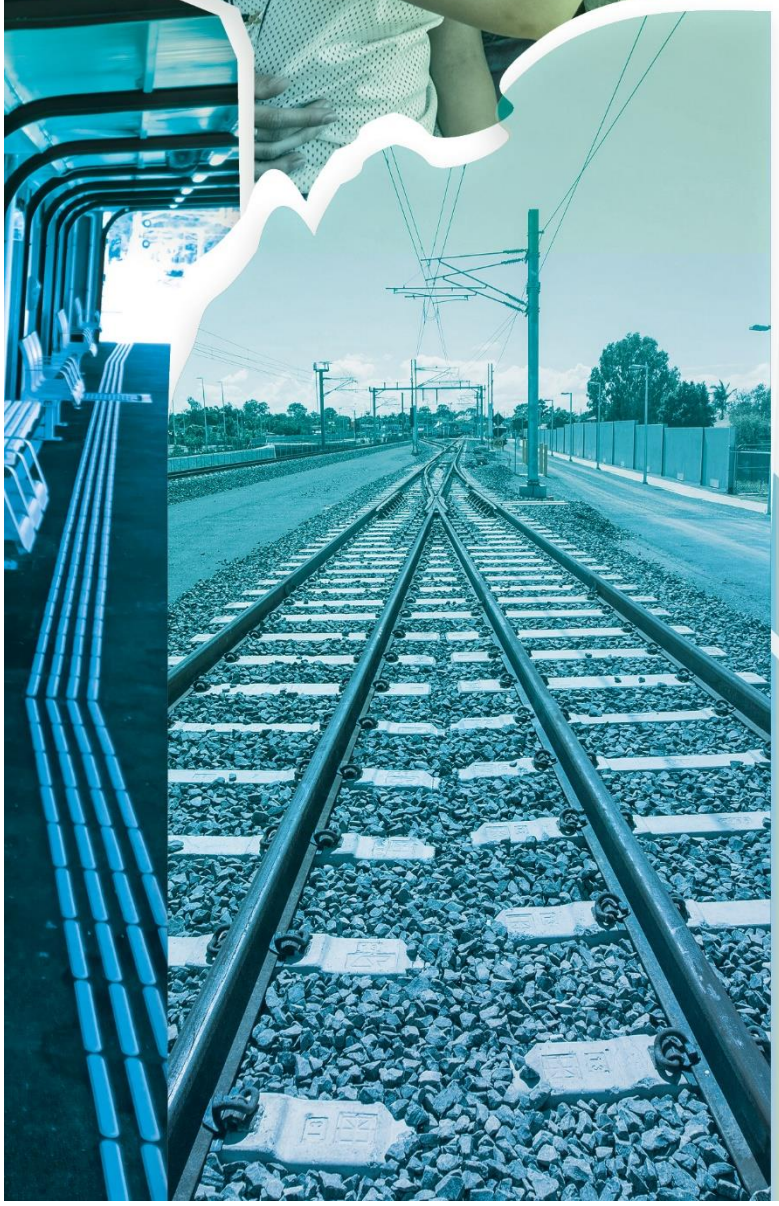


WMUP 6B Wairarapa Rail Upgrade Design

Level Crossings Risk Assessment

KiwiRail Holdings Limited

Reference: 523205-WAILLC-REP-MC-0001

Tucana Reference: [Client Document Code]

Revision: A

2024-02-16

aurecon JMDR

Bringing ideas to life

Document control record

Document prepared by:

Aurecon New Zealand Limited

Spark Central
Level 8, 42-52 Willis Street
Wellington 6011

PO Box 1591
Wellington 6140
New Zealand

T +64 4 472 9589
F +64 4 472 9922
E wellington@aurecongroup.com
W aurecongroup.com

Document control						
Report title		Level Crossings Risk Assessment				
Document code		523205-WAILLC-REP-MC-0001	**Project number**		523205	
File path		Https://aurecongroup.sharepoint.com/sites/523205/5_WorkingFiles/WOL Risk Assessment/WMUP6B LX Risk Assessment Report.docx				
Client		**KiwiRail Holdings Limited**				
Client contact		Andy Lyon	**Tucana Reference**		[Client Document Code]	
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
A	2024-02-16	Final Version	B. Feary S. Boldeman	P. Theiler B. Calcott D. Grist	M. Laing P. McGregor	M.Flannery
Current revision		**A**				

Approval			
Author signature		Approver signature	
Name	Various	Name	Matt Flannery
Title		Title	Major Project Director

Appendices

Figures

Tables

Explanatory Statement

This report has been prepared by Aurecon and JMDR at the request of KiwiRail exclusively for its use.

It has been prepared in accordance with our scope of service.

Aurecon and JMDR accept no responsibility to any third party for the use, or reliance on the report by any third party and the use of or reliance on the report by any third party is at the risk of that party.

The report is based on information provided to Aurecon and JMDR by KiwiRail and other parties. It is provided strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon and JMDR take no responsibility and disclaim all liability whatsoever for any loss or damage that KiwiRail or any other party may suffer resulting from any conclusions based on information provided to Aurecon and JMDR, except to the extent that Aurecon and JMDR indicate in the report that they have verified the information to their satisfaction.

1 Executive Summary

1.1 Background

The Wellington Metro Upgrade Programme (WMUP) is part of the Future Rail programme of works being undertaken by KiwiRail and Greater Wellington Regional Council (GWRC). WMUP6B is the upgrade of the Wairarapa Line to improve resilience, safety, reliability and provide more passenger and freight services.

As part of the WMUP6B capacity upgrades, safety improvements are proposed to the 30 public road level crossings between the Remutaka Tunnel and Masterton to reduce safety risks associated with doubling of peak time passenger services and an increase in rail line speed. The Wairarapa Line is changing from a rural to a semi urban line necessitating upgrades to manage more frequent and faster services.

KiwiRail has identified that the high number of level crossings, many of which are in close proximity, will affect the ability to run more frequent services and as such some will need to be closed. Level crossings present a risk to pedestrians and vehicles and the risk increases with more trains running more often at faster speeds.

The Transport Accident Investigation Commission (TAIC) has included 'Safety for Pedestrians and Vehicles Using Level Crossings' on their watchlist. This is an acknowledgement that there are long standing and serious safety transport concerns with road and pedestrian level crossings which policy makers, regulatory agencies and transport sector participants need to take faster action to deal with. The solution they have identified is 'The regulator, business operators, and road control authorities need to work closely to ensure the interface between rail and surrounding infrastructure provides the appropriate level of protection for pedestrians, road vehicles, trains, and those on board.'[1]

This study has been commissioned by KiwiRail to look at the Wairarapa Line as a whole and investigate in more detail the traffic, safety and amenity impacts of any closures. It is intended to provide evidence to support the variation to the existing safety case for operation of the Wairarapa Line. KiwiRail is required to establish the revised safety case for the approval of Waka Kotahi as the rail regulator.

The study examines the road and rail safety, local amenity, road network operational, whole of line and economic factors to build a case for closure or to remain open for each level crossing. Stakeholder consultation has been undertaken to contribute to the case. Each crossing has a ratio calculated to evaluate the risk versus cost for upgrade of the rail infrastructure (no road infrastructure costs have been included). Recommendations have been made on the basis of the factors evaluated for each crossing, for consideration by KiwiRail as part of the Wairarapa Line upgrade programme.

1.1 KiwiRail Level Crossing Closure Decision Making Process

KiwiRail does not have a published decision making procedure for closure of existing level crossings. Each crossing identified for closure is typically evaluated on a case-by-case basis using the KiwiRail and Waka Kotahi Level Crossing Risk Assessment Guide, KiwiRail Minimum Protection and Level Crossing Standards, Health and Safety best practice and site factors including the following principles which KiwiRail have published regarding establishment of new level crossings[2]:

- Level crossings are recognised internationally as introducing risk into the rail and road/pathway networks.
- KiwiRail regards safety as paramount, and endeavours to reduce the number of level crossings in New Zealand through closure and grade separation to make roads safer.
- In all cases a new crossing (in whatever form) must meet all safety, technical, railway operational requirements and legal requirements, and must not constrain the current and future use of the rail corridor for rail.

[1] https://www.taic.org.nz/watchlist/level-crossing-safety-pedestrians-and-vehicles

[2] https://www.kiwirail.co.nz/our-network/looking/level-crossings/new-crossings/ , https://www.kiwirail.co.nz/assets/Uploads/documents/Application-for-New-Level-Crossings-guidance-for-applicants-2.0-150321.pdf , https://www.kiwirail.co.nz/assets/Uploads/documents/Level-Crossing-Risk-Assessment-Guidance.pdf

- Crossing design must create a safe and hazard free area for public use; which does not permit deliberate or accidental use of railway operational areas.
- KiwiRail require that any new level crossing must be designed with a Criterion 1 solution from the outset or it shall require grade separation. Criterion 1 requires the Proposed Design and Future Score of a level crossing (when assessed using the Level Crossing Safety Impact Assessment (LCSIA) process) to achieve a 'Low' or 'Medium-Low' level of risk as determined by the LCSS (Level Crossing Safety Score).
- The general principle for modifying an existing level crossing is that the Proposed Design and Future Score LCSS achieves Criterion 1. Where the modifications required to meet Criterion 1 are not reasonably practicable for an existing level crossing upgrade then a documented risk assessment discussion between KiwiRail and the client shall be undertaken to agree on the required crossing treatment. In this case, the level of treatment applied must meet or exceed Criterion 2. Criterion 2 requires the Proposed Design and Future Score of a level crossing to achieve an LCSS number (out of 60) lower than, or equal to, the Updated Existing LCSS number.
- The responsibilities of each party at a public or private level crossing are set out in the Deed of Grant for the level crossing.

These practices and principles have guided the rail evaluation and the identification of upgrade proposals at existing level crossings.

The road evaluation builds on the site specific evaluation undertaken in the Level Crossing Safety Impact Assessments and So Far As Is Reasonably Practicable reports provided to the project team; adding safety, traffic and amenity factors related to the operation of the surrounding road network to enable a broader and more robust assessment of effects.

1.2 Safety Case Evaluation

1.2.1 Roading Assessment

Each crossing has been assessed in a Multi-Criteria Analysis (MCA) format to establish whether the Safety, Amenity and Whole of Line factors support the case for the crossing to be closed or support the case for the crossing to remain open with upgrades.

This involved scoring 13 Safety Factors and 9 Amenity Factors including the number of crossings in the vicinity, impacts on the road network and response times for emergency services. Additional site specific factors were identified for each crossing to add to the analysis. A full list of factors is included in Section 2.2 and Appendix A.

Consultation was undertaken with stakeholders to further refine the analysis of local and network impacts of crossing closure or upgrade.

Crossings have been identified for closure through the road assessment process are those where the balance of factors indicates closure would have a greater safety benefit and a lesser impact on amenity and the surrounding road network. The final recommendation for closure or upgrade has been based on both the road priority assessment and the rail assessment, which identifies the degree to which the investment in crossing upgrade is of economic benefit to the country.

1.2.2 Rail Assessment

The full Rail Assessment report is included in the appendices. Report extracts have been included in the body of the report to outline the Rail Assessment component of the project.

An Economic Comparison has been calculated for the upgrade proposal for each crossing. The benefit is based on the reduced travel time for each crossing if it was kept open and upgraded compared to closure which would require traffic to divert to other routes. The lower the ratio the less economic benefit would accrue to the economy versus the investment made in upgrading the crossing.

A key decision in whether to allow a level crossing to remain in place is the benefit to the local community. As level crossings are expensive high risk points, the argument for a level crossing to remain in place must be strong. Furthermore, the economic case for the level crossing to remain in place must similarly be strong.

A review of the economic benefit of the pool of level crossings reveals that the economic benefit of a small number of crossing is lower than the cost to upgrade it. This can be because the volume of traffic is low, or there are alternatives in place that are close by and therefore specific level crossings offer relatively little benefit.

A prioritised list of crossings for closure or upgrade has been identified based on the economic benefit to the local community. This has been used in combination with the roading assessment to provide a combined recommendation for each road level crossing.

1.2.3 Stakeholder Consultation

Three workshops were held in December 2023 with representatives from Carterton District Council (CDC), Masterton District Council (MDC) / the Save Judds Road Stakeholder group, and South Wairarapa District Council (SWDC). The intention of the workshops was to provide stakeholders with an understanding of the whole of line assessment process, and to invite stakeholders to identify local factors for inclusion in the multi-criteria road assessment. Details of issues discussed at each workshop are outlined in Section 2 of this report. The workshop slides and handouts are included in the Appendices.

There was general stakeholder support for the upgrade of level crossings, but significant concern in some instances regarding the impact of crossing closures on wider network safety and community amenity. Of particular concern were closures which redirected traffic to State Highway 2 (SH2).

There was a general consensus in the Carterton and Masterton stakeholder groups that SH2 was already congested, and adding traffic to SH2, and thus increasing local traffic interactions with SH2 traffic, would only exacerbate existing safety and congestion issues. Also of concern was the issue of community severance, in particular within the small communities where every street is important for a myriad of reasons. Also identified was the lack of understanding of the benefits to the community that the project would create. It was felt this had not been well communicated in previous stakeholder workshops.

During the workshops, the stakeholders identified prior submissions made during KiwiRail led consultation which should be considered. These were subsequently provided by KiwiRail and the factors identified were included in the MCA analysis.

1.3 Recommendations

1.3.1 Road Evaluation and Recommendations Process

Each level crossing was evaluated through the MCA process to identify factors in support of closure and factors in support of retention of the road level crossing and upgrade. Each crossing was considered individually and in relation to crossings on the surrounding road network.

Where there was no alternative road access the recommendation was clear, retain and upgrade the road crossing.

Where there was a significant safety issue, which was short stacking at the Judds Road level crossing, the recommendation was also clear, the short stacking risk should be addressed by closure unless it is feasible to address the risk through a major intersection upgrade involving traffic signals to remove the short stacking risk.

The Revans Street (SH53) and Fitzherbert Street (SH2) crossings were identified as requiring grade separation to meet KiwiRail Risk Criterion 1 and the SH53 crossing was identified in the So Far As Is Reasonably Practicable (SFAIRP) analysis as feasible to close if extensive road network changes led by the Road Controlling Authorities (RCA's) were possible. As such the Revans Street crossing was identified as a possible future closure.

The Norman Avenue level crossing is currently a dead end road for which upgrades do not meet KiwiRail Risk Criterion 1 or 2. It cannot be closed at present due to lack of an alternative route, however it may be a practical

option once the new connection from Wiltons Road is achieved. As such it was identified as a possible future closure.

All remaining level crossings had upgrade options available which met either KiwiRail Criterion 1, both Risk Criteria 1 and 2 or at a minimum Criterion 2 in the Future. A number of level crossings were on important routes that acted as a Primary or Secondary Collector roads within the road network, serviced significant rural or development areas or were routes on which or adjacent to which future development was planned or would require long detours. All level crossings had a local amenity benefit that had value to the surrounding community and stakeholders. These factors weighed against closure.

The final road assessment used to judge the remaining crossings was the overall benefit of level crossing closures to safety risk along the whole of line. Those crossings identified for closure were therefore those remaining after previous criteria were evaluated. The crossings where closure would have the least impact on the road network as they had an alternative route available and/or had low volumes of traffic to divert; would create an amenity benefit by providing an upgraded pedestrian level crossing and quieter street if they became a cul de sac; and with local safety or operational issues such as conspicuity, sight distance or side road conflicts that would be best addressed by closure.

The final criterion applied was the economic disbenefit of closure calculated in the rail assessment. The higher the cost to the country of detouring traffic versus the cost of upgrades, the higher the priority for upgrade as opposed to closure. The cut off used in the evaluation was a ratio of economic benefit to rail upgrade cost of less than 1.

1.3.2 Final Recommendations

The road and rail assessments were undertaken separately initially and conclusions reached for each assessment. The results have been combined for a final recommendation for each road level crossing assessed.

The road assessment identified eight level crossings for consideration for closure of the road crossing, one level crossing which could either be closed or investment made in a major intersection and crossing upgrade, and two level crossings which could be closed in the future subject to road network upgrades or changes. The remainder of the 30 level crossings in the study were identified to remain open with upgrades.

The rail assessment identified four crossings which should be closed now and one crossing which should be closed or a major crossing and intersection upgrade undertaken.

The combined recommendation for closure or upgrade has identified four level crossings for closure at this time:

- Victoria Street,
- Rhodes Street,
- Brandon Street, and
- Fox Street.

Two level crossings were identified for closure in the future when a link road is constructed and subject to extensive road network changes led by the Road Controlling Authorities, being Norman Avenue and SH53 Revans Street respectively. Judds Road was identified to either be closed at this time or upgraded subject to the test of the road and rail infrastructure upgrades being reasonably practicable.

Final recommendations were made based on the available data and conclusions from both the road and rail assessments as outlined in this report. Crossings are identified in the figure below and listed in priority order in the table below. Priority order is determined by the assessment of economic benefit to the country of upgrading the crossing based on the travel time cost of traffic detours if the crossing is closed. The lower the benefit cost ratio the less benefit accrued by proceeding with an upgrade and the more economically feasible closure becomes. The priority order ranks the crossings from least economically viable to upgrade (1) to most economically viable to upgrade (30).

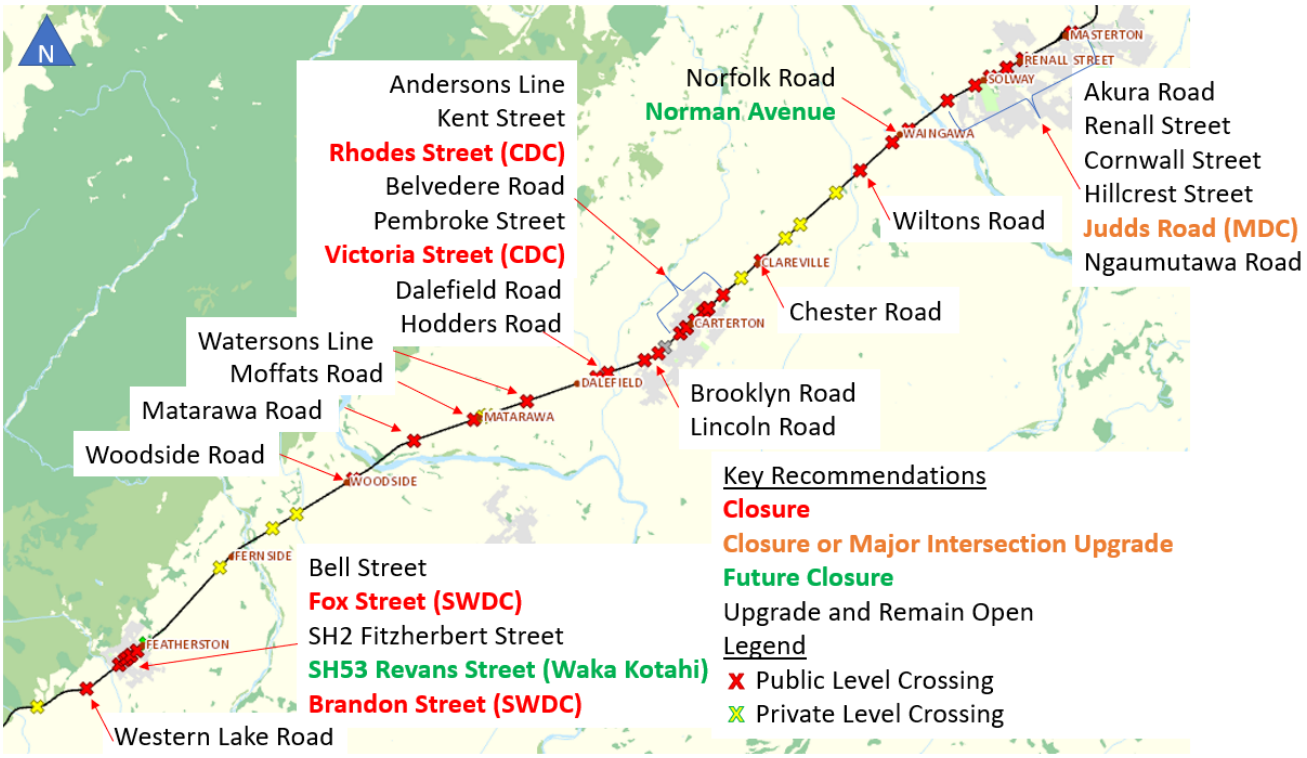


Figure 1 Level Crossing Recommendations

Table 1 Level Crossing Recommendations

Priority	Crossing	Recommendation	Location	Road Controlling Authority
1	459 Hodders Road	Do not close, dead end road. No alternative route available. Upgrades available to meet KiwiRail risk criteria 1 and 2.	Matarawa	Carterton District Council
2	1455 Victoria Street	Close - subject to Pembroke Street and/or Belvedere Road remaining open. Alternative routes available – shortest detour is to Pembroke Street to the north. Closure would provide additional space for pedestrian crossing facilities. Safer community environment created by cul de sac.	Carterton	Carterton District Council
3	1470 Rhodes Street	Close – subject to Kent Street and/or Belvedere Road remaining open. Crossing is inconspicuous. Train driver visibility of crossing is constrained. Low volumes. Alternative routes available which are of reasonable length. Medium Fatal Return Period.	Carterton	Carterton District Council
4	442 Brandon Street	Close - Alternative route is SH53 for the 381 vpd using the level crossing on this Access road. Closure would create more space for active controls for pedestrians to address high usage of the crossing by school children.	Featherston	South Wairarapa District Council
5	449 Fox Street	Close. Identified for closure in the District Plan. Alternative routes available. Closure addresses sight distance and side road conflicts and would provide more space for active controls for pedestrians.	Featherston	South Wairarapa District Council
6	1476 Andersons Line	Do not close. Dead End Road. Upgrades meet KiwiRail risk criteria 1 and 2.	Carterton	Carterton District Council
7	452 Bell Street	Can be closed as an alternative to Fox Street, however do not close if Fox Street is being closed as there are no other level crossings to the north in Featherston to maintain community connectivity. Low Risk Crossing and infrastructure upgrades meet KiwiRail risk criteria.	Featherston	South Wairarapa District Council
8	454 Matarawa Road	Do not close as Matarawa Road is a dead end. Upgrades are possible to meet KiwiRail Risk Criterion 2, which is supported by the SFAIRP analysis.	Matarawa	Carterton District Council
9	1485 Judds Road	To be closed to address short stacking risk if intersection upgrades are not reasonably practicable. Upgrades meet KiwiRail Risk Criterion 1 and 2. High amenity and safety value placed by the community on the Judds Road/Ngaumutawa Road intersection as an alternative to SH2.	Solway	Masterton District Council

Priority	Crossing	Recommendation	Location	Road Controlling Authority
10	460 Dalefield Road	Do not close. Secondary Collector with significant detours required. Crossing is Medium Low Risk and upgrades are available to address future risks.	Carterton	Carterton District Council
11	444 Revans Street (SH53)	Do not close at present. Proposed upgrades do not meet KiwiRail risk criteria however the SFAIRP analysis identifies it is not reasonably practicable to close or grade separate at this time and upgrade should proceed. 'Closure of Revans St is not an available option within the WMUP6B scope …Nevertheless, it is an option that should be considered further with a view to implementation at a future time.'	Featherston	Waka Kotahi Wellington
12	1473 Kent Street	Do not close as functions as a Secondary Collector Road with a future extension to Chester Road proposed. Upgrades meet KiwiRail Risk Criteria 1 and 2.	Carterton	Carterton District Council
13	1488 Cornwall Street	Do not close, low risk crossing which can be maintained as low risk with upgrades.	Masterton	Masterton District Council
14	1454 Brooklyn Road	Do not close. Secondary Collector with relatively long detours. Upgrades available to meet KiwiRail risk criteria 1 and 2.	Carterton	Carterton District Council
15	441 Western Lake Road	Do not close. Closure is not a realistic control due to the heavy vehicle detours required. Upgrades are available to meet KiwiRail Risk Criterion 2. Grade Separation is required to meet Criterion 1.	Featherston	South Wairarapa District Council
16	1467 Belvedere Road	Do not close. Upgrades meet KiwiRail risk criteria and road function is important for current and future development.	Carterton	Carterton District Council
17	457 Moffats Road	Do not close, long detours and crossing risks can be addressed to meet KiwiRail Risk Criteria 1 and 2.	Matarawa	Carterton District Council
18	1486 Hillcrest Street	Do not close. Upgrades available to meet KiwiRail risk criterion 1.	Solway	Masterton District Council
19	1453 Lincoln Road	Do not close. Primary Collector alternative to SH2. Upgrades are available to meet KiwiRail risk criteria 1 and 2.	Carterton	Carterton District Council
20	1457 Pembroke Street	Do not close. Case to remain open is high amenity value of level crossing connection for the community and redistribution of traffic to SH2 which is considered unsafe by the community, upgrades are available to meet KiwiRail risk criteria 1 and 2.	Carterton	Carterton District Council
21	1483 Norfolk Road	Do not close. Upgrades meet Criterion 2 level of risk however SFAIRP confirms closure and grade separation are not reasonably practicable.	Waingawa	Carterton District Council

Priority	Crossing	Recommendation	Location	Road Controlling Authority
22	1481 Wiltons Road	Do not close. Long diversions required. Future access for development required. Upgrades available to meet KiwiRail risk criteria 1 and 2.	Waingawa	Carterton District Council
23	446 Fitzherbert Street (SH2)	Do not close. Proposed upgrades do not meet KiwiRail risk criteria however SFAIRP analysis identifies it is not reasonably practicable to close this crossing or grade separate at this time.	Featherston	Waka Kotahi Wellington
24	1482 Norman Avenue	Do not close at this time. Closure can be considered in the future with the construction of a new connection from Wiltons Road into the Waingawa Industrial Area.	Waingawa	Carterton District Council
25	458 Watersons Line	Do not close. Long Detours required. Upgrades available to meet KiwiRail risk criteria 1 and 2.	Matarawa	Carterton District Council
26	1490 Renall Street	Do not close. Primary Collector Road. Upgrades available to meet Criterion 1.	Masterton	Masterton District Council
27	1480 Chester Road	Do not close. Primary Collector Road. Upgrades meet KiwiRail Risk Criteria 1 and 2.	Carterton	Carterton District Council
28	1484 Ngaumutawa Road	Do not close. Upgrades available to meet Criterion 2 however SFAIRP identifies it is not reasonably practicable to close and recommends upgrades	Carterton	Carterton District Council
29	1493 Akura Road	Do not close. Primary Collector road and alternative to SH2. Upgrades available to meet KiwiRail Risk Criterion 1.	Masterton	Masterton District Council
30	456 Woodside Road	Do not close. Long Detours required. Upgrades are available to meet KiwiRail Risk Criteria 1 and 2.	Woodside	South Wairarapa District Council

2 Introduction

2.1 Background

KiwiRail have engaged Aurecon and JMDR to undertake a whole of line, risk-based assessment covering all public rail level crossings between Remutaka Hill and Masterton. The study is intended to provide an independent means to support KiwiRail's spending allocation and crossing upgrade or closure decisions and hence enable optimal targeting of the available budgets to maximise the overall safety risk reduction on the Wairarapa Line. As such, the study evaluates road and rail safety, community amenity, road network effects and the economic benefits of upgrading level crossings versus closure.

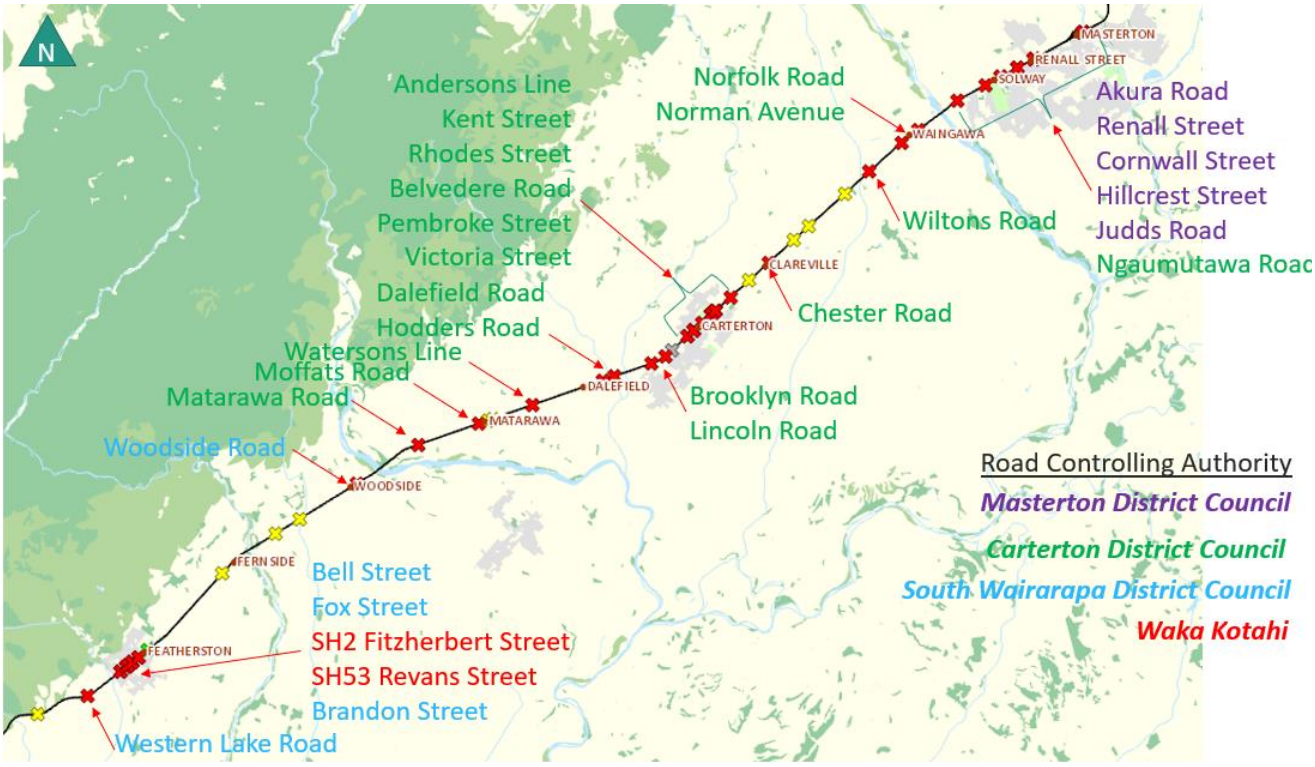


Figure 2 Wairarapa Line Crossings between Remutaka and Masterton

2.2 Stage 1 – Roading and Rail Assessment

2.2.1 Roading Assessment – Multi Criteria Analysis (MCA)

The roading assessment includes an evaluation of road related factors for all the road level crossings. The existing pedestrian level crossings have not been evaluated as there are no proposals to close pedestrian access at any of the level crossings on the Wairarapa Line, only to consolidate existing crossings.

A number of Road Safety and Amenity Factors have been identified and evaluated in the Multi-Criteria Analysis. The evaluation assesses each factor in terms of a case for closure of the level crossing, through qualitative and quantitative assessment measures. Positive factors support closure, negative factors support the case for the crossing to remain open.

As the range of factors cannot capture all possible issues for consideration, in addition to the factors, a number of site-specific issues have been added to the analysis tables for consideration for each crossing. The data used has been obtained from the LCSIA reports undertaken by Stantec, site visits, traffic and crash data collected, the Carterton modelling memo, the Judds Road SH2 memo, and the independent So Far As Is Reasonably Practicable (SFAIRP) reports undertaken by KiwiRail. All documents used have been listed in the appendices.

The scoring regime is outlined below and repeated in more detail in the appendices. Scoring has been used to determine the degree of positive or negative effect each factor would have if the crossing was closed. Factors scored relate to the safety of the crossing, community amenity and the surrounding road network. Scores have not been used to rank crossings or tallied to create a total score for each crossing as all factors are unlikely to be weighted as of equal importance so this cannot be done.

Some factors have been evaluated in several ways which could have a positive or negative effect, for example: if closure distributes traffic to other routes with a higher crash rate this factor is seen as supporting the case to remain open as the existing crossing is a lower safety risk; whereas the higher the number of level crossings in the vicinity of the studied crossing the more widely the traffic to be diverted can be distributed, supporting the case for closure, as closure effects can be minimised across multiple routes.

Two factors were seen as 'red flag' factors which either eliminated the possibility of closure or required the crossing to be closed or significantly upgraded.

The factor that eliminates the possibility of closure is if the road is a dead end road. This would remove road access to existing properties unless a new connecting road was built. This applies to Matarawa Road, Norman Avenue, Woodside Road, Hodders Road and Andersons Line level crossings.

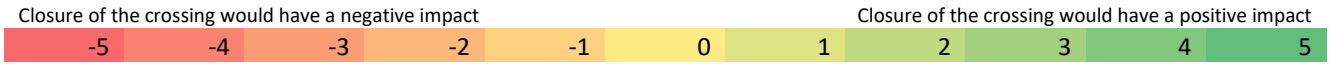
The factor that requires the crossing to be closed or significantly upgraded is short stacking, where the stacking distance to an intersection (including a safety offset) is within 5m of or less than the length of a bus, there is no downstream escape lane and the route is used by school buses. This applies at Judds Road. The posted stacking distance is 14 metres and a standard school bus is 11.3m long. The consequence of a train vs. bus crash is considered to be Serious, the highest likelihood and most serious consequence measure in the Safe Roads System.

The importance of each additional safety or amenity factor evaluated in the process is subjective but together they illustrate a case for consideration of closure or retention with upgrades.

Consideration of the effect of a crossing closure on the adjacent crossings and surrounding road network has also been included in the analysis to approximate a 'whole of line' effects assessment.

2.2.1.1 Safety Factors

Safety Factors have been scored on the following scale:



- **Dead End Road.** If a level crossing provides access to a dead end road the crossing is scored -5 as closure would remove access to properties. If the road is a through road the crossing is scored 0 as closure is neutral.
- **Safe and Appropriate Speed Differential.** Waka Kotahi have published the 'Safe and Appropriate Speed' on MegaMaps. Waka Kotahi define this as 'A safe and appropriate speed limit is a speed limit that is safe according to standards set by the Safe System and appropriate in terms of aligning with community wellbeing objectives as well as with the movement and place function, design and infrastructure of the street or road.' The crossing is scored according to the value of the speed differential between the Posted Speed Limit and the Safe and Appropriate Speed. The higher the difference between the posted speed limit and the Safe And Appropriate Speed the higher the positive score. The assumption is the greater the difference between what is posted and what is deemed safe the more positive closure of the crossing would be on safety.
- **Level Crossing Safety Score (LCSS).** Each crossing has an Updated Existing LCSS score recorded in the Level Crossing Safety Impact Assessment (LCSIA) Report. This score combines the Australian Level Crossing Management (ALCAM) risk score, the Site Specific score and the Engineer Scores calculated during the LCSIA assessment. Scoring is all positive in this category. The higher the LCSS score the higher the safety risk of keeping the crossing open so closure would have a positive impact.
- **Fatal Return Period.** Each crossing has a Fatal Return Period in years recorded in the LCSIA reports for the Updated Existing scenario. This is the number of years until a Fatal incident at the crossing. The lower

the return period the higher the risk of a fatality. Scores are all positive. The lower the return period the higher the positive score.

- **Short Stacking.** Short stacking risk is scored based on the short stacking length subject to whether there is an escape lane ahead. The short stacking length is measured between the level crossing and the vehicle limit line on the downstream side of the crossing. The shorter the distance the higher the score. All scores are positive as closure of the crossing would have a positive impact on the risk of short stacking.
- **Short Stacking Consequence.** The Short Stacking length is used to determine the likelihood and consequence of a multiple fatality crash involving a school bus. A standard school bus is 11.3m long. The likelihood is chosen from very likely/likely/unlikely/very unlikely based on short stacking length and escape lane presence and the consequence from single fatality/multiple fatality where Very Unlikely x Single or Multiple Fatality and Unlikely x Single Fatality is Significant and all other combinations are Serious. Serious scores 5 and Significant 4 as closure is positive for high consequence incidents.
- **New Crossings Criteria.** 1km Urban, 2km Rural. KiwiRail criteria under a historic Infrastructure Code Supplement G417, Company Procedure Q517 for approval of new public road or pedestrian level crossings is 'The nearest public level crossing shall be 1km in urban areas and 2km in rural areas.' We have used this standard as a test to evaluate for each crossing whether there are other crossings within this distance. If there are other crossings the subject crossing can be closed. The more crossings the higher the positive score as closure would not have a negative impact on the road network. If there are no crossings the score is -5 as closure would have a negative impact on safety on the road network, restricting access and requiring long detours.
- **Shunting at the Crossing.** Shunting at the level crossing can create the risk of a second train entering the crossing after drivers have stopped for a first train. Drivers may think the train they have seen is the only train and enter the crossing when the crossing is still operating. Shunting can also activate the crossing for longer periods resulting in drivers driving around the controls to avoid a delay. The score is 5 if shunting occurs at the crossing and 0 if it does not. Closure of the crossing would have a positive impact on addressing the risk of shunting.
- **Length of Diversion Route x volume**. This factor is a measure of the shortest diversion route to the nearest level crossing multiplied by the average daily traffic volume through the crossing. Scoring is all negative as closure would have a negative impact on the road network by adding traffic and risk to another level crossing. The higher the diversion route length x volume the higher the negative score.
- **Intersections on Diversion Route.** This factor is the number of intersections on the diversion route weighted by intersection type. An uncontrolled intersection has a weighting of 3, a priority controlled intersection a weighting of 2 and a roundabout a weighting of 1, with the weighting reflecting the safety of the intersection type. The greater the number of intersections x the weighting the higher the risk of collisions along the diversion route and the higher the negative impact of closing the level crossing.
- **Crash History on Diversion Route.** This factor is a measure of the number of injury crashes on the diversion route for the period 2017-2021. Crashes are weighted by the social cost of minor, serious and fatal injury crashes. The higher the total the less safe the diversion route and the more negative the score. Scores are zero for no crashes and negative for an injury crash history.
- **Average Daily Traffic Volume.** The annual average daily traffic volume through the crossing is scored on a negative scale. The higher the volume the more negative the score. Closure of the crossing would have a negative effect on the road network with traffic being distributed to other roads and level crossings.
- **# Crossings Affected within 1km.** This factor is the number of level crossings within a 1km radius of the subject crossing. The scoring is positive the more crossings are within 1km as it is anticipated crossing closure effects would be dissipated more widely and closure would not have a negative effect. If there are no crossings within 1km the score is -5 as closure would result in long detours.

2.2.1.2 Amenity Factors

- **Ambulance Station Proximity**[3]. This is a measure of the distance to the nearest Ambulance Station. The further away the Ambulance Station the less the impact of the crossing closure on Ambulance operations. Scores are all negative, the highest negative score is for crossings closest to the Ambulance Station.
- **Time difference to Ambulance Station**. This is a comparison between the travel time from the nearest Ambulance Station to the subject crossing and the travel time to the nearest diversion route crossing. If the diversion route takes more travel time the higher the negative impact of closing the crossing on Ambulance response times, longer diversion routes mean a higher negative score. If the diversion route takes less time the higher the positive impact of closing the crossing on Ambulance response times.
- **Fire Station Proximity**. This is a measure of the distance to the nearest Fire Station. The further away the Fire Station the less the impact of the crossing closure on Fire operations. Scores are all negative, the highest negative score is for crossings closest to the Fire Station.
- **Time difference to Fire Station**. This is a comparison between the travel time from the nearest Fire Station to the subject crossing and the travel time to the nearest diversion route crossing. If the diversion route takes more travel time the higher the negative impact of closing the crossing on Fire response times, longer diversion routes mean a higher negative score. If the diversion route takes less time the higher the positive impact of closing the crossing on Fire response times.
- **Police Station Proximity**. This is a measure of the distance to the nearest Police Station. The further away the Police Station the less the impact of the crossing closure on Police operations. Scores are all negative, the highest negative score is for crossings closest to the Police Station.
- **Hospital Proximity**. This is a measure of the distance to the nearest Hospital. The further away the Hospital the less the impact of the crossing closure on Hospital access. Scores are all negative, the highest negative score is for crossings closest to the Hospital.
- **One Network Framework (ONF) Movement Function**. This factor uses the ONF Movement categories to score the Movement Function. The Movement category is determined by the One Network Framework road classification such as 'Rural Road', 'Urban Connector', 'Local Street'. M1 is the highest movement category – Movement is Major and involves the 'mass movement of people and/or goods on streets that are of major importance in urban areas, within and between regions or nationally'. M5 is the lowest movement category – Movement is Low and involves the 'Local movement by people going about their daily lives.' Scores are all negative. The higher the movement function (i.e., M1) the higher the score as closure would have a more negative effect on the crossing.
- **One Network Road Category (ONRC) Hierarchy**. Under the ONRC system roads are classified by function. The higher the road function the higher the negative score as closure would have a more significant negative effect on the road network. -5 is scored for a Regional Road, -1 for an Access Road.
- **Over dimension Route**. This factor measures whether or not a road is an over dimension vehicle route. If it is it is scored -5 to indicate closure would have a significant negative effect on the road network requiring an alternative route to be established for over dimension vehicles. If the route is not an over dimension route it is scored 0.

2.2.1.3 Whole of Line

A separate discussion is included for the 'whole of line' assessment at each crossing. It covers which crossings traffic would be distributed to if the crossing was closed, likely diversion routes and a discussion of the impact of closure on other crossings.

[3] We note the Wellington Free Ambulance often dispatches ambulances from the road rather than from a station. This measure was used to approximate the effect on dispatches from the nearest ambulance station only and we acknowledge this measure cannot fully represent how Wellington Free Ambulance operate on this road network.

2.2.1.4 Site Specific Factors

Site Specific factors considered were different for each crossing and included: Crossing geometry and conspicuity, local access constraints, emergency management, SFAIRP reports, journey time for detours, Closure and Grade Separation reports, Master planning, vulnerable users, road network constraints, proximity and access to amenities, active modes, property access, detour route effects, consented activities, red flag scenarios, local road upgrades, intersection proximity, local and regional cycle routes, network accessibility, school bus routes, local development planned, existing detour routes, second train effect, delays at existing crossings, diverted traffic volumes, and existing business operations.

2.2.2 Rail Risk Assessment

Risks exist across any rail network, including the KiwiRail- rail network. Rail operators confront a wide range of different risks, and their management is a key activity. Risks change over time and can increase or decrease depending on rail traffic movements, asset configuration, passenger numbers and environmental conditions.

Common risks for a rail operation include:

- Rail traffic vehicles strike each other
- Rail vehicles derail
- Rail vehicles strike landslips or other obstructions
- Rail vehicles strike road vehicles at level crossings
- Rail vehicles derail at points/turnouts
- A rail vehicle strikes a pedestrian
- Rail vehicles strike maintenance vehicles

Safety risks are a critical component of the risk management process for any rail operator or rail maintainer. Safety risks, in an operating rail environment are impossible to eliminate entirely. This is consistent with any business, particularly for heavy industry, where there are large safety risks. They key process is to assess these safety risks, and then manage and reduce these safety risks professionally and efficiently.

Many of the risks within the rail environment are understood. Level crossings are a well-known risk area. Risks for level crossings in New Zealand are known and understood. KiwiRail has an active policy of working towards reducing the risk at level crossings where possible.

Where a rail line upgrade project is launched, then there is an opportunity for many of the risks to be addressed. Currently, within WMUP 6B, the intention is for a number of changes to be made, including:

- Improved roading leading up to the level crossings
- Upgraded lights and barriers
- Installation of pedestrian crossings
- Improved sighting and visibility

An engineering principle called SFAIRP (So Far as is Reasonably Practicable) is often applied to rail projects to guide the methodology and amount of resources to be applied in achieving risk reductions. This principle guides decision making on what improvements to make, and how much to spend. The principle operates such that all plausible and practical controls should be implemented to reduce risk, where possible.

As with any major project, the WMUP 6B project needs to assess risk and form a conclusion on the acceptability of risk.

The management of risk in this particular instance has some unusual attributes. For example, the risk associated with so many level crossings on a rail line with increased rail traffic and increasing road vehicle traffic at level crossings is clearly somewhat high, and with each level crossing closure, there is a significant reduction of risk. Closure of all the level crossings will dramatically reduce risk, which is a desirable outcome for the rail operator. Alternatively, the impact of closing all level crossings to the local community would be substantial, and not “reasonably practical”.

Even the closure of most of the level crossings would impose costs and time upon the local community. For the purposes of the SFAIRP principle, the local community is a legitimate stakeholder in the assessment of SFAIRP, and where a solution is chosen that is not practical for them, then it is not practical in general. Practicality needs to consider many different stakeholders, to varying degrees depending on who they are.

