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26 July 2024

Brent Alderton
Director of Land Transport
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Private Bag 6995
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Wellington 6141
New Zealand

Dear Brent,

Director approval for speed change – Kāpiti Expressway

New Zealand Transport Agency Waka Kotahi (NZTA) as Road Controlling Authority ('RCA') respectfully requests that the Director of Land Transport approves the setting of a permanent speed limit of 110km/h on a 24km section of the Kāpiti Expressway, and permanent speed limits of 50km/h, 80km/h and 110km/h for associated on- and off-ramps, in accordance with clause 2.6(2)(a) of the Land Transport Rule: Setting of Speed Limits 2022 (the Rule).

Background

In February 2017, the Mackays Crossing to Peka Peka Expressway was opened to address issues related to safety, route redundancy/resiliency, and congestion, and improve travel times for people and freight between Wellington and further north. The Mackays Crossing to Peka Peka Expressway connects the Transmission Gully motorway in the south to the Peka Peka to Ōtaki Expressway section further north. In December 2022, the Peka Peka to Ōtaki Expressway was opened. The Peka Peka to Ōtaki Expressway bypasses the Ōtaki township and connects the Mackays Crossing to Peka Peka section further south.

With the Peka Peka to Ōtaki section now open, our technical assessment attached in **Memo SH1 Kāpiti Expressway Mackays Crossing to Ōtaki Design, Construction, Management and Operations 110km/h readiness review** indicates the corridor north of the Poplar Road interchange at Raumati South to south of the Ōtaki northern interchange satisfies the safety, geometric and access requirements for a speed increase to 110km/h. This section consists of a 4-lane divided carriageway, and wire rope median and side barriers are provided for the corridor, with TL-5 barriers at the various structures. With Peka Peka to Ōtaki now open and the safety assessment complete, NZTA considers that good reason exists for the speed limits to now be set.

There are sections within Kāpiti Expressway that do not meet the 110km/h criteria and are excluded from this review. This includes the 3.2km stretch of road from the southern end of Raumati Straights between Poplar Avenue and Mackays Crossing, which connects with Transmission Gully. To safely support a 110km/h speed limit, this section would require safety improvements, such as roadside barriers, removal of existing accessways to the road, shoulder widening, and improvements to the ground and pavement conditions. The required mitigation works have not yet been fully assessed.

Matters for Approval

NZTA wishes to complete the speed limit changes as set out in this letter under clause 2.6.

NZTA considers that the requirements for clause 2.6 have been met. In particular:

- For clause 2.6(3)(a) NZTA took into account the guidance and information developed and maintained by NZTA Waka Kotahi (Agency) under clauses 3.14 and 3.15 including the MegaMaps tool and One Network Framework for development of the technical aspects.
- For clause 2.6(3)(b) NZTA assessed the speed limits of the adjoining roads and considered the impact of the speed change and received feedback from adjacent RCAs.
- For clause 2.6(4) NZTA considers that there is a good reason for the proposed speed limits to be set with the Peka Peka to Ōtaki section now open and the safety assessment complete.
- For clause 2.6(6) NZTA undertook consultation that aligns with the requirements of clause 3.9. Notably:
    - The consultation period was at least four weeks:
        - 22 April – 20 May 2024
    - Iwi partners were contacted prior to consultation and given the opportunity to provide feedback on the speed limit review.
- For clause 2.6 (7) NZTA considered consultation submissions received.

Attachment B is a copy of the approved and signed memorandum that records the process undertaken for these speed limit changes.

If NZTA receives your approval for setting the speed limit pursuant to clause 2.6, it will complete the speed change in accordance with that clause, by creating and submitting a land transport record of the speed change and publishing online the information required under clause 2.6(8).

We appreciate your consideration of these proposals. Please contact me if you wish to discuss any aspect of this letter or require any further information.

Vanessa Browne

National Manager, Programme and Standards

Attachment B

Kāpiti Expressway 110km/h speed limit changes memo

NZ TRANSPORT AGENCY WAKA KOTAHI

Memo

To	Vanessa Browne, National Manager Programme and Standards Transport Services
Cc	James Hughes; Kirstan O'Donoghue; John Baillie
From	Steph Robinson
Date	26/07/2024
Subject	SH1 Kāpiti Expressway 110km/h speed limit changes – north of the Poplar Avenue interchange at Raumati South to south of the Ōtaki northern interchange

SH1 Kāpiti Expressway – north of the Poplar Avenue interchange at Raumati South to south of the Ōtaki northern interchange

1. Scope

New Zealand Transport Agency Waka Kotahi (NZTA) as Road Controlling Authority (RCA) respectfully requests that the Director of Land Transport (Director) approves the proposed speed limits for Kāpiti Expressway – from north of the Poplar Avenue interchange at Raumati South to south of the Ōtaki northern interchange and the associated on- and off-ramps.

This memo outlines the process that NZTA has undertaken to determine the proposed speed limits and will accompany a submission letter to the Director of Land Transport requesting an alternative method to set speed limits: Director approval (clause 2.6) of the Land Transport Rule: Setting of Speed Limits 2022 (the Rule). The Director of Land Transport's approval is required for changes to 110km/h speed limits under clause 4.4(1) of the Rule. NZTA has ensured that the process aligns with the draft Setting of Speed Limits Rule 2024 which the Ministry of Transport consulted on in June-July 2024.

2. Background

State Highway 1 is a strategic transport corridor in the Wellington region that has previously faced issues related to changing traffic characteristics, safety, population increases, route redundancy/resiliency, high freight movement, and congestion. In February 2017, the Mackays Crossing to Peka Peka Expressway was opened to address these issues and improve travel times for people and freight between Wellington and further north. The Mackays Crossing to Peka Peka Expressway connects the Transmission Gully motorway in the south to the Ōtaki to Peka Peka Expressway section further north. In December 2022, the Peka Peka to Ōtaki Expressway was opened. The Peka Peka to Ōtaki Expressway bypasses the Ōtaki township and connects the Mackays Crossing to Peka Peka section further south.

There are sections within Kāpiti Expressway that do not meet the 110km/h criteria and are excluded from this review. This includes the 3.2km stretch of road from the southern end of Raumati Straights between Poplar Avenue and Mackays Crossing, which connects with Transmission Gully. To safely support a 110km/h speed limit, this section would require safety improvements, such as roadside barriers, removal of existing accessways to the road, shoulder widening, and improvements to the ground and pavement conditions. The required mitigation works have not yet been fully assessed.

Figure 1 – SH1 Kāpiti Expressway – Poplar Avenue interchange to Peka Peka schematic map

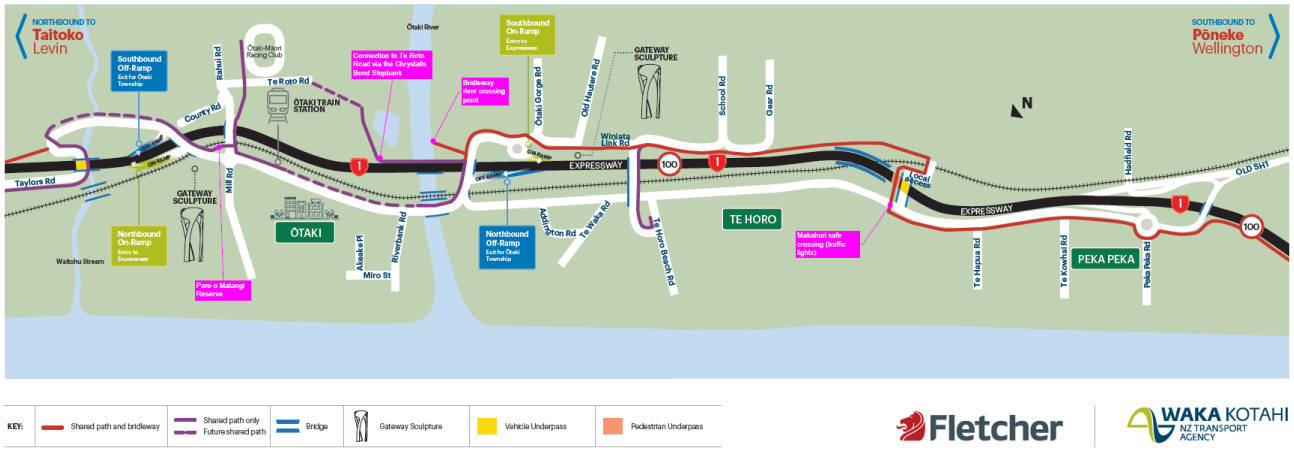


Figure 2 – SH1 Ōtaki to Peka Peka Expressway schematic map

3. Technical Considerations

All sections of the expressway assessed between Mackays Crossing and Ōtaki currently have a 100km/h posted speed limit.

NZTA has considered the geometric design of the corridors, taking into account the guidance and information developed and maintained by NZTA Waka Kotahi (Agency) including the Speed Management Guide (Readiness Review and the Emissions Review) and the NZTA Technical Note for 110km/h criteria (Draft, November 2023). NZTA has also prepared a Design, Construct, Management and Operations (DCMO) review to collate the relevant information to provide evidence to the Director that the road has been designed and constructed, and will be operated and managed, to the standard necessary to safely support 110km/h travel speeds as per the requirements of clause 4.4(2) of the Rule.

MegaMaps, Road to Zero Edition 2 contained the details for the Safe and Appropriate Speed (SAAS) for the Kāpiti Expressway between MacKays Crossing to Ōtaki as 100km/h. The One Network Framework (ONF) classification was also confirmed as an ‘inter-regional connector’ from MegaMaps.

Using the Speed Management Guide: Road to Zero edition, the SAAS was also assessed. As the new and existing road alignment had an ONF classification of ‘inter-regional connector’, the speed limit can range from 80 to 110km/h. The result of the assessment is listed in the summary table in Appendix A.

a. Project design cross-section and standards

The section of the Kāpiti Expressway over which the 110km/h posted speed limit is proposed consists of a 4-lane divided carriageway. The geometric design has adopted a 100km/h design speed, with a 110km/h design speed for some aspects. Wire rope median and side barriers are provided for the corridor, with TL-5 barriers at the various structures. The technical assessment indicates the corridor north of the Poplar Avenue interchange and south of the Ōtaki northern interchange satisfies the safety, geometric and access requirements for a speed increase to 110km/h.

The typical cross-section for the carriageway is identified in Figure 3 below.

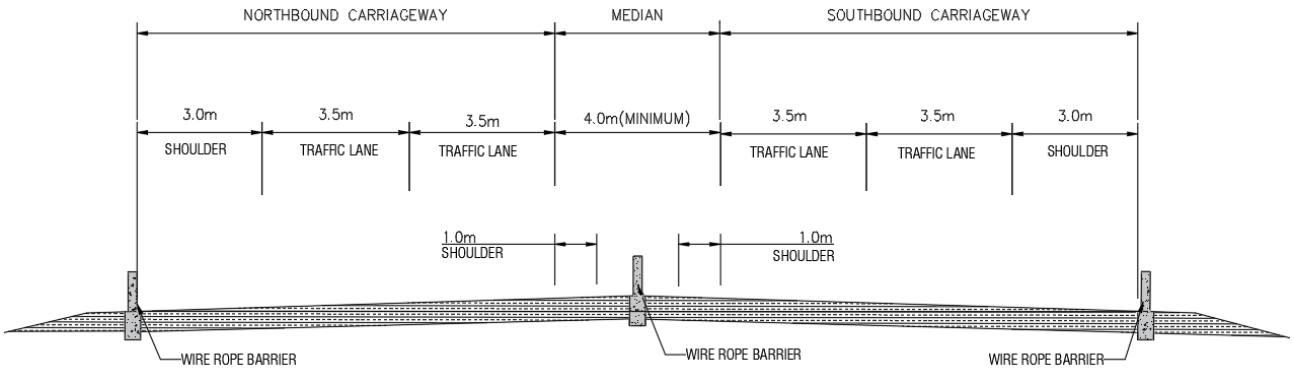


Figure 3 – Typical Cross-Section Kāpiti Expressway

4. Maori Partnership

Following the Minister's announcement of the proposed speed change consultation on the 9th of April 2024, NZTA contacted our iwi partners in the region – Muaūpoko, Ngāti Raukawa ki te Tonga, Ngāti Toa Rangatira, Te Ātiawa ki Whakarongotai, Taranaki Whānui and Ngā Hapū o Ōtaki – to inform them of the upcoming public consultation. We contacted iwi partners again during the last week of the consultation to remind them that there was still time to provide feedback. No feedback was received on the proposal to increase the speed limit.

5. Engagement and Consultation

Our formal consultation involved engaging with a range of key stakeholders, including:

- **Council partners** – Kāpiti Coast District Council, Horowhenua District Council, Greater Wellington Regional Council, Porirua City Council, Wellington City Council, Hutt City Council, Upper Hutt City Council, Palmerston North City Council, Manawatū District Council
- **Emergency Service partners** – NZ Police, Fire and Emergency NZ, Wellington Free Ambulance, St John's
- **Transportation partners** – Ia Ara Aotearoa/Transporting NZ, NZ Heavy Haulage Association
- **Other stakeholders** – AA, local business associations, cycle advocacy groups, advocacy/interest groups engaged during expressway construction.

Identified stakeholders were informed at the start of consultation via email from the Director of Regional Relationships and National Manager Programme and Standards. Key stakeholders received a follow up email during the last week of consultation.

Formal consultation on the proposed speed changes occurred from 22 April to 20 May 2024. Methods to inform the public about the consultation included:

- Physical brochures made available at council venues in Kāpiti, Horowhenua, Manawatū, and Porirua
- Content sent to council partners for sharing through their channels
- Print and radio advertising in Wellington, Kāpiti, Horowhenua, and Manawatū
- Project newsletters including the Mackays Crossing to Peka Peka revocation, and Ōtaki to north of Levin newsletters
- Social media posts on Facebook

Over 300,000 people viewed the two Facebook posts and over 1200 visited the consultation website.

A plan of the proposals used for consultation is shown in Figure 4 below.

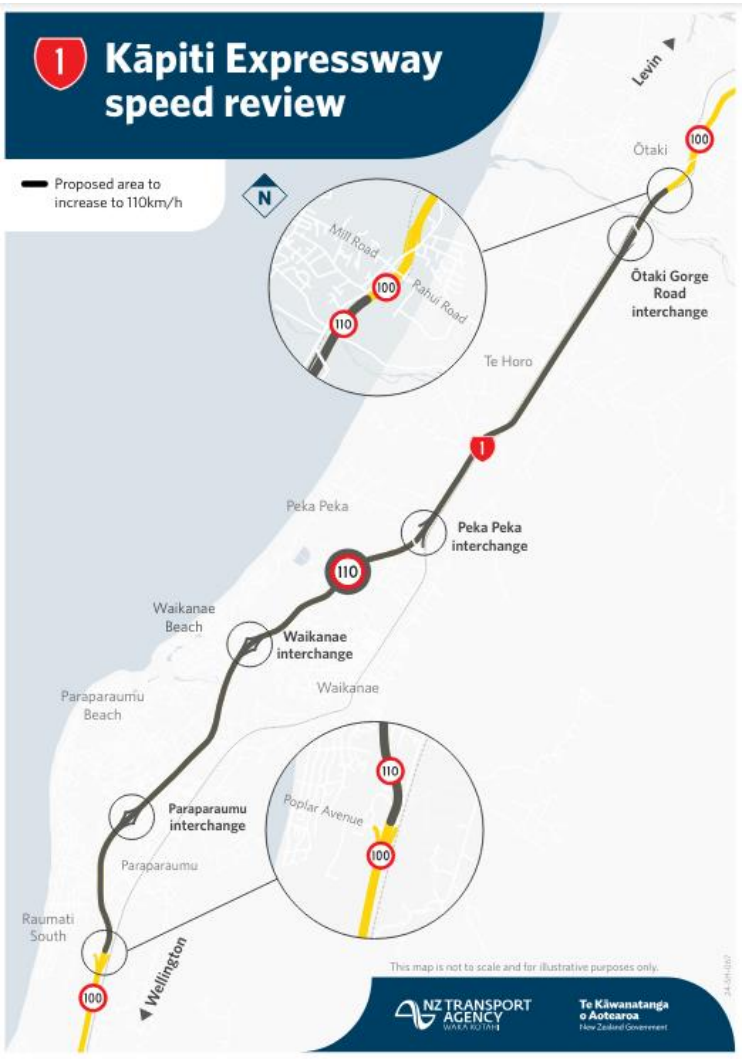


Figure 4 – Proposed Speed Limit Change - Kāpiti Expressway

The consultation questions were framed with the opening statement:

> *When considering a speed change on our state highways, we take into account a range of factors before making a decision, including safety, efficiency, accessibility, noise and environmental factors, as well as the views of the community and stakeholders.*

The first question, with response options given as a Likert scale, was:

> *What do you think about the proposed 110km/h speed limit on this section of State Highway 1?*

The Likert scale response options were Strongly Oppose, Oppose, Neutral, Support, Strongly Support, and Unsure.

The second, open-ended question was:

Why do you think that? Please tell us what is important to you.

NZTA received 3313 unique submissions in total, including 48 from businesses or organisations. Most submissions (3287) were made via the consultation webpage, with the remainder via email or hardcopy submission form. Almost all (99%) submitters were individuals, and the remainder were authorised representatives, submitting on behalf of organisations or groups. Submissions were received not just from the Kāpiti Region, but also from Wellington and further afield.

The overwhelming majority of submissions (93%) supported the proposed speed limit increase, with 91% strongly supporting it. 7% did not support the proposed increase.

a. Consultation feedback and response

The tables below set out the themes from consultation feedback and our response as NZTA.

Detailed submissions were received from the following organisations/groups:

Organisation	Summary of their feedback	Our response
New Zealand Automobile Association (NZAA), Manawatū District Council, Whanganui District Council, Wellington District Council	Strongly support increase in speed. Want the Kāpiti Expressway to be designated as a motorway, removing cyclists, pedestrians, and e-scooters. Their main safety concern is the potential presence of vulnerable road users. They believe there are existing alternatives for these road users. Suggest the economic benefits of increased speed including faster freight and passenger travel, outweigh potential increases in fuel use and CO2 emissions. Observe that the environmental impacts may be lessened as more efficient vehicles and electric vehicles become more prevalent.	We acknowledge the existing non expressway network including the revoked State Highway is high risk to cyclists because of intersections and driveways. By increasing the speed on the Kāpiti Expressway, we also acknowledge the risk to cyclists at ramps and interchanges. There are off-road facilities for the use of all cyclists along the Kāpiti Expressway from Poplar Ave Interchange to Ōtaki. There are no plans to designate Kāpiti Expressway as a motorway at this stage. Note: the current 90km/h speed limit for heavy vehicles and towing vehicles will still apply on the Kāpiti Expressway, which means journey times for vehicles carrying freight will remain unchanged. The 90km/h speed limit for heavy vehicles is set under the Land Transport (Road User) Rule 2004 and was deemed the appropriate speed limit for heavy vehicles when considering both safety and efficiency.
Cycling Network Action	Strongly opposed to increase in speed. Believe more speed leads to more risk and more harm, with road users have less time to react. Proposed speed doesn't align with safe and appropriate speed limits of Road to Zero strategy.	A 110km/h speed limit is safe and appropriate on sections of state highway that provide interregional connection and are designed to a high standard with adequate safety features. This includes: • a straight or slightly curved road design for visibility • at least two lanes in each direction for safe passing opportunities • physical separation between opposing lanes to prevent head-on crash risk

		• no driveways or intersections along the road. • The road should also carry less than 25,000 vehicles per day on average in each direction. An example of this is the Waikato Expressway, which has safely operated at a speed limit of 110km/h since 2022. This section of the Kāpiti Expressway has been designed and constructed as one of New Zealand's safest state highways. Because this road has features that make it safer to travel at 110km/h, the speed limit can be set higher than for other state highway sections.
Kāpiti Cycling Club	Submission does not explicitly indicate support or opposition to the proposed speed limit increase but conveys that the proposed speed will dissuade road cyclists from using the Expressway. Observe that while the shared user path between Ōtaki and Peka Peka is a wonderful addition to the trails network, it's not suitable for faster cyclists or road bikes due to it being unsealed. If the speed limit between Peka Peka and Ōtaki is increased, they request: • old SH1 Ōtaki to Waikanae have a reduced speed of 80km/h or less • the shoulders on old SH1 between Makahuri and Ōtaki be widened, sealed, and marked to make it safer for cyclists • shoulder maintenance on old SH1 be improved • the shared path between Ōtaki and Peka Peka be sealed and marked with centre lines on all corners and bends.	The Kāpiti Expressway allows for cyclists. While cyclists are at an elevated risk at any highway speed, the shoulder is sealed and generally wider than 2.0 metres which will provide for cyclists. There are also parallel off-road shared pathways along this section of highway that can be used as an alternative travel route by cyclists. The Peka Peka to Ōtaki corridor improvements project for the old SH1 is currently at the detailed design phase. We expect to finalise these designs, and begin installation work, in 2024. Along with those corridor improvements, we're expecting to put in place new speed limits for the section of old SH1 in 2024.
Tim Costley, MP for Ōtaki (on behalf of community)	Submission indicates support for the proposed speed limit increase. Observes that it's a safe, world-class expressway designed to be safe at higher speeds. The Government wants to see a transport system that boosts productivity and economic growth and allows New Zealanders to get to where they want to go quickly and safely.	
Upper Hutt District Council	Strongly support proposed increase in speed limit. Believe an integrated and coordinated approach which includes Transmission Gully needs to be advanced ASAP.	While Transmission Gully is operational, there are still remaining works that we need to complete before we begin a speed limit review.

	Indicate support for further measures that improve local and regional access to the Expressway; congestion; travel time reliability for people and freight; and road safety.	
NZ Police	Support proposed speed limit. Noted similar roads in New Zealand with a 110km/h speed limit haven't observed any detrimental effects to the safety of road users due to higher speed limits. **NZ Police submitted additional considerations, including:** • continued access to barrier protection systems to provide a safe operating environment for Police undertaking speed enforcement duties. • all traffic control devices installed on the road to indicate the speed limit, comply with all necessary rules/regulations including the Land Transport Rule (Traffic Control Devices) 2004. • the same safety features are extended into the reduced speed zone for a distance to ensure a safer transition. • Clear, evidence-based communication strategy that reinforces why a 110km/h speed limit is safe in certain road environments, including Kāpiti Expressway.	<u>Safe operating environment</u> We acknowledge the importance of barrier protection systems to provide a safe operating environment for NZ Police undertaking speed enforcement duties. Maintenance bays have been provided along the length of the corridor that will provide barrier protection to Police undertaking enforcement duties. • There are 14 maintenance bays in the northbound direction and 10 in the southbound direction. <u>Appropriate management of infrastructure</u> Should the proposed speed limit increase proceed, traffic control devices installed on the corridor will comply with all necessary rules and regulations, including the Land Transport Rule (Traffic Control Devices) 2004. This will be strictly monitored and enforced. The same 3 barrier safety system extends into the reduced speed zones: • Southbound, through the majority of the Raumati Straights section of the Kāpiti Expressway from the proposed 100km/h speed threshold. • Northbound, approximately 2km from the proposed 100km/h speed threshold to Taylors Road maintenance access. Further extension of the three-barrier system from Taylors Road maintenance access will be incorporated as part of the Ōtaki to north of Levin project. <u>Communication activity</u> Should the proposed speed limit increase proceed, then communication activity will be developed and run ahead of its implementation. The activity will reinforce the design and construction features that make 110km/h a safe and appropriate speed for this section of highway.

Horowhenua District Council	Council supports proposed increase in speed limit. Believe it's clear this approach will bring economic benefits to Horowhenua community and wider region.	

Main themes of supporting feedback received online (93%) and response:

Feedback theme	**Our response**
Better travel times, productivity or efficiencies	The proposed speed limit increase aligns with the Government's commitment to getting people where they need to go, safely and efficiently. Should the proposed speed limit be implemented, the impact on single journey times will be relatively small, with no impact on those heavy and towing vehicles, for whom the current 90km/h speed limit will remain unchanged. For some road users, particularly more frequent users, the impact of the reduced journey times may be greater, particularly when viewed cumulatively.
People are already travelling at 110km/h or higher	Speed enforcement interventions will continue for people who travel over the designated speed limit. Police will apply the same enforcement considerations to 110km/h roads as any other part of the road network. This includes deploying to locations where the road safety risk is greatest. Officers will continue to use discretion in applying enforcement interventions according to the circumstances, with a focus on ensuring people drive in a safe manner and at a safe speed. Drivers should continue to drive to the conditions, free from impairment and distraction, and make sure everyone in the vehicle is properly restrained. By doing this, you will dramatically reduce the chances of causing harm to yourself and others on the road.
Extend the 110km/h further	As indicated in our consultation information, it is our current expectation that a 110km/h speed limit may be able to be proposed for other sections of highway near the Kāpiti Expressway. Te Aranui o Te Rangihaeata – Transmission Gully is built to the same high safety and operational standards, and early indications are that the crash numbers reflect the same improvement in safety. While Transmission Gully is operational, there are still some remaining works that need to completed before we begin a speed limit review. The 3.2km Raumati Straights section of the Kāpiti Expressway doesn't yet meet the side barrier and shoulder width, and pavement requirements. Planning work is underway to scope and design the necessary improvements. The 1.6km northern end of Kāpiti Expressway between the Ōtaki northern interchange and Taylors would require improved roadside protection, widening the road to a dual lane carriageway, and widening of the left-hand shoulder to meet the standard for 110km/h. The planned Ōtaki to North of Levin Road of National Significance will extend the expressway further north and will be built to the same high safety and operational standards to allow a 110km/h speed limit. You can follow

	progress of this project here - Ōtaki to north of Levin (O2NL) | NZ Transport Agency Waka Kotahi (nzta.govt.nz)
Cars are safer now	We've heard that some people feel that the 110km/h speed limit is appropriate based on the belief that the safety standard of vehicles has increased in recent years. NZTA Waka Kotahi are working to support an overall safe system approach which includes not just safer vehicles, but safer drivers and safer roads, to ensure everyone can get where they need to go safely and efficiently. More information about vehicle safety can be found at nzta.govt.nz/safety/vehicle-safety/
Keep up with road speeds overseas	Our approach to setting speed limits is governed by the current Setting of Speed Limits Rule. This takes into consideration factors such as road classification, traffic volumes, road geometry and safety assessments. While NZTA Waka Kotahi continues to keep across speed management practices in other countries, our approach is not developed in response to speed limits in operation overseas. Different countries operate in different environments where factors such as road construction may vary.
The speed should be 120km/h or higher	Under the current Setting of Speed Limits Rule (2022), there is no provision for a speed limit of 120km/h or higher. The draft Setting of Speed Limits Rule (2024) recently consultated on contains some proposed changes to speed limits specified in the current Rule.

Main themes of opposing feedback received online (7%) and response:

Feedback theme	**Our response**
The increased speed limit will cause more/more serious crashes/110km/h is not safe, 100km/h or lower is better	A 110km/h speed limit is safe and appropriate on sections of state highway that provide interregional connection and are designed to a high standard with adequate safety features. This includes a straight or slightly curved road design for visibility, at least two lanes in each direction for safe passing opportunities, physical separation between opposing lanes to prevent head-on crash risk, and no driveways or intersections along the road. The road should also carry less than 25,000 vehicles per day on average in each direction. An example of this is the Waikato Expressway, which has safely operated at a speed limit of 110km/h since 2022. This section of the Kāpiti Expressway has been designed and constructed as one of New Zealand's safest state highways. Because this road has features that make it safe to travel at 110km/h, the speed limit can be set higher than for other state highway sections.
The increased speed limit will increase emissions and use of fuel	Calculating vehicle emissions is complicated as there are multiple factors that need to be considered, in addition to speed. There are over 4 million vehicles on Aotearoa roads, with over half of these classified as light passenger vehicles. Fuel consumption for light passenger vehicles will vary depending on the speed travelled as well as factors such as vehicle size, shape (related to air resistance), fuel type, age and how a person drives (e.g. sudden braking or accelerating). During congested conditions fuel efficiency is typically reduced resulting in higher vehicle emissions.

	NZTA Waka Kotahi, use the Vehicles Emissions Prediction Model (VEPM) to estimate fleet average emissions from vehicles in the fleet, based on their average speed and typical road, traffic and operating conditions, such as weather. VEPM predicts that the lowest emissions for the light vehicle fleet occur at average speeds between 70-75km/h. Speeds outside of this range, both lower and higher, are estimated to create higher emissions on average but other factors must be taken into consideration when considering speed management such as people's safety, roading infrastructure, traffic volume and operating conditions.
There are only minimal reductions in journey times, so the speed limit increase is not justified	While the reduction in journey times may be viewed by some as small, for other road users the reductions are seen as more significant, particularly for frequent users who may consider the cumulative impact of the reduced journey times.
Heavy vehicles, trailers and slower drivers travelling at 90km/h, will mean it is not safe for other vehicles travelling at 110km/h	The current 90km/h speed limit for heavy vehicles and towing vehicles will also apply on 110km/h roads. This section of the Kāpiti Expressway has at least two lanes in each direction, so other road users should be able to pass slower-moving vehicles safely and easily. The 90km/h speed limit for heavy vehicles is set under the Land Transport (Road User) Rule 2004. 90km/h was deemed the appropriate speed limit for heavy vehicles when considering both safety and efficiency.
There will be higher maintenance costs	It is not expected that an increase in the speed limit to 110km/h would result in a significant increase in highway maintenance costs along this section of the Expressway. This has proven to be the case on the section of the Waikato Expressway, where a 110km/h speed limit has been in operation since 2022. NZTA Waka Kotahi have liaised and planned with the relevant teams to allow for any increase in maintenance costs.
This section of expressway is mainly used by locals travelling short distances (with many being elderly)	Our analysis shows that a wide range of people are using this section of highway including locals, commuters, businesses and visitors. The needs of all road users were considered when proposing the increased speed limit.

Common themes of supporting and opposing feedback received online and response:

Feedback theme	**Our response**
Concern that drivers will just go faster (i.e. above 110km/h) / Speed limit needs to be policed/enforced, or have speed cameras	Speed enforcement interventions will continue for people who travel over the designated speed limit. NZTA Waka Kotahi will be working with NZ Police on speed enforcement for this section of highway. Police will apply the same enforcement considerations to 110km/h roads as any other part of the road network. This includes deploying to locations where the road safety risk is greatest. Officers will continue to use discretion in applying enforcement interventions according to the circumstances, with a focus on ensuring people drive in a safe manner and at a safe speed.

	Drivers should continue to drive to the conditions, free from impairment and distraction, and make sure everyone in the vehicle is properly restrained. By doing this, you will dramatically reduce the chances of causing harm to yourself and others on the road.
Too many poor drivers on the road, they need more training	Driver behaviour remains a key focus. We undertake marketing and education initiatives to help build awareness of how to make good driving choices. Find more information on driver education on our website: nzta.govt.nz/safety/building-your-driving-skills/
On/off ramps are too short, will create merging, congestion and safety issues	All ramps have been assessed as part of the proposed speed change and are not expected to operate less efficiently due to the proposed speed changes. As with any changes made on our state highways, we continue to monitor the impact and may decide to make further required changes if necessary.
More signage and education is needed regarding merging safely and using 2 lanes	We're currently reviewing and updating the road signage associated with the speed change to ensure clear messaging. This includes repeater signs on the main corridor within the proposed 110km/h section as well as advanced warning signage prior to the speed threshold change at both ends. Additional 100km/h signs will be installed beyond the thresholds to reinforce lower speed limits. Should the proposed speed limit increase proceed, then communication activity will be developed and run ahead of its implementation. This will include information regarding driving safely on the expressway.
Will create more traffic noise	The change in operational noise due to the speed proposal is expected to be minimal, with an approximately one decibel (dB) increase in noise levels. We will monitor traffic noise levels, should the proposed speed limit increase be implemented. This ongoing evaluation will allow us to make any necessary adjustments to our noise mitigation strategies, if necessary.
Concern for cyclists' safety	The Kāpiti Expressway allows for cyclists. While cyclists are at an elevated risk at any highway speed, the shoulder is sealed and generally wider than 2.0 metres which will provide for cyclists. There are also parallel off-road shared pathways that can be used as an alternative travel route by cyclists.

6. Requirements of the Speed Rule (2022)

The Land Transport Rule: Setting of Speed Limits 2022 sets the process for making new and altering existing speed limits. The Rule has provision for 'out of cycle' certification by using Clause 2.6 '*Alternative method for Agency (as RCA) or territorial authorities to set speed limits: Director approval before next plan'*.

For the Kāpiti Expressway - north of the Poplar Avenue interchange at Raumati South to south of the Ōtaki northern interchange speed changes:

- Transport Services provides details of the proposed speed limits and seeks the Director's approval to set these speed limits.
- It can be confirmed that regard was taken of the guidance and information developed and maintained by the Agency and that discussions with adjoining RCA have taken place with regards to the proposed speed limits.

- NZTA confirms that the requirements for Clause 4.4 (2) have been met, as outlined in the DCMO review.
- A good reason exists for the proposed speed limits to be set with the Peka Peka to Ōtaki section now open and the safety assessment complete.
- Consultation was undertaken via the Alternative Method for Agency to set speed limits: Director approval and clause 3.9 was applied. All submissions to the consultation were considered.

