Item 7.1 - Traffic - 7/02/20

N O R T H S Y D N E Y C O U N C I L

To the General Manager

Attach: 1. Road Safety Audit Report

SUBJECT: (7.1) Late Item – Union Street McMahons Point – Proposed Speed Cushions – Road Safety Audit Report

AUTHOR: Report of Traffic & Transport Engineer, Iman Mohammadi

DESCRIPTION/SUBJECT MATTER:

As part of the 2018/2019 implementation of North Sydney Council's Local Area Traffic Management (LATM) Action Plans, it is proposed to install traffic calming devices in Union Street, McMahons Point. The issue of the speeding motorists was also raised at the 519th Traffic Committee held on 7th September 2018 where the committee recommended:

4. ***THAT*** *Council urgently installs speed bumps along the road and also examine the kerb blister on the corner of Union Street.*

Community consultation took place from 13 March 2019 until 10 April 2019. 236 letters were sent to properties in the surrounding area, Union Precinct committee, and the survey was available online through Council's 'Have Your Say' webpage. A total of 49 responses were received, including 4 from the outside survey area.

The matter was discussed at the 525th Traffic Committee meeting held on 14th June 2019 and it was:

"Resolved to Recommend:

1. ***THAT*** *Council notes the outcome of the community consultation with regards to proposed speed cushions in Union Street.*
2. ***THAT*** *subject to an urgent road surface/speed cushion friction analysis being undertaken and if found to be satisfactory, Council installs three (3) rows of speed cushions in Union Street, McMahons Point as per the attached plan."*

Council's Traffic Engineer requested that a Road Safety Audit be undertaken by an external Traffic Consultant to further investigate the proposal to ensure the cushions will not have any negative impacts on the existing road and traffic conditions.

A "Road Safety Audit Stage 2 Preliminary Design Stage and Review of existing road and Traffic Condition" Report was prepared by "Transport & Urban Planning Pty Ltd dated 23rd January 2020.

The report reviews the existing road conditions as well as speed, volume and crash history in Union Street. It also reviews the proposed speed cushions and raises some concerns in relation to the proposed speed cushions. The consultant's Audit findings are summarised in a tabular format on the following page.

The consultant summarises its findings by stating that:

"Overall, the Audit team are doubtful that road cushions are the best solution to address the traffic issues in Union Street."

Item	Issue	Risk Ranking
1	**Isolated use of road cushions** The proposal is contrary to usual practice where speed control devices such as road cushions are installed as part of a Local Area Traffic Management (LATM) scheme.	Medium
2	**Delineation** Consideration should be given to providing clear delineation along Union Street, along the centreline and the parking lanes. Consideration should also be given to the priority of movements at the intersection of Woollcott Street and the installation of line marking and signage to clarify.	High
3	**Adverse Crossfall on Bend** If the proposal proceeds, there is a potential risk for run-off accidents for vehicles heading north-west not slowing down to less than 20km/h on approach to the road cushion due to the combination of steep grade on approach, adverse crossfall on the bend, the change in alignment, together with the road cushions.	Medium to High
4	**Impact on existing pavement** If the proposal proceeds, vehicles braking on approach to the road cushions will place additional load on the existing pavement due to steep downhill grade. Pavement strengthening works should be considered in addition to the installation of road cushions to minimise future risk through pavement failure.	Medium to High
5	**Design Guidelines** The proposed installations are contrary to Austroads Guidelines as follows; * Road cushions are not considered appropriate for use on bends where sight distance is limited or at intersections (refer to Austroads Guide to Traffic Management Part 8 - Section 7.2.2) Proposed road cushions at Locations 2 and 3 are located on 140º bends in the road alignment and near intersections at Locations 1 and 3. * Installation of road humps is generally best where the longitudinal grade of the road is less than 5%. The existing road grade at Locations 1 and 2 is greater than 5%.	Medium
6	**Impact of road cushions on user comfort and existing speed limit** Road cushions are intended to be traversed by vehicles at a speed less than 20km/h for user comfort. The existing speed limit is 50km/h. An appropriate and potentially safer speed limit in Union Street if road cushions are to be installed would be 40km/h.	Medium