The case was made in stakeholder consultations that the closure of level crossings would result in large scale increases in risks for road users. This argument was not convincing at the time, (with some exceptions). It is however accepted that the economic impact to the local community may be significant, this is an entirely acceptable consideration in the management of and decision for the closure of level crossings. It is acceptable, under certain circumstances, to increase the risk or to accept high risks for a rail operator, where the economic benefit to the community is strong. This practice generally should be discouraged and done only under very clear guidelines.

The need for KiwiRail to reduce risks to a SFAIRP level should be respected, particularly where a rational and fully informed SFAIRP assessment has been undertaken.

2.2.2.1 Economic Impact of Closure of a Level Crossing

Level crossings are an obvious point of risk for any rail operator. They allow road and rail vehicles to occupy the same space, and therefore creates the risk of a collision between the two.

A level crossing should only be installed where there is a clear need for one to be there. In general, this means that the amenity of the level crossing is high, and so taking the risk is justified. There is always some risk associated with operating trains, and at level crossing this cannot be reduced to zero, only mitigated.

The utility of a level crossing is closely tied to the usage. High use level crossings have a higher amenity, and those rarely used, have a low utility. Where a level crossing is provided to access properties that have no other access, then the utility can be high, even when the road traffic numbers can be small.

As part of this report an estimate was made of the economic utility of a level crossing, at a high level. Diversion distances are estimated from the distances between the different level crossings.

The purpose of road level crossings is to allow the movement of road vehicles across the rail line. The benefit of such a road crossing can be determined in terms of the number of road movements, and the distance to another crossing. Where there are other crossings nearby, the value of the level crossing may not be particularly high. Alternatively, where there are very few if any alternate crossing points, the economic benefit may be extremely high.

This of course assumes that there are multiple crossing points. In some cases there is only one access point across the rail line, and without the road level crossing there would be no access whatsoever to particular properties. These road crossings realistically cannot be closed.

This assessment can be performed on the basis of time needed to complete a crossing of the rail line. Additional time that is needed to complete a crossing comes at a cost. This can be modelled through using the effective additional time, and then applying a cost for this time. For the purposes of this review, a median wage for New Zealand was used.

The economic value of each crossing was calculated based on the value of additional time to divert to other routes if the crossing was closed [a travel time disbenefit] and compared to the rail infrastructure upgrade cost at each crossing. This created a comparison value of closure disbenefit versus upgrade cost.

A cut off value of 1 was used to identify which crossings should be recommended for closure, where the benefit attained through the upgrade is less than the cost of the upgrade.

2.2.3 Stakeholder Workshops

Three stakeholder workshops were held in December 2023 to outline the Stage 1 Road and Rail evaluation methodology and process to Wairarapa stakeholders and provide an opportunity for identification of additional issues for consideration during Stage 2 of the analysis.

Workshops were held on the following dates with the Aurecon NZ Ltd and the JMDR independent analysis team in attendance:

- Monday 4 December at 2pm, Carterton District Council, Carterton Events Centre, Carterton
- Tuesday 5 December at 9:30am, Save Judds Road Stakeholder Group (incorporating members of Masterton District Council), Breadcraft, Masterton
- Tuesday 5 December at 2pm, South Wairarapa District Council, SWDC Office Martinborough

Prior to the workshops no previous public consultation material, responses or submissions had been made available to the independent evaluation team. Subsequently, the following documents were provided for inclusion in the analysis:

- Letter 4/7/23 from Hon Kieran McAnulty to Mayor Ron Mark
- Petition from Barracks Residents dated 21/5/23 regarding disagreeing with closure of Judds Road / Ngaumutawa Road intersection to vehicle traffic
- Letter to KiwiRail from Monique Williams dated 1/6/23
- Letter to KiwiRail from Karen Hutchison, undated
- Wellington Transport Alliance review of SH2/Belvedere Intersection Sidra Memo
- Submission from Guusje de Schot dated 31/5/23.
- Official Information Act Request – Report - 2023-10-19T153059.952 Fatalities on the Wairarapa Line between 2007 and 2023
- Judds Road Crossing Consequences List – Judds Road Stakeholder Group
- Save Judds Road Finance Proposal incorporating letters of endorsement/support from Breadcraft, Comvita, Harvey Norman and Solway School and graphs of ‘urgent calls’, ‘urgent calls 2019-2022’ and ‘vehicle collisions 1880-2022’.

2.3 Stakeholder Consultation

Safety and amenity are both important considerations in the risk assessment process to ensure both road and rail safety and the network and community effects of closures are fully understood and incorporated in the decision making process.

Outlined below is a summary of key issues identified by the stakeholders during the December 2023 workshops. This includes the expected impact of closures on mobility and accessibility within the affected communities, what the community values and is concerned about, and the wider network effects.

2.3.1 Carterton District Council

- Community Severance is a major issue. The closures will affect people’s mental health.
- SH2 is not safe but the closures will mean more traffic will need to use SH2.
- Consultation with the community should be undertaken to bring them along the journey and understand the bigger picture, the why. What makes the WMUP6B project worth it for the Carterton community, what is the positive outcome? The benefits of the closures and upgrades to the community have not been communicated. This includes rail equipment being moved to allow space for a future cycle corridor and quiet cul de sacs being created which are safer for residents.
- There was an opportunity for KiwiRail to bring the community on the journey at the start of the project when Carterton were willing to work with KiwiRail to put out a good news story to the community but trust of KiwiRail has been eroded by lack of response to consultation submitted, chopping and changing of options, and lack of a logical explanation for the proposed closures.
- The logic of the closures is not apparent to the community. If safety is the key driver then why are crossings with a crash history not proposed to be closed and crossings with no history of crashes being closed.
- Safety should lead before budget – is the funding available to deliver what is best / safer recomended?
- There has been no response from KiwiRail to submissions made during the consultation process. There have been 6-7 consultation meetings with KiwiRail to date.

- Risks evaluated should be specific to Wairarapa not NZ wide risks. Focus on Carterton risks and issues in the evaluation. National and overseas statistics are not relevant to Carterton or the Wairarapa.
- In a small community every street is important for a myriad of reasons. For example Pembroke Street is the only access to the supermarket in Carterton.
- The preference is for KiwiRail to justify the closure rather than for the Council or Community to prove the roads should remain open. For example - closure of road crossings and conversion to a pedestrian crossing is illogical if there is the option to put in a pedestrian bridge. Or why not fence the entire urban corridor in Carterton – there are issues with people getting off the trains and walking along the rail corridor directly to their properties.
- The closure of Rhodes and Victoria are likely to be accepted by the community as logical closures but not others.
- The Council request to see the study report, dissect it and work with KiwiRail on what new crossings are to be closed rather than hear from KiwiRail on the closure decisions they have made.
- Group was encouraged about there now being a whole of line assessment rather than individual ones but stressed feedback has already been provided and not prepared to provide any more specifics until a tangible study plan was shared with them.
- Council has meeting records available from the consultation meetings which it can share. Public feedback was sent directly to KiwiRail so Council do not have access to it.
- Dave Campbell is a local resident with rail experience and expertise and is happy to provide advice to the Carterton working group if agreed.
- The community want to stay connected.
- The Carterton to Clareville cycle path is still on the books.
- Speed limit changes have affected emergency response times
- Speed limit reductions due to road works on SH2 over the past year have affected response times. Wellington Free Ambulance requested approval from Waka Kotahi to travel at higher than the temporary 30km/h speed limit but this was not granted. WFA have two stations, 1 in Greytown and 1 in Masterton. If the Greytown ambulance is on a call the Masterton ambulance is dispatched. The road works affected response times from Masterton to Carterton.
- Ambulances are usually out on the network when dispatched so measuring dispatch times or distances from the station does not make sense.
- Is this project aligning to the NZTA vision: A vision where everyone, whether they're walking, cycling, driving, motorcycling or taking public transport, can get to where they're going safely.

2.3.2 Masterton District Council / Save Judds Road Stakeholder Group, Masterton

- The group support KiwiRail upgrades to the level crossing but not the impact on the local roads. The concern is the level crossing risk is being transferred to other parts of the community by the closures.
- The impact will be sending trucks through town past schools, kindergartens, community facilities and the impact will be on other intersections. Closure would push more traffic back onto the Judds Rd/SH2 intersection and the newly upgraded SH2 roundabouts.
- SH2 currently carries heavy traffic such as forestry trucks through town.
- SH2 is already difficult to access from Judds Road. People do not try to turn right onto SH2 as it is dangerous. Traffic moving onto Ngaumutawa Road will increase volumes along the frontage of Solway Primary School which is already congested and places our children in more danger.
- Solway School's official school bus route is not through the Judds Road level crossing, however, several times a week the school uses charter buses to travel to the A & P Showgrounds or other destinations and these buses use Judds Road level crossing.

- The closest and newest subdivision to Solway Station is The Barracks that was advertised to 180 residents and vehicles as being close to this station which attracted buyers from Wellington who commute daily. Not all residents have the ability to walk the 450m distance and if the Judds Road crossing is closed this would require a further travelling distance of a 2 ½ km drive around local roads to get to the station. Residents have recently been given easier access to SH2 south by the introduction of the new Ngaumutawa Road roundabout, which has significantly increased safety for those heading south, but by closing the Judds Road crossing, completely eliminates that option, which then forces vehicles back down onto the dangerous Judds Rd/SH2 intersection.
- There are significant businesses and employers on Judds Road which are nationally important and key local employers including Breadcraft, Harvest Electronics, Comvita, and Harvey Norman. All of whom require easy access for heavy traffic vehicles from Ngamutawa Road which is the heavy traffic bypass road. Breadcraft is a civil defence food manufacturer and needs to be readily accessible in any emergency.
- There are a number of businesses based in the showgrounds including Age Concern Wairarapa and the Wairarapa Farmers Market. There are frequent events at the showgrounds on Judds Road, and access is all via Judds Road. This includes large horse floats and trucks on a regular basis.
- There is also a new business park development proposed behind Breadcraft/Harvest Electronics with additional heavy traffic access required from Judds Road.
- There is a population of 30,000 in the Masterton District and 5 level crossings spread across the wider district, compared to a population of 10,000 in Carterton district with 10 level crossings in their town centre. The closures proposed do not reflect the crossings per km argument KiwiRail are making in relation to Masterton due to the current and anticipated future population growth over the next few years.
- There is currently significant residential growth at the southern end of Masterton who require access heading north and use Judds Road as the access road onto the bypass. The western side of Masterton is already expanding and the local District Plan forecasts an additional 2300 homes for development in this area over the next 10 years.The Ministry of Education has forecast an additional 600 new primary school kids who will be distributed across existing schools further increasing vehicular traffic through the immediate area.
- Passenger train speed is not a factor at Judds Road due to the proximity of the rail station, as they are required to slow down to 20km/h as they are coming into and out of the station through the crossing. However, freight trains will still travel at 80km/h which is the line speed.
- The concerning safety issue at Judds Road is the short stacking – how can this be mitigated sensibly? Discussion followed on traffic signal options already accepted by KiwiRail as the “gold star” solution.
- Can a short stacking warning be set up for train drivers? At this crossing that would require a 1500m train warning distance and 2 minute closure of the level crossing. If this type of warning is used to stop trains the issue is impatient drivers crossing around barriers as they cannot see the train or get annoyed with the delay.
- Safety issue of drivers stopping at the tertiary signal across the rail tracks if the intersection is signalised has been managed at other level crossings by a 2 second delay between the green at the primary and tertiary signals. The tertiary signal green changes 2 seconds later to help clear the intersection and remove confusion for drivers as to which signal to stop at.
- The cycleway at the Judds Road crossing is in the Wairarapa Cycle Strategy but it is not funded and is not in the National Land Transport Plan (NLTP). A cycleway is not proposed at the Ngaumutawa Road Level crossing.
- The ambulance response is typically from out on the road rather than from the ambulance station so calculation of response times from the station is not realistic. The Judds Road closure increases Ambulance response times by 3 minutes and reduces the survivability of a cardiac arrest by 30%.
- If there was a major event on Judds Road such as a large fire, emergency services will want to arrive and park upwind of the event. Due to the northwesterly prevailing wind this means access from Ngaumutawa Road is required. If the crossing is closed emergency services will have to travel through town and into the toxic fumes which is dangerous to emergency services staff.
- The Judds Road Steering Group supports the traffic signals option at the Judds Road level crossing. The question is who pays. The group does not want the signals option dismissed because of cost. The Council

has currently agreed to contribute $400k reallocated from other roading priorities, however, a staged approach is preferable to allow for budgetting purposes.

- The National Government during the election campaign stated their intention to keep all crossings open. The Wairarapa National MP Mike Butterick and Labour MP Kieran McAnulty both support keeping the crossing open. Kieran and Mike are on the Judds Road Steering Group.

2.3.3 South Wairarapa District Council (SWDC)

- That engagement with KiwiRail so far had been positive, mature and SWDC had been listened to.
- There was a feeling that the big picture good news story about 'why' had been missing from the KiwiRail communications to date and there had been no regional media story
- Council has approved community engagement for the SWDC Master Plan which will run from 6 December 2023 to 18 February 2024. **https://swdc.govt.nz/featherston-masterplan/** . The conceptual master plan makes the following assumptions:
  - Closing the existing Fox Street Level Crossing to vehicles along with upgraded crossing facilities for pedestrians and cyclists. This will assist with reducing vehicle movements in Fox Street, supporting the proposed upgrades to the 'Town Heart.' However, it will mean that commuters will have to use Hickson Street and Bell Street to drive to the train station, rather than Fox Street and Johnston Street.
  - Retaining the Bell Street level crossing and upgrading it, for vehicles, pedestrians and cyclists.
  - Recognition that the Brandon Street Level Crossing will be part of the KiwiRail investigation
- Police, Fire and Ambulance are all aware of the assumptions in the master plan.
- Council are happy that all affected agencies have been well consulted.
- Masterplan consultation results will be compiled in April/May 2024.
- There will be pop up community sessions to discuss the masterplan post Christmas that KiwiRail could attend if Council receive questions/issues from the community about level crossings.
- Suggestion that KiwiRail submit on the Master Plan
- KiwiRail have been great to deal with in terms of the masterplan and have listened to Council.
- Featherston cycle facilities are not funded and not a priority due to the cost of living.
- Council are requesting all road level crossing closures have cycle and pedestrian facilities.
- The speed limit is being dropped on Western Lake Road.

2.3 Stage 2 - Combined Risk Assessment

2.3.3 Rail Assessment - Economic Comparison

An Economic Comparison has been calculated for the upgrade proposal for each crossing. The benefit is based on the reduced travel time for each crossing if it was kept open and upgraded compared to closure which would require traffic to divert to other routes. The lower the ratio the less economic benefit would accrue to the economy versus the investment made in upgrading the crossing.

The priority order ranks the crossings from least economically viable to upgrade (1) to most economically viable to upgrade (30).

Table 2 Economic Value to Upgrade Cost Ratio (Costs are rail related upgrade costs only)

Street name	Economic benefit	Upgrade cost (no closures)	Ratio
Rhodes Street	$395,451	$1,000,000	0.40
Fox Street	$501,784	$1,000,000	0.50
Brandon Street	$460,371	$800,000	0.58
Bell Street	$717,744	$800,000	0.90
Victoria Street	$751,358	$800,000	0.94
Kent Street	$1,583,783	$1,000,000	1.58
Andersons Line	$1,186,354	$700,000	1.69
Moffats Road	$1,195,142	$700,000	1.71
Brooklyn Road	$1,128,574	$600,000	1.88
Wiltons Road	$1,607,071	$700,000	2.30
Watersons Line	$1,923,432	$700,000	2.75
Belvedere Road	$2,249,130	$800,000	2.81
Pembroke Street	$2,640,462	$1,000,000	2.64
Hillcrest Street	$4,016,908	$1,000,000	4.02
Dalefield Road	$2,504,526	$600,000	4.17
Judds Road	$2,691,871	$800,000	3.36
Revans Street (SH53)	$1,124,400	$200,000	5.62
Lincoln Road	$3,514,575	$600,000	5.86
Western Lake Road	$7,778,585	$900,000	8.64
Fitzherbert Street (SH2)	$3,780,076	$400,000	9.45
Norfolk Road	$14,682,782	$600,000	24.47
Renall Street	$12,907,919	$400,000	32.27
Akura Road	$40,568,978	$1,000,000	40.57
Chester Road	$24,883,232	$600,000	41.47
Ngaumutawa Road	$18,586,217	$400,000	46.47
Hodders Road	Not calculated	$700,000	Not calculated
Matarawa Road	Not calculated	$700,000	Not calculated
Cornwall Street	Not calculated	$1,000,000	Not calculated
Norman Avenue	Not calculated	$600,000	Not calculated
Woodside Road	Not calculated	$800,000	Not calculated

Many of these level crossings have a very high economic benefit, and clearly should remain open.

Note these cost benefit numbers do not include the cost for disposal of the level crossing. Also note that there are costs associated with the long term management of the level crossing, which also have not been included. The analysis above is intended to provide some guidance as to the relative value of different level crossings.

The above list may be used as a priority list for which level crossings to close or to leave open.

2.3.4 Rail Recommendation

The installation of a level crossing into a rail system almost always increases the risk for both rail and road traffic. A key decision in whether to allow a level crossing to remain in place is the benefit to the local community. As level crossings are expensive high risk points, the argument for a level crossing to remain in place must be strong. Futhermore, the economic case for the level crossing to remain in place must similarly be strong.

A review of the economic benefit of the pool of level crossings reveals that the economic benefit of a small number of crossing is lower than the cost to upgrade it. This can be because the volume of traffic is low, or there are alternatives in place that are close by and therefore specific level crossings offer relatively little benefit.

The review has been asked to provide a list of level crossings, in order, as recommendations for whether each should be left open, or closed. This is provided below:

Table 3 Rail Evaluation – Level Crossing Recommendations

Priority	Level Crossing	Recommendation
1	Hodders Road	Remain open, it's the only access road to a small number of properties
2	Victoria Street	Close
3	Rhodes Street	Close
4	Brandon Street	Close
5	Fox Street	Close one of Fox or Bell
6	Andersons Line	Remain open, it's the only access road to a small number of properties
7	Bell Street	Close one of Fox or Bell
8	Matarawa Road	Upgrade and remain open
9	Judds Road	Close, or major work to reduce the risk associated with the short stacking
10	Dalefield Road	Upgrade and remain open
11	Revans Street (SH53)	Upgrade and remain open
12	Kent Street	Upgrade and remain open
13	Cornwall Street	Upgrade and remain open
14	Brooklyn Road	Upgrade and remain open
15	Western Lake Road	Upgrade and remain open
16	Belvedere Road	Upgrade and remain open
17	Moffats Road	Upgrade and remain open
18	Hillcrest Street	Upgrade and remain open
19	Lincoln Road	Upgrade and remain open
20	Pembroke Street	Upgrade and remain open
21	Norfolk Road	Upgrade and remain open

Priority	Level Crossing	Recommendation
22	Wiltons Road	Upgrade and remain open
23	Fitzherbert Street (SH2)	Upgrade and remain open
24	Norman Avenue	Upgrade and remain open
25	Watersons Line	Upgrade and remain open
26	Renall Street	Upgrade and remain open
27	Chester Road	Upgrade and remain open
28	Ngaumutawa Road	Upgrade and remain open
29	Akura Road	Upgrade and remain open
30	Woodside Road	Upgrade and remain open

We note that Judds Rd, without the short stacking, would remain open. There is a clear economic benefit to Judds Rd, however the risk of a very serious accident, to children on a school bus, trumps any consideration of the economic benefit.

As regards Judds Rd, the economic benefit listed above should not be interpreted as meaning that the economic benefit to remaining open is substantial. The cost of a major accident, with the deaths of a dozen children (not that this is how this is assessed) is very large indeed, and even a small probability of this occurring will heavily weigh on any economic appraisal. It is worth noting that the cost of such an accident will be borne by the Crown in New Zealand, and the cost will not be passed on the local community around Masterton. As such taking such an additional risk can be considered an example of the “tragedy of the commons”, where the costs associated with the taking of the risk are not paid for by the users of the asset.

2.3.5 Rail Assessment Conclusions

The following conclusions have been identified in this report

- The upgrade of level crossings in the Wairarapa region as part of the WMUP 6B will provide significant benefits in terms of safety risk reductions and of lives saved.
- The installation of pedestrian crossings to existing road crossings offers particularly high safety benefits
- The transition from road to rail for commuters produces a strikingly high predicted reduction in fatalities
- The road fatality rate in New Zealand is high, and so a transition from road to rail is highly desirable from a safety perspective
- The overall safety benefit from the upgrade of the Wairarapa line is substantial
- Several level crossings have been identified as uneconomic to remain open, including:
  - Victoria St
  - Rhodes St
  - Brandon St
  - Fox St
- Judds Rd, with the high short stacking risk, and the known use of the crossing by buses laden with school children, should either close or have major work done to mitigate the very serious risks associated with a large scale nation defining accident
- The implementation of the project will result in a major net improvement in safety to the public in the Wairarapa region

- The residual risk associated with level crossings is still significant, but this appears acceptable from an economic perspective in most cases. However, there is clearly the risk potential for more accidents, and this risk is unfortunately unable to be reduced any further with the project budgets allocated
- Any changes to the rail traffic profile, or for example the running of higher speed trains, may require a further assessment of the risks associated with the level crossings on the Wairarapa line

Note that this assessment has been performed for up to 20 trains/services per day in either direction, for the entire length of the Wairarapa line for a speed of 110 km/hr. This is higher than what is proposed for the new service pattern for the new rollingstock.

2.3.6 Combined Recommendations

The following road level crossings have been identified for closure and replacement with a pedestrian level crossing. The rail assessment has judged that the closures are a priority to address safety issues and the road assessment has judged the closure is feasible with a manageable impact on road operations. The crossings are listed in priority order:

- 1455 Victoria Street
- 442 Brandon Street
- 1470 Rhodes Street
- 449 Fox Street

Crossing # 1485 Judds Road has also been identified for possible closure to address a short stacking risk if intersection upgrades are not reasonably practicable. The LCSIA report identified there are upgrades available which meet KiwiRail Risk Criterion 1 and 2 although it was also considered feasible to eliminate the risk at the level crossing via closure. The level crossing and the Judds Road/Ngaumutawa Road intersection have a high amenity and safety value for the community as an alternative to the SH2/Judds Road intersection.

The safety recommendations identified in the LCSIA report for the Judds Road level crossing are as follows:include Half Arm Barriers, a pedestrian crossing with automatic gates, an emergency pullover on the northwest side of the crossing or signalisation of the intersection, replacement and new signs and restriction of the Breadcraft driveway closest to the level crossing to egress only.

Crossing #1482 Norman Avenue is identified for closure in the future when the construction of a new connection from Wiltons Road into the Waingawa Industrial Area is complete.

The remaining crossings should remain open with safety upgrades due to the impact closure would have on the surrounding road network and local access and amenity and the lower level of rail risk.

A short summary of the assessment, conclusions and recommendation is included below for each road level crossing. Full details are included in the appendices.

2.3.6.1 #441 Western Lake Road

- Road Assessment Conclusion: Do not close. Upgrades are available to meet KiwiRail Risk Criterion 2. Grade Separation is required to meet Criterion 1.
  - Alternative routes available however, Western Lake Road is a diversion route for SH53 when there is flooding. Some alternative routes are lower standard geometry, width and surfacing and add significant delays.
  - Closure would require grade separation to ensure continued access. SFAIRP confirms closure is not reasonably practicable, particularly due to the heavy vehicle detours required.
  - Upgrades required to address Medium High LCSS (Level Crossing Safety Score) and High Fatal Return Period, visibility of the crossing and speed differential between posted speed and safe speed. Proposed and Future Upgrades meet Criterion 2. Grade separation is required to meet Criterion 1.
- Rail Assessment Conclusion: Upgrade and remain open, Economic Ratio 8.6..
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.2 #442 Brandon Street

- Road Assessment Conclusion: State Highway 53 is an acceptable alternative route, however this crossing can be upgraded to meet KiwiRail risk criteria without grade separation.
  - Alternative route is SH53 for the 381 vpd using the level crossing on this Access road.
  - Closure would create more space for active controls for pedestrians to address high usage of the crossing by school children.
  - Upgrades required to address Medium LCSS Score and Medium High Fatal Return Period, poor crossing visibility and high demand for pedestrian facilities. Proposed Design Low Risk, Future Score medium Low Risk. Both the proposed design and future scenarios meet KiwiRail Criterion 1 and 2.
- Rail Assessment Conclusion: Close, Economic Ratio 0.6.
- **Recommendation: Close.**

2.3.6.3 #444 Revans Street (SH53)

- Road Assessment Conclusion: Do not close at present. Proposed upgrades do not meet KiwiRail risk criteria however the SFAIRP analysis identifies it is not reasonably practicable to close or grade separate at this time.
  - SH2 alternative route has been identified as feasible if one state highway crossing (SH2 or SH53) was to be closed, however it is not a reasonably practicable measure at this time.
  - SFAIRP identified it is not reasonably practicable to close or grade separate at this time.
  - Medium Low Risk crossing with a Medium High Fatal return period. Infrastructure options are available to address safety risks at opening. Proposed Design Medium Low Risk, Future Score Medium Risk. The proposed design achieves KiwiRail risk criterion 1 and the future score does not. Grade separation is required to meet criterion 1 for the future.
- Rail Assessment Conclusion: Upgrade and remain open, Economic Ratio 5.6.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.4 #446 Fitzherbert Street (SH2)

- Road Assessment Conclusion: Do not close. Proposed upgrades do not meet KiwiRail risk criteria however SFAIRP analysis identifies it is not reasonably practicable to close this crossing or grade separate at this time.
  - SH53 alternative route has been identified as feasible if one state highway crossing (SH2 or SH53) was to be closed, however it is not a reasonably practicable measure at this time. Of the two routes SH53 would be the more practical option to close.
  - Closure would require grade separation. SFAIRP identified it is not reasonably practicable to close or grade separate at this time.
  - Medium Low Risk crossing with Medium High Fatal return period. Upgrades available to address lack of conspicuity and short stacking risk. LCSS Proposed Design Medium Risk, Future Medium Risk. Neither meet KiwiRail Criterion 1 or 2. Grade separation is required to meet Criterion 1 for the Future Score.
- Rail Assessment Conclusion: Upgrade and remain open, Economic Ratio 9.5.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.5 #449 Fox Street

- Road Assessment Conclusion: Can be closed and is identified for closure in the District Plan, however upgrades are possible to meet KiwiRail risk criteria.

- Alternative routes available. Crossing is identified in the District Council's Masterplan for closure. Closure addresses sight distance and side road conflicts and would provide more space for active controls for pedestrians.
- Crossing is Medium LCSS Risk so does not meet KiwiRail Criteria. Crossing also has a Medium High Fatal return period. Proposed Design Medium Low Risk and Future Score Medium Low Risk. Both proposed and future scores meet KiwiRail Criterion 1 and 2.

- Rail Assessment Conclusion: Close. Economic Ratio 0.5.
- **Recommendation: Close road level crossing and provide pedestrian level crossing.**

2.3.6.6 #452 Bell Street

- Road Assessment Conclusion: Do not close if Fox Street is being closed as there are no other level crossings to the north in Featherston to maintain community connectivity. Low Risk Crossing and infrastructure upgrades meet KiwiRail risk criteria.
  - Alternative routes available however the nearest crossing (Fox Street) is proposed to be closed. This would mean all three level crossings east of SH2 would be closed (Fox, Bell and Harrison) meaning all access for Featherston north/east would be via SH2.
  - Low Risk crossing so meets KiwiRail criteria. Medium Fatality return period. Infrastructure upgrades can address safety and conspicuity issues. Proposed Design Low Risk, Future Score Low Risk. Both proposal and future meet KiwiRail Risk criteria.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 0.9.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.7 #456 Woodside Road

- Road Assessment Conclusion: Do not close. Long Detours required. Upgrades are available to meet KiwiRail Risk Criteria 1 and 2.
  - Long detour route to the south, dead end roads to the north and no crossings within 1km. Only access to Woodside Train Station from Woodside and Greytown.
  - Medium Low Risk crossing which meets KiwiRail Criteria. Medium Fatal return period and no history of incidents or near misses. Proposed Design and Future score are Low Risk and meet both KiwiRail Criterion 1 and 2.
- Rail Assessment Conclusion: Upgrade and stay open. Economic Ratio not calculated.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.8 #454 Matarawa Road

- Road Assessment Conclusion: Do not close as Matarawa Road is a dead end. Upgrades are possible to meet KiwiRail Risk Criterion 2, which is supported by the SFAIRP analysis.
  - Matarawa Road is a dead end road and access is required for a consented quarry and rural properties.
  - SFAIRP analysis supports upgrades as reasonably practicable.
  - Proposed Design Medium Low Risk and achieves KiwiRail Criterion 1 and 2. Future score Medium Risk and achieves Criterion 2. Grade separation is required to achieve Criterion 1 for the Future Score.
- Rail Assessment Conclusion: Upgrade and stay open. Economic Ratio not calculated.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.9 #457 Moffats Road

- Road Assessment Conclusion: Can be closed if detour route lengths are acceptable for the low volume (128vpd, 10%HCV) of traffic expected, however crossing risks can be addressed to meet KiwiRail Risk Criteria 1 and 2.
  - Alternative routes are available to the north and south and to Matarawa Train Station.
  - Medium Low risk crossing with Medium Fatality return period. Crossing risks are the private and KiwiRail accesses and history of near collisions. Proposed Design and Future Score are Low Risk and meet KiwiRail Criterion 1 and 2.
- Rail Assessment Conclusion: Upgrade and stay open. Economic Ratio 1.7.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.10 #458 Watersons Line

- Road Assessment Conclusion: Do not close. Long Detours required. Upgrades available to meet KiwiRail risk criteria 1 and 2.
  - Alternative routes available but relatively long detours required. Crossing is at the midpoint of a long straight. Operating speed is low relative to posted speed and close to safe and appropriate speed.
  - Upgrades required to address Medium Risk crossing and Medium High Fatal return period, lack of driver awareness of crossing, unprotected drainage ditches, lack of lighting and delineation. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail Criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and stay open. Economic Ratio 2.8.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.11 #459 Hodders Road

- Road Assessment Conclusion: Do not close, dead end road. Upgrades available to meet KiwiRail risk criteria 1 and 2.
  - Dead End Road. Closure would cut off access to rural properties.
  - Upgrades required to address Medium Risk LCSS Score, narrow sealed width, effects of horizontal and vertical curves and drop off to KiwiRail yard. Proposed Design and Future Score are both Medium Low Risk and meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Remain open, it is the only access road to a small number of properties. Economic Ratio not calculated.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.12 #460 Dalefield Road

- Road Assessment Conclusion: Do not close. Secondary Collector with significant detours required. Crossing is Medium Low Risk and upgrades are available to address future risks.
  - Secondary Collector Route for the south side of Carterton servicing rural properties. Significant detours required. Provides access to the Remutaka Ranges from Carterton and to Hodders Road which services a large rural area.
  - Crossing meets KiwiRail risk criteria with a Medium Low LCSS score. Proposed Design and Future Score are Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 4.2.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.13 #1453 Lincoln Road

- Road Assessment Conclusion: Do not close. Primary Collector alternative to SH2. Upgrades are available to meet KiwiRail risk criteria 1 and 2.
  - Primary Collector functioning as the main east-west corridor on the north side of Carterton. Traffic would divert to SH2. Functions as an alternative route to SH2.
  - Upgrades required to address Medium LCSS score and Medium High Fatal return period, sight distance issues, narrow sealed width and vehicle access within the level crossing. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 5.9.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.14 #1454 Brooklyn Road

- Road Assessment Conclusion: Do not close. Secondary Collector with relatively long detours. Upgrades available to meet KiwiRail risk criteria 1 and 2.
  - Alternative routes available however diversions would be relatively long. Road functions as a Secondary Collector on southern side of Carterton providing access to rural areas. Closure would create another detour in the Carterton township area with nearest parallel routes at Charles Street to the west and Victoria Street to the east.
  - Medium Low Risk – meets KiwiRail Criteria. Upgrades required to address Medium High Fatal return period, narrow sealed with and unprotected drop off. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 1.9.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.15 #1455 Victoria Street

- Road Assessment Conclusion: Can be considered for closure subject to Pembroke Street and/or Belvedere Road remaining open. Case to remain open is high amenity value of level crossing connection for the community and redistribution of traffic to SH2 which is considered unsafe by the community. Upgrades are available to meet KiwiRail risk criteria 1 and 2.
  - Alternative routes available – shortest detour is to Pembroke Street to the north. Closure would provide additional space for pedestrian crossing facilities. Safer community environment created by cul de sac.
  - Low mean operating speed, lack of incidents or near misses, high amenity value for local access across the crossing.
  - If crossing remains open upgrades required to address lack of sightlines and Medium High Fatal Return Period. Proposed Design is Low Risk and Future Score is Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.
- Rail Assessment Conclusion: Close. Economic Ratio 0.9.
- **Recommendation: Close road level crossing and provide pedestrian level crossing.**

2.3.6.16 #1457 Pembroke Street

- Road Assessment Conclusion: Can be closed if Belvedere Road and Victoria Street remain open. Case to remain open is high amenity value of level crossing connection for the community and redistribution of traffic to SH2 which is considered unsafe by the community, upgrades are available to meet KiwiRail risk criteria 1 and 2.
  - Secondary Collector providing east west access within Carterton with alternative routes available at Victoria and Belvedere Road. Issues with visibility and delays for drivers. Closure would provide more space for pedestrian facilities.

- High amenity value for community at this level crossing due to proximity of supermarket, aged care, preschool and school.
- If crossing remains open upgrades are required to address long crossing downtime, visibility for train drivers, lack of crossing conspicuity, Medium High Fatal return period. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 2.6.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.17 #1467 Belvedere Road

- Road Assessment Conclusion: Do not close. Upgrades meet KiwiRail risk criteria and road function is important for current and future development.
  - Alternative routes available however diversions would be relatively long. Road functions as a Secondary Collector on the northern side of Carterton providing access to rural areas. Provides an alternative route if other crossings such as Kent, Rhodes, Pembroke or Victoria are closed. Further development proposed in the area requiring access.
  - Medium Risk – does not meet KiwiRail Criteria, however, infrastructure upgrades are available to address safety risks including adjacent intersections, pedestrian demand and long barrier down times. Proposed Design and Future Score are Low Risk. Both achieve KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 2.8.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.18 #1470 Rhodes Street

- Road Assessment Conclusion: Can be closed if Kent Street or Belvedere Road remain open, however upgrades available to meet KiwiRail risk criteria 1 and 2.
  - Alternative routes available which are of reasonable length.
  - Amenity value for community at this level crossing due to adjacent sports fields, however alternative access available.
  - Medium Low Risk – meets KiwiRail risk criteria. Updates required to address Medium Fatal Return Period, Train driver visibility of crossing and inconspicuous crossing. Proposed Design and Future Score are Low Risk. Both meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Close. Priority Economic Ratio 0.4.
- **Recommendation: Close road level crossing and provide a pedestrian level crossing.**

2.3.6.19 #1473 Kent Street

- Road Assessment Conclusion: Can be closed if Rhodes Street and/or Belvedere Road remain open, however Kent Street has a higher function as a Secondary Collector Road with a future extension to Chester Road proposed and upgrades meet KiwiRail Risk Criteria 1 and 2.
  - Alternative routes available close by.
  - Upgrades required to address Medium Risk Crossing – does not meet KiwiRail risk criteria, and Medium High Fatal return period, lack of conspicuity, poor line of sight for train drivers, narrow sealed width. Proposed Design and Future Score are Medium Low Risk and both meet Criterion 1 and 2. With additional traffic from the closure of another crossing such as Kent Street the future score would remain in the Medium Low risk band.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 1.6.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.20 #1476 Andersons Line

- Road Assessment Conclusion: Do not close. Dead End Road. Upgrades meet KiwiRail risk criteria 1 and 2.
  - Dead end road providing access to rural properties to the north with low standard access to SH2. Long detour for rural properties.
  - Upgrades required to address Medium LCSS risk and Medium High Fatal return period, narrow sealed width. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Remain open, it is the only access road to a small number of properties. Economic Ratio 1.7.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.21 #1480 Chester Road

- Road Assessment Conclusion: Do not close. Primary Collector Road. Upgrades meet KiwiRail Risk Criteria 1 and 2.
  - Primary Collector Road - only access to farmland from Clareville and long detours would result.
  - Medium Risk – does not meet KiwiRail criteria, however, issues including High Fatal return period, accesses within the crossing and narrow sealed width can be addressed with infrastructure upgrades. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk Criterion 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 41.5.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.22 #1481 Wiltons Road

- Road Assessment Conclusion: Do not close. Long diversions required. Future access for development required. Upgrades available to meet KiwiRail risk criteria 1 and 2.
  - Alternative routes available but would require long diversions. Wiltons Road is a future access road and heavy truck route into the extended Waingawa Industrial Estate for which a roundabout has been constructed at the SH2 intersection.
  - Upgrades available to address safety issues including history of near misses and enable future closure of Norman Avenue Level Crossing. Proposed Design and Future Score are Medium Low and both meet KiwiRail risk criteria 1 and 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 2.3.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.23 #1482 Norman Avenue

- Road Assessment Conclusion: Do not close at this time. Closure can be undertaken in the future with the construction of a new connection from Wiltons Road into the Waingawa Industrial Area.
  - Dead end road currently, no alternative routes available.
  - Closure would cut off local businesses and is not a realistically available option but may be a practical option once the new connection from Wiltons Road is achieved. Closure is not reasonably practicable at this time.
  - Medium Low risk crossing – meets KiwiRail risk criteria. Safety issues including history of incidents and near misses, queuing and delays due to shunting can be partially addressed through infrastructure upgrades however Proposed Design and Future Score are Medium Risk. Neither meet Criterion 1 or 2.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio not calculated.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.24 #1483 Norfolk Road

- Road Assessment Conclusion: Do not close. Upgrades meet Criterion 2 level of risk however SFAIRP confirms closure and grade separation are not reasonably practicable.
  - Important access route to Waingawa Industrial Area. Detours are long and through residential areas.
  - Proposed Design and Future Score are Medium Risk and meet Criterion 2. Grade separation is required to achieve Criterion 1.
  - Infrastructure upgrade improvements available. SFAIRP identifies closure and grade separation are not reasonably practicable. Likely closest crossing at Norman Avenue will be closed in the future when the industrial area expands to the west.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 24.5.
- Recommendation: **Upgrade road level crossing and remain open.**

2.3.6.25 #1484 Ngaumutawa Road

- Road Assessment Conclusion: Do not close. Upgrades available to meet Criterion 2 however SFAIRP identifies it is not reasonably practicable to close and recommends upgrades
  - Ngaumutawa Road is the heavy traffic bypass for Masterton. Ngaumutawa Road links to Upper Manaia Road which provides access to rural properties which would have no alternative access. Future housing developments at West Bush Road will require access.
  - Proposed Design is Medium Low Risk and meets KiwiRail Risk Criterion 1 and 2. Future Score is Medium Risk and meets Criterion 2.
  - SFAIRP says it is not reasonably practicable to close and recommends upgrades. Upgrades required to address Medium LCSS Score, Medium High Fatal return period. (SH2/Ngaumutawa intersection has recently been upgraded to a roundabout to address safety issues).
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 46.5.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.26 #1485 Judds Road

- Road Assessment Conclusion: Can be closed to address short stacking risk if intersection upgrades are not reasonably practicable. Upgrades meet KiwiRail Risk Criterion 1 and 2. High amenity and safety value placed by the community on the Judds Road/Ngaumutawa Road intersection as an alternative to SH2.
  - Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road. If Judds Road is upgraded rather than closed, closure of Hillcrest Street can be considered.
  - Serious Short Stacking Risk at Ngaumutawa Road intersection can be addressed by closure or partially mitigated by traffic signals managing queuing in advance of the crossing. Risk of vehicle stalling on the crossing remains. Not a school bus route but used by school buses to transport children to activities.
  - High amenity value at this crossing due to access to Ngaumutawa Road as an alternative route to SH2 and access to Solway Station. SH2 intersection and redistribution of traffic to SH2 is seen by the community as dangerous with concerns about adding to high heavy commercial vehicle volumes on SH2 which traverses residential and commercial areas and increases in conflict with other road users.
  - Further residential and commercial/industrial development proposed on Judds Road which will add traffic to SH2 and Ngaumutawa Road intersections.
  - Proposed Design is Low Risk, Future Score is Medium Low Risk. Both meet Criterion 1 and 2.
- Rail Assessment Conclusion: Close, or major work to reduce the risk associated with short stacking. Economic Ratio 3.4.
- **Recommendation: Close if intersection upgrades to address short stacking are not reasonably practicable.**

2.3.6.27 #1486 Hillcrest Street

- Road Assessment Conclusion: Can be closed as alternative routes available, but do not close if Judds Road level crossing is being closed. Upgrades available to meet KiwiRail risk criterion 1.
  - Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road, however, Judds Road immediately south is proposed to be closed and closing Hillcrest Street would affect access to Solway Station and West Bush Road which is a Secondary Collector Road providing access between Solway and rural areas.
  - Medium Low LCSS score so meets KiwiRail Criteria. Medium Fatal return period. Proposed Design is Medium Low Risk and Future Score is Low Risk. Both achieve Criterion 1.
  - Upgrades required to address delays to drivers caused by crossing controls triggered when a train stops at Solway Station.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 4.0.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.28 #1488 Cornwall Street

- Road Assessment Conclusion: Can be closed as alternative routes available if Hillcrest Street and Renall Street remain open, however low risk crossing which can be maintained as low risk with upgrades.
  - Alternative routes available, however closure would cut off direct access to the heavy traffic bypass route, Ngaumutawa Road. One of several Collector routes linking SH2 and Ngaumutawa Road.
  - No significant safety issues if not closed as is a Low Risk crossing, however upgrades recommended to address sightline issues, long barrier down times as crossing is triggered by a train at Renall Street Station, and near misses. Proposed Design is Low Risk and meets KiwiRail Risk criterion 1 and 2. Future Score is Low Risk and meets criterion 1.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio not calculated.
- **Recommendation: Upgrade road level crossing and remain open.**

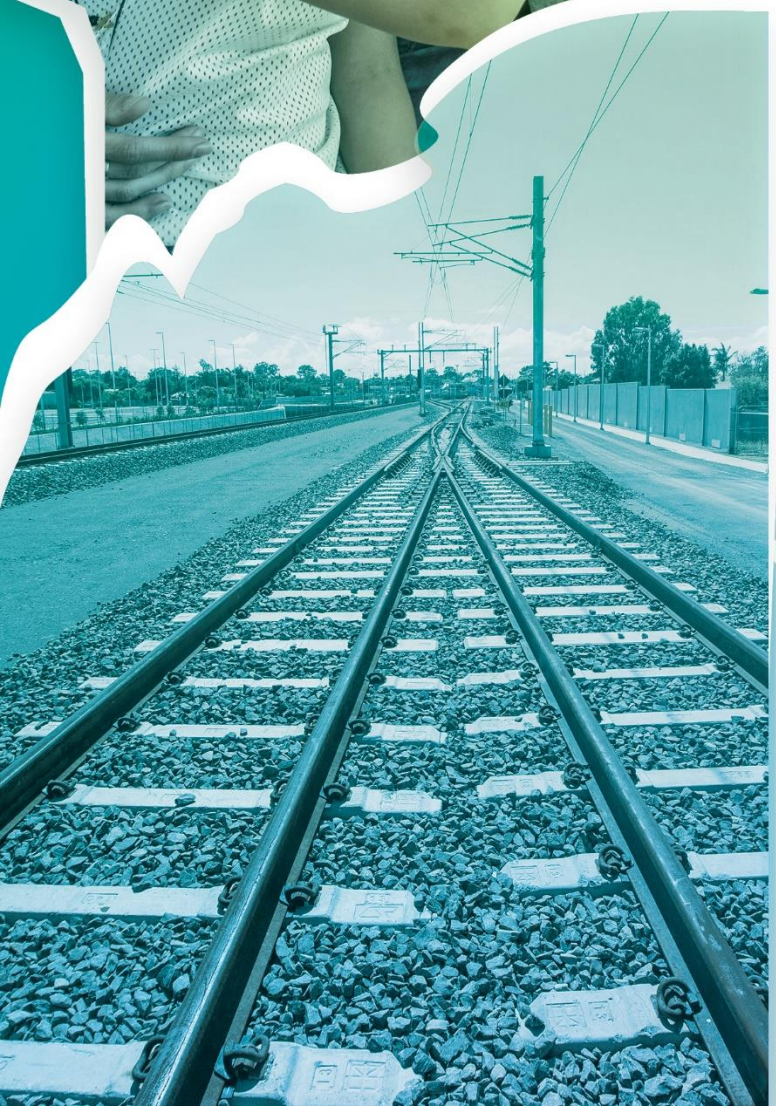
2.3.6.29 #1490 Renall Street

- Road Assessment Conclusion: Do not close. Primary Collector Road. Upgrades available to meet Criterion 1.
  - Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road however, as a Primary Collector Road there is a large volume of traffic to be redistributed and this route provides access to a large subdivision and rural areas. Provides access to Renall Street Station.
  - Low Risk Crossing – meets KiwiRail Risk Criteria with a Medium Fatal return period. Short stacking and safety risks including sightlines and inconspicuous crossing can be addressed with infrastructure upgrades. Proposed Design and Future Score are Medium Low Risk. Both meet Criterion 1.
- Rail Assessment Conclusion: Upgrade and remain open. Economic Ratio 32.3.
- **Recommendation: Upgrade road level crossing and remain open.**

2.3.6.30 #1493 Akura Road

- Road Assessment Conclusion: Do not close. Primary Collector road and alternative to SH2. Upgrades available to meet KiwiRail Risk Criterion 1.
  - Access to Masterton Train Station. Primary Collector linking Masterton town centre with rural areas to the north as an alternative to SH2.
  - Low LCSS score and Low Fatal Return Period. No history of incidents or near misses. Upgrades to sightlines can be undertaken. Proposed Design and Future Score are Low Risk and both meet Criterion 1.

