Karanga-a-hape Station Neighbourhood Improvements Project

75 % Detailed Design

Safe System Audit

22 December 2023

Ref: 310205582.100.108

PREPARED FOR:

Michael Wong and Sophia Wang
Auckland Transport

PREPARED BY:

Nick Gluyas and Keith Weale

Stantec

Revision Schedule

Revision No.	Date	Description	Prepared by	Quality Reviewer	Independent Reviewer	Project Manager Final Approval
0	22/12/23	Final	NG	KW	KW	ML

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Contents

Safe System Audit

1 Safe System Auditing for Transport Projects

A Safe System audit is an independent review of a future transport project to identify any safety concerns that may affect the safety performance and alignment to a Safe System. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A Safe System audit is therefore a formal examination of a transport project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc), carried out by an independent competent team who identify and document Safe System alignment and road safety concerns.

A Safe System audit is intended to help deliver a safe road system and is not a review of compliance with standards.

1.1 Safe System Audit Procedure

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 Safe System audit is a safety review used to identify all areas of a project that are inconsistent with a safe system and bring those concerns to the attention of the client so that the client can make a value judgement regarding appropriate action(s) based on the risk guidance provided by the Safe System audit team.

The key objective of a Safe System audit is summarised as:

> to deliver completed projects that contribute towards a Safe System by identifying and ranking potential safety concerns for all road users and others affected by a transport project.

A Safe System audit should be undertaken at project milestones such as:

- concept stage (part of a business case),
- scheme or preliminary design stage (part of pre-implementation),
- detail design stage (pre-implementation / implementation), and
- pre-opening / post-construction stage (implementation / post-implementation).

A Safe System audit is not intended as a technical or financial audit and does not substitute for a design check on standards or guidelines.

Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the design team on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the Waka Kotahi NZ Transport Agency Safe System Audit Guidelines, the audit report should be submitted to the client who will instruct the design team to respond. The design team should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client shall make the final decision and brief the design team to make the necessary changes and/or additions. As a result of this instruction the design team shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the Safe System audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the design team, safety engineer and client for each issue documenting the design team's response, client decision and action taken.

A copy of the report including the design team's response to the client and the client's decision on each recommendation must be given to the Safe System audit team leader as part of the important feedback loop. The Safe System audit team leader will disseminate this to team members.

1.2 Report Format

1.2.1 Safety concern ranking

The safe system auditors have ranked the identified safety concerns together with four categories of suggested actions as shown in Table 1.

Table 1: Safety concern ranking

Ranking	Suggested Action
Serious	A serious safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	A significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	A moderate safety concern that should be addressed to improve safety.
Minor	A minor safety concern that could be addressed where practical to improve safety.

The ranking of safety concerns is based on the probability of a crash combined with the most likely severity outcome of that crash, as indicated in Table 2.

Table 2: Safety concern risk rating matrix

		Severity Outcome				
		Non-injury	**Minor**	**Safe System injury threshold**	**Serious**	**Fatal**
		Property damage only (PDO).	Injury that is not serious but requires first aid, or that 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.	Death occurring as the result of injuries sustained in a 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**

Qualitative risk ranking requires professional judgement and a wide range of experience in projects of all sizes and locations. Factors that have been considered when qualitatively assessing the probability of a crash and the most likely severity outcome of that crash are described below.

Probability of a crash

The safe system auditors have drawn on historic crash rates or other research for similar elements of projects, or projects as a whole where appropriate, to assist in understanding the likely crash types, frequency, and likely severity that may result from a particular safety issue.

The probability of a crash in Table 2 has been qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the risk of a crash resulting from the presence of the issue.

It is sometimes helpful to use crash frequency as a surrogate indicator of crash probability as shown in Table 3.

Table 3: Crash frequency as an indicator of probability

Crash Frequency	Crash Probability
Multiple crashes (more than one per year)	Very likely
1 every 1 to 5 years	Likely
1 every 5 to 10 years	Unlikely
Less than 1 every 10 years	Very unlikely

Severity outcome

A crash of a particular type can result in a range of severity outcomes for the people involved. For the purposes of this assessment, the crash severity outcome in Table 2 has been qualitatively assessed as being the most likely or predominant severity outcome on the basis of factors such as speed, type of crash, type of vehicles, and the people likely to be involved.

The severity of an injury is determined in part by the ability of a person to tolerate the crash forces. A person wearing safety restraints in a modern motor vehicle will have a greater tolerance to the forces involved than a pedestrian or cyclist struck by a motor vehicle. The safe system auditors have also considered the likely user composition, and hence the likely severity of injury to the people involved in the crash. An able-bodied adult may have a greater ability to recover from higher trauma injuries than a child, whereas an elderly person may have poor ability to recover from high trauma injuries.

1.2.2 Comments

In addition to the ranked safety issues, it may be appropriate for the Safe System audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the Safe System audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, and items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, the auditors may give suggestions in some instances.

Decision tracking of safety concerns ranked as a comment is optional.

2 Safe System Audit Details

2.1 Type of Audit

This is a detailed design stage Safe System audit of a network package of proposed improvements.

This Safe System audit has been conducted by the team named in Section 2.2 as far as has been practicable in accordance with the guidelines for Safe System audits. (Waka Kotahi NZ Transport Agency, 2022)

This Safe System audit does not include a new Safe System assessment of the latest detailed design drawings. Instead, it refers to the most recent comprehensive Safe System assessment completed by Beca for the project. It is recommended that assessment (discussed in Section 4.1) be updated to include a re-assessment of the latest 75% interim and permanent detailed design drawings. Refer to Section 4.2.

The project is being designed in several packages as indicated in Figure 1. This Safe System audit addresses only two packages; the purple (interim scope) and the pink (permanent scope). The packages coloured grey and light blue are not included in this Safe System audit.

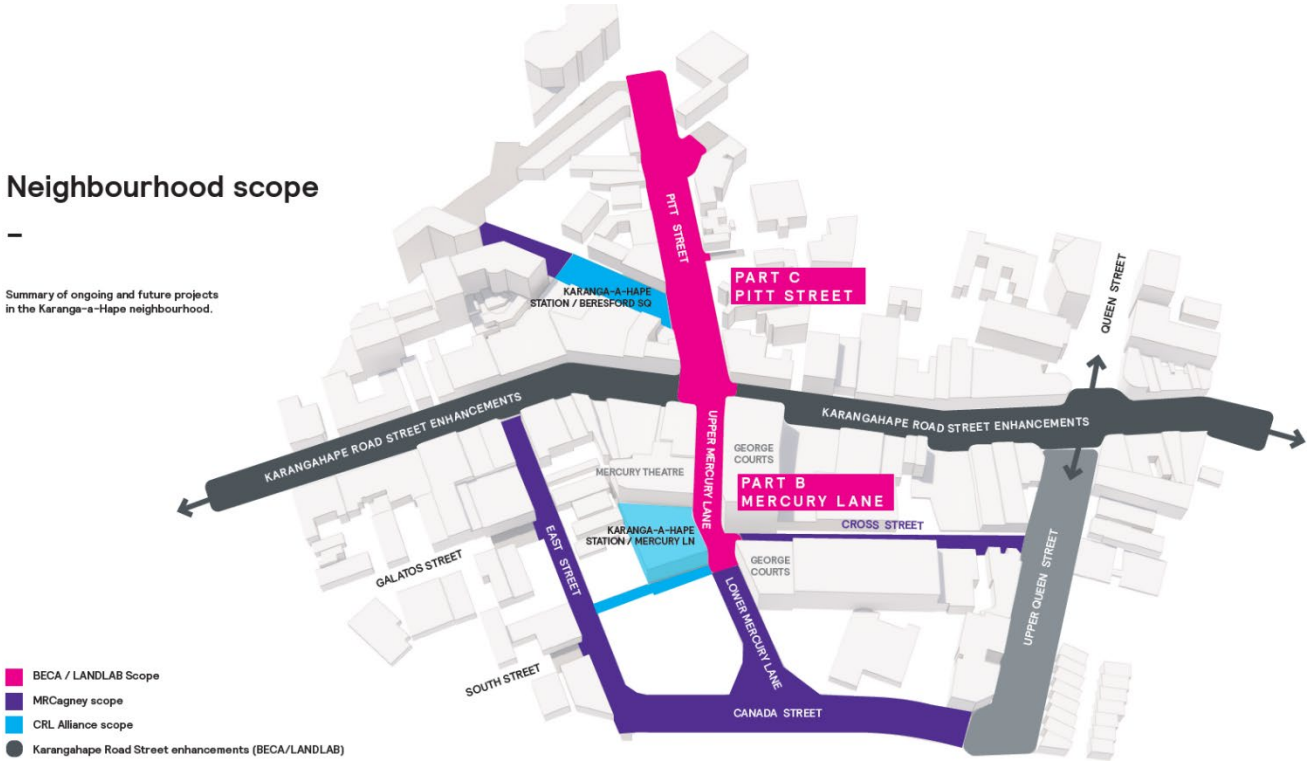

Figure 1: Design packages (LandLAB, 2022, p. 15)

2.2 Audit Team

This Safe System audit has been undertaken, by:

- Nick Gluyas, Stantec, and
- Keith Weale, Stantec.

2.3 Meetings and Site Inspections

A briefing meeting was held at 2:30 pm on 13 December 2023, primarily to explain the 12 options being considered for Upper Mercury Lane.

The audit team undertook a desktop review of the provided drawings on Monday 18 December 2023.

2.4 Previous Road Safety and Safe System Audits

The following road safety and Safe System audits are relevant to this project.

- Concept design road safety and non-motorised user audit (Stantec, 2022).
- Developed design safe system audit (Stantec, July 2023).

2.5 Documents Provided

The Safe System auditors referred to the following design drawings.

2.5.1 Permanent Scope

Table 4: Permanent Scope Drawing Register

Drawing Title	Drawing Number	Revision
Civil Works Plan – General Notes & Legend	3127079-CA-2100	G
Civil Works Plan – Sheet 1 of 6	3127079-CA-2101	G
Civil Works Plan – Sheet 2 of 6	3127079-CA-2102	G
Civil Works Plan – Sheet 3 of 6	3127079-CA-2103	G
Civil Works Plan – Sheet 4 of 6	3127079-CA-2104	G
Civil Works Plan – Sheet 5 of 6	3127079-CA-2105	G
Civil Works Plan – Sheet 6 of 6	3127079-CA-2106	G
Signage and Paint Marking Plan – General Notes & Legend	3127079-TA-1000	D
Signage and Paint Marking Plan – Pavement Marking Details	3127079-TA-1000A	D
Signage and Paint Marking Plan – Sheet 1 of 6	3127079-TA-1001	D
Signage and Paint Marking Plan – Sheet 2 of 6	3127079-TA-1002	D
Signage and Paint Marking Plan – Sheet 3 of 6	3127079-TA-1003	D
Signage and Paint Marking Plan – Sheet 4 of 6	3127079-TA-1004	D
Signage and Paint Marking Plan – Sheet 5 of 6	3127079-TA-1005	D
Signage and Paint Marking Plan – Sheet 6 of 6	3127079-TA-1006	D

2.5.2 Interim Scope

Table 5: Interim Scope Drawing Register

Drawing Title	Drawing Number	Revision
Interim Scope Civil Works Plan – General Notes & Legend	3127079-100- CA-2100	B
Interim Scope Civil Works Plan – Sheet 1	3127079-100-CA-2101	B

Interim Scope Civil Works Plan – Sheet 2	3127079-100-CA-2102	B
Interim Scope Civil Works Plan – Sheet 3	3127079-100-CA-2103	B
Interim Scope Civil Works Plan – Sheet 4	3127079-100-CA-2104	B
Interim Scope Civil Works Plan – Sheet 5	3127079-100-CA-2105	B
Interim Scope Civil Works Plan – Sheet 6	3127079-100-CA-2106	B
Interim Scope Civil Works Plan – Sheet 7	3127079-100-CA-2107	B
Interim Scope Civil Works Plan – Sheet 8	3127079-100-CA-2108	B
Interim Scope Civil Works Plan – Sheet 9	3127079-100-CA-2108A	B
Interim Scope Signage and Paint Marking Plan – General Notes & Legend	3127079-100-TA-1000	B
Interim Scope Signage and Paint Marking Plan – Pavement Marking Details	3127079-100-TA-1000A	B
Interim Scope Signage and Paint Marking Plan – Sheet 1 of 9	3127079-100-TA-1001	B
Interim Scope Signage and Paint Marking Plan – Sheet 2 of 9	3127079-100-TA-1002	B
Interim Scope Signage and Paint Marking Plan – Sheet 3 of 9	3127079-100-TA-1003	B
Interim Scope Signage and Paint Marking Plan – Sheet 4 of 9	3127079-100-TA-1004	B
Interim Scope Signage and Paint Marking Plan – Sheet 5 of 9	3127079-100-TA-1005	B
Interim Scope Signage and Paint Marking Plan – Sheet 6 of 9	3127079-100-TA-1006	B
Interim Scope Signage and Paint Marking Plan – Sheet 7 of 9	3127079-100-TA-1007	B
Interim Scope Signage and Paint Marking Plan – Sheet 8 of 9	3127079-100-TA-1008	B
Interim Scope Signage and Paint Marking Plan – Sheet 9 of 9	3127079-100-TA-1008A	A

3 Project Description

3.1 Project Background and Objective

Auckland Transport is implementing improvements on the streets surrounding Karangahape Road in anticipation of the completion of City Rail Link and the new Karanga-a-hape Station, which will become a focal point for public transport, with up to 40,000 people expected to use the station each day. The improvements will complement the new station by adding more space for community and business, making the surrounding areas better for pedestrians, and enabling easy connections between walking, bus, bike, and train (Auckland Transport, 2023)

The single stage business case (SSBC) objectives were to:

- reduce harm to vulnerable transport users,
- make better use of existing and future public transport and active mode infrastructure and investments in the city centre,
- improve the desirability of the Karanga-a-hape Station neighbourhood as a place for economic, cultural, and social activities,
- increase a sense of place in the Karanga-a-hape Station neighbourhood through expressing the unique character and identity in the streetscape. (Andrew Taylor Consulting, 2022).

3.2 Existing Conditions and Context

The existing conditions and context are summarised in Table 6.

