DETAIL DESIGN ROAD SAFETY AUDIT

SH1 WAIKATO EXPRESSWAY 110 KM/H SPEED REVIEW PROJECT TAMAHERE

PREPARED FOR WAKA KOTAHI NZ TRANSPORT AGENCY

26 October 2021

Stantec

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Abbreviations

ATP	audio tactile profiled (road marking)
RRPM	reflectorised raised pavement marker
SH1	State Highway 1
Waka Kotahi	Waka Kotahi NZ Transport Agency

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1 Introduction

1.1 Safety Audit Definition and Purpose

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, which is a safe road system free of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a Safe System and bring those concerns to the attention of the client so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

'to deliver completed projects that contribute towards a safe road system that is free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.'

A road safety audit should desirably be undertaken at project milestones such as:

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

A road safety audit is not intended to be a technical or financial audit and does not substitute for a design check of standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013 the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client will make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Project

Roadside and median safety barriers are to be installed along sections of the SH1 Waikato Expressway between Hampton Downs and Tamahere to provide continuous protection and to meet the safety criteria for raising the speed limit from 100 km/h to 110 km/h.

The Tamahere project location is shown circled in blue in Figure 1. It comprises the short 1.5 km section between the southern end of the Hamilton Bypass (under construction) and the northern end of the Cambridge Bypass, which was competed in 2015.

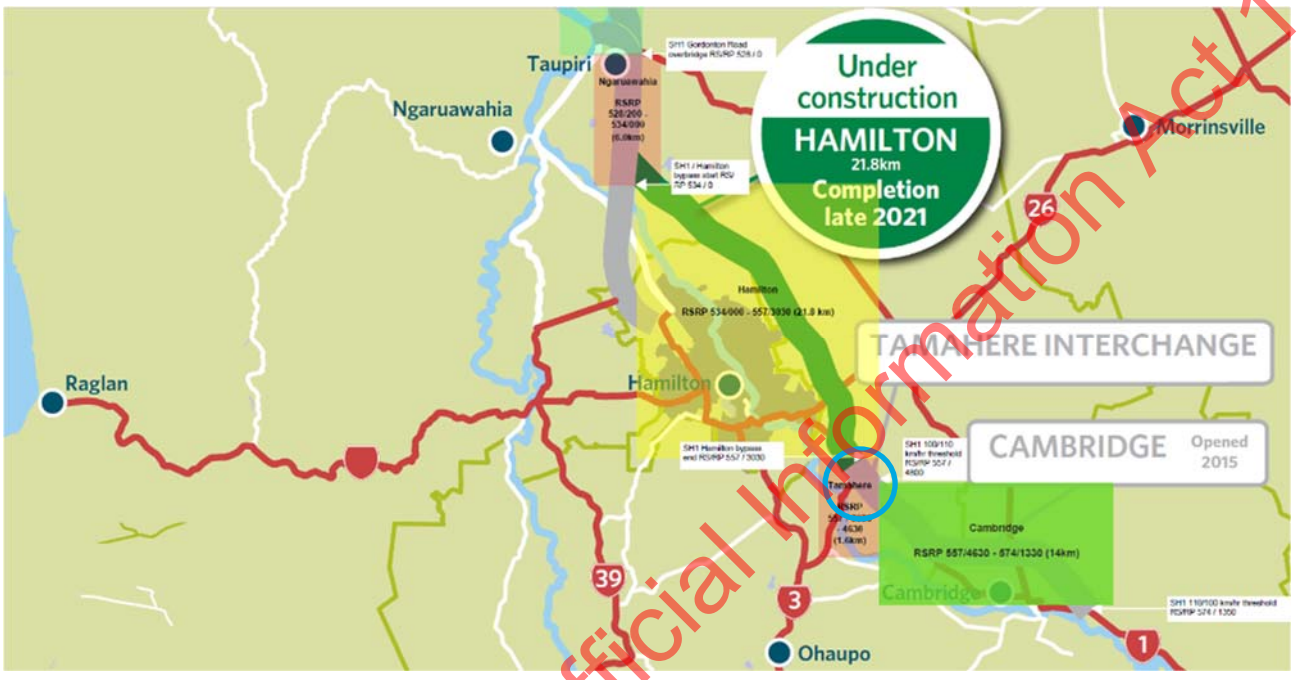

Figure 1: Project location

Flexible roadside protection barriers are proposed on both sides of the expressway from the south-facing ramps of the Tamahere interchange to the existing roadside barriers installed along the Cambridge Bypass. No alterations to the existing back-to-back semi-rigid median barrier are proposed. The roadside shoulders are to be widened to provide 3 m between the face of the barrier and the edge line.

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines – Interim release May 2013, by:

- Keith Weale, Stantec,
- Tegwen Atkinson, Stantec, and
- Heather Liew, Waka Kotahi.

1.4 Previous Road Safety Audits

There have been no previous road safety audits of the current project.

