Transport Planning and Design
Level 1, 284 Kilmore Street
www.viastrada.nz

Thorndon Connections cycleway audit – safety and accessibility

30% design audit

Report prepared for

Paneke Pōneke
Bike network plan

Absolutely Positively
Wellington City Council
Me Heke Ki Pōneke

November 2022

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<table>
<tr><th colspan="3">Quality Assurance Statement</th></tr>
<tr><td rowspan="3">ViaStrada Ltd
Level 1,
284 Kilmore Street
PO Box 22 458
Christchurch 8140
New Zealand
Phone: (03) 366-7605
www.viastrada.nz
info@viastrada.nz</td><td>Project manager:</td><td>Axel Downard-Wilke, ME (Civil), BE (Civil)
Director – Senior Transportation Engineer & Transportation Planner
027 292 9810
axel@viastrada.nz</td></tr>
<tr><td>Prepared by:</td><td>Megan Gregory, BE, MET
Senior Transportation Engineer
027 907 3431
megan@viastrada.nz</td></tr>
<tr><td>Reviewed by:</td><td>Glen Koorey, BE, ME (Civil), BSc, PhD
Director – Senior Transportation Engineer & Transportation Planner
027 739 6905
glen@viastrada.nz</td></tr>
<tr><td>Project number:
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Disclaimer

The findings and recommendations in this report are based on the site visit undertaken by the cycleway audit team (CAT), an examination of available relevant plans, the specified road and environs, and the CAT's professional knowledge and experience. However, it must be recognised that no audit can guarantee the elimination of all possible safety concerns as all traffic environments consist of a multitude of elements that are never completely within the control of engineering design.

Safety and accessibility audits, by nature, focus on aspects relating to safety and accessibility and therefore do not constitute a complete review of design or assessment of standards with respect to engineering or planning documents. Similarly, the safety audit focuses on the plans provided and the relevant design stage.

This audit applies to the stated project. Whilst some issues covered are general and might be applicable to other locations, the CAT does not take any responsibility for transferral of concepts to other projects or locations.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the CAT or their organisation(s).

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1 Introduction

1.1 Brief and project description

ViaStrada (the cycleway audit team, a.k.a. CAT) have been commissioned by the client to audit for Paneke Pōneke – Wellington's transitional cycle network. The audit is to be a combination of road safety and accessibility audits and is henceforth referred to as a CASA – i.e. "Cycleway audit – safety and accessibility". A number of CASAs will be undertaken on the various routes / packages at various design stages. The CASA process complies with Waka Kotahi NZ Transport Agency *Safe System audit guidelines* (2022).

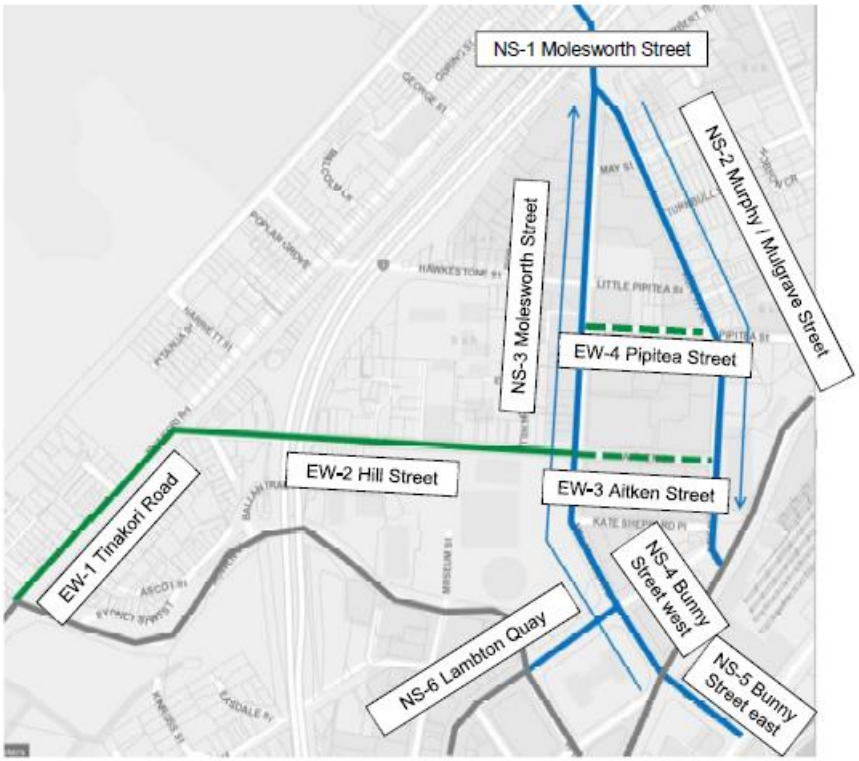


Figure 1-1: Extent of audit

This CASA is for the 30% design stage of the Thorndon Connections (formerly known as "Molesworth-Mulgrave") routes package, as shown in Figure 1-1.

Previous work on the project includes a Multi Criteria Analysis (WSP, October 2022) to determine treatment types for the various sections, plus associated modelling work.

The infrastructure assessed in this audit includes: painted markings, physically separated cycleways raised platforms, kerb changes and traffic signals (to the extent of detail provided at this stage).

1.2 The cycleway audit team

The CASA was carried out by the Cycleway Audit Team (CAT) consisting of:

- Megan Gregory, the cycleway audit team leader, of ViaStrada Ltd
- Axel Wilke, Glen Koorey, Nick Reid and John Lieswyn, cycleway audit team members, of ViaStrada Ltd

1.3 Meetings and site visits

A project briefing was conducted online on 26 October 2022, involving representatives from the client, the designer and the CAT. The designer's representative Chris Groom briefed the CAT on the project and clarified the scope of the audit.

The daytime site visit was undertaken prior to the plans being received, on 28 July 2022, from 2:30 to 4pm.

A night-time site visit was not undertaken.

1.4 Project information provided

The CAT has received the following plans and information on the roads and traffic within the audit area:

Table 1-1: plans reviewed

Document	*Date*	*Description*
Accessibility_ Road safety Audit - Thorndon Connections	31 October 2022	Email in response to request for further information regarding modelling details and vehicle tracking.
Traffic signal layouts design decision meeting 1.docx	18 October 2022	Memo on discussion between client and designer regarding signalised intersections.
MolesworthMulgrave-TransitionalCycleways-TrafficSignals-memo-Jul22.pdf	19 July 2022	Memo regarding changes made in the concept design at signalised intersections.
5-C3880.32_C30-C40(B) (General Layout).pdf	19 October 2022	Revised scheme plans (no speed humps on Tinakori Rd)
5-C3880.32_C115-C117 (Mulgrave St - Aitken St signals).pdf	21 October 2022	Signal plans for Mulgrave / Aitken intersection.
5-C3880.32_C113-C114 (Mulgrave St - Pipitea St signals).pdf	25 October 2022	Signal plans for Mulgrave / Pipitea intersection.
5-C3880.32_C109-C110 (Molesworth St - Tinakori Rd - Park St signals).pdf	25 October 2022	Signal plans for Molesworth / Tinakori intersection.
5-C3880.32_C105-C106 (Molesworth St - Hill St - Aitken signals) C105-C106.pdf	19 October 2022	Signal plans for Molesworth / Aitken intersection.
5-C3880.32_C111-C112 (Murphy St pedestrian crossing) C111-C112	19 October 2022	Signal plans for midblock pedestrian crossing on Murphy St.
5-C3880.32_C60-C68 (A) (Vehicle tracking).pdf	21 October 2022	Vehicle tracking at key intersections.
2022-10-17_FINAL_Transitional Cycleways Multi Criteria Analysis - MM_with appendix.pdf	17 October 2022	Multi-criteria analysis report.
Thorndon cycleways intersection modelling results	7 October 2022	Thorndon cycleways intersection modelling report.

1.5 Design vehicles / users

For intersections, Austroads *Guide to Road Design Part 4: Intersections and Crossings: General* (AGRD4, 2017) describes a design vehicle as the largest vehicle that can perform any particular turning

movement from the appropriate approach lane to the appropriate departure lane with adequate clearances to features such as kerbs and roadside furniture.

The CAT has assumed the following design vehicles for this project:

- 19 m semi-trailer is the maximum design vehicle expected to use roads connecting to the commercial area.
- 11.5 m rigid truck or urban bus on the main subdivision road network.
- People on bikes are anticipated to be confident riders with at least cycling competency of Grade 2 intermediate skills
- Being in the CBD, users of electric scooter users are expected to be common (including the current public share scooters by Beam and Flamingo). Unless otherwise specified, where an issue description refers to "cycleway users" or simply "cyclists", this also includes users of electric scooters or other small-wheeled electric devices.

1.6 Items not covered

This 30% CASA does not cover the aspects of:

- Cycleway marking design at side roads and driveways
- Cycleway and pedestrian crossing markings at floating bus stops
- Intersection design at:
  - Lambton Quay / Mulgrave St / Thorndon Quay
  - Bunny St / Lambton Quay / Molesworth St
- Intersection operation at:
  - Bowen St/ Tinakori Rd
  - Stout St / Whitmore St
- Parking management changes in this area

2 Audit procedure and report format

This audit follows the Waka Kotahi NZ Transport Agency *Safe System Audit Guidelines* (2022). The primary objective of a Safe System audit is to deliver a project that achieves an outcome consistent with the Safe System approach, that is, minimisation of death and serious injury.

The following section(s) of this report detail the issues identified in the audit.

2.1 Crash probability

The probability of a crash is qualitatively assessed based on expected exposure (how many road users will be exposed to the site) and the likelihood of a crash resulting from the presence of the particular safety issue. Probability ranges from "very likely" to "very unlikely".

Table 2-1: Relationship between crash probability and frequency

Probability of a crash occurring	**Frequency of crashes expected**
Very likely	One crash every 3 months (4+ crashes / year)
Likely	One crash every 3-12 months (1-4 crashes / year)
Unlikely	One crash every 1-7 years (0.1-1 crashes / year)
Very unlikely	One crash every 7+ years (<0.1 crashes / year)

2.2 Crash severity

The expected severity outcome of a crash is qualitatively assessed based on factors such as expected speeds, type of collision, and type of user/vehicle/object involved; Figure 2-1, which is based on Austroads *Guide to Road Safety part 6: Road Safety Audit* (2022) but in colour instead of greyscale, gives an indication of the expected crash severity based on these factors. Table 2-2 describes the four crash severities used.

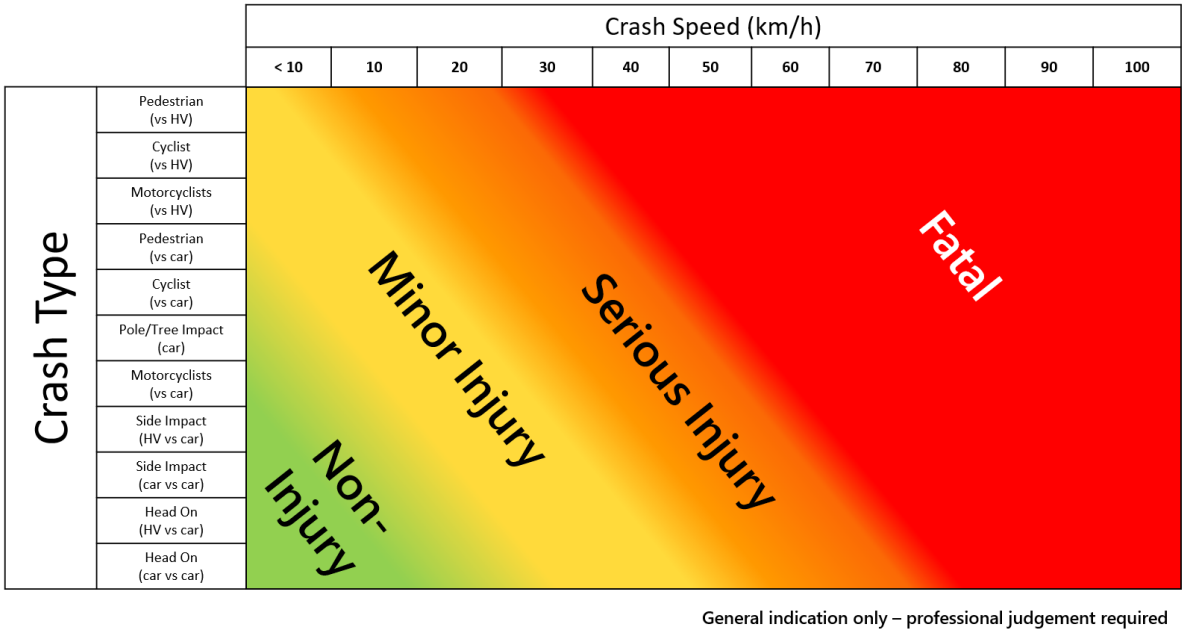


Figure 2-1: Expected crash severity by crash type and crash speed (adapted Austroads GRS6, 2002)

Table 2-2: Crash severity descriptions (adapted from Waka Kotahi Safe Systems Audit Guidelines, 2022)

Severity outcome	*Description*
Fatal	***Where Safe System boundary conditions are exceeded.*** ***A death occurring as the result of injuries sustained in a road crash within 30 days of the crash.***
Serious	***Where Safe System boundary conditions are exceeded.*** ***Injury (fracture, concussion, severe cuts or other injury) requiring medical treatment or removal to and retention in hospital.***
Minor	***Where Safe System boundary conditions are met.*** ***Injury that is not 'serious' but requires first aid, or which causes discomfort or pain to the person injured.***
Non-injury	***Where Safe System boundary conditions are met.*** ***Property damage crashes.***

Reference to historic crash data or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, probability and severity that may result from a particular concern.

