These LSP's will be delivered in partnership with the private sector build and development partners over the next 30 years and supply a variety of tenure options and housing types. These LSP's also seeks to be a change agent of the demographic, **accessibility** and **aging population** needs of Auckland. These LSP's are currently under development, with some significant infrastructure (bulk and reticulation) investments currently being undertaken through Piritahi and the Council family CCO's. Kainga Ora planned developments[108] in the Auckland area are shown below, indicating both numbers of new homes and proximity to the rail network. There is also a significant development around Middlemore.

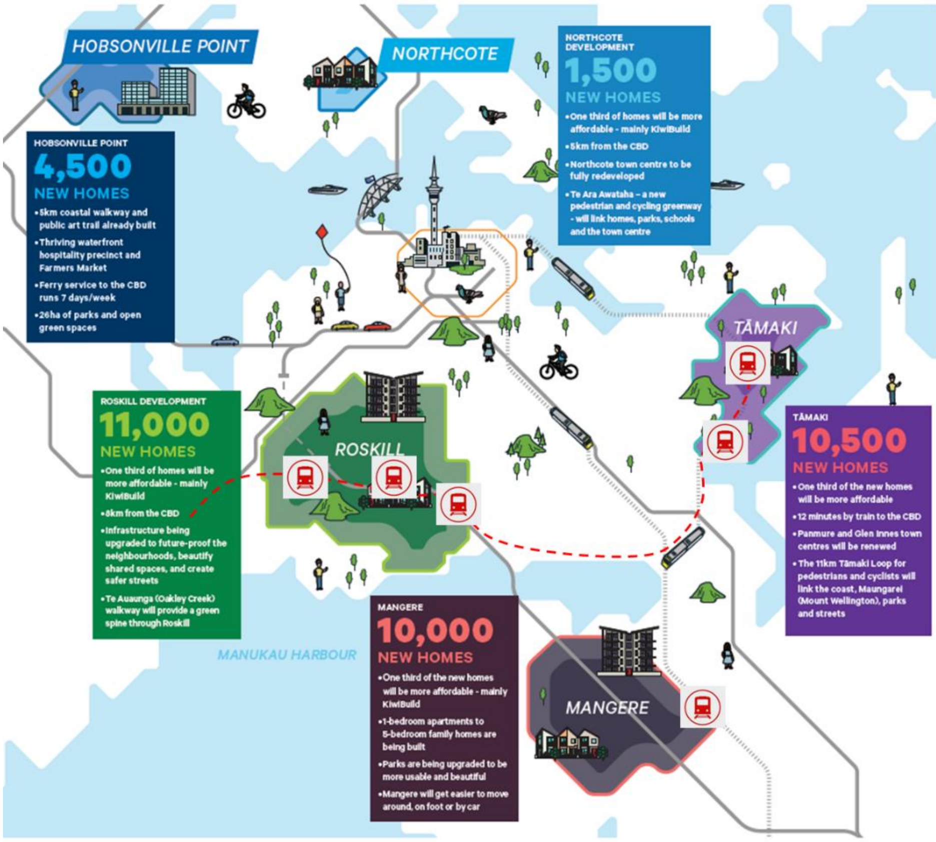

Figure 2-51: Kainga Ora planned Auckland developments and proximity to rail network

- Auckland Council (Eke Panuku) - regeneration efforts in Panmure should be cited as a good example of where (re)development from the Panmure train station, towards the town centre

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[108] These planned developments are not yet accounted for in the MSM model, so are not included in any of the passenger projections used in this PBC.

have integrated a variety of other projects and programmes like the Eastern Busway, all benefitting the town centre and creating a springboard for re-development and renewal. This re-development abuts the Tamaki development of Kainga Ora shown above.

- Public transport, communities and & kinship (whanau and hapu). With these LSP's in mind, and a historical backdrop of previously disadvantaged areas – PT will play an ever-increasing role of connecting communities across the city.
- Temporal scale – the next decade and beyond. The current property market correction is likely to result in public sector agents doing the heavy lifting - i.e., Kainga Ora, as the urban development authority, is currently well placed (expertise, mandate, and funding) to deliver and ensure integration & coordination of enabling infrastructure to support growth.

Spatially, PT customers, at scale, will be located in the following areas around the city:

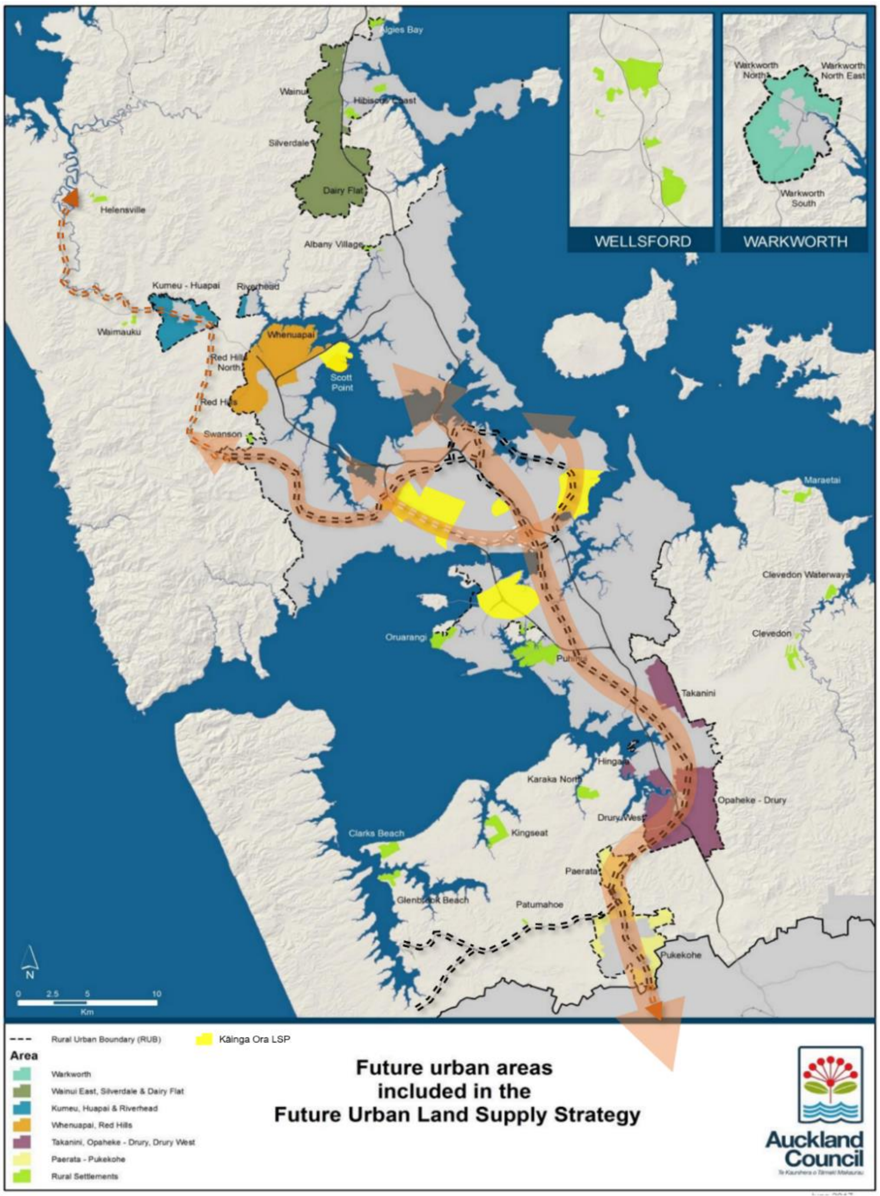


Figure 2-52: Urban development and movement

Adding a construction, logistic and supply chain layer over this map reinforces a call for city-wide transport planning and solutioning.

The success and timing of urban development is highly dependent on how successfully and efficiently the public sector's different roles and responsibilities, motivation and funding streams are aligned. Partnership and collaboration between Crown and Council family members will have to be front and centre of any delivery strategy.

In terms of rail's role in this, KiwiRail is currently engaged with Kainga Ora with the intent of establishing collaboration on infrastructure development and land acquisition that will assist future integration and help ensure that rail remains relevant in the housing delivery toolbox across Aotearoa. Auckland Transport has a critical role in ensuring that transport services are aligned with both infrastructure development and the needs of developing communities.

2.3.7.2 NORTHLAND AND WAIKATO/BOP RAIL DEVELOPMENT

As has been set out in earlier sections, the rail network in Auckland is part of the wider national railway network and needs to play its part in the existing and future national rail system. There are a range of rail infrastructure development initiatives underway or under investigation in the regions immediately adjacent to Auckland that are interdependent with the Auckland Rail PBC. These projects will help to facilitate the future freight and interregional demand expected on the Auckland network, and equally require ongoing access to capacity on the network in Auckland to fully realise their expected benefits.

2.3.7.2.1 NORTHLAND RAIL UPGRADE

NAL runs between Westfield Junction in Auckland, through Newmarket Junction and continues to the West via Swanson (end of electrified network) and then north as far as Otiria in the far north of the country. The electrified network extends only as far as Swanson and is therefore the end of the line for Auckland Transport's EMU trains, but not so for KiwiRail freight.

The NAL upgrade programme is being funded by a Crown investment via the Provincial Growth Fund (PGF), which is enabling the following staged improvements to rail in Northland:

- From January 2021, the NAL between Whangārei and Auckland can take conventional 9'6" shipping containers.
- From early 2022, the NAL between Whangārei and Auckland can take an 18-tonne axle load meaning KiwiRail's standard North Island locomotive and wagon fleet can operate (at present only light axle locomotives can be used).
- KiwiRail was funded by the PGF to purchase the land necessary for the connection to Northport, and at the time of writing this has been largely completed.
- The remaining step will be construction of the connection between the NAL and Northport, once funded.

Figure 2-53: Northland rail development strategy

This programme of works will bring the NAL up to a 'modern freight standard' so that it is consistent with the rest of the KiwiRail network, with these characteristics:

- 18 tonne axle loadings.
- High-cube container access.
- Limited speed restrictions.
- Modern locomotives and rolling stock that are inter-operable from across the rail network.
- High service reliability, frequency, and available capacity.

Marsden Point Rail Link (MPRL)

The MPRL was initially investigated as part of the KiwiRail Northern Rail Upgrade Programme (NRUP). It now forms a component of the rescoped Whangārei to Port Marsden (W2PM) project within the NZUP programme of works. Following the 2021 Baselining exercise, the Joint Ministers' have chosen a preferred W2PM project option comprising:

- Construction of the new rail Marsden Point Rail Link (MPRL) to Northport from the NAL.

- Further upgrade of the existing NAL from Whangārei to Otiria to 18 tonne axle-load, providing increased opportunity for freight transfer to rail from road.
- Safety improvements along the existing state highway.

These interventions replace the previous option of upgrading the existing state highway and will support the development of a rail enabled export port at Marsden Point, expanding the overall supply chain system and making Northport a more viable alternative to the POAL for some freight traffic.

The MPRL re-establishes a rail connected port in Northland via a new 19km track linking Northport at Marsden Point to the NAL at Oakleigh, within the designation granted in 2012. The rail designation runs from the estuary at Oakleigh via Mata Hill, along the Ruakaka river, through the Takahiwai Hills and on to Marsden Point. The key features of the line can be seen in the diagram below.

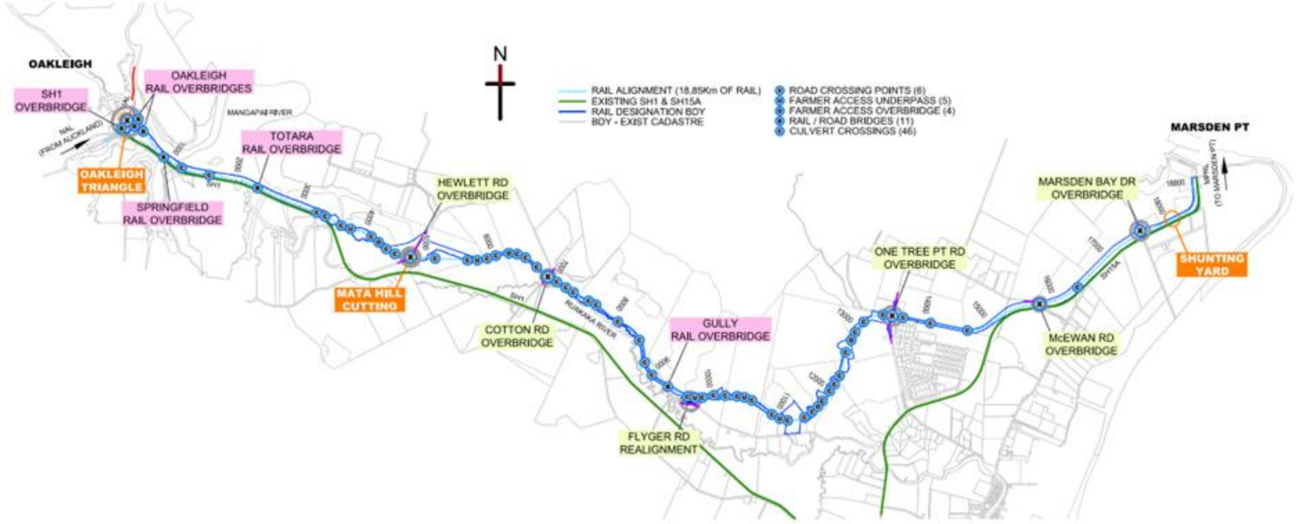


Figure 2-54: Marsden Point Rail Link

Collectively, the Northland Rail Upgrade and Marsden Point Rail Link seek to:

- re-establish a rail-connected port in Northland,
- strengthen integrated transport networks and support economic growth for the region,
- improve road safety and decrease carbon emissions (by reducing road freight), and
- add much-needed resilience to the wider North Island supply chain by creating more transport options.

Benefits expected:

- Increase the proportion of Northland freight moved by rail and reduce truck movements on constrained parts of the State Highway system.
- Reduce emissions - rail produces 70% fewer emissions than heavy road freight transport per tonne of freight carried.
- Provision of more resilient transport networks and optionality for Northland producers.
- Increase the prospects for economic prosperity and growth for the Northland region by providing better access to employment and jobs through business growth.

- Reduce the cost and impact of transport for Northland-based businesses and New Zealand more generally and to encourage better use of existing infrastructure.

Ports policy and growth is a primary driver of the need for and location of rail freight growth. Marsden Point is expected to grow and a further detailed business case for Marsden Point Rail Link construction funding was submitted to the Minister of Transport and Treasury in 2022. If Marsden Point becomes rail-enabled, rail freight is expected to grow strongly. Forecasts project growth to 8 trains per day between Northport and Auckland by the mid-2040s. This level of demand assumes no other interventions or changes to existing port policy and is therefore demonstrates a most likely level of freight demand on the NAL that the PBC should be resilient to.

2.3.7.2.2 UPPER NORTH ISLAND ELECTRIFICATION INVESTIGATION

At present, the electrified network in the upper North Island encompasses the existing Auckland metro area only – extending from Swanson in the north-west to Pukekohe[109] in the south. Various business cases are currently underway that consider further developments that would become more viable were further electrification to be enabled. This includes, for example, decarbonisation of large parts of KiwiRail's locomotive fleet and greater potential for inter-regional services to access further into the Auckland network.

Acknowledging this, and the potential for rail to help reduce the carbon emissions from long-distance passenger and freight transport, in its May 2023 budget, the Government announced $10 million for KiwiRail to prepare a detailed business case for further rail electrification in the North Island, with initial design and engineering to scope the work, enabling major investment decisions to be considered within this decade.

This initial funding will allow KiwiRail to look in detail at how best to electrify more North Island rail lines – such as the Golden Triangle (Tauranga – Hamilton – Auckland), which carries around half of all rail freight in New Zealand. It will also look at how best to complete electrification along the main North Island rail line, between Palmerston North and Wellington.

This type of investment would give further support to the future growth of inter-regional rail services between Auckland and other upper North Island locations. It is notable that the recent Parliamentary inquiry into the future of inter-regional passenger rail in New Zealand published its findings in July 2023. Inter alia, these findings recommended that:

- funding arrangements for future inter-regional passenger rail services reflect the level of national benefit of such services to New Zealand; and
- scoping studies should be progressed for inter-regional passenger rail services (including between Auckland and each of Wellington and Tauranga).

"The main finding of our inquiry is that the regional-centred approach to land transport in New Zealand has resulted in the potential for Inter Regional public transport, such as passenger rail, to be overlooked. There is a knowledge gap regarding what opportunities inter-regional services could unlock. We think that one clearly identified agency needs to be responsible for providing leadership and guidance regarding inter-regional public transport, identifying, and evaluating the public value of potential services, and supporting the work of other land transport agencies in this

[109] Electrification of the Papakura to Pukekohe section is currently under construction, with completion expected by early-mid 2024.

area. Essentially, we expect this agency to lay the tracks for the future of inter-regional public transport."

It is therefore critical that the Auckland Rail PBC ensure that future needs and integration of inter-regional rail services are contemplated.

2.3.7.3 AUCKLAND LIGHT RAIL

The Auckland Light Rail (ALR) project proposes to connect Auckland's city centre with Auckland Airport, via Kingsland, Onehunga, and Mangere. The proposed alignment is shown in Figure 2-55. The section between Wesley and Onehunga is inter-dependent with KiwiRail's existing Avondale-Southdown rail designation (which is owned by KiwiRail) and there is the potential that the projects could be co-located along this section. There is otherwise no interaction between the existing rail network and proposed light rail scheme. It is important that the Auckland Rail programme team work collaboratively with the ALR project team to maximise opportunities for integration. It may mean that further consideration of the Avondale – Southdown alignment is progressed to align with ALR timelines, if it proceeds.

Figure 2-55: Auckland Light Rail – proposed alignment

2.3.8 CONSTRAINTS

Constraints may limit, impact, or inform the investment proposal that this PBC develops and recommends. Climate change and funding have been identified as the two main constraints for the PBC.

2.3.8.1 CLIMATE IMPACTS ON THE RAIL NETWORK

Existing rail infrastructure is exposed to extensive damage from flooding, as shown by the exposure impact from a 1 in 100-year storm event (1% chance of occurring every year) in Figure 2-56. The pink shading reflects areas of the rail network that are exposed to flooding, with considerable impacts on the Western Line in particular.

Auckland Isthmus – Rail infrastructure exposed to a 1 in 100-year storm event

Western Line - Rail infrastructure exposed to a 1 in 100-year storm event

Southern Line - Rail infrastructure exposed to a 1 in 100-year storm event

Figure 2-56: Rail infrastructure exposure to 1 in 100- year storm event

Future projections outline a worsening impact on the rail network. The Westfield area including the Southdown freight depot are at risk of coastal inundation and storm surges by the mid-2000s and are extremely at risk by the late-2000s, with hotspots shown in Figure 2-56.

Sea levels are expected to also rise. The Ministry for Environment and the National Institute of Water and Atmosphere (NIWA) have indicated that sea levels may rise by one metre by the mid-2000s and two metres by the late-2000s under an RCP 8.5 scenario (worst case scenario). Certain areas of the network will be largely impacted including Britomart/Hobson Bay, Southdown/Westfield and Avondale/New Lynn. Sea levels around Auckland have risen in the past and are expected to continue doing so, possibly accelerating in the coming decades.

A summary of climate change impacts on rail is shown below.

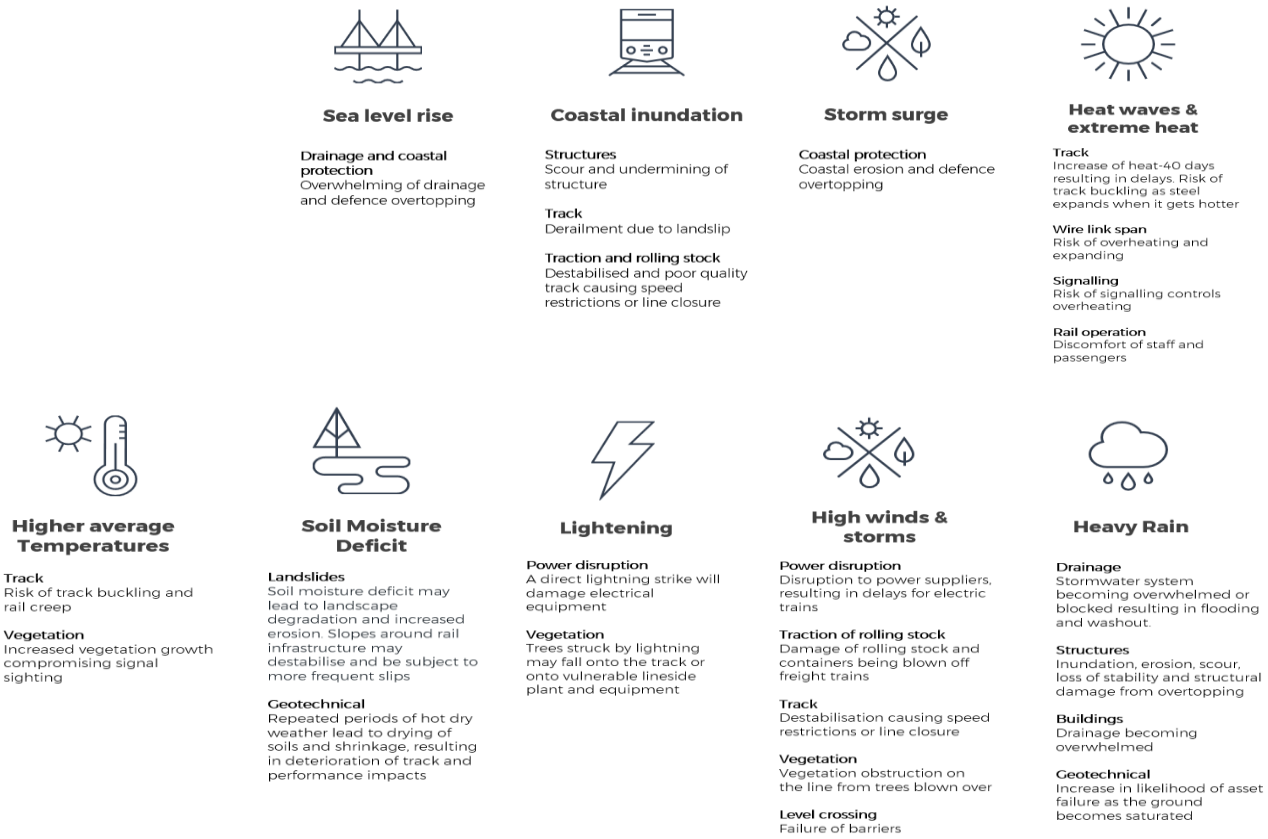


Figure 2-57: Summary of issues associated with climate change impacting the rail network.

These climate-related issues are projected to worsen without climate change intervention, further impacting the levels of service that rail can provide. There is a case that any new investment needs to have sustainability and adaptation as priority within projects. Network design ought to also contemplate how additional investment serves to improve the ability of the network to recover operationally should part of the network suffer partial closure as a result of a weather event.

2.3.8.2 FUNDING

This PBC sets out the infrastructure requirements to improve the Auckland rail network over the next 30 years. However, there are two aspects of funding that act as constraints.

The first constraint relates to the certainty of funding in an environment where funding priorities are revisited and (potentially) revised every three years. These timeframes present challenges for long term infrastructure with long lead times.

The second constraint is the magnitude of funding that may be required over the next 30 years and its overall affordability. Once all the incremental improvements are completed, the investment to deliver a step change in the rail network will be considerable. The size of this investment may present affordability challenges at the time it is needed, which may constrain the ability of rail to deliver on its required outcomes.

2.3.9 OPPORTUNITIES

2.3.9.1 SAFETY

Investment in the Auckland rail network will provide multiple opportunities to support broader safety outcomes.

Increased use of rail transport for passengers and freight will support the Government's Road to Zero Strategy and reduce road deaths by lowering the number of trucks on the road and by individuals choosing to use PT as opposed to driving.

More locally for Auckland, as outlined in Vision Zero, there is a goal to eliminate all transport deaths and serious injuries by 2050.

In the context of investing in the Auckland rail network, contributions to these safety goals can be made as follows:

- Level crossing removal – there is a base assumption that level crossings will be removed over time on the Auckland rail network. At present, level crossings are the interface of the road and active transport networks with the railway, and this presents a safety risk. Through the removal of the level crossings, through grade separation or closure, the safety risks associated with train vs car, truck, pedestrian, or cyclist crashes are removed. Auckland Transport is currently progressing the Level Crossing Removal Programme Single Stage Business Case to develop this programme in more detail. It is anticipated to be complete in 2024.
- Reducing network trespassing – as outlined in Problem 1, trespass incidents onto the network (including those related to self-harm) occur. While the trend is improving with fewer incidents occurring, the removal of network access at level crossings and improved pedestrian access (reducing bad pedestrian behaviours), will present fewer opportunities for trespassing onto the network. It is acknowledged that this safety concern will not be removed entirely.
- Reduction in exposure to road-based harm – mode shift from road to rail is expected to occur because of investment in the rail network. As a result, private vehicle travel will reduce (including nationally for inter-regional passenger and freight movements), resulting in less vehicles on the road and therefore a reduction in exposure to road-based safety risks.

2.3.10 UNCERTAINTIES

There are uncertainties that will impact the need and timing of investment in the Auckland rail network. These are summarised in Table 2-8 along with discussion of how they might impact the conclusions reached in this PBC.

Table 2-8: Uncertainty log

UNCERTAINTY	DISCUSSION
Long term effects of COVID-19 on patronage growth	COVID-19 has embedded changes in Aucklanders working and travel behaviours that could be enduring. It is uncertain whether these changes will remain permanently, or if a return to pre-COVID behaviours will eventually occur. Current indications are that city centres will see some level of permanent shift in travel demand (i.e., increased working from home). As Auckland's overall PT, and particularly rail, demand is heavily weighted to city centre trips, the impacts are more pronounced for rail. Depending on how fast (or slow) patronage grows in the future, the timing of interventions may shift. It is important to monitor patronage and be clear on the trigger points for intervention

UNCERTAINTY	DISCUSSION
Future of the upper North Island sea ports (Northport, POAL, Ports of Tauranga)	Future decisions over the future of the three upper North Island sea ports will have a material impact on rail freight flows into, out of and through Auckland. Changes to rail freight paths will influence the infrastructure responses that are required and the priority of where and when investment occurs. As major decisions on the future of the ports are made, the Auckland rail network investment programme should be reviewed to understand these implications.
Transport policy environment	There is an expectation that future transport policy changes will incentivise and assist with mode shift to more sustainable modes of travel, such as rail, for freight, metro, and inter-regional passenger markets. There is currently no certainty on either the timing or scale of those changes. This emphasises the need for clear triggers for investment as future policy changes could speed up, slow down, or change the priority of certain parts of the Auckland rail network investment programme. For example, if policy changes strongly incentivised rail freight and dramatically increased the amount of freight moved by rail, this could influence prioritisation decisions and accelerate the need for specific freight-related investments.
Auckland rail network expansion	Post-CRL the electrified network is limited to Pukekohe in the south and Swanson in the west. If passenger (metro and/or interregional) services were extended in either direction, this could impact the Auckland rail network's infrastructure. For example, an extension of passenger services further west may warrant consideration of western express services, which would have infrastructure implications for the NAL. Similarly, if new heavy rail branch lines are part of the long-term future for Auckland, the Auckland rail network the investment programme could need to reprioritise or change certain components and/or their recommended timing.

2.3.11 PARTNERS AND KEY STAKEHOLDERS

This section outlines the partners and key stakeholders involved with the Auckland Rail PBC.

2.3.11.1 PARTNER ORGANISATIONS

Auckland Transport and KiwiRail have jointly led the development of the PBC. Auckland Council and Waka Kotahi are key transport planning and funding partners.

A Project Control Group (PCG) was established and includes members from all four organisations. The PCG covers issues impacting the progression of the PBC and helps with external relationships as the PBC sits within a broader strategic context of other PBCs, including Auckland Council's Rapid Transit Plan and future land use assumptions, as well as KiwiRail's freight decarbonisation plan and Auckland Council's TERP.

The inter-relationships between each partner organisation and this PBC are summarised below.

Auckland Transport –an Auckland Council Controlled Organisation (CCO), is the joint client for this PBC, alongside KiwiRail. Auckland Transport is responsible for all the region's transport services, planning and funding. It is responsible for the 'above track' aspects of rail in Auckland, being rolling stock (including the existing Wiri depot), stations and metro passenger service provision.

KiwiRail –is a State-Owned Enterprise (SOE) and is the joint client for this PBC, alongside Auckland Transport. On behalf of the Crown, KiwiRail owns the railway land and infrastructure in New Zealand (including rail stations, most of which in Auckland are leased to Auckland Transport) and is responsible for the delivery and operation of new assets and services (excluding metro passenger) associated with the rail network recommended by this PBC. In the context of rail in Auckland, KiwiRail is responsible for the 'below track' aspects of rail, being the tracks and associated systems to operate the network (e.g. signalling, traction power supply systems). KiwiRail also operates freight services on the Auckland rail network.

Auckland Council - As the unitary authority for Auckland, Auckland Council is responsible for land use planning and setting long term policy in Tāmaki Makaurau. Through the Auckland Plan and approval of the Regional Land Transport Programme (RLTP), Council gives direction on transport policy and planning, including PT improvements. This makes Council responsible for funding Auckland Transport's activities (mainly as a co-funder with Waka Kotahi).

Waka Kotahi – Waka Kotahi is the Crown entity responsible for planning and investing in land transport networks, managing the state highway network, and providing access to, and use of, the land transport system. Waka Kotahi is a partner (including funding) to this PBC and is concerned with improving travel choice and reducing car dependency to increase the wellbeing of New Zealand's cities. Waka Kotahi is also the statutory rail regulator.

Mana Whenua – Mana Whenua are Treaty of Waitangi partners who have special interests in the outcomes of transport investments for Māori. Auckland Transport and KiwiRail will continue to engage with Mana Whenua on the key outputs from this PBC.

2.3.11.2 SUPPORTING WORKING GROUPS

Four participant groupings were established to support the development of the PBC and for its engagement process. The groups included: Technical and Operational, Funding Partners, Project Interfaces and Mana Whenua, Iwi, Communications. All groups were taken through key business case stages including workshops on 1) Investment Logic Mapping, 2) Long Listing, 3) Short Listing, 4) Phasing/Testing/Optimising, 5) Development of Solutions and 6) Review.

2.3.11.3 COMMUNICATIONS AND ENGAGEMENT PLAN

The communications and engagement plan is focused primarily on internal stakeholders from across agencies directly involved in the creation of the PBC (Auckland Transport, KiwiRail, Waka Kotahi and Auckland Council) and those who will be affected operationally by its outcomes. As such, stakeholders have been grouped as either Project Partners, Key Stakeholders, or Interested Parties, with the bulk of engagement focused on the first two groups. Project Partners and Key Stakeholders are being engaged through a mixture of participatory workshops, briefings, and information updates.

3 ECONOMIC CASE

3.1 OPTIONS DEVELOPMENT – PROCESS AND INPUTS

This section covers the development and assessment of the long list programme options, as well as the refinement of the short list options and their assessment, to identify the emerging preferred investment that best aligns with the programme's Investment Objectives. In doing so, the analysis demonstrates that a wide range of potential methods for addressing a transport system problem have been considered. This provides confidence to decision makers that the most appropriate solutions are being progressed.

This section is intended to provide a summary of the optioneering process of this PBC. Significant additional technical detail is provided in two Options Development Reports presented in appendices:

• Appendix G Options Development Report Part 1 – 2051 End State

• Appendix H: Options Development Report Part 2 – Refinement and Phasing

3.1.1 OVERVIEW

The overall optioneering process in this Programme Business Case (PBC) follows Waka Kotahi's Business Case Approach including idea generation, assessment of alternatives and options, option short-listing, and finally identification of a preferred option. These steps have been undertaken through a series of partner workshops, evaluation through a multi-criteria analysis (MCA) process, and regular project team progress meetings.

However, it was agreed in the early stages of this PBC that the complexity of a 30-Year programme, consisting of dozens of interventions across a complex rail network, with direct impact on at least four markets (including the needs of maintenance) would overwhelm a traditional linear sifting optioneering approach.

In recognition that a holistic, system- (and nation-) wide view of in Auckland was critical to identifying the desired outcomes from this PBC, an adapted non-linear optioneering process was developed with the project partners. This approach used the Waka Kotahi sifting approach as a foundation, which was then supplemented by the Long-Term Planning Process (LTPP) framework used by Network Rail in the UK. In particular, the following sequence was adopted for the optioneering phase of this PBC:

- developing Conditional Outputs (defined below),
- assessing existing network capacity constraints,
- developing an end state service and infrastructure concept, and
- developing a phasing of improvements over time divided into Indicative Configuration States – defined in Section 3.1.1.1 below.

The LTPP concept of Conditional Outputs (COs) are key rail-specific objectives defined for each of the four primary markets of freight, metro, Inter-regional, and maintenance. The COs are developed to understand how the attractiveness of rail service offerings on the network can be improved through investment. Some COs are demand objectives, similar to standard transport modelling metrics, while others are aspirational, driven by the broader objectives of encouraging mode shift. It is important to note that these targets are 'conditional' in the sense that they may turn out to be infeasible (either from an engineering or economic perspective) under further analysis and so should not be viewed as hard requirements, but as targets or aspirations.[110]

3.1.1.1 CONFIGURATION STATES

The PBC has adopted the concept of Configuration States (CS) to conceptualise the phasing of the 30-Year programme. As illustrated in Figure 3-1, a CS represents a set of infrastructure investments that allow a set of service benefits (or output capabilities) to be achieved. Multiple benefits can be provided by a single element of the infrastructure plan, which may relate to an increase in capacity or an improvement in service quality and efficiency, for one or more markets. It is important to note that in the context of the PBC, the Configuration States, and particularly their associated service concepts, are **illustrative only, and do not represent a commitment to future allocation of capacity on the network.** Access agreements, network timetables, etc. will be developed in subsequent phases of planning.

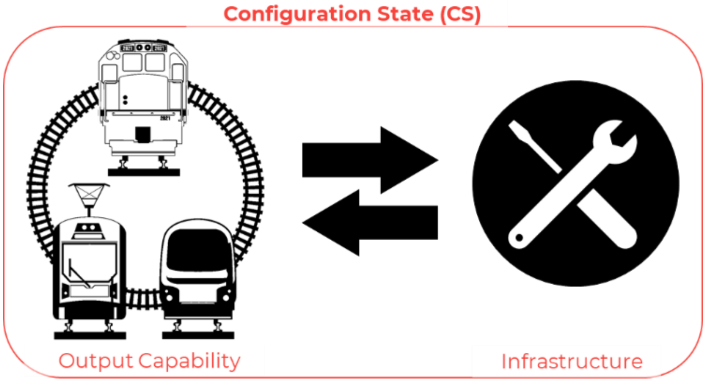


Figure 3-1: Configuration State Concept

For reference, CSs have been named according to the following conventions:

- CS0, CS1, CS2,… represent major configuration states associated with a large track configuration change such as 4-tracking of the Southern corridor.
- CS0-1, CS0-2, CS0-3,… represent interim states between the major CS states enabled by smaller scale infrastructure investments such as building turnback tracks to enable a peak overlay service, or procuring fleet to extend train lengths.

[110] There are several instances where CO's have been relaxed based on value for money assessments, which can be found throughout the document. These include relaxation of the standing time CO on the Southern Line to reduce costs associated with 9-car platform extensions (see Section 3.3.2.1.2), relaxation of the 45min journey time and off-peak car competitiveness COs where 4-tracking of the Inner Southern corridor was ruled out (see Section 3.2.4.5), and relaxation of the RTN frequency CO to allow uneven headways on the Western Line and avoid 4-tracking the Outer Western corridor (see Section 3.2.3.3.2). Additionally, all COs have been relaxed to some degree in that, to the extent to which they are achieved, this often occurs much later than would be desirable or required. For example, the peak capacity COs are not met for the Southern Line until much later than demand (see Section 3.3.2.1.1)

3.1.2 PROCESS OUTLINE

The nature of this project and the scale of the potential programme of works is significant. Though small in scale by international standards, the Auckland Rail Network (ARN) is a complex system. The complexity is due to:

- The high degree of mixed traffic (it is both a freight network and a heavy rail passenger network),
- The presence of multiple interconnected and highly trafficked 'flat' junctions, and
- The degree to which the network itself has been historically underinvested in.

Therefore, a detailed rail planning approach, which considers the network infrastructure, systems and operations in a holistic way, was required in this PBC. This approach would enable an efficient, reliable, regular, scalable, and maintainable service to be realised for both passenger and freight customers.

The optioneering process to develop the final 30-Year investment programme for the ARN consists of two parts. Part 1 determines the desired end state for the network in 2051 including enhancements to services and the supporting infrastructure investments required to enable them – resulting in an Initial Preferred 2051 End State. Part 2 determines the phasing of these investments over time, with subsequent refinements to the end state – resulting in a Final Preferred Programme.

The two parts of the optioneering process are documented separately:

- The development of the Initial Preferred 2051 End State is outlined in the *Options Development Report Part 1 – 2051 End State* (refer to Appendix G). An overview of the process followed in this report is presented in Figure 3-2.
- The development of the Final Preferred Programme outlined in the *Options Development Report Part 2 – Refinement and Phasing* (refer to Appendix H). An overview of the process followed in this report is presented in Figure 3-3.

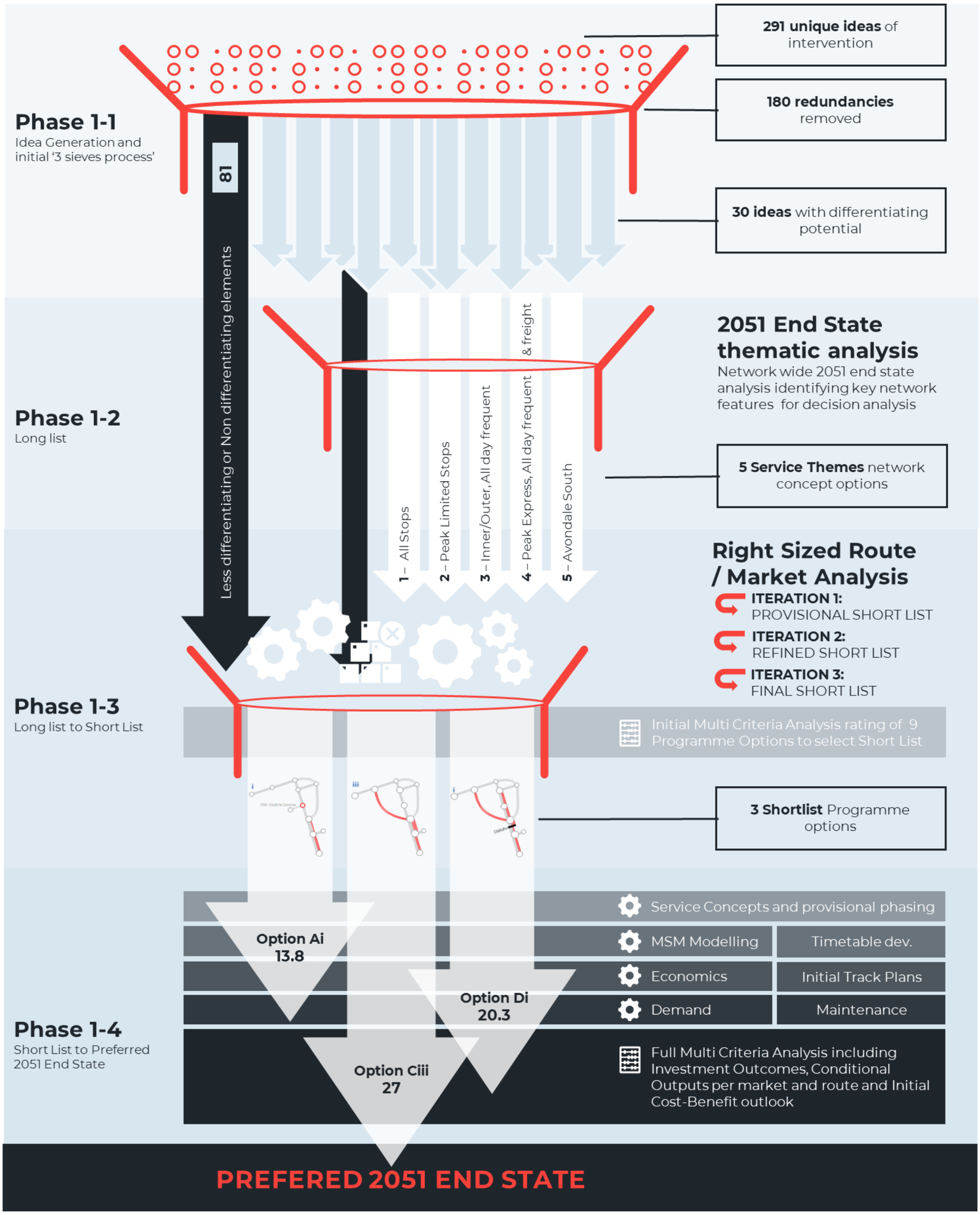


Figure 3-2: Optioneering Process Diagram, Auckland Rail PBC – Part 1 (2051 End State)

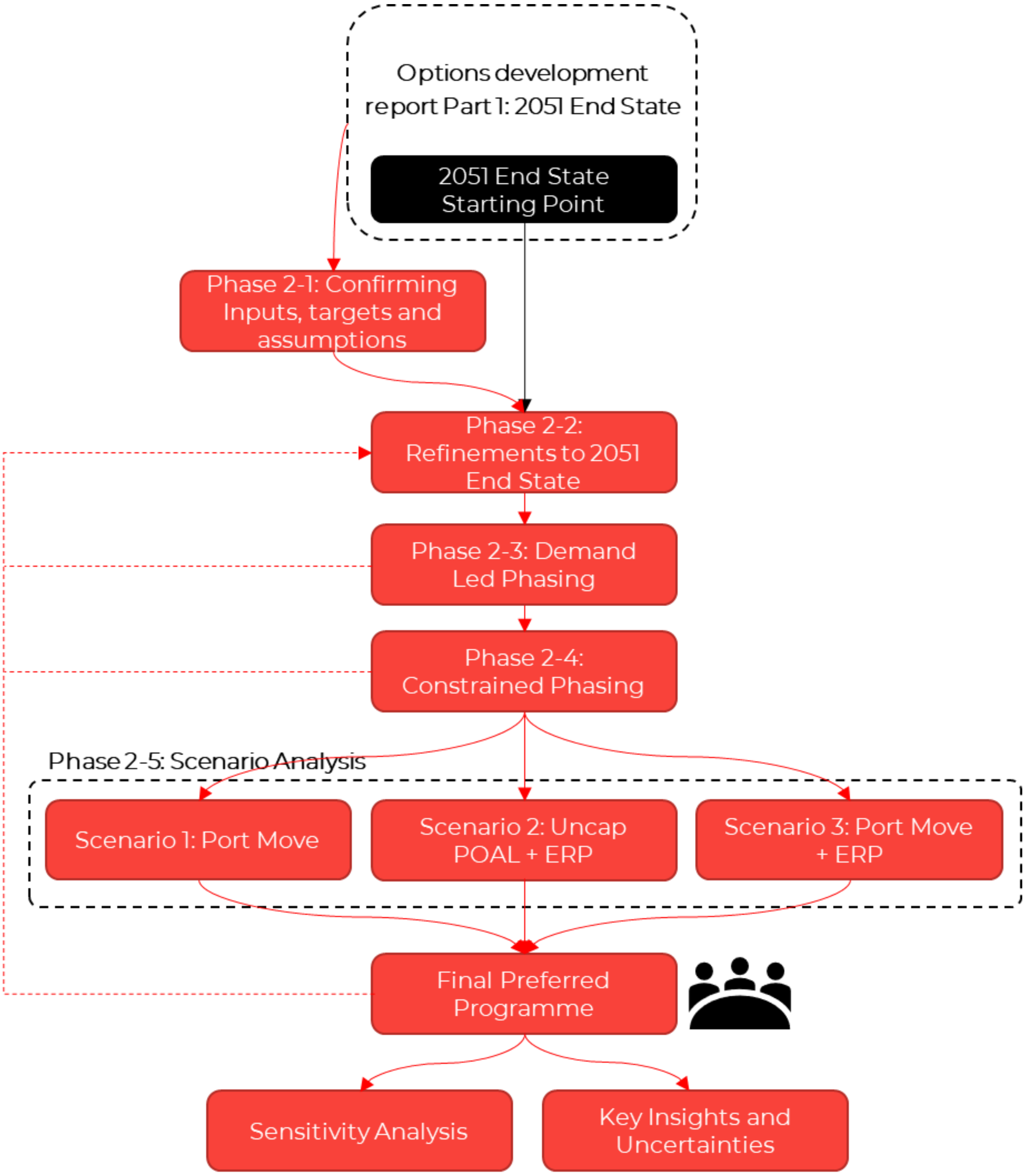


Figure 3-3: Optioneering process diagram, Auckland Rail PBC – Part 2 (refinement and phasing)

A summary of each sub-phase of the processes presented above is provided below, with further detail presented in the subsequent sections of this report. The result of this comprehensive analysis is a Final Preferred Programme that meets the overall Investment Objectives of the programme, is achievable from both financial and implementation perspectives, and is robust against macro level logistic and policy uncertainties.

3.1.2.1 PHASE 1 SUMMARY

Phase 1-1: Idea Generation

An initial blue-sky workshop was held with the project partners and key stakeholders to generate an unconstrained list of ideas that relate, or could be part of, the Auckland rail plan up until 2051. The key question asked during the workshop was "*what can be tested, and what can be changed, to deliver the client's Investment Objectives*?". This process generated 291 ideas.

After a review to remove duplications, a filtering process reduced the blue-sky list to ideas with differentiating potential only. These 30 ideas were then grouped and taken forward to the long list for assessment.

Phase 1-2: Ideas Generation to Long List

As alluded to previously, when a traditional linear approach is taken for a PBC of this scale and complexity it becomes overwhelming and impedes clear decision making. Instead, five thematic concepts were developed, building on the insights gained from the idea generation stage.

These concepts explored various service-led philosophies that could be implemented to operate the network. The philosophies were based on international examples to respond to the problem statements outlined in the Strategic Case. Importantly, these thematic concepts were not considered to be final standalone options. Instead, they were presented as distinct themes to gather feedback on specific issues, opportunities, and respective partner challenges. This approach was collectively agreed upon as the most suitable method to develop a set of multi-outcome options for the short-listing stage.

Phase 1-3: Long List to Short List

Analysis of the thematic service concepts identified the best performing elements of each concept to be taken forward into specific 2051 network wide options for assessment. The multi-step short list process expanded the initial five thematic concepts, to a set of nine specific infrastructure programmes.

These programmes were then assessed in an iterative manner to generate a provisional short list, followed by the final short list. With each iteration, further technical analysis and assessment enabled the gradual validation of assumptions, findings, and priorities. This was instrumental in providing a greater understanding of the key components to be delivered to achieve the desired future state of the network.

Phase 1-4: Short List to Initial Preferred 2051 End State

Technical analysis was undertaken to evaluate each of the short list options and their potential to deliver on the Investment Objectives and Conditional Outputs. The analysis was used to inform the client and Subject Matter Experts (SMEs) for the selection of the Initial Preferred 2051 End State at a workshop on 6th October 2022.

3.1.2.2 PHASE 2 SUMMARY

Phase 2-1: Confirming Key Inputs Targets and Assumptions

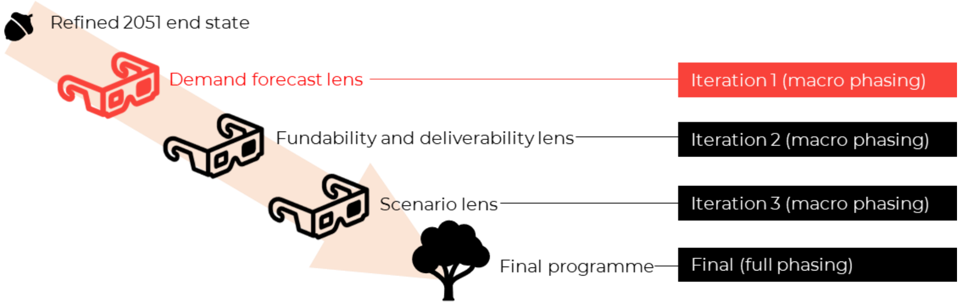
Via workshops and ad-hoc analysis, critical inputs and assumptions developed in the previous phases of optioneering were reconfirmed and in some cases modified, with a particular focus on defining demand and capacity.

Phase 2-2: Initial Refinements to the 2051 End Sate

The 2051 end state arrived at in Phase 1-4, was revisited and refined based on updated assumptions, revised inputs, and a greater level of understanding gained through the initial phasing analyses.

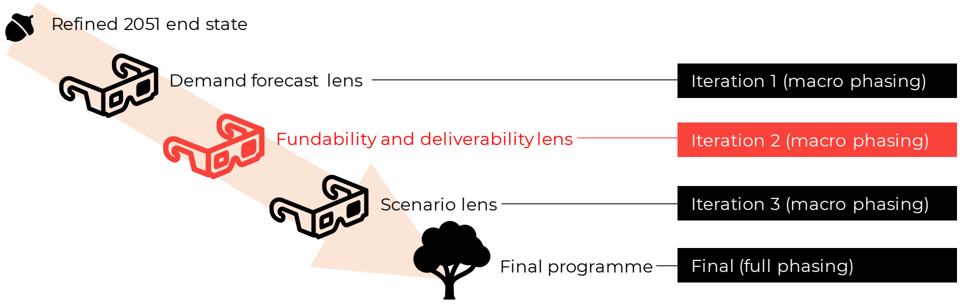
Phase 2-3: Demand Led Phasing

A bespoke Integrated Model (IM) was used to support the creation of phased Configuration States (CS) (service enhancements and enabling infrastructure interventions) over the 30-Year timeframe to meet indicative service patterns and projected growth for all markets under the base demand scenario. culminating in the refined 2051 end state arrived at in Phase 2-2. This analysis resulted in the first Iteration[111] of programme phasing, as illustrated below.



Phase 2-4: Constrained Phasing

Further analysis using the IM was undertaken, now considering implementability and cashflow in addition to demand and capacity. This led to adjustments to the demand-led phasing to reflect practical deliverability constraints including planning, consenting, and funding considerations. A key component of this phase was to also assess the range of potential trade-offs during periods where the required infrastructure-enabled capacity lags demand. This analysis resulted in the second Iteration of programme phasing, as illustrated below.



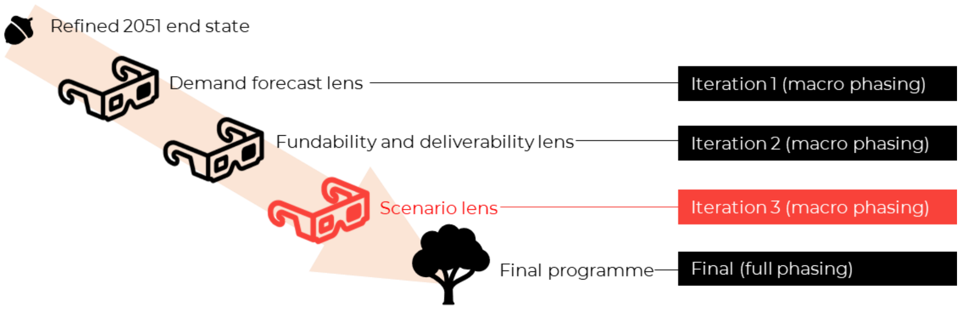
Phase 2-5: Scenario Analysis

The constrained phasing was then stress -tested over three different macro level scenarios to assess its robustness:

- Scenario 1: Ports of Auckland is closed, with freight flows shifted to North Port and Tauranga. Passenger demand is held constant.
- Scenario 2: Strong policy interventions are put in place to achieve the draft targets set out in the Emissions Reduction Plan (ERP) for both freight and passenger markets. This scenario also considered uncapping the Ports of Auckland (as opposed to the base scenario where growth is assumed to be capped at current volumes).
- Scenario 3: A combination of the above scenarios – 'ERP-scale' growth in passenger demand, overlaid with the Port Move scenario (Scenario 1) for freight.

On the basis of these analyses, final refinements were made to the phasing to improve its resilience, resulting in the third Iteration of the programme's phasing as illustrated below.

111 Note that in the Part 2 report (Appendix H), different iteration numbering was used. The numbering system is modified here for simplicity.



Final Preferred Programme

The Configuration State phasing produced in Phase 2-5 was then expanded to provide a detailed phasing of all asset categories required to support the configuration states, including track, signalling, traction power and Overhead Line Electrification (OLE), station upgrades, level crossing removals, fleet procurement, electric multiple unit (EMU) depot, and maintenance depot, plant and equipment. This asset-level phasing was developed as a starting point for future, more detailed investigation and pre-implementation phases, primarily for the purpose of validating feasibility of the overall programme and assessing realistic timings and costings. This work is documented within various asset working papers which informed the final capital cost estimates for the programme, as documented in the Capital Cost Report (Appendix K).

3.1.3 OPTIONS ASSESSMENT FRAMEWORK

An MCA framework was used as a tool throughout the long list and short list phases to assess the ability of the various options to deliver the outcomes desired from investment. The project specific MCA framework was developed with reference to the Waka Kotahi MCA user guidance and sample framework.

In addition to scoring options against the Investment Objectives (IOs), Conditional Outputs (COs) were developed as a further set of criteria to aid the optioneering process. As described in Section 1.1, in the context of this PBC COs are a set of practical rail specific targets that are expected to support the overall IOs of the programme, against which success is ultimately measured. In other words, the COs are a useful tool in developing, refining, and selecting options but are not considered a substitute for the IOs.[112] This approach is considered to align with Waka Kotahi MCA user guidance, which states, "*This guidance provides for flexibility in approach to accommodate a project's specific circumstances*."[113] The MCA framework assessment and the considerations used for each of the criteria are summarised in Table 3-2 on the following page. This is followed by the COs in Table 3-3.

[112] It is acknowledged that there is some duplication between IO and CO criteria. This is in part due to the fact that some measures are relevant to multiple objectives and / or customers (reliability for example is relevant to almost every IO) and effectively receive a higher weighting by being included across multiple criteria, appropriately reflecting their importance. All stakeholder and SMEs involved in the option assessment were aware of this duplication and the effect it had on scoring.

[113] Waka Kotahi NZ Transport Agency, 2023. *Multi-criteria analysis: user guidance (February 2023, version 2).* Pp 4. Retrieved 13 July 2023 from Multi-criteria analysis: user guidance (nzta.govt.nz)

Scoring

A standard seven-point scoring system was used to score the options, as presented in Table 3-1. When scoring, the options were compared against the Do Min scenario (defined in Section 3.1.6), which was assumed to have a neutral score of 0.

Table 3-1: MCA Scoring Scale

SCORE	SCORE DESCRIPTION
-3	Major adverse effect(s)
-2	Moderate adverse effect(s)
-1	Slight adverse effect(s)
0	Neutral / no change
1	Slight positive effect(s)
2	Moderate positive effect(s)
3	Major positive effect(s)

Table 3-2: MCA framework

ASSESSMENT		CONSIDERATIONS
Investment Objectives	IO1: Continually increase the use of rail in Auckland (all markets) over the next 30 years, by increasing its attractiveness[114]	Alternatives and options need to be assessed for their ability to deliver against IOs. IOs are derived from problem statements and benefit maps as part of ILM sessions. Each IO was further assessed against multiple criteria, such as against each rail market (passenger, freight and inter-regional).
	IO2: Reduce Auckland's net transport emissions by increasing rail's mode share over the next 30 years	
	IO3: The Auckland rail network supports and enables a denser urban form within the metro station catchments within the next 30 years	

[114] *Attractiveness factors include reliability, frequency, capacity, and travel time*

ASSESSMENT		CONSIDERATIONS
	IO4: The Auckland rail network is resilient and reliable for the future.	
Critical Success Factors	Potential achievability/deliverability - technical	What are the technical or practical considerations that may prevent an option from achieving IOs, for example local site geography or existing contracts/project interfaces? What are the technical risks involved in developing or implementing this option?
	Potential achievability/deliverability – safety and design	Are there significant health and/or safety risks associated with the option in its design, implementation, operation or maintenance? Does this option comply with the safe system approach? Can the risks be addressed in the design process to control it?
	Potential achievability/deliverability - consentability	What is the level of consenting complexity/difficulty? Are there risks of this adversely impacting on required project timeframes or other aspects of delivery?
	Potential affordability	Does the cost of the option fit within the likely funding available? What factors might affect the ability of the project owner to afford the cost to operate and maintain the option over its projected life?
	Supplier capacity and capability	Any external resourcing challenges, for example dependency on local construction firms, including interdependencies across projects.
	Scheduling/programming	When the alternative/option could be delivered and other timing requirements.
Opportunities and Impacts	Environmental effects	What environmental effects are associated with this option? Environmental effects could include those related to ecology, water quality, stormwater, noise and vibration, visual impact, urban design, natural hazards, contaminated land, landscape, heritage (including archaeology), biodiversity, resource efficiency and air quality.
	Social and cultural impacts	What social or cultural impacts are associated with this option? Social or cultural impacts may include, for example, human health, impacts on community in relation to jobs, recreation, services and severance, impacts on farming and business operations.

ASSESSMENT		CONSIDERATIONS
	Climate change mitigation	What is the long-term carbon emissions impact of the alternative or option? That is, consistent with carbon budgets once available.
	Climate change adaption	Is the alternative or option exposed to climate change risk or other natural hazards over time?
	Cumulative impacts	What cumulative impacts, if any, are associated with the option? Cumulative effects may be insignificant on their own but may accumulate over time or space with other effects to become significant. Consider implementation, operation and maintenance phases.
	Impacts on Te Ao Māori	What, if any, impacts are there on Te Ao Māori? This includes areas of significance for Māori, Māori land and Kaitiakitanga (recognition that the environment is a taonga).
	Property impacts	How does the option impact on property? Can the necessary property rights be obtained?
	Impacts on road safety	Extent to which the option reduces exposure to road-based safety risks.
CO Assessment	Refer to Table 3-3.	Conditional Outputs are statements of the long-term aspirations for the level of service provision desired to inform future investment decisions. Assessment has been undertaken for each conditional output which are categorised by market (metro passenger, freight, inter-regional and reliability). For robustness of assessment across the network, options throughout were broken down by four geographical locations across Auckland to assess the impact on each major rail line segment.
Cost	Capital cost	Does the cost of this option fit within the likely funding available? What factors might affect the ability of the project owner to afford the cost to operate and maintain the option over its projected life?
	Impacts on operating costs	

Table 3-3: Conditional Outputs

MARKET	CONDITIONAL OUTPUT	
Metro Passenger		Provide peak period capacity for base demand (metro passenger)
		Maximum length of standing (target <15mins)
		Enable incremental journey time improvements. This is particularly relevant for the phasing of the programme in that it establishes the principle that journey times, for all trips, should not be made worse when moving from one configuration state to another
		Point-to-point journey time comparable to off-peak car trips
	45min	Journey time to central business district area should not be more than 45 mins. This has typically been defined as a trip from anywhere on the network to Aotea and vice versa
	RTN	Comply with 2018 Regional Public Transportation Plan (RPTP) Rapid Transit Network (RTN) aspirations for services of 10 min (or better) minimum frequency between 6am and midnight
Freight		Provide peak period capacity for base demand (per forecasts provided)
		Provide optimal timetabling with freight destinations (i.e., ports, ferries, logistic industries etc)
	1500m	Enable transition to 1,500m freight trains from south of Auckland to Westfield / Southdown
Inter-regional		Provide peak period capacity for base services (Inter-regional passenger; # slots)
		Enable incremental journey time improvements
Reliability	6hrs	Enable 6 hours of productive maintenance per night (on average)
		Enable 30-minute evening service with one main closed (for maintenance)
	75%	Peak network capacity utilisation (target <75%). Utilisation refers to the percentage of available capacity allowed by infrastructure, that is utilised by rail services. A 75% target provides flexibility in future planning and allows for growth beyond what is predicted in the inputs to the PBC

Refinement of Investment Objectives

It may be noticed that in subsequent subsections, only three IO are presented in MCA summary tables and associated discussions, as opposed to the four presented in Table 3-2 and in the Strategic Case. This is because on completion of the Part 1 process in 2022, but before commencement of the Part 2 process in 2023, a workshop was held to reconfirm and refine the initial Investment Logic Mapping exercise that had been carried out at the beginning of the project. This session introduced IO4 as a new objective to the framework to acknowledge the critical importance of operational resilience and reliability to the future success of rail in Auckland, as evidenced in the Strategic Case particularly with respect to Problem 3 – inadequate network maintenance and renewals.

