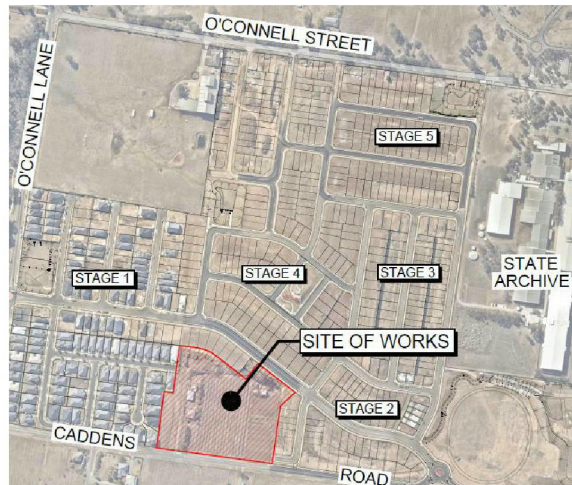


ROAD SAFETY ROAD SAFETY AUDIT REPORT
Stage 3 - Detailed Design Stage Road Safety Audit

ROAD SAFETY AUDIT FOR
PROPOSED RESIDENTIAL SUBDIVISION
AND BULK EARTHWORKS

CADDENS HILL (STAGE 7)



Ref. 18167 RSA Stage 3

24 January, 2019

Prepared By



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1.0 INTRODUCTION

1.1 Auditors and Audit Process

This report details the results of a Detailed Design Stage (Stage 3) Road Safety Audit of the proposed subdivision and bulk earthworks which form Stage 7 of the Caddens Hill Residential Subdivision.

The civil works plans were prepared by J. Wyndham Prince.

The Detailed Design Stage (Stage 3) Road Safety Audit was requested by Penrith City Council and Transport and Urban Planning were engaged by Legacy Property to carry out the Audit.

The Audit has examined the subdivisions civil design plans, which included plans outlined in Section 1.3. Lighting, linemarking or signposting plans were not available for inclusion in the Audit.

Road Safety Audit Team:

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

Terry Lawrence Director
Accredited Level 3 Road Safety Auditor
Auditor ID: RSA-02-0002

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

The audit commenced with an email briefing with John Tanyag of J. Wyndham Prince and continued with subsequent requests for additional information.

Although the audit is required for a greenfield site, a site inspection was undertaken for the Stage 2 Audit in June, 2018 to inspect the proposed connection points to existing roads. As Stage 7 is a greenfield site and construction has not commenced, a further site inspection was not considered necessary or beneficial. The plans were audited between 15 and 22 January with the Audit report prepared concurrently.

The audit has been carried out following the procedures set out in the Roads and Maritime Services Guidelines for Road Safety Audit Practices Part 1: Road Safety Audit. The audit examines the features of the proposal which may affect road user safety and it has sought to identify potential safety hazards. However, the auditors point out that no guarantee is made 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 within the existing road network.

1.2 Description of the Project

Stage 7 of the Caddens Hill Residential Subdivision consists of 45 Lots and is located between Caddens Road and Cadda Ridge Drive.

The proposal as it currently exists includes;

- Extension of Weema Street from the existing subdivision to the west - road extension known as Road 18;
- Road 18 - 16m wide road reserve with 8.0m wide carriageway and 4m verges both sides;
- Extension of Road 19 from the adjacent Stage 2 subdivision to the east - Road 19 runs east / west then turns with a 90 degree bend to run north / south;
- Road 19 (east-west) - 14.5m wide road reserve with 8.0m wide carriageway and 2.7m / 3.8m verges;
- Road 19 (north-south) - 16m wide road reserve with 8.0m wide carriageway and 4m verges both sides;
- New T-intersection at Weema Street / Road 18 and Road 19;
- New T-intersection at Road 18 and Road 19;
- 5 residential lots fronting Cadda Ridge Drive and 40 residential lots fronting Roads 18 and 19;
- Provision of 1.5m wide footpath on both sides of Road 18;
- Provision of 1.5m wide footpath on both sides of Road 19 (north-south section);
- Provision of 1.5m wide footpath on northern side of Road 19 (east-west section);
- Bulk earthworks over entire area of Stage 7, with both cut and fill up to 4m.
- Retaining walls 1m and 1.5m high between some residential lots;
- Stormwater drainage system in road carriageway connecting to existing stormwater system in Road 19 of adjacent Stage 2 subdivision;
- Kerb ramps at various road crossing points;
- Driveways to individual residential lots.

1.3 Audited Plans

The following plans were examined as part of the audit.