7. Transport Services Recommendation

Transport Services recommends that the Director of Land Transport certifies the speed limit proposals for Kāpiti Expressway - north of the Poplar Avenue interchange at Raumati South to south of the Ōtaki northern interchange, as listed below:

Corridor Name	Description	Start	End	Length (km)	Speed limit (km/h)
SH1 Kāpiti Expressway mainline	250m south of Rahui Road underpass to 300m north of Rongamau Footbridge	1782086, 5485304	1767831, 5467032	24.34	110
SH1 Ōtaki Gorge Road northbound off-ramp	Ōtaki Gorge Road Interchange	1780739, 5483730	1780919, 5484033	0.36	110
SH1 Ōtaki Gorge Road southbound on-ramp	Ōtaki Gorge Road interchange	1780839, 5483796	1780616, 5483510	0.37	110
SH1 Peka Peka Road northbound on-ramp	Peka Peka interchange	1775885, 5476899	1776091, 5477185,	0.35	110
SH1 Hadfield Road southbound off-ramp	Peka Peka interchange	1776150, 5477234	1776083, 5477111	0.15	110
SH1 Hadfield Road southbound off-ramp	Peka Peka interchange	1776083, 5477111	1775965, 5476901	0.25	80
SH1 Te Moana Road northbound on-ramp	Waikanae interchange	1771473, 5473935	1771934, 5474095	0.49	110
SH1 Te Moana Road northbound off-ramp	Waikanae interchange	1771138, 5473497	1771294, 5473732	0.29	110
SH1 Te Moana Road northbound off-ramp	Waikanae interchange	1771294, 5473732	1771418, 5473878	0.20	50
SH1 Te Moana Road southbound on-ramp	Waikanae interchange	1771490, 5473783	1771130, 5473444	0.50	110
SH1 Te Moana Road southbound off-ramp	Waikanae interchange	1771849, 5474042	1771635, 5473909	0.26	110
SH1 Kāpiti Road northbound on-ramp	Paraparaumu interchange	1768437, 5469531	1768747, 5469804	0.42	110
SH1 Kāpiti Road northbound off-ramp	Paraparaumu interchange	1768108, 5469198	1768316, 5469417	0.30	110
SH1 Kāpiti Road northbound off-ramp	Paraparaumu interchange	1768316, 5469417	1768380, 5469480	0.10	50
SH1 Kāpiti Road southbound on-ramp	Paraparaumu interchange	1768402, 5469413	1768106, 5469162	0.40	110
SH1 Kāpiti Road southbound off-ramp	Paraparaumu interchange	1768747, 5469770	1768574, 5469578	0.27	110
SH1 Kāpiti Road southbound	Paraparaumu interchange	1768574,	1768456,	0.18	50

Corridor Name	Description	Start	End	Length (km)	Speed limit (km/h)
off-ramp		5469578	5469457		

Outcome Endorsement

Name	Position	Date	Signature
Kirstan O'Donoghue	Team Lead, Road Safety, SaSS, Transport Services-Programme and Standards	26/7/24	
James Hughes	Lead Advisor Safety, Transport Services-Programme and Standards	26/7/24	

Decision

This decision is made by the National Manager Te Toki Manawa Programme and Standards, in accord with authority residing in NZTA.

Name	Position	Date	Signature
Vanessa Browne	National Manager Programme and Standards, Transport Services, Office of GM TS	26/7/24	

Appendix A

Summary Table

SH	Location	Existing PSL (km/h)	Proposed Speed Limit (km/h)	Speed Limit Type	Implementation Timeframe (FY)	Is proposed speed limit different from the Waka Kotahi confirmed assessment of safe and appropriate speed (SAAS) limit? (km/h)	Further information	Dates and times
1	Kapiti Expressway mainline	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. A three-barrier system is provided for the full length. Technical Review for 110km/h has been completed.	
1	Otaki Gorge Road northbound off-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Otaki Gorge Road southbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Peka Peka Road northbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Hadfield Road southbound off ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Hadfield Road southbound off-ramp	100	80	Permanent Speed	24-25	Yes (100km/h)	Change to the length of 80km/h on the offramp where it ties in with the local road posted speed limit	
1	Te Moana Road northbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Te Moana Road northbound off-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Te Moana Road northbound off-ramp	100	50	Permanent Speed	24-25	Yes (100km/h)	Change to the length of 50km/h on the offramp where it ties in with the local road posted speed limit	
1	Te Moana Road southbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	

SH	Location	Existing PSL (km/h)	Proposed Speed Limit (km/h)	Speed Limit Type	Implementation Timeframe (FY)	Is proposed speed limit different from the Waka Kotahi confirmed assessment of safe and appropriate speed (SAAS) limit? (km/h)	Further information	Dates and times
1	Te Moana Road southbound off-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Kapiti Road northbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Kapiti Road northbound off-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Kapiti Road northbound off-ramp	100	50	Permanent Speed	24-25	Yes (100km/h)	Change to the length of 50km/h speed limit on the offramp where it ties in with the local road posted speed limit.	
1	Kapiti Road southbound on-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Kapiti Road southbound off-ramp	100	110	Permanent Speed	24-25	Yes (100km/h)	ONF = interregional connector = meets criteria for 110km/h SaAS. Technical Review for 110km/h has been completed.	
1	Kapiti Road southbound off-ramp	100	50	Permanent Speed	24-25	Yes (100km/h)	Change to the length of 50km/h speed limit on the offramp where it ties in with the local road posted speed limit.	

NZ TRANSPORT AGENCY
WAKA KOTAHI

Memo

To	Kirstan O'Donoghue
Cc	James Hughes
From	Thayalan Sivachelvan
Date	22/06/2024
Subject	SH1 Kāpiti Expressway 110km/h readiness review of Design, Construction, Management and Operations – from Mackays Crossing to Peka Peka - Complete Corridor

SH1 Kāpiti Expressway Mackays Crossing to Ōtaki Design, Construction, Management and Operations 110km/h readiness review

1. Summary

The State Highway 1 Kāpiti Expressway has been identified as a corridor that may be safe & appropriate for a 110km/h posted speed limit between Mackays Crossing and Ōtaki. The expressway has been designed and constructed to a 110km/h standard, with only two sections requiring the safety infrastructure improvements recommended to provide additional safety support of a 31km continuous length between Mackays Crossing and Ōtaki.

The required infrastructure improvements and status of the sections are noted below:

- The 1.6km northern end of the alignment between Taylors Drive and Ōtaki Interchange which ties in with the existing SH1 section requires retrofit roadside protection, widening to dual lane carriageway, and widening of the left-hand shoulder. This section is to be designed as part of the Ōtaki to North of Levin project. Construction is expected to begin in 2025 and be completed in 2029. This section currently does not meet the 110km/h criteria and should be excluded from a 110km/h speed change on the Mackays Crossing to Ōtaki corridor.
- The 3.2km southern end of the alignment at Raumati Straights between Poplar Avenue and Mackays Crossing which ties in with the Transmission Gully corridor, requires retrofit roadside protection and access closure, widening of shoulder, and improvements to ground and pavement condition. This section currently does not meet the 110km/h criteria and, as the implication and detail of the required mitigation works have not been fully assessed at this stage, this section is excluded from the 110km/h review.

Engagement and consultation activities to achieve a 110km/h corridor between Mackays Crossing and Ōtaki were undertaken in April and May 2024. There were 3,313 total submissions received with 48 submissions from public organisations. The analysed feedback resulted in positive support from key stakeholders and 93% public support.

The assessed section of SH1 from approximately SH 01N RS/RP 995/5.34 (south of the Ōtaki Northern Interchange) to 1011/14.38 (north of Poplar Avenue Interchange) is found to meet the design, construction, management and operation requirements to be posted at 110km/h. Signage location finalisation and the works to install the signs will need to be completed if the increase is approved by the Director.

2. Purpose

This memorandum has been prepared to review the Kāpiti corridor between Mackays Crossing and Ōtaki for Design, Construction, Management, and Operational readiness to support a 110km/h speed limit.

The requirements for setting a 110km/h speed limit are provided in the Land Transport Rule: Setting of Speed Limits 2022 and the Speed Management Guide: Road to Zero edition. The rule states:

4.4 (1) A road controlling authority may not set a speed limit of 110km/h for a road unless the road controlling authority has requested and obtained the Director's approval under this clause.

4.4 (2) If the Director is satisfied that the road has been designed and constructed, and will be managed and operated, to the standard necessary to safely support 110km/h travel speeds, the Director—

(a) must give approval, and may do so unconditionally or subject to any conditions that the Director considers appropriate; and
(b) must set maximum lengths between speed limit signs for the road.

If the Director has approved a 110km/h speed limit, a period of consultation and certification is required to record the new speed limit in the National Speed Limit Register.

The Director has discretion over their approval. It should be demonstrated that the road has been designed and constructed and will be managed and operated, to the standard necessary to safely support 110km/h travel speeds.

3. Background

The Kāpiti Expressway is a strategic transport corridor in the Wellington region that has previously faced issues related to changing traffic characteristics, safety, population increases, route redundancy/resiliency, freight movement, and congestion. In February 2017, the Mackays Crossing to Peka Peka Expressway was opened to address these issues and improve travel times for people and freight between Wellington and further north. The Mackays Crossing to Peka Peka Expressway connects the Transmission Gully motorway in the south and to the Ōtaki to Peka Peka Expressway section further north. In December 2022, the Peka Peka to Ōtaki Expressway was opened. The Peka Peka to Ōtaki Expressway bypasses the Ōtaki township and connects the Mackays Crossing to Peka Peka section further south.

With the construction of SH1 Peka Peka to Ōtaki, SH1 Mackays Crossing to Peka Peka (excluding Raumati Straights) and SH1 Transmission Gully built to high safety and operational standards, there is an opportunity to set higher speed limits for the route north out of Wellington from north of the state highway interchange at Linden. The intention would be to continue the 110km/h limit to a location south of the planned roundabouts at Levin in due course, however, this part of the Ōtaki to North of Levin project is still in the design phase.

SH1 Mackays Crossing to Peka Peka is an 18km four-lane expressway that takes State Highway 1 along the Kāpiti Coast and was the first of the Wellington Northern Corridor projects completed. It separates local and highway traffic and aims for safer and shorter trips to and through the Kāpiti Coast - with local and national benefits. This section connects seamlessly to Peka Peka to Ōtaki at the Peka Peka interchange and includes the Raumati Straights section to the south.

Figure 1 – SH1 Kāpiti Expressway – Poplar Avenue interchange to Peka Peka Expressway schematic map

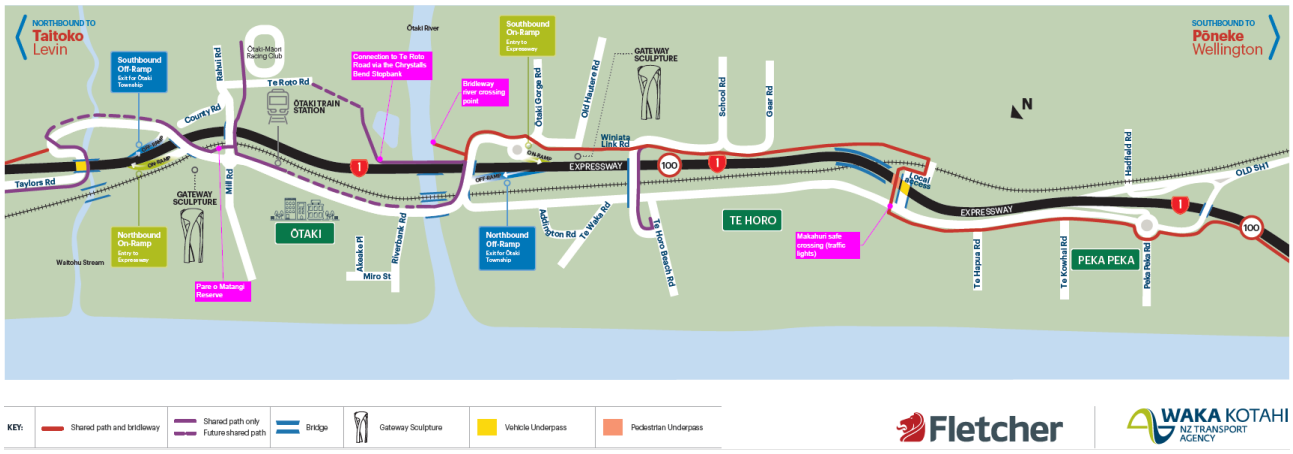


Figure 2 – SH1 Ōtaki to Peka Peka Expressway schematic map

4. Memorandum Scope

Based on the Setting of Speed Limits Rule 2022, the Director of Land Transport requires evidence that the SH1 Mackays Crossing to Ōtaki corridor has been designed, constructed, and will be managed and operated to safely support 110km/h travel speeds. This memorandum forms part of the evidence base to consider a 110km/h speed limit along the Kāpiti Expressway between Mackays Crossing just north of Paekākāriki and Ōtaki (approximately 31km) by reviewing the corridor's design, construction, management, and operational readiness for Mackays Crossing to Peka Peka Road

(RSRP 1011/18.04 to 1011/0.0, section length of 18 km) and Ōtaki to Peka Peka from Taylors Road to Peka Peka Road (RSRP 995/3.0 to 995/15.3, section length of 12.3km).

The Mackays Crossing to Peka Peka section design and construction readiness has been assessed against the NZTA Technical Note for 110km/h criteria. The management and operation of the 110km/h corridor reviewed NZTA's approach to managing the existing 110km/h corridors at the Tauranga Link Road, and the Waikato Expressway.

5. Design, Construction, Management and Operations 110km/h readiness

5.1. Design and Construction Review

The NZ Transport Agency Waka Kotahi assessed the Mackays Crossing to Ōtaki corridor for 110km/h readiness against the NZ Transport Agency Waka Kotahi Technical Note for 110km/h criteria (Draft, November 2023), provided in **Cover Letter Appendix D.**

The relevant assessment information is provided in the following attached documentation:

- The 110km/h readiness assessment reports are located within Memo **Appendix A**.
- Any departures identified during the 110km/h readiness review are noted in Memo **Appendix B**. Most departures did not require mitigation.

The assessment results are summarised in **Table 1 – Section Assessment against 110km/h design and construction compliance.**

NZ TRANSPORT AGENCY
WAKA KOTAHI

Memo

Table 1: Section Assessment against 110km/h design and construction compliance

		NZ Transport Agency Waka Kotahi Technical Note for 110km/h criteria Resolution								
Section	**RS/RP**	**Length**	**Standard of corridor – superelevation and sight distance**	**Dual Carriageway with median barrier**	**Traffic Volume**	**Interchange Spacing**	**KiwiRAP rating**	**Personal Risk**	**Collective Risk**	**Recommendations**
North of Poplar Avenue to Peka Peka Interchange	1011/14.99 to 1011/0.00	Y	Y	Y	Y	Y	4/5 star*	Y	Y	110km/h signage works.
Peka Peka Interchange to Ōtaki Northern Interchange	995/15.3 to 995/4.6	Y	Y	Y	Y	Y	4/5 star*	Not available	Not available	110km/h signage works

Notes

Y= Criteria achieved

N = Criteria not achieved

* Kiwirap rating = combination of all continuous sections achieves criteria

5.2. Management Review

NZTA has dedicated regional client maintenance and operations teams that report to a national management team to ensure the network is maintained and operating to an agreed level of service. The client management team focuses on two aspects:

- Network management; asset management, network controls, safety management, design & quality assurance; and
- Physical works; maintenance and renewals of sealed pavements, drainage and structures and environmental maintenance, traffic services, and incident response

The majority of New Zealand's State Highways are managed by NZTA in the form of long-term client-supplier contracts agreements. The Mackays Crossing to Ōtaki Expressway is managed by the Wellington Transport Alliance, an alliance between NZTA, WSP, and Fulton Hogan.

The characteristics of the 31km expressway corridor are as follows.

- The infrastructure supports a 110km/h corridor speed limit for the extent outlined in this report.
- Traffic is free flowing without variable speed limits.
- Corridor maintenance and improvements will be undertaken for level 3 temporary traffic management via the New Zealand Guide to Temporary Traffic Management (NZGTTM).
- Incident management will utilise pre-determined detours and NZGTTM with appropriate speed restrictions to enhance construction site safety.

Only two sections of safety improvements are required to enable a 110km/h section between Mackays Crossing and Ōtaki. One section is the 3.2km section of Raumati Straights at the southern end of the alignment. This section is excluded from the current scope due to the costs, funding, and timeline of any mitigation work being unknown. The other section is the 1.6km long northern end of the alignment between Taylors Drive and Ōtaki Interchange which ties in with the existing SH1 section and requires retrofit roadside protection, widening to dual lane carriageway, and widening of the left-hand shoulder. This section is excluded from the current scope due to the section being designed through the Ōtaki to North of Levin project.

Temporary Traffic Management

The Mackays Crossing to Ōtaki corridor is managed as a level 3 temporary traffic management road corridor. Once the 110km/h speed limit is certified, the corridor will apply the NZGTTM approach utilised on the Waikato Expressway 110km/h section; increased spacing between signs and larger text signage, and where required additional truck-mounted attenuators. This risk-based approach will be implemented by the Wellington Transport Alliance.

The Wellington Transport Alliance will review the risks and potential changes to maintenance and construction methodologies and reflect any changes within the below documentation:

- Maintenance and Incident Management Plan (MMP)
- Traffic Control Plan (TCP)

- establishes the practices for traffic management at a Network level, project level, and customer level
- temporary traffic management practices, such as mobile operations, stop/go operations, sign placement, set up and set down procedures

- Emergency Procedures and Preparedness Plan (EPPP)
  - organisational responses to incidents causing partial or complete closures of the state highway.

5.3 Operational review

The Ministry of Transport's Road to Zero strategy[1] required a partnership approach between infrastructure and enforcement to improve safety outcomes along the state highway. For the Mackays Crossing to Peka Peka 110km/h corridor to act as a safe system corridor, the existing partnership approach between safe roadsides (road infrastructure provided by NZTA) and compliance/enforcement (undertaken by the NZ Police) will continue.

Road Infrastructure

Except for the southern and northern ends of the alignment that do not meet the 110km/h speed assessment technical criteria, being Raumati Straights and the section between Taylors Road and Ōtaki northern interchange, the Mackays Crossing to Peka Peka corridor has been designed and constructed to a high safety standard (refer to section 5.1 Design and Construction review).

The central median has a safety barrier installed to mitigate the risk of cross-median crashes while side barriers are installed on both sides to prevent run-off road crashes. The side barriers are generally set back away from the edge line along the corridor allowing additional space for a driver to stop (and get out of the vehicle) in case of an emergency. In addition, exit and entry to the 110km/h corridor is limited to the interchanges. The roads that support 110km/h are designed, constructed, maintained, and operated to the necessary standards for the travel speed. These roads have safety features that significantly reduce the chance of a serious injury crash. For example, median barriers and two lanes in each direction will prevent head-on collisions - a primary cause of very serious crashes. If crashes do occur, these are not expected to result in death or serious injury due to the supporting safety infrastructure along these roads. As part of the Network Outcomes Contract (NOC) operational requirements of road infrastructure on the proposed 110km/h corridor, it is recommended the Level of Service (LOS) requirements for maintaining road surface, drainage, signage, delineation, lighting, and barriers are reviewed. It is also recommended that cyclist marking and signage at interchanges and ramps is reviewed to ensure consistency between the newer and older sections of the proposed 110km/h corridor.

Police Enforcement

NZ Police from the Wellington and Central Districts support the proposed speed limit change on Kāpiti Expressway, considering the safety features that have been incorporated into the corridor. They will apply the same enforcement considerations to 110km/h roads as any other part of the road network. This includes the deployment of enforcement resources to locations where the road safety risk is greatest. Officers will continue to use discretion in applying enforcement interventions according to the circumstances, with a focus on ensuring people drive in a safe manner and at a safe speed.

Discussions with NZ Police (refer **Appendix F – NZTA Police agreement-in-principle**) have indicated they will undertake minimal enforcement activities on the Mackays Crossing to Ōtaki corridor due to the road infrastructure creating a safer driver environment. Enforcement activities will predominantly be undertaken using mobile operations (unmarked vehicles driving the corridor) and static operations at off-ramps (off the main tranche) and maintenance bays (laser radars) along

[1] https://www.transport.govt.nz/area-of-interest/safety/road-to-zero/

the route. To assist and minimise NZ Police enforcement activities they have requested that the following items should be considered:

• Continued access to barrier protection systems to provide a safe operating environment for Police undertaking speed enforcement duties (speed camera vans and mobile Police patrols) with sufficient visibility and accessibility provided by the barrier protection.

• Before the speed limit change comes into force, ensure that all traffic control devices installed on the road to indicate the speed limit, comply with all necessary rules/regulations including the Land Transport Rule (Traffic Control Devices) 2004.

• The location at which the speed limit changes, should be at a point that can be observed from a distance taking into consideration of the roadside environment. This includes consideration of the road surface, distance from any corner, congestion points if lanes merge or roads intersect, road entry and exit points near the speed change location, and any safety features available immediately before and after the change in the posted speed limit.

• Where speed limits are increased, operating speeds may increase (depending on congestion and other factors). When this occurs, evidence suggests the crash risk increases (unless other mitigating measures are introduced to improve safety). The safety features designed within the new Kāpiti Expressway significantly reduce the risks associated with higher speeds, however, where the speed limit zone changes the same protections may not be available. To mitigate the risk during the transition to a lower speed zone, Police request the same safety features be extended into the reduced speed zone for a distance to ensure a safer transition.

• Increased speeds could negatively impact people's physical and mental well-being if they perceive the new speeds to be unsafe. A clear communication strategy focused on evidence is recommended concerning the safer operating environment on existing roads with speed limits set at 110km/h.

Detailed responses to each of the above comments have been provided by NZTA as below:

- Safe operating environment

NZTAacknowledge the importance of barrier protection systems to provide a safe operating environment for NZ Police undertaking speed enforcement duties. Maintenance bays have been provided along the length of the corridor that will provide barrier protection to Police undertaking enforcement duties. There are 14 maintenance bays in the northbound direction and 10 in the southbound direction.

- Appropriate management of infrastructure

Should the proposed speed limit increase proceed, traffic control devices installed on the corridor will comply with all necessary rules and regulations, including the Land Transport Rule (Traffic Control Devices) 2004. This will be strictly monitored and enforced.

The same three barrier safety system extends into the reduced speed zones:

- Southbound, through the majority of the Raumati Straights section of the Kāpiti Expressway from the proposed 100km/h speed threshold.

- Northbound, approximately 2km from the proposed 100km/h speed threshold to Taylors Road maintenance access. Further extension of the three-barrier system from Taylors Road maintenance access will be incorporated as part of the Ōtaki to north of Levin project.

- Communication activity

Should the proposed speed limit increase proceed, then communication activity will be developed and run ahead of its implementation. The activity will reinforce the design and construction features that make 110km/h a safe and appropriate speed for this section of highway.

Maintenance and Emergency Stopping Management

There is provision for stopping including non-discretionary and elective stopping to allow safe pull over in the event of voluntary or an emergency scenario.

To enable continuous safe stopping facilities, the Mackays Crossing to Ōtaki corridor has 3-metre-wide shoulders and designated maintenance bays. There are two full interchanges and two half interchange on/ off ramps along the length of the corridor.

A summary of the maintenance bay information with information on emergency access points along the Mackays Crossing to Ōtaki corridor is provided within **Table 2 and Table 3 – Mackays Crossing to Ōtaki 110km/h maintenance bays locations.**

	Maintenance Bays and Emergency Access locations	
Section	**Number of Maintenance Bays**	**Number of Emergency Access/on-off access Locations**
Northbound	7 (spaced less than 2.5km apart; maximum spacing is approximately 5.5km)	3 NB On-Ramps 1 Emergency Access at RS/RP 1011/0.74
Southbound	5 (generally spaced less than 3.0km: maximum spacing is approximately 6.4km)	3 SB On-Ramps 2 Emergency Accesses at RS/RP 1011/0.74 and RS/RP 1011/14.95

Table 2: Mackays Crossing to Peka Peka 110km/h maintenance bays and emergency access locations

	Maintenance Bays and Emergency Access locations	
Section	**Number of Maintenance Bays**	**Number of Emergency Access Locations**
Northbound	7 (generally spaced less than 2.5km apart; maximum spacing is approximately 3.2km)	1 near RS/RP 995/3.3
Southbound	5 (generally spaced less than 2.5km: maximum spacing is approximately 5.5km)	1 near RS/ RP 995/11.6

Table 3: Peka Peka to Ōtaki 110km/h maintenance bays and emergency access locations

In general, the management and operational review does not present any concerns related to increasing the speed to 110km/h.

Driver Behaviour Monitoring

The Tauranga Link Road and Cambridge 110km/h corridors undertook a monitoring programme to determine the effects of driver behaviours within a 110km/h environment **(refer to Cover Letter Appendix E – Mackie Research paper)**. The 110km/h sites were compared to two control sites.

The key observations from the one-year monitoring programme were:

- modest mean speed increases in both directions
- greater proportion of higher speed traffic, particularly in the right lane (lane 2)
- higher speed (lane 2) increases fall well short of the 10 km/h speed limit increase from 100km/h, and appear to have settled at a constant 3-5km/h increase in overall speeds
- context of control sites of similar road quality where no material changes in speed were observed
- lane distributions were not influenced, and the travel time improvements were modest
- some truck travel speeds have shown a concerning increase at the Tauranga site, warranting further investigation or speed control measures
- proportion of vehicles travelling over 110km/h increased substantially (as would be expected) and those travelling over 120km/h have also increased – though more so in the lighter traffic conditions 8 months following speed limit change compared to 12 months
- heavy vehicle speeds followed the same pattern, with higher speeds at 8 months post change, but little change in speed after 12 months
- on average, 0.3% and 1.4% of vehicles travelled over 130km/h in lane 1 and lane 2 respectively, fewer than that measured in the 8-month post change
- there have been no notable changes in lane distribution travel patterns compared to baseline

- between the hours of 3-6am, there was an average increase of 5% more vehicles travelling in lane 2 at 12 months post change compared to baseline

The perceptions survey supported the evidence from the evaluation and indicated that motorists are overall very supportive of the speed limit increase, feeling that the 110km/h environment is safe for most drivers. Motorists do, however, report large travel time benefits, when the actual measured travel time benefits may be much lower. The crash performance of these two sites over the next few years will add to the current findings to help explain the overall merit of the 110km/h speed limits.

The Mackays Crossing to Ōtaki corridor speed change will utilise the monitoring research captured from the Cambridge section and play the key learnings (additional driver behaviour research is not required). The items the Mackays to Peka Peka project will implement are:

- To improve speed compliance, installing more repeater signs mid-block in between the interchanges to reinforce the new speed limit.

- The signage strategy for transitioning back from 110km/h to 100km/h at the northern and southern ends of the Mackays Crossing to Ōtaki corridor will be agreed upon with national police i.e., warning signs (200m or 300m), threshold signs at the speed limit change point and repeater signs 250m past the threshold.

Noise Assessment

Discussions were had with Noise Subject Matter Experts, Resource Management Planners, and the Legal team within NZTA Waka Kotahi on Noise. The Peka Peka to Ōtaki stretch of SH1 Kāpiti Expressway was modelled, assessed, and mitigated for 110km/h and there were no additional noise effects to consider. No designation conditions exist on the Mackays Crossing to Peka Peka corridor, relevant to the proposed speed limit increase. The noise conditions for Mackays Crossing to Peka Peka corridor are specific to the construction and initial establishment of the road based on the original Notice of Requirement (NOR) and supporting documentation. The noise conditions were not designed to apply to subsequent activities/changes to the Expressway that might impact noise if these were not included in the original proposal (i.e. the NOR). The Legal team has noted that the speed limit change will not trigger any noise-related compliance issues as there are no relevant conditions on the Mackays Crossing to Peka Peka corridor, and as such, there are no further issues to address in relation to noise.

6. Vehicle Emission Impacts

Table 4 summarises the modelled results of the emissions assessment completed by AECOM in December 2023 for the Mackays Crossing to Ōtaki corridor with additional details provided in Memo **Appendix A**.

Section	Change in Emissions (tCO_2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO_2e)	Cumulative Change in Emissions (%)
	Current (2023)	Predicted (2030)	Current (2023)	Predicted (2030)	Predicted 2030	Predicted 2030
Mackays Crossing to Peka Peka	1450	1439	5.2%	4.8%	11,557	5.0%
Peka Peka to Ōtaki	918	911	4.9%	4.5%	7,314	4.7%

Table 4: Mackays Crossing to Ōtaki Summary of Vehicle Emission Results

Although the modelled predicted emissions increase, they are not a key criterion in determining the 110km/h readiness of the corridor from a safety perspective, they are still an important consideration when evaluating the impacts of the proposed speed limit change.

7. Key Supporting Documents

Key supporting document

- NZTA Technical Note for 110km/h suitability and Reports (Draft, November 2023)

8. Recommendations

The following key items are recommended to support the implementation of a 110km/h posted speed limit along each section of the State Highway 1 Mackays Crossing to Ōtaki.

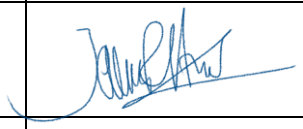
- Design and Construction
    - The southern end of the Mackays Crossing to Peka Peka corridor (Raumati Straights section) does not meet the safety criteria and will be excluded from the proposed speed limit change.
    - The SH1 corridor from Poplar Ave to the south of Ōtaki Northern Interchange is considered suitable for a 110km/h speed limit from approximately SH 01N RS/RP 995/5.34 (south of the Ōtaki Northern Interchange) to SH1 01N RS/RP 1011/14.38 (north of Poplar Avenue).
    - The northern end from south of Ōtaki northern interchange to Taylors Road does not meet the safety criteria and is included as part of the Ōtaki to North of Levin project and will be excluded from the proposed speed limit change.
    - Check new and existing signs align with the TCD rule (system management) for the new speed limit.
    - Edgeline markings are refreshed along the carriageway edges.

- Cyclist marking and signage at interchanges and ramps are upgraded to ensure consistency through the proposed 110km/h corridor.

- Management
    - Update the NOC contract for the Wellington Transport Alliance to incorporate 110km/h sections of the Mackays Crossing to Ōtaki corridor in management plans.

- Operations
    - Improve speed compliance by installing safety cameras if required.

9. Outcome Endorsement

Name	Position	Date	Signature
Kirstan O'Donoghue	Team Lead, Road Safety, SaSS, Transport Services-Programme and Standards	26/7/24	
James Hughes	Lead Advisor Safety, Transport Services-Programme and Standards	26/7/24	
Vanessa Browne	National Manager Programme and Standards, Transport Services, Office of GM TS	26/7/24	

Prepared for
Waka Kotahi
Co No.: N/A

110 km/h Readiness Assessment - SH1 Mackays to Peka Peka

19-Dec-2023

110 km/h Readiness Assessment - SH1 Mackays to Peka Peka

Client: Waka Kotahi

Co No.: N/A

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1	15-08-2023	Draft Report	Mike Pilgrim	
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Table of Contents

1.0 Introduction

The Mackays to Peka Peka (M2PP) Expressway is a key section of the Wellington Northern Corridor, a strategic transport link in the lower North Island. The route provides a critical upgrade to the previous State Highway 1, which faced issues related to traffic characteristics, safety, population increases in the region, route redundancy/ resiliency, freight movement and congestion. In February 2017, the 18 km M2PP Expressway was opened to address these issues, improving travel times for people and freight between Wellington and further north. The M2PP Expressway connects to Transmission Gully in the south and the Peka Peka to Ōtaki section further north.

AECOM was retained to complete an assessment of the corridor for its suitability for a 110km/h speed limit. The section of State Highway 1 (SH1) considered in this report starts north of Mackays Crossing through to Peka Peka Road, from approximately SH 01N RS/RP 1011/18.04 to 1011/0.0 (section length of ~18 km). This report includes a review of the current level of infrastructure, identification of potential safety concerns, evaluation of how the highway will be managed and operated, and recommendations related to the posted speed limit.

In completing this assessment, the Speed Management Guide – Road to Zero Edition and the Ministry of Transport, Land Transport Rule for Setting of Speed Limits were reviewed to understand current policy and guidance related to a 110 km/h posted speed limit. The NZ Transportation Agency Technical Note: “Criteria for considering a speed limit increase to 110 km/h” (2016 Draft) was also referenced.

1.1 Speed Management Guide

The One Network Framework classification of this section of SH1 is an *Interregional Connector*, which provides safe, reliable and efficient movement of people and goods between regions and strategic centres. The Speed Management Guide – Road to Zero Edition (2022) outlines criteria and desirable characteristics for an Interregional Connector with a speed limit of 110 km/h; refer to Table 1.

Table 1: 110 km/h Criteria for Interregional Connectors

Criteria for 110 km/h
More than 5km in length
Dual carriageway or median divided
Alignment is straight or curved
Land use is No Access
2 or more lanes in each direction
AADT is less than 25,000 per direction
Intersections are grade separated and have a spacing of 1.5 km or more
Personal Risk of Low or Low-Medium

The assessed corridor was reviewed against these criteria and deviations are discussed in Section 3.

1.2 Land Transport Rule: Setting of Speed Limits

The Land Transport Rule for Setting of Speed Limits 2022 (the Rule) was referenced to understand the requirements for increasing the posted speed to 110 km/h. The Rule outlines that the Director of Land Transport must be satisfied that the road has been designed and constructed, and will be managed and operated, to the standard necessary to safely support 110 km/h travel speeds.

The purpose of this report is to review the M2PP corridor from north of Mackays Crossing to Peka Peka Rd for Design, Construction, Management and Operational readiness to support a 110 km/h speed limit. An assessment of the impact on vehicle emissions was also completed.

2.0 Technical Approach and Evaluation Criteria

In addition to the criteria outlined in the Speed Management Guide, several other key geometric parameters were identified to assess the safety performance of the corridor at a 110 km/h posted speed. The NZ Transport Agency Technical Note: “Criteria for considering a speed limit increase to 110 km/h” (2016 Draft) was referenced in the selection and development of the key parameters.

Descriptions of the key parameters and the rating scales are provided in Sections 2.1 and 2.2.

2.1 Key Parameters

2.1.1 Length of Section

This parameter considers if the corridor section has sufficient length to warrant a posted speed increase.

2.1.2 Dual Carriageway & Median Barrier

Dual Carriageway & Median Barrier considers if the section of corridor has at least two traffic lanes in each direction to provide continuous overtaking opportunity. A median barrier system is required to mitigate the risk of cross-median (head on) crashes.

