Project Number: 5-C4654

AA Research Foundation

Safety Benefits of New Roads

29 March 2023

Contact Details

Mark Newsome

WSP
Level 3 The Westhaven
100 Beaumont St
Auckland 1010
+64 9 355 9500
+64 27 268 4817
mark.newsome@wsp.com

Document Details:

Date: January 31, 2023
Reference: 5-C4654
Status: Final.

Prepared by
Mark Newsome

Reviewed by
Fergus Tate

Approved for release by
Fergus Tate

Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
1	31/01/2023	Mark Newsome	Fergus Tate	Fergus Tate	DRAFT for client comment
2	03/10/2023	Mark Newsome	Fergus Tate	Fergus Tate	Final

Revision Details

Revision	Details
2	Introduction updated. Tables 3.1 to 3.4 updated to highlight % increase and number of fatal casualties. Appendix A updated to show old and new roads.

Contents

List of Figures

List of Tables

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for the AA Research Foundation ('**Client**') to show whether the construction of new roads reduces crashes and improves road safety compared to the previous route ('**Purpose**') and in accordance with the Contract for Research Work between WSP New Zealand Limited and the AA Research Foundation dated 16th November 2022. The findings in this Report are based on and are subject to the assumptions specified in the Report and the WSP Letter of proposal New Bypass Roads. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

Executive Summary

The purpose of this document is to investigate eight new bypasses constructed in New Zealand between January 2009 and December 2016 to understand the safety benefits that may have resulted from investing in these new roads.

The bypasses investigated were:

1. Northern Gateway
2. Ruby Bay
3. East Taupo
4. Tauranga Eastern Link
5. MacKays to Peka Peka
6. Te Rapa & Ngāruawāhia
7. Cambridge.

Due to the proximity of the sites and their opening dates, Te Rapa and Ngāruawāhia were combined in the analysis.

The analysis involved:

- An investigation of the crash and injury outcomes resulting from each of the bypasses.
- A separate analysis of deaths and serious injury (DSI) outcomes.
- A comparison of the crash data trend from each of the bypasses against the wider district (control area).
- An investigation of the types of crash and resulting injuries that have been saved.

The study method involved:

- Identifying an area of interest containing only the new and old roads.
- Extracting data from the Waka Kotahi Crash Analysis System (CAS) for the area of interest and surrounding district, before and after the provision of the bypass.
- Observing the change in crashes within the area of interest relative to the surrounding district.
- Excluding data from 2020-2021 (impacted by national/regional lockdowns resulting from the COVID-19 pandemic) and 2022 (impacted by CAS processing times). The exception being MacKays to Peka Peka where two analyses were undertaken due to the limited after period if COVID periods are excluded.

The study concluded that the construction of the new bypasses has resulted in:

- A 17.6% relative reduction and 22.5% absolute reduction in injury crashes for all sites (excluding 2020-2021).
- A 30.6% relative reduction and 29.2% absolute reduction in injuries for all sites (excluding 2020-2021). A chi-square test of independence confirmed the relation between injuries sustained and provision of bypass as being significant, $X2$ (1, N = 100,491) = 65.0636, $p < .001$.
- A 32.3% relative reduction and 37.3% absolute reduction in deaths and serious injuries for all sites (excluding 2020-2021). A chi-square test of independence confirmed the relation between injuries sustained and provision of bypass as being significant, $X2$ (1, N = 16,722) = 16.0737, $p < .001$.

- Reductions in injury crashes, total injuries sustained, and deaths and serious injuries sustained within the area of interest for the main movement groups.
- Relative to their surrounding districts, the worst performing bypasses for deaths and serious injury reduction were East Taupo and Ruby Bay. These were the only sites that didn't have a continuous median barrier provided as part of the bypass.

Findings in the study are limited by:

- Growth – Other than a comparison with the surrounding control area no correction has been made for increases in traffic volumes during the analysis period.
- Independent Travel on Old Road – No correction has been made for the proportion of injury crashes and outcomes that occur on the old road (i.e. local trips) regardless of the provision on the bypass. This is likely to have understated the crash reductions stated in this report.
- An assumption that there were no other safety improvements or that these were insignificant when considered against the safety benefits attained by the bypass.

1 Introduction

Improving road safety is often one of the key reasons for building new roads, but how much of a difference do these new roads make? The benefits of retrofitting existing roads with standard safety interventions are well documented[1] however this is the first known study in New Zealand to quantify the benefits of investing in a new road while also retaining the existing road.

This project analyses eight new roads (bypasses in particular) constructed in New Zealand between January 2009 and December 2016 to investigate the road safety outcomes that may result from investing in new roads.

The project involved:

a. An investigation of the crash and injury outcome resulting from each of the bypasses.
b. A separate analysis of deaths and serious injury (DSI) outcomes.
c. A comparison of the crash data trend from each of the bypasses against the wider district.
d. An investigation of the types of crash and resulting injuries that have been saved.

[1] Waka Kotahi Standard Safety Intervention Toolkit - https://www.nzta.govt.nz/assets/resources/standard-safety-intervention-toolkit/standard-safety-intervention-toolkit.pdf

2 Methodology

2.1 New Roads Investigated

A total of eight new roads were investigated in this study (Table 1). Note that Te Rapa and Ngāruawāhia have been combined due to the proximity of the sites and their opening dates.

Table 2 : New Roads Investigated in this Study

Number	Site	District	Opening Date
1	Northern Gateway	Auckland	January 2009
2	Ruby Bay	Tasman	October 2010
3	East Taupo	Taupo	October 2010
4	Tauranga Eastern Link	Tauranga & Western Bay of Plenty	July 2015
5	Mackays to Peka Peka	Kapati Coast	February 2017
6	Te Rapa & Ngāruawāhia	Hamilton & Waikato	December 2012 & December 2013
7	Cambridge	Waikato & Waipa	December 2016

In all cases, these new roads were bypasses of existing roads that served similar journeys.

2.2 Analysis of Crash and Injury Outcomes

The crash data analysed was that contained in the Waka Kotahi Crash Analysis System (CAS) as of January 2023.

To assess the crash and injury outcomes of each of these sites, an area of interest was identified that included the new road and the old road and associated intersections. Crashes within the area of interest were then considered before (thereby providing crash information for the old road only) and after (thereby providing crash information for both roads) the bypass was constructed. The change in crash and injury outcomes within the area of interest could then be largely explained by the provision of the new road.

As a control, the surrounding district (excluding the area of interest) for each site was considered using the same before and after periods. This was to account for any changes within the surrounding district that may have also influenced the results observed within the area of interest. A depiction of the study method is shown right (Figure 1).

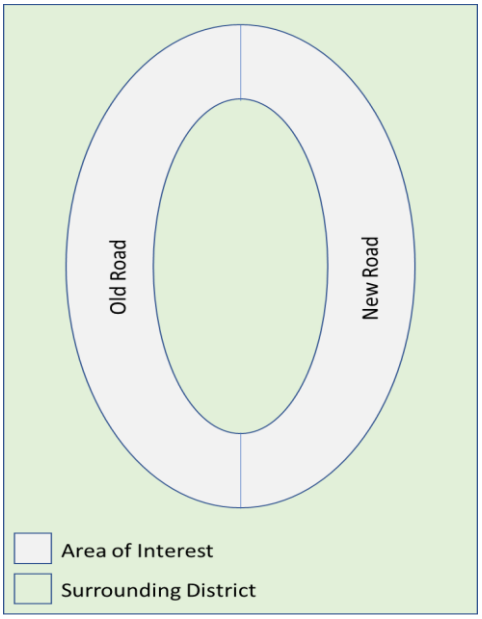


Figure 1 Depiction of Study Methodology

Note that the area of interest for each of the eight bypasses considered as part of this study is shown in Appendix A.

2.3 Data Exclusions

For each site, data from the year of opening has been excluded from this analysis. This is to avoid a bias in the before or after data from the inclusion of part of a year that may be subject to seasonal variations in crashes. In the case of Te Rapa & Ngāruawāhia data from both years of opening (2012 & 2013 respectively) were excluded.

Data from the years 2020-2022 have also largely been excluded from the analysis. This is because:

- Between 2020 and 2021 New Zealand was hit by the COVID-19 pandemic. To control the spread of the virus, a series of national and regional lockdowns were introduced that restricted travel and resulted in fewer crash occurrences during those years.
- Due to limitations in the processing of crash data and the timing of this project (crashes extracted early 2023), it appears that the crash data for 2022 is incomplete with a significant number of crashes still to be entered into CAS.