Table 6: Existing conditions and context

	Karangahape Road	Pitt Street	Hopetoun Street	Beresford Square	Day Street	Mercury Lane	Cross Street	East Street	Galatos Street	Canada Street	Upper Queen Street
Existing ADT (Mobile Road, 2020)	17507	20945	12124	1047	523	3141	1466	1047	314	6948	15073
2028 Estimated ADT (MRCagney)	5,000-10,000 (Assumed)	4248	5,000-10,000 (Assumed)	167	100-300 (Assumed)	2069	549	2041	100-300 (Assumed)	2784	10,000-15,000 (Assumed)
Pedestrian volumes (ADT)	500+ (Assumed)	13608 (MRCagney, 2028)	500+ (Assumed)	2089 (MRCagney, 2028)	200-500 (Assumed)	8852 (MRCagney, 2028)	1192 (MRCagney, 2028)	1117 (MRCagney, 2028)	200-500 (Assumed)	1494 (MRCagney, 2028)	500+ (Assumed)
Cyclist volumes (ADT)	300+ (Assumed)	258 (MRCagney, 2028)	100-300 (Assumed)	47 (MRCagney, 2028)	20-50 (Assumed)	23 (MRCagney, 2028)	18 (MRCagney, 2028)	75 (MRCagney, 2028)	50-100 (Assumed)	180 (MRCagney, 2028)	300+ (Assumed)
Road Classification	Arterial	Arterial	Arterial	Secondary Collector	Secondary Collector	Primary Collector	Secondary Collector	Secondary Collector	Access	Arterial	Arterial
Collective Risk (Megamaps)	High	High	Low	Low	Low	Low	Low	Low	Low	Low	Medium
Personal Risk (Megamaps)	High	High	Low	Low	Low	Low	Low	Low	Low	Low	Medium-High
Operating Speed (Megamaps)	24 km/h	24 km/h	42 km/h	20 km/h	20 km/h	23 km/h	20 km/h	29 km/h	20 km/h	31 km/h	32 km/h

3.3 Proposed Works

The proposed works include significant permanent improvements to Pitt Street and Upper Mercury Lane, along with smaller interim enhancements to Lower Mercury Lane, Canada Street, East Street, Cross Street, and Beresford Square. Included in the works will be a pedestrian mall on the upper section of Mercury Lane, more safe places for people to cross busy roads, linking cycleways, reallocating parking to support pick-up and drop-off spaces for the new station, new sections of bus lanes, and extending the hours of existing bus lanes. (Auckland Transport, 2023)

The improvements are shown in Figure 2. These require changes to the existing traffic circulation as shown in Figure 3 and parking changes as shown in Figure 4.

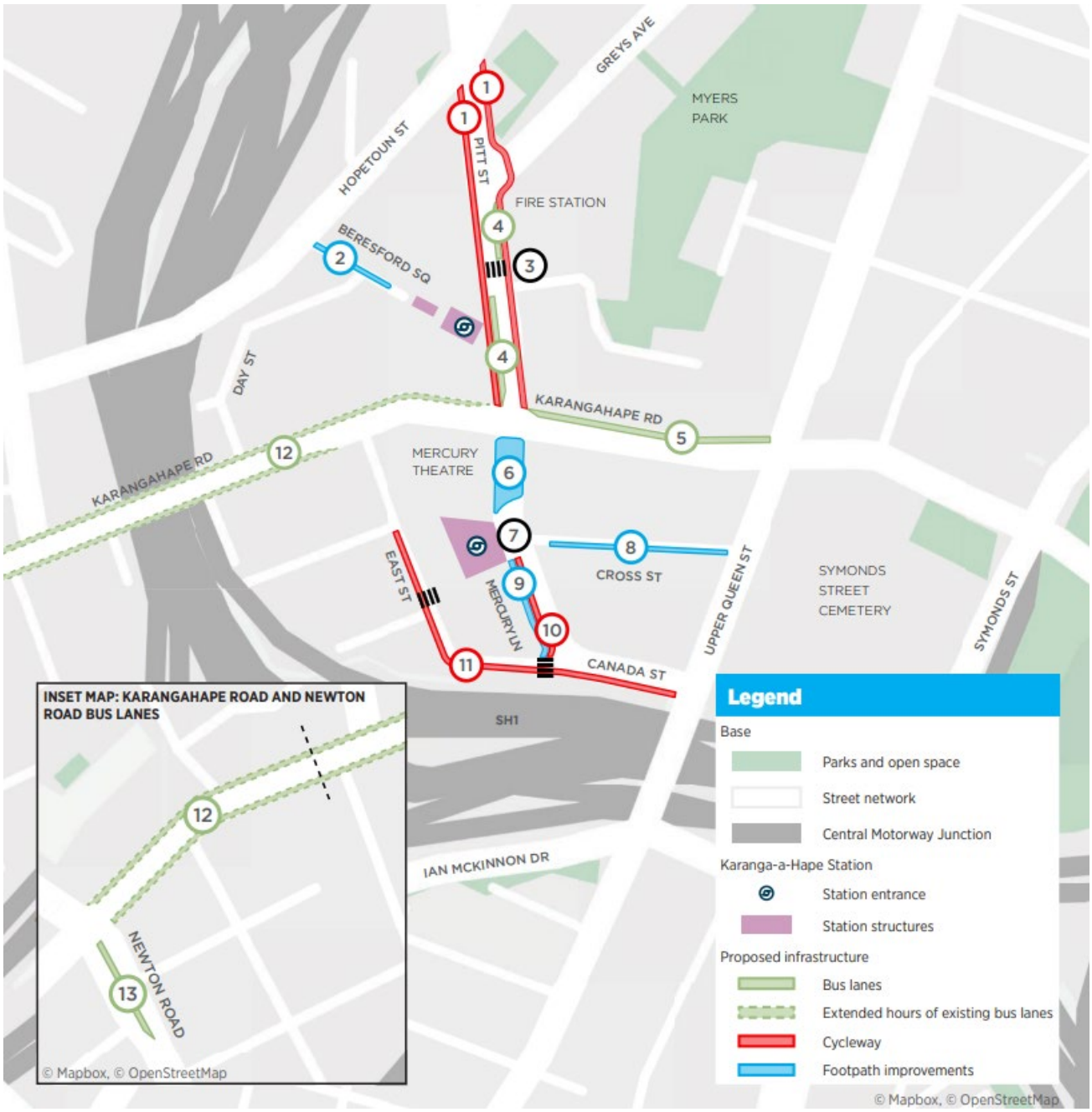

Figure 2: Proposed Karanga-a-hape Station neighbourhood improvements (Auckland Transport, 2023)

Figure 3: Proposed traffic circulation plan (Auckland Transport, 2023)

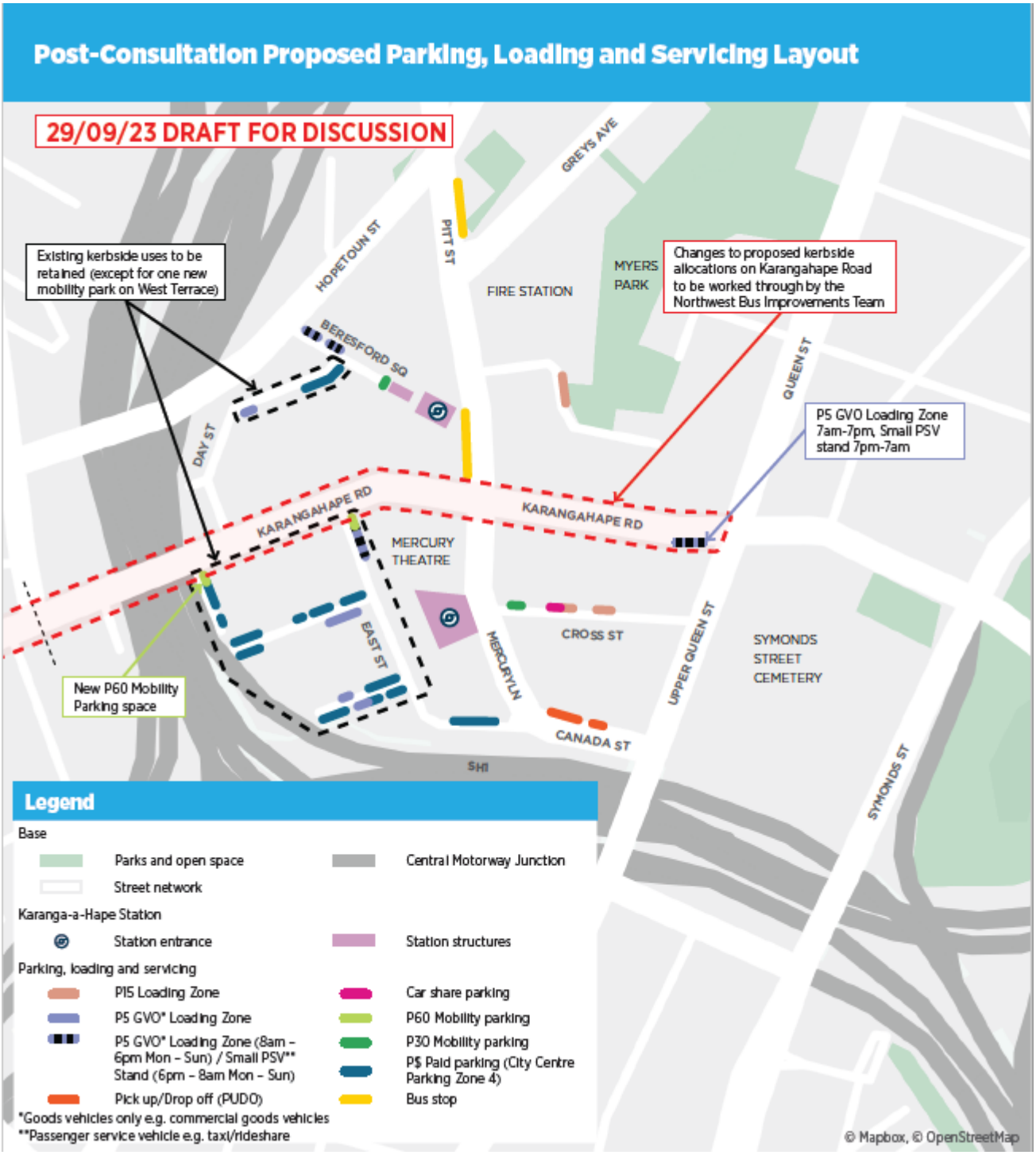

Figure 4: Proposed parking layout (Auckland Transport, 2023)

4 Assessment of Safe System Alignment – Permanent and Interim Scope

4.1 Beca Safe System Assessment Summary

Beca conducted a comprehensive network Safe System assessment for both the permanent and interim scope options listed below.

- Do Nothing – Existing environment prior to the station works commencing and including the Karangahape Road protected cycle lane
- Do Minimum – Link Alliance Design (pedestrian improvements on Mercury Lane adjacent to the Karanga-a-hape Station along with a mid-block crossing and reduced traffic lanes on Pitt Street)
- Option 1 – Enhancements to the Do Minimum (adds a shared space along Mercury Lane, cycling improvements on Pitt Street and pedestrian provisions to the Do Minimum)
- Option 2 – One-way circulation system (adds further vehicle restrictions with pedestrian malls and one-way streets to limit vehicle traffic, particularly around Mercury Lane, compared to Option 1)
- Option 3 – Traffic cells and modal filters (changes some of the one-way streets in Option 2 to cul de sacs to limit through vehicle movements)
- Option 4 – Pedestrian focussed neighbourhood (heavily restricts vehicle movements with pedestrian malls and provides more pedestrian provisions on Pitt Street and Karangahape Road compared to Option 2)

The results of the Beca Safe System assessment are summarised in Table 7.

Table 7: Safe System assessment score summary

	Intersection	Pedestrian	Cyclist	Motorcyclist	Total (out of 2880)
Do Nothing	86	228	165	241	719
Do Minimum	86	211	165	226	687
Option 1	86	193	130	219	628
Option 2	80	182	102	198	562
Option 3	77	178	105	187	546
Option 4	43	116	60	118	336

As expected, the most influential factors in aligning the project with a Safe System are achieved with safety improvements to pedestrian and cyclist facilities at intersections where pedestrians and cyclists conflict with motorised vehicles.

4.2 Permanent and Interim Scope Safe System Assessment

The 75% detailed design, which has been further developed since Beca completed the Safe System assessment referred to in Section 4.1 above, has not been reassessed. It appears to be very similar to, but not exactly the same as, Option 2 described in Section 4.1 and shown in Figure 5.

It is recommended that the Safe System assessment that Beca undertook be updated to reflect the 75% detailed design scope using the same basis for the assessment as before so that the latest design iteration can be scored against a consistent base methodology.

