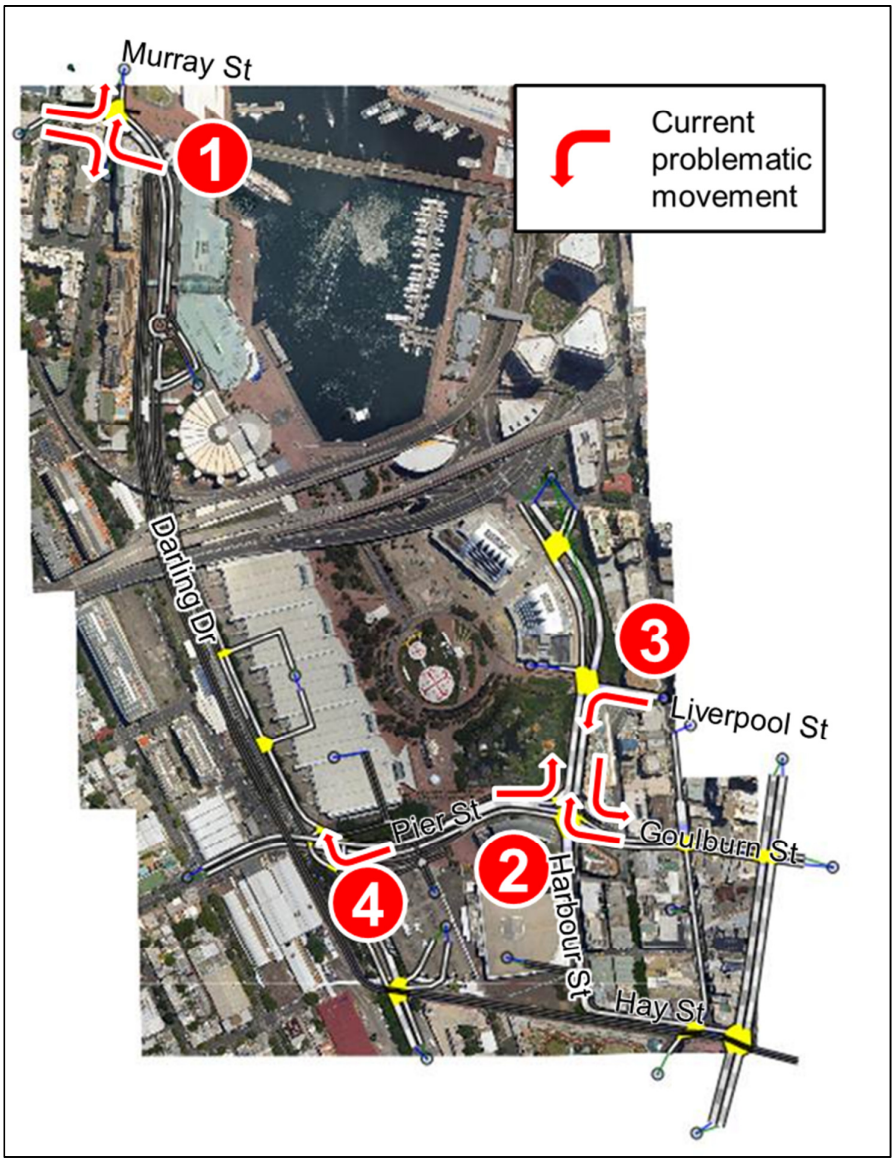


Figure 3-1 Existing Network Operational Issued Identified in Study area

3.2 Post Development Level of Service

AIMSUN model was developed for post development traffic condition to compare impact of the proposed SICEEP development on road network. In section 6.2 of the March 2012 Traffic and Transport Assessment Report documented forecast level of services (LoS) for post development condition. At that time modelling results were reported for original DA scheme. In that DA scheme Theatre car park was proposed off Exhibition Place Loop Road.

A revised Theatre Access Scheme is now developed. Essentially the Revised Theatre Access Scheme is similar to DA scheme with the relocation of the Theatre car park access to Darling Drive. The Theatre car park access on Darling Drive would be left-in/left-out.

Level of service was re-estimated for six key intersections. Table 3-2 summarises LoS results for post development traffic condition based on AIMSUN model. The LoS for both Friday and Saturday PM event traffic is shown in Table 3-2.

Table 3-2 Post Development Level of Service under Revised Theatre Access Scheme

Intersection	Control Type	Friday PM Event		Saturday PM Event	
		Overall Average Delay	LoS	Overall Average Delay	LoS
Darling Drive / Pyrmont Bridge Road / Murray Street	Signals	32	C	>100	F
Darling Drive / Pier Street	Roundabout	15	B	26	B
Darling Drive / Hay Street	Signals	20	B	21	B
Harbour Street / Pier Street / Goulburn Street	Signals	66	E	54	D
Harbour Street / Liverpool Street	Signals	68	E	71	F
Darling Drive / Ultimo Road	Signals	27	B	29	C

Note: AIMSUN model code: Hyder SICEEP Aimsun Model_R6_Future_New TH access. File: F:\AA004399\D-Calcs\Traffic Modelling\POST TENDER TRAFFIC STUDY\Modellings\AIMSUN_For Reporting June 13\TN3_AIMSUN Modelling Result\inputs\Future\AIMSUN Turn Table_Scenario Testing_Rev1_Friday Future_LoS_NewTH.xlsx. File: F:\AA004399\D-Calcs\Traffic Modelling\POST TENDER TRAFFIC STUDY\Modellings\AIMSUN_For Reporting June 13\TN3_AIMSUN Modelling Result\inputs\Future\ AIMSUN Turn Table_Scenario Testing_Rev1_Saturday Future_LoS_NewTH.xlsx

The level of service result at modelled intersections for revised Theatre access scheme was found in line with previous DA scheme.

The demolition of existing Entertainment Centre car park (currently have a capacity of 1800 car park) would improve LoS of Darling Drive/Hay Street intersection. With proposed 405 car park space at south west residential plot, the LoS for post development condition is forecast to be B at Darling Drive/Hay Street intersection.

The Theatre access car park off Darling Drive would not adversely impact the operation of roundabout with Pier Street. Model forecasts LoS B at this roundabout.

The analysis has forecast poor level of service F in Saturday PM peak for post development condition at Darling Drive/Murray Street. This is due to combined impact from existing and future SICEEP related traffic. The LoS for Friday peak is found to be C.

The LoS for post development condition at Harbour Street/Liverpool Street intersection is forecast to be F in Saturday PM peak. Even without SICEEP, LoS was found to be E primarily driven by the existing traffic. The result suggests minor impact from SICEEP at Harbour Street/Liverpool Street intersection.

3.3 Sensitivity Analysis of George Street LRT Proposal

In Section 6.3 of the March 2012 Traffic and Transport Assessment Report documented sensitivity analysis of George Street LRT Proposal. The scenario modelling was undertaken assuming George Street LRT proposal would increase traffic volume on Harbour Street by 10%. At that time assessment was undertaken using SIDRA.

At RMS request, the LoS analysis was undertaken using AIMSUN. The 10% traffic increase on Harbour Street as a result of LRT would further impact LoS for two intersections at Harbour Street/Goulburn Street and Harbour Street/Liverpool Street. Regardless of SICEEP these two intersections on Harbour Street would operate at poor level of service.

The impact of LRT on remaining four intersections assessed was found very small.

Table 3-3 summarises LoS results from sensitivity analysis based on AIMSUN model.

Table 3-3 Sensitivity Analysis Results

Intersection	Control Type	Friday PM Peak		Saturday PM Peak	
		Overall Average Delay	LoS	Overall Average Delay	LoS
Harbour Street / Pier Street / Goulburn Street	Signals	77	F	58	E
Harbour Street / Liverpool Street	Signals	>100	F	70	F

Note: AIMSUN model code: Hyder SICEEP Aimsun Model_R6_Future_New TH access. File: F:\AA004399\D-Calcs\Traffic Modelling\POST TENDER TRAFFIC STUDY\Modellings\AIMSUN_For Reporting June 13\TN3_AIMSUN Modelling Result\inputs\Future\AIMSUN Turn Table_Scenario Testing_Rev1_Friday Future_LoS_NewTH+10.xlsx. File: F:\AA004399\D-Calcs\Traffic Modelling\POST TENDER TRAFFIC STUDY\Modellings\AIMSUN_For Reporting June 13\TN3_AIMSUN Modelling Result\inputs\Future\AIMSUN Turn Table_Scenario Testing_Rev1_Saturday Future_LoS_NewTH+10.xlsx.

4 Findings

The results based on revised AIMSUN modelling in Technical Note 3 do not change the conclusion drawn in March 2013 Traffic and Transport Assessment Report.

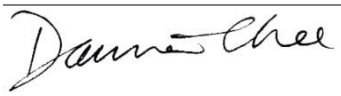
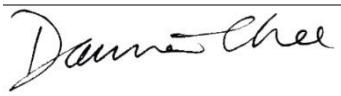
DARLING DRIVE, HAY STREET TO HARBOURSIDE ROUNDABOUT, DARLING HARBOUR

PRELIMINARY DESIGN ROAD SAFETY AUDIT

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

DARLING DRIVE, HAY STREET TO HARBOURSIDE ROUNDABOUT, DARLING HARBOUR

PRELIMINARY DESIGN ROAD SAFETY AUDIT

Author	Elizabeth McCann	
Checker	Damien Chee	
Approver	Damien Chee	

Report No F0001-AA004399-11-02-03-AAR-02

Date 28 June 2013

CONTENTS

1 INTRODUCTION

1.1 Project and audit details

Details of the audit have been summarised in Table 1.