2.3 Crash risk rating

The probability and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the Waka Kotahi Safety Concern Risk Rating Matrix shown in Table 2-3. The

qualitative assessment requires professional judgement and experience from a wide range of projects of varying sizes and locations.

Table 2-3: Safety concern risk rating matrix (from Waka Kotahi Safe Systems Audit Guidelines, 2022)

		Severity outcome			
		Non-injury	**Minor**	**Serious**	**Fatal**
		Property damage only (PDO)	Injury which is not 'serious' but requires first aid, or which causes discomfort or pain to the person injured.	Injury (fracture, concussion, severe cuts or other injury) requiring medical treatment or removal to and retention in hospital.	A death occurring as the result of injuries sustained in a road crash within 30 days of the crash.
Probability of a crash	**Very likely**	Minor	Moderate	Serious	Serious
	Likely	Minor	Moderate	Serious	Serious
	Unlikely	Minor	Minor	Significant	Serious
	Very unlikely	Minor	Minor	Significant	Significant

Safe System injury threshold

While all safety concerns should be considered for action, the client will make the decision as to what action will be adopted. This report gives safety ranking guidance and it is acknowledged the client must consider factors other than safety alone. The suggested action for each concern category is given in Table 2-4.

Table 2-4: Concern categories

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

In addition to the ranked safety issues, it is appropriate for the CAT to provide additional comments about items that may have a safety implication but lie outside the scope of the CASA. A comment may include: items where the safety implications are not yet clear due to insufficient detail for the stage of project; items outside the scope of the audit such as existing issues not impacted by the project; an

opportunity for improved safety that is not necessarily linked to the project itself, or drawing/signage issues that should be addressed but are not necessarily safety related. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the CAT.

2.4 Recommendations

Each issue is accompanied by a list of recommendations to address the issue. As per the safe systems framework, these are classified as relating to either:

- Primary treatments – i.e. those capable of virtually eliminating death or serious injury resulting from the particular safety issue; or
- Supporting treatments – reduce the overall harm caused by the safety issue.

2.5 Affected user groups

For ease of interpretation, each issue heading in this CASA report includes the severity rating, as well as include letters to denote the main user groups affected. The first row in the table also includes icons to denote possible sub-groups. The user letters and icons are presented in Table 2-5:

Table 2-5: User groups included

Main user group	*Heading letter*	*Possible sub-groups*
Pedestrians	**P**	Vision impaired pedestrians 
		Mobility impaired pedestrians 
		Wheelchair users 
		Bus patrons (waiting / alighting) 
		All pedestrians 
Cyclists	**C**	Enthused & confident cyclists 
		Interested but concerned cyclists 
		Cyclists using electric bikes 
		All cyclists 
E-scooter / device users	**E**	E-scooter users; other electric small-wheeled devices 

Motorists	M	Drivers	
		Buses	
		Motorcyclists / moped users	

Section 6 presents a summary of the issues identified and the audit statement to be signed by the designer, responding auditor, safety engineer, project manager and project sponsor.

2.6 Project team response process

In accordance with the procedures set down in the Waka Kotahi NZ Transport Agency *Safe System Audit Guidelines* (2022) the audit report will be submitted to the client who will instruct the wider project team to respond.

No changes, however small they may appear, may be made to any of our writings in the main audit section of our report without our express review and consent. This restriction includes our CAT responses.

> We do not consent to any changes … to be made to the main audit section of our report.

The safety issues raised in this audit will require responses from the designer and, after the CAT has had a chance to clarify issues further, the project safety engineer. Finally, the client decision and action taken against the safety issues will also be recorded.

The following people have been identified by the client for these roles (Table 2-6).

Table 2-6: project team members relevant to this audit (to be completed by the client)

Role	***Name***	***Organisation***
Designer response	Chris Groom	WSP
Safety engineer	Dennis Davis	WCC
Client decision	Renee Corlett	WCC
Action taken by		

3 Crash history

Waka Kotahi holds a national database of crashes (CAS) for New Zealand. Crashes are generally investigated for the previous five years to ensure a crash pattern is monitored, rather than one off events.

All reported crashes along the proposed corridor (including but not limited to those involving cyclists), from Waka Kotahi, New Zealand Transport Agencies Crash Analysis System (CAS) for the period 2017-2022 (inclusive)[1] are plotted in Figure 3-1.

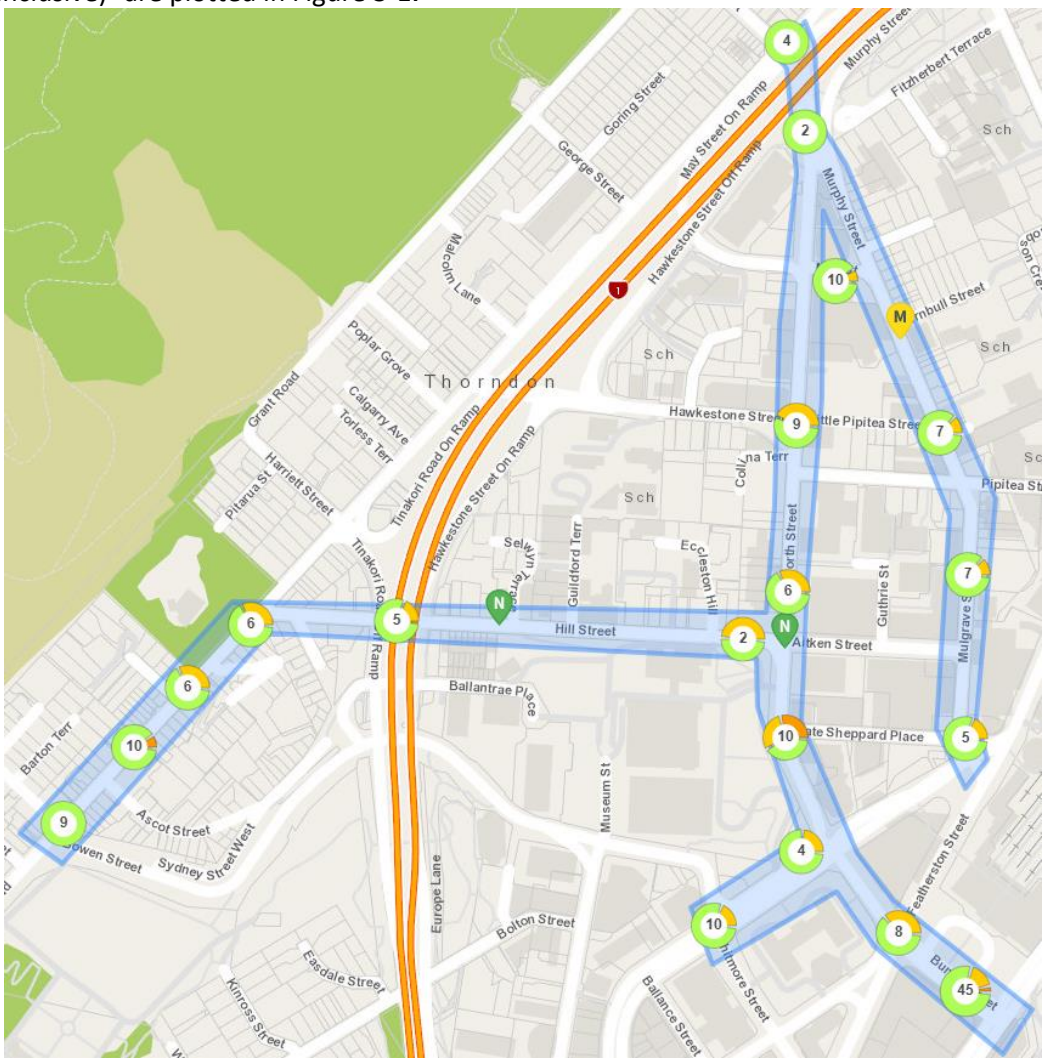


Figure 3-1: all crashes reported in the proposed Thorndon connections corridor

A total of 168 crashes were reported along the proposed Thorndon connections project corridor over the five-year period; the user groups and severities involved are detailed in

[1] Crash data were retrieved on 10 October 2022, but note that it can take up to three months for crashes to be recorded in CAS, so the data set used may not contain all crashes that occurred to this date.

Table 3-1:

Table 3-1: Crash severities for user groups

User group	*Non-injury*	*Minor injury*	*Serious injury*	*Fatal*
Motor vehicles only	115	12	2	0
Cyclists	9	6	1	0
Pedestrians	4	16	3	0

The largest crash clusters involving motor vehicles are on Bunny Street near the railway station. Other notable crash clusters are present at intersections between Molesworth Street and Kate Sheppard Place, Bowen Street and Tinakori Road, Bowen and Whitmore Street (more information on these clusters are included in Appendix A). These should be considered during the design process.

All crash factors by group are presented in Figure 3-2. Each crash may have several factors thus there are more factors at play then just the number of crashes.

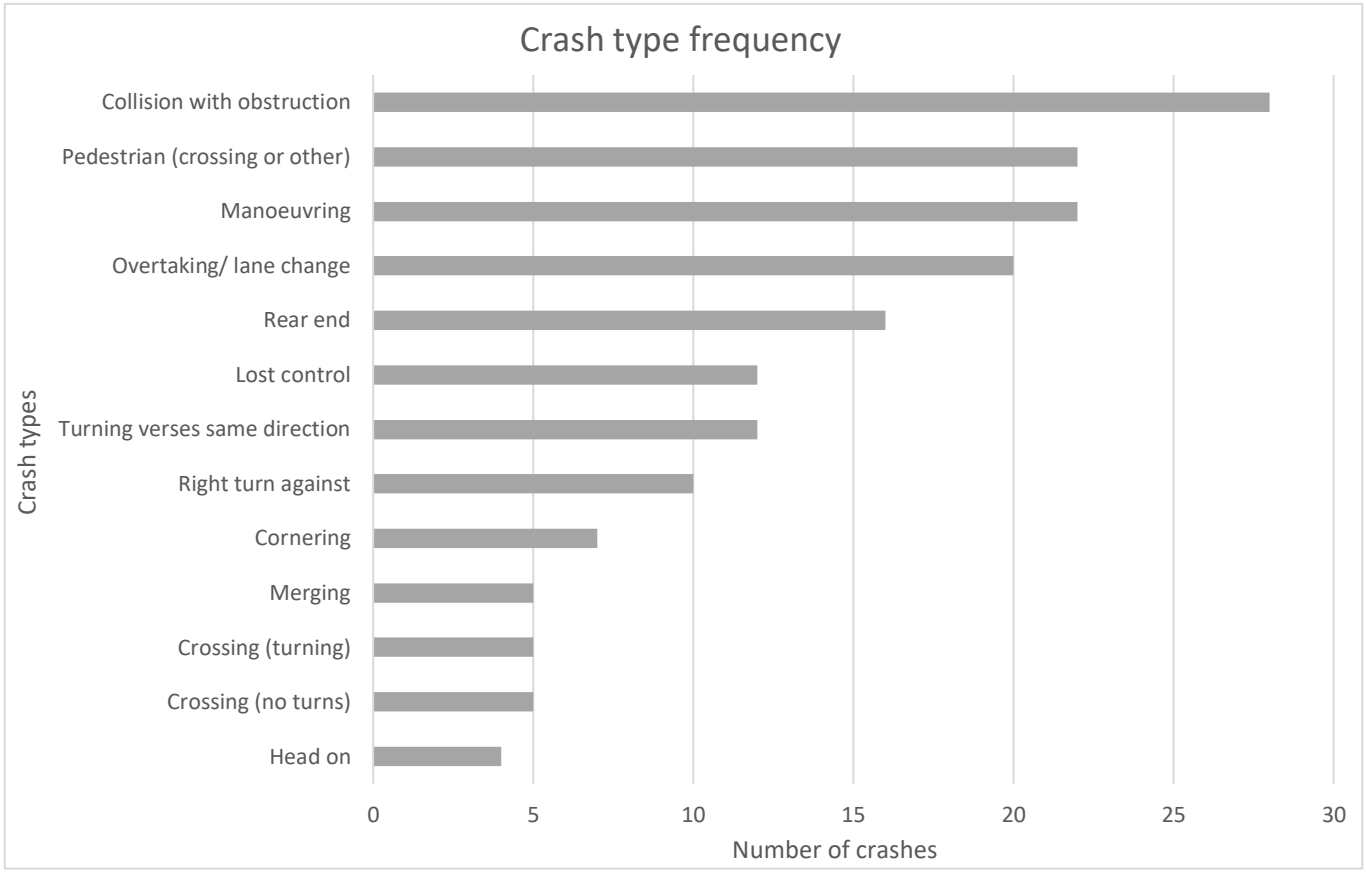


Figure 3-2: Reported crash factors (grouped)

The top four crash factors (collision with obstruction, pedestrians (crossing or other), manoeuvring and overtaking/ lane change) all point to the constricting environment of the road and amount of traffic on the route. Given the lack of alternative options, lack of space and the busy nature of the corridor these are unavoidable risks that should be minimised through design.