It is important to note, however, that although the factors of reliability and resilience were not considered explicitly as an IO in the Part 1 selection process, they did play a key role in the analysis and selection of options via the Cos (specifically the three Reliability Cos shown in Table 3-3). The adjusted framework should therefore be seen as simply elevating these Cos to the status of an IO to give them more prominence in the final PBC. This means that this change would have no impact on the options selected, as this IO has already been indirectly considered and assessed.

3.1.4 ALTERNATIVES AND OPTIONS

This PBC has been developed in alignment with the Waka Kotahi Intervention Hierarchy, giving consideration to a range of alternatives and options that seek to resolve the problems identified in the Strategic Case. The Intervention Hierarchy is shown in Figure 3-4.

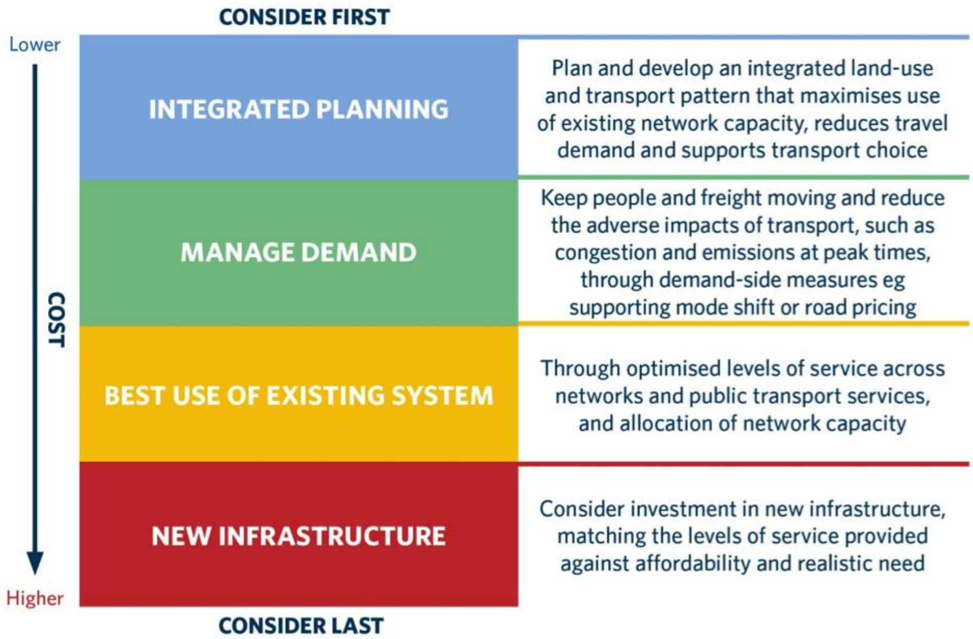


Figure 3-4: Waka Kotahi Intervention Hierarchy[115]

Figure 3-5 shows the numerous national, regional, and local policies and plans that have influenced the development of this PBC. Highlighted within these documents, within the broader context of Auckland, is a drive to increase the use of PT, including rail.

[115] Waka Kotahi NZ Transport Agency, 2020. *Intervention hierarchy*. Retrieved 11 July 2023 from Optioneering: Intervention hierarchy (nzta.govt.nz)

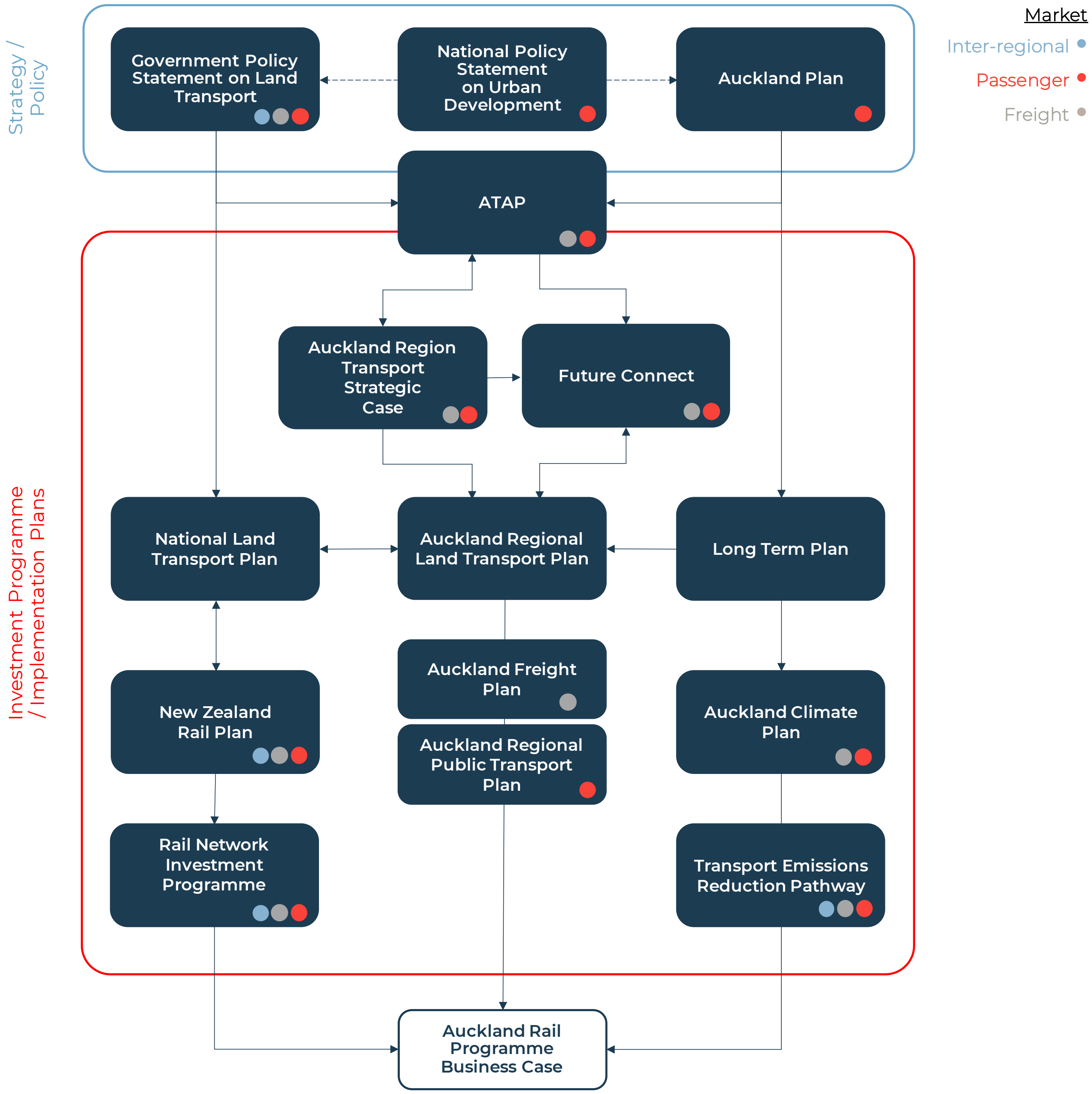


Figure 3-5: Strategic Policy Alignment, Auckland Rail PBC

Consequently, the investment proposed through this PBC is seen as the strategic response to many of these policies. This PBC serves to facilitate urban transformation and support wider decisions and policy shifts to enable **integrated planning** and **demand management** as described below.

Integrated Planning

The current capacity constraints on the network (as discussed in the Strategic Case) will need to be addressed if the outcomes being sought through the integrated land use planning that is already underway are to be achieved (for example, National Policy Statement on Urban Development; Auckland Plan). To this end, the Auckland Rail PBC does not seek to reduce travel demand, but rather create and cater for mode shift to the Auckland rail network. Rail is one component of supporting transport choice and reducing the carbon emissions from transport.

The options generated through this PBC consider how rail can become more viable for a wider range of potential users through infrastructure and/or service changes.

Manage Demand

The Auckland Rail PBC has been developed (in part) to determine the necessary response for rail as a result of wider demand management initiatives (planned and expected) to reduce private vehicle travel including road freight (for example, Government Policy Statement on Land Transport; Transport Emissions Reduction Pathway; Auckland Regional Public Transport Plan). The Auckland Rail PBC aims to both increase demand for rail travel by increasing the attractiveness of rail as a travel option, and provide the necessary capacity for travel that will be needed to accommodate the mode shift that those wider demand management programmes and policies create.

Optioneering in this PBC identified a few options that might help to manage the growth in demand to the extent possible, such as fare policy. These will be explored in the parallel policy workstreams outside the PBC, as they must be considered in the context of the wider transport system.

The primary focus of the Auckland Rail PBC is thus on the latter two interventions of the Intervention Hierarchy: **making best use of the existing system** and then considering what **new investment** might be needed to ensure that Auckland's rail network is fit for its growing future role.

Best Use of Existing System

The Auckland Rail PBC focuses initially on optimising the existing network once CRL opens via operational improvements and lower cost equipment and technology upgrades (including signalling, train control and network management upgrades). Physical infrastructure upgrades are considered only when the existing system can no longer be optimised to meet the increased market demands.

With a 30-Year horizon, any near-term alternatives for addressing capacity problems on the rail network would prove to be short lived in the context of growing demand (for the reasons outlined above). For example, introducing parallel bus capacity to alleviate capacity constraints on specific sections of rail is problematic as while it may provide relief for a short period, it is not consistent with rapid transit planning activities, undermines customers' experiences and wider goals for PT, may require subsequent infrastructure to be efficient, and has a limited lifespan before further intervention is required.

New Infrastructure

Where market demand exceeds the capacity or capability of the existing network infrastructure, then new infrastructure has been considered through optioneering and optimisation processes. At a point where major investment decisions are required to unlock the next step-change in capacity (e.g. additional main lines), value for money considerations should be made in conjunction with the Auckland Rapid Transit Network Plan (ARTNP) that takes an Auckland-wide view of the rapid transport network to ensure efficient investment overall and national policy where the line serves more than a metro purpose.

It should be noted that the PBC sponsors have excluded new rail corridors within the Auckland network from the scope of this PBC except for Avondale – Southdown[116] which is designated and owned by KiwiRail. Alternate corridors and potential modes will be considered as part of the ARTNP or in conjunction with wider national rail planning that takes a national view to ensure efficient overall investment.

3.1.5 KEY INPUTS AND ASSUMPTIONS

This section provides an overview of the key inputs and assumptions that have been used to inform the development of the Final Preferred Programme, including demand forecasts for the three primary markets of freight, metro passenger and inter-regional passenger. Further detailed inputs and assumptions are provided in Options Development Report Part 2 (Appendix H).

3.1.5.1 FREIGHT DEMAND

The PBC has drawn upon freight modelling used for rail decarbonisation and other KiwiRail studies. The KiwiRail freight forecasting model provides rail freight flow forecasts under a range of scenarios. It has been derived from Te Manatū Waka - Ministry of Transport (MoT) Freight Futures model, which forms part of the MoT's Transport Outlook modelling suite.

Forecast train volumes are provided per day, for each of the major freight lines on the Auckland rail network (depicted in Figure 3-6 in green, yellow and red highlight):

- The North Island Main Trunk (NIMT) freight, including MetroPort (MP) freight from Port of Tauranga and Westfield and domestic freight from various locations south of Auckland,
- Ports of Auckland (POAL) freight, including movements from POAL to Southdown and Wiri inland port (WPOAL), and
- Northland freight.

Freight volumes were then translated into train movements under a number of scenarios representing various macroeconomic policy and logistical conditions. These include closure of POAL, capping of POAL, and a strong policy push for increasing rail mode share to support emission reduction targets.

It is unlikely that any of these scenarios will come to pass exactly. Rather the future is likely to involve some combination of them. The scenarios should therefore be seen as providing the range of future freight demand that the rail network would need to be resilient to. Consistent with this, the PBC has taken a scenario-based approach that takes a base demand scenario for initial planning purposes, and then stress testing the base solution under a number of alterative scenarios to further refine it. Freight scenarios have been designed to **investigate the impact of different competitive port futures in the upper North Island**, and (like the rail freight market) are national rather than local.

For the NIMT, forecasts have also been produced for two lengths of MP trains: 750m and 1,500m. Given the significant growth expected on the NIMT under all scenarios, it is anticipated that

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[116] Avondale – Southdown runs from Avondale on the Western corridor to Southdown terminal on the southern corridor via a KR owned and designated corridor that runs through Onehunga and alongside SH20.

lengthening trains, as opposed to increasing train frequencies, will be a feature of freight requirements between Auckland and the Golden Triangle from the early 2030s.

Other smaller volume moves using main line tracks exist on the network that are also captured in planning. These are shown in Figure 3-6 and include bulk movements between Westfield/Southdown and the Mission Bush Line (MBL), Penrose siding, Southdown Lane siding, and Tamaki siding. Forecasts for these movements were obtained via discussions with KiwiRail.

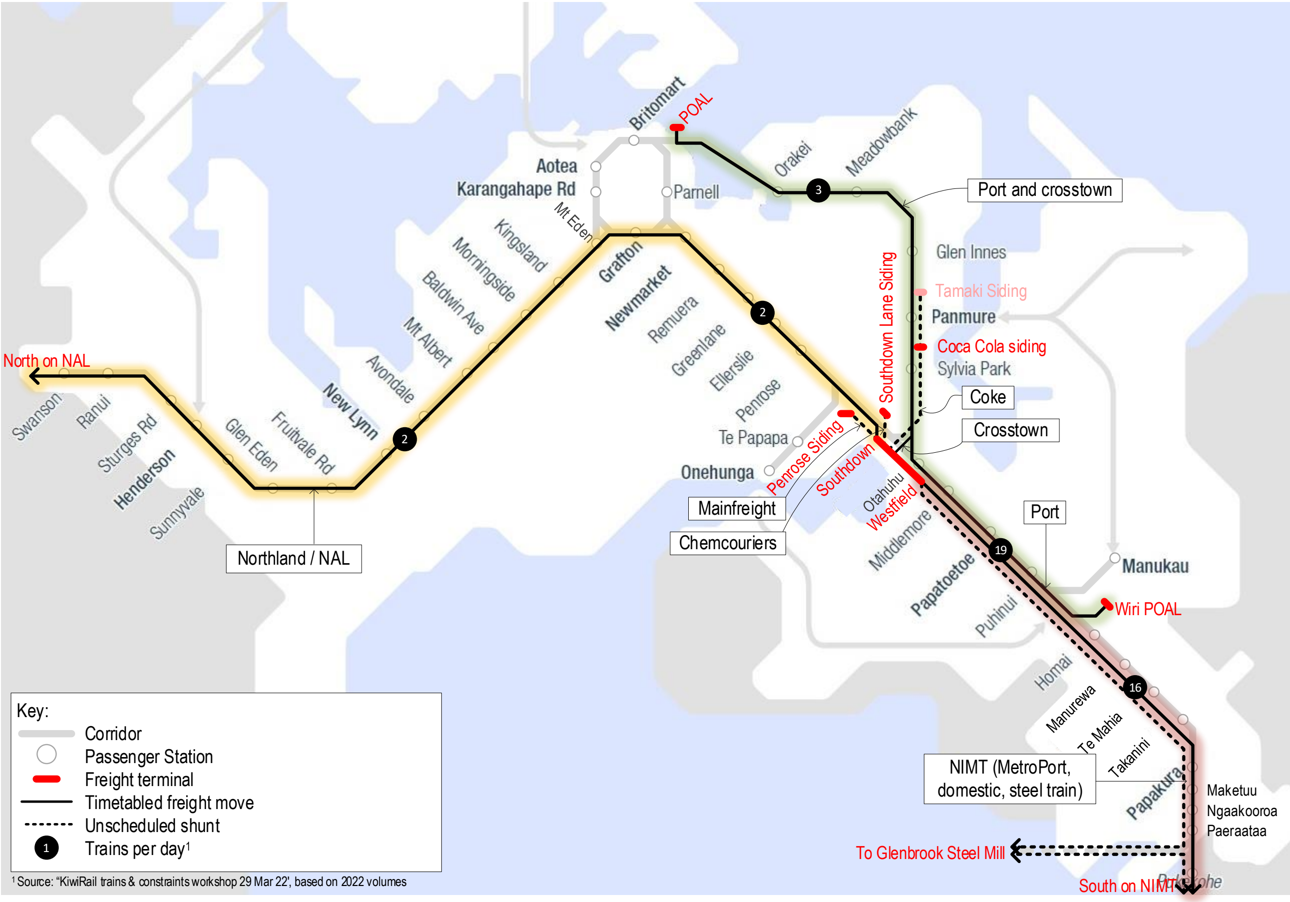

Figure 3-6: Freight lines on the Auckland Rail Network

3.1.5.2 METRO PASSENGER DEMAND

Metro passenger service demand is based on demand modelling using the Auckland Forecasting Centre's Macro Strategic Model (MSM). Demand modelling is an iterative process as demand is impacted by the attractiveness and capacity of rail services provided, which is within the scope of this PBC to determine. Various other factors including the makeup of the wider transport system, patterns of land use and policy levers such as road pricing have an impact on demand for heavy rail, which are also captured in the MSM including:

- Scenario I11.6 land use, which is the current agreed base land use scenario for planning in Auckland, and
- 'Reference Case' transport network, which includes the proposed development of the rapid transit network (i.e. CC2M, NW, WHC, A2B) over time plus a few other improvements to major corridors (e.g. SH20 and SH16 widening).

The MSM provides outputs that allow for the sizing of the service offering in terms of frequency, train lengths, and stopping patterns via plots and data tables which provide the number of passengers on board trains between stations, relative to the provided seating and standing capacity.

The MSM predicts 24-hour weekday travel demands, with this PBC focussing on the average 2 hour demands across the AM, Inter Peak , and PM peak periods. In reality, demand varies over these periods and in the case of the AM peak, 61% of the 2 hour demand occurs within a single high peak hour. The remaining 39% of demand occurs in shoulder peak periods which is an important consideration in the early stages of the 30-Year programme when capacity varies across the peak period due to varying train lengths (i.e. a mix of 3-car and 6-car EMU services) in operation. Generally planning has focused on the AM peak, as this results in the highest hourly loading on the network and is therefore the key driver of capacity improvements.

Initial modelling iterations for generating planning demands in this PBC were based upon 'unconstrained' runs in the MSM, which effectively remove PT vehicle capacity limits. These model runs also increased service frequencies to provide a picture of what the potential for PT ridership could be, based on highly attractive services and coverage of the network. In later model runs, and for the final analysis, capacity constraints were turned back on in the model. This approach allowed for a quantification of how much potential demand could be gained or lost through the various interventions considered by the PBC programme.

3.1.5.3 INTER-REGIONAL DEMAND

Inter-regional passenger demands provisioned for in the PBC include Hamilton to Auckland services, and the Northern Explorer tourism service operated by KiwiRail.

Objectives for Hamilton to Auckland in terms of service frequencies and stopping patterns, were provided by Waikato Regional Council. Note that by 2041, the Te Huia service is assumed to be replaced by a new high speed rail service operating at higher frequencies - up to 30min headways during peak periods by 2051. Termination of a Waikato Regional local service at Pukekohe is also included in the 2051 end state plan. The primary Hamilton to Auckland service is envisioned to serve the Auckland city centre.

Tourism trains are assumed to grow to 12 trains per week by 2051, one up and one down per day.

It is acknowledged that further growth in inter-regional traffic could occur beyond these assumptions over the next 30 years. As will be discussed in subsequent sections, a long-term planning target of 75% capacity utilisation has been adopted, in part so that such growth is not precluded in the future, and in acknowledgment that many of the infrastructure investments of this PBC will have lifespans of 100+ years. It would be a poor outcome if the network was completely full at the end of the (comparatively) short term 30-Year planning horizon, overlooking or even precluding an ongoing need to grow.

3.1.5.4 DEMAND SCENARIOS

The various freight demand scenarios were combined with different scaling of the MSM outputs to generate a set of overall network demand scenarios. These scenarios are defined in Table 3-4 below. In the absence of specific planning scenarios for inter-regional services, the same growth profile has been applied across all scenarios for this market, but further growth is not precluded.

Table 3-4: Demand scenario summary

MARKET	BASE SCENARIO	PORT MOVE SCENARIO	ERP + UNCAPPED POAL SCENARIO	ERP + PORT MOVE SCENARIO
Freight	KiwiRail scenario B1	KiwiRail scenario B	KiwiRail scenario D	KiwiRail scenario B
Metro	MSM forecast patronage without scaling	As per the Base Scenario	MSM forecast patronage scaled to represent ERP-level growth	As per ERP scenario
Inter-regional	As described in Section 3.1.5.3	As per the Base Scenario	As per the Base Scenario	As per the Base Scenario

For ERP scenarios, metro patronage levels that contribute to meeting the draft ERP targets in Auckland have been estimated. This demand scenario does not design the policy(s) required to reach that level of patronage but is intended to determine what service and infrastructure mix would be required to accommodate such a level if it were achieved.

Specific modelling was not undertaken as part of this PBC to estimate these rail patronage levels, and in any case ERP targets are not mode specific. The PBC team worked with Auckland Transport and AFC to estimate potential rail demand levels that would allow Auckland to meet its overall ERP target, informed in part by earlier modelling that Auckland Transport and Auckland Council had undertaken as part of the Transport Emissions Reduction Pathway (TERP) process. The estimation process resulted in the PT annual patronage levels and mode share shown in Figure 3-7. For comparison the 86 million annual rail boardings is compared to 2019 (pre COVID) ridership of around 21 million annual rail boardings. This represents an approximate four-fold increase to be achieved by 2035.

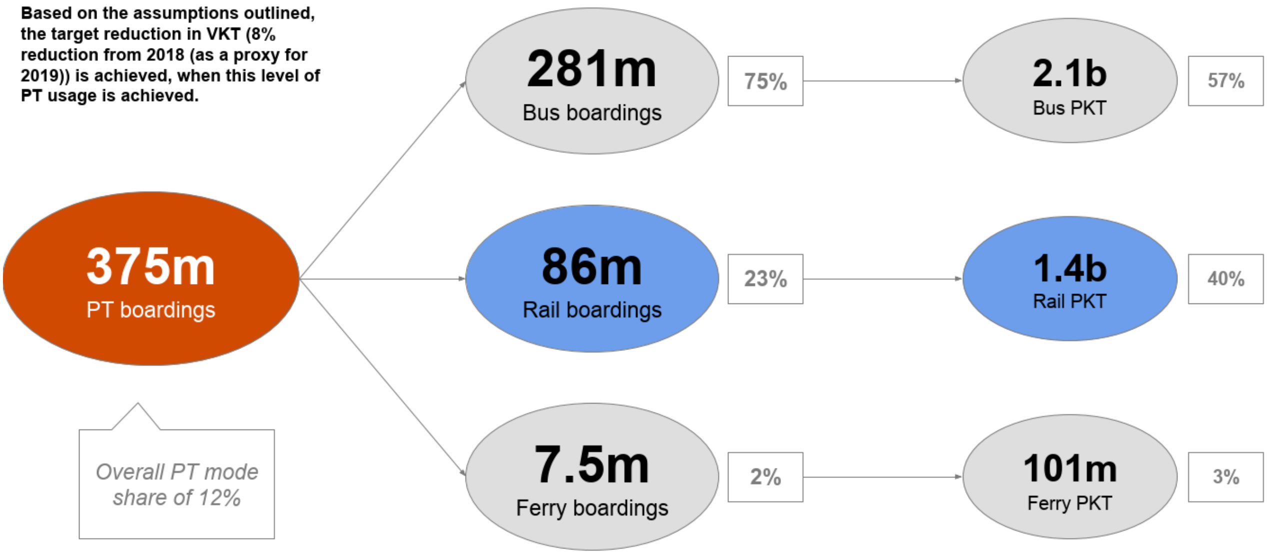

Figure 3-7: Estimated rail patronage required to meet draft ERP targets

3.1.5.5 CAPACITY UTILISATION METHDOLOGY

A key consideration in the development of the 30-Year programme, is the extent to which capacity is constrained on the network and what interventions are required to address this. The concept of capacity utilisation (or capacity consumption), as defined by the International Union of Railways (UIC) in UIC leaflet 406, has been used to measure how much capacity is consumed by a given pattern of operation and equipment, and is a reliable proxy for reliability of service. A value of greater than 100% represents a situation where the planned service pattern exceeds the available capacity of the railway system at a reliable level of service. The calculation of utilisation incorporates 'buffer' (aka 'additional time rates') for different modes and periods of operation, as shown in Figure 3-8. Of relevance to the PBC is the fact that a mixed mode railway operation is inherently less efficient than one which separates modes (i.e. all-stops metro and non-stop services such as express, inter-regional and freight), and therefore requires higher buffers.

Table 2 : Proposed additional time rates for lines

Type of line	Peak hour	Daily period
Dedicated suburban passenger traffic	18 %	43 %
Dedicated high-speed line	33 %	67 %
Mixed-traffic lines	33 %	67 %

Figure 3-8: UIC Leaflet 406 - Occupancy time rates

3.1.6 DO MIN

The Do Min scenario defines what the rail network and wider transportation networks and services will look like, and how it will perform, with no additional investment beyond what has already been committed and funded by 2051. The assumptions for the Do Min include:

- 11 heavy rail upgrade projects as listed in Table 3-5,

- Land use scenario I-11.6,[117]
- Passenger metro services as per the 2025 Train Plan for City Rail Link (CRL) Day One, A8i (reduced),
- Freight train volumes representing KiwiRail 'Business As Usual' scenario,
- Inter-regional train services (Te Huia),
- Maintenance access window of around 3 hours per night (average),[118]
- A base programme of renewals as advised by Auckland Transport and KiwiRail,
- Various transport network upgrade projects including the development a new Light Rail network with:
  - City Centre to Māngere (the CC2M project) implemented by 2031 with a 20tph service,
  - North-western light rail implemented by 2051 with a 20tph service, and
  - North Shore light rail implemented by 2051 with a 40tph service,
- Bus network structure based on the 2031 RLTP scenario with frequency and service adjustments for 2041 and 2051 to meet demand and to service new developed areas, respectively, and
- Congestion pricing has been incorporated into the DM for 2051 only and uses the recommended scheme from The Congestion Question (TCQ) report.

Table 3-5 Do Min rail projects

CRL (INCLUDING OTAHUHU 3RD PLATFORM, STRAND CROSSOVER, NEWMARKET CROSSOVER, INFILL SIGNALS)	PAPAKURA TO PUKEKOHE ELECTRIFICATION (P2P), INCLUDING SOUTHERN STATIONS (3 NEW STATIONS)
Western Power Feed	Auckland Transport EMU Batch 3 (including Wiri Depot upgrades)
Completion of Rail Network Growth Impact Management (RNGIM)	Pedestrian level crossing removal (x7)
Integrated Rail Management Centre	Church St East level crossing removal
Wiri to Quay Park and 3rd main (W2QP)	KiwiRail fencing programme
Henderson Station 3rd platform	

[117] Scenario i11.6 reflects the land use growth areas in the Auckland Plan development strategy, but it does not fully reflect either permissive zoning of the Auckland Unitary Plan or more recent land-use policy changes such as the National Policy Statement on Urban Development (NPSUD), which allows for more concentrated land use around rapid transit networks such as the Auckland Rail stations.

[118] The difference between first departure and last arrival on the Southern Line in the current metro timetable is around 5 hours 25 min on a weekday but this is very different to a 'productive' maintenance window (which requires at least 1 hour for set up / set down) and is further constrained by empty train moves and freight services. Section 6.3.6 of the Strategic Case presents data between 2018 – 2021 that shows an average access time of 3 hours, with significant variance between network segments. Refer to this section for further discussion.

The Options Development Report Part 1 (refer to Appendix G) outlines in more detail the assumptions that were made for the Do Min scenario.

3.1.6.1 DO MIN INFRASTRUCTRURE AND OPERATIONAL CONSTRAINTS

Analysis was carried out early in this PBC to assess the capacity of the Do Min ARN infrastructure, systems and equipment including track and signals, level crossings, tunnel ventilation (within the CRL), platforms, EMU fleet and stabling, and traction power. This work leveraged previous modelling and timetable development studies, as well as simulations and early analysis undertaken as part of this PBC for critical areas. This section provides an overview of the major constraints in the Do Min and the factors that influence them, with further detail provided in the Options Report Part 2 (Appendix H).

Track and signalling

The majority of the ARN is double tracked except for the single tracked Onehunga Branch Line (OBL), which can support a 20 min single track operation (alternating up and down movements), and the triple tracked Wiri to Westfield (W2W) segment. The W2W segment will operate as metro only on the up and down mains with the 3rd main being freight only. The single freight track supports a 20-30 min single track operation.

For double tracked segments, the signalling system is the primary constraint on capacity, which limits the minimum spacing of trains to between 3 to 5 minutes – determined based on a combination of previous studies and ad-hoc simulation analysis which considers the placement of signals, performance of the signalling system and rolling stock, and operational factors such as dwell times, etc. Note that in some areas, the placement of signals is constrained by the presence of level crossings, which results in reduced signalling capacity.

CRL

The CRL is expected to accommodate an ultimate volume of 24tph (per direction) assuming that driver assistance and automatic door operation systems are implemented in the future. The primary capacity constraints on the CRL relate to long dwell times at stations. This is due to high passenger volumes coupled with a two door EMU design, as well as the existence of tunnel ventilation zones between stations that cannot accommodate more than one train per direction at a time for safety reasons.

It is important to note that while the CRL is capable of up to 24tph, other bottlenecks on the network will prevent this from being achieved without further investment. Furthermore, the 24tph limit applies to a homogenous metro only service, while in many other parts of the network the mixing of freight, long distance passenger, express metro, and local metro services places additional constraints on capacity utilisation.

Level Crossings

Level crossings impose capacity restrictions on rail operations because of the safety risks associated with increased train frequencies. Increasing train volumes across a level crossing increase in the likelihood of collisions between trains and other road users. It has been assumed that the expected increase in train frequencies beyond current operation will trigger the need to eventually remove level crossings, either by grade separation or road closure. For the purpose of the PBC a 'level crossing capacity' was defined as 12 trains per hour in both directions combined, on both the Outer Southern Line (between Pukekohe and Wiri junction) and the Western Line (between Maungawhau and Swanson). However, this 'capacity limit' is treated differently from signalling capacities, since the latter are a set of physical limits while the former is a risk-based assumption.

EMU Fleet

Fleet size on opening day of the CRL will be 95 x 3-car units, which includes the current procurement of 23 x 3-car units (Batch 3). In addition to limiting the potential for increasing train frequencies beyond those of the CRL Day 1 timetable, this fleet also results in many trains needing to be run as single 3-car units, leading to shoulder peak capacity issues that will be described in later sections.

EMU and Inter-Regional Stabling

Metro EMU stabling is currently provided at Henderson (18), Strand (8), Wiri (28 stabling + 4 maintenance), Papakura (8), Britomart (4), and Manukau (2), supporting a total storage of 72 x 3-car units. By 2025 storage for 13 additional 3-car units will be provided at Pukekohe and 19 at Wiri, provide sufficient capacity for the fleet of 95 x 3-car units, with minor spare capacity across the network to allow for some operational flexibility.

Inter-regional trains are currently stabled in Hamilton (Te Huia services) and in Westfield yard (Northern Explorer), however based on the long-term EMU stabling strategy developed in the PBC, stabling of these services is ultimately expected to move to the Strand. The PBC allocates budget for upgrades that may be required at the Strand to accommodate future inter-regional stabling, or alternatively for the provision of inter-regional stabling at some other location. [119]

Traction Power System (TPS)

The current TPS supports CRL Day 1 operations with the addition of a new power feed currently being implemented at Glen Eden on the Western Line. However, the TPS will require further enhancement as metro services increase and freight and inter-regional services are progressively electrified. This PBC has utilised separate KiwiRail modelling of the TPS to determine an upgrade programme to accommodate this growth.

Stations

Stations have been assumed to not place hard capacity limits on the network. A programme of station upgrades has been developed to address existing deficiencies and improve service quality as patronage increases over time.

Freight Capacity Limits Imposed by Metro Operation

The current and planned (for CRL Day 1)[120] metro timetable implies constraints on when and where freight can run on the ARN. This in turn limits the total daily volume of trains that can be accommodated on all major freight lines while still achieving a reliable level of service.

The limit for reliable train operations entering and exiting Auckland on the NIMT is around 60 trains per day (30 trains per day per direction), which is driven primarily by the number of freight

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[119] For example at the planned EMU Tamaki depot should the Strand turn out to be infeasible for inter-regional (in a scenario in which PoAL closure results in significant redevelopment of Quay Park area which precludes its use as a stabling site).

[120] Note that the CRL day 1 timetable that has been adopted as a base assumption of the PBC, is not a confirmed and agreed to timetable, and is still under review and negotiation. Capacity limits could be shared out in a different way which may result in changes to the freight capacity limits set out in this section.

slots per hour provisioned within and around the metro timetable. Any growth beyond this would need to be accommodated by longer freight trains (planning has adopted a maximum train length of 1,500m for MetroPort (MP) services between Tauranga and Auckland).

The limit for the North Auckland Line (NAL) is assumed to be 5 – 7 trains per day while the limit for POAL is assumed to be 6 – 8 trains per day. These limits are significantly less than the NIMT as they account for exclusion periods due to high density peak (AM and PM) metro operation, port hours of operations, presence of light locomotive movements, cyclic patterns of operation, etc.

3.2 OPTIONS DEVELOPMENT – PHASE 1

This section presents a summary of the development of the Initial Preferred 2051 End State, with further detail provided in the Options Development Report Part 1 (refer to Appendix G). This options development process charts a course from initial blue-sky ideation to selection of an initial preferred 2051 end state via long list and short list assessments and workshops.

3.2.1 BLUE SKY IDEATION

A series of ideas generation workshops were held in April 2022 with subject matter experts and stakeholders from Auckland Transport, KiwiRail, Waka Kotahi, Waikato Regional Council, and WSP. Given the programme's significance and complexity, it was considered vital to approach the PBC with the broadest set of potential levers and components. Therefore, a blue-sky opportunity approach was taken to generate an unconstrained list of ideas that might impact, or form part, of Auckland's 30-Year rail plan.

In total, 291 initial ideas were established on the virtual brainstorming whiteboard, illustrative shown in Figure 3-9 A summary of themes from the ideation process is shown in Table 3-6, grouped to align with the Waka Kotahi Intervention Hierarchy.

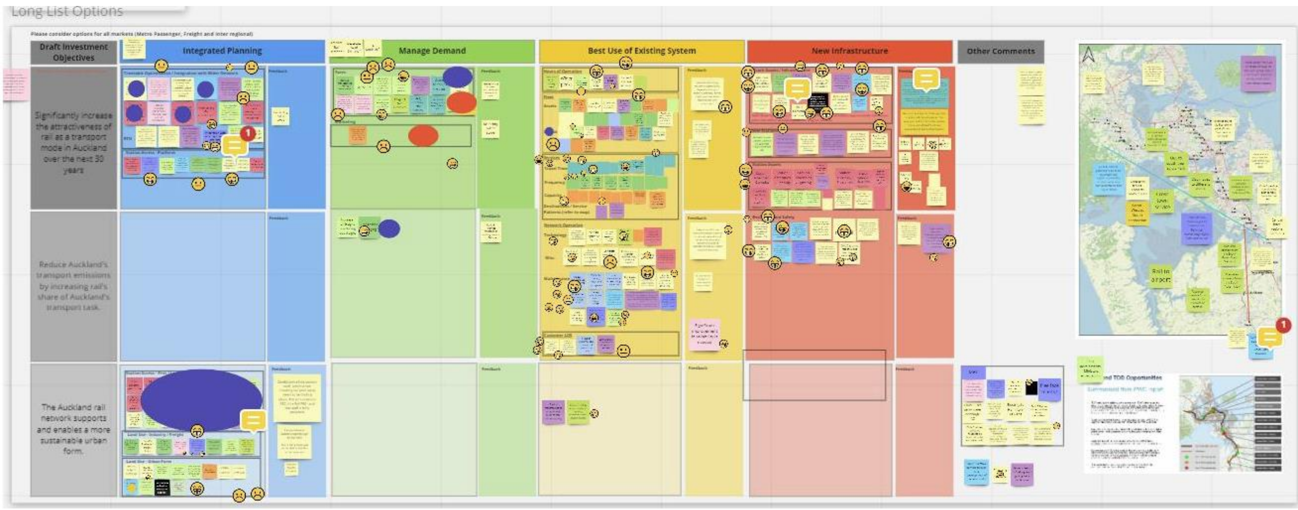

Figure 3-9: Ideas Generation

Table 3-6: Ideas generation and Intervention Hierarchy

INTERVENTION HIERARCHY	IDEA THEME	ILLUSTRATIVE IDEAS
Integrated Planning	Timetable optimisation / integration with wider network	Maximise use of the rail corridor by optimising its integration with the wider network
	Rapid Transit Network	Similar to point above with a specific focus on Heavy Rail as part of the broader RTN
	Station access – platform	Improvement of station and platform accessibility and providing more access points to platforms
	Station access – first / last mile	Enhancements to the wider transport network to improve first / last mile access to stations and connectivity with other modes (micro-mobility parking, park-and-ride, etc)
	Land use – industry / freight	Land use improvements to increase the addressable freight market of the rail network
	Land use – urban form	Land-use improvements within station catchments to support denser urban , in a manner that supports increasing heavy rail and wider PT use.
Manage Demand	Fares	Use of pricing to encourage rail use and manage the distribution of demand to make best use of capacity. Applicable to all markets
	Marketing	Use of marketing to encourage rail use. Applicable to all markets
Best Use of Existing System	Hours of operation	Improvements to the span of peak and all day services for all markets
	Fleet – assets	Enhancements to the performance of fleet (including speed, operational reliability, energy efficiency, axle loads etc)
	Fleet – layout	Enhancements to the interior layout of EMUs to accommodate more passengers (and potential to relax loading standards)
	Services – travel time	Faster travel times through stopping patterns and max speed improvements
	Services – frequency	More frequent services
	Services – capacity	Increased capacity particularly via longer train lengths
	Service – patterns	Improvements to route structure to better service demands, including adding new routes and network extensions
	Network operation – technology	Enhanced network operation via technology improvements (e.g. IOT and apps)
	Network operation – misc.	Included consideration for segregation of modes (freight and passenger), removal of

INTERVENTION HIERARCHY	IDEA THEME	ILLUSTRATIVE IDEAS
		service interlining, and greater competition for operations
	Network operation – maintenance	Enhancement including improved maintenance access (in time and space), plant/equipment and systems
	Customer level of service	Improved customer care and engagement
New Infrastructure	Track assets / infrastructure	Including grade separation of junctions, additional tracks, enhanced signalling, new corridors, geometry improvements, level crossing removals
	New stations	Add new stations to increase catchment
	Station assets	Improving and adding to station amenities including potential for Transit Oriented Development (TOD) better integrating the rail system with the surrounding community.
	Resilience and safety	Enhancements to improve safety at stations and platforms, at level crossings and along the corridor. Network wide enhancements to ensure efficient delay recovery

The full list of 291 ideas is provided in Appendix A of the Options Development Report Part 1 – 2051 End State (refer to Appendix G).

After a review to remove duplications, a three-step filtering process was applied to refine the list:

1. Is the idea within the scope of the PBC and in line with the Investment Objectives? (If not, remove it).
2. Is the idea more generic in nature, in that it could apply to any future programme? (If so, it is deemed non-differentiating and may be considered at a later stage in the PBC process).
3. Will the idea influence the provision of services for customers (passengers and freight)? (If so, it is deemed differentiating and will be taken forward as a long list option).

Upon testing the ideas against the steps above, 180 were removed due to redundancy, duplication, being out of scope, or for not enhancing service provision.

A further 81 suggestions were deemed to be **non-differentiating** (Step 2). These ideas, while relevant for the PBC to consider at some point, will not help to provide differentiation between broad programme options. For example, "*lighter units for faster acceleration and deceleration*". New fleet will be required under all options, therefore, whilst it is important to consider options for different types of rolling stock eventually, such decision making should be made at a later stage once the macro level elements of the programme have been determined. These 81 non-differentiating ideas were set aside to be tested and evaluated as part of the preferred programme.

The remaining 30 ideas were determined to be **differentiating** factors following Step 3 and were taken forward. These 30 ideas are presented in Table 3-7, grouped by service type.

Table 3-7: Categorisation of differentiating service ideas, Auckland Rail PBC

SERVICE TYPE	SUB-OPTIONS
Faster services (16 ideas)	• More express services • Less express services • Reduced dwell times
Longer trains (6 ideas)	• 9-car express • 9-car West • 9-car South
More frequent services (5 ideas)	• Frequent all day (< 10 minutes) • All-stops peak overlays West • All-stops peak overlays South • All-stops peak overlays East
New routes (4 ideas)	• South to West route (including Avondale – Southdown) • Manukau from South • OBL as alternative mode

It is important to note that all of the ideas relate to metro services, but as will be shown in subsequent sections of this Economic Case, the demands of freight and inter-regional markets are equally influential in selecting a 2051 end state.[121] The lack of representation of these markets in early optioneering phases is important to acknowledge as it demonstrates an initial bias in the process that was corrected over time leading to a somewhat non-linear optioneering process.

3.2.2 THEMATIC NETWORK CONCEPTS (LONG LIST)

3.2.2.1 LONG LIST DEVELOPMENT

Key considerations in the long list process, developed with PBC partners, and building on the outputs from the ideation process, are listed below. For further detail on this process refer to Options Development Report Part 1 (attached in Appendix G).

- Given the complexity and interconnected nature of the network, and the fact that the 30 differentiating service interventions determined in the previous phase could be combined in a

[121] Most major investments of the PBC, and specifically 4-tracking of the southern corridor, is driven primarily by the competing needs of freight and metro services. 4-tracking is required to meet these market needs alone, however that is not to say that without the 4-tracking inter-regional needs would simply not be met. In this scenario trade-offs would be required across all markets (metro, freight and inter-regional) and this is an important part of the justification for the investment.

practically infinite number of ways, a more exploratory approach was taken whereby a set of **thematic options** were developed,

- At this phase of the PBC, optioneering focused on the development of **service concepts**, rather than infrastructure solutions, with infrastructure treated as an enabler of the service option rather than being the focus of the optioneering. For example, an express service on the Southern Line along with other market demands, may require additional tracks. However, the focus of the options development is on the degree to which express services are operated (in this example), with the implication of additional tracks being considered in the options assessment,
- The themes selected represent a range of typical philosophical approaches to rail service planning and design using international examples. The **all stops** concept is similar to a German S-Bahn style operation with homogenous stopping patterns, while the **Inner-Outer** concept represents something more akin to areas of the over ground railway in the UK. A **peak express service** concept is similar in style to the JR East system in Japan which contains a variety of stopping patterns to serve diverse markets, and the **Avondale-Southdown service** broadly represents the idea of a freight bypass around a dense urban centre,
- However, it is important to note that the themes themselves were less important than the individual service options and ideas contained within them. These thematic concepts were not considered to be final standalone options. Instead, they were presented as distinct themes to gather feedback on specific issues, opportunities, and respective partner challenges, and
- Analysis of the thematic service concepts thus allowed the best parts of each option to be taken forward in a 'pick and mix' process, and further combined into specific 2051 network wide options for assessment in the short list. This provided a right-sized and manageable approach to this part of the options development process.

The resultant five thematic concept long list options are listed below. These concepts represent possible end states of the network, with services having been scaled to accommodate the 2051 forecast demands.

1. All Stops – similar to the base case, with passenger services stopping at every station.
2. Peak Limited Stops – express and limited stops services implemented to test benefits associated with faster travel time for the different geographies of Auckland.
3. Inner-Outer, All Day Frequent - express and limited stops services implemented to test benefits associated with faster travel time, with additional services in the inter-peak.
4. Peak Express, All Day Frequent, All-Day Freight – similar to Options 2 and 3, with further infrastructure interventions tested to improve capacity and resilience.
5. Avondale Southdown – similar to Option 4, with the addition of Avondale-Southdown as a major piece of infrastructure included in the network.

Table 3-8 shows how the five thematic concepts map to the general types of service ideas identified in the ideation phase: 'Faster services', 'More frequent services', and 'New routes'.

The idea grouping of 'longer trains' is not shown due to demand analysis showing that longer trains (9-car) would be required on all lines under all options (refer to Section 4.3.2 of Options Development Report Part 1 for detail).

In addition, 'Freight' was added at this point representing the key ideas of freight / passenger segregation. Provision of all-day freight paths for all major freight lines was incorporated into the analysis as central themes. This was based on the recognition that freight demand is highly sensitive to macro level economic and logistical decision making beyond the control of the freight operations and network planning. It was seen as imperative that the future network be resilient to these potential shifts in demand patterns and volumes.

Table 3-8: Summary of thematic concepts

	CONCEPT 1 *ALL STOPS*	CONCEPT 2 *PEAK LIMITED STOPS*	CONCEPT 3 *INNER-OUTER, ALL DAY FREQUENT*	CONCEPT 4 *PEAK EXPRESS, ALL DAY FREQUENT, ALL DAY FREIGHT*	CONCEPT 5 *AVONDALE SOUTHDOWN*
Faster Services					
No express, all-stops only	|				
Limited stops peak overlays		|			|
Express peak overlays				|	|
All day express			|		
Tidal express			|	|	
More Frequent Services					
Frequent all day (10min or better)			|	|	|
All-stops peak overlays West	|	|			
All-stops peak overlays South	|	|			
All-stops peak overlays East	|	|			
Freight					
Full separation of freight & passenger on NIMT South	|				
All-day paths on NAL and NIMT East (i.e. POAL)				|	|
New Routes					
Onehunga Branch removed			|		
Onehunga Branch replaced by South-west route				|	|
South & East-West segregation			|		|
Avondale-Southdown					|

3.2.2.2 LONG LIST ASSESSMENT

The five thematic long list options were assessed through a series of interactive workshops, supported by the MCA framework. The key questions asked during the workshop were "*what do rail users expect of the rail network?*" and "*what is the potential nature of the network in 2051?*".

Table 3-9 is a summary of the MCA, with the full long list MCA provided in Appendix E of the Options Development Report Part 1 (refer to Appendix G). Each line item corresponds to one or more rows of the MCA framework as indicated in brackets. Where aggregating scores over multiple criteria, the average was taken.

It is important to note that while IOs were scored and commented on in the Long List MCA and associated workshops, these criteria were not particularly instructive for the long list assessment. This is because the options developed in this phase are thematic in nature while the IOs relate to the programme as a whole. Instead, it is the conditional output assessment criteria that provided the most valuable information at this stage of analysis, as these present the required level of granularity to assess how different elements of the thematic concepts perform across geography and markets. They also represent a reasonable proxy for the IOs – being the rail specific targets that are expected to enable them.

Table 3-9: Long List MCA summary, Auckland Rail

OPTIONS	1	2	3	4	5	DM	COMMENTARY
Investment Objectives							
IO 1 (1-6)	1	1	2	3	3	0	Noting the caveat above that the IOs were of less significance in this round of assessment than that COs, the following themes emerged from the assessment: • A preference for separation of metro and freight services, allowing for greater flexibility in freight timetabling, and more efficient network operation. This is evidenced by the higher scoring of 4 and 5. • A preference for options that provided a wide span of high-quality service – specifically allowing all day high frequency metro services and all day freight paths. • A preference for some level of express services on the network, providing a more attractive service offering to enable greater mode shift. This is evidenced by the low scoring of Option 1 and progressive increase in the scores with higher levels of express.
IO 2 (7)	1	1	2	3	3	0	
IO 3 (8)	0	1	2	3	3	0	
Critical Success Factors							
Potential achievability/deliverability (9)	-1	-1	-2	-3	-3	0	Key differentiating elements included: high degree of land take and sensitive receiving environment between Wiri to Westfield; significant infrastructure pinch points on the Eastern and Western Lines (New Lynn Trench, CRL Connections to the NAL, Newmarket, Purewa Tunnel); and sensitivities on the Avondale-Southdown corridor. None of these option elements were considered to be fatal flaws but presented an early indication of the likely high costs of expanding track capacity in these areas, which would require high levels of benefit to justify in the absence of other lower cost alternatives.
Potential affordability (10)	-1	-1	-1	-3	-2	0	Affordability was considered to be correlated to anticipated capital costs as details on potential funding envelopes and the level of detail that would be required to assess likely funding sources or splits was not available at this time.
Supplier capacity and capability (11)						0	Not scored as not deemed a differentiator at this level of the PBC.
Scheduling/programming (12)						0	Not scored as not deemed a differentiator at this level of the PBC.
Opportunities and Impacts							
Environmental effects (13)	-1	-1	-1	-1	-2	0	The primary differentiators in this category of criteria were Climate change mitigation (15) and Property impacts (19). From a climate change perspective, it was identified that Options 4 and 5 had the most potential to create mode shift to rail (in freight and passenger markets) and therefore contribute the most to emissions reduction targets. It was acknowledged that the significant infrastructure expansion involved in these options would generate embodied/construction carbon which would offset some of the benefits, however at a PBC level of planning, detailed investigation has not been undertaken to assess this. Option 5 was seen as potentially favourable in this respect, achieving similar benefits with less construction than other options. From a property impacts perspective, it was again identified that Options 1, 4, and 5, which involve significant corridor expansion. In the case of Option 1 expansion to 6-tracks in the constrained Wiri to Westfield section would likely result in significant property impacts relative to the other options.
Social and cultural impacts (14)	2	2	1	1	1	0	
Climate change mitigation (15)	2	1	1	3	3	0	
Climate change adaptation (16)	-1	-1	-1	-2	-2	0	
Property impacts (19)	-2	-1	-1	-3	-2	0	
Impacts on road safety (20)	2	2	2	3	3	0	
Cumulative impacts (17)						0	Not assessed at this stage.
Impacts on Te Ao Māori (18)						0	Equity issues discussed through 'social and cultural impacts'. Scoring to be undertaken on subsequent assessment during the short list stage.
Conditional Output Assessment							
Network Wide							As described above, the COs were used to interrogate the performance of specific components of each option across geography and market. Table 3-10 summarises the CO elements of the MCA assessment showing which elements were deemed to be important for consideration in the short list and which were not. Commentary on this screening is provided in Section 3.2.2.3, and further detail is presented in *Options Development Report Part 1* (refer to Appendix G).
Maintenance (21-22)	2	2	2	3	2	0	
75% utilisation (23)	1	2	1	3	2	0	
Western							
Metro (24-27)	1	1.75	2	2.25	2	0	
Freight, NAL (42-43)	0.5	0.5	0.5	1.5	1.5	0	
Eastern							
Metro (28-31)	1	1.25	1.5	1.75	1.75	0	
Freight, POAL (44-47)	0.5	0.5	0.5	2	1	0	
Inner Southern							
Metro (32-35)	1	1.25	1.25	1.75	1.5	0	
Outer Southern							

OPTIONS	1	2	3	4	5	DM	COMMENTARY
Metro (36-39)	1	2	2	2.5	2.5	0	
Freight, NIMT (40-41)	2	1.5	1	1.5	1.5	0	
Inter-regional (48,49)	1	1	1	1.5	2	0	
Project-specific Critical Success Factors							
Capital cost (50)	-1	-1	-1	-3	-2	0	From a Capital cost (50) perspective, Options 1, 2, and 3 were evaluated similarly insofar as they consist of the same primary infrastructure upgrade, being the Southern corridor four-maining and network wide 9-car platform extensions. Option 4 includes much more extensive 4-tracking of the network through key pinch points which led to lower scoring. Of note, Option 5 which includes Avondale-Southdown, scored better than Option 4 from a capital cost perspective – partly due to the fact that the Avondale-Southdown corridor was seen as a lower cost alternative to 4-tracking of the Western and Inner Southern corridors at this point.

Table 3-10: Long list summary - Conditional Output Assessment Criteria Analysis

GEOGRAPHY AND MARKET	TAKE FORWARD	DISCOUNT
WEST		
Metro (24-27)	• Option 1: Local stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 4, 5: All-day frequent service *(discussion in Section 3.2.2.3.2)* • Option 4: Direct cross-town service • Option 5: Avondale-Southdown service	• Option 2, 3, 4, 5: Skip-stop or express stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 1, 2, 3: Non-frequent off-peak services *(discussion in Section 3.2.2.3.2)*
Freight, NAL (42-43)	• Option 4, 5: All day freight paths *(discussion in Section 3.2.2.3.1)* • Option 5: Avondale-Southdown *(discussion in Section 3.2.2.3.1)*	• Option 1, 2, 3: Off-peak freight paths only *(discussion in Section 3.2.2.3.1)* • Option 3: Freight mixed with local and express metro on two tracks
Inter-Regional	NA	NA
Access & Maintenance (21-23)	To be assessed further at next stage	NA
EAST		
Metro (28-31)	• Option 1, 2, 3: Local stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 3, 4, 5: All-day frequent service *(discussion in Section 3.2.2.3.2)*	• Option 4, 5: Skip-stop or express stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 1, 2: Non-frequent off-peak services *(discussion in Section 3.2.2.3.2)*
Freight, POAL (44-47)	• Option 4, 5: All day freight paths *(discussion in Section 3.2.2.3.1)*	• Option 1, 2, 3: Off-peak freight paths only *(discussion in Section 3.2.2.3.1)*
Inter-Regional	NA	NA
Access & Maintenance (21-23)	To be assessed further at next stage	NA
INNER SOUTH		
Metro (32-35)	• Option 2, 3, 4, 5: Skip-stop or express stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 3, 4, 5: All-day frequent service *(discussion in Section 3.2.2.3.2)* • Option 1, 4, 5: 6 mains Wiri to Westfield (W2W) • Option 5: Avondale-Southdown service	• Option 1, 2: Non-frequent off-peak services *(discussion in Section 3.2.2.3.2)*
Freight, NAL, POAL, and NIMT (42,43,44-47, 40,41)	• Option 1, 4, 5 | 6: mains W2W *(discussion in Section 3.2.2.3.3)* • Option 1, 2, 3, 4, 5: All day freight paths *(discussion in Section 3.2.2.3.1)* • Option 5: Avondale-Southdown	• Option 1, 2, 3: Off-peak freight paths only for NAL freight *(discussion in Section 3.2.2.3.1)*
Inter-Regional (48,49)	• Option 1, 2, 3 and 4: Improved travel time	• Option 5: Inter-regional via CRL

GEOGRAPHY AND MARKET	TAKE FORWARD	DISCOUNT
Access & Maintenance (21-23)	To be assessed further at next stage	NA
OUTER SOUTH		
Metro (36-39)	• Option 2, 3, 4, 5: Skip-stop or express stopping pattern *(discussion in Section 3.2.2.3.4)* • Option 3, 4, 5: All-day frequent service *(discussion in Section 3.2.2.3.2)*	• Option 1: Local stopping pattern only *(discussion in Section 3.2.2.3.4)* • Option 1, 2: Non-frequent off-peak services *(discussion in Section 3.2.2.3.2)*
Freight, NIMT (40-41)	• Option 1, 2, 3, 4, 5: All day freight paths *(discussion in Section 3.2.2.3.1)* • Option 5: Avondale-Southdown	• Option 1, 2, 3: Off-peak freight paths only for NAL freight *(discussion in Section 3.2.2.3.1)*
Inter-regional (48,49)	• Option 1, 2, 3 and 4: Improved travel time	
Access & Maintenance (21-23)	To be assessed further at next stage	NA

3.2.2.3 LONG LIST ASSESSMENT SUMMARY

The assessment of the long list identified the key components of the potential service concepts to be taken forward in a 'pick and mix' process and combined into specific 2051 network wide options for assessment in the short list. In doing so, a number of takeaways were identified, which are described in the subsections below.

3.2.2.3.1 ALL-DAY FREIGHT PATHS

Status quo on the existing network is for freight traffic to be restricted by metro peak periods, where access to Ports of Auckland and Northland is limited to off peak periods only[122]. This limits the flexibility and reliability of service for freight customers – a significant impediment to gaining mode share and meeting decarbonisation targets. For this reason, options which prevented all day freight access on a specific line were discounted as not meeting the IOs of the programme. It was also identified at this stage that the Avondale – Southdown corridor would be a viable solution to enabling all day freight access to Northland without impact to metro services.

3.2.2.3.2 RTN FREQUENCY

While it was recognised that base demand forecasts didn't strictly require services more frequent than every 15min in off-peak periods, it was nevertheless agreed that elements of the thematic service concepts that were not compliant with Auckland Transport's desired RTN frequency service standard[123] of 10min headways or better should be discounted, as they would not support the overall level of service of the programme to increase rail mode share and reduce emissions.

3.2.2.3.3 SOUTHERN CORRIDOR TRACK EXPANSION

An early insight into 4-tracking was discovered during the thematic long list development process. The analysis demonstrated **the need for a 4-track railway from Pukekohe to Puhinui,** even for the least ambitious metro service concept (the all-stops concept). By similar argument, the section of the corridor from Wiri to Westfield was also assessed to need at least four tracks to accommodate the high volume of trains due to the interlining of South and East-West lines, with the potential for 6-tracking to achieve targeted levels of reliability and flexibility.

3.2.2.3.4 EXTENT OF EXPRESS SERIVCES

It was identified that an exclusively **all-stops service on the Eastern and Western lines** would be suitable for the 30-Year plan. This was due to the significant runtime improvements provided to the Western Line by the CRL and the short length of the Eastern Line, with estimated travel times for all-stops services on these lines being competitive to comparable car trips.

On the other hand, the Southern Line was identified as having long travel times well in excess of equivalent car trips (particularly for off-peak periods) and missing the 45 min CO target by a substantial margin. Initial travel time testing estimated that the 45 min target would be very difficult to achieve. However express stopping patterns and a reduction in timetable buffer through improved network reliability may result in outcomes close to this target for the outermost stations. This led to a decision to pursue varying degrees of **express service on the Southern Line**.

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[122] Freight from south of Auckland can travel in the peak but is limited to 2 paths per hour.

[123] The RTN standard effectively implies a minimum 8tph service all day in the context of the Heavy Rail network due to the fact that the peak service pattern is built on overlays of 4tph

3.2.3 PROVISIONAL SHORT LIST OPTIONS

The long list process described above enabled the further development of options enroute to the short list assessment. It did not however produce a short list (as may be expected via a standard sieving process) because of the thematic nature of the long list options and the pick and mix strategy adopted to evaluate them as part of right sizing the optioneering approach for the highly complex rail network. There was therefore an interim step in the optioneering process between long list and short list evaluation in which a set of provisional short list options was developed prior to the final short list.

3.2.3.1 INITIAL PROVISIONAL SHORT LIST DEVELOPMENT

An initial long list workshop was held on 21 July 2022 to piece together components and features from the thematic concepts. This resulted in the development of nine initial provisional short list options. These nine options were categorised in four buckets in order of the level of expected cost.

3.2.3.2 REFINED PROVISIONAL SHORT LIST OPTIONS

The relative benefits of service/operational and cost/deliverability were then assessed against the nine provisional short list options by interrogating the question of *'what are the critical problems (deficiencies, constraints) that need to be addressed to achieve the Investment Objectives of the programme'*. This led to an initial refinement of the options prior to assessment via a formal MCA process, resulting in the options described below and presented in Figure 3-10.