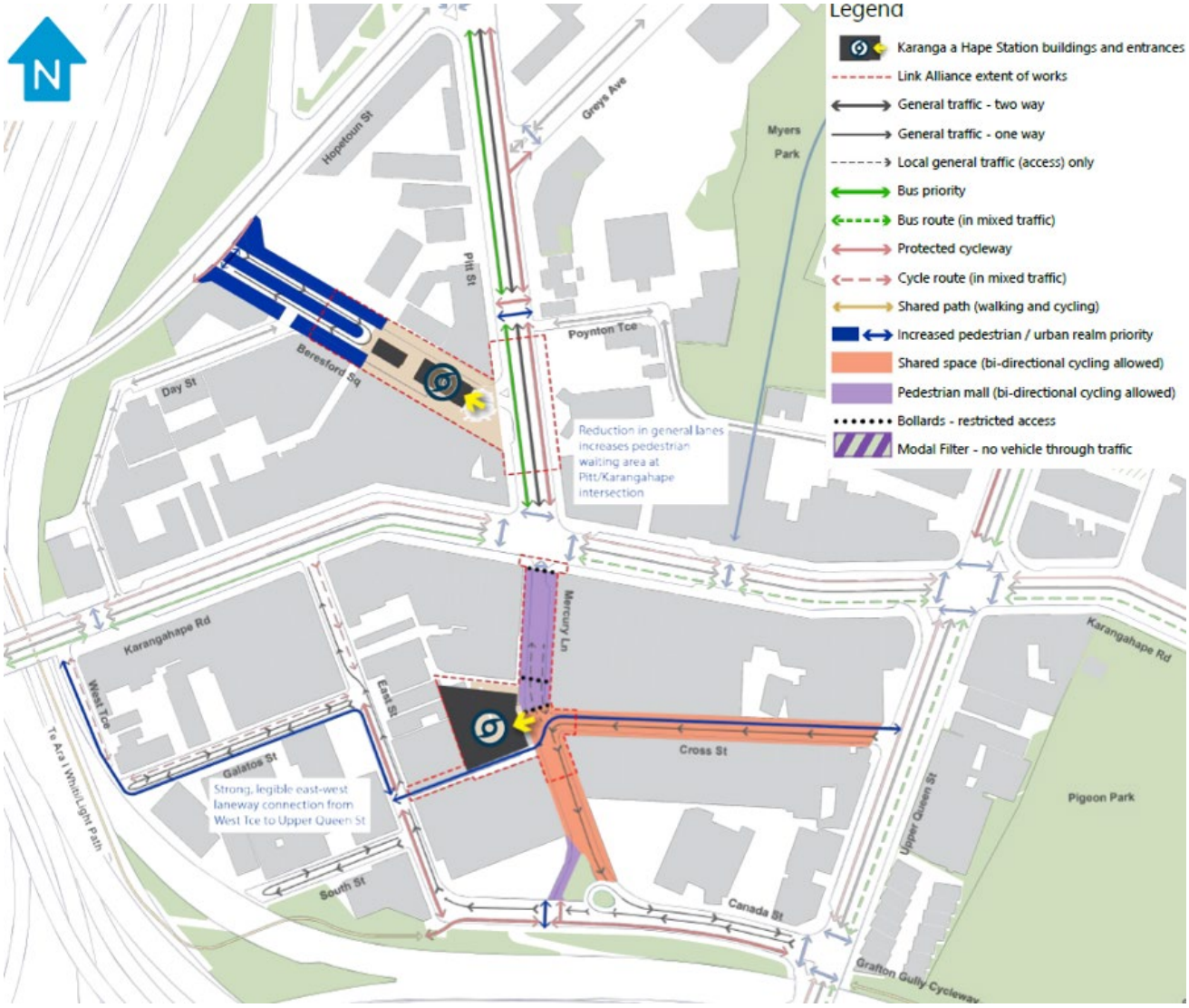

Figure 5: Option 2 assessed in the Beca Safe System assessment

4.3 Mercury Lane Safe System Assessment

4.3.1 Context

As part of this Audit, Auckland Transport has requested the Safe System Audit team undertake a safe system assessment of 12 alternative options proposed for the design of Upper Mercury Lane between Karangahape Road and Cross Street. Table 8 in Section 4.3.7 describes the proposals being considered.

4.3.2 Function

Mercury Lane is a primary collector road connecting Pitt Street and the upper CBD area to Upper Queen Street and the top end of Dominion Road. Most drivers appear to use Mercury Lane as a through route with a smaller proportion using it to access local businesses and a parking building that serves the Karangahape town centre.

Located within the 30 km/h CBD cordon, Mercury Lane is a one-way street with parking on both sides and relatively narrow footpaths. Alternative routes to bypass Mercury Lane include East Street and Upper Queen Street.

Figure 6: Mercury Lane (Google, October 2019)

4.3.3 Speed environment

The speed environment is likely to be less than 30 km/h based on the steep narrow route and the underlying speed limit which is 30 km/h.

4.3.4 Road users

Current road users are predominantly car drivers with occasional pedestrians and cyclists using the road to gain access to the Northwestern Cycleway. One signalised pedestrian crossing exists at the intersection with Karangahape Road.

4.3.5 Vehicle composition

The vehicle composition is likely to be consistent with other primary collector roads. The lane currently carries 3,200 vpd (2020 data) which, based on modelling, is likely to drop to 2,100 vpd in 2028 (assuming vehicles can still access Mercury Lane). Current cyclist numbers are likely to be between 20 and 50 cyclists a day with pedestrian numbers similarly low. However, with the opening of the CRL station and the proposed improvements in the area, pedestrian numbers are expected to increase to 9,000 per day with cyclist numbers increasing to more than 200 per day.

4.3.6 Crash History

A search of the CAS database showed eight crashes in the past 10 years. Most of these crashes involved vehicles crashing into parked vehicles. Seven of the eight crashes were non-injury with the remaining crash a minor injury crash involving a pedestrian. Driver error was noted in most crashes with alcohol a contributing factor in half of the crashes. Six of the eight crashes occurred at night. A strong theme of antisocial behaviour (alcohol, people playing in the road, 63% of crashes between the hours of midnight and 4 am, etc.) was evident from the crash reports.

4.3.7 Proposed Works

The following options are being considered for Upper Mercury Lane.

Table 8: Upper Mercury Lane Options Summary

Ref	Operational Description	Direction of Vehicle Travel	Access Controls / Enforcement
1	Pedestrian Mall - vehicle access by exception only	Authorised vehicles enter ped mall at north end, southbound direction of travel through ped mall section. Shared space south of ped mall to Cross St, two-way traffic to provide access into and out of Mercury Theatre and George Courts driveways.	Automated bollards either end of the mall (at Karangahape Road and north of George Courts driveway) with pre-arranged times to permit entry. Operations to be confirmed. Restricted access to specified vehicles as per Special Consultative Procedure - Emergency services, building maintenance, CRL Station maintenance Shared space between bollards and Cross St to enable two way access into Mercury Theatre and George Courts Driveways No parking permitted at all times
2	Shared Space - No kerb lines or line markings as per all shared spaces in City Centre (O'Connell, Fort Sreet etc)	Southbound - Karangahape Road to Cross Street	Loading permitted anywhere in space at set hours (TBD) No parking permitted at all times Cyclists permitted in both directions
3	Shared Space - No kerb lines or line markings as per all shared spaces in City Centre (O'Connell, Fort Street etc)	Northbound - Cross St to Karangahape Road	Loading permitted anywhere in space at set hours (TBD) No parking permitted at all times Cyclists permitted in both directions
4	Essential Vehicle Area (EVA) (similar to Queen St)	Authorised vehicles enter at Karangahape Road, southbound direction of travel. Two-way traffic at south end to provide access into and out of Mercury Theatre and George Courts driveways.	Access controlled by cameras enforcement - vehicles that to not comply with vehicle class restrictions ticketed (as per Queen St EVA) Potentially loading permitted at set times dependent on permissions (TBC) No parking permitted at all times
5	Essential Vehicle Area (EVA) (similar to Queen St)	Authorised vehicles northbound direction of travel. Two-way traffic at south end to provide access into and out of Mercury Theatre and George Courts driveways.	Access controlled by cameras enforcement - vehicles that to not comply with vehicle class restrictions ticketed (as per Queen St EVA) Potentially loading permitted at set times dependent on permissions (TBC) No parking permitted at all times
6	Authorised vehicles only (Number plate recognition)	Southbound - Karangahape Road to Cross Street	Automatic number plate recognition (ANPR) - understood to not currently be enforceable, requires (awaited) legislation change Potentially loading permitted at set times dependent on permissions (TBC) No parking permitted at all times
7	Authorised vehicles only (Number plate recognition)	Northbound - Cross St to Karangahape Road	Automatic number plate recognition (ANPR) - understood to not currently be enforceable, requires (awaited) legislation change Potentially loading permitted at set times dependent on permissions (TBC) No parking permitted at all times

Ref	Operational Description	Direction of Vehicle Travel	Access Controls / Enforcement
8	Pedestrian Mall - vehicle access by exception only	Authorised vehicles enter ped mall at south end, northbound direction of travel through ped mall section. Shared space south of ped mall to Cross Street, two-way traffic to provide access into and out of Mercury Theatre and George Courts driveways.	Automated bollards either end of the mall (at Karangahape Road and north of George Courts driveway) with pre-arranged times to permit entry. Operations to be confirmed. Restricted access to specified vehicles as per Special Consultative Procedure - Emergency services, building maintenance, CRL Station maintenance Shared space between bollards and Cross Street to enable two way access into Mercury Theatre and George Courts Driveways No parking permitted at all times
9	Fixed Pedestrian Mall - bollards both ends, vehicle access by pre-arranged TTMP	Either, dependant on TMP	Fixed bollards at Karangahape Road which require to be physically removed. This would require vehicles with permission to access obtaining a TMP and find a location to wait while the bollards are removed.
10	Fixed Pedestrian Mall - bollards Karangahape Road end only, vehicle access southbound by pre-arranged TTMP	Northbound - Cross Street to Karangahape Road. Shared space south of ped mall to Cross St, two-way traffic to provide access into and out of Mercury Theatre and George Courts driveways.	Fixed bollards which require to be physically removed. This would require vehicles with permission to access obtaining a TMP and find a location to wait while the bollards are removed
11	Revert to CRL Link Alliance design (Wide western footpath, existing eastern footpath, single 4.5m wide general traffic lane southbound) - Indented loading zone on eastern side	Southbound - Karangahape Road to Cross Street	Indented loading zone on eastern side No parking permitted at all times
12	LKA design but reversed traffic lane to northbound	Northbound - Cross St to Karangahape Road	Indented loading zone would need to swap sides but unclear if viable No parking permitted at all times

4.3.8 Project Design Safe System Assessment Summary

In assessing the 12 options being considered, the audit team determined that the options could be grouped based on the type of physical treatments being proposed for Mercury Lane (e.g., shared space versus separated space) and how restricted vehicular access will be. The following groupings were decided.

- Existing conditions
- Unrestricted vehicle access to shared space (Design Options 2 & 3)
- Legally enforced restricted vehicle access to shared space (Design Options 4, 5, 6 & 7)
- Physically (bollard) enforced restricted vehicle access to shared space (Design Options 1, 8, 9 & 10)
- Unrestricted vehicle access to non-shared space (CRL option) (Design Options 11 & 12)

The Safe System assessment matrix scores for the groupings are shown in Table 9. The scores for each crash type are shown in Figure 7. The detailed assessments are presented in Section 4.3.9.

By way of overall summary, the options that promote a self-explaining, slow speed, shared space are likely to perform better from a safe system perspective than options that retain separate dedicated spaces for vehicles and pedestrians. Similarly, the options that increasingly restrict vehicular access are likely to provide a progressively safer system.

Options 1, 8, 9 and 10 are likely to perform best from a safe system perspective.

Table 9: Safe System assessment score summary

Option	Score
Existing conditions	38 / 384
Design Options 2 & 3	26 / 384
Design Options 4, 5, 6 & 7	23 / 384
Design Options 1, 8, 9 & 10	9 / 384
Design Options 11 & 12	34 / 384

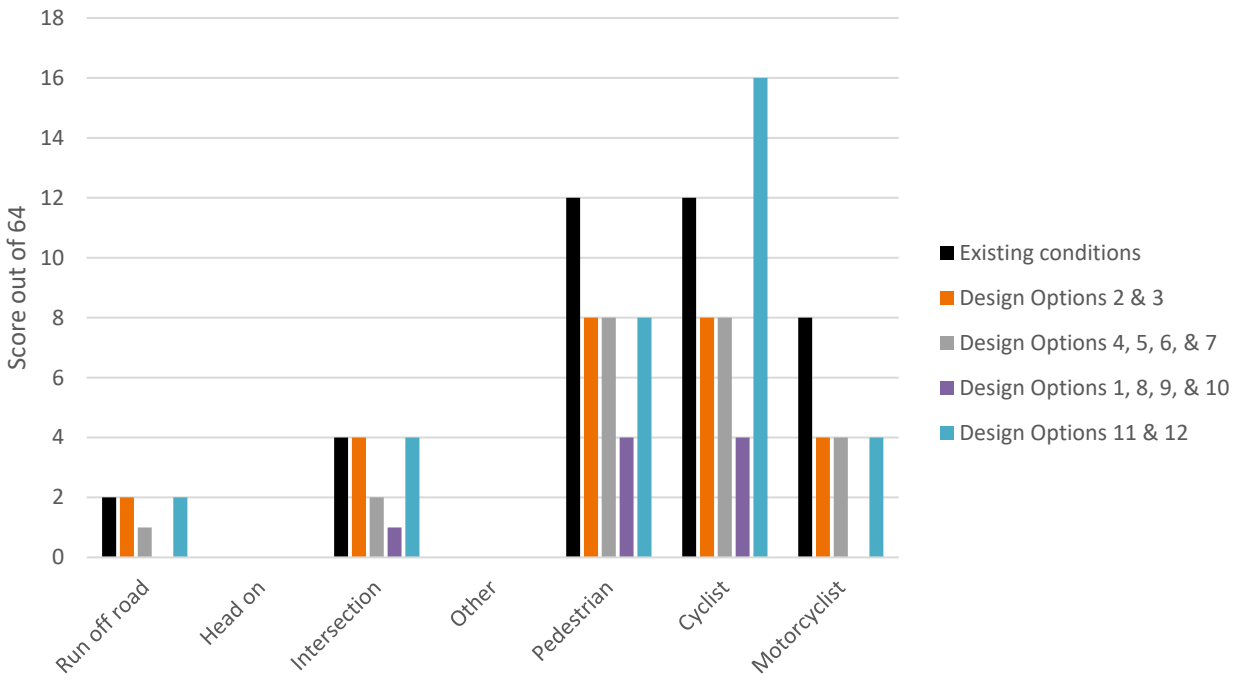

Figure 7: Safe System assessment score summary

4.3.9 Safe System Assessment Matrix

Table 10 to Table 14 provide a detailed breakdown of the safe system assessment of each option.

