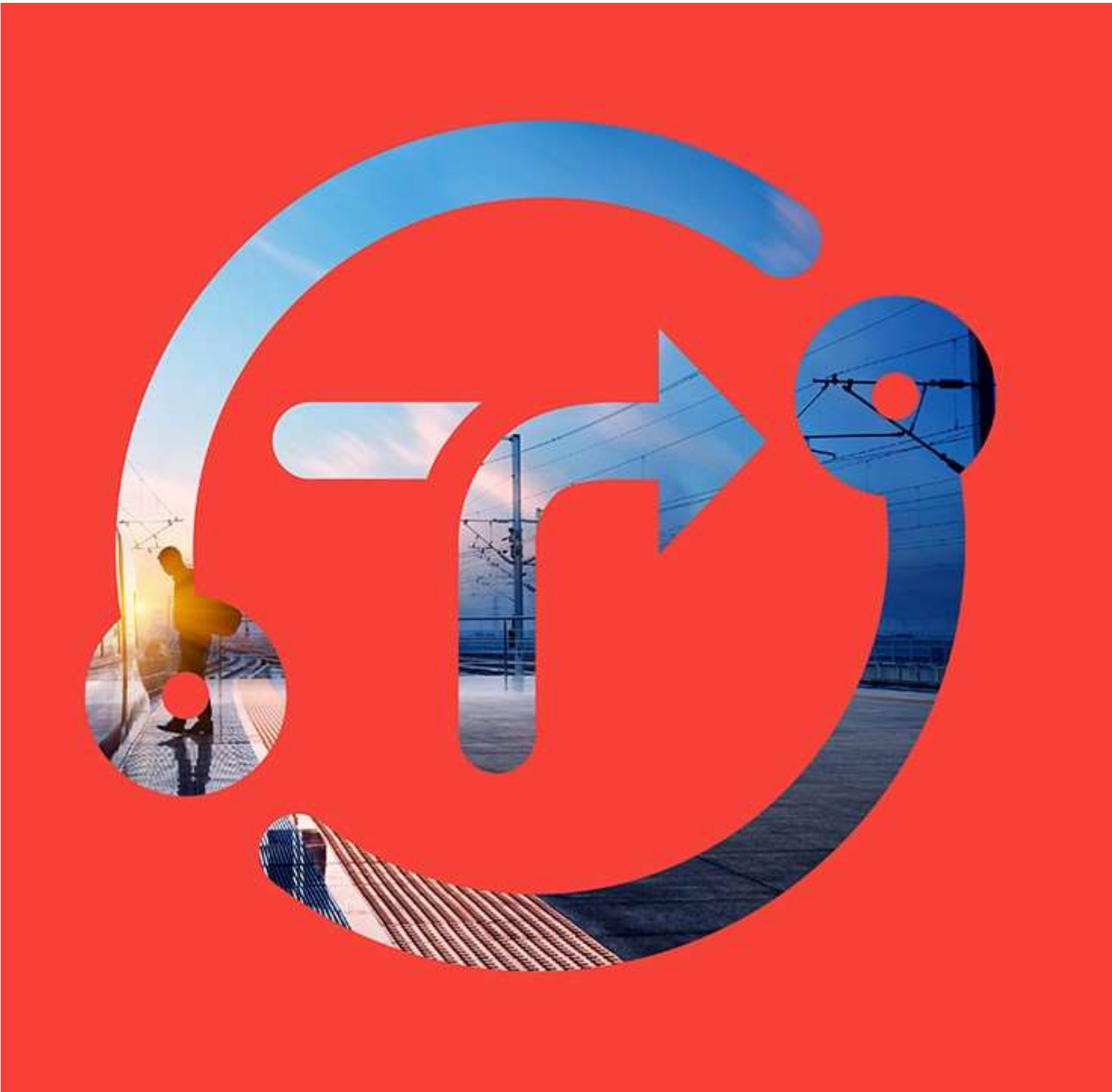
Rail Network Growth Impact Management (RNGIM) SSBC



Executive Summary

Purpose

In 2019, Auckland Transport (AT) on behalf of project partners KiwiRail, commissioned WSP Opus to develop this single stage business case (SSBC) to assess the case for change, optioneering and value for money of 'Catch-up Renewals' on Auckland's Metro Rail Network (AMRN).

This business case sets out the case for using a proportion of the Transitional Rail activity class funding from the National Land Transport Fund (NLTF). The Auckland Regional Land Transport Plan (RLTP) sets aside $125.5 million from 2018 to 2028 to be spent on the AMRN to address legacy issues. The RLTP states the funding is for *"works to address historic formation, drainage and track issues to bring the network up to a modern metro standard. This includes acceleration of some renewal activity to ensure programme is optimised and ensure the network will perform reliably under increased traffic volumes"*.[1]

Context

The AMRN is experiencing a period of significant tonnage growth as a result of increasing patronage, and freight tonnage. This tonnage growth is increasing the rate of wear and tear on the network and together with legacy maintenance issues and aging assets is leading to increasing Track Speed Restrictions (TSRs) and faults adversely affecting rail customers journeys. Exacerbating this, access windows to undertake inspections, repairs, and renewals are reducing and will reduce further when major projects such as the City Rail Link (CRL) are complete.

Analysis of train delay data between July 2016 and June 2019 identified 410,000 delay incidents with a root cause attributable to maintenance and renewals practices (Table 1-1).

There is an urgency to address legacy maintenance issues before major projects come online but also an opportunity to utilise the blocks of line that are required for construction of those major projects to address the legacy issues without causing additional disruption to rail customers.

A High-Level Infrastructure Review (HLIR) was completed in 2019 by WSP-Opus on behalf of KiwiRail that identified rail assets and procedures that need improvement to enable the AMRN to operate to modern metro standards and reduce the incidences of faults and TSRs. The HLIR identified issues with sleepers, rail, drainage and formation, and other rail assets. This SSBC builds on the findings of the HLIR.

Option Development

The project team together with sponsors AT, and partners KiwiRail and Transdev, identified and agreed three problems, six benefits, and three investment objectives, as shown in Appendix D.

Problem Statement One - Investment in the underlying rail network has failed to keep pace with growth, risking the success of planned and major projects and asset failure

Problem Statement Two - Current approaches to operating, maintaining and renewing the network struggle to cope with growth and ageing assets, and are inadequate for a future Metro environment

Problem Statement Three - Time and access for maintenance is limited and reducing with service growth, leading to inefficiencies and limiting progress on renewals needed prior to major projects

[1] Auckland Regional Land Transport Plan Appendix 3 - Rail Network Resilience and Performance Programme – Catch-up Renewals

To address the identified problems, nine intervention types were developed building on the findings of the HLIR. These intervention types cover a variety of interventions that could be delivered by different teams within KiwiRail and over different timeframes. The intervention types include technology, plant and equipment, competency and training, network changes, track renewals, track bed renewals, overhead and project management, standards and rules, and operating expenditure.

A longlist of five options were assessed against a do minimum using a multi-criteria assessment and shortlisted to three options. These three options were evaluated economically to determine a recommended option.

Recommended Option

The Recommended Option (Option 4) was selected over other options because:

- It can be delivered in a timely manner and enable benefits of major projects such as CRL to be fully realised,
- It includes network changes (such as crossovers) that will improve access and enable the network to be maintained more sustainably and safely, and
- It provides high value for money

The Recommended Option will cost $191 million over four years including contingency and excluding the ANAA funding contribution (see Section 10.1 for Project Delivery Costs details). The table below summarises the Recommended Option scope (dark blue) in addition to the do minimum (light blue)

Intervention Type		Detail	Cost	Relative to Existing
Technology		Investment in automated inspection equipment to supplement KiwiRail's ultrasonic rail inspections.	$6.3M	
Plant & Equipment		Additional high production plant to change methodologies like Tampers, PemLems, sleeper layers etc.	$3.0M	
Competency & Training		Investment and modernisation of competency framework. This approach would shift away from a reliance on organic On the Job (OJT) to be replaced with a new platform involving theoretical and practical lead training centre.	$3.5M	
Network changes		6-8 crossovers and sectioning, separate feed for EMU depots.	$15.3M	
Track renewals		Replacement of all rail pre-1975 (91lb and lower) and 50kg rail with rating of >C4 Replacement of all TPR sleepers, and Concrete sleepers pre-1986. Removal of all 91lb turnouts and 50kg turnouts older than 25yrs. Includes Destress sites where records are older than 8yrs.	$57.7M	
Track bed renewals		Allows for replacement of top and bottom ballast. Assumes that 60% of track not being resleepered, or formation upgraded will require ballast. Detailed investigation is required. Required for all resleepering works due to increased sleeper depth + allowance of 25% of remaining track for mudspot remediation. Detailed investigation is required.	$68.0	
Overhead & PM		Project delivery team including Site Management and Rail safety protection.	$25.1M	
Standard & Rules		Change to standards where appropriate. Implement rules to aid inspections e.g. train warning, bi-di blocking or ITD overhaul.	$2.3M	
			$181.2 M	

Figure 1-1 Recommended option - capex only excluding contingency

The results alignment for the Recommended Option is High because it contributes positively to safety and environmental outcomes of the Government Policy Statement, but mostly because of its contribution to the 'Access -liveable cities' outcome through reducing the number of incidents on the rail network that adversely affect customer travel times and reliability – thereby supporting mode-shift, making best use of an existing public transport network, and improving resilience of the network.

The Recommended Option has a benefit cost ratio (BCR) of 5.4 primarily through travel time savings as a result of reduced number of incidents, particularly track speed restrictions.

With a high results alignment and a BCR of 5.4, the Recommended Option has a priority order of 3 under the Transitional Rail activity class[2].

This project will be delivered by KiwiRail's Operations group, as the nature of the works required for the overall scope involves changes to the way railway infrastructure is maintained and operated and the majority of the work is core rail activities.

The project scope will be owned and governed by a joint Programme Governance Board (PGB), which comprises KiwiRail and AT. The Transport Agency is an observer on the PGB as the body providing Transitional Rail funding for the project. The joint PGB also governs other Auckland rail projects within the Transitional Rail activity class ensuring compatibility across the projects.

The indicative budget of $125.5m for this project in the RLTP is less than the Recommended Option delivery costs of $191m, so there is a potential funding gap of $65.5m. This issue has been escalated to the PGB and will need to be addressed at funding activity class level by a high-level review of the project priorities and budget cap, particularly given that other projects within the Transitional Rail activity class are also tracking higher than funding thresholds.

The highest delivery risks are resourcing the workload and delivering on-time to reduce disruption once CRL opens. The Recommended Option includes investment and procedures to reduce these risks through training, early procurement, network changes, and joint governance with other Auckland rail projects.

[2] A new activity class created for the current National Land Transport Programme

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Document History and Status

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Issue 1.3	13 Sep 2019	,			Draft
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Revision	Details
Issue 1.3	Draft issued to project team for review
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Issue 1.5	Draft issued to NZTA IQA for review
Issue 1.6	Full draft issued to NZTA IQA for review
Issue 1.7	Draft for client review
Issue 1.8	Full draft for NZTA

A – Strategic Case

1 Introduction

1.1 Purpose

This Rail Network Growth Impact Management (RNGIM) Catch-up Renewals Single Stage Business Case (SSBC) sets out the case for accelerated investment in rail network renewals to address historic formation, drainage and track issues to bring the network up to a modern metro standard. This is a long-standing issue recognised during previous rail upgrades and provided for in the recently established Transitional Rail Activity Class of the NLTF. The Transitional Rail activity class provides for activities primarily related to 'below-track' improvements on the rail network that enhance the reliability and capacity of the passenger rail service, enabling better access to housing and employment.

1.2 Background

1.2.1 Auckland Metro Rail Network (AMRN)

KiwiRail own, operate and maintain the national rail network, this includes the approximately 190km of track over which metro services operate in Auckland. The Auckland Network Access Agreement (ANAA) governs how metro services access the network and the contribution paid for the operation and upkeep of the rail corridor, bridges, tunnels, viaducts, overhead wires, signals and level crossings. Figure 1-1 illustrates the current rail network in Auckland. Every week in Auckland 78,000kms are travelled by passenger trains, and 370,000 tonnes of freight are shifted by rail (AT, 2016). It is a significant challenge for KiwiRail to manage the rail network under increasing demands from customers with assets fast reaching the end of their life cycle.

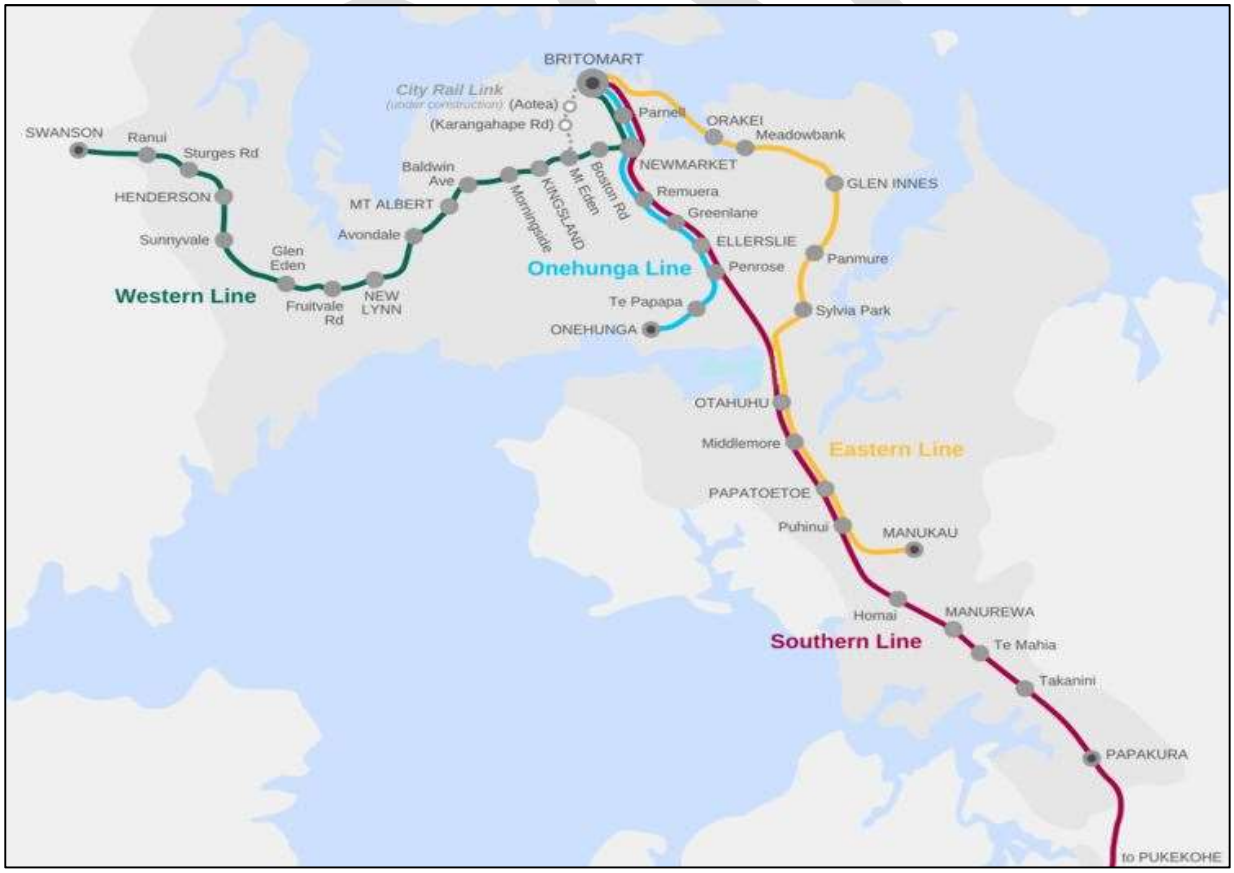


Figure 1-1: Current Auckland rail network

1.2.2 Growth of Rail

Auckland is New Zealand's largest city and home to almost 1.6 million people. Population growth has been substantial over the past few years and is expected to continue to grow by another 700,000 people in the next 30 years. This growth has contributed to significantly increased transport demands on the rail network. From 2013 to 2017 the Auckland population grew by 28% and rail patronage grew by 77% (CRL n.d., MoT 2018). There has been a doubling in the number of services running on the rail network in the past five years. Furthermore, freight tonnage is projected to grow by 50% in New Zealand by 2042 (MoT 2014).

Together with growth of rail customers, there will be growth in the number of rail assets in the Auckland network over the coming decades. This growth will include new, track, electric traction assets, signalling, stations and other rail assets associated with the City Rail Link (CRL) and Supporting Growth Programme.

The Auckland Transport Alignment Project (ATAP) report estimates an increase from today's c.100 million public transport passenger trips to 170 million annually in 2028, with rail currently making up 21% of the public transport mode share but this is expected to increase.

Auckland population grew by 28% from 2013 to 2017

Rail patronage has grown by 20% a year in recent years

Number of services running on the rail network has doubled in the last 5 years

Projected growth of rail assets including four more stations (CRL and the Supporting Growth south area)

Figure 1-2 Growth of rail

As shown in Figure 1-3, the proportion of passenger trains on the Auckland Metro Network is showing a substantial increase of 0.15 billion gross tonne-km since 2018. Meanwhile, the number of freight trains is also growing. This tonnage increase is resulting in increasing wear and tear on the rail assets.

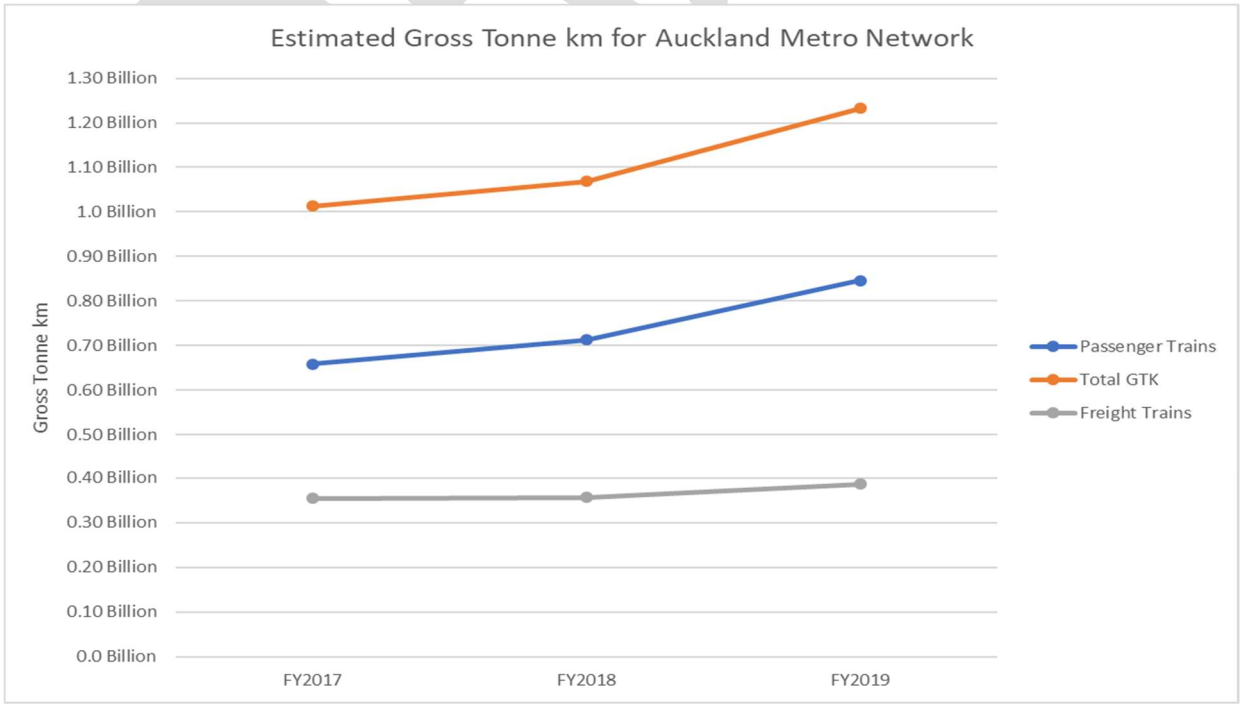


Figure 1-3: Tonnage growth

1.2.3 *Legacy Auckland Rail Network Asset Management*

Whilst rail in Auckland has enjoyed a resurgence on the back of significant investment in rolling stock and network electrification, investment in the underlying network assets, maintenance systems and approaches has not. To ensure the ongoing reliable operation of the network, this must change. Of the national network the Ministry of Transport (MoT) states "*Previous investment in New Zealand's rail network has centred on looking at 'how much' needs to be invested in rail to get the existing network functioning*". Budget 2019 includes $741 million to support rail including the intention to "*restore the track and other supporting infrastructure by addressing legacy maintenance issues across the rail network*" (MoT 2019); $376 million of this budget is included in the current National Land Transport Programme (NLTP) to be spent over three years (2018 to 2021) "*to maintain and improve heavy rail infrastructure in areas where demand is outstripping capacity, reliability needs to be improved, or where there is a need to reduce conflict between freight and passenger trains.. Initial investment will be focused in Auckland and Wellington, where large-scale and reliable public transport is essential to support forecast growth and minimise any increase to the number of vehicles on our roads.*"

As recognised by the MoT, historically the level of investment in maintenance and renewals undertaken on the Auckland rail network has been determined by the level of investment to keep things running, rather than responding to forecast growth or investing to achieve improved and sustainable outcomes for the longer term. Investment has been based on the short term workbank[3] rather than determined by an AMRN wide strategic assessment of asset condition. Available resources and funding have led to a more reactive than pre-emptive maintenance regime. There has been very little scope and opportunity to undertake more proactive works meaning asset management has not been able to keep pace with growth on the network and changing customer needs. This level of resourcing, reactive maintenance approach and age of assets had led to a backlog of renewal activity and a gradual deterioration of the underlying asset to undesirable conditions (see Figure 1-4).

