17.5 Proposed Investment Cash Flow

Assuming funding is confirmed in the first half of the 2018 calendar year, investigations, design and some procurement would commence promptly. This would enable early track infrastructure catch-up renewals throughout the network, to help minimise safety and performance risks and reduce the need for additional speed restrictions.

Table 27 provides a forecast of the cash flow for the proposed works. The actual drawdown of funds will be based on the actual cost of works.

Table 27 – Assumed Cash Flow for the Preferred Option (totalling $95.8m)

Financial Years							
2019	2020	2021	2022	2023	2024	2025	2026
$7.08m	$19.9m	$20.8m	$23.9m	$11.5m	$11.2m	$0.97m	$0.32m

GWRC and KiwiRail are committed to ensuring the investment and benefits highlighted in this business case can be realised in the proposed timeframe and within the constraints of the proposed estimate.

While a commitment is requested, it is emphasised that there may be possible minor adjustment of scope, cost, cash flow and programmes following further investigations and design to be undertaken during the investment period.

It should also be recognised that this will be a very busy period for rail work, as well as the wider transport network, therefore demand on resources could be high. There is room in the work programme to deliver some items later than currently proposed while still meeting the performance needs and targets.

18 Commercial Case

THE COMMERCIAL CASE OUTLINES HOW THE PREFERRED OPTION WILL BE PROCURED

18.1 The Procurement Strategy

KiwiRail will manage the procurement of investigations, design, materials and physical works for the track infrastructure catch-up renewals and slopes remediation works. KiwiRail has well established procurement and project governance processes in place consistent with a State Owned Enterprise. Therefore, it is not intended that this Business Case sets out these processes in specific detail.

As a general overview of the physical works, a combination of KiwiRail delivered works and construction contracts will be used. KiwiRail staff will generally deliver the track work (sleepers, rail etc.). A new team (or teams) will be established to deliver these works, including recruiting additional staff. This is covered in the Management Case.

For other works, construction contracts will be procured by competitive tender with the following details:

1. Tenders will be sought from contractors who have experience in renewing existing operating track infrastructure (i.e. trains are kept running at all times except for scheduled close downs);
2. A pre-qualification tender will be run to establish the short list of bidders; and
3. Tenders will be assessed on both non price attributes and cost.

18.2 Required Services

The services required for the preferred way forward are summarised as follows:

Investigation and Design

- Investigations and design of tunnel-track;
- Some design for required for (non-tunnel) track (especially where realignment is required such as track-lowering);
- Investigations, condition assessments and design of civils (formation, culverts, drainage etc.);
- Inspections and design of bridge renewals; and
- Investigation and design of slope treatment works.

Physical Works

- Project management and coordination with KiwiRail, GWRC, Transdev and other stakeholders;
- Replacing selected rail, fastenings and sleepers (including within tunnels);
- Cleaning, replacing and supplementing ballast;
- Renewal of selected civil assets (formation, culverts, drainage etc.);
- Renewing selected bridges;
- Slope treatment works on selected high risk slopes;
- Removal and disposal of all redundant track infrastructure; and
- Bus replacements for affected train services (Transdev).

18.3 Contract Provisions

Kapiti Line traction catch-up renewals (2013 – 2016 part of WMUP I), was delivered safely, cost effectively, with high build quality and low service disruption.

Continuous improvement was strongly driven by the contract structure. Cost per single track kilometre (STK) of wiring was reduced from a tendered cost of $883k per STK to $791k per STK by the final phase of works. This can be compared to a cost approaching $1m per STK for previous work packages.

A similar contract structure that contributed to the success of the Kapiti project will be adopted for the track infrastructure catch-up renewal works.

Alliancing principals would be incorporated into an industry standard contract. This would cover negotiations of any site unknowns or any other uncertainties with respect to rail corridor access.

The alliance process will help ensure the parties manage the works for a 'best-for-project' outcome. Additionally, there are incentives to manage risks effectively, reward excellence in safety management and drive productivity/ efficiency metrics over the duration of the contract.

19 Management Case

THE MANAGEMENT CASE EXPRESSES HOW THE PREFERRED OPTION WILL BE DELIVERED

19.1 Project Management Strategy and Framework

KiwiRail's standard project governance approaches, as adapted for the successful Kapiti Line traction catch-up renewals project, will be used. A summary of key elements includes:

- A 'Track Infrastructure Catch-Up Renewals' governance group consisting of Senior KiwiRail and Contractor Managers;
- MOT and GWRC representatives have the opportunity to form part of this group if desired. This group will oversee the work and sign-off on key decisions that need to be made;
- The KiwiRail Wellington Area management team will manage the investigations, design, procurement and delivery of the works on a day-to-day basis;
- A KiwiRail Project Manager will be appointed or recruited to this team and will utilise a mix of internal staff and external project management support;
- KiwiRail work crews will likely deliver the majority of the "plain" track works (such as resleepering), with slope remediation, bridge renewals and potentially tunnel-track renewals contracted out.
- Note that KiwiRail will ensure that catch-up works will not jeopardise their maintenance and steady state renewals programme throughout the network.
- The main advantage of the work being managed by the Wellington Area is that the project work can be seamlessly integrated with routine maintenance and steady state renewal works, its experienced engineering staff are part of the project and the effect of works on scheduled train services can be managed under the terms of the existing GWRC WNA access contract;
- For larger work packages, the Contractor Management team will be based in the KiwiRail Wellington Area office to maximise efficient, cooperative and constructive relationships;
- KiwiRail's track maintenance and engineering staff carry out the final quality inspection of each completed section as part of its hand over; and
- KiwiRail will provide monthly (to all) and quarterly (to MOT) progress updates on the project and any issues that may arise as the work proceeds. In particular, projected cash flows will be regularly updated and provided to NZ Treasury.

Key milestones for Option 4: Track Catch-Up Renewals & Slopes are as outlined in Table 28 assuming the investment is approved by May 2018.

Table 28 – Outline Project Milestones

Proposed Key Milestones	Estimated Timing
Consideration by Ministry of Transport & NZ Treasury	Nov 2017 – May 2018
Investment agreed/ approved	May 2018
Project initiation and start procurement process for some items	Jul 2018
Investigations and design	Jul 2018 – Jun 2019
Appoint contractors and commence establishment	Varies (most elements during 2019)
Commence physical works	Feb 2019
Completion of all physical works	2026

20 Decisions Sought

The decision makers are requested to:

Note the strategies and urgent need for the track infrastructure catch-up renewals on the WMRN by 2027 and that work needs to start as soon as possible to achieve this.

Agree that the preferred **Option 4: Track Catch-Up Renewals & Slopes** with an investment cost of $95.8 is adopted.

Agree that the adopted option be funded by the Crown at a cost of $95.8m.

Assuming the above items are approved:

Agree that KiwiRail procure and deliver the works with funding provided by the Crown through the Ministry of Transport.