2.1.3 Traffic Volume

Traffic Volume considers the AADT volume in each direction, which is related to the exposure of motorists along the corridor.

2.1.4 Interchange Spacing

Interchange Spacing considers the distance between interchanges along the assessed section, as measured from the end of the on-ramp taper to the start of the next off-ramp taper. If present, at grade intersections should have low volumes and be left-in and left-out only, desirably providing adequate deceleration and acceleration facilities for safe diverge and merge activity.

2.1.5 Side Friction Demand

Side Friction Demand considers the provided superelevation on a horizontal curve to identify if the side friction demand is approaching the maximum (f_{max}) for a 110 km/h design speed. At side friction demands approaching the maximum, drivers may feel like they are losing control on a horizontal curve.

2.1.6 Gradient

Gradient considers the roadway grade (positive or negative) and the length of the gradient. Roadway grades impact vehicle speeds relative to flat grades, especially for heavy vehicles. As discussed in Austroads Part 3, heavy vehicles are significantly slower on uphill grades of 6-9%. Sight distances are also influenced by high grades.

2.1.7 Median Shoulder

Median Shoulder considers the width between the edge of the inside travel lane and the median barrier. Median shoulders provide a recovery zone prior to the barrier if drivers exit the travel lane to the right and provide deflection space for oncoming vehicles in a flexible median barrier crash event noting that it is not necessary to contain all deflection within the median.

2.1.8 Left Shoulder

Left Shoulder considers the width between the edge of the outside travel lane and the edge of the paved shoulder, or edge barrier, whichever is closer. Space should be available for a stationary vehicle to be clear from the traffic lanes, as well as providing a recovery zone if a driver loses control. Additionally, the left shoulder width influences horizontal sight distance on curves.

2.1.9 Horizontal Curve Stopping Sight Distance

Horizontal Stopping Sight Distance considers the stopping sight distance of a driver on a horizontal curve. Stopping sight distance is a function of a driver’s perception reaction time, the design speed, the roadway gradient and a vehicle’s deceleration coefficient. Commonly accepted values for this calculation are a perception reaction time (PRT) of 2.5 s and a deceleration coefficient of 0.36 (90th

percentile braking on wet, sealed roads). On a horizontal curve, obstructions on the inside of the curve, such as a roadway barrier, impact a driver's sight distance. The Horizontal Stopping Site Distance (SSD) is calculated by considering the worst inside shoulder/median width ("offset") depending on direction, considering the lane nearest to the obstruction.

2.1.10 Vertical Curve Stopping Sight Distance

Vertical Stopping Sight Distance considers the stopping sight distance of a driver on a vertical crest curve (sag curves are not critical). The stopping sight distance of a vertical curve is influenced by the length of the curve and gradients.

2.1.11 Off-Ramp (Diverge) Awareness

Off-Ramp (Diverge) Awareness considers the sight distance available to both the start of the diverge taper and the physical nose to facilitate sufficient time for a driver to recognize and decelerate to an exit ramp. The minimum sight distance of the two shall be used to assess the parameter.

2.1.12 On-Ramp (Merge) Awareness

On-Ramp (Merge) Awareness considers 'mutual' sight distance between vehicles on an on-ramp and the mainline to facilitate safe and effective merging.

2.1.13 Additional Considerations

Additional considerations include anything observed by the AECOM assessment team that may influence safety at a particular segment of the road. This may include the presence of cycling facilities, signage or vegetation that influences sightlines, etc.

Cyclists are vulnerable road users that are at high risk of severe injury or fatality in the event of an impact at speeds greater than 50 km/h. On some roads, cyclists may be accommodated on the shoulder of the road, but off-road facilities should be provided where possible. If cyclists are expected on an expressway, attention should be given to ensure a paved shoulder and may include on/off ramp crossings.

2.2 Criteria Ranges

After the evaluation parameters were established, AECOM developed initial criteria for each parameter and an associated "Green", "Yellow" and "Red" ranking scale to flag potential areas of concern. AECOM held a meeting with Waka Kotahi to finalise the criteria classes as well as the general approach to assessing the performance of the road section at a 110 km/h posted speed.

"Green" refers to locations where the preferred design criteria is met, "Yellow" refers to locations where the minimum desirable design criteria is met and "Red" refers to locations where the minimum desirable design criteria is not met.

These criteria provide general guidance for assessment. Some of the parameters cannot be strictly defined due to natural variability in a driver population. For example, Stopping Sight Distance is influenced by an individual's perception reaction time and deceleration rate. Acknowledging this, a "Red" parameter may not be unsafe, but instead indicates that additional consideration is required in the assessment of the 110 km/h safety readiness.

Where areas are flagged as having two "Yellow" outcomes or a "Red" outcome, the parameter will be further considered to assess the level of risk associated with being outside the desirable criteria. Values may be below desirable but the length over which the low value exists is relatively short, hence the increased risk is only over a short period of time/ distance. In this case it may be acceptable to be outside the criteria, provided that there are no other compounding criteria that also fall outside of the defined limits.

Table 2 outlines the criteria selected to assess the performance of the corridor for each key parameter.

Table 2: Criteria for Assessing 110 km/h Readiness

Parameter	Green	Yellow	Red	Comments
Length of Section	> 10 km	5 – 10 km	< 5 km	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Dual Carriageway & Median Barrier	Two Traffic Lanes per direction and median barrier.	N/A	One Traffic Lane per direction and/or no median barrier.	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Traffic Volume (per direction)	< 25, 000	N/A	> 25, 000	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Interchange Spacing	Grade separated interchanges spaced at more than 1.5 km.	At-grade interchange with AADT< 100 vehicles, left-in and left-out only spaced at more than 1.5 km.	At-grade interchange with AADT> 100 vehicles. Interchanges spaced less than 1.5 km apart.	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Side Friction Demand	≤ 0.5 f_{max}	0.5 f_{max} – 0.75 f_{max}	≥ 0.75 f_{max}	f_{max} = 0.12 at 110 km/h (Austroads Part 3 Recommendation. Note that superelevation is rounded up to 0.5% in calculated f_{max} as per Austroads).
Gradient (average if multiple grades)	≤ 4 %	4% - 5% with length < 600 m 5% - 6% with length < 500 m 6% - 7%, with length < 400 m 7% - 8%, with length < 300 m	All other gradients	Roads of National Significance (2010) geometric guidelines limit grades >4% to a length <600 m and recommend a maximum grade of 8% for a length <300 m, with longer gradients suggested to provide crawler lanes.
Median Shoulder	≥ 1.0 m	0.75 – 1.0 m	< 0.75 m	Austroads Part 3 Recommendation.
Left Shoulder	≥ 2.5 m	2 – 2.5 m	< 2.0 m	Austroads Part 3 Recommendation.
Horizontal Curve Stopping Sight Distance	≥ 209* m	180 – 209* m	< 180* m	209 m is the SSD for a vehicle travelling at 110 km/h, given a PRT = 2.5s and deceleration coefficient of 0.36 with no gradient correction. 180 m is the SSD for a vehicle travelling at 110km/h, given a PRT = 2.5s and deceleration coefficient of 0.46 with no gradient.

Vertical Curve Stopping Sight Distance	≥ 209* m	180 – 209* m	< 180* m	Refer to Horizontal Stopping Sight Distance commentary.
Off-Ramp (Diverge) Awareness	≥ 240 m	180 – 240 m	< 180 m	240 m is approximately the distance to travel 8 seconds at 110 km/h.
On-Ramp (Merge) Awareness	≥ 6 s	4 – 6 s	< 4 s	Austroads Part 4c recommends a desirable 6 s of travel time at the design speed and an absolute minimum of 4 s.
* Values provided in the table are for a gradient of 0%. Stopping site distance criteria used in the assessment varies depending on the gradient of the roadway at the considered location.				

3.0 Corridor Analysis: Design and Construction 110 km/h Readiness

M2PP was constructed and opened for public use in February 2017. The design features were assessed by reviewing the Issued for Construction (IFC) drawings and AutoCAD models for the longitudinal section; no on-site measurements were completed to verify radii, superelevation, curve lengths or gradients. Consideration of noise compliance and streetlighting is outside the scope of this assessment.

To begin the 110 km/h safety assessment, the overall corridor was reviewed using the criteria provided in the Speed Management Guide, listed in Table 1, and a virtual “walk-through” was completed using Argonaut Ltd. Roadrunner video. The results of the initial corridor review are provided in Table 3.

Table 3: Initial 110 km/h Corridor Assessment

Criteria for 110 km/h	Mackays to Peka Peka Motorway Assessment	Meets Criteria? (Y/N)
More than 5km in length	Assessed section is >18 km in length	Y
Dual carriageway or median divided	Continuous median barrier and divided highway	Y
Alignment is straight or curved	Yes	Y
Land use is No Access	Land use is classified as No Access	Y
2 or more lanes in each direction	Entire route has two lanes in each direction	Y
AADT is less than 25,000 per direction	Based on Mobile Roads data in the vicinity of the corridor, AADT <25,000 per direction	Y
Intersections are grade separated and have a spacing of 1.5 km or more	There are two barrier gaps/ at grade access on Raumati Straights RS1011/18.2 I and 17.3 D All intersections on the M2PP expressway are grade separated and are spaced more than 1.5 km. Poplar Ave to Kapiti Rd ~3.5 km Kapiti Rd to Te Moana Rd ~ 5.5 km Te Moana Rd to Peka Peka Rd ~5.5 km	N
Personal Risk of Low or Low-Medium	According to Mega Maps, Personal and Collective Risk is Low (sourced 8 August 2023)	Y

Next, a more detailed review was completed at key cross-sections along the longitudinal section, where the existing geometric properties, such as the length of the vertical curve, horizontal radius, and superelevation, were compared to the 110 km/h performance criteria ranges in Table 2. Key cross-sections were identified as locations on the IFC Mainline drawings (provided by Beca) that had any of the following features:

- horizontal curve,
- vertical crest curve,
- steep gradient,
- combinations of curves/ gradients, and
- merge and diverge locations.

The provided AutoCAD IFC model was used to determine the median and shoulder widths. The as-built median drawings indicate a minimum 1000 mm median shoulder and the verge detail drawings indicate minimum 2500 mm shoulders.

The merge and diverge sight distances/ time to merge were measured using the Argonaut Ltd. Roadrunner Video. The camera is likely above driver eye height, which may result in overestimation of the available merge/diverge distances; however, consideration was given to this when the distances were estimated. For diverge locations, the distance from both the physical nose and the start of the taper back to where they were respectively no longer visible in the video was measured using the RP values. The physical nose varied depending on location - some locations had a sign that was mounted, others had a barrier end terminal.

For merge locations, the distance from the end of the taper back to the point where a vehicle on either the main alignment or the merge lane could no longer have a mutual sight distance to an adjacent driver was measured using the RP values in the Roadrunner video. This was converted to an equivalent time in seconds by conservatively assuming a speed of 110 km/h.

A summary of roadway cross-sections that had a “Yellow” or “Red” assessment value are provided in Table 4 and 5. Note that distance values are measured relative to the NB control string on the IFC drawings.

Table 4: Detailed Section Review of 110 km/h Readiness - Sections with Yellow or Red Assessment Scores

	Road Name/ Section: M2PP Main Alignment											
Location (Dist. on Mainline Drawings)	800	2935.18	3726.27	4400	4796.1	8923.76	9416.94	10783.22	12402.39	13177.15	13807.2	14649.25
Section in Report (If Applicable)	**3.1.1**	**3.1.2**	**3.1.3**					**3.1.4**		**3.1.5**	**3.1.5**	
Type of Curve/Condition [if applicable]	Other	Horizontal	Horizontal	Vertical Crest	Both V & H	Both V & H	Horizontal	Horizontal	Horizontal	Horizontal	Both V & H	Horizontal
Side Friction Demand (Radius and Superelevation) Criteria												
Assessment Score	***N/A***	***YELLOW***	***YELLOW***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***YELLOW***	***YELLOW***	***GREEN***
Gradient Criteria												
Assessment Score	***N/A***	***GREEN***	***N/A***	***N/A***	***N/A***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***N/A***	***N/A***
Median Shoulder Criteria												
Assessment Score	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***
Left Shoulder Criteria												
Assessment Score	***RED***	***GREEN***	***GREEN***	***YELLOW***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***
Horizontal Stopping Sight Distance												
Assessment Score	***N/A***	***YELLOW***	***RED***	***N/A***	***YELLOW***	***YELLOW***	***YELLOW***	***RED***	***YELLOW***	***YELLOW***	***YELLOW***	***YELLOW***
Vertical Stopping Sight Distance												
Assessment Score	***N/A***	***N/A***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***N/A***	***N/A***	***N/A***	***N/A***	***GREEN***	***N/A***
Sight Distance to Exit Ramp Diverge												
Assessment Score	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
Sight Distance to Entry Ramp Merge												
Assessment Score	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

Table 5: Merge and Diverge Sight Distances

Inputs:	**RS/RP 1011/15.8 NB Off**	**RS/RP 1011/15.8 SB On**	**RS/RP 1011/12.1 NB Off**	**RS/RP 1011/11.3 NB On**	**RS/RP 1011/12.1 SB On**	**RS/RP 1011/11.3 SB Off**	**RS/RP 1011/6.5 NB Off**	**RS/RP 1011/6.63 SB On**	**RS/RP 1011/5.8 NB On**	**RS/RP 1011/5.8 SB Off**	**RS/RP 1011/.12 NB On**	**RS/RP 1011/0.12 SB Off**
Sight Distance to Exit Ramp Diverge												
Assessment Score	***GREEN***	***N/A***	***GREEN***	***N/A***	***N/A***	***GREEN***	***GREEN***	***N/A***	***N/A***	***GREEN***	***N/A***	***GREEN***
Sight Distance to Entry Ramp Merge												
Assessment Score	***N/A***	***YELLOW***	***N/A***	***GREEN***	***YELLOW***	***N/A***	***N/A***	***GREEN***	***YELLOW***	***N/A***	***GREEN***	***N/A***

3.1 Design Review of Sections

Most of the corridor is in alignment with the 110 km/h readiness criteria provided in Section 2. In assessing the performance of the entire corridor, consideration must be given to the context of substandard segments. For example, if a short segment is not significantly below the desirable minimum standards, it may still warrant a consistent speed limit appropriate of the full length.

The sections that deviate from the requirements, resulting in either:

- two or more criteria with a “Yellow” Assessment Score, or
- one “Red” Assessment Score, are discussed as follows.

3.1.1 RS/RP 1011/18.04 to 1011/16.14 (Dist. 0 to 1900.0)

The southern end of the alignment, Raumati Straight, was constructed using the existing roadway cross section and has portions with a shoulder width less than 2 m, resulting in a “Red” Assessment score. With the reduced width, a vehicle may not be able to safely pull to the left in an emergency.

There are two gaps in the roadside barrier, one in each direction. The first, located at at RS1011/18.2, appears to provide access to a Kiwirail maintenance track. The network video (2022) shows wheel tracks into and out of this access indicating that it is currently being used.

The second access, located at RS1011/17.3 D, provides access to the GWRC farm stockyards. As part of the M2PP project a bridge was to be built within the farm to provide access to the stockyards allowing this access to be closed. We are unaware if this bridge has been constructed.

Overall, this section of the corridor does not meet the safety geometric or access criteria; therefore, the start/end of the 110 km/h posted speed limit would need to occur north of this section of highway.

3.1.2 RS/RP 1011/14.99 to 1011/14.36 (Dist. 2935 to 3564)

This section has “Yellow” Assessment Scores for both Side Friction Demand and Horizontal Stopping Sight Distance. As discussed in Section 2.1.5, side friction demand is related to occupant comfort. 51% of f_{max} is not considered to have a noticeable impact on driver comfort compared to the "Green” criteria of 50% and therefore it is not a concern for increasing the posted speed limit.

For this curve, the calculated worst case Horizontal SSD is 190 m, which is greater than the minimum desirable design criteria of 181 m. The side friction demand is close to the “Green” Assessment Score Criteria, and there is no compounding safety concern with the f_{max} value and the stopping sight distance value.

3.1.3 RS/RP 1011/14.20 to 1011/13.93 (Dist. 3726 to 3993)

This section has a “Yellow” Assessment Score for Side Friction Demand and a “Red” Assessment Score for Horizontal Stopping Sight Distance. The Side Friction Demand is 51% of f_{max}, which is close to the design criteria and is not a concern.

The Horizontal Stopping Site Distance (SSD) is 177 m, resulting in a “Red” Assessment Score. This is very close to the minimum desirable “Yellow” Assessment Score Criteria of 180 m.

The length of this substandard section is approximately 270 m. The assessment scores are close to “Green” and “Yellow” for Side Friction Demand and Horizontal SSD respectively, and the criteria do not create a compounding safety issue.

3.1.4 RS/RP 1011/7.28 to 1011/7.07 (Dist. 10783 to 10998)

This section has a “Red” Assessment Score for a Horizontal Stopping Sight Distance of 178 m (<183 m). However, the horizontal offset varies throughout the curve and approximately 64% of the curve has a centreline offset of 4.3 m or greater, which results in a Horizontal SSD of 189 m and an Assessment Score of “Yellow.”

It is noted that the length of this substandard section is approximately 215 m and the assessment scores are “Yellow” for most of the curve.

3.1.5 RS/RP 1011/4.81 to 1011/4.34 & 1011/4.09 to 1011/3.55 (Dist. 13177 to 13647 & 13807 to 14345)

These two sections have “Yellow” Assessment Scores for both Side Friction Demand and Horizontal Stopping Sight Distance. The Side Friction Demand is 51% of f_{max} for both curves, which is close to the design criteria and is not a concern. The Horizontal Stopping Site Distance (SSD) results in a “Yellow” Assessment Score for a Horizontal SSD of 193 m and 188 m, for the two curve segments respectively. Both of these are greater than the minimum desirable design criteria of 180 m.

The side friction demand is close to the “Green” Assessment Score Criteria and the criteria do not create a compounding safety issue.

3.1.6 Cycling Facilities

The Kapiti Shared Way is a separated shared path for cyclists that runs parallel to SH1. It is located on the west side of the highway from Poplar Ave to Otaihanga Rd, from which it transitions to the east side and then back to the west again at Ngarara Rd until it connects with the Peka Peka to Ōtaki Shared Path continuing north.

Northbound & southbound cyclists on SH1 are instructed with A43-2 “Cyclists Use Ramp” signs to exit at Poplar Ave, Kapiti Rd and Te Moana Rd. No green paint or cyclist crossing treatments are provided at the mainline on/off ramps, except for SB cyclists at Poplar Ave, as shown in Figure 1. Cyclist accommodation provided at subsequent intersections off of the mainline were not reviewed as part of this assessment.

No separated facilities are provided south of Poplar Ave along the Raumati Straight and cyclists choosing to travel SH1 will do so on the shoulder. In general, cyclists are at elevated risk at any highway speed; however, the shoulder is sealed and generally wider than 2.0 m (1.8 m minimum). Future consideration should be given to extend the off-road facilities past the Raumati Straight which has the narrowest shoulders along the corridor.

Figure 1: On road cycling facilities at southern end of the alignment (SB direction)

3.1.7 Merge/Diverge

There are several on/off ramps along the corridor. The sight distance to the diverge taper and physical nose provides more than the minimum stopping sight distance at each exit location and therefore has “Green” Assessment Scores. However, several of the on-ramps have elevation differences between the main alignment and the on ramp, which results in reduced mutual sight distances of 4-6 s (“Yellow” Assessment Criteria). Refer to Figure 2.

Figure 2: Southbound On-Ramp at Te Moana Road at lower elevation to mainline SH-1 reducing merge sight distance

Vegetation is typically planted on the slopes at these locations, which could further reduce mutual sight distance if they increase in height. If the speed limit was increased on the corridor, consideration should be given to removing the vegetation in this area and replacing it with ground cover plantings.

3.2 Construction Review

AECOM completed a corridor drive-through to review the safety hazards identified with the design and complete a construction assessment, identifying any additional features not detected in the desktop design scan.

In general, no noteworthy deviations were observed compared to the design review; however, the following two items were noted.

3.2.1 Vegetation on Merge Approach

As discussed in Section 3.1.7, vegetation was growing on the merge approach. The drive through conducted by AECOM did not identify any locations where the sight distance was reduced more than what was observed with the Roadrunner Video assessment, but it is recommended that this is monitored, and vegetation is replaced with ground cover plantings to maintain merge safety.

3.2.2 Barrier Openings

As discussed in Section 3.1.1, south of the study extents are two locations with openings in the shoulder barrier, approximately at RS/RP 1011/17.32 (Northbound) and RS/RP 1011/18.2 (Southbound). These openings present discontinuities in the barrier system and present safety risks for road users, even when operating at 100 km/h. Consideration should be given to closing these gaps.

4.0 Corridor Analysis: Management and Operation 110 km/h Readiness

Discussions were held with Waka Kotahi representatives involved in the management and operations (M&O) for the Mackays to Peka Peka Expressway, including a representative from Wellington Transport Operation Centre (WTOC) to discuss current characteristics of the motorway and potential considerations for the 110 km/h readiness assessment.

4.1 Management Review

The majority of New Zealand's State Highways are managed by Waka Kotahi in the form of long-term client-supplier contract agreements. The Mackays to Peka Peka Expressway is managed by the Wellington Transport Alliance, an alliance between Waka Kotahi, WSP and Fulton Hogan.

The characteristics of the 18 km Expressway corridor are as follows.

- The infrastructure supports a 110 km/h corridor speed limit for the extents outlined in this report.
- Traffic is free flowing without variable speed limits.
- Corridor maintenance and improvements will be undertaken via level 3 CoPTTM temporary traffic management.
- Incident management will utilise pre-determined detours and level 3 CoPTTM temporary traffic management with appropriate speed restrictions to enhance construction site safety.

4.2 Operational Review

As part of the NOC operational requirements of road infrastructure on the proposed 110km/hr corridor, it is recommended the Level of Service (LOS) requirements for maintaining road surface, drainage, signage and delineation, lighting and barriers is reviewed.

4.2.1 Maintenance Review

A maintenance review is necessary to determine if the corridor has sufficient infrastructure in place to ensure safe road maintenance at the posted speed limit of 110 km/h. This assessment includes consideration of safe stopping areas and access locations along the corridor both for maintenance efforts as well as for any voluntary or emergency stopping situation along the corridor.

Most of the corridor has a minimum of 3 m wide left shoulders in addition to designated maintenance bays, resulting in safe stopping zones. There are also several interchange on/off ramps along the corridor. A summary of the maintenance bay information and emergency crossover points along the corridor is provided in Table 6.

Table 6: Maintenance Bays and Emergency Bay Location Summary

	Number of Maintenance Bays / Safe Stopping Areas	**Number of Emergency Access/ On-Off Access Locations**
Northbound	7 (generally spaced less than 2.5 km apart; maximum spacing is approximately 5.5 km).	3 NB On-Ramps 1 Emergency Access at RS/RP 1011/0.74
Southbound	5 (generally spaced less than 3.0 km; maximum spacing is approximately 6.4 km).	3 SB On-Ramps 2 Emergency Accesses at RS/RP 1011/0.74 and RS/RP 1011/14.95

In general, the management and operational review does not present any concerns related to increasing the speed to 110 km/h.

5.0 Emissions Impacts

AECOM completed an assessment of how a speed limit increase from 100 km/h (baseline) to 110 km/h would impact vehicle emissions along the corridor. Based on the AADTs, % of heavy-combination vehicles (HCV) and length of the corridor, the Enabled Emissions (GHG emissions) were estimated using the Vehicle Emissions Prediction Model (VEPM) available from Waka Kotahi. Enabled emissions are those originating from vehicular use of the infrastructure and are expressed as carbon dioxide equivalents (CO_2e). Table 7 provides the input variables for the analysis.

Table 7: Input Data for Emissions Assessment

Section	Current AADT		HCV %	Predicted AADT		Distance (km)	Gradient	Total Annual VKT	
	NB	SB		NB	SB			Current 2023	Predicted 2030
Peka Peka to Te Moana interchange	6,573[1]	6,772[1]	10	7,550	7,779	6.2	0%	30,199,735	34,689,527
Te Moana Interchange to Kapiti Rd interchange	12,199	12,482	6.9	14,013	14,338	5.5	0%	49,547,108	56,914,633
Kapiti Road to Poplar Ave	10,023	10,321	7.8	11,513	11,856	3.7	0%	27,474,572	31,559,835
Poplar Ave to Mackays crossing	14,527	14,584	7.8	16,687	16,752	2.2	0%	23,376,133	26,851,517
Total						**18**		**143,001,051**	**164,263,359**

The current AADT values were obtained from Mobile Roads data and a 2% growth rate was assumed to predict the 2030 estimates. HCV percentages were also determined from Mobile Roads.

Two scenarios were modelled for the current year (2023) and predicted year (2030):

1. GHG estimated for the existing 100 km/h maximum speed limit, and
2. GHG estimated for the proposed 110 km/h maximum speed limit.

Note that the emissions analysis assumes that all light vehicles are travelling at the posted speed and heavy vehicles are travelling at 86 km/h (assumption within the Waka Kotahi VEPM model). A comprehensive list of assumptions is outlined in Appendix A.

The following summarises the results of the emissions assessment with supporting data in Table 8; additional details are provided in Appendix A.

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted *increase* in annual emissions of 1,439 tCO_2e for 2030.
- An increase in average fleet speed to 110 km/hr results in a predicted *increase* in GHG emissions of 4.8% for 2030 compared to 100 km/h.
- The increase in the average fleet speed to 110 km/hr results in a cumulative *increase* in GHG emissions from 2023 to 2030 (inclusive) of 11,557 tCO_2e, or 5.0%

[1] AADT for Te Moana to Peka Peka is not available from Mobile Roads. The AADT for the old SH1 in 2022 has been used with the value split evenly between north and southbound directions and the values adjusted using the on and off-ramp AADTs at Peka Peka

Table 8: Mackays to Peka Peka: Changes in Emissions from a posted speed increase from 100 km/h to 110 km/h

Section	Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Percentage Change in Emissions		Cumulative Change (tCO_2e)	Cumulative Change (%)
	Current 2023	Predicted 2030	Current 2023	Predicted 2030	Current 2023	Predicted 2030	2023 to 2030	2023 to 2030
Peka Peka to Te Moana interchange	6,696	7,259	7,024	7,585	4.9%	4.5%	2,613	4.7%
Te Moana Interchange to Kapiti Rd interchange	10,347	11,172	10,904	11,724	5.4%	4.9%	4,435	5.2%
Kapiti Road to Poplar Ave	5,840	6,314	6,146	6,617	5.2%	4.8%	2,436	5.0%
Poplar Ave to Mackays crossing	4,969	5,372	5,229	5,630	5.2%	4.8%	2,072	5.0%
Total	**27,852**	**30,116**	**29,303**	**31,555**	**5.2%**	**4.8%**	**11,557**	**5.0%**

Although predicted emissions increases are not a key criterion in determining the 110 km/h readiness of the corridor from a safety perspective, they are still an important consideration when evaluating impacts of the proposed speed limit change.

6.0 Recommendations

Following the design, construction, management and operational review, the SH1 corridor from north of Mackays Crossing to Peka Peka Rd is considered suitable for a 110 km/h increase from approximately SH 01N RS/RP 1011/15.5 to 1011/0.0. The southern end of the section does not meet the safety criteria and therefore the extent of the 110 km/h speed limit is shortened compared to the overall roadway length. Within this shortened section (approximately 15.5-16.2 km), there are isolated portions of the road that do not meet the “Green” geometric design criteria established in collaboration with Waka Kotahi; however, none of the sub-standard parameters result in a compounding safety issue. Refer to Section 3.1.

The proposed southern extent of the 110 km/h speed limit is at the change of cross-sectional environment where the roadway widens after the Raumati Straight, which has sections of insufficient shoulder width. The follow treatments are proposed:

- A 110 km/h 200 m Ahead Warning sign in the Northbound direction should be posted around RS/RP 1011/15.7 with a subsequent 110 km/h sign. The proposed location follows the roadway widening after the Raumati Straight, which should present drivers with slight visual cross-sectional changes in support of increased posted speeds. The location also is after the off-ramp in the Northbound direction. Several navigational signs are installed in preparation for the off-ramp and driver workload will be elevated at this location. It is therefore recommended to increase speed limit after this point.
- A 100 km/h 200 m Ahead Warming sign in the Southbound direction should be posted around RS/RP 1001/15.95 with a subsequent 100 km/h sign. This location follows the SB on-ramp merge taper and is prior to the transition to the Raumati Straights reduced roadway width.

The proposed northern extent of the 110 km/h speed limit change continues to the end of the corridor at RS/RP 1011/0.0 with possible connection to the Peka Peka to Ōtaki expressway section, which is reviewed in an independent report by AECOM. If the 110 km/h speeds are not continued, a 100 km/h Ahead and 100 km/h sign should be posted around this location in the Northbound direction with a similar set of 110 km/h signs in the Southbound direction. The sign placement locations shall consider the NB On-Ramp and SB Off-Ramp and associated elevated driver workload.

In general, the finalised sign locations shall ensure good visibility and provide a contrast in the road environment, enabling motorists to change speeds of travel accordingly. The sign locations will need to be confirmed by the designer following a site visit, to ensure there are no conflicts with other roadside furniture, vegetation, and other visual obstructions.

To improve highway safety along SH1 near the study area, it is recommended that Waka Kotahi closes the two gaps in the edge barrier on the Raumati straights section.

The estimated cumulative increase in emissions from 2023 to 2030 resulting from a speed limit increase from 100 km/h to 110 km/h is estimated to be 5.0% or 11,557 tCO_2e from 2023 to 2030 inclusive. Waka Kotahi must consider the travel time benefits from 110 km/h posted speed limit against the predicted emissions increases.

7.0 Conclusion

In conclusion, the assessed section of SH1 from approximately SH 01N RS/RP 1011/15.5 to 1011/0.0 is found to meet the design, construction, operation and maintenance requirements to be posted at 110 km/h. Signage location finalisation and the works to install the signs will need to be completed if the increase is approved by the Director in accordance with the Land Transport Setting of Speed Limits Rule.

The criteria for 110 km/h readiness was based on the Speed Management Guide, the NZTA Technical Note of 110 km/h criteria and other Austroads guidance for road/intersection design. AECOM's assessment focused on geometric criteria using provided IFC drawings and an AutoCAD model and did not consider on-site measurements, noise criteria or existing lighting.

Appendix A

Emissions Report

Prepared for
Waka Kotahi
ABN: N/A

Speed Change Impact on Vehicle Emissions - 110km/h Project

18-Dec-2023

Quality Information

Document	Summary of Speed Change Results - 110km/h Project
Ref	n/a
Date	01-Dec-2023
Originator	Renee McKay
Checker/s	Luke Elsen
Verifier/s	Anthony Hume

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
1	1/12/2023	Final	Anthony Hume Associate Director – Practice Lead Sustainability & Resilience	

1.0 Purpose of Document

Waka Kotahi commissioned AECOM to assess how a maximum speed change of 10km/h (from 100/km/h to 110km/h) may affect vehicle emissions. The three sections of motorway assessed were Peka Peka to Ōtaki, Mackays to Peka Peka, and Pūhoi to Warkworth.

2.0 Scope of Work

The scope of work covers the following tasks:

- Calculate enabled emissions[1] from the increase in speed limit. These are the GHG emissions that arise from the use of the infrastructure. Sources of enabled emissions include emissions from vehicles (including cars, buses, trucks, and trains) using the transport system.
    - Model GHG emissions are expressed as carbon dioxide equivalents (CO_2e)[2] using the most recent version (version 6.3) of the Vehicle Emissions Prediction Model (VEPM) available from Waka Kotahi.
- Model the following two scenarios for current and predicted years (2023 and 2030):
    1. GHG emissions estimated for the existing 100km/h maximum speed limit, and
    2. GHG emissions estimated for the proposed 110km/h maximum speed limit.

3.0 Method

The model developed uses the AADT, details of the vehicle fleet content and roadway length to calculate the Vehicle Kilometres Travelled (VKT) breakdown for each expressway section for both the current (2023) and predicted (2030) years. AADT values were obtained from Mobile Roads and a 2% growth rate was assumed for the predicted AADT. The VKT and speed data are then multiplied by the VEPM estimate of vehicle fleet emissions expected in the current and predicted years to calculate the emissions of CO_2e (in tonnes, shortened to tCO_2e). Finally, the change in emissions due to the increased speed limit and the percentage change are then calculated.

The VEPM tool can also consider grade changes on road sections. These are automatically factored into the end emission factors during the bulk run of the tool. The VEPM tool allows for different emission factors based on grade changes from -6 to 6% (increasing in 2% increments). As discussed below, the change in grade had no impact on the overall absolute change in emissions. However, it did factor into the percentage change in emissions.

4.0 Results Summary

Three road sections were assessed to quantify the emissions changes from a speed increase of 10km/h (from 100km/h to 110km/h): Peka Peka to Ōtaki, Mackays to Peka Peka, and Pūhoi to Warkworth. This section summarises the results for each road section within the assessment.

4.1 Peka Peka to Ōtaki

The findings for the Peka Peka to Ōtaki Road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 911 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted growth of 4.5% in GHG emissions for 2030 compared to 100km/h.

[1] Enabled emissions are those originating from third-party use of the infrastructure, e.g., vehicles emissions.
[2] Carbon Dioxide Equivalents (CO_2e) are a metric used to compare the emissions from different greenhouse gases based on their global warming potential.

- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions over the seven years between 2023 and 2030 of 7,314 tCO_2e, or 4.7%.

Table 1: Peka Peka to Ōtaki Summary of Results

Section	Change in Emissions (tCO2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Ōtaki	917.87	910.63	4.9%	4.5%	7,314.03	4.68%

Figure 1 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe and the predicted 2030 timeframe.

