TPC TRAFFIC PLANNING CONSULTANTS LTD

SH2: Baypark to Bayfair, Tauranga

ROAD SAFETY AUDIT
of the
50%-85% DETAILED DESIGN

A REPORT PREPARED FOR
NZ TRANSPORT AGENCY

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1.0 BACKGROUND

1.1 Road safety audit procedure

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 safety 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.

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, that is, minimisation 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 in order that the client can make a value judgement as to appropriate action(s) based on the 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 increasingly 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 the following project milestones:

- Concept stage
- Scheme or Preliminary design stage
- Detailed design stage, and
- Pre-opening / Post-construction stage.

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

In accordance with the procedures set down in the revised NZTA Guideline "Road Safety Audit Procedures for Projects" (interim release May 2013), this is a report to the client who then refers the report to the designer. The designer should consider the report and comment to the client on each of the concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the safety audit report recommendation.

For each audit team recommendation that is accepted, the client shall 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 to be completed by the designer, safety engineer and client for each issue documenting the designer response, client decision 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 feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The project

The project, for which this is the road safety audit, is the upgrade to a section of SH2 between the western end of the Tauranga Eastern Link (TEL) at the SH2/29A intersection at Te Maunga, and north of the Maunganui Road/Girven Road intersection (MGI). The SH29A and Truman Lane intersection is also included in the extent of the project.

The proposed works comprise: the grade separation of the MGI, the grade separation of the SH2/29A intersection, the grade separation of SH29A over the ECMT rail line and the widening of SH2. This requires a minimum of one free flowing lane in each direction at the MGI.

The overall project can be described as a split interchange as traffic southbound on SH2 wanting to access SH29A requires drivers to exit at the MGI and for traffic northbound on SH2, drivers will have to exit at SH29A to gain access to the MGI.

The design retains an at-grade intersection below the MGI flyover and replaces the current small roundabout with a larger signalised roundabout. Truman Lane will be connected to SH29A with a 3 leg dual lane roundabout west of the new SH2/SH29A interchange. This roundabout will help to transition from the high speed approach on

SH29A to the proposed SH2/29A diamond interchange. The T-intersection of Owens Place/Matapihi Road, west of the MGI, will be signalised and integrated with the signalised intersection at the MGI.

The SH2-TEL route forms one of the Roads of National Significance (RoNS). This is a key freight route for transporting goods from the Eastern Bay of Plenty agricultural and forestry areas to the Port of Tauranga and the wider markets.

The project objectives have previously been identified as:

1. Improve access for inter-regional road freight to the Port of Tauranga whilst maintaining rail services.
2. Improve safety for all road users.
3. Reduce congestion, improve vehicle journey time reliability and provide efficient traffic flows into Tauranga from the east.
4. Operation of an optimised 'One Network' plan that balances the needs of travel demands across the area.
5. Improved access for public transport users.
6. Improved access for tourism through and within Tauranga.

1.3 Documents provided

The drawings provided to the road safety audit team (SAT) were prepared by Jacobs, in conjunction with CPB, and are listed in the Appendix.

The drawings that were provided covered the following aspects of the design:

- Geometrics (85% issue)
- Structures (50% issue)
- Signs and pavement markings (50% issue)
- ITS and lighting (50% issue)
- Barriers and kerbs (50% issue)
- Footpaths and cycleways (50% issue)

Drawings were not provided for the following aspects:

- Drainage
- Pavement
- Landscaping
- Traffic signals

1.4 The safety audit team

This road safety audit was carried out, as far as practicable, in accordance with the revised NZTA Guideline "Road Safety Audit Procedures for Projects" (interim release May 2013) by:

- Steve Reddish, Senior Associate, Traffic Planning Consultants Ltd, Hawke's Bay;
- Bruce Robinson, Robinson Transportation Consulting, Tauranga;
- Ken Holst, Traffic and Safety Engineer, NZTA, Napier.

The SAT was briefed, and supplied with the drawings to be audited, by the Jacobs/CPB design team in the project offices, Auckland, on Wednesday 11th October 2017. The team subsequently carried out a desk top review of the drawings that day and the next. An exit meeting was held with members of the Jacobs/CPB team on Friday 13th September 2016 to give an early indication of the findings of the SAT.

1.5 Previous safety audits

Safety audits of the scheme design and specimen design were undertaken in November 2013 and September 2015 respectively, with the findings detailed in reports dated 23 November 2013 and 7 October 2015. Safety audits of the Jacobs/CPB tender design were undertaken in September and October 2016, with the findings summarised in reports dated 19 September 2016 and 17 October 2016.

1.6 Scope of safety audit

As noted in section 1.3, this road safety audit predominantly covers elements of detailed design that are at 50% issue, with only geometrics being at 85%. Also as previously noted, a number of design features are not covered in this safety audit. It is assumed that those aspects not covered in this safety audit and those that have yet to be fully developed will be subject to a further detailed design safety audit.

1.7 Report format

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

The expected probability of a crash occurring (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 (the likelihood of a fatality or serious injury) is qualitatively assessed on the basis of factors such as expected speeds, type of collision, type of vehicle, and road user 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 Assessment Matrix in **Table 1** below. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Table 1: Assessment Matrix

Likelihood of Fatality or Serious Injury	Probability of a Crash Occurring			
	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 category of concern is given in **Table 2**.

Table 2: Categories of Concern

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

In addition to the ranked safety issues, it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication, but which lie outside the scope of the safety audit. Therefore 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 directly 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, in some instances suggestions may be given by the safety auditors.

All potential concerns, comments and recommendations set out in this safety audit report should be noted and acted upon if appropriate.

1.8 Disclaimer

The findings and recommendations in this report are based on an examination of the relevant drawings, the specified road and environs, and the opinions of the safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe. Furthermore, no warranty is implied that all safety issues have been identified in this report. Road safety audits do not constitute a design review or an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific 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 strictly on the basis that anyone relying on it does so at their own risk without any liability to the safety auditors or their organisations.

2.0 AUDIT FINDINGS – General

Preamble:

Safety concerns that have been raised in previous safety audits, but which have yet to be addressed following the client decision, are repeated in this safety audit report for completeness. This report can then be seen as a stand-alone report without the need to refer back to previous safety audit reports.

It is also acknowledged that some matters raised in this safety audit will need input from the NZ Transport Agency before being able to be actioned by the designer/contractor.

2.1 Significant Concern – Speed limits and design speed

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely
Outcome – Significant

As a grade separated road with full barrier protection, it needs to be recognised that drivers' perception and expectations on the upgraded SH2 will be of a higher speed environment than is being proposed.

In the safety audit report of the tender design, the safety audit team (SAT) noted:

"The issue of speed environment, speed limits and design speeds has been raised in previous safety audits. The SAT acknowledges that the B2B link is to be designed to an 80 km/h design speed due to various constraints. The SAT is of the view that the transition northbound from motorway speeds (100 km/h+) on TEL to compliance with a speed limit of 70 km/h on a continuing grade separated route would not be achieved in reality. The SAT is also of the view that the 70 km/h speed limit on the Maunganui Road-Hewletts Road route is too high for safe operation given all the intersections, on-street parking and property accesses along the route.

Having regard to the above, the SAT considers that a more appropriate speed limit regime would be a northbound transition from 100 km/h to 80 km/h north of the Sandhurst Drive interchange (ie prior to the SH29A interchange) and then a transition from 80 km/h to 60 km/h north of the MGI flyover. These speed limits are also more in keeping with the Speed Management Guide."

It is acknowledged that speed limits are usually set at 10 km/h below the design speed, but the development of the factors that go into roading design mean that a road with a design speed of 80 km/h should be able to safely operate with a speed limit of 80

km/h. (**NB** the SAT has specific concerns related to speed issues at the flyover and these are covered in item **3.1**.)

Speed management measures not only apply to thresholds (refer to item **2.2**) and include repeat speed limit signage as shown on the traffic services drawings, but should also include dynamic/electronic speed signage which advises drivers of their speed and includes a message to slow down (see **Figure 1**). An alternative sign is one that reinforces the speed limit when it detects a vehicle exceeding the speed limit (see **Figure 2**).

Figure 1 – Dynamic sign showing speed and slow down message

Figure 2 – Dynamic sign reinforcing speed limit with wig-wag signals

Recommendations:

a. Implement an 80 km/h speed limit on the SH2 link between the end of TEL in the south and north of the MGI flyover and then a 60 km/h speed limit for the balance of the Maunganui Road-Hewletts Road route.

b. Consider dynamic/electronic speed signage on SH2 northbound to assist with consistent speed reductions by drivers that are aligned with the relevant design speeds for each segment.

Designer Response:	a. We have provided a geometric design that provides for an 80kph design speed environment in accordance with the PR and this is normally suitable for posted speed limit of 70kph. To implement a 80km/h speed limit (posted speed) would normally require a 90km/h design speed. To implement a 90km/h design speed would require significant re-design and threaten designation. We are conflicted with non-compliance with the PR's to address the Road Safety Audit comments. NZTA to advise. b. Dynamic/electronic speed signage can be installed on SH2 northbound, however, this is outside of project scope and NZTA to advise on provision.
Safety Engineer:	a. Under the Settings of Speed Limit Rule 2017 to change to a 70km/h speed limit needs the specific approval of the General Manager, Safety and Environment, NZ Transport Agency. Agree with the safety audit's team recommendation regarding having a section of lowered posted speed limit between the 100km/h TEL expressway and the 70km/h SH2 Maunganui Road section (it is expected near the completion of the Baylink project that consultation will be undertaken on lowering the speed limit on SH2 Hewletts Road and SH2 Maunganui Road to less than 70km/h). However, any change in speed limit will need to demonstrate a change in the road form and/or surrounding environment to reinforce what the safe and appropriate travel speed is for that particular section of road. b. There may be merit in installing dynamic/electronic speed signage to reinforce the safe and appropriate travel speed if has not been able to be reinforced by the design of the road form or the surrounding environment. The Contractor's design should not preclude the installation of these signs and associated ducting and infrastructure works post construction should it be considered that these are required.
Client Decision:	a. Agree with SAT recommendation to implement a posted speed limit of 80km/h between end of TEL and the southern approach to the

	MGI flyover, followed by a 60km/h speed limit prior to tying into Maunganui Road. The location of the 80/60km/h speed limit change at this location is subject to the Designer confirming there is sufficient length achieved for the 80km/h zone. The 60km/h speed limit will also apply to all traffic lanes parallel to the free flow lanes between SH2/SH29A interchange and MGI, which serve a local road function. Agree with Safety Engineer recommendation that change in speed limit will require public consultation by the Transport Agency. Design to ensure surrounding environment reinforces safe and appropriate travel for the posted speed limit – to consider use of hatch marking through shoulders at 80/60km/h transition. b. Proceed as per the Safety Engineer recommendation. Design to ensure surrounding environment and road form reinforce safe and appropriate travel speed. Design/construction not to preclude ability to implement dynamic/electronic speed signage, and to include ducting to allow for installation if required in the future.
Action Taken:	

2.2 Significant Concern – Threshold treatments

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely
Outcome – Significant

Following on from item **2.1**, in order to achieve a reduction in vehicle speeds on both SH2 northbound and SH29A eastbound where the speed limits reduce, it is important that there are threshold treatments that give a strong message of the requirement to slow down even though the actual road environment is not self-explaining for speed reduction.

Speed reduction on SH29A is particularly important given that the proposed speed limit change from 100 km/h to 50 km/h is only 220m prior to the roundabout. Refer also to item **3.3** regarding the approach to and visibility of the roundabout at Truman Lane.

The traffic services drawings show gated speed limit threshold signs on green backing boards together with the speed limit painted on the carriageway. However, the SAT is

of the view that the thresholds need to be further enhanced to maximise safety and minimise the risk of higher speed crashes.

Such measures include:

1. Mark the speed limit on the carriageway with a red background;
2. Mark the shoulders at the threshold with hatching (see **Figure 3**);
3. Extend the street lighting to include the threshold (see also item **2.9**);
4. Install dynamic/electronic speed signage per that shown in item **2.1** downstream of the threshold;

Figure 3 – Example of shoulder marking at threshold

Recommendation:

Provide additional treatments and measures, per 1-4 above, on SH2 northbound and SH29A eastbound at the change points to lower speed environments.