There are four clusters of crashes along the corridor. Further detailed are summarised in Appendix A.

Recorded crashes showed some common trends:

- crashes occurred most on Monday, Wednesday, and Friday (least on the weekend)
- crashes peak with evening traffic peaks (Figure 3-3):
    - 5pm-7pm (evening)
- as stated above, crashes were most often caused by collision with obstruction, pedestrians (crossing or other) and manoeuvring
- crashes involving cyclists most often resulted in no injury (six minor, one serious and nine non-injury)
- crashes occurred most between April – June
- crashes peaked in 2019 and decreased from here in 2020 the increase slightly again in 2021

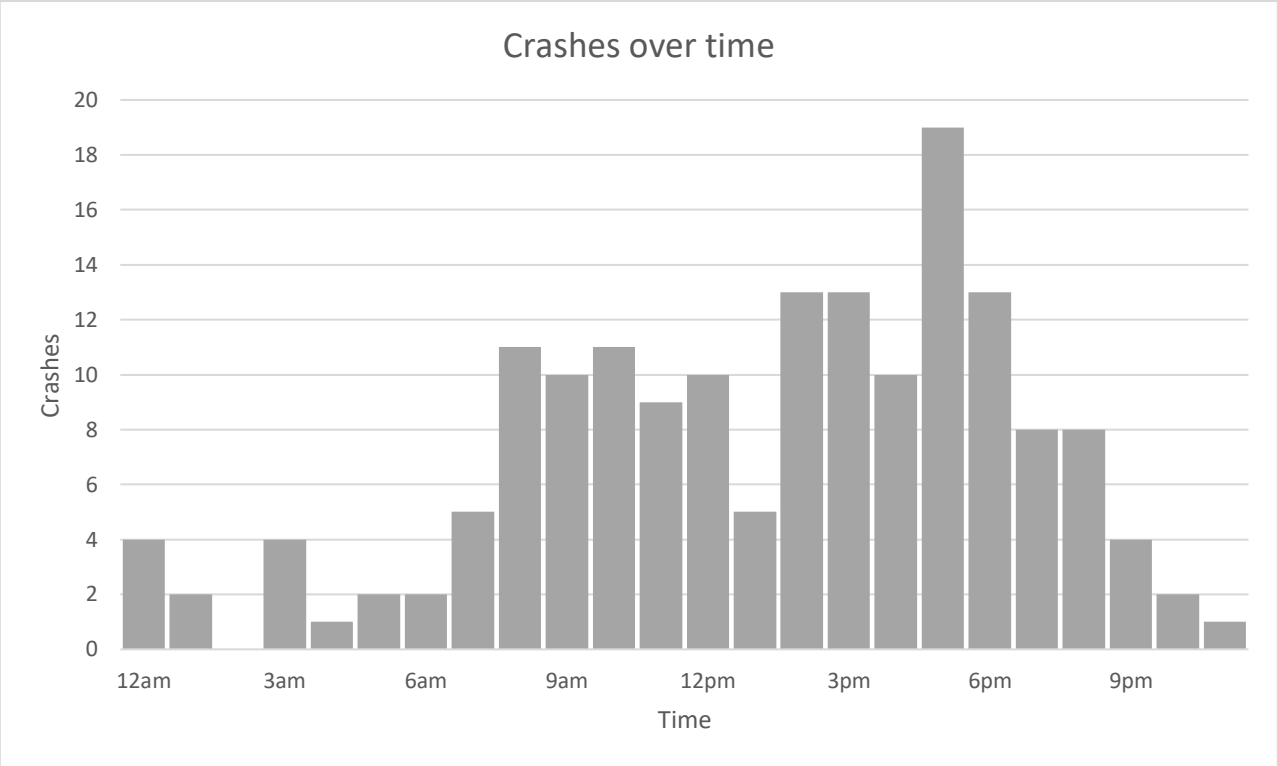


Figure 3-3: crashes by time of day

4 CASA findings – safety issues

4.1 Tinakori Rd and Hill St shared lanes in uphill direction (C30-C32) – C E Significant

The safety issue is the use of single-file mixed traffic in narrow lanes in the uphill direction where there is a significant speed differential.

The crash type expected is a motor vehicle hitting a cyclist. This could include drivers rear-ending cyclists, a driver side-swiping a cyclist when trying to overtake, a driver hitting a cyclist when entering or exiting a car parking space, or a cyclist being hit by an opening car door and falling into the path of live traffic.

The risk factors are high parking occupancy (thus high risk of cyclists being hit by car doors or vehicles entering / exiting parking spaces), limited opportunity for vehicles to pass cyclists and traffic volumes well above the recommended volumes for sharrow application.

The relevant standards is the Sharrow Markings: Best practice guidance note, which recommends the combinations of speed differential and traffic volumes appropriate for sharrow use, and cautions against sharrow applications on uphill routes due to the speed differentials.

Given that most inexperienced / unconfident cyclists would shy away from such a route and acknowledging that this route is a secondary route and a primary parallel route is planned for Bowen St, crashes of this nature are expected to be unlikely. However, given that motor vehicles are expected to be travelling at least at the speed limit of 30 km/h, crashes that do occur would likely result in serious injury.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.1.1	Significant traffic calming to reduce vehicle volumes and speeds so that the site is within the recommended ranges *(unrealistic for this route)*.
Supporting treatment recommendations:	
4.1.2	Some more traffic calming devices to reduce the speed differential.
4.1.3	Remove the centreline to reduce motor vehicle speeds.
4.1.4	Consider allowing cyclists to share footpaths over the Hill Street overbridge (where there's no driveways and no street furniture etc).
4.1.5	Put sharrows in green boxes to emphasise the mixed traffic designation
4.1.6	Repeat the 30 km/h markings at frequent intervals along Hill Street, including near the intersection with Tinakori Street.

Responses:	
Designer	• Should be noted that the changes proposed are improving safety and therefore the significant rating largely reflects the existing safety issues not changes as a result of the project. • Speed calming is proposed on both streets as shown in the drawings (speed humps and raised crossing) - chicanes have been added to Hill St to reduce vehicle speeds (in 90% designs). • Currently no centre line along most of Hill Street, no change proposed on Tinakori Road. • Footpath is too narrow for shared path (2.0m) so mixing cyclists and pedestrian at overbridge is not desirable. • Preference is to retain standard sharrows (e.g. no green boxes) for consistency across Wellington • 30km/hr speed limit markings will be repeated as recommended.
Safety Engineer	Agree with Designer's response. This location should be in the Monitoring Plan for speed, with further mitigation if necessary.
Proposed action	Will monitor the speeds in the area. Transformational team will look into further changes in the coming years.
Client decision	Accept the proposed action

4.2 Tinakori Rd pedestrian provision crossing Hill St (C30) – P Significant

The safety issue is the lack of pedestrian provision across Hill St for pedestrians walking along Tinakori Rd.

The crash type expected is pedestrian vs motor vehicle.

The risk factors include: the width of Hill St – i.e. increased crossing distance; the side-road angle, which allows for faster right turns in and left turns out of Hill St (these will be somewhat mitigated by the proposed raised pedestrian crossing across Tinakori Rd just west of Hill St.

The relevant standards and guidelines are in the Pedestrian Network Guidance (PNG) section on crossings, which includes reference to the Austroads Pedestrian Facility Selection Tool.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.2.1	Install raised platform OR refuge island AND/OR kerb extensions to reduce pedestrian crossing distance and channel motor vehicle tracking.

Crashes are expected to be very unlikely (one every 7+ years), but those that do occur would likely result in serious injury, due to the vehicle speeds involved.	***Supporting treatment recommendations:***
	4.2.2 N/A

Responses:	
Designer	• Should be noted that the changes proposed are improving safety and therefore the significant rating largely reflects the existing safety issues not changes as a result of the project. • Kerb extensions or refuge island will be considered at intersection subject to bus tracking. Limited scope for raised platforms so to be considered as part of Transformational Programme.
Safety Engineer	Agree with Designer's response.
Proposed action	Transitional project not introducing additional risk from current situation, and addressing existing vehicle/pedestrian safety concerns outside the impact of introducing new bike facilities is currently out of scope. Only raised platforms required to manage additional risks introduced from this project and where separation cannot be achieved, are considered in scope, to ensure the rapid roll-out of the project can be delivered within expected timeframes. The safety concerns raised at these additional side street locations will be passed on to the minor safety works programme to prioritise accordingly.
Client decision	Accept the proposed action

4.3 Setback of parking from Aitken St driveway (C32) – C E Moderate

The safety issue is the parallel parking on Aitken St is too close to the driveway (Figure 4-1).

Probability of crash occurring	Likely
Expected crash severity	Minor injury
Primary treatment recommendations:	
4.3.1	Increase parking setbacks to driveway to comply with CNG Technical Note on separated cycleways at side roads and driveways
Supporting treatment recommendations:	

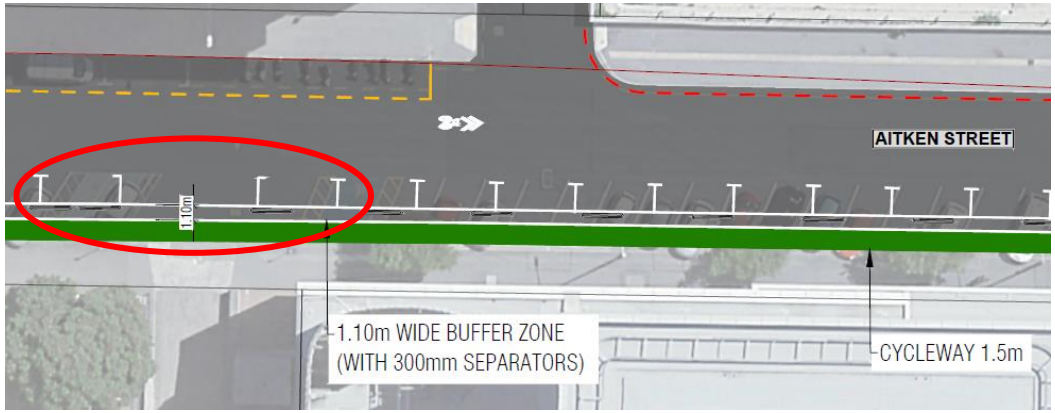


Figure 4-1: Aitken St driveway

The crash type expected is conflict between a motor vehicle entering the driveway and a cyclist on the cycleway, due to the driver's view of the cyclist being blocked by parked cars.

The risk factors are the high parking occupancy along Aitken St and the assumedly high turning volumes into the driveways.

The relevant guideline is Waka Kotahi's cycling network guidance (CNG) Technical Note on separated cycleways at side roads and driveways, which states that when there are more than four parking spaces on the approach to the driveway, the closest parking space should be set back 8 m from the driveway. On the downstream side a minimum setback of 3 m is recommended. The CNG High-use Driveway Treatment for Cycle Paths and Shared Paths Design Guidance note gives extra information for treatments at high-use driveways.

Given that Aitken St has a high parking occupancy and there is expected to be a high turning volume into the driveway, crashes are expected to be likely. The geometry will reduce vehicle turning speeds and therefore minor injury to the cyclist is expected.

4.3.2	Driveway marking treatments
4.3.3	Consult CNG High-use Driveway Treatment for Cycle Paths and Shared Paths Design Guidance note depending on volumes

Responses:	
Designer	• Agree, greater setback to be provided
Safety Engineer	Agree with CAT and Designer.
Proposed action	Designer to update in 90% designs

Client decision	Accept proposed action

4.4 Molesworth / Tinakori / Park – hook turn box placement (C33/C109) – C E Significant

The safety issue is the hook turn box in the north-east quadrant of the intersection sits partially in front of the departure cycle lane on Molesworth St. Therefore, cyclists waiting in the hook turn box could block the path of travel of cyclists heading through from Park St or the hook turn box in the north-west quadrant, forcing them to cut into the general traffic lane (see Figure 4-2).