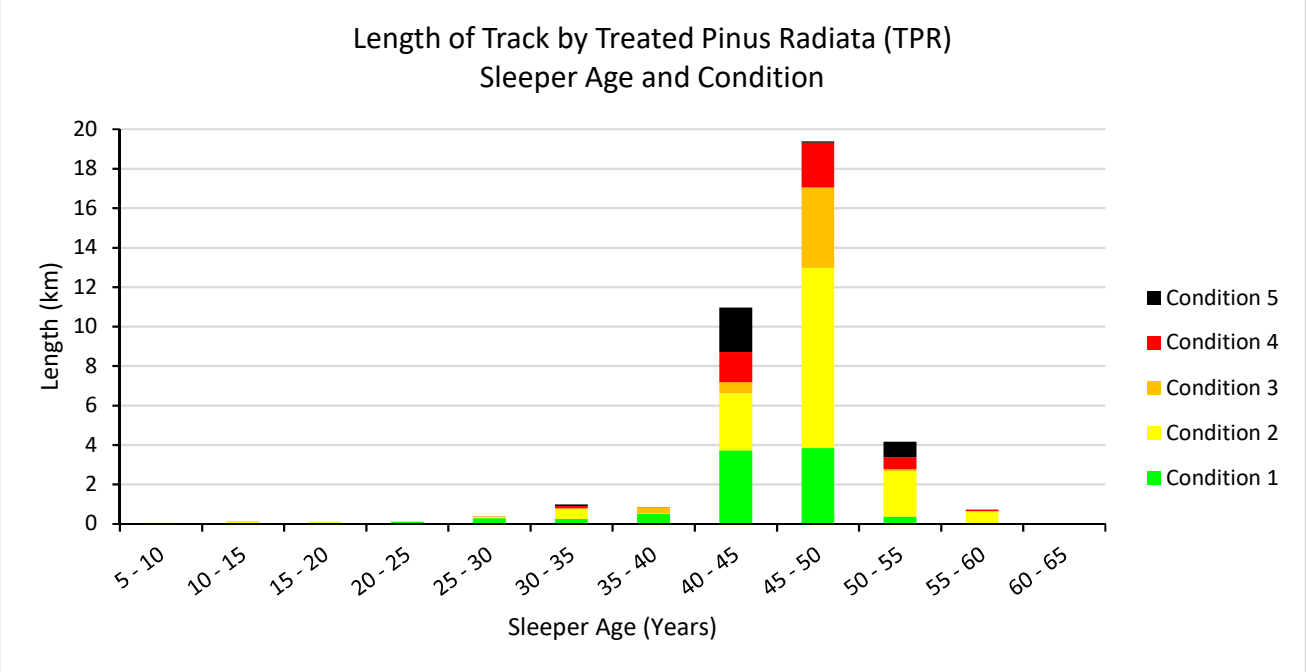


Figure 1-4: Length and age of sleepers

[3] A workbank is a list of forward workload that has been identified and planned by those maintaining and renewing the network, usually forecast over a number of years.

Condition ratings are described in Table 2-1. Due to the complexities in managing the network, there is increasing strain on KiwiRail to provide skilled and available personnel as described in the Auckland Network Management Plan (ANMP) for the Financial Year 2020, which reflects on the difficulties in keeping up with an aging rail network and the limitations created by historical budget constraints.

1.3 Previous Work

In 2019 KiwiRail commissioned WSP Opus to undertake a High-Level Infrastructure Review (HLIR) of the KiwiRail assets on the AMRN.

The HLIR identified deficiencies with physical infrastructure as well as technical skills and procedures in the context of a high usage metro network. The review concluded that an accelerated programme is needed to minimise operational risks and disruptions when CRL commences operations. The HLIR formed the starting point for discussions about the options to be assessed as part of this business case.

Some of the findings of the HLIR include:

- Track Alignment - In multiple locations, deterioration of the track bed, ballast and support components (sleepers and fastenings) has resulted in track geometry misalignments, cyclic top faults and twist faults. Track alignment issues result in Track Speed Restrictions (TSR), which slow passenger and freight journeys. There is a long-term gradual increase of TSRs.
- Rail - Rail repairs have had a relatively low impact on TSRs until recently. The recent increase in TSRs corresponds to more intensive management of Rolling Contact Fatigue (RCF) sites. Other rail defects such as track stability, weld quality and bolt holes associated with previously jointed track have also been identified on the network. A comprehensive rail management strategy is required to address the increasing RCF. Furthermore, there is no dedicated Auckland welding team to ensure welding skills are maintained and enhanced, this is inconsistent with international best practice.
- Sleepers – Approximately 7% of sleepers are older than 40 years and require renewal. Sleeper condition directly affects track stability. A programme of timber sleeper replacement with either concrete or composite sleepers is recommended.
- Rail Fastenings - Fastenings should be replaced with elastic type fasteners.
- Ballast - Significant areas of the network have insufficient ballast depth due to changes in standard ballast depth requirements over the life of the network (i.e. from 200mm – 300mm) or they feature contaminated ballast. The contamination was noticed on recent renewal at Papakura where the material from the shoulder was used to back fill the ballast between sleepers. This approach will reduce the performance of the asset and lead to premature failure of the ballast, formation or both.
- Turnouts - there is an increasing trend of points failures on the North Island Main Trunk (NIMT). The condition of the turnout permanent way components and the underlying ballast and formation condition is likely to be a contributing factor in this deteriorating performance.
- Formation - Much of the formation of the AMRN was constructed to the relevant standards of 100 years ago and doesn't meet current infrastructure standards. Over the period July 2013 to July 2019, formation repair work was the largest single reason for TSRs across the network. A longer-term strategy to formation repairs is required, coordinated with ballast and drainage maintenance or upgrades.
- Earthworks – Embankments across the network tend to have formation widths less than current standards, leading to cases of ballast spilling over the edge of formation, particularly where embankment settlement has led to the track being raised through increased ballast.
- Drainage - Increased inspection and a programme to address areas of poor drainage is required.

- **Structures** – There are inadequate walkways and fall protection for some underbridges. This represents a safety hazard for maintenance workers and can hamper routine maintenance inspections of these structures.

As a result of these failings there have been numerous incidents recorded over the last three years[4] amounting to an average of 152,000 delay hours per year, of which approximately half are attributable to the scope of this SSBC. The number of in-scope incidents are trending upwards by approximately 20% a year. In scope incidents recorded over the last three years are summarised below.

Table 1-1: Top high-level incident causes and delays related to scope of this SSBC

High Level Cause	Delay (hours) and relevance to SSBC scope	
	Relevant	Potentially relevant
Track Speed Restriction	310,492	
Driver Issue *Driver not maintaining run time are known TSRs*	25,771	1,710
Network Control		24,836
Points	22,527	
Network Access	22,424	
Emergency services call out		2,846
Signalling		17,064
Track Fault	16,941	
Train Manager Issue		5,677
Track Detection Metro	12,656	
Total	**410,811**	**52,133**

[4] Incident train delay data for the period 1 July 2016 to 30 June 2019 as provided by Transdev

1.4 Strategic Drivers

This section outlines how this SSBC is supported by and supports national, regional, and local strategies.

1.4.1 National Strategic Drivers

The Government Policy Statement (GPS) on Land Transport 2018-2028, includes a transitional rail activity class that supports investment in "improving urban rail services for passengers accessing housing, major employment areas and major metropolitan areas. This applies particularly to areas where demand is outstripping capacity and reliability needs to be improved or there is a need to reduce conflict between freight and passenger trains". This business case is seeking funding from this transitional rail activity class and is fully aligned with its intent.

This project is aligned with the four GPS outcomes:

- **Access** – The Access outcome states "Transport connections that are classified as nationally important need to be maintained or improved to be of the highest safety, quality and resilience". The AMRN is nationally important but as identified in the HLIR, many of the rail assets are in poor condition and some procedures and standards are out dated and not in accordance with modern metro standards.
- **Safety** – By ensuring the AMRN operates to modern metro standards, a continued mode shift towards rail will be supported, improving the overall transport system safety because rail is safer than road travel. Furthermore, this project seeks to reduce the risk of safety incidences occurring because of poor asset condition, such as the partial derailment that occurred near Britomart in 2018 and also eliminate risk to workers through improved practices e.g. maintenance procedures that reduce need for workers to be on the lines.
- **Environment** – Rail reduces greenhouse gas emissions compared with road. Legacy issues on the rail network are resulting in an increasing number of TSRs and other issues that result in slower and less reliable rail journeys, which in turn will reduce the uptake of rail if not addressed.
- **Value for money** – The GPS emphasises the need for ongoing improvements to further improve the returns from maintenance and will support this through investment in maintenance that improves the performance of the existing network.

Ministry of Transport "Through Budget 2019, a total of $1.042 billion has been approved as the first instalment of rail investments across the decade. This includes $741 million to support a resilient and reliable rail system to: restore the track and other supporting infrastructure by addressing legacy maintenance issues across the rail network …" (MoT 2019). This business case has been prepared in direct response to the need identified in Budget 2019 as it specifically addresses the legacy maintenance issues on the AMRN.

The NZ Transport Agency ("Transport Agency") Statement of Intent, identifies transitional rail, which this SSBC is included in, as providing a primary contribution to liveable communities. The statement also identifies that key rail safety indicators are either stalled or deteriorating.

1.4.2 Regional and Local Strategic Drivers

The Regional Land Transport Plan (RLTP) 2018-2028, recognises that "*Auckland's rail network forms a key part of the city's strategic public transport system and freight network*" and that meeting growing demand will require more passenger and freight trains on the network, increasing conflict between services unless ongoing investment occurs. The RLTP includes $125.5 million to be spent under '*Rail Network Resilience and Performance Programme – Catch-up Renewals*' from 2018 to 2028 on "*Funding for works to address historic formation, drainage and track issues to bring the network up to a modern metro*

standard. This includes acceleration of some renewal activity to ensure programme is optimised and ensure the network will perform reliably under increased traffic volumes".

The Auckland Plan, under the 'Transport and Access' outcome has a focus on making 'better use of existing transport networks including rail' through 'robust asset management processes to ensure we look after existing infrastructure'. Furthermore, this project is aligned with the Auckland Plan outcomes sought:

- Focus 1 – Make better use of existing transport networks including rail:
    - increased investment in small scale improvements that help optimise the network.
    - robust asset management processes to ensure we look after existing infrastructure
- Focus 2 – Target new transport investment to the most significant challenges.
    - new infrastructure and services must upgrade and expand Auckland's strategic rail network to ensure it operates effectively and efficiently as the population grows

The Auckland Transport Alignment Project (ATAP), specifically includes "*Rail network upgrades (Pukekohe electrification, third main rail line, rail level crossing and pedestrian crossing improvements*)" as a new project and "*Further rail network upgrades to enable express and inter-city trains*" as a future priority. These capital works are indicative of the changing rail network within Auckland that this business case needs to be cognisant of and support. Furthermore, ATAP recognises the importance that rail plays in Auckland transport accessibility, and notes that rail is "*providing a dual function of high capacity public transport backbone and strategic freight connections*" and that "*over half of Auckland's future transport investment will need to be on maintaining, operating and renewing existing assets*".

This project aligns strongly with the ATAP outcomes of:

- "*Enabling and supporting Auckland's growth*", it is clear that the road system alone cannot move the people and freight expected with Auckland forecast growth. Major projects like Supporting Growth identify rail as a critical transport element to support growth.
- "*Improving travel choice*" through provision of a reliable public transport service
- "*Congestion and access*" by addressing the reliability and safety of the rail network
- "*Safety, health, and the environment*" through reduction of harmful emissions, greenhouse gases
- "*Value for money*" by getting the best use out of an existing system and using economic analysis as an important part of choosing the preferred option

The Auckland Network Management Plan (ANMP), is a requirement of the ANAA, and sets out KiwiRail's asset management strategy and forward programme of works on the AMRN. The 2019-2022 ANMP identified significant gaps between the work being delivered and the work required to achieve modern metro standards such as a lack of modern equipment for some maintenance activities, ageing assets that are not up to current standards, and procedures that are not up to modern metro standards. The ANMP identifies work required to improve standards such as replacement of 91Lb rail with 50kg rail and replacement of timber sleepers with concrete or composite. This SSBC builds on the work identified in the ANMP.

The Auckland Rail Network High Level Infrastructure Review (HLIR), has built on the findings of previous assessments that have informed the ANMP with further identified problems and requirements for the AMRN (see Section 1.3).

The link between the problems, benefits and investment objectives identified in the project with outcomes sought in national, regional, and local strategic documents is detailed further in Appendix B.

1.5 Partners and Key Stakeholders

The project sponsor is AT. KiwiRail, Transdev Auckland and the Transport Agency are project partners. See Appendix A for list of key stakeholders..

Table 1-2 Project Partners

Organisation	Role and relevance
AT	Project Sponsor. AT will act as conduit for funding between the Transport Agency and KiwiRail.
KiwiRail	Project Partner. KiwiRail maintain the AMRN. They will be responsible for delivering the project.
Transdev Auckland	Project Partner. Transdev operates the trains and therefore will be affected by the outcomes sought by this SSBC and have extensive knowledge on the operation of the rail network
The Transport Agency	Project Partner. Funding is being sought from the Transport Agency, they will also be affected by the outcomes sought by this SSBC.

2 Problems

An investment logic mapping (ILM) exercise was undertaken on 29 May 2019, which involved the key stakeholders identified in Appendix A. The following three problems were agreed on:

Problem Statement One - Investment in the underlying rail network has failed to keep pace with growth, risking the success of planned and major projects and asset failure (40%)

Problem Statement Two - Current approaches to operating, maintaining and renewing the network struggle to cope with growth and ageing assets, and are inadequate for a future Metro environment (35%)

Problem Statement Three - Time and access for maintenance is limited and reducing with service growth, leading to inefficiencies and limiting progress on renewals needed prior to major projects (25%)

2.1 Problem One Evidence

Problem Statement One -

Investment in the underlying rail network has failed to keep pace with growth, risking the success of planned and major projects and asset failure (40%)

Problem one refers to underinvestment in the underlying rail network that if left unaddressed may lead to asset failure and reducing the success of major projects.[5]

The cause of the problem is the underinvestment in the underlying rail network failing to keep pace with growth. This is clear when looking at:

- the age of assets, with assets that are beyond their normal life expectancies still in use; and
- the trend in incidents occurring on the network, such as track speed restrictions and track faults (see Table 1-1), which can be attributed to the condition of the underlying rail assets. Delay incidents are tending upwards by approximately 20% a year. Track Speed Restrictions, which make up the largest proportion of incidents, are showing an increasing trend as seen in Figure 2-10.

[5] Investment in the underlying rail network can be defined as expenditure on operating, maintaining and renewing the Auckland Rail Network assets including track systems, signals, points, crossovers, junctions, structures, traction equipment (including overhead line equipment and substations), depot facilities and equipment. It excludes fleet (rolling stock) and train stations.

KiwiRail's condition rating system assigns a score to assets to describe condition (Table 2-1).

Table 2-1: Descriptions of Condition Ratings (KiwiRail, 2019)

Rating	Description
Condition 1	Asset meets code requirements
Condition 2	Asset meets code requirements, but some deterioration noted
Condition 3	Asset requires planned intervention to meet code requirements
Condition 4	Asset requires urgent intervention to meet code requirements
Condition 5	Asset likely to require intervention or Track Speed Restriction to mitigate

As shown in Figure 2-1, a significant length of the network contains condition 4 and 5 sleepers, which need urgent intervention to meet code. The length of sleepers at condition 4 and 5 is significant because failure of even a small section can significantly affect the operation of the network since there are no alternative rail routes i.e. failure on one part of a line will likely result in closure of the whole line with trains unable to re-route and therefore rail passengers and freight being delayed or needing to use alternative modes (buses etc). Of the condition 4 and 5 sleepers those that are under 20 years old are Hardwood South American (PDS), and those over 20 years old are Treated Pinus Radiata (TPR) as shown in Figure 2-9. Condition 5 sleepers likely require TSRs to maintain safety.

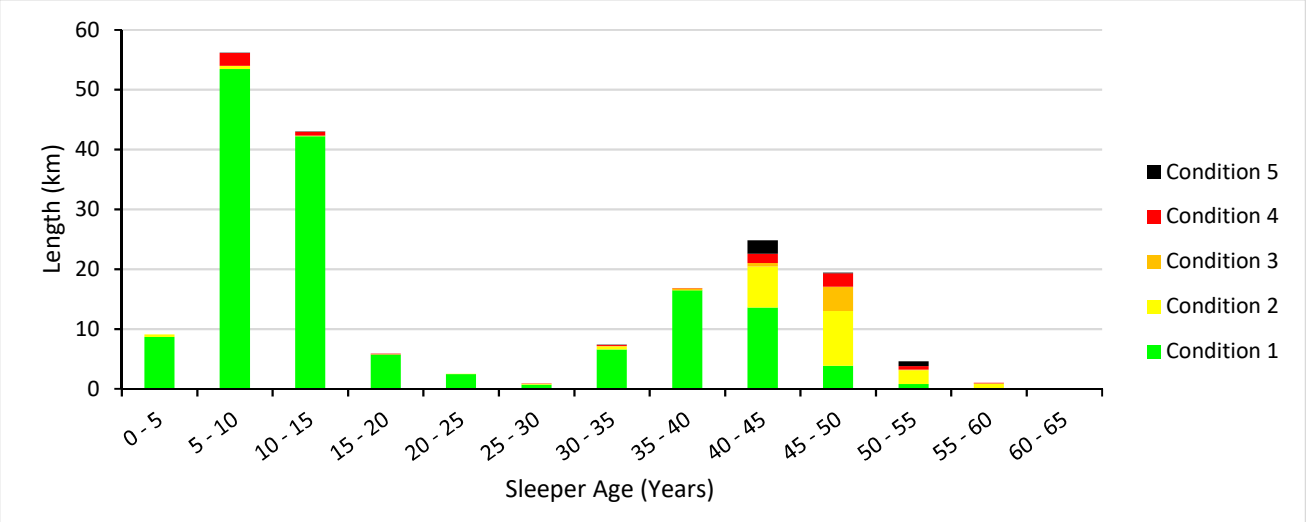


Figure 2-1: Length of Track by Sleeper Age and Condition for all Sleeper Types

Not only are sleepers in poor condition but the track that is laid on top of them is in poor condition too, as shown in Figure 2-2, Figure 2-3 and Figure 2-4, which demonstrate the volume of 91lb and pre-1975 rail on the Auckland network.