- Rail Assessment Conclusion: Upgrade and remain open. Priority Economic Ratio 40.6.
- **Recommendation: Upgrade road level crossing and remain open.**



Appendices

aurecon JMDR

Bringing ideas to life

Appendix A – MCA Analysis Factors

The MCA Analysis considered the following Safety and Amenity Factors.

Table A-1 MCA Factors – Safety Risk

Safety Risk	
Dead End Road	Measure - is the road a dead end road. Scoring - if yes, the crossing cannot be closed. If no, crossing can be closed
Short Stacking	Short Stacking risk identified at Judds, Belvedere, Fitzherbert, Hillcrest, Renall. Scoring: Short stacking is a high safety risk - closure would have a positive impact on safety. Scoring for short stacking is based on short stacking length. No short stacking is 0
Short Stacking Consequence	Short Stacking length used to evaluate risk of multiple fatality crash. Probability of a Crash vs. Consequence to determine Severity Outcome
LCSS Score	Measure of Level Crossing Safety Score from LCSIA. (Combines ALCAM, Site Specific, Engineer Scores) Scoring: High risk crossings - closure would have a positive impact on safety. Scoring is all positive. The larger the LCSS the higher the score.
Length of Diversion Route	Measure of length of diversion route to the nearest level crossing (NB: there are no grade separated crossings on the study corridor) multiplied by the volume through the level crossing. Scoring: The longer the diversion route the higher the negative impact on closure of the crossing. Scoring is all negative. The higher the diversion route x volume number is the more negative the score.
Fatal Return Period	Fatality Return Period from ALCAM LXM database Scoring: Low return period equates to a higher risk of a fatality. Closure would have a positive impact on safety. Scoring is all positive. The higher the return period the higher the score. Closure is positive.
ADT	Measure of Average Daily Traffic Volume through the level crossing Scoring: The higher the volume of traffic the higher the negative effect of closing the level crossing
Safe and Appropriate Speed	Measure of speed differential between existing posted speed limit and Safe and Appropriate speed from MegaMaps. Scoring: Higher speed differential means the road is less safe. Closure would have a positive impact on addressing the safety risk. Scoring is all positive. Bigger speed differential is a higher score
Intersections on Diversion Route	Measure of the number of intersections on the diversion route with the number weighted by intersection type. Scoring Uncontrolled weighting is 3, priority 2, roundabout 1. The greater the number of intersections on the route the greater the crash risk along the route and the higher the negative impact of closing the crossing. Scoring is all negative. The more factored intersections the more negative the score.
Crash History on Diversion Route	Measure of CAS Crash history on diversion route - Number of injury crashes years 2017-2021 (from MegaMaps). Scoring: Crash numbers are weighted by the social cost of the crashes. The higher the number of higher severity crashes the riskier the diversion route. Scoring is zero for zero crashes or negative. The more crashes the more negative the number.
# Crossings Affected	Measure - number of other level crossings within a 1km radius of the crossing proposed for closure. Scoring - the higher the number of other level crossing potentially affected the more positive the score as there are more crossings as an alternative route and to distribute traffic to
New Crossings Criteria	KiwiRail criteria for new crossings is the nearest public crossing shall be 1km in urban areas and 2km in rural areas. Scoring: If there are other crossings within this distance then the crossing can be closed. Closure would have a positive impact on rail operations. The more crossings the higher the score. If there are no crossings the score is -5 as closure of the crossing would have a negative impact on local access

Safety Risk	
Shunting at the crossing	Shunting at the crossing creates a second train risk and delays for drivers who may drive around controls. Scoring: Shunting is a high safety risk. Closure would have a positive impact on safety. Score is 5 for shunting, 0 for no shunting

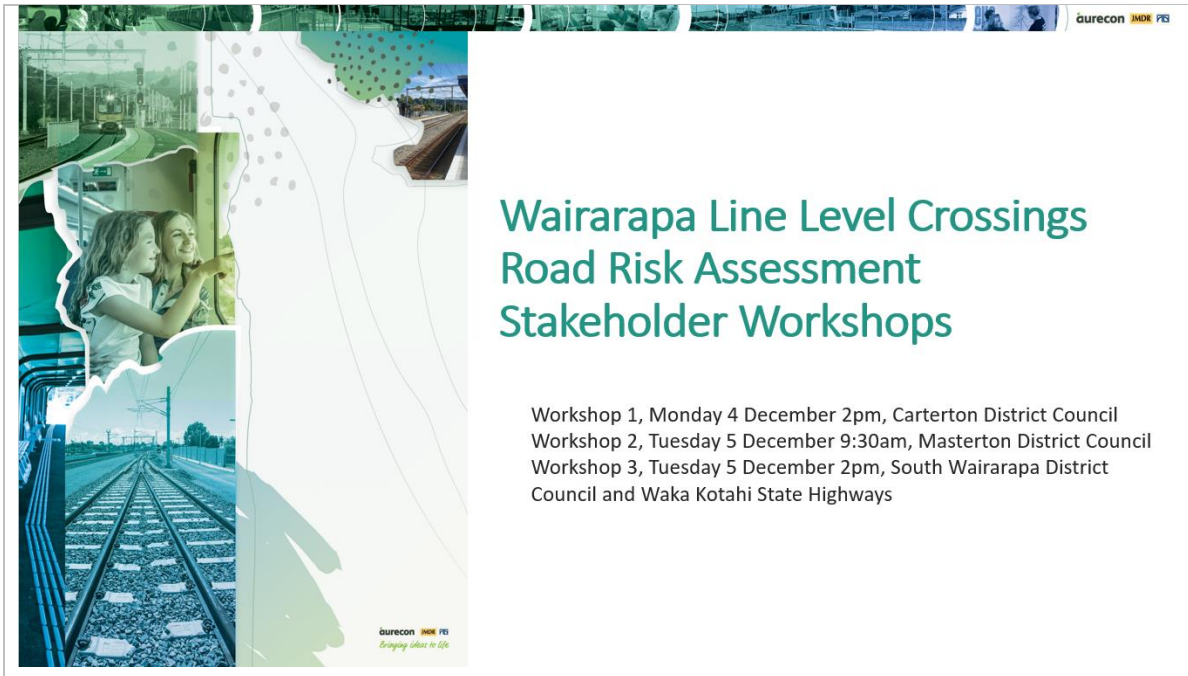
Table A-2 MCA Factors – Amenity

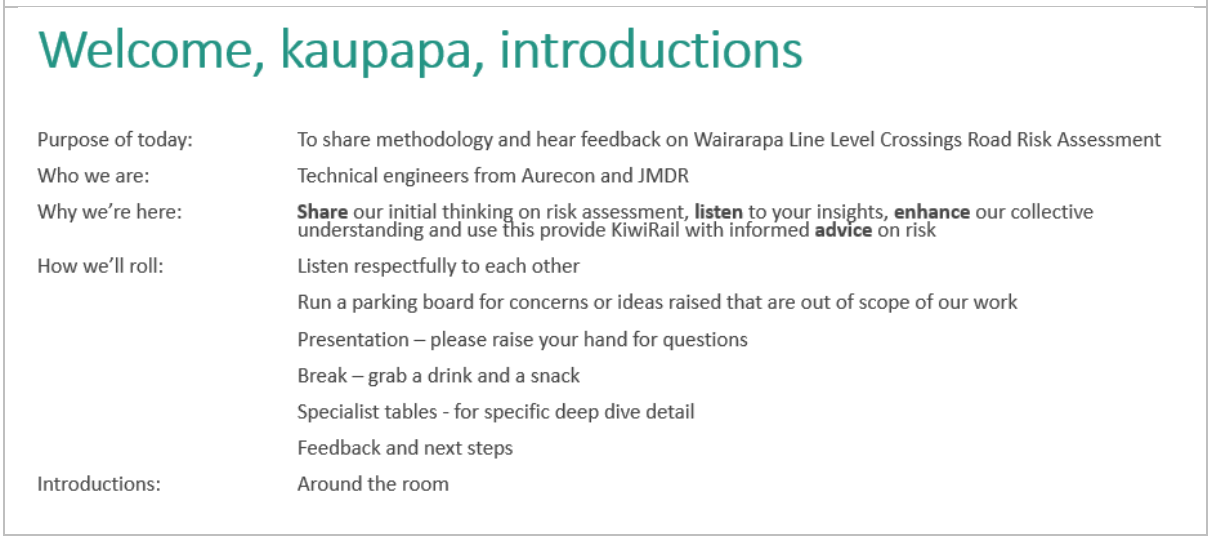
Amenity	
Ambulance Station Proximity	Measure - how close is the nearest Ambulance Station Scoring: The closer the ambulance station the higher the negative impact of closing the level crossing on routes for the ambulance. Larger negative number = smaller distance
Hospital Proximity	Measure - how close is the nearest Hospital Scoring: The closer the hospital to the level crossing the higher the negative impact of closing the crossing on routes for the public. Larger negative number = smaller distance
Fire Station Proximity	Measure - how close is the nearest fire station Scoring: the closer the fire station the higher the negative impact of closing the level crossing. Scoring should only be negative. Larger negative number is the higher impact of closure = smaller distance.
Police Station Proximity	Measure - how close is the nearest Police Station Scoring: The closer the police station to the level crossing the higher the negative impact of closing the crossing on routes for the Police. Larger negative number = smaller distance
One Network Framework - Movement	Using the ONF categories to identify a score for Movement. Scoring - M1 is highest volume in terms of movement and M5 is the lowest. Highest volume crossing the higher the negative impact of closing the crossing.
ONRC Hierarchy	Using the ONRC categories to identify a hierarchy score. Scoring range is negative. Lowest negative score is for access roads, highest negative score is for Arterial Roads
Over dimension Route	Measure - is the road an over dimension route or not. Scoring If it is an OD route closing it would have a negative effect. Yes = -3, No = +3
Fire Station Diversion Route	Measure - time difference between Fire Station and LX and Fire Station and nearest LX on the diversion route Scoring: If the diversion route takes more time, the higher the negative impact of closing the crossing on fire response times. Larger positive time difference = larger negative score
Ambulance Station Proximity	Measure - how close is the nearest Ambulance Station Scoring: The closer the ambulance station the higher the negative impact of closing the level crossing on routes for the ambulance. Larger negative number = smaller distance

Site Specific factors considered were different for each crossing and included: Crossing geometry and conspicuity, local access constraints, emergency management, SFAIRP reports, journey time for detours, Closure and Grade Separation reports, Masterplanning, vulnerable users, road network constraints, proximity and access to amenities, active modes, property access, detour route effects, consented activities, red flag scenarios, local road upgrades, intersection proximity, local and regional cycle routes, network accessibility, school bus routes, local development planned, existing detour routes, second train effect, delays at existing crossings, diverted traffic volumes, existing business operations.

Appendix B – Stakeholder Workshops

- Monday 4 December at 2pm, Carterton District Council, Carterton Events Centre, Carterton
- Tuesday 5 December at 9:30am, Save Judds Road Stakeholder Group, Breadcraft, Masterton
- Tuesday 5 December at 2pm, South Wairarapa District Council, SWDC Office Martinborough





Agenda

Project background and the safety case

Purpose of the study

Road MCA methodology and process

Rail Safety methodology and process

Deep Dive break out tables

Next Steps

Project overview

KiwiRail and Greater Wellington Regional Council are working together to build a better, more efficient and sustainable rail network for Wellingtonians.

The Wellington Metro Upgrade Programme (WMUP), which is part of Future Rail, is a $700 million programme of works to upgrade the existing rail infrastructure and build capacity to support more and faster trains.

New services will transform the rail connection to a semi-urban line:

- Installing modern new power systems for the overhead lines and signals
- Renewing tracks, including in tunnels, and refurbishing bridges
- Building additional track, passing loops and platforms so more trains can run
- Making level crossings safer

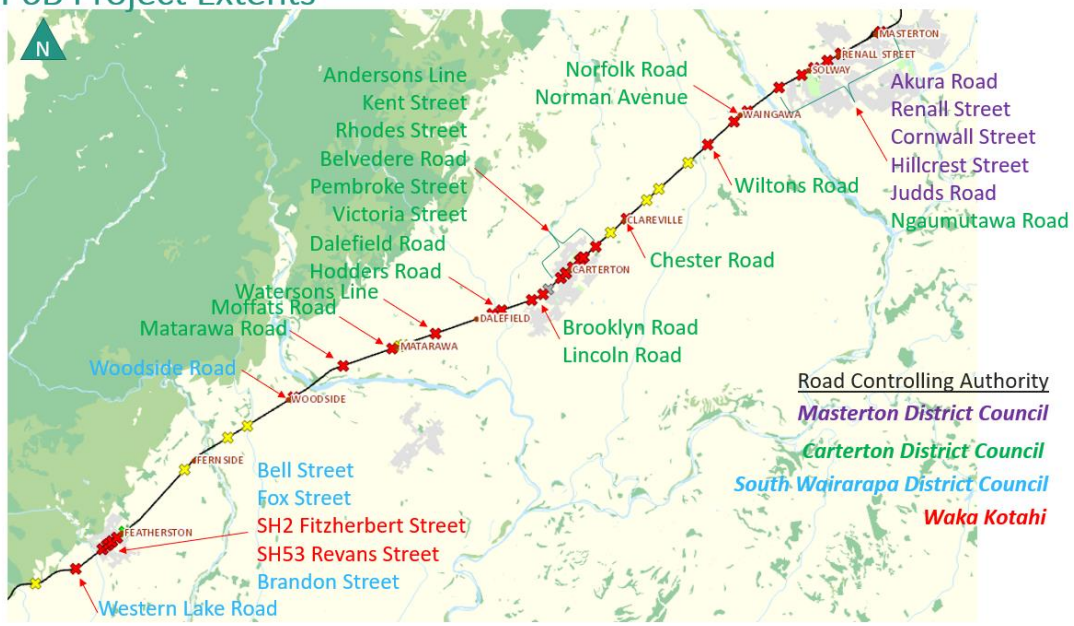
Wairarapa currently has 30 public level crossings - that's 1 every 1.5km, compared to 1 every 10km between Wellington and Upper Hutt.

Project Background and the Safety Case

Future Rail Programme → Wellington Metro Upgrade Programme (WMUP) → WMUP6B Wairarapa Line Upgrades

- To allow more frequent commuter trains to run KiwiRail must update the Rail Safety Case as part of its rail licence for approval by Waka Kotahi
- The Rail Safety Case must prove KiwiRail has the right approach, resources, competencies and culture to identify and assess risks and develop and implement measures to control them.
- Original safety assessments of level crossings - based on the safety characteristics of individual level crossings
    - Level Crossing Safety Impact Assessments (LCSIA's)
    - So Far As Is Reasonably Practicable (SFAIRP) assessments
    - Identify and Design Safety improvements at crossings and some closures.
- Community called for a better understanding of the safety risk and traffic impacts across the region and clarification of the criteria the rail regulator Waka Kotahi uses when assessing safety cases.
- KiwiRail engaged Aurecon and JMDR for an independent robust Whole Of Line, risk-based assessment covering all public level rail crossings between Featherston and Masterton.

WMUP6B Project Extents



Methodology and Process

Stage 1

Stage 2

Methodology and Process

What is an MCA and how does it help us make decisions?

- An MCA is a Multi-Criteria Analysis.
- An option assessment process used to compare different options.
- Based on an evaluation of multiple quantiative and qualitative criteria.
- Not a 'cookie cutter' approach, it is tailored to suit the project and the issues being evaluated.
- It is not designed to identify the final solution but to help in the decision making process along with other criteria.

How does KiwiRail evaluate level crossing safety?

- Normally KiwiRail looks at level crossings one at a time to determine the risk of a fatality – through the LCSIA (Level Crossing Safety Impact Assessment) process and makes closure or upgrade decisions through the SFAIRP Process (So Far As Is Reasonably Practicable).

How is this process different?

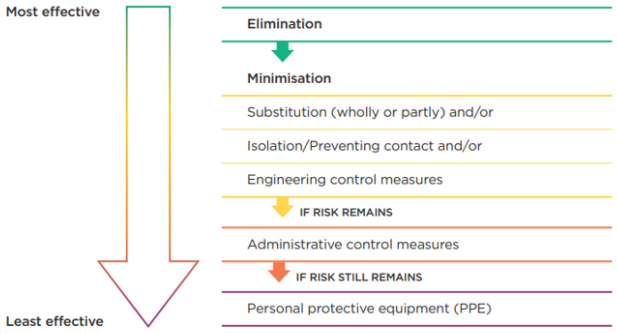
- Independent from KiwiRail
- Looking at many more factors including amenity values and the impact of closures on nearby crossings.
- First **Whole of Line** assessment process KiwiRail has engaged independent assessors to undertake.

What are we discussing today?

- What is important to you about the safety and operation of the level crossings?
- These factors will be included in the Multi-Criteria Analysis.

Options Evaluated

The Options Assessment uses KiwiRail Minimum Standards and the Hierarchy of Controls to work out the most effective control measures, so far as is reasonably practicable.



https://www.worksafe.govt.nz/assets/dmsassets/839WKS-5-HSWA-identifying-assessing-managing-work-risks.pdf

Elimination:
Closure, Grade Separation

Substitute, Isolate:
Grade Separation, Replace Road Crossing with Pedestrian Crossing

Engineering Controls:
Flashing Lights and Bells, Half Arm Barriers, Emergency Pedestrian Gates. Traffic Controls – traffic signals, roundabouts, turning restrictions.

Admin Controls:
Restrict heavy vehicle access

Road Risk Assessment – Stage 1

Multi Criteria Analysis of all existing crossings considering the criteria below:

- **Safety Risk**
  Dead End Road, Safe and Appropriate Road Speed, LCSS Score, Fatal Return Period, Short Stacking Risk and Consequence, Road Traffic Volume, New Crossing Standard, Shunting at the Crossing, Length of Diversion Route, Safety of Diversion Route, Crossings in the vicinity.
- **Mobility, Amenity and Accessibility**
  Ambulance Station proximity and response time, Fire Station proximity and response time, Police Proximity, Hospital Proximity, ONRC Movement Function, ONRC Hierarchy, Overdimension Route.
- **Whole of Line**
  Effect of closure on nearby crossings safety and operations
- **Evaluation of site specific factors**
  Crossing geometry and conspicuity, local access constraints, emergency management, SFAIRP reports, journey time for detours, Closure and Grade Separation reports, Masterplanning, vulnerable users, road network constraints, proximity and access to amenities, active modes, property access, detour route effects, consented activities, red flag scenarios, local road upgrades, intersection proximity, local and regional cycle routes, network accessibility, school bus routes, local development planned, existing detour routes, second train effect, delays at existing crossings, diverted traffic volumes, existing business operations, incident history.
- **Independent Safety Audit Findings**
  Geometry, road width and condition, access locations.

Rail Risk Assessment – Stage 1*

1. A review of each level crossing and what available controls are technically feasible.
2. A review of the costs of implementation of different controls
3. An assessment of the rail traffic profile including the risk reduction associated with the transfer of road users onto rail services.
4. An assessment of the potential rail traffic profile and the potential increase in passenger traffic on the Wairarapa Line
5. A recommendation on which protective measures/controls should be implemented to manage risks SFAIRP (So Far As Is Reasonably Practicable).

*The Rail assessment will be included in the report and evalution but is not included in this road-specific workshop.

MCA Workshop – Process

MCA Workshop – Summary

- What have we learned?
  - Opportunities
  - Concerns
  - Any actions
- One person from each group to give feedback

Programme

- Stage 2 and Study Completion

Next steps

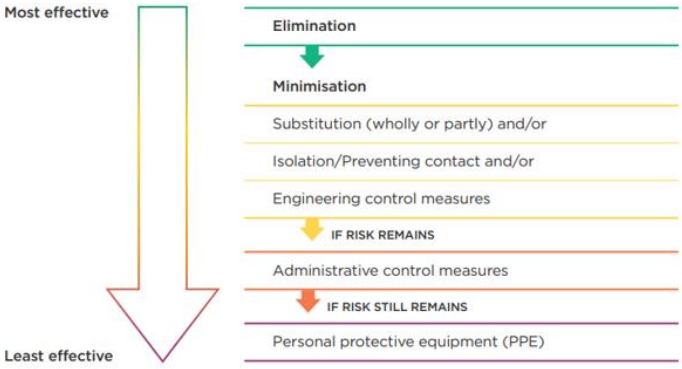
KiwiRail will review the study results along with the safety assessments for individual crossings and other factors, which will feed into updated level crossing upgrade/closure proposals.

How to contact us:

How would you like to receive feedback?

Workshop Handouts

Hierarchy of Controls



Elimination:
- Closure
- Grade Separation

Substitute, Isolate:
- Grade Separation
- Replace Road Crossing with Pedestrian Crossing

Engineering Controls:
- Flashing Lights and Bells
- Half Arm Barriers
- Emergency Pedestrian Gates
- Traffic Controls – traffic signals, roundabouts, turning restrictions

Admin Controls:
- Restrict heavy vehicle access

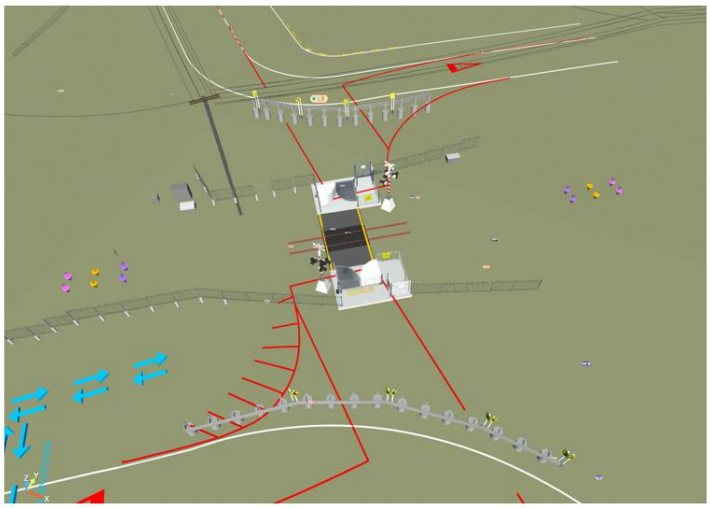
https://www.worksafe.govt.nz/assets/dmsassets/B39WK5-5-HSWA-identifying-assessing-managing-work-risks.pdf

Flashing Lights, Bells and Half Arm Barriers

EXAMPLE ONLY

Flashing Lights, Bells and Half Arm Barriers with Pedestrian Emergency Gates

EXAMPLE ONLY



Conversion from Road to Pedestrian Only Level Crossing

EXAMPLE ONLY

Traffic Signals

EXAM

Appendix C – MCA Summary (incorporating Stakeholder Workshop factors)

Square bullets indicate items which were scored in the Multi Criteria Analysis matrix. Arrow bullets indicate site specific items collated through the data evaluation and stakeholder workshop process.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
441	Western Lake Road	Stop	Featherston	South Wairarapa DC

Case for Closure – Positive Effects or low negative effects of closure	Case to remain Open – Negative Effects or low positive effects of closure
▪ Dead End Road – crossing is not on a dead end ▪ LCSS Score – Medium High Risk, does not meet KiwiRail Risk Criteria 1 or 2 ▪ Length of Diversion Route x ADT – Medium Low length x volume, medium low impact ▪ Fatal Return Period – High ▪ Ambulance - >10km away, low negative effect ▪ Hospital - >20km away, low negative effect ▪ Fire Station diversion route travel time is 1 minute shorter ▪ Ambulance Station diversion route travel time is 2 minutes shorter ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ No. of Intersections on Diversion Route – 1, low risk diversion route ▪ New Crossings criteria – 4 crossings (Brandon. Revans, Fitzherbert, Bell) within 2km radius so alternative routes available ➢ Road forms ‘S’ Curve affecting visibility of the crossing in both directions ➢ 1/2/2016 Car collided with train, Minor injuries ➢ 28/1/2021 Car collided with train, Fatality ➢ 27/1/2015, 9/12/2015 Near Collision with Heavy Road Vehicle ➢ 10/4/2019, 19/12/2021, 22/12/2021, 27/3/2023 Near Collision with Light Road Vehicle	▪ ADT – medium >1000vpd, negative effect of closure ▪ Fire - <5km away, medium negative effect ▪ Police - < 2km away, high negative effect ▪ Short Stacking Risk – no risk ▪ Crash History on Diversion Route – 1 Fatal crash, risky route ▪ Movement Function – Minor movement significance, minor negative effects ▪ ONRC Hierarchy – Secondary Collector ▪ # Crossings affected – none within 1km ➢ Part of a tourist route around Lake Wairarapa providing access to rest and recreation areas and the foothills of the Remutaka Ranges ➢ Grade Separation would be required to close ➢ Remutaka Cycle trail on the eastern side of the carriageway ➢ 2-3 times a year is used as a diversion route for SH53 when there is flooding ➢ Weight restricted bridge on Western Lake Road (5.6m wide Secondary Collector Road) – if the LX was closed HCV’s would not be able to access farms north of the bridge location ➢ Detour route via Longwood West Road (4.1m wide Access Road) and Viles Road (5.3m wide Access Road) adds 12 minutes to the journey. Narrow unsealed road with multiple stream fords and single lane bridges. ➢ Detour route via East-West Access Road (6.3m wide Secondary Collector Road) adds 50 minutes journey time

Crossing ID	Location	Current Control	Location	Road Controlling Authority
441	Western Lake Road	Stop	Featherston	South Wairarapa DC

	➢ SFAIRP says not reasonably practicable to close and recommends upgrades. Closure is not a realistic control due to the heavy vehicle detours required. ➢ Grade separation - the cost would be grossly disproportionate to the risk benefit, therefore is not reasonably practicable. ➢ Speed limit reduction to 60km/h from posted speed limit of 100km/h is proposed ➢ LCSS Proposed Design Medium Risk, Future Medium Risk – both meet KiwiRail Criterion 2. Grade separation is required to meet Criterion 1 for the future score.

Whole of line effect

- Shortest diversion route is to Brandon Street. 1133 vpd to be redistributed to other routes – Brandon, Revans, Fitzherbert and Bell are within 2km. Brandon St has an existing ADT of 381 vpd.
- Nearest crossing is Brandon Street 1.2km away in urban area of Featherston. If Western Lake Road level crossing is closed northbound traffic would most likely divert east at Viles Road and travel across country to SH53 and southbound traffic would use SH53 (5.7km) and travel across country via Donald Street. The closure would create long diversions and traffic would most likely use SH53 Revans Street level crossing in both directions so closure would most significantly affect Revans Street which has an ADT of 2559 vpd. The Western Lake Road volume could a 44% more traffic to Revans Street.

- **Conclusion: Do not close. Upgrades are available to meet KiwiRail Risk Criterion 2. Grade Separation is required to meet Criterion 1.**
- Alternative routes available however, Western Lake Road is a diversion route for SH53 when there is flooding. Some alternative routes are lower standard geometry, width and surfacing and add significant delays.
- Closure would require grade separation to ensure continued access. SFAIRP confirms closure is not reasonably practicable, particularly due to the heavy vehicle detours required.
- Upgrades required to address Medium High LCSS Score and High Fatal Return Period, visibility of the crossing and speed differential between posted speed and safe speed. Proposed and Future Upgrades meet Criterion 2. Grade separation is required to meet Criterion 1.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
442	Brandon Street	FLB	Featherston	South Wairarapa DC

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end	▪ Fire – <2km away, High negative effect ▪ Police – <2km away, High negative effect

Crossing ID	Location	Current Control	Location	Road Controlling Authority
442	Brandon Street	FLB	Featherston	South Wairarapa DC

- LCSS Score – Medium Risk, does not meet KiwiRail Criteria
- Length of Diversion Route x volume – Low length x volume, low impact
- Fatal Return Period – Medium High
- ADT – Low
- Ambulance – >10km away, low negative effect
- Masterton Hospital – >20km away, low negative effect
- Fire station diversion route time is one minute shorter
- No. of Intersections on Diversion Route – 1, low risk diversion route
- Crash History on Diversion Route – 1 minor, low risk
- ONRC Hierarchy – Access Road
- # Crossings affected - 4 within 1km can distribute traffic widely
- New Crossings criteria – 4 crossings (Revans, Fitzherbert, Fox, Bell) within 1km radius so alternative routes available

➢ Visibility of crossing is poor due to crest

➢ Closing the crossing would create more space for active controls for pedestrians

➢ Safer community environment created by cul de sac – no though traffic

- Ambulance Station diversion route is same time
- Short Stacking Risk – no risk
- Safe and Appropriate Speed – 20km/h speed differential (operating speed is low)
- Movement Function – Minor movement significance, minor negative effects

➢ High usage by children of pedestrian crossings due to proximity of Featherston School Te Kura o Paetūmokai

➢ Last level crossing for east-west traffic in the west of Featherston

➢ All traffic using Brandon Street level crossing to access destinations west of SH53 will be required to divert to SH53

➢ In the Featherston Urban Area 400m from the town centre

➢ No near miss or collision history in the past 10-years

➢ Proposed Design Low Risk, Future Score medium Low Risk. Both the proposed design and future scenarios meet KiwiRail Criterion 1 and 2.

Whole of line effect

- Shortest diversion route is to SH53 Revans Street (360m). 381 vpd to be redistributed to other routes – Revans, Fitzherbert, Fox and Bell are within 1km. Revans St has an existing ADT of 2559 vpd.
- The most likely diversion route is via SH53 to the east as there is no level crossing to the west of Brandon Street in Featherston township. This is an additional 15% of traffic onto the state highway.

- **Conclusion: Can close if State Highway 53 is an acceptable alternative route, however this crossing can be upgraded to meet KiwiRail risk criteria without grade separation.**
- Alternative route is SH53 for the 381 vpd using the level crossing on this Access road.
- Closure would create more space for active controls for pedestrians to address high usage of the crossing by school children.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
442	Brandon Street	FLB	Featherston	South Wairarapa DC

- Upgrades required to address Medium LCSS Score and Medium High Fatal Return Period, poor crossing visibility and high demand for pedestrian facilities. Proposed Design Low Risk, Future Score medium Low Risk. Both the proposed design and future scenarios meet KiwiRail Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
444	Revans Street (SH53)	FLB HAB	Featherston	Waka Kotahi Wellington

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end ▪ Length of Diversion Route x volume – Low length x volume, low impact ▪ Fatal Return Period – Medium High ▪ Ambulance - >10km away, low negative effect ▪ Masterton Hospital - >20km away, low negative effect ▪ Fire Station diversion route time is 1 minute shorter ▪ Ambulance Station diversion route time is 1 minute shorter ▪ No. of Intersections on Diversion Route – 0, low risk diversion route ▪ Crash History on Diversion Route – nil, low risk diversion route ▪ # crossings affected - 4 within 1km can distribute traffic widely ▪ New Crossings criteria – 4 crossings (Brandon, Fitzherbert, Fox, Bell) within 1km radius so alternative routes available ▪ Safer community environment created by cul de sac – no though traffic ▪ 22/2/2014 Near Collision Person	▪ LCSS Score – Medium Low Risk, meets KiwiRail Criteria ▪ ADT – Medium High ▪ Fire - <2km away, high negative effect ▪ Police - <500m away, high negative effect ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed – 10km/h speed differential ▪ Movement Function – Minor movement significance, minor negative effects ▪ ONRC Hierarchy – Primary Collector ▪ Over dimension route ➢ State Highway 53 to Martinborough ➢ Closure would require diversion of traffic to SH2 which is the CBD shopping street ➢ SFAIRP says not reasonably practicable to close and recommends upgrades ➢ Grade separation would be required to close. ➢ Access to fuel station on northern approach (40m) and Daniell Street on southern approach (50m). Low chance of forming queues. ➢ In proximity to main Featherston shopping area in the centre of town with a school close by ➢ Proposed Design Medium Low Risk, Future Score Medium Risk. The proposed design achieves KiwiRail risk criterion 1 and the future score does not. Grade separation is required to meet criterion 1 for the future.

Whole of line effect

Crossing ID	Location	Current Control	Location	Road Controlling Authority
444	Revans Street (SH53)	FLB HAB	Featherston	Waka Kotahi Wellington

- Shortest diversion route is to Fitzherbert Street (340m). 1133 vpd to be redistributed to other routes – Brandon, Revans, Fitzherbert and Bell are within 1km. Revans St has an existing ADT of 2559 vpd.
- The SFAIRP Report advises upgrades are reasonably practicable.
- The Stantec Closure option assessment report considered closure of Revans and Fitzherbert Street streets. 'It has been identified that closure of both level crossings is likely to result in wider negative effects on both the road and level crossing network which may negate any benefit derived from the closure of the crossings. Accordingly further assessment proceeded on the basis of closing one and diverting traffic onto the other crossing. Following consideration of the potential effects from increased traffic along either Revans Street or Fitzherbert Street and the potential impact of turning volumes at the diversion intersections, it has been concluded that closure of the SH53 level crossing to road vehicles would be the more practical option of the two.'
- 'WMUP6B position is that closure of Revans St is not an available option within the WMUP6B scope as it involves extensive road network changes and therefore should be led by the RCAs (Waka Kotahi and South Wairarapa DC). Nevertheless, it is an option that should be considered further with a view to implementation at a future time. Closure of the crossing is a suitable control. However, for the reasons above it is not at present a realistically available control. Therefore, closure is not reasonably practicable'
- 'Grade separation is considered in the Stantec Grade Separation report which identifies an extensive project to trench the railway through Featherston which will eliminate 5 road and 3 pedestrian crossings. Some crossings would be replaced by a bridge at the current road level and some would be closed. The preferred option will eliminate level crossing safety risk at all of the below crossings: Brandon St, Revans St (road and ped), Fitzherbert St (road and ped), Fox St, Bell St. Based on the information available, grade separation is a suitable control… but the cost would be grossly disproportionate to the risk benefit. Therefore, grade separation is not reasonably practicable.'

- **Conclusion: Do not close at present. Proposed upgrades do not meet KiwiRail risk criteria however the SFAIRP analysis identifies it is not reasonably practicable to close or grade separate at this time.**
- SH2 alternative route has been identified as feasible if one state highway crossing (SH2 or SH53) was to be closed, however it is not a reasonably practicable measure at this time.
- SFAIRP identified it is not reasonably practicable to close or grade separate at this time.
- Medium Low Risk crossing with a Medium High Fatal return period. Infrastructure options are available to address safety risks at opening. Proposed Design Medium Low Risk, Future Score Medium Risk. The proposed design achieves KiwiRail risk criterion 1 and the future score does not. Grade separation is required to meet criterion 1 for the future.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
446	Fitzherbert Street (SH2)	FLB HAB	Featherston	Waka Kotahi Wellington

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end	▪ LCSS Score – Medium Low Risk, meets KiwiRail Risk Criteria

Crossing ID	Location	Current Control	Location	Road Controlling Authority
446	Fitzherbert Street (SH2)	FLB HAB	Featherston	Waka Kotahi Wellington

- Length of Diversion Route x ADT – Medium Low length x volume, medium low impact
- Fatal Return Period – Medium High
- Short Stacking Risk – yes 7.7m into driveway and 30m into side road. Daniell St RTB limit line is 26m from level crossing limit line.
- Short Stacking Consequence – Serious
- No. of intersections on Diversion Route – 1, low risk diversion route
- Crash History on Diversion Route – 1 minor, low risk
- # Crossings affected – 4 within 1km can distribute traffic widely
- New Crossings criteria – 4 crossings (Brandon, Revans, Fox, Bell) within 1km radius so alternative routes available
- ➢ Lack of Conspicuity of crossing and very busy location
- ➢ Safer community environment created by cul de sac – no though traffic
- ➢ 18/3/2020 Near Collision Person
- ➢ LCSS Proposed Design Medium Risk, Future Medium Risk. Neither meet KiwiRail Criterion 1 or 2. Grade separation is required to meet Criterion 1 for the Future Score.

- ADT – High volume route
- Fire – <500m away, high negative effect
- Police – <500m away, high negative effect
- Fire Station diversion route is one minute longer
- Ambulance Station diversion route is same time
- Safe and Appropriate Speed – 10km/h speed differential
- Movement Function – Moderate movement significance, moderate negative effects
- ONRC Hierarchy – Regional Road
- ➢ State Highway 2 to Carterton and Masterton and part of the SH network. A SH bypass would be required if closed.
- ➢ SFAIRP says not reasonably practicable to close and recommends upgrades
- ➢ Grade separation would be required to close.
- ➢ Council Masterplan – traffic calming proposed (Raised Safety Platform) to reduce operating speeds and address u-turning safety issue.

Whole of line effect

- Shortest diversion route is to SH53 Revans Street. 8603 vpd to be redistributed to other routes – Brandon, Revans, Fox and Bell are within 1km. Revans St has an existing ADT of 2559 vpd.
- If Fitzherbert Street is closed traffic will likely divert to SH53 Revans Street which is a diversion of 160m to the south, 250m to the north. This is a significant volume of traffic to divert, effectively quadrupling traffic volumes on SH53.
- The SFAIRP Report advises upgrades are reasonably practicable.
- The Stantec Closure option assessment report considered closure of Revans and Fitzherbert Street streets. 'It has been identified that closure of both level crossings is likely to result in wider negative effects on both the road and level crossing network which may negate any benefit derived from the closure of the crossings. Accordingly further assessment proceeded on the basis of closing one and diverting traffic onto the other crossing. Following consideration of the potential effects from increased traffic along either Revans Street or Fitzherbert Street and the potential impact of turning volumes at the

Crossing ID	Location	Current Control	Location	Road Controlling Authority
446	Fitzherbert Street (SH2)	FLB HAB	Featherston	Waka Kotahi Wellington

diversion intersections, it has been concluded that closure of the SH53 level crossing to road vehicles would be the more practical option of the two.'

- 'WMUP6B position is that closure of Fitzherbert Street crossing is not an option within the WMUP6B scope as it involves extensive road network changes and therefore should be led by the RCAs (Waka Kotahi and South Wairarapa DC). Nevertheless, it is an option that should be considered further with a view to implementation at a future time…Closure of the crossing is a suitable control. However, for the reasons above, it is not a realistically available control… Therefore, closure is not reasonably practicable.'
- 'Grade separation is considered in the Stantec Grade Separation report which identifies an extensive project to trench the railway through Featherston which will eliminate 5 road and 3 pedestrian crossings. Some crossings would be replaced by a bridge at the current road level and some would be closed. The preferred option will eliminate level crossing safety risk at all of the below crossings: Brandon St, Revans St (road and ped), Fitzherbert St (road and ped), Fox St, Bell St. Based on the information available, grade separation is a suitable control… but the cost would be grossly disproportionate to the risk benefit. Therefore, grade separation is not reasonably practicable.'

- **Conclusion: Do not close. Proposed upgrades do not meet KiwiRail risk criteria however SFAIRP analysis identifies it is not reasonably practicable to close this crossing or grade separate at this time.**
- SH53 alternative route has been identified as feasible if one state highway crossing (SH2 or SH53) was to be closed, however it is not a reasonably practicable measure at this time.
- Of the two routes SH53 would be the more practical option to close.
- Closure would require grade separation. SFAIRP identified it is not reasonably practicable to close or grade separate at this time.
- Medium Low Risk crossing with Medium High Fatal return period. Upgrades available to address lack of conspicuity and short stacking risk. LCSS Proposed Design Medium Risk, Future Medium Risk. Neither meet KiwiRail Criterion 1 or 2. Grade separation is required to meet Criterion 1 for the Future Score.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
449	Fox Street	FLB	Featherston	South Wairarapa DC

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end ▪ LCSS Score – Medium Risk, does not meet KiwiRail Criteria ▪ Length of Diversion Route x volume – Low length x volume, Low impact ▪ Fatal Return Period – Medium High ▪ ADT – Medium Low Volume	▪ Fire - <2km away, high negative effect ▪ Police < 500m away, high negative effect ▪ Fire Station diversion route time is the same ▪ Ambulance Station diversion route time is the time ▪ Short Stacking Risk – no risk

Crossing ID	Location	Current Control	Location	Road Controlling Authority
449	Fox Street	FLB	Featherston	South Wairarapa DC

- Ambulance - >10km away, low negative effect
- Masterton Hospital - >20km away, low negative effect
- No. of intersections on Diversion Route – nil, low risk diversion route
- Crash History on Diversion Route – nil, low risk diversion route
- ONRC Hierarchy – Low Volume
- # Crossings affected - 3 within 1km can distribute traffic widely
- New Crossings criteria – 3 crossings (Brandon, Revans, Bell) within 1km radius so alternative routes available

➢ Shown as closed in District Council's Masterplan with a 1-way leg from Fox Street to the state highway.

➢ Crossing is between two priority controlled T-intersections within 15m of crossing – cross traffic unlikely to stop a limit line to look for trains

➢ Level crossing in a sag curve so northbound sight distance is poor

➢ Closing the crossing would create more space for active controls for pedestrians

➢ Safer community environment created by cul de sac – no though traffic

➢ 21/2/2014 Car collided with train while overtaking bus , Non Injury

➢ 2/6/2021 Near Collision Light Road Vehicle

➢ 31/8/2022 Near Collision Person

- Safe and Appropriate Speed – 20km/h speed differential (low operating speed)
- Movement Function – Minor movement significance, minor negative effects

➢ Fire station is located on Fox Street 110m from the crossing

➢ Near bus route 200 which provides a connection from the Featherston Train Station to Greytown and Martinborough

➢ Crossing is 200m from Featherston town centre and 500m from multiple schools and churches

➢ Proposed Design Medium Low Risk and Future Score Medium Low Risk. Both proposed and future scores meet KiwiRail Criterion 1 and 2.