Figure 4-2: Through-cyclist deviating to avoid cyclist waiting in hook turn box

The crash type expected is motor vehicle vs cyclist.

The risk factors include: the volumes of cyclists coming from Park St and wishing to turn left vs travel straight ahead; the volume of through-traffic from Park St;

The relevant guidance is the hook turns sub-section in the CNG section on cyclist waiting facilities at signalised intersections, which explicitly states "*It must be ensured that cyclists waiting in the hook-turn box do not impede the travel of through-cyclists and are not put into*

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.4.1	Modify the hook turn box so that it does not overlap the projection of the departure cycle lane.
Supporting treatment recommendations:	
4.4.2	N/A

the path of any motor vehicle movements." Crashes are expected to be unlikely, but those that do occur would result in serious injury due to the traffic speeds involved.		

Responses:	
Designer	• Cyclists will be travelling along the purple line in the figure above, not the yellow one, so will not need to move into the traffic lane. In addition, the vehicles are travelling in the same space (not in separate lanes) so bikes will not be moving into conflict with vehicles. No change proposed.
Safety Engineer	Agree with Designer's response.
Proposed action	No action required
Client decision	Accepted

4.5 Mixing lane widths (C33&C37) – C E Serious

The design includes two mixing lanes (i.e. shared by turning vehicles and through-cyclists):

- Murphy Street south approach to Murphy / Tinakori / Park,
- Molesworth south approach to Aitken / Hill / Molesworth

The safety issue is the mixing lanes are of the "in-between" width where it is not safe for motorists to overtake cyclists, but may appear wide enough that they'll attempt to do so. These lanes should be 3.2 m or narrower, to ensure cyclists and motorists mix in single file and are not tempted to try to pass each other within the lane.

The crash type expected is conflict between a cyclist and a motor vehicle.

The risk factors are the speed at which motor vehicles enter the mixing lane (see also issue 4.6) and the proportion of heavy vehicles.

There is currently little available NZ guidance on the design of mixing lanes, however ViaStrada are currently working on a technical note for Waka Kotahi on the subject.

It is expected that cyclist volumes will be high in these locations, as are traffic volumes; given also that mixing lanes are not common in Wellington, the probability of a crash

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.5.1	Reallocate road width to narrow the mixing lanes to 3.2 m or less.
4.5.2	Restrict the merge area of the mixing lanes (see issue 4.6) to lower vehicle entry speeds.
4.5.3	Molesworth St – consider continuing the two-way cycleway to the intersection, to negate the need for a mixing lane.

occurring is likely. Given that motor vehicles are expected to be travelling around 30 km/h (see also issue 4.6), crashes that do occur would likely result in serious injury.	***Supporting treatment recommendations:***	
	4.5.4	N/A

Responses:	
Designer	• Agree, will narrow the shared left turn lane for Murphy St/ Tinakori Rd/ Park St. For Aitken St/ Hill St/ Molesworth St shared left turn lane to be replaced with separated cycleway.
Safety Engineer	Agree with Designer's response.
Proposed action	Designer to update in 90% designs
Client decision	Accept the proposed action

4.6 Mixing lane lengths (C33&C37) – C E Serious

The design includes two mixing lanes (i.e. shared by turning vehicles and through-cyclists):

- Murphy Street south approach to Murphy / Tinakori / Park,
- Molesworth south approach to Aitken / Hill / Molesworth

The safety issue the long section available for merging in the mixing lanes. This length means drivers can enter the mixing lane at greater speeds, and cyclists are exposed to conflict over a greater distance.

The designer has indicated that the lengths of the mixing lanes have been determined based on vehicle tracking, and confirmed that peak queue lengths will be accommodated.

The crash type expected is conflict between a cyclist and a motor vehicle.

The risk factors are the speed at which motor vehicles enter the mixing lane and the proportion of heavy vehicles.

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.6.1	Restrict the merge area of the mixing lanes to lower vehicle entry speeds (see Figure 4-3). E.g. introduce a buffer between the mixing lane and adjacent through-lane and add a line of flexi-posts extending from the limit line.
Supporting treatment recommendations:	

There is currently little available NZ guidance on the design of mixing lanes, however ViaStrada are currently working on a technical note for Waka Kotahi on the subject.

It is expected that cyclist volumes will be high in these locations, as are traffic volumes; given also that mixing lanes are not common in Wellington, the probability of a crash occurring is likely. Given that motor vehicles are expected to be travelling around 30 km/h, crashes that do occur would likely result in serious injury.

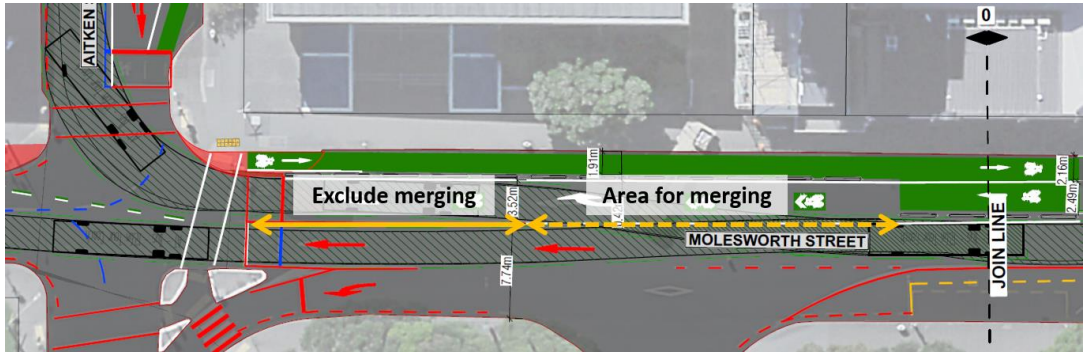


Figure 4-3: Areas of mixing lane where merging is allowed vs excluded, based on vehicle tracking

4.6.2	Reallocate road width to narrow the mixing lanes to 3.2 m or less (see issue 4.5).

Responses:	
Designer	• Restricting merge area at Riddiford St/ Mein St was trialled for the Newtown Cycleway which was not well received by the public. As a result no change to merge length at Murphy St/ Tinakori Rd/ Park St is proposed, as noted above at Aitken St/ Hill St/ Molesworth St, the shared left turn lane will be replaced with a separated cycleway.
Safety Engineer	Agree with Designer's response. Merging behaviour at this location should be included in the Monitoring Plan.
Proposed action	Designer to update in 90% designs
Client decision	Accept the proposed action – to include monitoring of merging as part of the monitoring plan

4.7 Murphy St southbound floating bus stop gap (C33) – P C E Serious

The safety issue is the insufficient gap between the cycleway and the kerb edge at the floating bus stop on Murphy St just south of Tinakori Rd in the southbound direction.

The crash type expected is conflict between a cyclist and a disembarking bus passenger.

The risk factors are the speed cyclists are travelling at on the downhill (southbound) direction, cyclists being distracted by the downstream merge to mixed traffic (see issue 4.8), and bus patrons not expecting to be in the path of cyclists.

The relevant guidance is Waka Kotahi's Public Transport Design Guidance (PTDG); the Design options for island bus stops section states an absolute minimum of 0.8 m for the gap between a cycleway and the bus stop in a "nominal width island bus stop design", i.e. the tightest option, which is not ideal for this city-centre location.

Given expected numbers of cyclists and bus passengers, crashes are expected to be likely. While no motor vehicles will be involved, collisions with cyclists travelling at a reasonable speed could still result in serious injury.

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.7.1	Increase the gap between the cycleway and bus stop.
Supporting treatment recommendations:	
4.7.2	N/A

Responses:	
Designer	• Agree that this treatment is less than desirable but disagree with level of risk, treatment is used elsewhere in Wellington and are proposed at other new locations around the city, cycle speeds will be managed by the ramps up to the platform. Also, cyclist attention is unlikely to be distracted by merge with a bus right beside or in front of them. • If space is available then a 0.8m buffer will be provided but is expected to be unlikely given lane width is already reduced to 3.2m. The alternative is forcing cyclists to merge with traffic and overtake the bus which is considered less safe.
Safety Engineer	Agree with Designer's response.
Proposed action	Continue to monitor the use of bus platforms on other projects and full review of treatment options that would be most suitable with Blind and Low Vision, CCS disability action group and Waka Kotahi. Ongoing educational campaign work on use.
Client decision	Accept the proposed action

4.8 Murphy St bus stop / pedestrian crossing / cycle transition (C33) – P C E Minor

The safety issue is southbound cyclists on Murphy St transitioning from the cycleway to mixed traffic immediately after the floating bus stop (see issue 4.7) and immediately before the new raised pedestrian crossing.

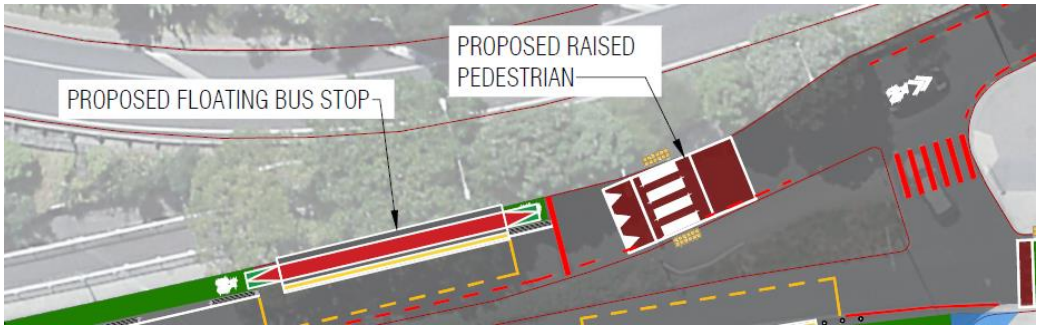


Figure 4-4: cycleway transition to mixed traffic between bus stop and pedestrian crossing

The crash type expected is conflict between a cyclist and a motor vehicle.

The risk factors include the proximity of the three conflict points, which increases the cognitive load on drivers and cyclists, the lack of sharrows at the merge location (it is not possible to provide these due to the bus stop and the pedestrian crossing) and the potential for drivers to be distracted looking for pedestrians at the crossing rather than cyclists at the merge point.

There are no specific standards relating to this issue. Best practice would be sharrows at and just prior to the merge location, but it is not possible to provide these due to the bus stop and the pedestrian crossing.

It is anticipated that cyclists will keep left approaching and crossing the pedestrian crossing, so crashes will be unlikely. The raised platform on the pedestrian crossing will slow motor vehicles, so crashes that do occur should only result in minor injury.

Probability of crash occurring	Unlikely
Expected crash severity	Minor injury
Primary treatment recommendations:	
4.8.1	Shift the bus stop northwards, so a merge can be established prior to the pedestrian crossing (this may also help addressing issue 4.7).
4.8.2	OR continue the cycleway past the pedestrian crossing and merge downstream.
Supporting treatment recommendations:	
4.8.3	As well as providing sharrows at the merge location, provide sharrows just prior to the merge, to alert drivers.
4.8.4	Put sharrows in green boxes, to emphasise the merge to mixed traffic.

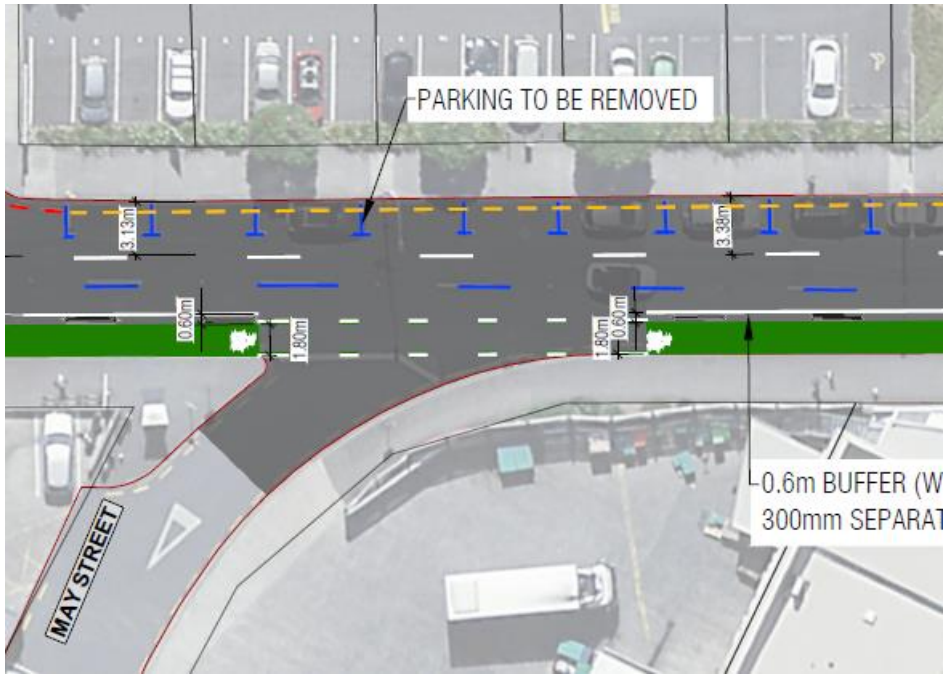
Responses:	
Designer	Agree, stop box to be shifted further north and add sharrow at merge location (the location of the stop box will be limited by the need to retain the current shelter in its location).

Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Designer to update in 90% designs
Client decision	Accepted

4.9 May St crossing Murphy St cycleway (C34) – C E Significant

The safety issue is the low angle between the direction May St drivers are heading, and the direction they must look back over their shoulder to see cyclists approaching on the cycleway. Figure 4-5 shows the site location.

The crash type expected is motor vehicle vs. cyclist.



Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.9.1	Cycleway (and pedestrian) raised platform across May St.
4.9.2	Painted island or mountable kerb extension to square up May St approach and reduce vehicle speeds, while still accommodating tracking of heavy vehicles
Supporting treatment recommendations:	
4.9.3	A more conspicuous marking treatment of the cycleway across the side road.
4.9.4	Note the existing limit line needs to be relocated.

Figure 4-5: May St low angle slip lane across Murphy St cycleway

The risk factors are the large kerb radius that allows for fast turning speeds, drivers wanting to act quickly to get into a gap in traffic on Murphy St, drivers not expecting a cycleway on the right-hand side of the street, cyclist speeds heading downhill, and the potential for motorists to misjudge the speeds of e-bikers.

The CNG section on left-turning conflicts at signalised intersections includes guidance on left-turn slip lanes, which can also apply to this situation.

Crashes are expected to be less than one per year, therefore classed as "unlikely"; those that do occur could result in serious injury due potential for drivers to travel at 30 km/h or greater, plus the speeds of cyclists travelling downhill on Murphy St.

Responses:	
Designer	• Agree to add painted or mountable kerb extension and remark limit line. • Raised platform not preferred as transitional cycleways approach is to avoid civil works where possible. Will investigate possibility of using a temporary speed hump or cushion to slow vehicle speeds. • Propose to add cyclist permanent warning sign for May Street traffic.
Safety Engineer	Agree with CAT and Designer's response. The more conspicuous marking treatment of the cycleway across the side road, using blocks of green as done in other transitional cycleways should be considered.
Proposed action	Designer to update in 90% designs
Client decision	Accepted

4.10 Murphy St transition from shared lane to right-hand side cycleway (C34) – C E Significant

The safety issue is that cyclists in the Murphy St shared lane might not realise they are supposed to transition into the cycleway on the right-hand side.

The crash type expected is motor vehicle vs cyclist in the continuation of the Murphy St general traffic lane that is not intended to be shared by cyclists.

The risk factors are: motor vehicle speeds (including those changing from the left lane); and

Probability of crash occurring	Very unlikely
Expected crash severity	Serious injury

the general expectation that cycleways are normally on the left-hand side of the road.

There are no particular standards relating to this issue.

Crashes are expected to be very unlikely, as most cyclists who missed the transition would soon realise and be able to enter the cycleway via the gaps between the separators. But crashes that do occur would result in serious injury assuming motor vehicles are travelling 30 km/h or greater.

Primary treatment recommendations:	
4.10.1	N/A
Supporting treatment recommendations:	
4.10.2	Colour area within the entry taper to the cycleway in green

Responses:	
Designer	• Agree to add investigate marking to direct cyclists to cycleway on right hand side of road
Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Designer to update in 90% designs
Client decision	Accepted

4.11 Mulgrave / Murphy / Pipitea LOS at diagonal cycle crossing (C34/C113) – C E Significant

The safety issue is that cyclists have a low level of service (LOS C), which will lead to some cyclists undertaking risky manoeuvres.

Cyclists travelling along the Murphy-Mulgrave corridor will notice that the green time (7 seconds) is much shorter than that allocated to the Murphy-Mulgrave general traffic (29 seconds). This will be especially frustrating at times when there is a green signal for the A (or B phase) but there is no traffic coming; in such cases cyclists may choose to run their red light and cross diagonally when they think it is safe to do so – but there may be traffic they have not anticipated or they may misjudge how long it will take them to cross the diagonal.

Other cyclists may choose to run their red light and go straight through the intersection during the A phase, continue along the right-hand side of Mulgrave St, and possibly try to re-enter the cycleway along the midblock.

The crash type expected is conflict between a motor vehicle and a cyclist.

The risk factors include: cyclists misjudging the situation (presence of motor vehicles, speeds of motor vehicles, time to cross); and anything that affects visibility at the intersection (e.g.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.11.1	Transition the cycleway from the right to the left side at a different location (see discussion at end of issue description)
4.11.2	OR: Keep the cycleway on the right-hand side of the road (noting this would incur other safety implications along the route and especially at the Lambton Quay end)
Supporting treatment recommendations:	

rain, fog, darkness at night time, sun glare).
There are no standards relating to this issue.
A study of a diagonal crossing on the Dunedin State Highway one-way pair showed a fair amount of red light running by cyclists, but there were no conflicts identified during the study period and it was observed that cyclists seemed to be able to judge the situation accurately. However, the Dunedin study was not a long-term study and Wellington conditions may differ. It seems reasonable that crashes might occur every one to seven years (i.e. "unlikely") but those that do would involve vehicles travelling above the safe system speed threshold and therefore result in serious injury.
The preferred treatment is to transition the cycleway from the right to the left side at a different location; options to investigate include:
• At the Aitken / Mulgrave T-intersection
  ○ Run the cycle movement in conjunction with Aitken St traffic
  ○ Because this is a T intersection, the crossing could involve a different crossing angle e.g. could cross to the centre of the head of the T, or even be aligned with the pedestrian crossing across Mulgrave St, to accommodate vehicle tracking
  ○ This could also help resolve the issue for cyclists turning right from Mulgrave to Aitken (see issue 4.14) as they would already be on the right-hand side of the road and could simply cross with the pedestrians crossing Aitken St
• Implement a midblock cycle crossing rather than a diagonal crossing at the intersection
  ○ e.g. in conjunction with the Murphy St midblock pedestrian crossing (see also issue 5.2, assuming the motor vehicle left turn from Murphy to Pipitea is not too high to affect operation at that intersection.
	4.11.3	OR: Improve the level of service for cyclists using the diagonal crossing e.g. by double-cycling the diagonal crossing phase (on demand)

Responses:	
Designer	• Propose to continue cycleway along right hand side to Aitken St and ban right turn from Murphy St into Pipitea Street
Safety Engineer	Agree with Designer's response.
Proposed action	Designer to update in 90% designs

Client decision	Accepted

4.12 Mulgrave / Murphy / Pipitea driver interpretation of intersection (C34/C113)– C E Minor

Note if the preferred treatment recommendations from issue 4.11 is implemented, this issue will be negated.

The issue is that motorists may make a false start in the cycle crossing phase. Diagonal cycle crossings and cycle Barnes Dances (i.e. an exclusive phase for cyclists where they can go in any direction) are uncommon. It is possible that motorists on Murphy St may expect a simple 2-phase operation and expect it to be their turn again after the Pipitea St traffic has had a turn. Similarly, drivers may react to the cycle signal changing to green in a similar way that drivers heading straight through often make a false start when their signal remains red but the adjacent traffic gets a green arrow during a diamond turn phase.

The crash type expected is motor vehicle vs cyclist.

The risk factors include: visibility of the cycle signal faces; motorist familiarity with the site; and motorist familiarity with non-standard / complex operations.

There are no standards relating to this issue.

Crashes are expected to be unlikely, as motorists generally realise their mistake and stop. Crashes that do occur should involve motor vehicles that have just started after having been stopped at a red signal, i.e. travelling at slower speeds, so should only result in minor injury.

Probability of crash occurring	Unlikely
Expected crash severity	Minor injury
Primary treatment recommendations:	
4.12.1	N/A
Supporting treatment recommendations:	
4.12.2	Ensure cycle signals are not visible to motorists.

Responses:	
Designer	• Issue resolved by keeping cycleway on right side of road and proposal to ban right turn movement
Safety Engineer	Agree with Designer's response.
Proposed action	Designer to update in 90% design
Client decision	Accepted

4.13 Mulgrave / Murphy / Pipitea alignment for motorists (C34/C113) – M

Minor

Note if the preferred treatment recommendations from issue 4.11 is implemented, this issue will be negated.

The safety issue is the cycleway transition changes the traffic lane alignment, with the potential for drivers travelling straight ahead to get confused about which lane to aim for.

The crash type expected is motor vehicle vs motor vehicle side swipe.

The risk factors are: motor vehicle speeds; motorist familiarity; visibility of lane markings (bad weather, night time, worn existing markings).

There is no standard relating to this issue. In most cases where lanes are offset through an intersection, continuity lines are used.

Crashes are expected to be likely, but should result in property damage only.

Probability of crash occurring	Likely
Expected crash severity	Non-injury
Primary treatment recommendations:	
4.13.1	N/A
Supporting treatment recommendations:	
4.13.2	Mark arrows on both departure lanes
4.13.3	Mark continuity for cycle diagonal crossing in green blocks, and standard white continuity lines for through-traffic.

Responses:	
Designer	• Issue resolved by keeping cycleway on right side of road
Safety Engineer	Agree with Designer's response.
Proposed action	Designer to update in 90% designs
Client decision	Accepted

4.14 Aitken / Mulgrave – cycle right turn (C35/C115) – C E

Significant

The safety issue is the lack of safe option for cyclists to turn right from Mulgrave St to Aitken St.

The advanced stop box (ASB) will only be accessible when Mulgrave traffic is stopped and assuming there isn't already a queue of cyclists in the cycleway. When Mulgrave has a green light, cyclists waiting in the cycleway to access the ASB will block cyclists travelling straight

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury

through, and these may attempt to pass by cutting into the live traffic lane.

Cyclists can't turn right in B1 phase, as they will conflict with the right turn out of Aitken. This also raises the issue with the current meaning of a standard green cycle signal, which says cyclists may proceed in any direction – it may be clear to cyclists that adjacent traffic on Mulgrave is stopped at a red signal, and they may assume that they can therefore turn right, without being aware that traffic on Aitken has a green signal.

The crash types expected are motor vehicle vs cyclist (the critical case) and cyclist vs cyclist.

The risk factors are motor vehicle volumes, motor vehicle speeds and cyclist volumes.

The CNG section on cyclist waiting facilities at intersections provides useful guidance.

Aitken St provides a useful connection between the two one-way streets, so it is expected that cyclists will want to turn right here, however most will attempt to mitigate the situation by transitioning upstream, waiting to the side of the cycle lane or transitioning to the footpath and using the pedestrian facilities. Therefore, crashes are expected to be unlikely, but those that do occur will cause serious injury, due to the motor vehicle speeds involved.

Primary treatment recommendations:	
4.14.1	Provide a waiting area accessible to right-turning cyclists, where they will not block the path of through-cyclists and can access the right-turn ASB when Mulgrave traffic is stopped.
Supporting treatment recommendations:	
4.14.2	N/A

Responses:	
Designer	• Issue resolved by keeping cycleway on right side of road from Pipitea Street and providing a cycle exclusive phase at Aitken St to enable cyclists to go both right and straight
Safety Engineer	Agree with Designer's response.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

4.15 Mulgrave at Lambton Quay (C35) – C E Significant

The safety issue is lack of continuity of provision through to Lambton Quay.

The crash type expected is motor vehicle vs cyclist.

The risk factors involve "downgrading" the level of provision (i.e. going from a physically separated cycleway to mixed traffic) in a location with high traffic volumes and just prior to a complicated intersection arrangement. Cyclists may not understand where they are expected to go, or how to approach the intersection.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	

There are no relevant standards related to this particular issue. The CAT suggests that, since sharrows have been provided to denote the transition from separated cycleway to mixed traffic cycling, best practice would be to continue sharrows to the intersection.

Crashes are expected to be unlikely, but those that do occur would result in serious injury due to the traffic speeds involved.