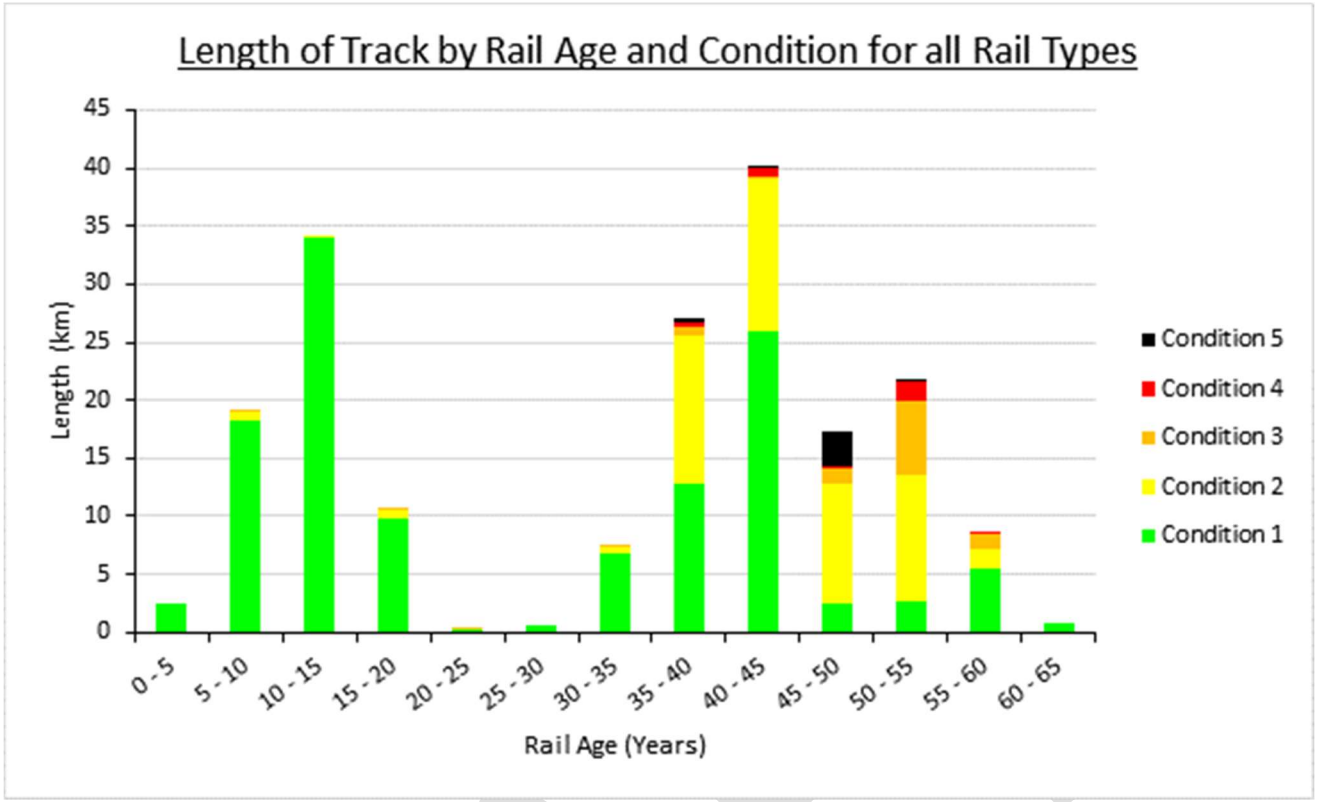


Figure 2-2: Length of track by rail age and condition (2019)

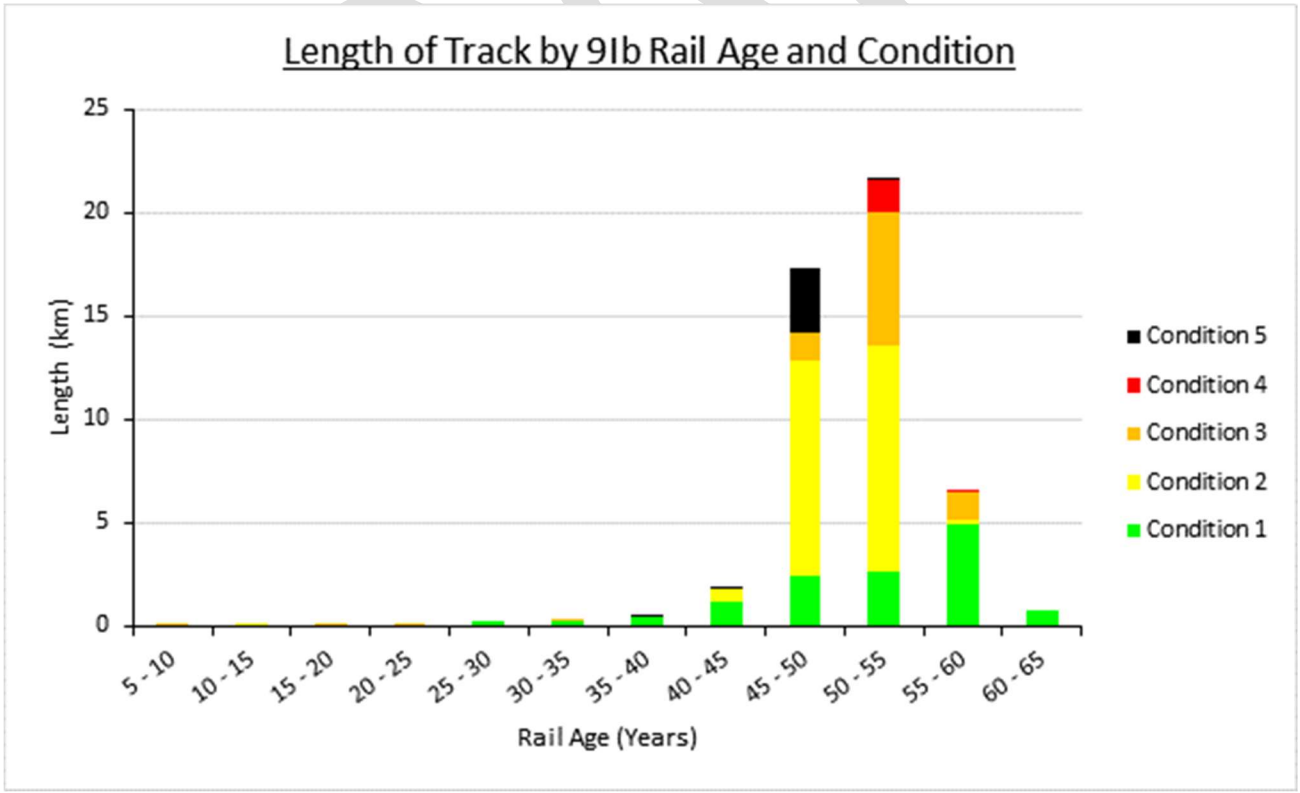


Figure 2-3: Length of 91lb rail by age and condition (2019)

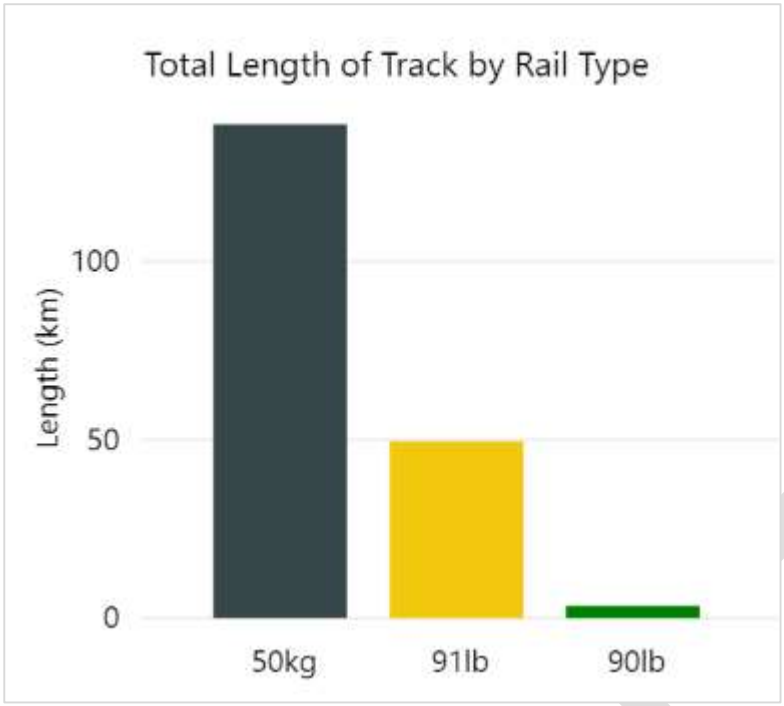


Figure 2-4: Total Length of track by rail type (2019)

The KiwiRail ANMP FY20-22 details a nine-point asset management strategy, which has been developed to ensure that KiwiRail are able to continue to provide a reliable and safe rail network into the future. This includes replacing all 91lb rail with new 50kg rail and eliminating all pre-1975 rail. However, this strategy requires acceleration and cannot be funded via existing arrangements.

The second part of the cause is the significant growth of demands on the rail network. Patronage growth and therefore tonnage growth are increasing significantly, with wear and tear proportional to this growth. As shown in Figure 2-5, the last 12 years has seen significant growth in rail demand, with rail patronage increasing by an average of 13% each year.

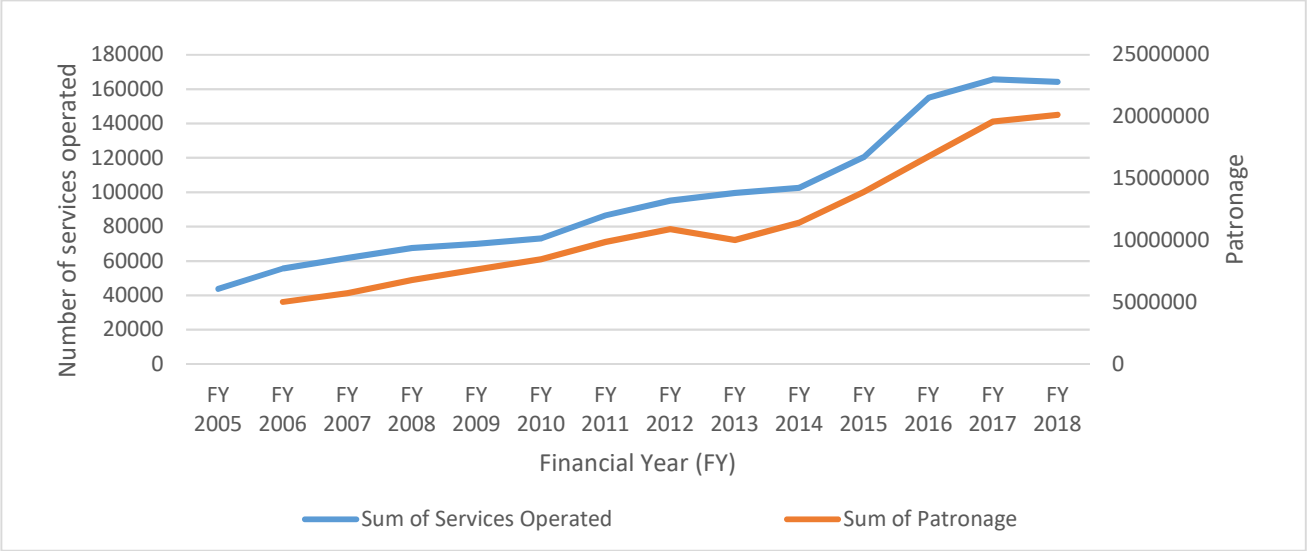


Figure 2-5: Annual rail passenger demand (2005-2018)

Freight is also growing as shown in Figure 2-6. The North Island Main Trunk (NIMT) traverses Auckland from Pukekohe to downtown Auckland and is responsible for carrying the bulk of rail freight in the city. Over the past five years, the tonnage has been steadily rising as the economy grows.

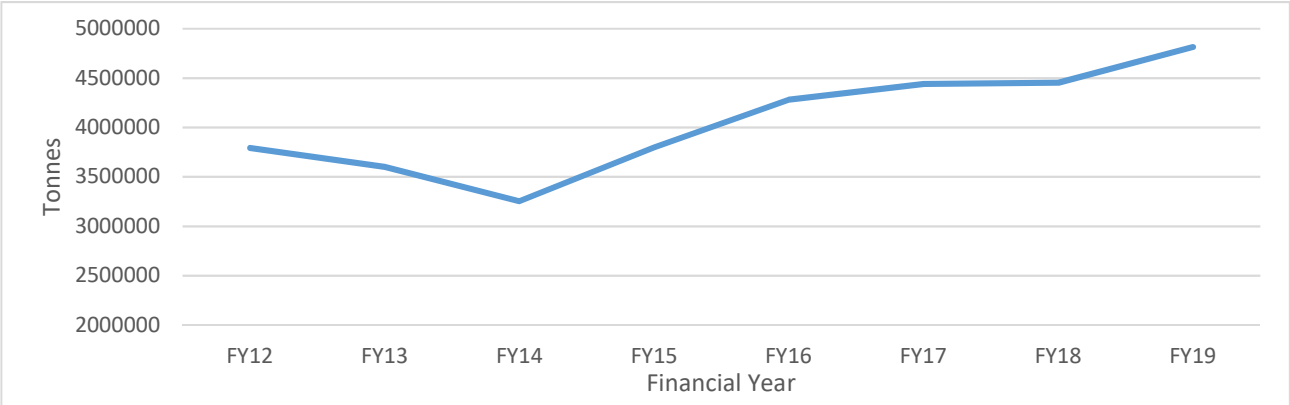


Figure 2-6: NIMT Line Auckland Section Average Freight Tonnage

This historic growth is forecast to continue with:

- Growth in the number of rail services – as additional passenger and freight rail services will be incrementally introduced as demand increases. AT anticipates 39 peak period services are required to cater for the increased patronage by year 2045, up from 22 services in 2016.
- Freight tonnage projected to increase by 50% by 2042 compared with 2012 levels (MoT 2014).
- Rail required to pick up demand from the congested road network. Road congestion is expected to get worse over the next 10 years as major RLTP construction works take place on the road network (see Figure 2-7). In 10 year's time it is expected the road network capacity will be back above the existing capacity; however, the transport system will still require rail mode share and volumes to increase to service growth as identified in the Auckland Plan.

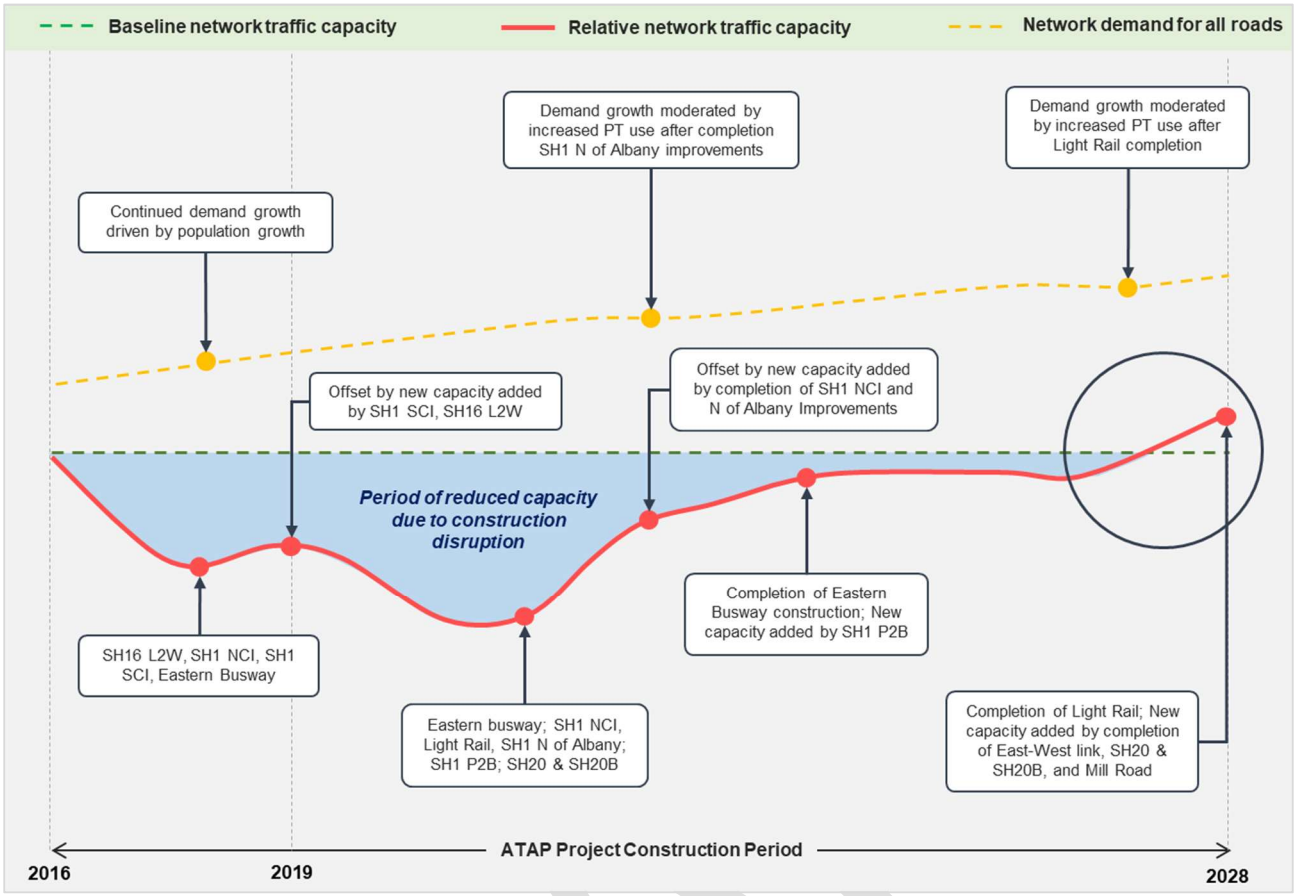


Figure 2-7: Road efficiency reduced during next 10 years – rail will need to help pick up demand

The effect of this problem is that major projects will not realise their projected benefits. The major projects that will be affected by the success or otherwise of this project include rail projects like CRL and urban development projects such as the Supporting Growth Programme.

Transformational rail projects like CRL rely on this project for their own success because the projected patronage for CRL and therefore benefits will only be achieved if people can get to the CRL i.e. if there are faults on the surrounding rail network people will choose to take alternative transport modes and the projected CRL patronage will not be achieved. As an example, see Figure 2-8.

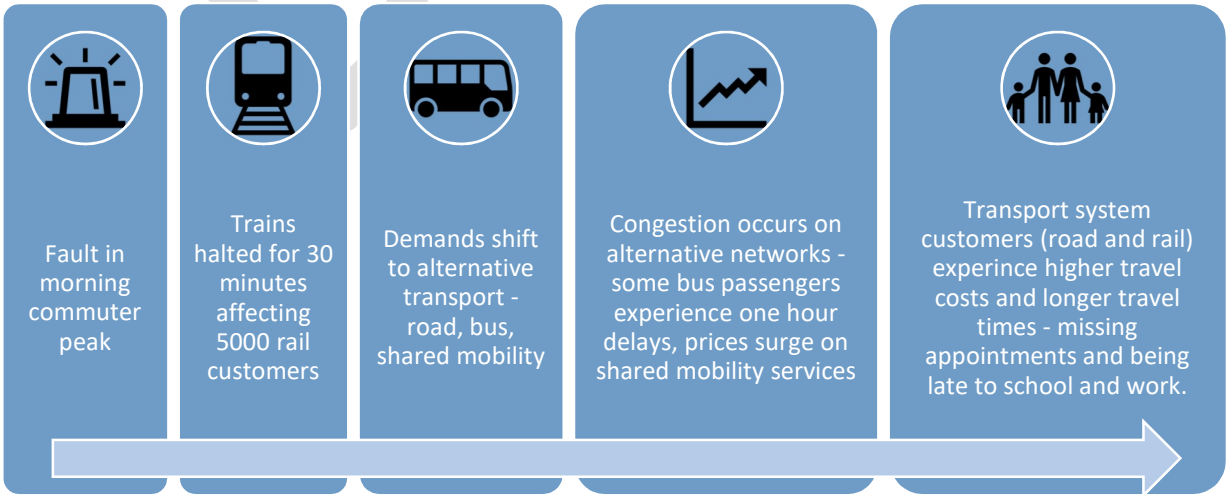


Figure 2-8: Effect of underinvestment in rail asset management – a fault in June 2019

Projects like the Supporting Growth Programme identified the need for increased reliance on the rail network in future to alleviate demands on the already congested road network. This will require a more resilient asset, greater resources and more innovative approaches to asset maintenance and management. Rail reduces congestion by 57 million light vehicle hours per year in Auckland (EY 2016). Furthermore, the public has strong support for development of the rail network, particularly in the south. Feedback received for Supporting Growth southern area found "*There was strong support for upgrades to the passenger rail network, including electrification of the rail line to Pukekohe, additional rail tracks and station*" and that the quality of the service needs to be adequate for the public to use public transport as an alternative to cars (i.e. they will use public transport if "*it was a faster journey, with frequent and reliable services*" (NZG 2018)). Faults, such as the fault in June 2019, will reduce the speed and reliability of rail journeys, resulting in fewer transport customers choosing rail and compromising the success of the Supporting Growth programme.