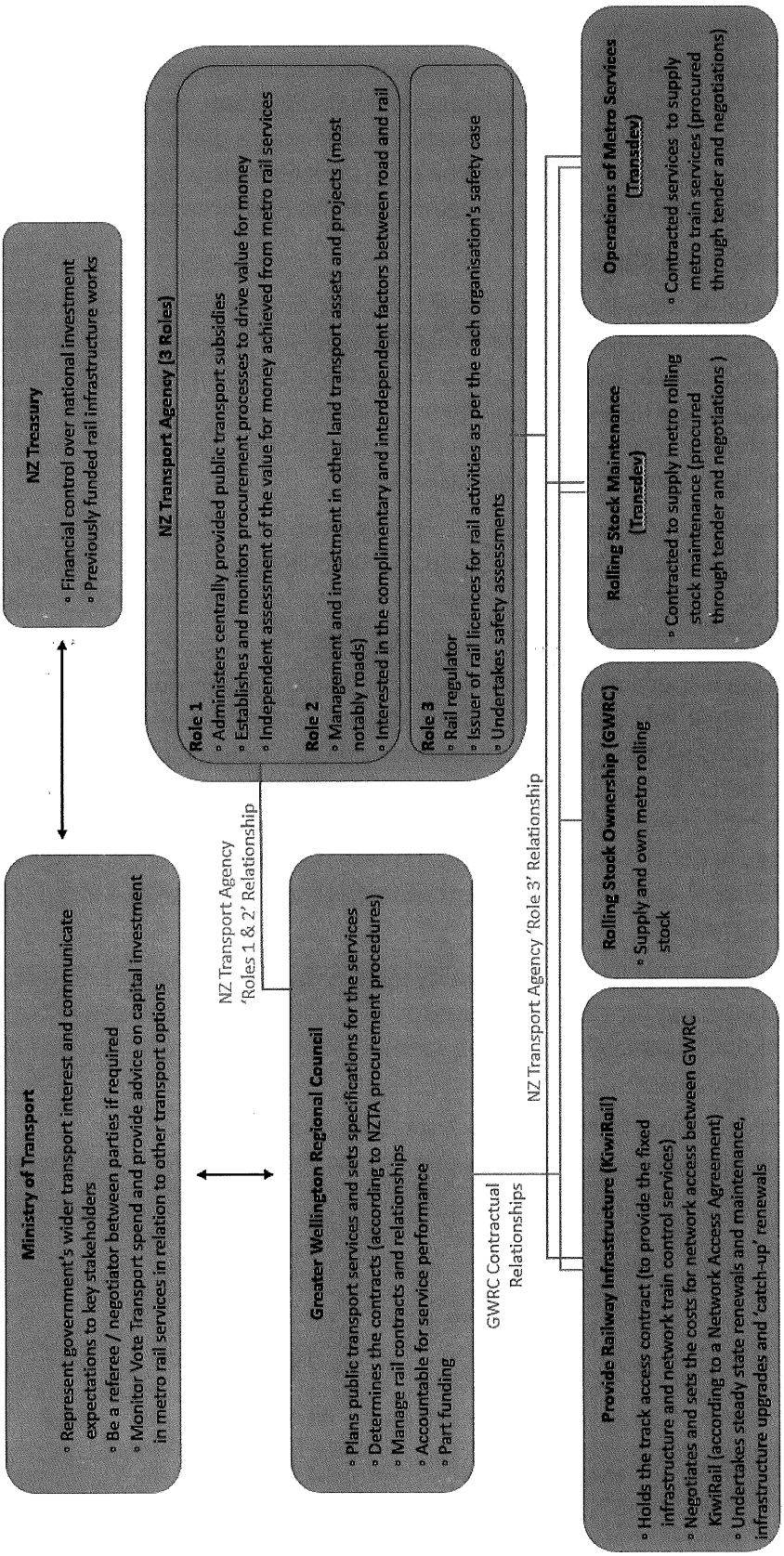
Appendix A – MROM Structure and Roles

Table 29 – MROM Organisations, Roles and Responsibilities

MROM Organisation	Roles and Responsibilities
GWRC	GWRC is the central stakeholder and funder which sets commuter rail strategies and puts in place the mechanism to deliver them. Their responsibilities include: • Planning, specifying and purchasing metro rail services; • Public Transport subsidy obtained from rates and NZTA; • Owning the metro rail rolling stock, depots and station buildings (except Wellington Station, carriage depot and Wairarapa diesel locomotives); and • Paying their share of the WNRM infrastructure operating, maintenance and steady state renewal costs, in accordance with the Wellington Network Agreement (WNA) circa $20m per annum. GWRC pay the majority of the costs (around 80%) towards the WMRN given their high use of the network.
KiwiRail Group	A State-Owned Enterprise. KiwiRail is the infrastructure owner (on behalf of the Crown) and provider for the WMRN. They are contracted to provide safe and reliable network services through the WNA. KiwiRail-operated freight and long-distance passenger trains also use the WMRN. They pay their portion of rail infrastructure operating, maintenance and renewal costs in accordance with the WNA.
NZ Transport Agency	The NZ Transport Agency provides oversight, safety regulation and operating funding through GWRC towards the WMRN. Responsibilities include: • Public Transport Framework and Investment – Setting the public transport procurement processes and administering subsidies; • Transport Corridor Investment – Investigation and development of recommendations to invest in land transport options; and • Rail Regulator – Responsible for issuing rail licenses, maintaining safety records and incident investigation. Separate to funding division.

MROM Organisation	Roles and Responsibilities
Metro Service Operator - Transdev Wellington Ltd	Transdev Wellington Ltd is under contract to GWRC to provide WMRN passenger train operations and maintenance services. A 9 + 6-year service contract commenced in July 2016. They have a key role in representing operator interests and providing expertise in operations and rolling stock maintenance.
Ministry of Transport	Have an overarching responsibility to represent the Crown's transport interests, ensure the MROM is working effectively and consider/ provide investment advice to NZ Treasury.
NZ Treasury	Responsible for assessing possible investments. If funding is approved, Treasury provides the funding though appropriations. Treasury have previously provided funding for rail infrastructure 'upgrade' works in Auckland and Wellington.

Figure 24 – MROM Structure



Appendix B – Condition Assessments

The following information is to help understand the condition assessments that are undertaken that form the asset condition database. Condition, along with other factors such as use, is used to determine the maintenance and renewals plans. Rate of change (typically deterioration) can be observed and can be used to determine when an asset will likely require renewal, preferably before it begins to exhibit performance issues.

Track Condition Assessments

KiwiRail undertakes a range of track inspections and assessments to assess and monitor track condition, forecast and plan track maintenance and renewals. These inspections and assessments also include track in tunnels. Inspections include in-vehicle inspections, detailed foot inspections which include manual measurements (every 80 days), rail defect inspections via ultrasonic testing, track geometry via the EM80 vehicle (see below) and special inspections such as yearly Engineering inspections.

During the Engineering Inspections, each asset is given a condition rating from 1 to 5 and a renewal date if required within 10 years (track is typically broken into ~100m-500m segments). This is the important inspection type for driving long-term plans and determining the volume of work required within the coming 10 years.

Another notable inspection undertaken uses the EM80 track evaluation rail car (on average every four months). This takes various track geometry measurements and produces a number of outputs including Track Quality Index (TQI). TQI is a measure of the condition of the track geometry. It is an aggregated measure of the horizontal curvature, the running surface of the rails, the gauge (distance between rails), the cant (super elevation) and twist (rate of change of cant). Lower TQI values indicate the line has track in better condition. Comparing TQI between lines of different characteristics is not valid; it is the trend over time for a line that is relevant.

Most lines in the WMRN have Track Quality Indices that are steady or improving and under the KPI targets, except for the Wairarapa Line which has been above the KPI target since 2013 and is steadily increasing as can be seen in Table 30 below with red text denoting TQI values above the KPI's.

Table 30 – Wellington Metro Railway Network Track Quality Index Summary

Line	KPI	Sep 12	Dec 12	Jun 13	Sep 13	Dec 13	Jun 14	Sep 14	May 15	Sep 15	Apr 16
Kapiti	**35**	32.1	35.4	32.6	32.8	34.9	33.8	33.3	33.8	34.2	33.6
Johnsonville	**64**	60.6	61.7	60.6	60.4	62.7	62.6	56.6	57.3	56.5	56.0
Hutt Valley	**33**	31.6	32.8	31.8	30.8	33.0	30.7	31.9	30.5	31.3	31.4
Melling	**43**	39.7	38.9	40.0	40.7	41.3	41.1	40.7	40.7	41.0	37.3
Wairarapa	**29**	28.8	28.8	29.7	29.7	32.1	28.8	30.9	30.1	31.3	31.4

Civils Condition Assessments

KiwiRail conducts hi-rail vehicle inspections weekly and detailed foot inspections every 80 days of the track and adjacent railway corridor. Obvious issues with civil infrastructure, in addition to track, are identified and recorded e.g. blocked cess drains or drainage issues.

KiwiRail conducts general inspections of culverts on a six yearly basis. Larger culverts (above 2m) are typically considered 'structures' and may be subject to a more rigorous inspection schedule, similar to KiwiRail bridges. General inspections consist of a visual inspection of accessible parts of the culverts. Culverts are rated on a scale of 1 to 5 with 1 being as new condition and 5 being unacceptable condition with issues requiring work identified and recorded. Work required is given a date which it must be completed by.

Bridge Condition Assessments

KiwiRail conducts general inspections of bridges on an annual basis which consists of a short visual inspection of accessible parts of the bridge. KiwiRail also conducts detailed inspections of bridges on a six yearly basis which consists of a thorough visual inspection of accessible parts of the bridge. For both inspections, numerical ratings of between 1 and 5 are assigned to each of the bridge components and the bridge as a whole, again with issues requiring work identified and recorded. Work required is given a date which it must be completed by.

Slopes Condition Assessments

KiwiRail conducted a slope rating exercise circa 2011 where some 3,000 slopes adjacent to main railway lines throughout New Zealand were inspected and assessed on a number of factors in accordance with KiwiRail's Slope Hazard Rating System, which included 166 slopes in the WMRN[47]. Slope rating scores and quantitative level of risks for each slope were determined. This exercise was undertaken to identify slopes adjacent to railway lines that pose risks to the safe operation of the railway and to understand the risks posed by those slopes. The exercise also identified and assisted in prioritising high risk slopes where risk mitigation works should be considered.

The WMRN slope ratings were reviewed in 2012 and this was the last network-wide review of slopes. Other than during general track inspections where the corridor is assessed as a whole, slopes do not receive regular inspections. A new condition assessment will be required as part of the slopes work in this business case.

[47] KiwiRail Slope Risk Ranking Wellington Metro Area, June 2011

Figure 25 – EM 80 Track Evaluation Rail Car Completing Track Inspections

Appendix C – Track Infrastructure Condition

The following information describes the parts of each asset type with especially poor condition, and lists the scope of Catch Up work required for each asset type that cannot be dealt with by "business as usual" renewal rates (TAC funded renewals).

Introduction

Railway renewal rates are not steady state, they tend to be unsteady due to large route segments or populations of a particular asset type being of a similar age. This results in a 'bow wave' of renewals coming due at once. In addition, WMRN track infrastructure renewals were not kept up with during the 1990's and 2000's as maintenance was largely deferred on commercial grounds as a consequence of a flawed railway operating model.

Previous major catch-up renewal programmes have not dealt with track infrastructure renewals and BaU renewals rates have not allowed any Catch Up. Given this, there is a material amount of investment for renewals due or coming due, mainly track renewals, required in the Wellington Metro Railway Network to ensure a reliable, effective and fit-for-purpose rail network. The primary elements of the required works, which are detailed further below, are:

- Track catch-up renewals;
- Tunnel track catch-up renewals;
- Replacing end of life civil assets (formation, cess drains, culverts and any other stormwater and drainage infrastructure);
- Renewing bridges with end of life timber elements; and
- Slope remediation.

Track Condition and Performance

The following information covers the two highest contributing asset types that are currently "weighing-down" the overall track condition and affecting performance. Treated Pinus Radiata Sleepers are the primary driver of the 'bow wave' of renewals required. Prematurely Decaying Sleepers are now relatively low in volume but contribute a disproportionately to performance issues such as TSR's. Other components such as a high proportion of life-expired rail and turnouts contribute to the poor condition, but are generally only included in the Catch Up scope where sleepers are also being replaced so are not covered in the information below.

TPRs and PDS will be renewed through both user-charge funded renewals (also referred to as steady state renewals) and Catch Up renewals. The track renewals that form the scope of the Catch Up works are detailed in the summary table, Table 34, at the end of this Appendix.

Treated Pinus Radiata Sleepers

Between the 1960's and 1980's Treated Pinus Radiata (TPR) sleepers were extensively used throughout the country, replacing the traditional hardwood sleepers. They were used due to the development of wood preservative treatment and availability of timber in New Zealand.

TPR sleepers are now obsolescent and have not been installed since the mid 1980's, having been supplanted by pre-stressed concrete sleepers. The useful life of TPR sleepers is approximately 40 years so the remaining TPR sleepers on the WMRN are at or near the end of their useful lives. The use of pre-stressed concrete sleepers is current practice throughout the KiwiRail network and other railways around the world due to their superior structural performance, lifespan, ease of inspection and replacement.