Table 10: Safe System assessment matrix: Existing Conditions

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure Comments:	3,200 vpd one way	3,200 vpd one way	3,200 vpd one way	N/A	Assumed to be 50 - 100 per day	Approximately 20 to 50 per day	Assumed to be 1% of traffic volume
Exposure Score:	2/4	2/4	2/4		3/4	2/4	2/4
Likelihood Comments:	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • One-way traffic	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • Low traffic speed		Factors that increase the likelihood include: • Narrow footpath • Jaywalking across short, signalised crossing Factors that decrease the likelihood include: • Signalised pedestrian crossing	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Nil	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed
Likelihood Score:	1/4	0/4	2/4		2/4	2/4	2/4
Severity Comments:	Factors that increase the severity include: • Crash into parked cars and buildings Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed		Factors that increase the severity include: • Vehicle speeds potentially greater than 30 km/h Factors that decrease the severity include: • Nil	Factors that increase the severity include: • Cyclist and vehicle speeds potentially greater than 30 km/h Factors that decrease the severity include: • Nil	Factors that increase the severity include: • Motorcycle and vehicle speeds potentially greater than 30 km/h Factors that decrease the severity include: • Nil
Severity Score:	1/4	1/4	1/4		2/4	3/4	2/4
Product	2/64	0/64	4/64		12/64	12/64	8/64
						TOTAL	**38/384**

Table 11: Safe System assessment matrix: Options 2 & 3 : Unrestricted vehicle access to shared space

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure Comments:	2,100 vpd one way	2,100 vpd one way	2,100 vpd one way	N/A	Assumed to be 9,000 per day	Approximately 200 per day	Assumed to be 1% of traffic volume
Exposure Score:	2/4	2/4	2/4		4/4	4/4	2/4
Likelihood Comments:	Factors that increase the likelihood include: • Steep downhill gradient • Proximity of planters • Slippery pavers Factors that decrease the likelihood include: • Low traffic speed • Side friction and traffic calming • Good level of lighting	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • One-way traffic	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • Low traffic speed		Factors that increase the likelihood include: • Walking amongst vehicles and cyclists • Prevalence of alcohol / drug impaired drivers and pedestrians in precinct Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting
Likelihood Score:	1/4	0/4	2/4		2/4	2/4	2/4
Severity Comments:	Factors that increase the severity include: • Crash into planters Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed		Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h
Severity Score:	1/4	1/4	1/4		1/4	1/4	1/4
Product	2/64	0/64	4/64		8/64	8/64	4/64
						TOTAL	**26/384**

Table 12: Safe System assessment matrix: Options 4, 5, 6 & 7 : Legally enforced restricted vehicle access to shared space

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure Comments:	Less than 1,000 vpd	Less than 1,000 vpd	Less than 1,000 vpd	N/A	Assumed to be 9,000 per day	Approximately 200 per day	Assumed to be 1% of traffic volume
Exposure Score:	1/4	1/4	1/4		4/4	4/4	1/4
Likelihood Comments:	Factors that increase the likelihood include: • Steep downhill gradient • Proximity of planters • Slippery pavers Factors that decrease the likelihood include: • Low traffic speed • Side friction and traffic calming • Good level of lighting	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • One-way traffic	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • Low traffic speed		Factors that increase the likelihood include: • Walking amongst vehicles and cyclists • Prevalence of alcohol / drug impaired drivers and pedestrians in precinct Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting
Likelihood Score:	1/4	0/4	2/4		2/4	2/4	2/4
Severity Comments:	Factors that increase the severity include: • Crash into planters Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed		Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h
Severity Score:	1/4	1/4	1/4		1/4	1/4	1/4
Product	1/64	0/64	2/64		8/64	8/64	4/64
						TOTAL	**23/384**

Table 13: Safe System assessment matrix: Options 1, 8, 9 & 10 : Physically enforced restricted vehicle access to shared space (bollards)

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure Comments:	Less than 1,000 vpd	Less than 1,000 vpd	Less than 1,000 vpd	N/A	Assumed to be 9,000 per day	Approximately 200 per day	Assumed to be 1% of traffic volume
Exposure Score:	1/4	1/4	1/4		4/4	4/4	1/4
Likelihood Comments:	Factors that increase the likelihood include: • Steep downhill gradient • Proximity of planters • Slippery pavers Factors that decrease the likelihood include: • Low traffic speed • Side friction and traffic calming • Good level of lighting	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • One-way traffic	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • Low traffic speed		Factors that increase the likelihood include: • Walking amongst vehicles and cyclists • Prevalence of alcohol / drug impaired drivers and pedestrians in precinct Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed • Good level of lighting
Likelihood Score:	0/4	0/4	1/4		1/4	1/4	0/4
Severity Comments:	Factors that increase the severity include: • Crash into planters Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed		Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Speed significantly lower than 30 km/h
Severity Score:	1/4	1/4	1/4		1/4	1/4	1/4
Product	0/64	0/64	1/64		4/64	4/64	0/64
						TOTAL	**9/384**

Table 14: Safe System assessment matrix: Options 11 & 12 : Unrestricted vehicle access (CRL option)

	Run-off road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure Comments:	2,100 vpd one way	2,100 vpd one way	2,100 vpd one way	N/A	Assumed to be 9,000 per day	Approximately 200 per day	Assumed to be 1% of traffic volume
Exposure Score:	2/4	2/4	2/4		4/4	4/4	1/4
Likelihood Comments:	Factors that increase the likelihood include: • Steep downhill gradient • Narrow roadway Factors that decrease the likelihood include: • Low traffic speed • No parked vehicles	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • One-way traffic	Factors that increase the likelihood include: • Nil Factors that decrease the likelihood include: • Low traffic speed		Factors that increase the likelihood include: • Jaywalking across short signalised crossing and in general along lane Factors that decrease the likelihood include: • Signalised pedestrian crossing • Wide footpaths	Factors that increase the likelihood include: • Steep downhill gradient • Cyclist riding on footpaths against flow of roadway traffic Factors that decrease the likelihood include: • Nil	Factors that increase the likelihood include: • Steep downhill gradient Factors that decrease the likelihood include: • Low traffic speed
Likelihood Score:	1/4	0/4	2/4		2/4	2/4	2/4
Severity Comments:	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Low traffic speed		Factors that increase the severity include: • Nil Factors that decrease the severity include: • Vehicle speeds likely to be less than 30 km/h due to side friction of narrow roadway	Factors that increase the severity include: • Nil Factors that decrease the severity include: • Nil	Factors that increase the severity include: • Motorcycle and vehicle speeds potentially greater than 30 km/h Factors that decrease the severity include: • Nil
Severity Score:	1/4	1/4	1/4		1/4	2/4	2/4
Product	2/64	0/64	4/64		8/64	16/64	4/64
						TOTAL	**34/384**

5 Safety Concerns - Permanent Scope Package

This chapter identifies safety concerns in the permanent scope package comprising:

- Pitt Street,
- Greys Avenue intersection,
- Pitt Street / Karangahape Road intersection,
- Upper Mercury Lane, and
- Mercury Lane / Cross Street intersection.

5.1 Southbound approach to Hopetoun Street Moderate

Changes to the southbound lane arrow markings on Pitt Street prior to the intersection with Vincent Street and Hopetoun Street are proposed. This will turn the kerbside lane from a 'through left' to a 'left only' lane.

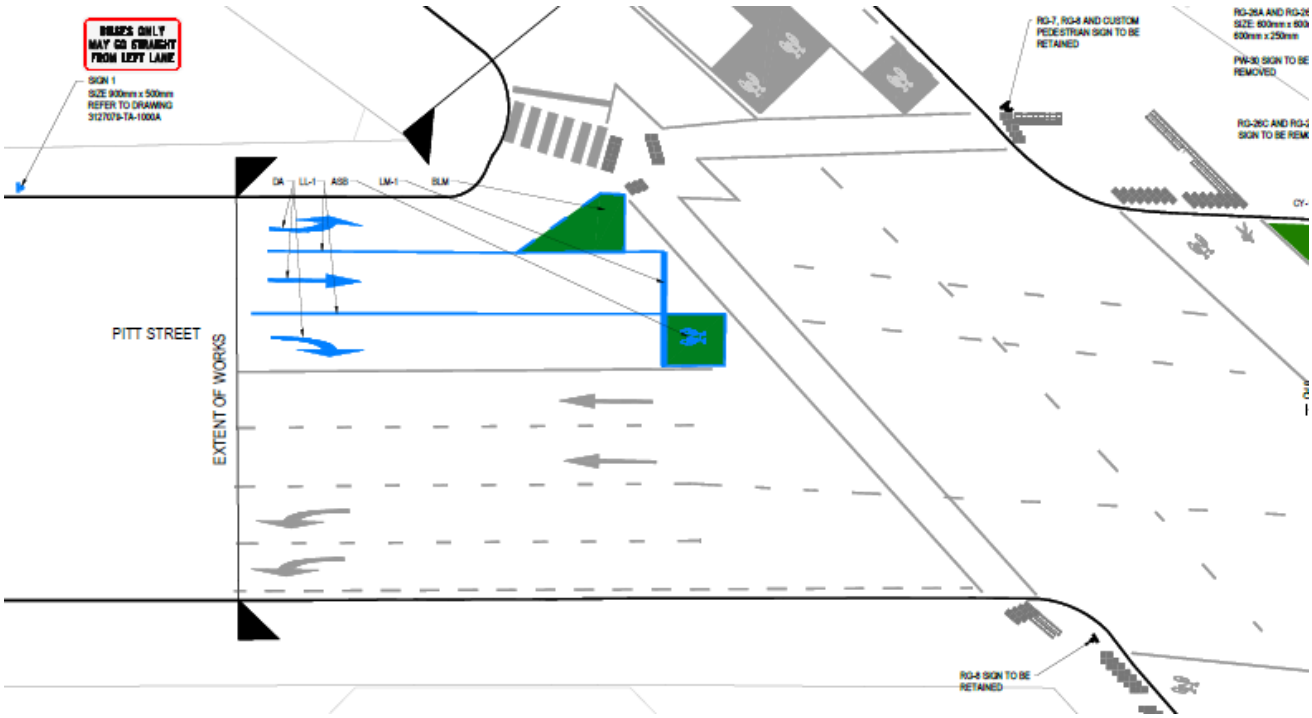

Figure 8: Proposed southbound lane markings on Pitt Street at Pitt / Vincent / Hopetoun

There are several lane arrow markings prior to the proposed markings that appear to have been overlooked. Refer to Figure 9.

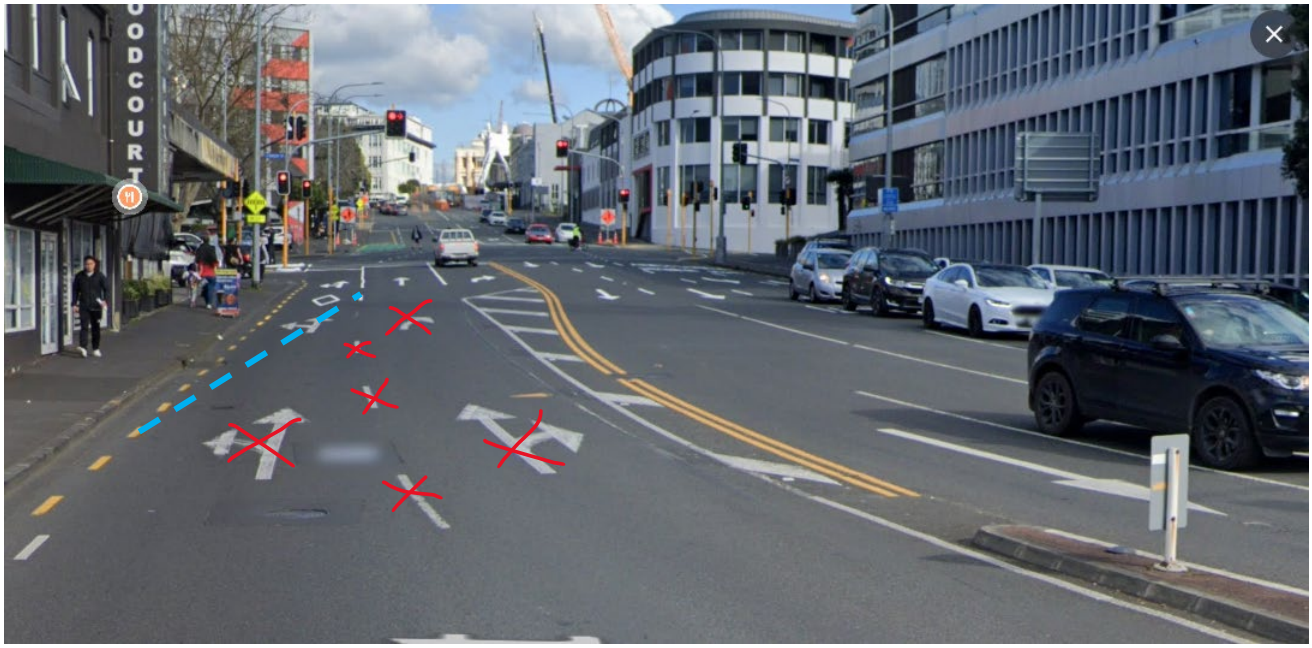

Figure 9: Southbound approach to Pitt Street / Vincent Street / Hopetoun Street with suggested marking amendments (Google, September 2022)

All the southbound lane arrow markings on Pitt Street between Hobson Street and the Vincent / Hopetoun intersection need to be updated to merge the two straight ahead lanes (from Union Street) into one through lane, thereby avoiding the kerbside through lane becoming a trap lane for the left turn into Vincent Street. If these markings are not changed the lane change / sideswipe crashes are likely.

Risk Ranking

The safety concern ranking is based on relatively common lane change / sideswipe crashes between vehicles on approach to the intersection.

Probability of a crash	Crashes resulting from this safety concern are likely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation

1 Ensure that the southbound lane markings between Hobson Street and Hopetoun Street are updated to merge the two straight ahead lanes (from Union Street) into one through lane, thereby avoiding the kerbside through lane becoming a trap lane for the left turn into Vincent Street.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

5.2 Pitt Street / Poynton Terrace Intersection Moderate

At Poynton Terrance the design has changed (from the Developed Design) and pedestrians and cyclists will now be required to give way to traffic entering and leaving Poynton Terrace. As this is the only side road intersection within the project area which has been treated in this manner (as Greys Avenue has a paired crossing) the need to give way is likely to be overlooked by many pedestrians and cyclists.