- A(i): Minimal investment option. 4-track south of Westfield, OBL as a shuttle.
- B(i): 4-tracking south of Westfield + Inner South widened to achieve passenger travel time savings. OBL as a shuttle.
- B(ii) Variant of Bi where the NIMT-E is 4-tracked as an alternative route for express trains.
- C(i): 4-tracking south of Westfield and 6-tracks from Westfield to Otahuhu, with the East West Line terminating at Otahuhu and a south to Manukau service in operation, avoiding the need for full W2W 6-tracking. A Newton to Newmarket (N2N) bypass to allow all day freight access without compromise to peak metro services.
- C(ii): Variant of Ci with Avondale-Southdown as an alternative to the N2N bypass.
- C(iii) Variant of Cii with 6-tracks W2W, thereby resolving expected passenger convenience and infrastructure complexity issues with the Manukau turnback (analysed further in the next phase of optioneering).
- D(i) A variant of Dii which provides a lower cost option of providing both express from the south and freight / passenger separation, by compromising on even passenger headways.
- D(ii) Avondale – Southdown plus 6-track Westfield-Wiri, plus widening of the Inner South for metro and inter-regional travel time savings, plus widening of the Outer Western corridor to achieve even headways.
- D(iii) A variant of Dii which adds 4-tracks to the NIMT-E, to provide more flexibility for maintenance. Again, this option was initially screened out, but added back for documentation purposes.

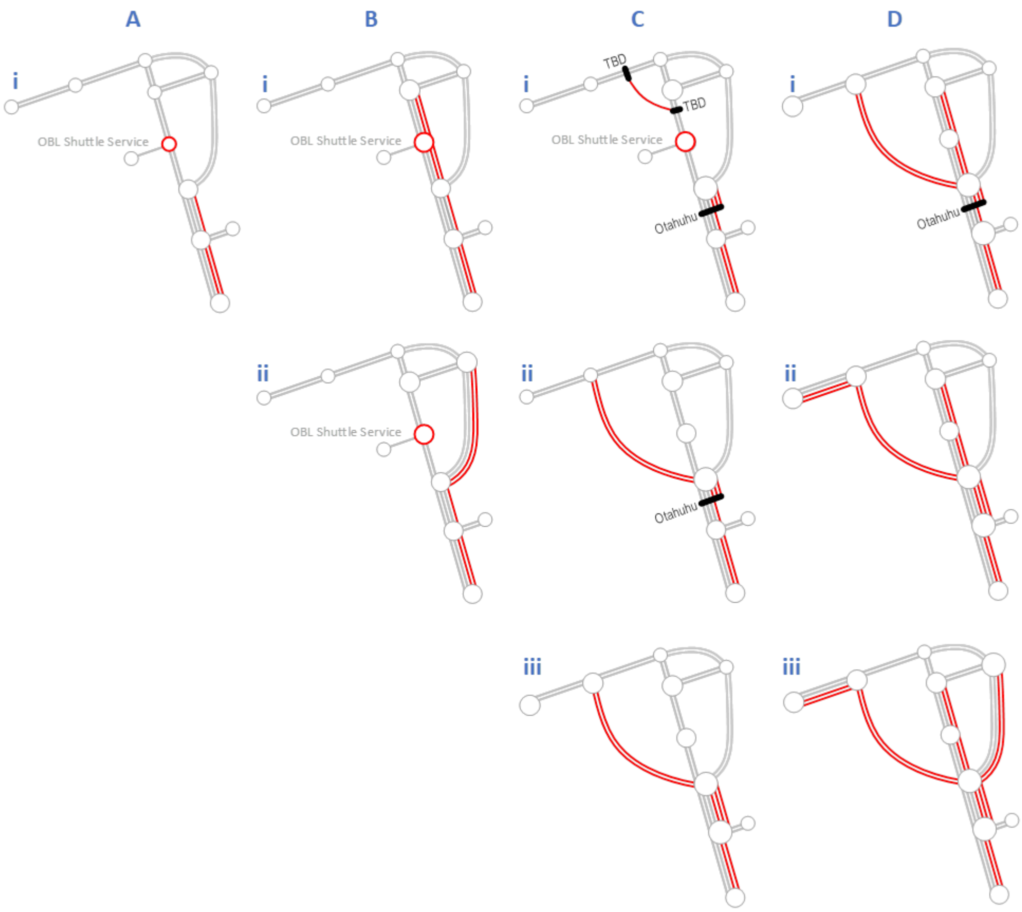

Figure 3-10: Refined provisional short-list of options

Summarised findings from the analysis that led to this refinement are provided in subsections below, with further details in the Options Development Report Part 1 (refer to Appendix G).

3.2.3.2.1 INADEQUATE FREIGHT ACCESS TO THE NORTH

The small segment of the network between N2N will experience unreliable and insufficient freight access (post CRL) due to trains having to merge and diverge between multiple interleaving metro services, as well as negotiate the high volume, flat junction at Newmarket. If not resolved this will continue to restrict freight access to off-peak periods and prevent the metro peak period from expanding on all lines. Three viable options were identified to address this issue:

1 Attempt to accommodate freight on a two-track railway via timetabling and precise operation.

2 Activate Avondale-Southdown as a mixed passenger and freight corridor to bypass N2N.

3 Build a shorter (and potentially cheaper) freight only bypass of N2N, likely a single-track tunnel closer to the city centre to reduce its length.

3.2.3.2.2 LONG RUNTIMES ON THE SOUTHERN CORRIDOR

Assuming no track speed upgrades, the target of a 45-min journey time to the city centre is not achieved under any option. The express services on the Eastern or Inner Southern corridors will be close to achieving this journey time if 4-tracking is implemented. 4-tracking of the Inner Southern corridor will provide better travel time to the city centre and is expected to be less costly with fewer environmental impacts in comparison to the Eastern corridor. As a result, 4-tracking of the Inner Southern corridor will be given preference over the Eastern corridor.

3.2.3.2.3 WIRI TO WESTFIELD HIGH UTILISATION:

This segment is expected to reach a critical capacity bottleneck in 2051 due to the high volume of passenger services and the requirement to provide access to Wiri Ports of Auckland (WPOAL).[124] The four options to address this are:

1. 4-tracking W2W which requires port trains to slot into a potentially insufficient 5 min headway gap.
2. Building turn-backs at Otahuhu and Puhinui to reduce metro train volumes between W2W, thus providing a wider headway gap for port trains.
3. Building five tracks to provide a dedicated mainline for port trains.
4. 6-tracking W2W to de-interline the Southern and Eastern Line services while also providing a wider headway gap for port trains.

3.2.3.2.4 ONEHUNGA CAPACITY AND POOR CROSSTOWN CONNECTION:

The OBL has a single track with short platforms which only supports 2 x 3-car tph service. The OBL also does not conform to RTN standards. Upgrading this section to double tracks, capable of accommodating nine car equivalent length trains would be extremely expensive due to the width of available corridor and density of level crossings. The two solutions taken forward are:

1. Convert the OBL to a shuttle service with a connection to the Southern Line, allowing the service to continue at 2x3-car tph, without consuming valuable capacity on the main line, and deferring a decision to upgrade or remove the OBL as part of a wider PT network plan.
2. Remove the OBL on implementation of Avondale-Southdown, which would provide an alternative heavy rail service to the neighbourhoods served by the existing OBL.

3.2.3.3 PROVISIONAL SHORT LIST ASSESSMENT

The nine short listed options discussed above were assessed through an MCA to reduce to a final short list of three options. It is worth noting that a high-level costing of differentiating elements was undertaken for these options. This was based on unit cost per km estimates for track expansion benchmarked against other comparable projects, and initial conceptual design work undertaken at more constrained areas. These areas included the Southern corridor 4-tracking, 6-tracking, and Westfield junction grade separation, to more accurately assess property and civil impacts.

In this assessment, Option A was used as the Reference Option, with other options scored relative to it. The analysis up to this point had demonstrated the need for Option A as a bare minimum to meet demand via 4-tracking of the Southern corridor to Westfield. By using this as the reference option, it provided more scope to utilise the 7-point scale (up and down from 0) in the MCA, and thus help provide more granularity for differentiating the other options. If the Do Min was used as the comparator in scoring, there would have been minimal differentiation between any of the greater investment options as Option A was already a material improvement (in relation to the benefits side of the MCA) over the Do Min.

The outcome of the provisional short list assessment is shown in Table 3-11 with further commentary provided in subsections below. The infrastructure upgrades are represented in a

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[124] This is the inland port at Wiri belonging to PoAL.

schematic form which shows the number of tracks between key nodes on the network as shown in the example in Figure 3-11 below. Red lines indicate where upgrades are proposed under the option.

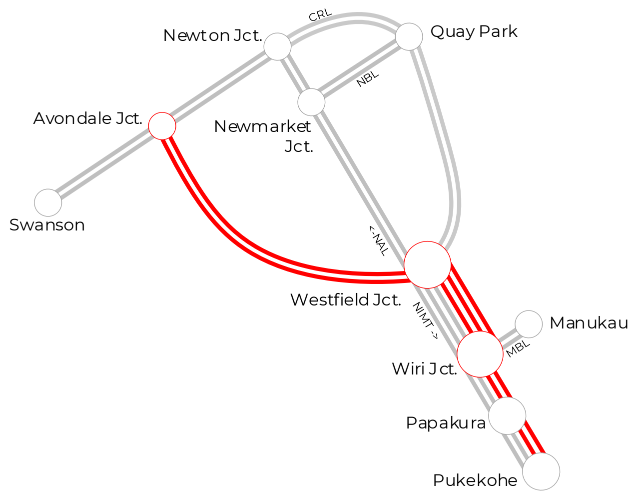
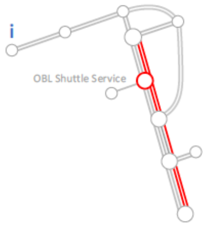
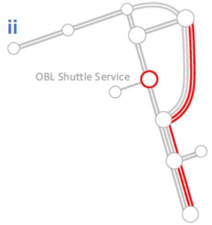
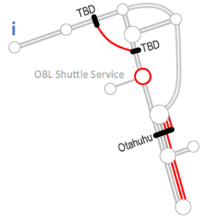
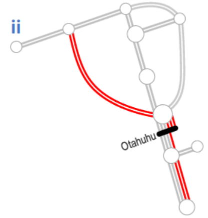
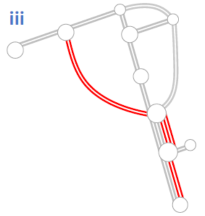
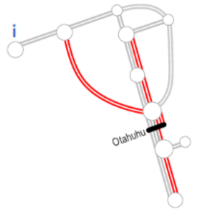
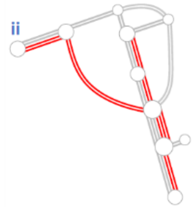
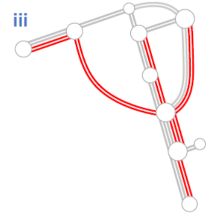


Figure 3-11: Schematic representation of the infrastructure upgrades – example option

Note that one mechanism used to sieve options in this phase was the rationale that some options represent subsets or phasings of others – for example Option Bi is an interim phasing of Option Di. Therefore, consideration of the more advanced Option Di, would allow for an assessment of Bi within its phasing analysis. This rationale was used to discount options Bi and Cii.

Table 3-11: Provisional short list MCA final assessment

Option	A (Reference Option)	Bi	Bii	Ci	Cii
					
MCA score (raw)	0	26	25	9	29
Incremental cost to Ref A ($B)	0	3.04	5.76	1.65	4.74
Total cost ($B)	13.59	16.63	19.35	15.24	18.33
Recommendation	Take Forward	Discount	Discount	Discount	Discount
Rationale	Minimum investment option. Though expected to not satisfactorily deliver on the IOs of the programme, this option was taken forward to ensure a thorough value for money assessment could be made in the short list assessment.	Effectively **a phasing of Option Di** – phasing and scenario analysis will identify when this infrastructure state needs to occur or what could trigger it.	**Option Bi preferred as a direct alternative** due to lower potential to improve rail attractiveness for passengers (See Section 3.2.3.3.1), significant deliverability concerns (See Section 3.2.3.3.2), environmental risk (see Section 3.2.3.3.3), and higher cost (+$2.36b) of the Eastern corridor track expansion.	**Options Cii preferred as a direct alternative**, given the lower potential for freight and passenger attractiveness (see Section 3.2.3.3.1), and the high levels of uncertainty around deliverability (see Section 3.2.3.3.2). This resulted in a very low overall MCA score of 8 which did not justify the cost savings over Cii of -$3.09b.	Effectively **a phasing of Option Di** – phasing and scenario analysis will identify when this infrastructure state needs to occur or what could trigger it.

Option	Ciii	Di	Dii	Diii
				
MCA Score (raw)	34	43	50	50
Incremental cost to A ($B)	6.68	7.78	15.07	20.83
Total cost ($B)	20.27	21.37	28.66	34.42
Recommendation	Take Forward	Take Forward	Discount	Discount
Rationale	Adds Avondale-Southdown and captures the Wiri to Westfield 6-tracking option.	Adds Avondale-Southdown and captures the Wiri to Westfield service adjustment option and the additional express benefits option of the inner NAL.	Incremental change of 4-tracking the Outer Western Line rejected on the basis of low benefit from an overall passenger rail attractiveness perspective (see Section 3.2.3.3.1) vs. significant deliverability concerns (see Section 3.2.3.3.2) and high cost (estimated to be $5.3b for this element alone).	Discounted for similar reasons as Dii as well the fact that the maintenance benefits of adding Eastern corridor 4-tracking were not expected to justify the high delta in cost and environmental risk (see Section 3.2.3.3.3 for discussion). This is reflected in the fact that there is no improvement to the overall MCA score between Dii and Diii.

3.2.3.3.1 INVESTMENT OBJECTIVE SUMMARY

This part of the assessment focused primarily on attractiveness of services to passengers and freight users, and the reliability of the network. Improving the reliability of the network will make it more attractive, thus inducing mode shift and a greater reduction in vehicle kilometres travelled (VKT) and emissions.

From a passenger attractiveness perspective, the following commentary informed the selection of options:

- Routing of express services: Routing of express services via the Southern Line in Di was assessed to result in better travel times and therefore provide more attractive services than via the Eastern Line in Dii given the slightly shorter route length and direct connectivity to Newmarket. Lower costs and less environmental impacts and risks reinforced this conclusion (see below).
- N2N treatment: The option containing the short N2N bypass (Ci) was likely to compromise the ability to run express services given that all day freight paths on the two tracked Inner Southern corridor would consume the slots that these would otherwise run in. This would also result in uneven headways on all lines including the Southern Line. The Avondale – Southdown corridor (in Cii, Ciii, Di, Dii, Diii) avoids these issues by completely removing freight from the Inner Southern corridor therefore enabling all day express and even headway operation on the Southern Line.

From a freight attractiveness perspective, it was found that options providing higher degrees of operational reliability and more separation between freight and metro services throughout the day were most strongly preferred. This differentiated options in two main areas:

- NAL: Options containing the Avondale – Southdown (A-S) corridor (Cii, Ciii, Di, Dii, Diii) were preferred over the N2N bypass given that while the N2N bypass addressed most freight/passenger conflicts, it was not as flexible due to a higher degree of mixed use on the high traffic section of the Inner Southern Line. The N2N bypass option (Ci) was in turn preferred over options with no separation of NAL freight and metro passenger (A, Bi, Bii) as these would not enable all day freight access.
- POAL: Options separating metro and freight through the W2W segment of the network were deemed to result in the highest degree of flexibility and reliability for freight. Whether this was achieved via a full 6-track solution (Ciii, Dii, Diii) or a modification in metro service patters (Ci, Cii, Di) was not generally considered differentiating from a freight perspective.

3.2.3.3.2 CRITICAL SUCCESS FACTORS SUMMARY

Critical Success Factors differentiated several options due to achievability and deliverability. The key findings were:

- N2N Bypass: Option Ci (N2N bypass option) has a high potential for geographical challenges and has a significant level of uncertainty around the proposal. While the alternative of Avondale – Southdown (in Cii, Ciii, Di, Dii, Diii) is a longer corridor, the land is already owned by KiwiRail and there is a far greater degree of certainty around the solution having been studied at various points over the past few decades.
- Inner-south corridor 4-tracking vs. Eastern corridor 4-tracking: Various options consider 4-tracking the Eastern corridor (Bii) or the Inner Southern corridor (Bi, Di, Dii) to achieve travel time benefits for express services, or both corridors to achieve greater maintenance and resiliency benefits (Diii). It was generally agreed that expansion of the Inner Southern corridor

would have an expected lower cost (being a shorter corridor), with fewer expected deliverability challenges, particularly considering the constraints of the Purewa tunnel, the causeway, and the Glen Innes to Mt Wellington section.

- **Outer Western Line 4-Tracking:** Option Dii and Diii address the problem of uneven headway on the East-West Line by adding a third and fourth main to separate freight and metro services. However, this was not considered to be justifiable due to the significant constraints and corridor widening that would be required at very high cost.

3.2.3.3.3 OPPORTUNITIES AND IMPACTS SUMMARY

The primary observation in this category of criteria was that options including 4-tracking of the Eastern corridor (B2, D3) were flagged as having significant environmental concerns in relation to impacts to Hobson Bay and the Orakei Basin.

3.2.3.3.4 PROJECT-SPECIFIC CRITICAL SUCCESS FACTORS SUMMARY

Qualitative capital costs were used in the MCA workshop assessment to differentiate between options.

3.2.4 PROGRAMME SHORT LIST

3.2.4.1 PROGRAMME SHORT LIST DEVELOPMENT

The three short list options represent a set of potential infrastructure schemes for the network. These options are illustrated in Figure 3-12. A summary of the key features for each of the options is provided in Table 3-12 on the following page.

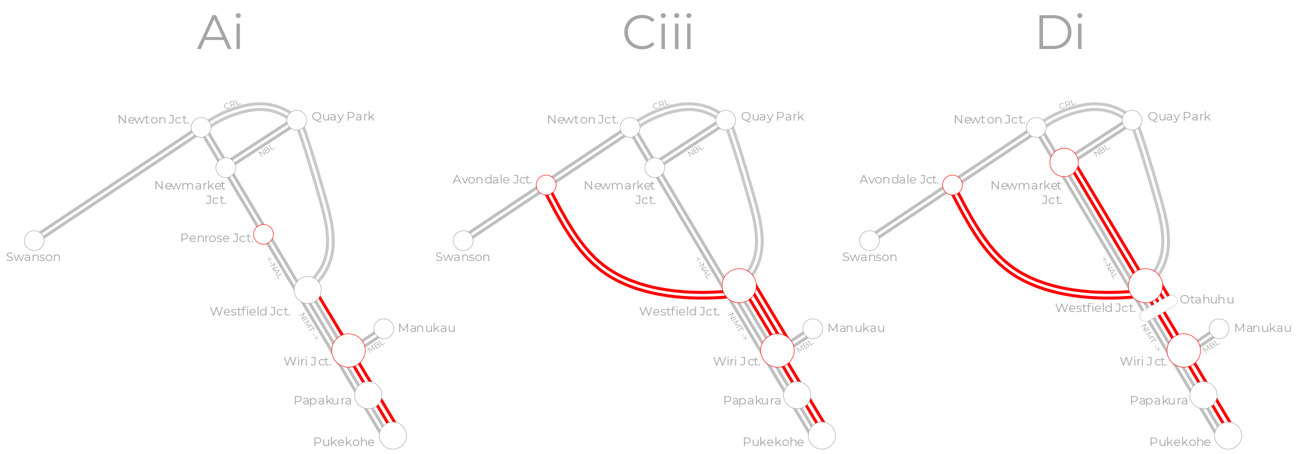
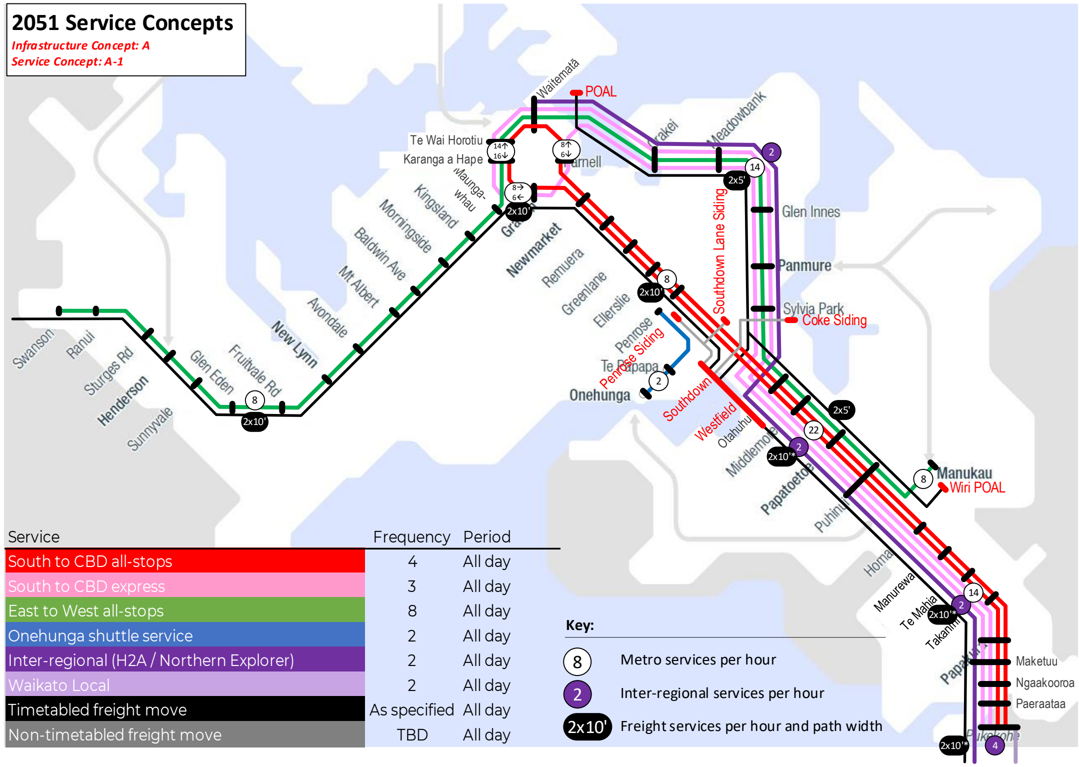


Figure 3-12: Short list initial infrastructure concepts

Table 3-12: Service concept key features across the short list

<table>
<tr><th>OPTION</th><th></th><th>MAIN FEATURES</th></tr>
<tr><td>Option Ai</td><td>



</td><td>

Routing of Express and Hamilton to Auckland (H2A)

- Via Eastern corridor due to lack of available capacity on the Inner Southern.
- Express and H2A trains need to alternate directions around the CBD in order to protect freight path from Newton to Newmarket i.e. 2 of 6 trains access the CRL via a clockwise move through Parnell and Grafton.
- On further inspection, this routing is assessed to be very likely infeasible without additional infrastructure intervention at Westfield and Quay Park.

Port train paths

- Only 5min paths can provided on the Eastern corridor, due to presence of express trains.

Metro headways

- 10min freight paths on the Western corridor, and the Wiri to Westfield 4-track configuration, triggers uneven headways of 5/10min splits, on all lines.

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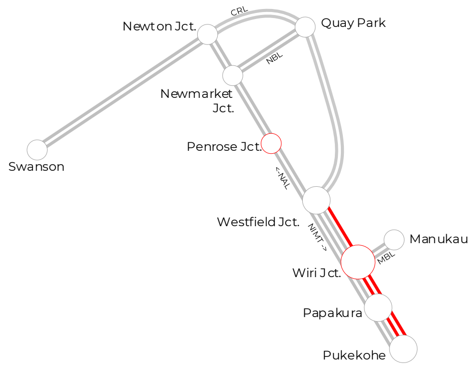
Macro Infrastructure Summary



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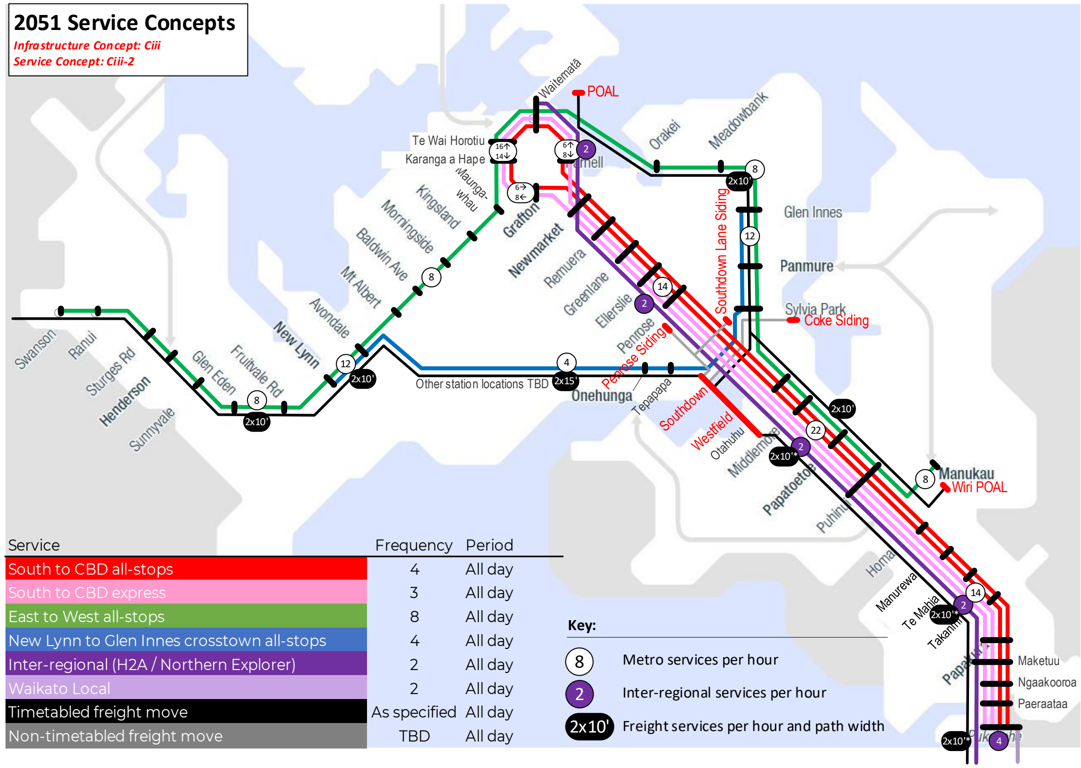
Option Ciii



Service	Frequency	Period
South to CBD all-stops	4	All day
South to CBD express	3	All day
East to West all-stops	8	All day
New Lynn to Glen Innes crosstown all-stops	4	All day
Inter-regional (H2A / Northern Explorer)	2	All day
Waikato Local	2	All day
Timetabled freight move	As specified	All day
Non-timetabled freight move	TBD	All day

Routing of Express and H2A

- Separation of freight onto Avondale - Southdown allows express and H2A services to be routed on the faster Inner Southern route.
- H2A serves Newmarket enroute to Waitematā.

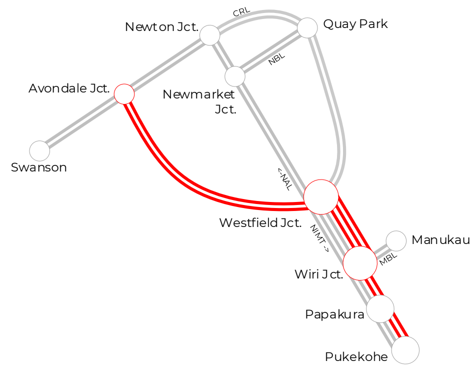
Port train path

- 10min can be provided along entire route.

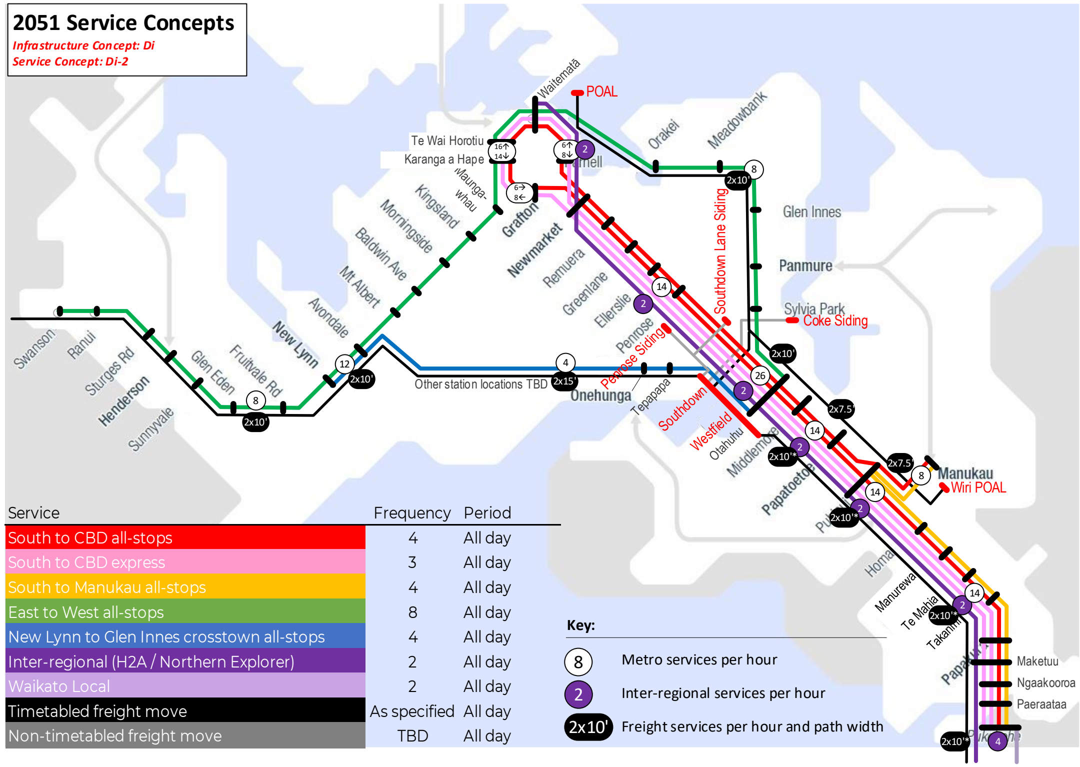
Metro headways

- 10min NAL freight path triggers uneven on East-West Line, however…
- Based on early timetable concept development, even headway can be protected on Southern Line due to the 6-tracking configuration between Wiri and Westfield.
- Avondale-Southdown service has an even headway if 4tph, otherwise uneven.

Infrastructure Summary



Option Di



Service	Frequency	Period
South to CBD all-stops	4	All day
South to CBD express	3	All day
South to Manukau all-stops	4	All day
East to West all-stops	8	All day
New Lynn to Glen Innes crosstown all-stops	4	All day
Inter-regional (H2A / Northern Explorer)	2	All day
Waikato Local	2	All day
Timetabled freight move	As specified	All day
Non-timetabled freight move	TBD	All day

Routing of Express and H2A

- Separation of freight onto Avondale - Southdown allows express and H2A services to be routed on the faster Inner Southern route. 4-tracking on Inner Southern allows skipping additional stations.
- H2A serves Newmarket enroute to Waitematā.

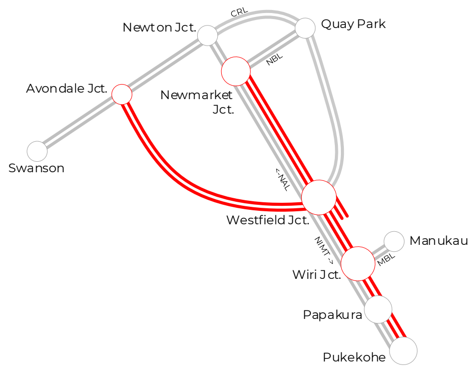
Port train paths

- 10min can be provided along NIMT-E but only 7.5' between Wiri and Westfield (unless south line forced to uneven headway).

Metro headways

- 10min NAL freight path triggers uneven on East-West Line, however…
- Based on early timetable concept development, even headway can be protected on Southern Line
- Avondale-Southdown service has an even headway if 4tph, otherwise uneven.

Infrastructure Summary



3.2.4.2 SHORT LIST COST ESTIMATES

Indicative cost estimates for the three short listed options were further developed and refined for the short list assessment. Option Ai contains many common features of all options – such as new fleet, level crossing removal, 4-tracking of Westfield to Pukekohe – so this provides a degree of commonality between all three options from a cost perspective. The cost of each differentiating element (with respect to Option Ai) for Options Ciii and Di, along with the total cost of each option, is presented in Table 3-13.

Table 3-13: Short list cost estimates ($millions)

	Ai		Ciii		Di	
	Lower	Upper	Lower	Upper	Lower	Upper
Common cost elements (e.g. fleet, level crossing removal, signalling etc.)	9(2)(i) - Commercial activities [redacted]					
Differentiating items						
4T Westfield Jcn – New Market (2T)						
6T Otahuhu – Westfield Jcn (2T)						
6T Wiri Jcn – Westfield Jcn (2T)						
4T Swanson – Avondale (2T)						
2T Avondale – Southdown						
Total – differentiating items						
Total cost estimate	17,472	24,823	24,142	34,993	25,232	36,708

These costs are the outputs of a capital cost model developed as part of this PBC. This estimated the various infrastructure, systems and equipment upgrades based on the following general methodology at the short list stage:

1 Develop the overall structure of cost elements in this PBC's scope.

2 Develop short list estimates using relative costing principles.

(a) Focus on cost of differentiating elements costed based on various approaches depending on criticality to the realisation of programme benefits and perceived risks in deliverability. This included:

(i) Previous business case work and costing studies (e.g. signalling enhancement information was taken from existing business cases, level crossings removals were costed based on a previous studies commissioned by Auckland Transport)

(ii) conceptual design for critical areas (e.g. Westfield junction, 4-tracking)

(iii) comparison with known actual costs for similar relevant interventions (e.g. unit costs for track expansion were compared against recent Wiri to Westfield works)

(iv) further cost modelling for specific elements (e.g. fleet unit cost vs. order size model).

(b) Sensitivity tested bookend estimates to confirm short list cost relativities.

3.2.4.3 PROGRAMME SHORT LIST ASSESSMENT

A workshop was held with technical specialists and stakeholders from Auckland Transport, KiwiRail and WSP in October 2022. The three short list options were assessed in a final MCA, which followed the same framework as used in the optioneering process. Table 3-14 provides a summary of the scoring of the MCA. It should be noted that the MCA scores presented in the table below are summarised averages (unweighted) and further detail is provided in Appendix G. This detail is important in establishing the full picture of the constraints that vary across the network and need to be considered holistically in reaching a final conclusion on the assessment of the three options. This was reinforced during the subsequent refinement of the preferred option, which confirmed that the expected constraints associated with Option Ai would actually occur earlier, and be more restrictive in achieving both the investment objectives and desired outcomes than assumed during the short list assessment. For these reasons, with the benefit of additional detailed information from analysing the preferred option, the summarised scores below for Option Ai are considered to overstate its performance relative to Options Ciii and Di (noting the overall limitations of a 3 point (positive) scale to the Do Min reference point of 0).

In addition to the MCA, Waka Kotahi's Appraisal Summary Table (AST) tool was used to summarise the key metrics and outputs for the short list assessment to assist in recommending a preferred end state for 2051. This includes a summary of the trade-offs between the different end states and a summary of the overall option selection/assessment rationale for each of the three shortlisted options. The completed ASTs are included in Appendix J for reference.

Table 3-14: Short list MCA summary

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Investment Objectives					
IO 1: Continually increase the use of rail in Auckland (all markets) over the next 30 years, by increasing its attractiveness (e.g. reliability, frequency, capacity and travel times)	0	2	3	2	Option Ciii was preferred from a passenger attractiveness perspective as having even headways across all lines (not the case for Options Ai and Di which require uneven headways on the Southern Line), all day express services on the Southern Line (which is not possible in Option Ai), and a more convenient service structure than Di. Both options Ciii and Di were estimated to generate an additional 1% mode shift to PT and an 8% increase in rail mode share as compared to Option Ai. From a freight perspective, both options Ciii and Di have additional flexibility for timetabling freight services, especially for NAL. Both NAL and POLA freight is constrained to off-peak periods in Ai, as this option does not allow for sufficient path widths between Wiri and

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
					Westfield or on the inner southern corridor. Constraining freight to off-peak on these lines means that demand cannot be met (across a range of likely scenarios) - hence Ai fails for freight on this objective. From a network reliability perspective, differentiation centred around Wiri to Westfield. Ai did not achieve the 75% capacity utilisation target (with a value of 83%) with expected reliability issues due to interlining of the south and east-west lines. Option Di was seen as having a critical constraint around Wiri junction that would compromise network reliability. By contrast, Ciii was seen as achieving a high level of reliability in this area.
IO 2: Reduce Auckland's net transport emissions by increasing rail's share of Auckland's transport task over the next 30 years	0	2	2	2	Options were not significantly differentiated by their CO2 emissions reduction potential, with all options deemed to generate similar levels of reduction. It should be noted that the performance of options was expected to differ significantly under scenarios outside of base demand e.g. a Port Move scenario or an strong policy setting to drive PT mode shift. Under such scenarios Option Ai would be expected perform significantly worse than Ciii and Di. • Total Auckland road CO2 (2051): 1.5 million tonnes. • Reduction in Auckland road CO2 (2051): 6,700 tonnes (-0.4%) under Ai and 8,000 tonnes (-0.5%) under Ciii and Di. • Freight-related CO2 avoided (2051): 16,600 tonnes.
IO 3: The Auckland rail network supports and enables a denser urban form within the metro station catchments within the next 30 years	0	1	2	2	Options Ciii and Di were scored higher on the basis of a modest improvement over Ai as a result of an overall increase in accessibility from improved all day service, and from the A-S corridor. The percentage of jobs accessible within 30min increased from 4.4% in Ai to 5.9% in Ciii and 5.4% in Di, and the percentage of jobs accessible within 60min increased from 7.0% in Ai to 9.4% in Ciii, and 9.9% in Di.
Critical Success Factors					

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Potential achievability/deliverability	Not scored				The deliverability criteria are highly dependent on phasing which will be addressed in Options Report Part 2. This criterion was not scored in the workshop, however much of the workshop discussions centred around the achievability/feasibility of the Wiri to Westfield option. On this point, it was generally agreed that the differences between Ciii and Di were not as significant as first anticipated. Both options required significant land take at the junction ends between Wiri to Puhinui and Westfield to Otahuhu, while the incremental land take required for Ciii was seen as relatively low risk, with the one exception of the Middlemore area. However, on this point it was noted that Ciii presented an opportunity for integrated development around Middlemore with the Hospital and Kainga Ora, which would support the IO of denser urban form. Furthermore, the complexity of the Puhinui to Wiri segment implied by Di was deemed to be highly challenging and potentially infeasible. Thus the options were not significantly differentiated overall, with a slight preference to Ai over Ciii and Di.
Potential affordability	Not scored				Potential affordability was assessed as being primarily correlated with the capital costs at this stage of analysis (presented in the Critical Success Factors section), given specific funding envelopes were not known. From an OPEX perspective, again all three options are relatively similar, as services are scaled to the same set of demands from a metro perspective (all options were assessed to have roughly the same revenue fleet requirements and thus operational costs would be similar) and would accommodate similar volumes of freight and inter-regional services (under base demand scenarios). Fundability is further discussed in the Part 2 report, being an important factor in assessing how quickly investments are phased over time.
Supplier capacity and capability	0	-3	-3	-3	Though options vary substantially by capital costs, all options contain significant construction costs over the first decade (50% between 2025-2035), being required in parallel with other major projects. Thus, this criterion was not considered differentiating.
Scheduling/programming	0	-3	-3	-3	Scored analogously to the Supplier capacity and capability.
Opportunities and impacts					

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Environmental effects	0	-2	-3	-3	Primarily differentiated by the inclusion of the Avondale – Southdown corridor. The creation of a new corridor, whilst designated already, will have temporary (construction) and permanent (operational) effects on the environment. Options Di and Ciii will have differing environmental impacts due to differences in the total length of widened corridor, however this was not deemed differentiating.
Social and cultural impacts	0	-1	-2	-2	Similarly, options were primarily differentiated by inclusion of Avondale – Southdown, resulting in the construction and operation of a railway within an established residential area including operation of heavy freight trains. It was noted that residential land around Onehunga can be developed to medium intensity, which may increase the size of the population exposed to adverse effects. It was also noted that under the assumed alignment, the railway would have an impact upon built heritage and natural heritage e.g., lava caves in Onehunga, and an existing school. Commentary included the suggestion that the new corridor will need to be grade separated (elevated/trenched) to reduce severance effects. The 6-tracking alignment in Option Ciii was also noted as having potential for community severance to be exacerbated if residential land is required for the widened corridor, with existing residents displaced from the community. However, this difference didn't lead to an overall difference in scoring between Ciii and Di.
Climate Change mitigation	0	1	2	2	All options delivered similar VKT reduction, however the lack of meaningful separation of freight and metro services under this option, does not support mode shift to rail freight and was therefore scored lower than options Ciii and Di.
Climate change adaptation	0	-1	-1	-1	Not deemed to be differentiating. All options include new infrastructure in areas exposed to sea level rise (Westfield) which presents a risk, but also an opportunity for mitigation as part of the project.
Cumulative impacts	0	-1	-2	-2	Options were again primary differentiated based on the inclusion of Avondale – Southdown corridor, for similar reasons to those provided above.

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Impacts on Te Ao Māori	Not scored				This scoring excluded the Te Ao Māori impacts, however project partners participated in hui with Iwi through mana whenua representatives in October and November to get input into the programme selection. In these sessions, initial thinking on options was shared with agreement to check back in later in the process. Key considerations from this engagement were environmental impacts and the need for mitigations, the potential benefits to create jobs from an increase in freight operations and construction, and the ability of the investments to support trips outside of the typical commuter peaks.
Property impacts	0	-2	-3	-3	All options were deemed to have a significant impact on property, with Ciii and Di receiving a lower score due to the following features: • Ciii includes widening of existing rail corridor to six tracks between Westfield and Wiri impacting residential, commercial, and recreational land, and existing infrastructure such as bridges. • Di includes widening of the existing rail corridor to four tracks between Westfield to Newmarket resulting in impacts upon adjacent properties along the whole length of the alignment. In some locations the rail corridor is directly adjacent to the State Highway network, into which expansion may, or may not, be feasible. The additional negative impacts of Ciii and Di over Ai were considered to be relatively similar in scale, resulting in the same score for each. For both Ciii and Di, the Avondale – Southdown corridor was not considered to be a major differentiator over Ai given that the majority of the Avondale-Southdown corridor is owned by KiwiRail (though it was acknowledged that designation boundaries may need to be widened to accommodate two tracks in some locations).
Impacts on road safety	0	1	1	1	All options include removal of level crossings and only result in a small vkt reduction. Therefore, a similar scale of benefit to road safety is expected across all options.

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Conditional Output Assessment					
Metro Passenger	*0*	*1*	*2*	*1*	Overall scoring based on the assessments below.
Provide peak period capacity for base demand (metro passenger)	0	1.5	2	1	Peak capacity was primarily differentiated by the Wiri to Westfield configuration. Option Di was scored lowest due to the utilization issues with the South to Manukau service where demand modelling showed that trains travelling to Manukau were significantly underutilised compared to those travelling to the CBD. Modelling showed CBD bound trains (red) at 117% seating capacity at Homai while the Manukau trains were at only 25%.. Options Ciii was scored higher than Ai given that the 6-track configuration provides substantial room for further growth.
Maximum length of standing (target <15mins)	0	1	1.25	0.5	For similar reasons Di was scored low due to the issues with the South to Manukau service. Ciii was scored higher than Ai given that the expected buffer reduction of the Wiri to Westfield 6-tracking solution, which improved travel times and therefore reduced standing times. The 'buffer reduction' was determined via conceptual timetabling which indicated that 6-tracking Wiri to Westfield would allow for an operation which segregated the east-west and Southern lines, thereby removing up to 7.5min in travel time from the east and Southern lines.
Enable incremental journey time improvements	0	1	2.5	1.5	All options were expected to provide improved travel times on the Southern Line, with Di provided slightly greater benefits due to the Westfield to Newmarket 4-tracking. However, the greatest benefits were judged to arise from 6-tracking in Option Ciii due to an expected buffer reduction (described above), which would benefit a greater number of passengers. This resulted in Ciii having the highest score.
Point-to-point journey time comparable to off-peak car trip	0	1	2.5	1.5	A similar logic was applied as per above.

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Journey time to central area should not be more than 45mins	0	0.25	0.75	0.75	A similar logic was applied as per above. For this metric, the only stations not meeting the target are those on the Outer Southern corridor. Di provides the best express benefits for those stations, but this was not deemed differentiating between the options.
Comply with 2018 RPTP RTN aspirations for service: 10 min (or better) minimum frequency between 6am and midnight	0	1	1.25	1	All options were assessed to provide an RTN compliant service frequencies of 8tph minimum. However, both options Ai and Di require uneven headways (5/10min split) on all lines due to the need to provide freight paths on the Inner Southern corridor in the case of Ai and the need to accommodate port trains between Puhinui and Otahuhu in Di. The 6-track configuration of Ciii allows for an even headway on the Southern Line. Thus, Ciii scored slightly higher.
Freight	*0*	*1*	*2*	*1*	Overall scoring based on the assessments below.
Provide peak period capacity for base demand (freight; # slots)	0	0.75	1.75	1.5	The options were differentiated as follows: • For POAL freight, Ai scored lowest given the significant constraints on freight paths imposed by the 4-track configuration of W2W along with all day RTN frequencies. Option Ciii scored higher than Di based on the fact that while Di theoretically provides sufficient capacity for port trains between Wiri and Westfield, this would require precise timetabling particularly between Wiri and Puhinui – presenting reliability issues. • For NAL, Ai scored a 0 (due to no improvement over current day), while both Ciii and Di scored highly with the inclusion of Avondale-Southdown. The options were not differentiated by the NIMT freight line given that all options provide a 4-track Southern corridor.
Provide optimal timetabling with freight destinations (i.e., ports, ferries, logistic industries etc.)	0	1	2.25	2	A similar logic was applied per above resulting in the same relative scoring

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Enable transition to 1,500m freight from south of Auckland to Southdown	0	0.75	0.75	0.75	Not differentiating as required under all options.
Inter-regional	*0*	*1*	*1*	*1*	Overall scoring based on the assessments below.
Provide peak period capacity for base services (Inter-regional passenger; # slots)	0	0.5	0.5	0.5	With all options containing the 4-tracking, peak capacity was expected to be provided for all options.
Enable incremental journey time improvements	0	0.5	0.75	0.75	With Avondale – Southdown, both options Ciii and Di allow for inter-regional services to be re-routed via the Inner Southern corridor, thereby providing an incremental benefit in runtime over Ai, reflected in the lower scoring for this option.
Reliability	*0*	*1*	*2*	*2*	Overall scoring based on the assessments below.
Enable 6hours of productive maintenance per night (on avg)	0	2	2.25	2.25	The options were differentiated on the ability to route freight between Avondale and Southdown under Ciii and Di, which reduces risk of maintenance down time waiting for trains on NAL between Newmarket and Avondale (9 km).
Enable 30 min evening service with one main closed (for maintenance)	0	0.5	0.75	1	Option Di was scored higher than Ai and Ciii for the Inner Southern segment of the network, given that the 4-track railway between Westfield and Newmarket would provide additional flexibility for running services while maintenance was carried out in this area. On the other hand, Option Ciii scored higher than Ai and Di for the Outer Southern segment (to Westfield) as the 6-tracking configuration would provide access for a nightly freight timetable and 24/7 passenger operation (close to RTN frequency) without conflicting with maintenance access requirements in this area. This led to the overall scoring giving a slight preference to Di over Ciii which, in turn, scored slightly higher than Ai.

	Do Min	Ai	Ciii	Di	DIFFERENTIATING COMMENTARY
Peak network capacity utilisation (target <75%)	0	1	1.75	1.25	Options were again primarily differentiated on the Avondale – Southdown and Wiri to Westfield segments, with greater utilisation provided by these infrastructure elements in relation to Ai.
Project-specific Critical Success Factors					
Capital cost	-	$17-25B	$24-35B	$25-37B	
Total MCA score	**-**	**13.8**	**27**	**20.3**	
Indicative BCR	-	0.7 – 1.0	0.6 – 0.8	0.6 – 0.8	For the purpose of helping to differentiate between options, Indicative Benefit Cost Ratios (IBCRs) were calculated. The use of an IBCR acknowledges some of the limitations with the short list analysis (e.g. omission of operating costs and certain benefit categories and, simplified, non-optimised phasing of each option). The IBCR for Option Ai is also likely overstated given the freight benefits are expected to be optimistic as detailed operating constraints have not been factored in at the short list stage (and those same constraints do not apply to Options Ciii and Di). It is also worth noting that the short list assessment was carried out before the MBCM was updated in April 2023, meaning certain benefits will be undervalued compared to the analysis of the preferred programme.

3.2.4.4 SHORT LIST ECONOMIC ANALYSIS

To differentiate between options with potentially similar MCA scores, an initial economic assessment of the three short list options was undertaken. The assessment considered the economic benefits associated with metro passengers and freight. Inter-regional passenger benefits were not considered at the short list stage, as no information was available to inform their estimation. These benefits would not be materially differentiating, as 4-tracking is included in all three options and this is the infrastructure that would generate additional travel time savings for inter-regional passengers.

Metro passenger benefits are based on MSM modelling undertaken by AFC of each option in 2051. As Option Ai would be a 'step' in getting to Options Ciii and Di over the 30-Year timeframe, it was also modelled in 2031 and 2041. Analysis of the options suggested that the additional investment in Options Ciii and Di would only likely be needed in the final decade. This means that benefits across the options are assumed to be the same until 2041. Between 2041 and 2051, linear interpolation is used for Options Ciii and Di, and this rate of growth is projected beyond 2051. It was acknowledged that this might overestimate the benefits late in the evaluation period where capacity constraints may start to be realised, but the effects of discounting in those future years were expected to mute any overestimation.

Freight benefits were estimated using KiwiRail's demand forecasts for business as usual (the Do Min) and freight scenario B1. A bottom-up approach to estimating the benefits was used, which drew on KiwiRail's Value of Rail report (2016 and 2021) and draft Decarbonisation Indicative Business Case to provide an initial methodology and a number of input values (such as CO_2 emission rates for diesel locomotives). KiwiRail SMEs provided a number of other required inputs, such as locomotive and wagon consists and weights for the four relevant services, that allowed net tonne-km for rail freight to be calculated and used in the analysis (for example). The benefits are based on all options being able to deliver the freight scenario B1 demands across a 24 hour period, but do not take into account the detailed timetabling distribution or freight services that would need to occur in reality. This will provide a greater limitation on Option Ai to achieve the estimated benefits than Options Ciii and Di which have much more timetabling flexibility. This means that estimated freight benefits for Option Ai are likely to be somewhat optimistic.

The range of benefits assessed for metro passenger and freight at the short list is summarised below, with further discussion included later in Section 3.4.3.2 as part of the recommended programme assessment, along with Appendix I:

- Metro passenger benefits:
  - Public transport user benefits, including travel time and reliability improvements
  - Fare revenue
  - Road user benefits, including travel time and reliability improvements
  - Crash cost reductions
  - CO_2 emission reductions
  - Air quality emission reductions
  - Health benefits associated with walking
  - Second round impacts (land use proxy)
  - Wider Economic Benefits (WEBS) – as a proportion of conventional transport benefits

- Freight-related benefits:
  - CO_2 emission reductions
  - Fuel cost reductions
  - Net maintenance cost savings
  - Congestion avoided – urban and rural
  - Crash cost reductions
  - Air quality emission reductions

Capital cost estimates for the three short list options were consistent with the range estimates discussed in Section 3.2.4.2. Given the long term nature of the programme options (i.e. implementation over 20-30 years), an indicative cashflow was developed to reflect the staged implementation for each option. As discussed above, given Option Ai is an earlier stage of the other two options, the cashflow over the first half (approximately) of the 30 years is very similar for all three options.

Operating costs were not explicitly estimated at the short list stage given the main aim of differentiating *between* options. A high level of effort is required to generate operating costs across the programme, as service specification and network configurations need to be estimated at each step in the programme. The operating costs across the options would be the same until Options Ciii and Di implemented their final states, which would then deliver some degree of differentiation. Given the indicative phasing had these changes occurring in the late 2040s, this meant the minor differences would be eroded further in the economic analysis because of discounting being applied. This meant all options would likely have a similar level of operating cost over the Do Min, and thus this would not be a significant differentiator between options. For these reasons, it was not considered to be a shortcoming of the assessment process to exclude an estimate of operating cost.

The economic assessment of the short list was based on the following parameters:

- The Do Min is as described above in Section 3.1.6.
- An evaluation period of 60 years, beginning in 2025, which is the first year of expected spend for the programme (i.e. post CRL Day 1).
- A 4% discount rate consistent with Waka Kotahi's Monetised Benefits and Costs Manual (MBCM).
- Benefits are calculated in 2021 dollars, using the valuations and appropriate update factors where necessary for values in the MBCM (August 2021)[125].
- Linear interpolation is used for estimating annual benefits between modelled year forecasts.

For the purpose of helping to differentiate between options, Indicative Benefit Cost Ratios (IBCRs) were calculated. The use of an IBCR as opposed to a formal BCR acknowledges some of the limitations with the short list analysis (e.g. omission of operating costs and certain benefit categories and simplified, non-optimised phasing of each option). Once a preferred programme

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[125] The short list analysis was conducted in late 2022 and was not revised when Waka Kotahi released an update to the MBCM in April 2023. The updated MBCM is utilised for the economic assessment of the recommended programme (see Section 3.4.3)

was selected, it would eventually be phased properly, to allow operating costs to be estimated and benefits (and costs) to be refined further.

Table 3-15 provides a summary of the short list economic assessment including a breakdown of the present value (PV) of the benefits and presentation of the IBCR range, derived from the cost estimate ranges. The incremental analysis is summarised in Table 3-16 to assess the relative value for money of the additional benefits that are likely with Options Ciii and Di.

Table 3-15: Short List economic assessment summary ($m)

	Option Ai		Option Ciii		Option Di	
Benefits (PV, 2021$)						
Metro passenger benefits						
PT user benefits	$ 2,683		$ 3,329		$ 3,262	
Road user benefits	$ 544		$ 671		$ 678	
Crash cost reductions	$ 32		$ 39		$ 39	
CO2 emission reductions	$ 19		$ 21		$ 22	
Air quality emission reductions	$ 3		$ 4		$ 4	
Health benefits (walking)	$ 148		$ 196		$ 183	
Second round impacts	$ 820		$ 902		$ 895	
Total (excl. WEBs)	$ 4,249		$ 5,162		$ 5,083	
WEBs	$ 1,230		$ 1,353		$ 1,342	
Total (incl. WEBs)	$ 5,479		$ 6,515		$ 6,425	
Freight benefits						
CO2 emission reductions	$ 77		$ 77		$ 77	
Fuel cost reductions	$ 827		$ 827		$ 827	
Net maintenance cost savings	$ 1,448		$ 1,448		$ 1,448	
Congestion avoided - urban and rural	$ 1,784		$ 1,784		$ 1,784	
Crash cost reductions	$ 156		$ 156		$ 156	
Air quality emission reductions	$ 565		$ 565		$ 565	
Total	$ 4,857		$ 4,857		$ 4,857	
Total benefits (excl. WEBs)	$ 9,106		$ 10,019		$ 9,940	
Total benefits (incl. WEBs)	$ 10,336		$ 11,372		$ 11,282	
Costs						
Capital cost estimates	Lower	Upper	Lower	Upper	Lower	Upper
Total (undiscounted, 2023$)	$ 17,472	$ 24,823	$ 24,537	$ 35,578	$ 25,622	$ 37,283
Economic costs (PV, 2021$)	$ 9,800	$ 13,930	$ 13,480	$ 19,550	$ 13,880	$ 20,190
Indicative BCR						
	Lower	Upper	Lower	Upper	Lower	Upper
IBCR *(used for differentiation purposes only)*	0.74	1.05	0.58	0.84	0.56	0.81

Table 3-16: Short list incremental assessment summary ($m)

Option	Next higher cost option	Incremental Benefits (PV, 2021$)	Incremental costs (PV, 2021$)	Incremental BCR
Ai	Ciii	$ 1,270	$ 4,345	0.29
Ai	Di	$ 1,195	$ 4,455	0.27

3.2.4.5 CONCLUSION

The following points were made as part of the overall assessment of the short list options:

- Option Ai was assessed to not provide satisfactory separation between freight and metro services. This will restrict the ability to provide all-day freight access to NAL, limiting the potential for further demand growth in freight and associated emissions reduction. The limitation on all-day freight access will restrict the ability to achieve the estimated level of freight benefits to some extent. Option Ai also prevents operation of all-day express metro services and results in uneven headway patterns. Therefore, passenger mode shift will be less appealing and a lower VKT reduction will be realised. Options Ciii and Di do not make these compromises.
- 4-tracking of the NAL in Option Di had been discussed during the optioneering. This was proposed to provide competitive travel time and to target the 45-minute journey time service to the city centre. The analysis discovered that the incremental runtime benefit would be relatively small compared to Options Ai and Ciii. A higher cost would be associated with the 4-tracking of Option Di. However, there would be no notable additional benefits, which leads to a lack of justification for this element of Option Di.
- The portion of the network between Wiri and Westfield is a single-tracked 7km section but has high traffic volumes and holds strategically important depots and stations. The 4-tracking of Option Ai is expected to cause significant capacity constraints, particularly at the Wiri to Westfield junction. This requires onerous restrictions from a timetable perspective, and precise operation to achieve desired levels of reliability. This is coupled with the inability of the option to provide adequate freight paths for port traffic.
- Option Di suggests restructuring the metro services. However, this shifts demand onto the alternative route to the city centre, resulting in overcrowding and undermining the basic aim of this service.
- Option Ciii provided 6-tracking, which resolved the issues discussed above and resulted in additional travel time and improved maintenance access benefits.

The issues of inadequate separation of modes within the inner network and poor performance of the 4-track Wiri to Westfield configuration led to a much lower overall MCA score for Option Ai compared to other options.

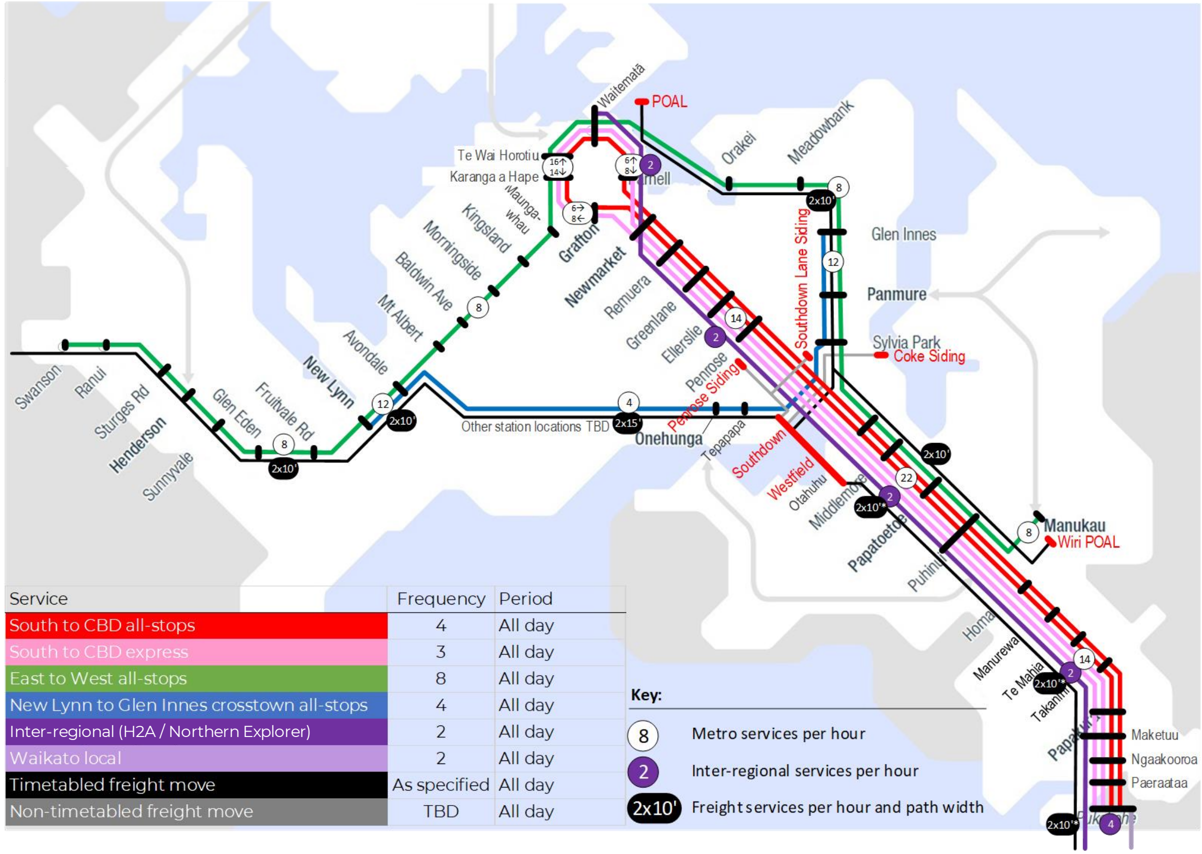
Option Ai achieved the higher indicative economic performance, though the ability for it to deliver the estimated freight benefits would be limited to some extent as noted earlier. The operational constraints evident later in the programme period, outlined through the MCA, would also mean further investment would be required almost immediately after 2051 (if not before). In effect, these shortcomings of Option Ai mean it is not actually a long term end state option for Auckland's rail network. This analysis shows that a further step change will be required beyond Option Ai for the rail network to continue to increase its role in the transport system in the future. So, while the incremental economic benefits of Options Ciii and Di appear to deliver poor value for money (i.e. incremental BCRs of less than 1), they are somewhat misleading given the substantial shortcomings of Option Ai noted above. Options Ciii and Di are viable long term solutions that deliver the necessary step change needed to overcome the operational constraints evident in Option Ai, setting the Auckland rail network up for continued success further into the future. Therefore, the substantial limitations associated with Ai's higher indicative economic performance meant that this option was discounted as it lacked the ambition required to achieve the overall IOs of the PBC in the long term.