The only exception to this is the Mackays to Peka Peka site where two analyses were undertaken (with and without the years 2020-2021) due to the after period being too short (only two full years) with the above data exclusions applied.

2.4 Assumptions

There were no other safety improvements within the area of interest or surrounding district of each bypass within the analysis period, or more likely, that these improvements were insignificant when considered against the safety benefits attained by the bypass.

3 Results/Findings

3.1 Analysis Periods

Table 1 sets out the Before and After periods used in the analysis. Number in () denotes number of full years of crash data in the analysis period. Two analyses have been provided for Mackays to Peka Peka due to the short analysis period if 2020-2021 is excluded.

Table 1 Analysis Periods

Number	Site	Surrounding District	Opening Date	Before	After
1	Northern Gateway	Auckland	Jan 2009	1999-2008 (10)	2010-2019 (10)
2	Ruby Bay	Tasman	Oct 2010	2001-2009 (9)	2011-2019 (9)
3	East Taupo	Taupo	Oct 2010	2001-2009 (9)	2011-2019 (9)
4	Tauranga Eastern Link	Tauranga & Western Bay of Plenty	Jul 2015	2011-2014 (4)	2016-2019 (4)
5	Mackays to Peka Peka	Kapati Coast	Feb 2017	2015-2016 (2)	2018-2019 (2)
5	Mackays to Peka Peka	Kapati Coast	Feb 2017	2013-2016 (4)	2018-2021 (4)
6	Te Rapa & Ngāruawāhia	Hamilton & Waikato	Dec 2012 & Dec 2013	2006-2011 (6)	2014-2019 (6)
7	Cambridge	Waikato & Waipa	Dec 2016	2013-2015 (3)	2017-2019 (3)

3.2 Number of Injury Crashes

The number of injury crashes recorded in the area of interest and the surrounding control area are listed in Table 2 together with the relative reduction. Numbers following a black arrow ↑ represent a percentage increase in in injury crashes.

Table 2 Number of Injury Crashes

		Area of Interest			Surrounding District			Relative Change
Number	Site	Before	After	% Reduction	Before	After	% Reduction	% Reduction
1	Northern Gateway	261	213	18.4%	31,217	28,926	7.3%	11.1%
2	Ruby Bay	49	23	53.1%	1,039	1,012	2.6%	50.5%
3	East Taupo	152	136	10.5%	998	1,013	↑1.5%	12.0%
4	Tauranga Eastern Link	90	104	↑15.6%	1,172	1,423	↑21.4%	5.9%
5	Mackays to Peka Peka	33	26	21.2%	128	186	↑45.3%	66.5%
5	Mackays to Peka Peka	52	55	↑5.8%	227	339	↑49.3%	43.6%
6	Te Rapa & Ngāruawāhia	192	123	35.9%	3,352	3,145	6.2%	29.8%
7	Cambridge	55	20	63.6%	916	1,239	↑35.3%	98.9%
	Total for all sites (excluding 2020-2021)	**832**	**645**	**22.5%**	**38,822**	**36,944**	**4.8%**	**17.6%**

Relative to their surrounding districts, all sites saw a reduction in the overall number of injury crashes following the introduction of the bypass. This ranged from a 5.9% relative reduction for

the Tauranga Eastern Link to a 98.9% relative reduction for Cambridge. For all sites (excluding 2020-2021), there has been a 17.6% relative reduction and 22.5% absolute reduction in injury crashes overall. This indicates that the bypasses have contributed positively towards a reduction in injury crashes.

Note that two sites - Tauranga Eastern Link and MacKays to Peka Peka (including 2020-2021) - had an injury crash rate that increased during the analysis period. In the case of Tauranga Eastern Link, this may have been because part of the new road followed the same alignment as the old road (meaning there were reduced speed limits in place during the before period while the safety improvements were constructed).

3.3 Number of Injuries

While the number of injury crashes is of interest it is the outcome of these crashes that is more important. Table 3 shows the number of injuries that resulted from crashes before and after the various bypasses were constructed. Numbers following a black arrow ↑ represent a percentage increase in in injuries.

Table 3 Number of Injuries

		Area of Interest			Surrounding District			Relative Change
Number	Site	Before	After	% Reduction	Before	After	% Reduction	% Reduction
1	Northern Gateway	372	302	18.8%	38,368	39,083	↑1.9%	20.7%
2	Ruby Bay	67	40	40.3%	1,496	1,318	11.9%	28.4%
3	East Taupo	239	180	24.7%	1,553	1,407	9.4%	15.3%
4	Tauranga Eastern Link	132	128	3.0%	1,511	1,787	↑18.3%	21.3%
5	Mackays to Peka Peka	48	36	25.0%	162	233	↑43.8%	68.8%
5	Mackays to Peka Peka	69	76	↑10.1%	284	419	↑47.5%	37.4%
6	Te Rapa & Ngāruawāhia	293	164	44.0%	4,501	4,039	10.3%	33.8%
7	Cambridge	80	22	72.5%	1,256	1,674	↑33.3%	105.8%
	Total for all sites (excluding 2020-2021)	**1,231**	**872**	**29.2%**	**48,847**	**49,541**	**-1.4%**	**30.6%**

Relative to their surrounding districts, all sites saw a reduction in the overall number of injuries following the introduction of the bypass. This ranged from a 15.3% relative reduction for East Taupo to a 105.8% relative reduction for Cambridge. For all sites (excluding 2020-2021), there has been a 30.6% relative reduction and 29.2% absolute reduction in injuries overall. This indicates that the bypasses have contributed positively towards a reduction in total injuries sustained.

It is interesting to note that for all but two of the sites - Ruby Bay and MacKays to Peka Peka (including 2020-2021) - the injury reduction was greater than the injury crash reduction. This indicates that fewer people are being injured per injury crash since the introduction of the bypasses.

3.4 Number of Deaths and Serious Injuries

Deaths and Serious Injuries pose a significant social and economic cost on New Zealand communities and are the focus of the Governments Road to Zero Strategy. Table 4 reports the change in Deaths and Serious Injuries associated with the provision of the respective bypasses. Numbers following a black arrow ↑ represent a percentage increase in in deaths and serious injuries while the number shown in () is the number of fatal injuries.

Table 4 Deaths and Serious Injuries

		Area of Interest			Surrounding District			Relative Change
Number	Site	Before	After	% Reduction	Before	After	% Reduction	% Reduction
1	Northern Gateway	62 (8)	35 (5)	43.5%	6,005 (706)	5,672 (485)	5.5%	38.0%
2	Ruby Bay	15 (2)	9 (1)	40.0%	413 (53)	311 (41)	24.7%	15.3%
3	East Taupo	44 (6)	42 (5)	4.5%	467 (132)	362 (83)	22.5%	↑17.9%
4	Tauranga Eastern Link	39 (6)	31 (6)	20.5%	328 (44)	373 (67)	↑13.7%	34.2%
5	Mackays to Peka Peka	10 (1)	1 (0)	90.0%	38 (4)	53 (1)	↑39.5%	129.5%
5	Mackays to Peka Peka	13 (2)	5 (0)	61.5%	67 (9)	87 (3)	↑29.9%	91.4%
6	Te Rapa & Ngāruawāhia	65 (12)	29 (7)	55.4%	819 (139)	815 (105)	0.5%	54.9%
7	Cambridge	9 (1)	6 (1)	33.3%	302 (49)	367 (39)	↑21.5%	54.9%
	Total for all sites (excluding 2020-2021)	**244 (36)**	**153 (25)**	**37.3%**	**8,372 (1,136)**	**7,953 (824)**	**5.0%**	**32.3%**

Relative to their surrounding districts, all but one site (East Taupo) saw a reduction in the overall number of deaths and serious injuries following the introduction of the bypass. For East Taupo there was a 17.9% relative increase (4.5% absolute reduction in the area of interest compared to a 22.5% reduction in the surrounding district) in deaths and serious injuries. For the remainder of the sites, these ranged from a 15.3% relative reduction for Ruby Bay to a 129.5% relative reduction for MacKays to Peka Peka (excluding 2020-2021). For all sites (excluding 2020-2021), there has been a 32.3% relative reduction and 37.3% absolute reduction in deaths and serious injuries overall. This indicates that the bypasses have contributed positively towards a reduction in deaths and serious injuries.

