DETAIL DESIGN ROAD SAFETY AUDIT

SH1 WAIKATO EXPRESSWAY 110 KM/H SPEED REVIEW PROJECT HAMPTON DOWNS

PREPARED FOR WAKA KOTAHI NZ TRANSPORT AGENCY

29 September 2021

Stantec

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QUALITY STATEMENT

PROJECT MANAGER s 9(2)(a)	**ROAD SAFETY AUDIT TEAM LEADER** s 9(2)(a)

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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.

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 and infill median barriers along the Hampton Downs section of the Waikato Expressway between the Meremere section (opened in 2006 and retrofitted with side and median barriers in 2017) and the Longswamp Section (opened in 2019). The 1.6 km Hampton Downs section is located between RP486/7.28 and RP 486/8.80 and includes the entrance and exit ramps of the Hampton Downs diamond interchange.

Although preliminary status is shown on the drawing set referred to in Section 1.8 of this report, BBO confirmed that the drawings were intended for a detail design road safety audit.

1.6 Briefing, Site Visit, Audit, Exit Meeting

Mclean Hastie 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 Friday 17 September 2021, after which the road safety audit team undertook a desktop audit via MS Teams.

A site visit was not permitted due to Auckland being under Covid-19 Level 4 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 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.

- 147130-02 WEX Hampton Downs - Barriers Set for RSA_v1.pdf as shown in Table 1-4.
- Hampton Downs 110 Speed Review DPS_v1.pdf

Detailed drawings titled 'Key Corridor Safety Retrofit Programme Waikato Expressway (SH1) Hampton Downs Section' (dated 9 September 2021) were produced by BBO. These drawings and a design philosophy statement were provided to the road safety audit team on Wednesday 15 September 2021.

New signage to reflect the proposed 110 km/h speed limit changes was not included in the scope of this road safety audit.

Table 1-4: Drawing titles

SHEET	DRAWING TITLE
GENERAL	
147130-02-1000	COVER SHEET
147130-02-1001	DRAWING INDEX & LOCALITY PLAN
GENERAL ARRANGEMENT & BARRIER	
147130-02-1200	GENERAL ARRANGEMENT & BARRIERS - OVERVIEW PLAN
147130-02-1201	GENERAL ARRANGEMENT & BARRIERS - SHEET 1
147130-02-1202	GENERAL ARRANGEMENT & BARRIERS - SHEET 2
TYPICAL DETAILS	
147130-02-1901	EDGE BARRIER DETAILS - TYPICAL EDGE DETAILS
147130-02-1911	BARRIER EDGE DETAILS - BARRIER TRANSITION TYPE A - SEMI-RIGID TO FLEXIBLE
147130-02-1912	BARRIER EDGE DETAILS - BARRIER TRANSITION TYPE B - STRONG POST TO WEAK POST
147130-02-1913	BARRIER EDGE DETAILS - BARRIER TRANSITION TYPE C - FLEXIBLE OVERLAP
147130-02-1921	TYPICAL DETAILS - MAINTENANCE ACCESS BAY TYPE 1 (FLARED W-SECTION BARRIERS)
147130-02-1922	TYPICAL DETAILS - MAINTENANCE ACCESS BAY TYPE 2 (TANGENTIAL W-SECTION BARRIERS)
147130-02-1923	BARRIER EDGE DETAILS - PROVISIONAL PAVEMENT DETAIL & DISH CHANNEL DETAIL

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 being under Covid-19 Level 4 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 Google Street View images and Argonaut Roadrunner videos.

2.1 Cross-section

2.1.1 Shoulder widths and lighting columns

Moderate

The design philosophy statement and the typical edge details on drawing 147130-02-1901 indicate that, although the existing shoulder next to kerbs is about 2.5 m wide, the barrier will always be installed with a 3.0 m minimum offset from the edge line. Where there are no kerbs, the seal is proposed to be widened to 3.0 m. The design philosophy statement states that, '…for 110 km/h retro fit projects is to retain existing lighting where practicable. Where existing columns are in front of or clash with new barrier, they will be relocated behind the new barrier clear of the deflection zone.' The general arrangement drawings tabulate exactly where each edge design applies. Thus, in all cases, there should be enough width for a vehicle to stop and for the passenger door to be opened.