Inadequate asset management of the rail network has the potential to affect the success of wider transport programmes and strategic outcomes, such as those sought in the GPS and Auckland Plan, as discussed in Section 1.4. The Value of Rail in New Zealand Report states rail in New Zealand delivers approximately $1.5 billion of benefits every year. A significant proportion of this benefit occurs in Auckland including 75% of the 76 million reduction of light vehicle hours on New Zealand roads every year. Other benefits include safety, with rail eliminating at least 271 safety incidents a year by moving vehciles off roads, and reduction of CO2 emissions by 488,000 tonnes per year.

Furthermore, when major projects such as CRL come online they will put further strain on deteriorating assets. CRL will provide additional service volumes and generate a bigger passenger demand. This is expected to create further stress on the deteriorating tracks. Without addressing the cause of the problem (i.e. the historic underinvestment in the underlying network), major projects will put the track assets under greater risk of failure, which will affect not only the service lines but also the wider network through the need for further TSRs to maintain safety.

2.2 Problem Two Evidence

Problem two refers to current rail asset management practices being inadequate to deal with growth and ageing assets causing the rail system to operate below modern metro standards. This would result in rail customers (passengers, freight, and workers) experiencing declining levels of service particularly in terms of reliability (or journey predictability), and if not addressed, ultimately safety. Train delay data (Table 1-1) shows numerous incidents recorded over the last three years[6] amounting to an average of 152,000 delay hours per year, of which approximately half are attributable to the scope of this SSBC. The number of in-scope incidents are trending upwards by approximately 20% a year.

Current approaches to operating, maintaining and renewing the network are below modern metro standards because of a lack of resources (including personnel) and inadequate practices and procedures. The Auckland Network HLIR (see Section 1.3) provides examples of sub-optimal maintenance and renewal procedures and resourcing.

[6] Incident train delay data for the period 1 July 2016 to 30 June 2019 as provided by Transdev

As stated in Section 2.1, demands on the rail network have seen significant growth over the last 10 years and are projected to continue to have strong growth. This growth is occurring in parallel with the ageing of the rail assets. Figure 2-1 shows much of the track in Auckland is in poor condition. Figure 2-9 illustrates that there are a significant number of Treated Pinus Radiata (TPR) timber sleepers that are 40-60 years old and with condition ratings of 4 and 5. As stated in the ANMP, "*the average expected life of timber is 35-45 years with the majority currently in track already older than 35 years*". A modern metro will require replacement of old timber sleepers with concrete or composite sleepers, which have significantly better life expectancy and performance. These require less access for maintenance and therefore better safety outcomes for maintenance staff, more time for other maintenance tasks and ultimately less disruption to passengers.

Figure 2-9 emphasises the worsening average condition of these sleepers with increasing age. Hardwood South American (PDS) sleepers have specifically been found to possess a consistent condition rating of around 4 even though they are younger than 20 years of age i.e. well below the average expected life of timber.

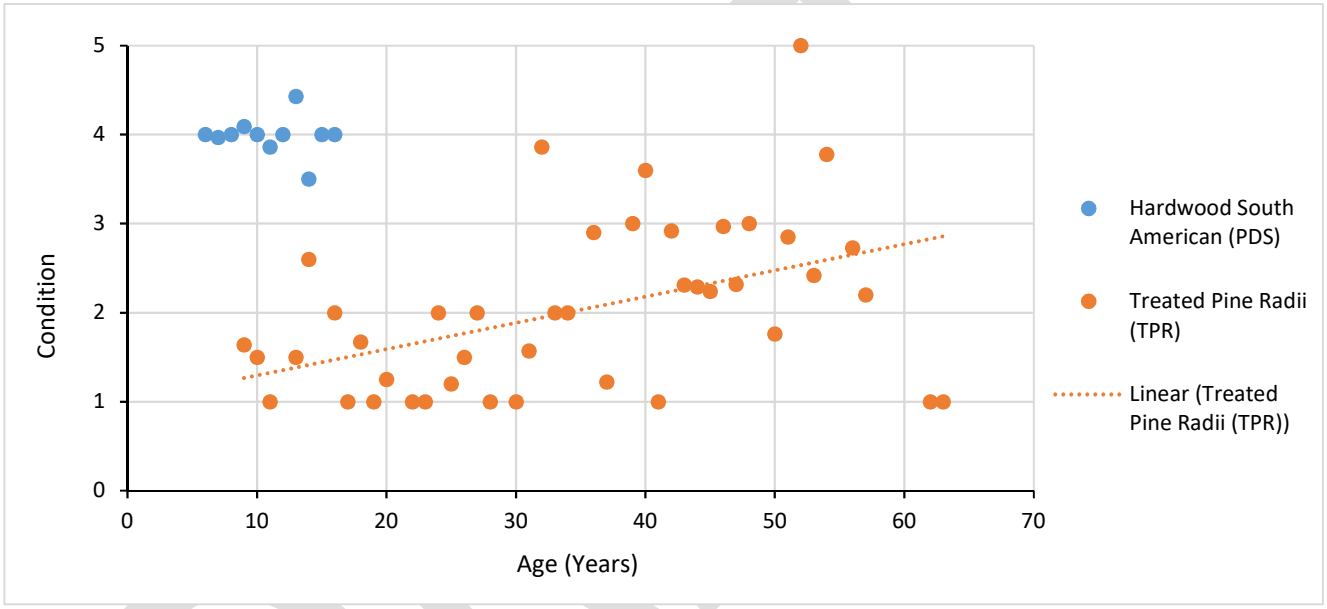


Figure 2-9: Average sleeper condition against age

The ageing assets require more frequent maintenance than modern alternatives and have higher risk of failure, increasing the risk of derailments and other events affecting customers journeys. KiwiRail puts in place TSRs when the track is in a poor condition to ensure customers and staff are safe on the rail network. KiwiRail have placed multiple TSRs due to ageing track assets, where most of these locations have been identified as needing the train tracks to be completely replaced. Seen in Figure 2-10 is a clear increasing trend in TSRs arising (i.e. new TSR) each month since early 2017.

Figure 2-11 shows that the number of TSR active each month has also been steadily increasing.

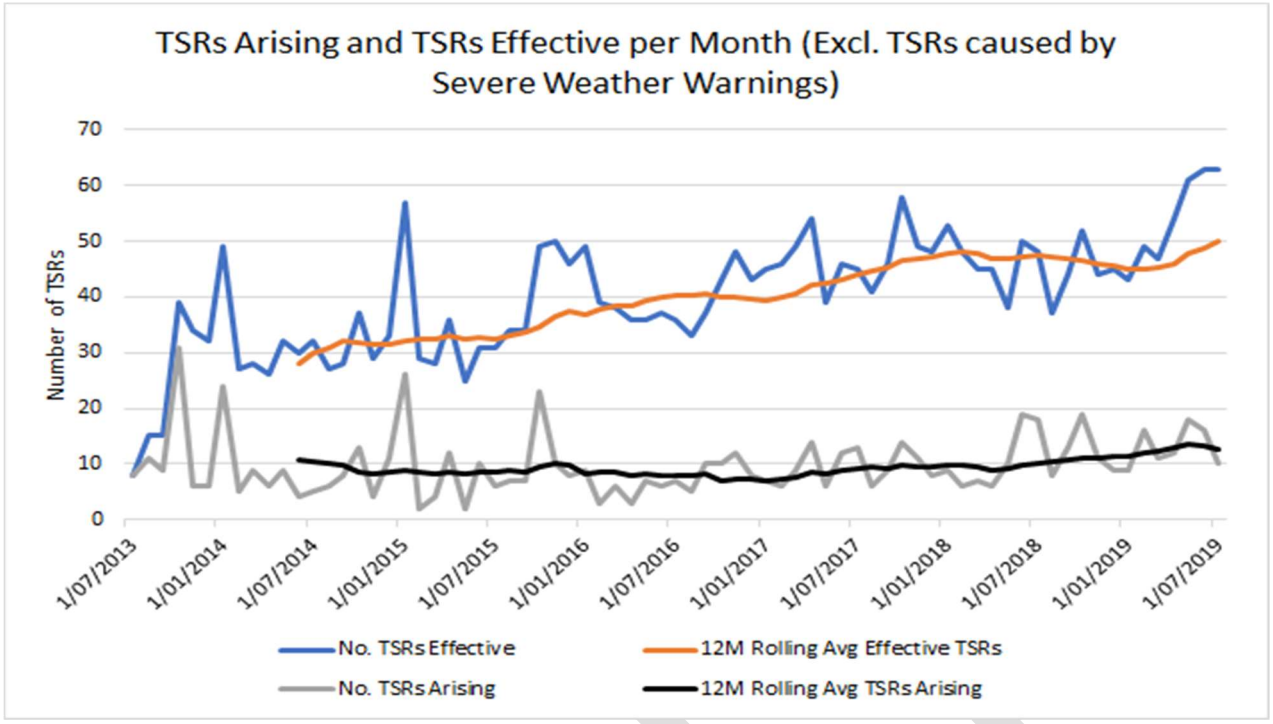


Figure 2-10: Rolling average of TSRs occurring and effective per month

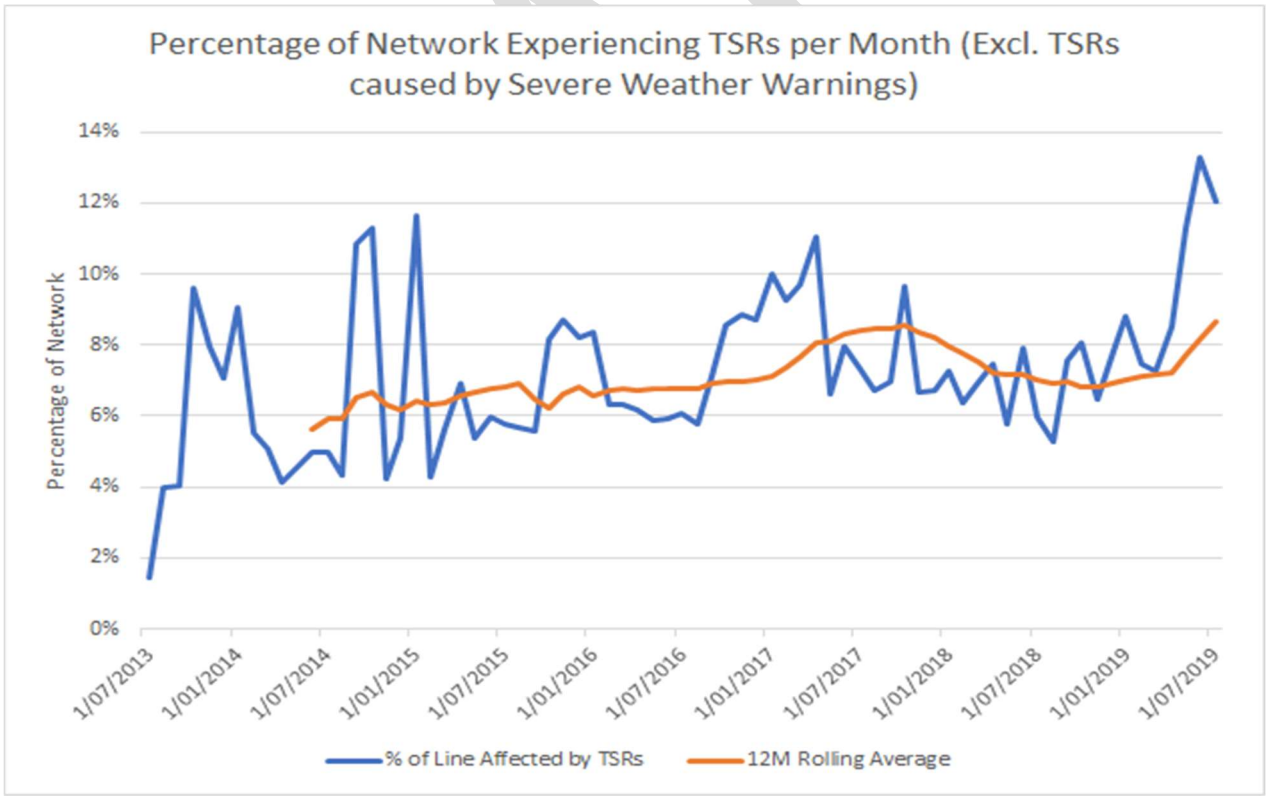


Figure 2-11: Percentage of Network Experiencing TSRs per Month

Figure 2-12 demonstrates the increase in passenger delay minutes between 2016 and 2019. As shown, passenger delays have been steadily increasing over recent years with an approximate 27% increase per annum for delays within scope of this business case (blue line). The current approach to dealing with aging assets that KiwiRail do not have the time or resource to fix immediately, is to apply TSRs to ensure the network is safe as the condition of sleepers and rail deteriorate. This

approach is essential to ensure the network is safe; however, clearly this results in increasing delays for rail passengers, which is not appropriate for a modern metro.

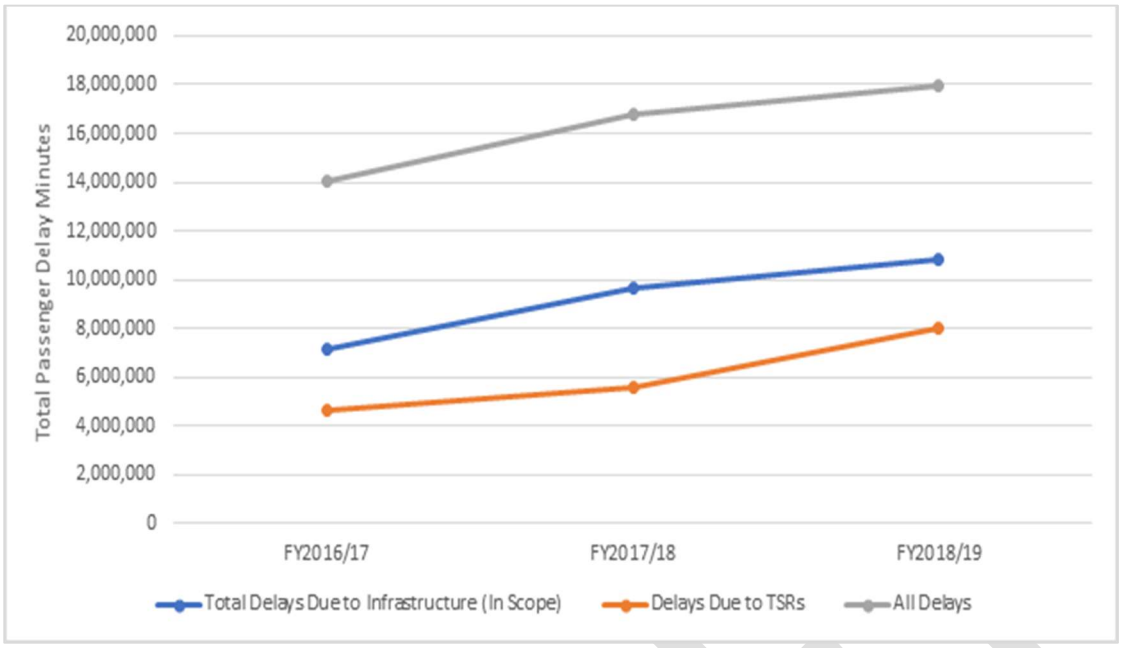


Figure 2-12: Yearly Passenger Delay Minutes

As stated in section 1.2.3 and in the ANMP FY2020-22, historically asset management of the AMRN has been more reactive than desired and only been able to address critical issues rather than more proactively adapting to changing customer needs. Asset management needs to be more proactive to meet international best-practice standards for a modern metro.

Customers expect a modern metro to provide:

- Safety – for workers, passengers, and freight
- Reliability – both reliability and punctuality are important, through a resilient system with built in redundancy and tolerances
- Comfort – with modern stations and a modern fleet (an electric rail fleet now with potential to change with new technologies)

Other investment is planned to ensure the network caters for a modern fleet and includes modern stations, but safety and reliability depend heavily on the success of the asset management programme.

KiwiRail has a Zero Harm business plan; however, the current condition of the Auckland rail network compromises the ability to make gains for employee safety. Notably, the ageing assets require more frequent, manual maintenance intervention than modern assets increasing the time on the network and therefore exposure to risk of injury to workers. Furthermore, the current condition of rail assets compromises customer safety and wellbeing because cancelled and delayed trains cause passengers to miss appointments, have less time with family, and change to less accessible or safe modes.

The current Auckland rail network has very limited built-in redundancy, meaning faults are becoming more frequent and have more significant effects. For example, the signal fault that occurred in June 2019 (see Figure 2-8) resulted in 5,000 commuters being delayed – and this does not recognise the knock-on effect it had on the road network with increased road congestion and buses being over-capacity (some bus passengers reported waiting over an hour to board a bus). Rail asset faults affect the entire transport system and adversely affect Aucklanders' wellbeing.

2.3 Problem Three Evidence

Problem Statement Three

Time and access for maintenance is limited and reducing with service growth, leading to inefficiencies and limiting progress on renewals needed prior to major projects (25%)

Problem three refers to time available to undertake maintenance reducing, causing inefficiencies in maintenance activities. These inefficiencies lead to:

- higher costs over the long-term as staff spend longer on each job; and
- more disruptions for customers, with safety measures like speed restrictions being required for longer.

If renewals are not completed before major projects, access windows will continue to shorten with the additional services running after completion of major projects (see Figure 2-14).

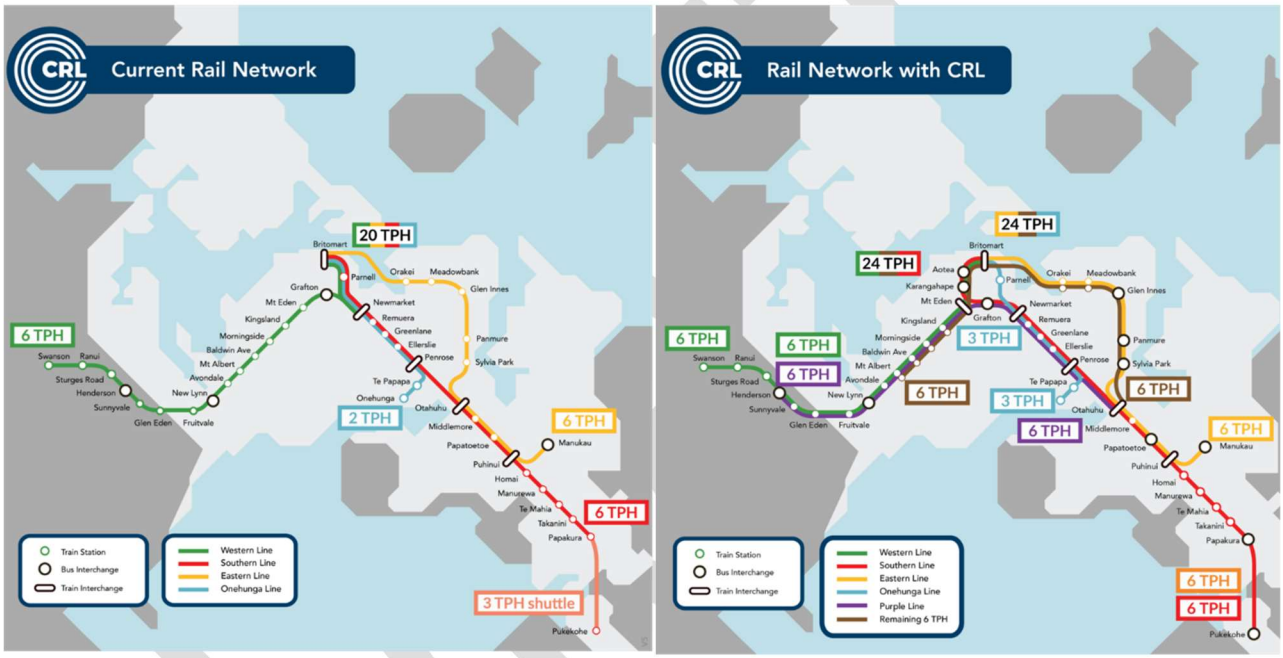


Figure 2-13: Growth of rail services planned as part of CRL (source: https://www.cityraillink.co.nz/crls-benefits)

Figure 2-14, the time available to undertake repairs is projected to reduce by approximately 10% to 30% across all the rail lines over the next two years because of the increasing frequency of services using the lines and therefore diminishing maintenance windows. Furthermore, services are expected to increase in frequency once CRL comes online. This combined with the increasing number of faults, as a result of ageing assets and out-dated procedures, means the time to repair each fault is significantly diminishing. Current maintenance work practices will need to be optimised to support peak productivity during the access windows available.