It is interesting to note that for all but three of the sites - Ruby Bay, East Taupo and Cambridge - the deaths and serious injury reduction was greater than the injury crash reduction. This indicates a reduction in severity as fewer people are being killed or seriously injured (per injury crash) since the introduction of the bypasses.

It is also interesting to note that relative to their surrounding districts, the worst performing bypasses for deaths and serious injury reduction - East Taupo (17.9% increase) and Ruby Bay (15.3% reduction) - were also the only sites that didn't have a continuous median barrier provided as part of the bypass.

In the case of East Taupo, it is also noted that the old road went through the town centre and included a significant length of 50km/h (town centre) and 80km/h (peri-urban fringe) speed limits whereas the new road is in a rural setting with a 100km/h speed limit for its entirety.

Despite being to a higher geometric standard with safer roadsides, the death and serious injury reduction appears to have been subdued by the increased operating speeds.[2]

3.5 Impact on Crash Type and Injuries

The impact of the bypass on the types of crashes that occurred has been investigated in terms of the following movement types:

- Bend lost Control/Head-on
- Crossing Turning
- Miscellaneous
- Overtaking
- Pedestrian/Vehicle
- Rear End/Obstruction
- Straight Lost Control/Head-on

Details of the changes in Injury Crashes, All Injuries and Deaths and Serious Injuries by Movement Type are contained in Appendix B.

3.5.1 Number of Injury Crashes within Area of Interest by Movement Group

There were reductions in injury crashes for all movement groups except Miscellaneous (14.3% increase) and Straight-Lost control/Head on (27.8% increase). Note that these crash types accounted for a relatively small proportion (0.8% and 10.8% respectively) of the injury crashes before the introduction of the bypasses.

Ignoring Miscellaneous (due to the very small sample size), the result for Straight-Lost control/Head on was somewhat unexpected as the new road has been designed to minimise injury crashes and Lost control/Head on is a common crash type each new road would have sought to reduce. One reason the Straight-Lost control/Head on crash type may have increased during the analysis period is because the straighter alignment and higher speed limits of the new road has resulted in an increased exposure by length and operating speed when compared against the more curvilinear alignment and lower speed limits of the old road.

Of the crash types where a reduction in injury crashes was observed, Pedestrian vs Vehicle (40.7% reduction), Crossing/Turning (30.9% reduction), Rear end/obstruction (30.5% reduction) and Bend-Lost control/Head on (26.6% reduction) were the most significant. Collectively, these crash types accounted for 82.7% of the injury crashes before the introduction of the bypasses.

3.5.2 Number of Injuries within Area of Interest by Movement Group

Miscellaneous aside, the number of injuries within the area of interest by movement group for each bypass, shows reductions in injuries for all remaining movement groups. Rear end/obstruction (40.1% reduction), Bend-Lost control/Head on (35.2% reduction), Pedestrian vs Vehicle (35.0% reduction) and Crossing/Turning (26.7% reduction) were the most significant.

[2] This aligns with well researched findings into the link between pre-impact speed and resulting injury. Refer Down with Speed: A Review of the Literature and the Impact of Speed on New Zealanders - 2000 (transport.govt.nz)

Collectively, these crash types accounted for 82.0% of the injuries before the introduction of the bypasses.

Interestingly, although the Straight-Lost control/Head on crash type resulted in more injury crashes (27.8% increase), there were fewer injuries (11.7% reduction) following the introduction of the bypasses. This means that the rate of persons injured per Straight-Lost control/Head on injury crash has significantly reduced.

3.5.3 Number of Deaths and Serious Injuries within Area of Interest by Movement Group

Miscellaneous aside, deaths and serious injuries within the area of interest showed, following the introduction of the bypass reductions in injuries for all remaining movement groups. Bend-Lost control/Head on (57.3% reduction), Straight-Lost control/Head on (40.0% reduction), Crossing/Turning (35.2% reduction) and Overtaking (21.4%) were the most significant. Collectively, these crash types accounted for 79.9% of the deaths and serious injuries before the introduction of the bypasses. Given that the bulk of deaths and serious injuries on high-speed rural roads are typically one of the three crash types - head on, run-off-road or at intersections[3], it is not surprising that the greatest reduction in deaths and serious injuries from the provision of a new road is in these areas.

[3] Refer section 2.3.2 of the High-risk rural roads guide (nzta.govt.nz).

4 Discussion

4.1 Ratio of After/Before Injuries

The figures below show the ratio of injuries sustained (after/before) the provision of a bypass and compares this ratio for the area of interest and the surrounding district for each bypass. Two plots are shown (Figure 2 shows all injury outcomes while Figure 3 shows death and serious injury outcomes).

In these figures a ratio of less than 1 indicates there are fewer injuries following the provision of the bypass and a ratio greater than 1 indicates there were more. The difference between the surrounding district and the area of interest x 100 is the same as the relative reduction reported in sections 3.3 and 3.4. The purpose of these plots is to show all the sites on the same positive scale to allow for the direct comparison between sites which have different periods of analysis.