4.15.1	Continue the separated cycleway to the intersection.
Supporting treatment recommendations:	
4.15.2	OR: Mark sharrows from end of cycleway transition to advanced stop boxes

Responses:	
Designer	• Propose to continue sharrow markings down to Lambton/ Mulgrave intersection for interim layout and investigate extending separated cycleway to Lambton/ Mulgrave when Thorndon Quay/ Hutt Road is in place. This is because extending cycleway would require changes to signal plan which is easier to align with Thorndon Quay/ Hutt Road
Safety Engineer	Agree with Designer's response. Current cycleway designs for TQ/HR and Lambton/Mulgrave to be shared and coordinated between Designers. Design to be audited in next stages for both projects.
Proposed action	Discussions with Thorndon Quay project manager in place to integrates designs.
Client decision	Accepted

4.16 Molesworth / Pipitea pedestrian crossing (C36) – P C E Significant

The safety issue is the distance between the proposed raised pedestrian crossing across Pipitea St is less than one car length. This means drivers exiting Pipitea St may drive over the crossing but block the cycleway while waiting to enter Molesworth St. Similarly, drivers turning into Pipitea St may make their turn and stop for a pedestrian on the crossing, thus blocking the cycleway. Alternatively, if a cyclist is present, exiting drivers may block the pedestrian crossing.

The crash type expected is motor vehicle vs cyclist.

The risk factors include speed and volume of traffic on Molesworth St, which may make motorists turning off Molesworth want to do so quickly to avoid blocking following traffic, and those turning onto Molesworth in a hurry to access a suitable gap.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.16.1	Move the raised crossing towards the intersection and incorporate the cycleway on the platform, i.e. a dual cycle-pedestrian crossing.

There are no standards that specifically refer to the gap between pedestrian crossings and cycleways, but the CNG Technical Note on Separated cycleways at side roads and driveways covers vehicle waiting spaces turning in and out of side streets, plus gives several examples of pedestrian crossings paired with cycle crossings.

Crashes are expected to be unlikely, but those that do occur would result in serious injury to a pedestrian or a cyclist.

4.16.2	OR: Move the raised platform forward but remove the zebra and make it a courtesy crossing / speed management device instead.
4.16.3	OR: Shift the raised crossing further back from the intersection, to allow one car length between it and the cycleway
Supporting treatment recommendations:	
4.16.4	N/A

Responses:	
Designer	• Propose to remove raised platform forward towards the intersection and make courtesy crossing
Safety Engineer	Agree with CAT and Designer's response. *Move* raised platform forward towards the intersection and make courtesy crossing.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

4.17 Aitken / Hill / Molesworth right turns (C37/C105) – C E Serious

The safety issue is the lack of provision for cyclists to turn right from Aitken St or Hill St to Molesworth St.

The plans indicate "right-turning cyclists from Aitken St and Hill St to filter right turn"; however, there is little space in the intersection for right-turning cyclists to wait free from the path of parallel and opposing through motor vehicles.

The crash type expected is conflict between a motor vehicle and a cyclist.

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.17.1	N/A

The risk factors for the Hill St approach include the lack of right-turning vehicles from this approach (since Molesworth St is one-way) and therefore no waiting right-turners in the intersection to "shelter" cyclists. Also, parallel through-traffic will likely err towards the right side of the lane, due to the bus stop on the departure side.

The risk factors for the Aitken St approach include right-turning cyclists having to get past the parallel through-traffic, as they are originating from a kerbside cycle lane. This is complicated by the taper on the cycle lane after the termination of the parking – drivers may use the "void space" (see Figure 4-6) to form two queues. Also, right-turning cyclists will want to wait a shorter distance into the intersection than right-turning drivers, because the cycle lane on Molesworth St is on the right-hand side.

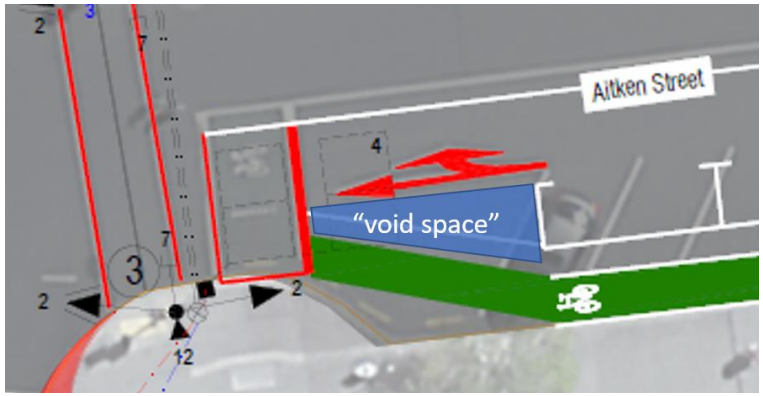


Figure 4-6: void space on Aitken St approach

There are no standards for this specific situation, but the CNG section on cyclist waiting facilities at intersections provides useful general guidance.

Given that Hill St is on the west-east cycle route, and Aitken St is a useful connector between the two north-south one-way streets, it is expected that cycle volumes will be reasonable. The lack of safe waiting space for right turning cyclists makes it likely that a crash will occur, and these crashes are expected to result in serious injury due to the anticipated speeds of motor vehicles travelling through the intersection.

Supporting treatment recommendations:	
4.17.2	Offset the Aitken St and Hill St approach lanes and provide a pocket right-turn cycle lane with advanced stop line on Hill St.
4.17.3	Reduce the width of the Aitken St approach lane and use flexi-posts / painted delineation in the "void space" where the lane tapers after the end of the car parking to avoid motorists forming two queues at the limit line.

Responses:	
Designer	• Agree, propose to restrict vehicle access to void space on Aitken St approach

	• Demand for right turn from Hill Street is expected to be very low as vehicles on Tinakori Road from the north or south can use either Mulgrave Street or Bowen Street respectively to access the Bunny Street / Lambton Quay area. Furthermore, any provision would need a separate phasing creating LOS issues for bikes and buses and would potentially create confusion for other vehicles.
Safety Engineer	Agree with Designer's response. Cycle right turn demand from Hill Street to be monitored, and further mitigation if necessary.
Proposed action	Monitor right turn demand as proposed above. Conduct cyclist count
Client decision	Accepted

4.18 Aitken / Hill / Molesworth – slip lane angle (C37/C105) – C E Significant

The safety issue is the left-turn slip lane from Molesworth St to Hill St involves a wide angle between drivers exiting onto Hill St and through-traffic approaching from Aitken St. This increases the risk of slip lane drivers not seeing cyclists in the mixed traffic lane.

The crash type expected is motor vehicle vs cyclist.

The risk factors include: speeds and volumes of traffic opposing the slip lane; most cycle traffic will be turning onto Molesworth St, so might not be expected on the Hill St departure.

There are no relevant standards pertaining to this specific issue.

Crashes are expected to be unlikely, but those that do occur would result in serious injury due to the traffic speeds involved.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.18.1	Investigate whether there is width to achieve a cycle lane on the Hill St departure, across the slip lane, and then transition to mixed traffic.
Supporting treatment recommendations:	
4.18.2	OR: Add a sharrow on the Hill St departure, in view of slip lane traffic, to alert motorists to the likely presence of cyclists.

Responses:

Designer	• Propose to add sharrow on Hill St departure lane. Is not sufficient width for cycle lane on Hill St
Safety Engineer	Agree with Designer's response.
Proposed action	No action required
Client decision	Accepted

4.19 Aitken / Hill / Molesworth – cycle left turn from Molesworth (C37/C105) – C E Significant

The safety issue is lack of provision for cyclists to turn left from the Molesworth St south approach. Cyclists will be on the right-hand side of the road, coming from the separated cycleway into a mixing lane shared with right-turners. Those wanting to turn left will have to cross the through-lane and merge into the left-turn lane, which could be difficult in peak traffic.

The crash type expected is motor vehicle vs cyclist.

The risk factors are speed and volume of motor vehicles.

There are no relevant standards pertaining to this specific issue.

Crashes are expected to be unlikely, but those that do occur would result in serious injury due to the traffic speeds involved.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.19.1	N/A
Supporting treatment recommendations:	
4.19.2	Provide a "reverse hook turn box" i.e. on the right-hand side of the intersection.
4.19.3	OR: provide a means for cyclists to join the pedestrian crosswalk.

Responses:

Designer	• Demand for left turn into Hill Street from Molesworth Street is expected to be very low as vehicles heading to Tinakori Road can use either Molesworth Street or Bowen Street to access areas to the north and south of Tinakori Road respectively. • Reverse hook turn box would be difficult to fit in this location. Preference is to mark left turn arrow on cycleway in advance of left turn lane and add sharrows on left turn lane. Cyclists going via the left turn lane would be lower delay than waiting at signals and cycleway reduces Molesworth St to one traffic lane making it easier to cross.
Safety Engineer	Agree with Designer's response.

	Proposal to be reviewed in next audit stage.
Proposed action	No action required.
Client decision	Accepted

4.20 Molesworth St two-way cycleway crossing Kate Sheppard Pl (C37) – C E Serious

The safety issue is that drivers do not expect to encounter cyclists travelling in the direction contraflow to the adjacent general traffic lane (in this case, the southbound cyclists).

The crash type/s expected is motor vehicle vs cyclist.

The risk factors are: the fact that the contraflow cyclists are travelling downhill and therefore faster than normal; the length of the potential conflict zone; the location on a bend in the road; drivers exiting Kate Sheppard Pl looking for a gap of traffic (i.e. looking left) knowing it is a one-way street and therefore not looking right towards the southbound cyclists; the use of a give way control that encourages drivers to proceed without stopping if they think it is clear; and the rarity of two-way cycleways in Wellington.

The relevant guidance is the Technical Note on separated cycleways at side roads and driveways.

Given the factors described above, and the record of pedestrian crashes at Kate Sheppard Pl, crashes are expected to be likely. As there is no traffic calming and a wide opening in the cycleway across the side street, drivers could achieve speeds above the safe system threshold and therefore cause serious injury.

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.20.1	Make Kate Sheppard Pl entry-only at Molesworth St.
4.20.2	Install a raised platform for the cycleway (and possibly include a pedestrian crossing).
Supporting treatment recommendations:	
4.20.3	Apply a stop control against Kate Sheppard Pl (if it isn't made entry-only).
4.20.4	Confirm the design vehicle for turning at Kate Sheppard Pl – reduce the gap in the cycleway accordingly.
4.20.5	Kerb extensions to narrow the side street at the intersection.
4.20.6	Apply markings / colour / different pavement surface across the platform to accentuate continuity of the cycleway.

	4.20.7	Include consideration of pedestrians (see also issue 4.21)

Responses:	
Designer	• Propose to make Kate Sheppard Place entry only and add kerb extensions to reduce crossing distance for pedestrians
Safety Engineer	Agree with Designer's response.
Proposed action	Designers to update in 90% designs. Specific letter to the properties on this road advising of proposal.
Client decision	Accepted

4.21 Molesworth St pedestrian crossing provision across Kate Sheppard Pl (C37) – P Significant

The safety issue is accessibility for pedestrians wanting to cross Kate Sheppard Pl. Vehicles queued at the limit line would block the path between the kerb cutdowns. Drivers may be focused on looking for cyclists on the cycleway and overlook pedestrians. The cycleway has precedence over turning traffic but pedestrians do not – this is ambiguous and inequitable.

The crash type expected is motor vehicle vs pedestrian.

The risk factors include: whether drivers are focussed on looking for cyclists and overlook pedestrians; pedestrians thinking they have precedence over turning traffic because cyclists do; the location of Kate Sheppard Pl on the bend in Molesworth St; and high traffic volumes that may make drivers more pressed to turn off Molesworth St, or accept smaller gaps if turning onto Molesworth St.

There are no relevant standards pertaining to this specific issue; the CAT suggests it would be best practice to prioritise pedestrian crossing throughout the CBD, and, in particular, were pedestrians are travelling parallel to a separated cycleway.

Based on the crash history (see section 3), which shows pedestrian issues as the second highest crash factor, and the specific incidents at Kate Sheppard Pl (see Appendix A.2) considering this in conjunction with the risk factors discussed above, crashes at flush zebras are expected to occur every 1-7 years ("unlikely" probability) and could result in serious injury.

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.21.1	Raised platform crossing for pedestrians at Kate Sheppard Pl.
Supporting treatment recommendations:	
4.21.2	Include pedestrians in consideration of treatment for cycleway across Kate Sheppard Pl (see issue 4.20)

Responses:	
Designer	• Should be noted the significant rating reflects the existing safety issues not changes as a result of the project. • Propose to add kerb extensions at Kate Sheppard Place to reduce crossing distance, raised platforms should be considered for Transformational Programme.
Safety Engineer	Agree with Designer's response. Include issue in Monitoring Plan.
Proposed action	Transitional project not introducing additional risk from current situation, and addressing existing vehicle/pedestrian safety concerns outside the impact of introducing new bike facilities is currently out of scope. Only raised platforms required to manage additional risks introduced from this project and where separation cannot be achieved, are considered in scope, to ensure the rapid roll-out of the project can be delivered within expected timeframes. The safety concerns raised at these additional side street locations will be passed on to the minor safety works programme to prioritise accordingly
Client decision	Accepted

4.22 Driveways on Molesworth St contraflow cycleway (C37) – C E Serious

There are two driveways on Molesworth St that cross the contraflow cycleway or two-way cycleway (which involves contraflow cycling):

- Between 54 and 38 Molesworth St – (typically locked) alleyway for maintenance vehicles
- 2 Molesworth St – Wellington High Court staff-only swipe-card access to underground parking.