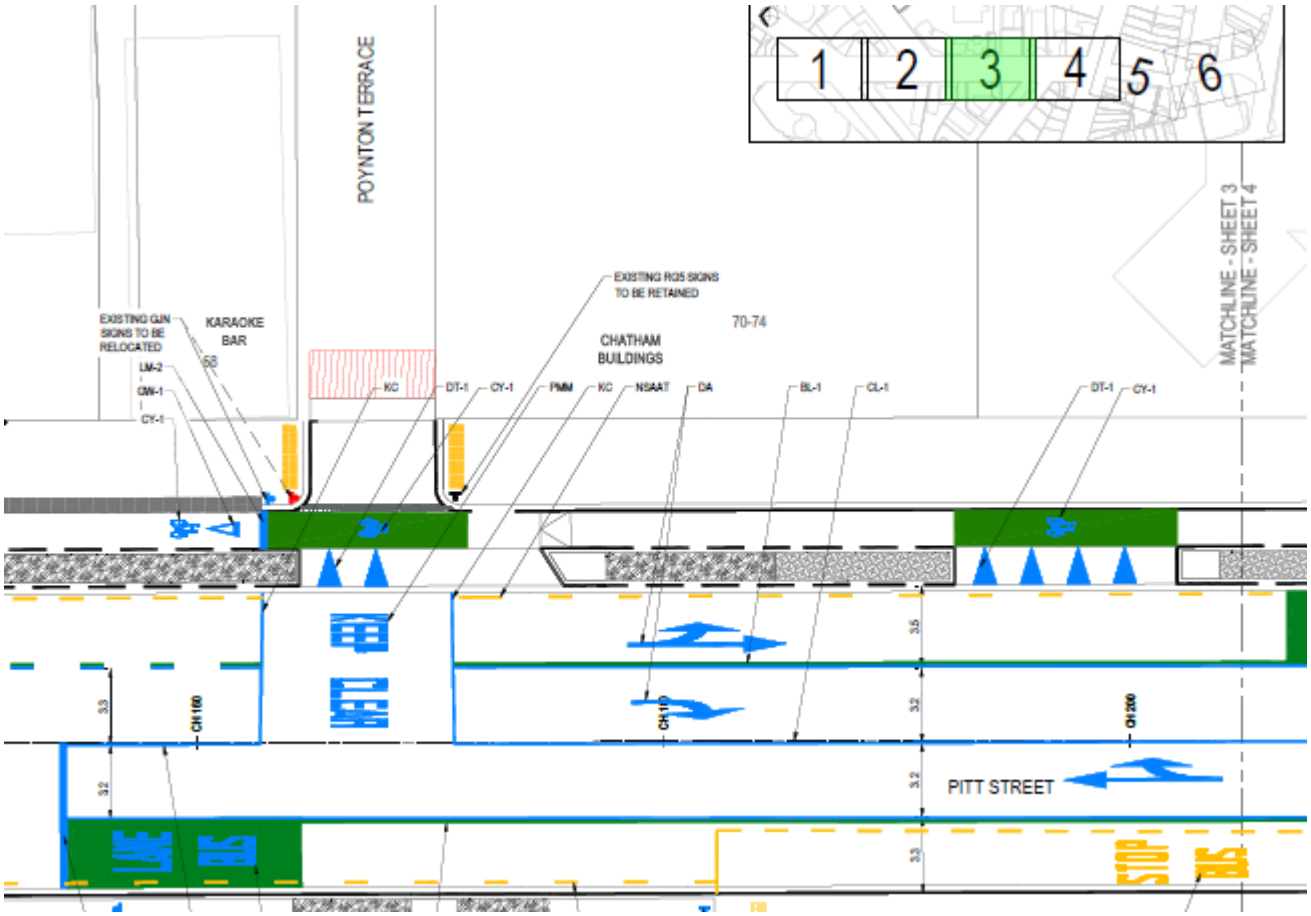

Figure 10: Pitt Street / Poynton Terrace

A design inconsistency such as this is likely to lead to conflicts between cyclists / pedestrians and vehicles accessing Poynton Terrace with occasional slow speed collisions between the modes.

Risk Ranking

The safety concern ranking is based on occasional slow speed crashes between cyclists and vehicles, or pedestrians and vehicles, most likely resulting in minor injury only.

Probability of a crash	Crashes resulting from this safety concern are likely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation

1 Amend the design to provide pedestrian and cyclist right of way over vehicles accessing Poynton Terrace.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

5.3 Pitt Street mid-block crossing Moderate

Pedestrians waiting to cross at the proposed Pitt Street mid-block crossing are likely to choose to wait by the kerb line at the road edge, not back at the tactile ground surface indicators behind the cycle path as intended by the designers. Pedestrians will naturally move as close to the edge of the road as possible and this behaviour was observed in Karangahape Road, and in one case was observed to result in a near miss between pedestrians and a passing e-scooter. This concern is also discussed in Section 5.4 (and shown in Figure 17 and Figure 19).

This places pedestrians in conflict with cyclists on Pitt Street who will assume they have priority through the crossing when the road signal is green (as presumably they will only be held on a red signal when the crossing is operating).

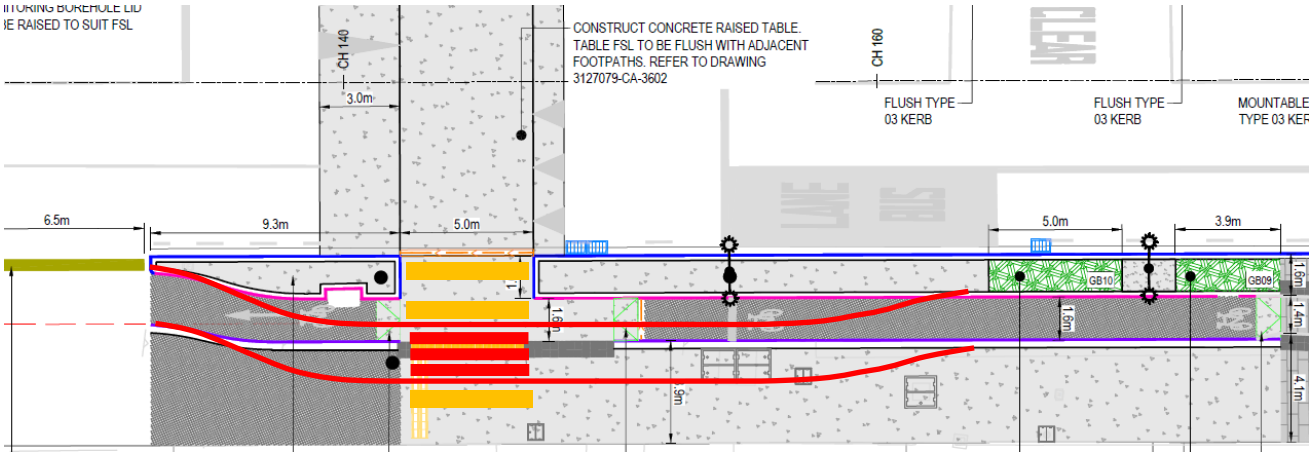

Figure 11: Pitt Street signalised pedestrian crossing

Given the berm at the road edge is 1.6 m wide there would appear to be enough space to place a push button at the road edge and allow pedestrians to wait where they will naturally choose to. If additional waiting area is a concern, then the design could be modified to provide a larger waiting area as suggested in Figure 11. The additional benefit of this amendment would mean that pedestrians cyclists would be able to ride through this area at all times, only having to stop for pedestrians when they cross the zebra crossing.

Risk Ranking

The ranking of this safety concern is based on a relatively slow speed crashes between cyclists and pedestrians resulting in minor injuries.

Probability of a crash	Crashes resulting from this safety concern are likely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendation

1 Modify the design to allow pedestrians to wait at the road edge (on both sides of Pitt Street), rather than behind the cycle path.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

5.4 Cycle path past Beresford Square

Comment

The audit team was asked to review and comment on the material finish of the cycleway behind the bus stop at Beresford Square.

This audit team understands:

1. That this area has been a challenge for the design team to determine a solution that best manages the conflict risk between cyclists and pedestrians.
2. The design team have chosen to treat the conflict risk by constraining cyclists to a defined zone, rather than adopt a ‘shared space’ on the basis that a defined path might help alert pedestrians to the potential presence of cyclists.
3. There is a belief that a shared space may reduce cycle speeds, but it might create potential confusion with cyclists / micro mobility weaving through pedestrians in a busy area.
4. The proposed horizontal and vertical deflection in the cycle path past the bus stop has been included to help reduce cycle speeds by creating a visual trigger of this is a high pedestrian amenity space.
5. There has been discussion about whether the cycle lane should be a different material (e.g., asphalt) in contrast to the stone, to help more clearly define the cycle lane but there is a concern is this could create an impression of cycle priority and lead to faster cycle speeds.

In considering the above elements the audit team agree with the belief that the key focus should be on achieving:

- a streetscape and footpath which is legible, safe, and attractive for all users, including children, older persons, and disabled people,
- safe and accessible access to public transport facilities (e.g., the floating bus stop)
- creating a safe thoroughfare for cyclists that encourages self-explaining (slow) speeds.

In considering the above challenges the project team should attempt to view the design from the perspective (and experience level) of the people who will use the infrastructure, not from the perspective of engineers who are viewing the project from a technical / legal perspective where compliance is assumed. The reality of heavily pedestrianised town centre areas is that they are often visited by inexperienced road users (young, elderly, non-drivers) who may have little or no understanding of road rules.

There is a real risk of designers being overly prescriptive in terms of how the streetscape should operate and that design messaging being completely overlooked, misunderstood, or ignored by many of the people using the infrastructure.

A good way to tackle an issue such as this (and many of the aspects described above) is to physically observe the way road users are currently interacting with similar facilities (such as the Karangahape Road cycle path) and assessing what is working well, what does not, what appears to be confusing, and then considering the relative merits of how the streetscape could be adapted to better manage conflict risk.

The audit team spent approximately 15 minutes observing interactions on Karangahape Road and noted the following.

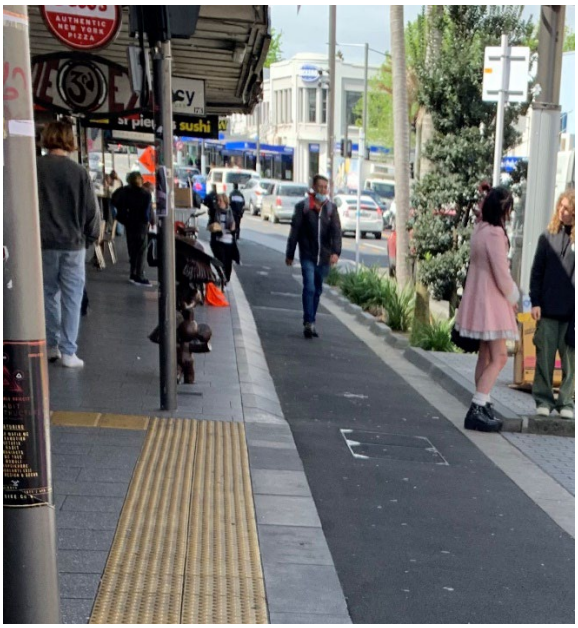

Figure 12: Pedestrians walking in the cycle path

Figure 13: Cyclists riding the wrong way the in cycle path

Figure 14: Cyclists riding on the footpath rather than in the immediately adjacent cycle path

Figure 15: Scooter riders heading the wrong way on the cycle path. e-scooter's parked in the cycle path.

Figure 16: Road cyclists riding through red signal phases.

Figure 17: Pedestrians waiting to cross in advance of the tactile pavers.

These images were taken within a very short timeframe and give a strong indication that the separated unidirectional cycle paths on Karangahape Road are not operating as the project team would have intended. That is not to say that the design is technically wrong or deficient, but rather that pedestrians, cyclists, and micro mobility users do not feel compelled to use them in the way they were intended to be used or to obey the rules of the road as motorised drivers would. In fact, more cyclists and micro-mobility users were observed using the facilities incorrectly than correctly. In contrast, motorised drivers generally feel compelled and are trained to use the facilities as intended and to obey the rules of the road due to the risk of being fined as they are not driving anonymous vehicles. This essentially suggests that non-motorised users are treating

the recently streetscaped areas as shared spaces, irrespective of whether there is a unidirectional cycle path running within the streetscape. It is possible that most non-motorised road users do not see that obeying the rules provides any advantage to their journey comfort or travel time and that instead, such rules restrict their enjoyment of the facilities. This attitude is likely to persist until there are so many non-motorised road users in a space that they come to the conclusion that obeying the rules is to their advantage.[1]

The design team should consider whether it is a good idea to extend a design philosophy that is not being used as intended or whether it would be a better idea to adapt the design to suit the way the road users are currently using it (and presumably will continue to want to use it). Better outcomes are achieved when the design philosophy is self-explaining to road users and naturally aligns with the way people intend to use the space, rather than relying on the assumed transfer of inherent rule obedience by motorised drivers to all road users.

The important question is whether the area will operate safely or not. The audit team did not observe any particularly unsafe behaviour on Karangahape Road in the relatively short time spent on site, other than one very slow speed near miss between a scooter user and a pedestrian standing in the cycle path near the St Kevins Arcade crossing. Generally, non-motorised users were travelling considerately and leaving plenty of space to negotiate around each other even if that involved cyclists on footpaths and pedestrians in the cycle path.

Regarding the proposed northbound cycle path between the Karangahape Road intersection and the Pitt Street mid-block crossing (past Beresford Square), the audit team believe it is highly unlikely that the path area will be used by all people as intended by the design team. It will almost certainly be used as a shared space by many road users, irrespective of the path surface material, colour, markings, and vertical alignment. That said, it will most likely operate reasonably safely as the streetscape itself will be self-explaining as a slow speed environment. It should perform better at Beresford Square than situations such as Quay Street outside the Ferry Building, because the cycle path is between a pedestrian area and a floating bus stop. It is not bisecting an area where all pedestrians are leaving the train station are trying to cross it to get across Pitt Street.

Recommendation

1 Consider whether it is a good idea to extend a design philosophy that is not being used as intended or whether it would be preferable to adapt the design to suit the way the road users are most likely to use the infrastructure.

This safety concern is ranked as a comment the decision tracking in the table below is optional.

Optional Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

[1] This is why the merge like a zip convention works so well. It reduces stress and works to everyone's advantage.

5.5 Pitt Street / Karangahape Road Moderate

Section 5.1.1 of the Developed Design SSA (3 July 2023) discussed several concerns with the proposed arrangement of the signalised pedestrian and cyclist crossings at the intersection of Pitt Street and Karangahape Road. This primarily related to the confusing hybridised way the footpaths and cycleways were to be arranged in each corner.