- Proposed civil works plans by J. Wyndham Prince - Project 110358 / CC 700 - 716 (Issued for CC Approval) as follows;

<i>DRAWING NUMBER</i>	<i>DRAWING TITLE</i>
700	Cover Sheet
701	Legend, Notes and Index
702	Site Layout
703	Road Setout Plan
704	Engineering Plan
705	Cut / Fill Plan
706	Site Section Sheet 1
707	Road Longitudinal and Typical Section Sheet 1
708	Road Longitudinal and Typical Section Sheet 2
709	Road Cross Section Sheet 1

710	Road Cross Section Sheet 2
711	Kerb Returns
712	Catchment Plan
713	Pit Schedule and Details
714	Drainage Longitudinal Section Sheet 1
715	Drainage Longitudinal Section Sheet 2
716	Drainage Longitudinal Section Sheet 3
717	Drainage Longitudinal Section Sheet 4
718	Drainage Calculations Sheet 1
719	Drainage Calculations Sheet 2
720	Drainage Calculations Sheet 3
721	Retaining Wall Plan and Details
722	Retaining Wall Section Sheet 1
723	Retaining Wall Section Sheet 2
724	Retaining Wall Section Sheet 3
725	Soil and Water Management Plan
726	Soil and Water management Notes
727	Signage and Linemarking Plan

- Landscape Masterplan Report by Place Design Group Project Reference: 2517024 dated September 2017
- Electrical Reticulation Plans by Power Line Designs dated 12.12.18 (Draft)

Appendix 1 shows the other documents referenced during the audit.

1.4 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 3.1 (containing this audit's findings) contains a column for any response.

2.0 RECOMMENDATIONS FROM PREVIOUS STAGE AUDITS

The Stage 2 Preliminary Design Stage Audit Report was prepared by Transport and Urban Planning dated 28 June, 2018.

Stage 2 Audit findings were as follows;

- Consider extending central median in Weema Street / Road 18 to block right turn movements into and out of driveways to Lots 706 and 709
- Ensure central median in Weema St / Road 18 is of sufficient width to hold regulatory signage and consider provision of KEEP LEFT signage at each median approach
- Consider provision of BB linemarking on approach to central median in Weema St / Road 18 and provision of painted island in Road 19 to define left in / left out traffic movements
- Consider provision of BB linemarking on bends in Road 18 (approx. Chainage 120 - 175) and Road 19 (approx. Chainage 280 - 315)
- Review location of kerb ramps at CH.30 on Road 18 given obstruction from central median. Consider relocating away from crest and median
- Review location of all kerb ramps to ensure maximum visibility for pedestrians towards oncoming traffic
- Ensure future line marking plans are prepared to relevant standards and guidelines
- Ensure future signage plans are prepared to relevant standards and guidelines
- Give consideration to landscaping in future design phases to ensure;
 - Maintenance of adequate sight lines for 50km/hr speed limit, including intersection of Weema St/Roads 18,19
 - Maintenance of adequate sight lines for drivers, pedestrians and cyclists at likely crossing locations for 50km/h speed limit.
 - Clear Zone issues and the size of the trunk of street trees when fully mature.
 - Spread and density of tree canopy and effect on street lighting when trees are fully mature.
- Ensure all storm water pit grates are suitable for both pedestrian and bicycle movements

Issues raised in the Stage 2 Audit have been considered in the Construction Certificate Plans.

3.0 AUDIT FINDINGS AND RECOMMENDATIONS

3.1 Risk Ranking

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 6: Road Safety Audit (See Appendix 3).

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

In addition, Appendix 2 shows the auditors comments on all matters considered as part of the Stage 3 audit.

3.2 Audit Findings

Landscaping

The proposed roadside landscaping is comprised of large shrubs / small trees up to 12m in height and with mature trunk diameters greater than 100mm.

Some proposed plantings are located on the approach side of opposing kerb ramps or pedestrian crossing points. When mature, these plantings have the potential to obscure sightlines to pedestrians. Consider removing proposed trees on the approach side of crossing points as noted in Table 3.1 Item 1.

Trees are also considered hazardous when too large or close to the travel lane. Mature trunk diametres greater than 100mm are considered non-frangible. Austroads Guide to Road Design: Part 6 Roadside Design and Safety Barriers (Table 4.1) recommends a 3m wide clear zone from the edge of the through travelled way for design speeds less than 60km/hr. A safety barrier system is recommended where trees with a mature trunk diameter greater than 100mm are located within the clear zone, to protect the occupants of errant vehicles.

Small tree species with a mature trunk diameter greater than 100mm are proposed within the clear zone in Road 18. These are generally located where risk to occupants of errant vehicles is low given the low speed urban road environment. However, the steep downhill grade of 9% on Road 18 eastbound towards a bend in the carriageway presents a greater risk for potential run-off accidents. Consider removing proposed

trees on eastern side of Road 18 (approx. CH.150-165) to provide clear zone in this area as noted in Table 3.1 Item 2.