There are currently 70,000 "failed" TPR sleepers in the WMRN. Failed is defined as being over 40 years of age. By the early 2030's, all TPR sleepers on the WMRN will be over 40 years of age, totaling 190,000 "failed" sleepers.

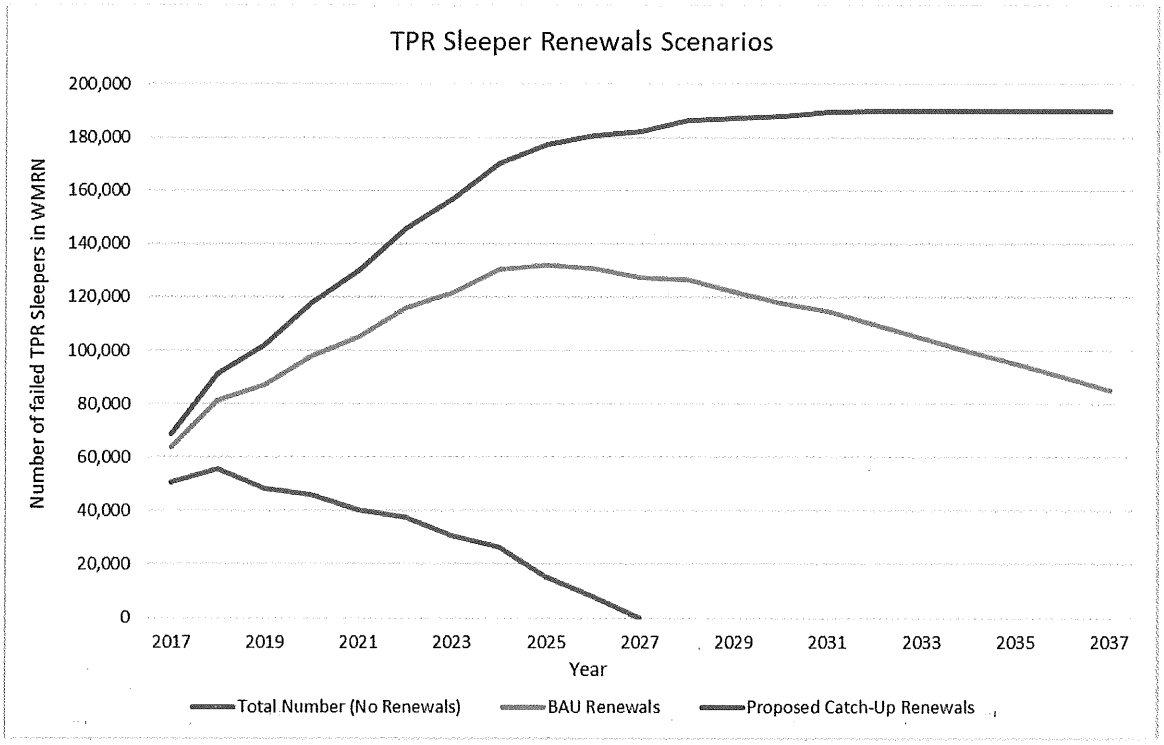
If the current steady state sleeper renewal rate is continued only 50,000 sleepers will be renewed by 2027 leaving 140,000 life expired sleepers still in service as shown in Figure 26. The consequence of this scenario is that the condition and performance of the network will drop significantly over this time. Under this scenario, speed restrictions are predicted to be applied to at least 30km of track (a third of failed TPR sleepers) across the network by 2027. This would result in lost time of at least 30 minutes throughout the WMRN, depending on the location of the speed restrictions. This is in addition to any other speed restrictions present due to other asset faults. Continuing renewals at this rate will see TPR sleepers remain in the network until the mid-2050's.

An alternative and preferred scenario is to significantly increase the TPR sleeper renewal rate to approximately 18,000 sleepers per year to eliminate the life expired TPR sleepers from the network within 10 years. This will avoid the condition and performance issues associated with large volumes of like expired timber sleepers throughout the network.

Under this scenario steady state renewal funding from user charges will continue to fund an (increased) steady state sleeper renewal rate and the track infrastructure catch-up renewals will fund the remainder, mostly those on the Wairarapa Line (from Upper Hutt to Masterton).

When replacing sleepers there are efficiencies in renewing rail, fastenings, ballast, formation, cess drains, culverts etc. which are taken into account in this Business Case where appropriate.

Figure 26 – TPR Sleeper Renewal Scenarios



Prematurely Decayed Sleepers

Prematurely Decayed Sleepers (PDS) are imported hardwood sleepers that have decayed due to a fungus infection and have expected lives of 1 to 10 years, much less that the 50 years expected from hardwood timber sleepers or the 80 years expected from modern pre-stressed concrete sleepers. This has created a significant and ongoing issue for KiwiRail throughout the country.

PDS were used intensively in Wellington from 2008 to 2011 in works associated with Wellington Regional Rail Project (refer to Section 8.1) with approximately 13,000 sleepers installed in the WMRN. Approximately 5,900 have been replaced to date, leaving 7,100 outstanding. PDS have accounted for around a quarter of the speed restrictions across the Network in the last 3 years.

Although there are not many of them, compared to other types of sleepers, they are installed into sections of the track that are difficult to access such as under turnouts, in tunnels, on bridges and underneath the road-seal on level crossings and many of the remaining sleepers are in Wellington junction (shared by all Lines). For this reason they require both special access and are much more expensive (usually up to twice as much) to replace than plain track. Sleepers in these locations are typically required to be replaced by either hardwood or composite sleepers which are more expensive than concrete.

PDS that are in tunnels have been included in the scope of the Catch Up works to ensure they are prioritised and are renewed in a suitable timeframe, i.e. before they show significant decay.

Figure 27 – End of Life and Poor Condition Track Photos

Rotten sleepers, ineffective fastenings, contaminated ballast and poor drainage (top and bottom)

Tunnel Track Condition and Performance

Five tunnels in the WMRN have track that is at or close to the end of its life, is performing poorly and require replacement within the next 8 years. Work in tunnels is orders of magnitude more difficult than out in the open air due to the confined spaces and health and safety risks (such as toxic gases). Additionally, two of the tunnels are very long which significantly increases the scope and complexity of the work. It is recommended that renewal of rail, sleepers, fastening, ballast and drains occur in one coordinated effort to increase efficiency, and leave the track fit for purpose with only minor maintenance required for decades.

Poor track condition and poor drainage, which causes further track deterioration, manifests into track geometry issues which cause rough riding, can reduce tunnel clearances and increase the likelihood of derailments. These risks are typically mitigated through the application of speed restrictions.

Derailment of a train within a tunnel is a worst case scenario and would result in significant damage to the train, tunnel and track and possible serious harm to the driver and passengers. Subsequent to a derailment there would likely be substantial service outages.

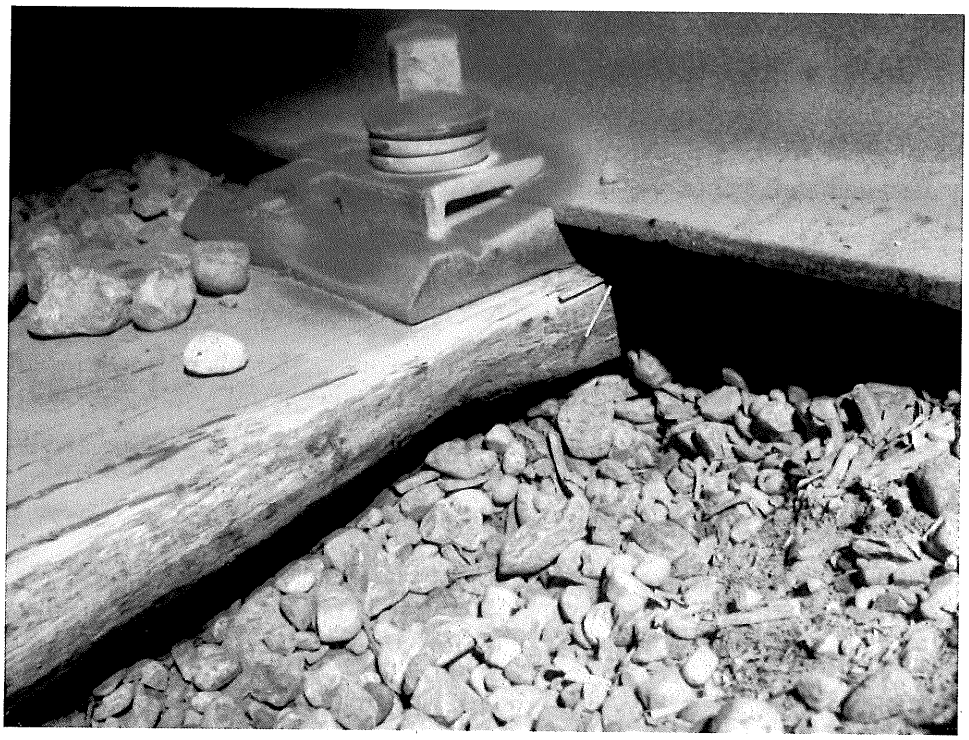
The tunnels in the WMRN requiring track catch-up renewals are summarized in Table 31 below.