Whole of line effect

- Shortest diversion route is to SH2 Fitzherbert Street (185m). 571 vpd to be redistributed to other routes – Brandon, Revans, SH2 Fitzherbert and Bell are within 1km. SH2 has an existing ADT of 8603 vpd.
- Depending on the direction of travel SH2 is a logical diversion route from Fox Street for destinations to the west and Bell Street for destinations to the east. If Fox Street was closed there are suitable alternative routes for traffic and connectivity of the road network would be maintained.
- **Conclusion: Can be closed and is identified for closure in the District Plan, however upgrades are possible to meet KiwiRail risk criteria.**

Crossing ID	Location	Current Control	Location	Road Controlling Authority
449	Fox Street	FLB	Featherston	South Wairarapa DC

- Alternative routes available. Crossing is identified in the District Council's Masterplan for closure. Closure addresses sight distance and side road conflicts and would provide more space for active controls for pedestrians.
- Crossing is Medium LCSS Risk so does not meet KiwiRail Criteria. Crossing also has a Medium High Fatal return period. Proposed Design Medium Low Risk and Future Score Medium Low Risk. Both proposed and future scores meet KiwiRail Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
452	Bell Street	FLB	Featherston	South Wairarapa DC

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end ▪ Length of Diversion Route x volume – Low length x volume, Low impact ▪ ADT – Medium Low Volume ▪ Ambulance - >10km away, low negative effect ▪ Masterton Hospital - > 20km away, low negative effect ▪ Ambulance Station diversion route time is 1 minute shorter ▪ No. of Intersections on Diversion Route – 1, low risk diversion route ▪ Crash History on Diversion Route – nil, low risk diversion route ▪ ONRC Hierarchy – Access Road ▪ # Crossings affected - 4 within 1km can distribute traffic widely ▪ New Crossings criteria – 4 crossings (Brandon, Revans, Fitzherbert, Fox) within 1km radius so alternative routes available ➢ Crossing is not conspicuous due to wide road and parking close to the rail line is permitted ➢ Long rear driveway to 39 Fox Street adjacent to the crossing and parallel to the rail line which limits visibility of FLB's ➢ 20 Johnson Street access in close proximity to level crossing (10m north)	▪ LCSS Score – Low Risk, meets KiwiRail Criteria ▪ Fatality Return Period - Medium ▪ Fire - <500m away, high negative effect ▪ Police – <500m away, high negative effect ▪ Fire Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed – 20km/h speed differential (low operating speed) ▪ Movement Function – Minor movement significance, minor negative effects ➢ If Fox Street level crossing is closed, closure of Bell Street also would increase length of detour required. ➢ Level crossing is 210m west of Featherston Train Station and within 100m of community centre ➢ Harrison Street crossing at Featherston Station is closed – no other crossings to the north in Featherston. ➢ No recorded history of incidents or near misses in past 10 years ➢ Proposed Design Low Risk, Future Score Low Risk. Both proposal and future meet KiwiRail Risk criteria.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
452	Bell Street	FLB	Featherston	South Wairarapa DC

- 2nd train risk due to crossing loop and siding north of Bell Street
- Closing the crossing would create more space for active controls for pedestrians
- Safer community environment created by cul de sac – no though traffic

Whole of line effect

- Shortest diversion route is to Fox Street, however Fox Street is proposed to be closed. 1594 vpd to be redistributed to other routes – Brandon, Revans, Fitzherbert and Fox are within 1km. Fox St has an existing ADT of 571 vpd which will also be redistributed when it is closed.
- The next closest diversion route is to SH2 Fitzherbert Street to the south (435m). Fitzherbert Street has an existing ADT of 8603 vpd. Closure of Fox and Bell Street would add 2000+ vpd to SH2. There are no other level crossings to the north in Featherston for Bell Street traffic to divert to. The next parallel road to the north is Harrison Street which is a cul-de-sac on both sides of the Wairarapa Line due to the Featherston Train Station. Closure of Bell Street would send all traffic from the northern side of Featherston south to SH2 as there would be no east-west links across the Wairarapa Line on the northern side of town.

- **Conclusion: Do not close if Fox Street is being closed as there are no other level crossings to the north in Featherston to maintain community connectivity. Low Risk Crossing and infrastructure upgrades meet KiwiRail risk criteria.**
- Alternative routes available however the nearest crossing (Fox Street) is proposed to be closed. This would mean all three level crossings east of SH2 would be closed (Fox, Bell and Harrison) meaning all access for Featherston north/east would be via SH2.
- Low Risk crossing so meets KiwiRail criteria. Medium Fatality return period. Infrastructure upgrades can address safety and conspicuity issues. Proposed Design Low Risk, Future Score Low Risk. Both proposal and future meet KiwiRail Risk criteria.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
456	Woodside Road	FLB	Woodside	South Wairarapa DC

Case for Closure	Case to remain Open
▪ ADT - High volume ▪ Ambulance – >5km away medium negative effect ▪ Masterton Hospital – >20km away low negative effect ▪ Fire Station – >5km away medium negative effect ▪ Police Station – >10km away low negative effect	▪ Dead End Road – Crossing is a dead end road to the north ▪ LCSS Score – Medium Low, meets KiwiRail risk criteria ▪ Length of Diversion route x volume – High length x volume, high risk route ▪ Fatal Return Period - Medium ▪ Short Stacking Risk – no risk

Crossing ID	Location	Current Control	Location	Road Controlling Authority
456	Woodside Road	FLB	Woodside	South Wairarapa DC

- Safe and Appropriate Speed – 40km/h speed differential

➢ Crossing located in a sag, northbound visibility is poor exacerbated by horizontal curves on both sides of the level crossing.

- Fire Station diversion route time is 1 minute longer
- Ambulance Station diversion route time is 3 minutes longer
- No. of Intersections on Diversion Route – 6 intersections, High risk
- Crash History on Diversion Route – 4 serious, 13 minor, High risk route
- Movement Function – Minor movement significance, minor negative effects
- ONRC Hierarchy – Secondary Collector
- # crossings affected – none within 1km
- New Crossings criteria – No crossings within 2km radius so no alternative routes available within a reasonable distance

➢ Woodside Road is on the Greytown-Woodside Cycle Trail Route. Access is 10m from crossing. Further expansion of cycle network proposed **https://swdc.govt.nz/wairarapa-five-towns-trails-network/**

➢ Only access road to Woodside Railway Station from Greytown via Wallace Street (50m). Large park and ride.

➢ Local cycling community (Vocal Local) located nearby

➢ Woodside Road is a crucial link in the network and convenient alternative routes are not available

➢ No recorded history of incidents or near misses in the past 10 years

➢ Proposed Design and Future score are Low Risk and meet both KiwiRail Criterion 1 and 2.

Whole of line effect

- Shortest diversion route is to Matarawa Road, however this is not a through route. Next closest is Moffats Road to the west. There is no diversion route to the north as Woodside Road leads to Underhill Road and Waiohine Valley Road which are dead end roads. 585 vpd to be redistributed to the south via a 15km route through Greytown and SH2.

- **Conclusion: Do not close. Long Detours required. Upgrades are available to meet KiwiRail Risk Criteria 1 and 2.**

Crossing ID	Location	Current Control	Location	Road Controlling Authority
456	Woodside Road	FLB	Woodside	South Wairarapa DC

- Long detour route to the south, dead end roads to the north and no crossings within 1km. Only access to Woodside Train Station from Woodside and Greytown.
- Medium Low Risk crossing which meets KiwiRail Criteria. Medium Fatal return period and no history of incidents or near misses. Proposed Design and Future score are Low Risk and meet both KiwiRail Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
454	Matarawa Road	Stop	Matarawa	Carterton District Council

Case for Closure	Case to remain Open
▪ LCSS Score – Medium Risk, does not meet KiwiRail Risk Criteria ▪ Length of Diversion Route x volume – Low length x volume, low impact ▪ Fatal Return Period – Medium High ▪ ADT – Low ▪ Ambulance – 10km away, low negative effect ▪ Masterton Hospital – >20km away, low negative effect ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ Fire – >5km away, low negative effect ▪ Police - >10km away, low negative effect ▪ Fire Station diversion route time is 1 minute shorter ▪ Ambulance Station diversion route time is 1 minute shorter ▪ No. of intersections on the diversion route – 0, low risk diversion route ▪ Crash history on the diversion route – nil, Low risk diversion route ▪ ONRC Hierarchy – Access ▪ New Crossings criteria – 1 crossing (Moffats) within 2km radius so alternative routes available ➢ Safety issues with narrow sealed width which results in edgebreak and vehicles straddling the centreline	▪ Dead End Road ▪ Short Stacking Risk – no risk ▪ Movement Function – Low movement significance, minor negative effects ▪ # crossings affected – none within 1 km ➢ Quarry will be expanding their operation and require access. ➢ SFAIRP says not reasonably practicable to close and recommends upgrades ➢ Grade separation would be required to close. ➢ Speed limit proposed to be reduced to 80km/h – to go to Council ➢ Proposed Design Medium Low Risk and achieves KiwiRail Criterion 1 and 2. Future score Medium Risk and achieves Criterion 2. Grade separation is required to achieve Criterion 1 for the Future Score.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
454	Matarawa Road	Stop	Matarawa	Carterton District Council

- KiwiRail paddock access is within level crossing – red flag scenario
- Road and rail cross at an acute angle (25 degrees) and the crossing is in a gully affecting sight distance
- Quarry development will increase number of heavy vehicles using the crossing
- 31/12/2022 Heavy vehicle collided with train, non-injury

Whole of line effect

- Shortest diversion route is to Moffats Road to the west. There is no diversion road to the north as the road is a dead end. 74 vpd to be redistributed to other routes – Moffats is within 1km. Moffats Road has an existing ADT of 128 vpd.
- SFAIRP Report - Closure is not practicable as: Matarawa Road is a dead end so closure would cut off farms and residents to the northwest of the tracks. The Fulton Hogan Quarry on Totara Flats Farm to the northwest of the crossing has been approved. There is a paper road which if formed would allow traffic to use Moffats Rd level crossing instead of the existing Matarawa Road crossing this would add 15 minutes to journeys. Closure is not a realistically available control. Therefore, closure is not reasonably practicable.
- Grade Separation – the cost would be grossly disproportionate to the risk benefit. It is not reasonably practicable.

- **Conclusion: Do not close as Matarawa Road is a dead end. Upgrades are possible to meet KiwiRail Risk Criterion 2, which is supported by the SFAIRP analysis.**
- Matarawa Road is a dead end road and access is required for a consented quarry and rural properties.
- SFAIRP analysis supports upgrades as reasonably practicable.
- Proposed Design Medium Low Risk and achieves KiwiRail Criterion 1 and 2. Future score Medium Risk and achieves Criterion 2. Grade separation is required to achieve Criterion 1 for the Future Score.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
457	Moffats Road	Stop	Matarawa	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end road ▪ Length of diversion route x volume – Low length x volume, low impact ▪ ADT – Low ▪ Ambulance – >5km medium negative effect ▪ Masterton Hospital – >20km away low negative effect ▪ Fire ->5km away medium negative effect ▪ Police – >5km away medium negative effect ▪ Ambulance Station diversion route time is 1 minute shorter ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ Crash History on Diversion Route – Nil, low risk diversion route ▪ ONRC Hierarchy – Access ▪ New Crossings criteria – 2 crossings (Matarawa, Watersons) within 2km radius so alternative routes available ➢ Moffats Road/Railway Road intersection immediately north of the level crossing ➢ Access to private property immediately northwest, two KiwiRail access tracks and farm accesses to the south ➢ 11/12/2018, 16/1/2019, 24/9/2019 Near Collision Light Road Vehicle	▪ LCSS Score – Medium Low, meets KiwiRail Risk Criteria ▪ Fatality Return Period – Medium ▪ Short Stacking Risk – no risk ▪ No. of intersections on diversion route – 2 intersections, medium risk ▪ Movement Function – Low movement significance, minor negative effects ▪ # crossings affected – none within 1km ▪ Fire Station diversion route time is 1 minute longer ➢ Access to the railway station at Matarawa (via. Moffats Road or Watersons Line and Railway Road) ➢ Proposed Design and Future Score are Low Risk and meet KiwiRail Criterion 1 and 2.

Whole of line effect

- Diversion Route is to Watersons Line -128 vpd (10%HCV) to be redistributed. Watersons Line has an existing ADT of 206 vpd. This is a 3.6km diversion to the south and an 8km diversion to the north.

- **Conclusion: Can be closed if detour route lengths are acceptable for the low volume (128vpd, 10%HCV) of traffic expected, however crossing risks can be addressed to meet KiwiRail Risk Criteria 1 and 2.**
- Alternative routes are available to the north and south and to Matarawa Train Station.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
457	Moffats Road	Stop	Matarawa	Carterton District Council

- Medium Low risk crossing with Medium Fatality return period. Crossing risks are the private and KiwiRail accesses and history of near collisions. Proposed Design and Future Score are Low Risk and meet KiwiRail Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
458	Watersons Line	Stop	Matarawa	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium Risk, crossing does not meet KiwiRail risk criteria ▪ Length of Diversion route x volume – Medium Low length x volume, medium low impact ▪ Fatal Return Period – Medium High ▪ ADT - Low ▪ Ambulance - >5km away, medium negative effect ▪ Masterton Hospital - >20km away, low negative effect ▪ Fire - >5km away, medium negative effect ▪ Police - >5km away, medium negative effect ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ Crash history on diversion route – nil, low risk route ▪ New Crossings criteria – 1 crossing (Moffats) within 2km radius so alternative routes available ➢ 'Tunnel' effect on Watersons Line reduces driver awareness of crossing ➢ Narrow road width, unprotected drainage ditches, lack of lighting and delineation	▪ Short Stacking risk – no risk ▪ No of intersections on diversion route – 2 intersections, medium negative effect ▪ Movement Function – Low movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector ▪ # crossings affected – 0 within 1km ▪ Fire Station diversion route time is one minute longer ▪ Ambulance Station diversion route time is one minute longer ➢ Access to the railway station at Matarawa via. Railway Road intersection immediately northeast of the level crossing ➢ Large detour if closed 4.2km from Watersons to Dalefield to the north and 7km to the south ➢ Crossing is at the midpoint of a 2km long straight ➢ Mean road operating speed is 58km/h ➢ Watersons Line and Railway Road are used as a recreational cycling route ➢ No recorded history of incidents or near misses in the last 10 years ➢ Proposed Design and Future Score are Medium Low Risk and meet KiwiRail Criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Moffats Road (3.5km) to the west on the south side of the crossing and Dalefield Road (4.1km) on the north side of the crossing. 206 vpd to be redistributed. Moffats Road has an existing ADT of 128 vpd and Dalefield Road has an existing ADT of 380vpd.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
458	Watersons Line	Stop	Matarawa	Carterton District Council

- There is alternative access to Matarawa Station via Railway Road if Moffats Road crossing is closed.

- **Conclusion: Do not close. Long Detours required. Upgrades available to meet KiwiRail risk criteria 1 and 2.**
- Alternative routes available but relatively long detours required. Crossing is at the midpoint of a long straight. Operating speed is low relative to posted speed and close to safe and appropriate speed.
- Upgrades required to address Medium Risk crossing and Medium High Fatal return period, lack of driver awareness of crossing, unprotected drainage ditches, lack of lighting and delineation. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail Criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
459	Hodders Road	Stop	Matarawa	Carterton District Council

Case for Closure

- LCSS Score – Medium Risk, Crossing does not meet KiwiRail Risk Criteria
- Length of Diversion route x volume – Low length x volume, low impact
- ADT - Low
- Ambulance – <10 km away low negative effect
- Masterton Hospital – >20km away, low negative effect
- Fire – >5 km away, medium negative effect
- Police – >5km away, medium negative effect
- Fire Station diversion route time is one minute shorter
- Ambulance Station diversion route time is one minute shorter
- Safe and Appropriate Speed – 40km/h speed differential
- No. of intersections on diversion route – 1 intersection, low risk
- Crash history on diversion route – 1 minor, low risk
- ONRC Hierarchy – Access
- # crossings affected – 1 within 1km

Case to remain Open

- Dead End Road – yes, property access only
- Fatal Return Period - Medium
- Short Stacking Risk – no risk
- Movement Function – Low movement significance, low negative effects

➢ Significant cost to provide a detour route

➢ Mean road operating speed is 30km/h

➢ Used as a maintenance access road for KiwiRail with unsealed accesses on the southwest and northwest sides of the crossing to open metal works and storage areas

➢ Proposed Design and Future Score are both Medium Low Risk and meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
459	Hodders Road	Stop	Matarawa	Carterton District Council

- New Crossings criteria – 2 crossings (Dalefield, Lincoln) within 2km radius so alternative routes available
- Fatality on Hodders Road Level Crossing
- Driveway to a house and farm 20m northeast of the crossing and accesses 20m southwest and 25m northwest into storage areas
- 7/1/2020 Car collided with train, non-injury
- 27/2/2020 Near Collision Heavy Road Vehicle
- 4/8/2020 Near Collision Light Road Vehicle
- Safety issues with narrow sealed width which results in edgebreak and ponding water. Crossing on a slight horizontal curve and south of a vertical crest. Steep drop off to KiwiRail yard.

Whole of line effect

- Shortest diversion route is to Dalefield Road, however Hodders Road is a dead end so there is no road link for traffic south of the level crossing to divert. 44 vpd use the crossing.
- Can be considered for closure only if Dalefield Road remains open and alternative access is provided to properties on Hodders Road south of the level crossing

- **Conclusion: Do not close, dead end road. Upgrades available to meet KiwiRail risk criteria 1 and 2.**
- Dead End Road. Closure would cut off access to rural properties.
- Upgrades required to address Medium Risk LCSS Score, narrow sealed width, effects of horizontal and vertical curves and drop off to KiwiRail yard. Proposed Design and Future Score are both Medium Low Risk and meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
460	Dalefield Road	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end road ▪ Length of Diversion route x volume – Low length x volume, low impact ▪ Fatal Return Period – Medium High ▪ ADT – Low	▪ LCSS Score – Medium Low, meets KiwiRail risk criteria ▪ Fire – <5km, medium negative effect ▪ Police – <5 km away, medium negative effect ▪ Fire Station diversion route time is 1 minute longer

Crossing ID	Location	Current Control	Location	Road Controlling Authority
460	Dalefield Road	FLB	Carterton	Carterton District Council

- Ambulance – <10km away low negative effect
- Masterton Hospital – >20km away, low negative effect
- No. of intersections on Diversion Route – 1 intersection low risk
- Crash History on Diversion Route – 1 minor injury, low risk
- # Crossings affected - 1 within 1km
- New Crossings criteria – 3 crossings (Hodders, Lincoln, Brooklyn) within 2km radius so alternative routes available
- Crossing at a skew and on a slight horizontal curve on the north approach
- Safety issues with narrow sealed width which results in edgebreak
- 18/9/2019 Near Collision Light Road Vehicle

- Ambulance Station diversion route time is 1 minute longer
- Short stacking risk – no risk
- Safe and Appropriate Speed – 20km/h speed differential
- Movement Function – Moderate movement significance, moderate negative effects
- ONRC Hierarchy – Secondary Collector
- Access from Carterton to the foothills of the Remutaka Ranges
- Access to Hodders Road. Closure would result in a significant detour (~13km) to get to Hodders Road which services a large rural area.
- Dalefield Road provides a crucial link in the network and convenient alternative routes are not available.
- 500m south of the crossing is peri-urban.
- Mean road operating speed is 56km/h.
- Proposed Design and Future Score are Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Lincoln Road to the east on the south side of the crossing (1.6km). 380 vpd to be redistributed to other routes – Hodders, Lincoln and Brooklyn are within 2km. Lincoln Road has an existing ADT of 1422 vpd. This would add 27% more traffic to Lincoln Road via Lincoln Road, Brooklyn Road and Thomas Road. Brooklyn and Thomas are Access roads.
- To the west the diversion route is via. Watersons Line and SH2 (4.2km)
- If closed traffic would divert to Lincoln Road or Watersons Line.

- Conclusion: **Do not close. Secondary Collector with significant detours required. Crossing is Medium Low Risk and upgrades are available to address future risks.**
- Secondary Collector Route for the south side of Carterton servicing rural properties. Significant detours required. Provides access to the Remutaka Ranges from Carterton and to Hodders Road which services a large rural area.
- Crossing meets KiwiRail risk criteria with a Medium Low LCSS score. Proposed Design and Future Score are Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1453	Lincoln Road	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of Diversion route x volume – Medium Low length x volume, medium low impact ▪ Fatal Return Period – Medium High ▪ Ambulance Station Proximity – >5km medium negative effect ▪ Masterton Hospital Proximity – 20km away, low negative effect ▪ Fire Station diversion route time is one minute shorter ▪ Safe and Appropriate Speed is 40km/h – 30km/h speed differential. The mean operating speed is 60km/h. ▪ No. of intersections on the diversion route – 1 intersection, low risk ▪ Crash history on the diversion route – Nil, low risk ▪ # of crossings affected – 1 within 1km ▪ New Crossings criteria – 6 crossings (Hodders, Dalefield, Brooklyn, Victoria, Pembroke, Belvedere) within 2km radius so alternative routes available ➢ Skewed crossing design, 30 degrees – difficult to see trains coming from the left ➢ Safety issues with narrow sealed width which results in edgebreak and ponding water. ➢ Vehicle access within the crossing.	▪ ADT - Medium ▪ Fire – >2 km, medium high negative effect ▪ Police - <5km, medium negative effect ▪ Ambulance Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Movement Function – Moderate movement significance, moderate negative effects ▪ ONRC Hierarchy – Primary Collector ➢ Alternative route to state highway – parallel feeder road into farm land. ➢ Potential for future subdivision development along Lincoln Road ➢ Provides access to Ticehurst Timber Processing Yard 60m north of the crossing ➢ Provides access to rail ballast stockpile ➢ Lincoln Road is part of a school bus route ➢ Lincoln Road is a detour road for locals wishing to avoid SH2 ➢ Carterton District Council is reducing the speed limit to 50km/h ➢ No recorded history of incidents or near misses in the past 10 years ➢ Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Brooklyn Road to the north (590m). 1422 vpd to be redistributed to other routes – Dalefield, Brooklyn, Victoria, Pembroke and Belvedere are all within 2km. Brooklyn Road has an existing ADT of 467 vpd.
- The southern diversion route via Charles St and SH2 to Brooklyn Road is 2.7km.

- **Conclusion: Do not close. Primary Collector alternative to SH2. Upgrades are available to meet KiwiRail risk criteria 1 and 2.**

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1453	Lincoln Road	FLB	Carterton	Carterton District Council

- Primary Collector functioning as the main east-west corridor on the north side of Carterton. Traffic would divert to SH2. Functions as an alternative route to SH2.
- Upgrades required to address Medium LCSS score and Medium High Fatal return period, sight distance issues, narrow sealed width and vehicle access within the level crossing. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1454	Brooklyn Road	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Length of Diversion route x volume – Low length x volume, low impact ▪ Fatal Return Period – Medium High ▪ ADT - Low ▪ Ambulance - >5km away, medium negative effect ▪ Masterton Hospital - > 15km away, low negative effect ▪ Ambulance Station diversion route time is one minute shorter ▪ No. of intersections on diversion route – 1 intersection, low risk ▪ Crash history on diversion route – nil, low risk route ▪ # crossings affected – 2 within 1km ▪ New Crossings criteria – 2 crossings (Lincoln, Victoria) within 1km radius so alternative routes available ➢ Safety issues with narrow sealed width which results in edgebreak and ponding water ➢ Unprotected drop off on southeast side of crossing ➢ Services the rural network, however this function is also undertaken by Dalefield Road and Belvedere Road.	▪ LCSS Score – Medium Low Risk, meets KiwiRail risk criteria ▪ Fire - <2km away, high negative effect ▪ Police - <3km, medium high negative effect ▪ Fire Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed is 40km/h – 10km/h speed differential. Mean operating speed is 45km/h. ▪ Movement function – Moderate movement significance, moderate negative effects ▪ ONRC Hierarchy – Secondary Collector ➢ Council are proposing to build a cycle lane on Brooklyn Road ➢ Provides access to a large area of farmland and detour routes via Dalefield Road and Belvedere Road would be relatively long. ➢ Brooklyn Road is part of a school bus route ➢ Costley Street level crossing was closed and is 250m northeast of Brooklyn Road. Closure would create an additional detour in the township area. ➢ No recorded history of incidents or near misses in the past ten years ➢ Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1454	Brooklyn Road	FLB	Carterton	Carterton District Council

Whole of line effect

- Shortest diversion route to the southwest is to Lincoln Road and to the north is Victoria Street. Long diversion routes to the south via SH2. 467 vpd to be redistributed to other routes – Lincoln and Victoria are within 1km. Lincoln Road has an existing ADT of 1422 vpd. Victoria Street has an existing ADT of 570 vpd.
- Detour north to Lincoln Road is 590m. Detour south via SH2 to Lincoln Road is 2.7km and to Victoria Street is 2.2km.

- **Conclusion: Do not close. Secondary Collector with relatively long detours. Upgrades available to meet KiwiRail risk criteria 1 and 2.**
- Alternative routes available however diversions would be relatively long. Road functions as a Secondary Collector on southern side of Carterton providing access to rural areas. Closure would create another detour in the Carterton township area with nearest parallel routes at Charles Street to the west and Victoria Street to the east.
- Medium Low Risk – meets KiwiRail Criteria. Upgrades required to address Medium High Fatal return period, narrow sealed with and unprotected drop off. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1455	Victoria Street	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead End Road – crossing is not on a dead end road ▪ Length of diversion route x volume – Low length x volume, low impact ▪ Fatal Return Period – Medium High ▪ ADT – Medium Low ▪ Ambulance - >5km away, medium negative effect ▪ Masterton Hospital - >15 km away, low negative effect ▪ Crash history on the diversion route – 1 minor, low risk ▪ ONRC Hierarchy – Access ▪ # Crossings Affected – 4 within 1km ▪ New Crossings criteria – 4 crossings (Brooklyn, Pembroke, Belvedere, Rhodes) within 1km radius so alternative routes available	▪ LCSS Score – Medium Low Risk, crossing meets KiwiRail Risk Criteria ▪ Fire - <1km away, high negative effect ▪ Police - <2km away, high negative effect ▪ Fire Station diversion route time is the same ▪ Ambulance Station diversion route time is one minute longer ▪ Short Stacking – no risk ▪ Safe and Appropriate Speed 30km/h – 20km/h speed differential. Mean road operating speed is 36km/h. ▪ No. of intersections on the diversion route – 6 intersections, high risk ▪ Movement Function – Minor movement significance, low negative effects ➢ Closest level crossing to the south – Costley Street – has previously been closed

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1455	Victoria Street	FLB	Carterton	Carterton District Council

➢ Closure would have a limited impact on residential properties north of the crossing as their detour route is 800m via. Lincoln Road and Kupe Drive. ➢ Closure would provide additional space for pedestrian crossing facilities ➢ Lack of sightlines ➢ Safer community environment created by cul de sac – no through traffic	➢ Pedestrians cross diagonally to access the path to the swimming pool – it is a high use path. ➢ Drivers do not exit right onto SH2 due to delays ➢ Kindergarten, childcare, church day group between LX and SH2 – closure would result in U-turns at pick up and drop off. ➢ There are no connecting streets from Victoria Street to the south that enable crossing the rail. ➢ A northern diversion would create rat running through residential streets. ➢ No recorded history of incidents or near misses in the past 10 years. ➢ Proposed Design is Low Risk and Future Score is Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Pembroke Street. 570 vpd to be redistributed to other routes – Brooklyn, Pembroke, Belvedere and Rhodes are within 1km. Pembroke St has an existing ADT of 1923 vpd.
- Detour to Pembroke Street to the north is 560m and to the south is 960m.
- Carterton Closures Evaluation – An assessment of the effects of diverted traffic on Belvedere Road/SH2/Park Road intersection was undertaken assuming Victoria Street, Pembroke Street and Rhodes Street level crossing were closed. The results of the modelling indicate that the effect of the diverted traffic at the SH 2/Belvedere Road/Park Road roundabout are minor, with only the morning showing a reduction in Level of service from B to C on Park Road. Overall, the intersection modelling shows that the intersection performs at LOS B in the morning peak and LOS A in the evening peak.

- **Conclusion: Can be considered for closure subject to Pembroke Street and/or Belvedere Road remaining open. Case to remain open is high amenity value of level crossing connection for the community and redistribution of traffic to SH2 which is considered unsafe by the community. Upgrades are available to meet KiwiRail risk criteria 1 and 2.**
- Alternative routes available – shortest detour is to Pembroke Street to the north. Closure would provide additional space for pedestrian crossing facilities. Safer community environment created by cul de sac.
- Low mean operating speed, lack of incidents or near misses, high amenity value for local access across the crossing.
- If crossing remains open upgrades required to address lack of sightlines and Medium High Fatal Return Period. Proposed Design is Low Risk and Future Score is Medium Low Risk. Both meet KiwiRail Risk Criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1457	Pembroke Street	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of diversion route x volume – Medium Low length x volume, medium low impact ▪ Fatal return period – Medium High ▪ Ambulance – >5km away, medium negative effect ▪ Masterton Hospital – >15km away, low negative effect ▪ Ambulance Station diversion route time 1 minute shorter ▪ Crash History on Diversion Route – 1 minor, low risk route ▪ # crossings affected – 4 within 1km ▪ New Crossings criteria – 4 crossings (Victoria, Belvedere, Rhodes, Kent) within 1km radius so alternative routes available ➢ Trains stopped at Carterton Station trigger the FLB's causing delays for drivers ➢ Level crossing is inconspicuous from a distance on road approaches. It is on a crest. ➢ Visibility for train drivers is blocked by surrounding buildings ➢ Safer community environment created by cul de sac – no through traffic ➢ 27/3/2022 Car collided with train, non-injury ➢ 1/10/2010, Near Collision Person ➢ 27/7/2010, 22/5/2012, Near Collision Light Road Vehicle	▪ ADT – Medium ▪ Fire - <2km away, high negative effect ▪ Police - <2km away, high negative effect ▪ Fire Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed – 20km/h speed differential ▪ No. of intersections on diversion route – 2 uncontrolled intersections, medium risk ▪ Movement function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector ➢ Access to Carterton Swimming Pool on NW of rail line. Alternative access via. Belvedere. ➢ Near Carter Court Aged Care Facility, Just Us Kids Preschool and Carterton School. ➢ New World Supermarket on corner of Pembroke/SH2 – closure would increase traffic volumes, sever access to the supermarket, increase difficulty of access at SH2 and create additional turning movements and congestion ➢ 150m west of Carterton Station ➢ Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Victoria Street. 1923 vpd to be redistributed to other routes – Victoria, Belvedere, Rhodes and Kent are within 1km. Victoria St has an existing ADT of 570 vpd.
- Carterton Closures Evaluation – An assessment of the effects of diverted traffic on Belvedere Road/SH2/Park Road intersection was undertaken assuming Victoria Street, Pembroke Street and Rhodes Street level crossing were closed. The results of the modelling indicate that the effect of the

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1457	Pembroke Street	FLB	Carterton	Carterton District Council

diverted traffic at the SH 2/Belvedere Road/Park Road roundabout are minor, with only the morning showing a reduction in Level of service from B to C on Park Road. Overall, the intersection modelling shows that the intersection performs at LOS B in the morning peak and LOS A in the evening peak. The effect of distributed traffic is minor.

- One of several parallel routes in the centre of Carterton providing east west links between Lincoln Road and SH2. Alternative parallel routes are Belvedere Road and Victoria Street.

- **Conclusion: Can be closed if Belvedere Road and Victoria Street remain open. Case to remain open is high amenity value of level crossing connection for the community and redistribution of traffic to SH2 which is considered unsafe by the community, upgrades are available to meet KiwiRail risk criteria 1 and 2.**
- Secondary Collector providing east west access within Carterton with alternative routes available at Victoria and Belvedere Road. Issues with visibility and delays for drivers. Closure would provide more space for pedestrian facilities.
- High amenity value for community at this level crossing due to proximity of supermarket, aged care, preschool and school.
- If crossing remains open upgrades are required to address long crossing downtime, visibility for train drivers, lack of crossing conspicuity, Medium High Fatal return period. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1467	Belvedere Road	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of diversion route x volume – Medium Low length x volume, medium low impact ▪ Fatal Return Period – Medium High ▪ Ambulance - >5km away, medium negative effect ▪ Masterton Hospital - >15km away, low negative effect ▪ Short Stacking Risk – yes 10.5m right turns into side road ▪ Short Stacking Consequence - Serious ▪ Crash history on diversion route – nil, low risk route	▪ ADT – medium ▪ Fire - <2km away, high negative effect ▪ Police - <2km away, high negative effect ▪ Fire Station diversion route time is the same ▪ Ambulance Station diversion route time is the same ▪ Safe and Appropriate Speed 30km/h – 10km/h speed differential. Mean road operating speed 47km/h ▪ No. of intersections on diversion route – 2 uncontrolled intersections, medium risk ▪ Movement Function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1467	Belvedere Road	FLB	Carterton	Carterton District Council

- # crossings affected – 4 within 1km, effects distributed more widely
- New Crossings criteria – 4 crossings (Victoria, Pembroke, Rhodes, Kent) within 1km radius so alternative routes available
- Offset T intersection layout with Wheatstone St 10m south of the level crossing and Wyndham St 30m north
- Very low volume turning movements from Belvedere into Wheatstone
- Pedestrian demand at intersection not catered for in current layout
- Trains stopped at Carterton Station trigger the FLB's, causing long delays for motorists
- Level crossing is inconspicuous on road approaches
- Better community environment created by cul de sac – no through traffic
- 23/9/2010, 9/11/2013, 8/11/2019, Near Collision Light Road Vehicle

- Park and ride facility proposed by GWRC in the vicinity of the level crossing
- Development proposed for KiwiRail land
- Provides access to rural areas
- 100m east of Carterton Rail Station which has a large park and ride area for Wellington commuters. Access is via Wheatstone Road.
- Wairarapa Five Towns Trail Network – trail between Carterton and Masterton begins opposite the Belvedere/Broadway intersection and continues along southeast side of the KiwiRail corridor
- Proposed Design and Future Score are Low Risk. Both achieve KiwiRail risk criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Pembroke Street. 1170 vpd to be redistributed to other routes – Victoria, Pembroke, Rhodes and Kent are within 1km. Pembroke Street has an existing ADT of 1923 vpd.
- North detour is 590m to Pembroke St. South detour is 570m via Davy St.
- Belvedere is the through route from SH2 into the rural area to the north. Alternative routes via Kent and Rhodes to the north and Pembroke and Victoria to the south would all require diversions via. local roads or SH2 to the south and local roads to the north.
- Carterton Closures Evaluation – An assessment of the effects of diverted traffic on Belvedere Road/SH2/Park Road intersection was undertaken assuming Victoria Street, Pembroke Street and Rhodes Street level crossing were closed. The results of the modelling indicate that the effect of the diverted traffic at the SH 2/Belvedere Road/Park Road roundabout are minor, with only the morning showing a reduction in Level of service from B to C on Park Road. Overall, the intersection modelling shows that the intersection performs at LOS B in the morning peak and LOS A in the evening peak.
- If Belvedere Road is closed, Pembroke Street should remain open.

- **Conclusion: Do not close. Upgrades meet KiwiRail risk criteria and road function is important for current and future development.**
- Alternative routes available however diversions would be relatively long. Road functions as a Secondary Collector on the northern side of Carterton providing access to rural areas. Provides an alternative route if other crossings such as Kent, Rhodes, Pembroke or Victoria are closed. Further development proposed in the area requiring access.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1467	Belvedere Road	FLB	Carterton	Carterton District Council

- Medium Risk – does not meet KiwiRail Criteria, however, infrastructure upgrades are available to address safety risks including adjacent intersections, pedestrian demand and long barrier down times. Proposed Design and Future Score are Low Risk. Both achieve KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1470	Rhodes Street	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Length of diversion route x volume – Low length x volume, low impact ▪ ADT – Low ▪ Ambulance - >5km away, medium negative effect ▪ Masterton Hospital - >15km away, low negative effect ▪ Ambulance Station diversion route time 1 minute shorter ▪ Crash history on diversion route – nil, low risk route ▪ ONRC Hierarchy – Low Volume ▪ # crossings affected - 5 within 1km ▪ New Crossings criteria – 5 crossings (Victoria, Pembroke, Belvedere, Kent, Andersons) within 1km radius so alternative routes available ➢ Crossing is inconspicuous on a straight, level residential street ➢ Train driver visibility of crossing is constrained by adjacent buildings	▪ LCSS Score – Medium Low, meets KiwiRail Risk Criteria ▪ Fatal Return Period - Medium ▪ Fire - <2km away, high negative effect ▪ Police - <2km away, high negative effect ▪ Fire Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed 30km/h – 20km/h speed differential. Mean road traffic speed 34km/h. ▪ No. of intersections on diversion route – 2 uncontrolled intersections, medium risk ▪ Movement function – Low movement significance, low negative effects ➢ Shared path being investigated along rail corridor in Carterton between Belvedere and Kent Streets ➢ Residential street with destinations for vulnerable road users nearby including Howard Booth Park, Carterton Holiday Park and rugby and soccer grounds. ➢ No recorded incidents or near misses in the past 10 years ➢ Proposed Design and Future Score are Low Risk. Both meet KiwiRail risk criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Kent Street. 400 vpd to be redistributed to other routes – Victoria, Pembroke, Belvedere, Kent and Andersons are within 1km. Kent St has an existing ADT of 1602 vpd.
- Diversion to the north is 400m and to the south via SH2 is 940m.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1470	Rhodes Street	FLB	Carterton	Carterton District Council

- Carterton Closures Evaluation – An assessment of the effects of diverted traffic on Belvedere Road/SH2/Park Road intersection was undertaken assuming Victoria Street, Pembroke Street and Rhodes Street level crossing were closed. The results of the modelling indicate that the effect of the diverted traffic at the SH 2/Belvedere Road/Park Road roundabout are minor, with only the morning showing a reduction in Level of service from B to C on Park Road. Overall, the intersection modelling shows that the intersection performs at LOS B in the morning peak and LOS A in the evening peak.
- Rhodes Street is a Low Volume Route linking SH2 to Wyncham Street. Kent Street and Belvedere Road also provide the SH 2 to Wyndham St connection.

- **Conclusion: Can be closed if Kent Street or Belvedere Road remain open, however upgrades available to meet KiwiRail risk criteria 1 and 2.**
- Alternative routes available which are of reasonable length.
- Amenity value for community at this level crossing due to adjacent sports fields, however alternative access available.
- Medium Low Risk – meets KiwiRail risk criteria. Updates required to address Medium Fatal Return Period, Train driver visibility of crossing and inconspicuous crossing. Proposed Design and Future Score are Low Risk. Both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1473	Kent Street	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of diversion route x volume – Low length x volume, low impact ▪ Fatal return period – Medium High ▪ Ambulance – 10km away, low negative effects ▪ Masterton Hospital – >15km away, low negative effects ▪ Crash History on Diversion Route – nil, low risk route ▪ # crossings affected – 4 within 1km ▪ New Crossings criteria – 4 crossings (Pembroke, Belvedere, Rhodes, Andersons) within 1km radius so alternative ▪ routes available ➢ Crossing is not conspicuous ➢ Train drivers have a poor line of sight to approaching traffic ➢ 5/9/2017 Car collided with train, non-injury ➢ Safety issues with narrow sealed width which results in edgebreak	▪ ADT – Medium ▪ Fire – <2km away, high negative effects ▪ Police – <2km away, high negative effects ▪ Fire Station diversion route time is the same ▪ Ambulance Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed 30km/h – 20km/h speed differential. Mean road traffic speed 43km/h. ▪ No. of intersections on diversion route – 2 uncontrolled intersections, medium risk route ▪ Movement Function – Minor movement significance, minor negative effects ▪ ONRC Hierarchy – Secondary Collector ➢ More residential development to happen to the north. Residential street with multiple cul de sacs branching from it. ➢ Cycleway proposed in the rail corridor between Belvedere Street and Kent Street terminating on the southern side of Kent Street. Future extension to Chester proposed by Carterton District Council. ➢ Timber yard – Timspec, within close proximity ➢ Residential street with destinations for vulnerable road users nearby including Howard Booth Park, Carterton Holiday Park and rugby and soccer grounds. ➢ Proposed Design and Future Score are Medium Low Risk and both meet Criterion 1 and 2. With additional traffic from the closure of another crossing such as Kent Street the future score would remain in the Medium Low risk band.

Whole of line effect

▪ Shortest diversion route is to Rhodes Street. 1602 vpd to be redistributed to other routes – Pembroke, Belvedere, Rhodes, Andersons are within 1km. Rhodes St has an existing ADT of 400 vpd.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1473	Kent Street	FLB	Carterton	Carterton District Council

- Can consider closure if Rhodes and Belvedere remain open. Diversion to the north is 400m and to the south via SH2 is 940m but pushes traffic through low volume short residential street (Rhodes) .

- **Conclusion: Can be closed if Rhodes Street and/or Belvedere Road remain open, however Kent Street has a higher function as a Secondary Collector Road with a future extension to Chester Road proposed and upgrades meet KiwiRail Risk Criteria 1 and 2.**
- Alternative routes available close by.
- Upgrades required to address Medium Risk Crossing – does not meet KiwiRail risk criteria, and Medium High Fatal return period, lack of conspicuity, poor line of sight for train drivers, narrow sealed width. Proposed Design and Future Score are Medium Low Risk and both meet Criterion 1 and 2. With additional traffic from the closure of another crossing such as Kent Street the future score would remain in the Medium Low risk band.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1476	Andersons Line	Stop	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of diversion route x volume – Low length x volume, low impact ▪ Fatal return period – Medium High ▪ ADT – Low ▪ Ambulance – >5km away, medium negative effect ▪ Masterton Hospital - >25km away, low negative effect ▪ Fire Station diversion route time 1 minute shorter ▪ Ambulance Station diversion route time 1 minute shorter ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ No. of intersections on diversion route – 2 priority controlled intersections, ▪ Crash history on diversion route – 2 minor, low risk route ▪ ONRC Hierarchy – Access	▪ Dead end road – yes ▪ Fire - <2km away, high negative effect ▪ Police - <2km away, high negative effect ▪ Short Stacking Risk – no risk ▪ Movement Function – Low movement significance, low negative effects ➢ Wairarapa Five Towns Trail Network – shared walking and cycleway corridor in the rail corridor would cross Andersons Line ➢ Safe and Appropriate Speed is 60km/h and mean road traffic operating speed is 47km/h. ➢ Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1476	Andersons Line	Stop	Carterton	Carterton District Council

- # crossings affected – 2 within 1km
- New Crossings criteria – 6 crossings (Victoria, Pembroke, Belvedere, Rhodes, Kent, Chester) within 2km radius so alternative routes available
- 18/10/2013 Car collided with train, non-injury
- 28/1/2010, 29/1/2019 Near Collision Light Road Vehicle
- Safety issues with narrow sealed width which results in edgebreak

Whole of line effect

- No diversion routes available.
- No direct links between Carterton township and Andersons Line except via SH2 and the level crossing.

- **Conclusion: Do not close. Dead End Road. Upgrades meet KiwiRail risk criteria 1 and 2.**
- Dead end road providing access to rural properties to the north with low standard access to SH2. Long detour for rural properties.
- Upgrades required to address Medium LCSS risk and Medium High Fatal return period, narrow sealed width. Proposed Design and Future Score are Medium Low Risk and both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1480	Chester Road	FLB	Carterton	Carterton District Council

Case for Closure

- Dead end road – crossing is not on a dead end road
- LCSS Score – Medium, does not meet KiwiRail risk criteria
- Fatal Return Period - High
- Ambulance - >10km away, low negative effect
- Masterton Hospital - >15km away, low negative effect
- Fire Station diversion route time is 1 minute shorter
- Safe and Appropriate Speed 60km/h – 40km/h speed differential

Case to remain Open

- Length of diversion route x volume – Medium length x volume, medium impact
- ADT – Medium
- Fire - <5km away, medium high negative effect
- Police - <5km away, medium high negative effect
- Ambulance Station diversion route time is 4 minutes longer
- Short Stacking Risk – no risk
- No. of intersections on the diversion route – 4 priority controlled intersections, medium high risk
- Movement function – Minor movement significance, low negative effects

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1480	Chester Road	FLB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Crash history on diversion route – 1 serious, 5 minor, medium low risk route ▪ New Crossings criteria – 1 crossing (Andersons) within 2km radius so alternative routes available ➢ Four accessways in immediate proximity of the crossing ➢ Clareville Showgrounds main entrance is 45m south of the level crossing creating the potential for queuing over the crossing. ➢ Safety issues with narrow sealed width which results in edgebreak and ponding water	▪ ONRC Hierarchy – Primary Collector ▪ # crossings affected – 0 within 1km ▪ Over dimension route ➢ Speed limit proposed to be reduced to 60km/h subject to Council approval. Mean traffic operating speed is 68km/h. ➢ Access to activity centres – Carterton Golf Club, A&P Showgrounds, Sports clubs, Carterton Roller Skaters, Menzshed ➢ Access to farmland and Clareville Cemetery. Connects Clareville to West Taratahi. ➢ No recorded history of incidents or near misses in the past ten years ➢ Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk Criterion 1 and 2.

Whole of line effect

- Very long detour to the east to Wiltons Road (5.2km via. SH2 to the south, 10.3km to the north via Taratahi).