There is a clear preference for Ciii over Di on the basis that it has the highest overall MCA scoring, lower cost, and slightly higher IBCR and incremental BCR. However, the 4-tracking element between Westfield and Newmarket was deemed to provide little benefit for its substantial cost, hence, was not justified as an isolated element of Option Di. Therefore, the two options would only be differentiated by the Wiri to Westfield segment of the network, for which the 6-tracking configuration was strongly preferred for the reasons described above. Thus, at the conclusion of the MCA analysis and selection process, it was agreed that Option Ciii was to be selected as the Initial Preferred 2051 End State.

3.2.4.6 INITIAL 2051 END STATE

The initial preferred 2051 end state is summarised in Figure 3-13. As noted in Section 3.1.1.1, the service concept shown here is indicative only.

Service Plan



Service	Frequency	Period
South to CBD all-stops	4	All day
South to CBD express	3	All day
East to West all-stops	8	All day
New Lynn to Glen Innes crosstown all-stops	4	All day
Inter-regional (H2A / Northern Explorer)	2	All day
Waikato local	2	All day
Timetabled freight move	As specified	All day
Non-timetabled freight move	TBD	All day

Infrastructure Plan

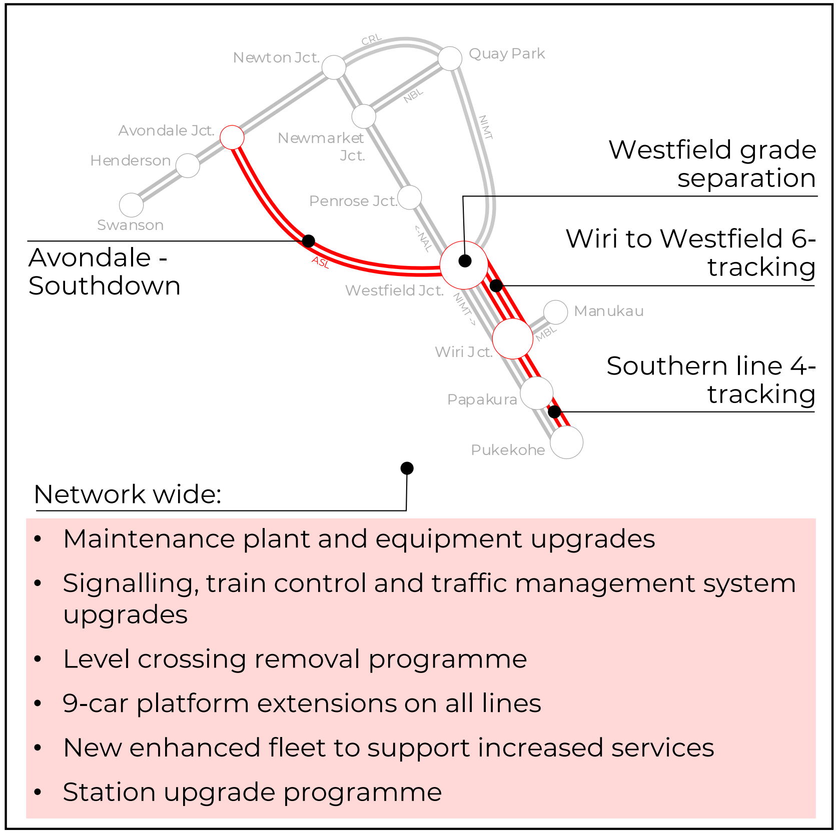


Figure 3-13: Initial preferred 2051 end state, summary

3.2.5 REFINED INITIAL 2051 END STATE

Section 3.2.4 documents the final phase of Part 1 of the optioneering process, which culminated in the selection of Ciii as the Initial Preferred 2051 End State for the ARN. Part 2 of the optioneering process focuses primarily on the phasing of the interventions contained within this end state, over the 30-Year timeframe. However prior to the analysis of phasing, an initial set of refinements was made to both the 2051 service and infrastructure concepts on the basis of further discussions with project partners, early analysis of phasing implications, and a refined approach to assessing capacity of the network.

The refinements described in this section are primarily service concept related and are consistent with the base infrastructure agreed upon in the Initial Preferred 2051 End State workshop held in October 2022 (with the exception of some minor adjustments to the adopted configuration of Avondale-Southdown (A-S) and its interface with the wider network). A description of the refinements is provided below, and the resulting 2051 end state programme is presented in Figure 3-14.

3.2.5.1 ONEHUNGA BRANCH LINE AND MT ALBERT STARTERS

The Initial Preferred 2051 End State included removal of the OBL on the basis that communities on this line would be well served by a new heavy rail service along the Avondale – Southdown corridor, as well as Auckland Light Rail (ALR) in 2051, coupled with the fact that demand modelling showed very low demand for OBL services in 2051 and limited potential for growth. However on further discussion with project partners, it was agreed to retain the OBL service (although terminating at Mt Albert instead of Henderson[126]) with existing service levels of 2 x 3-car tph[127] on the basis that a) this maintains a connection between the Western corridor and Newmarket which was seen as strategically important, and b) the decision to remove a branch line from service should only be made in the context of a broader transportation study which has the ability to carefully assess and offer comparable alternatives to the impacted communities.

3.2.5.2 AVONDALE-SOUTHDOWN

North-west tie-in:

A-S services were modified to be routed to Henderson rather than New Lynn in recognition of the fact that for the previous 25 years of the plan, some form of crosstown service has been operating to Henderson, and the infrastructure will already exist to facilitate the turnback.

As described above, OBL services are maintained but terminated at Mt Albert (avoiding the need for quad tracking of the Western Line west of Avondale, consistent with the previous optioneering of the 2051 end state). This requires Mt Albert track and station upgrades.

A partially grade separated junction with connections east and west is assumed as the minimum requirement for the Avondale Junction[128].

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[126] OBL services were modified to terminate at Mt Albert once Avondale-Southdown is implemented as opposed to Henderson, to avoid the need for additional tracks west of Avondale Junction.

[127] An additional 2tph was also added between Mt Albert and Remuera, consistent with the current plan for the CRL Day 1 Full timetable.

[128] The Eastern connection does not need to be grade separated

Alignment

Two alternatives were identified for the A-S corridor based on previous studies undertaken:

1. An alignment that follows the existing KiwiRail designation.
2. An alignment that follows the KiwiRail designation between Avondale and Hillsborough Rd, after which a new corridor is used that follows State Highway 20 to Church St which is then followed through Onehunga to connect to Westfield junction.

A high-level assessment of the two options led to the decision to adopt Option 1, following the KiwiRail designation exclusively, as this was deemed to have the least property costs and produce a better residential catchment for Royal Oak and Onehunga.

Stations

The initial plan was not specific on the number and locations of stations on the A-S corridor. The refined 2051 plan envisions 5 stations within the general zones listed below, along with a high-level rationale for their selection:

- Te Papapa (in order to maintain heavy rail services to this area and connect to Mt Smart Stadium),
- Onehunga (to maintain heavy rail services to this community and integrate with the wider PT network),
- Mt Roskill (a new catchment and could achieve connectivity with ALR if it proceeds)
- Wesley (a new catchment and could achieve connectivity with ALR)
- Owairaka (new heavy rail station, adding a new demand catchment to the network)

3.2.5.3 SOUTHERN LINE

Express services were reduced from the 6tph previously assumed, to 4tph due to lack of confidence in ability to operate 10 minute headways with 1,500m freight trains amongst limited stop passenger trains (metro and inter-regional). This headway assumption was revised to 12.5 mins, which limits the ability to run a 6tph metro express + 2 Inter regional + 2 freight up to 1,500m on the west mains with an acceptable headway pattern.

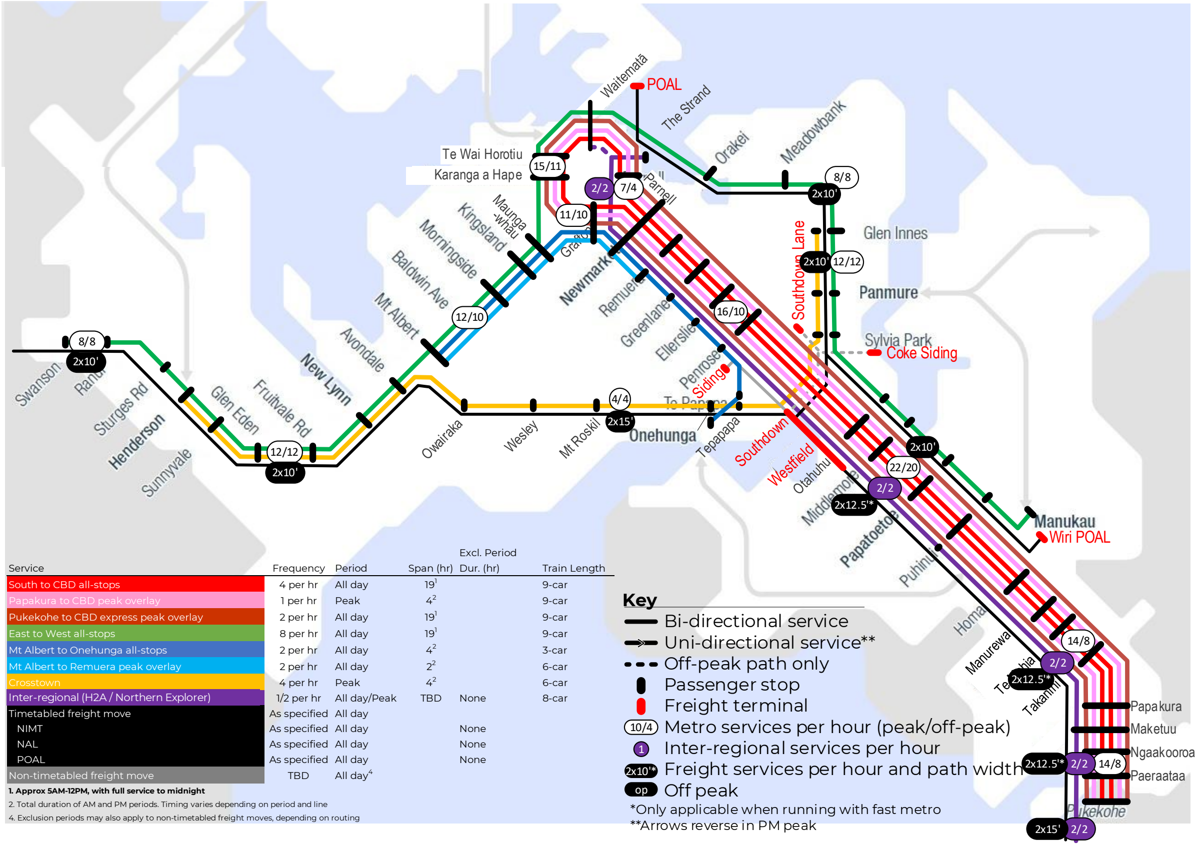
3.2.5.4 PENROSE SIDING ACCESS

A 3rd freight main was added in 2051 between Westfield/Southdown and the Penrose siding to ensure access to this siding is not cut off by high density metro services, including all day express services.

3.2.5.5 INTER-REGIONAL TERMINUS

Conceptual timetable analysis suggests that terminating Inter Regional services at the Waitematā (formerly Britomart) bay platforms will not be possible without compromise to the metro timetable. Further analysis should be undertaken to explore solutions in future project phases; for now the terminus is assumed to be maintained at The Strand with a potential opportunity to use Waitematā in the future.

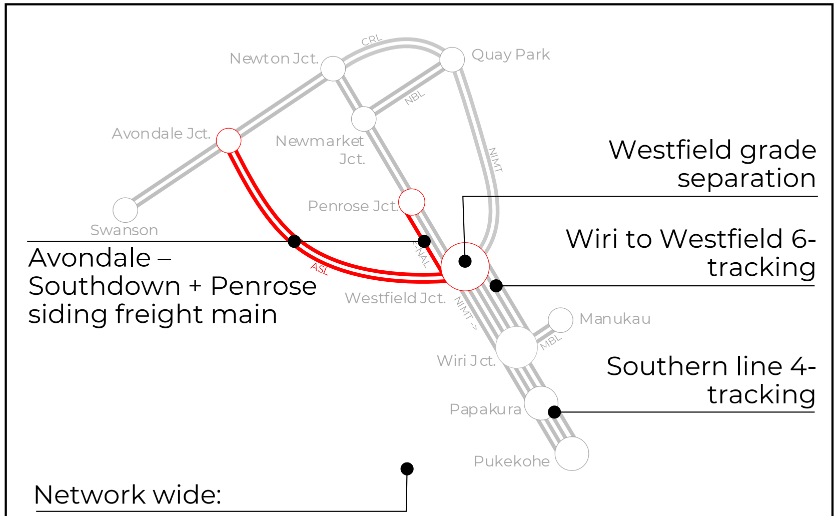
Service Plan



Service	Frequency	Period	Span (hr)	Excl. Period Dur. (hr)	Train Length
South to CBD all-stops	4 per hr	All day	19[1]		9-car
Papakura to CBD peak overlay	1 per hr	Peak	4[2]		9-car
Pukekohe to CBD express peak overlay	2 per hr	All day	19[1]		9-car
East to West all-stops	8 per hr	All day	19[1]		9-car
Mt Albert to Onehunga all-stops	2 per hr	All day	4[2]		3-car
Mt Albert to Remuera peak overlay	2 per hr	All day	2[2]		6-car
Crosstown	4 per hr	Peak	4[2]		6-car
Inter-regional (H2A / Northern Explorer)	1/2 per hr	All day/Peak	TBD	None	8-car
Timetabled freight move	As specified	All day			
NIMT	As specified	All day		None	
NAL	As specified	All day		None	
POAL	As specified	All day		None	
Non-timetabled freight move	TBD	All day[4]			

1. Approx 5AM-12PM, with full service to midnight
2. Total duration of AM and PM periods. Timing varies depending on period and line
4. Exclusion periods may also apply to non-timetabled freight moves, depending on routing

Infrastructure Plan



Network wide:

- Maintenance plant and equipment upgrades
- Signalling, train control and traffic management system upgrades
- Level crossing removal programme
- 9-car platform extensions on all lines
- New enhanced fleet to support increased services
- Station upgrade programme

Figure 3-14: Refined initial 2051 end state summary

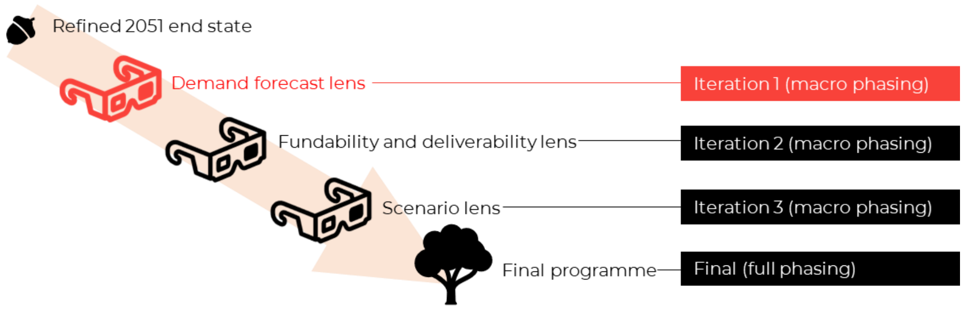
3.3 OPTIONS DEVELOPMENT – PHASE 2

This section presents the development of the Final Preferred Programme as outlined in the Options Development Report Part 2 (refer to Appendix H). This further refines the Initial Preferred 2051 end state arrived at in Part 1 and develops a phasing of infrastructure and service interventions over time, which optimises the objectives of demand, deliverability, and robustness against scenarios.

3.3.1 *DEMAND LED ANALYSIS*

In this phase of analysis, a first iteration of phasing was developed to meet the demand forecasts and quality of service targets of the three primary markets. The resulting phasing, referred to as the Demand Led Phasing, represents the investments that would be required to ensure that network capacity always meets the expected growth in demand over the 30-Year period.

This section provides a summary of the approach taken to develop this phasing and key outcomes of the analysis.



3.3.1.1 ANALYSIS APPROACH AND OUTCOMES

The analysis considered three primary corridors on the ARN in turn: Southern, Eastern, Western (including A-S). Within each corridor, trigger dates for discrete service enhancements contained within the 2051 initial preferred service concept, are assessed for each market. For example, in the south this includes the date by which frequency increases are required on the metro Southern Line to meet demands at an acceptable level of standing, and the date by which import and export (IMEX) freight between Auckland and Tauranga needs to increase train length (up to 1,500m). Finally, the timing of the infrastructure and system improvements required to meet all market needs together is assessed. For example, 4-tracking of the Southern corridor is required on the basis of a significant increase in local metro, express metro and inter-regional passenger traffic, as well as a wider freight path requirement to support longer trains.

The discrete service enhancements considered in the phasing analysis and their mapping to enabling infrastructure elements are illustrated in Figure 3-15. The colour coding maps a particular set of service enhancements to an infrastructure element. For example, both all-day express services on the Southern corridor, and all-day freight paths on the Western corridor, are enabled by A– S. This initial analysis contains four major infrastructure interventions across the network.

Southern corridor 4-tracking
9-car extensions (broken down further into east-west and Southern corridor extensions)
Additional Wiri to Westfield capacity expansion
Avondale – Southdown

Figure 3-15 also indicates when service improvements are required based on demand under the base case demand scenario, and subsequently when the enabling infrastructure elements are needed. As shown, some service enhancements are not driven by demand growth specifically, but by level of service targets that are intended to induce demand rather than respond to it. It is important to note however, that, while particular service enhancements are not demand driven under the base demand scenario, these may become demand driven under other scenarios. For example, under the Port Move scenario, growth on the NAL results in a clear date for when A-S would be required to meet demand.

Service enhancement			Infrastructure enhancement	
Southern				
Metro			• 4 tracking the southern line (including 1500m enablement)	Early 2030s
• Full 6-car operation	2025-2030			
• 14tph services to Pukekohe	2030 – 2034		• 9-car platform extensions, South line	Late 2030s
• 9-car operation, South line	2038 – 2042		• Avondale – Southdown	Level of service driven (2051 targeted)
• RTN frequency	Level of service driven	→		
• All day express	Level of service driven			
Freight				
• Longer train lengths introduced in peak	2030			
Inter-Regional				
• Increase to 2 paths per peak hour	2040 - 2050			
Western (including NAL and Avondale – Southdown)				
Metro			• Avondale – Southdown	Level of service driven (2051 targeted)
• CRL full timetable	2025			
• Full 6-car operation	2025 – 2030		• 9-car platform extensions, East-West line	Early 2040s
• 9-car operation, East-west line	2048 – 2052	→		
• RTN frequency	Level of service driven			
Freight				
• All day freight paths	Level of service driven			
Eastern (including POAL)				
Metro			• Wiri to Westfield Additional Capacity Expansion	Level of service driven (2051 targeted)
• 9-car operation, East-west line	2038 – 2042			Early 2040s
• RTN frequency	Level of service driven	→	• 9-car platform extensions, East-West line	
Freight				
• All day freight paths	Level of service driven			

Figure 3-15: Mapping of service enhancements to enabling infrastructure

3.3.1.1.1 CRITICALITY OF THE SOUTHERN CORRIDOR AND ALTERNATIVES CONSIDERED

A key outcome of the analysis presented in Figure 3-15, is the urgent need for 4-tracking of the Southern Line, with demand suggesting this infrastructure is required by the early 2030s.

Table 3-17 provides the primary rationale for this requirement, comparing the services planned in 2025 over the three markets, to those required to satisfy demand in the early 2030s, and the resulting utilisation on the network in its current 2-track configuration. As shown, a significant increase in metro frequency and freight train lengths is required between Wiri and Pukekohe in the initial 5-10 years of the programme. Accommodating all markets together on a two-track railway would result in a capacity utilisation significantly in excess of 100%, even with a fully optimised signalling system, which is beyond the limits of a reliable operation and well beyond the 75% capacity target to allow for future flexibility and accommodate future train services not anticipated in current forecasts (e.g. additional inter regional services).

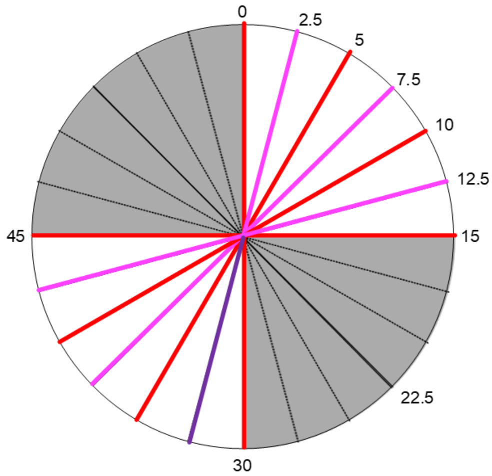
Table 3-17: Summary of service requirements

SEGMENT	MARKET	2025 (POST CRL)		EARLY 2030		
		SERVICES PLANNED	UTILISATION	SERVICES REQUIRED	REQUIRED BY	UTILISATION
Pukekohe to Papakura	Metro	6tph (2 express* + 4 local)	64%	14tph (4 express* + 10 local)	2030 – 2034	104%-129%**
	Inter - Regional	1tph		1tph	2030 – 2040	
	Freight	2tph @ 750/900m		2tph @ 1,500m	2030	
Papakura to Wiri	Metro	14tph (2 express + 8 local)	104%	14tph (4 express + 10 local)	2030 – 2034	129%-166%**
	Inter - Regional	1tph		1tph	2030 – 2040	
	Freight	2tph @ 750/900m		2tph @ 1,500m	2030	

This analysis led to the conclusion that 4-tracking from Wiri to Pukekohe is required by early 2030 (2032 adopted for planning) in order to resolve capacity issues and creates a more efficient railway operation with long distance / fast metro services segregated from all stops metros across the two pairs of mains. However, given the significant extent, cost and potential for disruption of 4-tracking, various alternatives were considered and evaluated. These are summarised in Table 3-18 below along with the rationale for why these were not preferred over the base concept. These alternatives include consideration for trade-offs between markets (for example running less metro services to accommodate more freight).

Table 3-18: Alternatives to 4-tracking

ALTERNATIVE	ANALYSIS
P2P 2-track only: Could freight, metro, or inter-regional services be reduced between Pukekohe to Papakura such that a 2-track configuration would be sufficient in this segment?	Reducing track capacity between P2P would result in material trade-offs such as: • Metro services would need to operate with 15min headway gaps between P2P (as illustrated in the figure below), creating heavy loading for some trains, with at least 2tph exceeding standing capacity south of Papakura, with knock-on impacts to following trains, or… • Freight would be restricted to 750m, meaning that between 5-10 750m MetroPort trains worth of demand per day would be lost from the late 2020s onwards (equivalent to between 270 – 540 truck trips each way between Auckland and Tauranga).

ALTERNATIVE	ANALYSIS
	 *Clockface required to support 1,500m freight on a 2-track railway*
Impact of less than forecast growth at new P2P stations: Does the above conclusion change if southern growth stations have less demand than expected?	A 40% demand reduction at stations between Papakura and Pukekohe was tested as a sensitivity. This reduced crowding levels under a 14tph service to Pukekohe in 2041 but still filled seating capacity by Homai, implying standing times of greater than 15min (30-45min). Furthermore, even with reduced demand, a 2-track P2P would still result in the need for a 15min headway gap in metro services to enable the 1,500m freight train.
3 track P2P: Would a 3-track railway be sufficient between P2P to separate freight from passenger services similar to the current W2W 3rd main?	This configuration would create a new bottleneck on the NIMT south of Auckland for long distance services (freight and Inter-regional) similar to the current single-track section through the Whangamarino wetland, requiring single track operation over 18km. Given the high volumes of freight and Inter Regional services anticipated, this bottleneck would likely need to be resolved soon after implementing the third main. Furthermore, in comparison to other segments of the Southern corridor, P2P is relatively easy to quad track given its greenfield nature. Note that the relationship between number of tracks and capacity is not linear – an additional 2 tracks will provide many multiples more capacity than a single additional track. E.g. the single track OBL accommodates 3tph while the double track MBL accommodates >16tph. A similar step change would be expected in moving from 2 tracks to 4 tracks.
Mixed freight train lengths: Could MetroPort be restricted to operate shorter trains during the metro peak period, to reduce the 15min path requirement and thereby make a P2P 2-	Such a trade-off would be operationally complex and less economic as it would result in an inefficient operation that would compromise the ability for freight to provide an attractive service to customers. Further, this would restrict metro to running a 4tph off-peak service and not meet aspirations of a RTN frequency of 10min or better all day.

ALTERNATIVE	ANALYSIS
track corridor acceptable?	
Incremental freight train lengthening: Could MetroPort trains be gradually lengthened over time (instead of a step change to 1,500m) to reduce track capacity impacts?	Motive power limits and consist weight are expected to drive step changes in length. 3 locos will be needed for 1 extra wagon over the 2 loco max weight, and all the draw gear will require upgrading by the same logic, to a 1,500m design capacity. The return on investment will likely drive maxing the length/weight immediately, though interim lengths could be considered.
Phasing of the 4-tracking: Could the Wiri-Pukekohe 4-tracking project be phased in the programme to provide interim benefits?	Phasing of the 4-tracking project is important and different phasings will produce interim benefits of varying degrees and to different markets. Generally: • 4-tracking Wiri to Westfield provides early benefits to freight by eliminating the need for freight only single-track operation and presents an opportunity for additional runtime benefits to limited stops services. • 4-tracking Wiri to Papakura provides the benefits of Wiri to Westfield 4-tracking plus allows additional Papakura starter metro services to be operated, and provides additional runtime benefits to limited stop services • 4-tracking Pukekohe to Papakura provides potential benefits to inter-regional services by providing an opportunity for these trains to pass freight trains along this 9km segment, which allows for faster travel times and dedicated slots without compromise to the metro timetable. It also provides a holding track for freight prior to merging with metro services. • 4-tracking Papakura to Wiri provides additional runtime benefits to limited stop services. All these factors should be considered as part of the 4-tracking project. However, a key finding of the PBC is that these interim phasings a) produce benefits that are minimal in comparison to the benefits released on completion of the full 4-track corridor and b) if pursued without careful consideration and planning, could lead to a delay in the completion of the overall 4-tracking project which is ultimately required to meet demand. This would likely result in a worse outcome. As will be discussed in Section 5, the PBC has therefore taken the view that the best phasing is that which is likely to deliver the entire 4-tracking works in the shortest possible time frame. By treating the Southern Line 4-tracking as a single project, this gives flexibility in future planning to pursue the most advantageous phasing from the perspective of all markets and gain efficiencies in planning, consenting and construction.
Running longer metro trains: Could fewer metro trains be operated	As will be discussed in future sections, the PBC does plan on running longer 9-car trains for the highest demand services, and future proofing for more services to run at 9-car in the future. However, the

ALTERNATIVE	ANALYSIS
at longer lengths to provide more track capacity for freight and inter-regional services?	programme prioritises improving metro service frequencies first for the following reasons; 1) passenger demand is expected to respond much more to improved frequency than to increased train capacities, so this approach supports the objective to drive mode shift to rail and thereby reduce emissions of the transport network overall, and 2) the investments required to run more metro services are the same investments that are needed to support increased capacity for all markets including freight and inter-regional, particularly on the Southern corridor. Therefore, the strategy to prioritise more frequent metro services is the best outcome for the network overall.

3.3.1.2 DEMAND-LED PHASING

The analysis conducted in this phase of optioneering led the development of indicative configuration state (CS) phasing illustrated in Figure 3-16: Demand-led phasing below. As shown the four major infrastructure interventions described above are phased in CS1, CS1.5, CS2 and CS3. Earlier interventions enable improved frequencies on the Western Line via early level crossing removals (CS0-1), and improved reliability, travel times and shoulder peak capacity (via network wide signalling, train control and traffic management enhancements and additional EMUs to expand all trains to 6-car lengths (CS0-2)).

Table 3-19 provides commentary on the service and infrastructure upgrades contained within each CS.

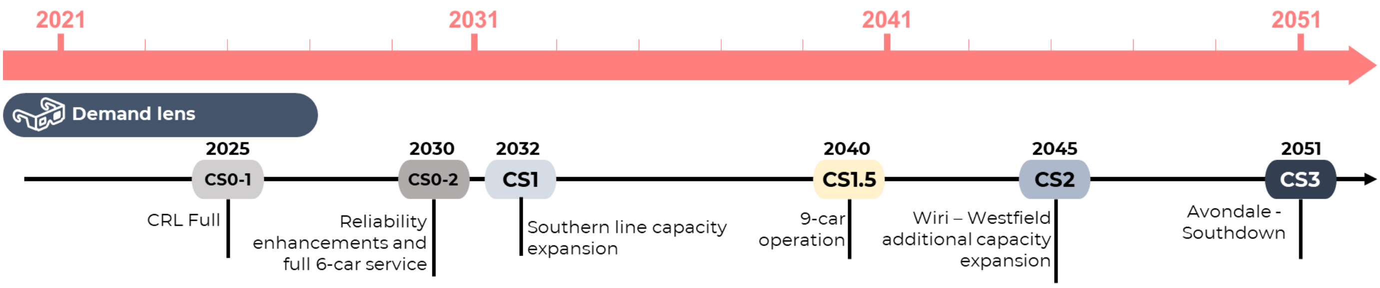


Figure 3-16: Demand-led phasing

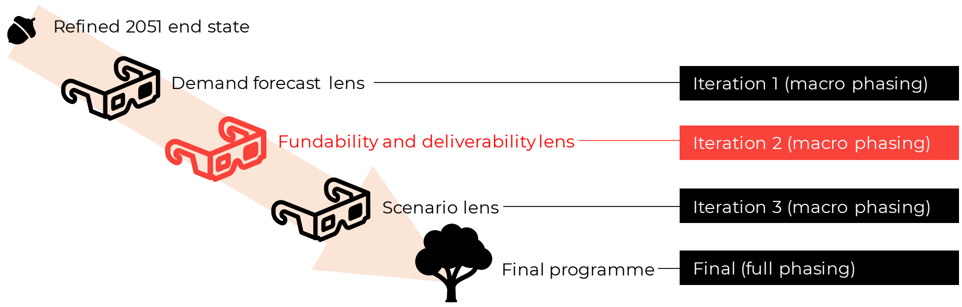
Table 3-19: Explanation of demand-led phasing / indicative configuration states

CS	DATE	SERVICE AND INFRASTRUCTURE UPGRADES
CS0-1	2025	Address demand growth on the West via introduction of additional peak overlay services (CRL Day 1 full) by early safety mitigations at level crossings on the Southern and Western lines.
CS0-2	2025-2030	Improve overall network reliability by upgrading signalling and traffic management systems, and improved maintenance access / plant / equipment and outcomes AND address metro capacity issue in shoulder-peak periods via running all trains a 6-car equivalent length by procuring additional fleet (and depot and stabling).
CS1	Early 2030s	Address demand growth on the south for passenger, freight and Inter Regional via additional peak metro services and more frequent and longer 1,500m MP trains, by 4-tracking Westfield to Pukekohe as quickly as possible (starting from Papakura to Pukekohe)

CS	DATE	SERVICE AND INFRASTRUCTURE UPGRADES
CS2	Late 2030s	Address further metro growth on the south, east and west via progressive introduction of longer metro trains by extending stations to 9-car.
CS3	Mid 2040s	Further improve network reliability, uncap freight capacity between Auckland Port, Wiri, and Southdown, and allow for RTN frequency on the East-West Line, by 6-tracking Wiri to Westfield and grade separating Westfield junction (potential for reprioritisation under scenario A and D).
CS4	Late 2040s	Allow metro to widen the Southern Line peak period, including span of express services, by decanting freight from the inner network and providing potential for capacity between Auckland and Northland by implementing the A-S link (potential for reprioritisation under scenario B).

3.3.2 CONSTRAINED ANALYSIS

This section describes the second iteration of phasing development which considered likely fundability and deliverability constraints. This step acknowledges a critical priority for this PBC is to produce a fundable and achievable programme, even if this may result in compromises to demand.



3.3.2.1 CONSTRAINED PHASING

The analysis conducted in this phase of optioneering led to modifications to the previous configuration state phasing as shown in Figure 3-17. The primary changes were pushing out the delivery date of the 4-tracking project (CS1) to 2042, and 9-car extensions beyond 2051 (outside of the evaluation period of the PBC) with an alternative solution proposed in 2040 with the introduction of a new peak overlay service between Glen Innes and Mt Albert (CS0-4). Discussion on these points are provided in subsections below, with further details in the Options Report Part II (Appendix H).

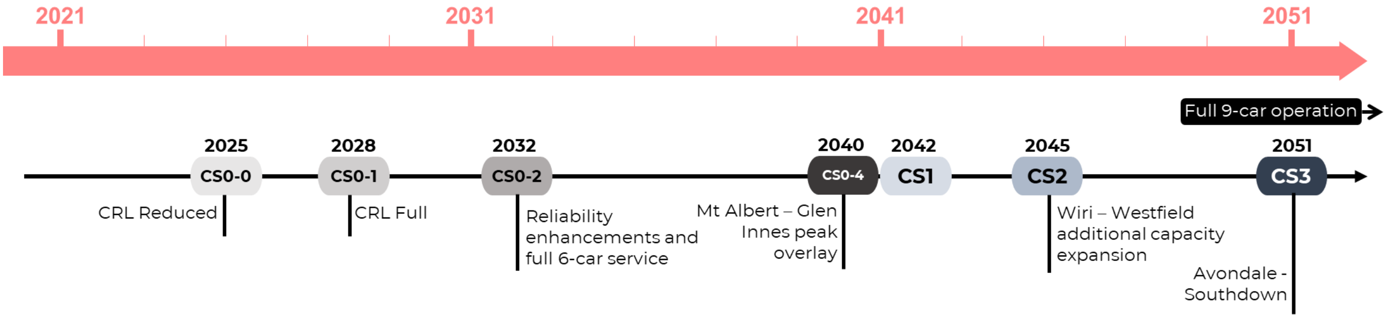


Figure 3-17: Constrained phasing

3.3.2.1.1 4-TRACKING

The main consideration in this phase of analysis was the deliverability of the 4-tracking project. In the previous iteration it was identified that this would be required to satisfy all demands by 2032, however, as this is a large brown field infrastructure project (requiring upgrades to nearly 40km of live railway) with a high degree of complexity across all phases, delivery by this date is not realistic. It was also acknowledged in this analysis that, based on the project partners understanding of historical funding constraints for rail, including the precedent set by ATAP, securing commitment to the level of funding required to meet demand on the Southern corridor would be unlikely in the early years of the programme. Equally however, it is important to note that if the entirety of the programme were based on funding constraints of the past, the step change of investment required to provide sufficient levels of reliability and capacity would never be achieved.

A detailed conceptual 4-tracking construction programme was developed to determine a realistic delivery timeline, taking into account these physical and financial constraints. Based on this, and further discussion on likely risks, it was agreed that a date of 2042 would represent both a fundable and deliverable programme.

3.3.2.1.2 9-CAR EXTENSIONS

Previous phasing assumed 9-car operation would be required to address crowding issues on both the Southern and East-West Lines in the early 2040s. However, it was acknowledged that:

- With exception of the Eastern Line, 9-car service provides significant excess standing capacity under base demands.
- The cost and complexity of implementing full 9-car operations over the entire network is high, with a large increase in the number of additional fleet and size of stabling required, plus the need to extend all platforms on the East-West Line to 9-car. Some of these stations are highly constrained, such as New Lynn and Manukau.
- On the Southern Line long standing times under 6-car operations may be mitigated by passengers transferring to the Eastern Line at Puhinui to get a seat, thus the crowding levels may be tolerable on the Southern Line till beyond 2051, though Eastern Line crowding would be exacerbated.

An alternative, lower cost solution was identified to run a peak overlay service between Mt Albert and Glen Innes on the East-West Line. An additional 4tph provides the equivalent capacity of a full 9-car 8tph East-West service but targeted to the area where capacity is needed and with less infrastructure overhead. The primary infrastructure requirement being the construction of turnback platforms at Mt Albert and Glen Innes.

3.3.2.2 SERVICE COMPROMISES

The phasing iteration presented above results in the 4-tracking project being delivered in 2042, while it is required by demand in the early 2030s.

This will result in a roughly 10-year period of constrained access where service compromises will be required across all markets. Operation of the network during this time period will be determined based on future negotiation and coordination between operators, and different decisions could be taken to prioritize certain markets over others.

To provide an assessment of the range of potential trade-offs, three scenarios were analysed

- Scenario 1: Freight growth prioritisation
- Scenario 2: Metro growth prioritisation
- Scenario 3: Potential balanced approach

While inter-regional prioritisation is not considered in a specific scenario, trade-offs between inter-regional and other markets are discussed in each scenario as sub-scenarios.

It must be noted all these scenarios (particularly 1 and 2), are meant to illustrate the range of potential impacts on all markets. The reality will be somewhere in between, and several optimisations may be pursued in future phases of implementing the programme, which will be discussed later.

Table 3-20 provides an overview of the results of the analysis. Note that passenger impacts are based on average loading. Actual impacts will be better or worse for different trains depending on headway patterns, demand differences between local and limited stop trains, and time within the peak period.

Table 3-20: Service trade-offs

SCENARIO	FREIGHT IMPACTS	METRO IMPACTS	INTER REGIONAL IMPACTS
Scenario 1: Freight growth prioritisation	Forecast demand met	• *Seating* capacity reached at Homai by 2028 • *Standing* capacity reached at Homai by 2037, with *long standing times* from Papakura (~47min) • Passengers *left behind* between 2037 and 2042	No impact assumed – however metro impacts may be mitigated via trade-offs with inter-regional.
Scenario 2: Metro growth prioritisation	Potential loss of 12-16 x 750m trains worth of demand per direction per day (roughly 25-35% of total 2051 forecast demand)	Forecast demand met	No impact assumed – however freight impacts may be mitigated via trade-offs with inter-regional.

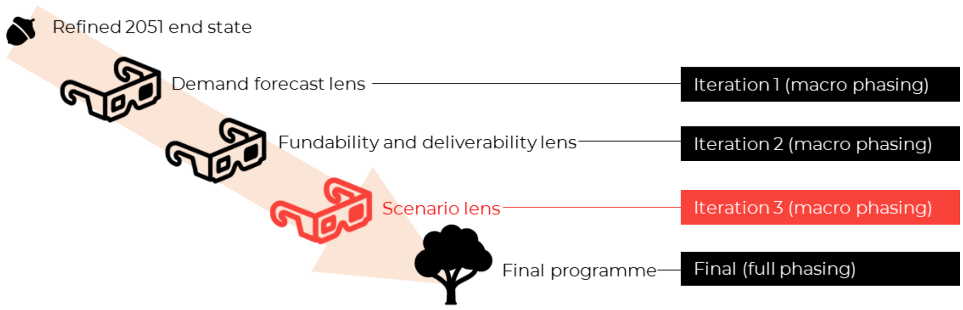
SCENARIO	FREIGHT IMPACTS	METRO IMPACTS	INTER REGIONAL IMPACTS
Scenario 3: Potential balanced approach	Potential loss of 8 x 750m trains worth of demand per direction per day (roughly 18% of total 2051 forecast demand)	• *Seating* capacity reached at Homai by 2028 • *Long standing times* from Homai by ~2035 (~ 37min), extending to Takanini by 2041 (~44min)	No impact assumed – however both freight and metro impacts may be mitigated via trade-offs with inter-regional.

The analysis presented in this section highlights the criticality of the 4-tracking project to the network. There is no service solution that can resolve satisfactorily the needs of all markets, even with the optimisations mentioned in Section 5.3.3. The compromises required without this infrastructure may significantly limit the attractiveness of heavy rail and its ability to support required levels of mode shift to meet emissions reductions targets, if not urgently progressed.

Beyond the 4-tracking project, the other elements of the programme become critical, reinforcing the fact that Ciii is an appropriate long-term solution for the network, as opposed to the minimum investment option Ai, which ends at the completion of the 4-tracking.

3.3.3 SCENARIO ANALYSIS

This section describes the final iteration of phasing development, which considers the impact of various scenarios on Iteration 3 developed in the previous phase. This step acknowledges that the future is uncertain and particularly in the case of freight, highly dependent on exogenous factors that a 30-Year investment plan for rail must be resilient to.



3.3.3.1 ANALYSIS SUMMARY

Three scenarios are considered as defined in 3.1.5.4,

- S1 Ports of Auckland (POAL) move,
- S2 POAL uncapped + ERP level metro passenger demand, and
- S3 POAL moves + ERP level demand.

For each scenario, analysis follows a similar approach to previous phases, with the demands on Southern, Eastern and Western corridors assessed over the three markets. This leads to a revised set of demand triggers and therefore a revised set of infrastructure triggers for each scenario. The analysis also identifies additional infrastructure that is required under some scenarios or removes the need for certain infrastructure elements under others. A summary of the key outcomes for each scenario analysis is presented in Figure 3-18[129], Figure 3-19, and Figure 3-20 below, with an overall discussion of the resulting triggers and refinements in Section 3.3.3.2. Further detailed analysis is presented in Options Report Part 2 (Appendix H).

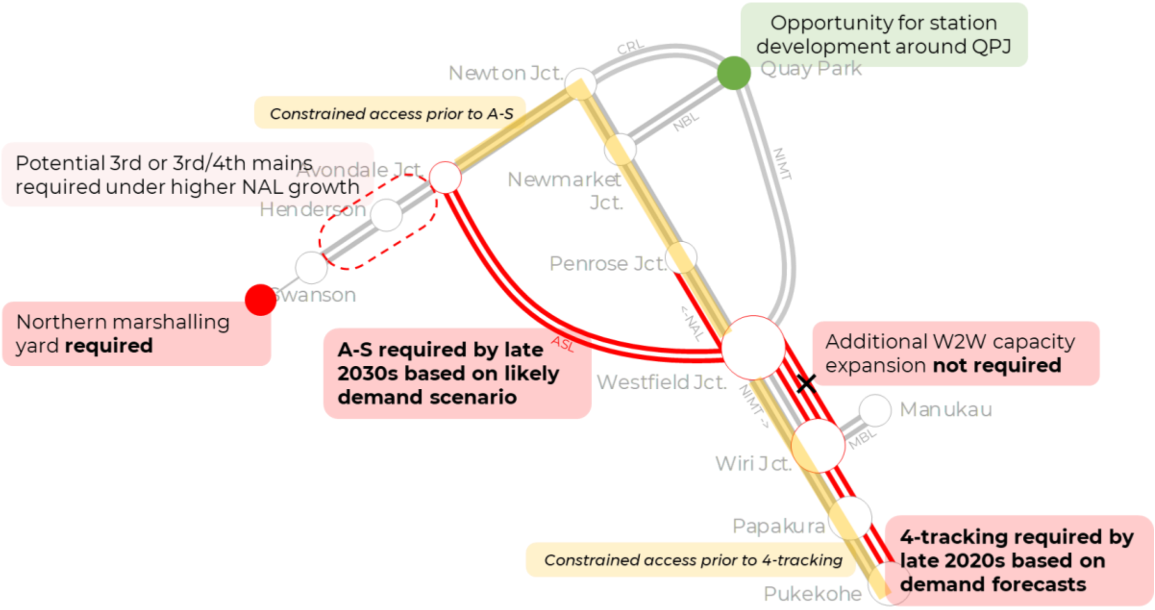


Figure 3-18: 'Scenario 1 – Port move' analysis outcomes

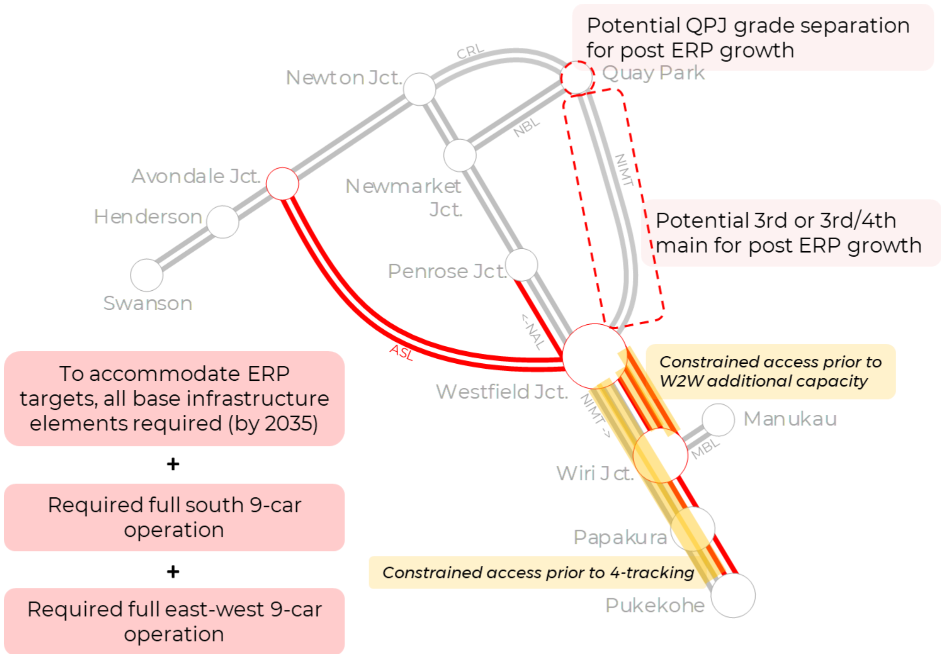


Figure 3-19: 'Scenario 2 – Port uncapped + ERP analysis outcomes

[129] Quay Park Junction (QPJ).

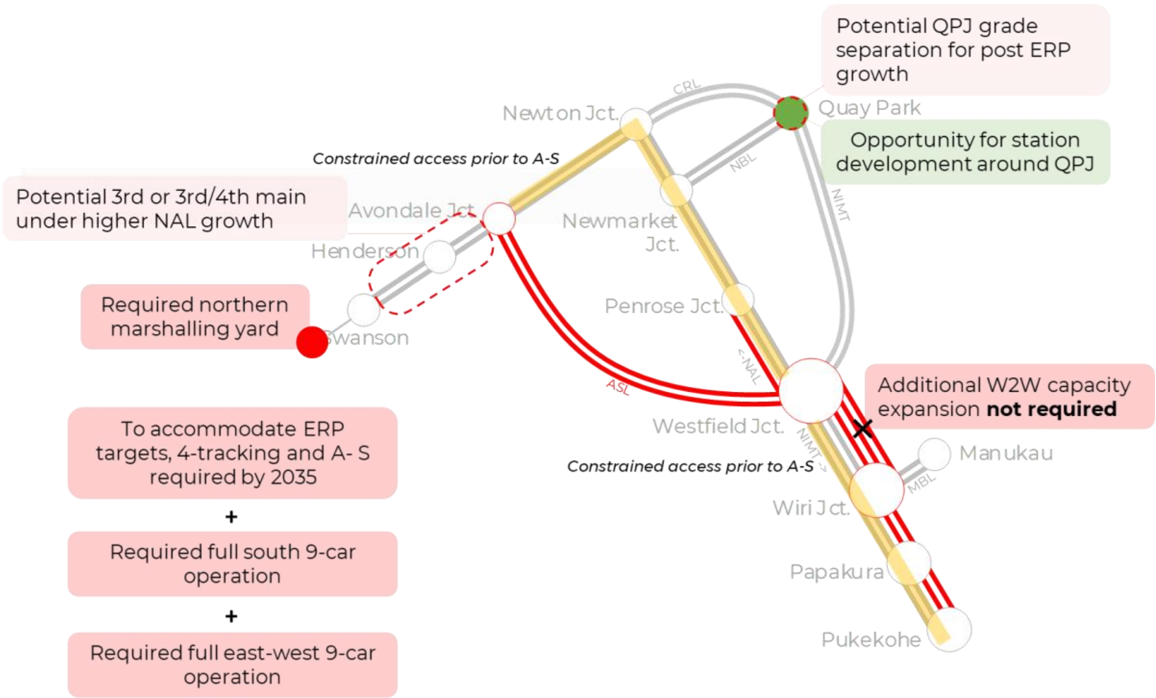


Figure 3-20: 'Scenario 3 – Port move + ERP' analysis outcomes

3.3.3.2 TRIGGERS AND REFINEMENTS

The scenario analysis shows that the previously developed Constrained Phasing iteration is generally robust against scenarios. The following major conclusions and refinements are suggested on the basis of the analysis:

- Under all scenarios, 4-tracking of the Southern corridor (and all supporting asset investments) is the priority for investment on the network, with increased urgency under alternative scenarios
- Avondale – Southdown is robust to scenarios but becomes more urgent under a Port Move scenario. This is because A–S has two potential triggers:
  - 1) The desire to run more frequent, faster metro services all day (relevant to all scenarios and more urgent under ERP)
  - 2) An increase in train volumes impacting peak metro services on the Western and Southern Lines (relevant under the port move scenario). A mitigation to these impacts was also identified in a marshalling yard to the north end of the network,
- Wiri to Westfield, additional capacity expansion is urgent under an uncapped port scenario but not required (though still providing benefit) under a port move scenario.
- 9-car extensions are required under ERP settings on all lines. Given the base demand scenario is closer to BAU growth, strategic inclusion / future proofing of 9-car extensions is therefore considered important.

The scenario analysis shows that 9-car train operation will be required on all lines to meet ERP targets. In addition, even under the base demand scenario, 9-car operation on the Southern Line will likely be required very soon after 2051 if not earlier for the heaviest demand express trains. It was therefore recommended that:

- The **Southern Line express services will be planned to run at 9-car**. These are the highest demand services on the network and likely to exceed acceptable crowding levels the earliest. The services can be implemented relatively early in the programme as many of the platform extensions required can be carried out in parallel with the 4-tracking project. Furthermore, implementing this service enhancement early acts as a mitigation against the constrained demand between 2030 and 2042. It is estimated that the 9-car express services can be enabled by 2037.
- **Eventual 9-car operations be progressively future proofed network wide.** The asset level phasing has adopted the principle that any time a platform at a station is touched (due to trackwork, level crossing removals, or some other reason) the platform will be lengthened to 9-car as part of this work.

Based on these insights the final refined CS phasing is presented in Figure 3-21

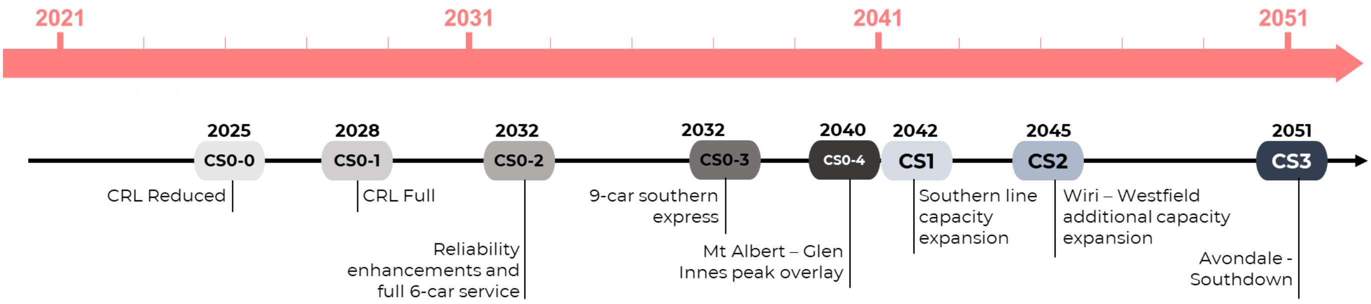


Figure 3-21: Final refined phasing

3.3.4 NETWORK EXTENSION SENSITIVITY

While not considered as an explicit scenario, potential extensions to the metro network are of considerable interest to various communities situated along the existing non-electrified rail corridor both south of Pukekohe and north of Swanson. The two mostly commonly discussed extensions are a northern extension along the NAL from Swanson to Huapai, and a southern extension along the NIMT from Pukekohe to Pokeno. A further extension of the network along MBL to Waiuku is also possible, but not considered here.

The northern extension to Huapai has been studied by Auckland Transport in 2016[130] including an assessment of economic viability. The study estimates 2-hour AM peak demand for heavy rail services in 2036 at 132 passengers, with an assumed growth rate of 2.35% per annum thereafter, leading to a 2051 demand estimate of 179 passengers. For reference, estimated 2051 demand at Swanson is 642 passengers for the 2-hour AM peak period. This would, in theory, add 14 passengers per train at Swanson during the AM peak hour period, equivalent to around 5%. At a high level – this shows that the Huapai extension adds little demand to the network, which could easily be accommodated within the capacity provided by the recommended programme.

The Huapai extension study estimated a capital cost of \$16.4m-\$18.5m and additional operating costs of \$5.1m-\$5.8m per year, leading to a BCR of 0.07[131]. Based on this analysis, it seems likely that

[130] Transport for Future Urban Growth Swanson- Huapai Rail Shuttle Proposal Review - High Level Feasibility and Cost Estimate Review, 2016.

[131] Note that these costs are not comparable to the cost estimates prepared for this PBC which contain required levels of contingency.

an extension to Huapai would have a net economic disbenefit to the programme. The study also highlights some potentially significant implementation challenges for the project including fire life safety risks associated with the Waitakere tunnel, electrification, and the potential need for new electric / battery hybrid rolling stock, which could lead to much more substantive costs.

No specific studies are available for the southern extension. The catchment of this segment of the railway (including Pokeno and Tuakau) is likely higher than that of the northern extension, however these communities are significantly further from the city centre, which could offset its catchment potential. Therefore, it is reasonable to expect a similar order of magnitude of demand for the southern extension and associated impact on the economic performance of the programme if included.

For both extensions discussed above, if land use patterns, polices, etc. changed such that a substantial increase in demand for heavy rail in these communities occurred over the next 30 years, Section 3.4.3.5 gives a range of what the impact on economic performance of the programme could be. The demand sensitivity analysis suggests that a 20% uplift in demand leads to a 0.1 increase in the BCR. However, this analysis does not account for the additional costs of providing these extensions which as indicated above, could be substantial and more than outweigh those benefits that are generated.

3.4 RECOMMENDED PROGRAMME

3.4.1 RECOMMENDED PROGRAMME DESCRIPTION

The configuration state phasing under presented in Section 3.1 is the final macro level phasing of the programme, which responds to demands within the likely constraints of deliverability and fundability and is robust against likely scenarios of demand growth. This programme was endorsed in a workshop involving all project partners and wider stakeholders from Auckland Transport, KiwiRail and Waka Kotahi in June 2023.

It is worth noting that the initial preferred 2051 end state agreed to in the October 2022 short list assessment workshop, differs from the final 2051 end state arrived at the end of the optioneering process culminating in the June 2023 workshop. These refinements resulted in a reduction in costs while all benefits were retained or enhanced, resulting in the BCR increasing from 0.58-0.84 at short list to 0.82-0.93 at the final preferred programme workshop.

As part of the PBC, a more detailed asset level phasing has been developed as a starting point for future more detailed business cases. This was required to validate feasibility of the overall programme and assess realistic timings and costing. The results of this work are contained primarily within the Capital Cost Report (see Appendix K). An overview of the major asset level improvements required to enable each configuration state is provided in Figure 3-22.

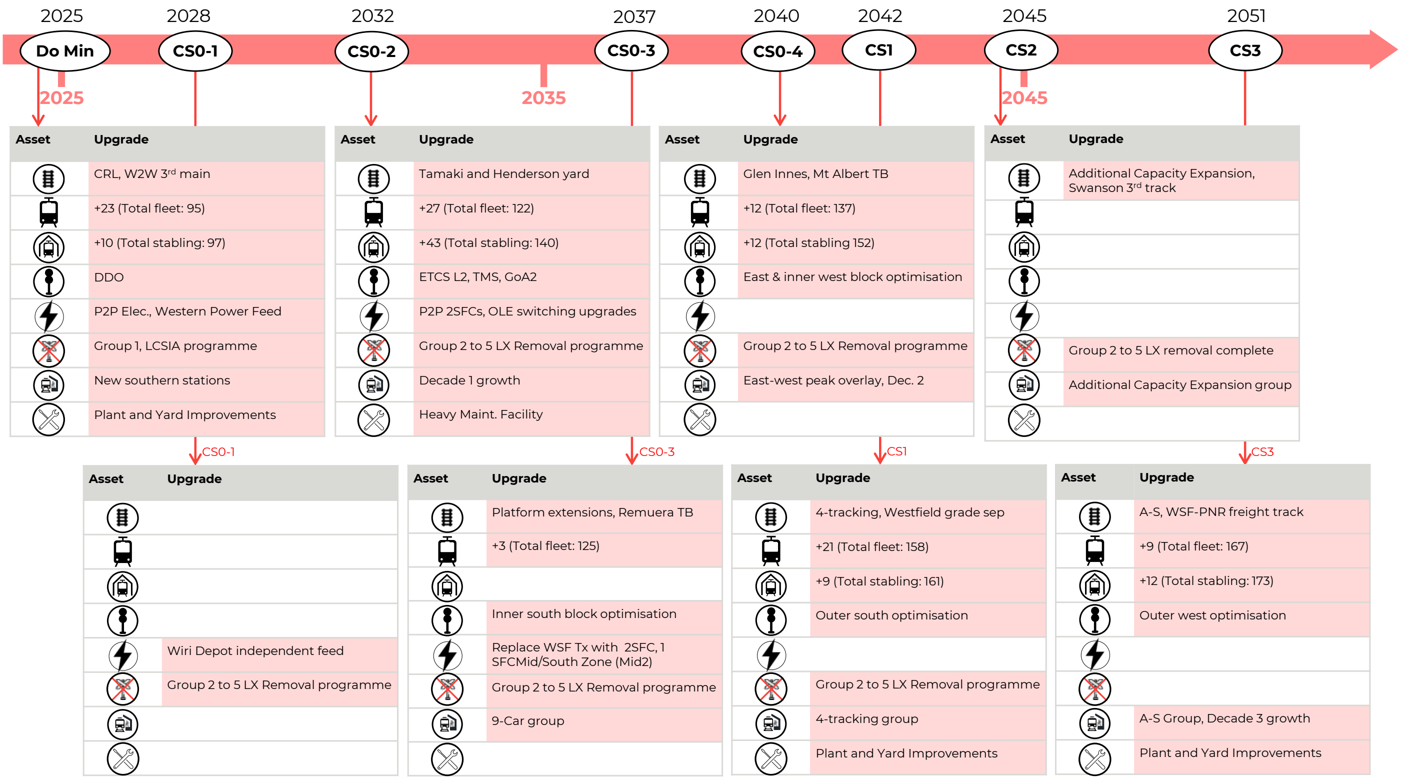


Figure 3-22: Asset level phasing of the final preferred programme

A summary of the overall programme including the primarily asset level interventions, is provided in Figure 3-23 below, the service concept enabled on completion of this programme in 2051 is provided in Figure 3-24, and a summary of the benefits to all network users (including the maintainer) are illustrated in Table 3-21. The reminder of this section provides an assessment of the final preferred programme, including its economic performance.