Designer Response:	1. Speed limit will be marked on the carriageway with a red background. 2. Shoulders at the threshold will be marked with hatching. 3. Street lighting will be extended to include the threshold. 4. Dynamic/electronic speed signage can be installed on SH2 northbound, however, this is outside of project scope.

	NZTA to advise on provision.
Safety Engineer:	As per the safety engineer's response to *Item 2.1: Significant Concern – Speed limits and design speed* above the change in road form and/or surrounding environment will need to extend through the section of road that reinforces the safe and appropriate travel speed, and not just at the threshold. With regard to the designer's response: 1. any colouring applied to the carriageway surfacing would need to be a long-life pavement marking material. The application of colouring onto pavement surfacing is to be confirmed with System Management. 2. shoulder bar marking at the speed limit change point is acceptable. 3. extending the street lighting to include the speed limit change threshold locations is acceptable. 4. Refer to safety engineer's response b) to *Item 2.1: Significant Concern – Speed limits and design speed* above.
Client Decision:	1. Agree with Safety Engineer recommendation. Use of any coloured surfacing be designed and installed in accordance with NZ Transport Agency's *Technical Advice Note #17-18,* and the *P33 specification for the supply and installation of coloured pavement surfacings.* 2. Proceed as per Safety Engineer recommendation. 3. Proceed as per Safety Engineer recommendation. 4. Refer to Client Decision response b) to *Item 2.1: Significant Concern – Speed limits and design speed* above. The speed limit reduction at the SH29A threshold is to be reinforced by the roundabout and lower speed curves leading to the SH2/SH29A interchange and so dynamic/electronic signage is not expected to be required on this approach in the future.
Action Taken:	

2.3 Comment – Forward sight distance

The SAT was advised at the briefing meeting that forward sight distance on horizontal curves has been appropriately assessed with respect to design speed to arrive at the design presented for safety audit.

However, as covered in item **3.1**, the SAT has concerns regarding forward visibility being at the minimum desirable threshold for northbound drivers on the MGI flyover where the vertical and horizontal curve combination has a concrete barrier on the inside of the curve at the back of a narrow 1.75m wide shoulder. Forward sight

distance for safe stopping (object height) should be achieved for actual speeds greater than the 80 km/h design speed at that location.

Designer Response:	Visibility provided in the design is compliant with the design speed quoted in the PRs. We are conflicted with non-compliance with the PR's to address the Road Safety Audit comments. NZTA to advise.
Safety Engineer:	Refer to the safety engineer's response to *Item 2.2 Significant Concern – Speed limits and design speed* above. The lane and shoulder widths marked are to reinforce, and provide the necessary forward sight distance, when travelling at the safe and appropriate travel speed.
Client Decision:	Proceed as per the Safety Engineer recommendations:- forward sight distance appropriate for 80km/h design speed to be provided.
Action Taken:	

2.4 Moderate Concern – Destination signage wording

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Moderate

Previous safety audits have raised safety concerns regarding the mixing of regional State Highway traffic movements with slower local links and intersections in this design which essentially is a split interchange design with some 800m between the two halves of the interchange. Whilst the design achieves uninterrupted flow for SH2 through traffic only, many other traffic movements require drivers to exit at one interchange in order to access destinations from the next one, which is counter intuitive.

As noted in previous safety audits, signage is critical to the safe operation of the overall layout to try and minimise the impacts of it not being self-explaining and the risks of GPS navigation devices directing drivers to undertake unsafe manoeuvres. Whilst local road users will get used to the arrangement, signage is very important for those drivers who are not familiar with the area or with names, including street names.

It is acknowledged that repeat advance warning destination signs are proposed both northbound and southbound on SH2, but the destination wording on these signs is also critical to assist those drivers who are not familiar with the area. In particular the SAT notes the following:

- The use of "Girven Road" on the various destination signs for northbound traffic is unlikely to be a known destination that will encourage drivers who want to go to

the Bayfair regional shopping centre to exit at SH29A. This can lead to unsafe manoeuvres elsewhere as northbound drivers find they cannot access Bayfair at the next interchange where Bayfair is located.

- Also, the use of "Tauriko" is not considered helpful to non-locals compared to the more strategic destination "Hamilton" which is similar to the use of "Rotorua" and "Whakatane" as used in the opposite direction.
- "Stadium" is also used on some destination signs, but most people would be looking for signs to "Baypark" rather than a generic stadium message (**NB** most stadia in NZ are signed with their actual names).

A signage regime that has destinations that are not readily known to people who are not familiar with the area can lead to unsafe manoeuvres not only at the intersections/interchanges, but also elsewhere on the road network.

Recommendation:

Ensure that all destinations used are likely to be known to motorists who are not familiar with the area, in particular include "Bayfair Shopping Centre" (brown background) on northbound signs, change "Tauriko" to "Hamilton" and use "Baypark Stadium" rather than the generic "Stadium".

Designer Response:	Naming convention agreed with NZTA before the Sign and Line design and these have been included in the design. NZTA to advise of any changes required to the naming convention.
Safety Engineer:	Agree with the designer's response that the Transport Agency will advise of any changes required to naming convention.
Client Decision:	Proceed as per the Safety Engineer recommendation.
Action Taken:	

2.5 Comment – Destination signage colours and lane assignment

1. Further to item **2.4** above, the background colour on a number of the destination signs should be reassessed in conjunction with the NZ Transport Agency destination signs policy (MOTSAM).

   The two one-way frontage roads that link the two interchanges, and which are also called "ramps," are signed as local roads, but in fact should be considered an integral part of the state highway system for the SH2/SH29A split interchange. It is considered that the gantry mounted ADS at the MGI for SH29A southbound and for SH2 northbound (drawing 3211) should be on a green background.

Conversely ADS installed on local roads should have a blue background. This would apply to the signs on Girven and Matapihi Roads (drawing 3211) and the ADS on Truman Lane (drawing 3214).

2. The gantry mounted lane assignment signs on the northbound and southbound approaches to the MGI have different destinations associated with each of the three traffic lanes on each approach. However, some of the destinations can be accessed from more than one lane. The signage is likely to lead to an imbalanced lane usage and potentially some unsafe lane changing when motorists realise they can use more than one lane. It is considered that these lane assignment gantry signs should be redesigned to reflect the destinations actually available from each lane. Refer to drawing 3211.

   A similar situation to the above relates to the gantry-mounted lane assignment signs on the northbound off-ramp at SH29A. (Note that the arrow on the overhead sign directing drivers to SH29A Welcome Bay should be a left turn arrow and not an angled arrow.) Refer to drawing 3213.

Designer Response:	- Background colour for gantry mounted ADS at the MGI for SH29A southbound and for SH2 northbound will be changed to green. - Background colour for ADS on Girven Road, Matapihi Road and Truman Lane will be changed to blue. - Gantry signs will be redesigned to reflect the destinations actually available from each lane. - Arrow in gantry mounted 'Welcome Bay' will be amended to a left turn arrow.
Safety Engineer:	- Agree with the designer's response that a green background will be used for guide signs along the MGI SH29A southbound, and SH2 northbound, approaches. - Agree with the designer's response that a blue background will be used for guide signs along the Girven Road, Matapihi Road and Truman Lane approaches. - Agree with the designer's response that the gantry signs will be redesigned to reflect the destinations actually available from each lane. - Agree with the designer's response that the gantry mounted "Welcome Bay" sign will have a left facing directional arrow. - Refer also the Safety Engineer's mark-up of the signs and delineation plans.
Client Decision:	Proceed as per Safety Engineer recommendations.
Action Taken:	

2.6 Comment – Drainage

As noted in section **1.3**, no drainage drawings were provided. The SAT was advised that surface water flow analyses have been undertaken and that projected water film depths should not pose a risk of aquaplaning.

No details of catch pit grates were provided. As noted in previous safety audits, these need to be of a cycle friendly design.

Also, as noted in previous safety audits, all manholes should be well clear of the carriageway. Whilst the SAT was advised that this would be the case, the SAT was not able to check this aspect as no drainage drawings were supplied.

Designer Response:	- The design has reduced the number of locations where aquaplaning as potential risk to 9 locations, where the depth of water film is approximately up to 1.5mm above the 5mm allowed. We will undertake risk assessment that to further assess the issue. - Cycle friendly catch pit grates details will be provided. - Four manholes are not positioned well clear of the road. One existing manhole in the shoulder of Girven Road. One existing in the shoulder of the MGI inner island. Two proposed manholes associated with SP1 are in the shoulder of Matapihi Road at the MGI interchange. Existing constraints limited the effective positioning of these manholes.
Safety Engineer:	Agree with the designer's response that: • Further risk assessment of the nine potential aquaplaning locations will be undertaken, and the appropriate design measures will be implemented to mitigate any risk identified. • Cycle friendly catch pit grates will be provided. Any manholes that are proposed to be located within a trafficable section of road is to undergo a safety in design review. This will determine the required mitigation measures as reviewed and agreed with System Management to allow safe and appropriate access by maintenance staff.
Client Decision:	Proceed as per Safety Engineer recommendations.
Action Taken:	

2.7 Comment – Landscaping

As noted in section **1.3**, landscaping details were not provided for this safety audit. Previous advice is that there is no landscaping proposed other than on the central islands of the roundabouts (MGI and SH29A/Truman Lane). Refer also to item **4.1**.

Designer Response:	Massed low planting is proposed on the shoulders adjacent to the concrete road safety barriers on the ramps at MGI to soften the visual impact of the concrete barriers.
Safety Engineer:	Any landscaping proposed for the central islands of roundabouts and within the Type 2 sightline criterion shall be of a ground cover variety that grows to a maximum height of 150mm. The same type of planting shall also be provided around any pedestrian crossing point within the pedestrian sight distance requirements.
Client Decision:	Proceed as per Safety Engineer recommendations. A further review of proposed landscaping at the MGI central island may be required as the urban design elements of this area continue to be developed.
Action Taken:	

2.8 Minor Concern – Kerb types

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Kerb types are generally specified on the drawings as being non-mountable on local roads and mountable on state highways. The SAT is pleased to note that mountable kerbs are shown on all traffic islands and adjacent to shared paths as recommended in previous safety audits.

There are three areas of potential safety concern related to kerbs as shown on the drawings provided to the SAT:

1. Drawing 3451 shows non-mountable kerbs in front of TL4 concrete barriers that are shown on drawing 3271. Such kerbs would adversely affect the performance of the barriers as an errant vehicle may get "vaulted" by the vertical face kerb.

2. As noted in item **2.5**, the two roads that link the two interchanges are treated as local roads, but should be considered to be part of the state highway system for the SH2/SH29A split interchange. Accordingly all kerbs on these links should be mountable. Whilst kerbing along the western side of the northbound link, adjacent

to the shared path, is shown as being mountable, the kerbing along the eastern side of the southbound link is shown as non-mountable (drawing 3452). From a safety perspective, it would be expected that the new 3m wide footpath in this location could become a shared path (see item **6.1**) and hence mountable kerb would benefit the safety of cyclists needing to leave or move onto the shared path.

3. At the Truman Lane roundabout vertical face kerbs are shown extending from Truman Lane onto the outside of the roundabout (drawing 3454). Any vehicle hitting a vertical face kerb at the entry or exit could lose control. If a barrier is installed per recommendation *a.* in item **4.2**, a vertical face kerb would adversely affect barrier performance. Furthermore, the roundabout intersection, including entry curves, is part of the state highway network and, as such, should have mountable kerbs, as noted above.