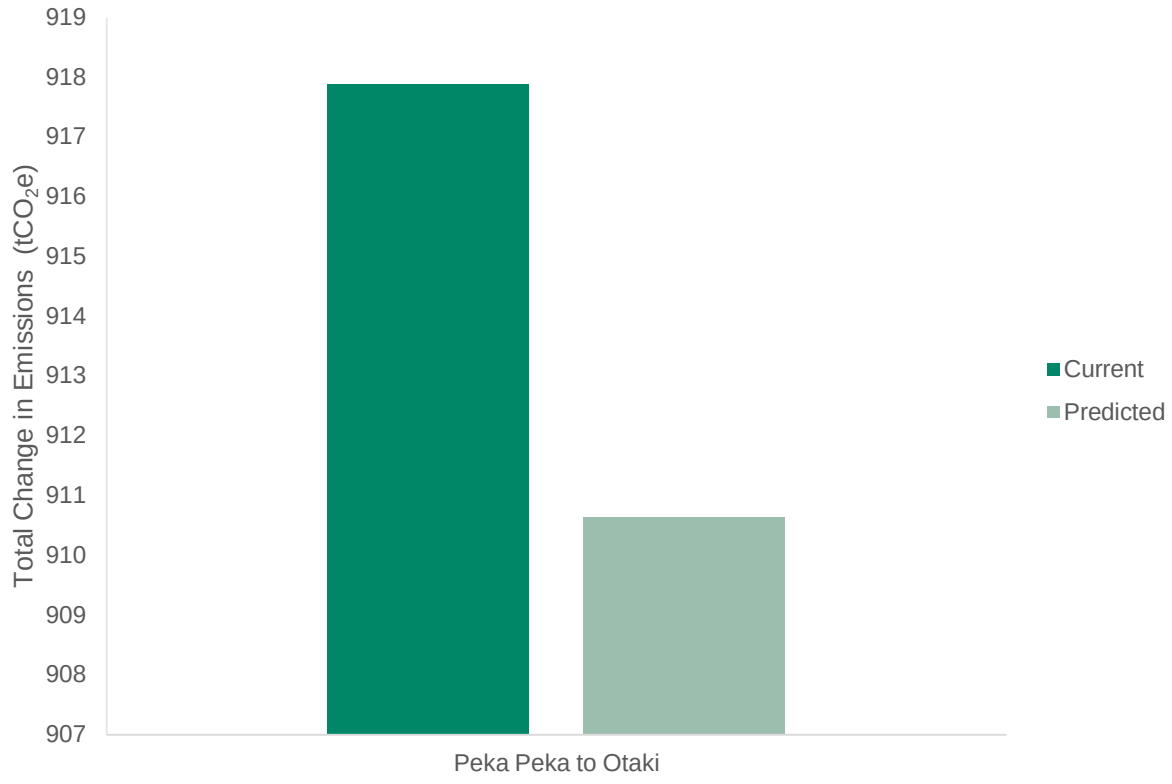

Figure 1: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Peka Peka to Ōtaki

4.2 Mackays to Peka Peka

The findings for the Mackays to Peka Peka Road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 1,439 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted increase of 4.8% in GHG emissions for 2030 compared to 100km/h.
- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions in seven years between 2023 and 2030 of 11,557 tCO_2e, or 5%

Table 2: Mackays to Peka Peka Summary of Results

Section	Change in Emissions (tCO_2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO_2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Te Moana interchange	328	325	4.9%	4.5%	2,613	4.7%
Te Moana Interchange to Kapiti Rd interchange	557	552	5.4%	4.9%	4,435	5.2%
Kapiti Road to Poplar Ave	306	303	5.2%	4.8%	2,436	5.0%
Poplar Ave to MacKays crossing	260	258	5.2%	4.8%	2,072	5.0%
Total	**1,450**	**1,439**	**5.21%**	**4.78%**	**11,557**	**5.0%**

Figure 2 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe as well as the predicted 2030 timeframe.

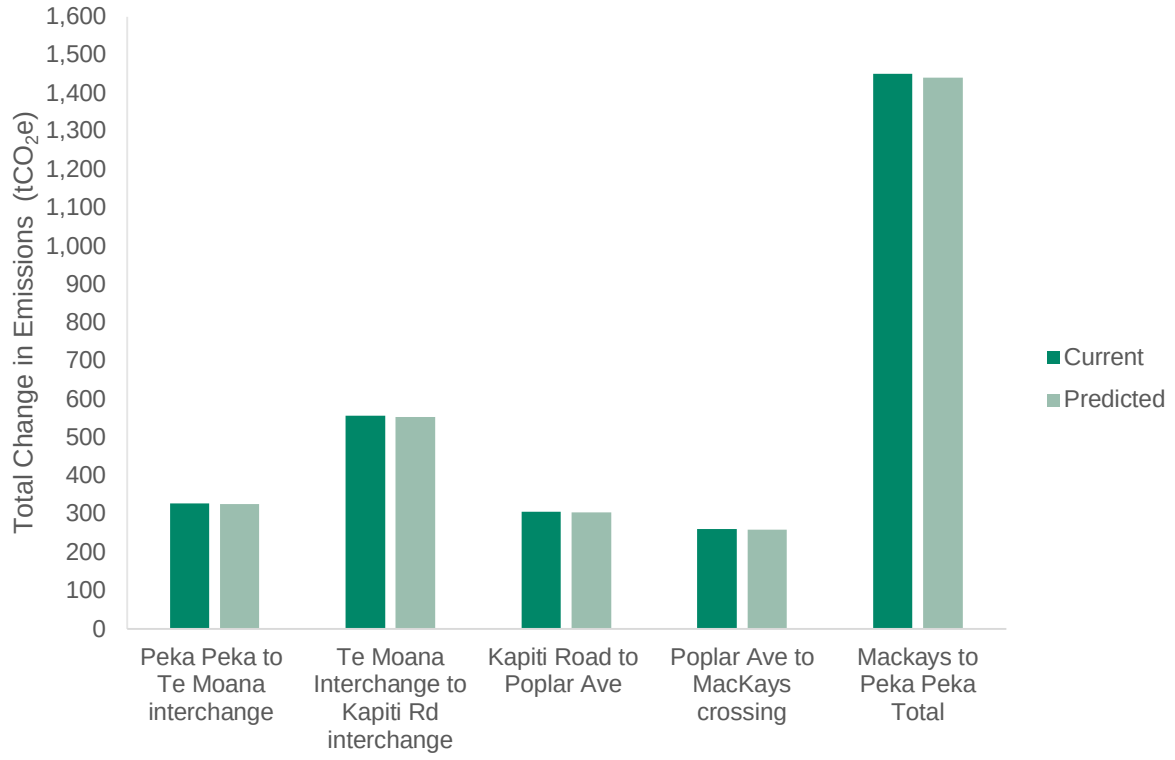

Figure 2: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Mackays to Peka Peka Road and its sections.

4.3 Pūhoi to Warkworth

The Pūhoi to Warkworth road was split into four sections, two of which had associated gradients. These gradients were factored into the calculations through the VEPM 6.3 emission factors. As these gradients did not impact the change in emissions (tCO_2e), the road was reported as a whole section with a 0% average gradient. The assumptions contained in VEPM limit the impact of some changes on the calculation of emissions. For example, heavy vehicles are assumed to be travelling at the same speed of 86km/h for both the 100km/h and 110km/h maximum speed limit scenarios. Another limitation is that CO_2, VOCs, and FC[3] emissions for light vehicles are not impacted by gradient. The results for the individual sections, including the gradients, can be seen in Appendix A.

The findings for the Pūhoi to Warkworth road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 1,334 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted increase of 4.5% in GHG emissions for 2030 compared to 100km/h.
- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions in a seven-year period from 2023 to 2030 of 10,717 tCO_2e, or 4.7%.

Table 3: Pūhoi to Warkworth Summary of Results

Section	Change in Emissions (tCO_2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO_2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Pūhoi to Warkworth	1,345	1,334	4.9%	4.5%	10,717	4.7%

Figure 3 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe and the predicted 2030 timeframe.

[3] Carbon dioxide, Volatile Organic Compounds, and Fluorocarbons

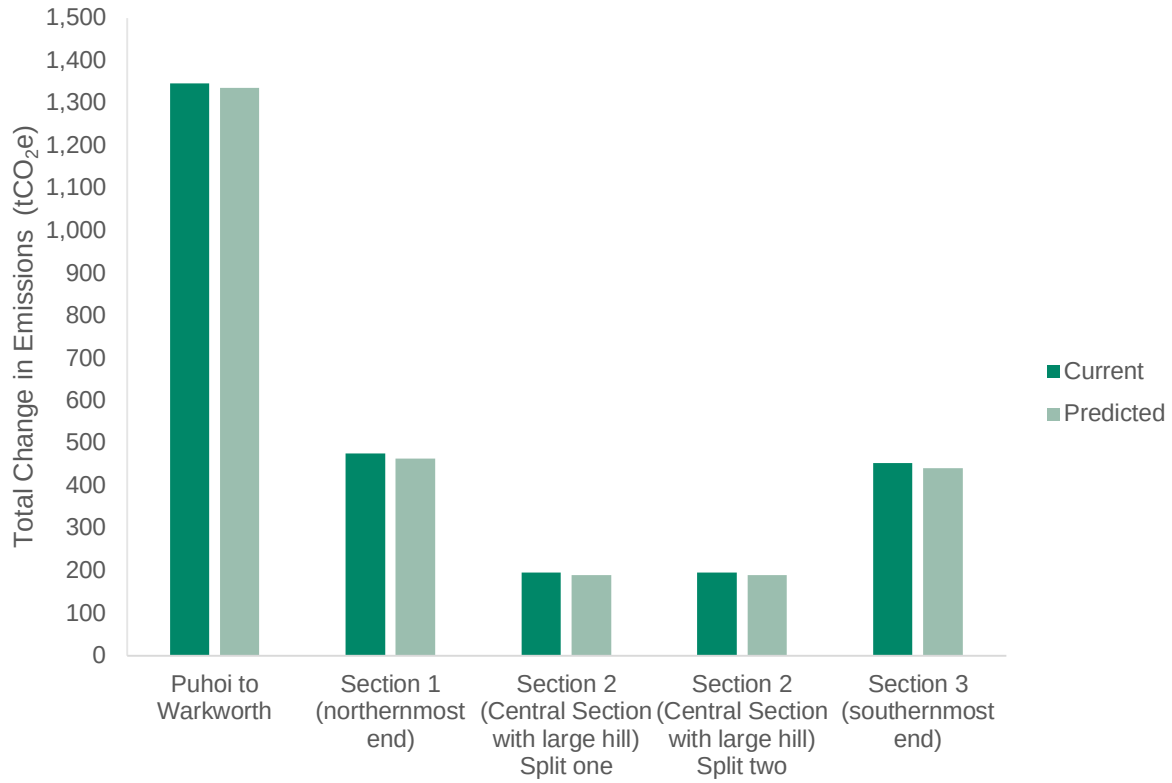

Figure 3: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Pūhoi to Warkworth and its sections.

5.0 Limitations and Assumptions

1. The calculations rely on the assumptions included in the Waka Kotahi VEPM (V6.3) default values, such as:
    a) Heavy commercial vehicles are travelling at a maximum of 86 km/hr
    b) Heavy commercial vehicle load is 50%
    c) Ambient temperature of 13.1 degrees Celsius
    d) Road gradient of 0% (unless stated otherwise). Where a maximum and minimum gradient was given for one section of road, an average of the two values was used.
2. The results assume that the proportion of Heavy/ Light Vehicles and the subgroups within those is an accurate representation of the traffic along the expressway sections.
3. This assessment assumes that all vehicles are travelling at the maximum speed of either 100km/h or 110km/h unless otherwise stated.
4. The results assumed that the AADT provided is an accurate average of the traffic throughout the 365-day year.
    a) Where the AADT was not provided for section breakdowns, the AADT values for the total road have been applied across all sections.
    b) Peka Peka to Ōtaki and the Peka Peka to Te Moana interchange section of the Mackays to Peka Peka Road both use data previous collected from the previous State Highway 1. Due to this, the current and predicted AADT as well as the %HCV for Peka Peka to Ōtaki and Peka Peka to Te Moana interchange are the same.
5. VEPM predicts emissions from vehicles in the New Zealand fleet under typical road, traffic, and operating conditions. Emissions factors used within VEPM are based on predicted fleet average emissions.

Appendix A

Full Summary of Results

Appendix A Full Summary of Results

1.0 Peka Peka to Ōtaki

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Ōtaki	9,413	9,413	10	10,813	10,813	12.3	0%	84,519,327	97,089,927	8,451,933	9,708,993	76,067,394	87,380,934	5,035.03	5,688.67	13,704.25	14,628.49	5,035.03	5,688.67	14,622.12	15,539.12	18,739	20,317	19,657	21,228	917.87	910.63	4.9%	4.5%	7,314.03	4.68%

2.0 Mackays to Peka Peka

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Te Moana interchange	6,573	6,772	10	7,550	7,779	6.2	0%	30,199,735	34,689,527	3,019,974	3,468,953	27,179,762	31,220,574	1,799.08	2,032.52	4,896.69	5,226.65	1,799.08	2,032.52	5,224.65	5,552.02	6,696	7,259	7,024	7,585	328	325	4.9%	4.5%	2,613	4.7%
Te Moana Interchange to Kapiti Rd interchange	12,199	12,482	6.9	14,013	14,338	5.5	0%	49,547,108	56,914,633	3,418,750	3,927,110	46,128,357	52,987,523	2,036.64	2,300.96	8,310.45	8,870.67	2,036.64	2,300.96	8,867.07	9,422.88	10,347	11,172	10,904	11,724	557	552	5.4%	4.9%	4,435	5.2%
Kapiti Road to Poplar Ave	10,023	10,321	7.8	11,513	11,856	3.7	0%	27,474,572	31,559,835	2,143,017	2,461,667	25,331,555	29,098,167	1,276.65	1,442.33	4,563.72	4,871.34	1,276.65	1,442.33	4,869.38	5,174.58	5,840	6,314	6,146	6,617	306	303	5.2%	4.8%	2,436	5.0%
Poplar Ave to MacKays crossing	14,527	14,584	7.8	16,687	16,752	2.2	0%	23,376,133	26,851,517	1,823,338	2,094,418	21,552,795	24,757,099	1,086.21	1,227.16	3,882.94	4,144.60	1,086.21	1,227.16	4,143.01	4,402.60	4,969	5,372	5,229	5,630	260	258	5.2%	4.8%	2,072	5.0%
Total								**130,597,548**	**150,015,511**	**10,405,079**	**11,952,148**	**120,192,469**	**138,063,363**	**6,199**	**7,003**	**21,654**	**23,113**	**6,199**	**7,003**	**23,104**	**24,552**	**27,852**	**30,116**	**29,303**	**31,555**	**1,450**	**1,439**	**5.21%**	**4.78%**	**11,557**	**5.0%**

3.0 Pūhoi to Warkworth

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Section 1 (northernmost end)	9,618	9,618	9.8	11,014	10,676	6.2	0%	43,599,013	49,163,639	4,272,703	4,818,037	39,326,310	44,345,602	2,545.36	2,822.97	7,085.00	7,423.92	2,545.36	2,822.97	7,559.54	7,886.07	9,630.36	10,246.90	10,104.89	10,709.04	474.53	462.14	4.93%	4.51%	3,746.71	4.71%
Section 2 (Central Section with large hill) Split one:	9,618	9,618	9.8	11,014	10,676	2.9	4%	17,832,769	20,108,799	1,747,611	1,970,662	16,085,157	18,138,137	3,465.38	3,860.64	2,897.89	3,036.52	3,465.38	3,860.64	3,091.98	3,225.54	6,363.27	6,897.16	6,557.36	7,086.18	194.09	189.02	3.05%	2.74%	1,532.47	2.89%
Section 2 (Central Section with large hill) Split two:	9,618	9,618	9.8	11,014	10,676	2.5	-6%	17,832,769	20,108,799	1,747,611	1,970,662	16,085,157	18,138,137	31.20	31.11	2,897.89	3,036.52	31.20	31.11	3,091.98	3,225.54	2,929.09	3,067.63	3,123.18	3,256.65	194.09	189.02	6.63%	6.16%	1,532.47	6.39%
Section 3 (southernmost end)	9,618	9,618	9.8	11,014	10,676	5.9	0%	41,562,988	46,867,752	4,073,173	4,593,040	37,489,815	42,274,712	2,426.49	2,691.14	6,754.14	7,077.23	2,426.49	2,691.14	7,206.51	7,517.80	9,180.63	9,768.38	9,633.01	10,208.94	452.37	440.56	4.93%	4.51%	3,571.75	4.71%
Pūhoi to Warkworth Whole Section								**123,565,640**	**141,938,280**	**12,109,433**	**13,909,951**	**111,456,207**	**128,028,329**	**7,213.90**	**8,150.09**	**20,079.87**	**21,433.30**	**7,213.90**	**8,150.09**	**21,424.77**	**22,767.53**	**27,294**	**29,583**	**28,639**	**30,918**	**1,345**	**1,334**	**4.9%**	**4.5%**	**10,717**	**4.7%**

SH1 Mackays Crossing to Peka Peka - Section Assessment against NZTA Technical Note for 110km/h criteria (November 2023)

Key

NZTA Technical Note for 110km/h cirteria - key criteria

Departure from NZTA Technical Note for 110km/h criteria

		Length				Standard of corridor – superelevation and sight distance, ramp awareness, merge distance, shoulder width, roadside risk, at grade intersections and direct accessways				Dual Carriageway with median barrier			
Section	**RS/RP**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**
Peka Peka Interchange to Maurice Smith Way	1011/0.000 to 1011/3.55	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None		None required	Y	None	Median barrier installed and dual carriageway both directions	None
Maurice Smith Way to Te Heke Place	1011/3.55 to 1011/4.81	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None	There are two sections between 1011/ 3.55 to 1011/4.09 and 1011/4.34 to 1011/4.81 have "Yellow" Assessment Scores for both Side Friction Demand and Horizontal Stopping Sight Distance. The Side Friction Demand is 51% of fmax for both curves, which is close to the design criteria and is not a concern. The Horizontal Stopping Site Distance (SSD) results in a "Yellow" Assessment Score for a Horizontal SSD of 193 m and 188 m, for the two curve segments respectively. Both of these are greater than the minimum desirable design criteria of 180 m.	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Te Heke Place to Kauri Road	1011/4.81 to 1011/7.07	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None		None required	Y	None	Median barrier installed and dual carriageway both directions	None
Kauri Road to Waikanae River Bridge	1011/7.07 to 1011/7.28	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None	This section has a "Red" Assessment Score for a Horizontal Stopping Sight Distance of 178 m (<180 m). However, the horizontal offset varies throughout the curve and approximately 64% of the curve has a centreline offset of 4.3 m or greater, which results in a Horizontal SSD of 189 m and an Assessment Score of "Yellow." It is noted that the length of this substandard section is approximately 215 m and the assessment scores are "Yellow" for most of the curve. 180 m is the SSD for a vehicle travelling at 110km/h, given a PRT = 2.5s and deceleration coefficient of 0.46 with no gradient. Given this is for an isolated section and near the design SSD, this is acceptable.	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Waikanae River Bridge to Conifer Court	1011/7.28 to 1011/13.93	Y	Corridor length does achieve >5km criteria	More than 5km length, part of 18km corridor	None required	Y	None		None required	Y	None	Median barrier installed and dual carriageway both directions	None
Conifer Court	1011/13.93 to 1011/14.20	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None	This section is on a curve has a "Yellow" Assessment Score for Side Friction Demand and a "Red" Assessment Score for Horizontal Stopping Sight Distance. The Side Friction Demand is 51% of fmax, which is close to the design criteria and is not a concern. The Horizontal Stopping Site Distance (SSD) is 177 m, resulting in a "Red" Assessment Score. This is very close to the minimum desirable "Yellow" Assessment Score Criteria of 180 m. The length of this substandard section is approximately 270 m. The assessment scores are close to "Green" and "Yellow" for Side Friction Demand and Horizontal SSD respectively, and the criteria do not create a compounding safety issue. Given this is for an isolated section and near the design SSD, this is acceptable.	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Conifer Court to Rongomau Lane	1011/14.20 to 1011/14.36	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None		None required	Y	None	Median barrier installed and dual carriageway both directions	None
Rongomau Lane	1011/14.36 to 1011/14.99	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	Y	None	This section has "Yellow" Assessment Scores for both Side Friction Demand and Horizontal Stopping Sight Distance. Side friction demand is related to occupant comfort. 51%of fmax is not considered to have a noticeable impact on driver comfort compared to the "Green" criteriaof 50% and therefore it is not a concern for increasing the posted speed limit. For this curve, the calculated worst case Horizontal SSD is 190 m, which is greater than the minimum desirable design criteria of 181 m. The side friction demand is close to the "Green" Assessment Score Criteria, and there is no compounding safety concern with the fmax value and the stopping sight distance value.	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Rongomau Lane to end of Mackays Crossing to Peka Peka expressway connection	1011/14.99 to 1011/18.04	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 18km continuous length of 110km/h corridor	None required	N	Y	This section has poor pavement condition and poor ground condition resulting in a significant risk to 110km/h implementation. The southern end of the alignment, Raumati Straight, was constructed using the existing roadway crosssection and has portions with a shoulder width less than 2 m between RS/ RP 1011 16.14 to RS/ RP 18.04, also resulting in a "Red" Assessment score. With the reduced width, a vehicle may not be able to safely pull to the left in an emergency. There are two gaps in the roadside barrier, one in each direction. The first, located at at RS1011/18.2,appears to provide access to a Kiwirail maintenance track. The network video (2022) shows wheeltracks into and out of this access indicating that it is currently being used. The second access, located at RS1011/17.3 D, provides access to the GWRC farm stockyards. As partof the M2PP project a bridge was to be built within the farm to provide access to the stockyards allowingthis access to be closed. We are unaware if this bridge has been constructed. Overall, this section of the corridor does not meet the safety geometric or access criteria; therefore, the start/end of the 110 km/h posted speed limit would need to occur north of this section of highway, ideally north of Poplar Avenue.	Close Accesses, increase shoulder width, improve pavement condition. Does not meet 110km/h criterion.The 110km/h section should be started North of Poplar Avenue.	Y	None	Median barrier installed and dual carriageway both directions	None
Mackays Crossing to Peka Peka Post Construction Audit Mar 2017(Rev B)						N	Y	Incomplete	Incomplete	N/A	N/A	N/A	N/A

	Traffic Volume				Interchange Spacing				KiwiRAP rating				Personal Risk				Collective Risk			
Section	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**
Peka Peka Interchange to Maurice Smith Way	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	Y	None	Relatively new section of road,Low	None	Y	None	Relatively new section of road,Low	None
Maurice Smith Way to Te Heke Place	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	Y	None	Relatively new section of road,Low	None	Y	None	Relatively new section of road,Low	None
Te Heke Place to Kauri Road	Y	None	Less than 25K vpd	None	Y	Interchange spacing does achieve >1500m criteria	Only one interchange along this section	None	TBC	None	Not rated	TBC	Y	None	Relatively new section of road,Low	None	Y	None	Relatively new section of road,Low	None
Kauri Road to Waikanae River Bridge	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Waikanae River Bridge to Conifer Court	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Conifer Court	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Conifer Court to Rongomau Lane	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Rongomau Lane	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Rongomau Lane to end of Mackays Crossing to Peka Peka expressway connection	Y	None	Less than 25K vpd	None	Y	None	Only one half interchange along this section	None	TBC	None	Not rated	TBC	TBC	None	Relatively new section of road,Low	TBC	TBC	None	Relatively new section of road,Low	TBC
Mackays Crossing to Peka Peka Post Construction Audit Mar 2017(Rev B)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Prepared for
Waka Kotahi
Co No.: N/A

110 km/h Readiness Assessment - SH1 Peka Peka to Ōtaki

19-Dec-2023

110 km/h Readiness Assessment - SH1 Peka Peka to Ōtaki

Client: Waka Kotahi

Co No.: N/A

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1	15-08-2023	Draft Report	Mike Pilgrim	
2	8-12-2023	Final Report	Graeme Doherty	

Table of Contents

1.0 Introduction

The Kāpiti Expressway is a strategic transport corridor in the Wellington region that has previously faced issues related to traffic characteristics, safety, population increases in the region, route redundancy/ resiliency, freight movement and congestion. In December 2022, the Peka Peka to Ōtaki (PP2O) Expressway was opened to address these issues and improve travel times for people and freight between Wellington and further north. The PP2O Expressway bypasses the Ōtaki township and connects to the MacKays to Peka Peka section further south.

AECOM was retained to complete an assessment of the corridor for its suitability for a 110km/h speed limit. The section of State Highway 1 (SH1) considered in this report is from Peka Peka Road to Taylors Road in Ōtaki (PP2O) from approximately SH 01N RS/RP 995/3.0 to 995/15.3 (section length of 12.3 km). This report includes a review of the current level of infrastructure, identification of potential safety concerns, evaluation of how the highway will be managed and operated, and recommendations related to the posted speed limit.

In completing this assessment, the Speed Management Guide – Road to Zero Edition and the Land Transport Rule for Setting of Speed Limits were reviewed to understand current policy and guidance related to a 110 km/h posted speed limit. The NZ Transportation Agency Technical Note: “Criteria for considering a speed limit increase to 110 km/h” (2016 Draft) was also referenced.

1.1 Speed Management Guide

The One Network Framework classification of this section of SH1 is an *Interregional Connector*, which provides safe, reliable and efficient movement of people and goods between regions and strategic centres. The Speed Management Guide – Road to Zero Edition (2022) outlines criteria and desirable characteristics for an Interregional Connector with a speed limit of 110 km/h; refer to Table 1.

Table 1: 110 km/h Criteria for Interregional Connectors

Criteria for 110 km/h
More than 5km in length
Dual carriageway or median divided
Alignment is straight or curved
Land use is No Access
2 or more lanes in each direction
AADT is less than 25,000 per direction
Intersections are grade separated and have a spacing of 1.5 km or more
Personal Risk of Low or Low-Medium

The assessed corridor was reviewed against the criteria and deviations are discussed in Section 3.

1.2 Land Transport Rule: Setting of Speed Limits

The Land Transport Rule for Setting of Speed Limits 2022 (the Rule) was referenced to understand the requirements for increasing the posted speed to 110 km/h. The Rule outlines that the Director of Land Transport must be satisfied that the road has been designed and constructed, and will be managed and operated, to the standard necessary to safely support 110 km/h travel speeds.

The purpose of this report is to review the PP2O corridor from Peka Peka Rd to Taylors Rd for Design, Construction, Management and Operational readiness to support a 110 km/h speed limit. An assessment of the impact on vehicle emissions was also completed.

2.0 Technical Approach and Evaluation Criteria

In addition to the criteria outlined in the Speed Management Guide, several other key geometric parameters were identified to assess the safety performance of the corridor at a 110 km/h posted speed. The NZ Transport Agency Technical Note: “Criteria for considering a speed limit increase to 110 km/h” (2016 Draft) was referenced in the selection and development of the key parameters.

Descriptions of the key parameters and the rating scales are provided in Sections 2.1 and 2.2.

2.1 Key Parameters

2.1.1 Length of Section

This parameter considers if the corridor section has sufficient length to warrant a posted speed increase.

2.1.2 Dual Carriageway & Median Barrier

Dual Carriageway & Median Barrier considers if the section of corridor has at least two traffic lanes in each direction to provide continuous overtaking opportunity. A median barrier system is required to mitigate the risk of cross-median (head on) crashes.

2.1.3 Traffic Volume

Traffic Volume considers the AADT volume in each direction, which is related to the exposure of motorists along the corridor.

2.1.4 Interchange Spacing

Interchange Spacing considers the distance between interchanges along the assessed section, as measured from the end of the on-ramp taper to the start of the next off-ramp taper. If present, at grade intersections should have low volumes and be left-in and left-out only, desirably providing adequate deceleration and acceleration facilities for safe diverge and merge activity.

2.1.5 Side Friction Demand

Side Friction Demand considers the provided superelevation on a horizontal curve to identify if the side friction demand is approaching the maximum (f_{max}) for a 110 km/h design speed. At side friction demands approaching the maximum, drivers may feel like they are losing control on a horizontal curve.

2.1.6 Gradient

Gradient considers the roadway grade (positive or negative) and the length of the gradient. Roadway grades impact vehicle speeds relative to flat grade, especially for heavy vehicles. As discussed in Austroads Part 3, heavy vehicles are significantly slower on uphill grades of 6-9%. Sight distances are also influenced by high grades.

2.1.7 Median Shoulder

Median Shoulder considers the width between the edge of the inside travel lane and the median barrier. Median shoulders provide a recovery zone prior to the barrier if drivers exit the travel lane to the right and provide deflection space for oncoming vehicles in a flexible median barrier crash event noting that it is not necessary to contain all deflection within the median.

2.1.8 Left Shoulder

Left Shoulder considers the width between the edge of the outside travel lane and the edge of the paved shoulder, or edge barrier, whichever is closer. Space should be available for a stationary vehicle to be clear from the traffic lanes, as well as provide a recovery zone if a driver loses control. Additionally, the left shoulder width influences horizontal sight distance on curves.

2.1.9 Horizontal Curve Stopping Sight Distance

Horizontal Stopping Sight Distance considers the stopping sight distance of a driver on a horizontal curve. Stopping sight distance is a function of a driver’s perception reaction time, the design speed, the roadway gradient and a vehicle’s deceleration coefficient. Commonly accepted values for this calculation are a perception reaction time (PRT) of 2.5 s and a deceleration coefficient of 0.36 (90th

percentile braking on wet, sealed roads). On a horizontal curve, obstructions on the inside of the curve, such as a roadway barrier, impact a driver's sight distance. The Horizontal Stopping Site Distance (SSD) is calculated by considering the worst inside shoulder/median width ("offset") depending on direction, considering the lane nearest to the obstruction.

2.1.10 Vertical Curve Stopping Sight Distance

Vertical Stopping Sight Distance considers the stopping sight distance of a driver on a vertical crest curve (sag curves are not critical). The stopping sight distance of a vertical curve is influenced by the length of the curve and gradients.

2.1.11 Off-Ramp (Diverge) Awareness

Off-Ramp (Diverge) Awareness considers the sight distance available to both the start of the diverge taper and the physical nose to facilitate sufficient time for a driver to recognize and decelerate to an exit ramp. The minimum sight distance of the two shall be used to assess the parameter.

2.1.12 On-Ramp (Merge) Awareness

On-Ramp (Merge) Awareness considers 'mutual' sight distance between vehicles on an on-ramp and the mainline to facilitate safe and effective merging.

2.1.13 Additional Considerations

Additional considerations include anything observed by the AECOM assessment team that may influence safety at a particular segment of the road. This may include the presence of cycling facilities, signage or vegetation that influences sightlines, etc.

Cyclists are vulnerable road users that are at high risk of severe injury or fatality in the event of an impact at speeds greater than 50 km/h. On some roads, cyclists may be accommodated on the shoulder of the road, but off-road facilities should be provided where possible. If cyclists are expected on an expressway, attention should be given to ensure a paved shoulder and may include on/off ramp crossings.

2.2 Criteria Ranges

After the evaluation parameters were established, AECOM developed initial criteria for each parameter and an associated "Green", "Yellow" and "Red" ranking scale to flag potential areas of concern. AECOM held a meeting with Waka Kotahi to finalise the criteria classes as well as the general approach to assessing the performance of the road section at a 110 km/h posted speed.

"Green" refers to locations where the preferred design criteria is met, "Yellow" refers to locations where the minimum desirable design criteria is met and "Red" refers to locations where the minimum desirable design criteria is not met.

These criteria provide general guidance for assessment. Some of the parameters cannot be strictly defined due to natural variability in a driver population. For example, Stopping Sight Distance is influenced by an individual's perception reaction time and deceleration rate. Acknowledging this, a "Red" parameter may not be unsafe, but instead indicates that additional consideration is required in the assessment of the 110 km/h safety readiness.

Where areas are flagged as having two "Yellow" outcomes or a "Red" outcome, the parameter will be further considered to assess the level of risk associated with being outside the desirable criteria. Values may be below desirable but the length over which the low value exists is relatively short, hence the increased risk is only over a short period of time/ distance. In this case it may be acceptable to be outside the criteria, provided that there are no other compounding criteria that also fall outside of the defined limits.

Table 2 outlines the criteria selected to assess the performance of the corridor for each key parameter.

Table 2: Criteria for Assessing 110 km/h Readiness

Parameter	Green	Yellow	Red	Comments
Length of Section	> 10 km	5 – 10 km	< 5 km	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Dual Carriageway & Median Barrier	Two Traffic Lanes per direction and median barrier.	N/A	One Traffic Lane per direction and/or no median barrier.	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Traffic Volume	< 25, 000	N/A	> 25, 000	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Interchange Spacing	Grade separated interchanges spaced at more than 1.5 km.	At-grade interchange with AADT< 100 vehicles, left-in and left-out only spaced at more than 1.5 km.	At-grade interchange with AADT> 100 vehicles. Interchanges spaced less than 1.5 km apart.	Based on recommendations in the NZTA Technical Note and Speed Management Guide
Side Friction Demand	≤ 0.5 f_{max}	0.5 f_{max} – 0.75 f_{max}	≥ 0.75 f_{max}	f_{max} = 0.12 at 110 km/h (Austroads Part 3 Recommendation. Note that superelevation is rounded up to 0.5% in calculated f_{max} as per Austroads).
Gradient (average if multiple grades)	≤ 4 %	4% - 5% with length < 600 m 5% - 6% with length < 500 m 6% - 7%, with length < 400 m 7% - 8%, with length < 300 m	All other gradients	Roads of National Significance (2010) geometric guidelines limit grades >4% to a length <600 m and recommend a maximum grade of 8% for a length <300 m, with longer gradients suggested to provide crawler lanes.
Median Shoulder	≥ 1.0 m	0.75 – 1.0 m	< 0.75 m	Austroads Part 3 Recommendation.
Left Shoulder	≥ 2.5 m	2 – 2.5 m	< 2.0 m	Austroads Part 3 Recommendation.
Horizontal Curve Stopping Sight Distance	≥ 209* m	180 – 209* m	< 180* m	209 m is the SSD for a vehicle travelling at 110 km/h, given a PRT = 2.5s and deceleration coefficient of 0.36 with no gradient correction. 180 m is the SSD for a vehicle travelling at 110km/h, given a PRT = 2.5s and deceleration coefficient of 0.46 with no gradient.