- **Conclusion: Do not close. Primary Collector Road. Upgrades meet KiwiRail Risk Criteria 1 and 2.**
- Primary Collector Road - only access to farmland from Clareville and long detours would result.
- Medium Risk – does not meet KiwiRail criteria, however, issues including High Fatal return period, accesses within the crossing and narrow sealed width can be addressed with infrastructure upgrades. Proposed Design and Future Score are Medium Low Risk and meet KiwiRail risk Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1481	Wiltons Road	Stop	Waingawa	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Length of diversion route x volume – Low length x volume, low impact	▪ Short stacking risk – no risk ▪ No. of intersections on diversion route – 5 priority controlled intersections, high risk route ▪ Crash History on Diversion Route – 1 fatal, 3 serious, 3 minor, high risk route

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1481	Wiltons Road	Stop	Waingawa	Carterton District Council

- Fatal Return Period – Medium High
- ADT - Low
- Ambulance – <10km away, medium low negative effect
- Masterton Hospital – <10km away, medium low negative effect
- Fire – <10km away, medium low negative effect
- Police – <10km away, medium low negative effect
- Fire Station diversion route time 1 minute shorter
- Ambulance Station diversion route time 2 minutes shorter
- Safe and Appropriate Speed – 40km/h speed differential
- ONRC Hierarchy – Access
- New Crossings criteria – 2 crossings (Norman, Norfolk) within 2km radius so alternative routes available. Norman is not accessible at present.

➢ 17/2/2013 Ute collided with train, Fatal Injury

➢ 12/5/2012, 27/8/2013, 31/5/2019, 14/12/2020, 14/7/2021, 8/4/2022, Near Collision Light Road Vehicle

➢ 7/11/2014, Near Collision Heavy Road Vehicle

- Movement function – Low movement significance, low negative effects
- # crossings affected – 0 within 1km

➢ Application for plan change to industrial land to the north – significant increase in traffic expected to service the industrial areas in Waingawa Industrial area

➢ Roundabout built at SH2/Wiltons Road to service Waingawa Industrial area

➢ Proposed Design and Future Score are Medium Low and both meet KiwiRail risk criteria 1 and 2.

Whole of line effect

- Shortest diversion route is to Norfolk Road. 154 vpd to be redistributed. Norfolk Road has an existing ADT of 1407 vpd.
- Detour to Norfolk Road to the south is via SH2 and is 2.6km. Detour to the north is via West Taratahi and is 11.3km.

- **Conclusion: Do not close. Long diversions required. Future access for development required. Upgrades available to meet KiwiRail risk criteria 1 and 2.**
- Alternative routes available but would require long diversions. Wiltons Road is a future access road and heavy truck route into the extended Waingawa Industrial Estate for which a roundabout has been constructed at the SH2 intersection.

➢ Upgrades available to address safety issues including history of near misses and enable future closure of Norman Avenue Level Crossing. Proposed Design and Future Score are Medium Low and both meet KiwiRail risk criteria 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1482	Norman Avenue	FLB HAB	Waingawa	Carterton District Council

Case for Closure	Case to remain Open
▪ Length of diversion route x volume – Medium low length x volume, medium low impact ▪ Fatal Return Period – Medium High ▪ ADT – Medium Low ▪ Ambulance – >15 km away, low negative effect ▪ Masterton Hospital – >5km away, medium negative effect ▪ Fire Station - >5km, medium negative effect ▪ Police Station – >10km away, low negative effect ▪ Fire Station diversion route time is 1 minute shorter ▪ Ambulance Station diversion route time is 1 minute shorter ▪ Safe and Appropriate Speed – 40km/h speed differential ▪ No. of intersections on diversion route – 2 intersections, medium risk ▪ Crash history on diversion route – nil, low risk route ▪ # crossings affected – 1 within 1km ▪ New Crossings criteria – 2 crossings (Wiltons, Norfolk) within 2km radius so alternative routes available ➢ Shunting through crossing causes second train risk and delays to motorists who may bypass controls. Second train movement has the potential to hold barriers down. ➢ Train shunting into adjacent timber yard ➢ Intersection immediately east of the crossing and significant commercial/ industrial sites to the northwest ➢ Industrial development will increase the volume of heavy vehicles using the crossing ➢ Risk of queuing around the bend in the intersection when the Level Crossing is activated	▪ Dead end road – no through roads to the north or south ▪ LCSS Score – Medium Low, meets KiwiRail Risk Criteria ▪ Short stacking risk – no risk ▪ Movement function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector ▪ Overdimension Route ➢ SFAIRP says not reasonably practicable to close and recommends upgrades. ➢ Grade separation would be required to close. ➢ Access to Waingawa Industrial Area. Significant amount of truck traffic along Waingawa Road via Norfolk Road and Norman Road ➢ Norman Avenue is a cul de sac

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1482	Norman Avenue	FLB HAB	Waingawa	Carterton District Council

- 20/10/2017 Heavy vehicle collided with train, non-injury
- 6/4/2017, 10/1/2019, 13/9/2019, 16/9/2019, Near Collision Heavy Road Vehicle
- 12/8/2016, 2/10/2017, 24/7/2019, 1/8/2019, Near Collision Light Vehicle
- Proposed Design and Future Score are Medium Risk. Neither meet Criterion 1 or 2.

Whole of line effect

- No diversion routes available for destinations north of the Norman Avenue Level crossing as the route is a dead end. 870 vpd use the crossing.
- SFAIRP report – There is the potential for future development in the area to result in the consolidation of crossing points when the industrial area expands to the south and the Wiltons Road crossing is reviewed. This may provide an opportunity to close Norman Avenue at a future time in favour of an improved crossing at Wiltons Road. Closure would cut off local businesses and is not a realistically available option but may be a practical option once the new connection from Wiltons Road is achieved. Closure is not reasonably practicable at this time.
- Grade separation - the cost would be grossly disproportionate to the risk benefit, therefore is not reasonably practicable.

- **Conclusion: Do not close at this time. Closure can be undertaken in the future with the construction of a new connection from Wiltons Road into the Waingawa Industrial Area.**
- Dead end road currently, no alternative routes available.
- Closure would cut off local businesses and is not a realistically available option but may be a practical option once the new connection from Wiltons Road is achieved. Closure is not reasonably practicable at this time.
- Medium Low risk crossing – meets KiwiRail risk criteria. Safety issues including history of incidents and near misses, queuing and delays due to shunting can be partially addressed through infrastructure upgrades however Proposed Design and Future Score are Medium Risk. Neither meet Criterion 1 or 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1483	Norfolk Road	FLB	Waingawa	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium High, does not meet KiwiRail risk criteria	▪ ADT – Medium ▪ Short stacking risk – no risk ▪ Movement function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Primary Collector

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1483	Norfolk Road	FLB	Waingawa	Carterton District Council

- Length of Diversion Route x volume – Medium Low length x volume, medium low impact
- Fatal Return Period - High
- Ambulance - >10km away, low negative effect
- Fire - >5km away, medium negative effect
- Police - >10km away, low negative effect
- Masterton Hospital >5km away, medium negative effect
- Fire Station diversion route time is 2 minutes shorter
- Ambulance Station diversion route time is 1 minute shorter
- Safe and Appropriate Speed – 40km/h speed differential
- No. of intersections on diversion route – 2 intersections, medium risk
- Crash History on Diversion route – nil, low risk route
- # crossings affected – 1 within 1km
- New Crossings criteria – 2 crossings (Wiltons, Ngaumutawa) within 2km radius so alternative routes available

- Train shunting into adjacent timber yard frequently activates the crossing, causes second train risk due to close proximity of timber yard siding, delays to motorists who may bypass controls. Second train movement has potential to hold the barriers down.
- Manual switching causing delays and frustration to motorists
- Industrial development will increase heavy vehicle volumes through the crossing
- 21/7/2023 Car collided with train
- 9/5/2018, 7/6/2019, Near Collision Heavy Road Vehicle
- 10/6/2013, 30/9/2015, 18/4/2018, 8/5/2019 (x2), 1/10/2020, 3/12/2020, 6/9/2021, 14/10/2021, 28/9/2022 Near Collision Light Road Vehicle

- Overdimension route

- Logging Truck Access
- SFAIRP says not reasonably practicable to close and recommends upgrades
- Grade separation would be required to close.
- Access to Waingawa Industrial Area. Significant amount of truck traffic along Waingawa Road via Norfolk Road and Norman Road.
- Speed limit reduction to 60km/h to go to Council for approval to address safety concerns
- Juken New Zealand Timber Mill access within level crossing
- Kiwi Lumber and Mainfreight in close proximity
- Waingawa Rail Freight Hub immediately southwest of the crossing
- Roundabout at SH2/Norfolk Road intersection constructed as main access to Waingawa Rail Freight Hub
- It is the main access to the West of Carterton
- Closure would result in large industrial vehicles, mainly logging trucks, being diverted by 10-15 mins through rural back roads and into the Chester Road residential area.
- Closure would split logging operations – trucks would have to undertake a right turn onto SH2
- Proposed Design and Future Score are Medium Risk and meet Criterion 2. Grade separation is required to achieve Criterion 1.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1483	Norfolk Road	FLB	Waingawa	Carterton District Council

Whole of line effect

- Nearest crossing is Norman Avenue, however Norman Avenue is a dead end with no links to Norfolk Road to the north or south. 1407 vpd to be redistributed via. nearest diversion route which is Wiltons Road. Wiltons Road has an existing ADT of 154vpd.
- Detour to the north to Wiltons Road is 11.3km, detour to the south via SH2 is 2.6km.
- SFAIRP Report – Closure is not reasonably practicable due to the impact on heavy vehicle traffic.
- Grade separation – the cost would be grossly disproportionate to the risk benefit, therefore is not reasonably practicable.

- **Conclusion: Do not close. Upgrades meet Criterion 2 level of risk however SFAIRP confirms closure and grade separation are not reasonably practicable.**
- Important access route to Waingawa Industrial Area. Detours are long and through residential areas.
- Proposed Design and Future Score are Medium Risk and meet Criterion 2. Grade separation is required to achieve Criterion 1.
- Infrastructure upgrade improvements available. SFAIRP identifies closure and grade separation are not reasonably practicable. Likely closest crossing at Norman Avenue will be closed in the future when the industrial area expands to the west.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1484	Ngaumutawa Road	FLB HAB	Carterton	Carterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ LCSS Score – Medium, does not meet KiwiRail risk criteria ▪ Fatal return period – Medium High ▪ Masterton Hospital - >5km away, medium negative effect ▪ Fire - >5km away, medium negative effect ▪ Police – 5km away, medium negative effect ▪ Fire Station diversion route time 1 minute shorter ▪ Ambulance Station diversion route time 2 minutes shorter ▪ No. of intersections on diversion route – 1 priority controlled, low risk route ▪ Crash history on diversion route – 1 minor, low risk route	▪ Length of diversion route x volume – Medium High length x volume, medium high impact ▪ ADT – Medium High ▪ Ambulance – <5km away, medium high negative effect ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed – 20 km/h speed differential ▪ Movement Function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Primary Collector ➢ SFAIRP says not reasonably practicable to close and recommends upgrades ➢ Grade separation would be required to close. ➢ If Judds Road is closed Ngaumutawa Road would have to become the Overdimension Route

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1484	Ngaumutawa Road	FLB HAB	Carterton	Carterton District Council

- # crossings affected – 1 within 1km
- New Crossings criteria – 1 crossing (Judds) within 1km radius so alternative routes available if Judds remains open.
- Upper Manaia Road intersection <20m north of the level crossing on a short radius curve with speed advisory 25km/h
- 5/2/2010, 27/1/2017, 28/3/2019, 6/5/2020, 23/10/2020, 26/5/2022, Near Collision Light Road Vehicle

which would require upgrades to the corridor but not to the level crossing as OD envelope is achieved

- No crossings within 1km radius if Judds Road is closed.
- School Route – which will have a 30km/h speed zone and Raised Safety Platforms
- Future cycleway link
- SH2/Ngaumutawa intersection has recently been upgraded to a roundabout to address safety issues
- Ngaumutawa Road is part of the heavy traffic bypass route around Masterton
- Major housing developments proposed in the Westbush area – eastern side of Ngaumutawa Road
- A potential shared path at the nearby SH intersection and local development is expected to increase road, ped and cycle volumes
- Proposed Design is Medium Low Risk and meets KiwiRail Risk Criterion 1 and 2. Future Score is Medium Risk and meets Criterion 2.

Whole of line effect

- Shortest diversion route is to Judds Road. 3600 vpd to be redistributed. Judds Road has an existing ADT of 961 vpd.
- SFAIRP Report – As the crossing sits on the current HCV bypass route it is not viable to close without an alternative in place.
- Grade separation – the cost would be grossly disproportionate to the risk benefit therefore it is not reasonably practicable.
- Ngaumutawa/Judds/Hillcrest/Cornwall/Renall are key Collector Routes linking Ngaumutawa Road and the rural areas north of Masterton with SH2. Ngaumutawa links to Upper Manaia Road and Boundary Road. Closing Ngaumutawa Road would affect access to Upper Manaia Road which provides access to rural properties to the east of Waingawa River.

- **Conclusion: Do not close. Upgrades available to meet Criterion 2 however SFAIRP identifies it is not reasonably practicable to close and recommends upgrades.**
- Ngaumutawa Road is the heavy traffic bypass for Masterton. Ngaumutawa Road links to Upper Manaia Road which provides access to rural properties which would have no alternative access. Future housing developments at West Bush Road will require access.
- Proposed Design is Medium Low Risk and meets KiwiRail Risk Criterion 1 and 2. Future Score is Medium Risk and meets Criterion 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1484	Ngaumutawa Road	FLB HAB	Carterton	Carterton District Council

- SFAIRP says it is not reasonably practicable to close and recommends upgrades. Upgrades required to address Medium LCSS Score, Medium High Fatal return period. (SH2/Ngaumutawa intersection has recently been upgraded to a roundabout to address safety issues).

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1485	Judds Road	FLB	Solway	Masterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Length of diversion route x volume – Medium Low length x volume, medium low impact ▪ ADT – Medium Low ▪ Masterton Hospital – >5km away, medium negative effect ▪ Fire Station diversion route time 1 minute shorter ▪ Ambulance Station diversion route time 1 minute shorter ▪ Short Stacking Risk – yes, 12.6m into Ngaumutawa Road (with 2m safety space). Signposted as 14m ▪ Short Stacking Consequence - Serious ▪ No. of intersections on diversion route – 2 priority controlled intersections, medium low risk ▪ Crash history on diversion route – 2 serious, 4 minor, medium risk route ▪ # crossings affected – 2 within 1km radius ▪ New Crossings criteria – 2 crossings (Ngaumutawa, Hillcrest) within 1km radius so alternative routes available ➢ Turning vehicles from the northeast do not have a good view of the rail line to the east due to the angle of approach ➢ Long delay for vehicles for SW bound passenger services ➢ Risk of crashes at Judds/Ngaumutawa Road is removed	▪ LCSS Score – Medium Low, meets KiwiRail Risk Criteria ▪ Fatal Return period – Medium ▪ Ambulance – <5km away, medium high negative effect ▪ Fire – <5km away, medium high negative effect ▪ Police – <5km away, medium high negative effect ▪ Safe and appropriate speed – 20km/h speed differential ▪ Movement function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector ▪ Overdimension route used by HPMV trucks to Breadcraft bakery and occasionally O/D vehicles which cannot negotiate the Ngaumutawa Road level crossing ➢ Closure would create a 1km long cul de sac off the state highway ➢ Limited space for heavy vehicles to turn around if crossing is closed ➢ Access for commercial/industrial premises in industrial zoned land ➢ Rear Entry to Solway Showgrounds from Judds Road ➢ Future cycleway alongside the rail corridor ➢ 250m south of Solway Station

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1485	Judds Road	FLB	Solway	Masterton District Council

- SH2/Ngaumutawa intersection has recently been upgraded to a roundabout and provides a safer diversion route
- Crossing used regularly for school buses.
- 25/8/2010 Near Collision Heavy Road Vehicle
- 15/3/2019 Near Collision Light Road Vehicle
- Residential development increasing in the area – services Barracks subdivision and future residential development in showgrounds
- Emergency services upwind of smoke in a fire event – predominant wind direction – would want to access Judds from Ngaumutawa
- Proposed Design is Low Risk, Future Score is Medium Low Risk. Both meet Criterion 1 and 2.

Whole of line effect

- Shortest diversion route is to Hillcrest Street. 961 vpd to be redistributed to other routes – Ngaumutawa and Hillcrest are within 1km. Hillcrest St has an existing ADT of 1306 vpd.
- 570m detour to Hillcrest St level crossing to the north via Ngaumutawa Road, 3.5km detour to the south to Hillcrest St via York Street or 2.6km to Ngaumutawa Road level crossing via High St.
- Judds Road Closure Evaluation – Closure proposed due to the short stacking risk. Effects: Risks of collisions removed at the LX and Ngaumutawa intersection; safety for vulnerable users improved by auto gates; through traffic removed; intersection on future cycleway removed improving safety; all traffic for Judds Road to use High Street intersection which may increase crashes; limited space for turnaround at new cul de sac – turns can be undertaken at Pragnell Street; increased traffic on Ngaumutawa Road.
- Ngaumutawa/Judds/Hillcrest/Cornwall/Renall are key Collector Routes linking Ngaumutawa Road and the rural areas north of Masterton with SH2. Judds and Hillcrest link to West Bush Road. Closing Judds Road would affect Hillcrest Street which is an indirect route to SH2. Traffic may divert to the more direct routes of Ngaumutawa Road, Cornwall Street or Renall Street.

- **Conclusion: Can be closed to address short stacking risk if intersection upgrades are not reasonably practicable. Upgrades meet KiwiRail Risk Criterion 1 and 2. High amenity and safety value placed by the community on the Judds Road/Ngaumutawa Road intersection as an alternative to SH2.**
- Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road. If Judds Road is upgraded rather than closed, closure of Hillcrest Street can be considered.
- Serious Short Stacking Risk at Ngaumutawa Road intersection can be addressed by closure or partially mitigated by traffic signals managing queuing in advance of the crossing. Risk of vehicle stalling on the crossing remains. Not a school bus route but used by school buses to transport children to activities.
- High amenity value at this crossing due to access to Ngaumutawa Road as an alternative route to SH2 and access to Solway Station. SH2 intersection and redistribution of traffic to SH2 is seen by the community as dangerous with concerns about adding to high heavy commercial vehicle volumes on SH2 which traverses residential and commercial areas and increases in conflict with other road users.
- Further residential and commercial/industrial development proposed on Judds Road which will add traffic to SH2 and Ngaumutawa Road intersections.
- Proposed Design is Low Risk, Future Score is Medium Low Risk. Both meet Criterion 1 and 2.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1486	Hillcrest Street	FLB	Solway	Masterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Length of diversion route x volume – Medium Low length x volume, medium low impact ▪ Short Stacking Risk – yes 32m into Ngaumutawa Road ▪ Short Stacking Consequence - Significant ▪ Safe and Appropriate Speed – 50km/h speed differential ▪ Ambulance Station diversion route time is 1 minute shorter ▪ No. of intersections on diversion route – 2 priority controlled intersections, medium low risk ▪ Crash history on diversion route – 4 serious crashes, medium risk route ▪ # crossings affected – 2 within 1km radius ▪ New Crossings criteria – 2 crossings (Judds, Cornwall) within 1km radius so alternative routes available ➢ Crossing controls are triggered when a train stops at Solway Station causing long delays for drivers	▪ LCSS Score – Medium Low, meets KiwiRail Risk Criteria ▪ Fatal return period – Medium ▪ ADT - Medium ▪ Ambulance - <5km away, medium high negative effect ▪ Masterton Hospital - <5km away, medium high negative effect ▪ Fire - <5km away, medium high negative effect ▪ Police - <5km away, medium high negative effect ▪ Fire Station diversion route time is the same ▪ Movement Function – Minor movement significance, low negative effects ▪ ONRC Hierarchy – Secondary Collector ➢ Cross town route between SH2 and Ngaumutawa Road ➢ Provides access to Solway Station ➢ Commercial Property at the intersection accessed off Ngaumutawa Road ➢ Large town catchment ➢ No recorded history of incidents or near misses in the past 10 years ➢ Proposed Design is Medium Low Risk and Future Score is Low Risk. Both achieve Criterion 1.

Whole of line effect

- Shortest diversion route is to Cornwall Street. 1306 vpd to be redistributed to other routes – Judds and Cornwall are within 1km. Cornwall has an existing ADT of 846 vpd.
- Northern detour - 520m from Hillcrest St to Judds Road to the west, 640m to Cornwall Street to the east. Southern Detour – 3.5km to Judds Road, 2.1km to Cornwall Street.
- Ngaumutawa/Judds/Hillcrest/Cornwall/Renall are key Collector Routes linking Ngaumutawa Road and the rural areas north of Masterton with SH2. Judds and Hillcrest link to West Bush Road. Closing Hillcrest would affect Judds Road, which is proposed to be closed so traffic would divert to Cornwall Street or Renall Street.

- **Conclusion: Can be closed as alternative routes available, but do not close if Judds Road level crossing is being closed. Upgrades available to meet KiwiRail risk criterion 1.**

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1486	Hillcrest Street	FLB	Solway	Masterton District Council

- Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road, however, Judds Road immediately south is proposed to be closed and closing Hillcrest Street would affect access to Solway Station and West Bush Road which is a Secondary Collector Road providing access between Solway and rural areas.
- Medium Low LCSS score so meets KiwiRail Criteria. Medium Fatal return period. Proposed Design is Medium Low Risk and Future Score is Low Risk. Both achieve Criterion 1.
- Upgrades required to address delays to drivers caused by crossing controls triggered when a train stops at Solway Station.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1488	Cornwall Street	FLB	Masterton	Masterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Length of diversion route x volume – Low length x volume, low impact ▪ ADT – Medium Low ▪ No. of intersections on diversion route – 1 priority controlled, low risk route ▪ # crossings affected – 2 within 1km ▪ New Crossings criteria – 2 crossings (Hillcrest, Renall) within 1km radius so alternative routes available ▪ Fire Station diversion route time is one minute shorter ▪ Ambulance Station diversion route time is one minute shorter ➢ Crossing is not conspicuous on the road approaches ➢ Crossing is triggered when a train stops at Renall Street Station creating delays for traffic ➢ Sightlines obscured for both train drivers and road traffic ➢ 10/12/2013, Near Collision Light Road Vehicle ➢ 28/7/2020, Near Collision Heavy Road Vehicle	▪ LCSS Score – Low, meets KiwiRail Risk Criteria ▪ Fatal Return Period – Medium Low ▪ Ambulance – <2km away, high negative effects ▪ Masterton Hospital – <5km away, medium high negative effects ▪ Fire - <5km away, medium high negative effects ▪ Police - <5km away, medium high negative effects ▪ Short Staking Risk – no risk ▪ Safe and Appropriate Speed – 20km/h speed differential ▪ Crash History on Diversion Route – 4 serious, 1 minor, medium risk route ▪ Movement function – Minor movement significance, minor negative effects ▪ ONRC Hierarchy – Secondary Collector ➢ 80m from Ngaumutawa Road intersection which is the heavy truck bypass ➢ Commercial access nearby ➢ Proposed Design is Low Risk and meets KiwiRail Risk criterion 1 and 2. Future Score is Low Risk and meets criterion 1.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1488	Cornwall Street	FLB	Masterton	Masterton District Council

- Safer community environment created by cul de sac – no though traffic

Whole of line effect

- Shortest diversion route is to Hillcrest Street. 846 vpd to be redistributed to other routes – Hillcrest and Renall are within 1km. Hillcrest St has an existing ADT of 1306 vpd.
- Ngaumutawa/Judds/Hillcrest/Cornwall/Renall are key Collector Routes linking Ngaumutawa Road and the rural areas north of Masterton with SH2. Cornwall and Renall link to Upper Plain Road. Closing Cornwall would affect Renall Street and Hillcrest Street depending on the origin and destination of trips.

- **Conclusion: Can be closed as alternative routes available if Hillcrest Street and Renall Street remain open, however low risk crossing which can be maintained as low risk with upgrades.**
- Alternative routes available, however closure would cut off direct access to the heavy traffic bypass route, Ngaumutawa Road. One of several Collector routes linking SH2 and Ngaumutawa Road.
- No significant safety issues if not closed as is a Low Risk crossing, however upgrades recommended to address sightline issues, long barrier down times as crossing is triggered by a train at Renall Street Station, and near misses. Proposed Design is Low Risk and meets KiwiRail Risk criterion 1 and 2. Future Score is Low Risk and meets criterion 1.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1490	Renall Street	FLB HAB	Masterton	Masterton District Council

Case for Closure	Case to remain Open
▪ Dead end road – crossing is not on a dead end road ▪ Short stacking risk – yes for the right turn into College Street and the right turn into the industrial complex at 133 Ngaumutawa Road and at 148 Renall Street ▪ Short Stacking Consequence - Serious ▪ No. of intersections on diversion route – 1 priority controlled, 1 roundabout, medium low risk route ▪ Crash history on diversion route – 1 serious, 4 minor, medium low risk route ▪ # crossings affected – 1 within 1km ▪ New Crossings criteria – 1 crossing (Cornwall) within 1km radius so alternative routes available ➢ Crossing sightlines obscured by surrounding buildings and vegetation	▪ LCSS Score – Low, meets KiwiRail Risk Criteria ▪ Length of diversion route x volume – Medium length x volume, medium impact ▪ Fatal return period - Medium ▪ ADT – Medium High ▪ Ambulance - <5km away, medium high negative effect ▪ Masterton Hospital - <5km away, medium high negative effect ▪ Fire - <5km away, medium high negative effect ▪ Police - <5km away, medium high negative effect ▪ Fire Station diversion route time 1 minute longer ▪ Ambulance station diversion route time 1 minute longer

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1490	Renall Street	FLB HAB	Masterton	Masterton District Council

➢ Crossing at a skew to the tracks ➢ Crossing is inconspicuous and blends into the background on a residential street ➢ 11/10/2014, 11/1/2014 Near Collision Light Road Vehicle ➢ Safer community environment created by cul de sac – no though traffic	■ Safe and Appropriate Speed – 10km/h speed differential ■ Movement function – Moderate movement significance, moderate negative effects ■ ONRC Hierarchy – Primary Collector ➢ Close to Renall Street Train Station – pedestrian access only. ➢ Proposed Design and Future Score are Medium Low Risk. Both meet Criterion 1.

Whole of line effect

- Shortest diversion route is to Cornwall Street. 4273 vpd to be redistributed. Cornwall St has an existing ADT of 846 vpd.
- Ngaumutawa/Judds/Hillcrest/Cornwall/Renall are key Collector Routes linking Ngaumutawa Road and the rural areas north of Masterton with SH2. Cornwall and Renall link to Upper Plain Road. Closing Renall would affect Cornwall Street and potentially add 500% more traffic to the level crossing.

- **Conclusion: Do not close. Primary Collector Road. Upgrades available to meet Criterion 1.**
- Alternative routes available as this is one of several east-west routes between SH2 and Ngaumutawa Road however, as a Primary Collector Road there is a large volume of traffic to be redistributed and this route provides access to a large subdivision and rural areas. Provides access to Renall Street Station.
- Low Risk Crossing – meets KiwiRail Risk Criteria with a Medium Fatal return period. Short stacking and safety risks including sightlines and inconspicuous crossing can be addressed with infrastructure upgrades. Proposed Design and Future Score are Medium Low Risk. Both meet Criterion 1.

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1493	Akura Road	FLB	Masterton	Masterton District Council

Case for Closure	Case to remain Open
■ Dead end road – crossing is not on a dead end road ■ No. of intersections on diversion route - 1 priority controlled, 1 roundabout, medium low risk route ■ Crash History on diversion route – 5 minor, low risk route ■ Shunting through crossing creates delays to motorists who may bypass the crossing controls out of frustration	■ LCSS Score – Low, meets KiwiRail Risk Criteria ■ Length of diversion route x volume – High length x volume, high impact ■ Fatal Return Period - Low ■ ADT – Medium High ■ Ambulance - <5km away, medium high negative effects ■ Masterton Hospital - <5km away, medium high negative effects ■ Fire - <2km away, high negative effects

Crossing ID	Location	Current Control	Location	Road Controlling Authority
1493	Akura Road	FLB	Masterton	Masterton District Council

➢ Sightlines on approach to crossing obscured by surrounding buildings and vegetation	▪ Police - <2km away, high negative effects ▪ Fire Station diversion route time two minutes longer ▪ Ambulance Station diversion route time is the same ▪ Short Stacking Risk – no risk ▪ Safe and Appropriate Speed – 20km/h speed differential ▪ Movement Function – Moderate movement significance, moderate negative effects ▪ ONRC Hierarchy – Primary Collector ▪ # crossings affected – 0 within 1km ▪ New Crossings criteria – 0 crossing within 1km radius so no alternative routes available within a reasonable distance ➢ Close to Masterton Station and access to carpark is on the RHS of the southern departure side ➢ No recorded history if incidents or near misses in the past 10 years ➢ Proposed Design and Future Score are Low Risk and both meet Criterion 1.

Whole of line effect

- Shortest diversion route is to Renall Street. 4423 vpd to be redistributed. Renall St has an existing ADT of 4273 vpd so it would effectively double traffic on Renall Street.
- Long diversion routes – to the north via Ngaumutawa Road is 2.4km, to the south via Villa St/Pownall St is 2.4km.

- **Conclusion: Do not close. Primary Collector road and alternative to SH2. Upgrades available to meet KiwiRail Risk Criterion 1.**
- Access to Masterton Train Station. Primary Collector linking Masterton town centre with rural areas to the north as an alternative to SH2.
- Low LCSS score and Low Fatal Return Period. No history of incidents or near misses. Upgrades to sightlines can be undertaken. Proposed Design and Future Score are Low Risk and both meet Criterion 1.

Appendix D - Rail Assessment Report

Level Crossings Risk Assessment

FOR

Aurecon

16/02/2024

Revision 1.0

NZ041-WLSA-001

JMD RAILTECH ENGINEERING Pty Ltd
Level 10, 51 Druitt St, Sydney, NSW 2000 – (02) 9299 5637 – **mail@jmdr.com**
www.jmdr.com

Disclaimers and Limitations

All JMDR engineering documents are periodically reviewed, and new editions are published, between editions, amendments may also be issued. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version including any amendments that may have been issued. Errors or omissions in this document should be reported to KiwiRail.

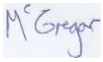
In preparing the Report, JMDR has relied upon data, surveys, analyses, designs, plans and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in the Report, JMDR has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. JMDR will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JMDR.

JMDR makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation.

Level Crossings Risk Assessment

Document Number	NZ041-WLSA-001
Prepared by:	Steve Boldeman
Date:	16/02/2024
Version	1.0

Authorisation of Report

Position:	Safety Assurance Manager	Position:	Principal Standards & Systems Assurance Manager
Name:	Steve Boldeman	Name:	Peter McGregor
Date:	16/02/2024	Date:	13/02/2024
Signature:		Signature:	
Position:		Position:	
Name:		Name:	
Date:		Date:	
Signature:		Signature:	

Document Control

Version	Date	Summary of Change
1.0	16/02/2024	Initial issue

JMDR

TABLE of CONTENTS

List of Tables

Figures

1. Introduction

1.1. Purpose (of this document)

This document reviews and discusses the safety for the whole of line for the WMUP 6B project for Wellington Metro. This safety assessment is concerned with the safety of level crossings in particular.

This report has been produced with the intention of being released to the general public of New Zealand. As such the structure, information provided, explanations, reflects this intention.

1.2. Exclusions

This report is not intended to be used as a safety report for the entire line, given all the signalling changes involved. This report focuses on the level crossing aspects of the rail safety, with particular regard to the risks associated with rail operation. It is not intended to be used as any of the following:

- A summary of safety assurance activities for the project
- A detailed review of the design
- A progress report on the project

This document also is not a comprehensive summary of the engagement with stakeholders performed for this project.

1.3. Overview of the project

This project has goals to upgrade the Wairarapa line from Maymorn to Masterton. The project is numbered WMUP 6B and is part of a series of projects intended to improve services provided within Wellington.

The project includes the following elements:

- Signalling upgrades
- Level crossing upgrades
- Points installation
- Track changes
- Some civil changes
- Roading changes at level crossings

Broadly the goals for the additional rail services are:

- To increase the daily services from Masterton to Wellington
- To increase the daily services from Wellington to Masterton
- To minimise delays to freight movements from Waingawa to Wellington port passenger traffic
- To raise the speed on the line to 110 km/hr, and thus provide for a travel time of 1 hour and 25 minutes for trips from Masterton to Wellington (and back again in another 1 hour 25 minutes)

Greater Wellington Regional Council has been funded by the federal government of New Zealand to procure the rollingstock needed for the expanded passenger services.

Some of the other project activities, unrelated to this specific project, but included in the overall program of work, include:

- Station upgrades

- Procurement of rollingstock
- Design of stabling at Masterton, Wellington or Levin Levin to accommodate the additional trains and services
- Design or construction of the proposed maintenance centre at Masterton
- Resolution of any safety issues associated with the Remutaka tunnel

There are a large number of existing level crossings within the project boundary. These level crossings have a mixture of different engineering controls over them, with some safety upgrades proposed.

1.4. Rail Systems and Operations

Rail systems are complex, require detailed procedures and processes to generate successful service operations. Rail systems are a type of heavy engineering, with the construction and maintenance of rail lines being extremely resource intensive. The installation of a rail line is a major endeavour, taking large commitments of time and money.

Notwithstanding the complexity of rail systems, they provide numerous benefits. These include:

- The ability to move large numbers of people quickly and efficiently
- The quality of the ride can be extremely high
- The emissions and carbon footprint for rail services is often very low, although this varies significantly depending on the system in question
- Rail is an extremely safe transport mode, comparable to air transport

The presence of a high quality rail system in an area can transform the economics of that region, with higher growth, wages, and standards of living. Rail in many cases is seen as the “gold standard” for public transport, which can justify the large cost and time taken to construct these systems.

The concentration of so many people as passengers into one vehicle brings challenges. The risk of so many people concentrated into one vehicle means that the consequence of any accident occurring can be dramatically magnified. Risks within the rail system need to be managed carefully.

Rail lines can be at ground level, or elevated and above ground, or below ground. The vast majority of rail systems around the world are at ground level, although in large cities there has been a strong trend to build either above or below ground level. Where level crossings are at ground level, access across them is needed. This can be provided by level crossings, or bridges over the track, or in subways under the track. Alternatively, where the track is raised road vehicles can pass underneath.

Where a level crossing is provided, these locations are a point of risk. Collisions between road and rail vehicles occur regularly, and there are deaths every year in New Zealand from these collisions. The safety risks with level crossings are quiet well understood.

Rail vehicles mostly operate with steel wheels on steel rails. Rail vehicles accelerate and decelerate slowly, due to the slippery surface between the two steel items. In many cases drivers of trains cannot see far enough ahead to be able to stop their vehicles ahead of a collision, and so need to be provided with information on what is coming ahead. This information is commonly provided through line side signals, which are the rail equivalent of a road traffic signal. The design, construction and maintenance of rail signals falls within the responsibility of an engineering discipline called “signalling”. The design and construction of level crossings, with lights and barriers is managed by the signalling discipline.

Much of the risk in an operating rail system and maintaining safe separation of trains is managed through the signalling system. The design of level crossings (with electric components) is one example.

As trains stop slowly, they cannot stop in time if they encounter an obstruction on a road level crossing. Whilst it can be easy for a road vehicle to move out of the way of a train, a train can do relatively little to stop in time. This is particularly the case for freight trains which may travel over 1km to finally stop from when the brake application to stop is made by the train driver

Rail systems can move both passenger and freight. The separation of these rail traffic types brings many benefits, but can be very expensive. The presence of both, heavy freight traffic, and passenger trains, can bring some challenges as freight trains are normally slower than passenger, and much heavier.

Risks at level crossings, for road vehicles, are typically managed through providing advance warning of the approach of a train. This is done through flashing lights, and in some cases, barriers. These measures do not stop a road vehicle from crossing a level crossing, a level crossing barrier is purely psychological, and will not stop a road vehicle other than a very small one (such as a cyclist).

The rail line from Wellington to Masterton in the rail industry is described as a regional line. Regional lines often link city centres to rural locations, with low traffic densities, and with stops spaced every 5 to 10 kilometres. Specific rail vehicles (rollingstock) are built to service regional lines, which have top speeds commonly of 130 to 160 km/hr. The current intention for the upgraded rail line for Wellington to Masterton is for a top speed of 110 km/hr.

1.5. The management of risk for rail systems and projects

Passenger trains and the rail networks and systems move large numbers of people, and this means that the consequences of an accident are significant. Accidents can involve injuries to death of dozens of people, and potentially even more. Complex and thorough methods and strategies have been developed to both assess and manage the probability of an accident and the consequences if an accident was to occur. Assessment methodologies vary from country to country, and from rail operator, however there are some broad principles that are almost universally deployed.

Rail systems are normally designed to be highly reliable with careful application of fail safe design techniques and operational principles to significantly lower the probability of accidents This is in part because of the significant consequences if an accident was to occur, but also because protecting passengers from harm is given a very level of importance. This can differ significantly from road transport, as private drivers have control over the vehicle, and are responsible for their actions. In practice this means that fatalities for road accidents may be perceived by the travelling public as more acceptable than accidents with passenger rail traffic.

The need to protect rail traffic from accidents means that specific rail asset solutions need to be implemented, as well as business processes. Any accident within a rail system is deeply scrutinised, to a level often consistent with a comparable accident in commercial aviation.

That said, the complete elimination of risks from a rail system is not possible. There is always some residual risk, and the reduction of this risk becomes progressively more difficult and expensive the smaller and more unusual it is . This is a well known characteristic of the management of risk for rail systems, and the complete elimination of risk is not economically feasible. There needs to be a level of balance between risk and cost, as all rail operators do not have infinite resources.

Level crossings are a key point of risk for any rail system. Road vehicles cross the rail line, which creates the risk of a collision. These can be fatal for the occupants of the road vehicle, and more rarely can cause fatalities to those on board the train, with the train driver being particularly at risk. Closing a level crossing improves the safety of the rail line, in exchange for increasing the road travel time for those living and driving around the rail line. Most if not almost all high intensity rail lines will have very few if any level crossings installed.

As New Zealand moves to a larger volume of rail traffic, there will be safety, regulatory and economic pressures to close more level crossings. This process may continue for an extended period, such as decades, and significantly impact road use within the areas where rail services are increasing.

Note that with increasing number of rail passenger traffic, almost all risk assessment methodologies deployed by different worldwide operators, when applied to the Wairarapa, will recommend increasing numbers of level crossing closures.

1.6. Economic opportunities for rail transport in the Wairarapa

The opportunity, and the economic benefits of, expanding rail transport into the Wairarapa appear to be clear. The rail line from the Remutaka tunnel, through to Masterton, is very flat, long and straight. This allows for fast and efficient rail travel.

The Remutaka mountain range poses a significant physical barrier for road travel both to and from the Wairarapa to Wellington. The road over the mountain range has an elevated risk profile, and it is slow and time consuming to cross. It has a long and winding road that has many points of risk, and has persistent fog and inclement weather. Rail transport is far easier, as there is a rail tunnel that is long, straight and direct from the Wairarapa through to Maymorn.

The existing rail line is clearly underutilised, and relatively inexpensive changes can result in substantial improvement to capacity. Current travel times can clearly be reduced substantially. This current project has proposed to reduce the travel time to 1 hour and 25 minutes between Masterton and Wellington, although it should be noted that it is possible for further reductions in this travel time.

Rail transport can be very energy efficient, and can be quick and cost effective. This however is achieved through giving trains the right of way through level crossings, and not imposing too many sections where the train needs to speed up and slow down. For efficient rail services, it is important that trains are not forced to frequently speed up and slow down, otherwise its much vaunted energy efficiency will not be achieved.

To achieve the full economic benefit for the expanded rail services, sufficient travel time reduction needs to be achieved to move commuters from road to rail transport. Faster travel times, with an expansion of the rail capacity in the Wairarapa, will bring economic benefits.

1.7. Role and responsibilities of KiwiRail/other parties

The overall objectives of the WMUP 6B project is to expand the rail services into the Wairarapa. This goal is an ambitious one, and requires coordination across several different government departments, organisations, and engineering disciplines.

KiwiRail is responsible for some of the infrastructure upgrades needed to achieve this goal. KiwiRail is the rail infrastructure owner, and coordinates the management of rail infrastructure such as

signalling and track. KiwiRail is managing many of the infrastructure upgrades, but not potentially all, and is the responsible party for the work presented here. The level crossing changes, upgrades, and related changes, are being managed by KiwiRail.

The manager of the rail services will not be KiwiRail, but Greater Wellington Regional Council (GWRC). This organisation is also responsible for the station upgrades, where applicable. The operator of passenger rail services at this time is Transdev, but the ultimate responsible party for passenger services is GWRC.

As part of the overall goal to increase rail services, new rollingstock is being procured. At the time of writing this report this procurement which has only just commenced will be managed by GWRC. As part of this process, there is an intention to build a maintenance centre to service the new rollingstock. One of the proposed sites for the maintenance centre is Masterton, but this remains to be decided. As a consequence the final design for the track layout at Masterton is still undecided. This may mean that the risk assessment may need to be updated where changes are made to the rail line within the Masterton area.

Once the Masterton line is upgraded, the following organisations have the following responsibilities:

Category	Participant
Stations maintenance	Councils
Track and signalling maintenance	KiwiRail
Freight train operator	KiwiRail
Log freight terminal	Centreport
Passenger service operator	Transdev
Rollingstock maintenance (passenger)	Rollingstock company to be chosen
Rollingstock maintenance (freight)	KiwiRail

TABLE 4 INDUSTRY PARTICIPANTS

2. Level Crossings and Risk

2.1. Overview

Level crossings are a location where road traffic can cross the rail line. A characteristic of level crossings is that road and rail traffic cross at the same grade, i.e., at the same height.

Rail traffic takes a long time to speed up and slow down, and so struggles to respond to obstructions on track in general, and especially those at level crossings. For example, a road vehicle broken down at a level crossing can easily be struck by the next passing train, even if the road vehicle is there for an extended period.

The presence of large numbers of level crossings allows for quick and easy crossing of the rail line close with only limited amount of delay to road users. Where there are only small number of level crossings, anyone that may need to cross the rail line will need to plan their journey with a focus on where to cross the rail line.

An example of a road level crossing is shown below. This one is located in Featherston, and has lights and bells but no barriers.

FIGURE 3 ACTIVE LEVEL CROSSING

Level crossings are divided into two main categories; pedestrian and road. Pedestrian crossings are designed for users of footpaths, and road crossings for small and large road vehicles. There are substantial differences between the two, the design philosophy and management.

Road and pedestrian crossings are further divided into two categories; active and passive. Broadly, passive level crossings have no electrical components, such as lights and bells. A passive level crossing will have such things as signs, kerbs, median strips, line marking, etc.

2.2. Road Crossings vs Pedestrian Crossings

Road crossings allow road vehicles to cross the rail line, pedestrian crossings allow pedestrians. For this review a pedestrian could be any of:

- Pedestrians
- Cyclists
- People on mobility devices

- Mothers with prams/strollers
- Pedestrians with domestic pets
- E-Scooters
- Children on skateboards (or adults for that matter)

Not defined as a pedestrian are horses and their riders, or road legal motorbikes.

The image below shows a typical pedestrian crossing at Upper Hutt. Note the prepared surface to allow pedestrians to cross the rail track, the gate, and the fencing around it.

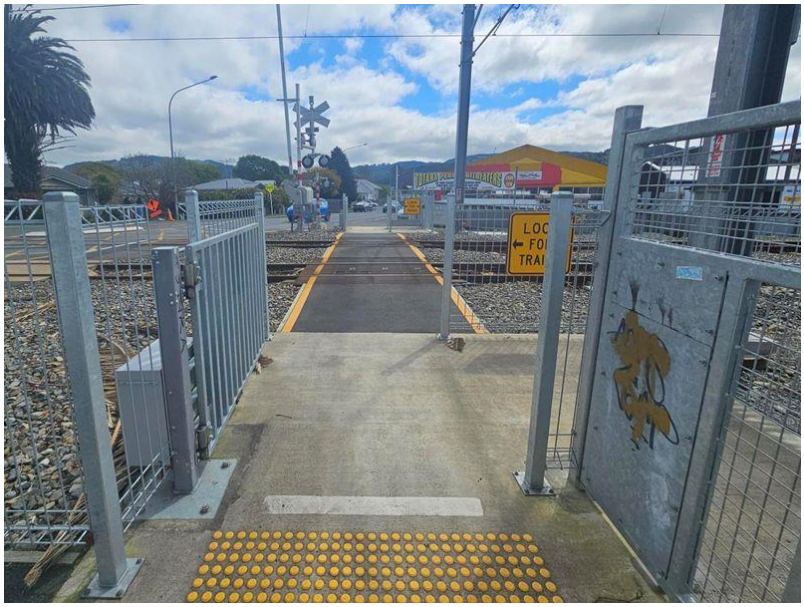


FIGURE 4 PEDESTRIAN CROSSING

Pedestrians are often allowed to walk alongside the road across a road level crossing, where there is no prepared pedestrian path. Whilst this is a very common configuration for road crossings, it is generally considered better if there is a separate pathway for pedestrians, and if needed, cyclists.