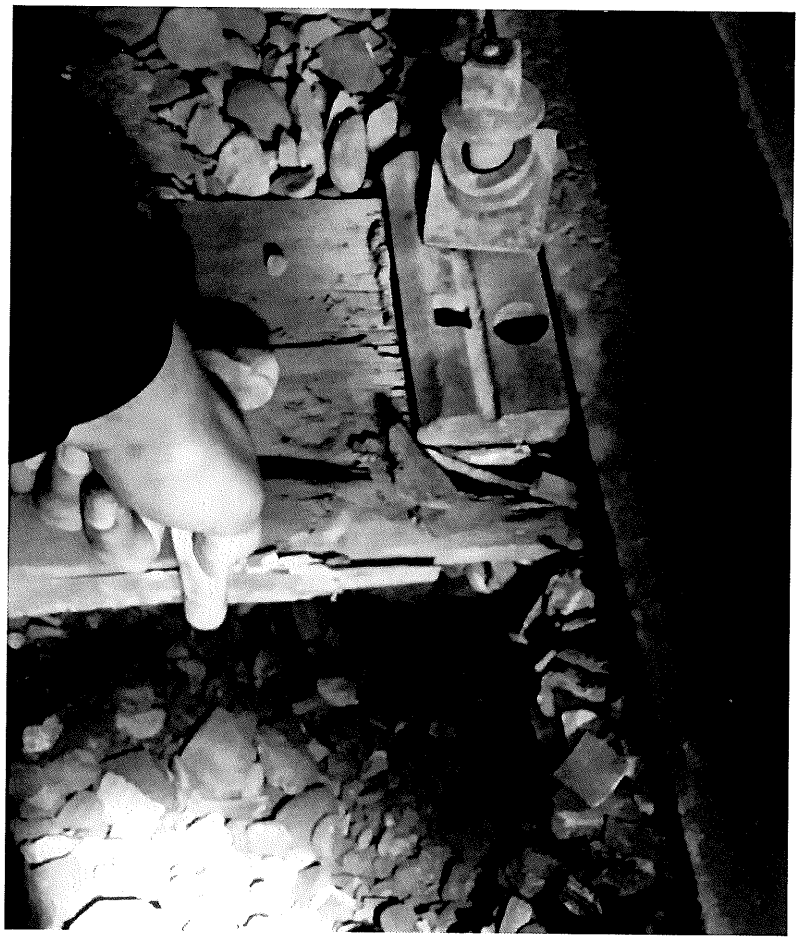
Table 31 – Poor Condition and End of Life Tunnel Track in the WMRN

Line & Tunnel	Length	Summary
Kapiti Tunnel 1 (Tawa No. 1)	1,238m Double Track	This tunnel has sleepers reaching the end of their life and rail with corrosion issues caused by water ingress and poor drainage. It requires track renewals and drainage works. Currently there are no speed restrictions in the tunnel, however if the track and drainage is not renewed within 6 years a speed restriction will likely be applied. There are efficiencies with delivering the work alongside Tunnel 2 renewal due to their proximity.
Kapiti Tunnel 2 (Tawa No. 2)	4,324m Double Track	The Down Main track of this double track tunnel was renewed in FY12. Both the Up Main track and the drainage is still required to be renewed and has been deferred since FY13 to hold expenditure within WNA limits. Both tracks have clearance issues, and a speed restriction is in place for freight trains. There are reoccurring track geometry issues in some locations exacerbated by poor drainage. There have also been periodic TSR's for Metro services related to these geometry issues. If the Up Main track is not renewed within 3-4 years a speed restriction will likely be applied that would exceed the TSR KPI target for the line. The Down Main is also required to be slewed to resolve the clearance issues and drainage renewed.

Line & Tunnel	Length	Summary
Kapiti Tunnel 7 Neptune	59m Single Track	This tunnel has concrete slab track which is reaching the end of its life. As it is at the bottom of a grade, a speed restriction on this tunnel can have a significant impact on the train timetables. It has been repaired multiple times; however the slab track needs to be replaced within 3-5 years due to reoccurring faults requiring TSR's.
Wairarapa Tunnel 1 (Maoribank)	572m Single Track	The track and formation in the tunnel are original dating from the 1955, are at the end of their lives and require replacement. The track should be renewed in conjunction with Tunnel 2 below for the best efficiency. It is at risk of a TSR within 5 years.
Wairarapa Tunnel 2 (Rimutaka)	8,779m Single Track	The track and formation in the tunnel are original dating from the 1955. While having provided good service for 60 years, most elements are at the end of their lives, causing geometry issues such as gauge, line and twist faults. The tunnel has a 60kph speed restriction throughout, equating to an extra journey time of 3 minutes (or half of the allowed Wairarapa Line TSR KPI). Replacement may be required to be carried out over multiple years to reduce service disruption. If not begun within 2 years, the current 60kph TSR will be reduced to 40kph (extra 8 mins journey time) and reduced again to 25kph by 2022 (extra 15 mins journey time). Full replacement should be completed by 2023 (within 5-6 years) to prevent service deterioration. This is one of the main contributions to the TSR forecast in Figure 14 in Section 6.3. Refer to the following page for photographs taken in the tunnel during inspections.

Figure 28 – End of Life and Poor Condition Track Tunnel Photos (Tunnel 2 WL)





Civils Condition and Performance

Formations and embankments are the civil structures beneath the track and are the foundation good track performance.

Cess drains, culverts and other stormwater and drainage infrastructure is required to convey direct rainfall, river flows, groundwater and stormwater runoff through the rail corridor. Properly designed and maintained drainage systems are essential to cost-effectively maintaining the formation, ballast and track.

Track line, level and overall condition cannot be economically or, eventually, practically maintained at all, in the absence of a sound formation which is well drained.

Drainage systems across the WMRN vary in condition and performance. Most locations are generally adequate to cope with current weather patterns, but not optimal in terms of the network maintenance strategy or for minimizing network asset life-cycle management expenditure. Cess drains, in particular, are often not well built or even non-existent in some sections of track.

There efficiencies in terms of cost and disruption to renew poor performing drainage system components at the same time as renewing other civil or track infrastructure at the same location.

Formation is a very long life asset but will eventually require rehabilitation. Failure becomes apparent with the appearance of mud spots and increased need to intervene to maintain track alignment. This failure is sped up by poor or inadequate drainage, increased traffic density and axle load as well as disturbance (such as sleeper replacement).

The scope of track infrastructure catch-up works for civils is summarised in Table 34, at the end of this Appendix. It includes either formation or drainage works where resleepering, as well as some locations on the Wairarapa Line which have already been re-sleepered but have poor formation with mud spots throughout.

Figure 29 – End of Life and Poor Condition Civils Photos

Bridges Condition and Performance

Timber rail bridges were constructed from the late 1800's to the mid 1900's due to readily available hardwood timber throughout New Zealand. Timber bridges are now obsolescent having been superseded by concrete and steel bridges.

KiwiRail have progressively been eliminating timber bridge elements on high-use lines throughout the country. This can mean either complete bridge replacement or replacement of end of life timber elements with concrete or steel elements.

Of the sixty rail bridges in the WMRN four still contain timber elements that are life expired and require replacement. These are summarised in Table 32 below. These bridges date from the 1880's to the 1940's and have survived to date with mostly minor maintenance work.

As the condition of bridges deteriorates, the risk of a speed restriction increases. A composite rating called a Health Index assesses and rates items such as general condition, strength, scour and fatigue and is used to predict when a speed restriction might be needed. The "replace by" dates below represent the date at which a speed restriction could be applied to each bridge.

Table 32 – Bridges with Life Expired Timber Elements in the WMRN

Line Bridge	Length, Constructed	Summary
Kapiti Bridge 23	6m, 1943	2 steel spans with 4 end of life timber piers Timber piers require replacement by 2021
Wairarapa Bridge 49	145m, 1880	9 steel spans, 7 concrete piers and 3 end of life timber piers Timber piers require replacement by 2021
Wairarapa Bridge 56	14m, 1915	2 steel spans with 3 end of life timber piers Timber piers require replacement by 2024
Wairarapa Bridge 63	31m, 1934	Four steel spans with five end of life timber piers Timber piers require replacement by 2022

Figure 30 – End of Life and Poor Condition Piers: Br49 WL

Figure 31 - End of Life and Poor Condition Piers: Br23 NIMT

Slopes Condition and Performance

The topography of the Wellington Metro Railway Network is characterized by numerous slopes, cuttings and embankments, and because of weather and geology, the risk of land movement and slips are facts of life. Slope failure poses a risk to the safety of trains and passengers and crew, and also has the potential to close routes for extended periods.

In 2011, 166 slopes in the WMRN were inspected and assessed as part of the development of KiwiRail's Slope Rating System. A risk rating number was developed for each. A rating of over 200 is currently the cut-off to trigger risk treatment measures for KiwiRail. Four slopes were rated above 250 corresponding to a very high risk and thirteen sites were rated between 200 and 250 corresponding to a high risk.

Risk treatment measures for high and very high risk slopes generally consist of engineering works to actively reduce the level of risk. These can range from comprehensive works (retaining walls, earthworks, anchored rock fall netting or anchored sprayed concrete walls) to more modest measures such as toe fences to prevent fretted material accumulating in cess drains.

Remote slope monitoring can be used to provide an early warning of debris falls or rock falls onto the track. Remote slope monitoring is used as a risk reduction measure by providing a forewarning of failure onto or below the line and enable trains to be halted prior to arriving at the site of failure. Monitoring systems therefore decrease the *consequence* of failure occurring, but do not alter the *likelihood*. This approach can be complementary to engineering works mentioned above but as it only addresses consequence and not likelihood it is not considered appropriate its own for high and very high risk slopes.

While these slopes do not affect the performance of the WMRN on a daily basis, like poor condition track does with speed restrictions, they do cause disruptions typically in winter months from nuisance rock fall. Depending on the location, severity and time of day, rock fall usually requires lines to be closed for between thirty minutes to up to a half a day and typically occur three or more times per month in the winter months. Slopes present significant risks and can cause major disruption to both road and rail networks if large failures occur. Refer to Part A for the impact when the railway is not available.

While some slopes do receive minor remedial work such as proactively removing the loose rocks, no major retaining or rock fall protection has been undertaken in the WMRN since 2011. This is in-part due to the fact that renewals works to address reliability issues with other assets take priority as their effects have daily implications. They are, however, identified in the risk register and the WMRN Asset Management Plan proposes to act upon 1-2 slopes per year over the coming ten years.

Geoscience completed a slope rating review in 2012[48] to incorporate works completed and developments and improvements made to the slope risk rating system. This updated and re-ranked the slopes from the 2011 study. Table 33 below lists the **three very high and fifteen high risk slopes** in the WMRN and summarises the proposed remedial solutions identified in this review. These remedial solutions will need a review alongside a further re-review of the

[48] Geoscience Wellington Metro Area Slope Rating Review, 4 December 2012

slopes. Some other known problem slopes (such as those around Paraparaumu) may take place of some in the list below that are re-rated as low priority.