1.5 Scope of this Road Safety Audit

This is a detail design road safety audit of the proposed installation of roadside barriers along the Tamahere section of the Waikato Expressway between the south-facing entrance and exit ramps of the Tamahere diamond interchange and the existing flexible roadside barriers along the Cambridge Bypass section.

The designers are contemplating extending the barriers along the ramps of the Tamahere interchange and thus asked the road safety audit team to include the interchange ramps in the safety audit.

1.6 Briefing, Site Visit, Audit, Exit Meeting

Lydia Gray of WSP (the designers) and Jeremy Froger of BBO, Shane Small of Waka Kotahi, and Thayalan Sivachelvan of Blue Barn (seconded to Waka Kotahi) briefed the road safety audit team on Wednesday 13 October 2021, after which the road safety audit team undertook a desktop audit via MS Teams.

A site visit was not permitted due to Auckland and Waikato being under Covid-19 Level 3 restrictions on movement and gatherings, and two of the road safety audit team members being based in Auckland. The safety audit team therefore conducted the safety audit using Google Street View images and Argonaut Roadrunner videos.

An exit meeting was held with the designers and Waka Kotahi representatives later that afternoon.

1.7 Report Format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the concern assessment rating matrix in Table 1-2. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e. to minimise fatal or serious injury crashes.

In undertaking this assessment, the safety audit team has utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1-1: Crash Frequency Descriptor

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than 1 per year)
Common	1 every 1-5 years
Occasional	1 every 5-10 years
Infrequent	Less than 1 every 10 years

Crash severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas an elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 1-2: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	**Frequency** (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this

ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 1-3.

Table 1-3: Concern Categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it may be appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, the auditors may give suggestions in some instances.

1.8 Documents Provided

The road safety audit team was provided with the following documents for this audit.

2-32875.31	C01 to C02	Rev A	General layout plan
2-32875.31	C03	Rev A	Typical section
2-32875.31	C04	Rev A	Maintenance bay detail
2-32875.31	C05	Rev A	Barrier transition type 1
2-32875.31	C06	Rev A	Barrier transition type 2

SNP Tamahere Barriers Memo for RSA prepared by WSP (dated 7.10.2021)

The following supporting drawings of the Hamilton Bypass were provided for information only

3311244-DR-CG-0738	Rev 1	Plan and longitudinal section of southern tie-in
3311244-DR-CG-0739	Rev B	Plan and longitudinal section of southern tie-in
3311244-DR-CB-0738	Rev 3	Barriers at southern tie-in (issued for construction)
3311244-DR-CB-0739	Rev B	Barriers at southern tie-in (not for construction)*

In addition to the above, an email titled 'SNP Tamahere barriers on ramps and gore areas' (dated 12.10.2021) was provided. This email outlined high level barrier locations and designs for the Tamahere interchange ramps.

*It is noted that the barriers shown extending along the ramps on this drawing are superseded by the 'for construction' drawings, which show the barriers termination at the nose of the exit ramp and the gore of the entrance ramp, the latter having been already installed.

1.9 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the road safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor are they an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

2 Safety Concerns

A site visit was not permitted due to Auckland and Waikato being under Covid-19 Level 3 restrictions on movement and two of the road safety audit team members being based in Auckland. The safety audit team therefore conducted the safety audit using recent Google Street View images and Argonaut Roadrunner videos.

2.1 Barriers

2.1.1 Existing median and roadside barriers

Moderate

The existing back-to-back semi-rigid median barrier and semi-rigid roadside barriers are likely to have been produced and installed to NCHRP 350 TL-3 standards.

Although the barriers appear not to have received any recent strikes (as would be evidenced by replaced sections of barrier) their performance in preventing a vehicle (especially a high centre of gravity vehicle) from crossing the median into opposing traffic or crashing into the gully or road below may be questionable. The main concern is their low mounting height in relation to the road surface, particularly on the interchange bridge.

Figure 2: Median barrier (Google, 2021)

Figure 3: Bridge barrier (Google, 2021)