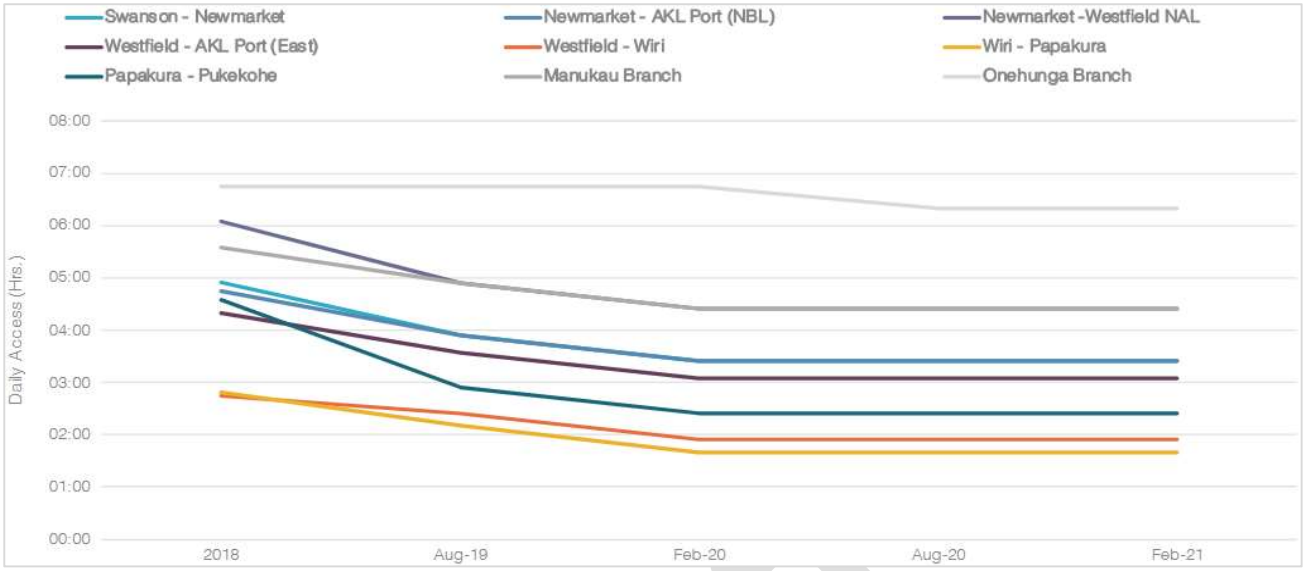


Figure 2-14: Maintenance access times, Auckland Network Maintenance Plan FY 2020 KiwiRail

Reducing access time for maintenance because of the increasing number of trains running on the network and constraints imposed for safety, has resulted in some maintenance jobs not being able to be completed in full during a single window. KiwiRail have had to adjust by splitting jobs and undertaking them across multiple access windows with start-up and stop inefficiencies or undertaking temporary repairs rather than full repairs leading to more frequent maintenance. As examples, access windows are issues for:

- Mudspot repairs – Access is an issue during the day, so emergency fixes are done at night and there is not sufficient time to do full mudspot repairs to the relevant code. Due to these constraints, mudspot repairs typically last six months when they should last five years if they are undertaken to code. This increases the maintenance costs over the long-term as more repairs are required.
- Spot resleepering - Due to small access windows during the day, resleepering is undertaken at night with only small gangs available. They can undertake 700m of spot resleepering per night but do not have the time to undertake the ballast, formation and tamping as the same time. As a result, TSRs (TSR) are required (see Figure 2-11 for increasing TSR).
- Inspections - There is limited access available for track inspections during the day due to the frequency of trains. This has led to a reliance on cab inspections or night time inspections.

Limited progress on maintenance activities is shown in the number of workorders that are being addressed within target timeframes. Priority 1-12 M125 faults are track faults, identified during inspections, that need to be resolved within a month of logging for priority 12 or immediately for priority 1 (with increasing durations for the priorities in between). In Figure 2-15, the records indicate that over the past five years only a small proportion of the M125 faults were addressed within desirable timeframes. This shows the current way of operating is insufficient, despite all the efforts from maintenance gangs. Although the past five years do not show a worsening trend, it is expected that with aging assets and a larger network to manage, the state of the network will deteriorate further with more workorders not completed on time.

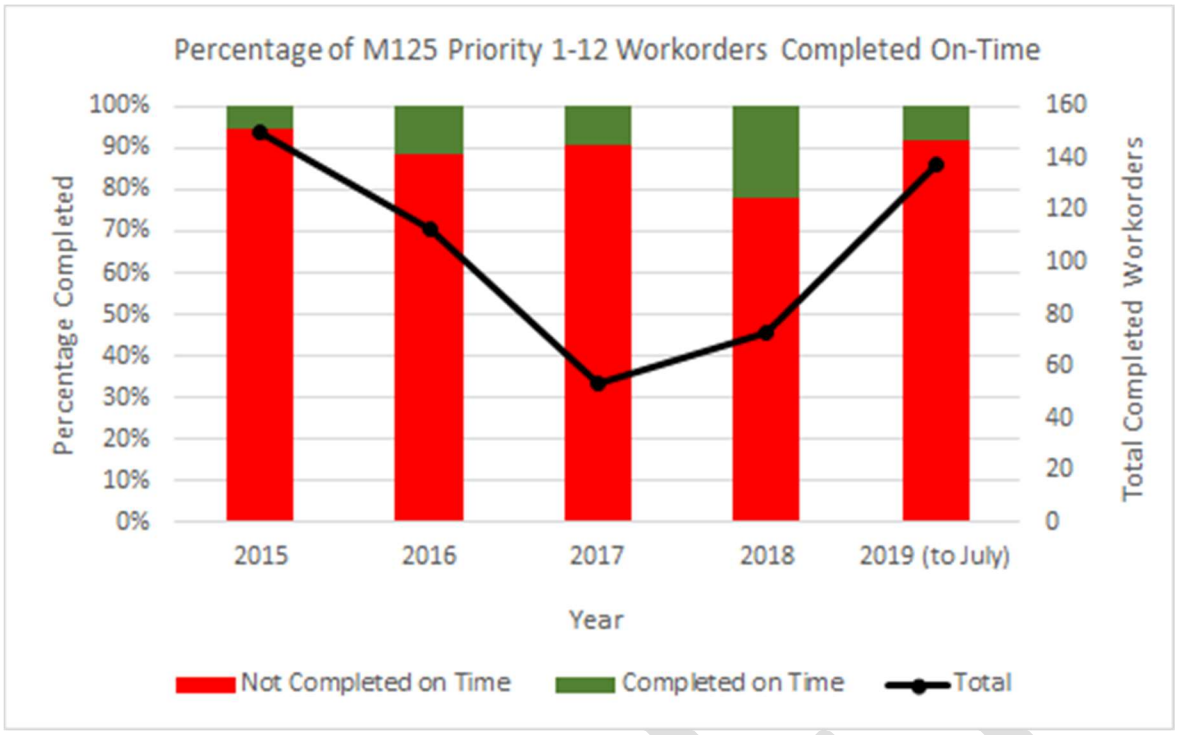


Figure 2-15: Priority 1-12 workorder completed on time (within one month)

3 Investment Objectives

3.1 Linkages of evidence to problems and benefits

The six benefits in Table 3-1 were developed with key stakeholders during the ILM workshop held on 29 May 2019. The key performance indicators (KPIs) also summarised in Table 3-1 are based on those that are currently reported by KiwiRail. Part of the scope of works of the recommended option within this SSBC is to develop new KPIs, baselines, and targets for reporting because many of the current KPIs are not effective for tracking the performance of the network to modern metro standards. Draft KPIs will be further developed and implemented in early 2020.

Table 3-1: Benefits and Key Performance Indicators

Benefit	Investment KPI	Baseline (2019 value)	Targets
Planned growth in population jobs & housing supported (20%)	Rail's contribution to ATAP targets for morning peak mode share for active modes and public transport are met	A quarter of all trips	A third of all trips by 2028
	Rail's contribution to ATAP public transport patronage are met	93 million	PT patronage grows to 170 million boardings in 2028
Enable the benefits of major investment (20%)	CRL timetable met as measured by "on-time" arrival	n/a	95% on-time completed trips
More capability to move freight & people (20%)	On time arrival of services	TBC	95% on-time completed trips
More efficient current & future systems (15%)	Reduction in renewals costs	Unit costs for rerailing ($330 per meter)	10% reduction in costs
	Productivity increases	KiwiRail current meters rerailed per 4-hour access window	10% increase in meters
Safer, more reliable services (15%)	Increase punctuality for all users	Transdev data	95% on-time completed trips
	Increase reliability for all users	Transdev data	95% on-time completed trips
	Decrease in network safety related incidents recorded	Number of safety incidents logged in KiwiRail Iris system	10% reduction in incidents logged
High availability and resilient network (10%)	Reduction in number of cancelled services	Number of cancelled services (Transdev data)	10% reduction in cancelled services

Three investment objectives were developed and agreed with stakeholders in a workshop on 13 June 2019. Each investment objective relates back to a corresponding problem statement. The investment objectives are:

Investment Objective One:

Support growth & major projects by investing in the underlying rail network

Investment Objective Two:

Deliver a modern Metro rail by investing in people, technology, systems and approaches

Investment Objective Three:

Timely resolution of legacy issues to deliver a safer, more resilient and sustainable rail network

The investment objectives outlined above have been used throughout the options assessment phase as a basis for assessing how proposed solutions or options align with the desired outcomes of the SSBC. The full ILM is included in Appendix D.

3.2 What do we need to address the problems and when?

There is an urgency to provide increased investment in rail asset management because:

- The current level of investment is struggling to cope with existing demands. Growth, together with aging assets, is quickly reducing the ability to manage with existing investment levels.
- The benefits of transformational projects such as the Supporting Growth Programme and CRL cannot be realised if management of the underlying rail asset is not improved to keep pace with growth. The CRL is due to come online in late 2024.
- Road congestion is expected to get worse over the next 10 years as major RLTP construction works take place on the road network (see Figure 2-7) while population and travel demand grow. This will, in turn, put more pressure on the rail network to accommodate more passengers
- There is an opportunity to utilise the blocks of line that are planned for the major construction projects (e.g. Wiri to Quay Park) to undertake works for this project if undertaken within the next four years.

The key areas that need to be addressed when developing options, in addition to meeting the investment objectives are indicated below.

- safe working conditions for rail staff and safe rail services for customers
- reliability for passenger travel and freight
- community satisfaction
- stakeholder satisfaction

B – Option Development

4 Do Minimum

The current asset management of Auckland's metro rail network is undertaken by KiwiRail. AT contributes a fair share of the total network maintenance cost in accordance with the ANAA, funded via fare box revenue, ratepayer contribution from Auckland Council and subsidy from the Transport Agency. It includes monitoring, renewal and remediation measures on its track assets and supporting infrastructures, such as bridges and rail crossings.

The do minimum scenario is the continuation of the current practices, which is to say reactively addressing issues. The project team, including rail experts from WSP Opus and Irontrack, in consultation with KiwiRail and Transdev has estimated it will cost $70 million over 10 years in addition to the current budgets just to maintain the network in a safe, steady state condition using current asset management practices (i.e. to continue doing what is currently done, budgets will need to be increased). This is because there will be an increasing number of issues to be rectified as assets age.

The Auckland Rail Network HLIR (see Section 1.3) states even the most optimistic forecasts indicate the current network can only just be maintained at a minimal acceptable standard with current funding and methods. Any further increase to metro or freight services is likely to lead to a network deterioration below a reliable or acceptable level.

Table 4-1 Do minimum levels of investment in addition to current budgets

Intervention	Additional investment over 10 years ($)
Track renewal (rail, sleepers, turnouts & distress)	$23.7m
Track bed renewal (ballast, formation & drainage)	$3.8m
Overhead & Project management	$5.5m
Operating expenditure	$38.0m
TOTAL (for 10 years)	$70.1m

5 Alternatives Considered

Stakeholders agreed that asset management of the rail network would need to include a variety of interventions to be effective, and some of these interventions could be considered alternatives.

For example, to improve asset management on part of the network an intervention could be to include additional track (supply) to improve access windows for maintenance activities, this is included in the Network Changes intervention type in Table *6-1*.

6 Longlist Development

6.1 Intervention Types

The options developed primarily consist of differing approaches to, levels of investment in, or timeframes for investment in, key intervention areas as shown in Table 6.1:

Table 6-1: Intervention types

Intervention type		Example of interventions
Technology		Automated inspection equipment to supplement KiwiRail's ultrasonic train inspections. Improvements would enable access to new technology and analysis techniques for asset management
Plant & equipment		Plant and equipment to enable change in methodologies and greater productivity. Examples are tampers to pack the rail ballast, rail cranes for lifting materials such as rail, mechanised sleeper droppers which lay multiple sleepers at once, and smaller items to enable production line efficiencies.
Competency & training		Investment and modernisation of competency framework. This approach would shift away from a reliance on organic On the Job (OJT) to be replaced with a new platform involving theoretical and practical lead training centre.
Network changes (access & resilience)		Introduction of crossovers and sectioning, changes to electrical feeders and neutral sections, separate supply feed for electric train (EMU) depot. This will enable more parts the electrified network to be isolated in sections to allow worker access without disrupting other sections.
Track renewal (rail, sleepers, turnouts & distress)		Rail (including rolling contact fatigue defect removal), replacement of age-expired and poor condition sleepers, turnouts and destressing treatments of rail to withstand changes in temperatures.
Track bed renewal (ballast, formation & drainage)		Ballast replacement, drainage upgrade and renewal of the formation which is the earthworks supporting the track and ballast.
Overhead & Project management		Project delivery team including Site Management and Rail safety protection. Development of further management plans i.e. Route/Section specific asset management strategies
Standards and rules		Change to standards for passenger bias where appropriate, implement rules to aid inspections e.g. train warning, bi-directional blocking of lines or Individual Train Detection (ITD) which are protection processes for workers in the live rail environment
Operating expenditure		Additional OPEX requirement to support the current asset condition and the disruptive period during major works being undertaken in Auckland area.

6.2 Themes

The project team developed option themes and agreed these with the key stakeholders. The themes considered:

- whether to keep business as usual practices or improve delivery practices
- What approach to take with renewals, asset or network level (i.e. age thresholds for replacing assets)
- what level of investment should be made.

The above considerations led to a development of a capital investment (renewal) timeframe (i.e. a step change in delivery approach could lead to renewals being undertaken in shorter timeframes).

It was agreed that there could not be a geographical focus to asset management because a fault or issue on one part of the network could affect the entire network (i.e. because there is limited route choice on the rail network).

6.3 Longlist

The intervention types and themes were combined to form the longlist of options for assessment, which are summarised in Table 6-2.

The option costs have been calculated for a 10-year period. Some options require CAPEX investment over a shorter period, so the remaining years are made up of OPEX only (i.e. some options have high upfront costs in order to be complete within 4-5 years before CRL opens but lower ongoing costs over the 10 years).

Table 6-2 Longlist of options

Option - Renewal & delivery approaches		Funding allocation	Reason for inclusion	CAPEX timeframe	Capital investment over 10 years ($)
1	Do minimum (see section 5)				
2	Asset renewals, Current delivery approaches	Maintain current ways of working but provide extra investment in track renewals, track bed renewals, overheads, and OPEX	To test whether investment in renewals and not practices is sufficient to achieve outcomes.	10 years	$130m
3	Asset renewals, Modified delivery approaches	Similar to above but with implementation of new technology, training, network changes, and standards to enable better ways of operating and maintaining the network.	To test whether slightly modifying practices together with renewals is enough to achieve outcomes.	8 years	$150m
4	Asset renewals, Enhanced delivery approaches	Larger scale overhaul of the rail track assets, high commitment to network infrastructure changes, training and equipment. Standards and rules changes to enable better operations	To test whether a significant change to practices that enables a step change in delivery would best achieve outcomes	5 years	$220m

Option - Renewal & delivery approaches		Funding allocation	Reason for inclusion	CAPEX timeframe	Capital investment over 10 years ($)
5	Network renewals, Modified delivery approaches	Complete overhaul of all aging assets network wide, high commitment to network infrastructure changes, training and equipment. Standards and rules changes to enable better operations	To test whether a comprehensive renewal of the network track assets can achieve the best outcomes	10 years	$390m
6	Network renewals, Enhanced delivery approaches	Comprehensive overhaul of all aging assets network wide, highest possible commitment to network infrastructure changes, training and equipment. Standards and rules changes to enable better operations	To test whether substantial renewal of network track assets and complete upgrade of existing training and equipment can achieve the best value for money outcomes	5 years	$390m

Further details about the longlist of programmes are provided in Appendix C.

7 Longlist Assessment

7.1 Evaluation Criteria

This section outlines the multi-criteria assessment (MCA) undertaken to narrow down the longlist of programmes to a shortlist. The MCA used a set of questions as well as draft KPIs, summarised in Table 7-1, to prompt the stakeholders in their discussion and evaluation of the longlist options. The Recommended option includes scope for developing new KPIs as discussed in Section 3.1.

Table 7-1: MCA criteria

	Criteria	KPIs and Questions used to guide evaluation	
Investment objectives	Investment objective 1 – Support growth and major projects by investing in the underlying rail network	Rail growth targets (passengers and freight) met Journey times maintained or improved CRL Timetable met	Will the capital works be complete in part or full by the time major projects (e.g. CRL) are complete? How likely are they to affect the outcome of major projects?
	Investment objective 2 – Deliver a modern metro rail by investing in people, technology, systems and approaches	On-time arrival of services Lost time minutes targets met Costs within international benchmarks Productivity within international benchmarks	Does the option invest in people (training, competency, headcount)? Does the option invest in technology, systems and approaches?
	Investment objective 3 – Timely resolution of legacy issues to deliver a safer more resilient and sustainable rail network	Increase punctuality and reliability for users Decrease network related safety incidents Less disruptions for customers and freight Reduction in number of cancelled services	Will the option deliver safety for customers and workers? Will the option result in a more resilient system? Will the option result in more sustainable practices?
Risks	Safety in design	How likely is option to remove risks to workers e.g. by removing need for being on the track or safer working practices? How likely is the option to reduce risk of asset failure that would affect customer safety (e.g. derailment or fault causing customer to be left waiting/walking in unsafe locations)?	
	Deliverability/ Feasibility	Availability of industry personnel, resources (plant etc), and organisational capacity to deliver the option.	
	Maintainability/ Sustainability	What is the amount of ongoing maintenance required?	
	Value for money	What is the benefit to cost ration likely to be? i.e. how likely is it to provide value for money to the funder?	
	Stakeholder and public acceptance	How likely is the option to be viewed positively by the public (e.g. by reducing disruptions)? How likely is the option to be viewed by stakeholder (i.e. by contributing towards organisation outcomes)?	

Criteria		KPIs and Questions used to guide evaluation
Effects	Economic	How likely is the option to support GDP?
	Social	How likely is the option to provide positive social outcomes such as local supply chain and employment opportunities?
	Environment	How likely is the option to enable mode shift away from road to rail, thereby reducing greenhouse gas emissions?

7.2 Evaluation Results

Table 7-2 summarises the MCA results for the longlist of options assessed with a weighting of 33 per cent investment objectives, 33 per cent risks and 33 per cent effects as the baseline assessment. Each of the options was scored against the do minimum. The full MCA including reasons for the scoring is included in Appendix C.

Table 7-2: Longlist MCA Results

Criteria		Option 2	Option 3	Option 4	Option 5	Option 6
Investment objectives	Support growth & major projects by investing in the underlying rail network	1	2	3	2	3
	Deliver a modern metro rail by investing in people, technology, systems and approaches	0	1	2	2	3
	Timely resolution of legacy issues to deliver a safer, more resilient and sustainable rail network	1	2	3	2	3
Risks	Safety outcomes	1	2	3	2	3
	Deliverability / Feasibility	0	-1	-2	-2	-3
	Maintainability / Sustainability	0	1	2	1	3
	Value for money / Affordability	1	2	3	0	0[7]
	Stakeholder and Public acceptance	1	2	3	1	2
Effects	Economic	0	1	3	2	3
	Social	0	1	2	3	2
	Environment	0	1	3	2	3
Total (weighted)		0.35	1.15	2.17	1.58	2.22
Rank		5	4	2	3	1

As shown above, Options 4 and 6 score the best with scores over 30% higher than the next ranked option. Option 2 scores the worse and is only very slightly better than the 'do minimum'.

[7] Options 5 and 6 were assigned a zero for Value for Money / Affordability on the grounds that their anticipated values are significantly beyond the threshold of available funding, which is critical given the limited funding of the Transitional Rail activity class.