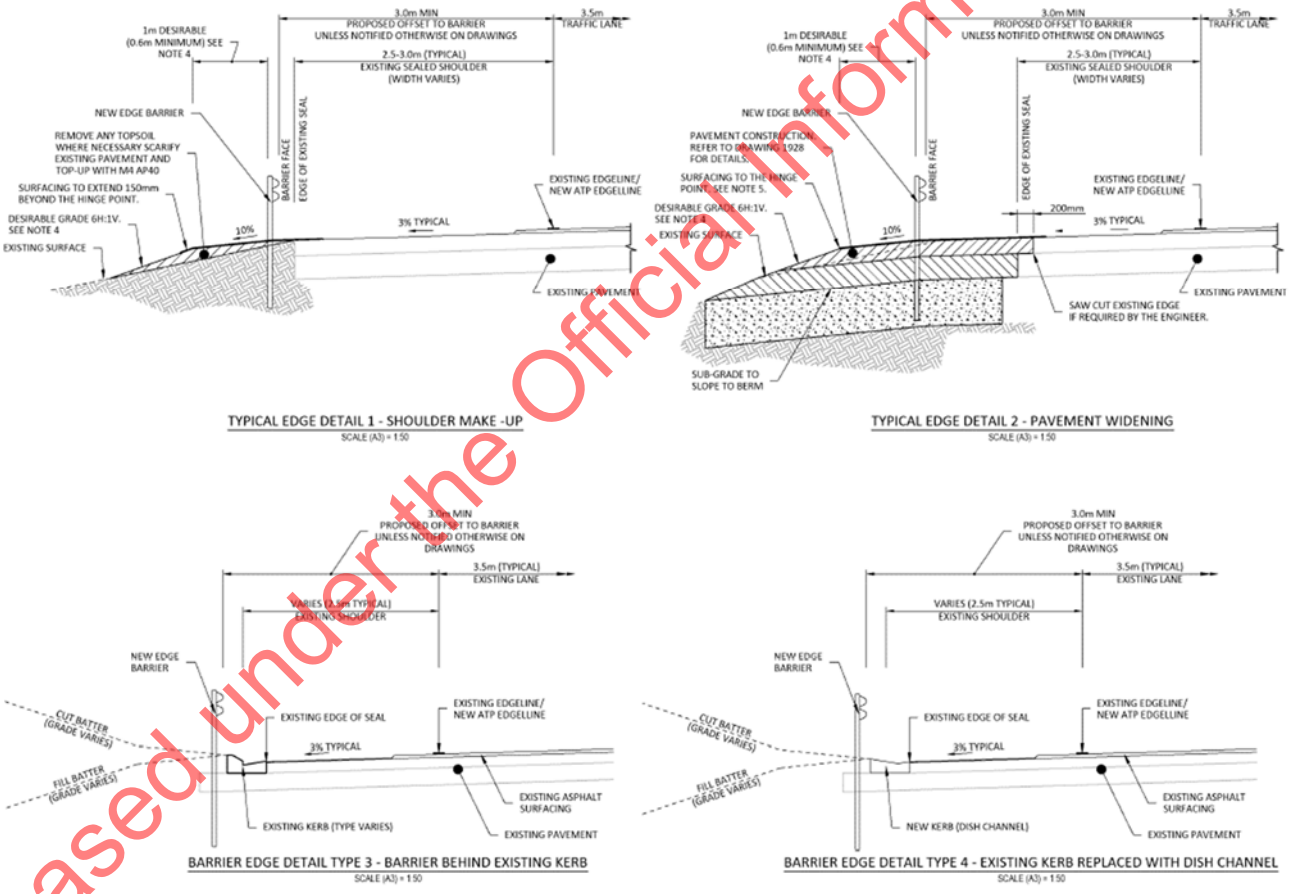


Figure 1: Proposed edge details

However, the lighting columns that would need to be relocated are not identified on the drawings, thus placing the onus on the contractor to determine which ones are to be shifted. There is also no criterion shown for how close the barrier can be to the lighting column before it needs to be shifted. Theoretically, the drawings could allow the back of the barrier to touch the lighting column.