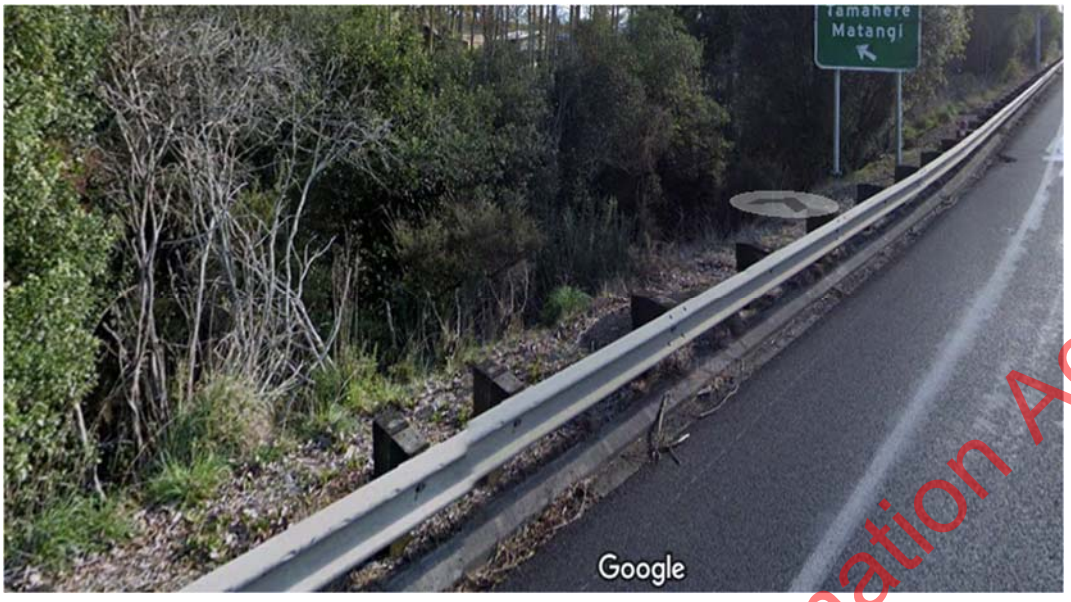

Figure 4: Roadside barriers across gully (Google, 2021)

Recommendation(s)

1. Replace the existing median and roadside barriers (and especially the bridge barriers) with a taller and more appropriate level of performance barrier system.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Agree in general principles, though this is currently outside the scope of the work, and would require some specialist bridge input into the affixing replacement barriers to the bridge deck. We have sourced plans of the original bridge, and preliminary advice is that concrete barriers would not be able to be placed without considerable strengthening of the bridge, and semi-rigid TL4 barrier (eg thribeam) would be more likely to be the appropriate treatment. The replaced roadside barriers would be at the same offset from the edgeline, which is in the order of 2.0m – considerably less that the 3.0m RONS standard elsewhere on the Waikato Expressway. The median barrier currently existing with a 5. 0m grassed median (with the exception of the bridge crossing itself), narrower than the desired minimum for wire rope barrier medians. It is noted that the Hamilton Section terminates with a double sided F shape concrete barrier TL4 height. A suitable treatment would likely be a double sided semi rigid barrier until the median widens to the existing	
Safety Engineer comment	Designer response is acknowledged. It is recommended to the client that all barriers including interchange bridge barrier be replaced thereby providing safety to road users.	
Client decision	This work is beyond the original scope of works and requires review. If mitigation of the existing risk is required, impact on the WEX 110km/h project (schedule, time, cost) to be approved and funding allocated.	
Action taken	A scope change request has been developed identifying the risk with the performance of the existing barriers and potential mitigation options. Date of resolution tbc.	

2.1.2 Flexible to semi-rigid barrier transition detail

Comment

The transition from flexible to semi-rigid barrier, which would be applied only near the northbound exit ramp, shows a 1 m lateral step from the widened shoulder width of 3 m to tie into an existing shoulder width of 2 m.

Normally the projected faces of the flexible barrier and the semi-rigid barrier would line up, i.e. be the same offset from the edge line, and the flexible barrier would deviate behind the semi-rigid barrier only locally.

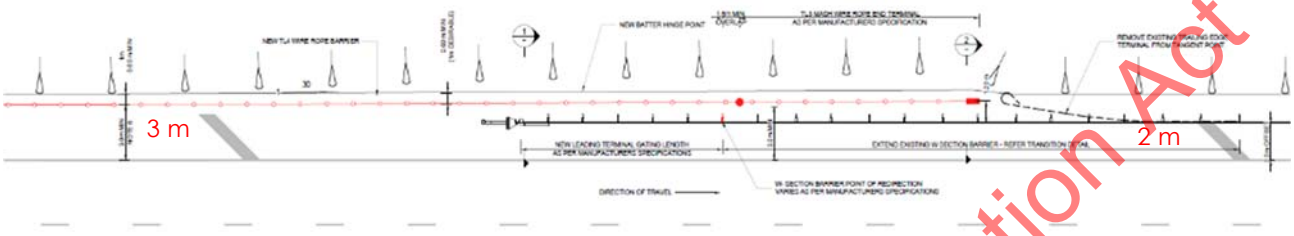

Figure 5: Flexible to semi-rigid barrier transition detail

Although the proposed detail appears to adopt the same performance principles as shown in the RSB7A standard drawing of Waka Kotahi, it may be worth checking that Waka Kotahi is comfortable with the proposed detail.

Designer response	Accepted. Propose to use a flared guardrail extension and terminal to widen to 3.0m rather than a lateral step. Detail updated.
Safety Engineer comment	Agree with designer's response.
Client decision	Agree with SAT and RSE
Action taken	The design has been updated to reflect the designers response.

2.1.3 Proposed northbound exit ramp barriers

Comment

The designers are contemplating providing barriers along the right-hand side of the exit ramp and connecting these to the existing barriers behind the nose with a crash cushion as indicated in Figure 6.