Vertical Curve Stopping Sight Distance	≥ 209* m	180 – 209* m	< 180* m	Refer to Horizontal Stopping Sight Distance commentary.
Off-Ramp (Diverge) Awareness	≥ 240 m	180 – 240 m	< 180 m	240 m is approximately the distance to travel 8 seconds at 110 km/h
On-Ramp (Merge) Awareness	≥ 6 s	4 – 6 s	< 4 s	Austroads Part 4c recommends a desirable 6 s of travel time at the design speed and an absolute minimum of 4 s.
* Values provided in the table are for a gradient of 0%. Stopping site distance criteria used in the assessment varies depending on the gradient of the roadway at the considered location.				

3.0 Corridor Analysis: Design and Construction 110 km/h Readiness

PP2O was constructed and opened for public use in December 2022. The design features were assessed by reviewing the Issued for Construction (IFC) drawings for the longitudinal section and the AutoCAD IFC model for cross-sections; no on-site measurements were completed to verify radii, superelevation, curve lengths or gradients. Consideration of noise compliance and streetlighting is outside the scope of this assessment. Given the short time period since opening, the 110 km/h readiness assessment will focus on geometric design features, as post-construction crash data has an insufficient sample size for calculating Personal or Collective Risk.

To begin the 110 km/h safety assessment, the overall corridor was reviewed using the criteria provided in the Speed Management Guide, listed in Table 1, and a virtual “walk-through” was completed using Argonaut Ltd. Roadrunner video. The results of the initial corridor review are provided in Table 3.

Table 3: Initial 110 km/h Corridor Assessment

Criteria for 110 km/h	Peka Peka to Ōtaki Motorway Assessment	Meets Criteria? (Y/N)
More than 5km in length	Assessed section is >12 km in length	Y
Dual carriageway or median divided	Continuous median barrier and divided highway	Y
Alignment is straight or curved	Yes	Y
Land use is No Access	Land use is classified as No Access	Y
2 or more lanes in each direction	Entire route has two lanes in each direction except at the Northern end of the alignment: *Northbound single lane (Dist 0 to 1580, RS/RP 995/ 4.6) over Waitohu Stream Bridge and underpass (Main Rd North)* *Southbound single lane (Dist 0 to 635, RS/RP 995/ 3.65)*	**N**
AADT is less than 25,000 per direction	Based on Mobile Roads data in the vicinity of the corridor, AADT <25,000 per direction	Y

Intersections are grade separated and have a spacing of 1.5 km or more	All intersections are grade separated and are spaced more than 1.5 km. Ōtaki SB off-ramp: Dist. 1155 Next Ōtaki SB on-ramp: Dist. 4780 (~3.6 km) Ōtaki NB on-ramp: Dist. 1180 Next Ōtaki NB off-ramp: Dist. 4380 (~3.2 km)	Y
Personal Risk of Low or Low-Medium	Insufficient time period post construction to assess crash data and Personal Risk Levels	N/A

Next, a more detailed review was completed at key cross-sections along the longitudinal section, where the existing geometric properties, such as the length of the vertical curve, horizontal radius, and superelevation, were compared to the 110 km/h performance criteria ranges in Table 2. Key cross-sections were identified as locations on the IFC Mainline drawings (provided by WSP) that had any of the following features:

- horizontal curve,
- vertical crest curve,
- steep gradient,
- combinations of curves/ gradients, and
- merge and diverge locations.

The roadway model was provided in AutoCAD for determination of median and shoulder width as no IFC cross-sections were available.

The merge and diverge sight distances/ time to merge were measured using the Argonaut Ltd. Roadrunner Video. The camera is likely above driver eye height, which may result in overestimation of the available merge/diverge distances; however, consideration was given to this when the distances were estimated. For diverge locations, the distance from both the physical nose and the start of the taper back to where they were respectively no longer visible in the video was measured using the RP values. The physical nose varied depending on location - some locations had a sign that was mounted, others had an end terminal.

For merge locations, the distance from the end of the taper to the point where a vehicle on either the main alignment or the merge lane could no longer have a mutual driver sight distance to the adjacent driver was measured using the RP values in the Roadrunner video. This was converted to an equivalent time in seconds by conservatively assuming a speed of 110 km/h.

A summary of roadway cross-sections that had a “Yellow” or “Red” assessment value are provided in Table 4.

Table 4: Detailed Section Review of 110 km/h Readiness - Sections with Yellow or Red Assessment Scores

	Road Name/ Section: PP2O Main Alignment										
Location (Dist. On Mainline Drawings)	**1.68**	**154.65**	**1150**	**1211.74**	**1668.02**	**2150.78**	**8846.65**	**9719.53**	**10115.39**	**10722.37**	**10900.83**
Section in Report (If Applicable)	**3.1.1**	**3.1.1**			**3.1.2**	**3.1.2**		**3.1.3**			
Type of Curve/Condition [if applicable]	Gradient	Vertical Crest	Diverge	Horizontal	Horizontal	Gradient	Horizontal	Both V & H	Horizontal	Horizontal	Horizontal
Side Friction Demand (Radius and Superelevation) Criteria											
Assessment Score	***N/A***	***N/A***	***N/A***	***GREEN***	***YELLOW***	***YELLOW***	***YELLOW***	***YELLOW***	***GREEN***	***GREEN***	***YELLOW***
Gradient Criteria											
Assessment Score	***GREEN***	***N/A***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***N/A***	***GREEN***	***GREEN***	***GREEN***
Median Shoulder Criteria											
Assessment Score	***GREEN***	***GREEN***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***
Left Shoulder Criteria											
Assessment Score	***RED***	***RED***	***N/A***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***	***GREEN***
Horizontal Stopping Sight Distance											
Assessment Score	***N/A***	***N/A***	***N/A***	***YELLOW***	***RED***	***RED***	***GREEN***	***YELLOW***	***YELLOW***	***YELLOW***	***GREEN***
Vertical Stopping Sight Distance											
Assessment Score	***N/A***	***GREEN***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***GREEN***	***N/A***	***N/A***	***N/A***
Sight Distance to Exit Ramp Diverge											
Assessment Score	***N/A***	***N/A***	***YELLOW***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
Sight Distance to Entry Ramp Merge											
Assessment Score	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***

3.1 Design Review of Sections

Most of the corridor is in alignment with the 110 km/h readiness criteria provided in Section 2. In assessing the performance of the entire corridor, consideration must be given to the context of substandard segments. For example, if a short segment is not significantly below the desirable minimum standards, it may still warrant a consistent speed limit appropriate of the full length.

The sections that deviate from the requirements, resulting in either:

- two or more criteria with a “Yellow” Assessment Score, or
- one “Red” Assessment Score, are discussed as follows.

3.1.1 RS/RP 995/3.0 to 995/4.6 (Dist. 1.68 to 1580)

The northern end of the alignment that ties into the existing SH1 is only a single lane for approximately 600 m SB (RS/RP 995/3.65) and 1580 m NB (RS/RP 995/4.6). This does not meet the dual lane carriageway criteria. Additionally, the left shoulder width from approximately RS/RP 995/3.0 to RS/RP 995/3.4 is less than 1.5 m, with some areas having no edge barrier, as shown in Figure 1. These features also result in a “Red” assessment.

Figure 1: Roadway cross section at start of alignment (Northern end, looking South)

This section of the corridor does not meet the safety geometric criteria; therefore, the start/end of the 110 km/h posted speed limit should be considered appropriately.

3.1.2 RS/RP 995/4.66 to 995/5.3 (Dist. 1668.02 to 2150.78)

The horizontal stopping sight distance (SSD) is a function of the lateral offset on the inside of a curve. This portion of the corridor has a “Red” assessment score for a Horizontal Stopping Sight Distance of 174.4 m (<180m), given the worst-case shoulder width of approximately 3 m in the transitions at the start and end of the curve. When including the transition lengths, 82% of the curve has a shoulder width greater than 3.4 m, which results in a horizontal stopping sight distance of 181 m, or a “Yellow” assessment score. The 18% of the curve with a “Red” score equates to 86 m of travel or approximately 43 m at the start and end of the curve. When the transition lengths are not included (i.e., only the horizontal curve is considered), 98% of the segment had a shoulder width resulting in a “Yellow” or “Green” assessment score.

This curve also had a “Yellow” assessment score for Side Friction Demand, which was 52% of f_{max} (>50%). As discussed in Section 2.1, side friction demand is related to occupant comfort, and 52% of f_{max} is not considered to have a noticeable impact on this.

The Horizontal SSD is close to the minimum desirable criteria (Yellow) or greater for most of the curve, and there are no other compounding geometric issues.

3.1.3 RS/RP 995/13.1 to 995/13.7 (Dist. 9335.46 to 9959.39)

Sections within this portion have “Yellow” Assessment Scores for both Side Friction Demand and Horizontal Stopping Sight Distance. The Side Friction Demand is 51% of f_{max}, which is close to the design criteria and is not a concern. Additionally, most of the curve has shoulder widths >5 m, resulting in a Horizontal SSD >210 m (Green Assessment Score).

There are no compounding geometric issues.

3.1.4 Cycling Facilities

The Peka Peka to Ōtaki Shared Path is a separated shared path for cyclists that runs parallel to SH1. It is located on the west side of the highway at the southern end of the corridor and transitions to the east side at the Makahuri Access Rd until its termination near Taylors Rd at the northern extent.

Cyclists who choose to cycle on the SH1 shoulder are provided with 'Cyclists Cross Here with Care’ signs (A43-3) and green paint at the Ōtaki on and off ramps in the northbound and southbound directions (refer to Figure 2). A ‘Use Ramp, Alternate Route Available’ sign is also provided for SB cyclists at the southern end of the corridor (Peka Peka off ramp). Cyclist accommodation provided at subsequent intersections, off of the mainline, were not reviewed as part of this assessment.

Although cyclists are at elevated risk at any highway speed, provision has been made for cyclists at the on and off ramp locations of the roadway and the shoulder is sealed and generally wider than 2.0 m. The southern portion of the roadway has an off-road dedicated cycling path.

Figure 2: On road cycling facilities at northern end of the alignment

Future consideration should be given to provide continuous off-road facilities along the entire corridor and to remove the green pavement markings, which may encourage more cyclists to use the expressway.

3.2 Construction Review

AECOM completed a corridor drive-through to review the safety hazards identified with the design and complete a construction assessment, identifying any additional features not detected in the desktop design scan.

In general, no noteworthy deviations were observed compared to the design review. At the time of the site visit, work was being completed on the cables for the median barrier at the northern end of the alignment and traffic was reduced to a single lane. It is recommended that this work is completed prior to any modification of posted speeds and a site visit confirms the road has been returned to a standard suitable for 110km/h.

4.0 Corridor Analysis: Management and Operation 110 km/h Readiness

Discussions were held with Waka Kotahi representatives involved in the management and operations (M&O) for the Peka Peka to Ōtaki Expressway, including a representative from Wellington Transport Operation Centre (WTOC) to discuss current characteristics of the motorway and potential considerations for the 110 km/h readiness assessment.

4.1 Management Review

The majority of New Zealand's State Highways are managed by Waka Kotahi in the form of long-term client-supplier contracts agreements. The Peka Peka to Ōtaki Expressway is managed by Wellington Transport Alliance, an alliance between Waka Kotahi, WSP and Fulton Hogan.

The characteristics of the 12km Expressway corridor are as follows.

- The infrastructure supports a 110km/h corridor speed limit for the extents outlined in this report.
- Traffic is free flowing without variable speed limits.
- Corridor maintenance and improvements will be undertaken via level 3 CoPTTM temporary traffic management.
- Incident management will utilise pre-determined detours and level 3 CoPTTM temporary traffic management with appropriate speed restrictions to enhance construction site safety.

4.2 Operational Review

As part of the NOC operational requirements of road infrastructure on the proposed 110km/hr corridor it is recommended the Level of Service (LOS) requirements for maintaining road surface, drainage, signage and delineation, lighting and barriers is reviewed.

4.2.1 Maintenance Review

A maintenance review is necessary to determine if the corridor has sufficient infrastructure in place to ensure safe road maintenance at the posted speed limit of 110 km/h. This assessment includes consideration of safe stopping areas and access locations along the corridor both for maintenance efforts as well as for any voluntary or emergency stopping situation along the corridor.

Most of the corridor has a minimum of 3 m wide left shoulders in addition to designated maintenance bays, resulting in safe stopping zones. There is also one interchange on/off ramp at the southern end of the corridor. A summary of the maintenance bay information and emergency crossover points along the corridor is provided in Table 5.

Table 5: Maintenance Bays and Emergency Bay Location Summary

	Number of Maintenance Bays	Number of Emergency Access Locations
Northbound	7 (generally spaced less than 2.5 km apart; maximum spacing is approximately 3.2 km).	1 near RS/RP 995/3.3
Southbound	5 (generally spaced less than 2.5 km; maximum spacing is approximately 5.5 km).	1 near RS/RP 995/11.6

In general, the management and operational review does not present any concerns related to increasing the speed to 110 km/h.

5.0 Emissions Impacts

AECOM completed an assessment of how a speed limit increase from 100 km/h (baseline) to 110 km/h would impact vehicle emissions along the corridor. Based on the AADTs, % of heavy-combination vehicles (HCV) and length of the corridor, the Enabled Emissions (GHG emissions) were estimated using the Vehicle Emissions Prediction Model (VEPM) available from Waka Kotahi. Enabled emissions are those originating from vehicular use of the infrastructure and are expressed as carbon dioxide equivalents (CO_2e). Table 6 provides the input variables for the analysis.

Table 6: Input Data for Emissions Assessment

Section	Current AADT		HCV %	Predicted AADT		Distance (km)	Gradient	Total Annual VKT	
	NB	SB		NB	SB			Current 2023	Predicted 2030
Peka Peka to Ōtaki	9,413	9,413	10	10,813	10,813	12.3	0%	84,519,327	97,089,927

The current AADT values were obtained from Mobile Roads data and a 2% growth rate was assumed to predict the 2030 estimates. HCV percentages were also determined from Mobile Roads.

Two scenarios were modelled for the current year (2023) and predicted year (2030):

1. GHG estimated for the existing 100 km/h maximum speed limit, and
2. GHG estimated for the proposed 110 km/h maximum speed limit.

Note that the emissions analysis assumes that all light vehicles are travelling at the posted speed and heavy vehicles are travelling at 86 km/h (assumption within the Waka Kotahi VEPM model). A comprehensive list of assumptions is outlined in Appendix A.

The following summarises the results of the emissions assessment with supporting data in Table 7; additional details are provided in Appendix A.

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted *increase* in annual emissions of 911 tCO_2e for 2030.
- An increase in average fleet speed to 110 km/hr results in a predicted *increase* in GHG emissions of 4.5% for 2030 compared to 100 km/h.
- The increase in the average fleet speed to 110 km/hr results in a cumulative *increase* in GHG emissions from 2023 to 2030 (inclusive) of 7,314 tCO_2e, or 4.7%.

Table 7: Peka Peka to Ōtaki: Changes in Emissions from a posted speed increase from 100 km/h to 110 km/h

Section	Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Percentage Change in Emissions		Cumulative Change (tCO_2e)	Cumulative Change (%)
	Current 2023	Predicted 2030	Current 2023	Predicted 2030	Current 2023	Predicted 2030	2023 to 2030	2023 to 2030
Peka Peka to Ōtaki	18,739	20,317	19,657	21,228	4.9%	4.5%	7,314	4.7%

Although predicted emissions increases are not a key criterion in determining the 110 km/h readiness of the corridor from a safety perspective, they are still an important consideration when evaluating impacts of the proposed speed limit change.

6.0 Recommendations

Following the design, construction, management and operational review, the SH1 corridor from Peka Peka Rd to Taylors Rd is considered suitable for a 110 km/h increase from approximately SH 01N RS/RP 995/5.44 (NB) and 995/3.86 (SB), to 995/15.3. The northern end of the section does not meet the safety criteria and therefore the extent of the 110 km/h speed limit is shortened compared to the overall roadway length. Within this shortened section (approximately 9.9-11.4 km), there are isolated portions of the road that do not meet the “Green” geometric criteria established in collaboration with Waka Kotahi; however, none of the sub-standard parameters result in a compounding safety issue. Refer to Section 3.1.

The proposed northern extent of the 110 km/h speed limit is at the change of cross-sectional environment where the roadway drops to one lane in each direction. The following extents are proposed:

- A 100 km/h 200 m Ahead Warning sign in the Northbound direction should be posted around RS/RP 995/5.24 with a subsequent 100 km/h sign. The proposed location is in advance of the Merge Ahead warning sign (located at RS/RP 995/4.84) to slow speeds and limit driver workloads through the merge area.
- A 110 km/h 200 m Ahead Warning sign in the Southbound direction should be posted around RS/RP 995/3.66 with a subsequent 110 km/h sign. The proposed location is following the transition to 2 lanes and close to the “Expressway Begins” sign.

The proposed southern extent of the 110 km/h speed limit change continues to the end of the corridor at RS/RP 995/15.3 with possible connection to the MacKays to Peka Peka expressway section, which is reviewed in an independent report by AECOM. If the 110 km/h speeds are not continued, a 110 km/h Ahead and 110 km/h sign should be posted around this location in the Northbound direction with a similar set of 100 km/h signs in the Southbound direction. The sign placement locations shall consider the SB Off-Ramp and associated elevated driver workload.

In general, the finalised sign locations shall ensure good visibility and provide a contrast in the road environment, enabling motorists to change speeds of travel accordingly. The sign locations will need to be confirmed by the designer following a site visit, to ensure there are no conflicts with other roadside furniture, vegetation, and other visual obstructions.

The estimated cumulative increase in emissions from 2023 to 2030 resulting from a speed limit increase from 100 km/h to 110 km/h is estimated to be 4.7% or 7,314 tCO_2e from 2023 to 2030 inclusive. Waka Kotahi must consider the travel time benefits from 110 km/h posted speed limit against the predicted emissions increases.

7.0 Conclusion

In conclusion, the assessed section of SH1 from approximately SH 01N RS/RP 995/5.44 (NB) and 995/3.86 (SB) to 995/15.3 is found to meet the design, construction, operation and maintenance requirements to be posted at 110 km/h. Signage location finalisation and the works to install the signs will need to be completed if the increase is approved by the Director in accordance with the Land Transport Setting of Speed Limits Rule.

The criteria for 110 km/h readiness was based on the Speed Management Guide, the NZTA Technical Note of 110 km/h criteria and other Austroads guidance for road/intersection design. AECOM’s assessment focused on geometric criteria using provided IFC drawings and an AutoCAD model and did not consider on-site measurements, noise criteria, existing lighting, or collision data post-construction.

Appendix A

Emissions Report

Prepared for
Waka Kotahi
ABN: N/A

Speed Change Impact on Vehicle Emissions - 110km/h Project

18-Dec-2023

Quality Information

Document	Summary of Speed Change Results - 110km/h Project
Ref	n/a
Date	01-Dec-2023
Originator	Renee McKay
Checker/s	Luke Elsen
Verifier/s	Anthony Hume

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
1	1/12/2023	Final	Anthony Hume Associate Director – Practice Lead Sustainability & Resilience	

1.0 Purpose of Document

Waka Kotahi commissioned AECOM to assess how a maximum speed change of 10km/h (from 100/km/h to 110km/h) may affect vehicle emissions. The three sections of motorway assessed were Peka Peka to Ōtaki, Mackays to Peka Peka, and Pūhoi to Warkworth.

2.0 Scope of Work

The scope of work covers the following tasks:

- Calculate enabled emissions[1] from the increase in speed limit. These are the GHG emissions that arise from the use of the infrastructure. Sources of enabled emissions include emissions from vehicles (including cars, buses, trucks, and trains) using the transport system.
    - Model GHG emissions are expressed as carbon dioxide equivalents (CO_2e)[2] using the most recent version (version 6.3) of the Vehicle Emissions Prediction Model (VEPM) available from Waka Kotahi.
- Model the following two scenarios for current and predicted years (2023 and 2030):
    1. GHG emissions estimated for the existing 100km/h maximum speed limit, and
    2. GHG emissions estimated for the proposed 110km/h maximum speed limit.

3.0 Method

The model developed uses the AADT, details of the vehicle fleet content and roadway length to calculate the Vehicle Kilometres Travelled (VKT) breakdown for each expressway section for both the current (2023) and predicted (2030) years. AADT values were obtained from Mobile Roads and a 2% growth rate was assumed for the predicted AADT. The VKT and speed data are then multiplied by the VEPM estimate of vehicle fleet emissions expected in the current and predicted years to calculate the emissions of CO_2e (in tonnes, shortened to tCO_2e). Finally, the change in emissions due to the increased speed limit and the percentage change are then calculated.

The VEPM tool can also consider grade changes on road sections. These are automatically factored into the end emission factors during the bulk run of the tool. The VEPM tool allows for different emission factors based on grade changes from -6 to 6% (increasing in 2% increments). As discussed below, the change in grade had no impact on the overall absolute change in emissions. However, it did factor into the percentage change in emissions.

4.0 Results Summary

Three road sections were assessed to quantify the emissions changes from a speed increase of 10km/h (from 100km/h to 110km/h): Peka Peka to Ōtaki, Mackays to Peka Peka, and Pūhoi to Warkworth. This section summarises the results for each road section within the assessment.

4.1 Peka Peka to Ōtaki

The findings for the Peka Peka to Ōtaki Road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 911 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted growth of 4.5% in GHG emissions for 2030 compared to 100km/h.

[1] Enabled emissions are those originating from third-party use of the infrastructure, e.g., vehicles emissions.
[2] Carbon Dioxide Equivalents (CO_2e) are a metric used to compare the emissions from different greenhouse gases based on their global warming potential.

- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions over the seven years between 2023 and 2030 of 7,314 tCO_2e, or 4.7%.

Table 1: Peka Peka to Ōtaki Summary of Results

Section	Change in Emissions (tCO2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Ōtaki	917.87	910.63	4.9%	4.5%	7,314.03	4.68%

Figure 1 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe and the predicted 2030 timeframe.

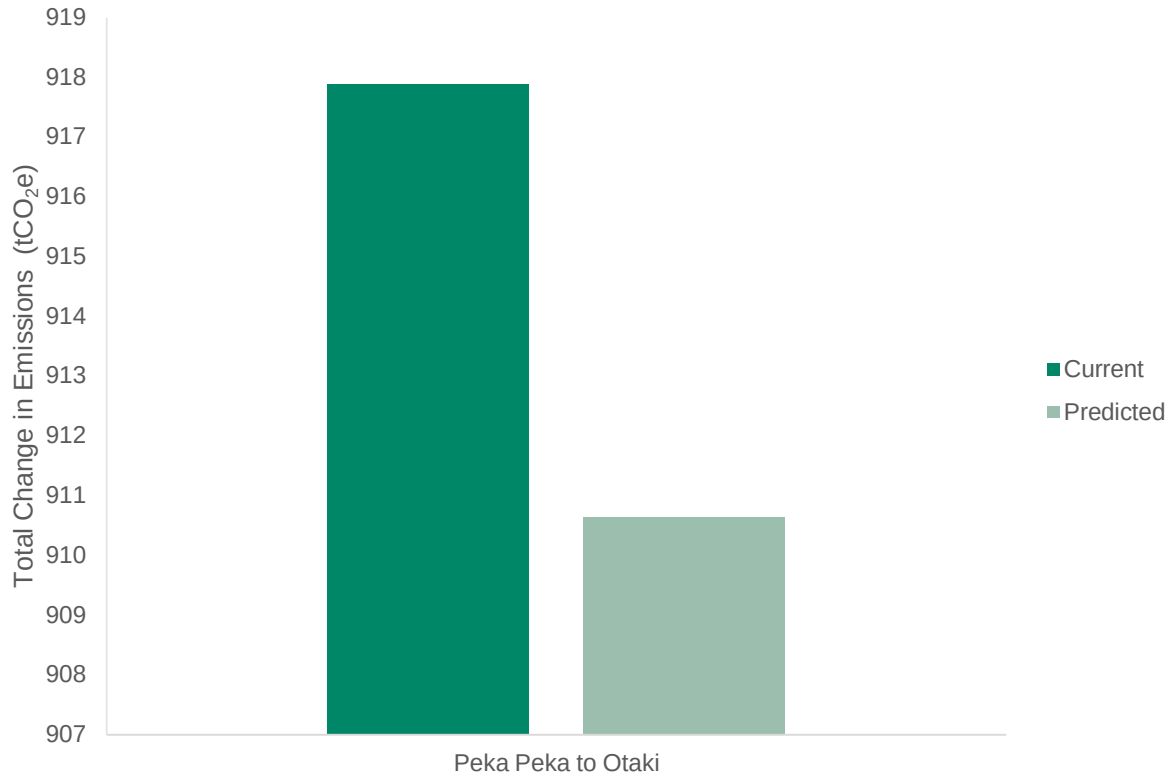

Figure 1: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Peka Peka to Ōtaki

4.2 Mackays to Peka Peka

The findings for the Mackays to Peka Peka Road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 1,439 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted increase of 4.8% in GHG emissions for 2030 compared to 100km/h.
- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions in seven years between 2023 and 2030 of 11,557 tCO_2e, or 5%

Table 2: Mackays to Peka Peka Summary of Results

Section	Change in Emissions (tCO_2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO_2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Te Moana interchange	328	325	4.9%	4.5%	2,613	4.7%
Te Moana Interchange to Kapiti Rd interchange	557	552	5.4%	4.9%	4,435	5.2%
Kapiti Road to Poplar Ave	306	303	5.2%	4.8%	2,436	5.0%
Poplar Ave to MacKays crossing	260	258	5.2%	4.8%	2,072	5.0%
Total	**1,450**	**1,439**	**5.21%**	**4.78%**	**11,557**	**5.0%**

Figure 2 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe as well as the predicted 2030 timeframe.

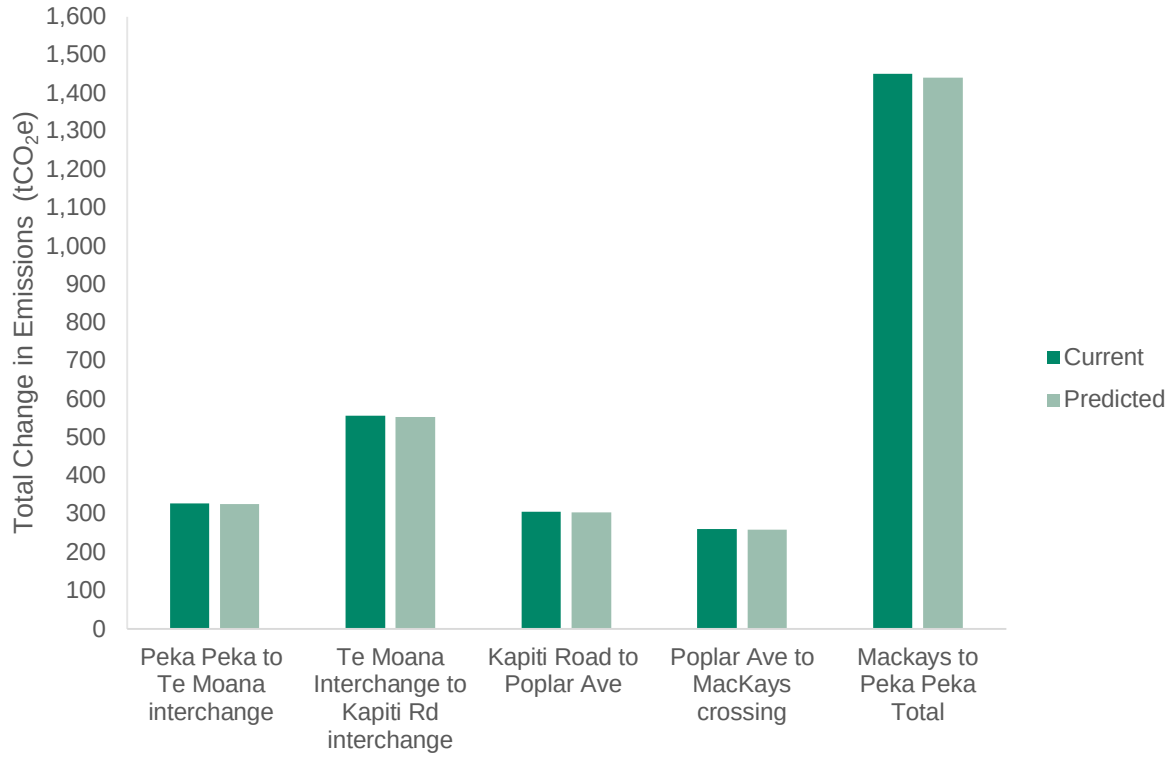

Figure 2: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Mackays to Peka Peka Road and its sections.

4.3 Pūhoi to Warkworth

The Pūhoi to Warkworth road was split into four sections, two of which had associated gradients. These gradients were factored into the calculations through the VEPM 6.3 emission factors. As these gradients did not impact the change in emissions (tCO_2e), the road was reported as a whole section with a 0% average gradient. The assumptions contained in VEPM limit the impact of some changes on the calculation of emissions. For example, heavy vehicles are assumed to be travelling at the same speed of 86km/h for both the 100km/h and 110km/h maximum speed limit scenarios. Another limitation is that CO_2, VOCs, and FC[3] emissions for light vehicles are not impacted by gradient. The results for the individual sections, including the gradients, can be seen in Appendix A.

The findings for the Pūhoi to Warkworth road include:

- An increase in the average fleet speed from 100 km/hr to the proposed 110 km/hr results in a predicted increase in annual emissions of 1,334 tCO_2e for 2030.
- An increase in average fleet speed to 110km/hr results in a predicted increase of 4.5% in GHG emissions for 2030 compared to 100km/h.
- The increase in the average fleet speed to 110km/hr results in a cumulative increase in GHG emissions in a seven-year period from 2023 to 2030 of 10,717 tCO_2e, or 4.7%.

Table 3: Pūhoi to Warkworth Summary of Results

Section	Change in Emissions (tCO_2e)		Change in Emissions (%)		Cumulative Change in Emissions (tCO_2e)	Cumulative Change in Emissions (%)
	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Pūhoi to Warkworth	1,345	1,334	4.9%	4.5%	10,717	4.7%

Figure 3 displays the total change in emissions if speeds were changed from 100km/h to 110km/h for the current 2023 timeframe and the predicted 2030 timeframe.

[3] Carbon dioxide, Volatile Organic Compounds, and Fluorocarbons

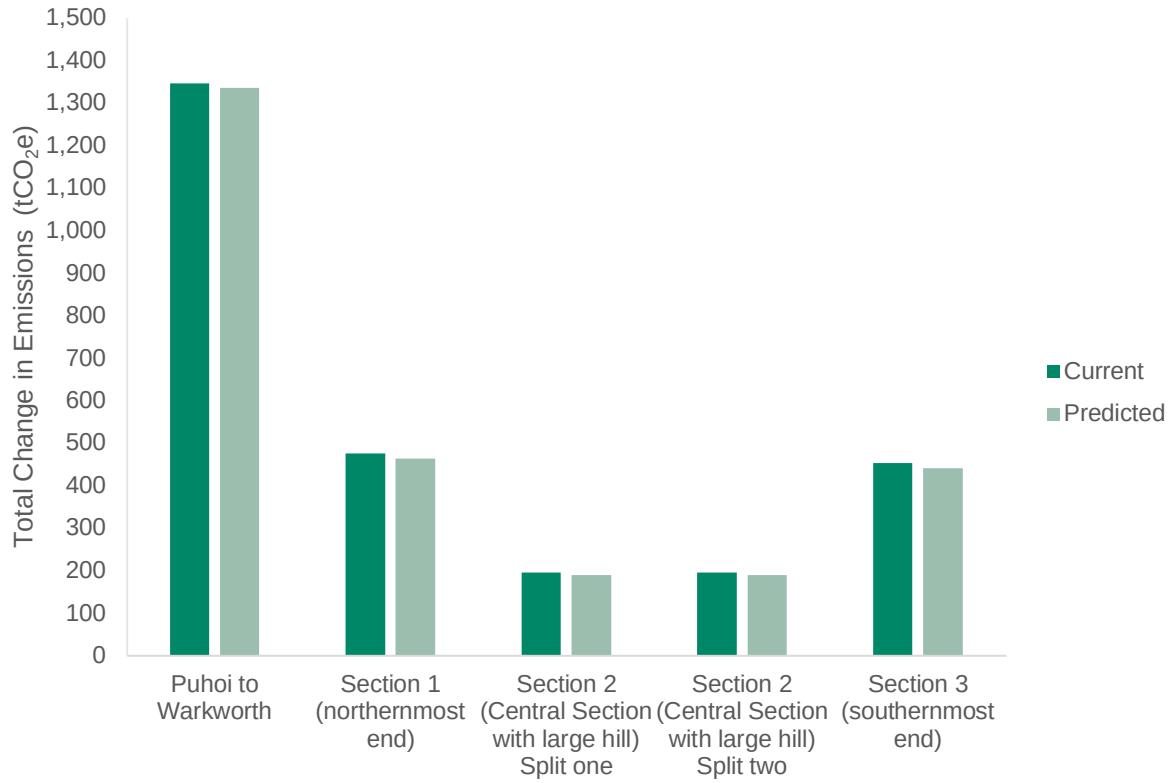

Figure 3: Total Change in Emissions (tCO_2e) across the current (2023) and predicted timeframes (2030) for Pūhoi to Warkworth and its sections.