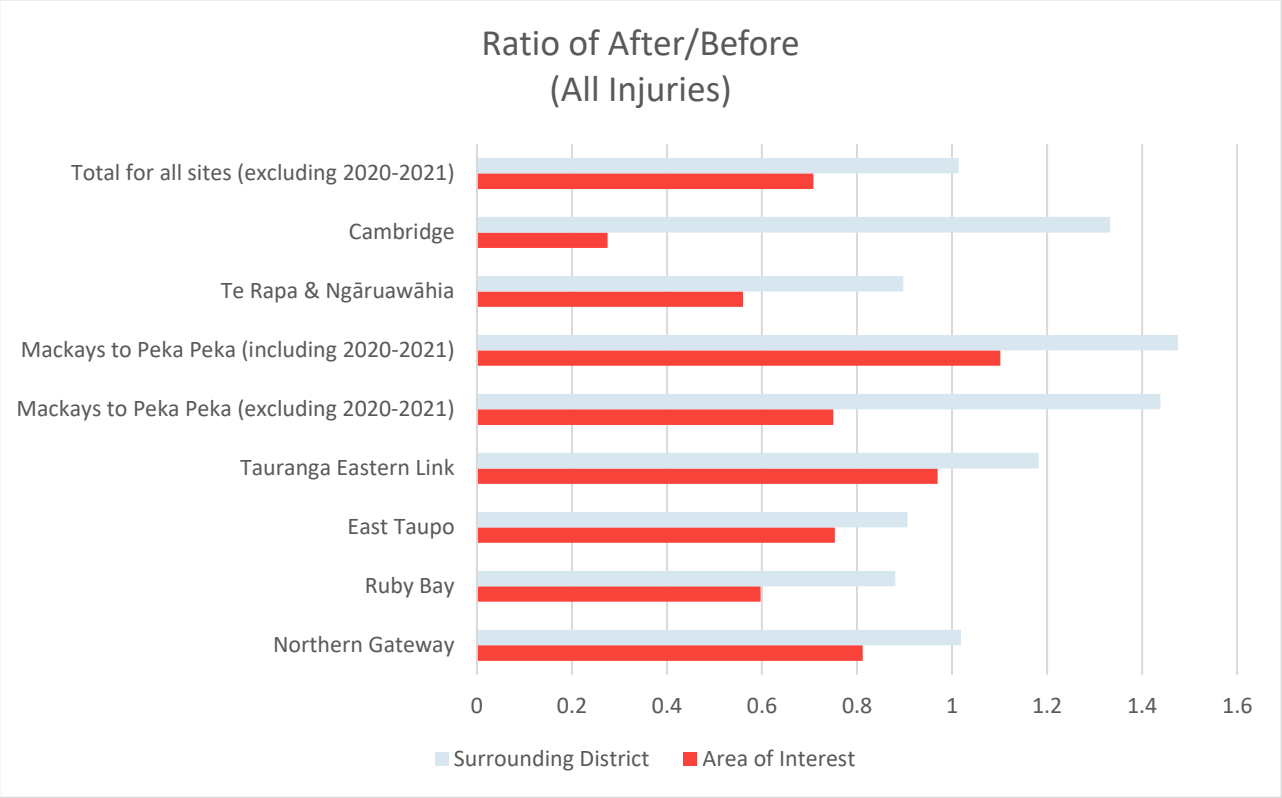


Figure 2 Ratio After/Before Injuries

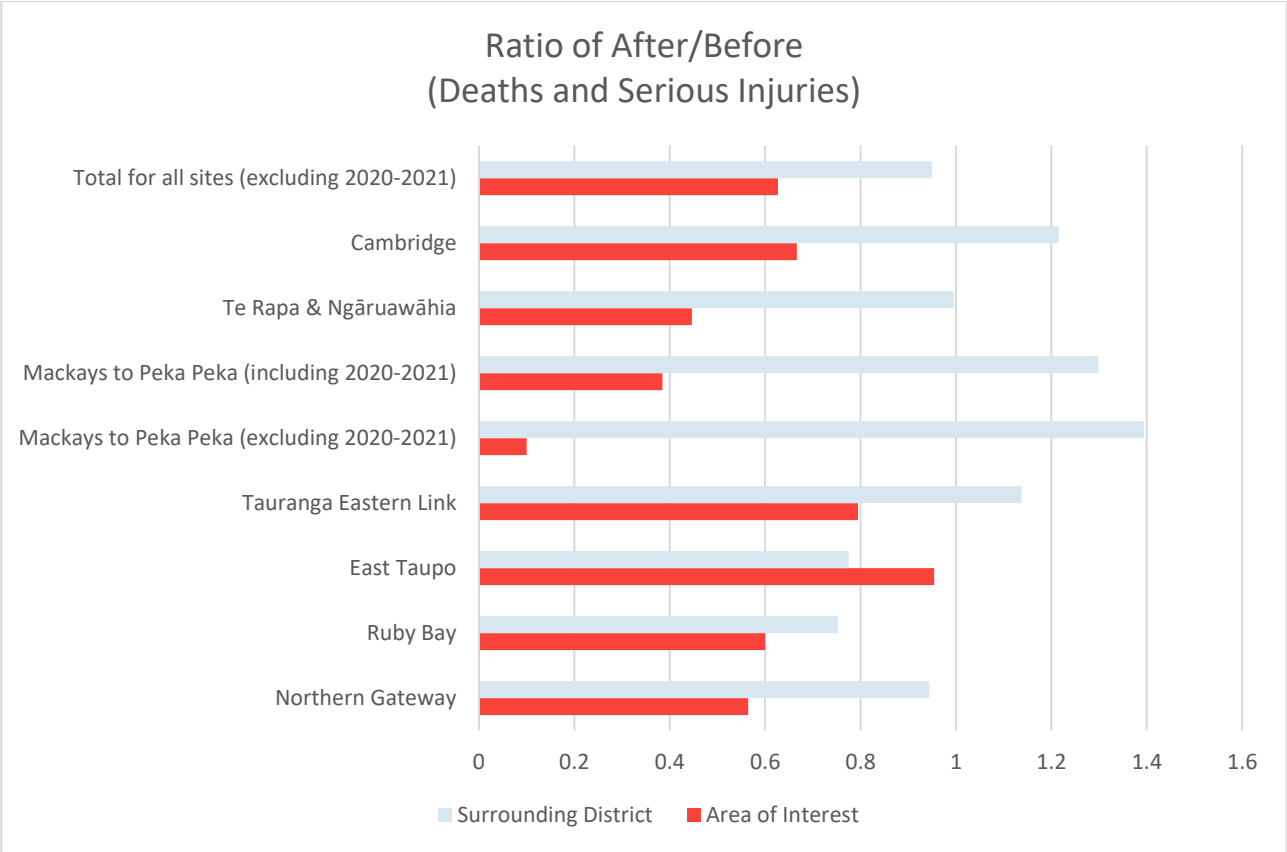


Figure 3 Ratio After/Before Deaths and Serious Injuries

While individual sites vary, it is interesting to note that when we look at the total for all sites (excluding 2020-2021), we can see that the surrounding district has had minimal change (ratio is close to 1) while within the area of interest, there has been a significant injury reduction (ratio is significantly lower than 1).

4.2 Statistical Analysis

A chi-square test of independence was performed to examine the relation between injuries sustained and the provision of a bypass. While the small sample sizes of some sites meant that some of the individual sites were not statistically significant, considering all sites (excluding 2020-2021), the relation between these variables was significant, $X2$ (1, N = 100,491) = 65.0636, $p < .001$. This means there were likely to be fewer injuries sustained within the area of interest following the provision of a bypass.

Likewise, the same analysis has been conducted for deaths and serious injuries considering all sites (excluding 2020-2021). The relation between these variables was also significant, $X2$ (1, N = 16,722) = 16.0737, $p < .001$. This means there were likely to be fewer deaths and serious injuries sustained within the area of interest following the provision of a bypass.

4.3 Limitations

These bypasses are generally located in areas of rapid growth. Other than the consideration of a control area this study has not adjusted the crash rates for growth

There is a base level of crashes (owing to local trips on the old road) that are unaffected by the provision of the new road (i.e. these trips would continue to be made on the old road). In theory,

these should be the same in the before and after periods meaning the absolute reduction in crashes and injuries within the area of interest can be directly attributed to the new road (assuming no other safety improvements were carried out on the old road) however the percent reduction is likely to have been understated because of this base level of crashes.

These issues are unavoidable as where there was once one road, there are now two and the new road is not a direct swap (in terms of trip generation and speed environment) for the old road.

5 Conclusions

1. Between January 2009 and December 2016, the construction of eight new bypasses has resulted in:

   a. A 17.6% relative reduction and 22.5% absolute reduction in injury crashes for all sites (excluding 2020-2021).

   b. A 30.6% relative reduction and 29.2% absolute reduction in injuries for all sites (excluding 2020-2021). A chi-square test of independence confirmed the relation between injuries sustained and provision of bypass as being significant, X2 (1, N = 100,491) = 65.0636, p < .001.

   c. A 32.3% relative reduction and 37.3% absolute reduction in deaths and serious injuries for all sites (excluding 2020-2021). A chi-square test of independence confirmed the relation between injuries sustained and provision of bypass as being significant, X2 (1, N = 16,722) = 16.0737, p < .001.

   d. A 26.6% to 40.7% reduction in injury crashes (within the area of interest) for each of the Bend-Lost control/Head on, Crossing/Turning, Pedestrian vs Vehicle and Rear end/obstruction movement groups which collectively accounted for 82.7% of the injury crashes before the introduction of the bypasses.

   e. A 26.7% to 40.1% reduction in injuries (within the area of interest) for each of the Bend-Lost control/Head on, Crossing/Turning, Pedestrian vs Vehicle and Rear end/obstruction movement groups which collectively accounted for 82.0% of the injuries before the introduction of the bypasses.

   f. A 21.4% to 57.3% reduction in deaths and serious injuries (within the area of interest) for each of the Bend-Lost control/Head on, Crossing/Turning, Overtaking and Straight-Lost control/Head on movement groups which collectively accounted for 79.9% of the deaths and serious injuries before the introduction of the bypasses.