Lighting

Street Lighting shown on the Draft Electrical Reticulation Plans does not appear to be located in consideration of proposed crossing points and intersections. Ensure appropriate street lighting is provided for Stage 7 of the residential subdivision, particularly at crossing points and intersections, during preparation of final Electrical Reticulation Plans.

Signage

Road 18 falls at a grade of 9% from the crest near Weema Street, eastbound then southbound towards the intersection with Road 19. Consider providing bi-directional hazard markers in Road 19 opposite Road 18 due to steep approach grade.

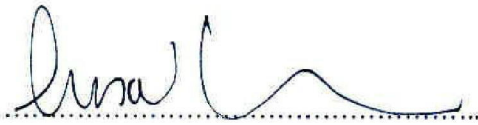
Table 3.1 below summarises those matters identified in the audit which require consideration by the design team.

TABLE 3.1

Item	Issue	Risk Ranking	Response by audit Manager	Other comments including Council/RMS
1	<p>Consider removing proposed trees on approach side of crossing points due to potential to obscure sight lines to pedestrians when mature, as follows;</p> <ul style="list-style-type: none"> * Road 19 - southbound approach to crossing point on 90 degree bend * Road 18 - southbound approach to crossing point before intersection with Road 19 * Road 18 - westbound approach to intersection with Road 19 for left turning vehicles approaching crossing point in Road 19. * Road 19 - eastbound / westbound approach to crossing point on eastern side of intersection with Road 18 	High		
2	<p>Consider removing proposed trees on eastern side of Road 18 (approx. CH.150-165) due to steep downhill grade / bend in carriageway and potential for run-off accidents</p>	High		
3	<p>Ensure appropriate street lighting is provided, particularly at crossing points and intersections, during preparation of final Electrical Reticulation Plans</p>	High		
4	<p>Consider providing bi-directional hazard markers in Road 19 opposite Road 18 due to steep approach grade</p>	Medium		

4.0 FORMAL STATEMENT

We have examined the plans detailed in Section 1.3 and we have audited these plans in accordance with the procedures set out in the RMS's Guidelines for Road Safety Audit Practices. The audit has been carried out for the sole purpose of identifying any features of the proposed design that could be altered or reconsidered to improve safety. The identified issues have been noted in this report in Table 3.1 and are put forward for consideration by the Project Manager.



Lisa Tulau
Lead Road Safety Auditor (Level 3) Audit Leader



.....
Terry Lawrence
Road Safety Auditor (Level 3)

24 January, 2019

APPENDIX 1

Documents Used During the Audit

1. Austroads Guide to Road Safety
Part 1: Road Safety Overview
Part 6: Road Safety Audit
2. Roads and Maritime Services - Guidelines for Road Safety Audit Practice Part 1: Road Safety Audit
3. Roads and Maritime Services - Road Environment Safety Guidelines
4. Austroads - Guide to Road Design
5. RMS (RTA) - Supplements to Austroads Guide to Road Design
6. RMS (RTA) - Road Design Guide

CHECKLIST 3: DETAILED DESIGN STAGE AUDIT RESIDENTIAL SUBDIVISION AT CADDENS HILL (STAGE 7)

Issue	Yes	No	Comment
3.1 General topics			
3.1.1 Changes since previous audit			
Do the conditions for which the scheme was originally designed still apply? (i.e. no significant changes to the surrounding network or area to be served, or traffic mix)	✓		
Has the design of the project remained unchanged since previous audit (if any)?			Comments from Stage 2 Audit considered in design
3.1.2 Drainage			
Will the new road drain adequately?	✓		
Are the road grades and crossfalls adequate for satisfactory drainage?	✓		
Are flat spots avoided or adequately dealt with at start/end of superelevation?			N/A
Has the possibility of surface flooding been adequately addressed, including overflow from surrounding or intersecting drains and water courses?			Not known
Is gully pit spacing adequate to limit flooding?	✓		
Is pit grate design safe for pedal cycles? (i.e. gaps not parallel with wheel tracks)	✓		
Will footpaths drain adequately?	✓		
3.1.3 Climatic conditions			
Has the design taken into account weather records or local experience which may indicate a particular problem? (for example, snow, ice, wind, fog)			Not known
3.1.4 Landscaping			
Will drivers be able to see pedestrians (and vice versa) past or over the landscaping?			Refer Table 3.1 Item 1
Will intersection sight lines be maintained past or over the landscaping?			Refer Table 3.1 Item 1
Will safety be adequate with seasonal growth? (for example, no obscuring of signs, shading or light effects, slippery surface, etc.)	✓		
Will roadside safety be adequate when trees or plantings mature (no roadside hazard)?	✓		Refer Audit findings - landscaping
Has 'frangible' vegetation been used in possible run-off road areas?			Refer Table 3.1 Item 2