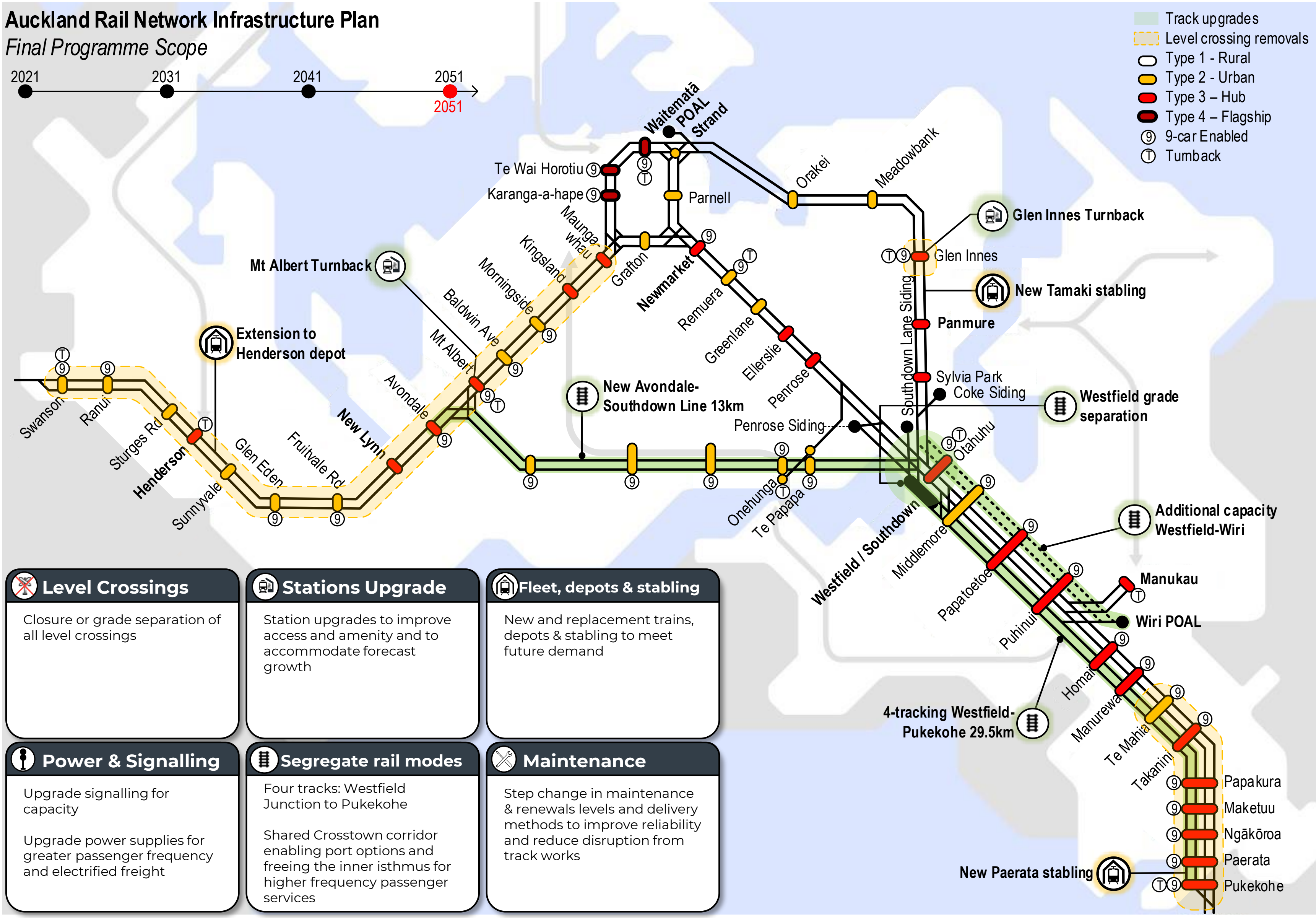
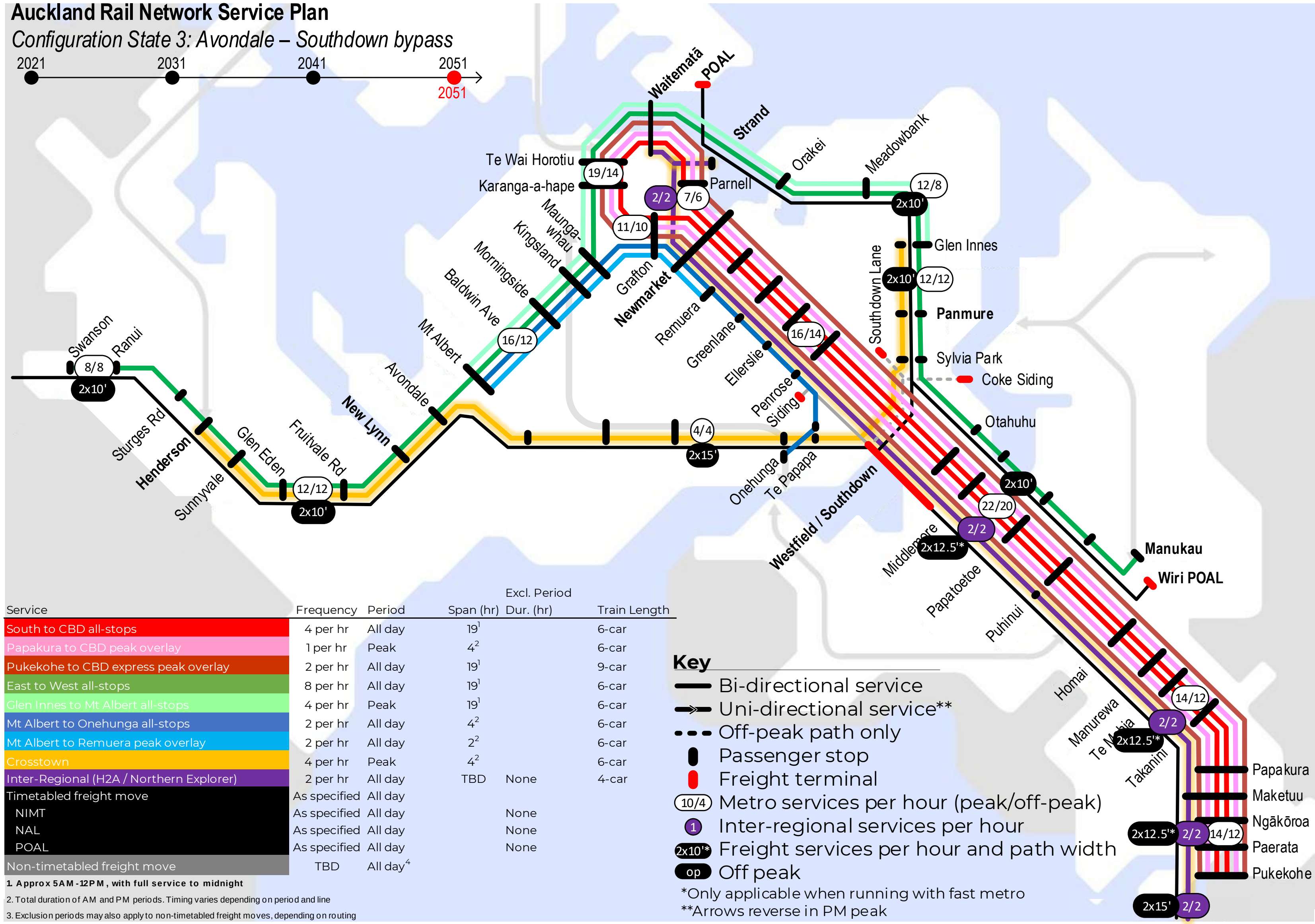


Figure 3-23: PBC Investment programme summary

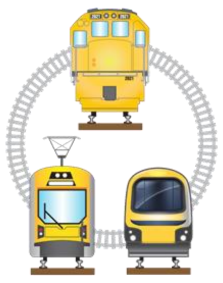
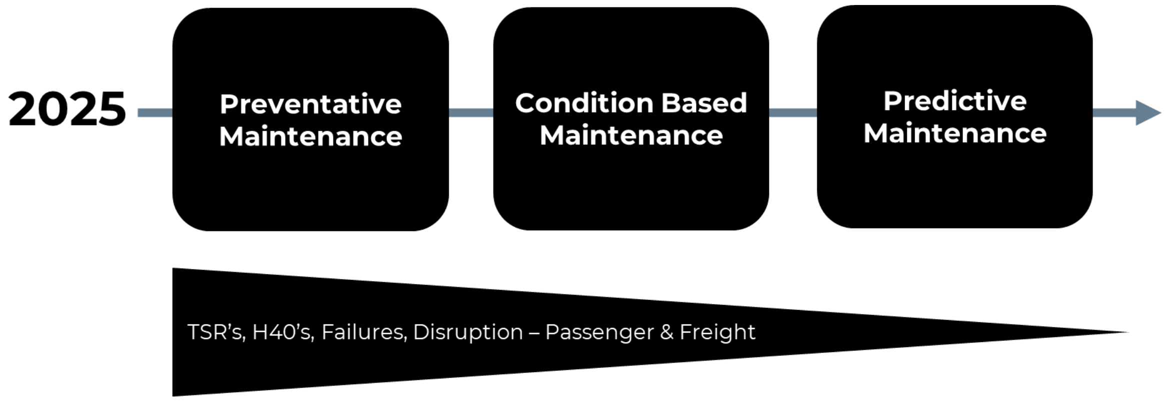
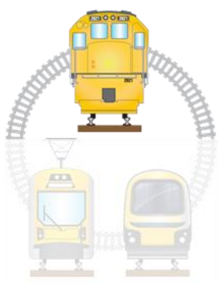
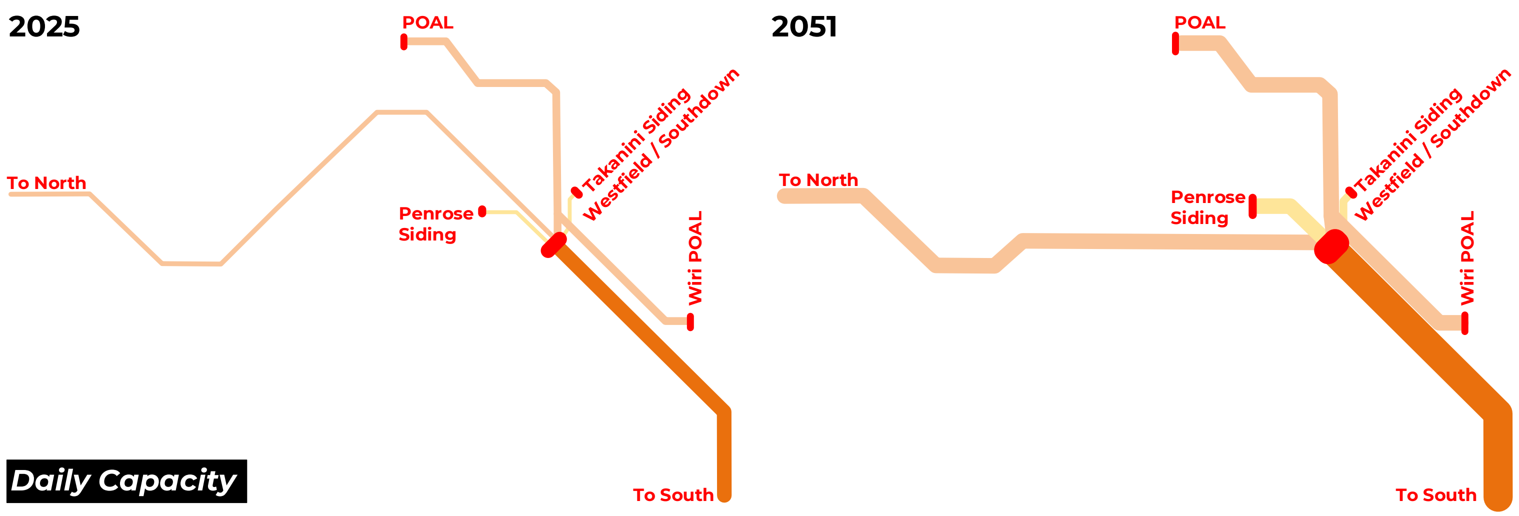
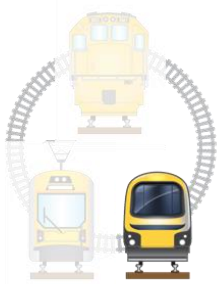
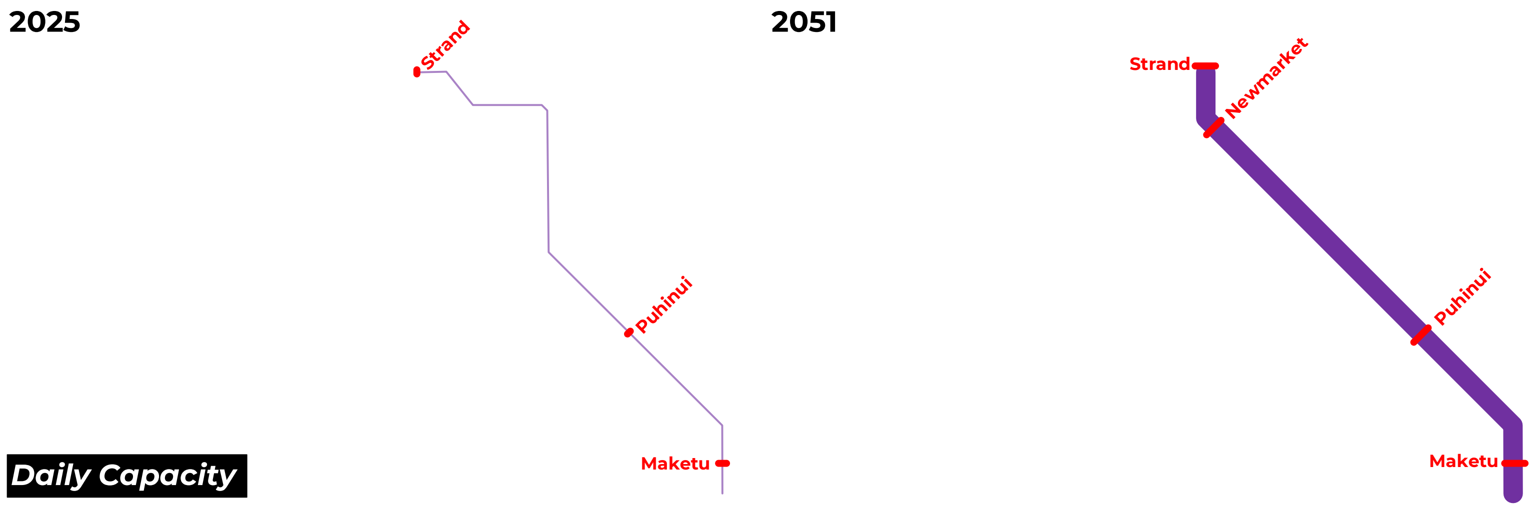


Service	Frequency	Period	Span (hr)	Excl. Period Dur. (hr)	Train Length
South to CBD all-stops	4 per hr	All day	19[1]		6-car
Papakura to CBD peak overlay	1 per hr	Peak	4[2]		6-car
Pukekohe to CBD express peak overlay	2 per hr	All day	19[1]		9-car
East to West all-stops	8 per hr	All day	19[1]		6-car
Glen Innes to Mt Albert all-stops	4 per hr	Peak	19[1]		6-car
Mt Albert to Onehunga all-stops	2 per hr	All day	4[2]		6-car
Mt Albert to Remuera peak overlay	2 per hr	All day	2[2]		6-car
Crosstown	4 per hr	Peak	4[2]		6-car
Inter-Regional (H2A / Northern Explorer)	2 per hr	All day	TBD	None	4-car
Timetabled freight move	As specified	All day			
NIMT	As specified	All day		None	
NAL	As specified	All day		None	
POAL	As specified	All day		None	
Non-timetabled freight move	TBD	All day[4]			

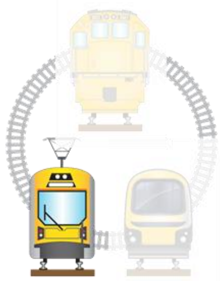
1. Approx 5AM-12PM, with full service to midnight
2. Total duration of AM and PM periods. Timing varies depending on period and line
3. Exclusion periods may also apply to non-timetabled freight moves, depending on routing

Figure 3-24: PBC final 2051 service concept

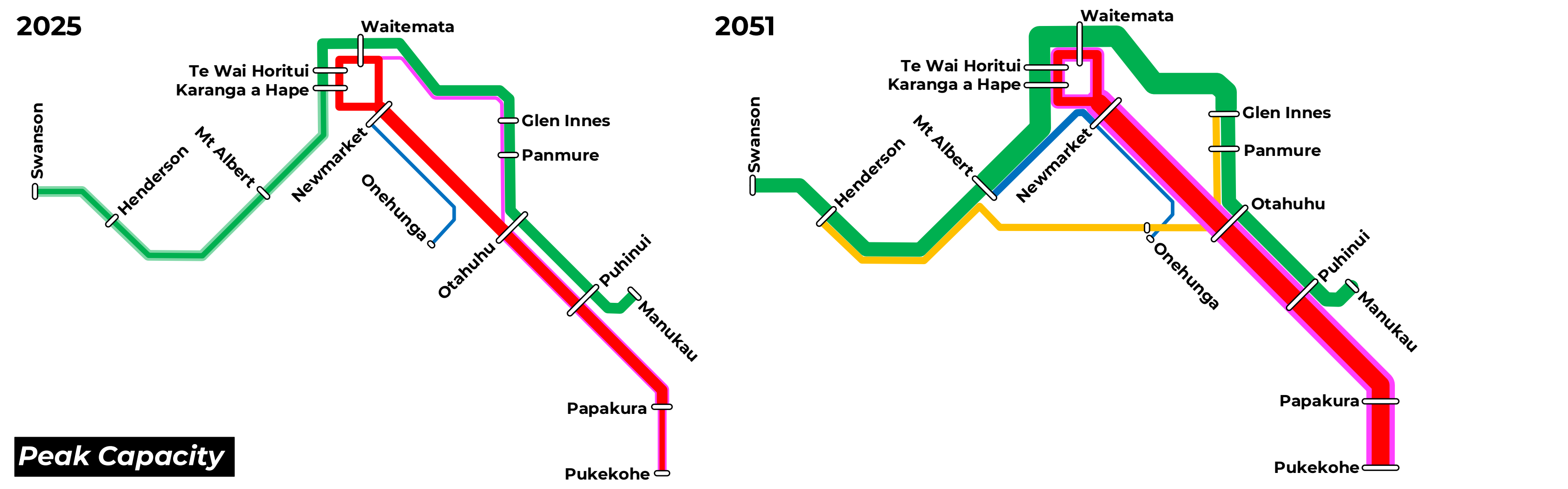
Table 3-21: Summary of benefits

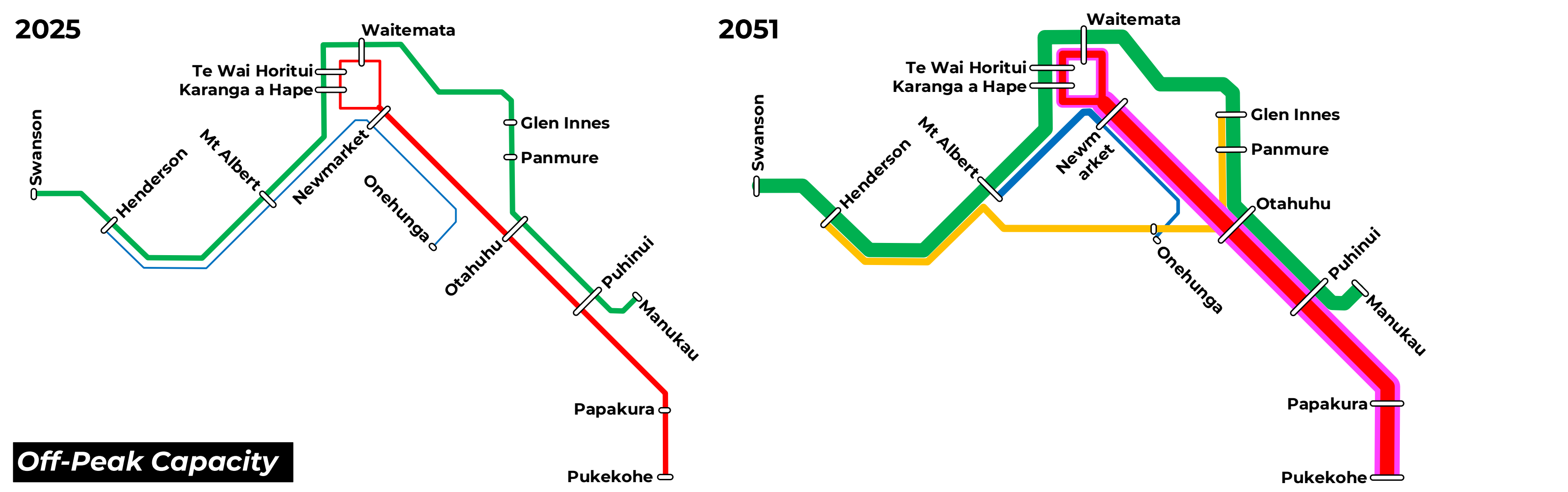
Market	User Benefits	Capacity Expansion
Maintenance 	More reliable, resilient, and robust infrastructure and services, by: • Widening effective window by 30-50% to 6 hours per night, planned proactively and rolling across targeted segments of the network • Improved productivity and safety with right sized plant and equipment. • Reduced reliance on block of line. • Staff and public safety improvements. • Ability to run services during maintenance on adjacent main(s).	
Freight 	• **Longer trains enabled** for greater economic and operational efficiency. • Significant capacity increases on all major freight lines: – NIMT 30 trains per day (tpd) x 750/900m max -> 30tpd @ 1,500m (equiv. 120tpd @ 750m) **up to 200% increase** – NAL 5-7tpd -> 16tpd **>300% increase** – POAL 6-8tpd -> 26tpd **>300% increase** • Optimal timetabling enabled with all metro exclusion periods removed	
Inter-Regional 	• Improved journey times with >**10min travel time savings** over current day • Increased capacity, with a **30min frequency enabled all day**, and longer trains (up to double current lengths) • Improved access to Auckland City Centre, with trains routed via Newmarket, **with direct platform transfer to metro trains arriving every 3-4 mins.**	

Metro



- **Increased capacity** with longer trains and more frequent services on all lines:
  - Eastern Line: Up to 12tph, all 6-car trains (**200% increase**)
  - Southern Line: 14tph all stations, 6 and 9-car (express) trains (**170-350% increase**)
  - Western Line: Up to 16tph, all 6-car trains (**270% increase**)
- **RTN frequency of 10min or better** on all lines, all day
- **Travel times of 45min or better to the city centre** for 95% stations
- **Southern express services operating all day** with savings of up to 15min over current timetable.
- A **new crosstown heavy rail connection** between west and east Auckland, and transfers to Auckland Light Rail





In addition to the benefits described above, the final preferred programme goes a significant way to achieving the broad strategic goal of segregating freight and passenger services on the Auckland network, as eluded to in the Strategic Case (Section 2.3.1.3.1).

The current, primarily two-tracked, network requires a high degree of mixed mode operations, with all-stops metro services running with non-stop services - express metro and inter-regional passenger and inter-port/inter-regional freight – on a shared pair of tracks.

Such networks are inherently complicated and inefficient to operate, impacting capacity realisation and reliability and hence as demand increases, most large cities opt to separate freight and passenger networks.

The initial groundwork for segregation is laid by the CRL project, which will create a high-capacity, passenger-only link within the inner network. Four-tracking of the southern corridor builds upon this segregation journey, allowing all-stops metro to be separated from the range of non-stopping services. Completing the picture is the Avondale – Southdown crosstown corridor, which enables further partial segregation of freight to Northland from passenger services.

Together these elements of the programme form a strategic vision for both future metro and future freight and logistics networks. This vision, depicted in Figure , exhibits the following key features:

- Full segregation to the south between stopping and through trains via the 3rd and 4th main lines.
- Intense metro-only passenger services;
  - i. around the waterfront through the City Rail Link, and
  - ii. through the middle of the isthmus.
- A shared freight and metro service to the south of the isthmus using the Avondale - Southdown Line.
- The possibility of a North Island Main Trunk (NIMT), which currently runs from Wellington to Britomart, instead running from Wellington to Whangarei/Marsden Point.

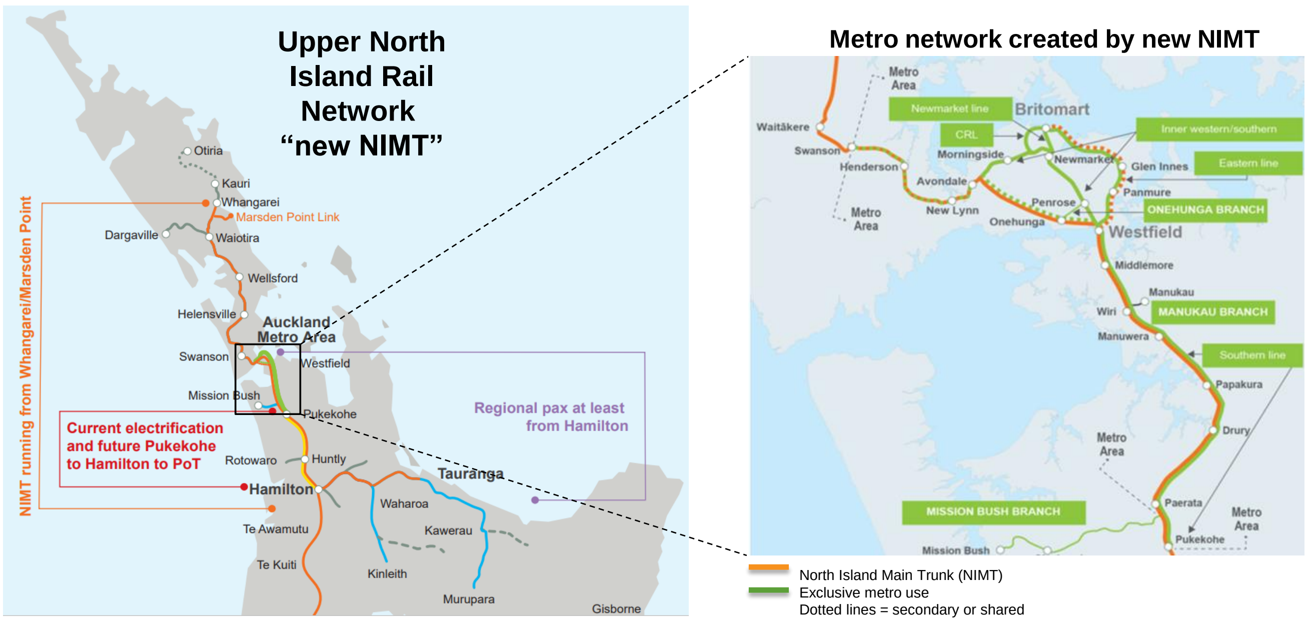


Figure 3-25: Future Auckland rail network local, regional and national strategic context

3.4.2 RECOMMENDED PROGRAMME INVESTMENT OBJECTIVE ASSESSMENT

Table 3-22 provides a summary of the performance of the preferred programme against the Investment Objectives.

Table 3-22: Assessment against Investment Objectives

IO/KPI	SUMMARY
Continually increase the use of rail in Auckland (all markets) over the next 30 years, by increasing its attractiveness	
Extent to which the option increases rail's attractiveness for metro passengers (i.e. service offering characteristics)	• Provides capacity to meet demand with standing times of 15min or less on all lines[132] • Delivers RTN frequency at all stations, all day, with trains running at 7.5min (avg.) headway. • Improves peak frequencies for 44 out of 45 stations[133] on the network with up to 270% increases in frequency at key stations • Provides Express services all day, improving the attractiveness of rail for Outer Southern customer catchments, with runtimes of approximately 55min from Pukekohe, a 10min improvement over day 1 operations and competitive to comparable car journeys of 65 – 130min peak and 45 – 65min off-peak. • Delivers improved travel times for all lines for local and express services with up to 8min travel time saved on the Eastern Line, and 5 min on the Western Line. • Inclusion of A-S metro service opens new catchment and can link to ALR for airport precinct access.
Extent to which the option increases metro passenger rail patronage	• Heavy rail boardings, based on MSM (2051 (incl. CRL)), extrapolated from annual weekday to annual: 76.2m • Additional rail patronage (2051): 21.2 million (+38.5%) • Passenger-km travelled across all PT modes increases to 3.44 billion km in 2051 (+8% compared to DM).
Extent to which the option increases metro passenger rail mode share	• Rail mode share based on MSM (2051) AM peak outputs is 25% from the addressable market[134] (acknowledging rail is not a viable option for large parts of Auckland).

[132] This is true for all lines with the exception of AM commuter trips to the central city on the Southern Line which can see longer standing times for passengers boarding in the outer south stations. However customers have the opportunity to transfer to an Eastern Line trains at any station between Puhinui and Otahuhu with high probability of getting a seat, thus the service provides optionality for customers sensitive to standing time.

[133] The only station to not receive frequency upgrades is Manukau is already well served on CRL Day 1

[134] The addressable market is defined as those trips to/from zones where rail is deemed as being viable transport mode. This is defined as any zone where a rail trip occurs (regardless of origin or destination).

IO/KPI	SUMMARY
	• In context of the overall transport network • PT mode share (2051): 15.1% (+3% compared to DM) • Rail mode share (2051): 4.4% (+38% compared to DM)
Extent to which the option increases the share of freight moved by rail	• Rail freight net tonne-km (2051): 3.9biliion (+163% compared to DM) under base demand scenario (B1) • Provides significant additional timetable flexibility accommodate different growth scenarios (e.g. if Ports of Auckland moves).
Reduce Auckland's net transport emissions by increasing rail's share of Auckland's transport task over the next 30 years	
Extent to which the option reduces Auckland's net CO2 emissions from transport	• Based on MSM (2051), road vehicle CO2 emissions are 1.497m tonnes per annum - a minor reduction from the Do Min. • There is a further 65,000 tonnes of CO2 removed from freight (as a result of mode shift from truck to rail). (revised method from short list leads to difference in magnitude) • Further discussion on this below.
Extent to which the option reduces on road vkt	• Total Auckland Road vkt (2051): 15.7b km (-0.6% compared to DM) • Freight-related vkt avoided (2051): 100 million km
The Auckland rail network supports and enables a denser urban form within the metro station catchments within the next 30 years	
Extent to which the option increases employment accessibility by PT (within 30 and 45 minutes travel)	• #Jobs accessible within 30min PT (2051): 60,341 (+6.6% compared to DM) • #Jobs accessible within 45min PT (2051): 204,342 (+10.3% compared to DM)
The Auckland rail network is resilient and reliable for the future. Achieved by increasing the available window for productive maintenance to 6 hours per day (on average) and keeping network utilisation below UIC (International Union of Railways) 406 planning limits for utilisation.	
Extent to which the option improves rail network reliability	• The current network operates at around 95% capacity with the primary bottleneck being Britomart Station. The CRL resolves this bottleneck with the main capacity constraint shifting to mixed use areas on the Southern Line where the Outer Southern is estimated to be at 101% capacity on CRL opening day (exceeding limits of reliable operation and significantly exceeding long term planning targets of 75%). preferred programme enables significant growth in train volumes while reducing / maintaining acceptable levels of utilisation across the network achieving the following utilisation by section: — West: 75%

IO/KPI	SUMMARY
	— East: 83% — Inner South: 75% — Outer South: 58% • 4-tracking and network sectionalisation will also enable 6-hour productive maintenance windows while minimising the impact on passengers

It is acknowledged that the results of modelling show limited potential for emissions reduction. This is primarily due to assumptions around the uptake of electric vehicles based upon MoT's fleet composition forecasts in VEPM. This results in a Do Min reduction in CO2 of 46% despite a 47% increase in VKT. Further to this, no land use response has been considered in ARPBC modelling to reflect higher potential intensification than currently zoned for around the rail network that may be induced by the significant capacity and level of service improvements enabled by the programme.

If the inbuilt MoT assumptions on EV usage do not come to pass, with a potentially much slower uptake rate, and if policy levers are put in place to accelerate shift to more sustainable modes (both in passenger and freight) then the carbon emissions avoided by the investment programme of the PBC would be expected to be significantly greater. On the other hand, without the investments of the PBC, the potential for these policy levers to be effective, with equitable outcomes, will be limited. As such investment in the Auckland Rail network provides a more resilient approach to mitigating the impacts of climate change (which already represent a significant cost to New Zealand with the recent events of extreme weather including Cyclone Gabrielle) and the potential for trade sanctions in 2050.

It is also acknowledged that the overall annual heavy rail patronage yielded through the modelling of 76.2M in 2051 does not satisfy the ex-ante ERP analysis presented in Section 3.1.5.4 which suggests heavy rail patronage would need to be of 86M by 2035 in order to satisfy ERP targets. This highlights the need for a broader system of investments and policy levers external to the PBC to achieve emissions reduction goals – improvements to the heavy rail network alone will not be sufficient. However, scenario analysis indicates that the recommended programme largely has capacity to accommodate these passenger volumes if a broader system of initiatives comes to pass (though likely not on the targeted timescales).

3.4.3 RECOMMENDED PROGRAMME ECONOMIC ASSESSMENT

3.4.3.1 ECONOMIC EVALUTION SUMMARY

The economic evaluation of the recommended option is consistent with the processes and guidance outlined in Waka Kotahi's Monetised Benefits and Costs Manual (MBCM), updated in April 2023. The detailed approach and results are provided in Appendix I.

The overarching evaluation parameters are listed below:

- The Do Min is as described above in Section 3.1.6.
- Benefits are calculated in 2022 dollars, using the appropriate update factors where necessary for values in the MBCM.

- Linear interpolation is used for estimating annual benefits between modelled year forecasts.
- Cost estimates, developed in 2023 dollars, have been converted back to 2022 dollars (for comparison with the benefits) by dividing by 1.056 to reflect one year of inflation[135].
- A 60-year evaluation period is used in the base assessment, which is considered to be an appropriate period given the long-term nature of most of the investment within the recommended programme.
- The evaluation period begins in FY25, which is the first year of expenditure for the recommended programme.
- The discount rate for the evaluation is 4% as per the MBCM.
- The calculation of CO_2 emission reduction benefits is based on model forecasts which include embedded assumptions around decarbonisation of the road-vehicle fleet – both private vehicle and HCVs (for freight). These are consistent with Waka Kotahi's Vehicle Emissions Prediction Model (VEPM). The long-term nature of this PBC means that the magnitude of possible emissions is extremely limited as the VEPM assumptions apply to the Do Min.

3.4.3.2 BENEFITS

The calculation of the benefits in the economic evaluation is based on the following data sources:

- Auckland metro passenger benefits are primarily based on Auckland Macro Strategic Model (MSM) modelling of the Do Min and the various configuration states of the recommended programme over time (for forecast years of 2025, 2031, 2041 and 2051), undertaken by the Auckland Forecasting Centre (AFC).
- Benefits associated with Inter-regional passengers are based on Te Manatū Waka – Ministry of Transport's Hamilton to Auckland Intercity Connectivity Project IBC (H2AIBC) (October 2022) but limited to the additional benefits that investment in the Auckland rail network would deliver to avoid double counting.
- Freight-related benefits are derived from analysis undertaken within KiwiRail's Decarbonisation Indicative Business Case (IBC) that is currently being developed. The benefits have been derived in conjunction with KiwiRail to ensure the same base data and approaches are being adopted between this PBC and the Decarbonisation IBC, limited to those freight services into or out of Auckland. The monetisation of benefits is based upon the methodologies used to estimate the economic value of rail in 2019 (KiwiRail, 2021), with valuations updated to be consistent with the April 2023 update of the MBCM where appropriate.
- Subject matter expert input has been used to derive input assumptions used in estimating the residual value of the programme components at the end of the evaluation period.
- Valuation inputs, such as values of time, are taken from the MBCM.
- In the absence of available modelled analysis, assumptions, based on literature or previous analysis are utilised, for example estimating Wider Economic Benefits (WEBs). This is considered appropriate given the nature of the programme analysis.

[135] https://www.rbnz.govt.nz/monetary-policy/about-monetary-policy/inflation-calculator - Q3 2022 to Q2 2023

- The rule of half is applied in the calculation of benefits that accrue transport users who have switched their mode of travel as a result of the recommended programme.

The wide range of economic benefits associated with the programme across the three areas (metro passenger, freight and Inter-regional passenger), along with the residual value are summarised below in Table 3-23, Table 3-24, Table 3-25, and Table 3-26 with additional detail around the estimation process for each one included in Appendix I.

Table 3-23: Economic benefit description summary – metro benefits

BENEFIT AREA: METRO PASSENGER	DESCRIPTION
PT user benefits	These accrue to PT users through the improvements in level of service delivered by the recommended programme. These improvements come from increased frequency, more capacity, reduced travel times and service changes (such as the introduction of express services) across the network. PT user benefits include the fare revenue resource cost correction. The utility, or generalised cost calculation in MSM that determines the transport mode that travellers choose includes fare costs. In accordance with the MBCM guidelines it is appropriate therefore that the increase in fare revenues is added back in as a resource cost correction. This is necessary to correct for the misperception in perceived costs for ex-car travellers who mode shift to PT under the consumer surplus calculation. The additional fare revenue is calculated within MSM.
PT reliability benefits (mode shift)	These accrue to passengers who were travelling by bus who are now attracted to rail by the higher level of service provided as a result of the investment programme. Reliability of rail services is greater than for bus services through its complete separation from general traffic congestion. These benefits are in addition to the PT user benefits calculated in MSM above.
Seated benefits	The additional seated capacity provided by a larger fleet of EMUs means there are fewer passengers that must stand on their journey. The difference in the value of time of seated and standing passengers is used to quantify this benefit and accrues to those passengers who were having to stand in the Do Min that are now able to sit for the duration of their journey. This benefit is adopted from the EMU Batch 3 business case where it was estimated in detail.
Rail service punctuality benefits	These benefits accrue to the number of passengers in the Do Min to reflect an improvement in on-time performance, based on the Auckland One Rail KPIs for existing service delivery. Without the investment in the programme, the overall level of metro service punctuality would not be expected to change. This level of variability in service delivery is not included in the MSM modelling and is a material benefit associated with

BENEFIT AREA: METRO PASSENGER	DESCRIPTION
	improving level of service, one of the identified problems that the recommended programme is solving.
Rail service reliability benefits	These benefits accrue to the number of passengers in the Do Min to reflect a reduction in unscheduled service cancellations, based on the Auckland One Rail KPIs for existing service delivery. Without the investment in the programme, the overall level of metro service reliability would not be expected to change. This operational variability is outside the ability of the MSM model to estimate. It is a material benefit associated with improving level of service, one of the identified problems that the recommended programme is solving.
Station amenity improvement benefits	These benefits accrue to the passengers using stations that are upgraded as part of the station upgrade component of the programme. The benefits are estimated using the MBCM's value of equivalent in-vehicle time for PT infrastructure improvements to stations. The benefits reflect the improved customer experience that will be delivered by this part of the recommended programme.
Health benefits from walking	Health benefits accrue to rail passengers who are either new, or have shifted from bus or car in the Do Min. An average walking distance for these passenger groups is applied to quantify the economic benefit of the additional walking that is likely to occur.
Road user travel time benefits	These accrue to road users (car and heavy commercial vehicles (HCVs)) through decongestion and the removal of some car trips from the network as they are attracted to rail with the improved capacity and service.
Road user reliability benefits	In addition to the road user travel time benefits, there will be travel time reliability benefits for road users as a result of less residual congestion on the road network. To account for this, a 15% increase is applied to the road user travel time benefits.
Crash cost reduction benefits	Crash cost reduction benefits occur as a result of reduced VKT due to the mode shift away from car to PT. Auckland's death and serious injury (DSI) crash data and total network VKT from year ending March 2023 is used to determine a DSI rate per million VKT, which is applied to the reduction in VKT from MSM and monetised using input values from the MBCM.
CO_2 emission reduction benefits	The removal of general vehicle travel reduces CO_2 emissions, and the reduction is quantified using the middle shadow carbon price from the MBCM and change in emission totals output from MSM. It is noted that MSM includes fleet decarbonisation assumptions consistent with Waka Kotahi's VEPM.

BENEFIT AREA: METRO PASSENGER	DESCRIPTION
Air quality improvement benefits	The removal of general vehicle travel reduces emissions and the reduction in CO, NO_x and PM_{10} is quantified using the relative values per tonne from the MBCM and change in emission totals output from MSM.
Second round impact benefits (land use change)	Second round benefits occur as a result of dynamic land use changes that the investment programme induces or unlocks. As accessibility improves as a result of the investment in the rail network, land values within station catchments will increase, which will in turn support higher land utilisation (e.g. increased density). These effects generate second round benefits, through the additional density, across virtually all the benefit categories. Dynamic land use changes have not been explicitly incorporated into the modelling, so instead a factor of 10% of conventional benefits is applied as a proxy, based on research summarised in Waka Kotahi's Technical Paper [136] that notes these benefits can be between 5% - 30% depending on the transformative nature of the project.
WEBs	The recommended programme delivers improvements in accessibility across the transport network (e.g. additional capacity, and reduced travel times and congestion) that will enable agglomeration, imperfect competition and labour supply benefits (i.e. WEBs). An allowance for these WEBs has been included in the economic assessment. An uplift of 25% of total conventional benefits has been assumed as a proxy for the WEBs, informed by other PT investments. Depending on the project, WEBs may represent a higher proportion of total benefits. For example, CRL which is also a transformative rail project, undertook detailed modelling of agglomeration, imperfect competition and increased labour supply benefits. In the case of CRL, WEBs accounted for nearly 30% of total benefits (or nearly 40% of the conventional benefits). WEBs have only been included in the metro passenger benefits. Inter-regional agglomeration, and dynamic clustering, have not been estimated or included as part of this PBC but will be assessed in KiwiRail's computable general equilibrium (CGE) modelling being undertaken by Sense Partners.

[136] NZTA Transformative Transport Projects (Dynamic Webs and Land Use Benefits and Costs) Technical Paper for Investment Decision Making Framework Review, December 2019.

Table 3-24: Economic benefit description summary – freight benefits

BENEFIT AREA: FREIGHT	DESCRIPTION
CO_2 emission reduction benefits	These benefits are as above for metro passenger benefits, but the benefits are as a result of less HCV travel, with rail carrying an increase in freight tonnage. Truck fleet decarbonisation over time from the VEPM is included in the underlying assumptions in KiwiRail's decarbonisation modelling and incorporated into the estimation process for emission reductions.
Fuel cost savings	The reduction in HCV-km that result from the freight mode shift from road to rail allow an estimate of fuel costs avoided to be made, which represent a saving in economic resources.
Net maintenance cost avoided	Transporting freight growth by rail instead of by HCV reduces the damage done to roads, which is quantified by estimating the road maintenance cost avoided. This saving is offset by an increase in rail network maintenance. In the case of this PBC, that is incremental rail network maintenance outside Auckland as the costs within Auckland are being included in the operating cost estimates.
Rural congestion reduction benefits	These are the benefits of avoided road congestion as a result of freight movements shifting from road to rail. The 2016 Value of Rail report estimated a rural congestion benefit per tonne-km removed from the road which provides the rural benefit estimate. The urban benefit is derived from reductions in estimated travel times within Auckland's urban limits (i.e. HCV-hours removed from the network).
Urban congestion reduction benefits	
Crash cost reduction benefits	These benefits are as above for metro passenger benefits, but the benefits are as a result of less HCV travel, with rail carrying an increase in freight tonnage.
Air quality improvement benefits	These benefits are as above for metro passenger benefits, but the benefits are as a result of less HCV travel, with rail carrying an increase in freight tonnage.

Table 3-25: Economic benefit description summary – inter-regional benefits

BENEFIT AREA: INTER-REGIONAL	DESCRIPTION
PT user benefits	PT user benefits from the H2AIBC have been adapted to reflect a further 20 minutes of travel time saving that could be realised once 4-tracking between Westfield-Pukekohe is completed.
CO_2 emission reduction benefits	10% of these benefits as calculated in the H2AIBC analysis are added to the Auckland programme benefits to reflect a 10% uplift in patronage (assumption) if the estimated travel time savings on the Auckland rail network are realised.
Other benefits	

Table 3-26: Economic benefit description summary – residual value

BENEFIT AREA: RESIDUAL VALUE	DESCRIPTION
Residual value	Rail infrastructure tends to have a very long useful life, which means that at the end of the economic evaluation period many assets will still have remaining life that does not require re-investment. This provides a discounted future benefit added in the final year of the evaluation, reflecting the significant long-term investment nature of the recommended programme. The traditional approach of straight-line depreciation of asset values has been adopted, as opposed to the net present value of future benefit streams. The long lives of many of the assets, coupled with implementation far in the future (e.g. in 25-30 years) leads to a considerable portion of useful life remaining at the end of the economic evaluation period. When combined with the overall scale of the programme, the resulting residual value is still material.

The resulting total and present value (PV) of these benefits across the recommended programme are shown in Table 3-27. The benefits presented represent the incremental benefits over and above the Do Min (i.e. those generated by the recommended investment programme).

Table 3-27 Economic benefit summary (2022$, millions)[137]

Benefit type	Total	PV
Metro benefits		
PT user benefits	22,322	5,400
PT reliability benefits (mode shift)	3,210	797
Seated travel benefits	129	37
Rail service punctuality benefits	445	123
Rail service reliability benefits	601	165
Station amenity improvement benefits	1,317	298
Health benefits from walking	343	84
Road user travel time benefits	5,968	1,433
Road user reliability benefits	895	215
VOC reduction benefits	-	-
Crash cost reduction benefits	350	85
CO2 emissions reduction benefits	133	35
Air quality improvement benefits	634	190
Second round impact benefits	3,635	886
Residual value	5,878	581
Total excl. WEBs	**45,862**	**10,329**
WEBs	9,996	2,437
Total incl. WEBs	**55,857**	**12,766**
Freight benefits		
CO2 emissions reduction benefits	895	257
Fuel cost saving	6,691	1,722
Net maintenance cost avoided	1,996	536
Rural congestion reduction benefits	3,301	890
Urban congestion reduction benefits	2,067	551
Crash cost reduction benefits	3,419	919
Air quality improvement benefits	3,063	960
Total freight benefits	**21,432**	**5,834**
Interregional benefits		
PT user benefits	7,665	1,586
CO2 emissions reduction benefits	1	0
Other benefits	313	65
Total IR benefits	**7,980**	**1,652**
Totals		
Total benefits excl WEBs	**75,274**	**17,815**
Total benefits incl WEBs	**85,270**	**20,252**

3.4.3.2.1 BENEFIT LIMITATIONS

There are a number of limitations associated with estimating the benefits for the recommended programme, which leads to the analysis being considered to be slightly conservative:

- Conservative estimates of benefits associated with addressing Level Crossings (on balance)
  MSM is limited in both its inclusion of all level crossings (i.e. the model does not include ALL roads in the region) and its reflection of localised traffic effects. The Level Crossing Single-Stage Business Case (SSBC) is expected to analyse the options at each level crossing location (grade separation or closure) in more detail and return more material transport network benefits associated with grade separating level crossings. In the case where closures are proposed, and this differs to the treatment assumed by this PBC, it could lead to disbenefits. On balance

[137] Source: PwC analysis

between these outcomes, it is expected that the overall impacts on estimated benefits would still be positive (i.e. additional benefits being generated).

- Potential demand constraints (off-peak especially)
  Off-peak demand is not as responsive to the improvement in service levels as might be expected (e.g. based on a review of the literature). This suggests that there could be some limitations to MSM's forecasting of behaviour change in response to off-peak changes to the PT system and there could be a material upside to the benefits, especially when combined with policy changes.
- Exclusion of potential policy impacts
  No assumptions around mode shift incentivisation or acceleration policies that could be implemented during the next 30 years (i.e. the life of the programme) have been made, other than the inclusion of congestion charging in 2051 (in both the Do Min and recommended programme). Implementing such policy changes would only be possible through progressing the programme to provide capacity to accommodate additional demand. This would only lead to an increase in the programme's benefits and would not substantially affect the costs (other than the timing of some investments).
- Dynamic land use and the National Policy Statement on Urban Development (NPS-UD)
  A specific programme land use scenario has not been developed, as the other major transport projects in Auckland have pursued. However, the effects are proxied through a percentage uplift in conventional benefits, noting this is an assumption in the middle of the potential range.
  The NPS-UD up-zoned station catchments as of right, which means that intensification around station nodes can occur regardless of the recommended programme from this PBC. This means the programme could be considered to be less 'transformational' from a land use perspective than some of the other major rapid transit projects. This could dilute the land use response that is potentially attributable to the programme, compared to those other projects. However land use scenario i11.6 will likely be slightly low in station catchments as the impacts of the NPS-UD will not have been fully incorporated, and this will underestimate some benefits. This underestimation could itself be offset by lower long term future population projections that are expected to be adopted in the near future.
- Inclusion of Light Rail (CC2M in 2031, other corridors in 2051)
  These projects are included in the Do Min, so if they were delayed there could be a marginal uplift in benefits. It is noted there isn't a material overlap in catchments and those projects boost the 'network effect' when included. This means the net effect of any deferral could be muted.

3.4.3.3 COSTS

The recommended programme consists of substantial capital investment and operational costs to deliver the increase in levels of service, both in terms of service provision (e.g. capacity and frequency) and network quality (e.g. maintenance). There is also a modest increase in renewals as a result of the network increasing in size and metro EMU fleet expanding throughout the programme.

The Financial Case provides a summary of the cost estimation process across the three cost categories, with the capital cost estimates detailed in the Capital Cost Report, which is attached in Appendix K.

As noted earlier, cost estimates all use FY23 as the base year. Benefits are in FY22 dollars therefore costs are converted back to FY22 dollars to allow sound comparison with the benefits. This means that the costs presented in this section will not be directly comparable with those presented later in this PBC.

For the Avondale-Southdown project, despite KiwiRail already owning the majority of the corridor, the economic assessment includes the full cost of the corridor (provided by KiwiRail's property team) to reflect the opportunity cost that it represents in an economic sense. This is consistent with MBCM guidance.

Capital costs (or capex) relate to the capital delivery of projects within the recommended programme.

Renewals are separated given the different treatment (capital or operating cost) by Auckland Transport and KiwiRail. These relate to infrastructure, rolling stock and system renewal, refurbishment and replacement costs that generally occur periodically (especially in the case of rolling stock and most systems) to allow the assets to function at the necessary level for their useful/design lives..

Operating costs (or opex) cover the following:

- For Auckland Transport, these relate to metro passenger service delivery and station operating costs.
- For KiwiRail, these relate to network management costs (including maintenance, control, inspections, technical support and overall management).

The resulting total and PV of the incremental capital, renewal and operating costs across the recommended programme (i.e. additional to Do Min costs) are shown in Table 3-28 below.

Table 3-28 Economic cost summary (2022$, millions)[138]

Costs	Total	PV
Capex	(19,677)	(11,901)
Renewals	(1,408)	(245)
Opex	(19,314)	(5,060)
Total	**(40,399)**	**(17,206)**

3.4.3.4 COST-BENEFIT SUMMARY

Table 3-29 summarises the economic assessment and benefit-cost ratio (BCR) for the recommended programme over a 60-year evaluation period. Benefits and costs are those over and above the Do Min.

[138] Source: PwC analysis

Table 3-29 Recommended programme economic assessment summary (2022$, millions)[139]

Summary	Total	PV
Benefits		
Metro benefits	39,983	9,748
Freight benefits	21,432	5,834
Inter-regional benefits	7,980	1,652
Residual value benefit	5,878	581
Total (excl. WEBs)	**75,274**	**17,815**
WEBs	9,996	2,437
Total (incl. WEBs)	**85,270**	**20,252**
Costs		
Capex	(19,677)	(11,901)
Renewals	(1,408)	(245)
Opex	(19,314)	(5,060)
Total	**(40,399)**	**(17,206)**
NPV (excl. WEBs)	n/a	**609**
NPV (incl. WEBs)	n/a	**3,046**
BCR (excl. WEBs)	n/a	**1.0**
BCR (incl. WEBs)	n/a	**1.2**

The recommended programme has a BCR of 1.0 when the estimate for WEBs is excluded, or 1.2 when they are included. When WEBs are excluded, the positive NPV shows that the estimated benefits of the programme are slightly higher than the estimated costs. When WEBs are included, or an allowance is made for some of the likely areas of conservatism discussed above, the positive NPV increases further.

The recommended programme's BCR reflects, in part, the major investment and long delivery time of the step change that is required. This means that the early part of the programme is sustained investment, with benefits not starting to be realised until after the step change is complete. Further to this, while the step change is large, the benefits can only start to build after that point – they do not immediately jump to a high value. This means there will be a long period over which the return on investment is realised. Figure 3-26 illustrates this point as the costs and benefits over time are presented graphically. Note that the large benefit in the final year of the period reflects the inclusion of the residual value of the infrastructure in the analysis.

[139] Source: PwC analysis

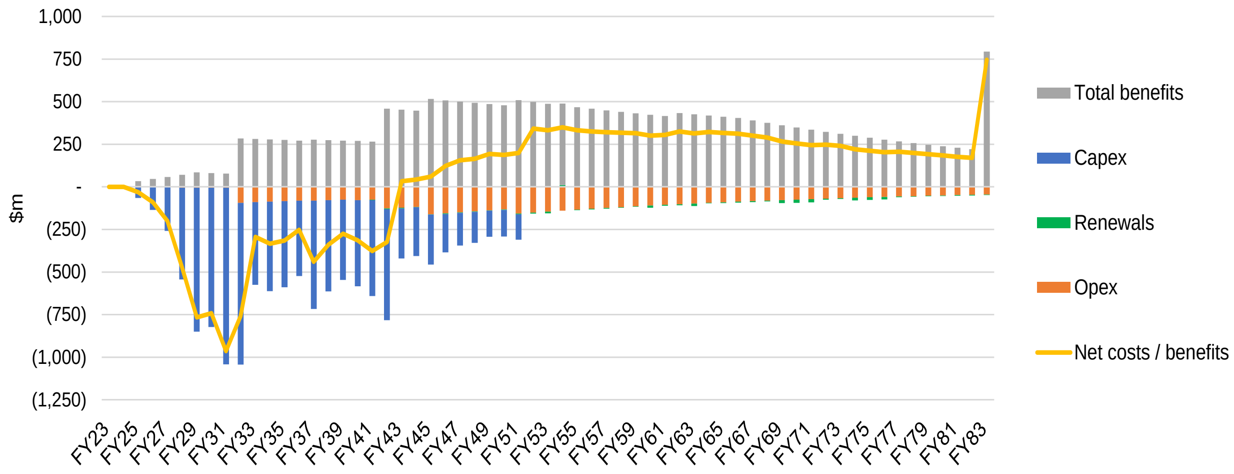


Figure 3-26: Programme discounted costs and benefits over time (2022, $millions)[140]

3.4.3.5 SENSITIVITY ANALYSIS

A range of sensitivity tests have been undertaken for the recommended programme to assess the impact on the BCR due to changes in a number of factors, which are discussed below.

Discount Rate

The base economic assessment uses a discount rate of 4%, recommended by the MBCM. Sensitivity tests using a lower discount rate of 3%, and a higher discount rate of 6% have been undertaken, consistent with MBCM guidance.

Evaluation period

The base case uses a 60-year evaluation period, reflecting the long-life infrastructure that forms a large part of the overall programme. A 40-year period is also tested, consistent with more 'typical' projects and a longer evaluation period of 80 years is also tested, which is an appropriate sensitivity test given many of the assets being constructed have 100 year lives and may not be built until later in the programme period.

Due to these long lives, and because the programme is progressively rolled out over the 30 years, we undertook a further sensitivity test using a 100 year evaluation period to capture the full economic life of most of the assets. Only some of the Avondale-Southdown infrastructure, which is delivered in the last few years of the programme period, would have any material residual life left at the end of a 100 year evaluation period, however the effects of discounting make it negligible in the context of the economic analysis.

Metro patronage

Given some degree of uncertainty in relation to metro passenger forecasts, a sensitivity test has been undertaken where the benefits (as a proxy for patronage) are increased and decreased by 20%. This upper and lower bound cover a range of possible reasons that could lead to lower or delayed benefits, or higher or accelerated benefits, including:

- the rate of recovery of rail patronage post COVID-19 and the major disruptions associated with the Rail Network Rebuild could be slower than expected. The 20% reduction represents a

[140] Source: PwC analysis

slower recovery from current patronage levels (which are currently at 75% of pre-COVID volumes), effectively removing any 'rebound' and growth reverting to 'typical' increases. When the uplift associated with CRL occurs, it is therefore occurring from a considerably lower base.

- the rate of growth, especially from the southern growth area around Drury and Paerātā could be slower than forecast in the base case demands if the current rate of development continues to lag behind earlier expectations (as a result of lower demand or demand shifting elsewhere in Auckland). This is consistent with Auckland Council's Future Development Strategy 2023-2053 (Draft)[141], which shows considerable delays to development timing in large parts of Ōpaheke, Drury, Paerātā and Pukekohe (generally 10-15 years or more). A reduction in 20% of metro passenger benefits is considered to be in excess of the upper limit for the impact that slower southern growth could contribute to.
- delays to the implementation of light rail in Auckland (across the three corridors) could impact metro patronage. There could be slight reductions given the overall network effect that is present when light rail is in place as part of the RTN. However, earlier modelling undertaken during the options development phase suggested these impacts would be very limited. This means the sensitivity test of a 20% reduction in metro passenger benefits will significantly overstate the impacts of light rail being delayed (in isolation of other changes).
- higher growth than expected could result from exogenous factors beyond the recommended programme (such as policy changes). A test with 20% increased metro benefits (as the proxy for patronage) is also included to reflect this. Given ERP targets are more than double forecast patronage (by 2035), an increase in patronage of 20% would still fall well short of hitting the ERP targets. If policies are implemented that could achieve the required level of growth, the benefits could be higher.

Inter-regional (H2A) patronage

For Inter-regional patronage, the base case includes a 10% increase in patronage reflecting the additional 20 minute travel time saving that is expected for Inter-regional passengers as a result of the recommended programme. Against a base improvement of 9 minutes in the H2AIBC, the resulting 29 minute saving could have a more material impact on demand and so a range of +20% (upper bound) and 0% (lower bound) is tested for additional Inter-regional patronage.

Freight demand scenarios

To test the sensitivity of freight-related benefits, two tests are undertaken. For the first, the different freight demand scenarios produced by KiwiRail are used to provide a lower and upper bound estimate. For the lower bound estimate, freight scenario A is used, which is a lower mode shift to rail, but still more than the Do Min. For the upper bound estimate, freight scenario D is used, which eases almost all rail operating constraints (in a freight context) and reflects a larger mode shift to rail from road freight.

Freight benefit area

For the second freight sensitivity test, the benefits remain limited to those related to the four Auckland freight services, but now confined to the geographical area within the 'Golden Triangle' (between Auckland, Hamilton and Tauranga). This test reflects more uncertainty around the rail

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[141] Retrieved from https://akhaveyoursay.aucklandcouncil.govt.nz/future-development-strategy , 28 August 2023

network's ability to accommodate additional demand outside that area without additional investment. This test is only included to generate a lower-bound estimate.

Carbon price

The base assessment of the recommended programme uses the middle shadow price of carbon. As sensitivity tests, the low and high shadow prices from the MBCM are used.