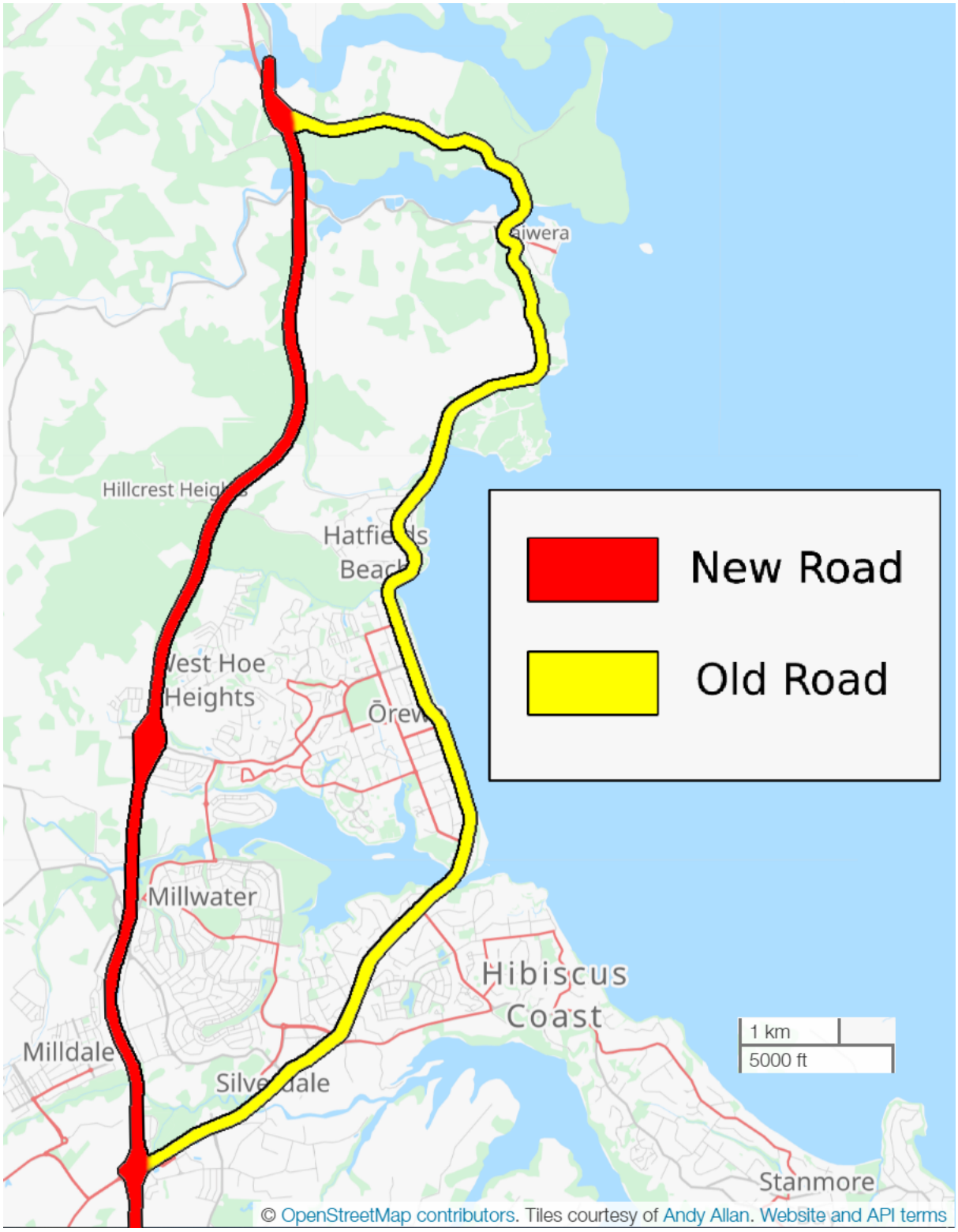
2. Relative to their surrounding districts, the worst performing bypasses for deaths and serious injury reduction were East Taupo (17.9% increase) and Ruby Bay (15.3% reduction). These were also the only sites that didn't have a continuous median barrier provided as part of the bypass.

3. The crash reductions stated above are limited by:

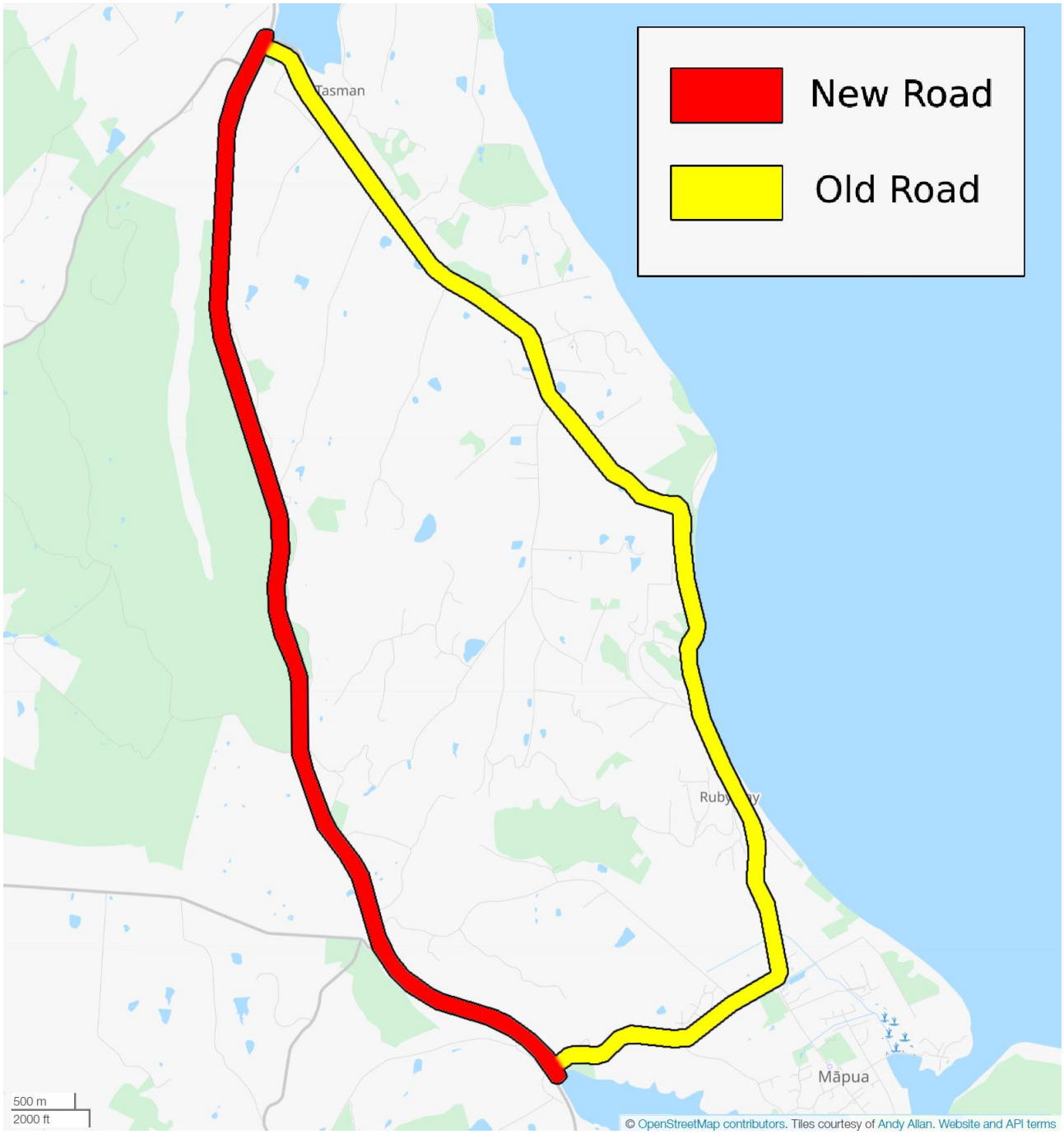
   - Growth – Other than the use of a control area no other correction has been made for increases in traffic volumes during the analysis period. This is likely to have understated the crash reductions stated in this report.
   - Independent Travel on Old Road – No correction has been made for the proportion of injury crashes and outcomes that occur on the old road (i.e. Local Trips) regardless of the provision on the bypass. This is likely to have understated the crash reductions stated in this report.
   - An assumption that there were no other safety improvements within the area of interest or surrounding district of each bypass within the analysis period, or more likely, that these improvements were insignificant when considered against the safety benefits attained by the bypass.