Table 1: Items raised in the review and Stage 2 Preliminary Stage Audit

Relates to ECM No: ECM 7820813 and 8019333
Standard or Guideline Used:

1. Austroads Guide to Road Safety
   Part 6: Managing Road Safety Audits
   Part 6A: Implementing Road Safety Audits
2. Austroads Guide to Road Design
3. Austroads Guide to Traffic Management
   Part 8: Local Area Traffic Management
4. RMS - Supplements to Austroads Guide to Road Design
5. AS 1742.13-2009 Manual of Uniform Traffic Control Devices Local Area Traffic Management

Signs & Lines Priority: N/A
Precinct and Ward: Union/ Wollstonecraft
Impact on Bicycles: Nil
Impact on Pedestrians: Nil
Impact on Parking: Nil

RECOMMENDATION:

1. THAT based on the finding of the Road Safety Audit and safety issues stated in the report, installation of speed cushions not to proceed.
2. THAT other alternate treatments be investigated by Council's Traffic Engineer to resolve the speeding issues and report back to Traffic Committee.

PROPOSED ROAD CUSHIONS

UNION STREET, McMAHONS POINT

ROAD SAFETY AUDIT

STAGE 2 PRELIMINARY DESIGN STAGE

AND

REVIEW OF EXISTING ROAD AND TRAFFIC CONDITIONS

Audit Reference: 19153 RSA Stage 2

Report Issue Date: 23 January, 2020

Prepared for: North Sydney Council

Prepared by:

TRANSPORT & URBAN PLANNING PTY LTD
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1.0 INTRODUCTION

1.1 Scope of the Review and Audit

North Sydney Council is proposing to install rubber road cushions in 3 locations on Union Street, McMahons Point.

The North Sydney Council Traffic Committee has requested that further investigation into the proposal be undertaken to ensure the proposal will not have any negative impacts on the existing road and traffic conditions.

Transport and Urban Planning has been engaged by North Sydney Council to provide a review of the existing road and traffic conditions and a Stage 2 Preliminary Design Stage Road Safety Audit on the proposed road cushion installation.

The review of existing road and traffic conditions included the examination of traffic data for Union Street, such as vehicle speed, volumes and vehicle type as well as crash data. Examination of existing traffic conditions and site inspection was undertaken on 18 December, 2019 and 22 January, 2020. Austroads Guides and Australian Standards for traffic calming devices used for Local Area Traffic Management and available research on road cushions was also considered as part of the review.

A Road Safety Audit is a formal assessment of the potential road safety risks associated with a new project or road improvement project conducted by an independent qualified audit team. The audit has been carried out following the procedures set out in Austroads Guides to Road Safety - Part 6: Managing Road Safety Audits and Part 6A: Implementing Road Safety Audits. The audit assessment considers all road users with the purpose of identifying possible deficiencies in the proposal that could result in road safety problems and suggests measures to eliminate or mitigate any risks identified by the audit team. It is intended that these matters be referred back to the designing group for their attention and re-evaluation.

This report details the results of the review of existing road and traffic conditions and Stage 2 Preliminary Design Stage Road Safety Audit for the proposed road cushions in Union Street, McMahons Point.

The review and audit commenced with an email briefing with Iman Mohammadi, Traffic and Transport Engineer with North Sydney Council and subsequent requests for additional information.

The proposal was reviewed and audited between 18 December, 2019 and 23 January, 2020 with the report prepared concurrently.

1.2 Audited Documentation

The following documentation was examined as part of the review and audit.

- Union Street - Speed Cushion Plan by North Sydney Council
- North Sydney Crash Data
- Union Street Traffic Data

Appendix 1 shows the other documents referenced during the audit.

1.3 The Audit Team

The Road Safety Audit Team members are:

Terry Lawrence	Director Accredited Level 3 Road Safety Auditor (Audit Leader) Auditor ID: RSA-02-0002
Lisa Tulau	Design Manager Accredited Level 3 Road Safety Auditor Auditor ID: RSA-02-0443

Terry Lawrence has over 40 years experience in all aspects of traffic engineering and transport planning, including road safety, and has qualifications in traffic engineering and urban planning. Terry has worked as a Traffic Consultant since 1990 and prior to that held various positions with the RMS and other government departments. Terry has over 20 years of experience as an accredited Road Safety Auditor.