Table 1 Details of the road safety audit

Audited project	Proposed upgrades to Darling Drive between Hay Street and Harbourside Roundabout, Darling Harbour.
Client/ contact	Lend Lease
Audit type	Preliminary design.
Background and purpose	The Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) is a major re-development of the Darling Harbour precinct and will involve the reconstruction of the Convention Centre, Exhibition Centre, and Entertainment Centre, as well as the construction of a hotel complex with 900 rooms. In addition to the land re-development along the Darling Harbour shoreline, the project will include significant changes to the surrounding road and transport network. This includes proposed upgrades along Darling Drive which will provide key "back of house" access to these land uses. A concept design road safety audit was required in order to refine the design prior to submission of the Major Project Application.
Scope of audit	The following were considered to be the "audit items" which were formally reviewed as part of this audit: ▪ The proposed road upgrades along Darling Drive as presented in concept plan *XWPDE-AA004399-NSX-SiteworksDarlingDrive.dwg* last modified on 8 May 2013 11:08;40AM. This only consisted of a concept in plan view. Long and cross sections and specific road design elements such as drainage, signs and lines, pavement, streetlighting etc were not provided and were not considered part of the audit items. The audit focussed on road safety issues that would be introduced as part of the proposed road upgrades, as well as any existing road safety issues that could be exacerbated by the works. Figure 1 provides locational references that are used throughout this report.
Audit team details	Damien Chee, Hyder Consulting – Lead Road Safety Auditor (level 3 accredited – RSA-02-0094). Elizabeth McCann, Hyder Consulting.
Audit methodology	▪ Review of the audit items, ie. the concept plan *XWPDE-AA004399-NSX-SiteworksDarlingDrive.dwg*. ▪ Day time inspection of site on 4 June 2013. It should be noted that the site (as inspected) was not an audit item. Rather, the purpose of the site inspection was to enhance the audit team's appreciation of the existing traffic, topography, land use conditions and road user behaviour and how these would affect or be affected by the proposed road upgrades. The site inspection was only used to contextualise the concept plan to the existing road and land scape. ▪ Reporting of audit findings in accordance with the NSW Centre for Road Safety's *Guidelines for Road Safety Audit Practices* (2011). ▪ Report includes completed *checklist 2 –Preliminary design road safety audit* as provided in the Austroads *Guide to Road Safety Part 6: Road Safety Audit*.
Material supplied	▪ See scope of audit for a description of the audit items supplied and reviewed as part of the audit.
Meeting and assessment details	As detailed above in audit methodology.

1.2 Responding to the audit report

Road safety audits provide the opportunity to highlight potential road safety problems and have them formally considered by the project manager in conjunction with all other project considerations. The responsibility for the project rests with the project manager, not with the auditor. The project manager is under no obligation to accept the audit findings. Also, it is not the role of the auditor to agree to, or approve the project manager's responses to the audit.

1.3 Previous audits and closed-out issues

There were no previous road safety audit reports provided to the audit team.

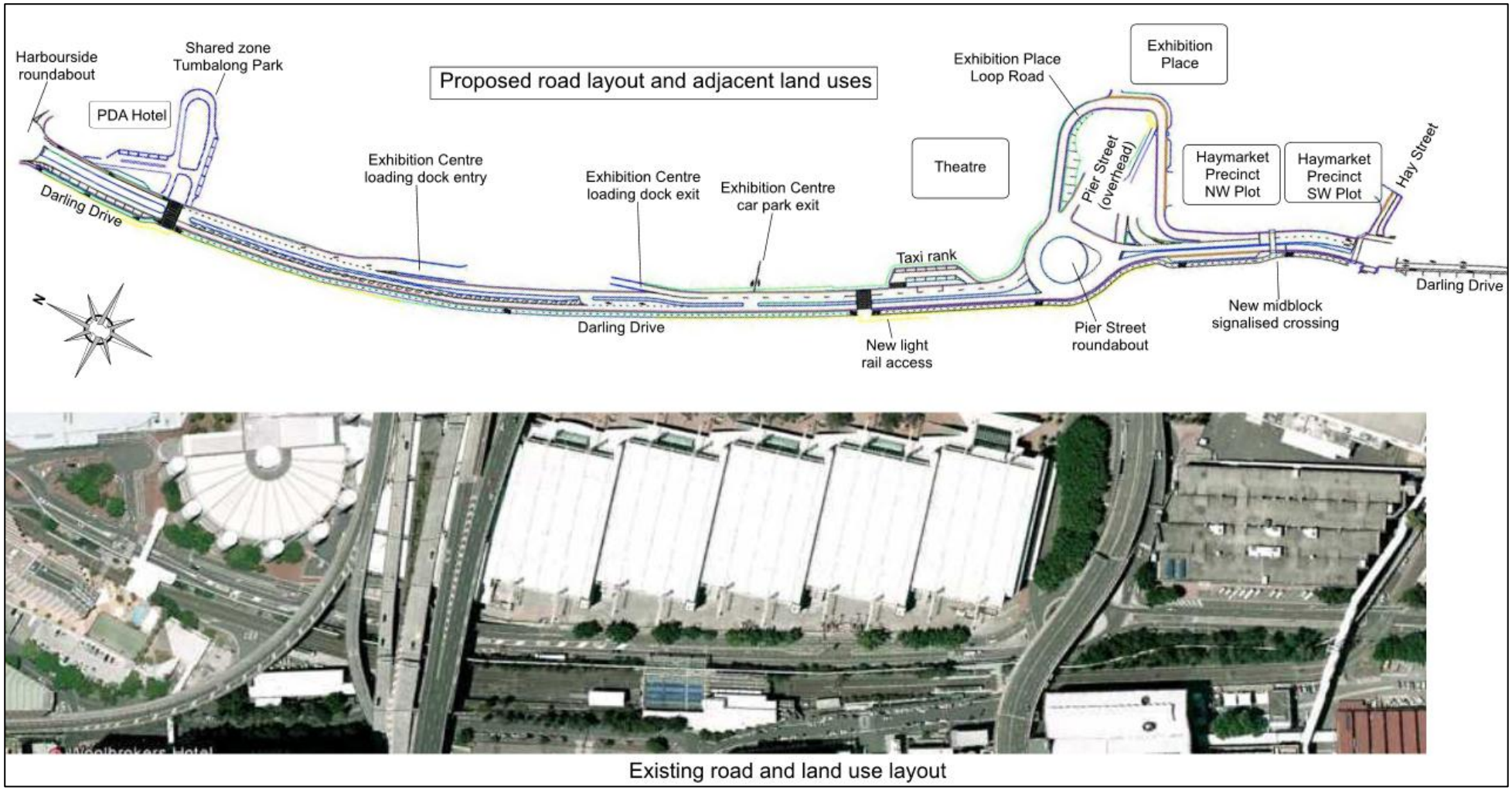
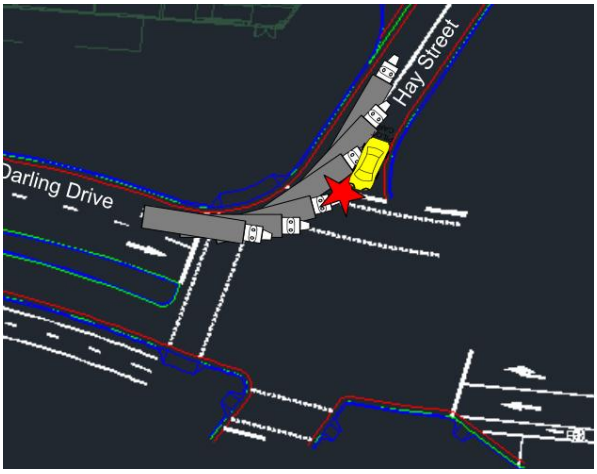


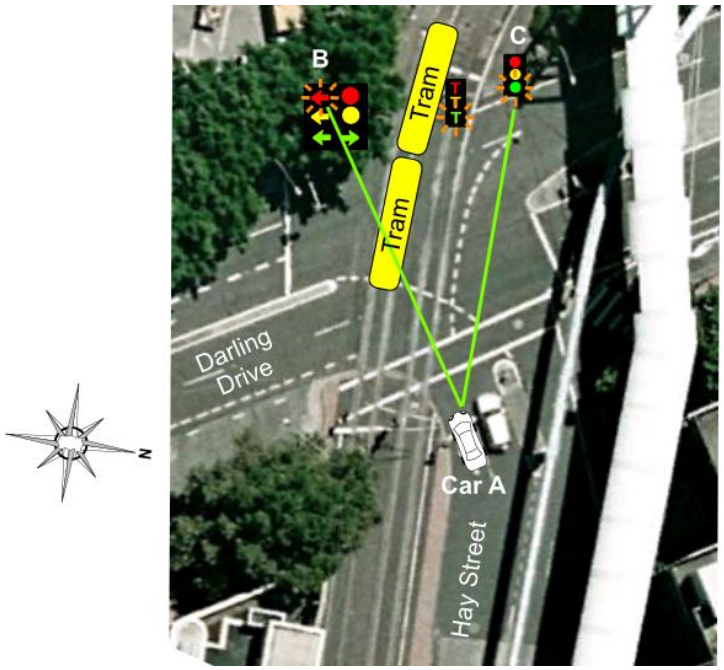
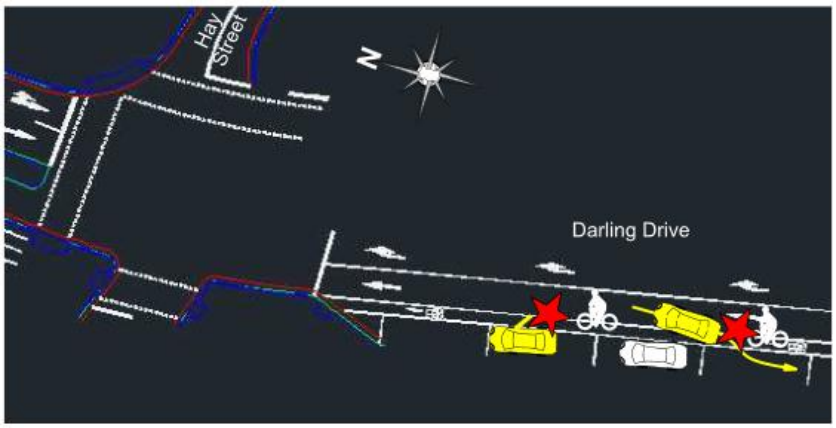
Figure 1 Locality map.