The safety concerns raised in the developed design SSA do not appear to have been considered in the designer team's response to that audit or the close-out process, so have been reproduced in this report for further consideration.

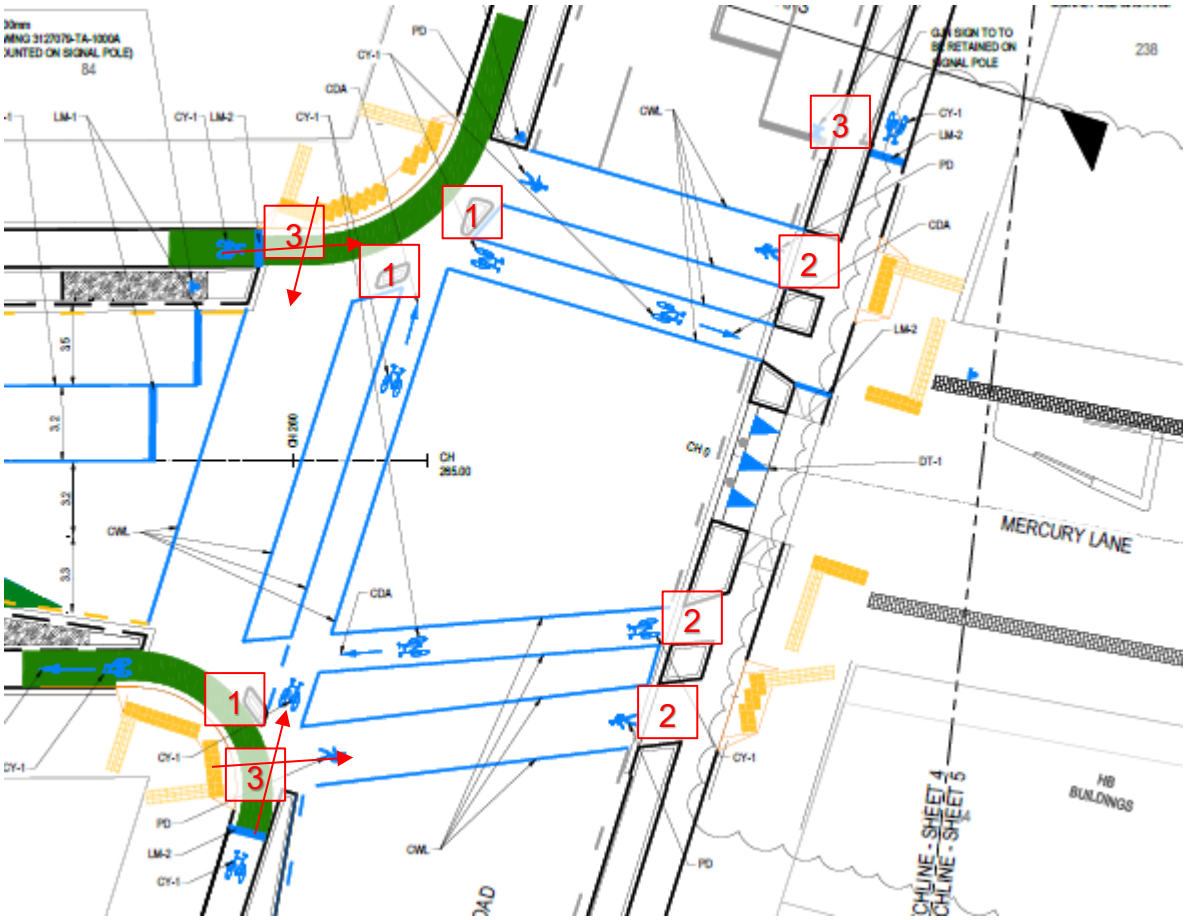

Figure 18: Proposed arrangement at Karangahape Road / Pitt Street

In summary, the proposed arrangement will create confusion regarding the correct place to call and wait for a crossing display and has not taken human behaviour into account. The confusion will not only place pedestrians and cyclists in conflict with one another but may also lead to pedestrians and cyclists waiting within the intersection, possibly leading to conflicts with turning vehicles, especially when there are dozens of pedestrians crowding at the crossings. The contributing factors are listed below.

1. The small islands within the intersection have little to no target value and will become trip hazards for pedestrians crossing the road, especially visually impaired who do not expect there to be island hazards in front of the tactile pavers. Further it is unclear what purpose these islands serve as it would not be possible for left turning vehicles to track into the cycle lane area without running into the garden / berm area on the exit of the turn anyway. Put differently, as left turn vehicles cannot track into the corner cycle lanes without crashing into the kerb buildout at the exit of the curve these islands offer no significant protection for cyclists - but they do create a hazard for non-motorised users crossing the road. The small islands within the intersection should be omitted.

2. On the Mercury Lane side of the intersection pedestrians are likely to wait by the kerb line at the road edge, not back at the tactile ground surface indicators behind the cycle path as intended by the designers. Pedestrians will

naturally move as close to the edge of the road as possible. That is human nature. It would only take a couple of pedestrians to move forward to trigger everyone else to join them. This exact tendency was observed at the crossing outside St Kevin's Arcade in Karangahape Road where the audit team observed a near miss between pedestrians waiting in advance of the tactiles at the road edge and a passing e-scooter. This places pedestrians in conflict with cyclists, particularly those cyclists heading west along the Mercury Lane portion of the Karangahape Road cycleway as they would assume they have continual uncontrolled priority through the intersection.

Figure 19: Pedestrians waiting to cross in advance of tactile pavers

Allowing cyclists to wait ahead of the pedestrians may be intentional to give cyclists a head start and thus reduce conflicts with pedestrians, but it is based on every member of the public understanding and obeying the arrangement all day every day, which is unlikely especially if/when Mercury Lane is a shared space with no mode separation.

3. All cyclists approaching the intersection appear to be controlled by limit lines that that will require them to stop and give way to pedestrians and cyclists crossing Pitt Street and Karangahape Road, but it is unclear how this will operate in a practical sense. For example

    a. Will cyclists be held on approach when the traffic signals turn red for vehicles? If so, that would be very unusual for a cycle path in a berm area which will not be viewed as being part of the road and subject to the rules of the road.

    b. Will cyclists need to stop and push a signal button to proceed through the intersection on their own mode-specific signal? If so, this is unlikely to be observed by most cyclists (especially those turning left into or out of Pitt Street and those heading west past Mercury Lane). This will likely result in red light running by cyclists.

    c. Assuming the Barnes dance signal phase will remain, cyclists are likely to want to cross with pedestrians on seeing the display change to green. The safety concern with that type of operation (if allowed) is that many of the cyclists will be waiting perpendicular to pedestrians who are crossing in a different direction (e.g., southbound cyclists on Pitt Street waiting to cross to Mercury Lane will be setting off in direct conflict with westbound pedestrians on the southern side of Karangahape Road waiting to cross Pitt Street).

4. As mentioned in 3 a) above, cyclists heading west along the Mercury Lane portion of the Karangahape Road cycleway are likely to believe they have continual uncontrolled priority through the intersection. This will conflict with the cyclists and pedestrians crossing from north to south across Karangahape Road when they reach the southern side of Karangahape Road / northern end of Mercury Lane.

The safety concerns could be mitigated by considering two alternative approaches.

One option is to accept that there will generally be a mêlée of hundreds of hurrying pedestrians and cyclists concentrated around the station precinct, and that attempting to formalise each into a separate facility will probably work only at off-peak times. In that case, allowing everyone to sort themselves out in one shared space on a raised safety platform signalised intersection operating as a Barnes dance might be the most appropriate solution. Although such solutions may look chaotic, they are generally safe as everyone is looking out for everyone else, and no one is trying to exercise priority over someone else as there is no assigned priority.

Another option, if separation of facilities through the intersection of Pitt Street and Karangahape Road is desired, is to assign priority very clearly at each conflict point. Layouts within the space available are suggested in Figure 20 and Figure 21.

It should be noted that a Barnes dance is not the safest or necessarily the most efficient phasing for the formalised layouts indicated in the proposed layout in Figure 18 or in the suggested alternative formalised layouts in Figure 20 and Figure 21. It should also be noted a Barnes dance phasing of the signals will result in some pedestrians and cyclists crossing diagonally and thus the proposed layout of crosswalk lines and one-way cycle crossings may not be used as intended.

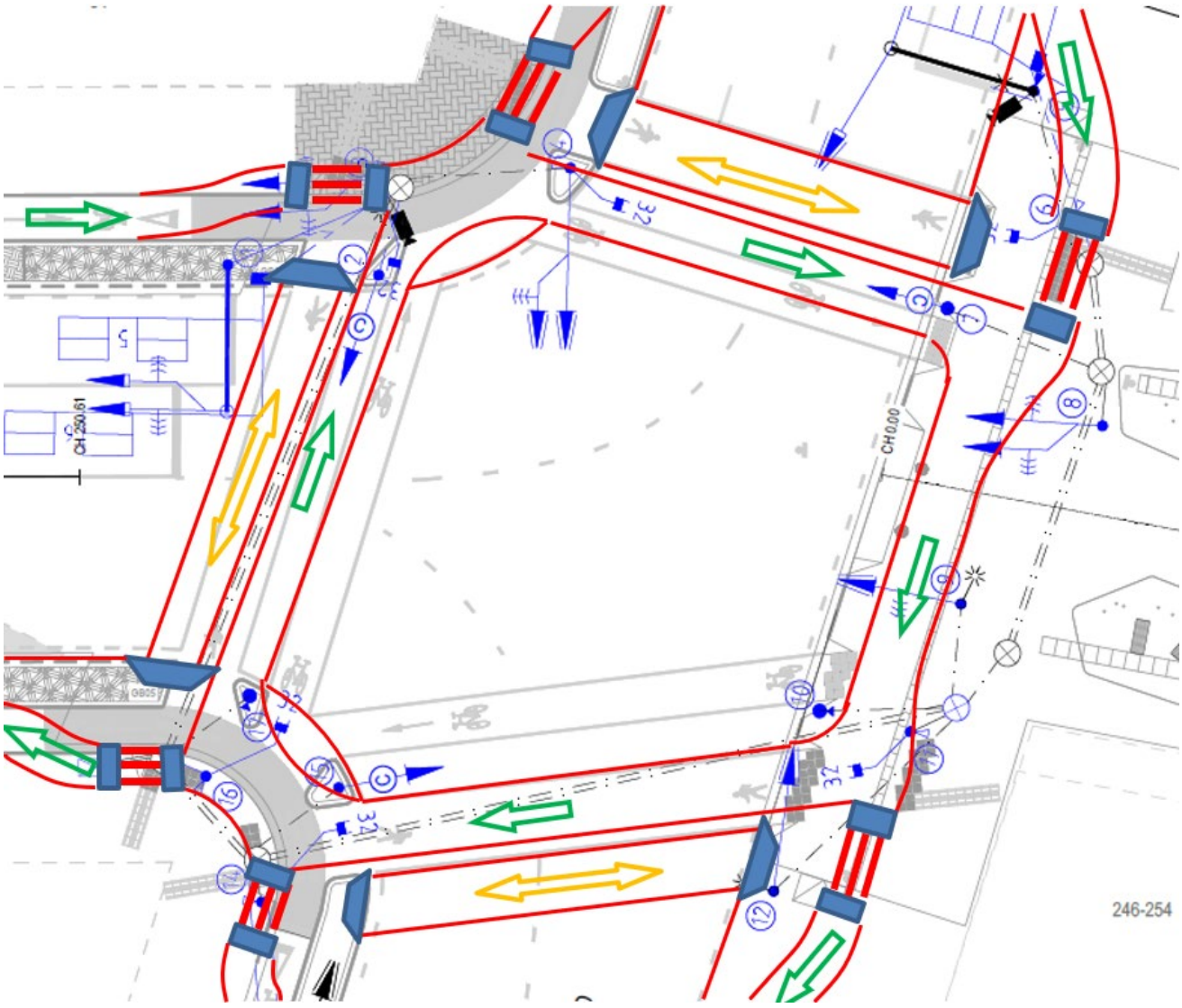

Figure 20: An alternative fully separated pedestrian and cyclist layout

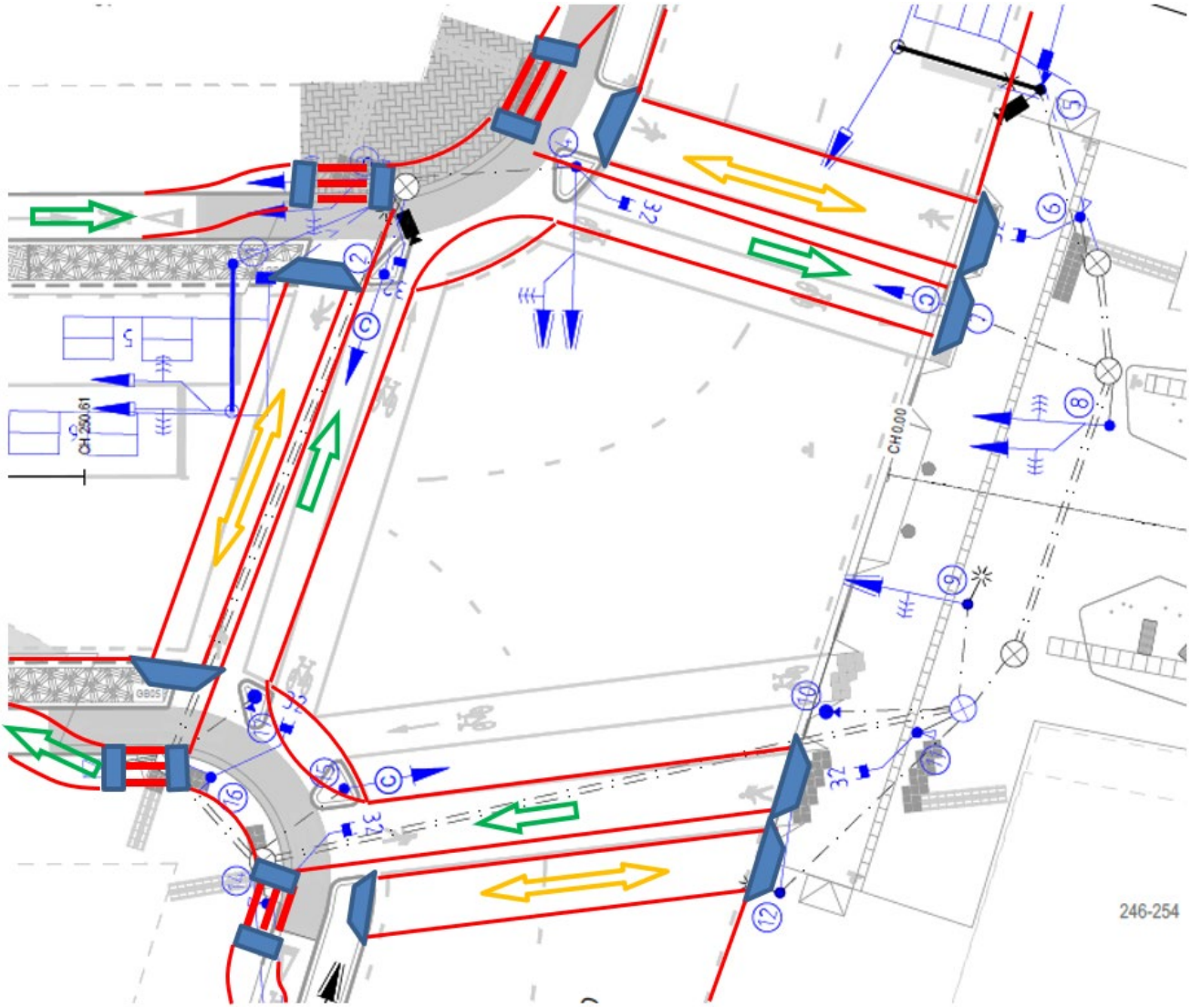

Figure 21: An alternative separated cyclist and pedestrian layout with shared space in Mercury Lane

Risk Ranking

The ranking of this safety concern is based on crashes between cyclists and pedestrians resulting in minor injuries.