Appendix A
Area of Interest Maps

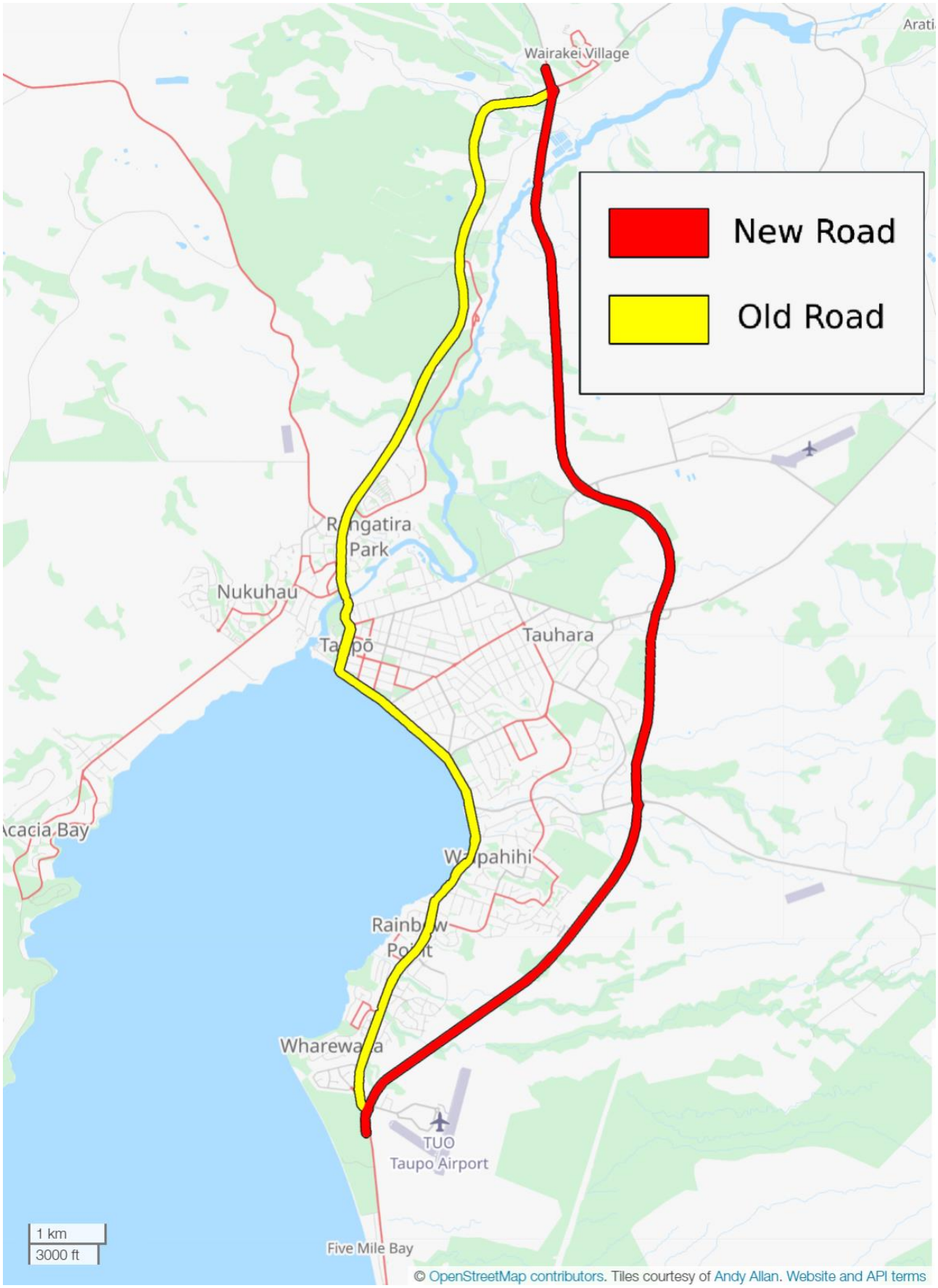
Northern Gateway



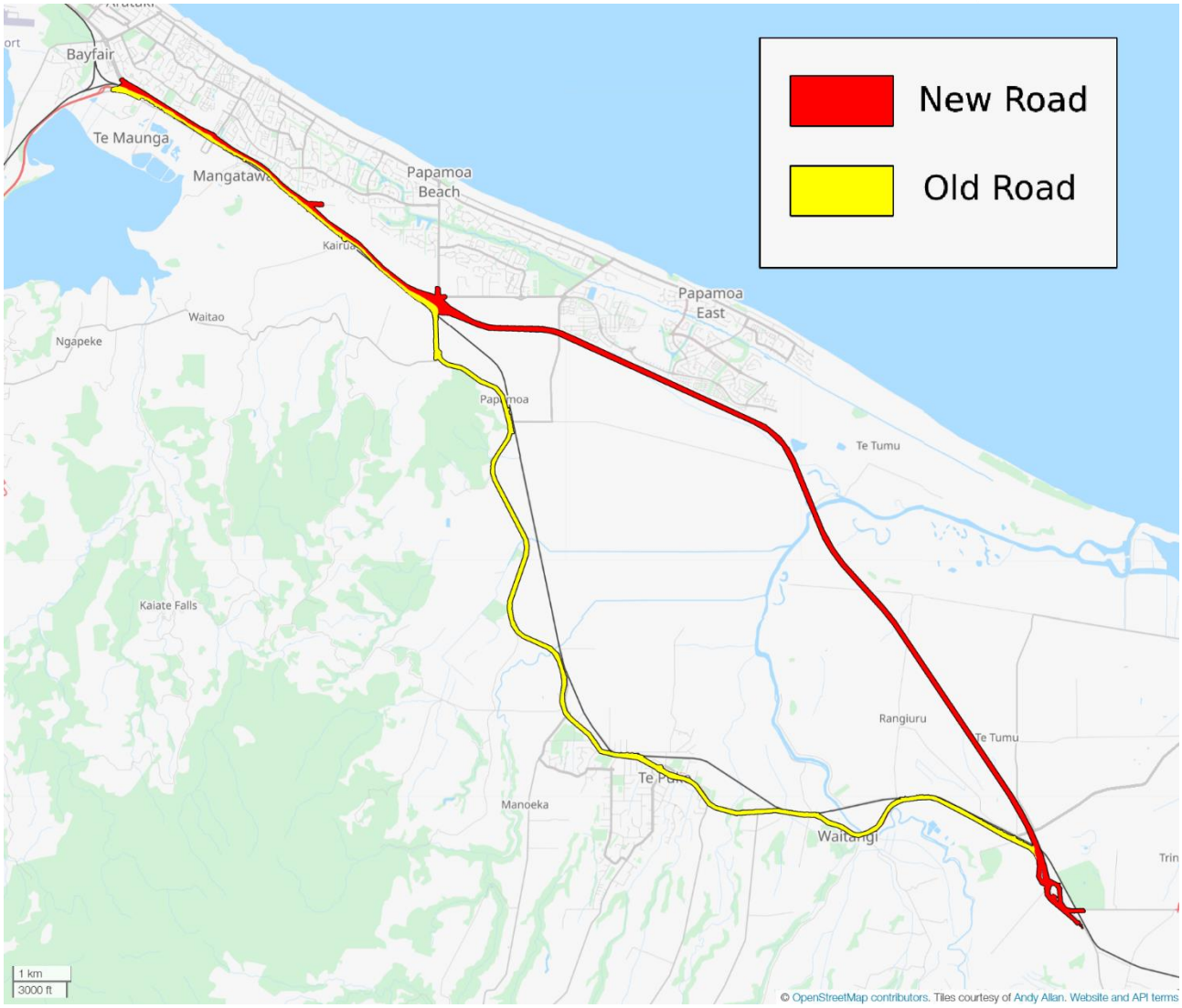
Ruby Bay


New Road
Old Road
Tasman
Māpua
500 m
2000 ft
© OpenStreetMap contributors. Tiles courtesy of Andy Allan. Website and API terms