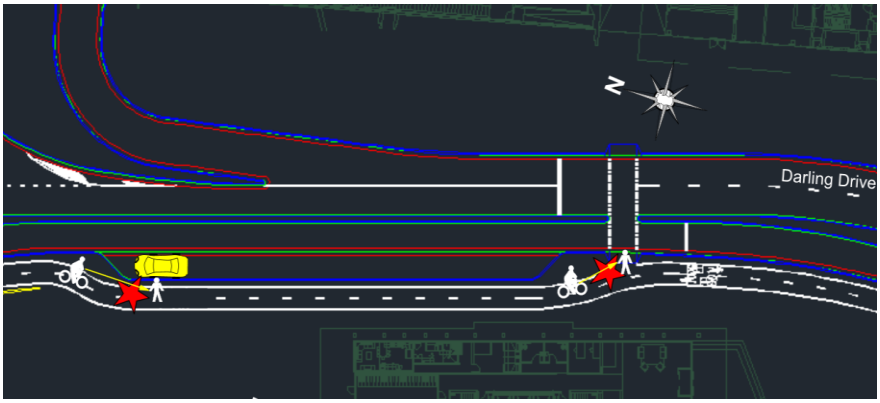
2 SAFETY AUDIT FINDINGS

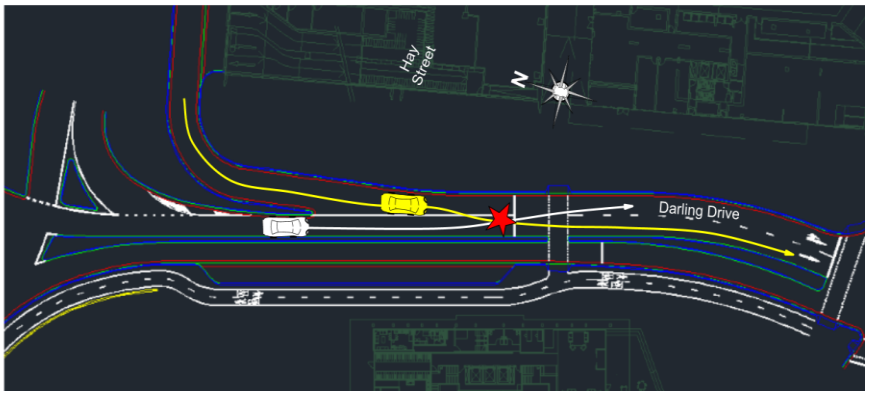
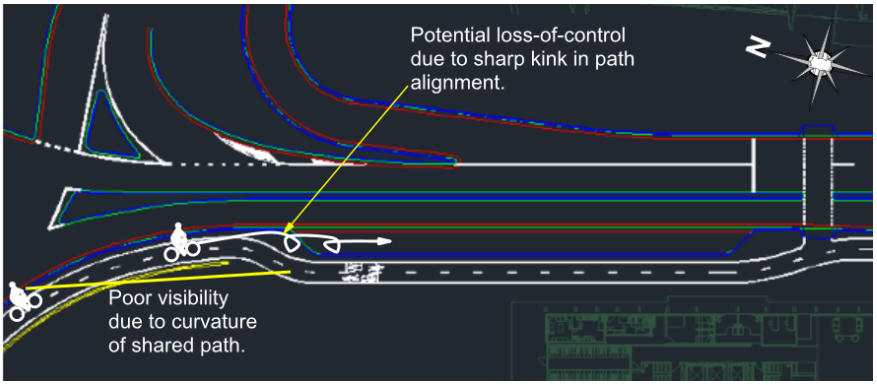
The road safety audit findings have been documented in Table 2. These are in geographical order from south to north.

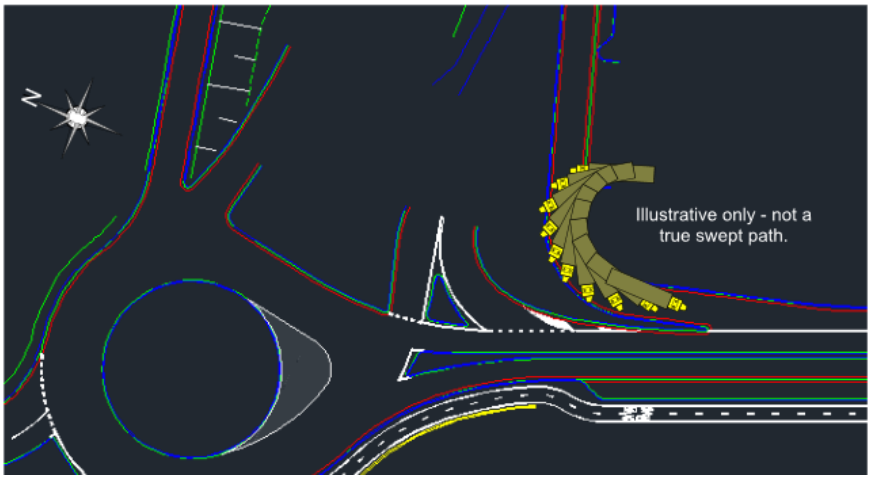
Table 2 Road safety audit findings

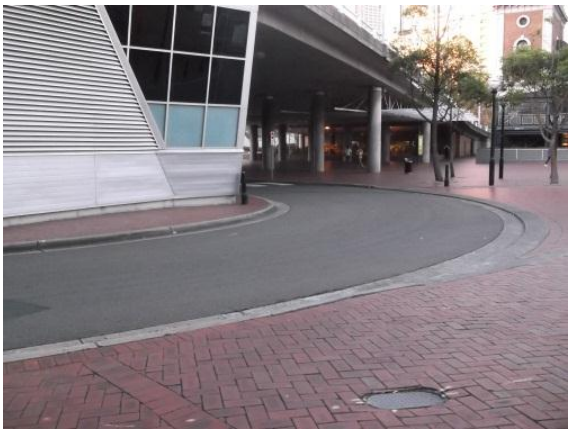
No	Location	Safety findings	Risk rating
1	Darling Drive/ Hay Street intersection.	At the southern entrance to the *Haymarket Precinct SW Plot*, the section of Hay Street leading to Darling Drive is very short, which could result in westbound traffic queuing back into the development. Additionally, eastbound (inbound) traffic may queue into the control area of the Darling Drive/ Hay Street intersection due to potential delays at gates in the driveway. This may lead to queued vehicles becoming trapped in the control area of the intersection (see below).  ***Above:*** *Risk of queue spillback from Haymarket Precinct SW Plot to the control area of the Darling Drive/ Hay Street intersection.*	Low
2	Hay Street.	At the interface between Darling Drive and Hay Street, the eastbound departure lane in Hay Street is narrow. The swept path envelope of a right-turning vehicle from Darling Drive may encroach over the centreline of Hay Street and increase *head-on* crash risk. This is also an issue for the southbound left turn movement from Darling Drive (shown below).  ***Above:*** *Head-on crash conflict due to limited swept path clearance for vehicles entering Hay Street.*	Medium

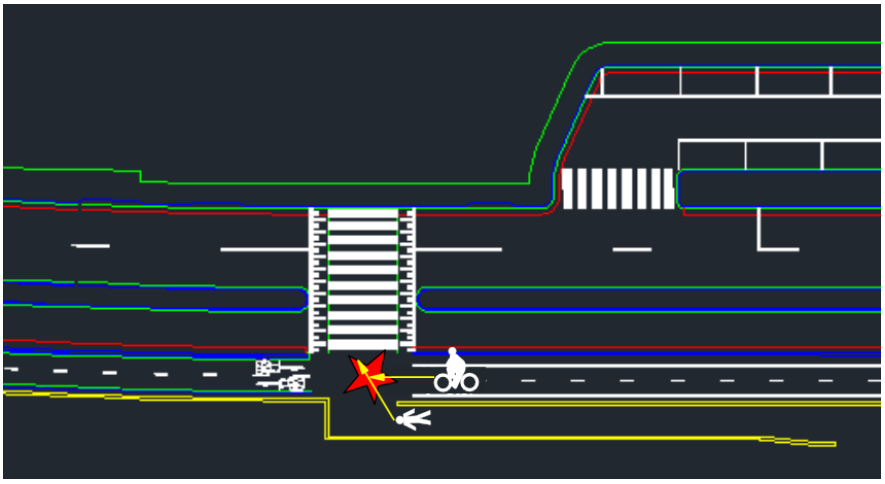
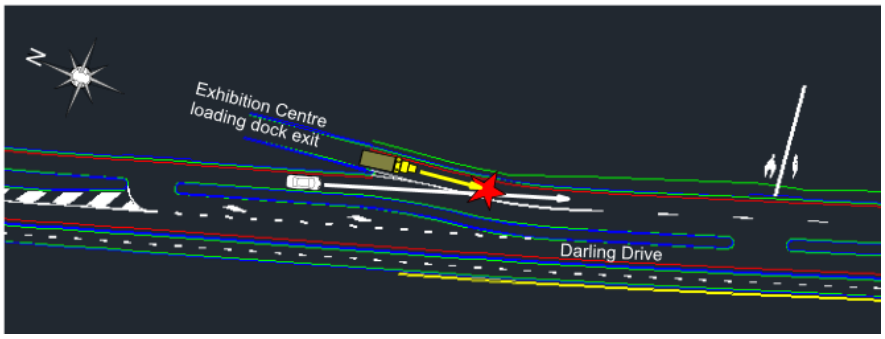
No	Location	Safety findings	Risk rating
3	Darling Drive/ Hay Street intersection.	The following observation was made regarding a current issue at the Darling Drive/ Hay Street intersection which would also affect safety of drivers egressing from the *Haymarket Precinct SW Plot*. Vehicles turning left from Hay Street to Darling Drive (Car A) would not see the red left turn arrow aspect (at B) due to a tram blocking their view. This driver would only see the full green aspect at the signals at C. As such, there is a potential tram-vehicle conflict as the left turning vehicle may believe they have right-of-way.  ***Above:*** *The left-turn arrow aspects from the signals at B would be obscured by passing trams. Egressing vehicles would only be able to see the full green aspect at C.*	Medium
4	Darling Drive northbound lane approaching Hay Street.	On the northbound bicycle lane along Darling Drive to the south of Hay Street, there is potential for cyclists to be impacted by opened doors and mirrors of vehicles parked in the parking bays. Furthermore, drivers manoeuvring into car spots would present further risk of vehicle-cyclist collisions.  ***Above:*** *Vehicle-bicycle crash conflicts along the western side of Darling Drive to the south of Hay Street.*	Medium