Table 33 – High Risk Slopes in the WMRN

Line	Km Location	Slope Risk Rating	Proposed Remediation Solution
Kapiti	13.368	322	TBC – originally suggested Tied back Timber Pole Wall
Kapiti	3.938	273	Toe Wall/Catch Fence
Kapiti	15.561	257	Erosion Protection at base of Embankment (2m high gabion basket wall). <Note: now thought to be lower priority>
Kapiti	26.147	246	Completion of embankment stabilisation works
Kapiti	10.255	245	TBC – possibly Slope Monitoring
Johnsonville	2.994	242	Rock fall Netting or Shotcrete (TBC)
Kapiti	9.94	233	Toe Retention/Scour Protection
Kapiti	30.81	230	Full retaining wall renewal
Wairarapa	49.48	230	Slope Monitoring
Kapiti	11.113	227	Rock fall Netting (selected areas of slope; assume 20% coverage)
Kapiti	34.863	220	Catch Fence at toe of slope
Kapiti	25.845	219	Embankment Widening Works <Note: now thought to be lower priority>
Kapiti	35.511	218	Slope Monitoring
Johnsonville	2.889	217	Completion of Stabilisation Works (Anchored Sprayed Concrete Wall) - TBC. <Note: now thought to be lower priority>
Johnsonville	3.796	215	Rock fall Netting
Kapiti	11.557	210	Catch Fence at toe of slope (assume 50% coverage)
Kapiti	34.953	209	Slope Monitoring
Johnsonville	2.49	206	Rockbolting to stabilise headscarp

Track Infrastructure Summary

Table 34 provides a summary of the quantities of track infrastructure catch-up renewals required on each line in the Wellington Metro Railway Network.

Table 34 – Summary of Track Infrastructure Catch-Up Renewals Required on the WMRN

Asset	Quantity	Comments
Wairarapa Line		
Track	Approx. 30km	Renewing approximately 30km of track including renewing TPR sleepers, rail, full ballast renewal, 12 level crossings and resleepering two bridges
Tunnel Track	9.3km	Full track renewal in Tunnels One and Two
Civils	45km	Provision for 20km of formation rehabilitation and 25km of drainage renewals
Bridges	3	Renewing Bridges 49, 56 and 63
Slopes	1	Slope remediation works at 49.4km
Kapiti Line		
Track	3.5km	Wellington platforms track and station entry track renewals including multiple turnout renewals in Wellington junction
Tunnel Track	5.66km	Full track renewal in Tunnels One, Two and Seven, including full drainage renewal in Tunnel Two Replacing PDS sleepers in Tunnels Three to Six
Civils	3.5km	Associated with platform track
Bridges	1	Renewing Bridge 23
Slopes	13	Slope remediation works to 13 high risk slopes, refer to Table 33
Hutt Valley Line		
Track	1.4km	Track renewal and lowering on both mains under a road bridge near Ava Station
Civils	1.4km	Associated with the track lowering above
Johnsonville Line		
Tunnel Track	945m	Replacing PDS sleepers in Tunnels One to Seven
Slopes	4	Slope remediation works to 4 high risk slopes, refer to Table 33

Appendix D – Proposed Investment Summary

There are six major drivers for investment in the WMRN. These are:

1. **Safety** – To ensure that the railway meets necessary and reasonable levels of safety for passengers, the public and staff.
2. **Renewals** – As described in the table below.
3. **Catch-Up Renewals** – Refer to Section 3.4.
4. **Upgrades** – Refer to Section 3.3
5. **Resilience** – Refer to Section 7
6. **Complementary Upgrades** – This category of work results from discussions and input from the NZ Transport Agency. These are works which have interdependencies or other synergies between rail and other Agency initiatives. The State Highway 2 Programme Business Cases (PBC) note the reliance on a functioning rail network to provide capacity in the Hutt Valley corridor and mitigate the effects of proposed State Highway works which will cause significant disruptions to the roading network over a prolonged period. Further discussion on this interlinkage is provided in Section 15.6 - Constraints and Dependencies.

Table 35 – Proposed Investment Summary

Possible Rail Investment	Description	Preliminary Budget Estimate	Link to Investment Drivers (Refer to Section 3.1)	
			Primary Driver	Secondary Driver(s)
Maintenance and Steady State Renewals	These maintenance and steady state renewals are for maintenance and periodic renewal of existing rail infrastructure with like-for-like components (albeit using their modern day equivalents which may have improved qualities compared to the original assets) to keep the network in a steady state condition. In general terms these are undertaken at a rate that sustains the overall asset level of service and existing risk profile. These works are funded through contributions from GWRC and KiwiRail Freight through the WNA terms.	FY19 onwards proposed budget of $23.7m p/a plus $7-8m operating costs	Sustainable Steady-State Maintenance and Renewals	Complementary
Track Infrastructure Catch-Up Renewals & Slopes	This Business Case Option 4.	$95.8m	Catch-Up Renewals	Resilience Complementary
Wairarapa Line (WL) enhancements	Part of Option 5 and 6 in this business case. Required for higher frequency passenger trains on the Wairarapa Line. Includes new and upgraded loops and automatic signaling to be installed. Currently, traffic on the Wairarapa Line section from Featherston to Masterton is controlled under Track Warrant.	$16.5m	Upgrade	Complementary
Masterton to Pahiatua (WL) refurbishment	Part of Option 5 and 6 in this business case. Provides an alternative route for freight trains during maintenance shut-downs on the Kapiti Line. Currently this section of the Wairarapa Line is not fit for freight services due to poor condition track, deficient bridges, slope and tunnel issues.	$26m	Catch-Up Renewals	Resilience Complementary
Unlocking Network Capacity and Improving Resilience*	Network modifications to enable proposed increased service frequency and improve operational resilience: <u>Hutt Valley Line modifications:</u> • Double tracking of the 3km-long single track section between Trentham and Upper Hutt including new signaling and overhead traction lines on the new Mainline, new and upgraded stations at Trentham and Wallaceville, upgraded signaling on the existing Mainline and new interlocking to operate changed arrangements at Upper Hutt and Trentham; • Modifications to Upper Hutt station to accommodate second Mainline and improve options for berthing and departing; and • Upgrade of the Woburn – Gracefield Junction to CBI controlled via Train Control (replaces manual control). <u>Kapiti Line modifications:</u> • An additional turn back siding at Plimmerton; • Extending the existing freight passing loop at Porirua or extending the Plimmerton turnback into a loop; and • Additional overhead traction power supply on the Kapiti Line. <u>Wellington modifications:</u> • Platform to Carriage-yard bypass to remove simultaneous Platform/Down Main movement conflict; • New crossovers from the EMU yard to the Johnsonville Line, and Johnsonville Line to Up Main; and • Possible requirement to replace ABox (Wellington junction interlocking) with CBI to support the changes above (see below).	$100.7m including $3m of GWRC funding	Upgrade	Complementary

* Refer to Wellington Metro Railway – Unlocking Network Capacity and Improving Resilience Business Case

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Possible Rail Investment	Description	Preliminary Budget Estimate	Link to Investment Drivers (Refer to Section 3.1)	
			Primary Driver	Secondary Driver(s)
A-Box Interlocking Renewal (Main Approach to Wellington Station)	ABox control system was installed in 1937 and works through electrically interlocked (miniature) manual levers. While the box itself was re-cabled 27 years ago (1990) and is currently reliable, it cannot operate indefinitely due to the age of its mechanical components and increasing difficulty in supporting these. A-Box is New Zealand's last manned signal box, its most complex interlocking and currently the busiest. Due to the complexity of the interlocking, replacement will need to be planned and procured well ahead of it becoming impossible to maintain it in safe and reliable operation. The above changes to the Wellington junction may instigate the requirement to convert ABox to CBI. Making changes to a mechanical interlocking is complicated and even small additions may be impossible to achieve. An assessment needs to be carried out on the feasibility of implementing the changes to the A-box interlocking. In the case of the requirement to convert to CBI, $8 million has been added as a contingency to the above project. This assumes the cabling stays the same and there are no track layout changes required, however these will be required later likely as part of resignaling Wellington Metro (refer ATP project below).	Preliminary estimate $8m plus cabling and track layout changes totals up to $15m	Safety	Upgrade
Ngauranga to Petone Seawall	There are four possible outcomes with different drivers and spending implications: Scenario 1: If the NZ Transport Agency shared pathway proposal does not proceed then either: Spend one time to enhance the existing seawall to increase resilience – approximately $20m; or continue to deal with risk of seawall failure. Scenario 2: NZ Transport Agency Seawall Option 1 proceeds, which provides a resilient seawall for the transport corridor, and a shared pathway. Scenario 3: NZ Transport Agency Seawall Option 2 or 3 proceeds, which also involves additional reclamation to enable rail alignment, to increase speed of rail up to 100km/hr. The cost for additional reclamation to undertake the curve easing is $20m, and to relocate the track is $10m. This scenario is part of Option 8 in Unlocking Network Capacity and Improving Resilience business case. Note this project is still being developed and a funding mechanism has not yet been finalised.	$30m	Resilience	Complementary
Automatic Train Protection (ATP)	Automatic Train Protection (ATP) or European Train Control System (ETCS) will likely be required to increase safety by increasing levels of automatic train protection and will be equivalent to the system in the Auckland Metro Area. If a risk assessment and Business Case justifies the need for this system, then the logical time to implement it is within 10 years – linked to half-life refurbishment of the EMU fleet. The cost estimate for this system incorporates some of the stand-alone projects listed such as Taita Interlocking (below), ABox and other signaling upgrades in the Unlocking Network Capacity business case. Therefore, if some of these projects are staged ahead of this project these costs can be excluded from this project. The cost indicated does include the necessary train modifications (i.e. not just an infrastructure cost).	Preliminary estimate $148m - $168m	Safety	Upgrade