7.2.1 MCA Sensitivity tests

To ensure conclusions drawn from the MCA results were robust and free of bias, a series of sensitivity test were undertaken by changing the weighting of the criteria.

As shown in Table 7-3, increasing the weighting of risks makes Option 4 the highest ranked option but otherwise the results are not sensitive to the weightings.

Table 7-3: MCA sensitivity analysis rankings

Test	Option 2	Option 3	Option 4	Option 5	Option 6
Base	5	4	2	3	1
30% IO, 50% risks, 20% effects	5	3	1	4	2
60% IO, 20% risks, 20% effects	5	4	1	3	2
30% IO, 20% risk, 50% effects	5	4	1	3	2

8 Shortlist

8.1 Reasons for Inclusion

Based on the MCA, and understanding a number of key risks and effects, three programmes were endorsed by stakeholders and taken forward to be shortlisted:

Table 8-1: Shortlisted options

Shortlisted Option	Reason for inclusion
Option 3	Included, despite not ranking in the MCA top three, to test whether a lower cost option would provide the best value for money
Option 4	Ranked 2nd in MCA and included to test value for money of medium cost option.
Option 6	Ranked 1st in MCA and included to test value for money of high cost option.

Option 5 was not progressed to the shortlist despite being ranked 3rd in the MCA because:

- It scored notably worse within the MCA than Options 4 and 6 and is a high cost option, so unlikely to differentiate itself economically
- It scored similar to Option 3, but Option 3 provided more point of difference for comparison against the two highest ranked option (4 and 6) because it is a lower cost option that may score well economically.

8.2 Shortlist Scope

The scope of the shortlisted programmes assessed is summarised in Table 8-2 below. A more detailed description is provided in the economic analysis in Appendix G.

Table 8-2: Shortlist Option Scope

	Option 3 Asset Renewal; Modified Delivery;	Option 4 Asset Renewal; Enhanced Delivery, Step Change	Option 6 Net Renewal; Enhanced Delivery & Step Change
CAPEX over 10 years	$150million	$220million	$390million
Delivery timeframe	8 years	5 years	5 years
Approach to renewals and delivery	Maintain current ways of working but provide extra investment in track renewals, track bed renewals, overheads, and OPEX and with implementation of new technology, training, network changes, and standards to enable better ways of operating and maintaining the network.	Larger scale overhaul of the rail track assets, high commitment to network infrastructure changes, training and equipment. Standards and rules changes to enable better operations	Comprehensive overhaul of all aging assets network wide, highest possible commitment to network infrastructure changes, training and equipment. Standards and rules changes to enable better operations

8.3 Shortlist Assessment

8.3.1 Evaluation Criteria

The shortlist was evaluated against the following criteria:

- Value for money - economic analysis
- MCA results (updated to reflect economic results)
- Affordability

8.3.2 Value for money

The value for money assessment of each of the shortlisted options was completed using procedures in the NZTA Economic Evaluation Manual (EEM)[8].

The benefits were calculated using historic incident data from Transdev, which provided a picture of the current delays incurred as a result of incidences on the network, the number of incidences that are attributable to the scope of this SSBC, and the upward trend of those incidences occurring.

The benefits calculated were grouped into the following categories:

- Passenger delays (i.e. delays to passengers but not cancellation of services)
- Isolated cancellations of passenger trains (i.e. where passengers would likely wait for the next service)

[8] EEM amendment 2, effective 1 July 2018

- Larger-scale cancellations of passenger trains (i.e. where passengers would likely seek alternative transport modes)
    - Planned (e.g. block of lines for planned maintenance)
    - Unplanned (e.g. major faults)
- Freight delays

The economic analysis found there is a total of $30.5million of delays on the network each year, of which $13.1million is attributable to the scope of this SSBC.

The results of the economic appraisal, including the benefit-cost ratio (BCR) of the shortlisted options is summarised in Table 8-3 below, and further detailed in Appendix G.

Table 8-3 Shortlist economic results

	Option 3 - Asset Renewal Modified Delivery Minimum Improvement	Option 4 - Asset Renewal Enhanced Delivery Enable Step Change	Option 6 - Network Renewal Enhanced Delivery Enable Step Change
Net Present Value (NPV) Costs	$198million	$212million	$358million
BCR	High to Very High	High to Very High	Medium

As shown above, Option 6 performs worse economically that the other shortlisted options. This is because it has significantly higher costs and there are diminishing returns on this additional investment compared with Options 3 and 4.

The incremental BCR was calculated to assess whether the incremental cost of the higher-cost Option 6 is justified by the incremental benefits gained (all other factors being equal).

Table 8-4 displays the Incremental Cost Benefit Analysis results at the base discount rate of 6%, and further detail is included in Appendix G.

Table 8-4 Incremental cost benefit analysis results (all benefits and costs are net present value)

	Option 4	Option 6	Incremental CBA (Option 6 – Option 4)
Present Value (PV) capital cost	$132.64 M	$312.72 M	$180.07 M
PV net maintenance cost (negative cost, i.e. a net benefit)	-$36.85 M	-$32.35 M	$4.49 M
PV TOTAL COST	**$95.79 M**	**$280.36 M**	**$184.57 M**
Passenger - travel time savings	$295.89 M	$365.96 M	$70.07 M
Freight - travel time savings	$15.22 M	$18.85 M	$3.63 M
Isolated cancellations	$11.25 M	$13.92 M	$2.67 M
Planned cancellations (block of line)	$114.58 M	$141.89 M	$27.32 M
Large cancellations - off-peak	$14.66 M	$18.15 M	$3.50 M
Large cancellations – peak	$74.73 M	$92.43 M	$17.70 M
Super Sunday implementation works	-$5.07 M	-$16.20 M	-$11.13 M
PV TOTAL BENEFIT	**$521.25 M**	**$634.99 M**	**$113.74 M**

	Option 4	Option 6	Incremental CBA (Option 6 – Option 4)
IRR	17.51%	11.45%	
FYRR	16.4%	5.9%	
NPV	$425 M	$355 M	
BCR	5.4	2.3	0.6

The incremental cost-benefit ratio is 0.6, i.e. there are an additional $184.57 M of costs and $113.74 M of benefits of the additional investment into Option 6 so the results to not justify the additional investment.

8.3.3 MCA score

The MCA score was taken from the longlist assessment with only the value for money being refined.

	Option 3 - Asset Renewal Modified Delivery Minimum Improvement	Option 4 - Asset Renewal Enhanced Delivery Enable Step Change	Option 6 - Network Renewal Enhanced Delivery Enable Step Change
MCA	1.15	2.17	2.22

Options 4 and 6 have the highest MCA scores from the longlist assessment, as shown above

8.3.4 Affordability

Affordability was assessed against the funding available through the Transitional Rail activity class. Affordability was discussed with stakeholders during the short list assessment workshop. Based on the funding available, it was determined by the stakeholder group that Option 6 would likely be unaffordable because it would require significantly more funds than are available in the Transitional Rail activity class. Option 4 was determined to be affordable with some risk given it was above anticipated thresholds, but on a much lesser degree than Option 6. Option 3 was determined to be the most affordable given it was more aligned with funding thresholds.

8.3.5 Summary of shortlisted results

The three shortlisted programmes were evaluated for:

- Value for money (benefit-cost ratios BCR)
- Affordability
- Multi-criteria assessment (MCA score from the longlist assessment)

Table 8-5:-Shortlist Evaluation Results

Evaluation Criteria	Option 3 Asset Renewal Modified Delivery Minimum Improvement	Option 4 Asset Renewal Enhanced Delivery Enable Step Change	Option 6 Network Renewal Enhanced Delivery Enable Step Change
Value for money (BCR)	High to Very High	High to Very High	Medium
Affordability	Very good	Acceptable	Poor
MCA score	1.15	2.17	2.22
Overall ranking	3rd	1st	2nd

As shown above, Option 4 is ranked 1st because it has both a high economic return and a high MCA score and is therefore taken through as the Recommended option.

Option 6 is not considered further because economically it performs worse than Option 4 but has a similar MCA score. Incremental analysis does not justify the additional investment in Option 6 and it is also less affordable than Option 4, which is critical given the limited funding in the 'Transitional Rail' activity class.

Option 3 is not considered further because economically it performs similar to Option 4 but has a significantly worse MCA score.

9 Recommended Option

9.1 Benefits

The Recommended option (Option 4) was selected over other options because:

- It can be delivered in a timely manner and enable benefits of major projects such as CRL to be fully realised,
- It includes network changes (such as cross overs) that will improve access and enable the network to be maintained more sustainably and safely, and
- It provides high value for money

9.2 Scope

The recommended option is a mix of intervention types including AMRN wide additional renewals and a significant change to practices that enables a step change in delivery.

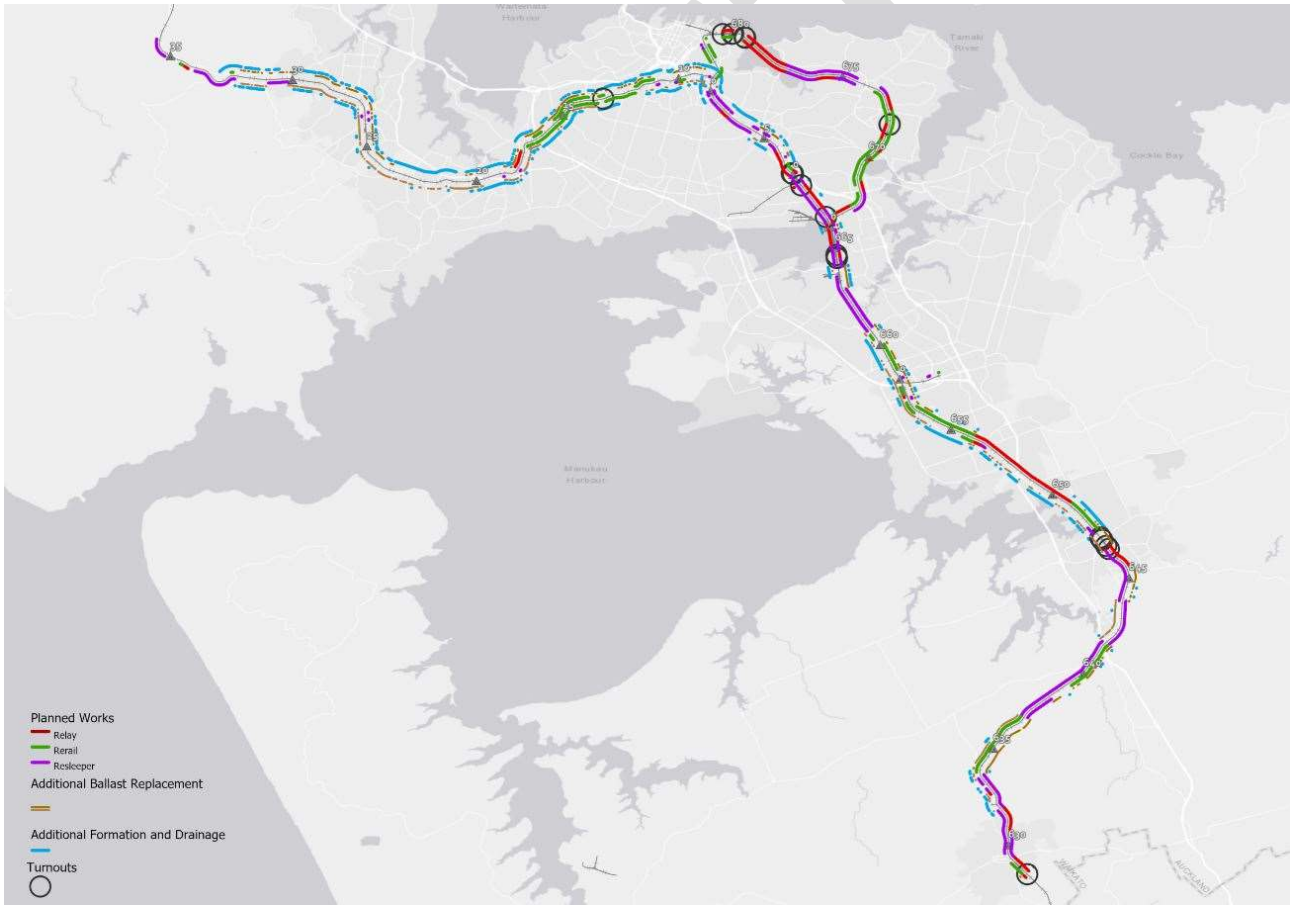


Figure 9-1 Geographic view of the RNGIM renewals workbank 2019-2024

See appendix L for a larger version of Figure 9-1.

Table 9-1 summarises the scope of works included within the Recommended Option. The do minimum level of investment is shown in the table in light blue, with the recommended option additional funding shown in dark blue. The option is comprised of a mix of investment types to maximise the sustainability of the step change including additional training, dedicated plant and expanded use of technology.

Table 9-1 Recommended Programme scope

Intervention Type		Detail	Cost	Relative to Existing
Technology		Investment in automated inspection equipment to supplement KiwiRail's ultrasonic rail inspections.	$6.3M	
Plant & Equipment		Additional high production plant to change methodologies like Tampers, PemLems, sleeper layers etc.	$3.0M	
Competency & Training		Investment and modernisation of competency framework. This approach would shift away from a reliance on organic On the Job (OJT) to be replaced with a new platform involving theoretical and practical lead training centre.	$3.5M	
Network changes		6-8 crossovers and sectioning, separate feed for EMU depots.	$15.3M	
Track renewals		Replacement of all rail pre-1975 (91lb and lower) and 50kg rail with rating of >C4 Replacement of all TPR sleepers, and Concrete sleepers pre-1986. Removal of all 91lb turnouts and 50kg turnouts older than 25yrs. Includes Destress sites where records are older than 8yrs.	$57.7M	
Track bed renewals		Allows for replacement of top and bottom ballast. Assumes that 60% of track not being resleepered, or formation upgraded will require ballast. Detailed investigation is required. Required for all resleepering works due to increased sleeper depth + allowance of 25% of remaining track for mudspot remediation. Detailed investigation is required.	$68.0	
Overhead & PM		Project delivery team including Site Management and Rail safety protection.	$25.1M	
Standard & Rules		Change to standards where appropriate. Implement rules to aid inspections e.g. train warning, bi-directional blocking or ITD overhaul.	$2.3M	
Total 10-year Cost (excluding contingency)			$181.2.3M	

9.2.1 Technology

- Investment in automated inspection equipment to supplement KiwiRail's existing EM80 Ultrasonic Inspection Vehicle
    - Investment in additional automated ultrasonic inspection equipment that can be fitted on either rolling stock or a specialist rail vehicle. Greater automation enables inspection of the rail at high speed and frequency while limiting track possession times for manual inspection
- Investment in non-destructive testing
    - A pedestrian or HiRail system with capability to perform ultrasonic testing and rolling contact fatigue defect identification including continuous eddy current testing
- Procurement management, implementation, training and certification

9.2.2 Plant and equipment

- Investment in additional high production plant dedicated for use on the AMRN to support optimisation of maintenance and renewals practices.
    - Dedicated surfacing equipment (Tamper) and measuring device
    - E-clip machines
    - Minor mechanical equipment
    - Additional welding equipment
    - Rail delivery system to allow handling of longer rails via the end of KiwiRail wagons

9.2.3 Competency and training

- Investment in developing a training and competency framework for KiwiRail and contractor personnel to the Australian TLI equivalent level which is the Australian industry standard.[9]
    - Consultant trainers and instructional writers
    - Dedicated Auckland training facility
    - Onsite training delivery support

9.2.4 Network changes – access and resilience improvements

- Installation of six cross over points mid-section between the train lines in the Papakura to Pukekohe section of the AMRN to enable flexibility and allow trains to cross
- Additional traction power feed to the Wiri depot to allow the isolation of the main lines while leaving the depot powered for EMU servicing

9.2.5 Track and track bed renewals

AMRN wide renewals programme.

- Rail – replacement of all pre-1975 rail (91lbs and lower) and 50kg rail with a condition rating of C4 or C5
- Sleepers – replacement of all Treated Pinus Radiata sleepers, and pre-1986 concrete sleepers
- Turnouts – removal of all 91lb turnouts and 50kg turnouts older than 25 years

[9] https://www.australianindustrystandards.org.au/training-packages/transport-and-logistics-rail-training-package/

- Destress – destressing of rail where the records are older than 8 years
- Ballast replacement – allows for replacement of top and bottom ballast profile to code. 60% of track not being resleepered, or having the formation upgraded, will require ballast replacement.
- Formation and drainage upgrade – required for all resleepering works due to increased sleeper depth and allowance of 25% of remaining track for mudspot remediation

See Appendix H for the detailed renewals programme, and Appendix L for a geographic representation of the renewals workbank.

9.2.6 Overhead and Project Management

Project delivery team including programme management, change management, site management and rail safety protection personnel and management. See 12.2 and Appendix E for further detail on the organisational structure

9.2.7 Standards and Rules

Review and update of KiwiRail's codes and standards to consider AMRN specific requirements including mixed passenger and freight services and new technology. Implementation of rules to aid inspections including train warning processes, bi-directional blocking of lines and protection processes

9.3 Investment Assessment

9.3.1 Results Alignment

A new activity class has been created called 'transitional rail' with funding specifically set aside for this activity. The results alignment for the Recommended Option is High because:

As part of Safety outcomes, it:

- Enhances actual and perceived safe use of and access to public transport. As discussed in section 9.3.5.1, the project will reduce the risk of safety incidents occurring and reduce the need for track speed restrictions to maintain safety. Furthermore, it will encourage rail use over road, which is a safety form of travel.

As part of 'Access – liveable cities' outcomes it:

- *Supports agreed integrated land use, multi-modal plans and mode shift in major metros.* As shown in Section 1.4.2 Auckland has a variety of adopted strategies and plans that all emphasise the importance of rail and the need to increase its mode share. Addressing the rail network defects will underpin the use of rail through addressing unreliability issues that deter rail use.
- *Makes best use of the public transport service operations and connection to other services.* The Recommended option will ensure the rail network operates well by reducing the number of incidents disrupting customers journeys including reducing the number of track speed restrictions. This will ensure rail patronage continues to grow as journeys are more reliable and travel times are quicker.
- *Addresses significant resilience risk to continued operation of the public transport network.* Without improvements to the rail assets, the operation of the rail network will deteriorate, as the number of incidents increase as discussed in section 1.3. There are no alternative rail routes, so an incident on a line can lead to the closure of that line forcing customers to use alternative modes such as cars.

- *Addresses an unplanned loss of an existing significant public funded transport connection*. Similar to the point above, failure to address the legacy issues will result in rail lines becoming closed as incidents occur.

As part of Environmental outcomes, it:

- *Enables long term reductions in greenhouse gas emissions from land transport*. By ensuring the rail network operates to modern metro standards, rail mode share will continue to increase, reducing carbon emissions on the overall transport system by shifting customers away from single occupancy vehicle use, as discussed in 1.4.1

The Recommended Option has a high results alignment.

9.3.2 Cost estimates

P50 risk-adjusted costs have been developed and are included in Appendix F along with a description of the cost estimation process. A costed programme has been developed for the recommended option using the following process, inputs and reviews (see Appendix H).

9.3.2.1 Cost process and inputs

Asset data was compiled following a review KiwiRail's Track logs, KiwiRail's asset and maintenance data (Maximo database), and KiwiRail's proposed capex programme for 2020-2025

Rail and sleeper asset data was used to develop quantities into three main job types:

- Rerail – replacement of life expired rail only where suitable sleepers are in place. This includes an allowance for replacement of fastening components and destress.
- Resleeper – replacement of life expired sleepers including new fastening components, ballast, formation and drainage.
- Relay – replacement of rail and sleepers as a single operation including ballast, formation, and drainage.
- Work was then split by line section, and by main. The programme was developed to start and finish a track section before moving on as to minimise disturbance to network users with the physical works to be completed by 2024. The workbank was then filtered to identify the type and volume of assets that need to be renewed / replaced.

9.3.2.2 Cost review process

The cost estimate assumptions, rates and assumed resourcing levels have been reviewed by the KiwiRail production, performance, and operational management team at the KiwiRail office at Westfield Junction.

The cost estimate was also reviewed at a workshop with the ANAA Working Group on August 21, 2019 attended by senior stakeholders from KiwiRail including the Professional Head of Track. Senior stakeholders from AT's Rail team and Transdev were also present. The rates and assumptions were reviewed in detail and approved as the recommended option.

9.3.3 Cost benefit appraisal

Table 9-2 displays the Cost Benefit Analysis for Option 4 at the discount rate of 6%. The cost benefit appraisal is detailed further in Appendix G.