Issue	Yes	No	Comment
3.1.5 Services			
Does the design adequately deal with buried and overhead services? (especially in regard to overhead clearances, etc.)			No detail provided
Has the location of fixed objects/furniture associated with services been checked? (including any loss of visibility, position of poles, and clearance to overhead wires)			Not known
3.1.6 Access to property and developments			
Can all accesses be used safely?	✓		
Is the design free of any downstream or upstream effects from accesses, particularly near intersections?	✓		
Do rest areas and truck parking area have adequate sight distance at access points?			N/A
3.1.7 Emergencies, breakdowns, emergency and service vehicle access			
Has provision been made for safe access and movements by emergency vehicles?			N/A
Does the design and positioning of medians and vehicle barriers allow emergency vehicles to stop and turn without unnecessarily disrupting traffic?			N/A
Have broken-down vehicles or stopped emergency vehicles been adequately considered?			N/A
Is provision for emergency telephones satisfactory?			N/A
Are median breaks on divided carriageways safely located? (i.e. frequency, visibility)			N/A
3.1.8 Future widening and/or realignments			
If the scheme is only a stage towards a wider or dual carriageway is the design adequate to impart this message to drivers? (is the reliance on signs minimal/appropriate, rather than excessive?)			N/A
Is the transition between single and dual carriageway (either way) handled safely?			N/A
3.1.9 Staging of the Scheme			
If the scheme is to be staged or constructed at different times: <ul style="list-style-type: none"> - Are the construction plans and program arranged to ensure maximum safety? - Do the construction plans and program include specific safety measures, signing, adequate transitional geometry, etc. for any temporary arrangements? 			N/A

Issue	Yes	No	Comment
3.1.10 Staging of the Work			
If the construction is to be split into several subprojects, is the order safe? (i.e. the stages are not constructed in an order that creates unsafe conditions.)			N/A
3.1.11 Adjacent Developments			
Does the design handle accesses to major adjacent generators of traffic and developments safely?			N/A
Is driver's perception of the road ahead free of misleading effects of any lighting or traffic signals on adjacent road?			N/A
Has the need for screening against glare from lighting of adjacent property been adequately considered?			N/A
3.1.12 Stability of Cut and Fill			
Is the stability of batters satisfactory (for example, no potential for loose material to affect road users)	✓		
3.1.13 Skid Resistance			
Has the need for anti skid surfacing been considered where braking or good road adhesion is most essential (for example, on gradients, curves or approaches to intersections and signals)			Not known
3.2 Design Issues (general)			
3.2.1 Geometry of Horizontal and Vertical Alignment			
Does the horizontal and vertical design fit together correctly?	✓		
Is the vertical alignment consistent and appropriate throughout?	✓		
Is the horizontal alignment consistent throughout?	✓		
Is the alignment consistent with the function of the road?	✓		
Is the design free of misleading visual cues (for example, visual illusions, subliminal delineation like lines of poles)?	✓		
3.2.2 Typical cross-sections			
Are lane widths, shoulders, medians and other cross section features adequate for the function of the road?	✓		
Are the shoulder widths adequate for stationary vehicles and errant vehicles?			N/A
Are median widths adequate for road furniture?	✓		
Is superelevation consistent with the road environment?			N/A
Is the width of traffic lanes and carriageways suitable in relation to:			
▪ alignment?	✓		
▪ traffic volume?	✓		
▪ vehicle dimensions?	✓		
▪ the speed environment?	✓		
▪ combinations of speed and traffic volume?	✓		

Issue	Yes	No	Comment
Are the shoulder crossfalls safe for vehicles to traverse?			N/A
Are batter slopes drivable for cars, trucks?			N/A
Are side slopes under structures appropriate?			N/A
Have adequate facilities been provided for pedestrians and cyclists?			No special provisions for cyclists
3.2.3 Effect of cross-sectional variation			
Is the design free of undesirable variations in cross section design?	✓		
Are crossfalls safe? (particularly where sections of existing highway have been used, there have been compromises to accommodate accesses, at narrowings at bridges, etc.)	✓		
Are any curves with adverse crossfall within appropriate limits?			N/A
Is superelevation provided and sufficient at all locations where required?			N/A
3.2.4 Roadway layout			
Are all traffic management features designed so as to avoid creating unsafe conditions?	✓		
Is the layout of road markings and reflective materials able to deal satisfactorily with changes in alignment? (particularly where the alignment may be substandard)	✓		
Is there adequate provision for overtaking?			N/A
Are overtaking lanes provided where required and safely commenced and ended?			N/A
Are overtaking requirements satisfactory?			N/A
Is the design free of sunrise/sunset problems?			Some roads east-west
Have public transport requirements been adequately catered for?			N/A
3.2.5 Shoulders and edge treatment			
Are the shoulders likely to be safe if used by slow moving vehicles or cyclists?			N/A
Are the following safety aspects of shoulder provision satisfactory? <ul style="list-style-type: none"> ▪ provision of sealed or unsealed shoulders ▪ width and treatment on embankments ▪ crossfall of shoulders 			N/A
3.2.6 Effect of departures from standards or guidelines			
Any approved departures from standards or guidelines: is safety maintained?			N/A
Any hitherto undetected departures from standards: is safety maintained?			N/A