The safety issue is, as noted in issue 4.20, drivers don't expect cyclists in the contraflow direction, which in this case is in the downhill direction therefore involving higher cycling speeds. The driveway between 54 and 38 Molesworth St will be located within the mixing lane for with-flow cyclists, adding further complexity to the task of drivers trying to exit the driveway.

The crash type expected is motor vehicle vs cyclist.

Probability of crash occurring	Likely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.22.1	N/A
Supporting treatment recommendations:	
4.22.2	Speed management measures on cycleway ahead of driveways
4.22.3	OR: a raised cycleway crossing of the two driveways

The risk factors include: the contraflow cyclists travelling in the downhill (fast) direction; the rarity of two-way cycleways in Wellington; the possibility of cyclists being knocked into the adjacent live traffic lane, plus location-specific factors: • Between 54 and 38 Molesworth St: heavy vehicles, potentially infrequent visitors / unfamiliar with the site; situation within the mixing lane; proximity to Aitken / Hill Molesworth intersection. • 2 Molesworth St – high driveway volumes (albeit consisting of frequent / familiar users). The relevant guidance is the Technical Note on separated cycleways at side roads and driveways and the High-use Driveway Treatment for Cycle Paths and Shared Paths Design Guidance note. Given the various risk factors at the two sites, crashes are expected to be likely (at least one per year) and would result in serious injury (or worse, where heavy vehicles are involved). We acknowledge that another option would be to remove the contraflow cycle provision. However, we suggest this contraflow section improves accessibility for cyclists from multiple locations and therefore prefer the approach of mitigating the risks at the two driveways and side-street in question.		

Responses:	
Designer	• Propose to include speed hump and driveway markings.
Safety Engineer	Agree with Designer's response.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

4.23 Flush zebra crossings (multiple locations) – P

Significant

The safety issue is that zebra crossings without a raised platform has been shown to increase crashes, because pedestrians feel overly confident but there is no physical element to slow approaching motorists.	

The crash type expected is motor vehicle vs pedestrian.

Flush zebra crossings are retained / relocated in several locations:

Table 4-1: Flush zebra crossing locations and risk factors

Location	Risk factors
Across Hawkstone St at intersection with Molesworth St (C36)	Vehicle turning speed (will be made worse by the removal of the existing kerb extension but likely still under 30 km/h); Exiting drivers focusing on finding a gap in traffic (potentially across two streams if they don't want to get stuck in the left-turn lane); Increased set back of the crossing from Molesworth St, which will reduce intervisibility between pedestrians and motorists.
Slip lane from Molesworth south to Hill St at Aitken / Hill / Molesworth signalised intersection (C105)	Vehicle turning speed – could be 30 km/h or more
U-turn from Molesworth St to Murphy St (C33)	
Slip lane from Bowen St to Lambton Quay at Bowen / Lambton / Whitmore intersection (C40) – *not clear if this is in scope*	Vehicle turning speed – could be 30 km/h or more

The Hawkstone St crossing is the main concern as the others involve only one lane of traffic and more constrained geometries. The risk factors include:

The relevant standards and guidelines are in the Pedestrian Network Guidance (PNG) section on crossings.

Based on the crash history (see section 3), which shows pedestrian issues as the second

Probability of crash occurring	Unlikely
Expected crash severity	Serious injury
Primary treatment recommendations:	
4.23.1	Install raised platforms for all zebra crossings
Supporting treatment recommendations:	
4.23.2	N/A

highest crash factor, considering this in conjunction with the poor safety rating of flush zebra crossings, and the risk factors discussed above, crashes at flush zebras are expected to occur every 1-7 years ("unlikely" probability) and could result in serious injury.		

Responses:	
Designer	• Should be noted the significant rating reflects the existing safety issues not changes as a result of the project. • No change proposed. Raised platforms should be considered for transformational project.
Safety Engineer	Agree with Designer's response. Speeds for these movements to be in Monitoring Plan, and further mitigation considered if necessary.
Proposed action	Transitional project not introducing additional risk from current situation, and addressing existing vehicle/pedestrian safety concerns outside the impact of introducing new bike facilities is currently out of scope. Only raised platforms required to manage additional risks introduced from this project and where separation cannot be achieved, are considered in scope, to ensure the rapid roll-out of the project can be delivered within expected timeframes. The safety concerns raised at these additional side street locations will be passed on to the minor safety works programme to prioritise accordingly
Client decision	Accepted

5 Comments

The following issues are considered by the CAT as worth mentioning although they are either not likely to result in safety risks, or are outside the CASA scope for this project stage.

5.1 Aitken / Hill / Molesworth – cycle left turn from Aitken (C34/C105) – C E

Comment

It would be preferable to provide a cycle bypass for cyclists turning left from Aitken St to Molesworth St, rather than require them to wait at a red signal. The CAT acknowledge the concerns of pedestrian advocates about cyclists mixing with pedestrians, especially near intersections. However, we suggest that many left-turning cyclists in this location will attempt this manoeuvre regardless and it is therefore preferable to formalise it so that cyclists will be channelled in a more predictable trajectory. This could be done through use of surface material / colour and pedestrian tactile pavers to warn vision impaired pedestrians.

Probability of crash occurring	N/A
Expected crash severity	N/A
Indicative treatment recommendations:	
5.1.1	Designate a cycle bypass for cyclists turning left from Aitken St to Molesworth St.

Responses:	
Designer	• Agree to add a cycle bypass
Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

5.2 Murphy St midblock crossing width (C34/C111) – P C E

Comment

There is a high pedestrian demand for the Murphy St midblock crossing, therefore it is worth making the crossing wider.

It would also be advantageous to make the crossing a dual pedestrian-cycle crossing, to allow cyclists access to destinations on the other side of the road (or as a transition point from right-hand side cycleway to left-hand side cycleway – see issue 4.11).

Probability of crash occurring	N/A
Expected crash severity	N/A

Note an advanced stop line only needs to be 200mm from the pedestrian crosswalk line (or any advance platform ramp) – see CNG section on cyclist waiting facilities at intersections.	***Indicative recommendations:***	
	5.2.1	Widen the Murphy St signalised midblock crossing provision for pedestrians.
	5.2.2	Convert the crossing to a dual pedestrian-cycle crossing.

Responses:	
Designer	• Agree to widen midblock crossing. WCC to advise whether a dual pedestrian and cycle crossing in this location is desired.
Safety Engineer	Agree with Designer's response. WCC to advise whether a dual pedestrian and cycle crossing in this location is desired.
Proposed action	If we are needing to make changes to the kerb and signals in this location then a dual crossing can be incorporated. Designers to update in 90% designs.
Client decision	Accepted

5.3 Mulgrave / Murphy / Pipitea cyclist awareness of phase (C34/C113) – C E

Comment

Note if the preferred treatment recommendations from issue 4.11 is implemented, this issue will be negated.

The issue is that cyclists may not realise they can turn left or right during the cycle phase, i.e. a lack of understanding of the current meaning of standard cycle aspect.

Whilst this could result in some cyclists wanting turn left or right onto Pipitea St doing so during the A or B (general traffic phases) and conflicting with motor vehicles, it is considered most likely that they would soon realise the C phase is available to them, and make a safer choice.

Probability of crash occurring	N/A
Expected crash severity	N/A
Primary treatment recommendations:	
5.3.1	N/A
Supporting treatment recommendations:	

		5.3.2	Add sign to the effect of “cycles can go in any direction on green signal”.

Responses:	
Designer	• Propose to have arrow markings and signs to communicate the turns that cyclists can make
Safety Engineer	Agree with CAT and Designer’s response.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

5.4 61 Molesworth St changes (C36) – C E

The design colour coding suggests existing shared through / left-turn lane to be retained, and through / right-turn lane to be shifted over, however this does not properly reflect the intention of there being one lane only in this section.

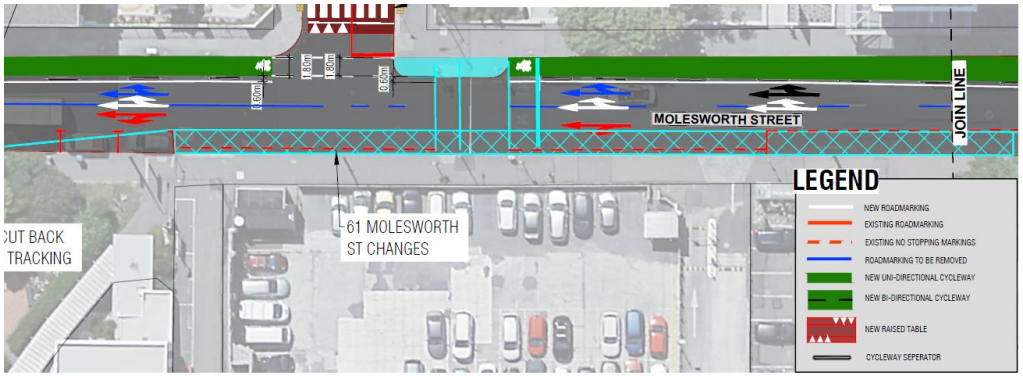


Figure 5-1: Lane markings at 61 Molesworth area

Comment

Probability of crash occurring	N/A
Expected crash severity	N/A
Indicative recommendations:	
5.4.1	Modify the lane arrows to show there is only one lane in this section.

Responses:	
Designer	• Agree to rationalise in 90% designs
Safety Engineer	Agree with CAT and Designer’s response.
Proposed action	Designers to update in 90% designs.

Client decision	Accepted

5.5 Bunny / Lambton / Molesworth intersection (C38) – P C E

Comment

Currently there is no clear indication of the connection between the bi-directional cycleways on Molesworth St and Lambton Quay, as well as the Bunny St route. The plans note "Transitional cycleways and bus interchange works to be aligned" and "Cycle phase proposed to enable cyclists between Lambton Quay and Molesworth St". The designer has provided more detail regarding the proposed intersection operation, but this needs to be reviewed in conjunction with a more detailed layout design.

Probability of crash occurring	N/A
Expected crash severity	N/A

Indicative recommendations:

5.5.1	It would be preferable to see an indicative plan of the proposals as soon as possible, to ensure that the final (90%) audit does not reveal significant change is required.

Responses:	
Designer	• Integrating as part of Stantec design for Wellington Bus Station upgrade. Designs to be shared when available.
Safety Engineer	Agree with CAT and Designer's response. Designs for this location should be shared and coordinated between Designers. The agreed proposed design should then be included in the next audits for both projects.
Proposed action	Provide designs for Audit when available
Client decision	Accepted

5.6 Contra-flow cycling on Bunny St (C38) – P C E M

Comment

The designers have indicated that contra-flow cycling on Bunny St is already permitted, but this is not likely to be obvious to cyclists themselves.

Probability of crash occurring	N/A
Expected crash severity	N/A
Primary treatment recommendations:	
5.6.1	Use signage and / or marking to make it clear that contra-flow cycling on Bunny St is permitted.

Responses:	
Designer	• Agree, propose to include contraflow cycle lane markings on Bunny St approach
Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Designers to update in 90% designs
Client decision	Accepted

5.7 Raised platform design – bus compatibility (various locations) – P C E M

Comment

To be an effective speed-calming device, a raised crossing should be at least 100 mm high, in which case it should also have a 6 m long tabletop so that long vehicles (e.g. buses) always have at least one set of wheels on the crossing; otherwise, they may bottom out. This may result in unnecessary damage to the road, trucks, and public transport vehicles. Some of the raised platforms are less than 6 m long.

Probability of crash occurring	N/A
Expected crash severity	N/A
Indicative recommendations:	
5.7.1	Ensure raised platforms are at least 100 mm high, with a 6 m long tabletop.

Responses:	
Designer	• Agree to amend designs on routes with high bus demands
Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Update 90% designs to reflect.
Client decision	Accepted

5.8 Buffered Advanced Stop Boxes preferred (various locations) – C E

Comment

The design includes some buffered advanced stop boxes (ASBs) that accord with the guidance note, but in other locations (including existing ASBs) the ASBs are too short and are not buffered.

Upgrading existing ASBs to buffered ASBs would be a low-cost but high-benefit project detail.

Probability of crash occurring	N/A
Expected crash severity	N/A
Primary treatment recommendations:	
5.8.1	Introduce buffered ASBs throughout.