The safety concern is that the desired 3.0 m width will not eventuate if it is left to the contractor to determine which lighting columns are to be relocated, especially if the existing lighting column position is only just shy of meeting the requirements and the barrier is shifted to miss the column or to achieve the desired clearance to the lighting column. The two lighting columns, each about 40 m behind the nose of

the two exit ramps, are examples where the flare of the barriers meeting the crash cushions needs to be accounted for.

Recommendation(s)

1. Show the lighting columns on the typical edge details with the minimum acceptable gap between the back of the barrier and the face of the lighting column dimensioned, and also on the general arrangement drawings, so that there can be no ambiguity concerning which lighting columns are to be relocated and which can remain in place.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Designer agrees. The drawings now detail where columns are to be relocated. An additional edge detail has been added to the drawing set for ***Barrier behind existing kerb – with lighting column***. The minimum gap between back barrier and light column is 150mm. Survey indicates there is space to accommodate barrier and 150mm gap between kerb and column in most instance. Where this is not achieved columns are shown to be relocated. The general arrangement plans also note the requirement for lighting to be relocated where the 150mm gap cannot be achieved.	
Safety Engineer comment	Agree with SAT. Designer to add lighting columns to the drawing set. Julian Chisnall, Team Lead Road Safety, Programme and Standards: Current best practice is to provide 1.5m between the back of the barrier system and the front face of the lighting column to mitigate the risk of an errant vehicle deflecting the barrier and striking the column. In locations where the 1.5mtr offset clearance cannot be achieved, 1mtr gap would be acceptable (but not desirable).	
Client decision	Agree with SAT and RSE. Scope to include the relocation of light columns beyond the barrier deflection zone (min 1mtr gap).	
Action taken	The design has been updated, indicating the relocation of affected light columns	

2.2 Maintenance Bays

2.2.1 Manoeuvring space

Moderate

The proposed Type 2 maintenance bay, which is intended to give access to the berm in both directions, is shown in Figure 2.

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

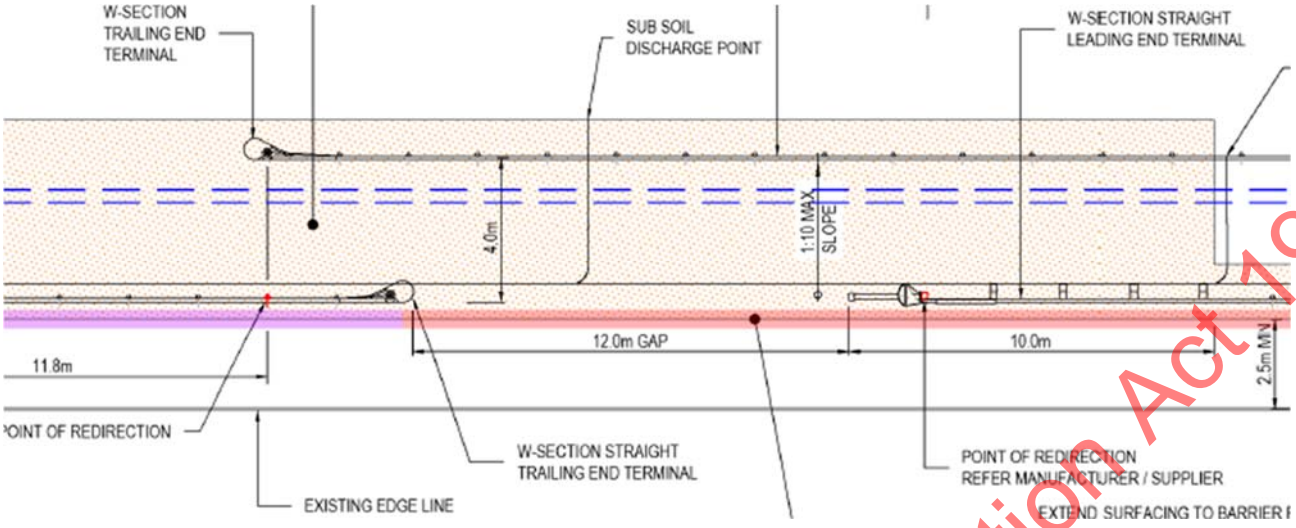


Figure 2: Maintenance access bay Type 2

The effective width of the maintenance bay would 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.