Recommendations:

a. Review the requirement for kerbing in front of the TL4 barriers on the southbound and northbound links between MGI and SH29A. Provide fully mountable kerbing if kerbs are still required.
b. Install mountable kerbs on the eastern side of the southbound link between MGI and SH29A.
*c. Install fully mountable kerbs at the Truman Lane roundabout in place of vertical face kerbs (refer also to item **6.2**).*

Designer Response:	a. The kerb will be retained but changed to a mountable kerb. b. Due to the ongoing discussions between NZTA and TCC regarding this issue, the provision of kerb in this area will be non-mountable as advised by the Agency. c. Fully mountable kerbs will be constructed at the Truman Lane roundabout in place of vertical face kerbs.
Safety Engineer:	a. As this will be a lower speed environment it is considered that the kerb type in front of the barrier will be less critical. A barrier kerb would help to reinforce the lower speed environment and discourage vehicles from purposely mounting the kerb. b. Agree with the designer's response to install non-mountable kerb along the eastern side of the southbound lane between MGI and SH29A. c. Agree with the designer's response to install fully mountable kerbs at the Truman Lane roundabout.
Client Decision:	a. Proceed with non-mountable kerbs, as appropriate with the posted speed limits referred to in *Client Decision response b) to Item 2.1*. b. Proceed as per Safety Engineer recommendation. c. Proceed as per Safety Engineer recommendation.

Action Taken:	

2.9 Moderate Concern – Street lighting

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

In the safety audit of the tender design, the SAT noted:

"The SAT also considers that interchanges/intersections should be lit to a higher standard than the specified V2 level given the number of potential conflict points and for the benefit of vulnerable road users in particular."

The client decision related to the above was that *"the designer, in collaboration with NZTA, is to consider specific areas or pedestrian routes where a higher level of lighting may be necessary"*. The safety engineer had suggested that crossing points be lit to the same standard as that provided at formal pedestrian crossings.

No information was provided to the SAT to indicate what lighting levels will be achieved in those areas where conflicts may arise with vulnerable road users in particular.

It was also noted that no amenity lighting is shown for the pedestrian routes on the roundabout central island at the MGI.

It should also be noted that carriageway lighting with LED luminaires can result in a "tiger" striping effect depending on the pole spacing and the set-up of the LED lamps in the luminaire. The outcome is that objects on the carriageway in the dark patches are not readily seen in contrast with the relatively excellent luminance in the well-lit areas.

NB As recommended in item **2.2**, the street lighting on SH2 and SH29A should be extended to the south and west respectively to ensure that the speed limit thresholds are well lit and highlight the change in speed environment.

Recommendations:

a. Review the lighting design at the interchanges/intersections to ensure that all areas where conflicts may arise with vulnerable road users are well lit.
b. Ensure that all pedestrian routes through the MGI are well lit, including those through the central roundabout island.

c. *Ensure that the lighting design and luminaire specification provide good uniformity of lighting along the carriageway and do not result in a "striping" effect.*
d. *Extend the lighting on SH2 and SH29A to the south and west respectively to include the speed limit thresholds.*

Designer Response:	a. Lighting design at the interchanges/intersections will be reviewed to ensure that all area where conflicts may arise with vulnerable road users are well lit. b. Lighting design for all pedestrian routes through the MGI will be provided including the central roundabout island, to ensure these areas are well lit. c. Lighting design and luminaire specification will be reviewed to ensure that it provide good uniformity of lighting along the carriageway and do not result in a "striping" effect. d. Lighting on SH2 and SH29A will be extended to the south and west respectively to include the speed limit thresholds.
Safety Engineer:	a. Agree with the designer's response that lighting design at the interchanges/intersections will ensure that all areas where conflict with vulnerable road users may arise are well lit. As a minimum these conflict areas shall be lit to the same standard as that provided at formal pedestrian crossings. b. Agree with the designer's response that all pedestrian routes through the MGI will be well lit, including those through the central roundabout island. c. Agree with the designer's response that the lighting design and luminaire specification will ensure good uniformity of lighting along the carriageway and not result in any "striping" effect. d. Agree with the designer's response that extending the street lighting to include the speed limit change threshold locations is acceptable.
Client Decision:	Proceed as per Safety Engineer recommendations a – d above.
Action Taken:	

2.10 Minor Concern – CCTV maintenance

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Drawings 3411, 3412 and 3414 show CCTV cameras at 4 locations. No maintenance bays are shown for these facilities. Safe access will be required to the maintenance

bays, with service vehicles able to pull safely out of the traffic lanes to avoid the risk of nose to tail crashes.

Recommendation:

Provide off-road hard-standing maintenance areas for all CCTV cameras which can be accessed safely.

Designer Response:	We will seek to include off-road hard-standing maintenance areas wherever possible and not just for the maintenance of CCTV infrastructure.
Safety Engineer:	Agree with the designer's response that off-road hard-standing maintenance areas will be provided at all CCTV camera locations and at other locations where there is a need for the safe ingress and egress of maintenance vehicle on a regular basis.
Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

2.11 Minor Concern – Street lighting poles

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Section 2.5 of the ITS/Lighting design report refers to the use of shear bases for street light poles that are not protected. Unless the poles are likely to be struck at high speed, ground mounted energy absorbing poles would provide a better alternative in terms of crash outcome. Also, shear base mountings require ongoing maintenance to ensure that they will perform correctly in the event of a crash.

In the same section of the design report there is reference to street light poles being set back 1.1m behind wire rope barrier. In terms of deflection for wire rope barriers, 1.5m is considered to be the desirable minimum setback. (This would only apply to the lighting on SH2 at the southern end of the project.)

Recommendations:

a. *For unprotected street light poles, use ground mounted energy absorbing poles rather than shear base poles, unless the pole is likely to be hit at speeds >80 km/h.*

b. Provide a minimum of 1.5m setback for street light poles located behind wire rope barrier.

Designer Response:	a. For unprotected street light poles as specified the poles used will be ground mounted energy absorbing. b. Setback will be provided for street light poles located behind wire rope barrier to allow the WRSB to operate correctly.
Safety Engineer:	a. Agree with the designer's response that ground mounted energy absorbing poles will be used where the street light pole is unprotected in a low speed environment (safe and appropriate travel speed < 80km/h). b. Agree with the designer's response to provide a minimum of 1.5m setback for street light poles located behind flexible barrier systems.
Client Decision:	a. Proceed as per Safety Engineer recommendation. b. Proceed as per Safety Engineer recommendation.
Action Taken:	

2.12 Comment – Cycle and pedestrian wayfinding and other signage

1. No wayfinding signage for pedestrians and cyclists has been provided at this stage. The SAT was advised that a wayfinding signage scheme would be developed. It is important from a safety point of view that wayfinding signage clearly directs pedestrians/cyclists to the safest route to key destinations.

2. In the design report covering kerbs, footpaths and cycleways, section 2.1.2, it is noted that signs and markings will be provided to direct cyclists onto the off-road facilities. These are not shown on the current signage and pavement marking drawings.

Designer Response:	Wayfinding measures will be provided to safely direct pedestrian and cyclist to the key destination.
Safety Engineer:	Agree with the designer's response that wayfinding signage will be provided to safely direct pedestrian and cyclists to key destinations. The format of the wayfinding signage is to be consistent with that developed on the TCC shared pedestrian/cycle path network.
Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

2.13 Comment – Pavement marking specifications

The pavement marking legend on drawing 3240 shows a single specification for edge lines (100mm HPLL), lane lines (100mm HPLL plus ATP + RRPMs) and border lines (200mm HPLL). Additional options need to be shown for the each so that there is consistency between the design report statements and the pavement marking drawings:

1. Lane lines on roundabouts should be only 100mm HPLL as ATP and RRPMs are not necessary on the circulating carriageway and can be a safety hazard for motorcyclists in particular.

2. Edge lines on the main SH2 expressway (LHS and RHS) should be 150mm being high volume/high speed. Also, in the design report for signage and pavement marking, section 2.1.2, it was stated that the expressway edge lines would have ATP + RRPMs (red LHS, yellow RHS), but this is not covered in the pavement marking legend. [**NB** RRPMs adjacent to edge lines are not needed when the carriageway is lit, though there should be yellow reflectors on the wire rope barrier posts per NZTA technical memorandum TM-2014.]

3. In the design report for signage and pavement marking, section 2.1.2, border lines at the ramp entries and exits are noted as having ATP, but this is not covered in the pavement marking legend.

The pavement marking legend also notes continuity lines as being 100-150mm HPLL. The SAT considers that all the continuity lines (both for tracking at intersections and for lane development) should be specified at 150mm wide so that they are clearly distinguishable in the complexity of the intersections where they are used.

Designer Response:	- ATP and RRPMS will be removed from the circulating carriageway on roundabouts. - Edge lines on the main SH2 expressway (LHS and RHS) will be changed to 150mm. - The design report section 2.1.2 will be amended to reflect that RRPMs adjacent to edge lines are not needed since the carriageway is lit. Yellow reflectors will be provided on the wire rope barrier posts as per NZTA technical memorandum TM-2014. - Design report section 2.1.2 will be amended. ATP will be removed from border lines at the ramp entries and exits. - All the continuity lines (both for tracking at intersections and for lane development) will be specified at 150mm wide.
Safety Engineer:	- Agree with the designer's response that audio tactile profiled markings and raised reflective pavement markers will not be applied to the circulating lanes on roundabouts. - Nearside and offside edge lines along the main SH2 expressway section (safe and appropriate travel speed of 100km/h) will be

	150mm wide high performance long life pavement marking including in the condition of rain. - Agree with the designer's response that raised reflective pavement markers will not be provided adjacent to the off side edge line within lit sections of the carriageway. Yellow reflectors shall be provided on the wire rope barrier posts as per NZTA technical memorandum TM-2014. - Disagree with the designer's response. Audio tactile profiled marking to be applied only where is it is 200 metres clear of an adjacent residential property within areas where the safe and appropriate travel speed is greater than 70km/h. - Continuity lines shall be applied as follows: o All continuity lines within the expressway section of the SH2 TEL shall be 200mm wide high performance long life markings including in the condition of rain. o All continuity lines within a safe and appropriate travel speed of 80km/h shall be 200mm wide long life markings. o All continuity lines within a safe and appropriate travel speed <80km/h shall be 150mm wide long life markings.
Client Decision:	Proceed as per all Safety Engineer recommendations above.
Action Taken:	

3.0 AUDIT FINDINGS – SH2

3.1 Moderate Concern – Geometry and shoulder widths of SH2 flyover

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

An area of potential concern to the SAT is the MGI flyover where the combined vertical and horizontal curves are both at the minimum for 80 km/h design speed, plus there are narrow shoulders (1.75m left hand side, 1.25m right hand side). There is also a TL5 concrete barrier each side of the bridge which will restrict forward sight distance on the inside of the curve (northbound).

It is likely that northbound speeds will often be higher than 80 km/h as drivers will have been travelling on a grade separated route for some distance. The safety concern at the flyover is that if there is an incident on the northern side of the flyover with vehicles slowing/stopping, some higher speed vehicles would not see the incident in time to safely stop, added to which they do not have a shoulder of sufficient width onto which to "escape."

To address the above safety issue, it is desirable that there be a wider shoulder on the inside of the curve (ie western side of the flyover) to provide better forward sight distance as well as an escape route. Forward sight distance for safe stopping (object height) should be achieved for speeds greater than 80 km/h.

Also, speed management measures should be applied to assist with achieving a safe operating speed.