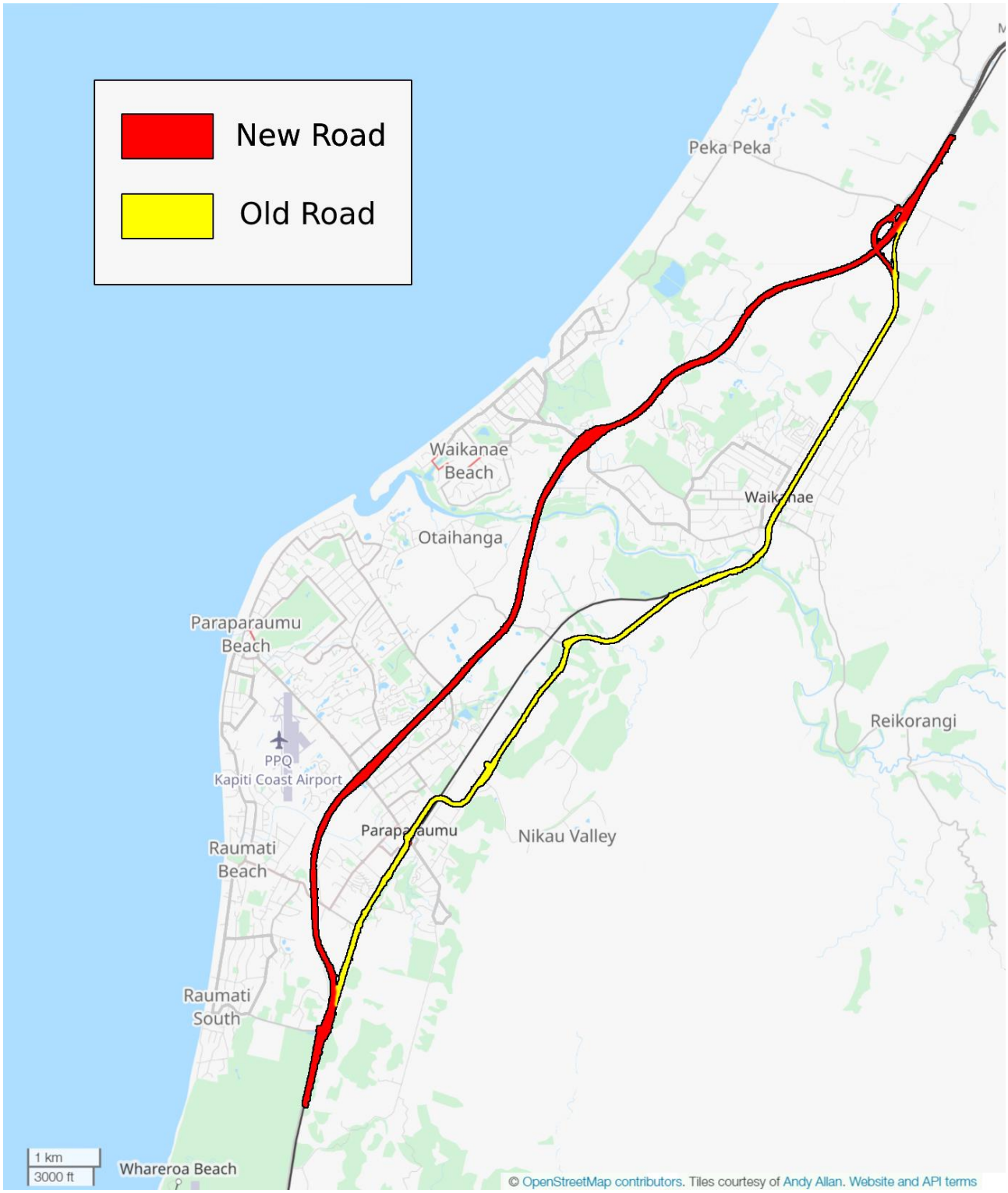
East Taupo


New Road
Old Road
Wairakei Village
Nukuhau
Tauhara
Five Mile Bay
TUO
Taupo Airport
1 km
3000 ft
© OpenStreetMap contributors. Tiles courtesy of Andy Allan. Website and API terms

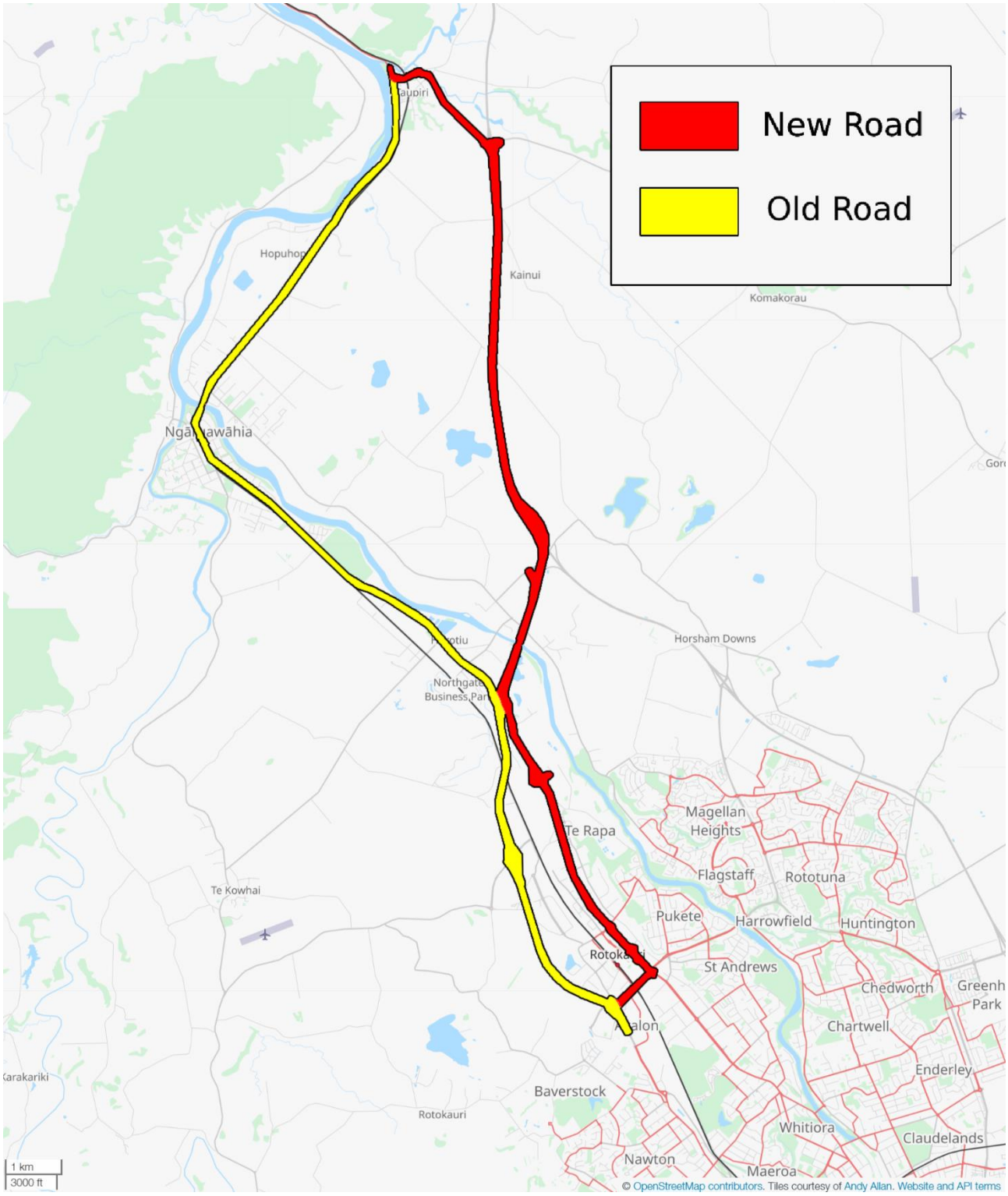
Tauranga Eastern Link



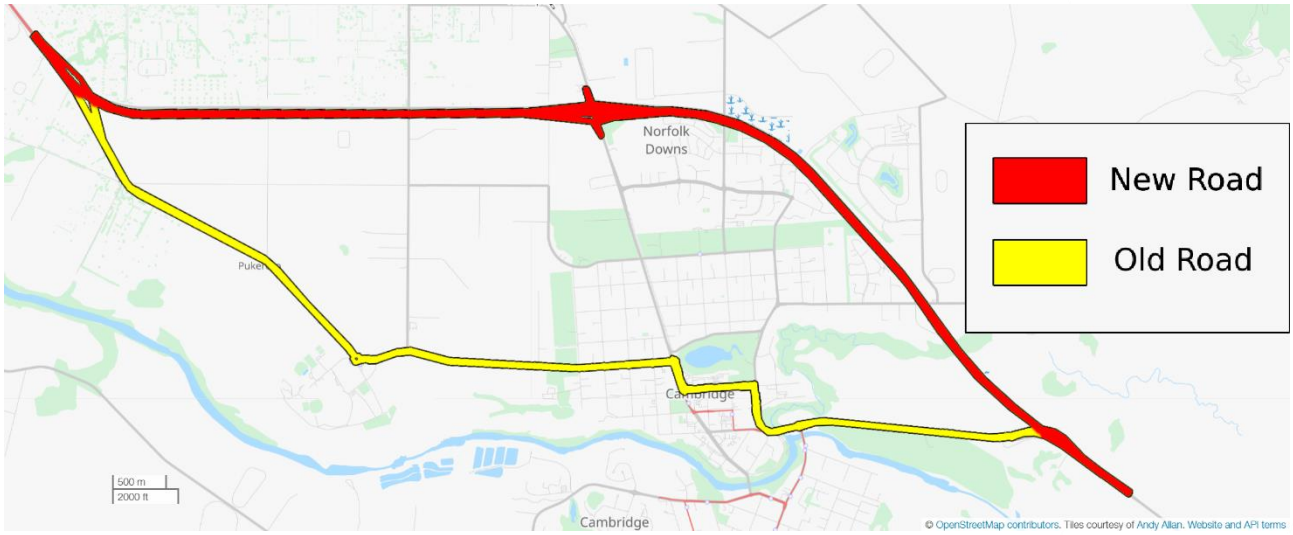
MacKays to Peka Peka



Te Rapa & Ngāruawāhia



Cambridge


Norfolk
Downs
New Road
Old Road
Puke
Cambridge
500 m
2000 ft
© OpenStreetMap contributors. Tiles courtesy of Andy Allan. Website and API terms