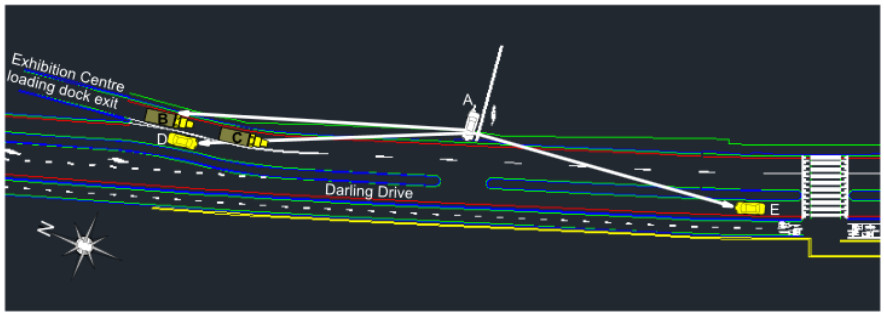
No	Location	Safety findings	Risk rating
5	New signalised midblock crossing on Darling Drive between Hay Street and Pier Street.	The existing midblock between the Pier Street roundabout and the Hay Street signals is approximately 140m long. The proposed signalised midblock crossing will create four short midblocks including (i) northbound carriageway between Pier Street and the crossing, (ii) northbound carriageway between the crossing and Hay Street, (iii) southbound carriageway between Hay Street and the crossing, and (iv) southbound carriageway between the crossing and Pier Street. There is a risk of queues from either of these three control points (ie. Pier Street roundabout, midblock signalised crossing, and Hay Street intersection) spilling back and straddling the upstream facility. In the case of upstream intersections, queued vehicles may become stranded in the control area of the intersection. Alternatively, the departure speeds may be significantly reduced such that a rear-end conflict arises between a vehicle departing an intersection (and hence accelerating) and a slowed or stationary vehicle on the departure side of the intersection. In the northbound direction, if queues spill back across the tram line, this could result in a potentially catastrophic crash between a tram and a queued vehicle. The added problem is that as a non-signalised facility, the Pier Street roundabout cannot be coordinated with the signalised midblock crossing or Hay Street intersection which would be both signal controlled and presumably SCATS linked.	Medium.
6	Darling Drive between Hay Street and Pier Street.	Pedestrians waiting to cross Darling Drive from the western side of the proposed signalised midblock crossing between Hay Street and Pier Street may be vulnerable to impacts from cyclists on the shared path.  ***Above:*** *Bicycle-pedestrian crash conflicts at taxi rank and signalised midblock crossing.*	High
7	Taxi rank on the western side of Darling Drive – south of the Pier Street roundabout	The taxi rank on the western side of Darling Drive also presents a bicycle-pedestrian crash conflict. Passengers boarding/ alighting from buses will be at risk of impacts from cyclists on the shared path (see diagram in item 6).	High

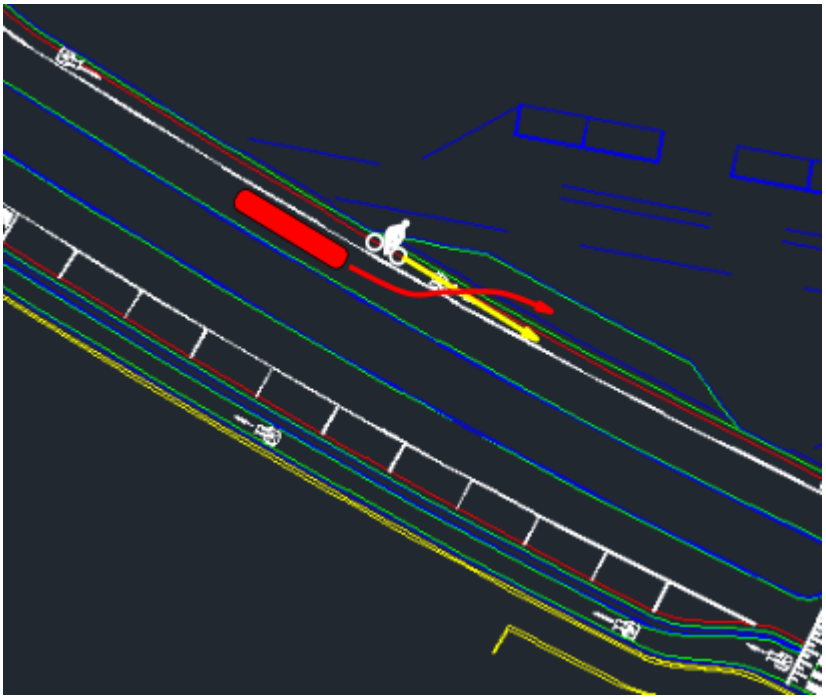
No	Location	Safety findings	Risk rating
8	Southbound carriageway of Darling Drive between Pier Street and Hay Street.	There is a possible weaving crash conflict in the midblock between Pier Street and Hay Street. Vehicles travelling in the southbound *through* lane of Darling Drive and intending to turn left into Hay Street will need to move from right to left. Vehicles egressing from the *Exhibition Place loop road* and intending to turn right into Ultimo Road would need to move from the left to the right. These weaving conflicts would occur over a 100-120m length of road (depending on the extent of queuing in the southbound approach to Hay Street). These crash conflicts are also likely to occur near the proposed signalised midblock pedestrian crossing, which creates additional risks of pedestrian-vehicle impacts.  ***Above:*** *Potential weaving crash conflict.*	Medium
9	Bus stop on Darling Drive between Pier Street and Hay Street	To accommodate the bus stop, there is a kink in the alignment of the shared path. On the southbound approach, this kink closely follows a corner, which could lead to *loss-of-control* events for cyclists. Furthermore, southbound cyclists may have poor visibility to the bus stop due to the curvature of the road and possible retaining walls. This could increase the risks of bicycle-pedestrian impacts.  ***Above:*** *Safety issues for cyclists at the sharp change in shared path alignment, and potential blind corner.*	High

No	Location	Safety findings	Risk rating
11	Exhibition Place loop road.	There is a potential vertical clearance risk along the proposed egress point from the *Exhibition Place loop road*. This is due to the westbound off-ramp from Pier Street.   ***Above:*** *Vertical clearance risk for Exhibition Place loop road.*	Medium
12	Exhibition Place loop road – driveway from Haymarket Precinct NW Plot.	In the egress lane of the Exhibition Place loop road, there is a driveway from Haymarket Precinct NW Plot. Vehicles egressing from this driveway into Darling Drive may experience difficulties in negotiating the hairpin curve without hitting structures adjacent to the road.  ***Above:*** *Potential challenge for vehicles egressing from Haymarket Precinct NW Plot.*	Low
13	Exhibition Place loop road - driveway from Haymarket Precinct NW Plot.	There are two exit lanes proposed from the *Haymarket Precinct NW Plot* to the *Exhibition Place loop road*. Given that the loop road is a one-way (clockwise) road, both lanes will be required to turn left. This will present a *side-swipe* crash conflict if two vehicle from adjacent egress lanes attempt to enter the loop road at the same time. Generally, dual turn lanes are not acceptable when the turning movement is not controlled.	Low

No	Location	Safety findings	Risk rating
14	Eastern portion of the Exhibition Place loop road.	There is poor *stopping sight distance* for traffic circulating along this loop road due to the Darling Harbour Operations Centre building. This is the case at both the approach and departure curves leading into this portion of the loop.  ***Above:*** *Poor stopping sight distance due to Darling Harbour Operations Centre building.*	Low
15	Whole scheme	There are long lengths of single lane carriageways bounded by kerbs and medians. This may not provide sufficient passing clearance in the event of broken down vehicle. This could result in extensive queuing/ congestion and associated *rear-end* crashes.	Low
16	Proposed zebra crossing at light rail station.	The proposed zebra crossing near the entrance to the light-rail station requires pedestrians to cross three lanes of Darling Drive in one stage, rather than in two separate stages which is currently provided (as shown in the photo below). The single stage crossing presents a more complicated crossing arrangement where pedestrians need to judge gaps in three lanes of traffic.  . ***Above:*** *Existing two-stage pedestrian crossing to be replaced by one-stage crossing.*	High

No	Location	Safety findings	Risk rating
17	New light rail access point. Ramp on the western side of the zebra crossing at Tumbalong Shared Zone.	Pedestrians emerging from the proposed new exit point for the light rail station may be hidden from the view of cyclists on the shared path, leading to possible bicycle-pedestrian collisions.  ***Above:*** *Potential conflict between bicycles and emerging pedestrians.* The same issue occurs at the ramp on the western side of the zebra crossing at *Tumbalong Shared Zone*.	High
18	Exhibition Centre loading dock exit.	There is a kink in the alignment of the southbound travel lane, immediately upstream of the added lane from the loading dock. Southbound drivers may misjudge the alignment and encroach into the loading dock exit lane. This could increase the risk of *side-swipe* crashes.  ***Above:*** *Kinked alignment in southbound lane and risk of encroachment into loading dock exit lane.*	Low

No	Location	Safety findings	Risk rating
19	Exhibition Centre car park egress.	Drivers turning right from the car park would need to judge gaps in three lanes of traffic including the southbound through travel lane, the southbound loading dock exit lane, and the northbound lane. This is considered a complex entering movement and may lead to poor gap acceptance and associated crash risks with Darling Drive traffic. Furthermore, visibility to the loading dock exit lane may be restricted due to the curvature of that lane. Vehicles in the loading dock exit lane may block visibility to other southbound vehicles.  ***Above:*** *The driver in car A may not be able to see vehicle B due to the curvature of the road and the property boundary. Vehicle C may block visibility to car D.*	High
20	Exhibition Centre car park egress.	There are two egress lanes marked. The northern lane is marked as a shared right-left turn lane. The provision of two adjacent lanes allowing left turns may result in *side-swipe* crashes. Generally, dual turn lanes are not acceptable when the turning movement is not controlled.	Medium
21	South of the Harbourside roundabout.	The proposed on-street parking spaces on the western side of Darling Drive may result in the northbound lane becoming blocked when vehicles manoeuvre into and out of parking spaces. This may lead to queue spillback and associated *rear-end* crashes.	Low
22	South of the Harbourside roundabout.	A southbound only cycle lane is provided adjacent to the southbound travel lane. However, this terminates at the zebra crossing outside the *Tumbalong Shared Zone*. Cyclists are required to cross the road and use the two-way cycleway from this point going southward. This has a number of safety and operational risks including: ▪ Cyclists crossing at this point may impact pedestrians using the crossing. ▪ Many cyclists would choose to continue southbound in the general travel lane. This could put them at risk of being impacted by other vehicles. It is also noted that this location also has a diverge to the Exhibition Centre loading dock and would cater for a high volume of heavy vehicles.	High