Recommendations:

a. *Increase the left hand side shoulder width northbound on the MGI flyover to both improve forward sight distance and provide sufficient space for a vehicle to avoid a rear end crash (refer also to item **2.3**).*
b. *Install dynamic/electronic speed signage northbound on SH2 prior to the MGI flyover (refer to item **2.1** for examples).*
c. *Also consider the option of installing queue detection and electronic "queue ahead" signage.*

Designer Response:	a. We have provided a left hand side shoulder in accordance with the PR. We are conflicted with non-compliance with the PR's to address the Road Safety Audit comments. NZTA to advise. b. Dynamic/electronic speed signage can be installed on SH2 northbound, however, this is outside of project scope and NZTA to advise on provision. c. Queue detection and electronic "queue ahead" signage can be installed. However, this is outside of project scope and NZTA to advise on provision.
Safety Engineer:	a. Refer to the safety engineer's response to *Item 2.2 Significant Concern – Speed limits and design speed* above. The lane and shoulder widths marked are to reinforce, and provide the necessary forward sight distance, when travelling at the safe and appropriate travel speed. Under the Settings of Speed Limit Rule 2017 to change to a 70km/h speed limit needs the specific approval of the General Manager, Safety and Environment. b. There may be merit in installing dynamic/electronic speed signage to reinforce the safe and appropriate travel speed if has not been able to reinforced by the design of the road form or the surrounding environment. The Contractor's design should not preclude the installation of these signs and associated ducting and infrastructure works post construction should it be considered that these are required. c. There may be merit in installing queue detection and electronic "queue ahead" active warning signage to reinforce the safe and appropriate travel speed if has not been able to reinforced by the design of the road form or the surrounding environment. The Contractor's design should not preclude the installation of these signs and associated ducting and infrastructure works post construction should it be considered that these are required.
Client Decision:	a. To be read in conjunction with Client Decision response a) *Item 2.1: Significant Concern – Speed limits and design speed* above. Designer to confirm if forward sight distance is achieved at 60 and 70km/h design speeds, and same for manoeuvring distance. b. As per Client Decision response b) to *Item 2.1: Significant Concern – Speed limits and design speed* above. c. Proceed as per Safety Engineer recommendation. Sufficient ducting is to be installed throughout project length, facilitating queue detection and signage if required in the future. ITS ducts may be used for this purpose.
Action Taken:	

3.2 Moderate Concern – Cyclists using SH2 flyover

Probability of Crash Occurring – Infrequent
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

As noted in previous safety audits, it is essential that southbound cyclists in particular are banned from the flyover so that they do not end up on the TEL route. The recommendation was that both signs and markings be provided to stop cyclists using the flyover. Drawing 3211 shows a single small RG-24 cyclists prohibited sign is to be erected behind the physical nose of the diverge. However, the SAT queries whether this is sufficient since the sign will not be obvious to cyclists until they have already moved over to cycle onto the flyover.

NB As noted in the decision tracking for the safety audit of the tender design, legally restricting cyclists from using the flyover will require public consultation and gazetting.

Recommendation:

Provide additional signage on the eastern side of Maunganui Road prior to the diverge to the flyover (eg at approx. ch 0) to advise cyclists that they are prohibited from using the flyover.

Designer Response:	Additional signage will be installed on the eastern side of Maunganui Road prior to the diverge to the flyover to advise cyclists that they are prohibited from using the flyover.
Safety Engineer:	To extend the restriction of pedestrians and cyclists from the current start and terminus of the SH2 Tauranga Eastern Link, to the western extent of the flyover, will require consultation with key stakeholders prior to the gazetting process. This should be done at the same time as any other restrictions being placed on road users with the design (consultation and gazetting of speed limit changes should be a separate exercise).
Client Decision:	Proceed as per Designer response for additional signage. Gazetting and consultation required for rule changes to be undertaken by Transport Agency.
Action Taken:	

3.3 Comment – Pavement marking at southern end

Pavement marking drawing 3243 does not show the correct lane marking for the two lanes northbound past the off-ramp at SH29A and the subsequent merge to one lane. It is assumed that this is a draughting error.

Designer Response:	Pavement marking drawing will be amended to show the correct lane marking for the two lanes northbound past the off-ramp at SH29A and the subsequent merge to one lane.
Safety Engineer:	The length of the lane merge needs to be consistent with the safe and appropriate travel speed for the section of highway.
Client Decision:	Proceed as per Designer Response/Safety Engineer recommendation.
Action Taken:	

4.0 AUDIT FINDINGS – SH29A

4.1 Moderate Concern – SH29A mainline approach to roundabout

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

In item **2.2** it was noted that speed reduction on SH29A eastbound approaching the Truman Lane roundabout is particularly important given that the proposed speed limit change from 100 km/h to 50 km/h is only 220m prior to the roundabout. Whilst speed reducing measures at the speed limit threshold are essential, visibility of the roundabout and road alignment ahead are also important to encourage approach speeds that are appropriate for safe entry onto the roundabout.

No details were provided regarding the landscaping of the roundabout central island and hence its visibility. The central island should be clearly visible by way of being mounded, landscaped and signed to provide an effective visual target.

Drawing 3214 shows only single PW-69 chevron signs on the central island for each approach to the roundabout. For the size of roundabout (approx. 45m diameter), there should be at least 2 x PW-69 chevron boards facing each approach. Also, the position of these signs should be determined on site after construction to ensure that they are in line with the projected vision of an approaching driver.

Notwithstanding the above, the central island is offset to the left in terms of drivers' view ahead on the high speed eastbound approach and additional delineation of the curved approach may be necessary.

Recommendations:

a. Ensure that the central island is appropriately mounded and landscaped to be identifiable as such from the approaches.
*b. Provide additional PW-69 chevron boards on the central island in direct line of vision for motorists. (**NB** the exact positioning of the PW-69 signs is best determined post construction.)*
*c. Install PW-67 chevron signs on the SH29A median at the eastbound curve approaching the roundabout per **Figure 4**. (**NB** this may be best assessed post construction.)*

Figure 4 – Example of PW-67 chevrons on a median approaching a roundabout.

Designer Response:	a. Central island will be designed to be more easily identified. Landscape features will further highlight its prominence. b. Additional PW-69 chevron boards will be installed on the central island in direct line of vision for motorists. c. PW-67 chevron signs will be installed on the SH29A median at the eastbound curve approaching the roundabout. (Assess need after opening)
Safety Engineer:	a. Agree with the designer's response that the central island will be designed to be more easily identified. For the landscaping ground cover with a maximum height of 150mm shall be provided on the parts of the central island where Criterion 2 sight distance is to be provided. b. A PW-69 chevron boards shall be provided for each approach lane to the roundabout. Refer to the signs and marking mark ups provided by the Safety Engineer for set-out of chevron boards. c. Agree with the designer's response that installing the PW-67 chevron signs on the SH29A median at the eastbound curve approaching the roundabout be assessed post construction.
Client Decision:	Proceed as per Safety Engineer recommendations a – d above.
Action Taken:	

4.2 Moderate Concern – SH29A edge barriers

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely

Outcome – Moderate

Where SH29A is being realigned on the approach to the Truman Lane roundabout (ie from ch 260), the existing edge barrier on the southern side is not shown as being replaced (drawing 3274) yet there is a significant drainage channel in that location.

Drawings also show a drainage feature on the southern side of the roundabout that is not protected. Any westbound vehicle losing control on the roundabout and leaving the carriageway is likely to end up in this feature which could lead to a vehicle rolling.

There are also swales on the northern side of realigned SH29A and the roundabout that are not protected.

There is no information as to how traversable (or not) by an errant vehicle the various drainage features are.

Recommendations:

a. Replace/extend existing guardrail along the realigned southern side of SH29A up to Truman Lane.
b. Provide edge protection along the northern side of SH29A if the swales are not shallow and not readily traversable (ie if side slopes are steeper than 1 in 6).

Designer Response:	a. Guardrail will be extended along the realigned southern side of SH29A up to Truman Lane. b. Swales will be protected.
Safety Engineer:	a. Agree with the designer's response that any hazards such as drainage systems along the realigned southern side of SH29A up to Truman Lane will be adequately treated, including installing a roadside barrier system. b. Agree with the designer's response that any hazards such as drainage systems along the northern side of SH29A will be adequately treated including installing a roadside barrier system.
Client Decision:	a. Proceed as per Safety Engineer recommendation. b. Proceed as per Safety Engineer recommendation.
Action Taken:	

4.3 Moderate Concern – SH29A link from SH2 to Truman Lane

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

1. The typical cross section on drawing 3003 shows the SH29A link from SH2 to Truman Lane as having 4.4m wide traffic lanes. The alignment has 100m and 90m radius reverse curves on a 4% gradient down to the roundabout at Truman Lane. A wide carriageway with wide lanes will encourage speed and the risk of loss of control crashes or crashes at the intersections at either end.

   The SAT assumes that the wide traffic lanes are a result of wanting to accommodate 18m semi-trailer design vehicles side by side. For the unlikely event of two of these vehicles being present at the same time, the need to accommodate them side by side is unnecessary and causing a design that would have adverse safety issues.

2. As noted in the previous safety audit, curve delineation signage (eg PW-67 chevrons) may also be needed to highlight the 100mR and 90mR reverse curves.

3. The barrier drawing 3274 shows shoulder widening and barrier set back on the inside of both the 100m and 90m radius curves to provide forward sight distance to the intersections ahead. The widened shoulders (ie greater than 2.5m wide) should be marked with diagonal lines per MOTSAM – these are not shown on pavement marking drawing 3244.

4. Given the risk that some drivers may track across the widened shoulders on the insides of the curves at higher speeds and risk loss of control when exiting the curves, the SAT considers that the edge lines should be marked with audio tactile profiled (ATP) marking to encourage appropriate lane discipline.

Recommendations:

a. Reduce the carriageway width and traffic lane widths based on the tracking of a single 18m design vehicle.
*b. Consider the installation of PW-67 chevron signs to highlight the reverse curves. (**NB** this may be best assessed post construction.)*
c. Mark the widened (>2.5m) shoulders with diagonal bar markings per MOTSAM.
d. Mark the left hand edge lines of each carriageway with ATP.

Designer Response:	a. Review but PRs require twin tracking of 18m vehicle. b. PW-67 chevron signs on the SH29A median at the eastbound curve approaching the roundabout will be assessed post construction. c. Widened (>2/5m) shoulders will be marked with diagonal bar markings as per MOTSAM. d. Agreed. Left hand edge lines of each carriageway will be marked with ATP.
Safety Engineer:	a. Agree with the designer's response regarding reviewing the tracking of the dual 18m design vehicles taking into account the safe and appropriate travel speed of the roundabout approach.

	b. Agree with the designer's response that installing PW-67 chevron signs on the SH29A median at the eastbound curve approaching the roundabout will be assessed post construction. c. Agree with the designer's response and all shoulders wider than two metres are to be marked with shoulder bars as per MOTSAM. d. Nearside and far side audio tactile profiled edge line markings shall only be marked 200 metres beyond any residential dwelling adjacent to the highway.
Client Decision:	a. Proceed as per Safety Engineer recommendation. It is expected that occasionally trucks may be present in both lanes on the westbound approach to the roundabout, serving either the industrial area on Truman Lane or heading onwards on SH29A. While the pavement area is required, the lanes should be marked at 3.5m with wider shoulders provided on both left and right hand sides to accommodate tracking movements. b. Proceed as per Safety Engineer recommendation. c. Proceed as per Safety Engineer recommendation. d. Proceed as per Safety Engineer recommendation.
Action Taken:	

4.4 Comment – SH29A link sag curve

The SAT noted that there is a sharp sag curve in the middle of the 90m radius horizontal curve on the SH29A link east of the Truman Lane roundabout and wonders whether this can be smoothed out for a more comfortable ride.

Designer Response:	We will try to smooth the sag curve out as much as possible.
Safety Engineer:	Agree with the designer's response that a more comfortable ride will be provided for the sharp sag curve in the middle of the 90 metre radius horizontal curve on the SH29A link east of Truman Lane roundabout.
Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

5.0 AUDIT FINDINGS – Interchanges

5.1 Significant Concern – MGI signalised roundabout: vulnerable road users

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely

Outcome – Significant

The SAT endorses the proposed signalised roundabout concept at the MGI as being a more safe system compliant form of intersection than a conventional signalised intersection, which incorporates cross movements and an inherently large number of conflict points which can lead to an increase in crash risk and crash severity, including associated risks to vulnerable road users. Vehicle-vehicle crashes at a signalised roundabout would have a noticeably lower risk of fatality or serious injury compared to crashes at a conventional signals layout where side impact crashes and post-impact trajectory issues can generate fatalities or serious injuries.

The SAT is however concerned about the safety of pedestrians and cyclists being required to cross the signalised roundabout at-grade. Vulnerable road users travelling between Girven Road and Matapihi Road to the west of Owens Place will have to negotiate 5 or 6 separate signalised crossings, depending on their route, to complete the 160m distance. The delay is likely to be significant and lead to pedestrians crossing the roads at other uncontrolled points or ignoring the signals at the crossing points. This would put them at risk of being hit by a vehicle. Furthermore, the delay at each point and subsequent risk of unsafe crossing would be heightened during inclement weather when pedestrians are less inclined to wait for cross signals.