5.0 Limitations and Assumptions

1. The calculations rely on the assumptions included in the Waka Kotahi VEPM (V6.3) default values, such as:
    a) Heavy commercial vehicles are travelling at a maximum of 86 km/hr
    b) Heavy commercial vehicle load is 50%
    c) Ambient temperature of 13.1 degrees Celsius
    d) Road gradient of 0% (unless stated otherwise). Where a maximum and minimum gradient was given for one section of road, an average of the two values was used.
2. The results assume that the proportion of Heavy/ Light Vehicles and the subgroups within those is an accurate representation of the traffic along the expressway sections.
3. This assessment assumes that all vehicles are travelling at the maximum speed of either 100km/h or 110km/h unless otherwise stated.
4. The results assumed that the AADT provided is an accurate average of the traffic throughout the 365-day year.
    a) Where the AADT was not provided for section breakdowns, the AADT values for the total road have been applied across all sections.
    b) Peka Peka to Ōtaki and the Peka Peka to Te Moana interchange section of the Mackays to Peka Peka Road both use data previous collected from the previous State Highway 1. Due to this, the current and predicted AADT as well as the %HCV for Peka Peka to Ōtaki and Peka Peka to Te Moana interchange are the same.
5. VEPM predicts emissions from vehicles in the New Zealand fleet under typical road, traffic, and operating conditions. Emissions factors used within VEPM are based on predicted fleet average emissions.

Appendix A

Full Summary of Results

Appendix A Full Summary of Results

1.0 Peka Peka to Ōtaki

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Ōtaki	9,413	9,413	10	10,813	10,813	12.3	0%	84,519,327	97,089,927	8,451,933	9,708,993	76,067,394	87,380,934	5,035.03	5,688.67	13,704.25	14,628.49	5,035.03	5,688.67	14,622.12	15,539.12	18,739	20,317	19,657	21,228	917.87	910.63	4.9%	4.5%	7,314.03	4.68%

2.0 Mackays to Peka Peka

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Peka Peka to Te Moana interchange	6,573	6,772	10	7,550	7,779	6.2	0%	30,199,735	34,689,527	3,019,974	3,468,953	27,179,762	31,220,574	1,799.08	2,032.52	4,896.69	5,226.65	1,799.08	2,032.52	5,224.65	5,552.02	6,696	7,259	7,024	7,585	328	325	4.9%	4.5%	2,613	4.7%
Te Moana Interchange to Kapiti Rd interchange	12,199	12,482	6.9	14,013	14,338	5.5	0%	49,547,108	56,914,633	3,418,750	3,927,110	46,128,357	52,987,523	2,036.64	2,300.96	8,310.45	8,870.67	2,036.64	2,300.96	8,867.07	9,422.88	10,347	11,172	10,904	11,724	557	552	5.4%	4.9%	4,435	5.2%
Kapiti Road to Poplar Ave	10,023	10,321	7.8	11,513	11,856	3.7	0%	27,474,572	31,559,835	2,143,017	2,461,667	25,331,555	29,098,167	1,276.65	1,442.33	4,563.72	4,871.34	1,276.65	1,442.33	4,869.38	5,174.58	5,840	6,314	6,146	6,617	306	303	5.2%	4.8%	2,436	5.0%
Poplar Ave to MacKays crossing	14,527	14,584	7.8	16,687	16,752	2.2	0%	23,376,133	26,851,517	1,823,338	2,094,418	21,552,795	24,757,099	1,086.21	1,227.16	3,882.94	4,144.60	1,086.21	1,227.16	4,143.01	4,402.60	4,969	5,372	5,229	5,630	260	258	5.2%	4.8%	2,072	5.0%
Total								**130,597,548**	**150,015,511**	**10,405,079**	**11,952,148**	**120,192,469**	**138,063,363**	**6,199**	**7,003**	**21,654**	**23,113**	**6,199**	**7,003**	**23,104**	**24,552**	**27,852**	**30,116**	**29,303**	**31,555**	**1,450**	**1,439**	**5.21%**	**4.78%**	**11,557**	**5.0%**

3.0 Pūhoi to Warkworth

Section	Current AADT		Predicted HCV Content %	Predicted AADT		Distance (km)	Gradient (nearest 2%)	Total Annual VKT		HCV Annual VKT		Light Annual VKT		HCV Annual tCO2-e @ existing 100km/hr		Light Annual tCO2-e @ existing 100km/hr		HCV Annual tCO2-e @ proposed 110km/hr		Light Annual tCO2-e @ proposed 110km/hr		Total Annual tCO2-e @ existing 100 km/hr		Total Annual tCO2-e @ proposed 110km/hr		Change in Emissions tCO2-e		Percentage Change in Emissions		Cumulative Change in Emissions tCO2-e	Cumulative Percentage Change in Emissions
	Northbound	Southbound		Northbound	Southbound			Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Current	Predicted	Predicted 2030	Predicted 2030
Section 1 (northernmost end)	9,618	9,618	9.8	11,014	10,676	6.2	0%	43,599,013	49,163,639	4,272,703	4,818,037	39,326,310	44,345,602	2,545.36	2,822.97	7,085.00	7,423.92	2,545.36	2,822.97	7,559.54	7,886.07	9,630.36	10,246.90	10,104.89	10,709.04	474.53	462.14	4.93%	4.51%	3,746.71	4.71%
Section 2 (Central Section with large hill) Split one:	9,618	9,618	9.8	11,014	10,676	2.9	4%	17,832,769	20,108,799	1,747,611	1,970,662	16,085,157	18,138,137	3,465.38	3,860.64	2,897.89	3,036.52	3,465.38	3,860.64	3,091.98	3,225.54	6,363.27	6,897.16	6,557.36	7,086.18	194.09	189.02	3.05%	2.74%	1,532.47	2.89%
Section 2 (Central Section with large hill) Split two:	9,618	9,618	9.8	11,014	10,676	2.5	-6%	17,832,769	20,108,799	1,747,611	1,970,662	16,085,157	18,138,137	31.20	31.11	2,897.89	3,036.52	31.20	31.11	3,091.98	3,225.54	2,929.09	3,067.63	3,123.18	3,256.65	194.09	189.02	6.63%	6.16%	1,532.47	6.39%
Section 3 (southernmost end)	9,618	9,618	9.8	11,014	10,676	5.9	0%	41,562,988	46,867,752	4,073,173	4,593,040	37,489,815	42,274,712	2,426.49	2,691.14	6,754.14	7,077.23	2,426.49	2,691.14	7,206.51	7,517.80	9,180.63	9,768.38	9,633.01	10,208.94	452.37	440.56	4.93%	4.51%	3,571.75	4.71%
Pūhoi to Warkworth Whole Section								**123,565,640**	**141,938,280**	**12,109,433**	**13,909,951**	**111,456,207**	**128,028,329**	**7,213.90**	**8,150.09**	**20,079.87**	**21,433.30**	**7,213.90**	**8,150.09**	**21,424.77**	**22,767.53**	**27,294**	**29,583**	**28,639**	**30,918**	**1,345**	**1,334**	**4.9%**	**4.5%**	**10,717**	**4.7%**

SH1 Peka Peka to Ōtaki - Section Assessment against draft NZTA Technical Note for 110km/h criteria (November 2023)

Key

NZTA Technical note for 110km/h cirteria - key criteria

Departure from NZTA Techncial Note for 110km/h criteria

		Length				Standard of corridor – superelevation and sight distance, ramp awareness, merge distance, shoulder width, roadside risk, at grade intersections and direct accessways				Dual Carriageway with median barrier			
Section	**RS/RP**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**
Taylors Road to Ōtaki Half Interchange	995/3.0 to 4.6	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 12km continuous length of 110km/h corridor	None required	N	Yes	The left shoulder width from approximately RS/RP 995/3.0 to RS/RP 995/3.4 is less than 1.5 m, with some areas having no edge barrier	Yes	N	Y	Single lane (decreasing direction) RS995/3.0 to 4.6, Single lane (increasing direction) RS995/3.0 to 3.6	Does not meet criteria. Start SB and end NB to be located after/ before these sections
Ōtaki Half Interchange to Rahui Road Bridge	995/4.6 to 995/5.3	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 12km continious length of 110km/h corridor	None required	Y	None	This section is on a horizontal curve. The horizontal stopping sight distance (SSD) is a function of the lateral offset on the inside of a curve. This portion of the corridor has a "Red" assessment score for a Horizontal Stopping Sight Distance of 174.4 m (<180m), given the worst-case shoulder width of approximately 3 m in the transitions at the start and end of the curve. When including the transition lengths, 82% of the curve has a shoulder width greater than 3.4 m, which results in a horizontal stopping sight distance of 181 m, or a "Yellow" assessment score. The 18% of the curve with a "Red" score equates to 86 m of travel or approximately 43 m at the start and end of the curve. When the transition lengths are not included (i.e., only the horizontal curve is considered), 98% of the segment had a shoulder width resulting in a "Yellow" or "Green" assessment score. For isolated lengths this is acceptable	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Rahui Road Bridge to Valentine Basin	995/5.3 to 995/13.1	Y	Corridor length does achieve >5km criteria	Over 8km in length	None required	Y	None		None required	Y	None	Median barrier installed and dual carriageway both directions	None
Valentine Basin to Mary Crest Basin	995/13.1 to 995/ 13.7	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 12km continious length of 110km/h corridor	None required	Y	None	Sections within this portion have "Yellow" Assessment Scores for both Side Friction Demand i.e. side friction f between 0.5 and 0.75 fmax and Horizontal Stopping Sight Distance i.e. SSD between 180-209m. The Side Friction Demand is 51% of fmax, which is close to the design criteria and is not a concern. Additionally, most of the curve has shoulder widths >5 m, resulting in a Horizontal SSD >210 m	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Mary Crest Basin to Peka Peka Interchange	995/13.7 to 995/15.3	N	Corridor length does not achieve >5km criteria	Less than 5 km in length, however part of 12km continious length of 110km/h corridor	None required	Y	None	Sections within this portion have "Yellow" Assessment Scores for Horizontal Stopping Sight Distance i.e. SSD between 180-209m. This is still acceptable for isolated sections.	None required	Y	None	Median barrier installed and dual carriageway both directions	None
Ōtaki SB off ramp	995/Ramp 1:0-410	N/A	N/A	N/A	N/A	Y	None	Otaiki SB off ramp requires large 50km/hr signs and roundel from post opening RSA	TBC as per post construction RSA	N/A	N/A	N/A	N/A

	Traffic Volume				Interchange Spacing				KiwiRAP rating				Personal Risk				Collective Risk			
Section	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**	**Criteria achieved**	**Departures**	**Comments**	**Mitigation required**
Taylors Road to Ōtaki Half Interchange	Y	None	Less than 25K vpd	None	Y	None	Only one interchange along this section	None	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC
Ōtaki Half Interchange to Rahui Road Bridge	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC
Rahui Road Bridge to Valentine Basin	Y	None	Less than 25K vpd	None	Y	Interchange spacing does achieve >1500m criteria	Spacing more than 1.5km	None	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC
Valentine Basin to Mary Crest Basin	Y	None	Less than 25K vpd	None	Y	None	No interchanges	None	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC
Mary Crest Basin to Peka Peka Interchange	Y	None	Less than 25K vpd	None	Y	None	Only one interchange along this section	None	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC	TBC	None	New Section of Road	TBC
Ōtaki SB off ramp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Criteria for a speed limit increase to 110km/h

TM 25XX November 2023

Purpose

This memorandum details the criteria that should be assessed as part of the consideration to increase the speed limit of a road to 110km/h. It gives some guidance about the acceptable range of values for each criterion.

Background

Historically, improvements to the road network in New Zealand have been designed for an open road speed of 100km/h. Wherever practical, this has translated into a design speed of between 100km/h and 110km/h for our state highways. This included dual carriageways before the introduction of the Roads of National Significance programme. More recently, with the advent of the safe system approach there has been a tendency to provide for higher speeds, even though the posted limit remained 100km/h, in order to provide additional safety factors for those drivers travelling at excessive speed. The philosophy has been to allow for this speed in the design, without actually encouraging or designing for it. This has very little impact on the safety risk providing the normal design practices of route delineation and sight distance provision are adhered to.

Vision Zero

With the adoption of vision zero in 2020, the update to the Land Transport Rule; Setting of Speed Limits 2022 and the requirement for every RCA to produce a Speed Management Plan, there is a sharper focus on the part that speed plays in the outcome of every crash. As a consequence, the requirements for the criteria to increase the speed limit to 110km/h are more definitive and should not be compromised.

Roads of National Significance (RoNS)

With the delivery of projects as part of the RoNS initiative it is acknowledged that drivers on this higher standard of road, i.e. median divided dual carriageways, are less likely to adhere so closely to the speed limit and the resulting operating speed would increase above 100km/h. As a result, designs for the RoNS projects have their safety factors assessed against operating speeds of 110km/h.

Key Influencing Factors

The following aspects of the corridor under consideration must be evaluated. Where applicable, the assessment should allow for any planned works to bring the corridor up to the required standard:

- Length of section
- Standard of the road corridor
- Dual Carriageway with median barrier
- Traffic volume
- Interchange spacing
- KiwiRAP rating
- Level of personal risk
- Level of collective risk

Recommended practice

The following section analyses the criteria to be considered in more detail and summarises the acceptable range of values for each one in Table 1. Sections of corridor that do not satisfy all the criteria may still be considered on a case-by-case basis.

Length of Section

The length of corridor under consideration should be a **minimum length of 5km and lengths of over 10km are preferable.** Care should be taken to start and finish the section in a location that will optimise safety and facilitate driver compliance. E.g. immediately downstream of an on-ramp merge.

Standard of Road Corridor

The key parameters that directly affect the safety of a corridor and are influenced by the operating speed are:

1. Superelevation

   The shape of the pavement of the corridor under consideration must be assessed and the relationship between the superelevation and curve radii must be suitable for 110km/**h i.e. the side friction demand must not exceed 0.75 of f_{max} (f_{max}=0.11 @110km/h)**

2. Sight distance

   a. Stopping Sight Distance

      Assess the demand on a driver who would be required to stop within the sight distance available.

      d=0.26 represents very light braking and the advice relating to its use has been moderated in the latest release of AGRD Part 3. It has been considered reasonable that a driver reacting to the presence of an object on the road is more likely to apply the brakes in a more deliberate manner.

      A deceleration factor of 0.36 has therefore been accepted with the same reaction time of 2.5s; combining to give a target sight distance of 209m. However, for isolated examples a combination of 2.5s reaction time and a deceleration factor of 0.46 may be acceptable.

   b. Off-ramp awareness

      AGRD Part4c requires sight distance equivalent to **10 seconds of travel time to the start of the diverge taper** right through to the pavement adjacent to the diverge physical nose and preferably to a distance of 60m along the ramp beyond that point.

   c. On-ramp merge

      AGRD Part4c requires '**mutual' sight distance** between vehicles on the ramp and the main-line **equivalent to 6 seconds of travel time** to facilitate safe and effective merging.

      In addition, there is a requirement for the **ramp drivers to be able to see the pavement throughout the merge area** at the appropriate merge speed.

3. Shoulder width
    a. The left-hand shoulder should be a consistent **width of 2.5m; 3.0m to a roadside safety barrier**
4. Roadside Risk management
    a. A **continuous safety barrier system** is the preferred treatment to manage the roadside risk
5. At-grade intersections and direct accessways
    a. **Should be designed to the same standard as grade separated interchanges** i.e. with deceleration and acceleration lanes that operate in an identical way to ramps.

Dual Carriageway (median divided)

The section must have at least 2 traffic lanes in each direction to provide continuous overtaking opportunity. The median must have a safety barrier system installed to mitigate the risk of cross-median crashes.

Traffic Volume

The 5-year projected AADT volume should not be greater than 25,000 vehicles for a permanent rise in speed limit. However variable speed limits may be considered for AADT volumes up to 40,000 vehicles. Wherever AADT volumes exceed 30,000 on a road already designated at 110km/h, consideration should be given to either varying the limit or lowering the limit permanently.

Interchange Spacing

T**he minimum distance between interchanges, measured from the end of the on-ramp taper to the start of the off-ramp taper, shall be 1500m.** Any at-grade intersections must low volume (AADT <100 vehicles), be left-in and left-out only and desirably provide adequate deceleration and acceleration facilities for safe diverge and merge activity.

KiwiRAP rating

The KiwiRAP rating shall be no less than 4 Star.

Levels of Risk (High Risk Rural Roads Guide Section 4.3.3)

Personal risk (Crash Rate) is defined as the Fatal and Serious crash risk per vehicle kilometres travelled. The level of Personal Risk shall be calculated as follows:

$$\text{Personal Risk} = \frac{\text{Fatal Crashes + Serious Crashes}}{\text{(Length of road in km x number of years of data x 365 x AADT)}/10^8}$$

Collective risk (Crash Density) is defined as the number of Fatal and Serious crashes per kilometre travelled. The level of Collective Risk shall be calculated as follows:

$$\text{Collective Risk} = \frac{\text{(Fatal Crashes + Serious Crashes)/number of years of data}}{\text{Length of road section km}}$$

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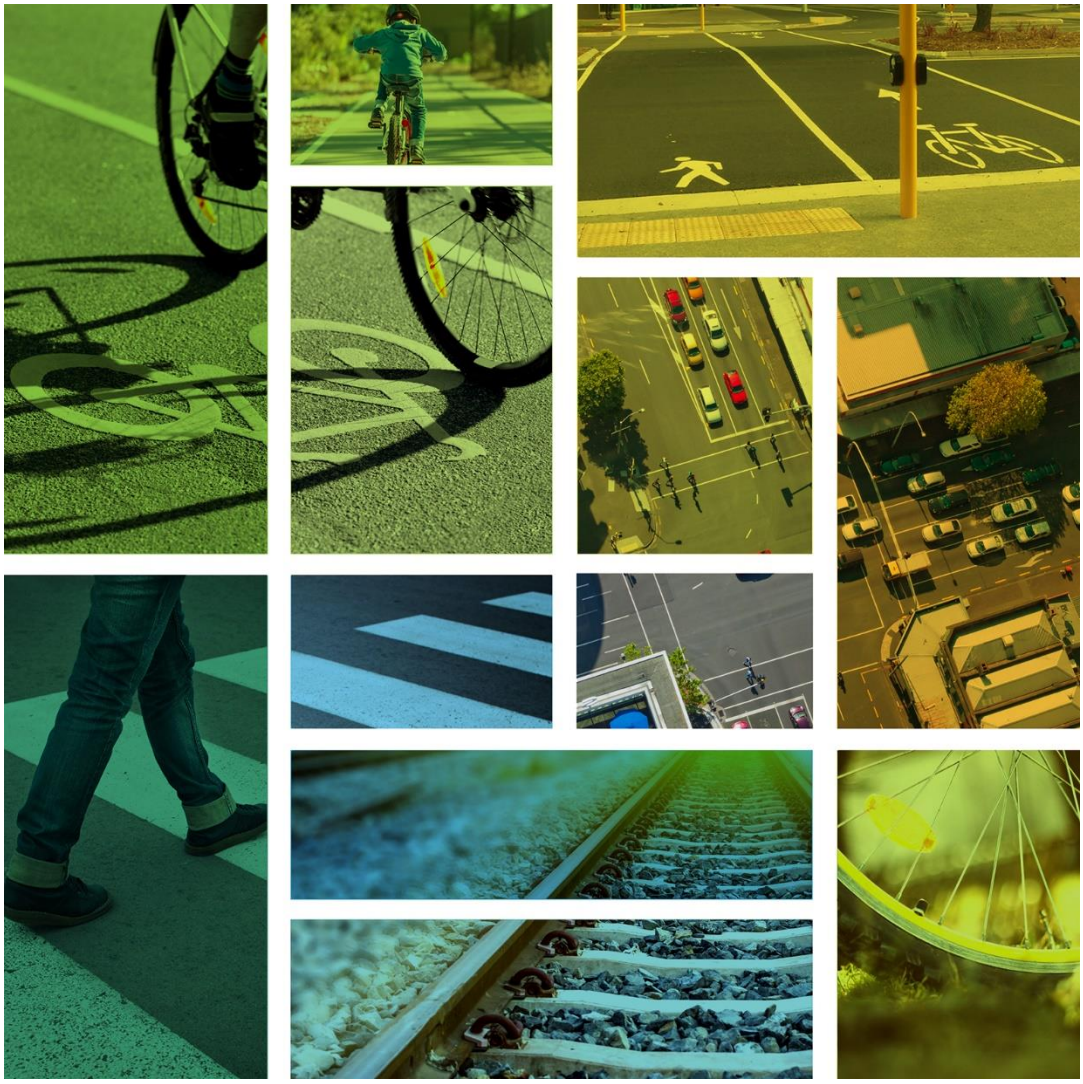
TABLE 1 – Criteria range and mitigation summary

Criterion	Range	Possible Mitigation
Length of Section	5km	N/A
Standard of Road Corridor	Operating Speed of 110km/h	Assess additional driver demand with higher speed
Superelevation	Assess side friction demand at 110km/h for all curves	Increase superelevation
Stopping sight distance	Assess combination of reaction time and deceleration factor required	Widen shoulder/ remove obstruction
Sight distance to exit ramp	Assess seconds of travel time available	Remove obstruction Increase target height
Shoulder width (LHS)	>2.5m (3.0m to barrier system)	Departure for short lengths <2.5m
Roadside Risk management	Continuous safety barrier system	Clear run-out area for short lengths
Dual Carriageway with median barrier	N/A	Retrofit safety barrier systems
Traffic Volume	AADT 15 – 25,000	Introduce Variable Speed limits/ Reduce permanent limit back to 100km/h
Interchange Spacing	Over 3km	N/A
KiwiRAP Rating	>4 Star	Improve key influencing factors to achieve minimum rating
Collective Risk	≤Medium/High*	Improve key influencing factors
Personal Risk	Low or Low-Medium*	Improve key influencing factors

*Ref HRRRG - Figures 4.1 and 4.2

Endorsed by: National Manager Programme & Standards



110 KM/H SPEED LIMITS

12 month evaluation report - DRAFT

19 JUNE 2019

MACKIE RESEARCH
OPTIMISING HUMAN SYSTEMS

Document Title:	110 km/h speed limits: 12 month evaluation report
Prepared for:	NZ Transport Agency
Prepared by:	Kylie Legg, Hamish Mackie, and Lily Hirsch from Mackie Research
Signed: 	Date: June 2019

Revision history

Revision No.	Amendments	Completed by	Date
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EXECUTIVE SUMMARY

In December 2017, two newly-built high quality expressways - SH1 Cambridge section of the Waikato Expressway (WCS) and SH2 Tauranga Eastern Link (TEL), received a speed limit change to 110 km/h.

This report builds on earlier findings to describe motorist behaviour at these two sites, twelve months following the 110km/h speed limit implementation, to confirm understanding of the merit of this initiative. For this longer-term evaluation, key points from a large-scale survey of motorist perceptions of the new 110 km/h speed limits is added to this report.

A before/after controlled study was implemented to understand the effects of the speed limit changes. At baseline, 1-month, 3-months, 8-months and 12-months following the speed limit change, traffic speed and lane distribution for cars and trucks were compared for the intervention and control sites. Upstream, downstream and off-ramp/flyover speeds, along with travel time, were also monitored for baseline vs 12-months.

Some key findings 12-months following the 110 km/h speed limit changes are as follows:

- Traffic speeds within the new 110 km/h zones typically increased by about 3-5 km/h compared with baseline
- Travel speed at the control sites (Kapiti Expressway and SH1 North of Auckland) remained largely unchanged
- There were no material changes in lane distribution
- Truck speeds had no material changes at WCS, but increased by 10km/h at TEL Westbound lane 2, which is concerning and warrants further investigation
- There were mixed outcomes for up and downstream speeds, with little change from baseline conditions at both 2 and 5km from the 110km/h zone.
- Travel times typically reduced by 12-20 seconds within the 11-13 km 'Blip-Track' sections.

There was little difference in the average speeds at 3, 8 and 12 months following 110 km/h implementation. The percentage of vehicles travelling over 120 km/h at WCS steadily increased over 8 months, but this trend has settled at 12 months. However, measures to enforce the speed limit at this site may still be required.

An online motorist perceptions survey was distributed to motorists who had recently travelled through the TEL or WCS 110 km/h speed limit sections in October 2018. This survey found that there was strong support for the speed limit change, with the majority of respondents feeling safe driving in the higher speed environment. Comparing the findings of the measured travel time survey and the perceived travel time changes from the motoring public, there is clear over-estimation of the travel time benefits gained from the 110 km/h speed limit, by the motoring public.

Over time the crash performance of these two 110 km/h sites will materialise. This will add to the current findings to help to explain the overall merit of the 110 km/h speed limits.

CONTENTS

1. INTRODUCTION

1.1. Background

The 2013-2015 Safer Journeys Action Plan[1] encompassed the Safe System approach to road safety with the vision of establishing "a safe road system, increasingly free of death and serious injury". The Action Plan incorporated the four pillars of a Safe System: safe roads and roadsides; safe speeds; safe road use; and safe vehicles.

Under the Safer Journeys Action Plan sits the *Safer Speeds Programme*, with a goal of achieving a "nationally consistent approach to speed limits that considers the Safe System approach"[2]. The *NZ Speed Management Guide*[3], produced as part of the *Safer Speeds Programme* recognises that not all of the roads in New Zealand have the same risk and therefore different speeds may be safe and appropriate depending on the road environment. For some roads this may mean a reduction in the speed limit, and for others this may mean an increase if the characteristics of the road support safe use at an increased speed. These speed limit changes would help reinforce to the motoring public that not all roads are equal and that it is safer to travel faster on some roads than others.

In August 2017, the *Land Transport Rule: Setting of Speed Limits 2017* enabled suitable roads to be set with a 110 km/h speed limit. Roads considered for a 110 km/h speed limit must be built to a standard where the higher speed limit is both safe and appropriate. These standards are:

- Two lanes in each direction;
- A median barrier;
- No significant curves;
- Grade separation at intersections; and
- No direct access to neighbouring properties

In December 2017, 110 km/h speed limits were implemented at two locations. Building on earlier analyses three and eight months following the introduction of the 110 km/h speed limits, this report presents an evaluation of motorist behaviour twelve months following the speed limit change. Motorist behaviour at the intervention sites is compared with similar sites where the speed limits were not changed. Using this information, confidence (or otherwise) can be gained in applying the speed limit change more widely, when road design permits. The longitudinal evaluation allows evaluation of the change in motorist behaviour as they become more familiar with the higher speed limits.

An online survey delivered 12 months following the introduction of the 110 km/h speed limit examined the experience, perceptions and responses of motorists who had recently driven either the Cambridge Expressway (WCS) or Tauranga Eastern Link (TEL) (Blewden, M. *et. al*, 2019). The addition of this data provides further information on the behaviour of motorists and their perceptions of the speed limit change.

1.2. Purpose

[1] http://www.saferjourneys.govt.nz/action-plans/2013-2015-action-plan/
[2] http://www.saferjourneys.govt.nz/action-plans/safe-speeds/
[3] NZ Transport Agency (2016). Speed management guide, NZ Transport Agency, Safer Journeys, New Zealand Government.

The main aim of this research is to examine the changes to driver speed, lane distribution and travel time following an increase in the maximum speed limit from 100 km/h to 110 km/h on two high-quality roads: SH2 Tauranga Eastern Link (TEL) and SH1 Cambridge Section of the Waikato Expressway (WCS). The research will also determine the impact of the speed limit changes on motorist attitudes.

2. METHOD

2.1. Overview

A pre and post study was designed to understand the effect of the speed limit changes at two sites (the intervention sites). In addition, data were collected at two sites with a similar road environment, but where the speed limit remained at 100 km/h (the control sites). Prior to the speed limit change, baseline data were collected at all sites. Follow-up data were collected at all sites 1 week, 1 month, 3 months, 8 months and 12 months following the implementation of the speed limit change.

2.2. Sites

The 110 km/h speed limit can only be applied to roads that have been built to a standard where an increase in the speed limit is both safe and appropriate. The factors that are considered by the Transport Agency for a road section to be eligible are if,

- It is a high volume national road;
- It is a median-divided road with at least two lanes in each direction;
- There is no direct access to any property;
- Intersections are grade-separated; and
- It has a low personal and collective crash risk

The two intervention sites are described below. The two control sites used for this study are potential candidates for a 110 km/h speed limit in the future.

Intervention sites

Two sites were chosen as the first suitable roads for the 110 km/h speed limit:

- SH1 Cambridge Section of the Waikato Expressway (WCS) – 16km section (Figure 1) and
- SH2 Tauranga Eastern Link (TEL) – 15km section (
- Figure *2*)

Figure 1: SH1 Cambridge Section of the Waikato Expressway (WCS)

Figure 2: SH2 Tauranga Eastern Link (TEL)[4]

Control sites

Two other state highways with similar high-quality designs were chosen as control sites. These were: SH1N Northern Motorway from the Johnstone's Hill Tunnels to Lonely Track and SH1 Kāpiti Expressway Makay's to Peka Peka (M2PP) (Figure 3). Both control sites have a similar look and feel to the intervention sites and their design standards meet the same criteria.

[4] Image source: NZ Transport Agency

Figure 3: SH1 Kāpiti Expressway Makay's to Peka Peka (M2PP)

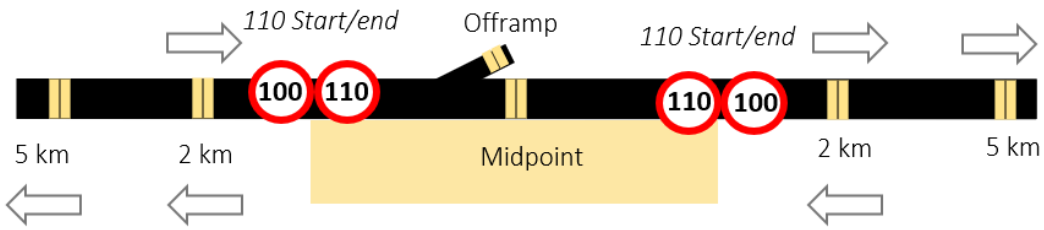
2.3. Speed and travel time

Spot speed and traffic volume

Vehicle speed, type, and lane occupancy up-stream, within, and down-stream the 110 km/h zone were measured by cut loops or pneumatic tubes at four locations in each direction (Figure 4). The measurements were taken at:

- *2km before the 110km section (upstream):* To measure if drivers anticipate the approaching speed limit change;
- *Midpoint of 110 km/h section:* To understand speed, traffic volume, and lane occupancy within the 110 km/h section;
- *2km and 5km after the 110 km section (downstream):* To determine how drivers readjust to a lower speed limit (100 km/h). To investigate if a 'halo' effect of continuing to travel at 110 km/h after leaving the 110 km/h speed limit area exists; and
- *On the offramps exiting the 110 km/h section (and at one overbridge):* To understand deceleration coming into intersections.

Figure 4: Speed measurement layout



Baseline data were collected from September to October 2017 and then the speed limit was changed on the 11th December 2017. Follow-up data were collected during the 1st week of the 110 km/h speed limit (as an informal check), 1-month, 3-months, 8-months and finally 12-months after the speed limit change (

Table 1). For the control sites, data were collected and analysed at baseline and at 3-months, 8-months and 12-months. Please note that this report does not report on the 1-week data.

Table 1: Breakdown of data collection period

Site	Condition	Period of collection
WCS	Baseline	13/10/2017 – 25/10/2017
TEL		14/09/2017 – 20/09/2017
M2PP		14/09/2017 – 20/09/2017
SH1N		14/09/2017 – 20/09/2017
WCS	1-month	16/1/2018 - 22/1/2018
TEL		19/1/2018 - 25/1/2018
WCS	3-months	12/3/2018 – 18/3/2018
TEL		12/3/2018 – 18/3/2018
M2PP		19/3/2018 – 25/3/2018
SH1N		12/3/2018 – 18/3/2018
WCS	8-months	12/8/2018 – 22/8/2018
TEL		20/8/2018 – 26/8/2018
M2PP		20/8/2018 – 26/8/2019
SH1N		18/8/2018 – 27/8/2020
WCS	12-months	3/12/2018 – 11/12/2018
TEL		3/12/2018 – 9/12/2018
M2PP		3/12/2018 – 9/12/2018
SH1N		3/12/2018 – 9/12/2018

Speed data were initially formed in a scatter plot to determine if any unusual speed patterns existed. These may have been caused by temporary speed limits, crashes, congestion, or tube failures. In instances where tube failures occurred, only robust portions of the data were used. Data were also sorted by speed to identify any speeds that were clearly unachievable (e.g. 255 km/h for a truck), and these extreme outlier speeds were removed.

The speed of all vehicles was calculated to understand the overall effect of the speed limit change on all drivers. Free speeds (>4 second headway) were calculated for the 3-month post intervention data to understand the effect of the speed limit change on those motorists who were unencumbered by other vehicles. The speed differences between all vehicles and free speed only vehicles were very small. In addition, between 41-50% of the traffic would have been omitted from the analysis if free speed only vehicles were used for the analysis and this was considered unrealistic. Therefore, the main analyses for the subsequent three, eight and twelve month post intervention were carried out for all vehicles.

Speed distribution graphs were produced to show how the speed patterns changed and summary statistics were produced. For the intervention sites this included before/after comparisons of 85%tile speeds at the locations outlined above (Figure 4) and also a range of speed and lane distribution summary statistics for the mid-point locations where the 110 km/h speed limit applied. These more detailed statistics were not carried out for the control sites.