Probability of a crash	Crashes resulting from this safety concern are likely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be moderate.

Recommendations

1 If mode separation is required, then consider adopting a layout like Figure 20 or Figure 21 which minimises conflicts between pedestrians and cyclists using the cycleways and clarifies who has priority in each waiting areas.

2 Alternatively (and assuming a Barnes dance phasing is desired), adopt a shared space layout rather than formalised active mode separation and priority control within the intersection.

3 Consider that at times pedestrians will crowd the corners of the intersection waiting to cross and may spill out into areas that cyclists need to use. Ensure that there is a clear distinction in paving and kerbs and channels between roadway, and footpath / cycleway areas.

4 Eliminate trip hazards for partially sighted pedestrians who will not expect tiny traffic islands to be placed within the crosswalk area, or a dedicated cycling area within a Banes dance crossing.

5 Ensure the signal phasing is integrated into and supports the safe operation of the intersection, rather than promoting behaviour (e.g., red light running, etc.) that does not align with the designed infrastructure.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

5.6 Cycleway markings

Comment

In several cases the markings proposed for the cycle path are not technically correct, or they have not been applied in way that adds significant value. For example

- Give way triangle markings have been proposed in advance of zebra crossings.
- Where give way triangle markings have been correctly located, they technically require an associated give way sign to be legalised. Refer to section 10.3(1) of the Traffic Control Devices Rule – for an intersection to be give way controlled a give way sign must be installed along with the triangle marking, unless the road surface makes the application of the road marking impractical.
- Many cycle symbols have been placed without arrows.
- Where cycle path arrows have been proposed they have been applied downstream from conflict points to reinforce to cyclists that they are going the correct way, rather than upstream of the conflict location to send a message that cyclists might be heading the wrong way. Arrows should be placed at all potential entry points, so cyclists don't make an incorrect decision and ride the wrong way on the cycle path.

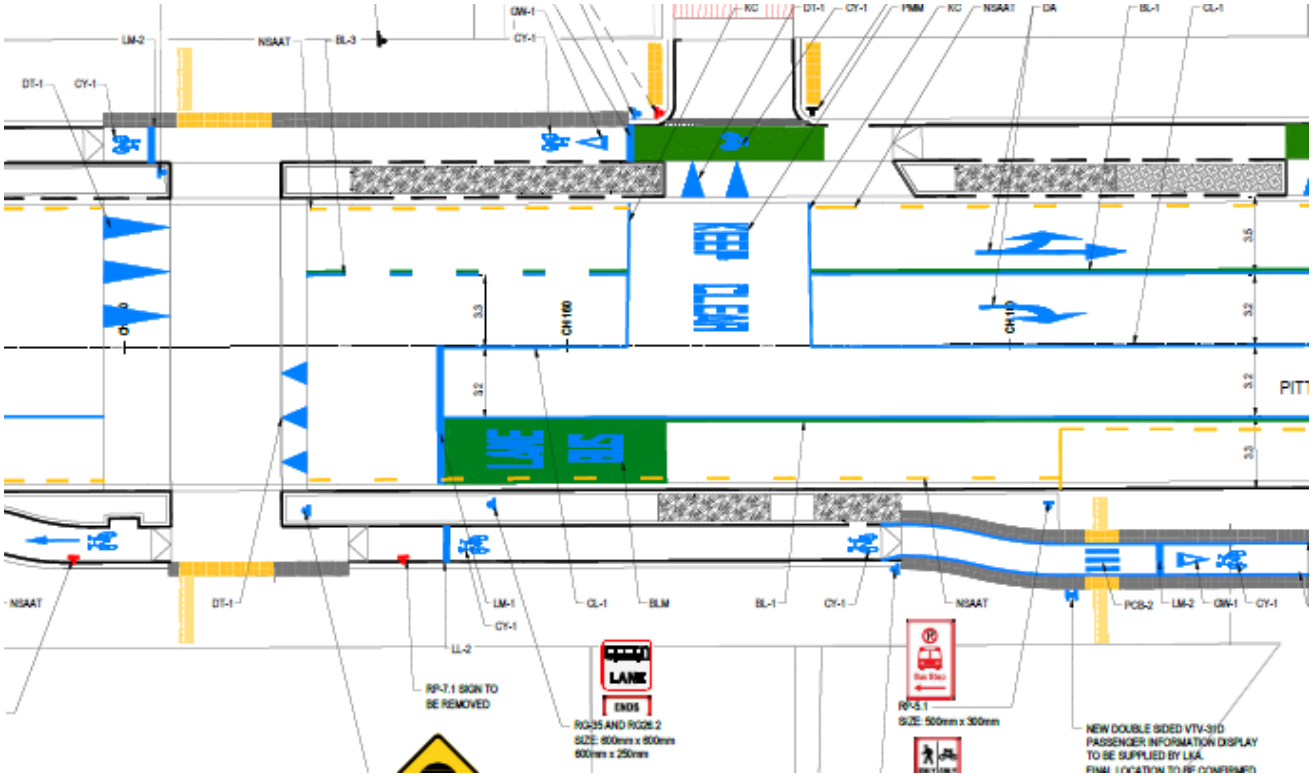

Figure 22: Examples of proposed cycle lane markings

Recommendations

1 All cyclist symbol markings should be accompanied with directional arrows to indicate one-way operation, especially at the point of entry.

2 Give way triangle markings should not be used in advance of zebra crossings.

3 Where give way triangle markings are utilised, they should be accompanied with a give way sign.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

6 Safety Concerns - Interim Scope Package

This chapter identifies safety concerns in the interim scope package comprising:

- Cross Street,
- Lower Mercury Lane,
- Canada Street,
- East Street, and
- Beresford Square.

6.1 Upper Queen Street / Canada Street

Comment

Two options for the connection between the Canada Street cycleway and the existing Grafton Gully cycleway, Upper Queen Street cycleways are shown in Figure 23 and Figure 24.

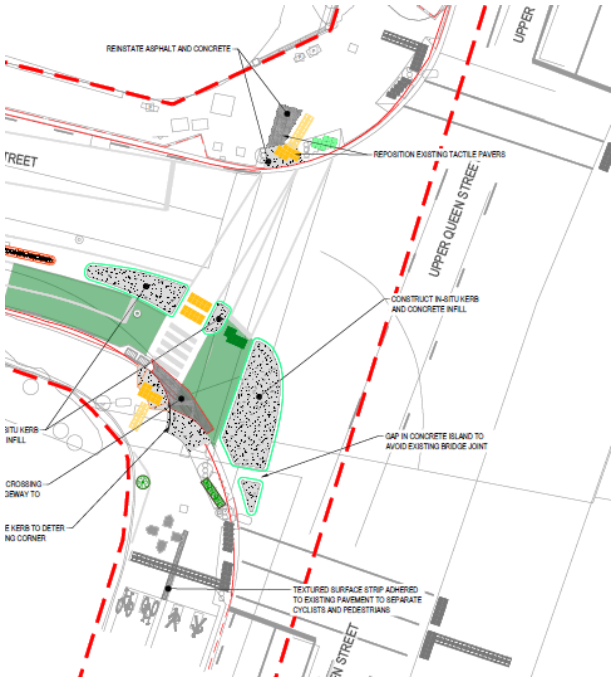

Figure 23: Option 1

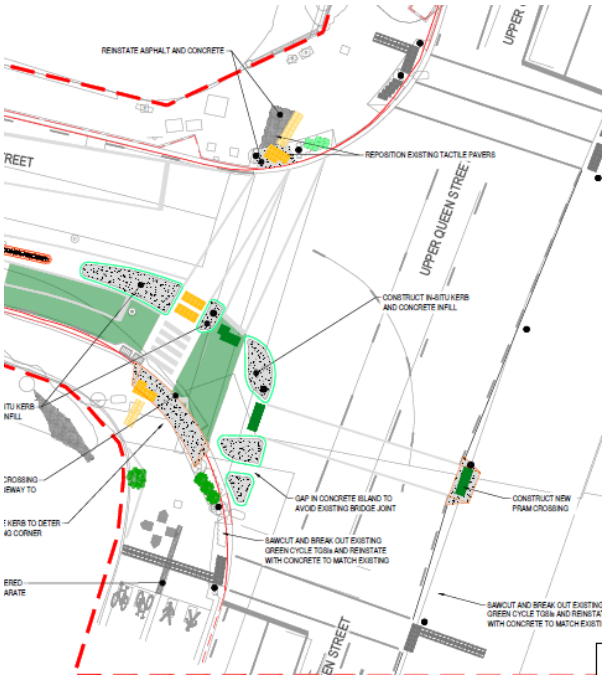

Figure 24: Option 2

Both options are a significant improvement on the layout proposed in the developed design and will help mitigate the concerns raised in the developed design audit. From a safe system perspective, the Option 2 layout would provide a safer alignment for cyclists, as the separated cycle crossing would reduce the number of conflict points and provide greater separation area between pedestrians and cyclists.

Recommendations

1 Adopt the Option 2 (Sheet 9) layout.

Since this safety concern is ranked as a comment, decision tracking in the table below is optional.

Optional Decision Tracking

Design team response	

Client safety engineer comment	
Client decision	
Action taken	

6.2 Cross Street dropped crossing

Minor

A new pram crossing proposed on Cross Street is shown in Figure 25.

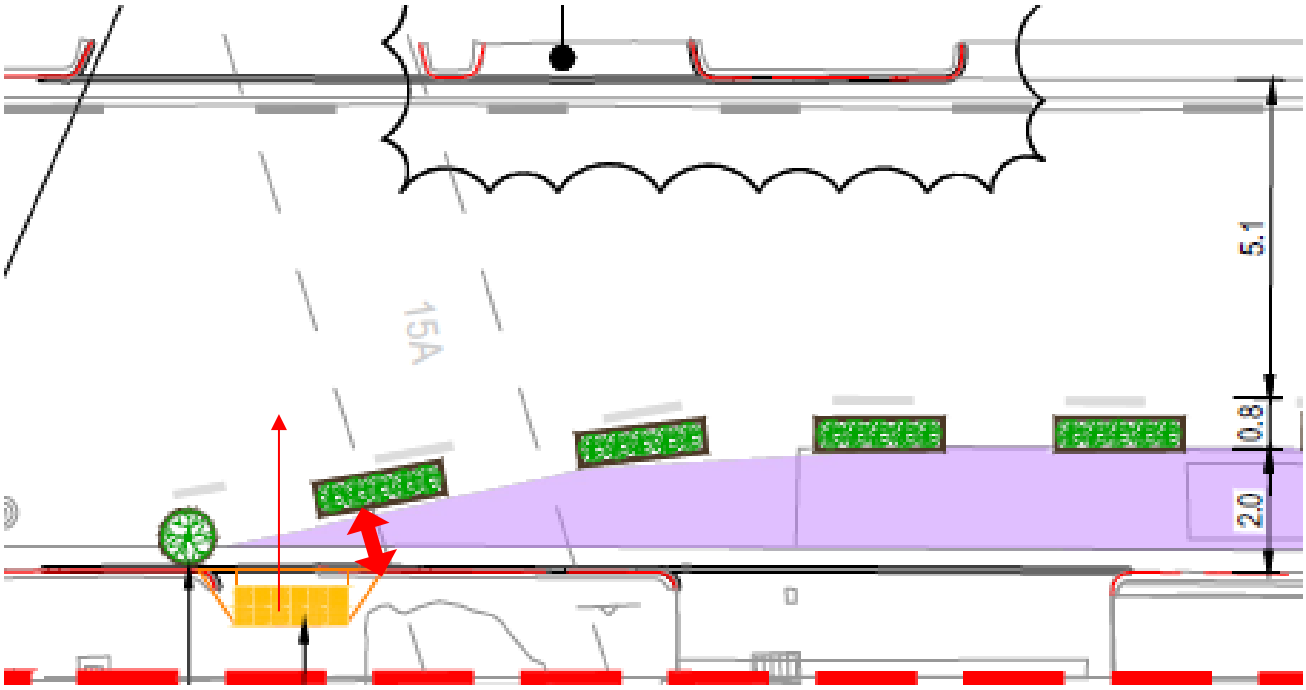

Figure 25: Proposed pram crossing on Cross Street

The location where the pram crossing is proposed will not provide enough space for a pram or a wheelchair to manoeuvre between the road kerb and the planter box. The tactile pavers also incorrectly suggest a crossing direction across Cross Street, rather than continuing along Cross Street. The audit team also noted there is an existing potential trip hazard approximately 5 m beyond the proposed pram crossing where there is an uneven step from the footpath down to a disused vehicle crossing. Refer to Figure 26.