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Possible Rail Investment	Description		Preliminary Budget Estimate	Link to Investment Drivers (Refer to Section 3.1)	
				Primary Driver	Secondary Driver(s)
Taita Interlocking	Elimination of remaining major non-computer based interlocking (outside Trentham – Upper Hutt). The existing installation (relay interlocking and cabling) dates from 1954 and is obsolescent. This will likely be covered as part of ATP upgrade or other signaling upgrade for cost and disruption efficiency.		Preliminary estimate $5m	Catch-Up Renewals	Complementary
Elimination of "At Grade" Road Level Crossings in the Wellington Metro Rail Network Area	These are long-term items, with safety considerations from both a road and rail perspective:		TBC	Safety	Resilience Complementary
	Kapiti (9):	Tawa Street – Tawa Basin*, Collins Avenue – Tawa Basin*, Pascoe Avenue – Mana, Steyne Avenue – Plimmerton, Beach Road – Paekakariki, McKay's Crossing (Whareroa Road) – QEII Park Paekakariki, Kapiti Road – Paraparaumu, Otaihanga Road – Lindale* & Elizabeth Street – Waikanae*			
	Hutt Valley (4):	Manor Park Road, Sutherland Avenue – Trentham, Ward Street – Upper Hutt & Blenheim Street – Upper Hutt.			
	Johnsonville (1):	Fraser Avenue*			
	Wairarapa (0):	Nil justification for grade separation between Upper Hutt to Masterton			
		** Identified highest priority level crossings*			
North – South Junction Improvements	Possible project to increase the amount of double track between North and South Junction (roughly 3.5km of single-track) on the Kapiti/ NIMT Line. The works would help increase line capacity if there was business justification to require this. The options are to lengthen the double tracking by around 500m to the south without requiring major civil works and/or an increase of over 1km at the north end; however this includes modification of Tunnel 7. This is included in Option 9 in the Unlocking Network Capacity business case and $50m has been used for the economic model.		TBC	Upgrade	Complementary
Future Catch up works	Future unknowns such as major bridge replacements or other catch up programmes beyond the current 10-12 year planning period. Work is currently underway to expand asset renewal planning to the 30 year window and identify if any major renewals. It will also identify whether these can be funded under MROM or whether the value or quantity of renewals is outside the affordability of MROM.		TBC	Catch-Up Renewals	

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Table 36 – Proposed Investment Summary Cash Flow

Investment ($m)	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	Total	Primary Investment Driver (Refer to Section 3.1)
Steady State Maintenance and Renewals												
Proposed GWRC Contribution "TAC" (funded via Passenger Fares, Rates & NZTA)	$19.8m	$24m	$24m	$24m	$24m	$24m	$24m	$24m	$24m	$24m	**$235.8m**	Steady State Maintenance and Renewals (incl. operational overheads)
Proposed KiwiRail Freight Contribution "TAC"	$5.02m	$5.7m	$5.7m	$5.7m	$5.7m	$5.7m	$5.7m	$5.7m	$5.7m	$5.7m	**$56.32m**	Steady State Maintenance and Renewals (Not incl. operational overheads)
Committed Crown Investments												
Traction Pole Catch-Up Renewals	$11.4m	$26.0m	$35.0m	$26.0m							**$98.4m**	Catch-Up Renewals
This Year's Pending Business Cases												
Track Infrastructure Catch-Up Renewals (This Business Case)		**$7.08m**	**$19.92m**	**$20.81m**	**$23.92m**	**$11.56m**	**$11.22m**	**$0.97m**	**$0.32m**		**$95.8m**	Catch-Up Renewals
Unlocking Network Capacity and Improving Resilience (Separate Business Case): • Double Tracking Trentham to Upper Hutt and Upper Hutt Station modifications; • Plimmerton Turn Back; • Wellington Junction modifications, contingency for ABox CBI; • Woburn re-signaling; • Kapiti Line Overhead Power Upgrades; and • Porirua or Plimmerton Freight Loop.		$3.71m	$36.3m	$41.49m	$19.2m						**$100.7m** (incl. $3m funded by GWRC)	Upgrade

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Investment ($m)	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	Total	Primary Investment Driver (Refer to Section **3.1**)
Other Potential Future Investments												
Taita Interlocking			$2.5m	$2.5m							**$5m**	Catch-Up Renewals
WL enhancements (note – phasing as per Option 5 and 6)			$0.5m	$5m	$6m	$5m					**$16.5m**	Upgrade
Masterton to Pahiatua refurbishment (note – phasing as per Option 5 and 6)			$3.9m	$10.4m	$9.1m	$2.6m					**$26m**	Catch-up Renewals
A Box Interlocking Renewal (note $8m also included in the Capacity business case)			$1m	$5m	$7m	$2m					**$15m**	Safety
Ngauranga to Petone Seawall Rail contribution				$3m	$15m	$12m					**$30m**	Upgrade
Automatic Train Protection (ATP)					$5m	$48m	$50m	$50m	$5m		**$158m**	Safety
Elimination of "At Grade" Road Crossings											**TBC**	Safety
North – South Junction Improvements (note likely to start after 2027)											**TBC**	Upgrade
Other Potential Future Investments (start after 2027)											**TBC**	Both

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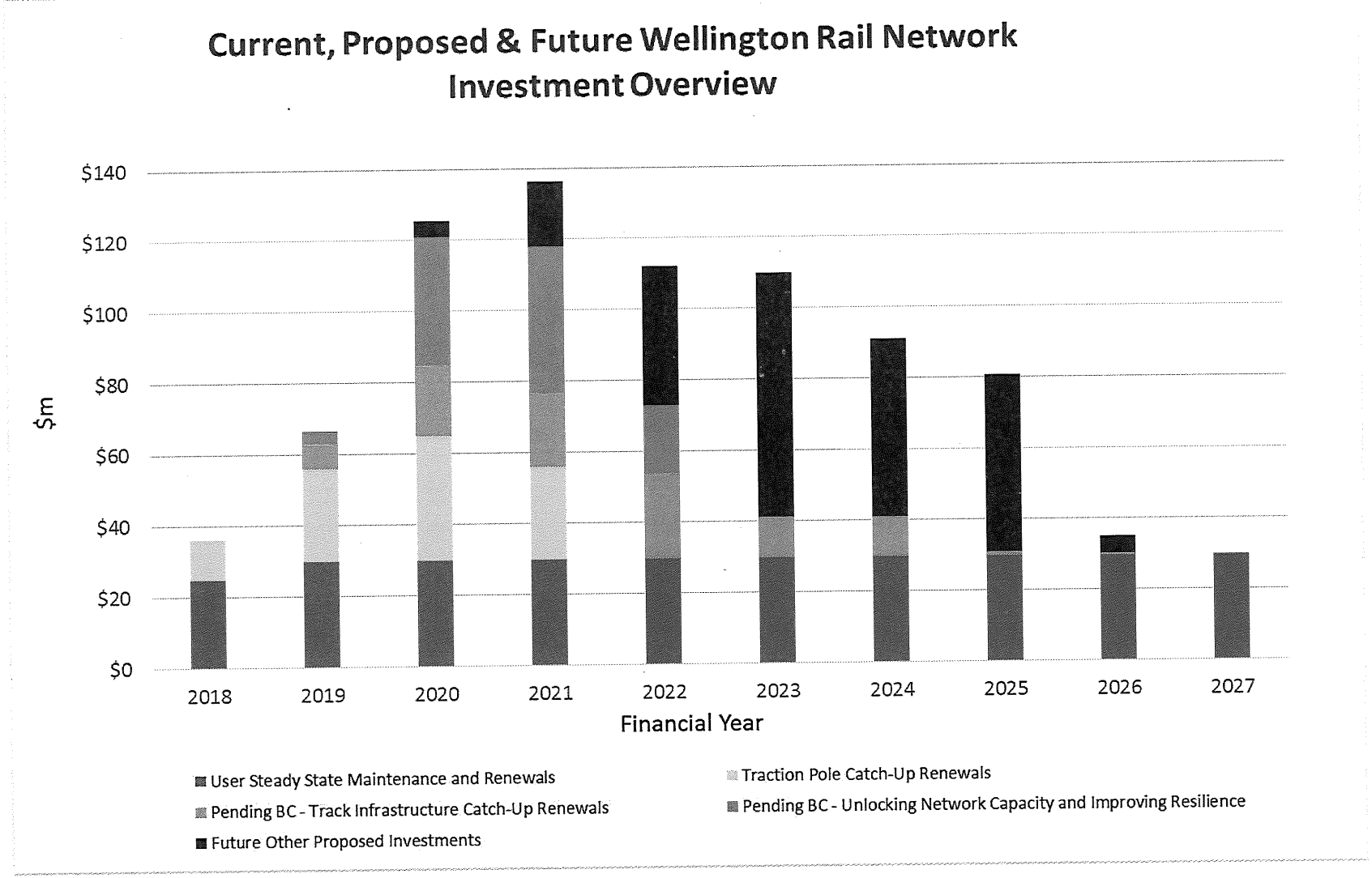
Figure 32 – Proposed Investment Summary Cash Flow Graph



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Appendix E – Supporting Strategy Extracts

Ministry of Transport – Government Policy Statement (GPS) on Land Transport 2015/16 – 2024/25

Extract

"34. We see the need for public transport to help unlock the potential of our urban areas by providing additional capacity on key corridors and a choice of ways to move around, particularly during peak commuting periods. This includes investment in infrastructure improvements, including support for improvements through service-related payments. Public transport will also continue to be funded to provide access and choice. GPS 2015 provides for increased provision of public transport, if justified by demand. Public transport is jointly funded with local government.

35. GPS 2015 supplements this investment from the Fund with Crown appropriations to advance passenger rail in Wellington (Wellington Metro Rail Package) and improve railway management (Rail – Public Policy Projects, and Rail – Railway safety)."