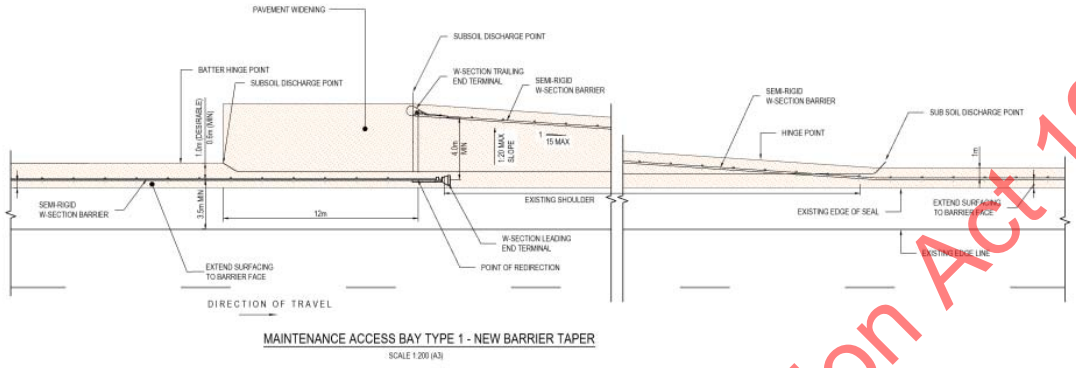
The possibility of using a lane closure traffic management plan with attenuation vehicles was discussed. However, the risk is that a maintenance person might try to use the bay not realising that it required a special temporary traffic management plan.

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 though 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.

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	The Type 2 layout has been removed and replaced with a Type 1 layout. The Type 1 layout allows the vehicle to pull onto the shoulder and reverse into the maintenance bay where they are isolated from the main carriageway by w-section barrier. The shoulder is widened to 3.5m on approach and departure from the maintenance bay to allow additional space to enter and exit. The 3.5m width includes a traversable dish channel to replace kerb and channel where required.	
Safety Engineer comment	Concur with SAT and Designer. Type 1 layout supplied by the designer addresses the concerns raised by SAT.	



MAINTENANCE ACCESS BAY TYPE 1 - NEW BARRIER TAPER

SCALE 1:200 (A3)

Client decision	Agree with SAT, Designer and RSE. The type 1 layout has been included within the scope.
Action taken	No further action required

2.3 Barriers

2.3.1 Deflection to lighting columns

Minor

As discussed in Section 2.1.1, the existing and even the relocated lighting columns are likely to be within the expected operating width of the semi-rigid barriers. The performance of the barriers and of the slip base lighting columns would be unpredictable in a crash.

It is acknowledged that the installation of the roadside barriers would be a significant safety improvement, even if they were not installed in accordance with accepted normal operating clearances. However, consideration may not have been given to mitigating the departure, like using a stiffer less deflective barrier system such as one of the Thrie-beam barrier systems.

Recommendation(s)

1. Mitigate the consequence of the close gap between the lighting columns and the back of the roadside barrier 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 is sought. Refer also to Section 2.1.1.
3. Where lighting columns are 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	1. Post spacing will be halved for 12m on approach and 6m on departure from lighting columns in the deflection width of the barrier system used. This will be added to the construction drawing set. 2. A minimum gap of 150mm is specified between existing lighting columns and new barrier. 3. New columns behind barrier will be ground planted collapsible.	

Safety Engineer comment	Concur with SAT and Designer. Designer to provide 1mtr workable width between back of the barrier to front of a lighting column. Julian Chisnall, Team Lead Road Safety, Programme and Standards: The proposal to reduce the post spacings will do little to mitigate the risk with a weak post W-beam system similar to that already installed. Halving the post spacing (from 1905mm down to 952mm) will reduce likely dynamic deflection by 15%, perhaps 20% at best.
Client decision	Agree with SAT and RSE. Scope to include the relocation of light columns beyond the barrier deflection zone (min 1mtr gap).
Action taken	The design has been updated, indicating the relocation of affected light columns

2.3.2 Median barrier

Moderate

The drawings show an existing flexible barrier along the edge of the median shoulder of northbound carriageway. There is no median barrier proposed for the southbound carriageway.