Lisa Tulau has extensive experience in road and traffic signal design with qualifications in civil engineering. Lisa has over 10 years of experience as an accredited Road Safety Auditor and holds the PWZTMP white card.

None of the auditors has had any involvement with the design or development of the project.

1.4 Previous Safety Audits

Transport and Urban Planning have not been advised of any previous design stage audits for the proposed road cushions in Union Street, McMahons Point.

2.0 PROJECT INFORMATION

2.1 Project Background

Local residents initially raised concerns with Council around 2017. The main issue raised by residents is vehicle speed. It is noted that vehicle speeds and potential unsafe traffic conditions in this section of Union Street were also raised in the community consultation undertaken for the LATM and Action Plan in LATM Zone 3, Final Report dated 09/02/2018.

In response to initial concerns and further complaints, traffic volume and speed data was collected by Council in July, 2018.

North Sydney Traffic Committee determined that the installation of road cushions would be an effective means of addressing the issues raised. Resident consultation was undertaken showing the 3 proposed locations for the installation of rubber road cushions.

The North Sydney Council Traffic Committee requested further investigation into the proposal to ensure the proposal will not have any negative impacts on the existing road and traffic conditions, particularly in relation to;

- night time conditions
- wet conditions
- possible loss of vehicle control due to excessive speed
- adverse friction on existing road pavement

2.2 Proposed Installation

A road cushion is a form of road hump that occupies only part of the travel lane and is designed to be more sympathetic to cyclists, buses and commercial vehicles than a full-width road hump.

The proposal includes the installation of rubber road cushions at 3 locations as follows;

Location 1 - Union Street approx. 10m east of Bank Street

Location 2 - Union Street approx. 20m south of Euroka Bus Stop

Location 3 - Euroka Street between Bank Lane and Woolcott Street

Figure 1 shows the location of the proposed rubber road cushions.

Concept Design by North Sydney Council

The road cushions are proposed in the through lane and adjacent parking bays at each location.

3.0 REVIEW OF EXISTING ROAD AND TRAFFIC CONDITIONS

3.1 Existing Road Alignment

Union Street has a straight alignment running east-west from Blues Point Road for approx. 420m before a 140º bend (centerline radius 40m). A further straight section of approx. 50m leads to another 140º bend (centerline radius 40m) opposite Bank Lane. Union Street changes to Euroka Street north of Bank Lane.

The road carriageway is generally 10m wide with 2 travel lanes and kerbside parking on both sides. Union Street has an uphill grade exceeding 5% from Blues Point Road to a crest near Chuter Street. From the crest, the downhill grade is approx. 8-10% towards the first 140º bend, then approximately 3-5% between bends. Crossfall in Union Street varies. Adverse crossfall was noted during inspection on the bend north-west of Bank Street.

The posted speed limit on Union Street is 50km/h.

A School Zone is located on Union Street, extending from Thomas Street to approx. 80m west of Blues Point Road.

Union Street is a bus route, with stops on both sides of the carriageway near Thomas Street and on both sides at Euroka Shelter between the 140º bends.

Centreline markings are provided in Union Street between Dumbarton Street and Woolcott Street. L1 markings are provided from Dumbarton Street to the bend north west of Bank Street, which has a narrow painted central median. BB centreline marking is provided between the painted median and Woolcott Street. Parking lanes on both sides of the road are marked in the section generally been Bank Street and Bank Lane.

Centreline markings, including the painted median are worn in this section indicating that vehicles are traversing the centreline. Vehicles heading north-west and buses heading south-east on Union Street were observed to traverse the centerline during site inspection.

Kerb blisters are provided on the northern side of Union Street at Bank Street.

Curve Warning with supplementary speed advisory of 25km/h signs are provided in addition to chevron alignment markers, in both directions, on the bend north-west of Bank Street.

Figure 1 shows the Surrounding Road Network.