Table 9-2 Economic results (all benefits and costs are net present value)

	P4
PV capital cost	$132.64 M
PV net maintenance cost (negative cost, i.e. a net benefit)	-$36.85 M
PV TOTAL COST	**$95.79 M**
Passenger - travel time savings	$295.89 M
Freight - travel time savings	$15.22 M
Isolated cancellations	$11.25 M
Planned cancellations (block of line)	$114.58 M
Large cancellations - off-peak	$14.66 M
Large cancellations – peak	$74.73 M
Super Sunday implementation works	-$5.07 M
PV TOTAL BENEFIT	**$521.25 M**
IRR	17.51%
FYRR	53.86%
NPV	**$425 M**
BCR	**5.4**

9.3.4 Sensitivity Tests

Sensitivity test of the Recommended Option economic performance, show that the BCR ranges from 2.1 (i.e. a Low BCR) to 10.3 (i.e. a very high BCR).

Table 9-3 Sensitivity tests

Sensitivity Test	BCR	NPV benefits
Discount Factor (4%)	10.3	$686 M
Costs (P95)	4.5	$405 M
Scenario 1 – Do min performance deteriorates to 200% (not 300%) in 2059	2.8	$175 M
Scenario 2 - Option 4 performance improvement is lower than expected	4.8	$363 M
Scenario 3 – Do min performance deteriorates to 150% (not 300%) in 2059	2.1	$104 M
25% of planned (block of line) cancellations will be impacted by this investment	4.8	$368 M
75% of planned (block of line) cancellations will be impacted by this investment.	6.0	$483 M

The Recommend Option has a High BCR.

9.3.5 Non-Monetised Benefits

Potential benefits that have not been monetised in the economic analysis include:

9.3.5.1 Safety benefits

Information on safety-related incidents and crashes/injuries over a three-year period were analysed and no incidents were found that resulted in injuries or fatalities. The rail operator takes an inherently conservative approach to managing safety risks and extensively uses Track Speed Restrictions when infrastructure condition issues cannot be immediately remedied. The economic impacts of managing safety are seen in the additional delays caused by TSRs rather than in safety risks being realised in injuries and fatalities.

Safety benefits are also realised through mode-shift from cars to rail, which is a safer form of transport. This mode-shift safety benefit has not been included in the analysis.

9.3.5.2 Impacts of public transport initiatives on demand for alternative modes

Where public transport service delivery is improved, this is likely to result in additional patronage as passengers are attracted to the system when performance improves relative to other modes. The EEM provides demand elasticities (as outlined in sections A14.3 – A14.5 of the EEM) to estimate these impacts. The additional passengers will generate an economic benefit in the form of their consumer surplus and decongestion benefits where they transfer from a private motor vehicle. These impacts are not included in the cost-benefit appraisal are unlikely to significantly impact the of the cost-benefit appraisal.

9.3.5.3 Amenity / other public transport user benefits

Rail asset condition improvements are expected to affect user amenity positively and therefore how customers feel when using the rail network.

The value of public transport service user benefits (other than fare change benefits, increased service frequency benefits and interchange reduction benefits), e.g. improved comfort, is usually based on a willingness-to-pay value derived from a stated preference survey or on values derived for similar service improvements in other areas. This assessment has not been included in the cost-benefit appraisal analysis.

9.3.5.4 Reliability improvement benefits

Reliability relates to the uncertainty in the time taken to travel from the start to the end of a person's journey. For a public transport journey, reliability can affect users in two ways:

- as a delay when picking up the passenger
- as a delay when the passenger is on the service.

Unreliable services cause adjustments in an individual's desired trip-making behaviour, for example, by catching earlier services to get to their destination on time. Therefore, an improvement in reliability generates a benefit to users in time savings and may also create demand for the service.

9.3.6 Prioritisation

With a high results alignment and a BCR of 5.4, the Recommended Option has a priority order of 3.

C – Readiness and Assurance

10 Financial Case

10.1 Project Delivery Costs

The project delivery capital requirements are set out in Section 9.2 and Appendix F. This includes provision for purchase of new equipment, procurement of materials, physical works to renew or remediate track, formation and drainage, review and update of codes and standards to reflect new approaches, investment in people and competency systems, and project management.

Previous approvals of funding are shown in Table 10-1. This includes the business case phase and $10m of funding approved and allocated from the Transitional Activity Class at 100% Funding Assistance Rate (FAR) by the Agency in July 2019 in advance of this business case. This funding was approved in order accelerate some works proposed within this business case and therefore it is appropriate for it to be included. Accelerated works include increased ultrasonic testing for Rolling Contact Fatigue (RCF) defects in the rail, a programme of rerailing to remove areas of RCF where necessary and urgent, fastening inspections and correction/resleepering where required. Project management and other data gathering activities are also included to improve understanding of the underlying asset condition. The action plan is underway and the associated workbank is included in the RNGIM cost estimate (Appendix F) and programme (Appendix H).

The anticipated annual cashflow for the proposed investment (this application) is shown in Table 10-2Table 10-1. The cashflow is based on the programme of work in Appendix H which details the phasing of the RNGIM workbank. A description of the cost estimation process is also included in Appendix F.

The capital requirement has been reduced by c.$3m per annum between 2021 and 2024 reflecting the existing contribution made by AT via the ANAA. AT currently funds approximately $5m per annum for network renewals, including traction and signalling equipment of which $3m is directly related to assets included within this business case.

Table 10-1 Project delivery costs capex- previous approvals

Financial Year	2019	2020	2021	2022	2023	2024	Total
Previous approvals							
DBC	$414,171	$485,829					$900,000
Action Plan		$10,090,671					$10,090,671
Total	**$414,171**	**$10,576,500**					**$10,990,671**

Table 10-2 Project delivery costs capex - this application

Financial Year	2020	2021	2022	2023	2024	Total
This application						
RNGIM Capex	$22,202,235	$55,602,839	$47,573,416	$35,099,236	$10,795,278	$171,273,004
Contingency	$1,345,852	$5,250,691	$6,251,377	$5,698,884	$4,008,821	$22,555,625
Admin @ 1%	$235,481	$608,535	$ 538,248	$407,981	$148,041	$1,938,286
Subtotal	$23,783,568	$61,462,065	$54,363,041	$41,206,101	$14,952,140	$195,766,915
AT ANAA Funding contribution		-$3,000,000	-$3,000,000	-$3,000,000	-$3,000,000	-$12,000,000
Total ($m)	**$23,783,568**	**$58,462,065**	**$51,363,041**	**$38,206,101**	**$11,952,140**	**$183,766,915**

10.2 Operating costs

Whilst a net saving in operating and maintenance costs is projected against the do minimum given the reduced need for maintenance intervention with newer assets, and more efficient work practices enabled by new technology, approaches and training, an increase in nominal cost over todays levels is anticipated. This reflects a future network with higher traffic levels, maintained to a higher metro standard. This will require a larger standing workforce, and higher management overhead than is the case today. Direct Opex associated with new equipment is estimated within this business case at c.$1.76m p.a. Under current arrangements, 100% of these costs will be borne by network users (AT and KiwiRail) in proportion to network usage. These costs are provided for within existing budget forecasts.

10.3 Funding Options

Options for funding the project capital requirement identified and assessed during the development this project include:

- KiwiRail
- Auckland Council / AT
- Private Sector
- Crown Grant
- Other Government Funding (e.g. Provincial Growth Fund)
- National Land Transport Fund / Transport Agency

As part of a previous application to the Crown (Budget 2018 – Vote Transport process), KiwiRail and Auckland Council/Transport funding were acknowledged as not viable. KiwiRail have insufficient capital to fund the proposed works and historically rely on Crown grants.

AT have no provision for this level of investment, and ratepayer funding of a Crown asset to address legacy issues via Auckland Council would not be supported.

Private sector input would be by way of debt financing rather than funding, which would simply increase the overall cost of the project and is not desirable when other funding sources are available.

Crown funding was originally considered as the most viable funding option. This was prior to the release of the 2018 Government Policy Statement, which provided for the creation of the Transitional Rail Activity Class within the NLTF, intended to fully fund priority 'below track' rail improvements in the rail network 'that enhance the reliability and capacity of the passenger rail service, enabling better access to housing and employment'. This activity is 'Transitional' in the sense that it provides for funding in advance of resolution of longer term arrangements via the 'Future of Rail' project.

On creation of the Transitional Rail Activity Class, projects previously submitted to the Crown, including this one, were transferred to the Transport Agency with the expectation they would be progressed.

NLTF Funding is therefore considered the intended and most efficient funding mechanism for investment over and above the current renewals provisions.

As KiwiRail are not yet an Approved Organisation, AT are submitting the Business Case on behalf of KiwiRail and will pass funds from the Transport Agency to KiwiRail with no contribution from AT or KiwiRail. Transitional Rail projects attract 100% FAR. As agreed with the Transport Agency,

given the pass-through nature of these projects, the standard AT administration charge will be reduced from 5.7% to 1% and is included with the capital cost estimate.

10.4 Affordability

The Transitional rail class has a cap of $780 million for the period of this investment (2019 to 2024). The indicative budget of $125.5m for this project in the RLTP.

Table 10-3 GPS Transitional Rail budget 2019 to 2024

Year	2019	2020	2021	2022	2023	2024	Total
$million	55	175	205	185	120	40	780

The recommended investment programme for RNGIM has project delivery costs of $191m so there is a potential funding gap of $65.5m.

Other projects seeking funding from the Transitional Rail class such as Third Main Wiri to Quay Park and Pukekohe to Papakura Electrification are also expected to require a higher level of funding than was anticipated when the Transitional Rail budget was set. This issue has been escalated to the PGB and will need to be addressed at funding activity class level by a high-level review of the project priorities and budget cap.

10.5 Financial Risk

Financial risk for this project sits with KiwiRail as the sponsoring and delivery organisation, and the Transport Agency who manage the Transitional Rail category on behalf of the Crown. As KiwiRail are not yet an Approved Organisation, AT are submitting the Business Case on KiwiRail's behalf and will pass funds through to KiwiRail – at no risk to, and with no contribution from AT. This funding model and funding risk allocation is reflected in the governance structure described in the Management Case section 12.2.

11 Commercial Case

11.1 Introduction

The commercial case provides evidence on the commercial feasibility of the investment and the procurement strategy to achieve the project outcomes. It describes the process for risk allocation and transfer, contract and implementation strategies and timescales.

11.2 Output based specification

The RNGIM programme (Appendix H) defines the expected outputs of this investment specifies the workbank for the next four years. All outputs (and their acceptance into production) will be in accordance with KiwiRail Codes and Standards.

11.3 Implementation strategy

This section provides an overview of the implementation strategy which is comprised of the following detailed elements:

- Procurement Strategy (Appendix J)
- Consenting Strategy (Appendix K)
- Programme (Appendix H)

11.3.1 Procurement Strategy

In line with the KiwiRail procurement policy, RGNIM procurement activities will be guided by the following overarching objectives:

- **Deliver the Best Value** – achieve best value in delivering RNGIM project objectives. Seek opportunities for efficiency and economies of scale across the project by working with wide Auckland Metro Program team and industry partners. The achievement of best value also requires that procurement procedures and contractual arrangements support the delivery of related government policy.
- **Establish Effective Governance and Control** – Conduct procurement activities in a manner that satisfies the requirements of accountability and internal control, fulfils the legal obligations, complies with financial constraints and effectively manages commercial risk.
- **Apply Standardised Approaches** – provide and enforce effective, efficient and consistent commercial arrangement for procuring works, products, and services of a common nature.
- **Build and Maintain Effective Supplier Relationships** – recognise that in order to achieve best affordable value appropriate relationships must be developed and maintained with suppliers and their supply chains.
- **Develop the Internal Capability of KiwiRail** – develop the internal capability of project delivery within KiwiRail, including multidiscipline design resource, project and contract management skill, track and OLE delivery resource including personnel and equipment.

As RNGIM will be funded from the transitional rail category of the NLTF, procurement processes will be in accordance with the Government Rules of Sourcing (GRoS) which applies to all projects in the activity class. The KiwiRail objectives, particularly development of internal KiwiRail capability, are consistent with the changes to the GRoS that will come into effect on 1 October 2019. These changes seek to achieve broader outcomes for New Zealand.

11.3.2 Procurement Strategy Summary and Delivery Model

Due to the nature of the scope works on the RNGIM project consisting of 4 years continuous network upgrades including network change and track renewal, equipment requisition, technology upgrades and competency and training, the intention is that KiwiRail will undertake the project management and core rail activities using their existing resource (supplemented by a recruitment and training programme) and supply chain, including track works (KiwiRail internal delivery), signalling and OLE maintenance (current network service contractors).

The procurement strategy is based on an assessment of KiwiRail's internal capability and market capacity to provide best value for money and mitigate the project risks. KiwiRail have a mature delivery capability and capacity demonstrated by the delivery of major rail infrastructure projects such as Developing Auckland's Rail Transport (DART), Auckland Electrification Project (AEP), North Canterbury Transport Infrastructure Recovery (NCTIR) and Wellington Metro Upgrade Programme (WMUP) as well as internal KiwiRail projects.

The proposed approach is summarised below, and all packages will be managed by the KiwiRail Capital Projects and Asset Delivery Team (CPAD)

- Package 1: Professional Services for early design input, concept design, and cost estimation. KiwiRail with support from professional services supplier under existing framework agreement.
- Package 2: Multidisciplinary (civil, traction and power) design package. KiwiRail will perform all track design and collaborate with Siemens for the signalling design. A

multi-disciplinary design firm will be engaged via closed tender for all other detailed design.

- Package 3: Specialist trade package – Signalling supply, installation and testing/commissioning. To be performed by the current signalling contractor Siemens.
- Package 4: Specialist trade package – Traction/OLE supply, installation and testing/commissioning. Open tender or closed tender with pre-approved Tier 1 or 2 contractor.
- Package 5: Track Work Supplement including re-railing, sleeper replacement, turnouts, and crossovers. To be delivered by internal KiwiRail teams. Specialist contractor to provide supplementary support for certain stages including major block of lines, engaged via closed tender.
- Package 6: Civil, Construction and Delivery package including formation upgrades and drainage. Open tender or closed tender with pre-approved Tier 1 or 2 contractor. Material for track work will be sourced using the exiting KRG supply chains to leverage and capitalise on existing commercial arrangement, which includes but not limited to rail, sleepers, turnouts, and ballast.
- Package 7: Equipment and plant purchasing through open tender.
- Package 8: Training and facility service provider through open tender.

Table 11-1 : RNGIM Estimated physical works

Description	Estimated budget	Estimated internal KiwiRail cost	Estimated specialist contractor cost
Network changes	[redacted]	[redacted]	9(2)(i) - commercial activities [redacted]
Track upgrade and renewals	9(2)(i) - commercial activities	[redacted]	[redacted]
Track bed renewals	9(2)(i) - commercial activities	[redacted]	[redacted]
Total	9(2)(i) - commercial activities	[redacted]	[redacted]

It is noted in the Procurement Strategy that KiwiRail need to ensure that the programme and internal management team is resourced to deliver this form of delivery model. A description of the management structure is in Section 0.

The selected delivery model with KiwiRail delivering a large proportion of the scope of works has been selected to maximise the use of in house resources, provide ongoing development of KiwiRail skills and capability, and maintain/leverage the current contractor relationship.

This model places KiwiRail in the lead and control position to perform as Project Manager and System Integrator and allows the achievement and delivery of the overarching project objectives.

11.3.3 Consenting Strategy

A preliminary scoping of consent and approval requirements (Appendix K) has been undertaken on the basis that the proposed works:

- Are within the existing rail designations
- Are a greater volume of KiwiRail business as usual renewals
- Asset renewals, e.g. new ballast, sleepers and rail
- Upgrading of existing rail lines

11.3.3.1 Statutory Approvals

The existing Auckland Rail Network is designated in the Auckland Unitary Plan (AUP) (Operative in Part). The designation provides for KiwiRail either itself or through its agents, *to develop, operate and maintain railways, railway lines, railway infrastructure, and railway premises as defined in the Railways Act 2005*.

Works undertaken within areas designated in the AUP must be in accordance with the purpose of the applicable designation and are subject to the Outline Plan Provisions of Section 176A of the RMA. An Outline Plan of Works will need to be submitted and accepted by the Council prior to works.

The RGNIM works are within the existing designation and are considered as activities that are core to operating transport infrastructure, so an application for an alteration to the designation and an Outline Plan of Works (OWP) are not expected to be required.

11.3.3.2 Archaeological Sites

If excavations disturb pre-1900 archaeological sites an archaeological authority is required under the Heritage New Zealand Pouhere Taonga Act 2014.

It is recommended that a list of recorded/known archaeological sites is made available to those working on the project, so they are aware of any risks. As this is also a recommendation for other projects in the Auckland Metro Programme such as Third Main Wiri to Quay Park and Pukekohe to Papakura it is suggested that KiwiRail develop (if not already available) a register of pre-1900 archaeologic sites for the full AMRN.

11.3.3.3 Contaminated Land

The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS) is a set of planning controls and soil contaminant values and earthworks is one of the categories of activities covered by the NESCS.

Under the regulations, land is considered to be actually or potentially contaminated if an activity or industry on the Hazardous Activities or Industries List (HAIL) has been, is, or is more likely than not to have been undertaken on that land. Railway yards, bulk storage of hazardous substances and sub stations are activities that are on the HAIL. Ballast is also generally considered to be contaminated (but is not soil).

If earthworks are required, an assessment under the NESCS will be required to determine if consent is needed.

11.3.4 Property Strategy

The RGNIM works will be within the existing rail designation boundaries and no additional property impacts or requirement for land acquisition have been identified for this project.

11.3.5 Risk Allocation and Transfer

KiwiRail faces a range of risks in relation to RNGIM delivery including resourcing, rail access and design interfaces. A full risk register is in Appendix I.

The risk allocation table below outlines the key of the project elements and identifies who is best placed to manage the risks.

Table 11-2 Risk allocation and transfer

Description	KiwiRail	Specialist contractors	Both
Professional services	X		
Signalling design	X	X (Siemens)	X
Signalling supply		X (Siemens)	
Civil design		X	
Civil construction		X	
Traction/Power design		X	
Traction/Power supply		X	
Track design	X		
Track construction	X	X	X
Training and competency		X	
Plant and equipment		X	

11.3.6 Sourcing Options

The following packages will be sourced according to Government Rules of Sourcing (GRoS) and KiwiRail's procurement policy;

Package	Scope	Sourcing option	Notes
Input to Professional Services package as needed by KiwiRail	Early design input, concept design, consent, land designation, cost estimation.	KiwiRail internal package with contracted professional services if needed Engage service provider who is a Professional Services Framework Panel member using a professional service contract	No open or closed tender process required
Multi-disciplinary design package	Civil, traction and power	A multi-disciplinary design firm will be engaged via closed tender	KiwiRail will deliver track design inhouse, and collaborate on signalling design with existing signalling contractor Siemens
Specialist trade package - Signalling	Signalling design, supply, installation and testing / commissioning	Direct sole source procurement (Siemens)	GRoS exception clause 15
Specialist trade package – Traction / OLE	Traction / OLE supply, installation and testing / commissioning	Open tender or closed tender with pre-approved Tier 1 or 2 contractor.	

Package	Scope	Sourcing option	Notes
Track Work Supplement	Re-railing, sleeper replacement, turnouts, and crossovers	Specialist contractor to provide supplementary support for certain stages including major block of lines, engaged via closed tender.	KiwiRail will deliver the majority of the track work themselves with support from this supplementary contractor where required.
Civil, Construction and Delivery package	Formation upgrades and drainage	Open tender or closed tender with pre-approved Tier 1 or 2 contractor	
Equipment and plant		Open tender via GETS system	
Training provision and facilities		Open tender via GETS system	

11.3.7 Pricing Framework and Charging Mechanisms

A contractor engagement framework was used to assess the suitable model and commercial framework based on the project profile and scope and is included in Appendix J Procurement Strategy.

The pricing and payment mechanisms will be agreed with suppliers as part of the procurement process and defined in the conditions of contract. These should be linked to performance measures, quality criteria and key deliverables and milestones.