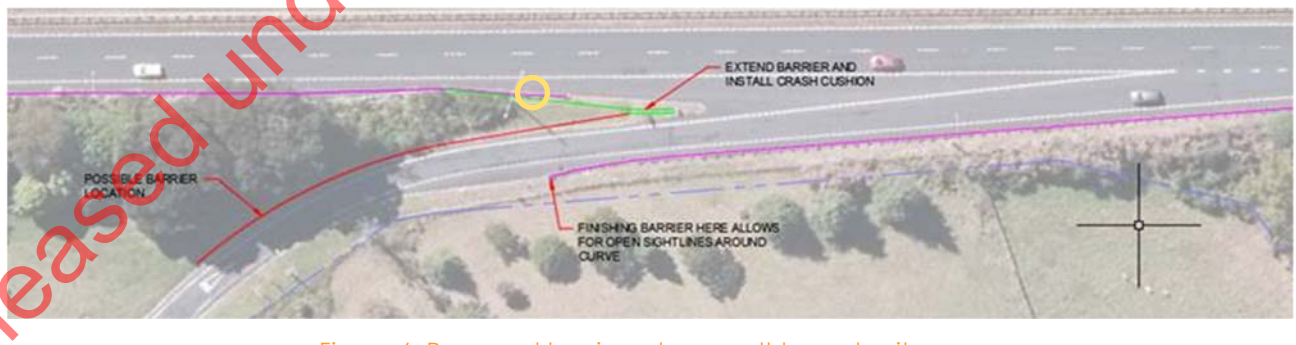

Figure 6: Proposed barriers along northbound exit ramp

Figure 7: Trees and lighting column along northbound exit ramp (Google, 2021)

The proposal would be a positive safety improvement as there are a number of large trees next to the ramp in Figure 7.

Refer to Section 2.1.7 concerning the proximity of the lighting column in Figure 6 (yellow circle) and Figure 7 to the proposed barrier and crash cushion.

2.1.4 Proposed northbound entrance ramp barriers

Comment

The designers are contemplating providing barriers along the left-hand side of the entrance ramp as shown in red in Figure 8 and Figure 9 and extending the existing barriers to the nose as indicated by the green line in Figure 8 and Figure 9. The southern end of the flexible barrier system already installed on the Hamilton Bypass project is shown by the yellow arrow in Figure 9.

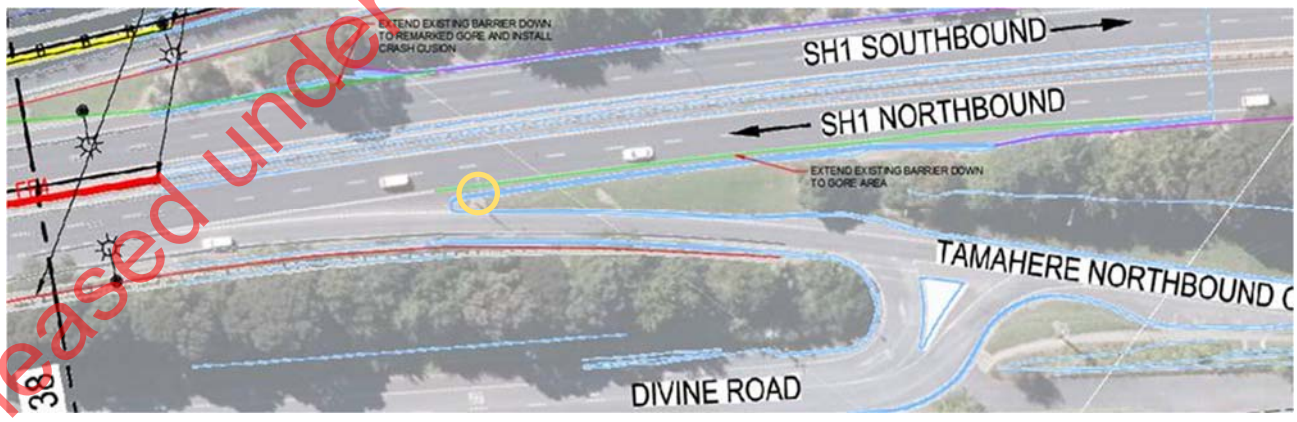

Figure 8: Proposed barriers along northbound entrance ramp

Figure 9: Trees and lighting column along northbound entrance ramp (Google, 2021)

The proposal would be a positive safety improvement as there are a number of large trees and a lighting column next to the ramp.

The ramp joins the expressway as a lane gain so intervisibility between drivers entering the expressway and drivers using the expressway should not be a significant factor.

Refer to Section 2.1.7 concerning the proximity of the lighting column in Figure 8 (yellow circle) and Figure 9 to the proposed barrier next to the expressway.

2.1.5 Proposed southbound exit ramp barriers

Comment

The designers are contemplating providing barriers along both sides of the entrance ramp as shown in red in Figure 10 and extending the existing barriers to the nose as indicated by the green line in Figure 10.