Issue	Yes	No	Comment
3.2.7 Visibility and sight distance			
Are horizontal and vertical alignments consistent with visibility requirements?	✓		
Has an appropriate design speed been selected for visibility requirements?	✓		
3.2.8 Environmental treatments			
Has safety been considered in the location of environmental features? (for example, noise fences)			N/A
3.3 Alignment details			
3.3.1 Visibility; sight distance			
Are horizontal and vertical alignments consistent with the visibility requirements?	✓		
Is the design free of sight line obstructions due to safety fences or barriers? <ul style="list-style-type: none"> ▪ boundary fences? ▪ street furniture? ▪ parking facilities? ▪ signs? ▪ landscaping? ▪ bridge abutments? ▪ parked vehicles in laybys or at the kerb? ▪ queued traffic? 	 		Refer Table 3.1 Item 1
Are railway crossings, bridges and other hazards all conspicuous?			N/A
Is the design free of any other local features which may affect visibility?	✓		
Is the design free of overhead obstructions (for example, road or rail overpasses, sign gantries, overhanging trees) which may limit sight distance at sag curves?	✓		
Has a clear headroom or a high vehicle detour been provided where necessary?			N/A
Is visibility adequate at: <ul style="list-style-type: none"> ▪ any pedestrian, bicycle or cattle crossings? ▪ access roads, driveways, on and off ramps, etc.? 	 		N/A
Has the minimum sight triangle been provided at: <ul style="list-style-type: none"> ▪ entry and exit ramps? ▪ gore areas? ▪ intersections? ▪ roundabouts? ▪ other conflict points? 	 		

Issue	Yes	No	Comment
3.3.2 New/existing road interface			
Have implications for safety at the interface been considered?	✓		
Is the transition from old road to the new scheme satisfactory?	✓		
If the existing road is of a lower standard than the new scheme, is there clear and unambiguous warning of the reduction in standard?			N/A
Have the appropriate provisions for safety been made where sudden changes in speed are required?	✓		
Is access or side friction handled safely?			N/A
Does the interface occur well away from any hazard? (for example, a crest, a bend, a roadside hazard or where poor visibility/distractions may occur)			Additional treatments added at intersection of Road 18/19 due to crest
If carriageway standards differ, is the change effected safely?			N/A
Is the transition where the road environment changes (for example, urban to rural; restricted to unrestricted; lit to unlit) done safely?			N/A
Has the need for advance warning been considered?			Not known
3.3.3 Readability of the alignment by drivers			
Will the general layout, function and broad features be recognised by drivers in sufficient time?	✓		
Will approach speeds be suitable and will drivers correctly track through the scheme?	✓		
3.3.4 Detail of geometric design			
Are the design standards appropriate for all the requirements of the scheme?	✓		
Is consistency of general standards and guidelines, such as lane widths and crossfalls, maintained?	✓		
3.3.5 Treatment at bridges and culverts			
Is the geometric transition from the standard cross-section to that on the bridge handled safely?			N/A
3.4 Intersections			
3.4.1 Visibility to and at intersections			
Are horizontal and vertical alignments at the intersection or on the approaches to the intersection consistent with the visibility requirements?	✓		
Is the standard adopted for provision of visibility appropriate for the speed of traffic and for any unusual traffic mix?	✓		

Issue	Yes	No	Comment
Will the design be free of sight line obstructions due to safety fences or barriers			
<ul style="list-style-type: none"> • boundary furniture? ▪ street furniture? ▪ parking facilities? ▪ signs? ▪ landscaping? ▪ bridge abutments? ▪ parked vehicles in laybys or at the kerb? ▪ queued traffic? 	<ul style="list-style-type: none"> ✓ ✓ N/A ✓ N/A ✓ ✓ 		Refer to Table 3.1 Item 1
Are railway crossings, bridges and other hazards all conspicuous?			N/A
Is the design free of any other local features which may affect visibility?	✓		
3.4.2 Layout			
Are intersections and accesses adequate for all vehicular movements?	✓		
Have the appropriate design vehicle and check vehicle been used for turning dimensions?			Turnpaths not provided for Stage 3
Are swept paths accommodated for all likely vehicle types? (has the appropriate design vehicle been used?)			Stage 2 turn paths show Penrith City garbage truck requiring full carriageway to be utilised at intersections
Are intersections free of any unusual features which could affect road safety?	✓		
Are pedestrian fences provided where needed? (for example, to guide pedestrians or discourage parking)			N/A
Has pavement anti-skid treatment been provided where needed?			Not known
Have islands and signs been provided where required?	✓		
Vehicles which may park at or close to the intersection: can they do this safely or does this activity need to be relocated?	✓		
Are safety hazards due to parked vehicles avoided?	✓		
3.4.3 Readability by drivers			
Will the existence of the intersection and its general layout, function and broad features be perceived correctly and in adequate time?	✓		
Are the approach speeds and likely positions of vehicles tracking through the intersection safe?	✓		
Is the design free of misleading elements?	✓		
Is the design free of sunrise or sunset problems which may create a hazard for motorists?			Some roads east-west
3.4.4 Detailed geometric design			