3.2 Traffic Speed and Volumes

Traffic Volume and Speed Counts were undertaken in the week of 27 July to 3 August 2019 in Union Street at the following locations;

- Between Thomas Street and Dumbarton Street; and
- North of Bank Street.

Tables 3.1 and 3.2 summarises the daily traffic volumes and 85th percentile vehicle speeds.

REV.	DETAILS OF REVISIONS	DATE

CAD FILE: 19153

JOB NO. 19153
DESIGNED: LT
DRAWN: LT
DATE: 15.1.20

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PROPOSED SPEED CUSHION INSTALLATIONS UNION STREET, McMAHONS POINT

SURROUNDING ROAD NETWORK

DRAWING NO. **FIGURE 1**

REV. **-**

SCALE: NOT TO SCALE

Reference to Tables 3.1 and 3.2 shows that;

- The 7 day average volume in this section of Union Street ranges between 3565-3972 vehicles per day (vpd).
    - The combined 85th percentile vehicle speeds (i.e. both directions) average 48-49km/h.

TABLE 3.1

DAILY VOLUME AND 85TH PERCENTILE VEHICLE SPEEDS IN UNION STREET BETWEEN THOMAS STREET AND DUMBARTON STREET

Criteria	Direction		Total
	North West	South East	
7 Day AADT Traffic Volume (vehicles per day)	1861	2111	3972
85th Percentile Vehicle Speed (km/h)	49	46	48

TABLE 3.2

DAILY VOLUME AND 85TH PERCENTILE VEHICLE SPEEDS IN UNION STREET NORTH OF BANK STREET

Criteria	Direction		Total
	North West	South East	
7 Day AADT Traffic Volume (vehicles per day)	1812	1753	3565
85th Percentile Vehicle Speed (km/h)	49	47	49