Relevant GPS Objectives below support the investment in passenger rail infrastructure:

National land transport objectives	Primary long term results
A land transport system that addresses current and future demand for access to economic and social opportunities	Support economic growth and productivity through the provision of better access to markets, employment and business areas Support economic growth of regional New Zealand through provision of better access to markets
A land transport system that provides appropriate transport choices	Provide appropriate travel choices, particularly for people with limited access to a private vehicle Increased safe cycling through improvement of cycle networks
A land transport system that is resilient	Improved network resilience at the most critical points
A land transport system that is a safe system, increasingly free of death and serious injury	Reduction in deaths and serious injuries
A land transport system that mitigates the effects of land transport on the environment	Mitigation of adverse environmental effects
A land transport system that delivers the right infrastructure and services to the right level at the best cost	Delivery of the right infrastructure and services to the right level Improved returns from road maintenance Improved returns from public transport

Source http://www.transport.govt.nz/assets/Uploads/Our-Work/Documents/GPS-2015.pdf

Business Growth Agenda Toward 2025	
Extract	Appropriate, resilient infrastructure supports investment, growth and the quality of life in all parts of New Zealand. We cannot become more internationally connected, link our regions and cities, and reduce the impacts of distance without the necessary infrastructure. In order to improve our domestic and international flows of people, goods and information we will continue to work on removing the bottlenecks on our road networks, strengthening rail, sea and air infrastructure, completing the deployment of ultra-fast and rural broadband and improving infrastructure decision making. We will also focus on increasing competition and efficiency in residential construction, reforming the social housing sector, rebuilding Christchurch, improving water management and investing in social infrastructure (including schools and hospitals) in order to provide infrastructure that meets the ongoing needs of our communities. This notes that in order to improve our domestic flows of people we will continue to work on strengthening rail infrastructure in order to provide infrastructure that meets the ongoing needs of our communities. In the Wellington region, a functioning commuter rail system decreases the pressure on housing in the city as it enables workers to live further afield and commute to their jobs. The Government's overall objective for transport is seeking an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country's economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders. A critical element of the Governments Transport strategy is Safer Journeys which has a focus on reducing road accidents. There is no simpler way to do this than to ensure the rail network is a resilient system that provides efficient and safe transport for people as an alternative to road journeys.
Source	http://www.mbie.govt.nz/info-services/business/business-growth-agenda/pdf-and-image-library/towards-2025/mb13078-1139-bga-report-00-intro-09sept-v9-fa-web.PDF

GWRC - Regional Land Transport Strategy 2010 – 2040	
Extract	The Strategy Vision is: "To deliver an integrated land transport network that supports the regions' people and prosperity in a way that is economically, environmentally and socially sustainable."
Source	http://www.gw.govt.nz/assets/council-publications/WRLTS-2010-2040-Doco-WEB.pdf

Connecting New Zealand - A summary of the Governments Policy Direction for Transport	
Extract	Moving our freight and people as safely and efficiently as possible, with a minimum of hold ups, is vital to speeding up economic growth. Growing the economy is central to both: • the government's overall goal for New Zealand — to grow the economy to deliver greater prosperity, security and opportunities for all New Zealanders • the government's objective for transport — an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders
Source	http://www.transport.govt.nz/assets/Import/Documents/Connecting20NZ-online-version-9-September.pdf

GWRC – Wellington Regional Public Transport Plan 2014	
Extract	"In February 2009 the Regional Transport Committee endorsed the Wellington Regional Rail Plan 2010 – 2035: A Better Rail Experience (the 2010 RRP). The Plan set out a pathway for the long term development of the region's metro rail network. The 2010 RRP was developed to maintain and grow rail's position as the key transport mode for long- to medium-distance and high-volume transport services in the subsequent 25 years. It covered the region's four electrified rail corridors – Kapiti, Johnsonville, Hutt Valley and Melling – as well as the train services operating from Masterton. The Plan recognised and encouraged the increasing popularity of rail as a sustainable transport choice for passengers and freight, a trend that was evident around the world. It also recognised that rail was an essential service underpinning greater Wellington's effective functioning and economic development. It acknowledged that, by providing an attractive and competitive rail service, users would be attracted away from cars and road congestion would reduce – a 'win-win' outcome."
Source	http://www.gw.govt.nz/assets/Transport/Regional-transport/RPTP/WGNDOCS-1386111-v1-FinalRPTPdocWEBversion.PDF

GWRC – Regional Land Transport Strategy 2010 – 2040	
Extract	The overall strategy vision is: "To deliver an integrated land transport network that supports the regions' people and prosperity in a way that is economically, environmentally and socially sustainable." Relevant details of the vision are: "The regional transport network will provide a high level of access, reliability and safety for both passengers and freight travelling within and through the region to support economic development and improve productivity. The regional transport network will be developed in a way which recognises the vital national role of Wellington as the capital city and the region's geographical position at the northern side of Cook Strait." "Access to and between key destinations such as Wellington City Central Business District and other regional centres, CentrePort, Wellington International Airport and Wellington Regional Hospital will be quick, easy, reliable and safe."
Source	http://www.gw.govt.nz/assets/council-publications/WRLTS-2010-2040-Doco-WEB.pdf

GWRC – Wellington Regional Rail Plan 2010 – 2035 (2013 Revised Edition)	
Extract	The Regional Rail Plan Vision is: "To deliver a modern, reliable and accessible rail system that competitively moves people and freight in an economic, environmental, integrated and socially sustainable way. The focus is on the metropolitan rail network which moves close to 9,000 passengers each weekday AM peak period. It is central to the vibrancy and economic development of our region."
Source	http://www.gw.govt.nz/assets/Transport/Public-transport/Train-docs/WellingtonRegionalRailPlan2010-2035.pdf

GWRC – Regional Land Transport Plan 2015	
Extract	"Ongoing investment in the region's rail network is an important part of this strategy. Rail is a very efficient way to move large numbers of people over longer distances and we will continue to build on the region's established rail network which links many communities within the region along several key corridors to the north of the Wellington City CBD. The priority is to improve rail's reliability, capacity and frequency, and over the longer term the aim is to further improve journey times and reach."
Source	http://www.gw.govt.nz/assets/Transport/Regional-transport/Wgtn-RLTP-2015.pdf

NZ Transport Agency – Integrated Planning Strategy 2010	
Extract	"The NZ Transport Agency's statutory purpose is to contribute to an affordable, integrated, safe, responsive and sustainable land transport system. Put simply, we focus on building a better transport system for New Zealanders. This is because transport is a significant contributor to economic growth and productivity, and a determinant of how well urban and rural areas function and the quality of life offered." The Land Transport Management Act makes clear that our role is to promote matters relating to the land transport system. This means we actively promote the efficiency and effectiveness of road (buses, taxis, cycling, walking and private vehicles), rail (passenger and freight) and coastal shipping networks and services. However, because we invest in road and passenger rail-related activities through the NLTP (National Land Transport Plan), we prioritise our involvement in these matters. "Improve journey time reliability at peak travel times, particularly in severely congested urban areas and on key freight routes..... [by reducing] congestion through public transport planning and investment...." "Reduce private vehicle travel, especially at peak travel times ... [by completing] 'missing links' in existing public transport and waking and cycling networks in major urban areas in collaboration with others."
Source	https://www.nzta.govt.nz/assets/Planning-and-investment/docs/integrated-planning-strategy.pdf

Health and Safety at Work Act 2015	
Extract	Health and safety duties include: • to eliminate risks to health and safety, so far as is reasonably practicable; and • if it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable. **Meaning of reasonably practicable** In this Act, unless the context otherwise requires, reasonably practicable, in relation to a duty to ensure health and safety or to protect property, means that which is, or was, at a particular time, reasonably able to be done in relation to ensuring health and safety or the protection of property, taking into account and weighing up all relevant matters, including— a) the likelihood of the hazard or the risk concerned occurring; and b) the degree of harm or damage that might result from the hazard or risk; and c) what the person concerned knows, or ought reasonably to know, about— i. the hazard or risk; or ii. ways of eliminating or minimising the risk; and d) the availability and suitability of ways to eliminate or minimise the risk; and e) after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk. **Duties of a Person Conducting a Business or Undertaking (PCBU) who manages or controls a workplace** A PCBU who manages or controls a workplace must ensure, so far as is reasonably practicable, that the workplace, the means of entering and exiting the workplace, and anything arising from the workplace are without risks to the health and safety of any person.
Source	http://www.legislation.govt.nz/act/public/2015/0070/latest/DLM5976660.html

Railways Act 2005	
Extract	7 General safety duties of rail participants and persons working for rail participants (1) A rail participant must ensure, so far as is reasonably practicable, that none of the rail activities for which it is responsible causes, or is likely to cause, the death of, or serious injury to, individuals. (2) No rail personnel of a rail participant may do or omit to do anything in respect of a rail vehicle, railway infrastructure, or railway premises if he or she knows or ought reasonably to know that act or omission will cause, or will be likely to cause, the death of, or serious injury to, individuals.
Source	http://www.legislation.govt.nz/act/public/2005/0037/latest/DLM342268.html

KiwiRail – Annual Report 2015	
Extract	"We will continue managing our programme of maintenance, repair and upgrade of our network, including the need for greater capacity and resilience in the Auckland and Wellington metro networks, while meeting financial targets."
Source	http://www.kiwirail.co.nz/uploads/Publications/KiwiRail%20Annual%20Report%202014-2015.pdf

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

KiwiRail

Appendix F – Investment Logic Map

Greater Wellington Regional Council and KiwiRail

Wellington Metro Network Upgrade Programme (Phase 3)

INVESTMENT LOGIC MAP
Programme

Ensuring Wellington Track Infrastructure can Maintain Regional Connectivity and Enable Growing Demand

PROBLEM ▶ **BENEFIT** ▶ **STRATEGIC RESPONSE**

Reliability/ Connectivity (80%)

Track infrastructure assets coming to the end of economic life & piecemeal replacement approach not keeping up is threatening regional connectivity, impacting travel reliability & capacity upgrades

Evidence
13 million journeys/year
Train performance stats
Asset condition reports
Modal share/line
Capacity upgrade delay
TQI
Speed restrictions

Resilience (20%)

Lack of rail corridor stability and Wellington vulnerability to forces of nature results in risk of line closure and major disruption to the whole regional transport system

Evidence
Geotech reports
KiwiRail outage stats
MOT report
Economic cost/day
Slope stability reports
(20 slopes above 200 rating)

Maintain Regional Connectivity (30%)
KPI1: Network availability
KPI2: Mode share

Maintain and Improve Service Quality (30%)
KPI1: Journey time
KPI2: Customer satisfaction

Better Value for Money (10%)
KPI1: Renewal unit costs
KPI2: Maintenance costs

Support Regional Growth (15%)
KPI1: Rail patronage

Improve Safety for Public and Staff (15%)
KPI1: Rail safety incidents
KPI2: Operational safety controls

Prepare a Single-Stage Business Case
outlining relevant aspects of:

- Existing rail needs (strategic context and relationship to public transport)
- Asset performance
- Social and economic railway relevance
- Risks (including risks of inaction)
- Opportunities
- Optioneering (of potential interventions to achieve outcomes
- Cost, Benefit and Value-for-money analyses

Provide a reasoned recommendation on the option selected and reasons why the preferred option should proceed.