Issue	Yes	No	Comment
Can the layout safely handle unusual traffic mixes or circumstances?	✓		
Does any median or any island safely account for: <ul style="list-style-type: none"> ▪ vehicle alignments and paths? ▪ future traffic signals? ▪ pedestrian storage space and surface? ▪ turning path clearance? ▪ stopping sight distance to nose? ▪ mountability by errant vehicles? 	 ✓ N/A ✓ ✓ ✓ ✓		
Is adequate vertical clearance to structures provided? (for example, powerlines, shop awnings)			N/A
3.4.5 Traffic signals			
Is the signal phasing/sequence safe?			N/A
Is adequate time provided for traffic movements and pedestrian movements?			N/A
Will the signal lanterns be visible? (for example, not obstructed by trees, poles, signs or large vehicles)			N/A
Are lanterns for other approach directions adequately shielded from view?			N/A
Are high-intensity signals and/or target boards provided if likely to be affected by sunrise/sunset?			N/A
Does the alignment (vertical and horizontal) provide satisfactory stopping sight distance to the intersection or back of queue?			N/A
Are pedestrian facilities provided where they are required?			N/A
Will approaching drivers be able to see pedestrians?			N/A
Are partially or fully controlled turning phases provided where required?			N/A
Are signal posts located where they are not an undue hazard?			N/A
Are road markings for turning traffic satisfactory?			N/A
Have adequate pedestrian phases been provided?			N/A
3.4.6 Roundabouts			
Is adequate deflection provided to reduce approach speeds?			N/A
If splitter islands are needed, are they adequate for sight distance, length, pedestrian storage, etc.?			N/A
Is the central island prominent?			N/A
Can the appropriate design vehicle and check vehicle be accommodated?			N/A

Issue	Yes	No	Comment
Are the central island details satisfactory? (delineation, mountability, conspicuousness)			N/A
Can pedestrians be seen by drivers in sufficient time?			N/A
Can pedestrians determine whether vehicles are turning? (no obstructions to sight lines)			N/A
Are direction markings in approach lanes provided where required?			N/A
Is the lighting adequate?			N/A
3.4.7 Other intersections			
Has the need for kerbed or painted islands and refuges been considered?	✓		
Do intersections have adequate queue length/storage for turning movements (including in the centre of a staggered intersection)?			N/A
3.5 Special road users			
3.5.1 Adjacent land			
Are all accesses to and from adjacent land/properties safe?	✓		
Have the special needs of agriculture and stock movements been considered?			N/A
3.5.2 Pedestrians			
Can pedestrians cross safely at: <ul style="list-style-type: none"> ▪ intersections? ▪ signalised and pedestrian crossings? ▪ refuges? ▪ kerb extensions? ▪ bridges and culverts? ▪ other locations ? 	N/A N/A N/A N/A		Refer Table 3.1 Item 1 Refer Table 3.1 Item 1
Is each crossing point satisfactory for: <ul style="list-style-type: none"> ▪ visibility, for each direction ▪ use by the disabled? ▪ use by the elderly? ▪ use by children/schools? 		✓	Refer Table 3.1 Item 1
Is pedestrian fencing on reservations and medians provided where required for each crossing?			N/A
Is fencing adequate on freeways?			N/A
Are pedestrians deterred from crossing roads at unsafe locations?	✓		
Are pedestrian related signs appropriate and adequate?			N/A

Issue	Yes	No	Comment
Is width and gradient of pedestrian paths, crossings, etc. satisfactory?	✓		
Is surfacing of pedestrian paths, crossings, etc. satisfactory?	✓		
Have dropped kerbs been provided for each crossing?	✓		
Have channels and gullies been avoided at each crossing?	✓		
Is lighting satisfactory for each crossing?		✓	Refer Table 3.1 – Item 3
Are crossings sited to provide maximum use?	✓		
Is avoidance of a crossing unlikely? (for example, by more direct but less safe alternative)			N/A
3.5.3 Cyclists			
Have the needs of cyclists been considered: <ul style="list-style-type: none"> ▪ at intersections (particularly roundabouts)? ▪ especially on higher speed roads? ▪ on cycle routes and crossings? ▪ at freeway entry and exit ramps? 			No special provisions for cyclists
Are shared cycleway/footway facilities (including subways and bridges) safe and adequately signed?			N/A
3.5.4 Motorcyclists			
Has the location of devices or objects that might destabilise a motorcycle been avoided on the road surface?	✓		
Is the roadside clear of obstructions where motorcyclists may lean into curves?	✓		
Will warning or delineation be adequate for motorcyclists?	✓		
Has barrier kerb been avoided in high-speed areas?			N/A
In areas more likely to have motorcycles run off the road is the roadside forgiving or safely yielded?			Refer Table 3.1 Item 2
Are all unnecessary poles, posts and devices removed or appropriately shielded?			N/A
Are drainage pits and culverts traversable by motorcycle?			N/A
3.5.5 Equestrians and stock			