VKT estimation approach

Given the embedded assumptions around fleet decarbonisation and the redistribution of trips in MSM that could potentially be muting VKT reductions, a sensitivity test was developed for VKT-related benefits (being CO_2, crash cost reduction and air quality benefits). This test is an alternative approach that utilises the forecast additional PT patronage to estimate the potential VKT reduction and in turn the corresponding benefits that are driven by changes in VKT. It is only included to generate an upper-bound estimate.

Second round impacts (land use change)

The base assessment of the recommended programme adopted an uplift of 10% of conventional benefits as a proxy for the second round impacts of land use change as a result of the investment programme. This assumption is informed by other PT investments in the absence of dynamic land use modelling. However, the literature notes that these effects can be higher – ranging from 5% to 30%. A sensitivity test is included where the second round impacts are removed (i.e. 0%) and increased to 15% (which is still a potentially conservative upper bound estimate given the range in the literature).

WEBs

The base assessment of the recommended programme adopted an uplift of 25% of total conventional benefits as a proxy for the WEBs, informed by other PT investments. However, WEBs may represent a higher proportion of total benefits and a sensitivity test is included where the uplift is assumed at 35% of total conventional benefits (for metro passenger benefits). As the MBCM notes that the inclusion of WEBs is itself a sensitivity test on the base case, the lower bound estimate is simply the base case excluding WEBs.

Cost

To test the sensitivity of the recommended programme to changes in cost, we use the P95 cost estimates for the capital costs to inform the lower bound estimate (i.e. lower bound BCR) along with a 10% increase in renewals and operating cost estimates. For an upper bound estimate, we reduce the P50 capital costs, renewals and operating cost estimates by 10%.

Prioritisation bookends

During the first half (approximately) of the programme, there is insufficient capacity to accommodate all the desired services across all markets. This means that compromises must be made. Section 3.3.2.2 explored this issue to understand the impacts of the different 'bookends' – where freight services are given complete priority (at the expense of some metro passenger services), and vice versa. The base case adopts more or less the status quo, with some freight growth being foregone and some restrictions on metro passenger services (e.g. limited provision of express services across the day). The sensitivity tests show the impact on the economic analysis of each market not having to compromise (by increasing the compromise on the other market):

- For the freight priority bookend, this removes the capacity constraint on freight services and sees the exclusion of additional Southern Line metro service capacity until 4-tracking south of

Westfield is delivered. This increases freight benefits and reduces metro passenger benefits (with a corresponding reduction in operating costs).

- For the metro priority bookend, this sees a reduction in available freight slots on the NIMT, which allows the CS1 service pattern to be implemented earlier (additional Southern Line peak capacity). This increases metro passenger benefits and operating costs and reduces the potential benefits that can be realised from freight.

Appendix I provides additional technical detail on how these two bookend scenarios have been modelled.

Avondale-Southdown early works

A sensitivity test was run with the A-S early works deferred from the early part of the programme in the base phasing (to tie in with delivery of CC2M through the corridor) to late in the programme when the main A-S works are scheduled in the 2040s. This deferral of cost reduces the present value of the early works and thus increases the overall BCR of the programme.

Assumption sensitivities

Finally, a lower and upper bound sensitivity test is undertaken for a number of more minor assumptions used in the economic analysis. The changes to each of these input assumptions are discussed below and summarised in Table 3-30:

- Peak congestion – refers to the percentage of congestion related value (CRV) that is applied to the value of time from the MBCM in the peak period.
- Interpeak congestion – refers to the percentage of congestion related value (CRV) that is applied to the value of time from the MBCM in the interpeak period.
- Station amenity in-vehicle time (IVT) – refers to the number of IVT minutes that is adopted to reflect the benefits associated with the station upgrade programme.
- Ex-bus reliability – refers to the assumed level of average minutes late that is adopted to generate a journey time reliability benefit for passengers that shift mode from bus (in the Do Min) to rail (in the option). The sensitivity test moves 2 minutes either side of the base assumption 5 minutes.
- Rail service punctuality – refers to the equivalent minutes saved from increased punctuality. The Auckland One Rail KPI is simply within 5 minutes (or not), meaning the actual variance could be much higher. The base case adopts a 5-minute improvement, and the sensitivity tests use 3 minutes lower/higher than this.
- Seated benefits – this is based on the analysis undertaken in the EMU Batch 3 business case, which used a fleet of 72 EMUs as the basis for the assessment (assuming all units (excluding spares) in service in the peak periods). Given Batch 3 forms part of the Do Min, i.e. a fleet of 95, we scale up this benefit in the upper bound test by 32% (95/72 -1) to reflect a larger fleet and therefore the potential to have more people standing in the Do Min.

The resulting BCRs (excluding WEBs) associated with the range of sensitivity tests are presented below along with the change in input variable(s) that is(are) being sensitivity tested.

Table 3-30 Sensitivity analysis summary[142]

SENSITIVITY TEST	LOWER		BASE BCR = 1.0 (EXCL. WEBS)	UPPER	
	INPUT	BCR	INPUT	INPUT	BCR
Discount rate	6%	0.79	4%	3%	1.2
Evaluation period	40 yrs	0.86	60 yrs	80 yrs 100 yrs	1.1 1.2
Metro patronage	-20%	0.97	Base case	+20%	1.1
Inter-regional (H2A) patronage	0%	1.0	+10%	+20%	1.0
Freight demand	Scen. A	0.84	Scen. B1	Scen. D	1.2
Freight benefit area	Golden Triangle	1.0	All	-	-
Carbon price	Low	1.0	Middle	High	1.0
VKT estimation approach	-	-	MSM-based	VKT-adjusted	1.1
Second round impacts	0%	0.98	10%	15%	1.1
WEBs	-	1.0	Excluded *(BCR incl. WEBs = 1.2)*	35%	1.2
Costs	P95 capex, R&O +10%	0.84	Base case	Base case minus 10%	1.2
Prioritisation bookends	Metro priority	1.0	Base case	Freight priority	1.1
Avondale-Southdown early civil works to align with ALR	-		Base phasing	Deferred	1.1

[142] Source: PwC analysis

SENSITIVITY TEST	LOWER		BASE BCR = 1.0 (EXCL. WEBS)	UPPER	
	INPUT	BCR	INPUT	INPUT	BCR
Assumption sensitivities		0.96			1.1
Peak congestion	75%		100%	100%	
Interpeak congestion	0%		10%	25%	
Station amenity IVT	2 min		3 min	3 min	
Ex-bus reliability	3 min		5 min	7 min	
Rail service punctuality	2 min		5 min	8 min	
Seated benefit	-		-	+32%	

The results of the various sensitivity tests generally show that a change to one of the variables/factors has a modest, or in many cases negligible, impact, suggesting the programme is relatively resilient to change in individual areas of influence. A combination of changes would amplify the impacts, but the overall effect is dependent on which factors change. The more impactful sensitivity tests are discussed below:

- A 20% reduction in metro passenger benefits, as a proxy for patronage, moves the BCR (excl WEBs) to just below 1.0. As discussed in the earlier commentary, delays to population growth in the southern growth area, as signalled in Auckland Council's draft FDS could contribute to a lower than forecast level of demand. When combined with the possibility of lingering effects of COVID-19 on travel behaviours and the rail network rebuild, a reduction of 20% would appear to be a feasible possibility. However, that is expected to be offset by exogenous effects to incentivise mode shift as a climate change response. These effects would be expected to more than offset any of the downside impacts, resulting in a net increase in the economic benefits from the recommended programme.
- If freight demand does not materialise to the levels envisaged in freight demand scenario B1 (the base case), then the sensitivity test using freight demand scenario A highlights the reduction in benefits that could materialise, leading to a BCR of 0.84. This reduction in benefits of approximately 20% suggests material sensitivity. However, demand that materialises over time would provide signals to adjust the timing of delivery of some of the interventions. This would potentially delay some investment, to counter the impacts of lower demand on the economic assessment. This means the resulting BCR under that future would be higher than indicated above, as some cost would not be being incurred (reducing the denominator in the calculation), leading a BCR closer to 1.0 (excl. WEBs). On the other hand, there is the potential that additional freight mode shift to rail occurs, which freight demand scenario D represents. Under this outcome, the upside in economic benefits is also material, leading a BCR of 1.2 (excl. WEBs). This supports the assertion that any additional rail freight demand that can be achieved is beneficial, and under the recommended programme there is the capacity to accommodate it once the 4-tracking south of Westfield is complete.

- When the P95 capital cost estimates are used and renewals and operating costs are increased by 10%, the BCR reduces to 0.84. This presents a pessimistic scenario where every project within the recommended programme goes over 'budget' and utilises nearly all the included contingencies. Across a programme of >100 individual projects, this would be unlikely, and as such the result of this test is probably overstating the overall sensitivity of the analysis to higher costs.
- The prioritisation bookends tests show that the allocation of track slots between markets, and the necessary compromises until the 4-tracking is delivered south of Westfield, will have a relatively minor impact on the benefits that can be realised.
  - Prioritising freight (over metro passenger services) generates slightly more net benefits and a higher (more positive) NPV. This occurs because the additional benefits from the freight services (~$1,150m PV) are greater than the metro passenger benefits foregone (less than $50m PV), at the same time as reducing metro service operating costs slightly (due to the removal of the services). The BCR (excl. WEBs) does not change (due to rounding to 1dp), but there is an increase in the overall NPV of around $1,200m (overall NPV is $1,800m).
  - At the other bookend, prioritising metro passenger services (over freight services) generates a slightly poorer economic outcome overall. The additional metro passenger benefits (~$600m PV) are higher than the freight benefits foregone (~$500m PV), but the additional operating costs associated with those services increases the overall PV of the costs. The overall impact is no change to the BCR (excl. WEBs) of 1.0 (at 1 decimal place), though the NPV reduces to only $50m overall.
  - The two bookends suggest that through those years when compromises between the rail markets are required (i.e. from the early 2030s to the early 2040s), allocating 'contested' slots to freight services would generate better economic outcomes. However, these decisions are complex and will need to include a range of other non-monetised factors such as customer impacts, timetable impacts etc.

3.4.4 RECOMMENDED PROGRAMME INVESTMENT ASSESSMENT PROFILE

Waka Kotahi's Investment Prioritisation Method (IPM) for the 2021–24 National Land Transport Programme (NLTP) has been used to determine the overall assessment profile for the recommended programme:

- GPS alignment: Very high
- Scheduling: Medium
- Efficiency: Low

Based on Figure 3 in the IPM document, this assessment profile leads to a priority order rating of 3.

The determination of each category rating is described below.

3.4.4.1 GPS ALIGNMENT

Proposed projects are compared against an investment prioritisation schedule for alignment with the Government Policy Statement on Land Transport 2021 (GPS). The schedule in the IPM contains the different GPS strategic priority areas and provides guidance on determining a rating within each area. Providing additional capacity for people to travel by rail, as well as improving their experience through reduced travel times meant that 'Better Travel Options' is the most appropriate strategic priority area for assessing the passenger-related aspects of the programme.

Improving freight connections is the most appropriate priority area for assessing the freight-related aspects of the programme.

The recommended programme delivers a near 10% increase in the number of jobs that can be accessed by PT within 45 minutes, which corresponds to a **very high** rating for GPS alignment.

The recommended programme will enable and deliver a 10% increase in rail mode share from the addressable freight market, from 16% in the Do Min to 26% with the improvements, which corresponds to a **very high** rating for GPS alignment under improving freight connections and climate change.

As both aspects of the programme generate a very high rating, we consider that the overall rating for the recommended programme is **very high** for GPS alignment.

Further to the above, a number of the major components of the recommended programme have been specifically identified as strategic priorities in the draft Government Policy Statement on Land Transport 2024 (Draft GPS 2024). The Strategic Investment Programme in the Draft GPS 2024 includes:

- Auckland third and fourth rail mains (Westfield – Pukekohe 4-tracking)
- Avondale to Onehunga rail link (Avondale – Southdown)
- Auckland level crossing removal programme.

3.4.4.2 SCHEDULING

There is a material interdependency between the recommended programme and CRL as CRL's ultimate capacity is dependent on most of the investment programme. Similarly, there is an interdependency between achieving ERP outcomes for freight and the recommended programme, as without the investment there will very limited ability to accommodate more freight on rail. There are also important interdependencies between the recommended programme and a number of projects currently underway, in that the programme relies on their completion (which are mostly scheduled to be complete in the 2021-24 NLTP period), primarily:

- Wiri to Quay Park Third Main
- Papakura to Pukekohe electrification, including the three new southern stations in this section of the network
- Te Tupu Ngātahi – Support Growth Alliance; the southern growth area is reliant on the rail network improvements to realise its planned growth over time
- Level Crossing SSBC
- Rail Network Rebuild
- Western Power Feed.

Further information on these interdependent projects is provided in Appendix F.

However, despite these important interdependencies, the timing of expected approval means that interdependency is not applicable as the 2021 NLTP period will be almost complete.

Given the timing of the recommended programme is to begin in the 2024 NLTP, with no proposed investment in the 2021 NLTP period, the criticality is considered to be **medium.** The recommended programme has a number of critical activities to be delivered in the 2024 NLTP period, namely:

- Takaanini level crossing removals so that Southern corridor capacity can be increased in the following NLTP period
- Upgrading the network signalling system to European Train Control System (ETCS) Level 2 to make the network ready to accommodate increased levels of traffic and deliver travel time improvements
- Delivery of new maintenance plant, equipment and depot(s) to allow an uplift in maintenance efficiency and output
- Route protection and some property acquisition for the Southern Corridor (Westfield – Pukekohe) and Western Corridor (level crossings)
- Preparation for and procurement of additional metro passenger rolling stock and depot given the long lead time for procurement and delivery to ensure metro capacity can be expanded by the early 2030s.

While these activities must get underway to ensure successful delivery of the time critical aspects of the programme, the assessment against the IPM for the 2021 NLTP gives the investment a **medium** rating for scheduling (based on criticality), as interdependency is not applicable given the timing of expected approval.

3.4.4.3 EFFICIENCY

The recommended programme has a BCR of 1.2 (including WEBs) or 1.0 (excluding WEBs), corresponding to a **low** efficiency factor using the investment prioritisation tables in the IPM (i.e. BCR between 1.0 and 2.9).

Through the sensitivity tests we have undertaken, the range of resulting BCRs is 0.79 – 1.2, which are all within the very low / low efficiency range.

4 FINANCIAL CASE

4.1 INTRODUCTION

This section provides a breakdown of the estimated funding requirements for the recommended programme across three categories of cost:

1 Capital costs (or capex)

2 Renewals:

(a) These relate to infrastructure, rolling stock and system renewal and replacement costs that generally occur periodically (especially in the case of rolling stock and most systems) to allow the assets to function at the necessary level for their useful/design lives.

3 Operating costs (or opex):

(b) For Auckland Transport (Auckland Transport), these relate to metro passenger service delivery and station operating costs.

(c) For KiwiRail, these relate to network management costs (including maintenance, control, inspections, technical support, and overall management).

Renewals are categorised separately due to the differing treatment by Auckland Transport (renewals are classed as capital expenditure) and KiwiRail (renewals are classed as operating expenditure).

Unless stated otherwise, all numbers in this section are expressed:

- in NZ dollars (NZD)
- in millions ($m)
- exclusive of Auckland Transport's indirect administration fee of 5.7%
- rounded to the nearest million.

Totals may not sum exactly due to rounding.

4.2 COMMITTED FUNDING

This section provides a summary of committed funding across the three categories of capex, renewals and opex for KiwiRail and Auckland Transport. This committed funding is excluded from subsequent sections of the Financial Case which deal with additional/new funding requirements.

4.2.1 CAPITAL PROJECTS

Auckland Transport and KiwiRail's capital projects with committed funding in place are summarised in Table 4-1 along with their budgeted costs through to completion over the next four years (FY24 – FY27), with most expected to be complete in FY26. These projects are all underway and will be complete, or substantially complete, by CRL Day 1.

Table 4-1 Capital projects with current funding commitments (excluding CRL)

	FY24	FY25	FY26	FY27	TOTAL (FY24-27)
KiwiRail	9(2)(i) - Commercial activities [redacted]				
Western Power Feed					
Wiri to Quay Park and 3rd main (W2QP)					
Integrated Rail Management Centre					
Papakura to Pukekohe electrification (P2P)					
Southern stations					
Progressive fencing					
Infill signals					
European Train Control System (ETCS) Level 2 (Business Case only)					
3rd/4th Main route protection (NOR only)					
Total – KiwiRail					
Auckland Transport					
Auckland Transport electric multiple unit (EMU) Batch 3 (23x 3-car units)					
Wiri EMU depot and stabling upgrades					
Pedestrian level crossing removal (x7)					
Church St East level crossing removal					
Total – Auckland Transport	100.5	180.9	45.1	5.0	331.5
Grand total	436.4	473.4	237.9	5.0	1,152.8

In addition to the projects above, CRLL is currently delivering the broader CRL project which includes CRL itself, 3rd platforms at both Otahuhu and Henderson stations, and the Strand and Newmarket crossovers.

Further to these projects with committed funding, the project partners acknowledged that some investment will be required in infrastructure maintenance plant and equipment to support a step change in maintenance and renewals levels and delivery methods to improve network reliability and reduce disruption from track works, regardless of the recommended programme. However, while it is agreed to be necessary, the funding for this investment is not committed and so is included in the subsequent sections relating to funding requirements.

4.2.2 RENEWALS

KiwiRail is currently delivering the RNR/RNGIM programme that has $171m of committed funding for FY24 (inclusive of the recent cost-scope adjustment of $75m). A further $159m will likely be requested for FY25 and FY26, but this is not currently funded. An extension of the RNR has been signalled as being required, with an estimated cost of some $410m (2024$, or $468m in nominal terms) to be spent between FY25-FY34, though no funding is currently committed.

For Auckland Transport, rail-related renewals with committed funding at the time of writing are minimal. There is $1.5m for minor EMU renewals over FY24 and FY25, plus $2.7m in FY24 for other rail renewals (stations etc).

A summary of the renewals for the two organisations with committed funding is provided in Table 4-2.

Table 4-2 Renewals with current funding commitments[143]

	FY24	FY25	FY26	FY27	TOTAL (FY24-27)
KiwiRail					
Catch up renewals (RNR / Rail Network Growth Impact Management (RNGIM))	9(2)(i) - Commercial activities [redacted]				
Renewals					
Auckland metro recovery					
Total – KiwiRail					
Auckland Transport					
Rolling stock					
Other rail					
Total – Auckland Transport					
Grand total	182.6	0.8			183.3

4.2.3 OPERATING COSTS

At the time of writing, funding commitments only exist for FY24 for both Auckland Transport ($195m) and KiwiRail ($5m – per the agreed Auckland Network Access Agreement (ANAA) budget). Beyond that (FY25 onwards), forecast operating costs are included in the programme costs to present the full picture of funding requirements. Note that from CRL Day 1 onwards, the forecast operating costs (in the absence of the recommended programme) would be expected to represent the minimum investment required to operate the network for the CRL Day 1 timetable.

4.3 COST ESTIMATION SUMMARY

This section provides a summary of how the different cost components of the recommended programme have been estimated.

[143] Source: KiwiRail and AT (as at August 2023)

4.3.1 CAPITAL COSTS

The approach to estimating the capital costs is summarised below and detailed in the Capital Cost Report which is attached in Appendix K.

4.3.1.1 COSTING GENERAL PRINCIPLES

Overall, the capital cost estimates used the following inputs:

- Instructions and guidelines in SM014 – Cost estimation manual (Waka Kotahi, 2021).
- Initial studies including outline conceptual designs and sketches aiming to depict the main characteristics of the proposed interventions for the vast majority of the proposed projects (e.g., 4-tracking Westfield – Pukekohe and level crossing removal).
- Parametric assessments using the results of the above studies for other projects (e.g., 4-tracking from Papakura to Pukekohe, Avondale Junction grade separation and additional capacity Wiri-Westfield).
- Asset working papers.
- Up-to-date requirements in accordance with the applicable standards and regulations.
- Previous studies undertaken by third parties.
- Inputs provided by KiwiRail and/or Auckland Transport.

The base year rates from June 2023 have been used for preparing the cost estimates. As an exception, the estimates for Avondale – Southdown are based on the cost report provided by Tonkin and Taylor (prepared in 2020) and inflated by 15% to bring the cost estimate in line with a base date of June 2023.

4.3.1.2 CAPITAL COST ESTIMATE COMPONENTS

The components within the capital cost estimate follow Waka Kotahi's SM014 manual as depicted in Figure 4-1 below.

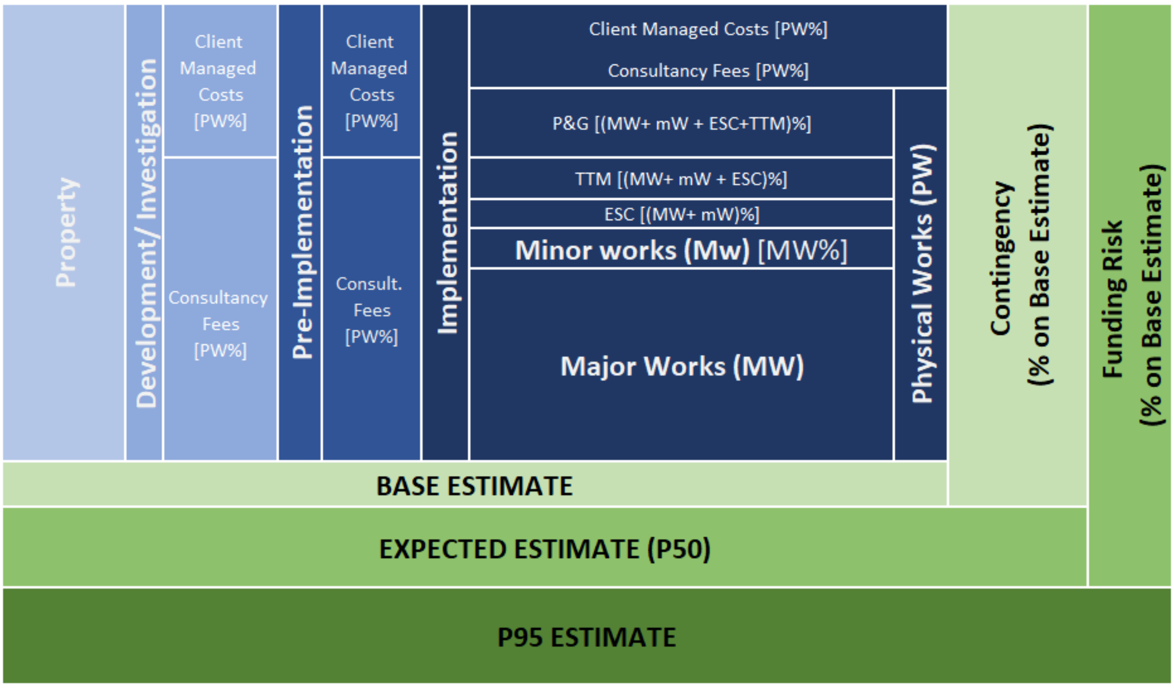

Figure 4-1 SM014 cost estimation components

4.3.1.2.1 PROPERTY

Costs estimates for property include gross acquisition costs of full sections when buildings are affected. No allowance was made for future surplus land disposal revenue for the following reasons:

- Detailed analyses regarding the impacts of a partial acquisition on the usability of the remaining parts of the property (e.g., access, parking lots, relocation of utilities, needs for consolidation, or other structural interventions) have not been undertaken, and are to be included in the next phase of the individual projects.
- Including gross costs provides a conservative approach, consistent with the low level of design and construction methodology details, which are appropriate for a PBC. This level of detail does not allow for a clear definition of the required property acquisition borders.

4.3.1.2.2 CONSULTANCY FEES AND CLIENT MANAGED COSTS

Consultancy fees and client managed costs are based on Auckland Transport's guidelines, extrapolated to reflect the high value of some of the projects in the programme, which fall outside of the Auckland Transport guidelines (i.e., greater than $500m in capital value).

4.3.1.2.3 PHYSICAL WORKS

The cost components included in the physical works estimates are summarised in Table 4-3.

Major costs represent identified high-cost items in the recommended programme. The methodology for quantifying the major cost for each asset type and project is detailed in the Capital Cost Report in Appendix K.

Minor costs represent a factor for 'minor works' which was applied to the major costs to cater for costs associated with smaller elements ("known unknowns"). The percentage used for each minor costs were dependant on the cost of the priced major costs, and the extent of minor works expected to be required. Further details are included in the Capital Cost Report in Appendix K.

Table 4-3 Physical works components

COST COMPONENT	PHYSICAL WORKS BASE PERCENTAGE
Major costs	As detailed in the cost model
Minor costs	0%, 25% or 35% x [major costs]
Environmental Statutory Compliance (ESC)	2% x [major costs +minor costs]
Temporary Traffic Management (TTM)	6% x [major +minor + ESC costs] or calculated based on a detailed build-up
Preliminary and General (P&G)	30% x [major + minor + ESC + TTM]

Disruption management costs are also included in the cost estimates. These have been globally estimated based on actual figures for similar interventions, and include provisions for:

- rail service replacements (mainly buses)
- signs, communication, and publicity
- management and other resources for transition stages.

4.3.1.2.4 CONTINGENCY

As outlined in the Waka Kotahi Cost SM014 Manual, risk and contingency represent financial provisions added to the Base Estimate to provide for uncertainty in relation to the estimate inputs and specific project related threats and opportunities.

- Contingency represents an addition to the Base Estimate, to provide for uncertainties in relation to specific project risks and opportunities, resulting in the “most likely” value (or “Expected Estimate”).
- Funding Risk represents supplementary provisions to cover unidentified risks (“unknown unknowns”). This is added to cover the difference between the statistical mean and statistical 95th percentile value.

The range of percentage contingencies applied in the capital estimates are summarised in Table 4-4, with additional detail and discussion included in the Capital Cost Report in Appendix K.

Table 4-4 Physical works contingency summary

COST COMPONENT	CONTINGENCY (50^{TH})	FUNDING RISK (95^{TH})
Property	15%	25%
Professional fees and client costs	10% - 20%	10% - 15%
Physical works	30% - 60%	10% - 50%

4.3.2 RENEWALS

To estimate the change in renewal spend because of the investment in the recommended programme, the forecast renewals discussed below for the existing network are used as the input across KiwiRail and Auckland Transport's renewal categories and then factored accordingly[144]. This factoring process was developed in conjunction with KiwiRail and Auckland Transport and is considered appropriate for PBC-level analysis.

4.3.2.1 INPUT RENEWAL FORECASTS

KiwiRail's forecast renewals costs for the next 30 years cover the periodic renewal of network infrastructure and systems and are based on KiwiRail's renewals forecasts to continue to support the CRL Day 1 timetable (i.e., the forecast does not include the impacts of the recommended programme). This forecast is $1.17b (2023$) in total, with an average spend of around $37m per year. This level of renewal spend is not committed or currently funded, but is considered to represent the minimum level of investment required.

For Auckland Transport, forecast renewal costs cover rail station-related renewals, EMU depot and stabling, and the periodic (~10 yearly) overhaul and refurbishment of its EMU fleet (which will be 95 units by CRL Day 1). The 10-year forecast (i.e., the amount submitted to the draft 2024-34 RLTP) is $173m (2023$) or just over $17m per year on average. As with KiwiRail's forecast renewals, this is not committed, but is considered to represent the minimum level of investment required.

Auckland Transport's replacement of the Batch 1 EMUs (the original fleet of 57 units) is planned in the early 2050s, with a total estimated cost of $655m (2023$). Around one third of that cost is assumed in the final year of the 30-Year programme. This reflects a spreading of total replacement cost over a few years prior to replacement.

4.3.2.2 ESTIMATION PROCESS

The process and assumptions for estimating a revised forecast as a result of the recommended programme are summarised below in Table 4-5 for KiwiRail's renewals and Table 4-6 for Auckland Transport's renewals.

[144] Neither KiwiRail or AT's current renewals forecast have committed funding beyond FY24, however they represent the minimum required investment going forward and would be expected to be funded through continuous programmes.

Table 4-5 KiwiRail renewal estimation

RENEWAL CATEGORY	FACTORING APPROACH
Track Traction Civil	Track and traction renewals would increase proportionally with increase in network length and increased tonnage (train frequency). For civil renewals, only network length applies as new track formation and drainage will be designed for higher axle loadings (tonnage). A lag period is applied to the increase in renewal spend for these assets to reflect renewals not being required for some time after delivery, especially for new investment in civil assets.
Signalling	Implementing ETCS L2 is expected to reduce signalling renewal requirements as a portion of wayside signals will no longer be needed. A 25% reduction has been estimated for forecasting purposes and is applied once ETCS L2 is in place. The removal of level crossings will reduce the complexity of signalling equipment and renewals in the vicinity as a considerable portion of signal maintenance (and by inference renewals) relates to the level crossings. In combination with ETCS L2, the reduction in renewal spend is estimated to be in the order of 50% compared to the current forecast. The other impact on the forecast signalling renewals would be the removal of the ~$50m signalling system replacement cost in year 30 of KiwiRail's current renewal forecast, as this would not be required given the capital investment in ETCS L2 as part of the preferred programme.
Telecommunications	As a result of moving to ETCS L2, there would be an expected increase in telecommunications renewals given the nature and requirements of that system. A 50% increase in telecommunications renewals spend once that system change occurs is adopted to forecast the spend in this category.
Structures Electrical	Renewals for these two categories are unchanged from the current forecast for the following reasons: • Major structures (e.g., bridges) delivered as part of the investment programme are unlikely to have substantive renewal requirements given their long design lives, especially within the 30-Year view of the programme. • Electrical renewals represent less than 1% of overall renewals and would not be expected to increase substantially with network length or other changes.

Table 4-6 Auckland Transport renewal estimation

RENEWAL CATEGORY	FACTORING APPROACH
Rolling stock	As Auckland Transport's EMU fleet expands, there will be a requirement to undertake periodic overhaul and refurbishment of the new trains. The same assumptions used in developing the current rolling stock renewal forecast are applied to the new fleet purchases, i.e. renewal cost being incurred every ~10 years from entry into service. Replacement occurs after ~35 years, though for the new fleet purchases in the investment programme this would occur outside the 30-Year programme period (but it is included in the economic analysis).
Depot and stabling	The average annual depot renewal cost from the current forecast is used as a proxy for the annual renewal cost for the new EMU depot once it is completed. A similar approach is used for stabling, but future costs are linked to the increase in fleet size as a proxy. The average annual stabling renewals from the current forecast are factored up by the increase in fleet size over time as a proxy for the expected increase in renewals requirements. The additional renewal costs are lagged by an assumed 10 years following completion to reflect the delay until renewals are likely to be required.
Rail station-related	Rail station-related renewals from the current forecast are assumed to double as a result of the station upgrades delivered as part of the programme. The current forecast renewal costs are increased over time by the proportion of the overall station upgrade spend within each configuration state. The additional renewal costs are lagged by an assumed 10 years following completion to reflect the delay until renewals are likely to be required. Rail station-related renewals are scaled further to reflect the increase in the number of stations that occurs when the new Avondale-Southdown stations are added in the final year of the programme.

4.3.2.3 RNGIM / RNR FUNDING REQUIREMENTS

As discussed earlier, KiwiRail will likely seek a further $159m for RNGIM/ RNR over FY25 and FY26, with a further extension signalled as being required. That extension has an estimated cost of some $410m (2024$, or $468m in nominal terms) in total between FY25-FY34. No funding is currently committed for either of these amounts. The extension of the RNGIM/RNR is required to address the necessary catch-up renewals across the rest of the network, which is estimated to cover roughly an additional third of the network (the remaining network has yet to be assessed, but given geology is considered less likely to need remediation). It is required to ensure that Auckland avoids the types of impacts currently being experienced as a result of underinvestment in required renewals (i.e. widespread closures and sustained degradation of service delivery). As no funding commitment currently exists, these costs are included in the required renewal funding forecast as a known gap, even though they will be progressed separately to the recommended programme (with the costs included in the Do Min in the Economic Case).

4.3.3 OPERATING COSTS

Operating costs cover ongoing metro service delivery, and network operations and maintenance, as forecast by Auckland Transport and KiwiRail.

Auckland Transport's operating costs are broken into the following categories:

- Track access charges (per the principles in the ANAA)
  (note this becomes a revenue for KiwiRail to fund operating and renewal costs)
- Rolling stock and management (covers rolling stock related costs including depot, stabling, service operations and staffing – predominantly costs relating to the current operator being Auckland One Rail)
- Station operations (split into three categories to cover Waitematā (Britomart), other network stations, and CRL stations (once they come online)).

KiwiRail's operating costs cover the following categories:

- Management costs
- Technical support
- Inspections
- Maintenance
- Network Control.

4.3.3.1 ESTIMATION PROCESS

To estimate the change in operating costs because of the investment in the recommended programme and the additional services that are provided, current budget forecast operating costs for FY23-FY25 are used as the input and then factored/scaled accordingly. This process was developed in conjunction with KiwiRail and Auckland Transport and is considered appropriate for PBC-level analysis.

KiwiRail's operating costs across the five categories are estimated to increase in response to four cost drivers, being tonnage, track/network length, rail service unit-km (RSUK) and number of services.

The relationship between each cost category and each cost driver was developed by KiwiRail for the purposes of the PBC and is shown below in Table 4-7. The elasticities are shown for a 50% increase in each cost driver.

The change in each of these cost drivers comes from the modelling undertaken on the recommended programme over time, establishing a timeseries for each driver, for example the network tonnage each year, or total RSUK each year across metro and inter-regional passenger services.

Table 4-7 KiwiRail operating cost category elasticity[145]

OPERATING COST CATEGORY	COST DRIVER (BASED ON A 50% INCREASE)			
	Tonnage	Track length	RSUK	Services
Management costs	5%	20%	5%	0%
Technical support	5%	20%	5%	0%
Inspections	15%	50%	25%	0%
Maintenance	25%	25%	25%	0%
Network control	0%	15%	0%	35%

Auckland Transport's operating costs have been aggregated up to two categories – those related to the delivery of metro passenger services (referred to as 'rolling stock and management') and those related to stations. In consultation with Auckland Transport, five cost drivers have been used to forecast Auckland Transport's operating costs over time, using the FY23 budget[146] (discussed earlier) to effectively derive a unit cost per cost driver that is used as the basis of estimating future costs. The five cost drivers are summarised in Table 4-8 below.

Table 4-8 Auckland Transport operating cost categories and drivers

OPERATING COST CATEGORY	COST DRIVER	USAGE
Rolling stock and management	Metro passenger service RSUK	Used to estimate service delivery related costs
	Number of EMU depots	Used to determine depot-related operating costs
	Size of the EMU fleet	Used as a proxy for operating costs associated with stabling
Stations	Number of stations (by type)	Used to determine total annual station operating costs
	Station upgrade programme	The station upgrade programme is assumed to double station operating costs (excluding Waitematā and CRL), on average. The portion of overall investment in each configuration state scales up Auckland Transport's station operating costs accordingly.

[145] Source: KiwiRail

[146] Plus AT's estimate of the future operating costs associated with the CRL and new southern stations.

A timeseries for each of the cost drivers comes from the recommended programme, where annual RSUK is calculated from the service specifications (including train length) for each configuration state.

As the recommended programme upgrades the current rail stations, additional operating costs are incurred progressively as that upgrade programme is rolled out, up to a doubling of station operating costs. Note that there is no impact on Waitematā (Britomart) and the CRL stations as their operating costs are not expected to change given they do not undergo upgrades that would materially change these costs. The addition of the new stations as part of the Avondale-Southdown project in the final year of the programme further increases station operating costs once those stations come online.

4.3.4 AUCKLAND NETWORK ACCESS AGREEMENT COSTS

KiwiRail charges users of the Auckland rail network for access, under the principle of recovering its costs of operating and maintaining the network (including renewals). The individual user charges are intended to reflect the user's contribution to those costs. The detailed calculation is complex, but it effectively reflects usage (a combination of the number of services operating and tonnage).

Auckland Transport currently pays Auckland Network Access Agreement (ANAA - alternatively referred to as Track Access Charges (TACs)) costs to KiwiRail for access to the network to operate its metro passenger services.

Network operating and renewals costs are forecast to increase substantially under business-as-usual operation, regardless of the recommended investment programme, to address the historical underspend in these areas. Costs will increase further in response to additional services being operated (e.g., higher maintenance and network control costs). This will lead to increases in ANAA costs for users of the network (principally Auckland Transport and KiwiRail freight services) under the principle of full cost recovery.

Auckland Transport's usage of the network, as it relates to ANAA costs, is around 75% currently (advised by KiwiRail). As metro passenger services increase throughout the programme, so too does Auckland Transport's share of usage, to around 85% by Configuration State 1. This level of usage (i.e. 85%) stays fairly constant thereafter. The increasing share of usage compounds the increase in ANAA costs for Auckland Transport, which are presented later in the Financial Case.

For the purposes of this PBC, indicative ANAA costs for Auckland Transport (and therefore revenue for KiwiRail) are based on Auckland Transport's estimated 75%-85% usage of the network and the cost recovery principle discussed above.

It is acknowledged that actual future ANAA costs will be subject to further commercial negotiations, which are outside the scope of this PBC. However, inability of users (including Auckland Transport) to meet ANAA costs has flow on implications for KiwiRail's ability to deliver the necessary level of maintenance and renewal activity under the current funding arrangements.

4.3.5 ESCALATION

Future capital and renewals costs are escalated using the horizontal construction index forecast until FY30, and then 2.5% per annum beyond that.

Future operating costs are escalated by forecast consumer price index (CPI), using NZIER's forecast for the next 10 years and the Reserve Bank of NZ's long term inflationary estimate (mid-point) beyond that.

4.4 PROGRAMME COSTS

This section outlines the total cost associated with the recommended programme, beyond what is already committed (covered in Section 4.2).

As discussed previously in the Strategic Case, the programme spans the defined period of 2021 – 2051 (i.e., FY22 – FY51). However, for the purposes of the Financial Case we only present FY25 (i.e. the first financial year of spend/funding required) onwards and do not include historical costs. This means that while the 'Decade 1' heading shows FY22-31, it actually only incorporates costs from FY25-31.

Costs in this section are presented in the follow ways:

- For tables:
  - Annual costs are presented for the first 10 years (i.e., FY25-FY34), which aligns with the Regional Land Transport Plan (RLTP) (2024-34) period
  - Costs are summarised for each of the three decades of the programme (i.e. FY22-FY31, FY32-FY41, FY42-FY51)
  - Grand total costs reflect the entire programme (i.e. FY22-FY51 – noting that spend is only forecast from FY25 onwards)
  - Costs are summarised for FY25-FY27 (i.e., the sum of those annual cashflows) for comparison with costs in the upcoming National Land Transport Programme (NLTP) (2024-27) and Rail Network Investment Programme (RNIP) (2024-27) periods
  - Costs are summarised for FY25-FY34 (i.e. the sum of those annual cashflows) for comparison with costs in the upcoming RLTP (2024-34) period
  - Escalation is **included** as a separate line item in all tables that are presented.
- For graphs/charts:
  - Annual costs are presented for FY25-FY51, split into the relevant categories for the specific chart (e.g. owner organisation, cost breakdown etc)
  - Escalation is **excluded** from the charts presented in this section, which present the real cashflows. Equivalent versions of all charts with escalation included are presented in Appendix L.
  - Auckland Transport's indirect administration fee of 5.7% is **excluded** from this section but discussed later in Section 4.6.1.1, when funding breakdowns are presented.
  - The allocation between organisation is based on the expected responsibilities agreed through the development of the cost estimates.

As noted earlier, the costs presented in this section represent additional/new funding requirements beyond what is currently committed (i.e., **committed costs are excluded from this section**).

4.4.1 SUMMARY

Estimated cost summaries for the recommended programme across capital, renewals and operating costs are shown below in Figure 4-2 (P50 capital costs), Table 4-9 (P50 capital costs) and Table 4-10 (P95 capital costs). The summary of costs is also shown by organisation (using the P50 capital costs) in Table 4-11 for Auckland Transport and Table 4-12 for KiwiRail. Summary tables by organisation using the P95 capital costs are included in Appendix L.

Figure 4-2 Recommended programme cashflow (P50 capital costs, real)[147]

9(2)(i) - Commercial activities

[redacted]

A similar summary chart using the P95 capital cost estimates is included in Appendix L.

[147] Source: PwC analysis

Table 4-9 Recommended programme cost estimate (P50 capital costs)[148]

Total funding required ($m) By spend category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Total capex	[redacted] 9(2)(i) - Commercial activities															
Total renewals																
Total opex																
Total funding required (real)																
Escalation																
Total funding required (nominal)	**500**	**642**	**819**	**1,230**	**1,800**	**1,810**	**2,312**	**2,430**	**1,613**	**1,794**	**9,809**	**20,408**	**23,870**	**54,087**	**1,960**	**14,951**

Table 4-10 Recommended programme cost estimate (P95 capital costs)[149]

Total funding required ($m) By spend category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Total capex	[redacted] 9(2)(i) - Commercial activities															
Total renewals																
Total opex																
Total funding required (real)																
Escalation																
Total funding required (nominal)	**510**	**666**	**890**	**1,471**	**2,239**	**2,266**	**2,905**	**3,040**	**1,891**	**2,110**	**11,642**	**24,488**	**28,628**	**64,758**	**2,066**	**17,987**

[148] Source: PwC analysis

[149] Source: PwC analysis

Table 4-11 Recommended programme cost estimate - Auckland Transport (P50 capital costs)[150]

Auckland Transport funding required ($m) By spend category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Total capex	[redacted] 9(2)(i) - Commercial activities															
Total renewals																
Total opex																
Total funding required (real)																
Escalation																
Total funding required (nominal)	**295**	**382**	**535**	**661**	**998**	**1,009**	**1,022**	**1,227**	**796**	**847**	**5,339**	**10,530**	**15,190**	**31,059**	**1,212**	**7,772**

Table 4-12 Recommended programme cost estimate - KiwiRail (P50 capital costs)[151]

KiwiRail funding required ($m) By spend category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Total capex	[redacted] 9(2)(i) - Commercial activities															
Total renewals																
Total opex																
Total funding required (real)																
Escalation																
Total funding required (nominal)	**205**	**259**	**285**	**569**	**802**	**801**	**1,291**	**1,203**	**817**	**947**	**4,469**	**9,878**	**8,681**	**23,028**	**748**	**7,178**

[150] Source: PwC analysis

[151] Source: PwC analysis

4.4.2 CAPITAL COSTS

Capital costs for the recommended programme, beyond what is already committed, are broken down by organisation (based on the current allocation of responsibilities between KiwiRail and Auckland Transport) in Figure 4-3, Table 4-13 (P50) and Table 4-14 (P95).

9(2)(i) - Commercial activities

[redacted]

Figure 4-3 Capital cost cashflow (P50, real)[152]

A similar chart using the P95 capital cost estimates is included in Appendix L.

[152] Source: PwC analysis

Table 4-13 Capital cost estimate by organisation (P50)[153]

Capex funding required ($m) By organisation	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport capex	[redacted] 9(2)(i) - Commercial activities															
KiwiRail capex																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)	**79**	**173**	**403**	**816**	**1,333**	**1,375**	**1,841**	**1,801**	**950**	**1,097**	**6,020**	**13,569**	**10,972**	**30,560**	**655**	**9,868**

Table 4-14 Capital cost estimate by organisation (P95)[154]

Capex funding required ($m) By organisation	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport capex	[redacted] 9(2)(i) - Commercial activities															
KiwiRail capex																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)	**90**	**197**	**473**	**1,056**	**1,772**	**1,830**	**2,434**	**2,411**	**1,227**	**1,413**	**7,853**	**17,649**	**15,729**	**41,231**	**760**	**12,904**

The capital costs for the recommended programme have also been broken down by asset category and phase (including property acquisition estimates) and are presented below. Table 4-15 and Table 4-16 summarise the asset category breakdown for the P50 and P95 estimates respectively.

Table 4-17 and Table 4-18 summarise the breakdown by phase (in total and by organisation) for the P50 and P95 estimates respectively. The phases are consistent with the definition in Waka Kotahi's SM014 manual.

Note that property acquisition costs for the programme are assigned to KiwiRail, except the costs associated with additional property acquisition that is required for level crossing removals, which are assigned to Auckland Transport. This allocation is subject to the following clarifications, where financial responsibilities will be confirmed as Auckland Transport and KiwiRail progress business cases and designs for these projects:

- Rail station land. For the purposes of this PBC, all land costs for station expansion have been allocated to KiwiRail.
- New EMU depot and stabling land. For the purposes of the PBC, all land costs associated with new depots and stabling for EMUs have been allocated to KiwiRail.

[153] Source: PwC analysis

[154] Source: PwC analysis

Table 4-15 Capital cost estimate by asset category (P50)[155]

9(2)(i) - Commercial activities

Capex funding required ($m) By asset category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Maintenance plant and equipment	[redacted]															
Stations (new)	[redacted]															
Platforms	[redacted]															
Signalling, Telecomms, Network Control	[redacted]															
Traction power system	[redacted]															
EMU rolling stock	[redacted]															
EMU depots and stabling	[redacted]															
Regional Services stabling	[redacted]															
Level crossing removal	[redacted]															
Station improvement	[redacted]															
Maintenance depots and access	[redacted]															
Track	[redacted]															
Disruption management charges	[redacted]															
Programme level studies and investigations	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	79	173	403	816	1,333	1,375	1,841	1,801	950	1,097	6,020	13,569	10,972	30,560	655	9,868

Table 4-16 Capital cost estimate by asset category (P95)[156]

9(2)(i) - Commercial activities

Capex funding required ($m) By asset category	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Maintenance plant and equipment	[redacted]															
Stations (new)	[redacted]															
Platforms	[redacted]															
Signalling, Telecomms, Network Control	[redacted]															
Traction power system	[redacted]															
EMU rolling stock	[redacted]															
EMU depots and stabling	[redacted]															
Regional Services stabling	[redacted]															
Level crossing removal	[redacted]															
Station improvement	[redacted]															
Maintenance depots and access	[redacted]															
Track	[redacted]															
Disruption management charges	[redacted]															
Programme level studies and investigations	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	90	197	473	1,056	1,772	1,830	2,434	2,411	1,227	1,413	7,853	17,649	15,729	41,231	760	12,904

[155] Source: PwC analysis

[156] Source: PwC analysis

Table 4-17 Capital cost estimate by phase (P50)[157]

Capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation																
Property																
Implementation																
Physical works																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)	**79**	**173**	**403**	**816**	**1,333**	**1,375**	**1,841**	**1,801**	**950**	**1,097**	**6,020**	**13,569**	**10,972**	**30,560**	**655**	**9,868**

Auckland Transport capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation																
Property																
Implementation																
Physical works																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)	**23**	**46**	**182**	**313**	**593**	**637**	**619**	**669**	**206**	**227**	**2,414**	**4,094**	**2,781**	**9,288**	**251**	**3,516**

KiwiRail capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation																
Property																
Implementation																
Physical works																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)	**56**	**127**	**220**	**503**	**740**	**738**	**1,222**	**1,131**	**744**	**870**	**3,606**	**9,475**	**8,191**	**21,272**	**404**	**6,351**

[157] Source: PwC analysis

Table 4-18 Capital cost estimate by phase (P95)[158]

Capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation	[redacted]															
Property	[redacted]															
Implementation	[redacted]															
Physical works	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	**90**	**197**	**473**	**1,056**	**1,772**	**1,830**	**2,434**	**2,411**	**1,227**	**1,413**	**7,853**	**17,649**	**15,729**	**41,231**	**760**	**12,904**

Auckland Transport capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation	[redacted]															
Property	[redacted]															
Implementation	[redacted]															
Physical works	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	**25**	**52**	**211**	**422**	**793**	**859**	**840**	**914**	**279**	**305**	**3,202**	**5,467**	**3,838**	**12,506**	**288**	**4,699**

KiwiRail capex funding required ($m) By phase	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Investigation	[redacted] 9(2)(i) - Commercial activities															
Pre-implementation	[redacted]															
Property	[redacted]															
Implementation	[redacted]															
Physical works	[redacted]															
Total capex funding required (real)	[redacted]															
Escalation	[redacted]															
Total capex funding required (nominal)	**64**	**146**	**262**	**635**	**979**	**971**	**1,594**	**1,496**	**949**	**1,108**	**4,651**	**12,183**	**11,891**	**28,725**	**472**	**8,204**

[158] Source: PwC analysis

4.4.3 RENEWALS

Renewals costs for the recommended programme, additional to those committed renewals, are shown over time in Figure 4-4 below and broken down by organisation in Table 4-19. Estimated ANAA costs to Auckland Transport (revenue to KiwiRail) are included given they are intended to contribute to renewals as well as operating and maintenance costs.

As discussed earlier, most of the required funding represents a minimum investment scenario (i.e., renewals associated with the current network), as renewals associated with the new capital investment in the recommended programme are fairly modest to FY51. For example:

- the large spike in renewals for Auckland Transport in FY51 is the beginning of the replacement of the Batch 1 EMUs (i.e. the initial fleet of 57 units)
- the substantial activity for KiwiRail ($50m - $100m per year) between FY25 -FY34 is the catch-up renewals programme (RNR completion and extension) that is required regardless of further capital investment.

The consequential renewals associated with the new capital investment programme for KiwiRail generally occur far beyond 2051 (as discussed earlier in Section 4.3.2). For Auckland Transport, consequential renewals associated with the new fleet, depot and stations start to occur late in the 30-Year period (i.e. third decade onwards).

As discussed earlier in Section 4.3.2, the recommended programme results in modest reductions in some areas of KiwiRail's current renewal spend (e.g. signalling), as that forecast excludes the recommended programme. These impacts are reflected in the forecasts presented below.

9(2)(i) - Commercial activities

[redacted]

Figure 4-4 Renewals cashflow (real)[159]

[159] Source: PwC analysis

Table 4-19 Renewals cost estimate by organisation[160]

Renewals funding required ($m) By organisation	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport	[redacted] 9(2)(i) - Commercial activities															
Rolling stock																
Other																
Subtotal AT renewals																
ANAA (payment to KiwiRail)																
Total AT renewals incl. ANAA																
KiwiRail																
Capex renewals																
Catch-up renewals																
Subtotal KiwiRail renewals																
ANAA (payment from AT)																
Total KiwiRail renewals incl. ANAA																
Total renewals funding required (real)																
AT escalation																
KiwiRail escalation																
Total escalation																
Total renewals funding required (nominal)	**191**	**154**	**94**	**78**	**122**	**82**	**109**	**99**	**121**	**141**	**1,125**	**887**	**1,826**	**3,838**	**439**	**1,191**

[160] Source: PwC analysis

4.4.4 OPERATING COSTS

Operating costs for the recommended programme, additional to those committed operating costs, are shown over time in Figure 4-5 below and broken down by organisation in Table 4-20. These costs reflect both the increase in metro passenger service provision over time (for Auckland Transport), and the additional network operating costs (for KiwiRail) – most of which are intended to be funded by the forecast increase in Auckland Transport's ANAA costs.

In the case of Auckland Transport's operating costs, these are gross costs (i.e., excluding any fare revenue).

9(2)(i) - Commercial activities

[redacted]

Figure 4-5 Operating cost cashflow (real)[161]

[161] Source: PwC analysis

Table 4-20 Operating cost estimate by organisation[162]

9(2)(i) - Commercial activities

Opex funding required ($m) By organisation	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport	[redacted]															
Rolling stock & management																
Stations																
Subtotal AT opex																
ANAA (payment to KiwiRail)																
Total AT opex incl. ANAA																
KiwiRail																
Network opex																
ANAA (payment from AT)																
Total KiwiRail opex incl. ANAA																
Total opex funding required (real)																
AT escalation																
KiwiRail escalation																
Total funding required (nominal)	**229**	**315**	**322**	**337**	**345**	**353**	**362**	**530**	**543**	**556**	**2,664**	**5,952**	**11,073**	**19,689**	**867**	**3,893**

[162] Source: PwC analysis

4.5 FUNDING SOURCES

Existing and potential funding sources for the recommended programme are summarised in Table 4-21 below. It is expected that as individual projects from the programme are taken forward, individual funding and/or financing strategies and agreements will be put in place. The list below should be viewed as non-exhaustive as the individual project characteristics may support further alternative funding and/or financing approaches.

Table 4-21 Existing and potential funding sources

FUNDING SOURCE	DESCRIPTION
National Land Transport Fund	The NLTF funds the following aspects of activity class categories: • Public Transport Infrastructure: most infrastructure-related costs • Public Transport Services: PT operational costs • Rail Network: possible where interventions improve the strategic rail freight network and where there are significant freight-related benefits. • Walking and Cycling: improvements to station connectivity • Road to Zero (expected to be re-named to 'Safety'): specific safety improvements, potentially including removal or grade separation of level crossings[163]. The degree of NLTF assistance depends on the relevant Funding Assistance Rate (FAR) and the timing of the intervention with respect to the NLTP funding cycle. In the instance that major investments are unaffordable for Auckland Transport at the normal FAR rate, Waka Kotahi can consider varying the FAR for specific projects. There is existing precedent for this, however it is subject to individual project negotiation and request to, and approval by, the Waka Kotahi Board. For KiwiRail's projects to be eligible for NLTF funding, they need to be included in the RNIP, which KiwiRail is ultimately responsible for preparing. This process is discussed further below for reference.
Crown funding	Crown funding can be provided to support KiwiRail network projects or significant projects that councils are unable to fund. The Crown has previously shown willingness to fund rail projects, for example through the NZ Upgrade Programme. The Crown has also recognised that the significant costs of some mass transit projects are beyond the means of traditional transport funding and that Crown funding will be required.
Council funding (rates)	Auckland Council finances PT services and supporting infrastructure with a mixture of rates, debt and PT specific levies. Auckland Council may also be able to capture the value of transport projects more directly from those who benefit the most. This can be done by way of development contributions or targeted rates, as are being considered as funding mechanisms for other major transport projects.

[163] There remains considerable uncertainty over which activity class would be used to fund level crossings and alternative funding sources may be required.

Public transport fares	The recommended programme will increase both metro passenger capacity and service frequency, which will increase total fare revenue. This additional revenue is expected to offset the cost of operating the new services. Over the period to including FY51 the additional fare revenue is estimated to be $490m, (real) based on MSM modelling of the recommended programme.
Additional policy mechanisms (RFT, transport pricing)	Policy and regulation can influence how the transport system is used and can also create new transport funding streams. Examples include the Auckland regional fuel tax, implemented in 2018, and congestion charging, as explored for Auckland most recently through The Congestion Question (2021). Funds raised from these policy mechanisms can be directed to specific transport projects or to classes of projects more generally.

4.5.1 NLTF FUNDING FOR RAIL

In 2021 amendments to the Land Transport Management Act 2003 (LTMA 2003) enabled KiwiRail to access the NLTF to fund development of the rail network.

To secure funding KiwiRail must prepare an RNIP[164] that sets out those rail activities it wants to be funded from the NLTF. The approval authority for the RNIP is the Minister of Transport. The process for preparation and approval of the RNIP aligns with the development of RLTPs and the NLTP and is shown below in Figure 4-6.

Figure 4-6 RNIP process

For the Auckland and Wellington regions, and those where the Minister of Transport appoints KiwiRail to the Regional Land Transport Committee (Waikato and Bay of Plenty), the RLTP must include a list of any significant rail activities proposed by KiwiRail to enable co-ordinated planning. KiwiRail is currently preparing the second RNIP that will come into effect on 1 July 2024, and through this will seek initial funding support for the KiwiRail elements of the recommended programme.

[164] The RNIP is a 3-year programme, with a ten-year outlook, and must take into account the purpose of the LTMA 2003 which is to contribute to an effective, efficient, and safe land transport system and the Government Policy Statement on Land Transport (GPS).

Auckland Transport's rail projects will be submitted and prioritised for NLTF co-funding through the RLTP process, which follows similar timeframes to the RNIP.

4.6 FUNDING AND AFFORDABILITY

The recommended programme represents a considerable investment over the next 30 years and will place pressure on potential funding sources.

As discussed earlier in the Economic Case, in developing the phasing for the programme, affordability constraints have been considered, informed by the project partners' views on likely funding constraints, particularly in the first decade.

To assess the affordability challenges of the recommended programme, the breakdown of costs by responsible organisation (i.e. KiwiRail or Auckland Transport), and ultimate funding source under the current funding arrangements, are presented in this section. The current funding arrangements that inform that breakdown are summarised in Table 4-22 below.

Table 4-22 Current / status quo funding arrangements

ORGANISATION	STATUS QUO ARRANGEMENTS
Auckland Transport (including ANAA costs)	51% NLTF 49% Auckland Council local share
KiwiRail	ANAA (revenue from Auckland Transport to KiwiRail for its share of renewals and opex) 100% NLTF (capital and net renewals/opex (i.e., after ANAA revenue))

4.6.1 FUNDING REQUIREMENTS

The total funding requirements for the recommended programme (using the P50 capital cost estimates) using the current funding arrangements are summarised in Table 4-23 below. Appendix L includes the same analysis using the P95 capital cost estimates.

The forecast funding requirement over the 2024-34 period is shown annually to provide a granular breakdown of funding requirements in the near term, along with the effective FAR across the programme to highlight the overall contribution of the NLTF. The assumption is that the RNIP (2024-27) adopts the necessary projects from the recommended programme so that funding from the NLTF can be sought.

The total funding requirements for the programme are then broken down by cost category (capex, renewal and opex) and presented in Table 4-24 - Table 4-26 below.

Table 4-23 Total programme funding summary (P50 capital costs)[165]

Total funding required ($m) By funder	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
AT total funding required (incl. ANAA)	9(2)(f)(iv) - Active consideration [redacted]															
KiwiRail total funding required (incl. ANAA)																
Total funding required (real)																
Escalation																
Total funding required (nominal)																
Funded by:*																
*(*actual funding splits are subject to future decisions*																
Auckland Council (real)																
Escalation																
Auckland Council (nominal)																
NLTF (real)																
Escalation																
NLTF (nominal)																
Effective programme FAR - total																

Table 4-24 Capital cost by funding source (P50 capital costs)[166]

Capex funding required ($m) By funder	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport capex	9(2)(f)(iv) - Active consideration [redacted]															
KiwiRail capex																
Total capex funding required (real)																
Escalation																
Total capex funding required (nominal)																
Funded by:*																
*(*actual funding splits are subject to future decisions)*																
Auckland Council (real)																
Escalation																
Auckland Council (nominal)																
NLTF (real)																
Escalation																
NLTF (nominal)																
Effective programme FAR - capex																

[165] Source: PwC analysis

[166] Source: PwC analysis

The equivalent table using the P95 capital costs is included in Appendix L.

Table 4-25 Renewals by funding source[167]

9(2)(i) - Commercial activities

Renewals funding required ($m) By funder	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport	[redacted]															
Total renewals funding required (excl. ANAA)																
ANAA renewals (payment to KiwiRail)																
Total renewals funding required (incl. ANAA, real)																
KiwiRail																
Total renewals funding required (excl. ANAA)																
ANAA renewals (payment from KiwiRail)																
Net renewals funding required (incl. ANAA, real)																
Total renewals funding required (real)																
Escalation																
Total renewals funding required (nominal)																
Funded by:*																
*(*actual funding splits are subject to future decisions)*																
Auckland Council (real)																
Escalation																
Auckland Council (nominal)																
NLTF (real)																
Escalation																
NLTF (nominal)																
Effective programme FAR - renewals																

[167] Source: PwC analysis

Table 4-26 Operating cost by funding source[168]

Opex funding required ($m) By funder	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Auckland Transport	[redacted] 9(2)(i) - Commercial activities															
Total opex funding required (excl. ANAA)																
ANAA opex (payment to KiwiRail)																
Total opex funding required (incl. ANAA, real)																
KiwiRail																
Total opex funding required (excl. ANAA)																
ANAA opex (payment from KiwiRail)																
Net opex funding required (incl. ANAA, real)																
Total opex funding required (real)																
Escalation																
Total opex funding required (nominal)																
Funded by:*																
*(*actual funding splits are subject to future decisions)*																
Auckland Council (real)																
Escalation																
Auckland Council (nominal)																
NLTF (real)																
Escalation																
NLTF (nominal)																
Effective programme FAR - opex																

The sum of Auckland Transport's ANAA costs across renewals and opex [redacted] 9(2)(i) - Commercial activities) represents a significant increase over current levels (circa $30m). This presents an affordability challenge for the upcoming RLTP period given the current level of ANAA cost is unaffordable to Auckland Transport. As noted earlier, the ANAA payments are critical (under the current funding settings) to enable KiwiRail to deliver the necessary level of regular annual maintenance and renewal activity.