Although the existing northbound carriageway barrier would probably prevent a cross-median head-on crash in the southbound direction, even given the higher probable impact angle, the median turf is likely to be soft and wet in winter. High centre of gravity vehicles such as SUVs are susceptible to roll-over crashes when hitting a soft berm even if it is deemed to be fully traversable in theory.

Recommendation(s)

1. Consider installing median barriers wherever there is a likelihood of a rollover crash due to soft turf in the median. This recommendation should apply to the full length of the Waikato Expressway under consideration in this 110 km/h project.

Frequency Crashes are likely to be common	Severity Death or serious injury is unlikely	Rating The safety concern is moderate
Designer response	The Designer acknowledges this is a risk. However, except for the short section under the interchange bridge, modification to the median is not part of the project scope.	
Safety Engineer comment	Agree with SAT.	
Client decision	Agree with Designer. Following a discussion with Principal Traffic and Safety Engineer Richard Landon-Lane on 08/12/2021, the southbound direction right-hand curve at the northern extent of the proposed 110km threshold (RS/RP 486/7.28) predominantly means any run-off road vehicles will likely vear to the left-hand-side, so the risk of a vehicle entering the right-hand side median turf in minimal. Also, the existing median barrier/turf layout is also present at other locations across the state highway network and should be reviewed at a regional/national level.	

	
Action taken	No further action required

2.4 Road Signs and Markings

2.4.1 Gore signs and markings

Minor

The existing exit and entrance ramp gore areas have no hatching. Since there will 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 Hampton Downs and Ohinewai interchanges are not.

The drawings do not indicate how or if the exit signs on the noses are to be relocated to allow the crash cushion to be installed.

Figure 3: Hampton Downs northbound exit ramp gore and nose (Google, 2021)

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. Indicate where the exit signs are 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	1. Chevron markings have been added to the drawings for installation at the exit's. 2. Exit signs will be relocated behind the crash cushion. This will be added to the construction drawing set.	
Safety Engineer comment	Concur with SAT and Designer.	
Client decision	Agree with SAT, Designer and RSE.	
Action taken	No further action required	

2.4.2 Cyclist signs and markings

Comment

The designers confirmed that 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 shown in Figure 4 below) and signed crossing points across exit and entrance ramps. shown in Figure 5 below. The latter is in an existing 110 km/h speed limit zone. Such shoulder buffers and cyclist crossings are not present on the Hampton Downs section or other recently opened sections such as the Huntly Bypass.

Figure 4: Existing buffer strip Rangiriri to Ohinewai (Google, 2021)

Figure 5: Exit ramp cyclist crossing at Cambridge (west) interchange (Google, 2019)

Ag, 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.

Designer response	The Designer agrees that a consistent approach would be beneficial. Cycle markings can be added if required by Waka Kotahi. Similar to the Rangiriri exits.
Safety Engineer comment	Concur with SAT and Designer. Cycle markings to be added similar to the Rangiriri exits.

Client decision	Agree with SAT, Designer and RSE. Cycle markings to be included within scope.
Action taken	Cycle markings have been added to the drawings.

2.4.3 RRPMs and ATP

Comment

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.

For ease of application of the ATP markings (i.e. not having to stop the machine at each RRPM) and to improve the reflectivity of the RRPMs, perhaps the RRPMS could be placed just to the left of the ATP marking.

Designer response	ATP will be refreshed as part of the project. South of the interchange the ATP is offset beside the edge line with a gap at RRPM's. North of the southern ramps ATP is on the edge line with RRPM's offset beside the edge line. Any new ATP will be installed beside the edge line. ATP installation requirements will be added to the construction drawing set.
Safety Engineer comment	Agree with Designer.
Client decision	Agree with SAT. Designer and RSE.
Action taken	The design has been updated, indicating the location of RRPMs and ATP

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 21 September 2021

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

Signed s 9(2)(a) Date 21 September 2021

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

Signed Date 29 September 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 08/12/2021

s 9(2)(a) Design Manager, BBO]

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 03 December, 2021

[Shashi Lakshminarasimhaiah, Safety Engineer, NZTA]

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 08/12/2021

[Shane Small, BE(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 08/12/2021

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:...08/12/2021.....

5 References

Google. (2019, December). Street View.

Google. (2021, February). Street View.

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