Issue	Yes	No	Comment
Have the needs of equestrians been considered, including the use of verges or shoulders and rules regarding the use of the carriageway?			N/A
Can underpass facilities be used by equestrians/stock?			N/A
3.5.6 Freight			
Have the needs of truck drivers been considered, including turning radii and lane widths?			N/A
Have the needs of freight transport been considered, adequately signed and catered for?			N/A
3.5.7 Public transport			
Have the needs for public transport been considered, adequately signed and catered for?			N/A
Have the needs of public transport users been considered?			N/A
Have the manoeuvring needs of public transport vehicles been considered?			N/A
Are bus stops well positioned for safety?			N/A
3.5.8 Road maintenance vehicles			
Have the needs of road maintenance vehicles been considered, adequately signed and catered for?			N/A
Can maintenance vehicles be safely located?			N/A
3.6 Lighting, signs and delineation			
3.6.1 Lighting			
Has lighting been adequately provided where required?			Refer Table 3.1 – Item 3
Is the design free of features which interrupt illumination? (for example, trees or overbridges)			Refer Table 3.1 – Item 3
Is the design free of lighting poles that would present a fixed roadside hazard?			No detail provided
Are frangible or slip-base poles to be provided?			No detail provided
Ambient lighting: if it creates special lighting needs, have these been satisfied?			N/A

Issue	Yes	No	Comment
Is the lighting scheme free of confusing or misleading effects on signals or signs?			Refer Table 3.1 – Item 3
Does the lighting adequately illuminate crossings, nearby paths, refuges, etc.?			Refer Table 3.1 - Item 3
Are all gore areas adequately illuminated?			N/A
Are all merge areas adequately illuminated?			N/A
Is the scheme free of any lighting black patches?			Refer Table 3.1 – Item 3
If there are locations with accident problems that are known to be amenable to treatment with improved lighting, has this lighting been provided?			Not known
3.6.2 Signs			
Are signs appropriate for their location?	✓		Refer to Table 3.1 Item 4
Are signs located where they can be seen and read in adequate time?	✓		
Will signs be readily understood?	✓		
Are signs appropriate to the driver's needs? (for example, direction signs, advisory speed signs, etc.)	✓		
Are signs located so that drivers' sight distance is maintained?	✓		
Are signs located so that visibility is maintained: <ul style="list-style-type: none"> ▪ to/from accesses and intersecting roads? ▪ to/from pedestrians and important features on the road? 	✓ ✓		
Have the consequences of vehicles striking signposts been considered?			Not known
Are sign supports out of the clear zone?	✓		
If not, are they: <ul style="list-style-type: none"> ▪ frangible? ▪ shielded by barriers (e.g. guard fence, crash cushions)? 			Not known
Has an over-reliance on signs (in lieu of adequate geometric design) been avoided?	✓		
Are signs on the new scheme consistent with those on the adjoining section of road (or will the previous signs need to be upgraded)?	✓		

Issue	Yes	No	Comment
3.6.3 Marking and delineation			
Are markings (lines, arrows, etc.) consistent with standard markings?	✓		
Have any locations where standard markings might be confusing or misread been identified and treated in a way which considers road users' likely responses?			N/A
Are barrier lines (no overtaking) provided where required?	✓		
Are raised retroreflective pavement markers (RRPMs) provided where necessary?			N/A
Are curve warning signs, advisory speed plates or chevron alignment markers provided where required?			No warning signs provided on curves / bends
Are markings on the new scheme consistent with those on the adjoining section of road (or will the previous markings need to be upgraded)?	✓		
Are diagonal markings or chevrons painted where required?			N/A
Will markings and delineation be visible at night-time?	✓		
Will markings and delineation be visible in wet weather?	✓		
Has the need for profiled (audible) line marking been considered?			N/A
Have both high and low-beam cases been considered?			Not known
Are guide posts of the frangible type?			N/A
3.7 Physical objects			
3.7.1 Median barriers			
Have median barriers been considered and properly detailed?			N/A
Have all design features that require special attention (for example, end treatments) been considered?			N/A
3.7.2 Poles and other obstructions			
Are all poles located well away from moving traffic?			Not known
Have frangible or breakaway poles been included where required?			Not known
Are median widths adequate to accommodate lighting poles or trees?		✓	
Is the position of traffic signal controllers and other service apparatus satisfactory?			N/A
Is the roadside clear of any other obstructions that may create a safety hazard?	✓		
Have all necessary measures been taken to remove, relocate or shield all hazards?			N/A