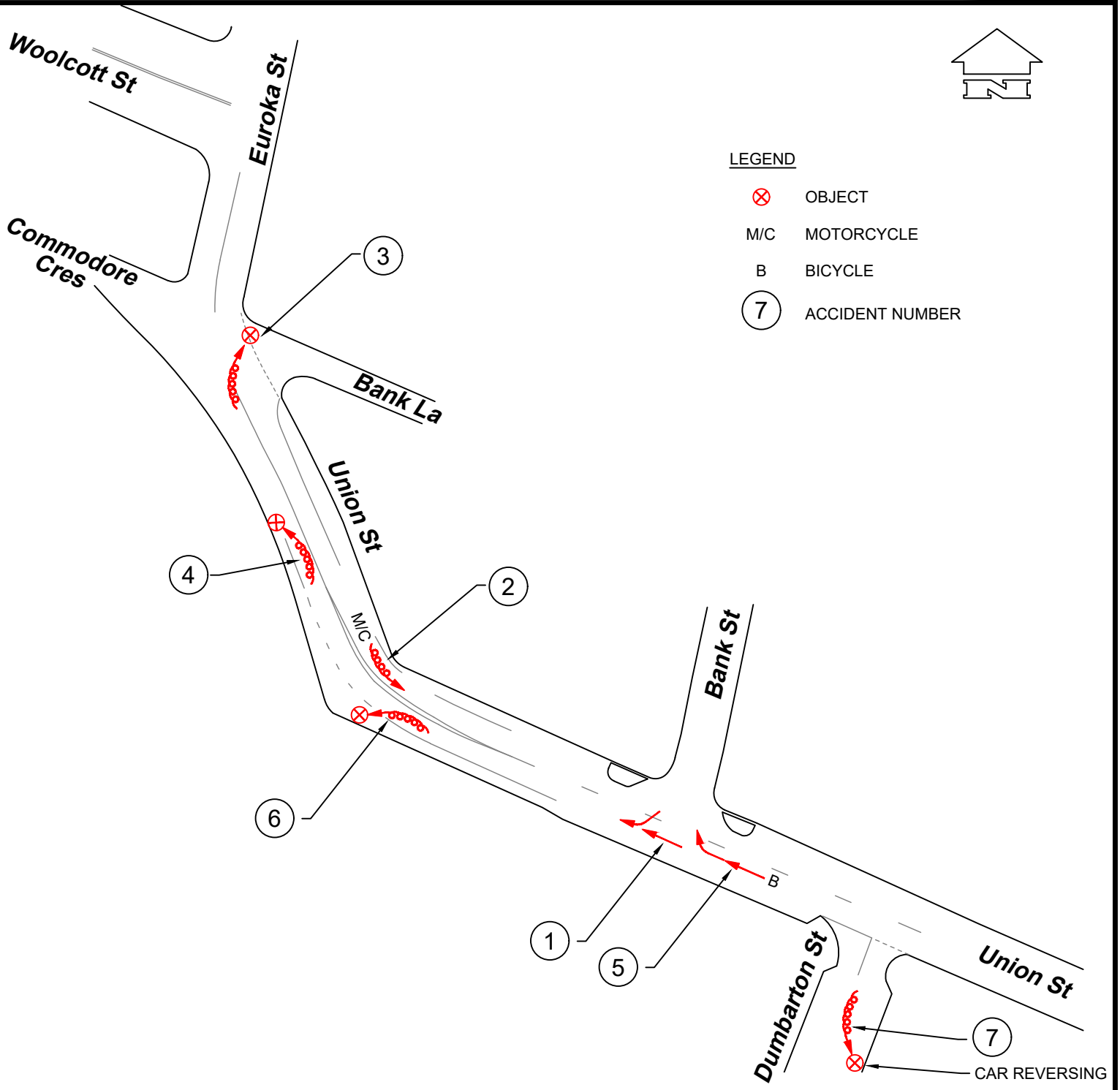
3.3 Crash History

Crash data provided by North Sydney Council for the period between 1 October 2010 and 30 June 2018 (i.e. 7 years, 9 months) has been examined.

A review of the crash data reveals that there was a total of 6 reported crashes, 4 of which were injury (casualty) crashes.

Two (2) crashes were intersection type accidents which occurred in Union Street at Bank Street. There were four (4) run off the road type crashes that occurred at or between the bends in Union Street. Three (3) of these were injury (casualty) crashes.

Figure 2 shows a crash diagram of this section of Union Street.



UNION STREET, DUMBARTON STREET - WOOLCOTT STREET, MCMAHONS POINT

8 YEAR RMS CRASH DATA, 1 OCTOBER 2010 - 30 JUNE 2018

7 Crashes, 3 Non Casualty, 4 Casualty

ACC No.	DATE	DAY	TIME	RUM CODE	WET/DRY	INJURIES
1	22/10/10	Fri	12:20	11, right far	Dry	0
2	05/06/11	Sun	11:30	88, out of control on bend	Dry	1
3	12/12/16	Mon	23:50	85, off right/left bend => object	Dry	1
4	16/12/16	Fri	09:30	71, off road left =>object	Wet	1
5	10/03/17	Fri	12:10	32, right rear	Dry	1
6	06/06/18	Wed	10:25	81, off left/right bend => object	Dry	0
7	09/04/14	Wed	06:55	71, off road left =>object (car reversing)	Dry	0

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FIGURE 2

ROAD SAFETY AUDIT

UNION STREET, MCMAHONS POINT

CRASH DIAGRAM

JOB NO.19153

20/01/20

4.0 AUDIT FINDINGS

4.1 Responding to the Audit report

As set out in the road safety audit guidelines, responsibility for the road design always rests with the designer / project manager and not with the auditor. A project manager is under no obligation to accept any or all the audit recommendations. Also, it is not the role of the auditor to agree to or approve of the project manager's response to the audit. Rather, the audit provides the opportunity to highlight potential problems and have them formally considered by the project manager, in conjunction with all other project considerations.

To assist with this, Table 4.1 (containing this audit's findings) contains a column for any response.

4.2 Risk ranking of safety issues

Risks and potential safety issues have been identified and ranked using Austroads Ranking method, based on frequency, severity, overall level of risk and treatment approach presented in Tables 4.1 to 4.4 in Guide to Road Safety Part 6A: Implementing Road Safety Audits (See Appendix 2).