[168] Source: PwC analysis

4.6.1.1 AUCKLAND TRANSPORT INDIRECT ADMIN FEE

The costs presented in the analysis above all exclude Auckland Transport's indirect admin fee. This fee is added in accordance with Waka Kotahi's policy[169] that approved organisations account for appropriate administration costs through an agreed and documented process. Auckland Transport's methodology for determining and allocating indirect administration costs (e.g., a portion of delivery-related overheads) associated with delivering its approved activities is well established and approved by Waka Kotahi.

9(2)(i) - Commercial activities [redacted]

Table 4-27 Auckland Transport indirect admin fee (P50 capital costs)[170]

Auckland Transport funding required ($m)	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Decade 1 FY22-31	Decade 2 FY32-41	Decade 3 FY42-51	Grand total FY22-51	Total FY25-27	Total FY25-34
Total funding required (incl. ANAA, real)	9(2)(i) - Commercial activities [redacted]															
Indirect admin fee																
Total funding required (incl. ANAA, indirect admin fee, real)																
Escalation																
Total funding required (incl. ANAA, indirect admin fee, nominal)																

The equivalent table using the P95 capital costs is included in Appendix L.

169 https://www.nzta.govt.nz/planning-and-investment/planning-and-investment-knowledge-base/archive/201821-nltp/planning-and-investment-principles-and-policies/investment-and-funding-assistance-policy/administration-policy/#accounting-for-the-cost-of-administration

170 Source: PwC analysis

4.6.2 AFFORDABILITY ANALYSIS

Across the recommended programme it is expected that most projects would be eligible for NLTF funding under either the Public Transport Services or Public Transport Infrastructure activity classes.

To provide a view on potential affordability under current funding arrangements, expected funding requirements against NLTF activity class funding ranges from the Draft GPS on Land Transport (2024) have been included in the analysis presented below. Nominal totals are used in the analysis as it is assumed that the activity class ranges in the Draft GPS are nominal values. This analysis is presented for FY25-FY34 (as this aligns with the draft funding range forecasts in the Draft GPS) in the following tables:

- Table 4-28 assesses the Public Transport Infrastructure activity class, which is expected to co-fund Auckland Transport's capex and renewals at 51% FAR and fully fund KiwiRail's capex.
- Table 4-29 assesses the Public Transport Services activity class, which is expected to co-fund Auckland Transport's opex at 51% FAR.

KiwiRail's opex for the ANAA programmes (net of ANAA revenue from Auckland Transport) is expected to be fully funded from the Rail Network activity class, and this would need to be managed/prioritised alongside other KiwiRail commitments.

It is acknowledged that this analysis makes the simplifying assumption that only these activity classes are used to fund the various activities, and that the activity class ranges are still draft. The analysis is intended to highlight the potential order of magnitude of the affordability challenge to inform subsequent funding discussions.

Table 4-28 Public Transport Infrastructure activity class analysis (P50 capital costs)[171]

Total funding captured ($m)										
NLTF Activity Class (draft GPS 2024) - PT Infrastruct	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34

[redacted] 9(2)(i) - Commercial activities

Table 4-28 highlights a major affordability problem under current funding settings for the Public Transport Infrastructure activity class. Over the RLTP period, the recommended programme would utilise an increasing share of the Public Transport Infrastructure activity class range, reaching nearly 180% of the upper bound range (or over 300% of the lower bound range) in FY31. Given this activity class needs to fund all PT infrastructure activities (including bus, ferry and on-demand transport) nationally, this highlights a considerable affordability challenge beyond the first few years under current funding arrangements. This strongly suggests that the current funding arrangements will need to be changed if the recommended programme is to be delivered.

[171] Source: PwC analysis

Table 4-29 Public Transport Services activity class analysis[172]

Total funding captured ($m) NLTF Activity Class (draft GPS 2024) - PT Services	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34

9(2)(i) - Commercial activities

[redacted]

The analysis of the Public Transport Services activity class initially suggests that the level of service proposed through the RLTP period may be affordable, especially as this uses gross opex before fare revenue is included. However, Auckland Transport's rail opex is generally around 30% of Auckland Transport's overall PT opex, which suggests that Auckland Transport's overall PT opex costs could require nearly half of the national activity class total (once an allowance for farebox recovery (assumed to be 30% - 40%) is included). While not as material a challenge as the capital costs from the other activity class, this will still present an affordability challenge.

The draft NLTF activity class funding ranges provide one way of considering affordability and the analysis has highlighted specific and significant challenges associated with the capital aspects of the programme.

4.6.3 IMPORTANCE OF EARLY FUNDING

The funding requirement in the next 3-4 years is critical to:

- enable a lift in productivity for maintenance and renewals activity as demands on the network post-CRL opening grow, and
- confirm options and secure designations for some of the critical programme elements like 4-tracking between Westfield and Pukekohe and a new EMU depot.

The early funding for the investigation and planning activities (refer to Table 4-17) is 'no regret' as putting in place the appropriate planning protections will ensure these programme components are not precluded in the future, even if implementation funding is not confirmed.

The much more significant costs are associated with property acquisition and construction that start to occur from the late 2020s, as shown in Figure 4-7. There is some scope to stage these costs over time, by adjusting the timing of certain programme elements. Notice of Requirements (NORs) often have long lapse periods (e.g., 10-15 years) but this does not mean that construction must start immediately or that funding must be in place before the NOR can be secured.

Investing in the planning phase therefore preserves the option to meet the forecast delivery profile, but also the flexibility to respond to affordability challenges by delaying some property purchase and construction elements if all funding avenues have been exhausted. That said, the KiwiRail and Auckland Transport Boards would be unlikely to advance designations without some funding for forecast hardship property purchase requests.

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[172] Source: PwC analysis

9(2)(i) - Commercial activities

[redacted]

Figure 4-7 Capital cost cashflow by phase (P50)[173]

4.7 FUNDING RISKS

The main funding risks relate to:

- The scale of forecast service increases beyond the CRL Day 1 timetable, which drives a step change in operating and maintenance cost. This level of increase may not be affordable,
- the scale of the recommended programme and the timing of certain projects, which includes the potential requirement for advance property purchase,
- securing the proposed level of investment against projected budgets, and
- project cost increases.

Investing organisations (Auckland Council (via Auckland Transport), KiwiRail, Waka Kotahi, and central Government) have competing financial priorities and responsibilities within defined budget parameters, and the recommended programme will be competing against other priorities for investment.

The overall scale of the programme presents an affordability challenge as outlined previously. As discussed above, the immediate funding requirement to progress various business cases, assess options and secure long-term designations is low. The substantial cost associated with property acquisition and construction occurs much later (for most of the programme). This may mitigate some short term affordability challenges, but not the overall challenge for the programme.

Advance property purchase is an area of funding risk. As noted above, funding constraints tend to result in property acquisition costs occurring close to the start of construction. There is a risk that the NOR and designation process triggers the need for advance property purchase, which would bring forward some of the property costs. This can be the case where the purchase is compulsory,

[173] Source: PwC analysis

generally under grounds of hardship. For more 'discretionary' acquisitions, this risk is compounded if funding for advance property purchase is not available and the properties are redeveloped in the interim, leading to higher future acquisition costs. This could occur if this discretionary property funding is allocated to the delivery of other projects, which may be more likely when overall funding is constrained.

A related risk is the funding arrangements themselves given joint funding requirements (or interdependencies) across KiwiRail and Auckland Transport for aspects of the programme. The risk is that if either organisation is unable to secure its necessary funding, the whole project (or potentially group of projects) is put at risk. This will need to be managed by both organisations as discussed further in the Management Case, in relation to programme governance and progression.

Cost increases may eventuate due to increased market rates, supply chain disruptions, new regulation, or ineffective collaboration between delivery organisations. Project and programme costs should be refined in subsequent project-level business cases to ensure the programme is affordable. This may require further adjustments to the recommended timing for various projects, noting the trade-offs that will need to form part of those decisions.

Pipeline certainty is crucial in providing the construction sector with the confidence they need to effectively plan and prepare for future projects. By establishing a clear and predictable pipeline of upcoming rail works, construction contractors can retain the appropriate capacity and capability to deliver projects. This, in turn, helps to mitigate cost escalation caused by inconsistent periods of high and low project demands.

The Management Case describes the funding risks to the PBC in additional detail, along with their causes, consequences, owners, and appropriate controls.

5 COMMERCIAL CASE

5.1 PURPOSE

The purpose of the Commercial Case is to describe the commercial aspects of the programme. At the PBC stage, this includes summarising the potential procurement approaches for the projects and components in the programme (focussing on those nearer-term projects), a high-level assessment of the market's ability to deliver, consenting considerations, property requirements and risk sharing.

5.2 PROGRAMME COMPONENTS

The components of the overall programme have been organised into six indicative groups of similar types of projects, at similar stages of investigation:

- GROUP A – Southern Corridor
- GROUP B – Crosstown Corridor
- GROUP C – Western and Eastern Corridor
- GROUP D – Electric multiple unit (EMU) fleet
- GROUP E – Signalling, telecoms, network control and traction power
- GROUP F – Maintenance plant, depots/satellite, sidings and renewals.

The major projects included in each group are summarised in Table 5-1 below and further detail on the rationale for the groupings and project phasing, is provided in the Management Case.[174]

Table 5-1: Summary of projects by group

GROUP	INDICATIVE PROJECT NAME
GROUP A – Southern Corridor	
	Westfield (Penrose) to Pukekohe: 4 track, including: Westfield Junction Westfield to Wiri: additional track capacity
	Westfield to Papakura stations
	Level crossings – Takaanini (Group 2 Level Crossings (LX))
	Papakura to Pukekohe: 4 track

[174] Level crossings may not be removed in the current geographical groupings, but potentially by a different phasing or priority set by the Level Crossing SSBC. This may include the need to remove the remaining pedestrian only crossings before the road crossings.

GROUP	INDICATIVE PROJECT NAME
	Level crossings – Papakura to Pukekohe (Group 5 LX)
	Depot / stabling (South)
	Station upgrades – Southern stations not on 4-track sections (i.e. NAL)
GROUP B – Crosstown Corridor	
	Avondale-Southdown corridor including new stations and tie-ins
	Onehunga Connectivity Study
GROUP C – Western and Eastern Corridor	
	Level crossings – West inner and mid, Glen Innes (Group 3 LX), includes connected station upgrades
	Level crossings – Outer west (Group 4 LX), includes connected station upgrades
	Station upgrades – Western and Eastern
	Depot / stabling (East, West)
GROUP D – EMU fleet	
	EMU fleet (including driver assist) – linked to depot and stabling
GROUP E – Signalling, telecoms, network control and traction power	
	European Train Control System (ETCS) Level 2
	Sectioning, power study, power feeds
GROUP F – Maintenance plant, depots/satellites, sidings and renewals	
	First decade productivity priorities (plant, equipment, depots/satellites)
	Renewals (catch up renewals network completion)

5.3 PROCUREMENT OPTIONS

It is anticipated that this PBC will be approved by the Auckland Transport, KiwiRail and Waka Kotahi Boards in late 2023. The programme requires a range of business cases to then be developed to enable the eventual range of physical works to commence in the future. While this PBC has been jointly led, further business case and delivery work will be led by the organisation responsible for that project, or group of projects/assets. Each subsequent business case will include project-specific management and commercial cases that will define their respective procurement approaches at a more granular level. These approaches will also be aligned to those of the responsible organisation.

Table 5-2 summarises the next phases for projects within the programme and their expected procurement approach, noting these approaches are subject to further consideration and development by the relevant owner organisations.

Table 5-2: Summary of projects and expected procurement approach – next phase

PROJECT	LEAD AGENCY	OTHER AGENCY	SCOPE / APPROACH	RATIONALE	EXPECTED PROCUREMENT APPROACH
GROUP A – Southern Corridor					
Westfield (Penrose) to Pukekohe 4-track *(Includes Westfield Junction, scope for Westfield to Wiri: additional track capacity and Westfield to Papakura stations)*	KiwiRail	Auckland Transport	Indicative Business Case (IBC) for the whole corridor, expected to lead to multiple (possibly four) Detailed Business Cases (DBCs) for the sub-parts	Whole corridor IBC to gain alignment end-to-end, before splitting into multiple DBCs for component parts to allow the fastest progression to delivery. This removes dependencies within the DBCs to allow each to progress as quickly as possible.	Significant scale projects - Procurement strategy to be developed.
Level crossings – Takaanini (Group 2 LX)	Auckland Transport	KiwiRail	Included within the current Level Crossing Single-Stage Business Case (SSBC). NOR to follow.	Utilising the current SSBC will allow the Group 2 LX to go to consenting to expedite the path to delivery.	Subsequent procurement strategy to be developed
Papakura to Pukekohe: 4 track	KiwiRail	Auckland Transport	The Notice of Requirement (NOR) for P2P 4-tracking is currently underway	In progress.	NOR in progress
Level crossings – Papakura to Pukekohe (Group 5 LX)	KiwiRail leading NOR / Auckland Transport leading Level Crossing SSBC		Included in both the NOR for P2P and the Level Crossing SSBC	As above for Takaanini.	NOR in progress

PROJECT	LEAD AGENCY	OTHER AGENCY	SCOPE / APPROACH	RATIONALE	EXPECTED PROCUREMENT APPROACH
Depot / stabling (South)	Auckland Transport	KiwiRail	SSBC (covering fleet, depot and stabling)	While the scale of investment will be significant, an SSBC is recommended to define fleet requirements, integrated with depot and stabling needs. The stabling component is expected to be delivered as a single programme overtime, supporting an SSBC as the next step. The SSBC can draw on ARPBC asset strategies.	Procurement strategy to be developed.
Station upgrades – Southern stations not on 4-track sections (i.e. NAL)	Auckland Transport	KiwiRail	Proposed SSBC for station upgrades (all corridors)	• An SSBC will consider station upgrades as geographic programmes, but the triggers for construction will vary. There will also be interdependencies with level crossing • removal, and the SSBC will identify potential for synergies with level crossing planning activities (designations etc).	Procurement strategy to be developed.
GROUP B – Crosstown Corridor					
Avondale-Southdown corridor including new stations and tie-ins	KiwiRail	Auckland Transport	SSBC, NOR	Since there is an existing designation in place, an SSBC is considered appropriate to re-confirm the corridor designation (required before 2029).	Procurement strategy to be developed.

PROJECT	LEAD AGENCY	OTHER AGENCY	SCOPE / APPROACH	RATIONALE	EXPECTED PROCUREMENT APPROACH
Onehunga Connectivity Study	Auckland Transport	KiwiRail	Study (or IBC)	The relationship of Auckland Light Rail, the Onehunga Branch Line and Avondale-Southdown requires a study to confirm the role, timing and function of each in the area.	Traditional contract.
GROUP C – Western and Eastern Corridor					
Level crossings – West inner and mid, Glen Innes (Group 3 LX), includes connected station upgrades	Auckland Transport	KiwiRail	Included within the current Level Crossing SSBC	Utilising the current SSBC will allow the Group 3 and 4 LX to go to consenting to expedite the necessary planning protections. The Group 3 LX crossings are higher priority for delivery.	Subsequent procurement strategy to be developed
Level crossings – Outer west (Group 4 LX), includes connected station upgrades					
Station upgrades – Western and Eastern	Auckland Transport	KiwiRail	Proposed SSBC for station upgrades (all corridors)	Covered above.	Procurement strategy to be developed.
Depot / stabling (East, West)	Auckland Transport	KiwiRail	SSBC (covering fleet, depot and stabling)	Covered above.	Procurement strategy to be developed.
GROUP D – EMU fleet					
EMU fleet (including driver assist) – linked to depot and stabling	Auckland Transport	KiwiRail	SSBC (covering fleet, depot and stabling)	Covered above.	Procurement strategy to be developed.

PROJECT	LEAD AGENCY	OTHER AGENCY	SCOPE / APPROACH	RATIONALE	EXPECTED PROCUREMENT APPROACH
GROUP E – Signalling, telecoms, network control and traction power					
ETCS Level 2	KiwiRail	Auckland Transport (relating to fleet)	DBC	A DBC is underway for a network system upgrade to ETCS2; it has telecoms and network control elements	Traditional contract.
Sectioning Power study Power feed	KiwiRail	Auckland Transport (relating to fleet)	• DBC • Initial study • SSBCs or DBCs	Tailored approaches. The initial study will cover the technical requirements and constraints, which will in turn determine the proposed investment pathway.	Traditional contracts.
GROUP F – Maintenance plant, depots/satellites, sidings and renewals					
First decade productivity priorities (plant, equipment, depots/satellites)	KiwiRail		SSBC(s) and/or DBC(s) depending on complexity relating to land take	The mix of work for the next phase will be determined by KiwiRail and informed by the AMP.	Traditional contracts.
Renewals (catch up renewals network completion)	KiwiRail	Auckland Transport	DBC	A DBC is proposed as the learnings from the current Rail Network Rebuild (RNR) can be utilised to inform cost and procurement requirements.	Traditional contract.

5.3.1 PROFESSIONAL SERVICES

It is expected that the professional services to deliver the business cases, design and/or planning projects (including consenting and NOR) and other studies will be procured through a mix of direct appointment, invited tender and open tender, depending on the scale, complexity, and urgency of the project. Options for procuring professional services are discussed in Table 5-3 below.

Table 5-3: Professional services procurement approach

CONTRACT TYPE	BENEFITS	DISBENEFITS
Individual contracts	Manage each project as a discrete scope. Control delivery.	Lose aggregation-saving opportunities. Less innovation and collaboration between project teams.
Panels	Pre-qualification saves tendering time. Access to a number of different teams, with confidence that they all have the requisite skills. Opportunities to encourage collaboration and standardisation of approach.	Additional project management time to administer several contracts. Process required to allocate projects within panel. Lengthy procurement process to establish panels.
Alliances	One stop shop. Collaboration is driven contractually for all parties (including clients). Good financial performance is incentivised. Incentivises innovation. Aggregation opportunities – outcomes such as time saving can be explicitly incentivised.	High establishment cost. Lengthy procurement process. Requires significant scale project to realise savings and make it viable.

The merits of the different approaches will need to be considered by the lead agency in conjunction with their individual organisation's procurement rules.

5.3.2 IMPLEMENTATION

For most projects within the programme, the implementation phase is many years away and the delivery model for implementation will vary across the programme. A detailed procurement strategy will be developed for each project in the programme at an appropriate time in advance of and closer to the implementation of each project, with consideration of factors such as:

- Scale and complexity.
- Timing and urgency.
- Scope definition.
- Supplier market conditions.
- Client involvement, control and capability.
- Demonstration of value for money.

5.3.3 GROUP A PROCUREMENT

The Group A projects relate to the 4-tracking between Westfield and Pukekohe which has been identified as one of the most critical projects within the programme. This is because:

- It unlocks a wide range of benefits,
- has a considerable lead time given the extent of the physical works that will ultimately be required, and
- construction of the 4-tracking will trail demand, leading to some demand likely being spilt from the early 2030s until it is completed (i.e. for more than a decade).

Thus, there is a need to consider the fastest route to completion of the full corridor. For this reason, and the interdependency of the individual projects within Group A, this PBC has considered a proposed procurement approach for this group of projects to inform Auckland Transport and KiwiRail's immediate next steps in advancing them.

Figure 5-1 illustrates the phasing of the different stages for the Southern Corridor projects in Group A over the next five years, with indicative durations.

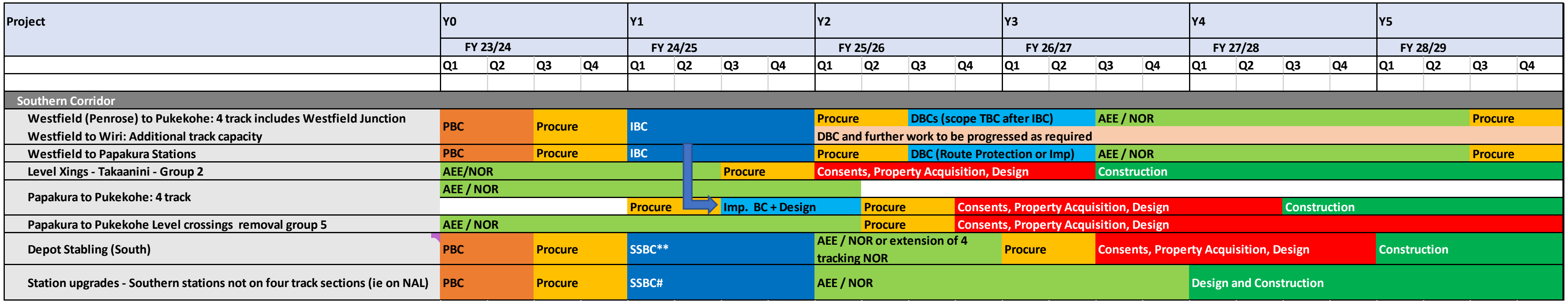

Figure 5-1: Group A phasing and procurement – next five years

There is a need to procure an IBC for the whole corridor (acknowledging that the Papakura to Pukekohe section is well advanced), and the proposed approach is to ensure that the remaining NOR process (for Westfield to Papakura) is started as quickly as possible, as it is assumed the NOR south of Papakura is secured through the current process. This sees a single procurement phase in the first half of 2024 that would initially procure the IBC for the whole corridor to develop and evaluate a range of potential options (particularly north of Papakura), and to ensure the corridor is considered end-to-end. Following the completion of the IBC, and depending on its recommendations, multiple DBCs are envisaged, acknowledging that breaking the corridor into distinct projects may provide an overall faster route to construction. For example, splitting out a DBC for the northern part of the corridor will allow the NOR to begin more quickly through removing dependencies on other parts of the Southern Corridor group of projects. Overall, this approach:

- Generates time efficiencies given the overlap of the scope in the different phases (e.g. business case option assessment and NOR alternatives assessment).
- Provides a more attractive package to industry (i.e. size and scale).
- Enables the most efficient delivery of the high priority corridor, acknowledging that not all components of the corridor have equal urgency. Splitting into multiple DBCs facilitates this approach.

The approach stops short of bundling consenting, as progressing the NOR first allows the designation to be confirmed relatively quickly with a lower level of design. This provides certainty regarding designation footprint and allows property acquisition negotiations to commence, particularly for strategic properties. It is also consistent with the approach of progressing the most efficient (in terms of time) delivery strategy for the corridor.

Figure 5-1 indicates that if the business case and NOR phases were procured and progressed jointly, Westfield to Papakura could be ready to procure consents, property acquisition and detailed in 2029.

Note that the Papakura to Pukekohe 4-track NOR is up to the southern extent of Papakura station. The Papakura Station designation and requirements fall into the scope of the Westfield to Papakura section. The designation of stations south of Papakura falls into the current Papakura to Pukekohe 4-track NOR scope, and the proposed footprint will be checked to ensure sufficient space is incorporated.

The IBC for the corridor will inform any refinements to the indicative project elements as they are taken forward, with the Management Case in that IBC defining the implementation strategy and associated timings.

Once a project has been through the pre-implementation phase and funding has been secured, it will be ready for implementation, which can be procured in different ways. Selecting a preferred delivery model will consider a range of factors, including scale, complexity, risk, programme (timing) and degree of certainty, as shown in Waka Kotahi's selection diagram reproduced in Figure 5-2.

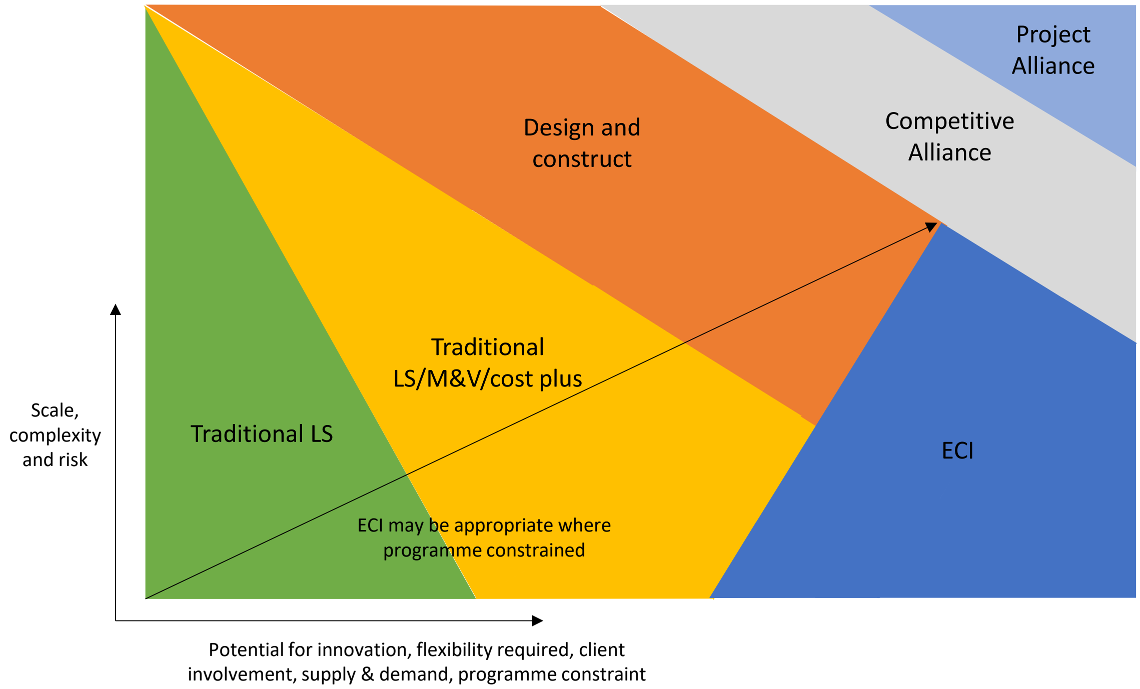

Figure 5-2 Delivery model selection[175]

Table 5-4 below summarises the benefits and disbenefits of some construction procurement approaches that could be applied to the Group A projects, noting there are a wider range of potential models that the individual projects will consider in more detail in the subsequent phases of their development.

Table 5-4: Benefits and disbenefits of potential construction procurement options for Group A projects

OPTION	BENEFITS	DISBENEFITS
Design and Construct	Transfers complexity to contractor.	Likely fewer bids reducing competitive tension (or no bids as

[175] Source: Adapted from Waka Kotahi (2014)

OPTION	BENEFITS	DISBENEFITS
		contractors don't want to assume risk). Higher tender box price as contractors include risk pricing. Process to manage variations is difficult and costly.
Alliance	High degree of collaboration between client, designer and contractor. Effective way to manage complexity and maximise innovation.	High start-up costs and high overhead costs. Significant resource commitment from owner organisations required to participate in Alliance decision making.
Early Contractor Involvement	Collaborative procurement model. Contractor involved early to influence design, ensure it is practical to construct and bring innovation. Activities can occur in parallel (design and consenting and property purchase) to speed up overall timeframes. Earlier commitment of construction resources and earlier procurement of long lead time items.	Relationship breakdowns between parties can significantly impact performance. Strong leadership and significant client resource commitment required to ensure no-blame culture to achieve transparency and collaboration. Construction component may not be competitively tendered so competitive pricing is not guaranteed. However price can be peer reviewed. Can include invited tender for construction but may not attract much interest as incumbent has significant head start.

5.3.4 PROCUREMENT RISKS

Procurement risks such as achieving poor value for money, or provision of insufficient information to tenderers, will be the responsibility of the procuring organisation and can be mitigated through peer review of the delivery strategy and procurement process (either internally or externally). Additional procurement related risks include ineffective processes that benefit some tendering parties over others, tenderers having existing relationships and perceived unfair advantages in the procurement process, and a lack of market interest and capability, leading to a lack of competitive tension and lower value for money.

These risks are not unique to this programme and there are a variety of ways to mitigate and reduce their likelihood, for example through packaging projects together to increase scale, and undertaking market engagement to obtain insights on preferences and appetite for different aspects of the programme.

5.4 MARKET ASSESSMENT

The capacity in the market for professional services and physical infrastructure and works required by the programme, is discussed below.

5.4.1 OVERALL MARKET CONTEXT

The recommended programme requires some $20.7 billion (P50, 2023$) in capital delivery (excluding renewals) over the next 30 years, with a substantial spend of around $1 billion per year from FY2029 through to FY2042. The highest spend is forecast in the early 2030s at around $1.4 billion per year, for two years.

For context, over the last few years of delivery in the rail market, which includes CRL, there has been in the order of $1 billion of capital delivery (excluding renewals) each year. Delivery of the recommended programme as currently phased, would see a return to, and sustaining of this level of capital delivery activity by the late 2020s. In and of itself, given recent precedent, this suggests that the delivery of the programme would be achievable.

However, in the context of the overall infrastructure delivery market, there will be other significant competing demands which will pushing NZ's capital delivery market to new levels. The continuing recovery from Cyclone Gabrielle, along with the Auckland mega projects – Waitematā Harbour Connections (WHC), Auckland Light Rail (ALR) and Northwest Rapid Transit – will place pressure on the overall market's ability to deliver to the necessary capacity if current proposals remain unchanged. For example., WHC and ALR each have greater funding requirements that are greater than that of the entire recommended rail investment programme. If concurrent delivery is expected, this could result in around $5 billion (or more) of new infrastructure needing to be delivered in Auckland annually.

The recommended programme differs slightly from those mega projects, in that it is as the name suggests, a programme of investment that is delivered over time. In contrast, the mega projects are projects with concentrated (albeit extended) periods of delivery. This is both an opportunity and a risk for the rail programme. It is an opportunity in that the relative lower level of activity provides less of a challenge to resource, along with some flexibility to move certain components of the programme. At the same time, it is a risk that funding is deprioritised for the rail programme which slows down delivery, leading to delays in the realisation of benefits and compromised outcomes needing to be sustained. This could occur because some decision makers may see the overall programme as being 'flexible' with regards to timing. While this is true of some elements in the later years, the next decade is critical to secure the necessary planning protections and get underway with 4-tracking south of Westfield, along with the expansion of the EMU fleet (plus depot and stabling) and beginning to deliver on level crossing removals.

5.4.2 PROFESSIONAL SERVICES

Professional services required by the programme are expected to be able to fulfilled by the local market, although other major infrastructure projects will be competing for these resources at the same time.

5.4.3 INFRASTRUCTURE

Compared to other infrastructure assets, there is more limited capacity for rail construction within NZ, particularly in specialist fields such as signalling, track design and construction.

Completion of the CRL (currently signalled in late 2025) marks the start of the programme outlined in this PBC and will also create a 'hole' in the rail project delivery pipeline. This will provide rail construction capacity that can be utilised, but there will need to be some 'shovel ready' projects to make use of it. If there are substantial delays to rail construction projects, NZ runs the risk of losing the necessary market skills that in turn would lead to delays and higher prices for construction.

Station, station access, and other smaller improvement projects will be able to draw on an existing pool of local contractors where highly specialised rail-specific construction is not required.

5.4.4 ROLLING STOCK

New Zealand has no domestic rolling stock construction capacity; requiring all train fleet expansion and replacement to be tendered on the international market as it has been recently (e.g. Auckland's EMU fleet from CAF in Spain/Mexico, Wellington's Matangi EMU fleet from Hyundai Rotem in Korea). There is significant capacity within the international market, and it is expected that there will be sufficient market interest in train fleet expansion and replacement projects to ensure competitive procurement processes. Rolling stock order sizes (and follow on order options) will need to be considered further through the fleet strategy work as part of the programme to ensure they are of the right scale to generate the desired level of market interest.

5.4.5 SIGNALLING

The recommended programme is reliant on an upgrade to the signalling system (i.e. moving to ETCS Level 2) to improve operational resilience, enhance safety and efficiency (operating and capital). This upgrade will require international signalling expertise. KiwiRail have identified that even internationally, this market is constrained, and as such represents a risk to the programme if there are material delays to the implementation of the ETCS Level 2 upgrade.

5.5 CONSENTING

This section provides a high-level assessment of the planning inputs that are likely to be required for the large infrastructure projects within the programme.

5.5.1 STATUTORY CONTEXT

A consenting strategy will be developed for each project at the appropriate business case stage. Some projects will be undertaken within KiwiRail's existing rail designations; however it will be necessary to alter existing, or seek new designations where projects fall outside of the current designation boundary (notably 4-tracking), requiring a Notice of Requirement (NOR) under either the Resource Management Act 1991 (RMA) or future legislation such as the . Natural and Built

Environments Act (NBA)[176] .[177]. . Processing pathways will be developed depending upon the scale and nature of the route or works package. Standard RMA two step or direct referral options, as well as any available 'fast track' process will all be explored.

The introduction of new legislation to repeal and replace the RMA (and/or it's successors), is a key risk. While the NBA was passed in August 2023 changes and/or repeal of this new existing legislation is likely. Any new legislation has the potential to create uncertainty due to untested terms and concepts, which would likely result in legal challenge, litigation, and delay.

The RMA has also been amended and several new National Policy Statements (NPS) and National Environmental Standards (NES) have been proposed or are now in effect. The changes include:

- National Policy Statement on Freshwater Management 2020 (NPS-FW) and the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (Freshwater NES)[178;]
- National Policy Statement on Urban Development (NPS-UD) 2020[179]
- National Policy Statement for Highly Productive Land (NPS-HPL) 2022[180.]
- National Policy Statement for Indigenous Biodiversity (NPS IB) 2023
- Any new National Direction released in the future may have an impact on consenting pathways and therefore risk. Any new framework or regime will be assessed for each subsequent business case.

The applicable planning documents in each case outline the specific requirements that must be met to demonstrate sufficient need for an NOR (or consent) to be granted, and RMA case law currently provides considerable precedent.

There is a high likelihood that one or more of the activities associated with delivering the range of projects in the recommend programme will exceed the permitted activity thresholds within Auckland Council's Unitary Plan, meaning resource consents would be required. The activities (at this stage) that are considered to trigger these requirements, and are therefore considered to be higher risk, are:

- removal of vegetation / trees (particularly in areas identified as significant ecological areas, within the riparian margin, notable trees, the open space zone,
- earthworks and discharges that may impact on waterways and wetlands (particularly through more rural environments, e.g., south of Papakura),

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[176] The Natural and Built Environment Bill was introduced into parliament alongside the Spatial Planning Bill (SPA) on the 14 November 2022.

[177] An alternative approach is to go direct to a board of inquiry, if the Minister for the Environment accepts and decides that a proposal submitted for resource consent is nationally significant.

[178] The NPS-FW provides a significantly stronger policy direction and regulations pertaining to wetlands and river loss, culverts, and fish passage.

[179] The NPS-UD requires that Councils enable development of >6 storeys within walking distance of rapid transit stations. This policy strongly encourages greater intensification around stations, prompting significant opportunity for mode shift.

[180] The NPS-HPL provides direction to improve the way highly productive land is managed. This is to be achieved by map and zoning highly productive land, and by managing the subdivision, use and development of this non-renewable resource.

- stormwater discharges from additional impervious areas,
- diversion and dewatering (take) of groundwater,
- discharges of sediment and other potential contaminants (from activities such washwater etc during construction), and
- the construction and placement of structures in waterways (i.e., impacts on fish passage).

Resource consent may be required pursuant to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health for works on contaminated land and resource consents will likely be required under the National Environmental Standard for Freshwater Management 2020 for works in or in close proximity to freshwater (wetlands etc).

5.5.2 ALTERNATIVES ASSESSMENT

Under the NOR provisions of the RMA, the consideration of alternative routes, sites and methods is required.. Alternatives assessment will be needed at each stage of project development, sufficient to satisfy RMA (or any other new legislative) requirements. An initial assessment has been undertaken as part of the options evaluation process in this PBC, noting that a high-level nature of assessment has been applied to help identify material areas of differentiation between options.

At each subsequent stage, a potentially more granular process of identifying and assessing alternatives will be undertaken, commensurate with the level of detail available at that stage. In selecting preferred/recommended options, the site selection, site layout and concept designation process will involve consideration of impacts on the existing natural and built environment, as well as social and cultural values.

5.5.3 CONSULTATION AND ENGAGEMENT

It is expected that projects will be delivered in partnership with or with the active engagement of mana whenua, consistent with KiwiRail and Auckland Transport's typical business activities for the planning and delivery of physical works projects. Collaboration with mana whenua at the early stages of a project is important to ensure a partnership approach is taken in line with Te Tiriti o Waitangi - The Treaty of Waitangi.

Engagement with other affected parties and the wider public will be undertaken as appropriate for each individual project. This will include Local Board engagement, which has occurred as part of finalising this PBC. Comprehensive Local Board engagement was undertaken during July and August 2023, providing presentations to each Local Board and submitting reports for formal feedback. The feedback received from the local boards was generally supportive of the overall aspirations of the programme. There were shared themes around improving maintenance (of track and train; increasing levels of graffiti was raised multiple times) and reliability of services. Multiple Local Boards advocated for the protection of the long-term aspirations of the programme to mitigate the risk of changes over political cycles.

5.5.4 PLANNING COMPLEXITY

A high-level assessment of the planning requirements and complexities is summarised in Table 5-5 below. A difficulty rating (high/moderate/low) refers to the expected difficulty based on the expected activities and estimates for the associated timeframes. More detailed assessments will be undertaken to determine complexity as each project within the programme progresses through subsequent phases of development.

Table 5-5: Initial assessment of planning complexity

PROJECT GROUP	CONSTRAINTS AND PLANNING MATTERS	DIFFICULTY
GROUP A – Southern Corridor	• Property impacts • Noise and vibration (during construction and operation as a result of significant increases in train movements) • Amenity – visual impacts (notably Paerātā stabling site which is zoned Future Urban zone), light spill (if sites operate 24/7) • Impacts for historic heritage • Impacts on notable trees • Impacts to significant ecological areas (Paerātā stabling site in close proximity) • Vegetation removal (riparian margins and significant ecological areas) • Stormwater Management (works within stormwater management areas), including flood hazards and overland flow paths • Impacts to freshwater (wetlands) • Land contamination • Other network utilities such as the National Grid • Other existing Designations (such as Waka Kotahi, Watercare etc) • Land identified as highly productive land • Business disruption • Permanent severance of community (if crossing routes closed) • Addressing level crossings, especially grade separation, will be a complexity/constraint in the planning process.	High • There will be significant changes to the existing corridor, which will require changes to the designation boundary. • The works will also require works in/over sensitive environments such as freshwater (streams/wetlands) or protected vegetated areas as well as potentially extending into areas identified as containing highly productive soils. As a result, the activity status and level of information required to support the Assessment of Environmental Effects will be higher.
GROUP B – Crosstown Corridor	• Property impacts • Noise and vibration (during construction and operation as a result of significant increase in train movements) • Amenity – visual impacts (from the removal of level crossings and introducing new bridges etc) • Impacts to historic heritage • Impacts on notable trees • Vegetation removal (riparian margins and significant ecological areas)	High • As above

PROJECT GROUP	CONSTRAINTS AND PLANNING MATTERS	DIFFICULTY
	• Stormwater Management (works within stormwater management areas), including flood hazards and overland flow paths • Impacts to freshwater (wetlands) • Land contamination • Other network utilities such as the National Grid • Other existing Designations (such as Waka Kotahi, Watercare etc) • Business disruption	
GROUP C – Western and Eastern Corridor	• Property impacts • Noise and vibration (during construction) • Traffic impacts (during construction, road closures, diversions etc) • Impacts on street trees • Amenity – visual impacts, including light spill (if sites operate 24/7) • Stormwater management including flood hazards and overland flow paths • Land contamination • Business disruption • Permanent severance of community (if crossing route was to be closed – therefore important to retain pedestrian movement) • Addressing level crossings, especially for grade separation will be a complexity/constraint in the planning process.	High • The works are likely to be highly disruptive during the construction phase in built up environments, notably for noise and vibration, traffic management, and landscape visual change (particularly where level crossings may be removed and new bridges/underpasses etc are installed).
GROUP D – EMU fleet	• Depot and stabling impacts are included in the geographical corridors.	• N/A • There will be negligible constraints or relevant planning matters pertaining to the procurement of rolling stock only.
GROUP E – Signalling, telecoms,	• Construction noise and vibration • Property impacts	Low • All works are likely to be contained within the

PROJECT GROUP	CONSTRAINTS AND PLANNING MATTERS	DIFFICULTY
network control and traction power		existing or future designated corridor.
GROUP F – Maintenance plant, depots/satellites[2], sidings and renewals	• Construction noise and vibration • Operational noise • Light spill from night works	Low • All works are likely to be contained within the existing or future designated corridor.

[1] National Policy Statement for Highly Productive Land 2022

[2] Locations are flexible to ensure compliance.

5.6 PROPERTY

Property strategies will be developed by each of the subsequent business cases once the extent of any required property outside the existing rail corridor is determined. The property strategy will identify any strategic acquisitions and recommend an acquisition approach specific to individual properties and will be completed as part of seeking approval for implementation funding for individual projects.

A total of $2,600m (P50, 2023$) has been included in the cost estimate for the recommended programme. This is mainly driven by 4-tracking between Westfield – Pukekohe, additional capacity between Westfield – Papakura, and the level crossing removal and station upgrade groups of projects.

Property acquisition costs are assigned to KiwiRail ($2,050m in total (P50, 2023$)), except the additional property acquisition which is required for level crossing removals which are assigned to Auckland Transport ($550m in total (P50, 2023$)), subject to the following clarifications:

- Rail station land. For the purposes of this PBC all land costs for station expansion have been allocated to KiwiRail. As Auckland Transport and KiwiRail progress business cases and designs for station upgrades, confirmation of financial responsibilities for project delivery, including property purchase, will be confirmed.
- New EMU depot and stabling land. For the purposes of the PBC all land costs associated with new depots and stabling for EMUs have been allocated to KiwiRail. As Auckland Transport and KiwiRail progress business cases and designs for new depot and stabling areas, confirmation of financial responsibilities for project delivery, including property purchase, will be confirmed.

Property requirements for each project or project group are summarised in Table 5-6 below, with further detail provided in the Capital Cost Report, attached in Appendix K. All figures quoted below are the P50 estimates and are in 2023 dollars (i.e. escalation is excluded).

Table 5-6: Anticipated property requirements by project

PROJECT / PROJECT GROUP	INDICATIVE PROPERTY REQUIREMENTS	PROPERTY COST SPLIT
GROUP A – Southern Corridor • Westfield (Penrose) to Pukekohe 4-track *(Includes Westfield Junction, scope for Westfield to Wiri: additional track capacity and Westfield to Papakura stations)* • Level crossings – Takaanini (Group 2 LX), Papakura to Pukekohe (Group 5 LX)	• A total of $1,995m has been included in the programme cost estimate across these aspects of the recommended programme. This will deliver the necessary corridor width over the ~38km route, much of which is outside the existing designation. • Consenting, property acquisition and design activities are anticipated between 2025 – 2029 for the Papakura to Pukekohe section at an estimated cost of $162m (included within the total above).	• KiwiRail: $1,759m Auckland Transport: $237m (relating to level crossings)

PROJECT / PROJECT GROUP	INDICATIVE PROPERTY REQUIREMENTS	PROPERTY COST SPLIT
• Papakura to Pukekohe: 4 track • Depot / stabling (South) • Station upgrades – Southern stations not on 4-track sections (i.e. NAL)	• Timing of property acquisition is subject to further refinement north of Papakura, but is likely to begin around 2029.	
GROUP B – Crosstown Corridor • Avondale-Southdown corridor including new stations and tie-ins	• KiwiRail already owns most of the corridor, but some additional acquisition will be required prior to construction, with $26m included in the property estimate. This acquisition could occur in advance to complete the corridor once funding is available to de-risk the project. • A further $14m is included for Onehunga Branch Line station upgrades that would be contingent on future decisions.	• KiwiRail: $40m Auckland Transport: $-
GROUP C – Western and Eastern Corridor • Level crossings – West inner and mid, Glen Innes (Group 3 LX) • Level crossings – Outer west (Group 4 LX) • Station upgrades – Western and Eastern • Depot / stabling (East, West)	• A total of $531m has been included in the programme cost estimate across these aspects of the recommended programme (including depot and stabling costs for the new EMUs). • Timing for consenting, property acquisition and construction for the level crossing removals has some flexibility to fit funding availability and demand triggers.	• KiwiRail: $217m Auckland Transport: $314m (relating to level crossings)
GROUP D – EMU fleet	• There are no property requirements for the new fleet of EMUs themselves, but a total of $104m has been included across Group A and C to cover depot and stabling requirements. Property acquisition will need to begin around 2029 for new EMU depot/stabling.	• KiwiRail: $104m Auckland Transport: $- • *Notes that depot and stabling costs are included in the Group A and C estimates.*

PROJECT / PROJECT GROUP	INDICATIVE PROPERTY REQUIREMENTS	PROPERTY COST SPLIT
GROUP E – Signalling, telecoms, network control and traction power	• A $12m property allowance has been included for traction power. This will be refined in subsequent stages.	• KiwiRail: $12m Auckland Transport: $-
GROUP F – Maintenance plant, depots/satellites, sidings and renewals	• A $22m property allowance has been included at this stage. This will be refined in subsequent stages for the depots and sidings.	• KiwiRail: $22m Auckland Transport: $-

The following principles for property acquisition will guide the development of the property strategy for each project:

- The programme is about long-term affordability and property will be generally acquired closer to implementation. Typically, most property to be purchased for a project is acquired in the three years prior to implementation.
- There will be a contingent property liability as soon as the NOR is lodged for each project.
- The Requiring Authority will take the lead on property negotiations for that specific project, utilising the current processes of that organisation (Auckland Transport or KiwiRail). Both Auckland Transport and KiwiRail have well proven property acquisition and management processes, and dedicated teams in place to manage these property purchases and the ongoing management of these properties.
- Where there is opportunity for strategically important properties (as identified by the project's property strategy) to be acquired, these should be taken. A strategic property fund, discussed below, could assist with achieving this principle.
- A programme wide property resource(s) as part of the overall programme management team will look at opportunities for resultant value capture from residual land as part of the land use integration opportunities of the programme. This is discussed further in the Management Case.

5.7 RISK SHARING/ALLOCATION

Commercial risk allocation will be dependent on the procurement approach and delivery model chosen for each project within the programme. A key principle will be that risks will be allocated to the organisation that is best placed to manage them.

KiwiRail and Auckland Transport are individually responsible for the delivery of the projects that make up their share of the programme. In this way the two organisations are jointly responsible for the delivery of the overall programme. Individual project owners will be responsible for managing the cost and delivery risk of the programme elements within their control, accountable to both the PCG and their own organisation. The use of suitable contracts that appropriately allocate risk between the parties will help to mitigate the exposure of the client organisations to undue levels of risk. The Management Case describes the governance and management arrangements for the programme going forward.

Subsequent business cases will determine the best means for managing commercial risk at the individual project level, including the most appropriate design, construction, and operation forms of tender and contract as discussed earlier. The delivery of the more minor or continuous elements of the programme will use established processes and approaches – a continuation of business as usual.

6 MANAGEMENT CASE

The following sections describe the arrangements that will be implemented for the successful delivery of the preferred Auckland rail network. The delivery arrangement for subsequent phases is described, and the project planning, governance structure, risk management, stakeholder management, benefits realisation, and assurance explained.

6.1 PROGRAMME MANAGEMENT

The Auckland rail system is managed directly by its owners KiwiRail and Auckland Transport. KiwiRail is responsible for infrastructure and access to the rail network. Auckland Transport is responsible for operating passenger services and the electric multiple unit (EMU) fleet. Waka Kotahi is a funder/co-funder and the safety regulator. Each organisation has an important role to play in the operation of the rail network in Auckland and their project governance input is required to ensure the successful delivery of the recommended rail programme for Auckland to 2051.

The Auckland Rail PBC and the improvements to the network it recommends sit within the wider context of Auckland Metro Programme governance established between KiwiRail and Auckland Transport, noting that this arrangement is focused on project delivery. This Management Case draws on that structure, shown in Figure 6-1. [181]

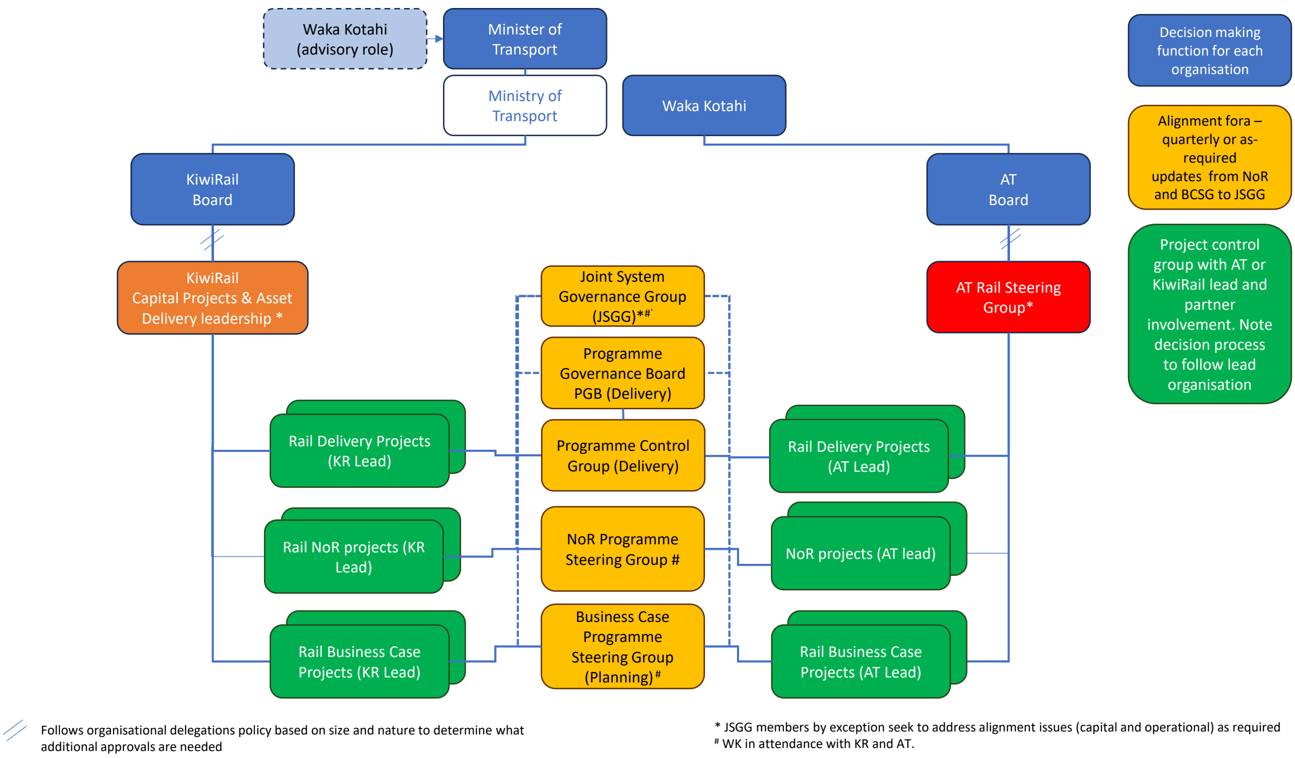


Figure 6-1 Governance structure

[181] The Minister of Transport and Waka Kotahi are the respective funding pathways for Rail Network Investment Programme (RNIP) and RLTP. This structure does not relate to operational reporting.

The Joint System Governance Group (JSGG) provides governance for the overall integrated development of the Auckland rail system and acts as the point of escalation as set out under alignment fora below.

Auckland Transport and KiwiRail are committed to working together to develop more efficient ways of delivering the programme. An ideal state, which would significantly improve delivery timeframes and the achievement of forecast outcomes would be to fund the recommended investment in the Auckland rail network as a programme. This would enable most projects within the programme to be delivered under a joint collaborative structure and create a level of funding certainty that is not currently afforded to these projects.

Another imperative for both Auckland Transport and KiwiRail is to identify opportunities to deliver business case and consenting phases more efficiently than current standard practice, so that the lead time to construction is reduced. A joint programme delivery mechanism would provide both organisations with a level of agility to better deliver projects of the size, complexity, geographical spread, and multiple interfaces (social, economic, environmental, technical, operation) of those recommended for the Auckland rail network over the next 30 years. It would also enable a better approach to ongoing change management and to better managing the impacts on existing services.

In the immediate term, depending on funding certainties, market appetite and resource, the first phase of the recommended investment programme will follow the approach set out below, with each organisation leading its respective projects, partnering with the other and managing programme interdependences through the established alignment forums. It is expected that different delivery models will be appropriate for some elements of the programme.

6.1.1 DECISION MAKING STRUCTURES

The established structure mirrors the organisation delegations of the project lead.

KiwiRail	Auckland Transport
Projects led by KiwiRail Capital Projects and Asset Delivery follow organisational delegations and large projects are recommended to the KiwiRail Board Capital Committee, and ultimately the KiwiRail Board.	Projects led by Auckland Transport follow organisational delegations, with large projects progressing through Auckland Transport Design and Delivery Committee, and then the Auckland Transport Board.
The Minister of Transport determines project investment levels and takes Waka Kotahi advice into account.	Waka Kotahi determines investment levels.

6.1.2 ALIGNMENT FORUMS

The successful management of programme delivery requires strong alignment through the business case, planning and delivery phases of projects.

Three alignment forums have been established by the Auckland Metro Programme within Capital Projects and Asset Delivery.

The Programme Control Group (PCG) oversees the delivery the Auckland Metro Programme from inception to practical completion and is accountable for programme delivery. The PCG includes senior members from KiwiRail and Auckland Transport.

The Programme Governance Board (PGB) includes KiwiRail, Auckland Transport and Waka Kotahi, oversees the Auckland Metro Programme from inception to handover of the asset to Network Services and is ultimately accountable for its success.

The Joint System Governance Group (JSGG) reporting line is the escalation route for any issues which cannot be addressed by the PGB. The representative from each of the PGB member organisations is responsible for reporting back to their respective Boards. The JSGG includes Waka Kotahi and MoT representation, and its structure is shown below.

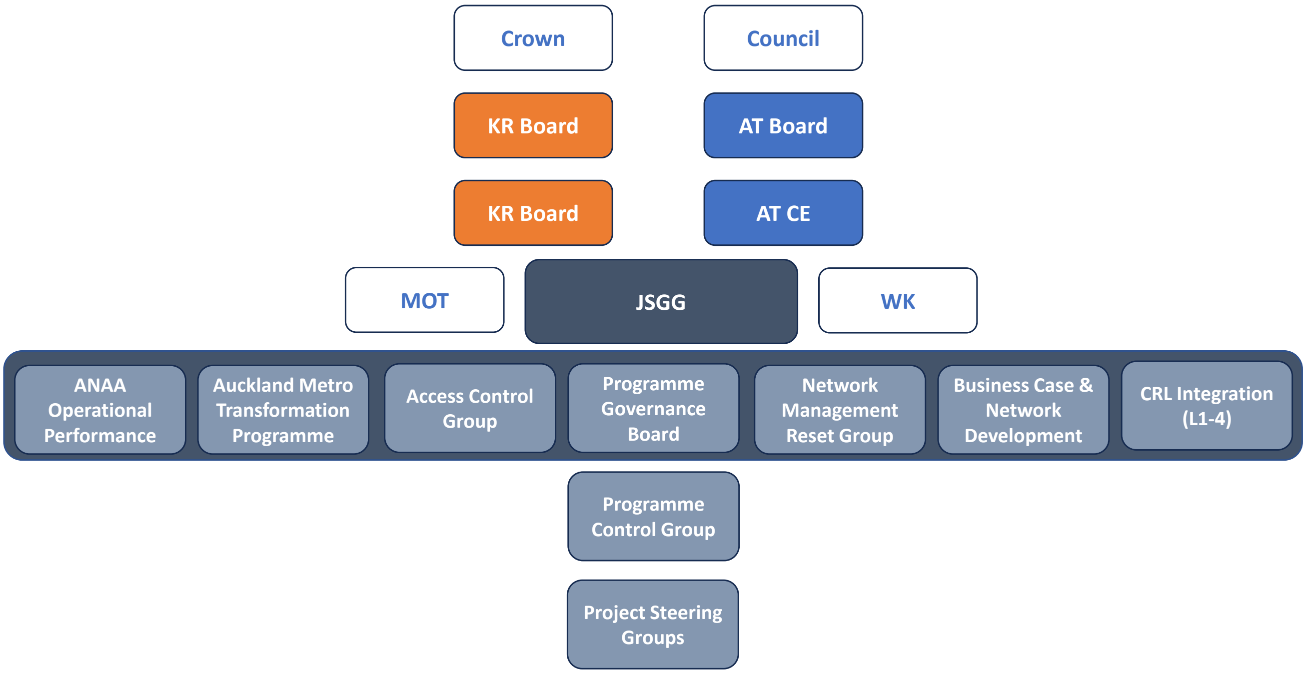


Figure 6-2: JSGG structure

As set out above, delivery project governance is via the PCG and PGB, which report monthly. It is envisaged that business cases and NoR would report periodically via the newly established Business Case & Network Development subgroup.

This subgroup will in turn be informed by steering groups that are being set up for coordination purposes. This reflects the difference in development processes between business cases and projects. Membership of the Business Case Project Steering Group (BCPSG) is made up of representatives from KiwiRail, Auckland Transport and Waka Kotahi, who are all equal partners in the success of the Steering Group.

KiwiRail also has delivery-focussed Project Steering Groups (PSGs) that include broader KiwiRail representatives to support, enable and advise on the following areas:

- Commercial
- Technical and Engineering
- Programme Resource
- Sustainability.

The respective chair of each delivery focussed PSG (except Business Case and NoR) provides a quarterly update to the PCG and papers (as required) for escalation to PGB. The BCPSG provides an update to the JSGG as required. A Steering Group for NoRs is yet to be established but would likely report in a similar fashion to the BCPSG.

Auckland Transport has a Rail Development Programme Control Group (PgCG) to provide oversight of both programme and project level management and decision making. This group acts as the Project Control Group for the constituent projects of the programme. It aligns strategic, operational and delivery elements of the rail programme across Auckland Transport.

It is intended that these groups would also work collaboratively with other partner organisations (e.g., Auckland Council) in respect of wider land use integration, transport system planning, and specific project governance, as required.

An important function of these groups will be to confirm and implement the appropriate delivery mechanisms for each project within the programme and identify the relevant teams within each organisation to progress the tasks.

The decision to formally endorse business cases and lodge project documentation for route protection will ultimately be made in accordance with Auckland Transport and KiwiRail delegation policies for each organisation's responsibilities.

6.1.3 BUSINESS CASE CO-ORDINATION

Recognising the significant pipeline of new rail business cases that will be undertaken over the next decade, KiwiRail, Auckland Transport and Waka Kotahi have established the BCPSG to coordinate the development of rail business cases in the Auckland region.

The BCPSG has no decision-making responsibilities but will provide guidance to support the development of high-quality business cases that are prepared on time and on budget.

The BCPSG will have visibility of the pipeline for Auckland rail projects and provide insights to the JSGG on opportunities to optimise phases, expand the industry capability base and recommend priorities within the pipeline.

The purpose of the BCPSG is to:

- ensure there is visibility of the pipeline of business cases and that they are well coordinated between partner organisations,
- ensure there is an understanding of the interdependencies between business cases and projects across the Auckland transport system,
- ensure the right business cases are started at the right time,
- ensure that high-quality business cases are prepared and submitted,
- test the requirements, scope, and methodology of each business case with the sponsor,
- recommend which organisation will lead and support in order to provide a best 'whole of system' outcome,
- ensure governance processes are followed correctly and risks are appropriately managed by each organisation,
- confirm funding sources and availability,
- provide an overview of the status of business cases throughout their development, and
- track and consolidate lessons learnt from completed business cases, as well as business case procurement.