Issue	Yes	No	Comment
Can roadside drains and channels be safely traversed by any vehicle that runs off the road?			N/A
3.7.3 Crash barriers			
Are crash barriers provided where necessary and properly detailed? (for example, at embankments, structures, trees, poles, drainage channels, bridge piers, gore areas)			N/A
Is the crash barrier safe? (i.e. unlikely to create a danger for road users including pedestrians, cyclists, motorcyclists, etc.)			N/A
Are the end conditions of the crash barrier safe and satisfactory?			N/A
Is the guard fence designed according to standards for: <ul style="list-style-type: none"> ▪ end treatments? ▪ anchorages? ▪ post spacing? ▪ block outs? ▪ post depth? ▪ rail overlap? ▪ stiffening at rigid obstacles? 			N/A
Is all guard fence necessary? (i.e. what it shields is a greater hazard than the fence)			N/A
Where pedestrians and cyclists travel behind guard fence, is the rear of the fence safe for them?			N/A
3.7.4 Bridges, culverts and causeways/floodways			N/A
Are bridge barriers and culvert end walls safe regarding: <ul style="list-style-type: none"> ▪ visibility? ▪ ease of recognition? ▪ proximity to moving traffic? ▪ the possibility of causing injury or damage? ▪ collapsible or frangible ends? ▪ signs and markings? ▪ connection of crash barriers? ▪ roadside hazard protection? 			N/A
Is the bridge railing at the correct level and strong enough?			N/A
Is the shoulder width on the bridge the same as on the adjacent road lengths?			N/A
Is safe provision made for non-vehicular traffic over structures? (for example, pedestrians, pedal cycles, horses/stock, etc)			N/A
Are all culvert end walls (including driveway culverts) drivable or outside the clear zone?			N/A

Issue	Yes	No	Comment
Have causeways/floodways etc. been given correct signing and adequate sight distance?			N/A
3.8 Additional questions to be considered for development proposals			
3.8.1 Horizontal alignment			
Is visibility adequate for drivers and pedestrians at proposed accesses?			N/A
Is adequate turning space provided for the volume and speed of traffic?			N/A
Are curve radii and forward visibility satisfactory?			N/A
Are sight and stopping distances adequate?			N/A
3.8.2 Vertical alignment			
Are gradients satisfactory?			N/A
Are sight and stopping distances adequate?			N/A
3.8.3 Parking provision			
Is on-site parking adequate to avoid on-street parking and associated risks?			N/A
Are parking areas conveniently located?			N/A
Is adequate space provided in parking areas for circulation and intersection sight distance?			N/A
3.8.4 Servicing facilities			
Are off-street loading/unloading areas adequate?			N/A
Are turning facilities for large vehicles provided in safe locations?			N/A
Is emergency vehicle access adequate?			N/A
3.8.5 Signs and markings			
Have necessary traffic signs and road markings been provided as part of a development?			N/A
Is priority clearly defined at all the intersection points within the car park and access routes?			N/A
Will the signs and markings be clear in all conditions, including day/night, rain, fog, etc.?			N/A
3.8.6 Landscaping			
Does landscaping maintain visibility at intersections, bends, accesses and pedestrian locations?			N/A
Has tree planting been avoided where vehicles are likely to run off the road?			N/A
3.8.7 Traffic management			
Have any adverse area-wide effects been addressed?			N/A

Issue	Yes	No	Comment
Will the design keep travel speeds at a safe level?			N/A
Are the number and location of accesses appropriate?			N/A
Are the facilities for public transport services safely located?			N/A
Are any bicycle facilities safely located in respect of vehicular movements?			N/A
Are pedestrian facilities adequate and safely located?			N/A
3.8.8 Other			
Has appropriate street lighting been provided?			N/A
Are all roadside hazards appropriately dealt with?			N/A
Has safe pedestrian access to the development been provided?			N/A
3.9 Any other matter Safety aspects not already covered			
Is the road able to safely handle oversize vehicles, or large vehicles like trucks, buses, emergency vehicles, road maintenance vehicles?			N/A
If required, can the road be closed for special events in a safe manner?			N/A
If applicable, are special requirements of scenic or tourist routes satisfied?			N/A
Have all unusual or hazardous conditions associated with special events been considered?			N/A
Have all other matters which may have a bearing on safety been addressed?			N/A

APPENDIX 3

Austroads Risk Assessment Tables 4.1 to 4.4 Extract

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.’