The risk rankings and Austroads suggested treatment approach are defined as follows:

- Intolerable - Must be corrected
- High - Should be corrected or the risk significantly reduced, even if the treatment cost is high
- Medium - Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high
- Low - Should be corrected or the risk reduced, if the treatment cost is low

4.3 Items raised in this review and Stage 2 Preliminary Stage Audit

Item 1 - Isolated use of road cushions

Speed control devices such as road cushions are usually installed as part of a wider traffic calming scheme in a local area. Under this proposal, road cushions are to be installed in isolation on a short section of Union Street. For the section between Blues Point Road and Dumbarton Street there are no Local Area Traffic Management (LATM) devices to lower vehicle speed.

Item 2 - Delineation

Existing delineation on Union Street is worn and unclear.

Priority at the intersection with Woolcott Street is unclear and confusing, particularly as Give Way signage at the adjoining intersection on the northern side of the railway overbridge is visible.

Consideration should be given to providing clear delineation along Union Street, along the centerline and the parking lanes.

Consideration should also be given to the priority of movements at the intersection of Woolcott Street and the installation of linemarking and signage to clarify.

Item 3 - Adverse Crossfall on Bend

Adverse crossfall was noted on the bend north-west of Bank Street during site inspection. With the installation of road cushions on this bend, there is a potential risk for vehicles heading north-west not slowing down to less than 20km/h for run-off accidents due to the combination of steep grade on approach, adverse crossfall on the bend, the change in alignment, together with the road cushions.

Item 4 - Impact on existing pavement

The road cushion installations are proposed on an existing road carriageway with approach grades exceeding 5% in places. If the proposal proceeds, vehicles braking on approach to the road cushions will place additional load on the existing pavement. Pavement strengthening works should be considered in addition to the installation of road cushions to minimise future risk through pavement failure.

Item 5 - Design Guidelines

In relation to current design guidelines for road cushions, it is noted that;

- road cushions are not considered appropriate for use on bends where sight distance is limited or at intersections (refer to Austroads Guide to Traffic Management Part 8 - Section 7.2.2) Proposed road cushions at Locations 2 and 3 are located on 140º bends in the road alignment and near intersections at Locations 1 and 3.
- Installation of road humps is generally best where the longitudinal grade of the road is less than 5%. The existing road grade at Locations 1 and 2 is greater than 5%.

Item 6 - Impact of road cushions on user comfort and existing speed limit

Road cushions are intended to be traversed by vehicles at a speed less than 20km/h for user comfort. The existing speed limit is 50km/h. An appropriate and potentially safer speed limit in Union Street if road cushions are to be installed would be 40km/h.

Item 7 - Considerations if installation proceeds

If the proposal proceeds, Austroads recommendations for the spacing of road cushions should be adopted to ensure cyclists are accommodated and are not negatively impacted. Road cushions should be installed with a 750mm gap between the base of the cushion and the lip of the kerb and between adjacent cushions (refer to Austroads Guide to Traffic Management Part 8 - Section 7.2.2)

Road cushions are generally 1.6m to 1.9m wide. The narrower cushion may be less effective in reducing vehicle speed (refer to Austroads Guide to Traffic Management Part 8 - Section 7.2.2)

As Union Street is a bus route, consideration should be given to the use of narrower 1.6m wide cushions to allow buses to straddle the cushions.

Overall, the Audit team are doubtful that road cushions are the best solution to address the traffic issues in Union Street.

TABLE 4.1

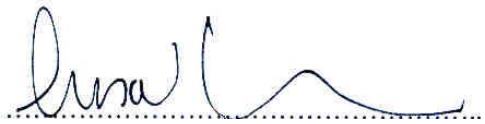
Item	Issue	Risk Ranking	Response by audit Manager	Other comments including Council/TfNSW
1	**Isolated use of road cushions** The proposal is contrary to usual practice where speed control devices such as road cushions are installed as part of a Local Area Traffic Management (LATM) scheme.	Medium		
2	**Delineation** Consideration should be given to providing clear delineation along Union Street, along the centerline and the parking lanes. Consideration should also be given to the priority of movements at the intersection of Woolcott Street and the installation of linemarking and signage to clarify.	High		
3	**Adverse Crossfall on Bend** If the proposal proceeds, there is a potential risk for run-off accidents for vehicles heading north-west not slowing down to less than 20km/h on approach to the road cushion due to the combination of steep grade on approach, adverse crossfall on the bend, the change in alignment, together with the road cushions.	Medium to High		
4	**Impact on existing pavement** If the proposal proceeds, vehicles braking on approach to the road cushions will place additional load on the existing pavement due to steep downhill grade. Pavement strengthening works should be considered in addition to the installation of road cushions to minimise future risk through pavement failure.	Medium to High		