Responses:	
Designer	• Agree, propose to add to Molesworth St approach at Park St/ Tinakori Rd/ Molesworth St intersection. In other locations cyclists will use the cycleway and ASBs will be removed.
Safety Engineer	Agree with CAT and Designer's response.
Proposed action	Designers to update in 90% designs.
Client decision	Accepted

6 Audit statement

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified to improve safety.

The safety issues identified and noted in this report are summarised in Table 6-1.

Table 6-1: Summary of Issues

Serious	*Significant*	*Moderate*	*Minor*	*Comments*	*Total*
6	*13*	*1*	*3*	*8*	*31*

Issue		**Ranking**
4.1	Tinakori Rd and Hill St shared lanes in uphill direction (C30-C32)	Significant
4.2	Tinakori Rd pedestrian provision crossing Hill St (C30)	Significant
4.3	Setback of parking from Aitken St driveway (C32)	Moderate
4.4	Molesworth / Tinakori / Park– hook turn box blocking through-cyclists (C33/C109)	Significant
4.5	Mixing lane widths (C33&C37)	Serious
4.6	Mixing lane lengths (C33&C37)	Serious
4.7	Murphy St southbound floating bus stop gap (C33)	Serious
4.8	Murphy St bus stop / pedestrian crossing / cycle transition (C33)	Minor
4.9	May St crossing Murphy St cycleway (C34)	Significant
4.10	Murphy St transition from shared lane to right-hand side cycleway (C34)	Significant
4.11	Mulgrave / Murphy / Pipitea LOS at diagonal cycle crossing (C34/C113)	Significant
4.12	Mulgrave / Murphy / Pipitea driver interpretation of intersection (C34/C113)	Minor
4.13	Mulgrave / Murphy / Pipitea alignment for motorists (C34/C113)	Minor
4.14	Aitken / Mulgrave – cycle right turn (C35/C115)	Significant
4.15	Mulgrave at Lambton Quay (C35)	Significant
4.16	Molesworth / Pipitea pedestrian crossing (C36)	Significant
4.17	Aitken / Hill / Molesworth right turns (C37/C105)	Serious
4.18	Aitken / Hill / Molesworth – slip lane angle (C37/C105)	Significant
4.19	Aitken / Hill / Molesworth – cycle left turn from Molesworth (C37/C105)	Significant
4.20	Molesworth St two-way cycleway crossing Kate Sheppard Pl (C37)	Serious

4.21	Molesworth St pedestrian crossing provision across Kate Sheppard Pl (C37)	Significant
4.22	Driveways on Molesworth St contraflow cycleway (C37)	Serious
4.23	Flush zebra crossings (multiple locations)	Significant
5.1	Aitken / Hill / Molesworth – cycle left turn from Aitken (C34/C105)	Comment
5.2	Murphy St midblock crossing width (C34/C111)	Comment
5.3	Mulgrave / Murphy / Pipitea cyclist awareness of phase (C34/C113)	Comment
5.4	61 Molesworth St changes (C36)	Comment
5.5	Bunny / Lambton / Molesworth intersection (C38)	Comment
5.6	Contra-flow cycling on Bunny St (C38)	Comment
5.7	Raised platform design – bus compatibility (various locations)	Comment
5.8	Buffered Advanced Stop Boxes preferred (various locations)	Comment

No table of contents entries found.

Designer:	Chris Groom	Position	Senior Transport Planner
Signature		Date	15/11/2022
Safety Engineer:	Dennis Davis	Position	Principal Transport Engineer
		Date	17/11/2022
Client:	Brad Singh	Position	Manager – Transport & Infrastructure
Signature		Date	29/11/2022
Project Manager – action completed:	Renee Corlett	Position	Project lead
Signature		Date	25/11/2022
Audit report distributed on:		Date	

Appendix A Crash history – intersection details

A.1 Bowen Street / Tinakori Road

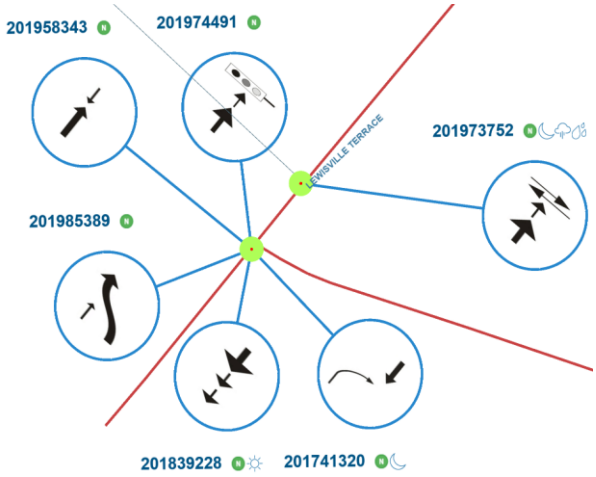


Figure 6-1: Bowen Street and Tinakori Road intersection crash diagrams

Crash data for the Bowen / Tinakori intersection shows:

- crashes were most often to do with manoeuvring
- none involved pedestrians or cyclists
- one occurred in wet conditions
- two occurred at night
- crashes occurred the most on Wednesday or Friday
- four of the six crashes occurred in 2019

A.2 Kate Sheppard Place / Molesworth Street

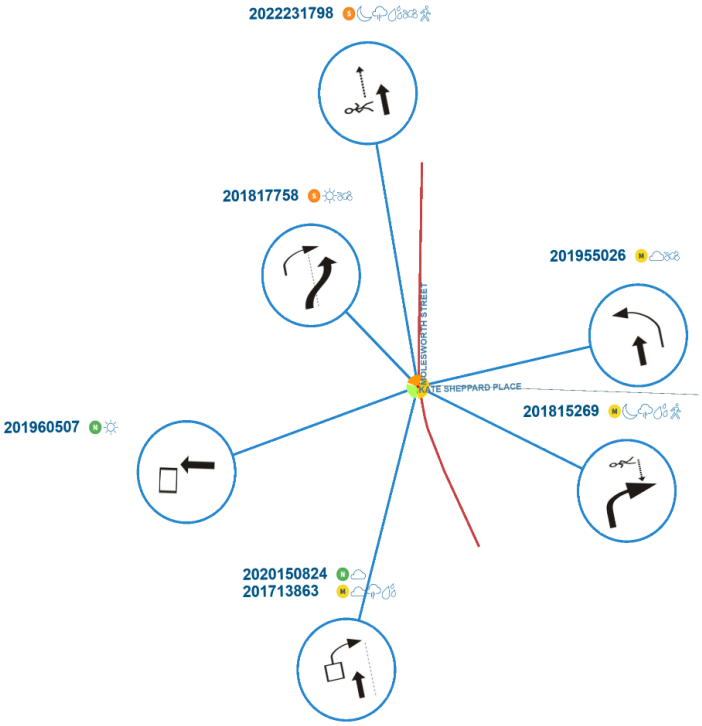


Figure 6-2: Kate Sheppard Place and Molesworth Street intersection crash diagram

Crash data for the Kate Sheppard / Molesworth intersection shows:

- crashes were most often to do with manoeuvring
- two involved pedestrians (one minor and one serious)
- three occurred in wet conditions
- two occurred at night
- crashes occurred most on Tuesday or Wednesday
- crashes were well spread between 2017-2022 (with two in 2018)

A.3 Bunny Street at Railway Station (out of scope for now)

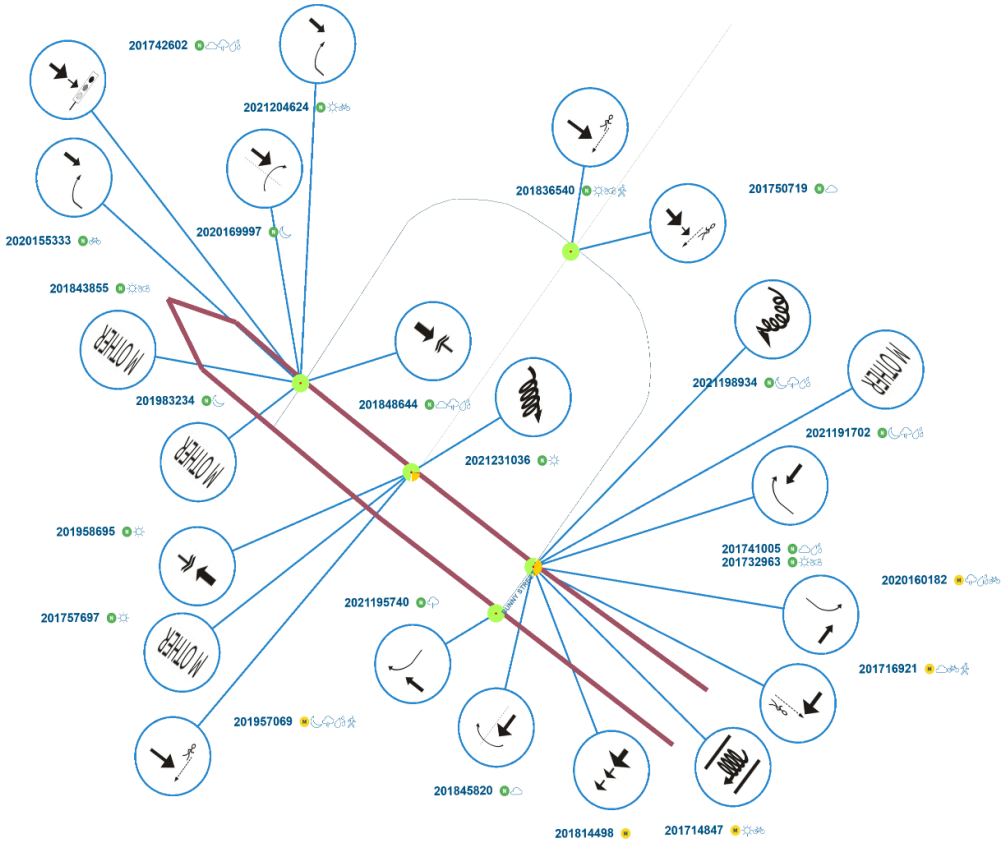


Figure 6-3: Railway entrance and exit crash diagrams (on Bunny Street)

Crash data for the Railway station entrance and exit on Bunny Street shows:

- crashes were most often to do with manoeuvring
- five crashes involved cyclists (three minor and two non-injury), three involved pedestrians (two minor and one non-injury)
- most occurred in good weather
- Most crashes occurred during the day
- four of the six crashes occurred on Tuesday, Saturday and Sunday
- five of the six crashes occurred in 2017 followed by 2018 and 2021

A.4 Bowen Street / Whitmore Street

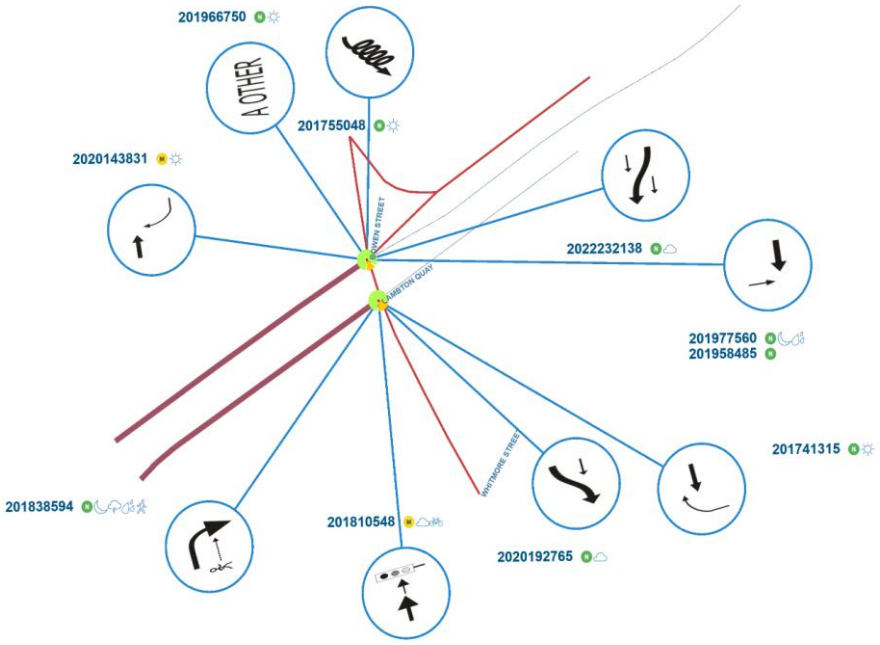


Figure 6-4: Bowen and Whitmore Street intersection crash diagrams

Crash data for the Bowen / Whitmore intersection shows:

- crashes were most often to do with manoeuvring
- only one involved a cyclist and one a pedestrian
- two occurred in wet conditions
- two occurred at night
- crashes occurred most on Tuesday or Sunday
- crashes remain consistent over differed years