No	Location	Safety findings	Risk rating
23	Tumbalong Shared zone	The zebra crossing has driveways on either side of it leading into the Tumbalong Shared Zone. As an environment with a potentially high volume of pedestrians, this is not considered an appropriate arrangement. The vehicles turning into and out of the driveways would increase the likelihood of pedestrians being impacted. This is especially since in most cases the driver's attention would be focussed on other conflicting traffic streams. Pedestrians using the zebra crossing are led to an "island" between a number of driveways where they would be forced to walk on the roadway. This is also unconventional as a shared zone as it mixes the functions of off-road/ kerb-protected pedestrian space with those of a true shared zone where pedestrians can move freely in road-vehicular space. Right-turning egress movements from *Tumbalong Shared Zone* are permitted through the gap in the median. This will allow egressing vehicles to turn across the path of pedestrians using the crossing. Again, drivers would be focussing their attention on traffic from the north and south, rather than any pedestrians crossing at this location.	High
24	Southbound bus stop on Darling Drive to the south of Harbourside roundabout.	Buses moving into and out of this bus stop would compromise the safety of cyclists in the southbound only cycleway. This is likely to increase the risk of bus-bicycle crashes.  ***Above:*** *Potential crash conflict between bus moving into the bus stop, and cyclist on the bicycle lane.*	High

3 CONCLUDING STATEMENT

We have undertaken a preliminary design road safety audit using reference documents in Section 1 of this report.

The audit has been carried out for the sole purpose of identifying any features of the scheme and the adjacent roadways which could be altered or removed to improve the safety of the scheme.

Issues identified have been noted in this report for the Project Manager and Designer to review and assess, and where appropriate make the necessary recommendations to improve safety.

Damien Chee
Audit Team Leader
Hyder Consulting Pty Ltd

APPENDIX A: ROAD SAFETY AUDIT CHECKLIST

(Note: These checklist questions have been used as prompts for consideration. As such, comments have only been provided to elaborate on issues and/or to demonstrate that consideration was given to each safety aspect. Readers should not interpret this as a complete register of responses to each and every checklist question as that is not the intention of the checklist).

CHECKLIST 2: PRELIMINARY DESIGN STAGE AUDIT

Issue	Yes	No	Comment
2.1 General topics			
2.1.1 Changes since previous audit			
Do the conditions for which the scheme was originally designed still apply? (for example, no changes to the surrounding network, area activities or traffic mix)		✓	Major land use changes are planned.
Has the general form of the project design remained unchanged since previous audit (if any)?			No previous audits were received.
2.1.2 Drainage			
Will the scheme drain adequately?	✓		
Has the possibility of surface flooding been adequately addressed, including overflow from surrounding or intersecting drains and water courses?	✓		
2.1.3 Climatic conditions			
Has consideration been given to weather records or local experience that may indicate a particular problem? (for example, snow, ice, wind, fog)	✓		
2.1.4 Landscaping			
If any landscaping proposals are available, are they compatible with safety requirements? (for example, sight lines and hazards in clear zones)	✓		
2.1.5 Services			
Does the design adequately deal with buried and overhead services? (especially in regard to overhead clearances, etc)	✓		
Has the location of fixed objects or furniture associated with services been checked, including the position of poles?	✓		
2.1.6 Access to property and developments			
Can all accesses be used safely? (entry and exit/merging)		✓	Some egresses have dual turn lanes which are not controlled,
Is the design free of any downstream or upstream effects from points of access, particularly near intersections?		✓	- some visibility issues noted.
Have rest areas and truck parking accesses been checked for adequate sight distance, etc.?			NA.
2.1.7 Adjacent developments			
Does the design handle accesses to major adjacent generators of traffic and developments safely?	✓		Although some issues were noted.

Issue	Yes	No	Comment
Is the driver's perception of the road ahead free of misleading effects of any lighting or traffic signals on an adjacent road?	✓		
2.1.8 Emergency vehicles and access			
Has provision been made for safe access and movements by emergency vehicles?		✓	The raised median and lack of passing clearance on the one-lane sections will affect accessibility.
Does the design and positioning of medians and vehicle barriers allow emergency vehicles to stop and turn without unnecessarily disrupting traffic?		✓	
2.1.9 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?)		✓	
Is the transition between single and dual carriageway (either way) handled safely?	✓		
2.1.10 Staging of the scheme			
If the scheme is to be staged or constructed at different times: ▪ 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?			Unknown.
2.1.11 Staging of the works			
If the construction is to be split into several contracts, are they arranged safely?			Unknown.
2.1.12 Maintenance			
Can maintenance vehicles be safely located?		✓	Same as emergency vehicles.
2.2 Design issues (general) **2.2.1 Design standards**			
Is the design speed and speed limit appropriate? (for example, consider the terrain, function of the road)	✓		
Has the appropriate design vehicle and check vehicle been used?	✓		

Issue	Yes	No	Comment
2.2.2 Typical cross-sections			
Are lane widths, shoulders, medians and other cross-section features adequate for the function of the road?		✓	Passing clearance is inadequate on one-lane sections
Is the width of traffic lanes and carriageway suitable in relation to: ▪ alignment? ▪ traffic volume? ▪ vehicle dimensions? ▪ the speed environment? ▪ combinations of speed and traffic volume?	✓ ✓ ✓ – ✓		
Are overtaking/climbing lanes provided if needed?		✓	One lane sections!
Have adequate clear zones been achieved?	✓		This is a low speed urban environment.
2.2.3 The 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 or there have been compromises to accommodate accesses, etc.)	✓		
Does the cross-section avoid unsafe compromises such as narrowings at bridge approaches or past physical features?	✓		
2.2.4 Roadway layout			
Are all traffic management features designed to avoid creating unsafe conditions?		✓	Closely spaced intersections are a concern
Is the layout of road markings and reflective materials able to deal satisfactorily with changes in alignment? (particularly where the alignment may be substandard)			Unknown - linemarking plans were not available.
2.2.5 Shoulders and edge treatment			
Are the following safety aspects of shoulder provision satisfactory: ▪ provision of sealed or unsealed shoulders ▪ width and treatment on embankments ▪ crossfalls all of shoulders		✓	Cyclelanes adjacent to parking lanes and bus stops.
Are the shoulders likely to be safe if used by slow moving vehicles or cyclists?		✓	
Are any rest areas and truck parking areas safely designed?			NA.

Issue	Yes	No	Comment
2.2.6 Effect of departures from standards or guidelines			
Any approved departures from standards or guidelines: is safety maintained?	✓		
Any hitherto undetected departures from standards: is safety maintained?	✓		
2.3 Alignment details **2.3.1 Geometry of horizontal and vertical alignment**			
Do the horizontal and vertical design fit together correctly?	✓		
Is the design free of visual cues that would cause a driver to misread the road characteristics? (for example, visual illusions, subliminal delineation such as lines of trees, poles, etc.)		✓	Kinked alignment of southbound lane at loading dock exit.
Does the alignment provide for speed consistency?	✓		
2.3.2 Visibility; sight distance			
Are horizontal and vertical alignments consistent with the visibility requirements?	✓		
Will the design be free of sight line obstructions due to safety fences or barriers? ▪ boundary fences? ▪ street furniture? ▪ parking facilities? ▪ signs? ▪ landscaping? ▪ bridge abutments? and Structures ▪ parked vehicles in laybys or at the kerb? ▪ queued traffic?	 ✓ ✓ ✓ 	 ✓ ✓ ✓ 	Visibility may be impacted by trees, retaining walls, structures associated with the development.
Are railway crossings, bridges and other hazards all conspicuous?	✓		
Is the design free of any other local features which may affect visibility?	✓		
2.3.3 New/existing road interface			
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)	✓		
If carriageway standards differ, is the change effected safely?	✓		

Issue	Yes	No	Comment
Is the transition where the road environment changes (for example, urban to rural; restricted to unrestricted; lit to unlit) done safely?	✓		
Has the need for advance warning been considered?	✓		Although signage plans were not available.
2.3.4 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 can drivers correctly track through the scheme?	✓		
2.4 Intersections **2.4.1 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?	✓		
Will drivers be aware of the presence of the intersection? (especially on the minor road approach)	✓		
Will the design be free of sight line obstructions due to: ▪ safety fences or barriers? ▪ boundary fences? ▪ street furniture? ▪ parking facilities? ▪ signs? ▪ landscaping? ▪ bridge abutments?	✓ ✓ ✓ ✓ ✓ ✓ ✓		Existing visibility issues at Pier Street roundabout due to landscaping and bridge structures.
Are railway crossings, bridges and other hazards near intersections conspicuous?	✓		
Will the design be free of any local features which adversely affect visibility?	✓		
Will intersection sight lines be obstructed by permanent or temporary features such as parked vehicles in laybys, or by parked or queued traffic generally?	✓		
2.4.2 Layout, includes its appropriateness			
Is the type of intersection selected (cross roads, T, roundabout, signalised, etc.) appropriate for the function of the two roads?	✓		
Are the proposed controls (Give Way, Stop signals, etc.) appropriate for the particular intersection?	✓		
Are junction sizes appropriate for all vehicle movements?		✓	Swept path clearance at Hay Street looks questionable.