Compounding the risk to pedestrians and cyclists is the complex signals operation at the roundabout. A signalised roundabout operation generally relies on short cycle times and linking of movements to minimise queuing on the roundabout and minimise delays. The SAT has not observed a signalised roundabout operation that includes pedestrian phases to take pedestrians onto the centre island. None of the other successfully implemented signalised roundabouts in the region have pedestrian phases crossing the circulatory roadway streams onto the central island. This will introduce delays to traffic[1], as well as pedestrians, and potentially adversely affect the linking of movements which in turn can lead to drivers failing to see a red light and put pedestrians at risk.

It should be noted that the roundabout is quite small for a signalised roundabout operation, in that there is minimal space for queuing of stopped vehicles on the circulating carriageway. There is thus a risk that movements could be blocked and, again, pedestrians put at risk when trying to negotiate the intersection.

[1] A summary of the initial modelling for the signals operation provided to the SAT indicates poor levels of service and that significant delays will accrue in the peak periods in particular. The signal head, detection and wiring drawings and level of service summaries provided do not provide details of the assumed pedestrian call frequencies, walking speeds, etc, for the SAT to adequately assess their effect. The SAT strongly suggests that, prior to signing off the final design, the signal timing plans including SCATS Controller Information Sheets be subjected to a signal expert peer review team to confirm that their operational and safety performance is achievable in practice. (Refer also to item **5.2**.)

Throughout the development process of this project the SAT has queried why grade separation for pedestrians and cyclists could not be included. The existing subway across Maunganui Road north of the MGI is well used despite not being "friendly" from a personal security perspective. An extension and upgrade of this facility would enable an improved linkage between Girven and Matapihi Roads, reducing delay and exposure to traffic for pedestrians and cyclists. An alternative could be a subway diagonally across the MGI utilising natural light and ventilation by opening it up within the roundabout central island.

Recommendation:

Provide grade separation for pedestrians and cyclists moving between Girven and Matapihi Roads by either extending and upgrading the existing subway or providing a new subway diagonally across the MGI intersection from Bayfair to the southwest corner.

Designer Response:	Upgrading the existing subway or providing a grade separated route at MGI were not considered feasible options. NZTA required that the signalised circulatory be adopted as part of the permanent works. Assuming a walking speed of 1.2m/sec for pedestrians and dismounted cyclists and 1.4m/sec for when cyclists are riding along the shared path. The design has an approximate cycle time of 70 seconds in comparison to a cycle time of up to 125 seconds for the Specimen Design.
Safety Engineer:	In terms of safe system, grade separation between active road users and vehicle traffic would provide the best outcome. If a grade separated facility can be provided within the project it needs to be provided for the greatest desired pedestrian connectivity across the intersection. The project needs to confirm whether a facility like this can be provided. The pedestrian and cycle facilities being provided at the signalised roundabout is also an effective safe system treatment (though not as effective as a grade separated facility) due to the speed management of traffic through the intersection, the shorter crossing lengths and conflict areas for active road users, and also provides greater connectivity for active road users. If it is confirmed within the project that there is no reasonably practical way a grade separated pedestrian and cyclist facility can be provided, then any at-grade facility should incorporate those features to reinforce the safe and appropriate travel speed for pedestrians. This could include: • raised pedestrian platforms across traffic lanes. • raised speed platforms on the approaches to the roundabout. • providing all weather structures to protect active road users on the approaches to, and travelling through, the intersection. • posting a speed limit <50km/h (This may be difficult to achieve

	if the surrounding environment does not reinforce a safe and appropriate travel speed of 40km/h).
Client Decision:	Proceed as per the Safety Engineer recommendation to provide an effective safe system treatment for pedestrians and cyclists, with the construction of at-grade crossing facilities through the signalised roundabout. All items identified in the Safety Engineer's recommendations will be considered further in the development of the intersection's urban design and through a series of workshops with road safety and cycling specialists and stakeholders. Investigations have determined that it is either not feasible or practical to provide a grade-separated facility connecting Girven and Matapihi Roads, either through extending the existing underpass or by providing a new facility. Extending the underpass is not a desirable option due to existing CPTED and personal security issues. The underpass does not meet today's recommended height and width requirements, and its hidden entranceways, poor lighting and lack of passive surveillance provide little deterrent to undesirable behaviour. The underpass has a poor history with respect to crime and vandalism, and the consultation process identified numerous cases where members of the local community did not feel safe using the existing underpass. The underpass is currently 28 metres long and would need to be extended to approximately 60 metres to accommodate the additional road width being constructed as part of the Bay Link project, thereby exacerbating the issues described above. A new, wider underpass is not desirable as many of the CPTED/personal security risks cannot be suitablytly mitigated due to site constraints or project requirements, including its long length (120m), hidden accesses and indirect route for pedestrians, making the at-grade route a more attractive option. A new underpass would also face significant challenges relating to utilities and property acquisition, requiring considerable investment (~$10.5M, excluding property), and adversely impact on the delivery of the existing D&C contract. A new overpass across MGI would mitigate the majority of personal security/CPTED and construction risks associated with the underpass options, but the location for a structure is constrained by the airport flight envelope, in conjunction with the proposed flyover (vehicle) structure. The only feasible location, avoiding the vehicle structure would add approximately 300 metres onto on a one-way trip and provide an unattractive option, compared to the direct at-grade facility at MGI. Note that:-

	• the at-grade facility will require pedestrians to cross a maximum of 5 crossings depending on starting point/destination. This number includes crossings of Owens Place and Matapihi Road which would not be served by a State Highway grade-separated facility. • The traffic signal operation utilises a shorter cycle time than used at traditional signalised intersections, reducing waiting time for pedestrians at crossing points and generally allowing pedestrian phases to be called multiple times in a cycle. • A UK based specialist has been engaged as part of the project to review and provide input in the design and operation of the traffic signals. • Investigations are ongoing into the feasibility of a grade-separated facility downstream of MGI, near Concord Avenue, which would serve a broader purpose to improve pedestrian and cyclist connections across the wider network through to Matapihi Road. July 2019 Update In late 2018 NZTA following a request from public groups opposing proposed signalised crossings and the removal of the underpass NZTA approved an additional scope to progress a new grade separated pedestrian cycle underpass adjacent to the existing underpass. The project team investigated all practicably feasible options including recommendations of the RSA such as diagonally through the RAB. The area is extremely complex with a network of underground services that conflict possible underpass locations. A preferred alignment with least conflict was identified adjacent to the existing underpass and a concept design progressed. The underpass concept design was costed at $13 million but following detailed design in mid 2019, this estimate was raised to $33 million. This has made the underpass no longer a viable value for money solution. The project continues to investigate other viable grade separated crossing options in the form of a cycle overbridge in the vicinity of Concorde Avenue with rough order estimate of cost $10-15M.
Action Taken:	

5.2 Moderate Concern – MGI additional issues

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Moderate

Whilst the SAT is primarily concerned about the safety of vulnerable road users at the MGI (item **5.1**), there are a number of other safety matters that need to be taken into consideration as the design develops:

1. The signals layout will need to be clear to motorists on the circulating carriageway with sufficient lanterns in view, though it will also be important to ensure that there is no "read-through" of signals leading to a driver potentially proceeding through a red signal when a green signal is seen at the next control point on the roundabout or on the adjacent approach.

2. It is understood that there are to be separate cycle and pedestrian crossings at each crossing point, but the pavement marking and kerb drawings do not show separated facilities.

3. On drawing 3451, no ramp is shown for cyclists to access the shared path from Maunganui Road southbound prior to Girven Road (approx. ch 370).

4. The pavement marking drawings for the MGI (drawings 3241 and 3245) do not show spiral lane markings on the circulating carriageway to safely direct (a) two lanes of traffic from Girven Road to Maunganui Road northbound or (b) the right turn from Maunganui Road southbound to Matapihi Road.

5. The left lane on Girven Road westbound is a left turn only lane and can lead to some motorists being "trapped" in the lane and making unsafe manoeuvres prior to or on the roundabout. Both lane assignment signage and additional arrow markings are needed to mitigate the situation.

6. On the Matapihi Road departure from the MGI, the left hand lane is shown as left turn only into Owens Place. Most drivers exiting the roundabout are likely to be in the left hand lane and there is then only 30m to the limit line at the Owens Place signals. There is thus likely to be unsafe lane changing and frustration that can lead to crashes. There are two lanes on the departure side of the intersection so the left hand lane on Matapihi Road from the roundabout could be used for both through and left turn movements.

7. The limit line on Girven Road is set back some 25m from the roundabout – it is not clear to the SAT why this has been done as it could lead to slower moving cyclists

and possibly some vehicles entering the roundabout when the circulating traffic has a green signal.

8. Drawing 3241 indicates that the lane lines on the MGI circulating carriageway are to have ATP and RRPMs. This is unnecessary and would be unsafe for motorcyclists in particular who are negotiating the roundabout (refer also to item **2.13**).

Recommendations:

a. Address the issues 1 – 8 noted above.
b. Ensure that the layout and operation of the signalised roundabout with pedestrian crossings of the circulatory roadway is peer reviewed by expert(s) experienced in the set-up and operation of signalised roundabouts.

Designer Response:	1. The signal layout will be clear to motorists and there will be no opportunity for read through. 2. We are providing the shared cycle/pedestrian crossings. 3. Cycle ramp will be provided to access the shared path from Maunganui Road southbound prior to Girven Road. 4. Pavement marking drawings for the MGI will be amended to show spiral lane markings on the circulating carriageway. 5. Lane assignment signage and additional arrow markings will be provided on Girven Road westbound. 6. Left hand lane on Matapihi Road from the roundabout will be used for both through and left turn movement. 7. Limit line will be moved towards roundabout as much as possible. 8. ATP and RRPMs will be removed from the MGI circulating carriageway lane lines. b. Review being undertaken.
Safety Engineer:	1. Agree with the designer's response that there will not be "read-through" of the signal layout. The signal design will need to be reviewed by a System Optimisation team member with extensive experience in signalised roundabout design. 2. Agree with the designer's response pedestrian and cycle signalised crossing facilities will be provided. These facilities will need to be reviewed by a System Optimisation team member with extensive experience in the design of pedestrian and cyclists signalised crosswalk design. 3. Agree with the designer's response that a cycle ramp will be provided to access the shared path from Maunganui Road southbound prior to Girven Road. 4. Agree with the designer's response that the pavement marking drawings for the MGI will be amended to show spiral lane markings on the circulating carriageway. Refer also to the mark-up of the signage and pavement marking drawings as provided by the safety engineer. 5. Agree with the designer's response that lane assignment signage

	and additional arrow markings will be provided on Girven Road westbound. Refer also to the mark-up of the signage and pavement marking drawings as provided by the safety engineer. 6. Agree with the designer's response that the left hand lane on the Matapihi Road westbound direction from the roundabout will be a shared through and left turn lane. 7. Agree with the designer's response that the limit line for the Girven Road westbound approach will be moved towards the signalised roundabout as much as possible. 8. Agree with the designer's response that audio tactiled profiled marking and raised reflective pavement markings will be removed from the MGI circulating carriageway lane lines. b. Agree with the designer's response. The layout and operation of the signalised roundabout with pedestrian crossings of the circulatory roadway should also be peer reviewed by a System Optimisation team member extensively experienced in the set-up and operation of signalised roundabouts.
Client Decision:	Proceed as per Safety Engineer recommendations 1-8 above. b. Proceed as per Safety Engineer recommendation. They layout and operation of the signalised roundabout will be reviewed both by a UK based independent specialist, as noted in Client Decision response to *Item 5.1: Significant Concern – MGI signalised roundabout: vulnerable road users*, and the Transport Agency's internal System Optimisation team. In addition to the above, this element of the design is subject to a Category 1 Design Check and specific traffic signal audits, as part of the design and installation.
Action Taken:	

5.3 Minor Concern – SH2/SH29A interchange

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

There are a couple of minor safety matters at the SH2/SH29A interchange that should be addressed as the design develops:

1. The limit line for the signals at SH29A/southbound off-ramp/southbound on-ramp is set back some 10m from the primary signal and the median island is some 17m from the intersection (refer drawing 5201). These generate a large "no man's area" within which there are double right turns from the off-ramp and onto the on-ramp. Observations elsewhere have shown that most drivers do not follow tracking lines in these situations and conflicts can often arise.