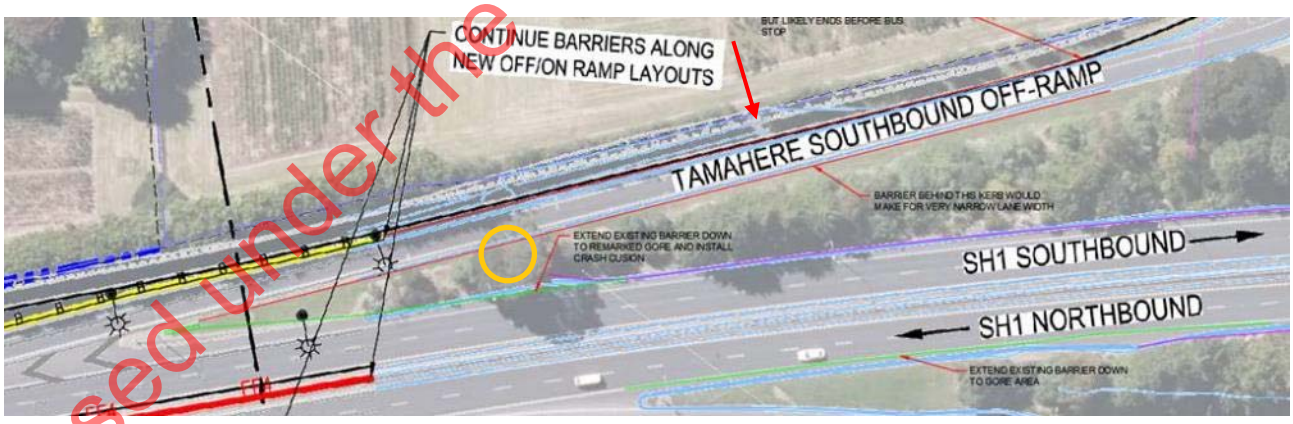

Figure 10: Proposed barriers along southbound exit ramp

Figure 11: Trees and lighting column along southbound exit ramp (Google, 2021)

The proposal would be a positive safety improvement as there are a number of large trees next to the ramp.

However, the designers expressed concern that installing barriers along the exiting edge of seal on both sides of the ramp would not provide enough width (5 m to 5.5 m) for broken down vehicles to stop or for emergency vehicles to pass without significant widening of the pavement.

The barriers on both sides of the ramp probably do not need to be extended as far down the ramp as proposed. The is a farm gate about halfway down the ramp, to which access would need to be maintained. the barriers could probably end at the gate. The ramp is straight and has good sight distance along it. Speeds would be bleeding off as drivers slowed for the ramp terminal intersection. The greatest risk of a crash would be close to the nose where drivers might suddenly realize that they have reached the exit and swerve across the gore losing control and crashing into the trees on either side of the ramp.

If the decision to provide barriers or not is to be based on the need to widen the ramp, then it is suggested that the left-hand barriers rather be set back beyond the existing kerbs close to the fence line than be omitted. If the barriers were set back sufficiently from the kerb, the kerb should not be a factor provided that the strip between the kerbs and the barrier were filled with hardfill. Again, it would be safer to provide the barriers and accept a slight risk of less than perfect barrier performance, than to omit the barriers.

Refer to Section 2.1.7 concerning the proximity of the lighting column in Figure 10 (yellow circle) and Figure 11 to the proposed barrier next to the expressway.

2.1.6 Proposed southbound entrance ramp barriers

Comment

The designers are contemplating providing barriers along both sides of the entrance ramp as shown in red in Figure 12 and extending the existing barriers to the nose as indicated by the green line in Figure 12.

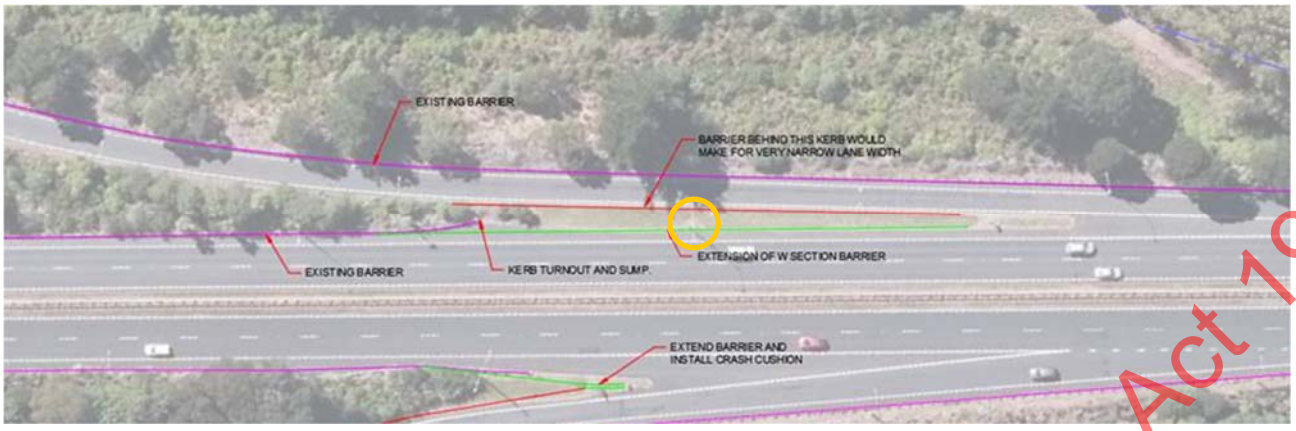

Figure 12: Proposed barriers along southbound entrance ramp

Figure 13: Lighting column near southbound entrance ramp merge

With the exception of the lighting column shown in Figure 13, there are no other significant hazards that motorist need to be protected from in the vicinity of the merge area.