Issue	Yes	No	Comment
Are the intersections free of any unusual features which could affect road safety?	✓		
Are the lane widths and swept paths adequate for all vehicles?		✓	Hay Street. Exhibition Place loop road.
Is the design free of any upstream or downstream geometric features that could affect safety? (for example, merging of lanes)		✓	Weaving crash risk from Pier Street to Hay Street.
Are the approach speeds consistent with the intersection design?	✓		
Where a roundabout is proposed: ▪ have pedal cycle movements been considered? ▪ have pedestrian movements been considered? ▪ are details regarding the circulating carriageway sufficient?	✓ ✓ ✓		
2.4.3 Readability by drivers			
Will the general type, function and broad features be perceived correctly by drivers?	✓		
Are the approach speeds and likely positions of vehicles as they track through the scheme safe?	✓		
Is the design free of sunrise or sunset problems that may create a hazard for motorists?	✓		
2.5 Special road users **2.5.1 Adjacent land**			
Will the scheme be free of adverse effects from adjacent activity and intensity of land use? (if not, what special measures are needed?)	✓		
2.5.2 Pedestrians			
Have pedestrian needs been satisfactorily considered?		✓	Many cycle - pedestrian conflicts.
If footpaths are not specifically provided, is the road layout safe for use by pedestrians? (particularly at blind corners or on bridges)	✓		
Are pedestrian subways or footbridges sited to provide maximum use? (i.e. Is the possibility of pedestrians crossing at grade in their vicinity minimised?)			NA.
Has specific provision been made for pedestrian crossings, school crossings or pedestrian signals?	✓		
Where present, are these facilities sited to provide maximum use with safety?	✓		However, issues with crossing 'distances at the zebra crossings and grevinge. midblock TCS.

Issue	Yes	No	Comment
Are pedestrian refuges/kerb extensions provided where needed?		✓	
Has specific consideration been given to provision required for special groups? (for example, young, elderly, disabled, deaf or blind)	✓		
2.5.3 Cyclists			
Have the needs of cyclists been satisfactorily considered, especially at intersections?		✓	A bicycle crossover is required at the zebra crossing at Tumbalong Shared Zone.
Have cycle lanes been considered?	✓		
Are all cycleways of standard or adequate design?	✓		
Where a need for shared pedestrian/cycle facilities exists, have they been safely treated?	✓		
Where cycleways terminate at intersections or adjacent to the carriageway, has the transition treatment been handled safely?		✓	See above.
Have any needs for special cycle facilities been satisfactorily considered? (for example, cycle signals)		✓	
2.5.4 Motorcyclists			
Has the location of devices or objects that might destabilise a motorcycle been avoided on the road surface?	✓		This is a low speed environment
Will warning or delineation be adequate for motorcyclists?	✓		
Has barrier kerb been avoided in high-speed areas?	✓		
In areas more likely to have motorcycles run off the road is the roadside forgiving or safely shielded?	✓		
2.5.5 Equestrians and stock			
Have the needs of equestrians been considered, including the use of verges or shoulders and rules regarding the use of the carriageway?			NA
Can underpass facilities be used by equestrians/stock?			
2.5.6 Freight			
Have the needs of truck drivers been considered, including turning radii and lane widths?		✓	Turning path risks at Hay Street and Exhibition Place Loop Road.
2.5.7 Public transport			
Has public transport been catered for?		✓	Conflicts between pedestrians / bus commuters and bicycles.
Have the needs of public transport users been considered?		✓	

Issue	Yes	No	Comment
Have the manoeuvring needs of public transport vehicles been considered?	✓		
Are bus stops well positioned for safety?		✓	Crossing movements are necessitated.
2.5.8 Road maintenance vehicles			
Has provision been made for road maintenance vehicles to be used safely at the site?		✓	Lack of passing clearance No parking provisions.
2.6 Signs and lighting **2.6.1 Lighting**			
Is this project to be lit? Will safety be maintained if the project is not lit?	✓		
Is the design free of features that make illuminating sections of the road difficult? (for example, shadow from trees or over bridges)		✓	Lots of shadowing under Pier Street.
Has the question of sighting of lighting poles been considered as part of the general concept of the scheme?	✓		
Are frangible or slip-base poles to be provided?	✓		
Are any special needs created by ambient lighting? Will safety be maintained if special treatments are not provided?	✓		
Have the safety consequences of vehicles striking lighting poles (of any type) been considered?	✓		
2.6.2 Signs			
Are signs appropriate for their location?			
Are signs located where they can be seen and read in adequate time?			Signage plans were not provided nor audited.
Will signs be readily understood?			
Are signs located so that visibility to and from accesses and intersecting roads is maintained?			
Are signs appropriate to the driver's needs? (for example, destination signs, advisory speed signs, etc.)			
Have the safety consequences of vehicles striking sign posts been considered?			
Are signs located so that drivers' sight distance is maintained?			
Where signs are to be located in the clear zone, are they frangible or adequately shielded by a crash barrier?			

Issue	Yes	No	Comment
2.6.3 Marking and delineation			
Has the appropriate standard of delineation and marking been adopted?	✓		
Are the proposed markings consistent with the works in the adjoining section of the route?	✓		
Are the previous/adjacent markings to be upgraded? If not, will safety be maintained?	✓		
2.7 Traffic management **2.7.1 Traffic flow and access restrictions**			
Can traffic volumes from the proposed scheme be safely accommodated on existing sections of road?			Unknown. A modelling project is underway.
Have parking provision and parking control been adequately considered?		✓	
Can any turn bans be implemented without causing problems at adjacent intersections?	✓		
Has the effect of access to future developments been considered?		✓	There are a number of deficiencies such as right turn lanes from car parks which are not controlled.
Is safety maintained for any traffic diverting to other roads? (for example, to avoid a traffic control device)	✓		
2.7.2 Overtaking and merges			
Are overtaking sight distance and stopping distance adequate?			NA - This road is divided throughout Urban environment.
Have suitable shoulder widths been provided at lane drop merges?		✓	
Have standard signs and markings been provided for any lane drop?			Signage plans not provided.
Has adequate sight distance been provided to any lane drop?	✓		
Are shoulders wide enough opposite access points and intersections?		✓	Risks of pedestrians being struck by bicycles and turning vehicles
2.7.3 Rest areas and stopping zones			
Are there sufficient roadside stopping areas, rest areas and truck parking areas?			NA
Are any entries and exits to rest areas or truck parking areas safe?			

Issue	Yes	No	Comment
2.7.4 Construction and operation			
If the scheme is to be constructed 'under traffic', can this be done so safely?	✓		
Can the scheme be safely constructed?	✓		
Have the maintenance requirements been adequately considered?		✓	
Is safe access to and from the works available?	✓		
2.8 Additional questions to be considered for development proposals			
2.8.1 Horizontal alignment			
Is visibility adequate for drivers and pedestrians at proposed accesses?		✓	The structures themselves may compromise sight lines.
Is adequate turning space provided for the volume and speed of traffic? Are curve radii and forward visibility satisfactory?		✓	
Are sight and stopping distances adequate? •		✓	Not in Exhibition Place Loop Road.
2.8.2 Vertical alignment			
Are gradients satisfactory?	✓		
Are sight and stopping distances adequate?	✓		
2.8.3 Parking provision			
Is on-site parking adequate to avoid on-street parking and associated risks?		✓	Risk of door opening vs. bicycles.
Are parking areas conveniently located?	'	✓	
Is adequate space provided in parking areas for circulation and intersection sight distance?	✓		
2.8.4 Servicing facilities			
Are off-street loading/unloading areas adequate?	✓		
Are turning facilities for large vehicles provided in safe locations?	✓		
Is emergency vehicle access adequate?		✓	
2.8.5 Signs and markings			
Have necessary traffic signs and road markings been provided as part of a development?			Signage plans not provided.

Issue	Yes	No	Comment
Is priority clearly defined at all the intersection points within the car park and access routes?	✓		
Will the signs and markings be clear in all conditions, including day/night, rain, fog, etc.?			Unknown
2.8.6 Landscaping			
Does landscaping maintain visibility at intersections, bends, accesses and pedestrian locations?			Unknown. Landscaping plans not provided.
Has tree planting been avoided where vehicles are likely to run off the road?			
2.8.7 Traffic management			
Have any adverse area-wide effects been addressed?		✓	Risks of queue spillback to sensitive pedestrian & vehicle conflict areas.
Will the design keep travel speeds at the safe level?	✓		
Are the number and location of accesses appropriate?	✓		
Are the facilities for public transport services safely located?	✓		
Are any bicycle facilities safely located in respect to vehicular movements?		✓	Pedestrians are compromised.
Are pedestrian facilities adequate and safely located?	.	✓	
2.8.8 Other			
Has appropriate street lighting been provided?	✓		
Are any roadside hazards appropriately dealt with?	✓		
Has safe pedestrian access to the development been provided?	✓		
2.9 Any other matter **2.9.1 Safety aspects not already covered**			
Have all unusual or hazardous conditions associated with special events been considered?	✓		
Is the road able to safely handle oversize vehicles, or large vehicles like trucks, buses, emergency vehicles, road maintenance vehicles?		✓	
If required, can the road be closed for special events in a safe manner?	✓		Although it is critical for "back of house" access to development.
If applicable, are special requirements of scenic or tourist routes satisfied?	N/A		
Have all other matters which may have a bearing on safety been addressed?	✓		

DESIGNERS RESPONSE TO PRELIMINARY ROAD SAFETY AUDIT

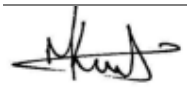
Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

DARLING HARBOUR LIVE

SYDNEY INTERNATIONAL CONVENTION EXHIBITION & ENTERTAINMENT PRECINCT

DESIGNERS RESPONSE -

PRELIMINARY ROAD SAFETY AUDIT

Author	Joe Heydon	
Checker	Michael Kurtz	
Approver	Greg ives	

Report No

Date 24th June 2013

CONTENTS

1 INTRODUCTION

1.1 PROJECT AND AUDIT DETAILS

This Report forms a designer's response to the preliminary road safety audit undertaken on the 13th of June 2013, for the proposed upgrades to Darling Drive between Hay Street and Harbourside Roundabout, Darling Harbour. The road safety audit report document number is F0001-AA004399-11-02-03-AAR-02.

It is noted that there have been some design changes since this road safety audit was undertaken, around the access and egress movements to the proposed Theatre building. Additional comments are contained after the designer's response, provided by the road safety auditor on this design change.