It is appreciated that the large area for the double right turns is generated by the design requirement of wanting to accommodate two 18m semi-trailer design vehicles side by side. For the unlikely event of two of these vehicles being present at the same time, the need to accommodate them side by side is considered unnecessary and is causing a design that could have adverse safety issues. Truck drivers needing to turn simultaneously are habitually experienced to stagger their turns to avoid any conflict.

In the opinion of the SAT, the design should be based on a car turning alongside an 18m semi-trailer and the designs of the median island and the traffic signals layout be adjusted accordingly.

(**NB** if this is not acceptable, then additional tracking lines need to be installed on the inside of the right turn tracks to try and provide guidance to drivers.)

2. Drawing 5201 also shows the primary traffic signal pole for the SH29A/southbound off-ramp intersection located within the shoulder as there is no footpath on the northern side of the bridge. The SAT considers that this area of shoulder should be painted with closely spaced diagonal lines (hatching) to help reduce the likelihood of a vehicle tracking onto the shoulder and hitting the pole, plus it would help reduce the risk of a driver inadvertently turning left onto the off-ramp.

Recommendation:

Address the issues 1 and 2 noted above.

Designer Response:	1. PRs require that the tracking be undertaken by two 18m semi-trailers. 2. The design has been updated since then and the traffic signal pole is now located behind the safety barrier, out of the shoulder.
Safety Engineer:	1. Agree with the safety audit team's recommendation about the extent of "no-man's area" provided with the signal design. Suggest the provision of two x 18m semi-trailer design vehicles being side by side be reviewed in conjunction with staggering the limit lines to determine if this assists with rationalising the tracking envelopes. The safety engineer was not provided a copy of Drawing 5201 so unclear on the delineation of the median. The delineation of the right turn, and the delineation of the median area beyond the extents of the median island, needs to be effective in providing a safe and appropriate travel speed median. There may need to a traversable extent of island within the median to provide the lane discipline and speed management of the right turn for smaller design vehicles, and provide the manoeuvring area for larger design vehicles. The intended design is to be provided to the safety engineer to effectively provide the response on this. 2. Agree with the designer's response that the traffic signal pole will

	be located behind the safety barrier and not within the shoulder.
Client Decision:	1. Proceed as per Safety Engineer recommendation – design to be provided to the Safety Engineer to provide effective response. 2. Proceed as per Safety Engineer recommendation.
Action Taken:	

6.0 AUDIT FINDINGS – Other matters

6.1 Minor Concern – Link roads (ramps) between interchanges

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

1. As noted in item **2.5**, the SAT is of the view that the two roads that link the two interchanges are part of the state highway system for the SH2/SH29A split interchange and should be treated as such. To this end, as covered in item **2.8**, the kerbing along the southbound link should be mountable. Regardless of the status of the road, it is considered that the footpath on the eastern side of the southbound link should be widened to allow for cyclists to use it (ie become a shared path), especially as much of the new section of footpath between the SH29A interchange and Exeter Street is to be formed to a width of 3m. (NB there should be adequate width available to widen – see **Figure 5**.)

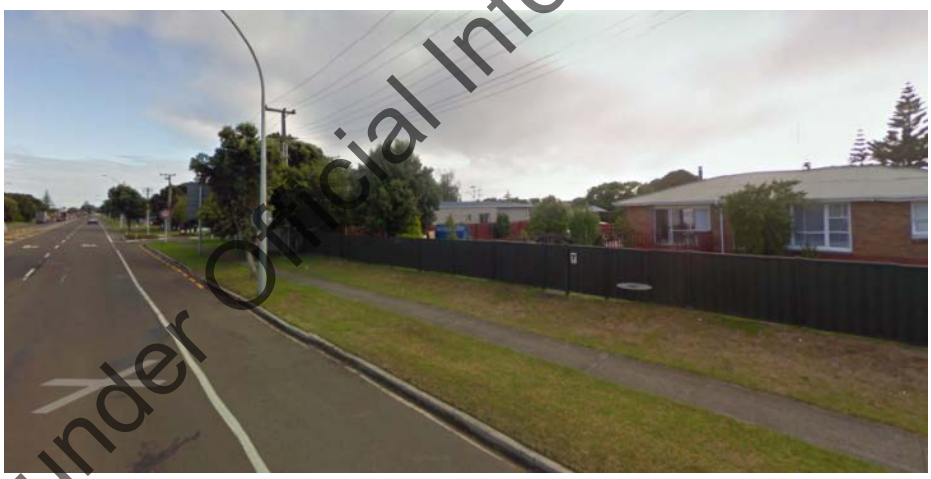

Figure 5 – Maunganui Road at Exeter Street

2. The cross section at ch 900 on drawing 3002 shows the link roads as having 3.5m wide lanes with a narrow 500mm shoulder hard up against the mainline concrete safety barrier. Given that the link roads will have a speed limit of 50 km/h, in order to make these roads more self-explaining for this speed, the SAT considers that it could be more appropriate to have 3.3m wide lanes with a slightly wider shoulder adjacent to the concrete barrier, which would allow for more recovery space in the event of a driver drifting out of lane.

Recommendations:

a. Widen the footpath along the western side of the southbound link to 3m and make it a shared path. (As a minimum, widen the remaining section of 1.8m wide

footpath between Exeter Street and the new 3m wide footpath leading up to the SH29A interchange ie ch 830 to 970.)

b. Widen the shoulder of the link roads adjacent to the mainline concrete safety barriers by making the traffic lanes 3.3m wide.

Designer Response:	a. Path between Exeter Street and SH29A to be widened to 3.0m shared path (subject to variation). Path between Girven Road and Exeter Street crosses many driveways. It is the designer's opinion that the creation of a shared path at this location will increase likelihood of accidents between vehicles using driveways and cyclists. However, currently PR only requires 1.8m pedestrian path and need further discussion with relevant parties. b. PR's requires 3.5m lane, min 0.5m shoulder, wider shoulder and reduced lane width will be incorporated into the design.
Safety Engineer:	a. Agree with the designer's response that a three metres wide shared pedestrian cycle path will be provided. b. Agree with the designer's response in that the lane and shoulder widths will be reallocated to support the safe and appropriate travel speed along the link roads. These reallocation should consider looking at narrower lane widths of between 3 and 3.3 metre width and wider shoulders (this could be done using wider edge and lane lines). It is also unclear if on-street parking is to be removed along the southbound link. If it is to be removed then this will need to be consulted on and the parking restriction gazetted.
Client Decision:	a. Proceed as per Safety Engineer recommendation. b. Proceed as per Safety Engineer recommendation, increasing right side shoulder by reducing lane width to 3.2 metres, and formally removing on-street parking along southbound link through gazetting.
Action Taken:	

6.2 Minor Concern – Truman Lane roundabout

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

The SAT considers that the following safety matters with regard to the Truman Lane roundabout should be addressed as the design is further developed:

1. As noted in item **2.8**, some vertical face kerbs are shown on drawing 3454 extending into the roundabout. The balance of the outside of the roundabout's

circulating carriageway has no kerbing. The SAT considers that there is the potential for some vehicles to track off the carriageway in areas with no kerbing with the risk of then losing control. Kerbing can also offer definition of the carriageway, particularly in dark and/or inclement weather conditions, and also contribute to enhancing the change in speed environment. (**NB** If safety barriers are installed per the recommendation in item **4.2**, additional kerbing may not be required in those locations.) In this regard, as a precedent we note that the current "urban" roundabout which this one is replacing has full kerbing.

2. Pavement marking drawing 3244, does not show a continuity line for development of the additional lane on the Truman Lane approach to the roundabout.

3. Also, on the same drawing, the arrows to be marked on the Truman Lane approach do not reflect the roundabout layout and this could be confusing to some motorists as to which lanes lead to which exits. The arrows should be for left or right turns with no ahead arrows. It is also not clear to the SAT if a double left or double right turn is proposed since the tracking diagram drawing 3072 shows both.

4. Drawing 3244 indicates that the lane lines on the circulating carriageway are to have ATP and RRPMs. This is unnecessary and would be unsafe for motorcyclists in particular who are negotiating the roundabout (refer also to item **2.13**)

Recommendation:

Address the kerbing and pavement marking issues noted in 1 – 4 above.

Designer Response:	1. Barrier will be installed as a recommendation in item 4.2. Therefore, kerbs are not required. 2. Pavement marking drawing will be amended to show a continuity line for development of the additional lane on the Truman Lane approach to the roundabout. 3. Arrows on the Truman Lane approach will be amended to reflect the roundabout layout. 4. Agreed. ATP and RRPMs will be removed from circulating carriageway lane lines at the roundabout.
Safety Engineer:	1. Agree with the designer's response that a road side barrier system will be installed and that a kerb is not required. 2. Pavement marking drawing will be amended to show a continuity line for development of the additional lane on the Truman Lane approach to the roundabout. 3. Agree with the designer's response that the approach lane arrows will be consistent with the circulating lane arrangement on the roundabout. 4. Agree with the designer's response that audio tactile profiled

	markings and raised reflective pavement markers will not be provided on the circulating lanes of the roundabout.
Client Decision:	Proceed as per Safety Engineer recommendations 1-4 above.
Action Taken:	

6.3 Comment – Shared path and speed limit on Truman Lane

In the safety audit of the tender design, the SAT noted:

"…the extent of works on Truman Lane is shown at approx. ch 500…[and] shows the shared path starting/ending and the 50 km/h/80 km/h transition occurring at approx. ch 480. The existing speed limit transition is north of the Baypark access and the shared path should at least continue to the Baypark access. It is important that the extent of works reflects the need to tie in with the appropriate requirements for paths and speed limit changes beyond ch 600."

In the decision tracking, the safety engineer agreed with the SAT and the client decision was that the shared path should be extended to the Baypark car park main access.

The SAT notes that and the shared path has not been extended on the drawings and that the speed limit change is still shown at approx. ch 460 (drawing 3213).

It is the opinion of the SAT that the shared path should be extended to the Baypark main access and that the 80/50 speed limit change should also be relocated to south of the Baypark access (approx. ch 600).

Designer Response:	- Agreed. Shared path will be extended to the Baypark main access. - Agreed. 80/50 speed limit change will be relocated to south of the Baypark access.
Safety Engineer:	a) Agree with the designer's response to extend the shared pedestrian cycle path to the Baypark main access. b) The speed limits, and the speed limit change points, will need to reflect the safe and appropriate travel speeds through the surrounding environment.
Client Decision:	a) Current access is undesirable due to length and so discussions with TCC and Baypark are ongoing to optimise access for pedestrians and cyclists to venue. Design of shared pedestrian cycle path to tie-in to this point once confirmed. b) Proceed as per Safety Engineer recommendation. It is proposed that the Truman Lane 80km/h speed limit be moved beyond the Baypark entrance – this is supported by TCC.

Action Taken:	

6.4 Moderate Concern – Shared path down to Truman Lane

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

A long section of the shared path that runs from the SH29A link down to Truman Lane was provided to the SAT (drawing 3122), but no other details. The path is shown with a 5% downgrade and what appear to be tight horizontal curves for safe cyclist use, though the radii are not defined on the long section.

Furthermore, if there is a steep drop adjacent to any section of the path, fencing will be needed

Recommendation:

Ensure that the final design of the path is safe for all users.

Designer Response:	Final design will be provided as safe for all users.
Safety Engineer:	Agree with the designer's response that the final design of the shared pedestrian/cycle path will be made safe for all users. For the purposes of the design any curve less than three metres radius shall be deemed to be out of context for cyclists on any shared path. This shall include where the path terminates at the road and access is onto a cycle lane.
Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

6.5 Minor Concern – Baypark access from SH29A

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Drawings show a left in/left out access to Baypark on SH29A and located approx. 40m from the Truman Lane roundabout. The taper for the entry lane commences just 20m from the roundabout. The safety concern is that just as vehicles are accelerating away from the roundabout, some vehicles will be slowing and braking. This can lead to nose to tail crashes or unsafe lane changing.

Recommendation:

If the Baypark access on SH29A is required, it should only be used for events and under approved temporary traffic management.