A major difference between a pedestrian crossing and a road crossing is that the pedestrian gate is strong enough to stop pedestrians. Barriers on a road level crossing are not designed to retain vehicles, and are there to inform the driver to stop. They do not have the ability to stop even the smallest vehicle, and if struck are design to break in a safe way (they are often described as frangible).

Where it is identified that there are a significant number of cyclists (or equivalent), the footpath can be widened to allow for them. When this occurs, the widened footpath is called a Shared User Path. There are other variants of footpaths to be used for cyclists (and equivalent).

Pedestrian crossings are also designed to allow for those with disabilities. Mobility vehicles need to be able to cross the pedestrian crossing smoothly and efficiently, without any risk of being caught or trapped over the rails or elsewhere.

2.3. Managing Cyclists, E-Scooters and E-Bikes

Cycling has experienced something of a renaissance in New Zealand. With dedicated government focus, and renewed interest, cycling, and prepared paths intended for their use, has expanded significantly since 2010.

Greater Wellington has generated some maps of officially designated cycleways, which have been included in the Appendices. Note that no officially designed cycleway has been identified for crossing the rail line in Wairarapa, or even in Masterton.

There are several different types of accessways that can be provided for cyclists:

Right of way type	Description
Separated cycle path	Separate cycle path for cyclists only
Shared path	Pathway separated from the road which can be used by both cyclists and pedestrians
On road cycle lane	A separated cycle land intended only for cyclists
On road shared	Shared bus lanes

TABLE 5 CYCLEWAY TYPES

The New Zealand government published a declaration - *Power-assisted Cycles (Declaration Not to be Motor Vehicles) Notice 2013* that provides the basis for the rules described below.

A number of new vehicle types have entered the market, including e-scooters and e-bikes. These vehicles can under certain circumstances use either footpaths, or use cycleways. E-bikes are capable of speeds well in excess of that possible for unpowered bicycles, however, as long as these vehicles are under 300 watts, they are still considered to be “normal” bicycles.

An important distinction between e-bikes and low powered scooters is that e-bikes are intended to be powered by muscular energy, and scooters by motors. There is no maximum speed for an e-bike, although many different versions provide no further assistance once a specific speed is reached, typically 25 km/hr or 32 km/hr.

E-scooters can use footpaths, and are required to:

- Have wheels smaller than 355mm
- Are limited to power output on the motor to less than 300 watts
- Have only two wheels

E-scooters are not designated as bicycles, and are used in the same places as where pedestrians are permitted. This includes footpaths.

The image below shows the pedestrian crossing surface, and the implementation of “Velostrail”, which allows the safe crossing of the pedestrian crossing for mobility vehicles, bicycles, shopping trolleys, wheel chairs, and other such devices.

FIGURE 5 VELOSTRAIL ACROSS PEDESTRIAN CROSSINGS

2.4. Level Crossing Accidents in New Zealand

New Zealand has a large number of level crossings, the vast majority of which are managed by KiwiRail.

The table below lists the total number of fatalities for New Zealand at level crossings.

Year	Involving motor vehicle	Pedestrian	Cyclist	TOTAL
2014	5	0	0	5
2015	0	3	0	3
2016	0	6	1	7
2017	5	3	0	8
2018	2	2	0	4
2019	4	4	0	8
2020	2	2	0	4
2021	2	2	0	4
2022	1	4	0	5
TOTAL	21	26	1	48

TABLE 6 FATALITIES AT LEVEL CROSSINGS PER YEAR

The split between the different accident categories is:

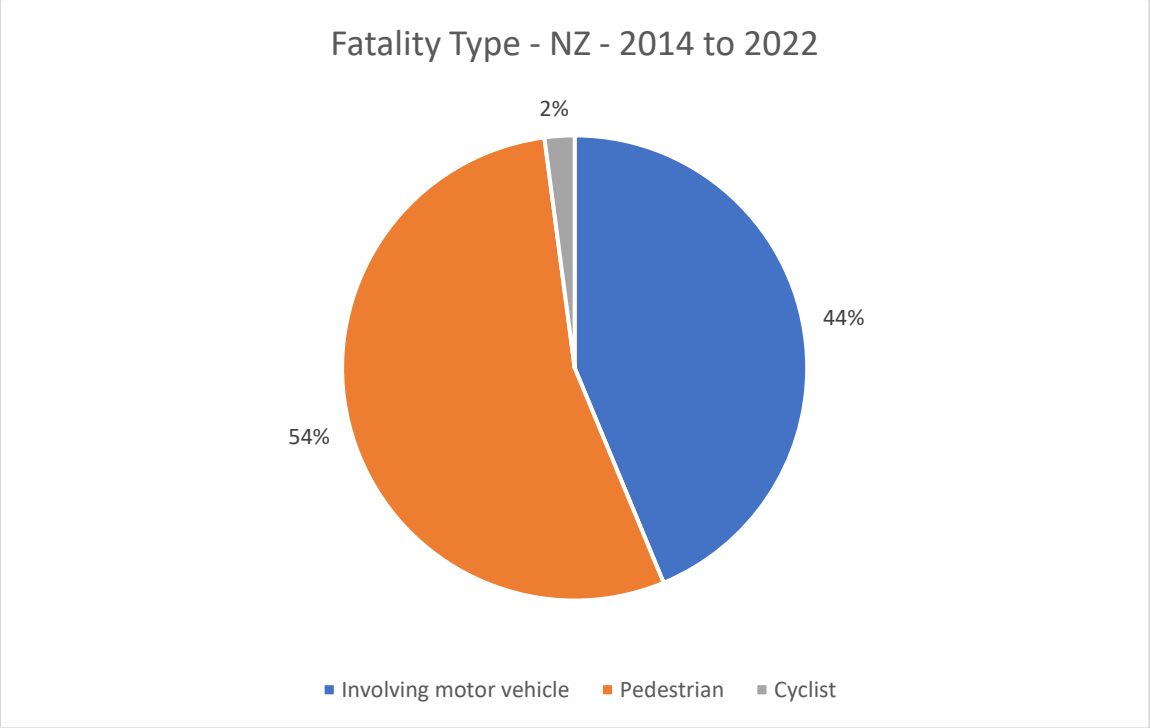


FIGURE 6 NEW ZEALAND – LEVEL CROSSING FATALITY TYPE

2.5. Consequences of an Accident

Any risk assessment needs to consider the consequences of an accident. The table below lists the different accident scenarios and what is considered to be the potential consequence of the incident. Note that this table does not suggest that this is always what happens, but is the worse case scenario.

Accident Scenario	Potential Consequence
Maintainer struck by broken barrier	Fatality
Maintainer struck by road vehicle when performing maintenance	Fatality
Pedestrian struck by train	Fatality
Cyclist struck by train	Fatality
Pedestrian struck by cyclist	Fatality
Cyclist struck by road vehicle	Fatality
Road vehicle (sedan/SUV) struck by train	1-2 fatalities
Truck (B doubles) struck by train	Up to 5 fatalities
Bus struck by train	Up to 15 fatalities

TABLE 7 LEVEL CROSSING ACCIDENT CONSEQUENCE

3. Current Configuration and Proposed Changes

3.1. Overview

The Wairarapa line is an old rail line initially constructed in the 1880's. It is currently in use for both passenger and freight services, with a small number of both per day. Passenger numbers are low, but there are plans for expansion and upgrades to the rail line to allow for faster and more frequent services. The line is narrow gauge, and mostly flat and straight, and makes its way through high quality farming land. The connection through to Wellington is through the Remutaka ranges, which is a mountain chain. This connection is through a long single track tunnel, which can only support one train at a time in one direction only.

The schematic below shows the Wairarapa rail line, with the tunnel marked in orange.

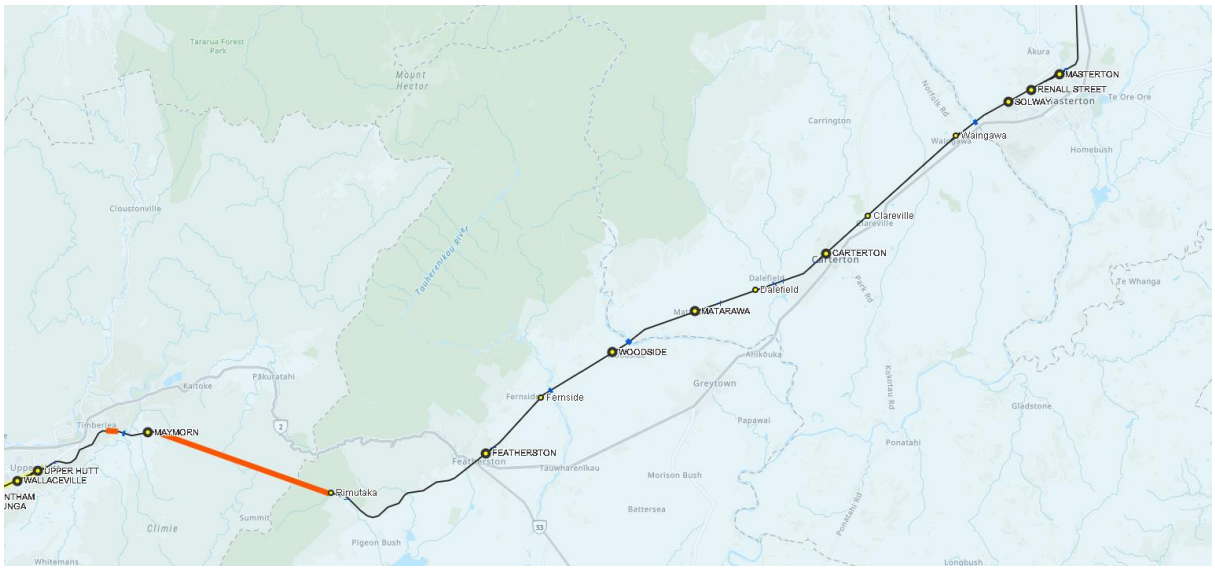


FIGURE 7 PROJECT BOUNDARIES AND LOCATION

There are three stations in Masterton town, which are relatively close together. All are currently in use, although Masterton is obviously the major station.

The Wairarapa line is an integral part of the Wellington passenger rail system. The map below shows the relationship of the line to the rest of the network.

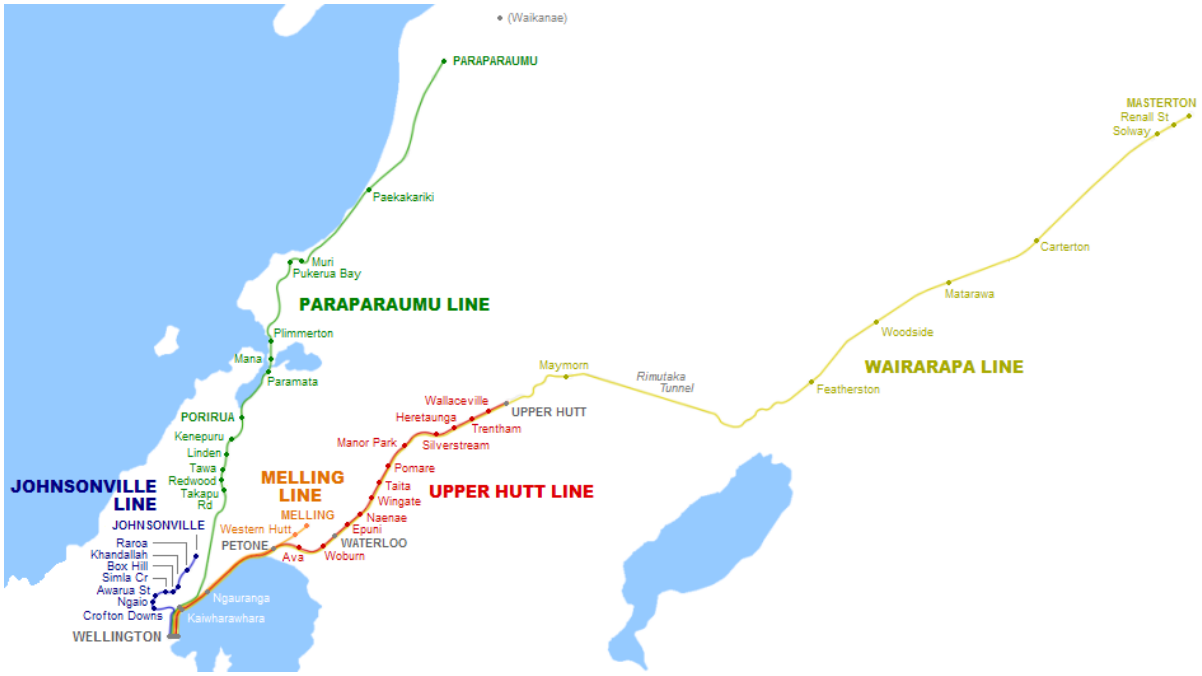


FIGURE 8 WELLINGTON RAIL SYSTEM

Rail services from Masterton travel along the Wairarapa line, and then along the combined Upper Hutt line, and then into Wellington. Rail services from Masterton run express from Upper Hutt, which means that they have limited stops upon reaching Upper Hutt. Note that the number of kilometres from Masterton to Wellington is higher than for any other station on the Wellington metro network. Masterton is approximately 91 track kilometres from Wellington.

The Wairarapa line is not electrified, and so there is no overhead wiring. There is no intention at this stage to put overhead wiring over the rail system in the Wairarapa, it will remain unelectrified.

At present the rail line can be described as:

- Single track, with a small number of loops where trains can pass one another
- Several stations, almost all of which are one sided.
- Numerous level crossings
- Line side signals
- Crossing loops
- Pedestrian crossings

There are numerous level crossings already installed into the project area. The schematic below shows the names of these level crossings, and their location.

FIGURE 9 LEVEL CROSSINGS

The Wairarapa line will be changing from a rural railway to a semi-urban line.

The level crossings have different protection over them, and this will be discussed in a later section.

The current track layout is shown below. Note that currently there is only one track, with a passing loop a Featherston, and stabling at Masterton. There are other smaller connections to the main rail line, which are not relevant to the current analysis and discussion.

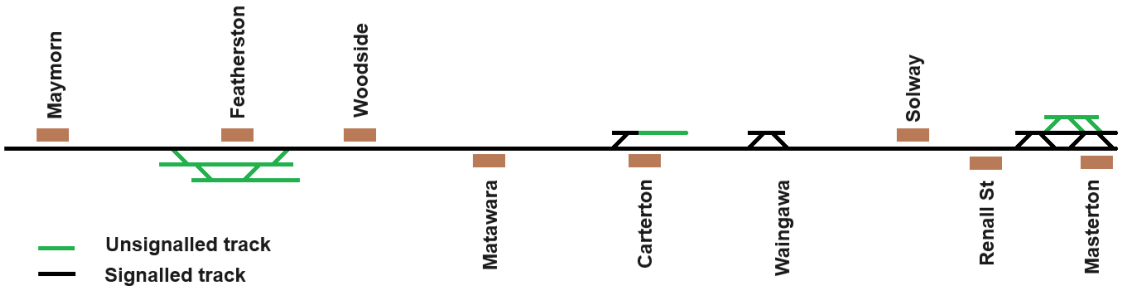


FIGURE 10 CURRENT TRACK LAYOUT

There is currently no intention for the project to complete any of the following:

- Elevating the rail line into a viaduct
- Double tracking the line
- Bridging out level crossings
- Expanding stations

3.2. Centreport Waingawa log hub

Centreport is a government owned port operator what provides a variety of different freight and maritime services around Wellington. This includes the loading and shipping of logs from the freight terminal at Waingawa, to send to the port at Wellington.

The freight terminal at Waingawa is the origin of approximately one freight trip per day. This trip is a return trip daily. The current plan is for this freight trip to occur outside of peak periods, so as not to interfere with peak passenger services.

The movement of logs by rail is significantly cheaper, and more environmentally friendly than moving the freight by road. The use of rail significantly contributes to the cost effectiveness of the export of logs from the Wairarapa.

There is not planned to be any freight for the Masterton line other than the movement of logs from Waignawa. Thus there is no expectation of freight movements through Masterton.

A need has been identified for trains to pass one another at Woodside. This has resulted in the identification of the installation of a passing loop at Woodside.

3.3. Level Crossings

There are a large number of level crossings currently installed into the Wairarapa line. These level crossings have been in place for a while, and have a moderate amount of road traffic over them. A small number of these level crossings are designated as High Productivity Motor Vehicle (HPMV) routes, and also some are designated as state highways.

At the time of writing of this report, there are currently 30 level crossings identified as being within the project boundary.

As the Wairarapa line is almost entirely single track, the vast majority of level crossings have only one track. A small number of level crossings are proposed to have an additional track, in which case some modifications are to be made to allow for the second track.

Many of the level crossings currently installed have no “active” protection, which is that there are electrical components that provide warnings to road users on the approach of a train. Providing lights and warning alarms is known to greatly improve the safety of any level crossing, and the current intention is for this to be done. Note that some of the existing level crossings have only passive road signs in place for protecting the level crossing.

At this time there are very few road bridges (grade separations) over the Wairarapa rail line.

3.4. The configuration of the Wairarapa line after the project

The Wairarapa rail line will be upgraded in the following way:

- The addition of loops
- Upgrades of level crossings
- Conversion of the track warrant section into a fully signallised rail line
- Addition of signals to allow for increased capacity

A passing loop allows trains moving in different directions to pass one another. A single line permits trains to only move in one direction, and this can be overcome with passing loops.

At this time, passing loops are to be installed in the following locations:

- Maymorn
- Waingawa

A number of level crossings have been identified to be closed. This report is intended to inform the decision on which of the level crossings are to be closed, and which are to remain open.

4. Risk Management for Rail Operators/Owners

4.1. Overview

Risks exist across any rail network, including the KiwiRail- rail network. Rail operators confront a wide range of different risks, and their management is a key activity. Risks change over time, and can increase or decrease depending on rail traffic movements, asset configuration, passenger numbers and environmental conditions.

Risk management is, in New Zealand, and many other English speaking countries, a mandatory requirement for the management of rail systems. Furthermore, the assessment of risk needs to be followed up with action to remediate and reduce these risks where identified. The legal approval of the right for rail operators to manage rail services will almost always be linked to formal business processes around the management of risks. KiwiRail, as with many other rail operators, has provided guarantees that these business processes will be applied, and any default may have serious legal consequences.

Some key categories for risk for a rail operator include:

- Cost
- Punctuality of rail services
- Environment
- Safety
- Business reputation
- Others

Common risks for a rail operation include:

- Rail traffic vehicles strike each other
- Rail vehicles derail
- Rail vehicles strike landslips or other obstructions
- Rail vehicles strike road vehicles at level crossings
- Rail vehicles derail at points/turnouts
- A rail vehicle strikes a pedestrian
- Rail vehicles strike maintenance vehicles

Safety risks are a critical component of the risk management process for any rail operator or rail maintainer. Safety risks, in an operating rail environment are impossible to eliminate entirely. This is consistent with any business, particularly for heavy industry, where there are large safety risks. They key process is to assess these safety risks, and then manage and reduce these safety risks professionally and efficiently.

In New Zealand, as well as other countries such as the United Kingdom, Australia, and the European Union, there is broad understanding that insisting upon the complete elimination of safety risks will produce perverse results. Many activities in society include risk, and some jobs include substantial amounts of risk. Obvious examples are construction workers, miners and forestry workers. Insisting upon the complete elimination of all risks would mean many people would never leave their homes.

Rail operators will attempt to manage risks to as low a level as possible. This process is limited by the resources available, including financial and technical resources. Risks can be addressed through projects, maintenance activities, better management practices, installing new systems, or large scale

asset replacements. Another risk mitigation is to implement operational rules to manage the way trains are operated, so that risks are managed to an acceptable level.

Rail operators will have many risks that would be preferable to reduce or eliminate. Risks should be reduced where possible, but there are almost always constraints on track access, finances, equipment availability, and skilled resources to complete risk mitigation projects. Changes to the rail system need to be prioritised so that the largest improvements can be achieved with the constraints on available resources.

Many of the risks within the rail environment are understood. Level crossings are a well known risk area. As discussed in Section 2, risks for level crossings in New Zealand are known and understood. KiwiRail has an active policy of working towards reducing the risk at level crossings where possible.

Where a rail line upgrade.project is launched, then there is an opportunity for many of the risks to be addressed. Currently, within WMUP 6B, the intention is for a number of changes to be made, including:

- Improved roading leading up to the level crossings
- Upgraded lights and barriers
- Installation of pedestrian crossings
- Improved sighting and visibility

Large projects such as this line upgrade provide the ability for rail operators to make sweeping changes to improve the risk profile for specific problem areas. A common issue raised with large projects, which are modifying existing rail assets, is achieving an acceptable level of risk reduction. In general, this problem is managed through the following:

- Designing to an engineering standard
- Contract documentation that identifies any potential future asset configuration
- Risk assessment processes, including Safety in Design Processes (SiD)

An engineering principle called SFAIRP (So Far as is Reasonably Practicable) is often applied to rail projects to guide the methodology and amount of resources to be applied in achieving risk reductions. This principle guides decision making on what improvements to make, and how much to spend. The application of the SFAIRP principle is well defined in legislation in the United Kingdom and Australia. The principle operates such that all plausible and practical controls should be implemented to reduce risk, where possible.

The subject of the current review is the risk associated with level crossings. The current situation is unusual in many respects, which will be discussed below.

4.2. Assessing Risk

A key step in managing risk is its assessment. High risks need to be managed with a high priority, and low risks are managed where possible. A key principle of any risk management is that resources, where available, should be applied in the most efficient way. Resources are always limited, and it is important what resources are available are applied to reduce risk as far as possible. This principle underlies the work described in this report.

Risks can be considered to be a combination of the following:

- The likelihood that the risk will be realised
- The consequence of the risk being realised

- The risk type; for example, is it a safety risk or a punctuality risk. Also, some risks are transient, and do not exist once an asset is put into service, for example.

A full assessment of all the risks includes an assessment of the potential mitigations that can be deployed to manage the risk. Mitigations are often referred to as “controls”. Where risks are excessive, then more controls may be needed. Where risks are deemed acceptable, or the cost of managing the risk is too high or excessive, then nothing more may be needed.

There are a variety of different methods to complete any risk assessment, and these tend to vary based on the industry, and to a lesser extent, the complexity. A large variety of different processes exist to assess risk, and which ones are used depends on the industry and the goals and processes in that industry. Risk management in the rail industry can be expected to be quite different from that in aviation, or in oil and gas.

Notwithstanding the methodology of the risk assessment, there are some broad principles that should be identified for any risk assessment process:

- Risks need to be identified for the consequence of the occurrence
- Risks need to be assessed for the likelihood of any occurrence
- Risks assessments are formally documented
- Risk assessments are performed by the designers of new equipment
- More serious risks, where possible, are addressed first

As a sample of the different ways of assessing risk, these include:

- Workshops
- Risk assessment methodologies, such as LOPA (Level of Protection Analysis)
- Processes described in standards, particularly New Zealand standards, and those generated by KiwiRail for use in their network
- Explicit estimation of risk
- Bespoke methodologies for specific risks
- Risk assessments for safety functions, particularly for SIL assessments
- Risk summary tools, such as Risk Bow Ties

This paper uses an explicit risk assessment methodology.

Given the large variety of different risk assessment methodologies, there is always a possibility that different methodologies will produce different answers. Hopefully, where possible, the application of different methodologies should produce similar results.

Th rail industry commonly approaches the problem of assessing risk in the following way:

- Standards are produced to regulate the way designs are created
- Design decisions are “pre-made” within different standards, for which a risk analysis is not needed
- Some designs standards provide for a variety of different design options, which need to be risk assessed

4.3. Risk Acceptance Principles

Complete risk reduction is a very expensive goal. The worldwide rail industry possesses many different engineering systems to reduce risk, and their deployment will effectively reduce risk, but costs can be prohibitive for any but the best funded rail systems.

It is incumbent on any rail operator to minimise risks as much as possible given the limited resources available. Rail operators cannot demand infinite budgets from central governments, and so need to make do with the funding as provided. This situation needs to be managed as professionally as possible.

Risk acceptance is the process of accepting risks that will often continue to exist indefinitely in a rail system. Risk acceptance means that risks have been formally accepted, and there is typically a formal process for this, especially within large projects. Risks are assessed and then categorised, and assessed for likelihood and consequence. Where possible there are hopefully many effective controls to be implemented that can manage risks to an acceptable level. Where this cannot be achieved, then risks may need to be accepted, in some cases higher than what a rail operator would prefer. These are referred to as residual risks.

It can be sometimes difficult to determine when risks have been reduced to an acceptable level. As some risks can be very expensive to eliminate, or even effectively reduce, this can often be a topic of heated debate. Commonly, a project will attempt to use what resources are available to manage risks to an acceptable level.

Notwithstanding the approach taken, it is important to have some clear guidelines on where to stop and accept risks.

Different rail operators have different rules on where to stop with additional cost and controls. These vary from country to country, and from rail operator to rail operator. Some of the different approaches include:

- Working to a clearly defined set of engineering standards
- Apply the same level of risk as in other installations on the same or similar networks
- Applying the SFAIRP principle
- Assessing risk formally, using Quantitative Risk Assessment (QRA) principles

In France a system called Globalement Au Moins Équivalent (GAMAB) is used. This process have some broad similarities with some of the other risk acceptance principles above. This risk acceptance principle has not been adopted in the English speaking world.

An older and very popular technique, that continues to be used (although discouraged) is the ALARP (As Low as Reasonably Practical) principle. This principle holds that risks should be managed to a level with a predefined acceptability level, and below this no further controls are needed. This technique tended to be very quick and easy to apply, and gave answers quickly and clearly, hence its popularity.

In the UK, Australia and New Zealand, the SFAIRP principle is commonly applied. SFAIRP stands for So Far as is Reasonably Practicable, and is a principle of risk acceptance. This means that the maximum amount should be done to reduce risk, even where risks are already low. Other risk acceptance principles would strongly suggest that where enough is done, nothing further is required.

Where risk acceptance is controversial, then the risk acceptance principle tends to be more complicated and detailed. Broadly, the SFAIRP principle is useful for the assessment and acceptance of complex risks, although much more detail can be needed to complete the process.

4.4. The hierarchy of controls

Risks are managed through the application of controls, which reduce the risk. Controls have a different level of effectiveness, and this is referred to as the hierarchy of controls. It is a hierarchy as

some controls are better than others, and the best type (or the most effective) type of control is to eliminate the hazard entirely, and the least effective is PPE (which stands for Personal Protective Equipment).

The hierarchy of controls is often drawn as below.

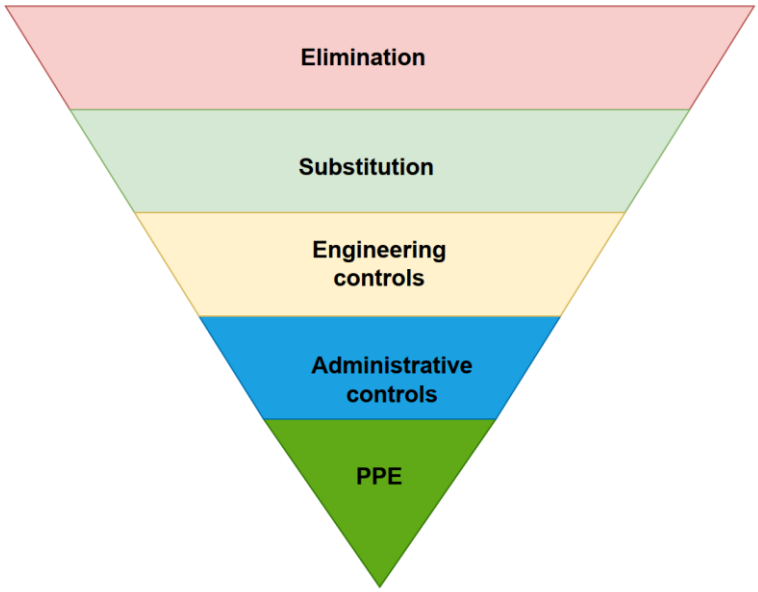


FIGURE 11 HIERARCHY OF CONTROLS

Note that the implementation of a level crossing, with lights and barriers, can be classified as an administrative control (or alternatively as a partial engineering control), as lights and barriers do not stop vehicles from entering a level crossing, only indicating that vehicles shouldn't enter the crossing. No physical barrier is provided to stop vehicle from entering the level crossing. Note that this is not the case for pedestrian gates, which are a physical barrier, and so are classified as an engineering control.

4.5. Risk tolerability

Risk tolerability refers to the willingness of a society or organisation to accept risk. Risk tolerability arises in risk work where different activities have different risk profile, and risks in one area are accepted, whereas in another would not be accepted.

The concept of risk tolerability arises where products and services are provided to multiple rail operators, across multiple jurisdictions. This principle can be used to determine what is acceptable for a wide variety of different assets and systems, and has been proven useful for product developers.

Risk tolerability can be assessed as a number of deaths per passenger kilometre. Risk tolerability can be extended to a variety of different metrics, such as the number of deaths per level crossing per year. It is noted in Section 7 that the overall level of deaths at level crossings in New Zealand is high, and this can be highly relevant to the acceptance of further risks. Governments will be highly unlikely to accept further risk increases where there is general unhappiness with the existing level of fatalities.

Notwithstanding all the different risk acceptance principles above, broadly the risk tolerability for a rail system within a country or for a specific rail operator should be applied. Any risk acceptance

process needs work within the confines of the overall risk tolerability that a country and rail operator will accept.

It is broadly accepted in this report that the level of crossing fatalities in New Zealand is higher than what a number of government departments consider acceptable. There has been sustained management action across a number of government departments in New Zealand for this risk category, and a clear and strong intention to reduce the number of fatalities, particularly at a national level.

4.6. Assessing the Consequence of Accidents

The potential consequence of an accident is highly relevant to the management of risk. Consequence of an accident is often assessed as being one of a variety of different levels, as identified below:

- Minor injuries of all types
- Serious injuries, with life affecting consequences
- Single fatalities
- Multiple fatalities
- Over ten fatalities
- Over 100 fatalities

Moving down this list, the consequences are described as being more severe. The level of acceptability for these different levels of consequence varies depending on the severity level. As part of the risk review and acceptance process, there needs to be a formal consideration of the consequence.

The level of tolerability for major accidents is extremely low, and should have a very low frequency of occurrence. It is noted that, where the consequence of an accident increases, the number of safety controls, and the level of integrity of these, is much higher. For assets installed into a rail system, the varying level of potential consequence of an accident can determine things like the design process, review and approval processes.

4.7. Contributing to the Risk

KiwiRail has access to a variety of different mitigations for the risk at level crossings, however, this is most effective where people intend to follow laws or directions. In many cases this does not happen, and people take substantial additional risk, and this can be very difficult to stop. Some of the behaviors that are very difficult to manage include:

- Trespassing into the rail corridor
- Pedestrians entering the rail corridor through a pedestrian crossing, and not exiting when a train approaches
- Drivers going around barriers
- Drivers ignoring flashing lights and driving onto the intersection
- Drivers ignoring cross-hatching and stopping across an active level crossing
- Pedestrians using the road to cross a level crossing, rather than using the footpath provided
- Drunk drivers

The current practice in the rail industry is not to have expensive asset solutions for illegal behaviour. There are a variety of reasons for this, including:

- The additional cost of managing these risks is substantial

- Resources need to be diverted away from protecting people who don't break any rules, who are more deserving of controls to protect them
- With measures to stop illegal behaviour, the perpetrators may find more ways to invalidate these controls, defeating them, making the implementation of the controls in the first place pointless
- The duty of care KiwiRail has for those committing illegals acts is clearly lower than for those that genuinely attempt to follow the rules

4.8. Application of Risk Management to WMUP 6B

As with any major project, the WMUP 6B project needs to assess risk and form a conclusion on the acceptability of risk. A formalised process needs to be applied, with a suitable methodology. The SFAIRP methodology will be applied, and then a determination made.

The management of risk in this particular instance has some unusual attributes. For example, the risk associated with so many level crossings on a rail line with increased rail traffic and increasing road vehicle traffic at level crossings is clearly somewhat high, and with each level crossing closure, there is a significant reduction of risk. Closure of all the level crossings will dramatically reduce risk, which is a desirable outcome for the rail operator. Alternatively, the impact of closing all level crossings to the local community would be substantial, and not "reasonably practical".

Even the closure of most of the level crossings would impose costs and time upon the local community. For the purposes of the SFAIRP principle, the local community is a legitimate stakeholder in the assessment of SFAIRP, and where a solution is chosen that is not practical for them, then it is not practical in general. Practicality needs to consider many different stakeholders, to varying degrees depending on who they are.

The case was made in stakeholder consultations that the closure of level crossings would result in large scale increases in risks for road users. This argument was not convincing at the time, (with some exceptions). It is however accepted that the economic impact to the local community may be significant, this is an entirely acceptable consideration in the management of and decision for the closure of level crossings. It is acceptable, under certain circumstances, to increase the risk or to accept high risks for a rail operator, where the economic benefit to the community is strong. This practice generally should be discouraged, and done only under very clear guidelines.

The need for KiwiRail to reduce risks to a SFAIRP level should be respected, particularly where a rational and fully informed SFAIRP assessment has been undertaken.

5. Road Vehicles and the Wairarapa Line

5.1. Overview

The WMUP 6B project will impact upon local roads in the Wairarapa region.

For the purposes of this review, we note the following about the road traffic profile for the Wairarapa:

- Most of the road vehicles are single occupant
- Most of the road vehicles are privately owned
- There are some commercial vehicles, and buses
- The road system in the Wairarapa is characterised by flat roads, relatively low speeds, and good visibility
- The road over the Remutaka is of elevated risk, winding, and often has poor visibility due to fog and other inclement weather

5.2. Accident Rates for roads in New Zealand

Broadly, there are widely differing accident rates for different transport modes. Road traffic users have a far higher risk profile than that for rail passengers, and this is a well reported feature of road travel.

Some statistics are provided below to confirm this. A variety of different reports have produced estimates of the rate of fatality for different jurisdictions and transport modes.

Broadly, these metrics are calculated from the following formula:

$$Fatalities\ per\ billion\ pas\ km = \frac{Number\ of\ fatalities}{No\ of\ pass \times No\ of\ years\ of\ data\ \times average\ trip\ distance}$$

The International Railway Safety Council provides the following statistics for the safety of different transport modes (for Europe)[4]:

Transport Mode	Fatalities per billion passenger kilometre
Airline passenger	0.08
Railway passenger	0.09
Bus/coach occupant	0.24
Car occupant	2.52
Power-two wheels (motor bikes and e-bikes, e-scooters)	36.41

TABLE 8 FATALITIES PER BILLION PASSENGER KILOMETRE

The formal BITRE Australian Infrastructure and Transport Statistics 2022 Yearbook provides the following for the fatality rates per billion kilometres[5]:

Transport Mode	Fatalities per billion passenger kilometre
Road	4.33

[4] https://international-railway-safety-council.com/safety-statistics/, sourced from the European Rail Agency

[5] https://www.bitre.gov.au/sites/default/files/documents/bitre-yearbook-2022.pdf

Transport Mode	Fatalities per billion passenger kilometre
Rail	1.17
Air	0.61

TABLE 9 AUSTRALIA FATALITIES PER BILLION PASSENGER KILOMETRE

Problems arise with the interpretation of the number of the number of rail deaths. Deaths in a rail system arise from a number of causes, including:

- Suicides
- Natural causes
- Vandals/trespassers killed during commission of crimes
- Falls on stairs
- Deaths to road users at level crossings
- Rail accidents

Each of these categories is different depending on the jurisdiction and rail operator. Suicides and deaths from natural causes, where the person dies in and around the rail system, are not counted in the fatality statistics, although this rule may not be consistently applied. Vandal deaths are often not counted, depending on the jurisdiction.

Falls on stairs are a significant cause of death in Australia. These are normally elderly people who are required to ascend or descend large flights of stairs. This accident cause is not considered to be relevant for WMUP 6B, as almost all stations are single sided, and where they are not, are connected from nearby roads and footpaths with pedestrian crossings.

A review from Europe found the following for rail accidents[6]:

Transport Mode	Fatalities per billion passenger kilometre
Rail accident only	0 85

TABLE 10 EUROPE FATALITIES PER BILLION PASSENGER KILOMETRE

From Australia (the state of Victoria), we have the following statistics[7]:

under consideration).

Table 3. Annual average fatality rates (F) across nine travel modes, Victoria, Australia 2012–2016.

Travel Mode	Fatalities per 100 Million Minutes		Fatalities per 100 Million Km		Fatalities per 100 Million Stops	
	Fatality Rate	95% CI	Fatality Rate	95% CI	Fatality Rate	95% CI
Car driver	0.19	0.16–0.23	0.37	0.30–0.45	4.05	3.31–4.90
Car passenger	0.16	0.11–0.21	0.30	0.22–0.40	3.01	2.18–4.06
Taxi passenger	0.00	0.00–0.60	0.00	0.00–1.4	0.00	0.00–13.42
Motorcycle rider	13.08	9.44–17.69	24.64	17.78–32.32	334.62	241.54–452.50
Pedestrian	0.20	0.14–0.28	2.83	2.01–3.87	2.38	1.69–3.26
Cyclist	0.34	0.16–0.64	1.83	0.86–3.46	8.42	3.97–15.88
Bus passenger	0.04	0.00–0.19	0.11	0.00–0.51	0.83	0.08–3.86
Tram passenger	0.00	0.00–0.15	0.00	0.00–0.72	0.00	0.00–2.40
Train passenger	0.02	0.00–0.07	0.03	0.00–0.12	0.42	0.04–1.96
Average	0.21	0.18–0.23	0.47	0.42–0.54	3.81	3.34–4.34

FIGURE 12 ROAD FATALITY RATES IN VICTORIA

[6] https://www.sciencedirect.com/science/article/abs/pii/S000145752100213X
[7] Source: Fatal and Serious Injury Rates for Different Travel Modes in Victoria, Australia, Sustainability 2022, 14, 1924. https://doi.org/10.3390/su14031924

As with the other sources, we note the extremely high fatality rate for motorcycle riders. This is consistent across multiple sources and studies.

This presentation was provided by the New Zealand transport department, and provides benchmarking across multiple jurisdictions[8]:

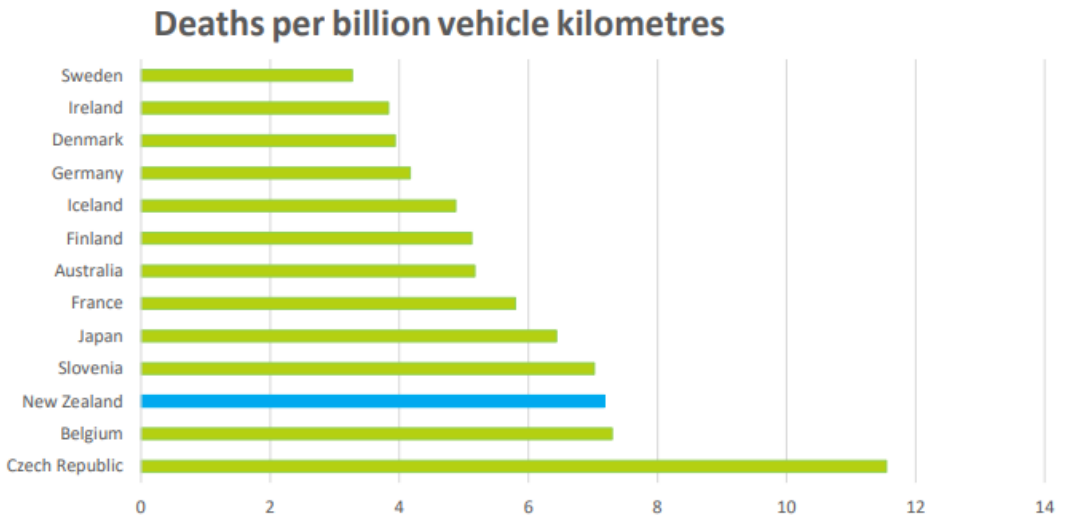


FIGURE 13 ROAD DEATHS PER COUNTRY – MULTIPLE COUNTRIES

New Zealand in the above figure there are approx. 7 deaths per billion passenger kilometres.

For New Zealand, for road transport, another source of accident statistics concludes[9]:

Road safety and traffic data

							2019 % change over			
	1990	2000	2010	2017	2018	2019	2018	2010	2000	1990
Reported safety data										
Fatalities	729	462	375	378	378	352	-6.9%	-6.1%	-23.8%	-51.7%
Injury crashes	12 818	7 830	10 959	11 245	11 690	11 750	0.5%	7.2%	50.1%	-8.3%
Injured persons hospitalised	5 718	3 054	2 881	3 334	3 384	3 367	-0.5%	16.9%	10.2%	-41.1%
Deaths per 100,000 population	21.4	12.0	8.6	7.9	7.7	7.1	-8.6%	-17.7%	-41.0%	-66.9%
Deaths per 10,000 registered vehicles	3.3	1.8	1.2	1.0	1.0	0.8	-15.9%	-31.1%	-55.0%	-75.9%
Deaths per billion vehicle kilometres	..	13.6	9.3	8.0	7.8	7.2	-8.0%	-22.3%	-47.3%	..

FIGURE 14 NZ FATALITIES PER BILLION PASSENGER KILOMETRE - ROAD

A figure of 7 deaths per billion kilometres for passenger road traffic will be used in the calculations below.

[8] https://www.transport.govt.nz/assets/Uploads/Presentation/Overview-of-Road-Safety-in-NZ-Data-packs-for-reference-groups.pdf
[9] https://www.itf-oecd.org/sites/default/files/new-zealand-road-safety.pdf

5.3. Accident Rates for rail in New Zealand

A detailed internet search for statistics for New Zealand has failed to reveal any published statistics on the fatality rate per billion kilometres for rail travel in New Zealand. This number will be produced from other information, including statistics on the number of fatalities for the rail industry, as shown below.

The statistics below were obtained from the NZ Transport Agency[10]:

			2014 Jan - Jun	2014 Jul - Dec	2015 Jan - Jun	2015 Jul - Dec	2016 Jan - Jun	2016 Jul - Dec	2017 Jan - Jun	2017 Jul - Dec	2018 Jan - Jun	2018 Jul - Dec	2019 Jan - Jun	2019 Jul - Dec	2020 Jan - Jun	2020 Jul - Dec	2021 Jan - Jun	2021 Jul - Dec	2022 Jan - Jun	2022 Jul - Dec	2023 Jan - Jun
Level Crossing Incident	Motor Vehicle	Fatal Injury	4	1	0	0	0	0	1	4	0	2	2	2	1	1	2	0	0	1	0
		Serious Injury	2	2	0	1	2	1	2	2	4	3	5	0	0	0	0	0	0	2	0
	Pedestrian	Fatal Injury	0	0	1	2	3	3	2	1	1	1	2	2	2	0	0	2	2	2	1
		Serious Injury	0	2	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	0	0
	Cyclist	Fatal Injury	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Serious Injury	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Non Level Crossing Incident	Motor Vehicle	Fatal Injury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Serious Injury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Passenger and public on platform	Fatal Injury	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Serious Injury	1	0	4	0	0	0	0	0	1	0	0	0	0	0	1	2	2	0	0
	Unauthorised members of the public	Fatal Injury	1	4	4	7	10	1	1	7	7	6	2	5	6	3	6	2	2	3	3
		Serious Injury	1	0	1	0	1	0	2	0	1	1	2	1	1	1	2	0	0	1	1
	Rail Personnel	Fatal Injury	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Serious Injury	2	0	2	2	1	0	0	1	2	1	2	0	1	3	0	3	2	1	3
Total		Fatal Injury	5	5	5	10	14	5	4	12	8	9	6	9	9	4	8	4	4	6	4
		Serious Injury	7	4	7	3	4	2	4	3	8	7	9	1	3	4	4	5	4	4	4

FIGURE 15 NEW ZEALAND RAIL FATALITIES

To calculate the fatalities per billion kilometres for New Zealand, we use an estimate of 800 million passenger kilometres in 2022, and assume that 700 million passenger kilometres as an average for the entire time period. Given there is only one rail fatality for the entire period of 9.5 years, this provides the following estimate:

$$Fatalities\ per\ billion\ km = \frac{1}{9.5 \times 0.7} = 0.15$$

The statistics below are provided from an analysis is Australia, and include New Zealand[11].