2 DESIGNER'S RESPONSE

The designer's response to the road safety audit findings have been documented in Table 2.

2.1 CHECKLIST

The Road Safety Audit is undertaken by an independent assessor, not part of the design team. The Road Safety Auditor uses the checklist found in Append A of the audit report, as a prompt only to assist the road safety audit process, to demonstrate that consideration was given to each safety risk. We believe that the key safety risks are outlined in the Road Safety Audit.

The designer's response only addresses the safety risks identified within the Road Safety Audit, and not the checklist, as the safety audit has already considered the auditor's comments outlined in the checklist.

No	Location	Safety findings	Designer's response
1	Darling Drive/ Hay Street intersection.	At the southern entrance to the *Haymarket Precinct SW Plot*, the section of Hay Street leading to Darling Drive is very short, which could result in westbound traffic queuing back into the development. Additionally, eastbound (inbound) traffic may queue into the control area of the Darling Drive/ Hay Street intersection due to potential delays at gates in the driveway. This may lead to queued vehicles becoming trapped in the control area of the intersection	30m of vehicle queue containment has been provided between the control point and the property boundary, with a further 8m provided between the property boundaries to Hay Street. Should additional queue containment be required, this will be addressed during the detailed design stage, to ensure that queue containment is contained within the property boundary and access road.
2	Hay Street.	At the interface between Darling Drive and Hay Street, the eastbound departure lane in Hay Street is narrow. The swept path envelope of a right-turning vehicle from Darling Drive may encroach over the centreline of Hay Street and increase *head-on* crash risk. This is also an issue for the southbound left turn movement from Darling Drive	The width of the access road provided to the SW plot car park is 6.0m. If required, design changes to the road width will be made during the detailed design stage, and vehicle swept path analysis will be undertaken to confirm sufficient road width, to reduce risk of head-on crashes. Vehicle classification movements into the SW development are limited.

No	Location	Safety findings	Designer's response
3	Darling Drive/ Hay Street intersection.	The following observation was made regarding a current issue at the Darling Drive/ Hay Street intersection which would also affect safety of drivers egressing from the *Haymarket Precinct SW Plot*. Vehicles turning left from Hay Street to Darling Drive (Car A) would not see the red left turn arrow aspect (at B) due to a tram blocking their view. This driver would only see the full green aspect at the signals at C. As such, there is a potential tram-vehicle conflict as the left turning vehicle may believe they have right-of-way.	This intersection currently operates in this fashion with the exit from the existing car park. There is effectively no change proposed for this intersection from what currently operates. Changes will be required to the existing signals on the junction of Darling Drive and Hay Street, to accommodate the Haymarket development. Visibility to traffic signals for traffic egressing from Hay Street will be considered during the design of the traffic signals for this junction.
4	New signalised midblock crossing on Darling Drive between Hay Street and Pier Street.	The existing midblock between the Pier Street roundabout and the Hay Street signals is approximately 140m long. The proposed signalised midblock crossing will create four short midblocks including (i) northbound carriageway between Pier Street and the crossing, (ii) northbound carriageway between the crossing and Hay Street, (iii) southbound carriageway between Hay Street and the crossing, and (iv) southbound carriageway between the crossing and Pier Street. There is a risk of queues from either of these three control points (i.e. Pier Street roundabout, midblock signalised crossing, and Hay Street intersection) spilling back and straddling the upstream facility. In the case of upstream intersections, queued vehicles may become stranded in the control area of the intersection. Alternatively, the departure speeds may be significantly reduced such that a rear-end conflict arises between a vehicle departing an intersection (and hence accelerating) and a slowed or stationary vehicle on the departure side of the intersection. In the northbound direction, if queues spill back across the tram line, this could result in a potentially catastrophic crash between a tram and a queued vehicle. The added problem is that as a non-signalised facility, the Pier Street roundabout cannot be coordinated with the signalised midblock crossing or Hay Street intersection which would be both signal controlled and presumably SCATS linked.	The proposed signalised pedestrian crossing will be assessed during the detailed design stage to ensure that the signal phasings do not disrupt the operation of adjacent intersections. NSW road rule "128 Entering blocked intersections", states that A driver must not enter an intersection if the driver cannot drive through the intersection because the intersection, or a road beyond the intersection, is blocked.

No	Location	Safety findings	Designer's response
5	Darling Drive between Hay Street and Pier Street.	Pedestrians waiting to cross Darling Drive from the western side of the proposed signalised midblock crossing between Hay Street and Pier Street may be vulnerable to impacts from cyclists on the shared path.	The crossing will be designed to ensure adequate sight lines are maintained for pedestrians, cyclists and motorists. Consideration will be given to the provision of adequate standing room for pedestrians waiting to cross the proposed signalized mid-block crossing, to protect them from impacts from cyclists, during the detailed design stage.
6	Loading Zone on the western side of Darling Drive – south of the Pier Street roundabout	The truck loading / refuse collection zone on the western side of Darling Drive also presents a bicycle-pedestrian crash conflict. People boarding/ alighting from vehicles in this zone will be at risk of impacts from cyclists on the shared path	This zone is intended for use by refuse vehicles collecting refuse from the student accommodation plot, seasonal loading/unloading into the student accommodation by students and taxi drop-off to this plot. It is not anticipated that a high turnover of vehicles movements will occur in this zone, on a daily basis. A 1.0m clearance zone has been provided between the face of kerb of the loading zone along Darling Drive, opposite the proposed student accommodation plot, and the edge of the proposed shared cycle way, in accordance with design guidelines to protect cyclists from the impact of vehicle door openings, and people alighting from vehicles.
7	Southbound carriageway of Darling Drive between Pier Street and Hay Street.	There is a possible weaving crash conflict in the midblock between Pier Street and Hay Street. Vehicles travelling in the southbound *through* lane of Darling Drive and intending to turn left into Hay Street will need to move from right to left. Vehicles egressing from the *Exhibition Place loop road* and intending to turn right into Ultimo Road would need to move from the left to the right. These weaving conflicts would occur over a 100-120m length of road (depending on the extent of queuing in the southbound approach to Hay Street). These crash conflicts are also likely to occur near the proposed signalised midblock pedestrian crossing, which creates additional risks of pedestrian-vehicle impacts.	The location of the crossing has been assessed for weaving and merging movements for through traffic on Darling Drive west of the crossing intending to turn left at Hay Street access lane. Vehicles exiting from Exhibition Place have approximately 335m to change lanes prior to the junction of Ultimo Road with Darling Drive. Only vehicles requiring access to the SW residential plot will require changing lanes to gain access to Hay Street, and there is approximately 88m of travel lane available to undertake this movement. Drivers making this movement will be predominately residents aware of this movement from continued use.

No	Location	Safety findings	Designer's response
8	Loading Zone on Darling Drive between Pier Street and Hay Street	To accommodate the loading zone, there is a kink in the alignment of the shared path. On the southbound approach, this kink closely follows a corner, which could lead to *loss-of-control* events for cyclists. Furthermore, southbound cyclists may have poor visibility to the loading zone due to the curvature of the road and possible retaining walls. This could increase the risks of bicycle-pedestrian impacts.	The kink in the shared cycle way alignment will addressed in the detailed design stage.
9	Exhibition Place loop road.	There is a potential vertical clearance risk along the proposed egress point from the *Exhibition Place loop road*. This is due to the westbound off-ramp from Pier Street.	Vertical clearance for vehicles anticipated to use the Exhibition Place loop road has been assessed, and can be accommodated. This area is currently used by semi-trailers to allow access to / from the entertainment centre.
10	Exhibition Place loop road – driveway from Haymarket Precinct NW Plot.	In the egress lane of the Exhibition Place loop road, there is a driveway from Haymarket Precinct NW Plot. Vehicles egressing from this driveway into Darling Drive may experience difficulties in negotiating the hairpin curve without hitting structures adjacent to the road.	Swept path movements of vehicles exiting the NW plot of the Haymarket development have been assessed and considered acceptable.
11	Exhibition Place loop road - driveway from Haymarket Precinct NW Plot.	There are two exit lanes proposed from the *Haymarket Precinct NW Plot* to the *Exhibition Place loop road*. Given that the loop road is a one-way (clockwise) road; both lanes will be required to turn left. This will present a *side-swipe* crash conflict if two vehicle from adjacent egress lanes attempt to enter the loop road at the same time. Generally, dual turn lanes are not acceptable when the turning movement is not controlled.	The exit movement from this car park will be controlled by boom gates and is not dissimilar to the exit from the existing car park. Consideration of only one egress lane from the NW plot car park will be considered during the detailed design or greater spacing of the egress lanes to reduce the risk of side swipe impacts.
12	Eastern portion of the Exhibition Place loop road.	There is poor *stopping sight distance* for traffic circulating along this loop road due to the Darling Harbour Operations Centre building. This is the case at both the approach and departure curves leading into this portion of the loop.	The Exhibition Place loop road is a one way access road. Consideration has been given to conflicts with pedestrians using the existing pedestrian ramp by relocated the bottom of the ramp away from the bend in the road, and by providing a pedestrian crossing. Sightlines and visibility will be considered further during the detailed design stage.

No	Location	Safety findings	Designer's response
13	Whole scheme	There are long lengths of single lane carriageways bounded by kerbs and medians. This may not provide sufficient passing clearance in the event of broken down vehicle. This could result in extensive queuing/ congestion and associated *rear-end* crashes.	Where possible, in the absence of dual lanes along Darling Drive, breakdown lanes and on-street parking such as taxi holding zones etc. have been provided to assist broken down vehicles. Mountable kerbs will be provided for the central median where this cannot be achieved.
14	Proposed zebra crossing at light rail station.	The proposed zebra crossing near the entrance to the light-rail station requires pedestrians to cross three lanes of Darling Drive in one stage, rather than in two separate stages which is currently provided (as shown in the photo below). The single stage crossing presents a more complicated crossing arrangement where pedestrians need to judge gaps in three lanes of traffic.	This pedestrian crossing is now proposed as a signalised crossing, following recent design changes to the Theatre.
15	New light rail access point. Ramp on the western side of the zebra crossing at Tumbalong Shared Zone.	Pedestrians emerging from the proposed new exit point for the light rail station may be hidden from the view of cyclists on the shared path, leading to possible bicycle-pedestrian collisions.	Adequate visibility to pedestrians emerging from the light rail stop will be provided to cyclists using the shared cycle way. There is a level difference which will improve visibility between cyclists and pedestrians at this junction.
16	Exhibition Centre loading dock exit.	There is a kink in the alignment of the southbound travel lane, immediately upstream of the added lane from the loading dock. Southbound drivers may misjudge the alignment and encroach into the loading dock exit lane. This could increase the risk of *side-swipe* crashes.	This will be addressed in the detailed stage e.g. a physical median may be extended from the loading dock ramp egress, along the delineation line to prevent vehicles from impact of side swipe. Trucks egressing at this location will generally be in off-peak hours.