Designer Response:	It is our understanding that this access is only operated under TTM.
Safety Engineer:	Agree with the designer's response that the Baypark access south of the SH29A/Truman Lane roundabout will only be used for events and under approved temporary traffic management. Designer to review the delineation and signage for the left turn in (marking of shoulder bars and a RD6L *"Keep Left"* regulatory sign), and also construction material (concrete to separate it from state highway)
Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

6.6 Moderate Concern – Queues at Matapihi Road railway crossing

Probability of Crash Occurring – Infrequent
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

In the safety audit of the tender design, the following was stated:

"No information was provided as to how any queues on Matapihi Road across the railway crossing would be cleared through co-ordination with the traffic signals at Owens Place and MGI. It will be important that there is a mechanism to facilitate the clearance of any queues from the crossing when a train is imminent."

The above still applies.

Recommendation:

Ensure that the traffic signals set up at Matapihi Road / Owens Place / MGI provides a mechanism to ensure that any queue of vehicles across the rail line can be safely cleared prior to a train arriving.

Designer Response:	Queue detection on Matapihi Road is provided which will be controlling traffic signals at Matapihi Road / Owens Place / MGI.
Safety Engineer:	Agree with the designer's response that the activation of the level rail warning system and the barrier operation is linked to the Matapihi Road/ Owens Place /MGI signalised intersection such that any Matapihi Road queues are cleared before the barriers are lowered.
Client Decision:	It is unclear whether the queue detection system is sufficient to override the signalised roundabout lights in order to clear the queue, or if this would provide a beneficial outcome. Explore option further to determine viability and benefits of queue detection system, and use yellow hatch markings on crossing box as additional mitigating factor.
Action Taken:	

6.7 Comment – Lighting at Matapihi Road railway crossing

In the safety audit of the tender design, the SAT noted:

"The SAT is not aware whether or not additional street lighting is proposed to be installed at the railway crossing. It would certainly be beneficial from a road safety perspective if good lighting were installed at the crossing for the benefit of all road users, whether installed under the rail relocation contract or the B2B project."

In the decision tracking, the safety engineer supported the above and the client decision was that the NZTA should *"explore whether additional lighting at the level crossing is required."*

The SAT is not aware of the outcome of the above, though a new street light is shown on the southern side of Matapihi Road at the railway crossing as part of the lighting scheme for Matapihi Road (drawing 3411).

Designer Response:	Lighting will not be provided at the site of the rail crossing as part of the B2B project as it is outside the project boundary. NZTA to consider and action.
Safety Engineer:	Agree with the safety audit team's comment that the pedestrian level rail crossings are to be well lit. As a minimum these shall be lit to the same standard as that provided at formal pedestrian crossings.

Client Decision:	Proceed as per Safety Engineer recommendation.
Action Taken:	

6.8 Comment – Overhead signs on Maunganui Road

There are three overhead cantilever signs to be installed on Maunganui Road facing southbound traffic. Drawing 3271 shows the sign at ch 30 being protected by a safety barrier, but no protection is shown for the other two cantilever signs.

It should also be noted that the safety barrier that is shown protecting the sign at ch 30, extends over approx. ch 5 to 35 and may obstruct access to one or more property driveways. There is also a concrete power pole at the corner of Maunganui Road and Concord Avenue (see **Figure 6**).

Consideration needs to be given as to whether the poles supporting the cantilever signs need to be protected or not, especially if the speed limit on Maunganui Road is reduced per the recommendation in item **2.1**.

Figure 6 – Maunganui Road at Concord Avenue

Designer Response:	- Safety barrier has been removed because the gantry is outside of the clear zone. - Safety barriers have been removed because the gantries are outside of the clear zone. - Safety barriers are considered non necessary since the gantries are outside of the clear zone.
Safety Engineer:	The philosophy of a clear zone is not consistent with the application of the safe system approach. If the design is including additional roadside hazards within the highway designation then these are to be effectively treated to reduce the likelihood of any fatal or serious casualties should

	the hazard be struck.
Client Decision:	Agree with the Safety Engineer recommendation;- road side barriers to be provided for all gantries where practicable. Where not practicable, these should be agreed with the Transport Agency on a case by case basis.
Action Taken:	

6.9 Comment – New Bayfair access on Maunganui Road

A new Bayfair shopping access is proposed on Maunganui Road approx. 100m north of the existing access. The SAT has the following concerns with regard to this proposed access:

1. The access is to be located at ch 170 and exiting vehicles may be able to drive around the crash cushion on the gore area of the diverge to the flyover to gain direct access to the flyover. This would be a potentially dangerous manoeuvre that could result in side impact crashes.

2. The access is to be located where two lanes are being developed and a driver signalling to turn left into the access may be interpreted by a following driver as just changing lanes, leading to possible nose to tail crashes or a late unsafe lane change.

3. With both accesses being shown as entry and exit, there is likely to be weaving/lane changing in the short 100m between the accesses (eg a southbound vehicle passing a vehicle slowing to enter the first access and then quickly changing lanes to enter at the second access; a vehicle exiting the first access and changing lanes to pass a vehicle slowing for the second access.)

The SAT considers that safety would be significantly improved if either this new access was deleted or was made entry only with a deceleration area that vehicles can move into prior to turning. The following (existing) access at ch 270 should then be made exit only. (**NB** the SAT is aware that a separate independent safety audit of the Bayfair accesses has been carried out (for Bayfair), but the results of the audit were unavailable at the time of this safety audit.)

Designer Response:	- The placement of barrier and crash cushion has been lengthened to deter the dangerous manoeuvre. - The designer agrees SAT comment but additional access (future provision for) is provided as a variation from the NZTA to the contract.

	NZTA to consider and action. - Designer agrees that a safer arrangement would be a left in and out arrangement. Operation of the accesses outside of designer's control. NZTA to consider and action. - Designer agrees that a safer arrangement would be a left in and out arrangement. Operation of the accesses outside of designer's control. NZTA to consider and action issue.
Safety Engineer:	- For the new access at Distance 170m agree with the designer's response that the roadside barrier system placement and crash cushion will be designed such that exiting vehicles from Bayfair will not be physically able to access the flyover. - For the existing access at Distance 270m agree with the designer's response that having this as a egress only, and the new access at Distance 170m as an ingress only, would be a safer arrangement.
Client Decision:	Roadside barrier system to be extended to prevent unsafe movements. Entry/egress only arrangement as suggested above is undesirable from Bayfair perspective. Continuing to explore options and mitigate design issues through separate safety audit process for Bayfair access, by others.
Action Taken:	

6.10 Comment – U-turns on Girven Road

Based on the drawings provided to the SAT, the Bayfair shopping centre access on Girven Road east of the MGI is to remain, but will be left in and left out only. Whilst a solid median is to be taken past the access to the "extent of works", the SAT is concerned that unsafe U-turns will be undertaken at the end of the median island.

In the opinion of the SAT, the solid median should be extended to tie in with the solid median on the approach to the Gloucester Road traffic signals.

Designer Response:	Designers agrees with the RSA comment and extended median would prevent U-turns within Girven Road, outside of project extents. NZTA to confirm provision.
Safety Engineer:	Agree with the designer's response that the solid median be extended to tie with the solid median on the approach to the Gloucester Road traffic signals. If this extension is not provided then a U-turn restriction can be implemented, though this will need to be consulted on and gazetted on to make legally enforceable.
Client Decision:	Proceed as per Safety Engineer recommendation.
Action	

Taken:	

6.11 Comment – Pedestrian route from Bayfair shopping centre to MGI

The SAT has noted in previous safety audits that

"there are no paths from the Bayfair shopping centre that would guide pedestrians (or cyclists) to the proposed signalised crossing facilities at the MGI. Currently pedestrians and cyclists are guided to the subway under SH2. Appropriate signage and paths will need to be developed within the shopping centre as well as on the road reserve."

The client decision with regard to this item in the last safety audit was that the NZTA and designer should *"collaborate with Bayfair to ensure that footpaths align with the shopping centre's expansion plans."*

This matter is repeated in this report for completeness.

Designer Response:	Designer agrees that the footpaths should coordinate between the B2B project and shopping centre expansion. NZTA to action.
Safety Engineer:	Agree with the designer's response that the shared paths between the B2B project and the shopping centre expansion should be coordinated. If at-grade paths are being provided between the shopping centre and Owens Place the functionality and aesthetics of these should be of optimum design i.e. providing a covered pathway or some form or weather protection for path users between the two destinations.
Client Decision:	Design of footpaths and cycleways being co-ordinated with Bayfair expansion to ensure functionality and aesthetics are optimised.
Action Taken:	

6.12 Comment – Minor signage issues

1. The speed limit changes on the northbound on-ramp at MGI and the southbound on-ramp at SH29A should be gated per normal NZTA requirements (drawings 3211 and 3213).

2. The Bayfair exit should have a RG-17 keep left sign on the splitter island and a no right turn (RG-7) or a positive turn left (RG-12) sign facing exiting vehicles (drawing 3211).

3. The splitter island on Exeter Street at Maunganui Road should have a RG-17 keep left sign if there is room. Also consider changing the no right turn sign (RG-7) to a positive turn left sign (RG-12) (drawing 3212).

4. Consideration should be given to installing a traffic signals ahead (PW-3) warning sign on the reverse curved link from Truman Lane to the SH2/SH29A interchange (drawing 3214).

Designer Response:	- Agreed. Speed limit changes on the northbound on-ramp at MGI and the southbound on-ramp at SH29A will be gated as per normal NZTA requirements. - Signs will be provided at the Bayfair exit as per SAT comment. - Signs will be provided at the splitter island on Exeter Street at Maunganui Road as per SAT comment. - Consideration will be given by designer to provide the (PW-3) Warning Sign.
Safety Engineer:	- Agree with the designer's response that all speed limit change points are to be gated. The designer should refer to the Speed Management Guide and the Setting of Speed Limits Rule 2017 for the regulatory requirements for speed limits. - Agree with the Designer's response that a RD6L *"Keep Left"*, and a RD1R *"No Right Turn"* will be provided at the Bayfair exit. The RD1R *"No Right Turn"* sign is to be located on the splitter island, and on the right-hand side of the roadway opposite the limit line. - Agree with the designer's response that a RD6L *"Keep Left"* sign be installed on the splitter island if practicable. The RD1R *"No Right Turn"* sign will be provided at the exit, located on the splitter island, and on the right-hand side of the roadway opposite the limit line. - Agree with the designer's response that the installation of the WA4 *"Traffic Signals Ahead"* be considered as a post-construction installation after evaluating whether the sign is warranted. - Refer also to the Safety Engineer's mark-up of the signage and pavement marking drawings.
Client Decision:	Proceed as per all Safety Engineer recommendations above.
Action Taken:	

7.0 AUDIT STATEMENT

We certify that we have used the drawings listed in the Appendix 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. The problems identified have been noted in this report, together with recommendations, which should be studied for implementation.

s 9(2)(a) [redacted]

Signed:.....Date: 24 October 2017

s 9(2)(a) [redacted]
Senior Associate
Traffic Planning Consultants Ltd, Hawke's Bay

s 9(2)(a) [redacted]

Signed:.....Date: 24 October 2017

s 9(2)(a) [redacted]
Robinson Transportation Consulting, Tauranga

s 9(2)(a) [redacted]

Signed:.....Date: 24 October 2017

Ken Holst, Dip TP (NSW), NZCE
Traffic and Safety Engineer
NZ Transport Agency, Napier

Designer:	*Name*.....	*Position*.....
	Signature.....	*Date*.....
Safety Engineer:	*Name:* Adam Francis	*Position:* Senior Safety Engineer
	Signatur s 9(2)(a) [redacted]	*Date:* 4th December 2017
Project Manager:	*Name: Greig Stephen*	*Position:* Senior Project Manager
	Signature s 9(2)(a) [redacted]	*Date:* 31 January 2018
Action Completed:	*Name*.....	*Position*.....
	Signature.....	*Date*.....