5.4. Transitioning from Roads to Rail

For this review, an estimate will be provided for the improvement in safety (for passengers) when there is a transition from road to rail. For this analysis, we will assume the following:

- Future rail passengers move approx. 60 km, from the Wairarapa, to Wellington
- This movements occur only on work days, so approx. 250 days per year
- A passenger that moves from the Wairarapa to Wellington in the morning also returns home by rail
- Weekend travel will not be included

So, the number of lives saved per year, based on the above scenario:

[10] https://www.nzta.govt.nz/assets/resources/rail-safety-statistics/rail-safety-statistics-end-30-jun-2023.pdf
[11] https://www.bitre.gov.au/sites/default/files/documents/international_comparisons_2020.pdf

Parameter	Value
Passengers	1000
Kilometres per trip	60
Trips per day	2
Work days per year	250
Kilometres travelled per year	30,000,000
Deaths (road) per billion km	7
Deaths (rail) per billion km	0.15
Difference in fatality rate	6.85
Lives saved per year thousand passengers	0.2055

TABLE 11 PASSENGER LIVES SAVED FOR THE ROAD/RAIL TRANSITION

The estimate is that 1 life will be saved every 5 years, for only 1,000 people that transition. This is a remarkably high number, as each train proposed for the Wairarapa has a potential capacity of 600 passengers. With seven services per day, and a good level of uptake of the rail service for the Wairarapa, there could potentially be an even larger number of lives saved.

As a transport planner within the NZ government, transitioning from road to rail may be highly attractive from a safety perspective.

5.5. Level Crossing Accidents (road related)

The number of road related level crossing fatalities is given as below:

Year	Fatalities (road only)
2014	5
2015	0
2016	0
2017	5
2018	2
2019	4
2020	2
2021	2
2022	1

TABLE 12 PASSENGER LIVES SAVED FOR THE ROAD/RAIL TRANSITION

There are a total of 9 years worth of data, and 21 fatalities. This provides an estimate of 2.33 deaths per year, road related, for all New Zealand.

The table below shows the calculation of the yearly rate of fatalities, for roading, for level crossings, for New Zealand:

Parameter	Value
Number of level crossings	3000
Fatalities	21
Years of data	9
Fatalities per level crossing per year	0.00077

TABLE 13 PASSENGER LIVES SAVED FOR THE ROAD/RAIL TRANSITION

The rate of fatalities, per level crossing, is relatively low. More modelling will be generated below for the expected changes in fatalities based on the proposed changes to the Wairarapa line.

5.6. Asset ownership and level crossings

Government departments have different areas of responsibility, and these are clearly defined. It is important to review who the final asset owners are for the different assets installed relevant to this review. These are:

Area	Description
Rail corridor fencing	KiwiRail
Station slab	KiwiRail
Roads (not state highway)	Local councils
Road traffic signalling	Local council
State highways	Waka Kotahi
Track assets	KiwiRail
Signalling assets including level crossings	KiwiRail
Road assets around level crossings	Local councils
Power	KiwiRail

TABLE 14 ASSET OWNERS

KiwiRail, in the delivery of a major project, may decide to expand the above scope, and modify or install assets other than what is listed above. For example, KiwiRail is not responsible for road traffic signalling, but may opt to install road traffic lights at a particular location. Other government entities will be delighted to accept any improvements not funded by themselves directly, however, this is done on an ad hoc basis, and where this occurs, this should not be interpreted that KiwiRail has responsibilities extending beyond what they are tasked to do.

6. Pedestrian Accidents and Level Crossings

6.1. Overview

Road level crossings can include pedestrian crossings. Most of the level crossings in the Wairarapa do not have dedicated pedestrian crossings alongside them. The photo below shows a typical level crossing for the Wairarapa and New Zealand in general.

The current state of level crossings in the Wairarapa is that many of the level crossings do not have much by way of facilities for pedestrians. Many of the road level crossings have limited if any provision for pedestrians, and the photo below is characteristic of the configuration of level crossings in the Wairarapa.

FIGURE 16 A TYPICAL LEVEL CROSSING IN THE WAIRARAPA

In the project there has been a strong focus on the risks associated with roading accidents at level crossings. It is noted however that KiwiRail is challenged with higher than acceptable pedestrian fatalities at level crossings.

The rail industry in New Zealand, and Australia as well, have identified the risks associated with pedestrian crossings. One key problem is that pedestrians either don't notice, or ignore, warnings about approaching trains. Numerous videos, and CCTV footage, show pedestrians crossing a pedestrian crossing with a train approaching. This problem is very similar to the problems encountered with Light Rail as a rail transport mode, where pedestrians are not looking where they are going.

To counter this problem, the current philosophy is to put pedestrian crossings, with warnings, to protect pedestrians. This solution is composed of the following:

- Active warning lights to indicate the approach of a train
- Fencing to direct pedestrians onto the footpath
- Gates that close to prevent pedestrians from accessing the rail corridor when a train is approaching
- Other fencing to prevent pedestrians from going around the pedestrian crossing

- An emergency release button to allow pedestrians on the track to escape if the gates close when they are in the middle of the track
- Nice smooth footpaths with clearly indicated linemarking
- Special pads or other structures to prevent wheels of a different variety of wheeled items from being caught next to the rail

These controls are considered to be very effective in reducing the risk. The photo below shows the proposed asset solution for pedestrian level crossings.

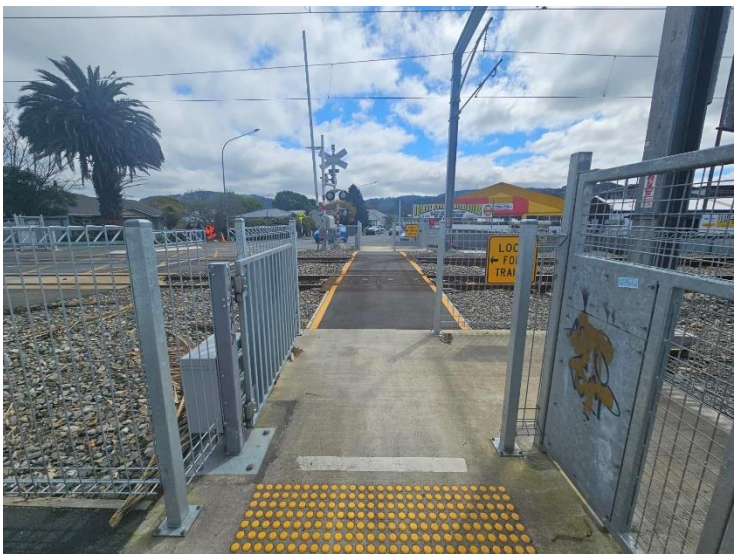


FIGURE 17 A PEDESTRIAN LEVEL CROSSING AT UPPER HUTT

Note that for this level crossing, there is a bitumen crossing across the rail track. There is a lot of fencing for a modern pedestrian crossing, which directs pedestrians to the correct place.

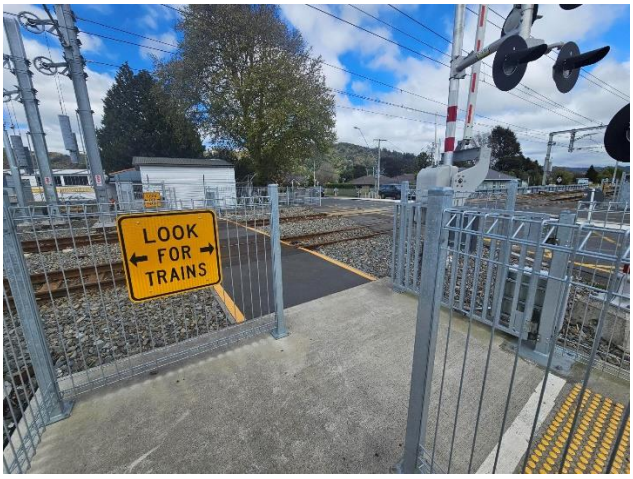


FIGURE 18 A PEDESTRIAN LEVEL CROSSING AT UPPER HUTT

Pedestrian crossings have automatic gate, which closes when needed. This gate is sufficiently strong to prevent unauthorised incidental access to the rail corridor.

6.2. Managing Pedestrian Flows

Pedestrians are smaller and less heavy than road vehicles, so the installation of fencing is very effective in managing pedestrians and where they walk. Modern rail fences in New Zealand are very

rigid, and have sufficient structural strength to stop any but the most determined pedestrian. Gates can be forced, but this requires a lot of strength and determination, and is something that would only be done by a pedestrian determined not to follow the path set out.

Vandalism is a genuine problem for many rail operators. Vandals can have multiple intentions, including the desire to graffiti the sides of trains or other infrastructure. It is typically very difficult, and not viable from an economic perspective, to make the rail system safe for vandals. Most rail operators attempt to minimise vandalism, although there have been some attempts made to corral vandals into less dangerous places in some rail systems.

This principle extends to those pedestrians that willingly and knowingly enter the rail corridor without permission. It is difficult to prevent this, and it is can be common depending on the location. It should be observed however that the duty of care to those that trespass into the rail corridor is lower than for those who follow the rules provided for them.

6.3. Bikes and E-Scooters

In some circumstances bikes and E-Scooters are permitted to use footpaths. Below are notes on the proposal for where these shall be used for the 6B project.

The table below indicates which of the different cycleway access strategies have been deployed in the WMUP 6B project.

Right of way type	Description
Separated cycle path	None
Shared path	Five currently identified for WMUP 6B
On road cycle lane	None
On road shared	None

TABLE 15 INTENDED APPLICATION FOR WMUP 6B

It can be noted that the Wairarapa typically has wide streets, and there may be relatively little need for dedicated cycleways on roads.

The risk of cyclists colliding with pedestrians on level crossings has not been explicitly considered in this report.

7. Short Stacking and Level Crossing Accidents

7.1. Overview

Short stacking is a level crossing road layout configuration where the distance between a rail track, and the limit line on the road is less than a desirable amount. In a short stacking situation, a road vehicle can pull up at the limit line and then be sitting across the rail line. In severe cases, the driver of the road vehicle may not even be aware of the approach of a train on the rail track, as the front of the vehicle has passed the level crossing.

A typical short stacking configuration is shown below as a general case.

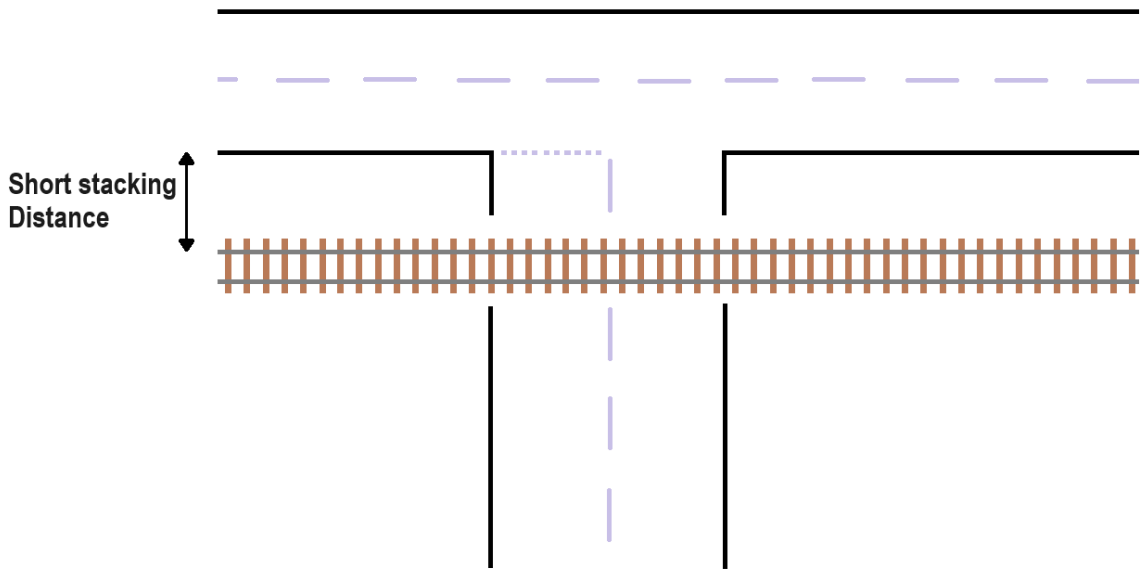


FIGURE 19 A TYPICAL LEVEL CROSSING IN THE WAIRARAPA

The distance between the limit line and the closest rail track should where possible be greater than 30 metres. This allows for some tolerance with where the driver of the vehicle may stop in and around the limit line.

A number of accident scenarios are possible. For example, there is the obvious case of where the driver pulls up at the limit line, and then is struck by a train. Alternatively, a road vehicle may pull up behind another road vehicle stopped at the limit line. Another accident scenario is that a large vehicle stalls at the limit line, and then not able to pull away when a train approaches.

Level crossing accidents, where they are fatal, frequently result in the death of one or two people. In a collision between a large train, and a small passenger sedan, it is the sedan that suffers most of the damage, and whilst the damage to the front of the train may be significant, this is only small relatively speaking compared to the damage to the sedan. It is typically the road vehicle that suffers most of the damage, as they are almost always much lighter and smaller than a train.

This risk is of particular concern for Judds road.

7.2. Discussing Judds Rd

Judds Rd is a level crossing located in urban Masterton, and is severely short stacked. There is only 13 metres between the limit line, and the closest rail track. This is a very short distance, and for many rail operators (in Australia at least) this configuration would be unacceptable.

Judds Rd has been the subject of major community action for the level crossing to remain open. KiwiRail has flagged the intention of the project to close the level crossing entirely, and this has been met with some concern from the local community.

7.3. Vehicle Lengths in New Zealand

The following table was consolidated from Vehicle and Dimensions Mass 2016 Rule 41001/2016[12]

Vehicle type	Maximum length (metres)
Towing vehicle, full trailer, pole trailer (excluding load)	11.5
Simple trailer	12.5
Rigid vehicle (not towing)	12.6
Rigid bus	13.5
Articulated buses	18
Towing vehicle and semi-trailer	19
Towing vehicle and full trailer – excluding load	20
Towing vehicle and full trailer – including load	22
Any other combination of vehicles	20
Vehicles that need approval from KiwiRail to use a level crossing	25
Proforma design HPMV – log truck	23.4
Proforma design HPMV – truck trailer combinations	23
Proforma design HMPV – B train	23

TABLE 16 MAXIMUM PERMITTED VEHICLE LENGTHS

As Judds Rd is shortstacked at 13 metres, potentially many of the vehicles listed above will be, when sitting at the limit line for the intersection, infringing upon the space in which the train moves (the kinematic envelope). This includes both rigid buses and articulated buses.

Below are some schematics highlighting the vehicle lengths involved. Three different vehicles are shown, including an articulated bus;

[12] https://www.nzta.govt.nz/assets/resources/rules/docs/vehicle-dimensions-and-mass-2016-as-at-1-may-2021.pdf

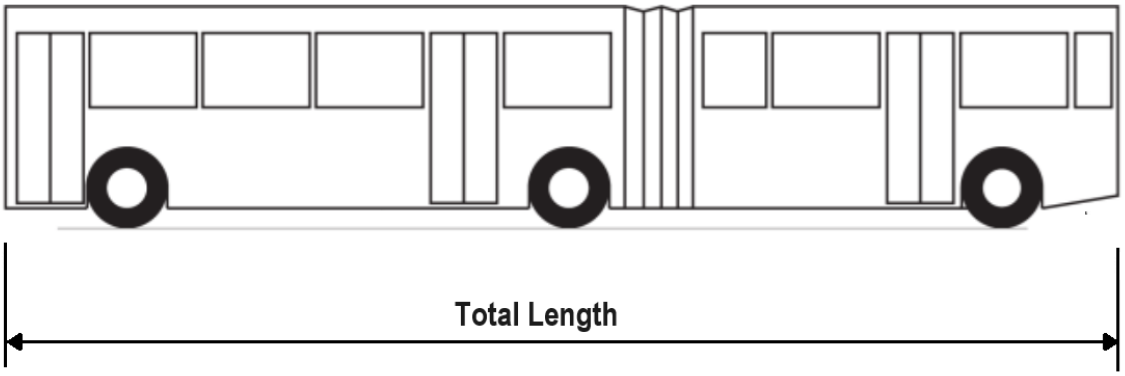


FIGURE 20 AN ARTICULATED BUS

So, for example, the articulated bus in New Zealand is permitted to have a length of up to 18 metres. This does not mean that all articulated buses are this length, but it does mean that some of them might be. This length is clearly longer than the short stacking distance for Judds road.

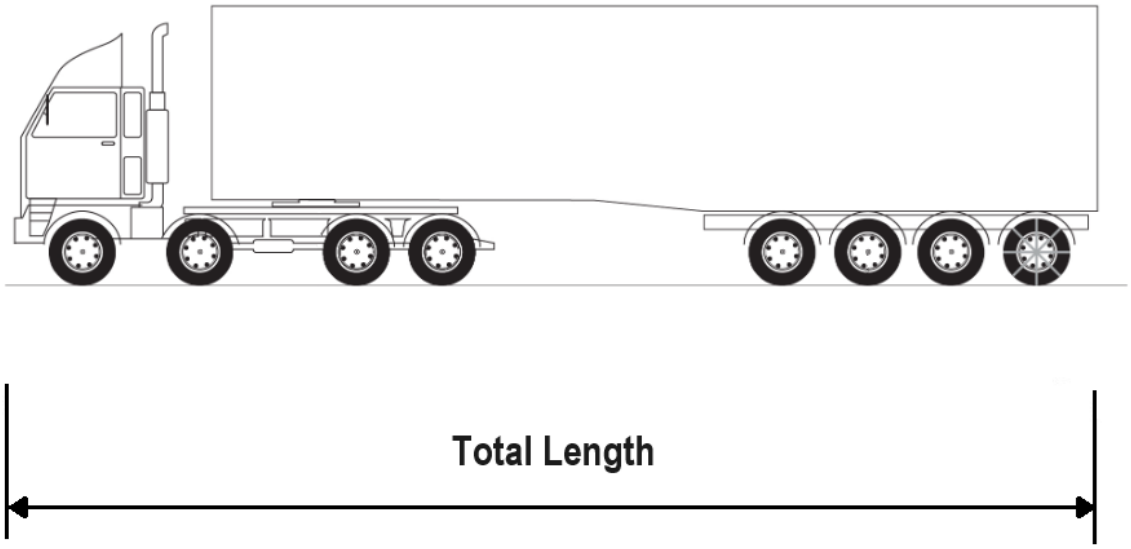


FIGURE 21 A TRUCK

For the vehicle type above, the maximum permitted road legal length is 22 metres, depending on the loading and a small number of other factors.

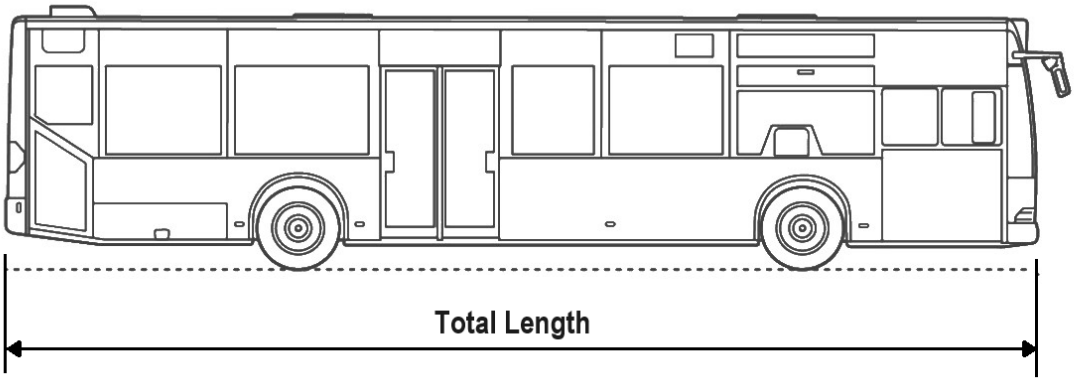


FIGURE 22 A RIGID BUS

The vehicle above is a rigid bus, the type commonly used for passenger movements, and for carrying school children. This type of vehicle is not articulated. Note that in New Zealand, it is permissible to have 3 children for every 2 seats, this is allowed for the purposes of efficiency.

This vehicle is very likely to be struck by an oncoming train, if stopped at the limit line for the road intersection. The outcome of this type of scenario depends on the exact positioning of the bus, how far into the intersection it is, and whether the bus is the full legal length or a little shorter than that.

7.4. Consequences

The consequences of a train striking a road vehicle laden with passengers can be high. In general while it is possible, it is unlikely that passengers on the train will be seriously injured or killed, but there have been cases of fatalities for the train passenger. Where a road vehicle has a large number of occupants, then the risk arises that there may be multiple fatalities. In bad cases this can be over 10 people.

A particularly severe example of a collision between a bus and a train occurred in France on the 17th Dec 2017. In this accident a bus passed onto a road level crossing as a train was approaching. In the subsequent accident, there were 6 fatalities, with all of them being young students.

FIGURE 23 REMAINS OF BUS AT AN ACCIDENT IN PERPIGNAN, FRANCE - 2017[13]

Note that in this accident the impact was so severe that the front of the bus is at 90 degrees to the rest of the bus.

This accident highlights the consequences of a large scale accident. In France there were a series of enquiries into the accident, with the then Prime Minister of France, Édouard Philippe, visiting the accident site.

Other major accidents around the world, in the last 14 years or so, including the one discussed above, involving buses at level crossings, include:

Country	Date	Deaths	Details
South Africa	25/08/2010	10	Minibus struck by train going around the booms
Argentina	13/08/2011	11	Driver of bus drove around barriers
Germany	19/12/2012	0	Two freight train strike stalled bus
US - Pennsylvannia	26/04/2013	1	Train hits bus
Canada	18/09/2013	6	Bus fails to stop at level crossing with active protection
Ukraine	4/02/2014	13	Bus ignored traffic lights
US - Texas	14/01/2015	10	US prison bus struck by train
US - Mississippi	7/03/2017	4	Freight train struck charter bus stuck on tracks
Russia	6/10/2017	16	Train struck bus
France	14/12/2017	6	Train struck school bus
US - New Jersey	9/07/2018	0	Train strikes bus
Serbia	21/12/2018	5	Train strikes school bus

[13] Photo sourced from https://www.thelocal.fr/20171215/france-perpignan-millas-deadly-train-crash-what-we-know-so-far

Country	Date	Deaths	Details
US - Texas	25/01/2019	1	Train strikes a school bus
Mexico	7/01/2020	7	Freight train strikes bus
Germany	24/05/2022	0	Passenger train strikes bus

TABLE 17 BUS ACCIDENTS AT LEVEL CROSSINGS

Note the number of fatalities, and there are a typically up to 10 fatalities, with more in Russia and Ukraine.

7.5. A Nation Defining Accident

Any accident where there are fatalities is a terrible tragedy, however, where there are multiple deaths, this type of accident is far more serious. A fatal accident where 10 people are killed is very serious, and a plausible accident for Judds road in Masterton. This kind of incident can have the most profound impact to a country, and there can be calls for inquiries, royal commissions, criminal charges, and major changes to the leadership position of different government departments.

After a major accident (involving fatalities) there are normally a series of investigations into the occurrence. These investigations can produce recommendations to improve safety, which in some cases can be overdue, but in others can be effective but expensive and time consuming to implement. Rail safety systems in rail systems can experience a lot of change after a terrible accident.

Major accidents (involving fatalities) bring other impacts as well. There can be a general loss of confidence in the use of a rail system, such that passenger numbers drop. Also, major accidents will bring foreign press and reporting, which can be adverse to the country where the accident occurred. All of these consequences are real, and need to be considered. It is far preferable to minimise the probability and avoid any potential accident.

Any accident that occurs at Judds road is foreseeable. The risk associated with the level crossing is known, but given the utility of the road, a preference has been expressed to see it remain open. Were an accident to occur at this level crossing, there would be a period of soul searching as to the occurrence, and will not be needed should changes to the level crossing be made, or it is closed entirely.

7.6. Discussion

The purpose behind the above discussion is to highlight the risks associated with Judds Road level crossing. This crossing is a special case within the overall project, and has been considered separately from all the others. The consequences of an incident at this level crossing are different to all the others within the project boundary.

Presenting the consequences in such as frank way is intended to demonstrate the real consequences associated with buses and level crossings. Judds Rd is short stacked, which represents a substantial increase in the risk associated with collisions between buses and trains. In the stakeholder consultation sessions with local councils, it was noted that Judds Rd level crossing is consistently used by school buses almost daily, which again raises the risk even further.

The shortstacking is severe enough that both rigid buses, and articulated buses can be struck by a train, even when the road vehicle is stationary at the limit line for the adjacent level crossing.

There are some factors that deserve to be mentioned that are relevant to a consideration of the risk at Judds Rd:

- The level crossing is located close to a station, and some trains may not be doing line speeds on approach to the level crossing
- There is relatively limited freight on this section of the Wairarapa Line
- The local community strongly believes that there is a significant impact to road traffic for the closure of Judds rd.

In terms of the other 30 level crossings within the project boundary, these level crossings have no specific risk factors that increase the baseline risk associated with accidents involving buses, and so have not been discussed any further here.

It has been proposed that road traffic signalling should be installed over the level crossing. Where this occurs, there is still the possibility that a bus may stall at the limit line, and be struck by a train anyway.

A number of potential mitigations can be implemented to reduce the risk over Judds Rd:

- Closure of the level crossing
- Installation of road traffic signalling
- Slewing the track
- Moving the station
- Speed restrictions
- Obstacle detection
- Installation of a slip lane
- Reconfiguration of the road as one way

There may be other potential solutions, in addition to ones provided above. There are many options for the reduction of risk at Judds Rd.

Overall it is very compelling to recommend the closure of Judds Rd. This crossing is unsuited to major rail operations in general, and has a configuration that is in broadly unacceptable. The desire of the local community to leave the level crossing open, whilst motivated by a desire to maintain a strong local economy, creates a risk that is almost definitely unacceptable in the long term. This is especially so where no meaningful mitigations are imposed over the level crossing.

In terms of the legal position of KiwiRail, their responsibilities extend to maintaining a safe rail system, and Judds road creates a significant risk.

8. Valuing Level Crossing Utility

8.1. Overview

Level crossings are an obvious point of risk for any rail operator. They allow road and rail vehicles to occupy the same space, and therefore creates the risk of a collision between the two.

A level crossing should only be installed where there is a clear need for one to be there. In general this means that the amenity of the level crossing is high, and so taking the risk is justified. As mentioned in other sections of this report, there is always some risk associated with operating trains, and at level crossing this cannot be reduced to zero, only mitigated.

The utility of a level crossing is closely tied to the usage. High use level crossings have a higher amenity, and those rarely used, have a low utility. Where a level crossing is provided to access properties that have no other access, then the utility can be high, even when the road traffic numbers can be small.

As part of this report an estimate was made of the economic utility of a level crossing, at a high level. Diversion distances are estimated from the distances between the different level crossings,

8.2. Estimated Diversion Distances

An example of the mechanism by which the diversion distance is estimated is shown below. Google maps was used to estimate the linear distances between a level crossing, and the nearest effective substitute. This estimation process is shown below for Brandon St and Revans St.

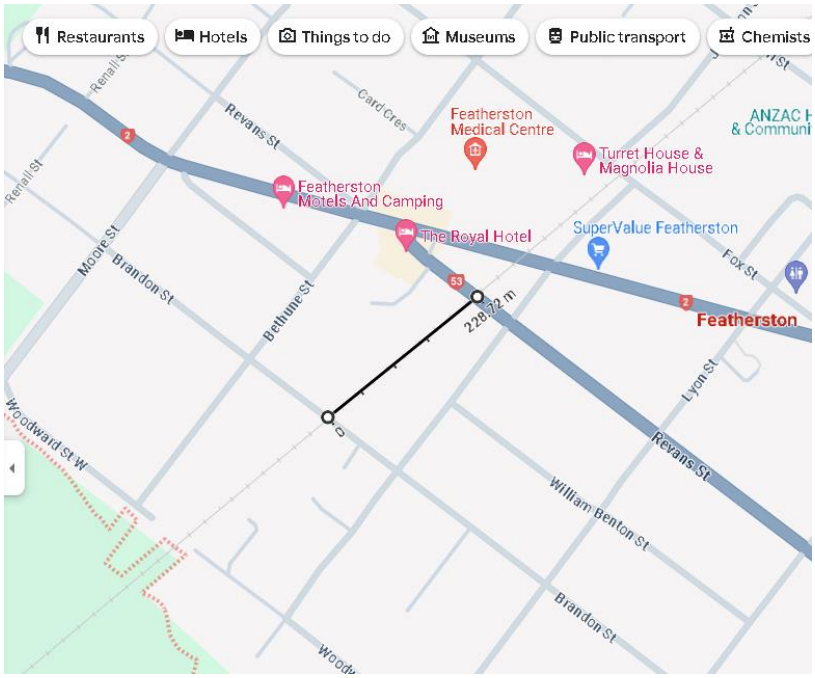


FIGURE 24 DISTANCE BETWEEN LEVEL CROSSINGS

For this calculation mechanism to be meaningful, the alternative level crossing needs to provide access to the vast majority of destinations that the other level crossing provides access to. The example above works well, as access for both level crossings is comparable, just the driving distances can be longer.

The above scenario can be compared with the scenario below:

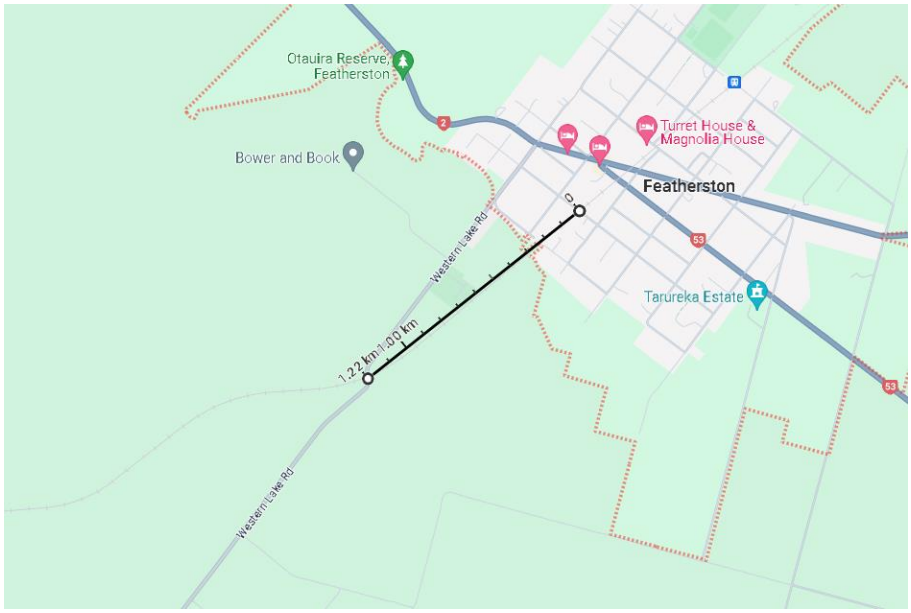


FIGURE 25 WESTERN LAKE AND BRANDON ST

The figure above shows the distance between Western Lake Rd and Brandon St. It can be seen immediately that Brandon St and Western Lake roads go in completely different directions, and Brandon St is not a very good substitute for Western Lake Rd.

Crossing ID	Location	Potential Alternatives
441	Western Lake Road	Western lake road is a lonely road with few real alternatives. The nearest alternatives are in Featherston and are a poor substitute.
446	Fitzherbert Street (SH2)	This is also the state highway, and there are alternative crossing points nearby. Note that as a state highway this road should allow for continuous road movements.
442	Brandon Street	Revans St nearby is an effective substitute as a road level crossing.
449	Fox Street	Both the nearby Bell St are effective alternatives for this level crossing.
452	Bell Street	Fox St is an effective substitute for Bell St.
444	Revans Street (SH53)	Fitzherbet st is an effective alternative to this road, which is also a state highway.
454	Matarawa Road	Matarawa Rd provides access to some properties for which any other access would be difficult.
457	Moffats Road	Watersons Line provides alternative access across the rail corridor, but is 1.7 km away.
456	Woodside Road	This level crossing provides the only meaningful access to a variety of properties, and Woodside station.

Crossing ID	Location	Potential Alternatives
460	Dalefield Road	Dalefield road has a few effective alternatives, that are over 1 km away. Hodders Rd, which is the closest road level crossing, is not an effective alternative.
1453	Lincoln Road	Lincoln road runs almost alongside the rail line. There are alternatives, which can be used, but the distances are quite large between them.
459	Hodders Road	Hodders Rd provides access to some properties for which any other access would be difficult.
1455	Victoria Street	There are effective alternatives to Victoria St as a level crossing, including Pembroke St.
458	Watersons Line	There are effective alternatives to this level crossing but they are over 1 km away.
1454	Brooklyn Road	There are effective alternatives to this road level crossing.
1483	Norfolk Road	This road provides good quality access to a variety of businesses alongside the rail corridor. Whilst there is an alternative in Wiltons Rd, the use of this road involves a very long detour, and is a poor substitute.
1482	Norman Avenue	Normal Avenue road level crossing provides the only access point to multiple businesses.
1467	Belvedere Road	There are high quality alternatives for this road level crossing.
1486	Hillcrest Street	There are high quality alternatives for this road level crossing.
1485	Judds Road	There are high quality alternatives for this road level crossing.
1470	Rhodes Street	There are high quality alternatives for this road level crossing.
1480	Chester Road	Access without Chester road is difficult, with the only other access to some properties through an unsealed road. Other access points are available, at a large distance from the road level crossing point.
1481	Wiltons Road	Access without Wiltons road is difficult, with the only other access to some properties through an unsealed road. Other access points are available, at a large distance from the road level crossing point.
1476	Andersons Line	Andersons line level crossing provides the only access to multiple properties.
1457	Pembroke Street	There are numerous high quality alternatives for this road level crossing.
1484	Ngaumutawa Road	Judds Rd is a good quality alternative for Ngaumutawa Rd.

Crossing ID	Location	Potential Alternatives
1490	Renall Street	Cornwall St is a good quality alternative for Renall St road level crossing.
1493	Akura Road	Alternative access across the rail line exists, but involves significant detours.
1473	Kent Street	Rhodes St is an effective alternative to Kent St level crossing.
1488	Cornwall Street	There are high quality alternatives for this road level crossing.

TABLE 18 EFFECTIVE REPLACEMENTS FOR LEVEL CROSSINGS

Using the process described above, and taking note of the availability of alternatives for the level crossing, the following table was compiled for the distances to the nearest available alternative:

Level Crossing ID	Street name	Council	Linear distance to next crossing (metres)
1470	Rhodes Street	Carterton District Council	180
449	Fox Street	South Wairarapa DC	160
442	Brandon Street	South Wairarapa DC	220
452	Bell Street	South Wairarapa DC	220
1455	Victoria Street	Carterton District Council	240
1473	Kent Street	Carterton District Council	180
1476	Andersons Line	Carterton District Council	1500
457	Moffats Road	Carterton District Council	1700
1454	Brooklyn Road	Carterton District Council	440
1481	Wiltons Road	Carterton District Council	1900
458	Watersons Line	Carterton District Council	1700
1467	Belvedere Road	Carterton District Council	350
1457	Pembroke Street	Carterton District Council	250
1486	Hillcrest Street	Masterton District Council	560
460	Dalefield Road	Carterton District Council	1200
1485	Judds Road	Masterton District Council	510
444	Revans Street (SH53)	Waka Kotahi Wellington	80
1453	Lincoln Road	Carterton District Council	450
441	Western Lake Road	South Wairarapa DC	1250

Level Crossing ID	Street name	Council	Linear distance to next crossing (metres)
446	Fitzherbert Street (SH2)	Waka Kotahi Wellington	80
1483	Norfolk Road	Carterton District Council	1900
1490	Renall Street	Carterton District Council	550
1493	Akura Road	Masterton District Council	1670
1480	Chester Road	Carterton District Council	4100
1484	Ngaumutawa Road	Masterton District Council	940
459	Hodders Road	Carterton District Council	N/A
454	Matarawa Road	Carterton District Council	N/A
1488	Cornwall Street	Masterton District Council	N/A
1482	Norman Avenue	Carterton District Council	N/A
456	Woodside Road	South Wairarapa DC	N/A

TABLE 19 EFFECTIVE DIVERSION DISTANCES

The distances to the next level crossing will be used as an input into the following processes.

8.3. Estimated Road Traffic Numbers (per day)

The table below lists the estimated road traffic numbers for each of the different level crossings. These numbers were in almost all cases extracted from the relevant LCSIA for the specific level crossing. In a very small number of cases the ALCAM (Australian Level Crossing Assessment Model) website was used as the source of the AADT numbers.

Crossing ID	Location	Council	AADT
441	Western Lake Road	South Wairarapa DC	1133
446	Fitzherbert Street (SH2)	Waka Kotahi Wellington	8603
442	Brandon Street	South Wairarapa DC	381
449	Fox Street	South Wairarapa DC	571
452	Bell Street	South Wairarapa DC	594
444	Revans Street (SH53)	Waka Kotahi Wellington	2559
454	Matarawa Road	Carterton District Council	74
457	Moffats Road	Carterton District Council	128
456	Woodside Road	South Wairarapa DC	585
460	Dalefield Road	Carterton District Council	380

Crossing ID	Location	Council	AADT
1453	Lincoln Road	Carterton District Council	1267
459	Hodders Road	Carterton District Council	44
1455	Victoria Street	Carterton District Council	570
458	Watersons Line	Carterton District Council	206
1454	Brooklyn Road	Carterton District Council	467
1483	Norfolk Road	Carterton District Council	1407
1482	Norman Avenue	Carterton District Council	870
1467	Belvedere Road	Carterton District Council	1170
1486	Hillcrest Street	Masterton District Council	1175
1485	Judds Road	Masterton District Council	961
1470	Rhodes Street	Carterton District Council	400
1480	Chester Road	Carterton District Council	1105
1481	Wiltons Road	Carterton District Council	154
1476	Andersons Line	Carterton District Council	144
1457	Pembroke Street	Carterton District Council	1693
1484	Ngaumutawa Road	Carterton District Council	3600
1490	Renall Street	Carterton District Council	4273
1493	Akura Road	Masterton District Council	4423
1473	Kent Street	Carterton District Council	1602
1488	Cornwall Street	Masterton District Council	846

TABLE 20 ADJUSTED AVERAGE DAILY TRAFFIC

The abbreviation “AADT” stands for Adjusted Average Daily Traffic, is the number of road vehicles and pedestrians crossing the level crossing. For the purposes of this work, the AADT numbers will be assumed to be all road vehicles.

Note that the traffic volumes are not high in comparison to a highly dense urban environment such as Auckland.

These numbers were collected in many cases at least 2 years from the writing of this report. It is possible that the traffic numbers may have increased by a few percent since the data relevant to each level crossing was collected. Nonetheless, these are the latest formal numbers available for road traffic numbers for each crossing.

8.4. Economic Impact of Closure of a Level Crossing

The purpose of road level crossings is to allow the movement of road vehicles across the rail line. The benefit of such a road crossing can be determined in terms of the number of road movements, and the distance to another crossing. Where there are other crossings nearby, the value of the level crossing may not be particularly high. Alternatively, where there are very few if any alternate crossing points, the economic benefit may be extremely high.

This of course assumes that there are multiple crossing points. In some cases there is only one access point across the rail line, and without the road level crossing there would be no access whatsoever to particular properties. These road crossings realistically cannot be closed.

This assessment can be performed on the basis of time needed to complete a crossing of the rail line. Additional time that is needed to complete a crossing comes at a cost. This can be modelled through using the effective additional time, and then applying a cost for this time. For the purposes of this review, a median wage for New Zealand was used.

Note that the analysis provided here is very high level, and it is possible to go into a lot of detail into the analysis. Some factors that could be considered include the wear and tear to road vehicles, and the cost for additional maintenance on roads for additional kilometres. This is balanced by the need for additional maintenance on the level crossing where it is installed. These effects are expected to be small in comparison to the time lost with alternative routes.

Where additional time is needed for a road user to cross the rail tracks, this additional time has an economic impact, as there are costs associated with this. For the purposes of this analysis a median wage of $31.60[14] was used.

The following process is used to determine the cost of diversion time:

$$Time = \frac{distance}{speed}$$

The extra distance travelled is:

Extra distance = AADT x diversion distance

So, for example, for Bell St, the extra distance travelled is:

Extra distance travelled per day = 0.22 km x 594 = 130.68 km

Per year the extra distance travelled is = 130.68 x 365 = 47,698.2 kilometres

The additional travel time is converted into a time, using a speed of 30 km/hr (as an average), yields the following:

$$Additional\ time\ per\ year = \frac{47{,}698.2}{30 km/hr} = 1589.94\ hours$$

The value of this additional time is calculated using a cost per hour, which is based on the median wage of New Zealand ($31.60 per hour):

Value of the additional time = 1589.94 x $31.60 per hour = $50,242.10

[14] https://www.stats.govt.nz/information-releases/labour-market-statistics-income-june-2023-quarter

This cost is incurred each year, into the future. Using a discount rate of 7% for costs incurred into the future, the value of the time, into the future, is given by:

Economic value of the crossing =

$$Economic\ value\ of\ crossing = \frac{\$50{,}242.10}{0.07} = \$717{,}744$$

The relative value of the crossing, compared to the upgrade cost, is given by the following ratio:

$$Cost\ to\ benefit\ ratio = \frac{\$717{,}744}{\$800{,}000} = 0.897$$

Where the upgrade cost is estimated as $800,000. In this case the cost benefit ratio is estimated to be below 1, so the benefit for the installation of the level crossing is less than the installation cost.

Using the same process, the Cost Benefit ratios are calculated and displayed in the table below:

Street name	Economic benefit	Upgrade cost (no closures)	Cost benefit
Rhodes Street	$395,451	$1,000,000	0.40
Fox Street	$501,784	$1,000,000	0.50
Brandon Street	$460,371	$800,000	0.58
Bell Street	$717,744	$800,000	0.90
Victoria Street	$751,358	$800,000	0.94
Kent Street	$1,583,783	$1,000,000	1.58
Andersons Line	$1,186,354	$700,000	1.69
Moffats Road	$1,195,142	$700,000	1.71
Brooklyn Road	$1,128,574	$600,000	1.88
Wiltons Road	$1,607,071	$700,000	2.30
Watersons Line	$1,923,432	$700,000	2.75
Belvedere Road	$2,249,130	$800,000	2.81
Pembroke Street	$2,640,462	$1,000,000	2.64
Hillcrest Street	$4,016,908	$1,000,000	4.02
Dalefield Road	$2,504,526	$600,000	4.17
Judds Road	$2,691,871	$800,000	3.36
Revans Street (SH53)	$1,124,400	$200,000	5.62
Lincoln Road	$3,514,575	$600,000	5.86
Western Lake Road	$7,778,585	$900,000	8.64
Fitzherbert Street (SH2)	$3,780,076	$400,000	9.45

Street name	Economic benefit	Upgrade cost (no closures)	Cost benefit
Norfolk Road	$14,682,782	$600,000	24.47
Renall Street	$12,907,919	$400,000	32.27
Akura Road	$40,568,978	$1,000,000	40.57
Chester Road	$24,883,232	$600,000	41.47
Ngaumutawa Road	$18,586,217	$400,000	46.47
Hodders Road	Not calculated	$700,000	Not calculated
Matarawa Road	Not calculated	$700,000	Not calculated
Cornwall Street	Not calculated	$1,000,000	Not calculated
Norman Avenue	Not calculated	$600,000	Not calculated
Woodside Road	Not calculated	$800,000	Not calculated

TABLE 21 ECONOMIC VALUE TO UPGRADE COST RATIO

Many of these level crossings have a very high economic benefit, and clearly should remain open.

Note these cost benefit numbers do not include the cost for disposal of the level crossing. Also note that there are costs associated with the long term management of the level crossing, which also have not been included. The analysis above is intended to provide some guidance as to the relative value of different level crossings.

The above list may be used as a priority list for which level crossings to close or to leave open.

9. Formal Risk Modelling

9.1. Overview

Formal risk modelling is required to assess the change in risk profile for various options for WMUP 6B.

The risk associated with the level crossings is composed of several components, and these are:

- The reduction in fatalities due to the transition from road to rail
- The reduction in fatalities due to the installation of pedestrian level crossings
- The reduction in fatalities due to the upgrade of protective elements such as bells and barriers at the level crossing

The approach applied in this report is for a formal modelling exercise (i.e. mathematical). No modelling is performed on the changes to road configuration, such as kerbing, line marking or signage.