It is recognised that funding constraints will result in changing priorities over the 30-Year timeframe of the programme. This is a risk to the benefits case and to timelines for delivery. It is proposed that the Auckland Rail PBC becomes the baseline programme for the Auckland rail network. It has significantly better resolution of rail system interdependencies than standard funding processes. For example, between:

- level crossings and maintenance track access,
- the 4-tracking project, stations and level crossings, and
- power requirements and fleet expansion programmes

Variations to timing will be monitored, providing transparency of the extent to which funding or other factors affect programme delivery.

6.2 RECOMMENDED PROGRAMME

The relative priorities to progress individual projects within the recommended programme vary, subject to a range of matters, including:

- urgency – demand pressure (both freight and passenger), central Government climate change commitments, or the timing of related projects can influence the urgency of delivery. Additional capacity and level crossing replacement projects are relevant in this regard,
- contribution to programme outcomes – The extent to which a project contributes to the overall programme benefits including dependencies with other projects, accessibility, resilience etc., and
- financial and delivery benefits – route protection can reduce property and construction costs associated with a project and support early discussions with affected landowners. Benefits achieved can be significant if protection is obtained prior to development. This is particularly relevant for the additional capacity projects that could have significant impacts on privately owned property.

Projects within the Auckland rail network recommended programme have been grouped primarily by geographic location and will be progressed as packages of work according to the following considerations:

- Project type, e.g., physical footprint required, has property and consenting considerations.
- Scope complexity and risk.
- Nature of interdependency between elements and customer outcomes.
- Time pressure to progress - demand triggers for implementation.
- High stakeholder interest / need to earn social licence.

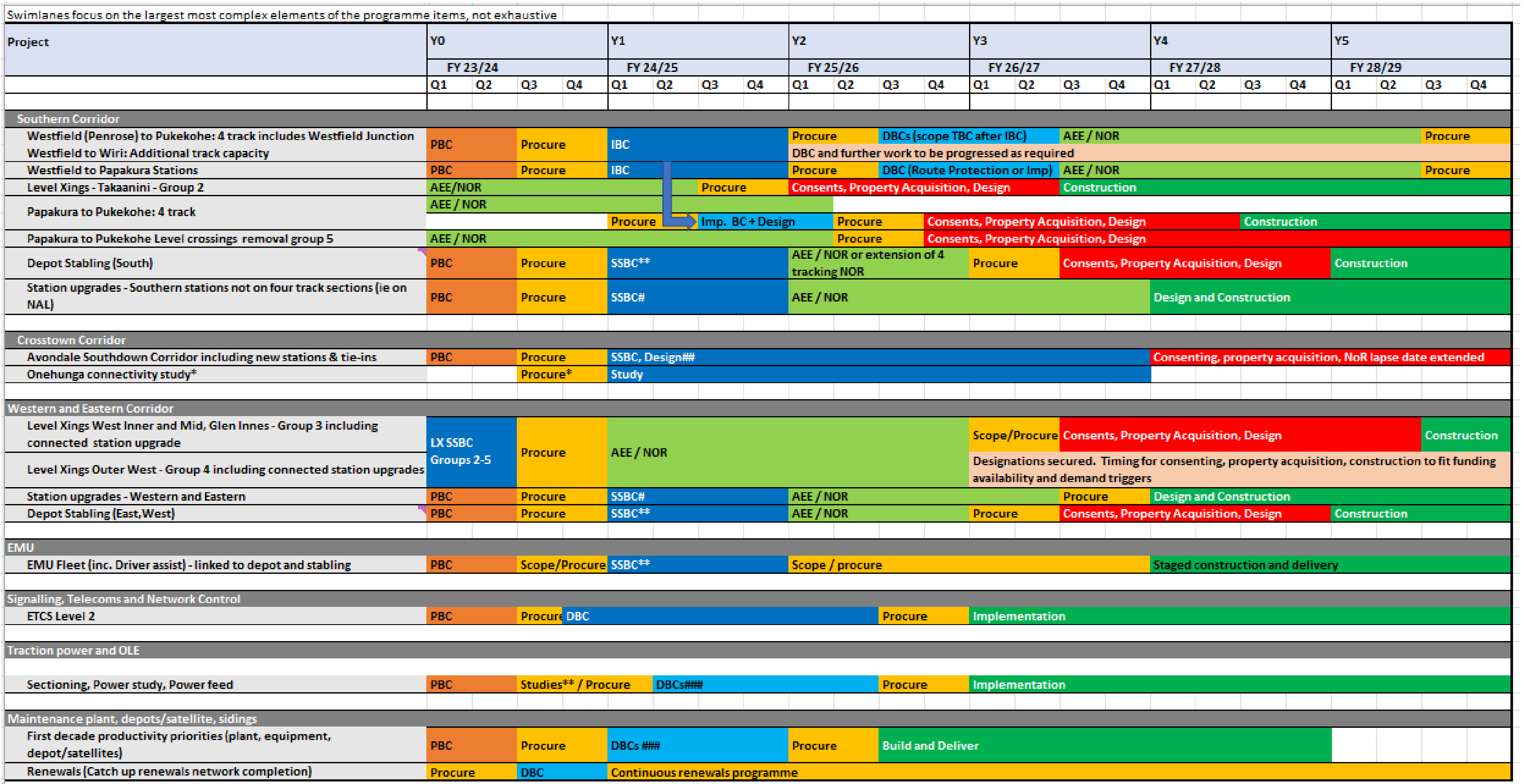
Indicative phasing for each group of projects is shown in Figure 6-3.

For groups without a geographic focus (stations, traction…) the intention of the group structure is to:

- set the asset strategies for these asset classes, and
- enable a delivery pathway for the asset class where a more efficient host project has not been identified.

Prior to the commencement of each phase, detailed scoping will be undertaken. This will consider scope inclusions and exclusions, procurement methods, timing, and delivery mechanisms. As a result, this indicative project phasing may change. Each group is discussed in more detail below.

It is important to recognise that a range of future uncertainties that could influence the grouping, prioritisation, and delivery timing of projects within the programme. Uncertainties could include decisions about the future location of the Port of Auckland and emissions reduction priorities and timing (refer Appendix N). KiwiRail and Auckland Transport are committed to being agile and will regularly review (at least triennially, in line with RLTP requirements) the overall programme prioritisation.



*Study timing ideally has certainty around Light Rail decisions.
** Within one SSBC. Note interdependency to be managed with power study and approach to depot backup power feeds
# Within one SSBC
Extent of design will be influenced by ALR.
If Southern requirements confirmed in W-Pukekohe alignment, interdependencies with Group 1 to be managed

Figure 6-3: Indicative project phasing and approach– Auckland Rail Network Recommended Programme[182]

[182] The Level Crossing SSBC is also assessing crossings on the OBL which are referred to as Group 6.

6.2.1 PROJECT GROUPS

6.2.1.1 GROUP A – SOUTHERN CORRIDOR

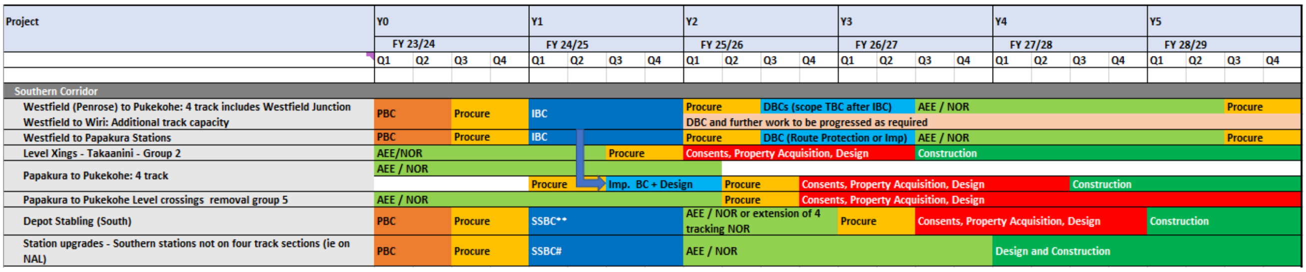


Figure 6-4: Indicative Project Phasing

Southern Corridor: Westfield - Pukekohe additional track capacity, including level crossing removal, is the highest priority project group within the programme from a demand and critical path perspective. It will lift the capacity of the Auckland rail network, improve levels of service, and support more resilience for one of the busiest parts of New Zealand's national rail network.

Auckland Transport has existing priority projects under investigation in this area. A Single Stage Business Case (SSBC) for level crossing removal is currently being progressed. Notices of Requirement for Takaanini level crossings were lodged in November 2023, with a hearing scheduled for early 2024. These projects will be ready to progress to consent, detailed design, and construction by mid FY24/25. The Supporting Growth Alliance has also investigated level crossing removals between Papakura and Pukekohe for route protection purposes, and the Auckland Transport Level Crossing Removal SSBC is confirming the appropriate solution and phasing for all level crossings on the Auckland electrified rail network. A key principle for implementation is that when a section of track is upgraded, level crossings are removed, and stations upgraded at the same time, noting that business case approvals and funding for these components may be managed separately.

This project group has significant scale and complexity and is likely to be delivered in several stages. As the projects within the group progress, the scope of subsequent phases will be further developed and confirmed. These workstreams will be led by KiwiRail, working closely with Auckland Transport due to the interdependency with Group C (Level crossings and station upgrades).

As the projects within the group progress, the scope of subsequent phases will be further developed and confirmed. These workstreams will be led by KiwiRail.

This project group includes:

- **Westfield – Pukekohe business cases** for remaining route protection, property purchase and requirements to enable increased track capacity and station expansion.
- **Westfield to Pukekohe Level Crossing Removal for the Takaanini cluster (Group 2 level crossings) and the level crossings between Papakura and Pukekohe (Group 5 level crossings)**
- **Papakura to Pukekohe 4-tracking**[183], and level crossing removal notices of requirement are planned for lodgement in Q3 2024, with a hearing likely to be held in late 2024 or early 2025.

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[183] Route protection DBC already complete.

The next phase for this corridor section would be to procure consents, land purchase, detailed design and potentially also construction services.

- **Westfield to Papakura 4-tracking.** This project also includes the **Westfield Junction grade separation**, **station upgrades** for this section of line and consideration of whether **further additional track capacity** is required for this section.

This group of projects is located within a constrained urban environment, with existing buildings and other activities operating near the rail corridor. Each is required to consider the extent to which additional capacity over and above four tracks are required. This would require extensions to the existing rail designation and likely substantial impacts on privately owned property. Each project will need to communicate this need and socialise this with key stakeholders and affected parties.

The Westfield Junction grade separation is technically complex and is considered to carry high consenting risk and high complexity. Indicative and detailed business cases have not been prepared for this element and are required before route protection and consenting can be undertaken.

Given the complexity of this group of projects, an Indicative Business Case (IBC) is recommended to first develop and evaluate a range of potential options for the corridor. Following the completion of the IBC, and depending on its recommendations, a number of individual Detailed Business Cases (DBCs) will be scoped to the next level of detail.

Notices of Requirement to 4-track the Papakura to Pukekohe section are planned to be lodged in mid-2024 to secure route protection for this section. A route protection DBC has already been prepared and approved. As such, only an Implementation DBC would be required to reconfirm scope and costs closer to the time of implementation.

The procurement processes for the Southern Corridor group (Group 1), including the 4-tracking business cases, will consider how best to integrate the various components of the group, and whether material cost and overall project time efficiencies can be gained by bundling them into joint business cases. In some instances, this may only require consideration of route protection footprints, rather than for construction, depending on delivery timeframes and urgency. These interdependencies will need to be managed between KiwiRail and Auckland Transport to ensure that delivery of the most urgent capacity improvements in the corridor between Westfield and Pukekohe are not delayed.

There would be some synergy in delivering Group 5 level crossing removals at the same time as the Papakura to Pukekohe 4-tracking project, but these could also be delivered independently of that project.

6.2.1.2 GROUP B – CROSSTOWN CORRIDOR

Project	Y0				Y1				Y2				Y3				Y4				Y5			
	FY 23/24				FY 24/25				FY 25/26				FY 26/27				FY 27/28				FY 28/29			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Crosstown Corridor																								
Avondale Southdown Corridor including new stations & tie-ins	PBC		Procure		SSBC, Design##												Consenting, property acquisition, NoR lapse date extended							
Onehunga connectivity study*			Procure*		Study																			

Figure 6-5: Indicative Project Phasing

The **Crosstown corridor** additional track capacity is the next priority project group.

The **Avondale-Southdown** corridor has a degree of interdependency with the Westfield Junction grade separation and additional capacity projects. It also has interdependencies with Mt Albert and Glen Innes stations (as they are the proposed terminus stations for a crosstown metro passenger service). KiwiRail holds an existing designation for this corridor, which is due to expire in 2029, and owns most of the property within the designation.

From a demand perspective, Avondale-Southdown timing is scenario dependent. In the PBC base case its need is not triggered until later in the 30-Year programme horizon. It is highly interdependent with the Auckland Light Rail project, which is currently working towards lodgement of its Notices of Requirement. It is also interdependent with containerised freight growth to and from Northport.

Early engagement with Auckland Council Local Boards has highlighted that the strategic importance of the corridor to the long-term heavy rail network has not been understood by the community. Consequently, a business case is required to confirm that the designated alignment remains appropriate, to evaluate its inter-relationship with the Auckland Light Rail project, and to inform the reconfirmation of its designation before 2029. Since there is an existing designation in place, an SSBC is considered appropriate to re-confirm the corridor.

The Onehunga connectivity study includes a requirement to confirm the role and function of the Onehunga Branch Line (OBL), stations, and connectivity with the surrounding area. It has a key interdependency with the Avondale-Southdown business case and with the Auckland Light Rail project. Due to these interdependencies, ideally the connectivity study would be considered within a similar timeframe to these two projects. The Level Crossing SSBC will also assess the 8 level crossings on the OBL in further detail.

6.2.1.3 GROUP C – WESTERN AND EASTERN CORRIDOR

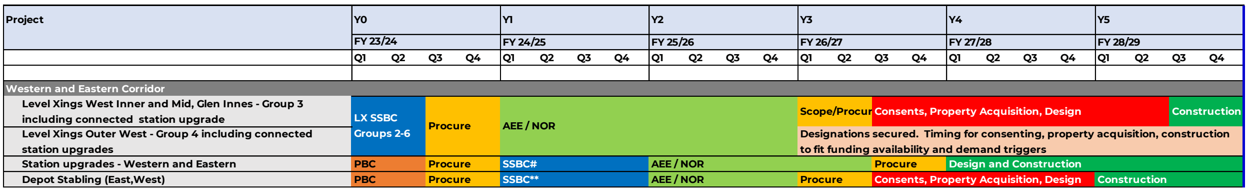

Figure 6-6: Indicative Project Phasing[184]

Projects on the Western and Eastern Corridor are comprised primarily of station upgrades and level crossing removals.

As mentioned previously, Auckland Transport is currently progressing an SSBC for level crossings. This is expected to be complete by mid-2024 and its scope includes level crossings on the Western and Eastern Corridor, Onehunga Branch Line as well as those previously identified on the Southern Corridor. The SSBC will confirm the prioritisation of crossings on the Eastern and Western Line (level crossing Groups 3 and 4).

Group 3 and 4 level crossings and station upgrades could be progressed together, via a traditional route protection, consenting and construction pathway. Because level crossings are often in close proximity to stations, there can be synergy in considering these in parallel, where appropriate. As such, there is an early need to develop a business case that considers station upgrades so that relevant stations can be designated at a similar time as the level crossings, where possible.

[184] The Level Crossing SSBC is assessing all level crossings on the Auckland electrified rail network including those on the OBL referred to as Group 6

The business case will most likely be an SSBC with scope to encompass stations north of Westfield Junction on the Southern Line. This SSBC will consider station upgrades as geographic programmes, but the triggers for construction will vary. For some, there are interdependencies with early level crossing replacements, while others need to be upgraded in response to expected demands post-CRL opening, with the rest upgraded to meet Auckland Transport's Transport Design Manual standards, or due to the increased patronage triggered by the 30-Year investment programme. NORs for the 14 stations not located on sections of line flagged for other works could either be progressed at the same time as the other level crossings and stations, or closer to the time of implementation.

Auckland Transport will be the overall lead organisation for Group C projects. KiwiRail is the landowner of the stations and will, in most instances designate stations works while Auckland Transport will designate road related works such as level crossing removal solutions.

6.2.1.4 GROUP D – EMU FLEET, DEPOT AND STABLING

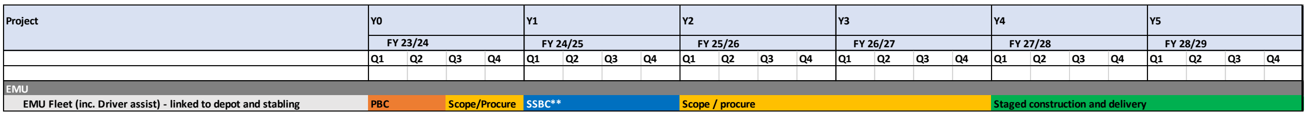

Figure 6-7: Indicative Project Phasing

Figure 6-7 shows indicative project phasing for **EMU fleet, depot and stabling**. These activities are interdependent and need to be progressed in parallel through the business case phase. Furthermore, there is a need to consider the location of depot stabling in the context of investment on the Southern, Crosstown, Western and Eastern corridors. Hence, Group A and Group B include location specific sub-projects that will be advanced from the single EMU Fleet, Depot and Stabling SSBC led by Auckland Transport.

An SSBC is recommended on the base case assumption that all stabling would be progressed as a single programme. A further requirement is Auckland Transport's need for back-up power supplies at each depot when the main traction power system is unavailable. Requirements and funding for this will be led by Auckland Transport, working closely with KiwiRail due to interdependencies with Group E considerations.

A new depot and additional stabling will require additional property outside KiwiRail's existing rail designation and will therefore have additional consenting requirements and a longer timeframe for delivery. Where additional designation footprint is required for the depot and/or stabling, the hypothesis is that KiwiRail will undertake the designation activity, but this will be resolved through the SSBC. Auckland Transport will lead the fleet strategy and procurement elements of this group.

6.2.1.5 GROUP E – SIGNALLING, TELECOMMUNICATIONS, NETWORK SYSTEMS, TRACTION CONTROL

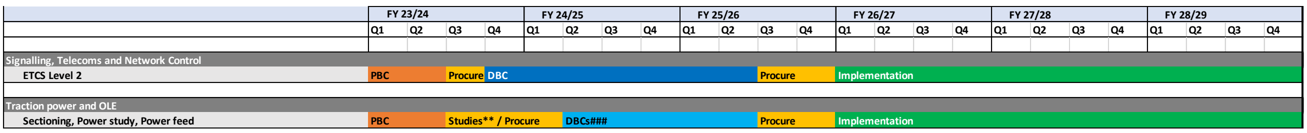

Figure 6-8: Indicative project phasing

Figure 6-8 shows the indicative project phasing plan for **Signalling, Telecoms, Network Control, Traction Power and Overhead Line Electrification (OLE)**. These workstreams will be led by KiwiRail.

While these activities are relatively discrete, there are interdependencies, which is why the asset subgroups are recommended to form part of this grouping. Additional studies and business cases are required to confirm the timing and specific features for each:

- A detailed business case for a network system upgrade to European Train Control System (ETCS) Level 2 is underway; it has telecoms and network control elements.
- Within this group, two projects are important to realising the maintenance productivity objectives:
  - a sectioning DBC and related safety case should be progressed quickly to enable single-line running
  - a study is required on the viability of introducing back-up power feeds to depots to support an additional 30-minute maintenance window
- A power study and business case for upgrading and additional power feeds for the core rail network, and route protection are also urgent priorities due to the lead times with securing additional land and the need for these to be operational ahead of the next tranches of EMU or Electrified Freight.
- Group E will be the parent group for the delivery of system level requirements like ETCS2 and Network Power Feeds and will set the strategy for sectioning and OLE requirements in delivery projects (e.g. Group A). Group E will drive these requirements where a more efficient parent/host project has not been identified.

6.2.1.6 GROUP F – MAINTENANCE DEPOTS, PLANT, AND RENEWALS

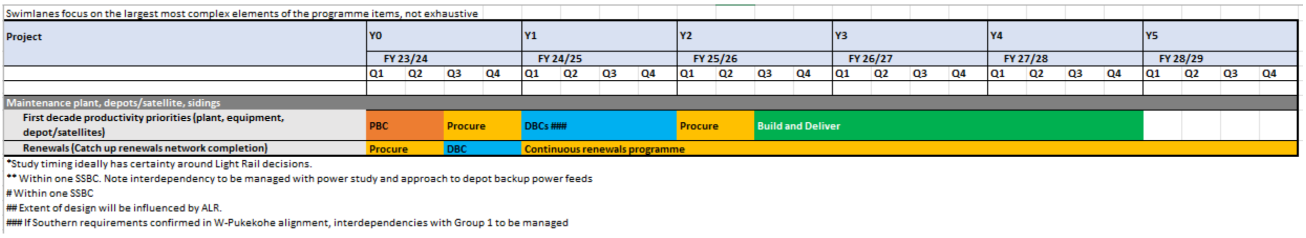

Figure 6-9 – Indicative project phasing

Figure 6-9 shows indicative project phasing for maintenance depots, plant, and renewals. This workstream will be led by KiwiRail. Maintenance satellites / depot, sidings and plant are critical enablers for increasing maintenance and renewals productivity levels and reducing disruption to operations. Due to the critical priority for improving maintenance productivity, and because additional property is likely to be required, there is also some urgency to progressing this workstream.

The business cases in this group are likely to proceed directly to the detailed business case phase. There are interdependencies between the purchase of new plant and equipment, and the maintenance depots and sidings required to house these things, that could be resolved through a joint business case.

There is a need to identify appropriate locations for the satellite /depots and sidings which may involve NORs and property purchase where additional designation footprint is required. Based on early scoping of potential depot locations, a decision will be made whether to integrate the planning and consenting phase with other project groupings such as the Group A – Southern Corridor.

A detailed business case for a new programme of catch-up renewals will also be influenced by the timing of purchase and availability of new maintenance plant and equipment. For this reason, it will be progressed separately from the other business cases in this group.

6.2.1.7 SUMMARY AND OUTCOMES SOUGHT

Table 6-1 summarises the next phases for projects within the programme, noting that there are four broad categories:

- Business cases.
- Route protection – preparation of NoR documentation for lodgement.
- Pre-implementation management – resource consent applications, detailed design.
- Implementation - construction and operational readiness.

It is noted that maintenance, depot and OLE sectioning business cases and their subsequent implementation are urgent and underpin the strategy to reduce operational disruption by improving maintenance and renewals productivity as soon as possible.

Table 6-1: Project group summary

PROJECT GROUP	SCOPE	LEAD AGENCY	OTHER AGENCY	PROCUREMENT METHOD
Southern Corridor – Westfield to Pukekohe	• IBC first covering full scope, then separate DBC and NOR depending on IBC recommendations. • Noting that NOR preparation for Papakura to Pukekohe section is already underway.	KiwiRail	Auckland Transport	Procurement strategy to confirm contract form
Southern Corridor Stations	IBC, DBC for Route Protection or Implementation, NOR, consents, design and construction	Auckland Transport	KiwiRail, station designator[185]	
Takaanini level crossings	Consents, detailed design, construction	Auckland Transport	KiwiRail	

[185] A variety of processes have historically been followed for rail station land ownership, incorporating land parcels within and external to the rail corridor e.g., station access / lifts within the road corridor. For the purposes of the PBC all property costs for station expansion have been allocated to KiwiRail. As Auckland Transport and KiwiRail progress business cases and designs for station upgrades, confirmation of financial responsibilities for project delivery including for land purchase will be confirmed.

PROJECT GROUP	SCOPE	LEAD AGENCY	OTHER AGENCY	PROCUREMENT METHOD
Papakura to Pukekohe level crossings	NOR underway, consents design and construction	Auckland Transport	KiwiRail	
Crosstown Corridor - Avondale to Southdown	SSBC, re-confirm NOR, design, property, consents	KiwiRail	Auckland Transport	
Crosstown Corridor – Onehunga connectivity study	Interdependent with Avondale to Southdown and Auckland Light Rail projects – timing and project scope to be confirmed.	Auckland Transport	KiwiRail	
Remaining level crossing replacement	Finalise SSBC, NOR, consents – grouped according to delivery programme.	Auckland Transport	KiwiRail	
Station upgrades	SSBC grouping programme of upgrades by geographic location, NOR, consents, design, and phased delivery to coincide with level crossing upgrades or demand triggers	Auckland Transport	KiwiRail, station designator	
EMU fleet and depot stabling	• SSBC which considers timing of depot stabling delivery in context of fleet procurement and location in relation to Southern Corridor and Western and Eastern Corridor investment	Auckland Transport	KiwiRail[186],	

[186] The development of new depot / stabling areas for an expanded EMU fleet outside current KiwiRail land ownership has not been undertaken in Auckland recently. Costs associated with the development and delivery of depot/ stabling buildings, facilities and land will be significant. For the purposes of the PBC all property costs associated with new depots and stabling for EMUs have been allocated to KiwiRail. As Auckland Transport and KiwiRail progress business cases and designs for new depot and stabling areas, confirmation of financial responsibilities for project delivery including for land purchase will be confirmed.

PROJECT GROUP	SCOPE	LEAD AGENCY	OTHER AGENCY	PROCUREMENT METHOD
	• NOR, consents, design and construction			
Signalling, telecommunications, network systems, and traction control.	• Traffic Management System (TMS) upgrade, ETCS Level 2 DBC and delivery, • Signal optimisation	KiwiRail	Auckland Transport	
Traction power	• Power study • Power feed DBC, possible NOR and consents, design, and construction • OLE Sectioning DBC[187]	KiwiRail	Auckland Transport	
Maintenance depots, plant and equipment	DBCs, possible NORs and consents, construction and procurement	KiwiRail		
Renewals	DBC and delivery	KiwiRail	Auckland Transport	

In the next five years following the endorsement of this PBC, the following outcomes are sought:

- Business cases undertaken to confirm the recommended rail network and enable investors to make decisions on whether projects will proceed directly to the implementation phase or alternatively to route protect corridors for longer term projects.
- Projects that are required to enable a lift in maintenance productivity and support operational efficiency are implemented.
- Projects that require an increased designation footprint for implementation are route protected.
- Consenting, detailed design and construction procurement begins for projects that already have a confirmed designation or that do not require additional footprint outside the existing designation (e.g., level crossing closures, additional fleet, and maintenance plant and equipment).

[187] OLE sectioning is within the Traction Asset Class and critically enabling to the Maintenance strategy. Further testing is required to determine which team within KiwiRail should lead this business case.

- Programme optimisation - considers minimum technical requirements, the nature of interdependencies and how the programme of indicative projects above are best structured through the business case and NoR processes to balance time, cost and quality.

Group 1 projects, with high complexity, high consenting risk, large footprint requirements, and urgency in terms of delivery to meet demand, require efficient progress of business cases and NORs, to secure physical footprint and to commence negotiations for property acquisition. The timely availability of property acquisition funding is an important consideration for these projects.

Other projects require business cases to evaluate and confirm options for implementation but have smaller footprints, lower consenting requirements or are relatively operational in nature.

6.2.1.8 PROGRAMME DELIVERY APPROACH

The long-term vision for Auckland's rail network is a comprehensive programme to be delivered in its entirety over a 30-Year period. The benefits identified in this PBC are reliant on the delivery of the whole programme. The same range of benefits will not arise if elements within the programme are not delivered. For example:

- The recommended **maintenance and resilience** programme elements are pre-requisites for the success of the overall programme. Without a reliable and maintainable network, including investment in plant and equipment to achieve these outcomes, it is not possible to run reliable, frequent, and fast services. The forecast step-change in usage intensity means the network must become more resilient to climate, with more optionality, and by segregating all-stops and non-stop traffic in order to achieve the desired level of system reliability.
- **4-tracking the Southern corridor to Pukekohe** is needed to enable material mode shift, reduce vehicle kilometres travelled (VKT) and meaningfully deliver on climate treaty objectives.
  - 4-tracking will provide attractive frequencies and express services for passengers with the longest journey times. Passengers between Papakura and Pukekohe have the longest journeys and therefore have the greatest impact on Auckland's emissions and congestion reduction. 4-tracking also enables growth from beyond Auckland's southern border. Mode shift for these passengers delivers the greatest economic benefit.
  - Freight demand cannot grow beyond the early-mid 2030s until 4-tracking delivers the capacity to enable longer freight trains to operate188. Freight services provide the greatest economic benefits on a per-train basis, and therefore are fundamental to deliver the outcomes sought by the programme. Unless 4-tracking is extended to Pukekohe, freight benefits can only be achieved at the expense of the equally valuable passenger services.
- The **crosstown Avondale-Southdown corridor** delivers a significant proportion of the overall programme benefits. This corridor removes most freight services from the inner network, enables express services from the Outer Southern network to continue past Westfield Junction

[188] There are practical limitations on the frequency of freight trains including into and out of ports. It is not feasible that trains can be unloaded and reloaded in time windows as small as 30 minutes (as implied by assumptions that 2 slots per hour = 48 tpd). However, longer trains can be turned around as quickly, or nearly as quickly, as shorter trains. This is one of the main reasons why longer freight trains need to be enabled before freight can grow beyond the mid-2030s.

to the inner network and significantly improves network resilience. It also creates significant optionality for future passenger services. The PBC includes an option for a crosstown route using this corridor, connecting Henderson and Glen Innes.

- The 'outer loop' or 'figure 8' across the isthmus created by this corridor offers multiple future metro passenger service options that can enhance Auckland's connectivity[189], similar to the inner-loop created by the CRL tunnel. Freight and metro services can be compatible at low utilization levels, but in a high-utilisation environment, the right investment is required to enhance service reliability and safety.
- For the national freight and logistics industry, the Avondale-Southdown corridor significantly enhances operational efficiency as the North Island Main Trunk (NIMT) Line effectively extends between Wellington and Whangarei, reducing freight reliance on the inner Auckland network and allowing it to be utilised for more intensive passenger operations.

These outcomes will noticeably enhance the attractiveness of both freight and passenger services, enabling the mode shift required to deliver the scale of benefits identified for the PBC programme. Figure 6-10 shows the network enabled by the crosstown corridor.

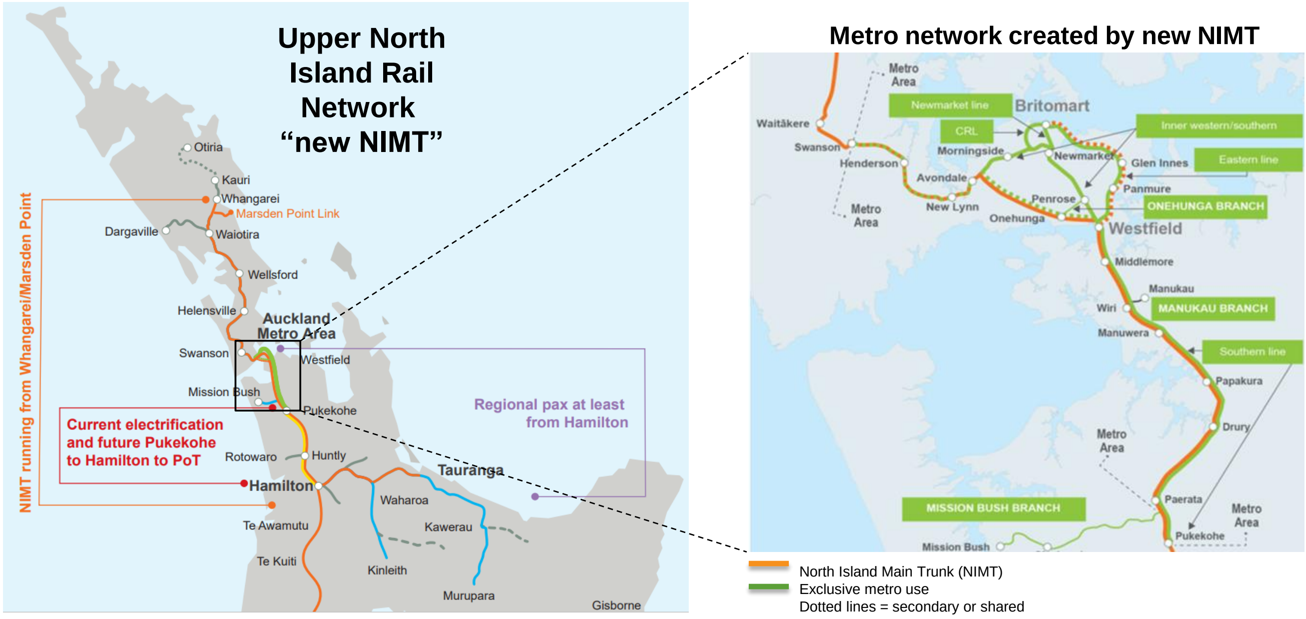

Figure 6-10: Future Auckland Rail Network local, regional and national strategic context

- **Level crossing removals** are also an essential programme element. If level crossing removals are not implemented, the increased train frequencies required to accommodate forecast growth in passenger and freight demand would require extremely high barrier-down times of up to 50% during peak hours. The PBC does not include road user benefits of avoiding these

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[189] This optionality extends to other future corridors, such as the North-west Rapid Transit corridor (which could link into the existing rail network on the Western Line in the vicinity of Morningside). This is unlikely to be possible without precluding future growth of rail freight north of Auckland or movement of the Auckland port, unless the Avondale-Southdown corridor has already been developed such that freight does not need to utilise the inner Western Line. The rail network in Auckland is part of the wider national network and planning is not sound without considering impacts on all of the markets that rely on it.

delays as this will be assessed by the Auckland level crossing SSBC using network traffic modelling of all modes. The PBC assumes that increased services and passenger mode shift expected from this PBC requires that level crossings are removed.

- Station upgrades are an important element in enabling access for more people to the network, as well as service quality enhancement contributing to mode shift.
- Fleet, depots & stabling, additional services and capacity require a sufficient train fleet and places to stable and maintain them.
- System investment in power, network and signalling are critical to network operation and the programme.

The PBC has identified a significant package of benefits (and economic benefits) at local, regional, and national levels that will result from the successful delivery of the recommended programme. These benefits arise from the interactions of the whole programme, not its separate component parts. If parts of the programme are not delivered, then the benefits will also not be delivered. It is therefore the view of the joint KiwiRail and Auckland Transport team that the programme should be considered, funded, and delivered as the holistic package identified.

The following sections discuss the governance, key activities, roles and responsibilities, risks, and stakeholder engagement requirements applicable for each stage. This is followed by some additional overall programme management considerations.

6.3 BUSINESS CASE AND ROUTE PROTECTION MANAGEMENT

This section describes the approach to managing the next phase of each project or group of projects within the programme. Most projects will require a business case. Some have additional footprint requirements that will require an alteration to the rail corridor designation. Some can be delivered using existing business as usual mechanisms within each organisation.

The management of these processes is shown in Table 6-2 below.

Table 6-2 Management of the business case and NoR process

STAGE	MANAGEMENT
Indicative, Detailed and Single Stage Business Case	• The decision to formally submit and endorse documents will be made by the respective Auckland Transport and KiwiRail Boards for all projects as per current processes for both organisations. • Prior to this, owner endorsement from relevant subject matter leads will be obtained, as per each organisation's Quality Assurance processes and any 'pre-Board' committees as required. • To ensure that the documents prepared are appropriate to the review panels within each organisation and to the funder (Waka Kotahi) regular (monthly) meetings will be established with the Investment Quality Assurance team within Waka Kotahi and both owner organisations (Auckland Transport and KiwiRail) to agree levels of detail and standard approaches prior to submission.

Notice of Requirement	**Lodgement** • The decision to formally lodge documents will be made by the respective Auckland Transport and KiwiRail Boards for all projects as per current processes for both organisations. • To ensure that the documents prepared are appropriate to the receiving authority (Council) regular meetings will be established with the regulatory arm of Council to agree levels of detail and standard consent conditions (if applicable) prior to lodgement. • Once the decision is made to lodge, and documents are formally lodged; the lead project planner will manage the interface with the receiving authority (Council) and the hearing processes on behalf of the specific requiring authority (Auckland Transport or KiwiRail). **Hearing** • Leading into and during any hearings there is a need for fast decision making in respect of a number of key aspects, including conditions, submitter negotiations and requests from the hearings panel/court. • Both Auckland Transport and KiwiRail have considerable experience in managing these dynamic situations and the project team will work closely with the requiring authority (Auckland Transport or KiwiRail) to ensure that the required delegations and decision-making approval processes are in place prior to lodgement.
Property agreements	Where the identified route protection mechanism does not include a designation process, such as a developer agreement, the following steps will be undertaken: • Project team working closely with Auckland Transport and/or KiwiRail property teams providing technical advice to negotiations. • Auckland Transport and/or KiwiRail will develop agreements with relevant developers. • Auckland Transport and/or KiwiRail property teams will remain the ‘custodian’ of the agreement and ensure any conditions are undertaken and the agreement is monitored and actioned as required.

6.3.1 PROPERTY

The scale of property acquisition likely to be required is such that an approach to secure strategic properties in advance of construction is recommended. Whilst the majority (80%) of property purchase is typically anticipated in the three years prior to implementation of a project, there are anticipated to be a number of strategic acquisitions that could occur prior to route protection being enacted, or during the route protection process.

Where additional footprint outside the existing rail corridor is required, detailed business cases and notice of requirement documentation will confirm the extent of requirement and develop a property strategy. The property strategy will identify any strategic acquisitions and recommend an acquisition approach specific to individual properties.

Typically, the purchase and ongoing management of property purchases will be undertaken by the purchasing entities (requiring authorities), applying business as usual acquisition policies. Both Auckland Transport and KiwiRail have well proven property management processes and dedicated teams in place to manage these property purchases and the ongoing management of these properties.

6.3.2 RISK AND OPPORTUNITY MANAGEMENT

The Auckland Rail programme is a large programme comprised of multiple projects. There are a range of policy and land use uncertainties which transpire into risks and opportunities. These must be managed appropriately, to the extent possible, to enable successful delivery.

A risk register has been developed and endorsed by the KiwiRail and Auckland Transport governance team. The risk management process is consistent with typical risk management processes undertaken by Auckland Transport and KiwiRail and has been prepared in accordance with Waka Kotahi Z/44 requirements. Appendix M includes details of the methodology undertaken to identify and manage risk for the Auckland rail programme.

6.3.3 ENGAGEMENT

Auckland Transport and KiwiRail have experienced teams responsible for leading an ongoing engagement and consultation programme. Communications to external stakeholders and wider public will be delivered collaboratively. The purpose of this plan is not solely to 'engage' with partners and stakeholders, but also to collaborate with and empower others, particularly partner organisations who have their own roles and responsibilities in the delivery of an integrated urban transport system and sustainable land use pattern (e.g., Waka Kotahi and Auckland Council).

A Communications and Engagement Management Plan has been prepared which outlines key phases of engagement and responsibilities.

The general philosophy is that engagement levels broaden through the project delivery cycle. Communication at the programme level is being approached in four key phases:

- Phase I – seeking feedback on the strategic direction and programme recommendations from key stakeholders and partners.
- Phase II – explain what the programme involves and offers to the public, customers, suppliers and transport associations / interest groups.
- Phase III – programme wide updates, post submission of PBC.
- Phase IV – project delivery updates for NoRs, Business Cases or Delivery.

Phase I has occurred. Four mana whenua hui have been completed and workshops and business meetings have been complete with 17 local boards. Mana whenua and the local boards requested ongoing involvement in future planning and delivery stages and to start community engagement early. Resolutions received in support from 16 LBs[190]. Maungakiekie-Tāmaki local board opposes the Avondale to Southdown corridor.

Phase II will follow submission of the PBC to the Auckland Transport, KiwiRail and Waka Kotahi Boards. To support Phase II online collateral is being developed to:

- enable the key programme messages to reach as wide an audience as possible; and to;
- explain the criticality of the level crossing removal programme and the role of the Avondale – Southdown corridor.

Phase III and IV – these stages will utilise a variety of engagement tools and tactics which may include local and central Government relations, community specific events, communication collateral, surveys, newsletters, and media engagement. Table 6-3 provided more detail of this.

Table 6-3 Engagement during preparation of business cases, NoR and delivery phases

Theme	Programme Wide response	Project specific response
Mana whenua	• Regular hui to communicate progress and discuss specific project activities.	• Regular hui. • Discussions around impacts and mitigations on specific sensitive locations
Public engagement	• **Continue to build understanding** of wider Auckland rail network progress and the process of business cases and route protection as set out in the Programme Wide Comms and Engagement Strategy • **Inform stakeholders about the processes for route protection** (e.g., via e-updates, meetings, and website information) and provide an opportunity for participation (i.e. submission on the NoR or similar as appropriate).	• Develop project specific engagement plans and materials for each project. • Identify potentially affected land owners and arrange meetings to explain likely implications for their properties. • **One-on-one engagement with landowners / developers** (e.g., meetings) regarding potential effects and opportunities for shared alignment in outcomes (e.g. through developer agreements)
Stakeholders	• Provide information (and seek feedback) on staging and timing for the preferred network, including specific opportunities for sequencing (e.g., meetings with utility providers regarding integration of utilities within the future transport corridor).	• Ongoing attendance at existing stakeholder forums.

[190] Key themes of feedback from the resolutions were to advocate that funders meet their obligations across the 30-year programme; support a well-maintained and reliable network; support rail connections for passengers in the north (across Waitematā and north of Swanson); support adding utilities to rail corridors, as work is completed.

Theme	Programme Wide response	Project specific response
	• Ongoing workshops and communications with Programme-wide stakeholders and stakeholder groups e.g., Development/Freight/Road Users Group, Active Modes/Public Transport Advocacy Group and Environmental/Social Impact Group	
Environment	• Further understand specific issues/ environmental/ urban development effects and opportunities in the preferred network to identify potential design responses and environmental management / mitigation (for route protection documentation	• Will be considered in more detail as part of the preparation of assessment of environmental effects documentation.
Property	• Identify opportunities for Auckland Transport and KiwiRail to undertake early property acquisition (e.g. willing buyer/willing seller arrangements.	• Information to be passed on by project team to appropriate owner organisation.
Decision makers	• Enable programme leadership team to inform decision makers on the risks and opportunities of potential business case and route protection mechanisms for the preferred network.	• Regular update of risks and opportunities registers. • Project team to work with Owner Interface Managers to allow briefing into owner organisations.

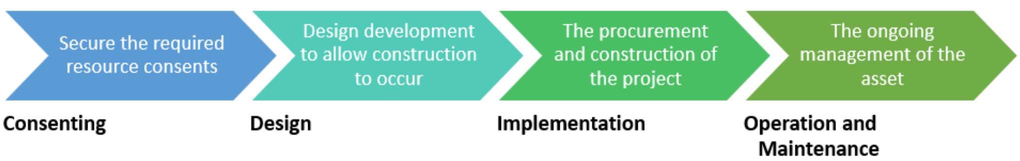
6.4 PRE-IMPLMENTATION MANAGEMENT

This section covers the management of tasks after the designation has become operative.

During this phase of the programme the key tasks could include:

Table 6-4 Key tasks post designation

TASK	COMMENTARY
Management of designations obtained in previous phase.	This could include the management of conditions and the potential for monitoring lapse periods as required. The requiring authority for a project will be responsible for the management of a specific designation. Both Auckland Transport and KiwiRail have existing and proven systems for the management of these designations.
Scoping, procurement, and delivery of required implementation DBCs for longer-term projects.	Where longer term implementation timeframes are identified for projects within the programme, the DBCs undertaken will focus on the case for investment to route protect the identified preferred interventions. For these projects. given this route protection focus, there will need to be a further investment 'gate' to confirm the case for investment in the implementation of the identified interventions when required in the future. This subsequent investment decision will require appropriate information.

TASK	COMMENTARY
	It is proposed that this sits within the business case framework as an Implementation Detailed Business Case (ImpDBC). The scope of each ImpDBC will be informed by the specific intervention but is anticipated to include: • Review of any changes in critical assumption since package DBC completed. • Further design development. • Site investigation. • Review for asset management (maintenance opportunities and prioritisation). • Sustainability. • Shutdown and disruption management. • Safety audit. • Parallel estimate. • Consenting strategy. • Delivery programme. • Confirmation of funding sources. • Inter-dependences with other projects and any critical triggers. • Procurement strategy. • The scoping of this ImpDBC will be undertaken by the lead entity for the intervention and it is recommended that: • Scoping is undertaken at least three years prior to planned implementation. • The ImpDBC is completed at least one year prior to planned implementation, earlier if property issues are anticipated.
Scoping, procurement, and delivery of projects to implementation	Once a project has funding (through acceptance of DBC or ImpDBC) the next stage in the implementation of the project will include four stages as shown in Figure 6-11 below.  Figure 6-11 Project implementation Depending on the project, there will be a range of different options to deliver each of these stages. For example, consenting, design and implementation could all be procured separately from one another, or in one collective contract (such as an Alliance).

TASK	COMMENTARY
	This will be very dependent on the project risks as defined in the DBC or ImpDBC. It is anticipated that the DBC/ ImpDBC will include a procurement strategy that will outline in detail how each of these steps will be procured and managed. Both Auckland Transport and KiwiRail have the systems and capability to successfully manage the procurement and delivery of each of these steps.
Purchasing and management of property acquisitions.	Typically, most property purchase for a project is anticipated in the three years prior to implementation. Both Auckland Transport and KiwiRail have well proven and tested property acquisition and management processes and dedicated teams in place to manage these property purchases and the ongoing management of these properties.

6.4.1 RISK AND OPPORTUNITY MANAGEMENT

Both the Auckland Transport and KiwiRail delivery systems and processes have risk management at their core. In terms of the key, critical risks envisaged at this time for this stage of the programme, these are considered to be:

- Availability of funding for implementation of maintenance, renewals, property and projects, resulting in:
  - Risk to network performance and levels of service caused by continuing de-prioritisation and funding deficits for maintenance and renewals, and
  - critical infrastructure elements being delivered further behind demand, or being delivered piecemeal, comprising overall programme benefits.
- Significant landowner opposition to elements of the programme resulting in delays through the court process, reputational damage, and media coverage. An increased need to respond to concerns from landowners drains resources from other project areas.
- Major service disruption during construction resulting in impacts on services to customers, and consequently demand uptake, and compromised ability to perform required maintenance.
- Construction of ALR precludes Avondale – Southdown: There is a portion of the Avondale - Southdown corridor between Sandringham and Hillsborough that ALR seeks to use. There is a risk that ALR, if it proceeds, does not adequately provision for future heavy rail which causes the Avondale-Southdown project to be either precluded or made significantly more costly and disruptive (i.e., requiring more land take) or practically precluded.
- Other notable risks identified include impact of construction on services, potential for service metro service expansion to compromise the PBCs recommended maintenance window, the potential for key elements of the programme to be deprioritised, compromising the overall network strategy (including the level crossing programme in particular), and deliverability risks due to the availability of the market to respond to a 'peaky' programme of works.

- These risks (and others identified currently in the programme risk register (Appendix M), and that will be identified closer to the time), during the scoping and the continued project development phases will need to be proactively managed to ensure the successful implementation of the projects moving forward. The programme should monitor the findings from City Rail Link (CRL) reviews to identify lessons which can be drawn, particularly for the larger projects.[191]

6.4.2 PROGRAMME REVIEW

Review of the overall programme is important to ensure programme outcomes are delivered, as progressing the programme without periodic review could undermine the outcomes sought.

The Auckland Rail PBC has recommended project prioritisation within the programme that is currently considered to best deliver the outcomes sought.

A review mechanism is recommended, in six-year increments, to re-consider programme implementation and prioritisation based on the information at that time, including considerations such as scale and pace of development, mode share outcomes, contribution to climate change response, and impacts of policy changes. The six-year review timeframe[192] is intended to align with Rail Network Investment Programme (RNIP)/RLTP timeframes. Given this programme has a 30-Year implementation horizon, it is almost certain that circumstances will change and this have an impact on the delivery and prioritisation of the programme.

6.4.3 BENEFITS REALISATION

Ongoing tracking and measurement are another important aspect of the programme to make sure the outcomes sought are delivered. This is particularly important for a programme of this scale and duration where there is likely to be considerable change in what occurs (such as pace and scale of land use) over this long time period.

The PBC includes a programme wide Benefit Logic Map (BLM). Adopting a BLM approach ensures the benefits of each project align with strategic objectives and help deliver the programme-level benefits. The BLM also allows proposed outputs to be logically mapped to benefits (via outcomes), so that different scenarios can be compared on the basis of their benefits impact. A single BLM for the programme will also:

- Allow subsequent time profiling of benefit realisation to inform prioritisation discussions, by sub-programme and programme.
- Allow more effective and consistent programme communications and stakeholder engagement.
- Minimise the amount of re-work when completing the benefits for the DBCs.
- Inform the consenting strategy.

The BLM will act as a reference document for validating each options' contribution to programme benefits. Analysing options in this way will immediately address the value for money strategic objective, by transparently demonstrating the:

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[191] City Rail Link Interim Review, Phase 1: Preliminary Lessons Learnt Findings, Prepared for the New Zealand Infrastructure Commission, July 2023

[192] Two funding cycles

- contribution towards the desired programme-wide results (benefits),
- return on the investment – expected benefits compared with expected cost, and
- reason for the decisions, especially where there is a cost benefit ratio lower than would normally be required for inclusion in the NLTP.[193]

In addition, value for money also requires investments to be made at the right time. Developing a benefit realisation profile based on when outputs are complete (i.e., when assets are commissioned) will allow resources to be focused on those activities that shift the benefits dial the most. Re-prioritising initiatives if strategic objectives change, or external factors dictate - becomes a simple exercise of re-mapping the outputs and outcomes to the updated benefit set.

Table 6-5 below presents a recommended benefits monitoring approach for the measurable outcomes for the programme. Some of the benefits associated with the programme, such as reduction in CO_2 emissions, are not able to be directly measured since they represent a change relative to a counterfactual and therefore require a suitable proxy instead. In this case, additional patronage and freight tonnage provide a suitable proxy, as increases in these metrics infers a reduction in private car and truck travel.

As projects within the programme develop, more specific benefit realisation plans may be appropriate, and this will be considered as part of the subsequent business case phases for those projects.

It should be noted that over the life of the programme, there will be exogenous factors, such as policy changes, that have an impact on some of the same benefits/measures/metrics as presented here and the monitoring regime should be updated over time to incorporate these effects to the extent possible.

[193] Government Policy Statement on Land Transport, 2021, Section 3.2

Table 6-5 Benefits realisation and monitoring

BENEFIT / MEASURE	APPROACH / DISCUSSION	RESPONSIBLE ORGANISATION AND FREQUENCY
Rail patronage	From a metro passenger perspective, many of the benefits of investing in the recommended programme can be assessed by continuing to monitor patronage levels. Auckland Transport has a well-established patronage monitoring regime which provides regular updates to the Auckland Transport Board. This monitoring will therefore include the successful contribution of the recommended programme to grow rail demand and deliver on the expected patronage of 76million trips by 2051. Peak period service monitoring (as a subset of overall monitoring) will also be beneficial to help track the longer-term recovery post-COVID and be used to reconfirm future rolling stock requirements over time. Baseline: • 21 .3million boardings (annual) – 12 months to 2020, pre-COVID • 11.9 million boardings (12 months to June 2023) Targets: • 43 million boardings (annual) in 2031 – will be depending on recovery post-COVID, Rail Network Rebuild (RNR) • 59 million boardings (annual) in 2041 • 76 million boardings (annual) in 2051	• Auckland Transport • Continue to report monthly as is current practice.
Southern rail patronage	A further layer of monitoring should be undertaken on the Southern Line services to track the rate of growth from the Southern Growth Area to determine whether the expected levels of patronage eventuate. This will be monitored in conjunction with the rate of dwelling/population growth that Auckland Council will be tracking as that is the underlying driver of rail patronage. The rate of development and population increase in the area is largely outside of Auckland Transport's control, but will have an impact on the timing of service changes (e.g., introduction of 9-car services from the south) or network slot allocation.	• Auckland Transport • Monitored as part of overall rail patronage reporting

BENEFIT / MEASURE	APPROACH / DISCUSSION	RESPONSIBLE ORGANISATION AND FREQUENCY
Reduced rail journey times	Station to station journey times and station dwell times should be baselined (once any maintenance activities are completed or track speed restrictions are removed). Once relevant investments from the recommended programme are made (e.g., implementation of ETCS Level 2, additional track capacity), the same journey times should be measured again. The comparison of these two data sets will determine whether the service travel time benefits envisaged by the recommended programme have been successfully delivered. Baseline: • Papakura to Aotea: — 56 minutes on CRL Day 1 (all stops) • Swanson to Aotea — 40 minutes on CRL Day 1 Targets: • Papakura to Aotea: — 45 minutes in 2033 once ETCS L2 is implemented (all stops) — 40 minutes in 2043 once 4-tracking is implemented to allow all day express service operation (express) • Swanson to Aotea — 35 minutes in 2033 once ETCS L2 is implemented	• Auckland Transport / Auckland One Rail • Measure post implementation of the necessary infrastructure and monitor quarterly to ensure the benefits are maintained.

BENEFIT / MEASURE	APPROACH / DISCUSSION	RESPONSIBLE ORGANISATION AND FREQUENCY
Punctuality and reliability of metro services	Auckland One Rail (AOR) currently measures punctuality (arrival within 5 minutes of timetabled time) and reliability (service cancellations) of metro services (refer discussion in the Strategic Case). Some performance issues are outside AOR's control due to restrictions imposed by KiwiRail (discussed below). The recommended programme should materially reduce these restrictions, in turn improving punctuality and reliability KPI performance. Under a more reliable network, target performance (e.g. 95% of services within 5 minutes) could be raised to improve customer confidence. For example, the target could become 98% of services within 3 minutes. In addition, the performance metric could be improved to provide additional insight, as opposed to being binary - within 5 minutes or not. Baseline: • Prior to Rail Network Growth Impact Management (RNGIM)/RNR, AT metro service punctuality was hovering around 95% (on target). Since then (to the time of writing) punctuality has varied between 60% - 95%. • Prior to RNGIM/RNR, AT metro service reliability was consistently around 97% (on target). RNGIM/RNR has had less impact on reliability. Targets: • Retain punctuality target of 95% arrivals with 5 minutes of timetabled time, with banded non-performance (e.g. 5 minute increments). Retaining the same target against a backdrop of increasing service delivery, along with refined performance reporting will track benefit realisation. • Reliability of 97.5% (an improvement on the current 95% target)	• Auckland Transport / Auckland One Rail • Continue to monitor and report monthly as per current practice

BENEFIT / MEASURE	APPROACH / DISCUSSION	RESPONSIBLE ORGANISATION AND FREQUENCY
Improved customer experience	Auckland Transport undertakes a periodic customer satisfaction survey across its transport modes. Improved satisfaction for rail customers would be expected as the programme progresses to reflect the improved level of service that is provided. The regular nature of these surveys means that the impact on customer satisfaction can be assessed as a result of the major step changes in improvement over time. Auckland Transport should review the survey contents to ensure sufficient granularity exists in the measures for rail, as a subset of PT	• Auckland Transport • Quarterly surveys, consistent with current customer insight work programmes
Maintenance hours	One of the important outcomes of the recommended programme is the provision of 6 hours productive maintenance time (on average) per night. In itself, this is not a benefit, but it is a critical enabler of the other benefits. KiwiRail currently measure this (as shown in the Strategic Case) and this should continue to be monitored to ensure it trends in the right direction and gets to the target duration so the necessary level of maintenance activity can be delivered. The other important components of maintenance will be budgets and outputs. Both of these should be monitored and reported as part of the overall maintenance regime that underpins the broader outcomes desired by the programme (i.e., mode shift to rail). Baseline: • Varies by line (2 hours per night on the NIMT (Southern Line), 3.5 hours per night on the NAL (Western Line) – network average is between 2 – 3 hours per night. Targets: • 6 hours productive maintenance (on average) per night by 2044 (once 4-tracking is complete (2042) and operations are bedded down).	• KiwiRail • Monitoring should continue to occur quarterly to monitor maintenance access improvements over time

<table>
<tr><th>BENEFIT / MEASURE</th><th>APPROACH / DISCUSSION</th><th>RESPONSIBLE ORGANISATION AND FREQUENCY</th></tr>
<tr><td>Temporary speed restrictions (TSRs) / network faults</td><td>Specific targets for TSRs or network faults are complex to define, and so have not been at this point in time. As shown in the Strategic Case, KiwiRail monitor and measure a variety of network faults which provide a useful indirect measure of some of the benefits that are expected from the recommended programme in terms of network reliability and performance.

Monitoring the trends evident in the fault data as part of the overall programme monitoring regime will be an important indicator for benefits realisation in conjunction with available maintenance hours and renewals/maintenance budgets.</td><td>• KiwiRail
• Continue to monitor and report monthly as per current practice</td></tr>
<tr><td>Freight service performance</td><td>Similar to the above for metro passenger services, KiwiRail monitors the performance (punctuality and reliability) of its freight services. While overall performance will be subject to impacts outside the Auckland rail network, improvements in performance will be a useful indicator of some of the benefits of the recommended programme being realised.

Similar to metro service performance monitoring, additional granularity could be added to the measurement to increase the available insight (e.g., punctuality bands instead of binary cut-off of 30 mins).

Baseline:
• Prior to RNGIM/RNR, KiwiRail freight service punctuality was between 92% - 97% (below/on target).
• Prior to RNGIM/RNR, KiwiRail freight service reliability was consistently around 98% (above target).

Targets:
• Punctuality target of 95% should be retained, but introduce banded non-performance (e.g., 10 minute increments) as opposed to binary performance (yes/no)
• Reliability target of 95% should be retained, but increase completed trips target above 87%</td><td>• KiwiRail
• Continue to monitor and report monthly as per current practice</td></tr>
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BENEFIT / MEASURE	APPROACH / DISCUSSION	RESPONSIBLE ORGANISATION AND FREQUENCY
Freight tonnage	The recommended programme delivers considerably more capacity for freight on the Auckland rail network. KiwiRail need to be able to monitor services and tonnage through the network to ensure the freight-related benefits are being delivered. It is acknowledged that freight demand uptake is not solely reliant on the recommended programme of investment as it is subject to various commercial and economic factors outside the programme's control. Baseline: • 5.7 million tonnes of freight moved by rail on the Auckland network in 2019 Targets: • 9 million tonnes of freight moved by rail on the Auckland network in 2031 • 15 million tonnes of freight moved by rail on the Auckland network in 2044 (post 4-tracking) • 18 million tonnes of freight moved by rail in 2051	• KiwiRail • Annual reporting of total freight tonnage and net tonne-km moved by rail should continue by KiwiRail to track demand levels.
Interregional patronage (Hamilton to Auckland)	Given benefits have been estimated relating to interregional services (i.e. Te Huia (or its future equivalent)), patronage on these services should be monitored to determine if they eventuate. It is expected that the investment in H2A rail improvements will be required to measure patronage over time and this can be used to assist in determining the interregional benefits realisation. This monitoring should also include service journey times, to ensure the expected additional travel time savings generated through the Auckland network are realised for interregional services once 4-trcking south of Westfield and signalling system upgrades are in place.	KiwiRail / Waikato Regional Council / Te Manatū Waka

APPENDIX A –METRO SERVICE CAPACITY ANALYSIS SUMMARY

APPENDIX B – METRO SERVICE CAPACITY ANALYSIS DETAIL

APPENDIX C – ROLE OF PORTS

APPENDIX D – FREIGHT SERVICE CONSTRAINTS

APPENDIX E – STRATEGIC ALIGNMENT

APPENDIX F – PROJECT DEPENDENCIES AND INTERFACES

APPENDIX G – OPTIONS DEVELOPMENT REPORT PART 1

APPENDIX H – OPTIONS DEVELOPMENT REPORT PART 2

APPENDIX I – ECONOMIC ASSESSMENT METHODOLOGY

APPENDIX J – APPRAISAL SUMMARY TABLES

APPENDIX K – CAPITAL COST REPORT

APPENDIX L – ADDITIONAL P95 CAPITAL COST SUMMARIES

APPENDIX M – RISK REGISTER

APPENDIX N – UNCERTAINTY LOG