Item	Issue	Risk Ranking	Response by audit Manager	Other comments including Council/TfNSW
5	**Design Guidelines** The proposed installations are contrary to Austroads Guidelines as follows; * Road cushions are not considered appropriate for use on bends where sight distance is limited or at intersections (refer to Austroads Guide to Traffic Management Part 8 - Section 7.2.2) Proposed road cushions at Locations 2 and 3 are located on 140º bends in the road alignment and near intersections at Locations 1 and 3. * Installation of road humps is generally best where the longitudinal grade of the road is less than 5%. The existing road grade at Locations 1 and 2 is greater than 5%.	Medium		
6	**Impact of road cushions on user comfort and existing speed limit** Road cushions are intended to be traversed by vehicles at a speed less than 20km/h for user comfort. The existing speed limit is 50km/h. An appropriate and potentially safer speed limit in Union Street if road cushions are to be installed would be 40km/h.	Medium		

3.0 AUDIT TEAM STATEMENT

We hereby certify that the audit team have examined the documents listed in Section 1.2 and that this audit has been carried out independently of the design team in accordance with the procedures set out in the Austroads Guide to Road Safety Part 6: Managing Road Safety Audits and Part 6A: Implementing Road Safety Audits.

The audit has been carried out for the sole purpose of identifying any features of the proposed design that could be altered or removed to improve the safety of the proposal. The identified issues have been noted in this report in Table 3.1. The accompanying findings and recommendations are put forward for consideration by the Project Manager for implementation.



Lisa Tulau
Lead Road Safety Auditor (Level 3)

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Terry Lawrence
Road Safety Auditor (Level 3) Audit Leader

23 January, 2020

Disclaimer

This report contains findings and recommendations based on examination of the related documentation that is relevant at the time of production of the report. Information contained within this report is prepared with due care by the Road Safety Audit Team.

The Road Safety Audit Team does not warrant, guarantee or represent that this report is free from errors or omissions or that every deficiency has been identified. Further, if all the recommendations in this report were to be followed, this would not confirm that the proposed design is 'safe'; rather, adoption of the recommendations should improve the level of safety of the proposal.

Subject to any responsibilities implied in law which cannot be excluded, the Road Safety Audit Team is not liable to any party for any losses, expenses, damages, liabilities or claims whatsoever, whether direct, indirect or consequential, arising out of or referable to the use of this report, howsoever caused whether in contract, tort, statute or otherwise.

APPENDIX 1

Documents Used During the Audit

1. Austroads Guide to Road Safety
   Part 6: Managing Road Safety Audits
   Part 6A: Implementing Road Safety Audits

2. Austroads Guide to Road Design

3. Austroads Guide to Traffic Management
   Part 8: Local Area Traffic Management

4. RMS - Supplements to Austroads Guide to Road Design

5. AS 1742.13-2009 Manual of Uniform Traffic Control Devices Local Area Traffic Management

APPENDIX 2

Austroads Risk Assessment Tables 4.1 to 4.4 Extract

How does the client decide whether or not to accept an audit finding or recommendation?

Part of the answer can lie at the start of the design process: could an audit have been undertaken earlier? Certainly, the earlier an audit is undertaken, the sooner a potential problem can be addressed. This generally means it will be easier or cheaper to resolve the problem.

Faced with an audit finding or recommendation that is difficult to resolve, the client needs to consider the:

- likelihood that the identified problem will result in harm
- severity of that harm
- effectiveness of a remedy in reducing the harm
- the designer's advice/response to the audit
- cost of remedying the problem (there may be several alternative treatments).