The ramp joins the expressway as a standard entrance ramp merge so intervisibility between drivers entering the expressway and drivers using the expressway is a significant factor to be considered when placing the barriers in a position that could obstruct the intervisibility.

Refer to Section 2.1.7 concerning the proximity of the lighting column in Figure 12 (yellow circle) and Figure 13 to the proposed barrier next to the expressway.

2.1.7 Lighting columns — Minor

Figure 14 shows a typical lighting column close to the edge of the expressway. Some, such as the one arrowed in Figure 14 at the northbound exit ramp are behind existing barriers. Others, such as the one in the foreground of Figure 14 at the southbound entrance ramp are currently exposed.

The designers are contemplating extending the barriers on all four ramps up to the nose as described in the preceding Sections 2.1.3, 2.1.4, 2.1.5, and 2.1.6. In all cases there one or more lighting columns that would be within the operating zone of a barrier. The performance of the existing and proposed barriers, and of the slip base lighting columns, would be unpredictable in a crash.

Figure 14: Lighting column close to edge of expressway (Google, 2021)

It is acknowledged that the installation of the roadside barriers would be a safety improvement, even if they were not installed in accordance with accepted normal operating clearances. However, consideration should be given to mitigating the departure, like using a stiffer less deflective barrier system or replacing the lighting columns with fewer high mast lighting columns in less vulnerable positions.

Recommendation(s)

1. Mitigate the consequence of the potentially narrow gap between the lighting columns and the back of the roadside barriers by using a stiffer less deflective barrier system.
2. In conjunction with the recommendation above, specify on the cross-section edge details what minimum clearance between the lighting columns and the back of the barrier would be sought.
3. Where lighting columns might need to be relocated, specify ground-planted frangible lighting columns to replace the slip-base columns.

Frequency **Crashes are likely to be occasional**	**Severity** **Death or serious injury is unlikely**	**Rating** **The safety concern is minor**
Designer response	Agreed, included in plan and details.	
Safety Engineer comment	Acknowledge designer's response. It is recommended to the client that slip base light columns are the preferred option. Clearance from the proposed barrier to all light columns should be as per Waka Kotahi guidelines	
Client decision	Agree with SAT and RSE. However, M23 Appendix A, notes the below: 'm) For new installations, lighting columns shall be installed so that there is at least 1.5 m clearance between the closest parts of the barrier system and the lighting column. In retrofit situations only, this may be reduced to 1.0 m with application to, and acceptance by, the Lead Safety Advisor. Lighting columns behind barriers should not be on a frangible 'slip base' (for retrofit installations these should be modified to reduce the risk of being activated by a deflecting barrier).' Based on this requirement, ground-planted frangible lighting columns are to be specified.	
Action taken	The design has been updated to ground-planted frangible lighting columns.	

2.2 Maintenance Bays

2.2.1 Manoeuvring width

Moderate

The proposed maintenance bays, which are intended to give access to the berm in both directions, are shown in Figure 15 and Figure 16. Although the detail shows a width of 4 m, the layout indicates 3 m.

The designers explained that entry would be in the forward direction, as opposed to reversing into the bay.