Appendix B
Impact on Movement Type

Number of Crashes within Area of Interest by Movement Group

		Bend-Lost control/Head on			Crossing/Turning			Miscellaneous			Overtaking		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	71	54	23.9%	75	45	40.0%	2	4	-100.0%	20	17	15.0%
2	Ruby Bay	24	9	62.5%	6	7	-16.7%	0	0	-	3	0	100.0%
3	East Taupo	22	22	0.0%	50	46	8.0%	2	1	50.0%	3	7	-133.3%
4	Tauranga Eastern Link	23	21	8.7%	22	12	45.5%	2	1	50.0%	7	9	-28.6%
5	Mackays to Peka Peka	6	4	33.3%	7	2	71.4%	1	0	100.0%	0	3	-
5	Mackays to Peka Peka	7	10	-42.9%	16	10	37.5%	1	1	0.0%	2	4	-100.0%
6	Te Rapa & Ngāruawāhia	24	14	41.7%	42	35	16.7%	0	1	-	14	7	50.0%
7	Cambridge	3	3	0.0%	18	5	72.2%	0	1	-	0	1	-
	Total for all sites (excluding 2020-2021)	**173**	**127**	**26.6%**	**220**	**152**	**30.9%**	**7**	**8**	**-14.3%**	**47**	**44**	**6.4%**

		Pedestrian vs Vehicle			Rear end/obstruction			Straight-Lost control/Head on			Grand Total		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	18	11	38.9%	57	54	5.3%	18	28	-55.6%	261	213	18.4%
2	Ruby Bay	0	1	-	11	2	81.8%	5	4	20.0%	49	23	53.1%
3	East Taupo	18	10	44.4%	45	29	35.6%	12	21	-75.0%	152	136	10.5%
4	Tauranga Eastern Link	3	5	-66.7%	23	33	-43.5%	10	23	-130.0%	90	104	-15.6%
5	Mackays to Peka Peka	1	0	100.0%	11	8	27.3%	7	9	-28.6%	33	26	21.2%
5	Mackays to Peka Peka	2	1	50.0%	15	18	-20.0%	9	11	-22.2%	52	55	-5.8%
6	Te Rapa & Ngāruawāhia	16	8	50.0%	64	32	50.0%	32	26	18.8%	192	123	35.9%
7	Cambridge	3	0	100.0%	25	6	76.0%	6	4	33.3%	55	20	63.6%
	Total for all sites (excluding 2020-2021)	**59**	**35**	**40.7%**	**236**	**164**	**30.5%**	**90**	**115**	**-27.8%**	**832**	**645**	**22.5%**

Number of Injuries within Area of Interest by Movement Group

		Bend-Lost control/Head on			Crossing/Turning			Miscellaneous			Overtaking		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	115	78	32.2%	107	74	30.8%	2	8	-300.0%	28	20	28.6%
2	Ruby Bay	29	14	51.7%	10	19	-90.0%	0	0	-	5	0	100.0%
3	East Taupo	32	32	0.0%	72	63	12.5%	2	1	50.0%	3	12	-300.0%
4	Tauranga Eastern Link	33	26	21.2%	35	13	62.9%	3	1	66.7%	7	10	-42.9%
5	Mackays to Peka Peka	6	4	33.3%	12	2	83.3%	1	0	100.0%	0	9	-
5	Mackays to Peka Peka	7	13	-85.7%	22	13	40.9%	1	1	0.0%	2	10	-400.0%
6	Te Rapa & Ngāruawāhia	49	15	69.4%	57	56	1.8%	0	1	-	17	9	47.1%
7	Cambridge	3	4	-33.3%	25	6	76.0%	0	1	-	0	1	-
	Total for all sites (excluding 2020-2021)	**267**	**173**	**35.2%**	**318**	**233**	**26.7%**	**8**	**12**	**-50%**	**60**	**61**	**-1.7%**

		Pedestrian vs Vehicle			Rear end/obstruction			Straight-Lost control/Head on			Grand Total		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	19	12	36.8%	77	74	3.9%	24	36	-50.0%	372	302	18.8%
2	Ruby Bay	0	1	-	14	2	85.7%	9	4	55.6%	67	40	40.3%
3	East Taupo	18	11	38.9%	92	33	64.1%	20	28	-40.0%	239	180	24.7%
4	Tauranga Eastern Link	3	5	-66.7%	29	46	-58.6%	22	27	-22.7%	132	128	3.0%
5	Mackays to Peka Peka	1	0	100.0%	16	11	31.3%	12	10	16.7%	48	36	25.0%
5	Mackays to Peka Peka	2	1	50.0%	21	26	-23.8%	14	12	14.3%	69	76	-10.1%
6	Te Rapa & Ngāruawāhia	16	10	37.5%	100	46	54.0%	54	27	50.0%	293	164	44.0%
7	Cambridge	3	0	100.0%	36	6	83.3%	13	4	69.2%	80	22	72.5%
	Total for all sites (excluding 2020-2021)	**60**	**39**	**35.0%**	**364**	**218**	**40.1%**	**154**	**136**	**11.7%**	**1,231**	**872**	**29.2%**

Number of Deaths and Serious Injuries within Area of Interest by Movement Group

		Bend-Lost control/Head on			Crossing/Turning			Miscellaneous			Overtaking		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	28	11	60.7%	11	6	45.5%	0	2	-	8	2	75.0%
2	Ruby Bay	5	2	60.0%	5	6	-20.0%	0	0	-	0	0	-
3	East Taupo	9	6	33.3%	16	14	12.5%	1	1	0.0%	1	3	-200.0%
4	Tauranga Eastern Link	14	11	21.4%	8	2	75.0%	0	0	-	3	2	33.3%
5	Mackays to Peka Peka	2	1	50.0%	1	0	100.0%	0	0	-	0	0	-
5	Mackays to Peka Peka	3	2	33.3%	2	0	100.0%	0	1	-	0	0	-
6	Te Rapa & Ngāruawāhia	22	2	90.9%	10	6	40.0%	0	0	-	2	4	-100.0%
7	Cambridge	2	2	0.0%	3	1	66.7%	0	1	-	0	0	-
	Total for all sites (excluding 2020-2021)	**82**	**35**	**57.3%**	**54**	**35**	**35.2%**	**1**	**4**	**-300.0%**	**14**	**11**	**21.4%**

		Pedestrian vs Vehicle			Rear end/obstruction			Straight-Lost control/Head on			Grand Total		
Number	Site	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction	Before	After	% Reduction
1	Northern Gateway	7	7	0.0%	6	4	33.3%	2	3	-50.0%	62	35	43.5%
2	Ruby Bay	0	1	-	0	0	-	5	0	100.0%	15	9	40.0%
3	East Taupo	6	4	33.3%	7	4	42.9%	4	10	-150.0%	44	42	4.5%
4	Tauranga Eastern Link	1	3	-200.0%	4	5	-25.0%	9	8	11.1%	39	31	20.5%
5	Mackays to Peka Peka	0	0	-	2	0	100.0%	5	0	100.0%	10	1	90.0%
5	Mackays to Peka Peka	1	0	100.0%	2	2	0.0%	5	0	100.0%	13	5	61.5%
6	Te Rapa & Ngāruawāhia	7	4	42.9%	4	8	-100.0%	20	5	75.0%	65	29	55.4%
7	Cambridge	0	0	-	4	1	75.0%	0	1	-	9	6	33.3%
	Total for all sites (excluding 2020-2021)	**21**	**19**	**9.5%**	**27**	**22**	**18.5%**	**45**	**27**	**40.0%**	**244**	**153**	**37.3%**

wsp.com/nz