Lane Occupancy

In addition to speed measurements, the pneumatic tubes and cut loops were used to classify the proportion and type of vehicles travelling in each lane. This measurement was useful to understand how traffic patterns in each lane by vehicle type might change after the implementation of the 110 km/h speed limit and according to time of day (such as rush hour). This is important because the higher speed limit does not apply to all vehicles and therefore some vehicle types would be expected to travel almost exclusively in the left-hand lane. This applies to all trucks and buses over 3.5 tonnes and light vehicles towing a trailer caravan which have a default speed limit of 90 km/h, and school buses which are limited to 80 km/h.

Heavy vehicles

Heavy vehicles were classified in three different methods (Appendix A) depending on the type of equipment used to capture the data. Cut loop data classified vehicles into 5 EEM classes. Classes 4 and 5 were considered heavy vehicles in the analysis. For tube data, axle classes were used. Classes 5-14 were considered heavy vehicles in the analysis. Radar data was used at M2PP to classify by length but was not used in the analysis.

Travel time

The time it took vehicles to travel from one point to another within the 110 km/h section was estimated using a Bluetooth and Wi Fi-detecting system called 'BlipTrack'. The BlipTrack technology detects in-vehicle Bluetooth and Wi Fi devices such as mobile phones and in-car communication and audio systems (between 4-14% of the traffic flow). Each device's unique media access control (MAC) address is anonymised by the BlipTrack unit within an embedded encryption system. The anonymised identifier and encryption process means that the data cannot be tracked back to any individual or device.

By re-identifying the devices between two sensors of a known distance apart, vehicles' travel times can be understood. A weighted average travel time based on the count of vehicles (devices) and average travel time of vehicles in 10-minute periods were used for the travel time calculations. These short time-frames were used to ensure that travel time was proportional to traffic density. In this way, faster travel times when the roads were quiet could be understood separately to slower travel times when the roads were more congested.

BlipTrack sensors were placed at the start and end of the WCS and TEL sections. The TEL BlipTrack sensors were 11km apart and the WCS sensors were 13km apart.

Motorist perceptions

A perceptions survey was developed and distributed to motorists who had recently travelled through the TEL or WCS 110 km/h speed limit sections in October 2018. Automatic Number-Plate Recognition (ANPR) was used to obtain vehicle registrations, which were matched to addresses via the NZ Transport Agency's Motor Vehicle Register. Motorists received a letter with a link to an online survey. The survey asked about their perceptions of the speed change, any differences in travel time, and safety implications since the 110 km/h speed limit was introduced. The process was approved by Transport Agency legal personnel and care was taken to protect privacy and inform motorists of how this process was carried out.

More detail about the survey and findings can be found in *Blewden, M. et. al, 2019. 110 km/h Speed Limits. Motorist Perception Survey Final Report.*

3. RESULTS: SPEED, LANE OCCUPANCY, AND TRAVEL TIME

In this section, vehicle speed and travel time at WCS and TEL before the speed limit change, one month, three months and eight months after the speed limit change are reported. In addition, vehicle speed is also reported for the two control sites: SH1N and M2PP.

3.1. Cambridge section of the Waikato Expressway (WCS)

Table 2 shows the number of vehicles that were included in the count, speed and travel time analysis. Please note that the figures presented in this section relate to all vehicles. There were lower traffic volumes in the winter (8 month) collection period which may have been due to seasonal effects.

Table 2: Data collected at WCS

Condition	Vehicles included in analysis		
	Speed data	*Travel time data (BlipTrack)*	*BlipTrack proportion of traffic*
Baseline 100 km/h limit	104,506	4,540	4%
1-month 110 km/h limit	124,056	10,129	8%
3-months 110 km/h limit	118,761	9,524	8%
8-months 110 km/h limit	90,639	3,923	4%
12-months 110 km/h limit	124,445	4,203	3%

The 85%tile speeds for the baseline and 12-month post implementation conditions at the various data collection locations for WCS are presented in Table 3. Within the 110 km/h speed limit area 85%ile speeds increased by 1-5 km/h. Unfortunately, roadworks at the northern end of the data collection area (upstream and downstream of the 110 km/h area towards Hamilton) affected the data and so the traffic speeds do not represent 110 km/h speed limit conditions. Therefore, we cannot be certain of the effects of the 110 km/h speed limit change on up and downstream effects for WCS.

Table 3: WCS 85%tile speed results at various locations around the 110 km/h speed limit zone

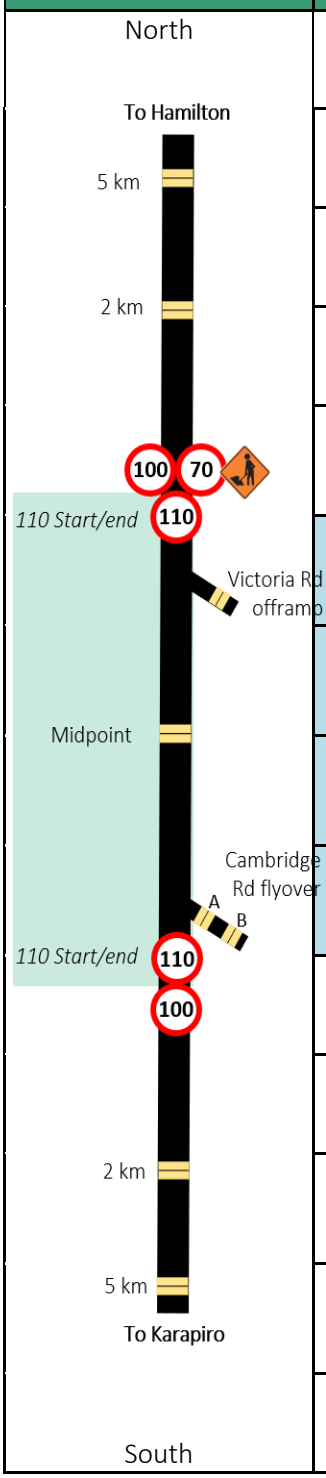
Layout map	Site	85%tile speed (km/h)		Change in speed (km/h)	Notes
		Baseline	12-months post		
	Northbound +5km Lane 1	60	63	3	Both conditions temp 70 km/h
	Northbound +5km Lane 2	66	67	+1	Both conditions temp 70 km/h
	Northbound +2km Lane 1	86	78	-8	Both conditions temp 70 km/h
	Southbound -2km Lane 1	78	82	+4	Both conditions temp 70 km/h
	Victoria Road offramp	84	82	-2	
	Northbound Midpoint Lane 1	109	110	+1	
	Northbound Midpoint Lane 2	114	115	+1	
	Southbound Midpoint Lane 1	104	109	+5	
	Southbound Midpoint Lane 2	111	116	+5	
	Cambridge Rd Flyover A	105	107	+2	
	Cambridge Rd Flyover B	96	104	+8	
	Northbound +2km Lane 1	98	111	+13	Baseline resealing near tube location
	Southbound -2km Lane 1	95	108	+13	Baseline resealing near tube location
	Southbound +5km Lane 1	95	94	-1	

Table 4 presents detailed speed and lane distribution data, measured at the midpoint of the 110 km/h section. Please note that heavy vehicles included classes Bus & HCV, HCV1 and HCV2.

Table 4: WCS midpoint results

Condition	Measurement	WCS NB Lane 1	WCS NB Lane 2	WCS SB Lane 1	WCS SB Lane 2
Baseline 100 limit	Average speed (km/h)	101	106	97	104
1-month 110 limit		105	109	100	110
3-months 110 limit		101	112	100	108
8-months 110 limit		108	113	98	112
12-months 110 limit		102	109	101	110
Change in average speed 12-months		+1	+3	+4	+6
Baseline 100 limit	85%tile speed (km/h)	109	114	104	111
1-month 110 limit		113	115	108	116
3-months 110 limit		108	119	108	114
8-months 110 limit		116	120	106	118
12-months 110 limit		110	115	109	116
Change in 85%tile speed 12-months		+1	+1	+5	+5
Baseline 100 limit	% >110 km/h	11%	26%	4%	17%
1-month 110 limit		28%	39%	8%	50%
3-months 110 limit		10%	59%	9%	34%
8-months 110 limit		44%	68%	4%	58%
12-months 110 limit		15%	40%	11%	46%
Change in % >110 km/h 12-months		+4%	+14%	7%	+29%
Baseline 100 limit	% >120 km/h	2%	5%	1%	3%
1-month 110 limit		3%	6%	1%	7%
3-months 110 limit		1%	12%	1%	5%
8-months 110 limit		7%	14%	0%	10%
12-months 110 limit		2%	6%	1%	7%
Change in % >120 km/h 12-months		+0%	+1%	0%	+4%
Baseline 100 limit	Lane split all vehicles	79%	21%	80%	20%
1-month 110 limit		78%	22%	79%	21%
3-months 110 limit		77%	23%	80%	20%
8-months 110 limit		78%	22%	81%	19%
12-months 110 limit		77%	23%	81%	19%
Change in lane split all vehicles 12-months		-2%	+2%	+1%	-1%
Baseline 100 limit	Lane split heavy vehicles	97.4%	2.6%	97.5%	2.5%
1-month 110 limit		97.8%	2.2%	97.9%	2.1%
3-months 110 limit		96.8%	3.2%	97.5%	2.5%
8-months 110 limit		98%	2%	98%	2%
12-months 110 limit		97.5%	2.5%	97.8%	2.2%
Change in lane split heavy vehicles 12-months		+0.1%	-0.1%	+0.3%	-0.3%

Baseline 100 limit	Heavy vehicles 85%tile speed km/h	95	102 (n=175)	93	95 (n=174)
1-month 110 limit		95	102 (n=73)	93	107 (n=70)
3-months 110 limit		92	102 (n=81)	93	98 (n=119)
8-months 110 limit		99	107 (n=96)	90	102 (n=79)
12-months 110 limit		93	102 (n=112)	93	100 (n=102)
Heavy vehicle 85%tile speed change 12-months		-2	0	-0	+5
Baseline 100 limit	% heavy vehicles	8.4%	0.9%	7.3%	0.8%
1-month 110 limit		6.4%	0.5%	7.0%	0.6%
3-months 110 limit		7.7%	0.8%	6.9%	0.7%
8-months 110 limit		6.7%	0.6%	7.8%	0.6%
12-months 110 limit		8.0%	0.7%	8.3%	0.8%
Change in % heavy vehicles 12-months		-0.4%	-0.2%	1.0%	0.0%

A key finding from Table 4 is that the proportion of vehicles travelling over 110 km/h has increased substantially (as would be expected) and those travelling over 120 km/h have also increased – though more so in the lighter traffic conditions 8 months following speed limit change than 12 months. Heavy vehicle speeds followed the same pattern, with higher speeds at 8 months post change, but little change in speed after 12 months. On average, 0.3% and 1.4% of vehicles travelled over 130 km/h in lane 1 and lane 2 respectively, less than that found in the 8 month post change. There have been no notable changes in lane distribution travel patterns compared to baseline. Between the hours of 3-6am, there was an average increase of 5% more vehicles travelling in lane 2 at 12 months post change compared to baseline (Appendix B).

To give a more detailed account of the speed patterns before and after the 110 km/h speed limit change, speed distribution curves are shown below in

Figure 5 and Figure 6.

Figure 5: WCS northbound speeds

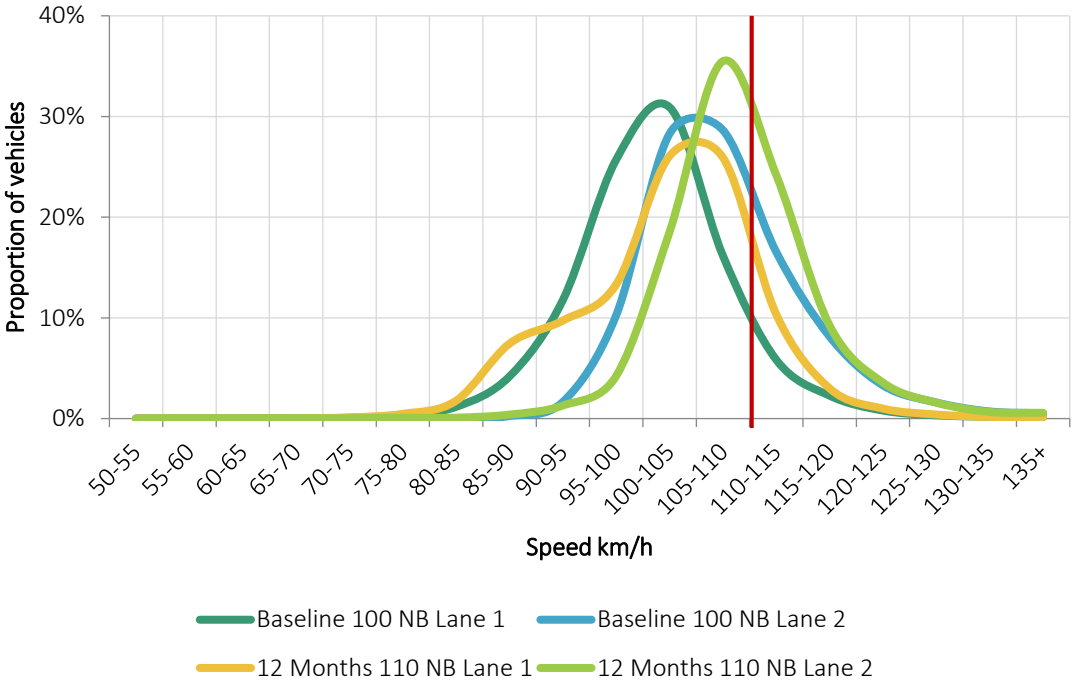
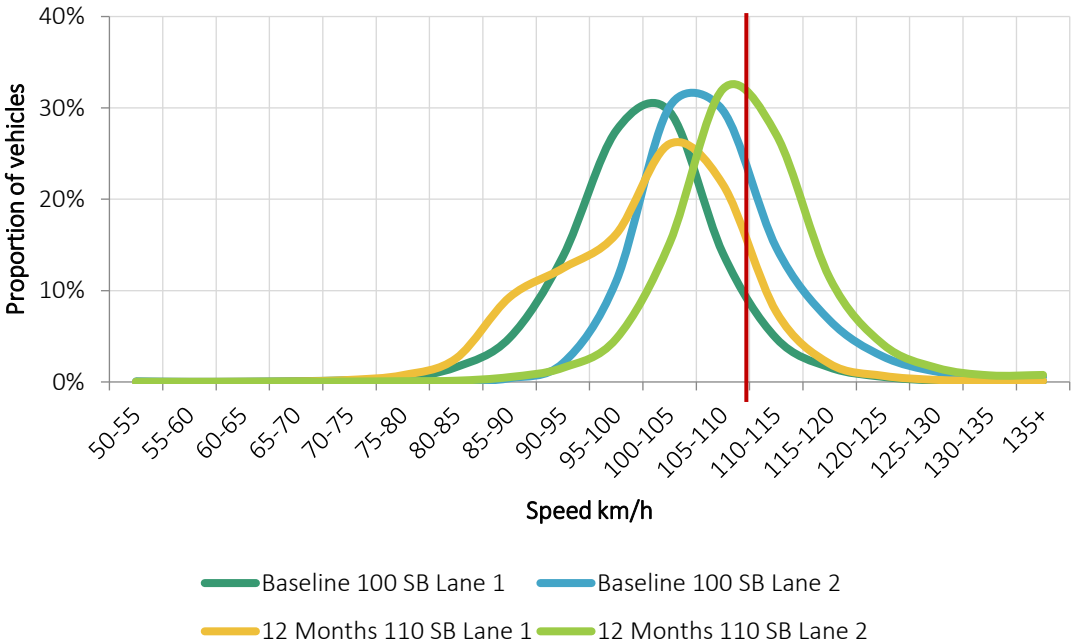


Figure 6: WCS southbound speeds



Figures 5 and 6 show that both lane 1 and 2 speeds have increased, as expected post speed limit change. However, the speed distribution of traffic remained the same as baseline conditions, with the majority of traffic travelling under the new speed limit.

Table 5 shows that there have been modest travel time reductions of 17-20 s (over a 13km section between blip-track sensors) following the speed limit increase. This is half of the theoretical travel time difference if a vehicle increased from 100 km/h to 110 km/h over the 13km section (45 seconds).

Table 5: WCS weighted average travel time (min:sec)

WCS	Baseline	1-month change	3-month change	8-month change	12-month change	12-months
NB travel time	7:48	-00:20	-00:18	-00:19	-00:17	07:31
SB travel time	7:50	-00:16	-00:17	-00:20	-00:20	07:30

These data are supplemented with findings from the motorist perceptions survey conducted at WCS in November 2018 (Blewden, M. *et. al*, 2019). Most motorists felt safe driving under the new conditions and viewed a range of speeds from 10 km/h under to 5 km/h over the 110 km/h speed limit was acceptable – as evidenced by figures 5 and 6. In addition, travel times were perceived to be more consistent and 5-10 minutes faster under the new conditions, a much greater perceived reduction than evidenced in table 5.

3.2. Tauranga Eastern Link (TEL)

Table 6 shows the number of vehicles that were included in the speed and travel time analysis for TEL. Please note that the figures presented in this section relate to all vehicles. Less data were acquired 8 months post limit change, possibly due to fewer travellers in winter (August).

Table 6: Data collected at TEL

Condition	Vehicles included in analysis		
	Speed data	***Travel time data (BlipTrack)***	*BlipTrack proportion of traffic*
Baseline 100 limit	70,385	6,825	10%
1-month 110 limit	79,226	10,668	13%
3-months 110 limit	72,874	10,215	14%
8-months 110 limit	70,160	4,908	7%
12-months 110 limit	78,838	4,987	6%

The 85%tile speeds for the baseline and 12-month post implementation conditions for TEL are presented in

Table 7. 85%ile speeds increased by 3-5 km/h, similar to that observed in WCS. The up and downstream data was more reliable for TEL and the results suggest that there have been variable changes (no average change in speed, range -6 to +5 km/h) in speeds up and downstream of the 110 km/h speed limit area. However, overall it is difficult to account for all the factors that may have contributed to these up and downstream speeds, especially for the locations 5 km from the 110 km/h speed limit area.

Table 7: TEL 85%tile speed results

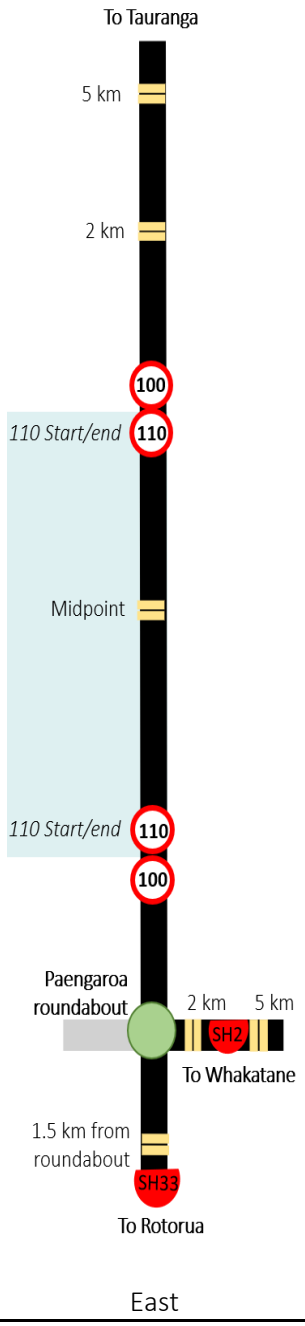
Layout map	Site	85%tile speed (km/h)		Change in speed (km/h)	Notes
		Baseline	12-months post		
	Westbound +5km Lane 1	100	102	+2	
	Westbound +5km Lane 2	109	112	+3	
	Westbound +2km Lane 1	105	107	+2	
	Westbound +2km Lane 2	113	112	-1	
	Eastbound -2km Lane 1	102	104	+2	
	Eastbound -2km Lane 2	114	112	-2	
	Westbound Midpoint Lane 1	106	111	+5	
	Westbound Midpoint Lane 2	113	116	+3	
	Eastbound Midpoint Lane 1	105	110	+5	
	Eastbound Midpoint Lane 2	113	116	+3	
	Westbound -2km Lane 1	96	97	+1	
	Eastbound +2km Lane 1	96	101	+5	
	Eastbound +5km Lane 1	103	101	-2	
	SH33 Northbound -1.5 Lane 1	104	98	-6	1.5km south of Paengaroa roundabout
	SH33 Southbound +1.5 Lane 1	97	98	+1	1.5km south of Paengaroa roundabout

Table 8 presents the speed results measured at the midpoint of the 110 km/h section. Please note that heavy vehicles included classes Bus & HCV1, HCV1 and HCV2.

Table 8: TEL midpoint results

Condition	Measurement	TEL WB Lane 1	TEL WB Lane 2	TEL EB Lane 1	TEL EB Lane 2
Baseline 100 limit	Average speed (km/h)	99	105	98	106
1-month 110 limit		102	108	101	109
3-months 110 limit		102	110	101	110
8-months 110 limit		103	109	101	110
12-months 110 limit		102	109	101	110
Change in average speed 12-months		+3	+4	+3	+4
Baseline 100 limit	85%tile speed (km/h)	106	113	105	113
1-month 110 limit		110	114	109	115
3-months 110 limit		110	116	110	116
8-months 110 limit		111	116	110	116
12-months 110 limit		111	116	110	116
Change in 85%tile speed 12-months		+5	+3	+5	+3
Baseline 100 limit	% >110 km/h	6%	22%	5%	22%
1-month 110 limit		13%	33%	10%	36%
3-months 110 limit		15%	39%	11%	41%
8-months 110 limit		16%	39%	11%	41%
12-months 110 limit		15%	39%	12%	41%
Change in % >110 km/h 12-months		+9%	+17%	+7%	+19%
Baseline 100 limit	% >120 km/h	1%	5%	1%	4%
1-month 110 limit		1%	5%	1%	4%
3-months 110 limit		1%	7%	1%	6%
8-months 110 limit		1%	6%	1%	6%
12-months 110 limit		1%	6%	1%	6%
Change in % >120 km/h 12-months		+0%	+1%	0%	+2%
Baseline 100 limit	Lane split all vehicles	80%	20%	79%	21%
1-month 110 limit		79%	21%	77%	23%
3-months 110 limit		80%	20%	78%	22%
8-months 110 limit		80%	20%	78%	22%
12-months 110 limit		79%	21%	77%	23%
Change in lane split all vehicles 12-months		-1%	1%	-2%	+2%
Baseline 100 limit	Lane split heavy vehicles	98%	2% (n=66)	98%	2% (n=76)
1-month 110 limit		98%	2% (n=56)	98%	2% (n=76)
3-months 110 limit		99%	1% (n=37)	98%	2% (n=72)
8-months 110 limit		98%	2% (n=45)	98%	2% (n=57)
12-months 110 limit		98%	2% (n=58)	98%	2% (n=70)
Change in lane split heavy vehicles 12-months		0%	0%	0%	0%

Baseline 100 limit	Heavy vehicles 85%tile speed km/h	94	100 (n=66)	93	103 (n=76)
1-month 110 limit		95	104 (n=56)	97	106 (n=76)
3-months 110 limit		94	105 (n=37)	93	103 (n=72)
8-months 110 limit		94	107 (n=45)	93	107 (n=57)
12-months 110 limit		94	110 (n=58)	93	102 (n=70)
Heavy vehicles 85%tile speed change 12-months		0	+10	0	-1
Baseline 100 limit	% heavy vehicles	10%	1%	15%	1%
1-month 110 limit		9%	1%	13%	1%
3-months 110 limit		11%	1%	14%	1%
8-months 110 limit		9%	1%	13%	1%
12-months 110 limit		10%	1%	13%	1%
Change in % heavy vehicles 12-months		0%	0%	-2%	0%

In a similar pattern to WCS, the proportion of traffic travelling over 110 (and to a lesser extent 120km/h) increased at TEL following the introduction of the 110 km/h speed limit. On average, 0.2% and 1.1% of vehicles travelled over 130 km/h in lane 1 and lane 2 respectively, comparable to that found for WCS. WB lane 2 heavy vehicle speed had a significant increase at 12 months, though this appears to be skewed by a few vehicles, with 7 of the 58 heavy vehicles in WB lane 2 travelling over 110 km/h. However, this may require heavy vehicular speed to be controlled in this area. There have been no notable changes in total lane distribution travel patterns at TEL. Time of day analysis indicated that there was a slightly lower percentage of cars travelling in lane 1 between 8am – 5pm compared with baseline conditions, with on average, 3% more cars travelling in lane 2 during these hours at 12 months post change (Appendix B).

Figure 7 and Figure 8 below show the speed distributions for TEL. An interesting phenomenon was a relatively high proportion of lower speed vehicles (around 90-95 km/h) in Lane 1, present twelve months following the introduction of the 110 km/h speed limit. It is not known what has caused this traffic pattern (possibly a congestion effect), but it was also present in the data one three and eight months following the increased speed limit. Table 8 earlier suggests this phenomenon was not caused by heavy vehicle speed changes and the lane 1 speeds for them have not changed from baseline.

Figure 7: TEL midpoint westbound speeds

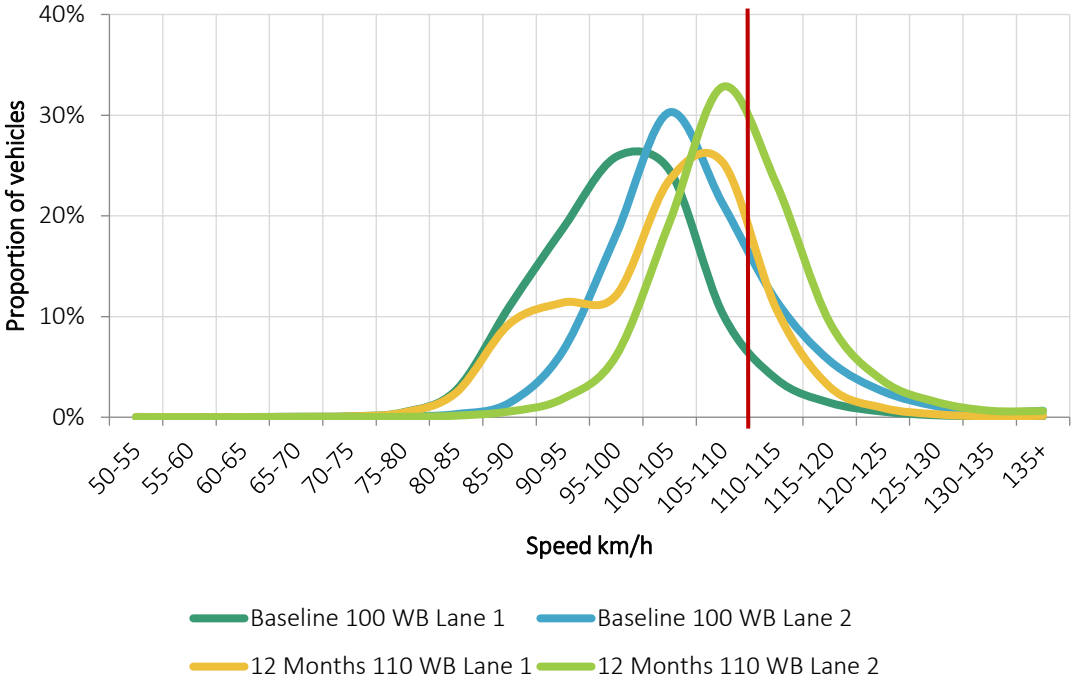


Figure 8: TEL midpoint eastbound speeds

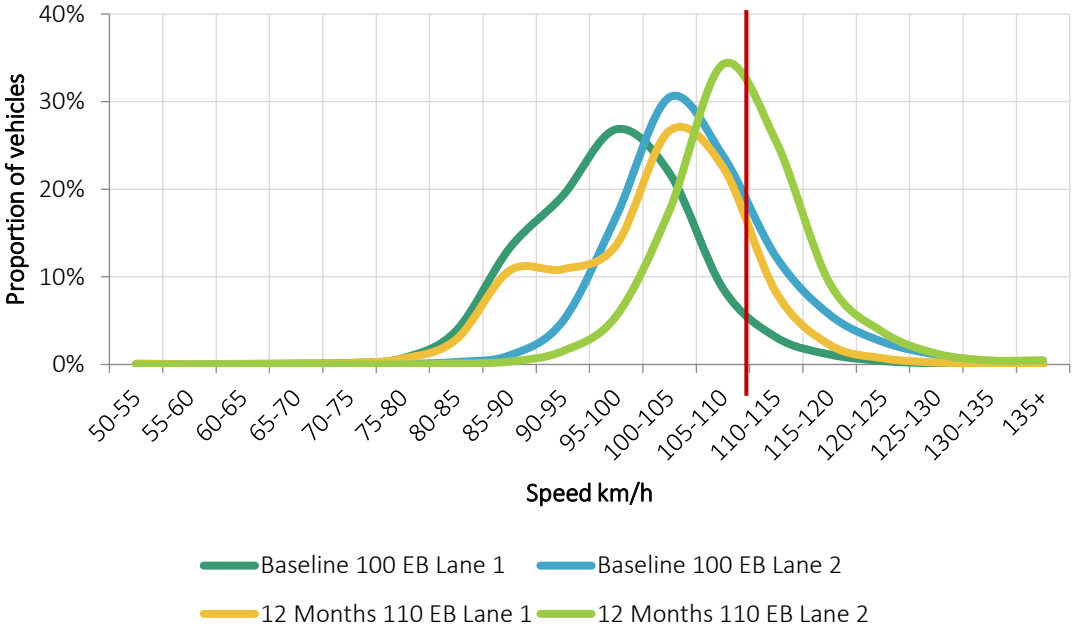


Table 9 shows that there have been modest reductions of 12-17 seconds in travel times following the speed limit increase (over a 11 km Blip-track distance). By comparison, if a vehicle actually increased from 100 km/h to 110 km/h over the 11 km section, it would travel 38 seconds faster.

Table 9: TEL weighted average travel time (min:sec)

TEL	Baseline	1-month change	3-months change	8-months change	12-months change	12-months
WB travel time	6:45	-00:17	-00:13	-00:16	-00:17	06:28
EB travel time	6:42	-00:13	-00:09	-00:12	-00:12	06:30

These data are supplemented with findings from the motorist perceptions survey conducted at TEL in November 2018 (Blewden, M. *et. al*, 2019). Similarly to WCS, most motorists felt safe driving under the new conditions and viewed a range of speeds from 10 km/h under to 5 km/h over the 110 km/h speed limit was acceptable – as evidenced by figures 7 and 8. In addition, travel times were perceived to be more consistent and 5-10 minutes faster under the new conditions; again a greater perceived reduction than evidenced in table 9.

3.3. Control site: SH1 Kāpiti Expressway Mackay's-Peka Peka (M2PP)

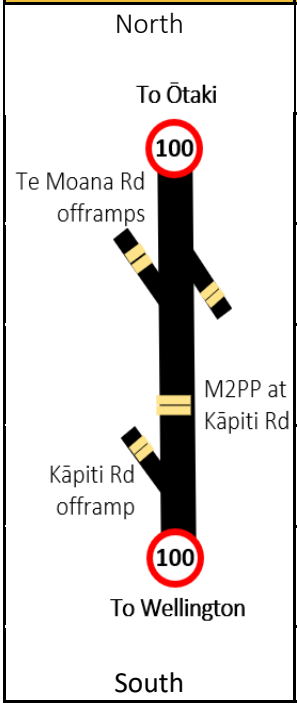
Baseline data were collected in September 2017, and the speed limit has remained as 100 km/h. Data were collected 3, 8 and 12 months after the speed limit was changed at the intervention sites. Table 10 gives a breakdown of the data that were collected (speed data), and

Table 11 shows the speed changes at the various data collection locations. Please note that BlipTrack data were collected but are not reported on for the control sites. There were higher traffic volumes in the March (3-month) collection period which may have been due to seasonal effects.

Table 10: Data collected at M2PP

Condition	**Number of vehicles included in analysis**
Baseline 100km/h limit	81,154
3-months 100km/h limit	134,311
8-months 100km/h limit	81,373
12-months 100km/h limit	91,696

Table 11: M2PP 85%tile speed results

Layout map	Site	85%tile speed km/h		Change in speed km/h
		Baseline	12-months	
	Te Moana Rd Offramp Southbound	98	96	-2
	Te Moana Rd Offramp Northbound	93	94	+1
	M2PP at Kapiti Rd Northbound Lane 1	105	106	1
	M2PP at Kapiti Rd Northbound Lane 2	113	112	-1
	M2PP at Kapiti Rd Southbound Lane 1	109	106	-3
	M2PP at Kapiti Rd Southbound Lane 2	116	114	-2
	Kāpiti Rd Offramp	93	90	-3

There were minimal differences in the 85%tile speeds on M2PP pre and post speed change at the intervention sites.

Table 12 shows the speed and lane distribution on M2PP near the Kāpiti Road flyover from the baseline condition as well as 1-month, 3-months, 8-months and 12-months after the speed limit change at WCS and TEL. Please note that the speed limit at M2PP remained at 100 km/h over the study period.

Table 12: M2PP speed and lane distribution near the Kāpiti Road flyover

Condition	Measurement	M2PP NB Lane 1	M2PP NB Lane 2	M2PP SB Lane 1	M2PP SB Lane 2
Baseline 100 limit	Average speed km/h	98	105	100	107
1-month follow-up		99	105	100	107
3-months follow-up		99	105	99	107
8-months follow-up		99	104	99	107
12-months follow-up		99	106	99	107
Change in average speed		+1	+1	-1	0
Baseline 100 limit	85%tile speed km/h	105	112	106	113
1-month follow-up		106	111	106	114
3-months follow-up		105	111	106	114
8-months follow-up		105	111	106	113
12-months follow-up		106	112	106	114
Change in 85%tile speed		1	0	0	1
Baseline 100 limit	% >100	37%	77%	46%	83%
1-month follow-up		42%	79%	45%	87%
3-months follow-up		41%	77%	44%	86%
8-months follow-up		38%	72%	42%	85%
12-months follow-up		43%	81%	44%	87%
Change in % >100		+6%	4%	-2%	+4%
Baseline 100 limit	Lane split all vehicles	79%	21%	78%	22%
Follow-up 100 limit		79%	21%	80%	20%
3-months follow-up		78%	22%	80%	20%
8-months follow-up		77%	23%	80%	20%
12-months follow-up		79%	21%	80%	20%
Change in Lane split		0%	+0%	+2%	-2%

Figure 9 and Figure 10 show the speed distribution curves for M2PP at Kāpiti. As in the data presented above, it is clear that there has been no change in speed at the control sites over the study period.