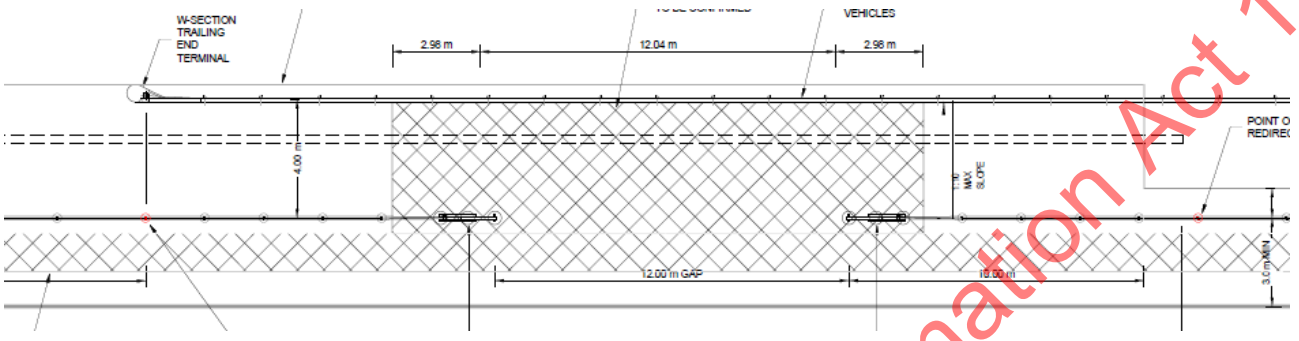

Figure 15: Maintenance access bay detail

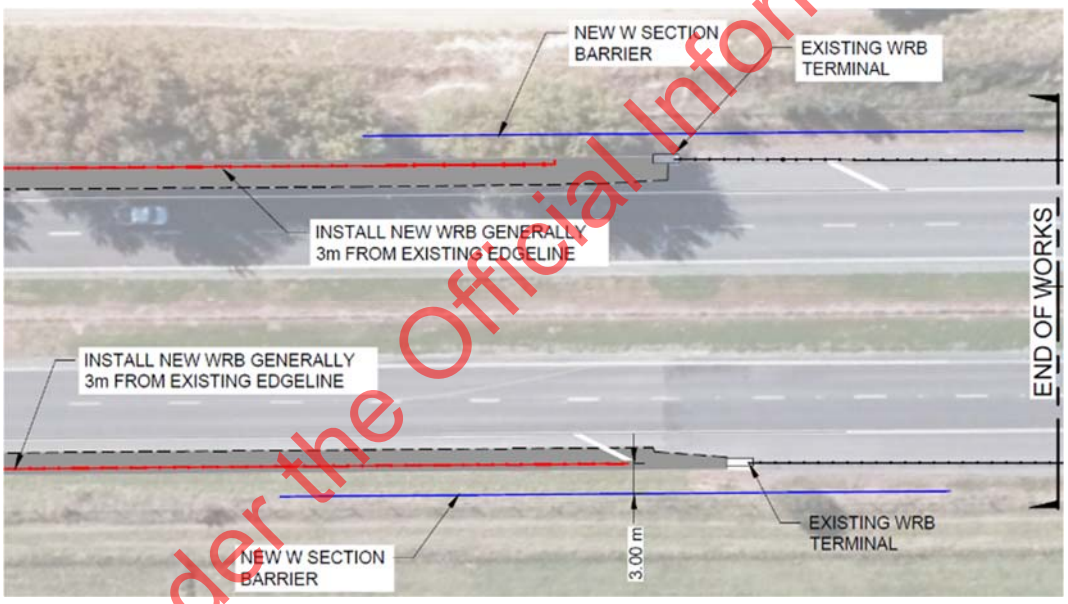

Figure 16: Proposed location of maintenance bays

The effective width of the maintenance bay in the detail in Figure 15would be less than the 4 m width shown when the widths of the end terminals are taken into account. There is thus unlikely to be enough width for a maintenance truck to manoeuvre into the maintenance bay from the shoulder and a portion of the through lane will likely be required for the manoeuvre. Similarly, exiting the bay might require the front of the vehicle to swing wide into the adjacent lane. This would mean blocking the through lane while manoeuvring in or out, effectively bringing all traffic in that lane to an unexpected halt. This would be unsafe, not only for the general traffic, but also for the maintenance personnel.

The proposal to reduce the width to 3 m, due to space constraints, could render the maintenance bay almost unusable for any vehicle other than a ute.

The possibility of using a lane closure traffic management plan with attenuation vehicles was discussed in a similar audit of the Hampton Downs section. However, the risk is that a maintenance person might try to use the bay not realising that it required a special temporary traffic management plan.

From a safety in design perspective, a driver trying to climb out of a vehicle is likely to stand on or fall over the barriers, even if parked beyond the double barrier section as the available width for the maintenance bay would still be limited by the road reserve boundary and cut or fill embankment.

Furthermore, the gap in the roadside barrier will leave any worker of vehicle in the maintenance bay exposed to the risk of a vehicle leaving the road at that point.

Recommendation(s)

1. Amend the design to a disengaging overlapping barrier layout that will allow maintenance vehicle drivers to pull over onto the shoulder first and then access the maintenance bay without encroaching into the adjacent through lane, while also fully shielding the maintenance vehicle and any personnel in the maintenance bay. This may require additional access bays or alternative arrangements to service the berm in both directions.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	The current location shown is the widest location within the project length. Tracking paths with a 8m truck have been run on the current arrangement, which indicates that an additional 5m of length is required for the vehicle to make the entry. Also we acknowledge the difficultly exiting the vehicle, and have extended the paved area of the maintenance bay 12m beyond the rear barrier terminal to enable a vehicle to park clear of the barrier obstructing the doorway. Detail updated. An alternate arrangement to ensure that the appropriate TMP is followed is to remove the gap, and allow access into the bay area by means of a wire rope drop in conjunction with the lane drop. This would allow the rear barrier to be removed as well.	
Safety Engineer comment	Concern from SAT is noted, while it is preferable to have overlapping barriers , the option proposed by the designer also mitigates the risk highlighted by SAT. An alternate arrangement is not preferable. it is recommended to the client that the arrangement proposed by designer be opted.	
Client decision	Agree with Designer and RSE.	
Action taken	The design has been amended to improve maintenance bay vehicle entry and personnel exiting the vehicle within the maintenance bay.	