For the purposes of this report, the focus will be on fatalities purely, and not on other types of injuries.

The approach to modelling will be as follows:

- Previous incidents and fatalities are analysed to determine the link between asset configuration, usage, and fatalities
- A model is constructed that links fatalities to configuration
- This model is then applied to estimate future performance

The model relies upon the principle that history repeats itself, and that past performance will continue into the future. In general this assumption is not an extreme one, and asset and safety performance in the past is very likely to continue into the future.

9.2. Rail Traffic Modelling

At the time of writing, rail services are expected to be:

- Seven passenger trains leaving from Masterton, in the morning, moving all the way to Wellington, on week days
- Seven passenger trains moving from Wellington main station to Masterton station, work days only
- Two passenger trains, to and from Wellington Station and Masterton, on weekends
- Two freight trains, moving from Centreport (Waingawa) to the port at Wellington, on both weekdays and weekends
- No allowance is made at this time for special event trains

Note that currently, there are bus services from Masterton to Featherston, at particular times of the day. The assumption is that this will not continue once the new rail services are introduced.

So the estimated number of services per day is:

Location	Weekday/weekend	No
Maymorn – Waingawa	Weekday	9
Maymorn – Waingawa	Weekend	4
Waingawa – Masterton	Weekday	7

Location	Weekday/weekend	No
Waingawa – Masterton	Weekend	2

TABLE 22 SERVICE LEVELS – PROPOSED

The current level of rail traffic is listed below:

Location	Weekday/weekend	No
Maymorn – Waingawa	Weekday	6
Maymorn – Waingawa	Weekend	3
Waingawa – Masterton	Weekday	5
Waingawa – Masterton	Weekend	2

TABLE 23 SERVICE LEVELS – CURRENT

This is relevant to the estimation of incidents and fatalities. The expectation is that the risk of a collision between a road and rail vehicle increases as the volume of both road and rail traffic increases.

After much internal discussion, it was decided to model 20 rail services per day for the new rail services. This is because:

- The current intention for rollingstock procurement is to source 7 new trains, which can easily provide many more services than that listed above
- The provision of new rail services to the Wairarapa is expected to be a big success
- The use of a higher number for rail services allows KiwiRail to provide more services into the future with the coverage of the formal risk assessment.

9.3. Pedestrian Accident Modelling

There is a strong expectation that the number of pedestrian fatalities will be reduced upon completion of the project. The current design intention, at the time of writing of this review, many of the level crossings will have dedicated pedestrian crossings installed for the use of pedestrians.

Below are the different types of level crossings in New Zealand. This information was current in Nov 2021.

Level Crossing Type	Count
Combined Pedestrian and Road	380
Pedestrian only	181
Road only	2488

TABLE 24 LEVEL CROSSING TYPES IN NEW ZEALAND – NOV 2021

Note that the vast majority of level crossings are for roads only, and there are far fewer pedestrian crossings than there are road crossings.

The number of pedestrian crossings will increase upon completion of the WMUP 6B project.

As noted in Section 2.4, there were 26 reported fatalities in New Zealand over a 9 year period. It is assumed that these fatalities occurred at locations where no pedestrian crossing was installed. It is

assumed there are approx. 400 road level crossings where pedestrians may cross. Based on this very rough estimation, the following calculation is provided of the fatality rate per road level crossing:

Parameter	Value
Fatalities (New Zealand)	26
Years	9
Fatalities per year	2.8889
Relevant level crossings	400
Fatalities per level crossing per year	0.007222
Number of urban crossings in 6B	17
Reduction in fatalities per year	0.123

TABLE 25 PEDESTRIAN FATALITIES AVOIDED

We observe that the estimated improvement in pedestrian fatalities is significant.

Note that in a small number of cases two pedestrian crossings are being installed into one road crossing. This is because there is pedestrian traffic on both sides of the road crossing. Provisionally, at the time of writing of this report, the level crossings with two pedestrian crossings being installed are:

- Rhodes St
- Fox St
- Cornwall St
- Kent St
- Pembroke St
- Hillcrest St
- Fitzherbert St
- Renall St
- Ngaumutawa Rd

Where this level crossing is flagged as closed, then only one pedestrian will be installed instead of two. The safety benefit of the reduction in pedestrian fatalities will still be achieved, as a pedestrian crossing will still be installed.

9.4. Structure of the Model

To estimate the number of fatalities from either the old or the new configuration, the following mathematical model will be used:

Fatalities per year per level crossing = no of near misses x % collisions x % fatalities x no of fatalities

Each of the terms in the above equation is:

Fatalities per year – the number of people fatally injured, for each level crossing

Near misses per year – a near miss is a potential accident that is reported through the KiwiRail incident reporting system. Near misses can be very common, and only a small number of these ever become accidents. Near misses greatly outnumber collisions, and of course fatal accidents.

% collisions – this is the percentage of all near misses that become accidents where there is a collision between a road and rail vehicle. The collision is where a rail vehicle comes in contact with a road vehicle. The collision does not need to have caused any injuries or fatalities.

% fatalities – this is the percentage of incidents where there was a collision, and resulted in a fatal accident. There can be one or more fatalities.

No of fatalities per accident – the average number of fatalities per fatal accident. This will be assumed to be 1.09 per accident, based on historical data.

For the purposes of the analysis here, it is assumed that 11.6% of all collisions result in a fatality. This number was generated from a detailed analysis of the incident data provided by KiwiRail.

The source of these numbers was a detailed investigation into KiwiRail's fatal accidents and near misses, completed in May 2022. This work was presented to an industry forum in July 2022 in Wellington. Further details are provided below.

9.5. Statistical Analysis

Two sets of data were obtained from KiwiRail, and these were:

- A list of all the level crossings and relevant attributes (such as road and rail traffic numbers)
- A list of all the near misses, including the incidents resulting in collisions and fatalities

As part of this data set information was included on the number of fatalities for each fatal accident.

The database of all level crossings was obtained in February 2022. The list of incidents covered the time period Oct 2010 to the 6th Sept 2021. The database supplied contained 2554 near miss/collision/fatality records.

The two databases were cross-referenced to consolidate the information into one single source. For each level crossing a tally of the different near miss and incident data was created, and then this tally was added to the level crossing attribute data.

The different attributes listed in the level crossing database included:

- Road speed limit
- Road angles
- Max train speed, in both the up and down direction
- Road width
- Average Annual Daily Traffic
- Daily train volumes
- Road surface materials
- Number of tracks

The number of near misses was found to corelate with a variety of different variables. The best and most useful representation of the number of the number of near misses is given by the table below:

Near miss estimation – yearly numbers			
	AADT (road traffic)		
Rail traffic (daily)	**0 – 100**	**101 - 1000**	**> 1000**
2 or less	0.01	0.03	0.06
3-8	0.02	0.05	0.12
9-20	0.03	0.09	0.18
>20	0.06	0.14	0.34

TABLE 26 YEARLY NEAR MISS ESTIMATION – YEARLY

These numbers were estimated for sealed roads only, unsealed roads is a different calculation and not discussed here.

One variable not considered here is the number of tracks. This parameter was excluded as it was highly correlated with the amount of rail traffic.

The next table is the key one for completing the calculation. The ratio of the number of near misses to the number of collisions was determined. This number was linked to the controls imposed over the level crossing.

Near miss to collision - rate	Conversion Percentage
Nothing	37%
Signs	32%
Lights	12%
Lights and barriers	7%

TABLE 27 YEARLY NEAR MISS ESTIMATION – CONVERSION RATIO

Note that the conversion drops as the control type is “upgraded”. A lower conversion rate is “better”, and a higher one “poorer”. We can also see that there is a large benefit in converting from signs, to lights, but a relatively smaller benefit to convert from lights to lights and barriers.

The physical meaning of the above table is that the controls are effective in reducing incidents, as there are fewer near misses that become collisions. The reduction is particularly dramatic for the transition from signs (passive protection) to lights (active protection).

9.6. Conversion Costs

Rough costs of the conversion from one control type to another is listed below:

	Starts with			
Conversion (to)	**Nothing**	**Stop signs**	**Lights**	**Lights and barriers**
Nothing	$0	-	-	-
Stop signs	$10,000	$0	-	-
Lights	$500,000	$500,000	$0	-
Lights and barriers	$700,000	$700,000	$600,000	$0

TABLE 28 CONVERSION COSTS

Note the particularly high cost of conversion from lights to lights and barriers.

Conversion	**Estimated Cost**
Installation of one pedestrian crossing alongside a road level crossing	$200,000
Installation of two pedestrian level crossings on either side of a road level crossing	$400,000
Closure of a passive level crossing	$50,000
Closure of an active level crossing, and replacement with a pedestrian level crossing	$400,000

TABLE 29 OTHER COSTS

These numbers shall be used for the estimation of cost benefit for the upgrades of the level crossing.

9.7. Judds Rd Collision Estimation

The frequency of accidents at Judds rd was estimated. This model operates in the following way:

- The number of services is estimated
- The number of buses per day is estimated
- The time the line is blocked per day
- The time the line is occupied by a train
- The frequency of both vehicles being in the same place at the same time is estimated
- The number of fatalities per year is estimated

Whilst it is possible for vehicles other than buses to be stuck by a train, the most serious incident is related to the collision between a bus and a train. This is the one that is used for the modelling here. As part of the modelling for the “standard” risk associated with the collision between road vehicles and trains, this is modelling in other part of the analysis presented here.

The calculations to estimate the accident frequency are listed in the table below:

Parameter	**Value (existing)**	**Value**	**Units**
Traffic per day (road)	1000	1000	
Each direction (road)	500	500	
% percentage buses	1.5%	1.5%	

Parameter	Value (existing)	Value	Units
Buses per day	7.5	7.5	
Waiting time at intersection	60	60	seconds
Blockage time per day	450	450	
Number of services per day (both directions)	10	20	
% time level crossing blocked	0.521%	0.521%	
% time level crossing lights stop bus entering when dangerous	20%	20%	
Effective blocking time	90	90	seconds
Train travel speed (effective)	50	50	km/hr
Train travel speed	13.88	13.88	m/s
Train length	200	200	metres
Time over level crossing	14.4	14.4	seconds
Time over level crossing per day	144	288	seconds
Seconds per day	86400	86400	
Collisions risk per day	1.73611E-06	3.47222E-06	
Years to collision	1578.08	789.04	Years
Lives lost per accident	10	10	
Lives per year (fatalities)	0.006337	0.01267	

TABLE 30 JUDDS RD ACCIDENT FREQUENCY ESTIMATE

The increase in risk has been estimated. Note that at present, there are only 3 services per day in each direction from Masterton, as buses are replacing some trains. This has not been factored into the assessment.

Again, the number of rail services has been set to 20, which is a little higher than what is currently proposed for the Wairarapa line.

9.8. Applying Absolute Limits on Risk Tolerability (Judds Rd)

Whilst the SFARIP principles does not permit the use of absolute limits on risk tolerability, internal discussions have suggested that this process would be helpful and should be applied.

Safety Integrity Levels are a commonly used technique to manage the effectiveness and reliability of safety systems. They are fully defined in standard set IEC 61508. The defined safety levels can be applied to a variety of different industries, including the rail industry. SILs are a very common safety management mechanism, with equipment designed for specific levels.

The use of SILs has been deployed in this review with the rate of dangerous failure being the benchmark. A SIL is a rating of the risk reduction of different asset systems, rated from 0 to 4, or

sometimes 1 to 4. Various standards discuss SILs, and they provide a level of acceptability for risk. Other methods exist to perform the same function, but this method is probably the best to apply in this instance.

Broadly, the level of risk acceptability, linked to a SIL, is listed in the table below:

SIL (level)	Acceptable rate of dangerous failures per hour
1	10^{-5} to 10^{-6}
2	10^{-6} to 10^{-7}
3	10^{-7} to 10^{-8}
4	10^{-8} to 10^{-9}

TABLE 31 SILS AND ACCEPTABLE RATES OF DANGEROUS FAILURES

Based on the calculation in Table 30, the level of SIL applied for the Judds Rd level crossing would be a 2. Now note that this application is not how the standard is intended to be used, rather this risk reduction is achieved through the application of asset strategies. However it is possible to apply these levels to determine a risk tolerability level, as is done here.

So how to interpret this result? Signalling as an asset class is often applied to various different operating railways, and JMDR is familiar with what is normally acceptable for a variety of different rail systems. As a rough guide, the table below lists what would typically be applied:

Application	Rail application SIL (typicals)
4	Mainline signalling for mixed use rail system
3	Rail signalling in remote/regional areas (typically limited or no passenger traffic)
4+*	High speed rail, long tunnels, high risk applications
2	Tunnel ventilation systems
1	Security systems
4	Level crossings in high use areas
3	Level crossings in regional areas (typically limited or no passenger traffic)
2	Coal loops, intermodal terminals, yard, etc

TABLE 32 SILS AND COMMONLY APPLIED LEVELS

*this level does not formally exist in the standards, but is useful from the perspective of safety for rail systems to note that in some cases more than SIL 4 is required.

As can be seen from the table above, the 2 rating would be on the low side. An alternative way of describing this is that the risk reduction associated with the level crossing at Judds Rd is less than what would normally be acceptable. Summary

The table below shows the totals for the various different scenarios.

Fatalities per Year – estimated – complete project				
Category	**Current**	**Do nothing**	**Proposed (no closures)**	**Proposed with level crossing closures**
Road Crossing	0.066	0.115	0.057	0.0515*
Judds Rd (short stacking)	0.006336	0.01267	0.01267	0
Pedestrian related**	0.13	0.13	0	0
TOTAL	0.2023	0.2577	0.0697	0.0515

TABLE 33 FATALITY ESTIMATE SUMMARY TABLE

*For the purposes of the table above, the following level crossings are assumed to be closed:

- Judds Rd
- Fox St
- Victoria St
- Rhodes St
- Brandon

** Akura Road is not having active pedestrian level crossing installed at the time of writing of the report.

The use of this list does not imply that the decision has been made to close these level crossings, this was done to demonstrate the change in fatalities per year for a specific example.

9.9. Discussion

The installation of a level crossing into a rail system almost always increases the risk for both rail and road traffic.

A key decision in whether to allow a level crossing to remain in place is the benefit to the local community. As level crossings are expensive high risk points, the argument for a level crossing to remain in place must be strong. Futhermore the economic case for the level crossing to remain in place must similarly be strong.

A review of the economic benefit of the pool of level crossings reveals that the economic benefit of a small number of crossing is lower than the cost to upgrade it. This can be because the volume of traffic is low, or there are alternatives in place that are close by and therefore specific level crossings offer relatively little benefit.

The review has been asked to provide a list of level crossings, in order, as recommendations for whether each should be left open, or closed. This is provided below:

Priority	Level Crossing	Recommendation
1	Hodders Road	Remain open, it's the only access road to a small number of properties
2	Victoria Street	Close
3	Rhodes Street	Close
4	Brandon Street	Close

Priority	Level Crossing	Recommendation
5	Fox Street	Close one of Fox or Bell
6	Andersons Line	Remain open, it's the only access road to a small number of properties
7	Bell Street	Close one of Fox or Bell
8	Matarawa Road	Upgrade and stay open
9	Judds Road	Close, or major work to reduce the risk associated with the short stacking
10	Dalefield Road	Upgrade and stay open
11	Revans Street (SH53)	Upgrade and stay open
12	Kent Street	Upgrade and stay open
13	Cornwall Street	Upgrade and stay open
14	Brooklyn Road	Upgrade and stay open
15	Western Lake Road	Upgrade and stay open
16	Belvedere Road	Upgrade and stay open
17	Moffats Road	Upgrade and stay open
18	Hillcrest Street	Upgrade and stay open
19	Lincoln Road	Upgrade and stay open
20	Pembroke Street	Upgrade and stay open
21	Norfolk Road	Upgrade and stay open
22	Wiltons Road	Upgrade and stay open
23	Fitzherbert Street (SH2)	Upgrade and stay open
24	Norman Avenue	Upgrade and stay open
25	Watersons Line	Upgrade and stay open
26	Renall Street	Upgrade and stay open
27	Chester Road	Upgrade and stay open
28	Ngaumutawa Road	Upgrade and stay open
29	Akura Road	Upgrade and stay open
30	Woodside Road	Upgrade and stay open

TABLE 34 LEVEL CROSSING RECOMMENDATIONS

We note that Judds Rd, without the short stacking, would remain open. There is a clear economic benefit to Judds Rd, however the risk of a very serious accident, to children on a school bus, trumps any consideration of the economic benefit.

As regards Judds Rd, the economic benefit listed above should not be interpreted as meaning that the economic benefit to remaining open is substantial. The cost of a major accident, with the deaths of a dozen children (not that this is how this is assessed) is very large indeed, and even a small

probability of this occurring will heavily weigh on an y economic appraisal. It is worth noting that the cost of such an accident will be borne by the Crown in New Zealand, and the cost will not be passed on the local community around Masterton. As such taking such an additional risk can be considered an example of the “tragedy of the commons”, where the costs associated with the taking of the risk are not paid for by the users of the asset.

10. Conclusion

The following conclusions have been identified in this report

- The upgrade of level crossings in the Wairarapa region as part of the WMUP 6B will provide significant benefits in terms of safety risk reductions and of lives saved.
- The installation of pedestrian crossings to existing road crossings offers particularly high safety benefits
- The transition from road to rail for commuters produces a strikingly high reduction in fatalities
- The road fatality rate in New Zealand is high, and so a transition from road to rail is highly desirable from a safety perspective
- The overall safety benefit from the upgrade of the Wairarapa line is substantial
- Several level crossings have been identified as uneconomic to remain open, including:
    - Victoria St
    - Rhodes St
    - Brandon St
    - Fox St
- Judds Rd, with the high short stacking risk, and the known use of the crossing by buses laden with school children, should either close or have major work done to mitigate the very serious risks associated with a large scale nation defining accident
- The implementation of the project will result in a major net improvement in safety to the public in the Wairarapa region
- The residual risk associated with level crossings is still significant, but this appears acceptable from an economic perspective in most cases. However, there is clearly the risk potential for more accidents, and this risk is unfortunately unable to be reduced any further with the project budgets allocated
- Any changes to the rail traffic profile, or for example the running of higher speed trains, may require a further assessment of the risks associated with the level crossings on the Wairarapa line

Note that this assessment has been performed for up to 20 trains/services per day in either direction, for the entire length of the Wairarapa line for a speed of 110 km/hr. This is higher than what is proposed for the new service pattern for the new rollingstock.

Appendix A — Accidents and Level Crossings

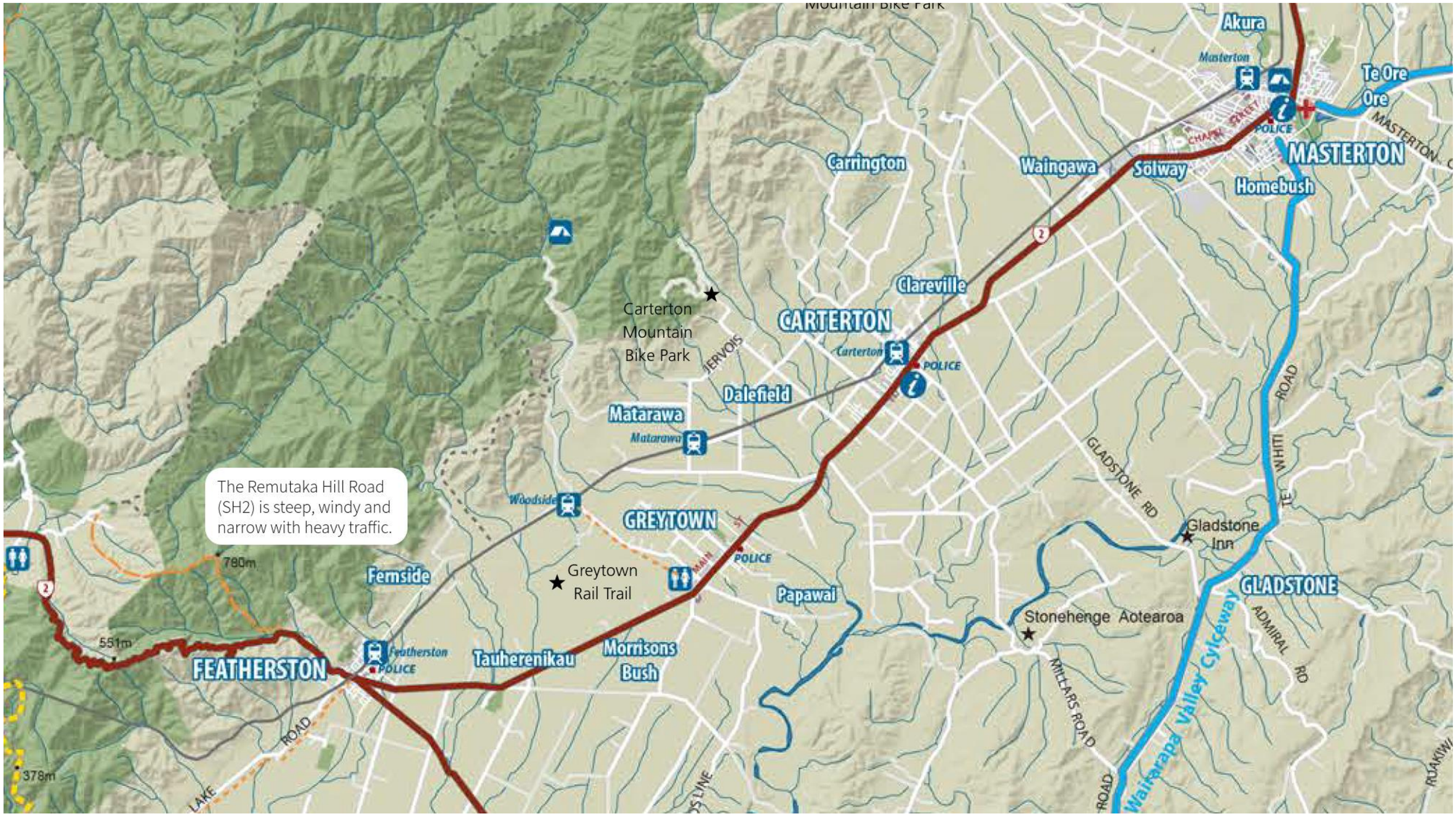
Country	Date	Deaths	Details
US - North Carolina	13/05/2010	0	Amtrak train hit a low loader (17 injured)
South Africa	25/08/2010	10	Minibus struck by train going around the booms
Germany	23/03/2011	0	Lorry struck by train, rear-ended onto track (22 injured)
US - California	24/06/2011	6	Truck brake failure strike train at level crossing
US - Maine	11/07/2011	1	Garbage truck struck at level crossing
Argentina	13/08/2011	11	Driver of bus drove around barriers
Poland	28/11/2011	2	Train hit lorry
US - California	1/10/2012	0	Amtrak train strikes truck at crossing
Australia - Mel	3/11/2012	1	Train strikes truck at Abbott level crossing
Italy	25/11/2012	6	Train strike van in Calabria
Germany	19/12/2012	0	Two freight train strike stalled bus
Slovakia	23/01/2013	1	Train hits snowplow
US - Pennsylvannia	26/04/2013	1	Train hits bus
US - Baltimore	26/05/2013	0	Train hits garbage truck
Canada	18/09/2013	6	Bus fails to stop at level crossing with active protection
US - Virginia	11/10/2013	1	Train collides with truck
US - Wisconsin	21/10/2013	0	Train strikes stalled truck
Ukraine	4/02/2014	13	Bus ignored traffic lights
Estonia	16/04/2014	2	Train strikes truck
US - Indiana	28/10/2014	0	Train collides with semi, 24 injured
US - Texas	14/01/2015	10	US prison bus strike by train
US - California	24/02/2015	1	Truck turned on track and then stuck
US - North Carolina	9/03/2015	0	Amtrak train struck a truck with an oversize load
Germany	16/05/2015	2	Tractor got stuck on the level crossing
Czech republic	22/07/2015	3	Truck enters active level crossing - does not exit level crossing
US - Florida	4/01/2016	0	Passenger train strikes garbage truck
United Kingdom	10/04/2016	0	Train collides with tractor
US - Tennesee	14/07/2016	0	Train strikes tractor
UK	10/09/2016	0	Train collides with tractor
US - Mississippi	7/03/2017	4	Freight train struck charter bus stuck on tracks
Russia	6/10/2017	16	Train struck bus
Finland	26/10/2017	4	Train struck military vehicle/truck
France	14/12/2017	6	Train struck school bus
US - Virginia	31/01/2018	1	Charter train struck a garbage truck
Italy	23/05/2018	2	Train strikes truck
US - New Jersey	9/07/2018	0	Train strikes bus
Serbia	21/12/2018	5	Train strikes school bus
US - Texas	25/01/2019	1	Train strikes a school bus

Country	Date	Deaths	Details
US - New York	26/02/2019	2	Two trains hit a pickup truck
US - Illinois	28/07/2019	1	Train hits stalled truck
Mexico	7/01/2020	7	Freight train strikes bus
US - Connecticut	24/01/2020	0	Train strikes maintenance vehicle (on a crossing)
UK	23/07/2021	0	Train crashed into lorry
Hungry	5/04/2022	5	Work truck struck by train
US - Illinois	11/05/2022	0	Train crashed into truck
Germany	24/05/2022	0	Passenger train strikes bus
US - Missouri	27/06/2022	4	Amtrak train struck a dump truck
US - Connecticut	17/10/2022	0	Train struck a vehicle a crossing
US - Connecticut	17/10/2022	0	Train crashed into truck

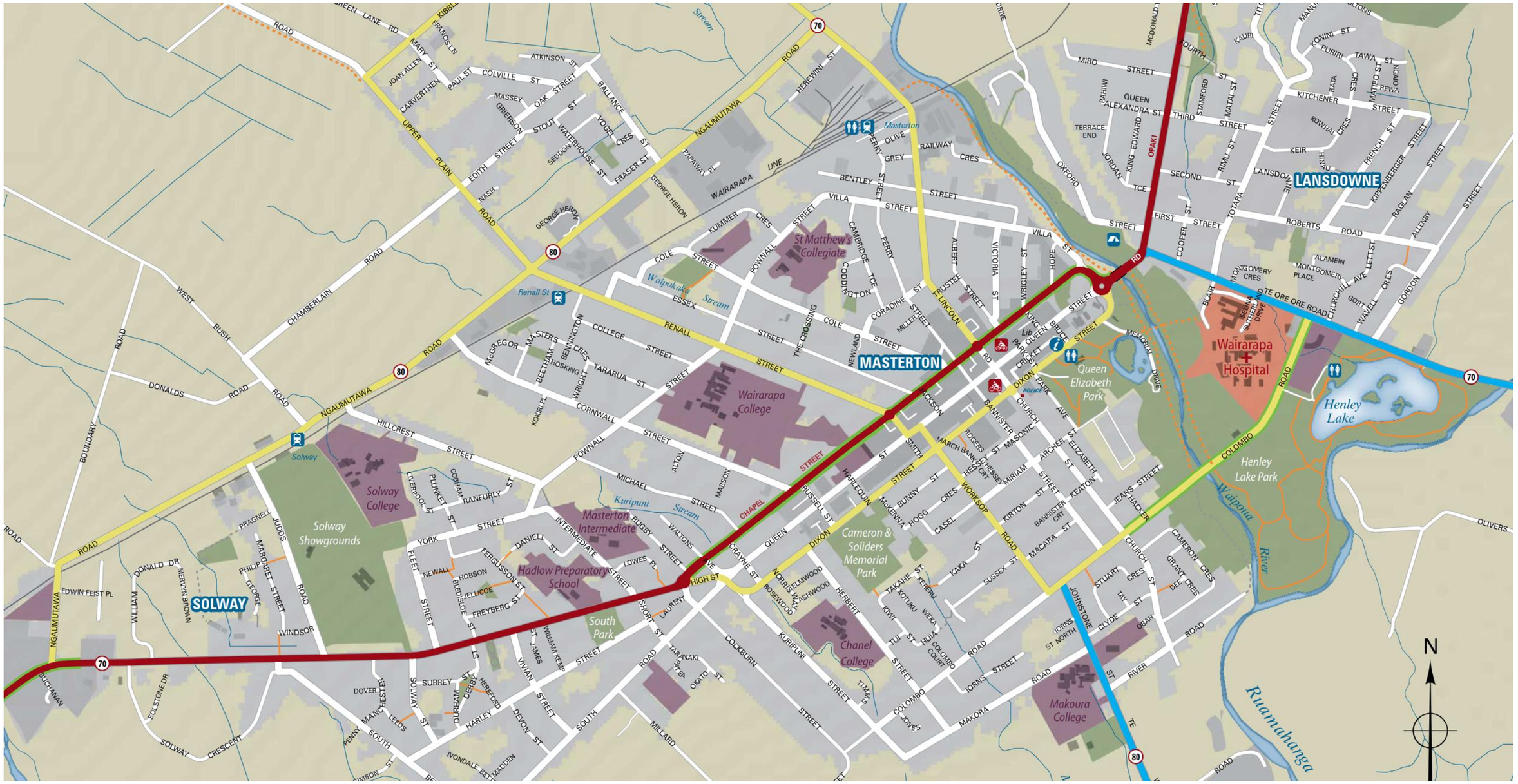
Appendix B — Proposed Pedestrian Level Crossing Changes

Crossing Name	Position classification	Current Ped Crossing Protection	Future Ped Crossing Type
Maymorn Pedestrian Crossing	Urban	Passive	Typical
Western Lake Road	Rural	N/A	Shared User Path
Brandon Street	Urban	Shared	Typical
Revans Street	Urban	FLB	Typical
Fitzherbert Street	Urban	FLB	Typical
Fox Street	Urban	Shared	Shared User Path
Bell Street	Urban	Shared	Typical
Woodside Road	Rural	N/A	Shared User Path
Matarawa Road	Rural	N/A	N/A
Moffats Road	Rural	N/A	N/A
Watersons Line	Rural	N/A	N/A
Hodders Road	Rural	N/A	N/A
Dalefield Road	Rural	N/A	N/A
Lincoln Road	Rural	N/A	N/A
Brooklyn Road	Urban	N/A	N/A
Victoria Street	Urban	Shared	Typical
Pembroke Street	Urban	Shared	Shared User Path
Belvedere Road	Urban	Shared	Typical
Rhodes Street	Urban	Shared	Typical
Kent Street	Urban	Shared	Typical
Andersons Line	Rural	N/A	N/A
Chester Road	Rural	N/A	N/A
Wiltons Road	Rural	N/A	N/A
Norman Ave	Rural	N/A	N/A
Dalefield Road	Rural	N/A	N/A
Ngaumutawa Road	Urban	N/A	Shared User Path
Judds Road	Urban	N/A	Typical
Hillcrest Street	Urban	Shared	Typical
Cornwall Street	Urban	Shared	Typical
Renall Street	Urban	Shared	Typical
Akura Road	Urban	Shared	XXX

Appendix C — Cycleway through the Wairarapa (marked in Blue)



Appendix D — Cycleway through Masterton (marked in Blue)



Appendix E — Calculation Sheet

Crossing ID	Location	Council	AADT	Diversion length (m)	Diversion distance per day	Economic Value of Crossing	Proposed number ped crossings	Initial Configuration	Final Configuration	Cost (excluding closure and ped crossing)	Rail services - peak days - current	Rail Services - peak days - assumed (one direction)	Max rail services (both directions)	Near misses - current	Near misses - proposed	Conversion ratio - (near misses to collisions)	Conversion ratio - proposed (near misses to collisions)	Fatalities - current (estimated)	Fatalities - do nothing	Fatalities - proposed (upgrades only)	Reduction in fatalities per year	Proposed to be closed	Implementation cost (excluding closure)	Estimated fatalities - incl assumed closure	Reduction in fatalities - closure	Ped fatalities applied	Cost - pedestrian crossing upgrade	Fatalities - do nothing (inc pedestrian fatalities)	Fatalities (safe rd) - characteristics	Total fatalities combined - do nothing	Cost combined (by upgrade)	Reduction in fatalities	Upgrade cost (no closures)	Cost benefit ratio	Closure cost
1470	Rhodes Street	Carterton District Council	400	180	72	$345,451	2	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	Yes	$400,000		0.00237937	0.00722	$600,000	0.00639937	0	0.00639937	$800,000	0.00698404	$1,000,000	0.46	$400,000
449	Fox Street	South Wairarapa DC	571	160	91.36	$501,784	2	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	Yes	$400,000		0.00237937	0.00722	$400,000	0.00639937	0	0.00639937	$800,000	0.00698404	$1,000,000	0.58	$400,000
442	Brandon Street	South Wairarapa DC	381	220	83.82	$460,371	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	Yes	$400,000		0.00237937	0.00722	$200,000	0.00639937	0	0.00639937	$600,000	0.00698404	$800,000	0.58	$400,000
452	Bell Street	South Wairarapa DC	394	220	130.68	$717,744	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0.00722	$200,000	0.00639937	0	0.00639937	$800,000	0.00698404	$800,000	0.90	$400,000
1455	Victoria Street	Carterton District Council	570	240	136.8	$751,658	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	Yes	$400,000		0.00237937	0.00722	$200,000	0.00639937	0	0.00639937	$600,000	0.00698404	$800,000	0.94	$400,000
1479	Kent Street	Carterton District Council	1400	180	288.36	$1,565,783	2	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.00267475	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0.00722	$400,000	0.012269898	0	0.012269898	$1,000,000	0.00534124	$1,000,000	1.58	$400,000
1476	Andersons Line	Carterton District Council	144	1300	216	$1,186,354	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.14	0.32	0.07	0.000564634	0.005544386	0.001212966	0.004433202	No	$700,000	0.001212966	0.004433202	0	$0	0.005544386	0	0.005544386	$700,000	0.00433202	$700,000	1.69	$50,000
457	Moffats Road	Carterton District Council	118	1700	217.6	$1,185,142	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.14	0.32	0.07	0.000564634	0.005544386	0.001212966	0.004433202	No	$700,000	0.001212966	0.004433202	0	$0	0.005544386	0	0.005544386	$700,000	0.00433202	$700,000	1.73	$50,000
1454	Brooklyn Road	Carterton District Council	467	440	205.48	$1,126,574	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0	$0	0.00237937	0	0.00237937	$600,000	0.00866404	$600,000	1.88	$400,000
1461	Wrihens Road	Carterton District Council	154	1900	292.6	$1,607,071	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.14	0.32	0.07	0.000564634	0.005544386	0.001212966	0.004433202	No	$700,000	0.001212966	0.004433202	0	$0	0.005544386	0	0.005544386	$700,000	0.00433202	$700,000	1.78	$50,000
458	Waiterenos Line	Carterton District Council	206	1700	350.2	$1,923,432	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.14	0.32	0.07	0.000564634	0.005544386	0.001212966	0.004433202	No	$700,000	0.001212966	0.004433202	0	$0	0.005544386	0	0.005544386	$700,000	0.00433202	$700,000	2.75	$50,000
1467	Belvedere Road	Carterton District Council	1170	350	409.5	$2,249,130	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0.00722	$200,000	0.012269898	0	0.012269898	$800,000	0.00534124	$800,000	3.81	$400,000
1457	Pembroke Street	Carterton District Council	1923	250	480.75	$2,690,462	2	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0.00722	$400,000	0.012269898	0	0.012269898	$1,000,000	0.00534124	$1,000,000	2.64	$400,000
1486	Hillcrest Street	Masterton District Council	1306	560	731.36	$4,016,908	2	Flashing lights	Barriers + flashing lights	$600,000	5	7	20	0.09	0.14	0.12	0.07	0.001136738	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0.00722	$400,000	0.012269898	0	0.012269898	$1,000,000	0.00534124	$1,000,000	4.03	$400,000
460	Dalefield Road	Carterton District Council	380	1200	456	$2,504,326	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0	$0	0.00237937	0	0.00237937	$600,000	0.00866404	$600,000	4.17	$400,000
1485	Judds Road	Masterton District Council	961	510	490.11	$2,693,871	1	Flashing lights	Barriers + flashing lights	$600,000	5	7	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	Yes	$400,000	0	0.00237937	0.00722	$200,000	0.00639937	0.001267	0.012269237	$600,000	0.00766404	$600,000	3.36	$400,000
444	Revans Street (SH35)	Waka Kotahi Wellington	2559	80	204.72	$1,114,400	1	Barriers + flashing lights	Barriers + flashing lights	$0	6	9	20	0.09	0.14	0.07	0.07	0.001103527	0.002945774	0.002945774	0	No	$0	0.002945774	0	0.00722	$200,000	0.010165774	0	0.010165774	$200,000	0.00722	$200,000	5.62	$400,000
1453	Lincoln Road	Carterton District Council	1412	450	635.4	$3,514,575	2	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.00267475	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0	$0	0.005049898	0	0.005049898	$600,000	0.00234124	$600,000	5.86	$400,000
441	Western Lake Road	South Wairarapa DC	1133	1250	1416.25	$7,778,585	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.14	0.32	0.07	0.007126267	0.013466394	0.002945774	0.010520262	No	$700,000	0.002945774	0.010520262	0.00722	$200,000	0.020686394	0	0.020686394	$900,000	0.01720262	$900,000	8.64	$50,000
446	Fitzherbert Street (SH2)	Waka Kotahi Wellington	9503	80	688.14	$3,780,576	2	Barriers + flashing lights	Barriers + flashing lights	$0	6	9	20	0.09	0.14	0.07	0.07	0.001103527	0.002945774	0.002945774	0	No	$0	0.002945774	0	0.00722	$400,000	0.010165774	0	0.010165774	$400,000	0.00722	$400,000	9.45	$400,000
1483	Norfolk Road	Carterton District Council	1407	1900	2673.3	$14,682,782	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.00267475	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.00234124	0	$0	0.005049898	0	0.005049898	$600,000	0.00234124	$600,000	24.47	$400,000
1490	Rewall Street	Carterton District Council	4273	550	2350.15	$12,907,919	2	Barriers + flashing lights	Barriers + flashing lights	$0	6	9	20	0.09	0.14	0.07	0.07	0.001103527	0.002945774	0.002945774	0	No	$0	0.002945774	0	0.00722	$400,000	0.010165774	0	0.010165774	$400,000	0.00722	$400,000	57.77	$400,000
1455	Jikara Road	Masterton District Council	4423	1670	7386.41	$40,568,978	0	Flashing lights	Barriers + flashing lights	$600,000	5	7	20	0.09	0.14	0.12	0.07	0.00267475	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.002104124	0.00722	$0	0.012269898	0	0.012269898	$600,000	0.00934124	$600,000	67.61	$400,000
1480	Chester Road	Masterton District Council	1105	4200	4180.5	$24,883,232	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.00267475	0.005049898	0.002945774	0.002104124	No	$600,000	0.002945774	0.002104124	0	$0	0.005049898	0	0.005049898	$600,000	0.00234124	$600,000	67.47	$400,000
1494	Ngaururahanui Road	Masterton District Council	3600	840	3384	$18,586,217	2	Barriers + flashing lights	Barriers + flashing lights	$0	5	7	20	0.09	0.14	0.07	0.07	0.000155527	0.007945774	0.002945774	0	No	$0	0.002945774	0	0.00722	$400,000	0.010165774	0	0.010165774	$400,000	0.00722	$400,000	46.47	$400,000
459	Redliers Road	Carterton District Council	44	N/A	#VALUE!	#VALUE!	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.09	0.32	0.07	0.000188311	0.002156422	0.000519842	0.001858458	No	$700,000	0.000519842	0.001858458	0	$0	0.002156422	0	0.002156422	$700,000	0.001858458	$700,000	#VALUE!	$50,000
454	Waiterenos Road	Carterton District Council	74	N/A	#VALUE!	#VALUE!	1	Signs	Barriers + flashing lights	$700,000	6	9	20	0.09	0.09	0.32	0.07	0.000188311	0.002156422	0.000519842	0.001858458	No	$700,000	0.000519842	0.001858458	0	$0	0.002156422	0	0.002156422	$700,000	0.001858458	$700,000	#VALUE!	$50,000
1488	Cornwall Street	Masterton District Council	846	N/A	#VALUE!	#VALUE!	2	Flashing lights	Barriers + flashing lights	$600,000	5	7	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0.00722	$400,000	0.00929937	0	0.00929937	$1,000,000	0.00866404	$1,000,000	#VALUE!	$400,000
1482	Norman Avenue	Carterton District Council	870	N/A	#VALUE!	#VALUE!	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0	$0	0.00237937	0	0.00237937	$600,000	0.00866404	$600,000	#VALUE!	$400,000
456	Westdale Road	South Wairarapa DC	585	N/A	#VALUE!	#VALUE!	1	Flashing lights	Barriers + flashing lights	$600,000	6	9	20	0.09	0.14	0.12	0.07	0.001136738	0.00237937	0.001212966	0.000966404	No	$600,000	0.001212966	0.000866404	0.00722	$200,000	0.00929937	0	0.00929937	$800,000	0.00866404	$800,000	#VALUE!	$400,000

Appendix E - References

- SFAIRP Statement Report – Fitzherbert St (SH2) FINAL, KiwiRail, 25/07/23
- SFAIRP Statement Report – Matarawa Rd FINAL, KiwiRail, 20/12/22
- SFAIRP Statement Report – Ngaumutawa Rd FINAL, KiwiRail, 02/02/23
- SFAIRP Statement Report – Norfolk Rd FINAL, KiwiRail, 20/12/22
- SFAIRP Statement Report – Norman Ave FINAL, KiwiRail, 20/12/22
- SFAIRP Statement Report – Revans St (SH53) FINAL, KiwiRail, 25/07/23
- SFAIRP Statement Report – Western Lake Rd FINAL, KiwiRail, 14/02/23
- Memorandum – Review of Judds Road State Highway 2 Intersection, Ann Fosberry, Aurecon, 02/05/23
- Memorandum – Carterton – SH2/Belvedere Intersection SIDRA, Ann Fosberry, Aurecon, 09/06/2023

LCSIA Risk Assessments for Rail Crossings 2021 (Wairarapa Region), Stantec

- 640602-TR-RA-001-[P02] – Western Lake Road LCSIA
- 640602-TR-RA-002-[P02] – Fitzherbert Street (SH2) LCSIA
- 640602-TR-RA-003-[P02] – Brandon Street LCSIA
- 640602-TR-RA-004-[P02] – Fox Street LCSIA
- 640602-TR-RA-005-[P02] – Bell Street LCSIA
- 640602-TR-RA-006-[P02] – Revans Street (SH53) LCSIA
- 640602-TR-RA-007-[P02] – Matarawa Road LCSIA
- 640602-TR-RA-008-[P02] – Moffats Road LCSIA
- 640602-TR-RA-009-[P02] – Woodside Road LCSIA
- 640602-TR-RA-0010-[P02] – Dalefield Road LCSIA
- 640602-TR-RA-0011-[P02] – Lincoln Road LCSIA
- 640602-TR-RA-0012-[P02] – Hodders Road LCSIA
- 640602-TR-RA-0013-[P02] – Victoria Street LCSIA
- 640602-TR-RA-0014-[P03] – Watersons Line LCSIA
- 640602-TR-RA-0015-[P02] – Brooklyn Road LCSIA
- 640602-TR-RA-0016-[P01] – Norfolk Road LCSIA
- 640602-TR-RA-0017-[P01] – Norman Avenue LCSIA
- 640602-TR-RA-0018-[P01] – Belvedere Road LCSIA
- 640602-TR-RA-0019-[P01] – Hillcrest Street LCSIA
- 640602-TR-RA-0020-[P01] – Judds Road LCSIA
- 640602-TR-RA-0021-[P01] – Rhodes Street LCSIA
- 640602-TR-RA-0022-[P01] – Chester Road LCSIA
- 640602-TR-RA-0023-[P01] – Wiltons Road LCSIA
- 640602-TR-RA-0024-[P01] – Andersons Line LCSIA
- 640602-TR-RA-0025-[P01] – Pembroke Street LCSIA
- 640602-TR-RA-0026-[P01] – Ngaumutawa Road LCSIA

- 640602-TR-RA-0027-[P01] – Renall Street LCSIA
- 640602-TR-RA-0028-[P01] – Akura Road LCSIA
- 640602-TR-RA-0029-[P01] – Kent Street LCSIA
- 640602-TR-RA-0030-[P02] – Cornwall Street LCSIA

aurecon JMDR

Bringing ideas to life

Document prepared by:
Aurecon New Zealand Limited

A: Spark Central
Level 8, 42-52 Willis Street
Wellington
6011
New Zealand

PO Box 1591
Wellington
6140
New Zealand

T: +64 4 472 9589
+64 4 472 9922

E: wellington@aurecongroup.com

W: aurecongroup.com