Figure 9: M2PP at Kāpiti Rd northbound speeds

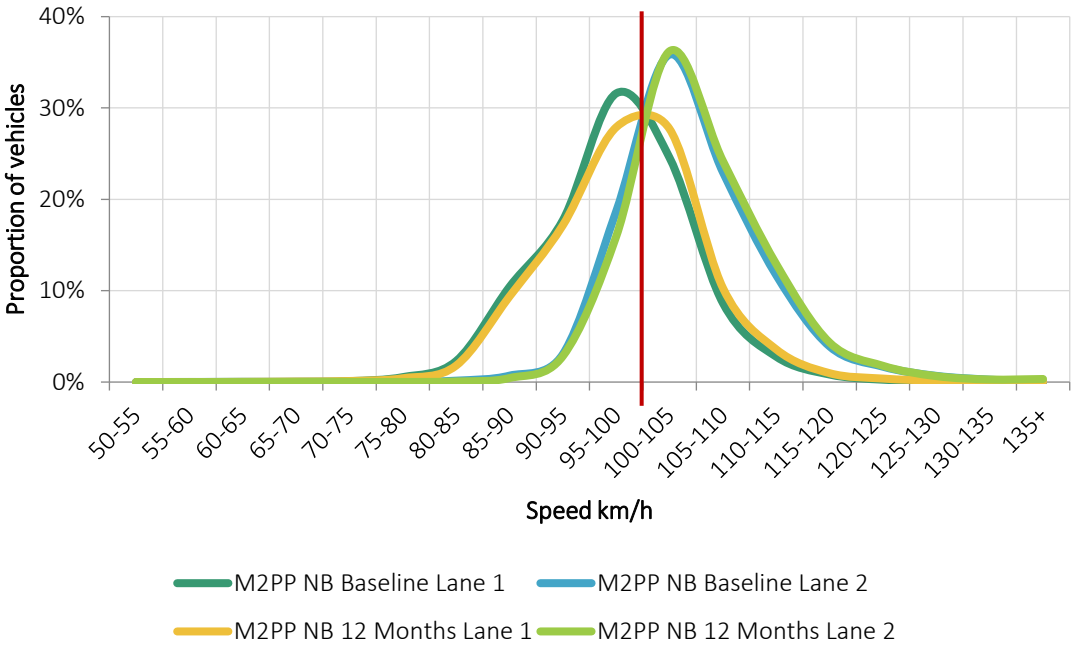
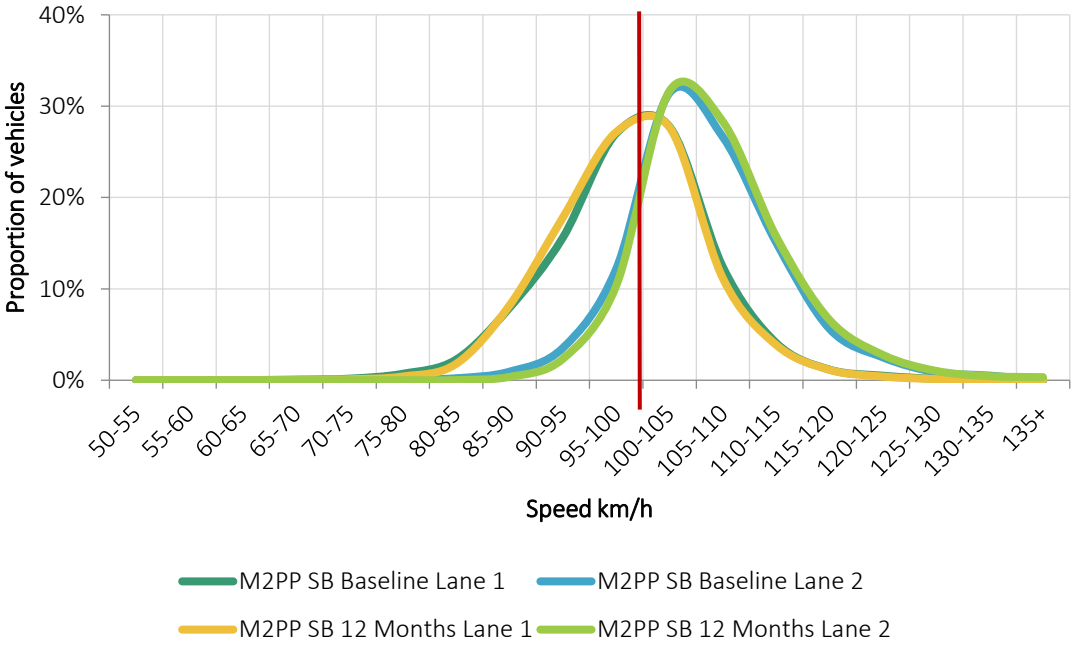


Figure 10: M2PP at Kāpiti Rd southbound speeds



3.4. Control site: Northern Motorway from Johnstone's Hill Tunnels to Lonely Track (SH1N)

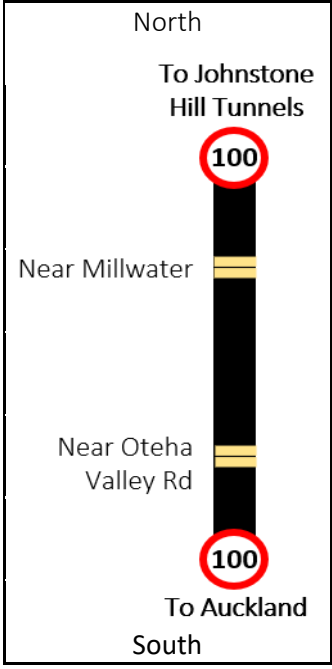
As with Kāpiti, baseline data were collected in September 2017 and the speed limit has remained at 100 km/h. Data was collected after 3, 8 and 12 months of the speed limit changes at the intervention sites. Table 13 gives a breakdown of the data that were collected by the pneumatic tubes and cut loops (speed data) and Table 14 shows the speed data pre and post speed change at the intervention sites. Although BlipTrack (travel time) data were collected at this site they are not reported here. SH1N follows similar design standards to TEL and WCS and is a candidate site for the 110 km/h speed limit change in the future.

There were higher traffic volumes in the March and December (3 and 12 month) collection periods which may have been due to seasonal effects.

Table 13: SH1N Data collection periods

Condition	**Number of vehicles included in analysis**
Baseline 100 limit	187,656
3-months 100 limit	202,928
8-months 100 limit	188,894
12-months 100 limit	218,316

Table 14: SH1N 85%tile speed data

Layout map	Site	85%tile speed km/h		Change in speed km/h
		Baseline	12-months	
	Near Millwater SB Lane 1	104	103	-1
	Near Millwater SB Lane 2	108	107	-1
	Near Millwater NB Lane 1	105	104	-1
	Near Millwater NB Lane 2	114	114	0
	Near Oteha Valley Rd SB Lane 1	100	97	-3
	Near Oteha Valley Rd SB Lane 2	107	104	-3
	Near Oteha Valley Rd NB Lane 1	104	103	-1
	Near Oteha Valley Rd NB Lane 2	110	109	-1

There were minimal differences in the 85%tile speeds on SH1N pre and post speed change at the intervention sites.

Figure 11: SH1N northbound speeds

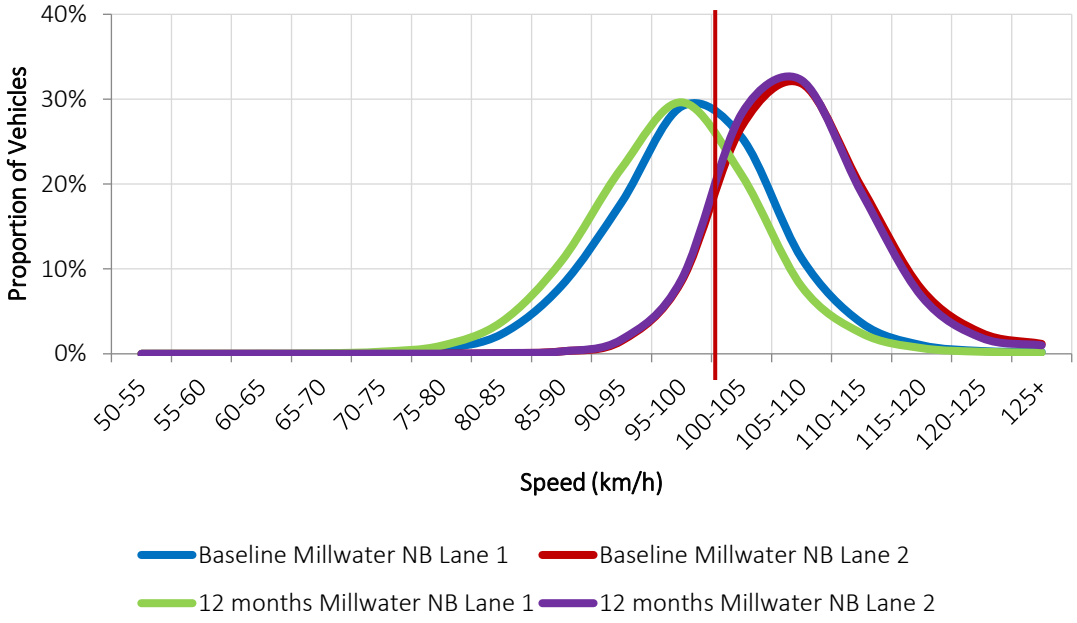
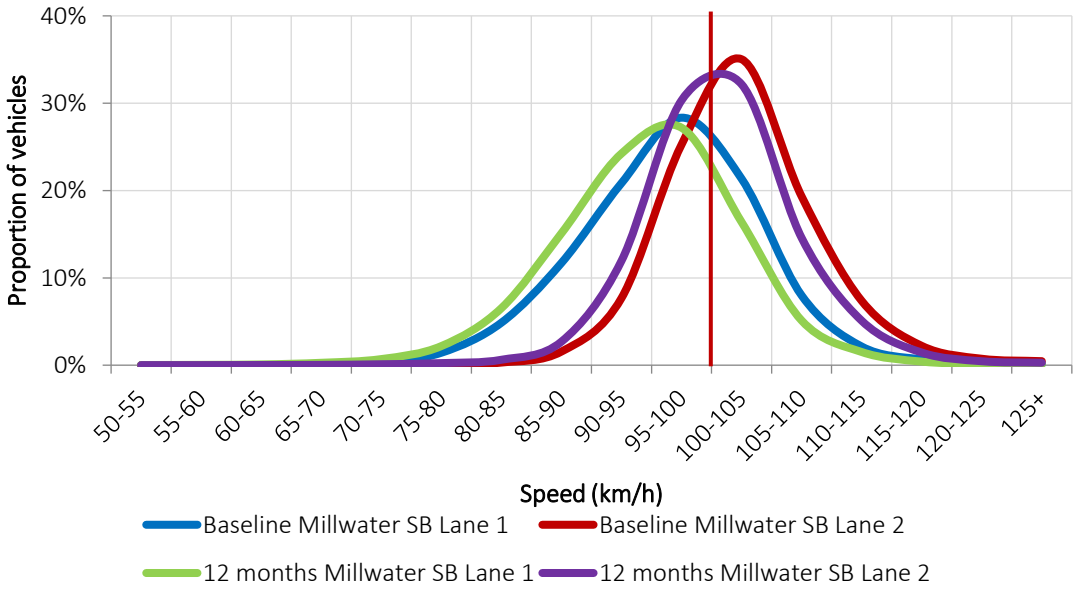


Figure 12: SH1N southbound speeds



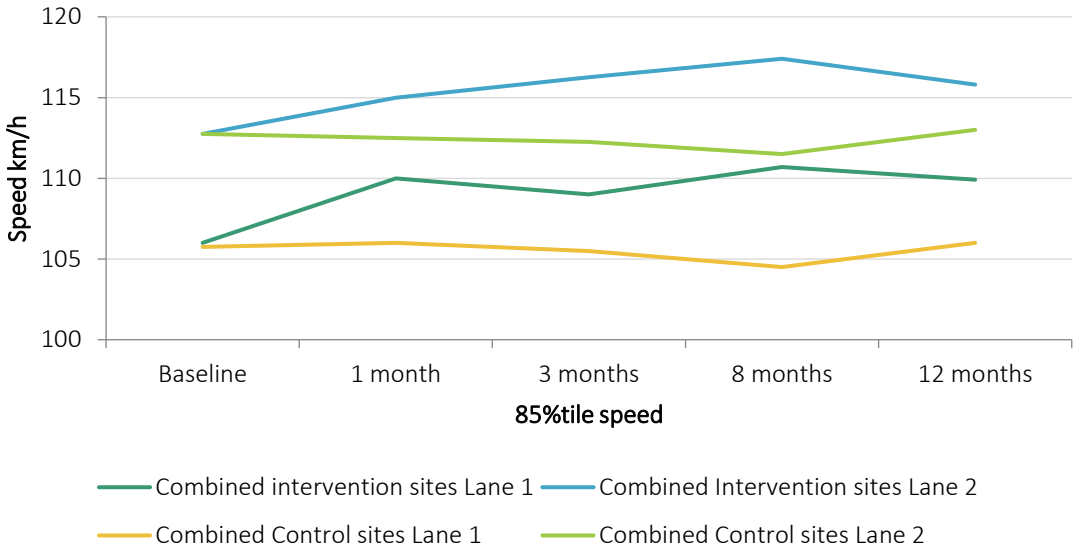
The speeds at SH1N have not materially changed in the twelve months since the speed limit increase at the intervention sites. In addition to the Kāpiti findings, this shows that the speed increases at the 110 km/h sites are unique and likely due to the new speed limit.

3.5. Comparison of 110 km/h sites with control sites

Changes in speed at the 110 km/h sites (both locations) were compared with the M2PP and SH1 north control sites over twelve months (Figure 13). The effects of the new 110 km/h speed limit are clear, with 85%tile speeds increasing tangibly over the 12 months at the intervention sites peaking at 8 months. Speeds at control sites over the same period remained relatively unchanged. Both Lane 1 and Lane 2 speed were relatively high at all sites at baseline.

A positive finding from the 12-month data is that the gradual increases in speed have settled down somewhat, perhaps indicating that traffic behaviour has reached a state of equilibrium in response to the new speed environment.

Figure 13: 85%tile speed changes at intervention sites and control site



Effect sizes (Cohens d) were carried out for the summary speed results to estimate whether the changes were meaningful (Table 15). Effect size is calculated by dividing the change in mean speed (before vs after) by the average of the standard deviations. Effect sizes of 0.2 are considered small, 0.5 medium and 0.8 and greater, large[5].

Table 15: Effect sizes for the speed increases at both 110 km/h locations

	Baseline mean speed (km/h)	12-month mean speed (km/h)	Change mean speed (km/h)	SD baseline	SD 12 month	Effect size
Combined intervention sites L1	99	102	3	8.2	8.9	0.31
Combined intervention sites L2	105	109	4	8.1	7.4	0.57
Combined control sites L1	99	98	1	7.4	7.3	0.17
Combined control sites L2	106	105	1	6.7	6.8	0.08

[5] Cohen, J. (1992). "A power primer." Psychological Bulletin **112**(1): 155-159.

The change in speed limit to 110 km/h had no effect on the control sites and had a small to medium effect on lane 1 speeds and a medium effect on Lane 2 (right hand) speeds. These results suggest that traffic travelling in Lane 1 (left lane) have been relatively less affected by the 110 km/h speed limit than those travelling in Lane 2, which is understandable as left lane travellers are more likely to be comfortable with slightly slower speeds, and those wanting to travel faster are more likely to use the right lane.

4. DISCUSSION AND CONCLUSION

4.1. Travel speed

At both intervention sites, the increase in speed limit from 100 km/h to 110 km/h has not brought about a 10 km/h increase in speeds, but rather a 1-5 km/h increase (depending on which measures are used). There was little difference in the average speeds at 3, 8 and 12 months post speed change. A maximum increase of 13km/hr was observed 2km south of the 110km/h section at WCS, though this was affected by the relatively slow baseline conditions due to resealing near the tube location and was consistent from 1-12 months post change. These roads are well designed and the higher speeds under the baseline conditions may reflect the self-explaining nature of the roads. So, to some extent motorists may be influenced by the speed environment, regardless of the speed limit. There may also be some uncertainty about the enforcement threshold for the new speed limits, which can also affect motorists chosen speed. However, motorist perceptions of the speed limit change are favourable, with the majority feeling safe driving in the higher speed environment and reporting more consistent and reduced travel times (Blewden, M. *et. al*, 2019).

Some higher speeds in the right-hand lanes (Lane 2) following the 110 km/h speed limit are of concern, with an average of 42% Lane 2 (right-hand lane) motorists travelling above 110 km/h at 12 months compared with baseline average of 22%. However, this follows the normal distribution of speed patterns following a speed increase of 10 km/h. An average of 2% more Lane 2 motorists exceeded 120 km/h at 12 months following the speed limit change across both sites, less than the 5% observed in the 8 months following the speed limit change. The increasing percentage of motorists exceeding 120km/h at WCS appears to have settled over the 12 months of the speed limit change, as motorists become accustomed to the new speeds. With an average of only 21% of total motorists travelling in Lane 2, it is likely that these higher speeds are due to motorists requiring more speed to overtake travellers in Lane 1. However, some enforcement of the speed limit especially of right-hand lanes may be warranted.

There was little evidence of trucks travelling faster in lane 1 following the speed limit change. The 85%tile truck speeds in Lane 1 typically remained constant at 93-99 km/h across the baseline, 1-month, 3-month, 8 month and 12-month measurements. Heavy vehicle speeds at WCS changed little compared with baseline conditions. Lane 2 heavy vehicle speeds remain similar following the speed limit change except for westbound TEL traffic, showing a large speed increase of 10 km/h. An average of only 2% of heavy vehicles travel in lane 2, however, 7 of the 58 vehicles measured were travelling in excess of 110km/h, indicating that this area may require some speed control measures, particularly given that the speed limit for trucks has remained unchanged with the 110 km/hr speed limit change.

The control sites of SH1N and M2PP did not experience increases in speeds despite having similar design standards and potentially some public expectation of a future speed limit increase. Together with the intervention site findings, this suggests that we can be confident that the changes in traffic speeds where the speed limit was increased, was due to the speed limit increase and not to other factors such as time of year.

4.2. Lane occupancy

The lane splits following the 110 km/h speed limit change remained relatively constant with an average of 79% of vehicles occupying the left lane during baseline conditions. In addition, truck

lane distribution remained constant across the conditions, with an average of 98% occupancy in the left lane, which would be expected given their speed limit remained at 90 km/h. Lane splits varied according to time of day, however the patterns remained similar for both all and heavy vehicles. At WCS, the 5% increase in traffic travelling in lane 2 may reflect the relatively higher proportion of heavy vehicles travelling at these times and the ability of lighter vehicles to overtake them within the allowable higher speed limit. At TEL, a marginal 3% increase in cars using lane 2 between the hours of 8am-5pm was potentially indicative of a higher rate of overtaking. This is a positive finding in that it suggests that the natural pattern of driver behaviour has been very marginally affected by the speed limit change. The minimal overall differences in left lane occupancy suggest that the majority of motorists don't feel a need to overtake slower vehicles because they are already travelling at a speed that is acceptable to them.

These data are supported by the perceptions of motorists' behaviour survey (Blewden, M. *et. al*, 2019) which indicated that the behaviour of other motorists with respect to lane changes and occupancy was the same or better at both WCS and TEL after the 110 km/h speed increase.

4.3. Up and downstream effects

The impacts of the 110 km/h speed limit on up and down stream speeds were mixed. More detailed trends are outlined below.

WCS

An important part of this research was to identify if drivers reduced their speed again after leaving the 110 km/h section. A notable change at the Waikato Expressway location was that 85%ile speeds 2 km south of the 110 km/h section increased significantly when the speed limit changed. This effect was also evident in the 3 and 8 month analysis. The speed increase was heightened by the relatively low baseline speeds and remains constant over the 3, 8 and 12 month analyses, but should be viewed with caution, as it appears that speed has significantly increased at this location. However, speed values here were similar to those observed in a comparable site (2 km west of 110 km/h section) at TEL, indicating that the actual speeds observed were as expected.

SH1 5km south of WCS returns to one lane in each direction and has sections with higher crash rates and significant road side hazards. The 85th percentile speeds 5km south of the expressway were 95 km/h at baseline and 94 km/h after 12 months, which is positive in that drivers appear to reflect this increased risk in their driving. Motorist perceptions supported this by reporting that the transition back to 100 km/h at WCS was obvious (Blewden, M. *et. al*, 2019).

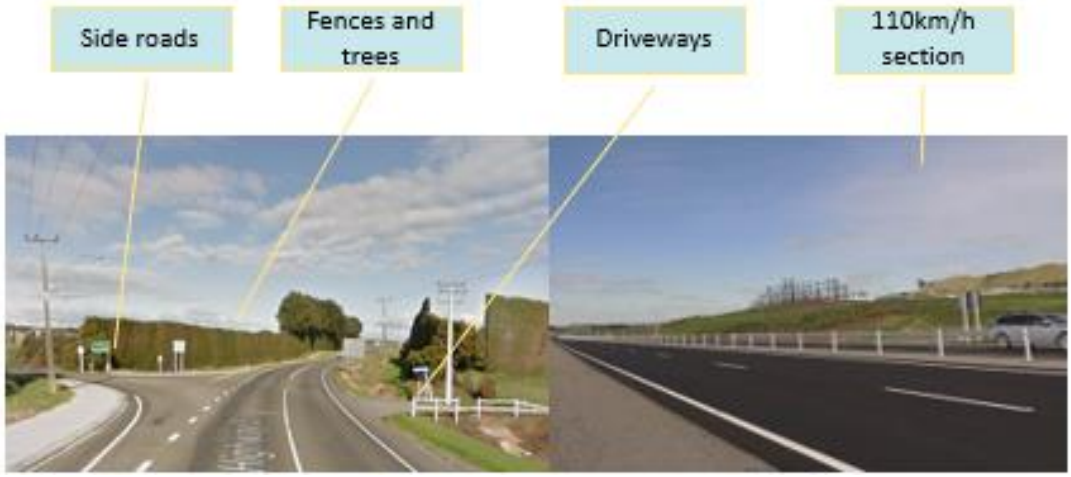
TEL

There was no significant change in either up or downstream speeds following the 110 km/h speed limit at TEL. Vehicles 85%tile speeds 2 km west of the 110km/h zone (both up and downstream) were relatively high, though unchanged from baseline conditions. This may reflect the conditions of the road at this point, with motorists driving to the road conditions, though there could be cause for concern that higher speeds are spilling over into nearby 100 km/h zones. However after 5 km, speeds reflect the 100km/h limit.

East of TEL, SH33 returns to one lane in each direction with sections featuring significant road-side hazards and higher crash rates. It is pleasing that there were not increases in speed at this location and in fact they seemed to reduce somewhat following the 110 km/hr speed limit change. Figure 14 shows the difference in the road environment at this location compared with the 110 km/h section, and so we would expect speeds to be materially different. In addition,

motorists reported that the transition back to 100 km/h at TEL was obvious (Blewden, M. *et. al*, 2019).

Figure 14: SH33 5 km south of TEL



Control sites

The 85%tile speeds on M2PP (Kapiti) expressway were already relatively high when measured at baseline in September 2017 and at all locations either decreased or remained within 1 km/h of the baseline speeds at the 12-month follow up. The high-quality road is likely to make drivers feel confident in travelling at a higher speed, so it is not surprising that drivers are already travelling at speeds higher than the 100 km/h limit. The SH1N site showed a small amount of speed reduction at the 12-month follow up, which may have been due to traffic congestion.

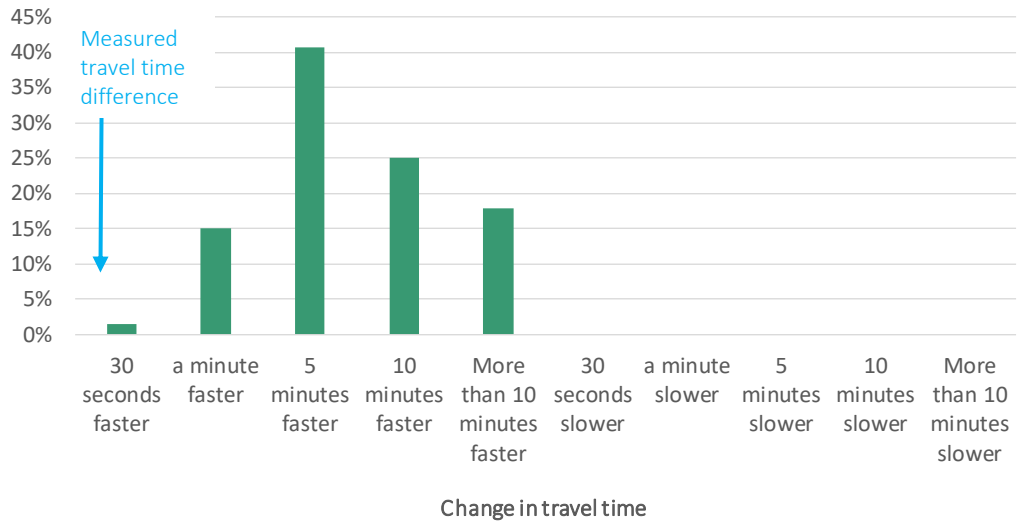
The potential for both roads to have a 110 km/h speed limit in the future is being considered. Potentially traffic congestion at certain times, as possibly seen at SH1N, could undermine the case for a 110 km/h speed limit, if sudden queues are to be expected near or within a 110 km/h speed limit zone, although variable speed limits may help with this.

4.4. Travel time

Between baseline and at 12-month follow-up, travel time decreased by 12-20 seconds across both treatment locations. This was a slight reduction on the 9-18 seconds seen at 3 months post change, however similar to the 1 and 8 month post change travel times. These improvements are modest and are likely to be inconsequential to any journey. Naturally, if people's trips included greater lengths of 110 km/h speed limits, the travel time benefits would be greater, but this seems relatively unlikely in New Zealand's challenging terrain. Given that 110 km/h speed limits are likely to remain as isolated patches of the road network for the foreseeable future, any travel time benefits of the higher speed limit are likely to be limited.

However, the majority of motorists perceived travel time reduction for both locations to be around 5-10 mins with more consistent travel times and less congestion (Blewden *et. al*, 2019). This perceived effect of the increase in speed limit may have more impact on motorists' attitudes and subsequent behaviour than any real benefits realised. Figure 15 shows the distribution of motorists' responses to how much time they believed was saved following the 110 km/h speed limit change, compared with the approximate actual magnitude of change measured through this project.

Figure 15: Ratings of how much travel time had changed with the new 110 km/h speed limits from the perceptions survey (Blewden et al., 2019)



4.5. Conclusion

The 110 km/h speed limit changes at Waikato and Tauranga have resulted in modest mean speed increases in both lanes, and a greater proportion of higher speed traffic, particularly in the right lane (lane 2). Overall, even the higher speed (lane 2) increases fall well short of the 10 km/h speed limit increase, and appear to have settled at a constant 3-5km/hr increase in overall speeds. These changes are within the context of control sites of similar road quality where no material changes in speed were observed. Lane distributions have not been influenced and the travel time improvements are modest. However, some truck travel speeds have shown a concerning increase at the Tauranga site, warranting further investigation or speed control measures. The perceptions survey findings support evidence from this evaluation, and indicate that motorists are overall very supportive of the speed limit increase, feeling that the 110 km/h environment is safe for the majority of drivers. Motorists do, however, report large travel time benefits, when the actual measured travel time benefits are much lower. The crash performance of these two sites will add to the current findings to help to explain the overall merit of the 110 km/h speed limits.

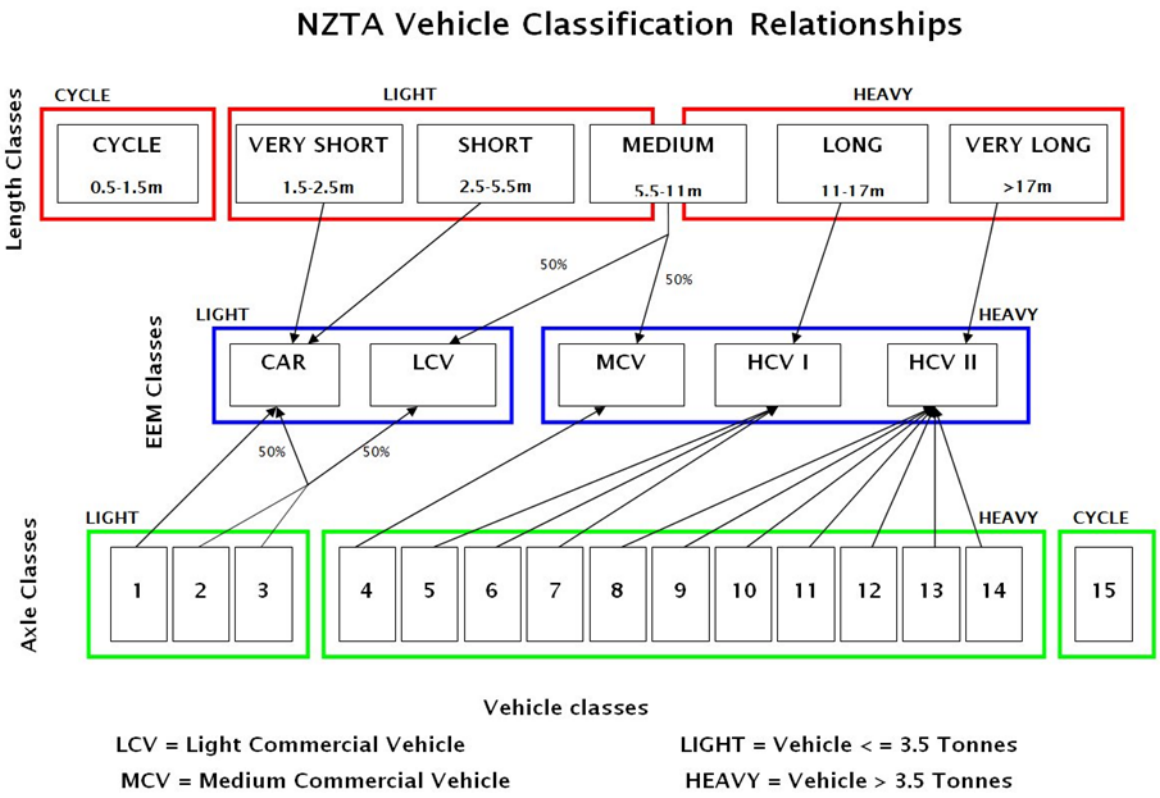
4.6. References

Blewden, M., Hirsch, L., Mackie, H. (2019). 110 km/h speed limits: Motorists perception survey final report. Report prepared for NZ Transport Agency by Mackie Research

APPENDICES

Appendix A: NZTA Vehicle classifications

Figure 16: Vehicle classification



Appendix B: Lane split by time of day (WCS and TEL) at 12 months

Appendix B describes the lane splits of all and heavy vehicles travelling at WCS and TEL according to time of day.

Figure 17: WCS Percentage of vehicles in Lane 1 by time of day

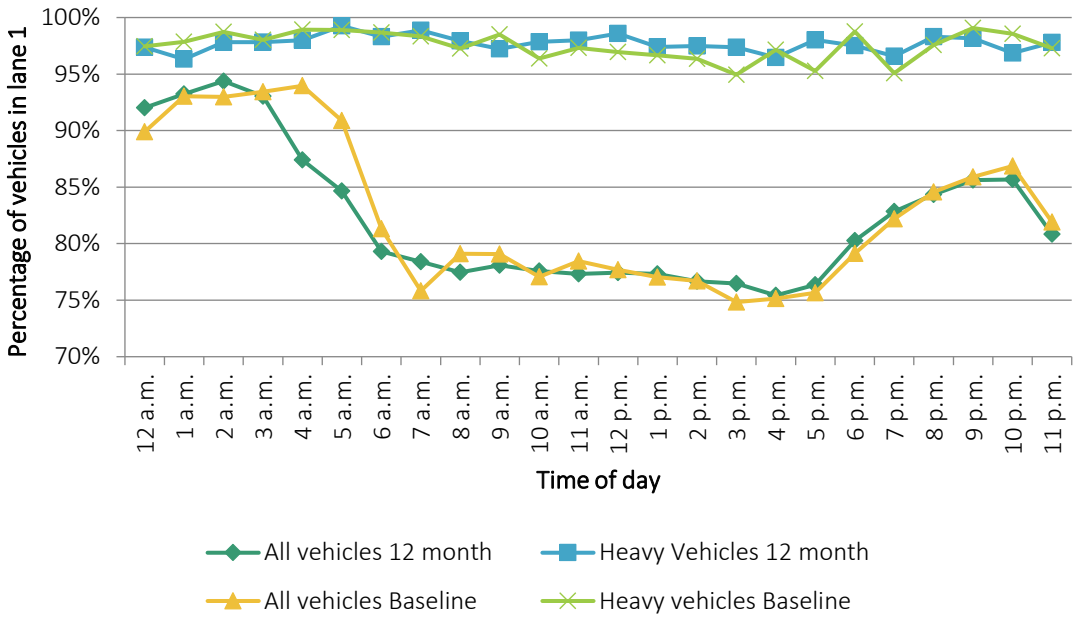


Figure 18: TEL Percentage of vehicles in Lane 1 by time of day