2.3 Road Signs and Markings

2.3.1 Gore signs and markings

Minor

The existing exit and entrance ramp gore areas have no hatching. Since there may now be crash cushions on the exit noses, thus reducing the area on and behind the noses for recovery, both exit ramps would benefit from increased visibility. It is acknowledged that the interchange is lit, but speeds will be higher.

All exit gores should be marked with diagonal chevron bars for consistency along the Waikato Expressway. Te Kauwhata, Rangiriri and Huntly interchanges are marked, but interchanges such as Hampton Downs, Ohinewai, and Tamahere are not.

The exit signs on the noses may need to be relocated to allow the crash cushions to be installed.

Recommendation(s)

1. Mark the exit and entrance gore areas with diagonal chevron bars. Apply this to all exits on the Waikato Expressway for consistency.
2. Check if the exit signs need to be relocated behind the installed crash cushions.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Agreed. Chevrons in the gore area of the southbound offramp are included in the Hamilton Section plans. Hatching in northbound offramp has been added to the drawings, and sign relocation provisionally included if necessary.	

Safety Engineer comment	Agree with designer's response.
Client decision	Agree with SAT and RSE.
Action taken	The design has been updated.

2.3.2 Cyclist signs and markings

Comment

Cyclists would still be allowed to use the 110 km/h sections of the Waikato Expressway.

Some sections of the existing Waikato Expressway cater for cyclists in the form of painted buffer strips (e.g. Rangiriri to Ohinewai) and signed crossing points across exit and entrance ramps as shown in Figure 17 which is in an existing 110 km/h speed limit zone along the Cambridge Bypass not far from the Tamahere interchange. Such shoulder buffers and cyclist crossings are not present on the Hampton Downs section or the Tamahere section or other recently opened sections such as the Huntly Bypass.

Figure 17: Exit ramp cyclist crossing at Cambridge (west) interchange (Google, 2019)

Since the Waikato Expressway looks like a motorway, it would be reasonable to assume that some drivers would not expect to encounter cyclists in such an environment and would therefore not be looking out for cyclists.

While the buffer strips and signed crossing points provide no physical protection for cyclists, the signs and markings may remind drivers to be on the lookout for cyclists. The converse *may* also be true—where the signs and markings end or are not present, drivers may think that cyclists are not allowed on the expressway.

A consistent philosophical approach should be taken regarding the provision of cyclist signs and markings along the entire length of the Waikato Expressway.

2.3.3 RRPMs and ATP

Comment

The drawings do not indicate any change to the existing edge line markings, which do not include ATP but do include RRPMs. For consistency along the Waikato Expressway a decision should be made to include ATP along all sections, unless they could be annoying for people living close by.

The ATP markings applied on the recent Longswamp to Rangiriri project (June 2020) coincided with the RRPMs. Not only did the application cover the RRPMs in many cases, but the raised portion of the ATP also tended to mask the full effectiveness of the RRPM reflectivity, effectively reducing the RRPM to about half its reflective area when viewed from the low angle of a passenger vehicle.

Fortunately, it appears that the exiting RRPMs along the Tamahere section are set far enough away from the existing edge line for ATP to be applied between the line of RRPs and the edge line. However, the foregoing comment should be borne in mind when drawing up any specifications or drawings for ATP.

Figure 18: Existing RRPM position in relation to edge line

3 Audit Statement

We declare that we remain independent of the design team and have not been influenced in any way by any party during this road safety audit.

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed, or modified in order to improve safety.

We have noted the safety concerns that have been evident in this audit and have made recommendations that may be used to assist in improving safety.

Signed s 9(2)(a) Date 22 October 2021

s 9(2)(a)
Technical Director – Roads and Highways, Stantec

Signed s 9(2)(a) Date 26 October 2021

s 9(2)(a)
Project Transportation Engineer, Stantec

Signed Date 26 October 2021

Heather Liew, BEng(Hons), MET
Safety Engineer, Waka Kotahi

4 Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

4.1 Designer's Responses

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report and I have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.

Signed s 9(2)(a) Date 17/02/2022

s 9(2)(a)

4.2 Safety Engineer's Comments (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.

Signed s 9(2)(a) Date 01/03/2022

s 9(2)(a)

4.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report, together with the designer's responses and the comments of the safety engineer (if applicable) and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.

Signed Date 02/02/2022

[Shane Small, BEng(Civil), Project Manager, NZTA]

4.4 Designer's Statement

I certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.

Signed s 9(2)(a) Date 17/02/2022

s 9(2)(a)

4.5 Safety Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, safety audit team leader, safety engineer, and project file.

Date:.....

5 References

Google. (2019, December). Street View.

Google. (2021, May). Street View.

Google. (2021, February). Street View.

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