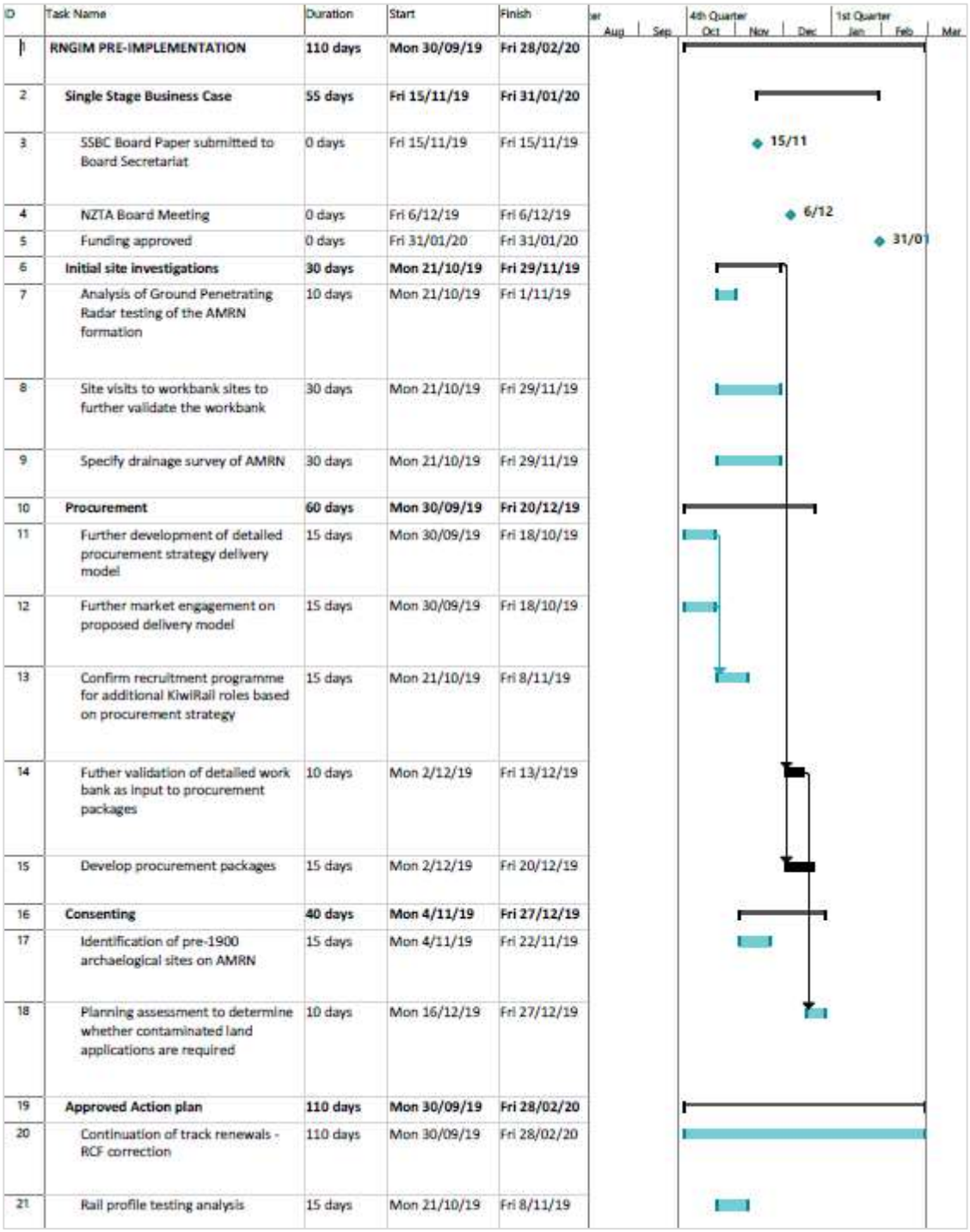
11.3.8 Contract Length

The length of the contracts will be confirmed as part of procurement process. They are expected to align with the programme for pre-implementation and implementation outlined in Section 11.3.9 and Appendix H.

11.3.9 Programme

KiwiRail is responsible for the project management and monitoring and control of the RNGIM project including design, physical works and handover to KiwiRail maintenance and operations divisions. A detailed costed and resourced programme is included in Appendix H.

Pre-implementation activities are detailed in Figure 11-1 and in Appendix H. The following programme describes the activities that will take place prior to the release of the funding for the SSBC investment programme. These interim tasks will enable KiwiRail to further prepare for mobilisation, recruitment and procurement as soon as the SSBC funding is approved.
No additional funding is sought for these pre-implementation activities.



ID	Task Name	Duration	Start	Finish
1	**RNGIM PRE-IMPLEMENTATION**	**110 days**	**Mon 30/09/19**	**Fri 28/02/20**
2	**Single Stage Business Case**	**55 days**	**Fri 15/11/19**	**Fri 31/01/20**
3	SSBC Board Paper submitted to Board Secretariat	0 days	Fri 15/11/19	Fri 15/11/19
4	NZTA Board Meeting	0 days	Fri 6/12/19	Fri 6/12/19
5	Funding approved	0 days	Fri 31/01/20	Fri 31/01/20
6	**Initial site investigations**	**30 days**	**Mon 21/10/19**	**Fri 29/11/19**
7	Analysis of Ground Penetrating Radar testing of the AMRN formation	10 days	Mon 21/10/19	Fri 1/11/19
8	Site visits to workbank sites to further validate the workbank	30 days	Mon 21/10/19	Fri 29/11/19
9	Specify drainage survey of AMRN	30 days	Mon 21/10/19	Fri 29/11/19
10	**Procurement**	**60 days**	**Mon 30/09/19**	**Fri 20/12/19**
11	Further development of detailed procurement strategy delivery model	15 days	Mon 30/09/19	Fri 18/10/19
12	Further market engagement on proposed delivery model	15 days	Mon 30/09/19	Fri 18/10/19
13	Confirm recruitment programme for additional KiwiRail roles based on procurement strategy	15 days	Mon 21/10/19	Fri 8/11/19
14	Futher validation of detailed work bank as input to procurement packages	10 days	Mon 2/12/19	Fri 13/12/19
15	Develop procurement packages	15 days	Mon 2/12/19	Fri 20/12/19
16	**Consenting**	**40 days**	**Mon 4/11/19**	**Fri 27/12/19**
17	Identification of pre-1900 archaelogical sites on AMRN	15 days	Mon 4/11/19	Fri 22/11/19
18	Planning assessment to determine whether contaminated land applications are required	10 days	Mon 16/12/19	Fri 27/12/19
19	**Approved Action plan**	**110 days**	**Mon 30/09/19**	**Fri 28/02/20**
20	Continuation of track renewals - RCF correction	110 days	Mon 30/09/19	Fri 28/02/20
21	Rail profile testing analysis	15 days	Mon 21/10/19	Fri 8/11/19

Figure 11-1 Pre-implementation activities

12 Management Case

12.1 Project Roles

The project sponsor is [ ] KiwiRail Chief Operating Officer – Capital Projects and Asset Development (CPAD) and he chairs the joint Programme Governance Board (PGB), comprising KiwiRail and AT. The Transport Agency is an observer on the PGB as the body providing Transitional Rail funding for the project. This collective group owns the scope for the project.
This project will be governed by the PGB above, but will be delivered by KiwiRail's Operations group, as the nature of the works required for the overall scope involves changes to the way railway infrastructure is maintained and operated and the majority of the work is core rail activities.

A project team has been established to deliver the RNGIM project and has provided input to the proposed scheme, cost estimate and supporting documentation for this business case. This core team shown in **Error! Reference source not found.** will continue to develop RNGIM through pre-implementation and will be supplemented by additional professional services suppliers, designers and contractors for the subsequent stages of the project as described in the Procurement Strategy in Appendix G.

Table 12-1 Project roles

	Role	Name
	Project Sponsor (KiwiRail)	{[ ], Chief Operating Officer, CPAD
	Project Sponsor (Auckland Transport)	[ ], Manager Strategic Rail Development
	Project Director (KiwiRail)	[ ] Programme Director CRL & Auckland Projects
	Programme Manager (KiwiRail)	[ ], Metro Services Infrastructure Manager to begin with followed by appointment of a full-time person during the mobilisation period

12.2 Governance Structure

Governance for the project is provided by the Auckland Metro **Programme Governance Board** (PGB). This body, chaired by KiwiRail, comprises senior members from KiwiRail, AT and the Transport Agency to provide strategic direction to the Project Director. The PGB is the sponsor for the project and is the owner of the project scope. They are the decision-making body responsible for leadership of the project and ensuring its success.

The PGB reports to the KiwiRail Board Sub Committee for Infrastructure & Asset Management (IAMC), and ultimately the KiwiRail Board. This reporting line is the escalation route for any issues which cannot be addressed by the PGB. The representative from each of these organisations is responsible for reporting back to their own respective Boards.

Beneath the PGB sits the **Programme Control Group** (PCG). This is chaired by the Project Director and is the forum for addressing delivery issues for the portfolio of projects within Auckland Metro Programme. The RNGIM Programme Manager provides a monthly status report for this meeting and uses this forum to inform the project governance framework of progress, performance and to escalate any issues.

The North Island Planning Team is responsible for coordinating and scheduling the works and resources across the business as usual activities (maintenance of the metro network), and delivery of the RNGIM scope of works.

The Special Projects Manager will lead the change management (transition) needed on the network, standards and codes, teams, equipment, and asset management of the network. The governance and delivery structure is included in Appendix E.

12.3 Assurance and Acceptance

12.3.1 Single Stage Business Case Review

AT has engaged an independent peer reviewer, John Allard of Allard Transport and Management Consulting, to review the evaluation procedures and results for this business case against the Transport Agency Economic Evaluation Model (EEM) and the option assessment process followed for the SSBC.

The Transport Agency's Investment Quality Assurance (IQA) team will review the business case report and supporting information for alignment with the Transport Agency business case approach and SSBC guidelines. Their recommendations will be documented Business Case Quality Assessment Form and appended to the SSBC report prior to submission to the Transport Agency Board for investment approval.

The cost estimate assumptions, rates and assumed resourcing levels have been reviewed by the KiwiRail production, performance, and operational management team at the KiwiRail office at Westfield Junction.

The cost estimate was also reviewed at a workshop with the ANAA Working Group on August 21, 2019 attended by senior stakeholders from KiwiRail including the Professional Head of Track. Senior stakeholders from AT's Rail team and Transdev were also present. The rates and assumptions were reviewed in detail and approved as the recommended option.

12.3.2 KiwiRail Professional Head Design Review and Approval

KiwiRail will need to continue to ensure that it complies with KiwiRail's Engineering Codes and Standards. As part of the ongoing design development process, KiwiRail have and will continue to ensure that appropriate review and approval at specified development or stages is provided by KiwiRail's professional heads for each main discipline, and by KiwiRail Chief Engineer as shown in **Error! Reference source not found.**

This process will also ensure that where the infrastructure being delivered interfaces with other KiwiRail functions such as rolling stock, that the provisions required under the National Rail Systems Standards (NRSS) and the Railways Act 2005 are discharged.

The objectives of this design function will be to:

- To review scheme, preliminary and detail design drawings against KiwiRail's approved standards and industry standards
- To provide feedback to the Programme Manager, Design Manager and design consultants where required, before being approved for construction
- To assist the project to deliver compliant and high quality in the final product being delivered.

Input is particularly critical during the delivery phases (scheme design, preliminary design and detailed design), where all aspects of the design will be peer reviewed to ensure compliance with KiwiRail Engineering requirements.

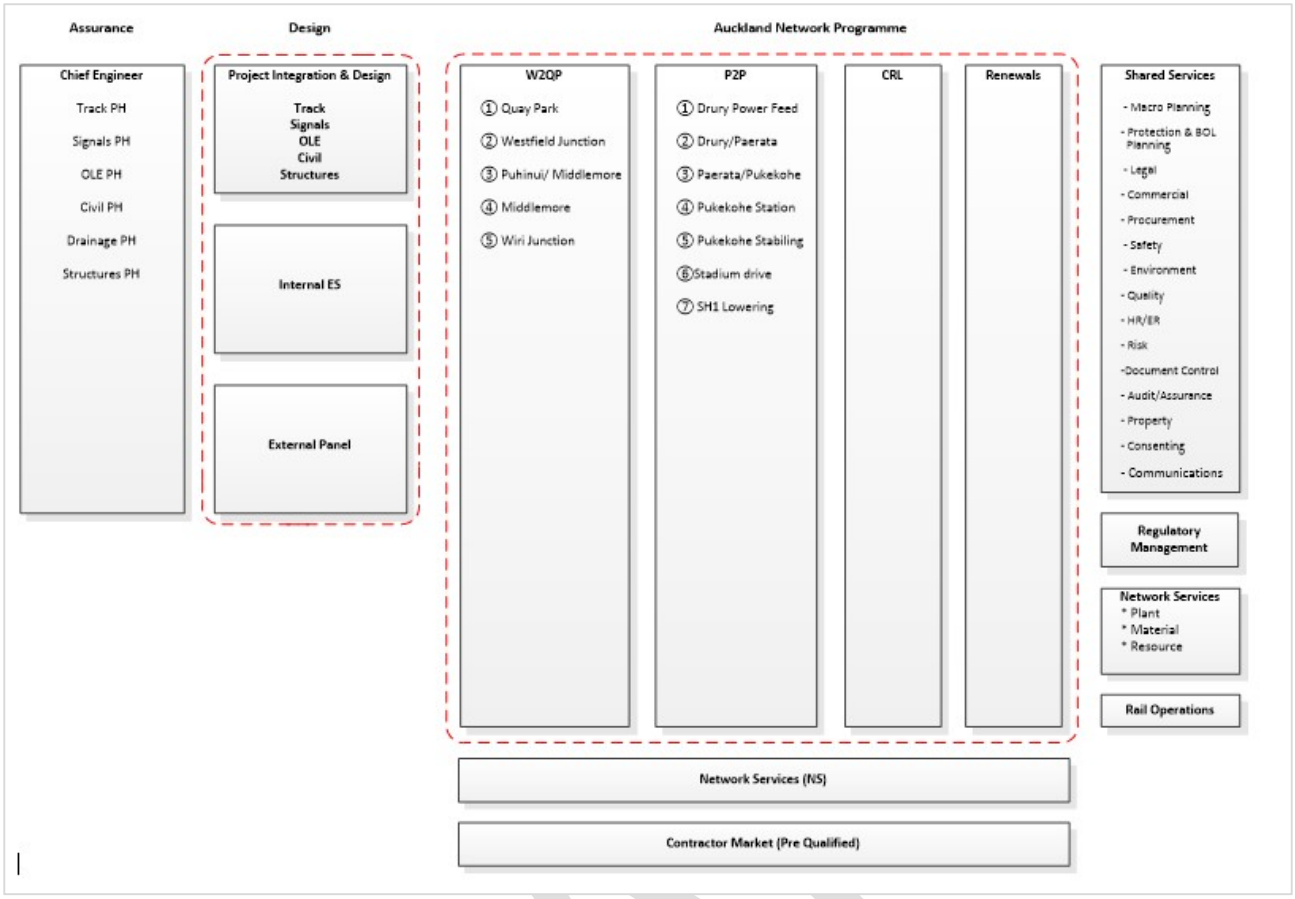


Figure 12-1: KiwiRail design assurance structure

12.3.3 KiwiRail legal and Procurement Teams

Associated contractual arrangements that will be entered into by KiwiRail for the delivery of the project will need to be reviewed by KiwiRail legal to ensure that appropriate provisions and protection mechanisms are incorporated to protect KiwiRail and the Sponsors.

KiwiRail procurement team has helped develop and review the procurement strategy for RNGIM. They will also review phased elements of EOI, RFP and RFT processes, as well as support KiwiRail legal on contract development and execution. The KiwiRail procurement team will also help support the project to ensure probity and appropriate competitive processes are used for the contracting of the project.

12.3.4 KiwiRail Health, Safety and Environment Committee (HSEC)

The project will provide information to the HSEC committee on safety performance of the project throughout the project lifecycle. Any significant safety requirements that arise from project delivery will need to be notified to the KiwiRail HSEC.

12.3.5 Handover

The CPAD manual includes a matrix detailing the handover process and nominated leads for each functional area. As part of the handover process, documents including but not limited to asset data, as built (for upload to the enterprise asset management system Maximo), and construction certificates signed off by the delivery team and project sponsor.

12.4 Change Control

KiwiRail will implement a comprehensive change control process that will be the responsibility of the Programme Manager to administer. Levels of change authorisation are established at the outset of each phase.

Any change request must be accompanied by a detailed description of the proposed change and its impact upon the project, including time, cost, safety, environmental and quality. Changes with a significant impact on scope/programme/budget/risk profile will require PCG or PGB approval. It will be the responsibility of the Programme Manager to determine the level of authorisation required based upon the parameters agreed as part of the PCG/PGB process.

KiwiRail will also ensure that it complies with the Safety, Health and Environment (SHE) Change Control standard, as depending upon the type and scope of the change there may need to be input, and approvals needed from KiwiRail business units such as Zero Harm, Property, Engineering, Finance, and Legal as part of the change management process.

12.5 Cost Management

KiwiRail will implement a robust financial tracking and reporting system through complying with the CPAD programme management framework. Financial budgets will be developed against the detailed work breakdown structure (WBS) for the approved scope of works being completed. Costs for the period and year to date will compare this with the anticipated and baseline cashflows. Any variances will be investigated and reported separately. Depending of the size of the variance, appropriate reporting will occur to the PGB and PCG as necessary.

KiwiRail will also implement a monthly project reporting system, which forecasts 'cost to complete'. This will be used to provide regular updates on financial performance of the project to the PGB and PCG.

It is the responsibility of the Project Manager to track and report expenditure on the project, and the Project Manager will work closely with the CPAD team to ensure the accuracy and timeliness of project finances.

Contingencies will be calculated and managed in accordance with the requirements in the Transport Agency's Cost Estimation Manual (SM014).

12.6 Risk and Issues Management

The expected risks and opportunities associated with delivering the programme and achieving the intended outcomes are summarised in Table 12-2. These risks and opportunities are addressed through the Management Case (Part C).

Table 12-2: Risks and opportunities associated with implementing and achieving outcomes

Risk Description	Rating	Risk Mitigation
Quality of work affected by the level of competency of local workforce.	Risk - Very High	Recommended Option includes investment in a dedicated training programme and facility for both KiwiRail and external staff. Knowledge transfer to KiwiRail people by partnering with external competent personnel. Early engagement with Tier 1-3 contractors has already commenced.
Suitable competent people may not be available in the numbers required.	Risk - Very High	
Market constrains the availability of competent personnel to carry out this work within the stipulated timeframes.	Risk - Very High	
Work continues beyond 2024 leading to disruption of the CRL timetable due to increased number of TSRs and BOL post CRL opening.	Risk - Very High	Clearly defined programme of work supported by a training, resourcing and procurement strategy. Governance structure, PMO and dedicated project delivery and management team. Integrated programme for all Auckland Metro rail projects.
Access windows are not available due to competition from other projects, with a resulting delay to the programme.	Risk - High	Integrated programme and joint governance structure for all Auckland Metro rail projects. Block of Line Committee process reviewed.
Increased volume of renewals and maintenance on the rail network leads to increased disruption of services leading to customer dissatisfaction and mode shift by both passenger and freight customers.	Risk - High	Integrated programme for all Auckland Metro rail projects. Investment is intended to minimise disruption in services post 2024, project delivery and management structure are in place to deliver programme by 2024.
The funding requested is insufficient to deliver the full programme or work and all the benefits are not realised.	Risk - High	Detailed programme and cost developed using a bottom up estimate based on asset condition and age data. Contingency.
The funding requested is above the amount available in the NLTP Transitional Rail class.	Risk – High	This issue has been escalated to the PGB and will need to be addressed at funding activity class level by a high-level review of the project priorities and budget cap.
Safety - Opportunity to maintain the safety of the Auckland Rail Network in the longer term and reduce the risk of asset failure	Opportunity - Very high	Programme of investment in maintenance, renewals and working practices and competencies is an opportunity to mitigate the risk of potential asset failure in the future. More inspections of the network due to post maintenance and renewals

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Appendix A
Partners and Key Stakeholders

Appendix A – Partners and Key Stakeholders

Appendix B
Strategic Alignment Assessment

Appendix B – Strategic Alignment Assessment

Appendix C
Multi-Criteria Assessment and Long List of Programmes

Appendix C – Multi-Criteria Assessment and Long List of Programmes

Appendix D
Investment Logic Map

Appendix D – Investment Logic Map

Appendix E
Organisational Structure

Appendix E – Organisational Structure

Appendix F
Cost Estimates

Appendix F – Cost Estimates

Appendix G
Economic Evaluation

Appendix G – Economic Evaluation

Appendix H
Programme

Appendix H – Programme

Appendix I
Risk Register

Appendix I – Risk Register

Appendix J
Procurement Strategy

Appendix J – Procurement Strategy

Appendix K
Consenting Strategy

Appendix K – Consenting Strategy

Appendix L
Geographic view of the renewals workbank

Appendix L – Geographic view of the renewals workbank

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