Sponsors: Michael McKeon (KR) /Barry Fryer (GWRC)
Facilitator: Mark Young
Accredited Facilitator: Yes

Version no: 1.0
Workshop: Aug 11th 2017
Last modified by: Mark Young
Template version: 5.0

Appendix G – Benefit Realisation Risk Assessment

Table 37 – Benefit Realisation Risk Assessment Summary

Main Risks	Likelihood	Consequence	Comments, Impacts and Mitigations
Rail Service Punctuality Worsens (or in the case of the Wairarapa Line Remains Poor) due to Other Factors	Medium	Low	Despite track infrastructure catch-up renewals, other factors like rolling stock condition/ availability, faults, failures and errors affect the ability for the network to meet punctuality targets, thus reducing the ability for the initiative to realise the full benefits expected. **Mitigation:** Maintain good asset management and operational practices.
Forecasted Future Demand for Rail is Less Than Currently Expected	Medium	Low	Track infrastructure catch-up renewals do not meet full benefits and/ or benefits are instead realised later than that modelled in the economic assessment. **Mitigation:** Ensure values used in the economic assessment are realistic and conservative.
Future Road Transport Infrastructure Changes	Medium	Low	Road network development increases the ability for the road networks to mode share and thus may reduce demand for passenger rail. **Mitigation:** Ensure NZTA are consulted as part of this Business Case process and advise of any possible road network development.
External Transport Technology Developments	Medium	Low	Future technology developments (i.e. rail technology changes, introduction of driverless cars) impacts on benefits realisation of investment. **Mitigation:** Monitor possible future transport technology developments and their possible impact and factor into economic assessment.

Appendix H – Cost and Benefit Descriptions

The option assessment has taken place using transportation (industry) standard methods of costing and benefit analysis. Economic derivations have been undertaken by KiwiRail (primarily costing), GWRC (benefit calculation). Computation of Net Present Value (NPV) costs and benefits has been completed and verified by project advisors and use NZ Treasury advised discount rates (6% for FY 2018) and periods (40 years).

Independent verification has been undertaken by Aurecon, experts in transportation analyses. Verifiers have completed similar verification processes for the NZ Transport Agency, amongst others.

Costs

The costing of options has been undertaken by KiwiRail using rates based on delivery of recent maintenance and renewal of the same or similar assets and by taking into consideration site specific aspects.

Option costs take into account items such as:

- Investigations, design, procurement, project management and coordination;
- Site establishment (for physical works);
- Physical construction works;
- Removal and disposal of redundant track infrastructure;
- Bus replacement for affected train services;
- Contingencies are applied as appropriate for each asset class; and
- Optimism bias, based on guidance within HM Treasury Green Book.

Scrapping and Returns

There is little to no value in the majority of the track and bridge components that will be removed, however some materials may be able to be used for maintenance repairs in yards and other locations where the specification of the materials required is much lower than the main lines (due to low speed running and low use, for example).

Benefits

Each of the benefits identified (congestion benefits, safety and vehicle emission reduction) have been calculated from industry best-practice. Benefits have been supplied by GWRC who maintain the benefits calculation models for regional public transport.

Data from the NZ Transport Agency and GWRC have been used in the overall calculation of congestion, safety and emissions. For congestion, the benefits are calculated based on a value of time supplied by the NZ Transport Agency and the expected modal change from GWRC patronage forecasts – see the following table for a more detailed description.

Base Adjustment

It was decided that the benefits base will be "Option 7: Moderate Change to Timetable (Kapiti and Hutt Valley) and Minimising Network Improvements" in the Business Case also submitted called "Unlocking Network Capacity and Improving Resilience", which aligns with GWRC Regional Public Transport Plan.

Using this "Option 7: Moderate Change to Timetable (Kapiti and Hutt Valley) and Minimising Network Improvements" as a base, therefore attributes negative benefits for all options in this business case, which do not deliver good benefit outcomes, from a congestion and emissions perspective. Positive safety benefits for all options in this business case, against the base, have been established as increased congestion (slower moving traffic) actually improves safety.

Description of Specific Cost and Benefit Items

The following table outlines briefly how some component costs and benefits have been derived. Depending on the option, a benefit may eventuate as an avoided cost. Care should therefore be taken when interpreting the sign of numbers (positive or negative) in the economic assessment.

Table 38 – Cost and Benefit Descriptions

Cost/ Benefit	Description
Capital Expenditure	The cost of adding or replacing track infrastructure, or avoidance of costs in particular options.
Maintenance and Operations	The on-going cost of maintaining and operating the railway, or avoidance of costs in particular options.
Congestion Benefit Lost Due to Mode Shift from Rail to Road	A 2016/ 17 Wellington congestion benefit was calculated by estimating the difference in vehicle travel time with and without rail (based on work completed by independent advisors Ernst and Young). The difference in travel time was given a monetary value by applying the NZ Transport Agency base value of time taken from the Economic Evaluation Manual. The 2016/ 17 Wellington congestion benefit was then pro rata with the ratio of passenger kilometers travelled in 2015/ 16. Over time this annual benefit increases with the patronage growth forecast by GWRC.
Safety	Benefit (or disbenefit) is a function of the number of vehicles (or freight) displaced from rail to road should the railway system hypothetically be closed/ absent. The calculated difference in road safety performance is converted to a monetary safety benefit.
Emissions	A function of passenger kilometres travelled and monetary rates for emissions.
Lost Rail Revenue	Lost rail fare revenue has been calculated by taking GWRC's existing conservative long term patronage forecasts under the

Cost/ Benefit	Description
	different options. The average fare per passenger has been established for options where Wairarapa Line is decommissioned, by using a pro rata of the ratio of passenger kilometres travelled on the Wairarapa Line vs all other lines in 2015/ 16.
Rail Contract Cost	Rail contract cost savings have been calculated by taking GWRC's existing long term forecast and adjusting for cost lines that will change if the Wairarapa Line were to be decommissioned. The adjustments have been based on factors such as the ratio of stations on the Wairarapa Line vs. all rail stations in the Wellington region.
Unscheduled Outage Costs	An estimation of costs for occasional impromptu repairs and providing bus replacements.

Appendix I – Economic Analysis Summary

Table 39 – Economic Analysis Summary

Benefits	PV of benefits as calculated					PV of net benefits (PV option – PV do min benefits)			
	Option 2	Option 3	Option 4	Option 5	Option 6	Option 3	Option 4	Option 5	Option 6
Congestion benefit lost due to mode shift from rail to road	-$878,047,334	-$723,550,031	-$200,243,403	-$200,243,403	-$200,243,403	$154,497,303	$677,803,931	$677,803,931	$677,803,931
Safety (Crash cost) savings	$29,235,685	$24,091,504	$6,667,355	$6,667,355	$6,667,355	-$5,144,181	-$22,568,330	-$22,568,330	-$22,568,330
Vehicle emission reductions	-$1,979,075	-$1,630,846	-$451,339	-$451,339	-$451,339	$348,229	$1,527,736	$1,527,736	$1,527,736
PV total net benefits						**$149,701,351**	**$656,763,337**	**$656,763,337**	**$656,763,337**
Costs	**PV of costs as calculated**					**PV of net costs (PV option – PV do min costs)**			
Construction/ implementation (incl. preconstruction)	$0	$31,254,835	$80,567,806	$116,088,281	$134,328,883	$31,254,835	$80,567,806	$116,088,281	$134,328,883
Maintenance & Operation	-$203,118,925	-$178,385,723	-$41,986,440	-$57,753,485	-$61,766,186	$24,733,202	$161,132,485	$145,365,439	$141,352,739
PV total net costs						**$55,988,037**	**$241,700,291**	**$261,453,720**	**$275,681,622**
					BCR =	2.7	2.7	2.5	2.4

Incremental Cost-Benefit Analysis of Project Options

Target incremental BCR (A12.4) 1.0

Step	Base Option for Comparison			Next Higher Cost Option			Incremental Analysis			
	Option	Costs	Benefits	Option	Costs	Benefits	Incremental Costs	Incremental Benefits	Incremental BC Ratio	Base Option for Next Step
1	Option 3	55,988,037	149,701,351	Option 4	241,700,291	656,763,337	185,712,254	507,061,986	2.7	Option 4
2	Option 4	241,700,291	656,763,337	Option 5	261,453,720	656,763,337	19,753,429	0	0.0	Option 4
3	Option 4	241,700,291	656,763,337	Option 6	275,681,622	656,763,337	33,981,331	0	0.0	Option 4

Preferred Project Option: **Option 4**

Note: See assumptions in Table 40

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Table 40– Economic Analysis Assumptions

Economic Assessment Assumptions	
1	The benefit calculations are based on patronage numbers provided by GWRC and use the Ernst Young 'Value of Rail in Wellington 2016' report benefit values.
2	Cost estimates for the work were based on or supplied by KiwiRail. This in turn has been informed by consultant estimates and empirical costs from recent similar works.
3	No options explicitly consider the disruption and/ or economic impact to freight (including shift from rail to road) due to undertaking the works. It is assumed the impact on freight services is non-existent to very low; this is because the works can be sequenced so that freight trains continue to operate (i.e. workers get off and clear to allow freight trains to pass, wrong line run trains so they can work on the other track, etc.).
4	A conservative approach was taken with safety (crash cost) savings, and use the Ernst Young 'Value of Rail in Wellington 2016' report benefit values.
5	Option 5 and 6 benefits have been conservatively assumed as being no higher than Option 4 benefits.
6	Operating and maintenance figures (Opex) were supplied by GWRC and KiwiRail, and integrated into the model.