This requires engineering judgement and additional road safety engineering advice about managing the risk.

There may be occasions that the audit recommendations require consideration of issues outside the original scope of the project. This should not be an excuse to dismiss these and they still require consideration by the appropriate authority or person. It may be that the original scope of the project needs to be altered.

C. Risk ranking of safety issues

The following tables may be useful to provide an indication of the level of risk and how to respond to it. Determine into which category in Table 4.1 and Table 4.2 the issue best fits. From this select the risk category in Table 4.3 and its suggested treatment approach in Table 4.4. This is not a scientific system and professional judgement should be used. Section 9.3 provides an evidence based approach to prioritising the treatment of works emanating from road safety audits of existing roads.

Table 4.1: How often is the problem likely to lead to a crash?

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table 4.2: What is the likely severity of the resulting crash type?

Severity	Description	Examples
Catastrophic	Likely multiple deaths	High-speed, multi-vehicle crash on a freeway. Car runs into crowded bus stop. Bus and petrol tanker collide. Collapse of a bridge or tunnel.
Serious	Likely death or serious injury	High or medium-speed vehicle/vehicle collision. High or medium-speed collision with a fixed roadside object. Pedestrian or cyclist struck by a car.
Minor	Likely minor injury	Some low-speed vehicle collisions. Cyclist falls from bicycle at low speed. Left-turn rear-end crash in a slip lane.
Limited	Likely trivial injury or property damage only	Some low-speed vehicle collisions. Pedestrian walks into object (no head injury). Car reverses into post.

Table 4.3: The resulting level of risk

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table 4.4: Treatment approach

Risk	Suggested treatment approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs is high.
Medium	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high.
Low	Should be corrected or the risk reduced, if the treatment cost is low.

D. Implementing the agreed changes

Once the corrective action report has been finalised, the agreed actions need to be implemented. The designer has to develop design changes that address the safety problems. If one is at the pre-opening stage, the actions need to be implemented as soon as possible on site. Temporary warning, delineation or other treatment may be needed until the agreed solution is implemented.

Actions taken should be recorded (for example, description of work, by whom and when). This is to fully close out the road safety audit finding as well as to factual record what works were completed. Reasons for any variations from the proposed action must also be set out in writing.

Framing responses to audit findings or recommendations

When an audit finding or recommendation is not accepted, or is accepted only in part, care should be taken about framing the corrective action report, bearing in mind that it may become a public document in the event of a crash occurring.

Consider the following responses to findings or recommendations made during a pre-opening audit of a project to widen the carriageway of a two-lane, two-way road to provide an overtaking lane:

- *Safety issues:*
  'Fixed objects within the new clear zone. These include a concrete bus shelter and stockpiles of aggregate and box culverts.' Three sections of guard fence are now nearer the edge line, but do not have safe end treatments.
- *Findings or recommendations*
  Take action to reinstate appropriate clear zones for this road. Pay attention to the guard fence.
- *Responses:*
  'The bus shelter was constructed before work on the overtaking lane. It is 4 m from the edge line. The expense of moving it is not considered justified. Most of this highway has objects within the clear zone, for example 3 km to the south there are 150 trees within 1.5 m to 6 m from the edge line. The stockpiles cannot be removed as there are few stockpile sites in the area. All the guard fence was constructed before construction of the overtaking lane. Compared with other guard fence in this region, it is not considered a priority and no action is planned to install the correct end treatment.'
  How might these responses be viewed by someone injured in a collision with the bus shelter, a stockpile or a guard fence end (or by a lawyer)? It would be of little comfort for drivers to know they would have been even worse off had the car veered off the road 3 km further on, or that the road authority had a problem finding stockpile sites, or that it's not the client's problem because the fixed objects were put in earlier by someone else. What these responses lack, and what any response needs, is a consideration of points in the previous inset ('How does the client decide whether or not to accept an audit finding or recommendation', in B above), an explanation of why action cannot be taken (for example, financial implications) and consideration of other possible options to reduce the risk associated with significant problem.