No	Location	Safety findings	Designer's response
17	RL5.8m Exhibition Centre loading dock exit	The driver of a truck leaving the Exhibition Centre lower loading dock will need to look towards the north to judge gaps to enter Darling Drive. Whether the approaching vehicle is proceeding straight or turning left into Tumbalong Place makes little difference. The truck driver still needs to judge the approaching vehicle's speed and hence how much gap is available. The egressing truck would be commencing the turn from rest or a very low speed. By the time the driver has selected a gap, he/she is no longer looking north, but rather starts to look south to the road environment ahead. From this position he/she can see both sides of the pedestrian crossing and hence any pedestrians crossing at this location.	Swept path analysis of trucks leaving the lower Exhibition loading dock will be undertaken during the detailed design stage to ensure adequate protection to pedestrians in the vicinity of this loading dock egress location.
18	Exhibition Centre car park egress.	Drivers turning right from the car park would need to judge gaps in three lanes of traffic including the southbound through travel lane, the southbound loading dock exit lane, and the northbound lane. This is considered a complex entering movement and may lead to poor gap acceptance and associated crash risks with Darling Drive traffic. Furthermore, visibility to the loading dock exit lane may be restricted due to the curvature of that lane. Vehicles in the loading dock exit lane may block visibility to other southbound vehicles.	The proposed egress from the Exhibition Centre car park is similar to existing conditions, barring the loading dock movement. However, it not anticipated that movements from the car park and the loading dock will occur concurrently that often. Visibility and sightlines for traffic movements at this junction have been considered and will be considered further during the detailed stage.
19	Exhibition Centre car park egress.	There are two egress lanes marked. The northern lane is marked as a shared right-left turn lane. The provision of two adjacent lanes allowing left turns may result in *side-swipe* crashes. Generally, dual turn lanes are not acceptable when the turning movement is not controlled.	The exit movement from this car park will be controlled by boom gates and is not dissimilar to the exit from the existing car park. Consideration of only one egress lane from the Exhibition Centre car park will be considered during the detailed design, or greater spacing of the egress lanes, or provision of medians to reduce the risk of side swipe impacts.
20	South of the Harbourside roundabout.	The proposed on-street parking spaces on the western side of Darling Drive may result in the northbound lane becoming blocked when vehicles manoeuvre into and out of parking spaces. This may lead to queue spillback and associated *rear-end* crashes.	This area is proposed as a taxi holding area only, with taxis driving forward into a space and moving forward within the taxi holding zone, prior to egress.

No	Location	Safety findings	Designer's response
21	South of the Harbourside roundabout.	A southbound only cycle lane is provided adjacent to the southbound travel lane. However, this terminates at the zebra crossing outside the *Tumbalong Shared Zone*. Cyclists are required to cross the road and use the two-way cycleway from this point going southward. This has a number of safety and operational risks including: • Cyclists crossing at this point may impact pedestrians using the crossing. • Many cyclists would choose to continue southbound in the general travel lane. This could put them at risk of being impacted by other vehicles. It is also noted that this location also has a diverge to the Exhibition Centre loading dock and would cater for a high volume of heavy vehicles.	It is necessary to link cyclists on the southbound lane with the existing southbound cycle network. It is not possible to safely link them north of the Harbourside roundabout, due to the existing grade separated road configuration. It was therefore thought best to safely connect them at the proposed pedestrian crossing. Consideration will be taken during the detailed design stage for conflict with pedestrians and cyclists at this crossing.
22	Tumbalong Shared zone	The zebra crossing has driveways on either side of it leading into the Tumbalong Shared Zone. As an environment with a potentially high volume of pedestrians, this is not considered an appropriate arrangement. The vehicles turning into and out of the driveways would increase the likelihood of pedestrians being impacted. This is especially since in most cases the driver's attention would be focussed on other conflicting traffic streams. Pedestrians using the zebra crossing are led to an "island" between a number of driveways where they would be forced to walk on the roadway. This is also unconventional as a shared zone as it mixes the functions of off-road/ kerb-protected pedestrian space with those of a true shared zone where pedestrians can move freely in road-vehicular space. Right-turning egress movements from *Tumbalong Shared Zone* are permitted through the gap in the median. This will allow egressing vehicles to turn across the path of pedestrians using the crossing. Again, drivers would be focussing their attention on traffic from the north and south, rather than any pedestrians crossing at this location.	The arrangement of the Tumablong Place shared zone will be considered during the detailed design stage to consider pedestrian and vehicle movements. It is only anticipated that very low vehicle movements will occur on a daily basis in this area, and any high volumes during event mode will be addressed by event management and operational measurements e.g. stewards and traffic marshals. Shared zones are proving to improve pedestrian safety as drivers and pedestrians alike are more cautious.
23	Southbound bus stop on Darling Drive to the south of Harbourside roundabout.	Buses moving into and out of this bus stop would compromise the safety of cyclists in the southbound only cycleway. This is likely to increase the risk of bus-bicycle crashes.	Consideration will be given to cyclist movements during the detailed design stage, to reduce/avoid potential conflicts with bus movements.

3 POST AUDIT DESIGN CHANGES

3.1 THE THEATRE

Since the road safety audit was undertaken, there has been a design change in the vicinity of the proposed Theatre car park access and egress. Previously, access for vehicles entering and exiting the Theatre car park, was provided on Exhibition Place. There was a proposed taxi holing zone to the west of the Theatre building, linked to Darling Drive. The pedestrian crossing linking Tumbalong Place and the light rail stop was proposed as either a zebra crossing or a staggered crossing.

Following the change to the Theatre building, access and egress will now be provided to the Theatre car park from Darling Drive. The taxi holing area has been replaced by an indented bus stop and the proposed pedestrian crossing is now proposed as a signalised crossing. Please see Figure 1 below:

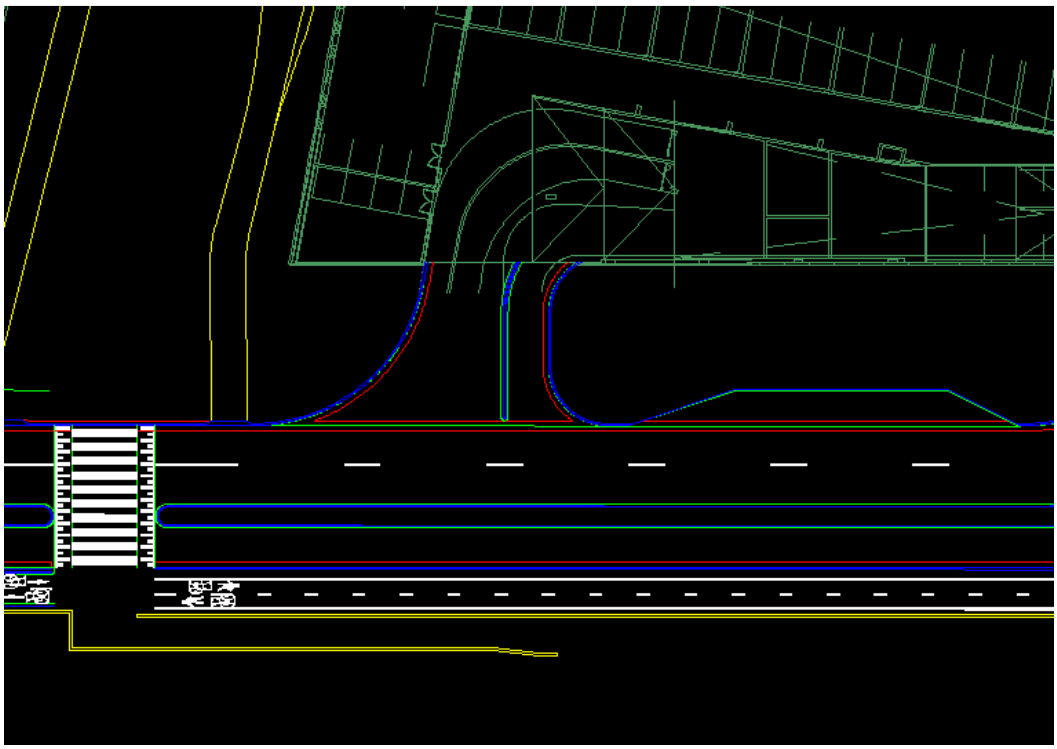


Figure1: Revised Theatre layout design

Road safety audit commentary on this revised access has been provided by the auditor and is found as Appendix A to this Report.

APPENDIX A

Joe Heydon

From: Damien Chee
Sent: 19 June 2013 7:54 PM
To: Greg Ives; Joe Heydon; Sally Manahan; AA004399
Subject: RE: Theatre car park entry/egress

Hi Greg

We have now reviewed the left-in-left-out access/egress associated with the Theatre car park. We regard this to be a similar set of circumstances as the previously proposed taxi rank as the taxi rank is essentially a left-in-left-out arrangement. As per the audit report we had no issue with the taxi rank. As such, we also have no issue with the current proposal to have a left-in-left-out arrangement for the Theatre car park.

Kind regards

Damien

Damien Chee
Principal Traffic Engineer
Hyder Consulting Pty Ltd
Locked Bag 6503 North Sydney NSW 2060 Australia
Level 5, 141 Walker Street North Sydney NSW 2060 Australia
Direct: +61 2 8907 9052 | Fax: +61 2 8907 9001
Mobile: +61 403 535 793
Web: www.hyderconsulting.com