Project Manager to distribute audit report incorporating decision to designer, Safety Audit Team Leader, Safety Engineer and project file. ***Date:*****.....**

APPENDIX

Drawings provided for road safety audit

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
INDEX & LAYOUT				
B2B-DRG-AD01-1001	B	COVER SHEET		
B2B-DRG-AD01-1002	B	SHEET INDEX	SHEET 1	
B2B-DRG-AD01-1003	B	SHEET INDEX	SHEET 2	
B2B-DRG-AD01-1005	B	GENERAL ARRANGEMENT	STRING NAMES	
TYPICAL SECTIONS				
B2B-DRG-RG01-3001	B	TYPICAL CROSS SECTION	SHEET 1	
B2B-DRG-RG01-3002	B	TYPICAL CROSS SECTION	SHEET 2	
B2B-DRG-RG01-3003	B	TYPICAL CROSS SECTION	SHEET 3	
B2B-DRG-RG01-3004	B	TYPICAL CROSS SECTION	SHEET 4	
B2B-DRG-RG01-3021	B	CONCRETE EDGE DETAILS	EDGE TREATMENT	
ROAD PLANS				
B2B-DRG-AL01-3051	B	GENERAL ARRANGEMENT	PLAN	SHEET 1
B2B-DRG-AL01-3052	B	GENERAL ARRANGEMENT	PLAN	SHEET 2
B2B-DRG-AL01-3053	B	GENERAL ARRANGEMENT	PLAN	SHEET 3
B2B-DRG-AL01-3054	B	GENERAL ARRANGEMENT	PLAN	SHEET 4
TRACKING				
B2B-DRG-AL01-3071	B	TRACKING CURVES	OVERALL PLAN	
B2B-DRG-AL01-3072	B	TRACKING CURVES	BAYPARK ROUNDABOUT	PLAN
B2B-DRG-AL01-3073	B	TRACKING CURVES	SH29A/SH2 INTERSECTION	PLAN
B2B-DRG-AL01-3074	B	TRACKING CURVES	MGI INTERSECTION	PLAN
PLAN & LONG-SECTION				
B2B-DRG-AL01-3101	B	PLAN & LONG-SECTION	MAINLINE - MC10	SHEET 1
B2B-DRG-AL01-3102	B	PLAN & LONG-SECTION	MAINLINE - MC10	SHEET 2
B2B-DRG-AL01-3103	B	PLAN & LONG-SECTION	MAINLINE - MC10	SHEET 3
B2B-DRG-AL01-3105	B	PLAN & LONG-SECTION	SH29A - MC30	SHEET 5
B2B-DRG-AL01-3106	B	PLAN & LONG-SECTION	SH2/SH29A - MC50	SHEET 6
B2B-DRG-AL01-3107	B	PLAN & LONG-SECTION	SH29A SOUTHBOUND OFF-RAMP-MCA0	SHEET 7
B2B-DRG-AL01-3108	B	PLAN & LONG-SECTION	SH29A SOUTHBOUND ON-RAMP-MCB0	SHEET 8
B2B-DRG-AL01-3109	B	PLAN & LONG-SECTION	SH29A NORTHBOUND ON-RAMP-MCC0	SHEET 9
B2B-DRG-AL01-3110	B	PLAN & LONG-SECTION	SH29A NORTHBOUND OFF-RAMP-MCD0	SHEET 10
B2B-DRG-AL01-3111	B	PLAN & LONG-SECTION	TRUMAN LANE-MCE0	SHEET 11
B2B-DRG-AL01-3113	B	PLAN & LONG-SECTION	OWENS ROAD - MC40	SHEET 13
B2B-DRG-AL01-3114	B	PLAN & LONG-SECTION	GIRVEN ROAD - MC20	SHEET 14
B2B-DRG-AL01-3115	B	PLAN & LONG-SECTION	MATAPIHI ROAD - MCG0	SHEET 15
B2B-DRG-AL01-3116	B	PLAN & LONG-SECTION	MGI SOUTHBOUND OFF-RAMP - MCJ0	SHEET 16
B2B-DRG-AL01-3117	B	PLAN & LONG-SECTION	MGI SOUTHBOUND ON-RAMP - MCK0	SHEET 17
B2B-DRG-AL01-3118	B	PLAN & LONG-SECTION	MGI NORTHBOUND ON-RAMP - MCL0	SHEET 18
B2B-DRG-AL01-3119	B	PLAN & LONG-SECTION	MGI NORTHBOUND OFF-RAMP - MCM0	SHEET 19
B2B-DRG-AL01-3120	B	PLAN & LONG-SECTION	MGI ROUNDABOUT - MCQ0	SHEET 20
B2B-DRG-AL01-3121	A	PLAN & LONG-SECTION	SH29A ROUNDABOUT - MCR0	SHEET 21
B2B-DRG-AL01-3122	A	PLAN & LONG-SECTION	CYCLE PATH & RAIL ACCESS - MCF0	SHEET 22

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
CROSS SECTIONS MAINLINE				
B2B-DRG-AL01-3601	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 1
B2B-DRG-AL01-3602	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 2
B2B-DRG-AL01-3603	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 3
B2B-DRG-AL01-3604	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 4
B2B-DRG-AL01-3605	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 5
B2B-DRG-AL01-3606	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 6
B2B-DRG-AL01-3607	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 7
B2B-DRG-AL01-3608	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 8
B2B-DRG-AL01-3609	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 9
B2B-DRG-AL01-3610	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 10
B2B-DRG-AL01-3611	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 11
B2B-DRG-AL01-3612	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 12
B2B-DRG-AL01-3613	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 13
B2B-DRG-AL01-3614	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 14
B2B-DRG-AL01-3615	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 15
B2B-DRG-AL01-3616	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 16
B2B-DRG-AL01-3617	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 17
B2B-DRG-AL01-3618	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 18
B2B-DRG-AL01-3619	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 19
B2B-DRG-AL01-3620	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 20
B2B-DRG-AL01-3621	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 21
B2B-DRG-AL01-3622	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 22
B2B-DRG-AL01-3623	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 23
B2B-DRG-AL01-3624	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 24
B2B-DRG-AL01-3625	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 25
B2B-DRG-AL01-3626	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 26
B2B-DRG-AL01-3627	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 27
B2B-DRG-AL01-3628	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 28
B2B-DRG-AL01-3629	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 29
B2B-DRG-AL01-3630	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 30
B2B-DRG-AL01-3631	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 31
B2B-DRG-AL01-3632	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 32
B2B-DRG-AL01-3633	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 33
B2B-DRG-AL01-3634	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 34
B2B-DRG-AL01-3635	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 35
B2B-DRG-AL01-3636	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 36
B2B-DRG-AL01-3637	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 37
B2B-DRG-AL01-3638	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 38
B2B-DRG-AL01-3639	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 39
B2B-DRG-AL01-3640	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 40
B2B-DRG-AL01-3641	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 41
B2B-DRG-AL01-3642	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 42
B2B-DRG-AL01-3643	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 43
B2B-DRG-AL01-3644	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 44
B2B-DRG-AL01-3645	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 45
B2B-DRG-AL01-3646	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 46
B2B-DRG-AL01-3647	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 47
B2B-DRG-AL01-3648	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 48
B2B-DRG-AL01-3649	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 49
B2B-DRG-AL01-3650	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 50
B2B-DRG-AL01-3651	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 51
B2B-DRG-AL01-3652	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 52
B2B-DRG-AL01-3653	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 53
B2B-DRG-AL01-3654	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 54
B2B-DRG-AL01-3655	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 55

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
CROSS SECTIONS MAINLINE				
B2B-DRG-AL01-3656	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 56
B2B-DRG-AL01-3657	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 57
B2B-DRG-AL01-3658	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 58
B2B-DRG-AL01-3659	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 59
B2B-DRG-AL01-3660	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 60
B2B-DRG-AL01-3661	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 61
B2B-DRG-AL01-3662	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 62
B2B-DRG-AL01-3663	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 63
B2B-DRG-AL01-3664	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 64
B2B-DRG-AL01-3665	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 65
B2B-DRG-AL01-3666	B	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 66
B2B-DRG-AL01-3667	A	DETAIL CROSS-SECTIONS	MAINLINE - MC10	SHEET 67

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
SIGNS				
B2B-DRG-AD01-1007	A	SHEET INDEX	SIGNS & PAVEMENT MARKINGS	
B2B-DRG-SL01-3211	A	TRAFFIC SERVICES	SIGNAGE	SHEET 1
B2B-DRG-SL01-3212	A	TRAFFIC SERVICES	SIGNAGE	SHEET 2
B2B-DRG-SL01-3213	A	TRAFFIC SERVICES	SIGNAGE	SHEET 3
B2B-DRG-SL01-3214	A	TRAFFIC SERVICES	SIGNAGE	SHEET 4
B2B-DRG-SL01-3221	A	TRAFFIC SERVICES	GUIDE SIGN DETAILS	SHEET 1
B2B-DRG-SL01-3222	A	TRAFFIC SERVICES	GUIDE SIGN DETAILS	SHEET 2
B2B-DRG-SL01-3223	A	TRAFFIC SERVICES	GUIDE SIGN DETAILS	SHEET 3
B2B-DRG-SL01-3224	A	TRAFFIC SERVICES	GUIDE SIGN DETAILS	SHEET 4
B2B-DRG-SL01-3226	A	TRAFFIC SERVICES	SIGN DETAILS REGULATORY	
PAVEMENT MARKINGS				
B2B-DRG-SL01-3240	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	LEGEND
B2B-DRG-SL01-3241	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	SHEET 1
B2B-DRG-SL01-3242	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	SHEET 2
B2B-DRG-SL01-3243	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	SHEET 3
B2B-DRG-SL01-3244	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	SHEET 4
B2B-DRG-SL01-3245	A	TRAFFIC SERVICES	PAVEMENT MARKINGS	SHEET 5

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
BARRIERS				
B2B-DRG-AD01-1004	A	SHEET INDEX	BARRIERS & KERBS	
B2B-DRG-RF01-3271	A	TRAFFIC SERVICES	BARRIERS	SHEET 1
B2B-DRG-RF01-3272	A	TRAFFIC SERVICES	BARRIERS	SHEET 2
B2B-DRG-RF01-3273	A	TRAFFIC SERVICES	BARRIERS	SHEET 3
B2B-DRG-RF01-3274	A	TRAFFIC SERVICES	BARRIERS	SHEET 4
B2B-DRG-RF01-3275	A	TRAFFIC SERVICES	BARRIERS	SHEET 5
B2B-DRG-RF01-3281	A	TRAFFIC SERVICES	BARRIERS	TYPICAL DETAILS
B2B-DRG-RF01-3282	A	TRAFFIC SERVICES	BARRIERS	TL4 TO TL5 TRANSITION
KERBS, FOOTPATH & CYCLEWAYS				
B2B-DRG-PT01-3451	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	SHEET 1
B2B-DRG-PT01-3452	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	SHEET 2
B2B-DRG-PT01-3453	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	SHEET 3
B2B-DRG-PT01-3454	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	SHEET 4
B2B-DRG-PT01-3460	A	TRAFFIC SERVICES	CYCLEWAY TRANSITIONS	
B2B-DRG-PT01-3461	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	SECTIONS
B2B-DRG-PT01-3462	A	TRAFFIC SERVICES	KERBS, FOOTPATH & CYCLEWAY	VEHICLE CROSSING

FILENAME	REV	TITLE-1	TITLE-2	TITLE-3
LIGHTING/ITS				
B2B-DRG-AD01-1006	A	TRAFFIC SERVICES	LIGHTING	
B2B-DRG-LV01-3401	A	TRAFFIC SERVICES	ITS & LIGHTING	LEGEND
B2B-DRG-LV01-3402	A	TRAFFIC SERVICES	ITS & LIGHTING	DETAILS
B2B-DRG-LV01-3411	A	TRAFFIC SERVICES	LIGHTING	SHEET 1
B2B-DRG-LV01-3412	A	TRAFFIC SERVICES	LIGHTING	SHEET 2
B2B-DRG-LV01-3413	A	TRAFFIC SERVICES	LIGHTING	SHEET 3
B2B-DRG-LV01-3414	A	TRAFFIC SERVICES	LIGHTING	SHEET 4
B2B-DRG-LV01-3431	A	TRAFFIC SERVICES	ELECTRICAL RETICULATION	SHEET 1
B2B-DRG-LV01-3432	A	TRAFFIC SERVICES	ELECTRICAL RETICULATION	SHEET 2
B2B-DRG-LV01-3433	A	TRAFFIC SERVICES	ELECTRICAL RETICULATION	SHEET 3
B2B-DRG-LV01-3434	A	TRAFFIC SERVICES	ELECTRICAL RETICULATION	SHEET 4