Given the tight area where the pram crossing is proposed, it is likely that many pedestrians will bypass the pram crossing in favour of using the less restrictive (wide) redundant vehicle crossing. Those footpath users face an increased risk of a slip, trip or fall due to the uneven step depth from the footpath down to the sloped vehicle crossing.

Figure 26: Existing abandoned vehicle crossing and uneven footpath step.

The design team should consider omitting the pram crossing and adjusting the wide abandoned vehicle crossing to better facilitate the movement of pedestrians from the footpath area across into the protected road shoulder area, whilst also addressing an existing potential trip hazard.

Risk Ranking

The safe system audit team has assigned the following risk based on an increased risk of a slip, trip, or fall due to the uneven tread depth on the footpath step.

Probability of a crash	Crashes resulting from this safety concern are unlikely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation

1 Consider omitting the pram crossing and instead adapting the wide abandoned vehicle crossing (as suggested in Figure 26) to facilitate the movement of pedestrians from the footpath across into the protected road shoulder area. This would provide an additional benefit of addressing an existing trip hazard.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

6.3 Upper Queen Street / Cross Street intersection Minor

The proposed amendments to the intersection between Upper Queen Street and Cross Street are shown in Figure 27.

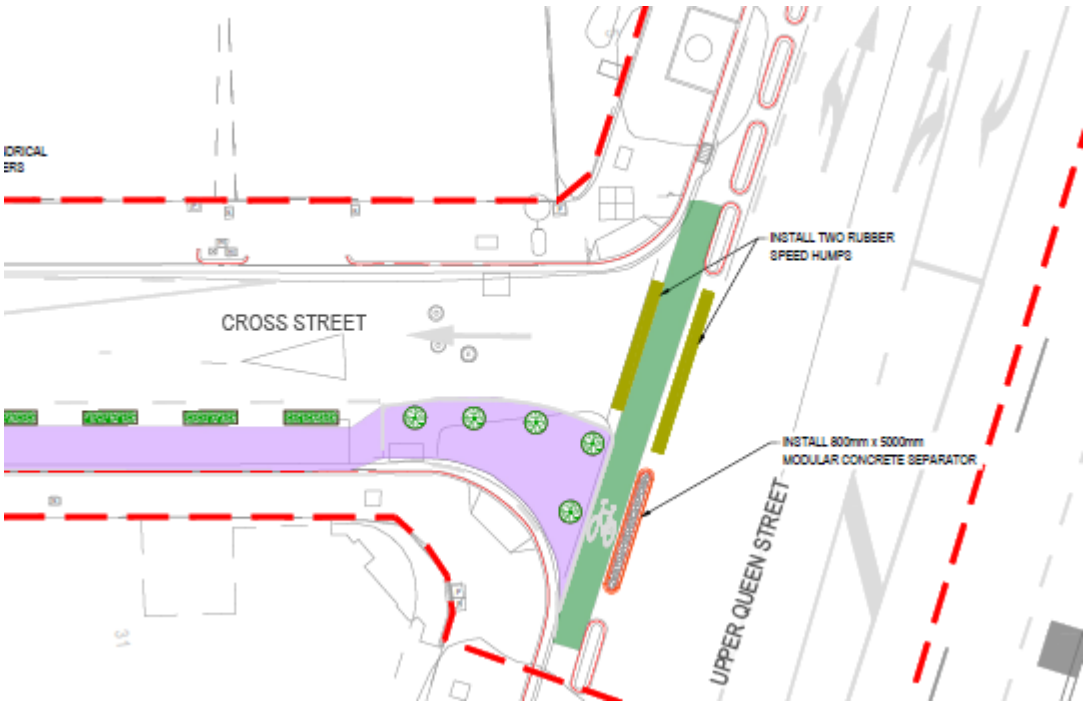

Figure 27: Upper Queen Street / Cross Street intersection

The following concerns were noted:

1 Two rubber speed humps are proposed either side of the cycle lane. The downstream hump is largely superfluous and is likely to extend the time vehicles require to clear a conflict area. This in turn could lead to crashes between vehicles turning right from Queen Street into Cross Street and opposing northbound traffic on Upper Queen Street.

2 Keep clear markings are not proposed across the northbound lanes of Upper Queen Street. With the restrictions placed on Mercury Lane, and the only way to access the Karangahape car park building being via Cross Street, the traffic volume on Cross Street is likely to increase significantly – especially in the morning peak period when northbound traffic volumes on Upper Queen Street are also likely to be high. Without the addition of a keep clear marking the right turn into Cross Street is more likely to tail back towards the Karangahape Road / Queen Street intersection and start to block the through lanes. There is limited southbound visibility through the Karangahape Road / Queen Street intersection (from Queen Street into Upper Queen Street) – late lane change manoeuvres and an increased risk of side swipe crashes could be expected. The addition of a reasonable length of keep clear marking on Upper Queen Street would also help address the risk that a driver in the right northbound lane leaves a small gap for right turning traffic, only for a vehicle travelling left lane to not be seen and an increased chance of a collision.

3 The leftmost northbound lane on Upper Queen Street is still incorrectly shows the existing lane making as a 'through left' lane. On site it is marked as a left only lane. The developed design audit confirmed that this lane will remain a left turn only lane and that the drawings need to be corrected. The drawings have not yet been updated to show this.

Risk Ranking

The safe system audit team has assigned the following risk ranking to this safety concern based on relatively slow speed crashed between right turning vehicles entering Cross Street and through vehicles on Upper Queen Street.

Probability of a crash	Crashes resulting from this safety concern are unlikely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendations

1 Omit the downstream rubber speed hump on the western side of the cycle lane.

2 Install keep clear markings across both northbound lanes of Upper Queen Street (in front of Cross Street).

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

6.4 Connection to The Lightpath

Minor

The pedestrian and cycling connection between The Lightpath and the Canada Street two-way cycleway will cross the Canada Street footpath. The updated design does not propose to flag this conflict risk area to pedestrians or cyclists. There are limit lines for cyclists prior to crossing the footpath area but no but no zebra markings or clear reason for cyclists to stop at the limit line. It would be safer to clearly assign priority (e.g., with a zebra crossing), rather than hope that pedestrians and cyclists will work out who should give way to whom.

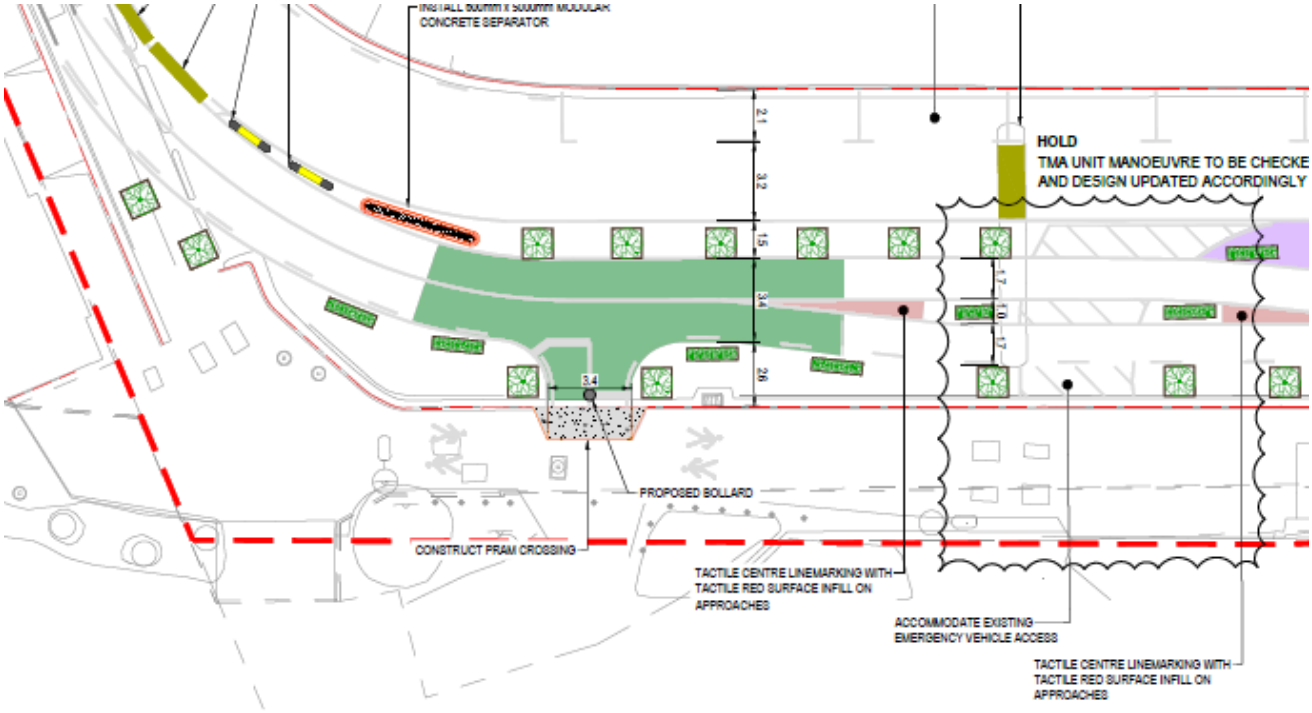

Figure 28: Proposed connection to The Lightpath

The intervisibility between The Lightpath users and the footpath along Canada Street has been a safety concern since safety audits of the design phase of The Lightpath. Minor improvements to slow speeds between The Lightpath and the shared path along Canada Street were made after one or two serious crashes caused by high speed and lack of intervisibility around corners. The poor visibility can be appreciated in Figure 29.

Figure 29: Existing poor visibility around inside corner of The Lightpath (Google, 2023)

The proposed reinstatement of the shared path to a footpath along Canada Street will mitigate some of the safety concerns associated with the existing layout, but The Lightpath connection will still cross the footpath in an area where intervisibility is still obstructed by the substation, vegetation, and the high fence shown in Figure 29.

The opportunity presents itself to improve the intervisibility by eliminating the minor drop-off hazard that the fence is protecting and reducing the obstruction caused by vegetation on the western side of the crossing as suggested in Figure 30.

Figure 30: Existing termination of The Lightpath with suggested improvements (Google, 2023)

A suggested improvement is shown in Figure 31. This would extend the cycleway to the start of The Lightpath and give a clearer indication of priority of pedestrians over cyclists. This is based on the removal of the vegetation and fencing as indicated in Figure 20.

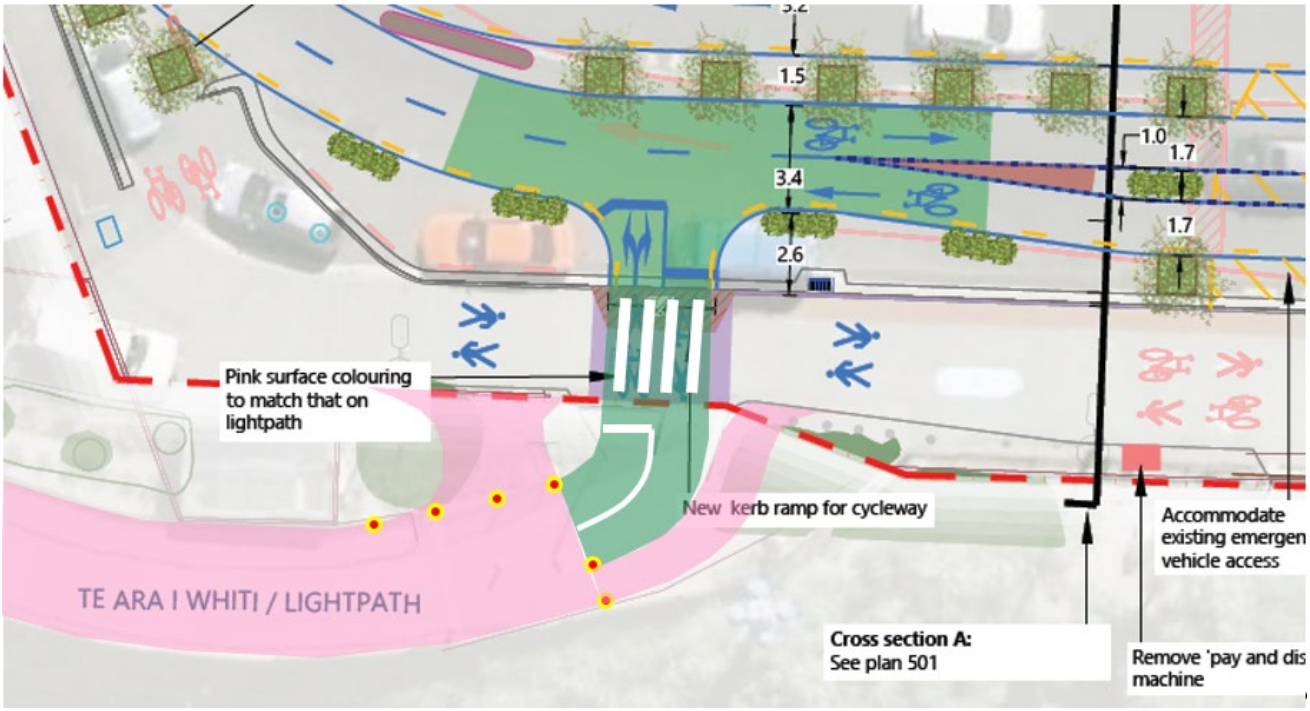

Figure 31: A suggested improvement in priority indication

Risk Ranking

The safe system audit team has assigned the following risk ranking to this safety concern.

Probability of a crash	Crashes resulting from this safety concern are unlikely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendation

1 Improve the intervisibility and legibility of the connection between The Light path and the Canada Street cycleway as the cycleway crosses the footpath.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

6.5 East Street Cycle Path Connectivity

Minor

The design has been updated on East Street and the existing separated cycle path now terminates South Street rather than extending up to Galatos Street. Refer to Figure 27.

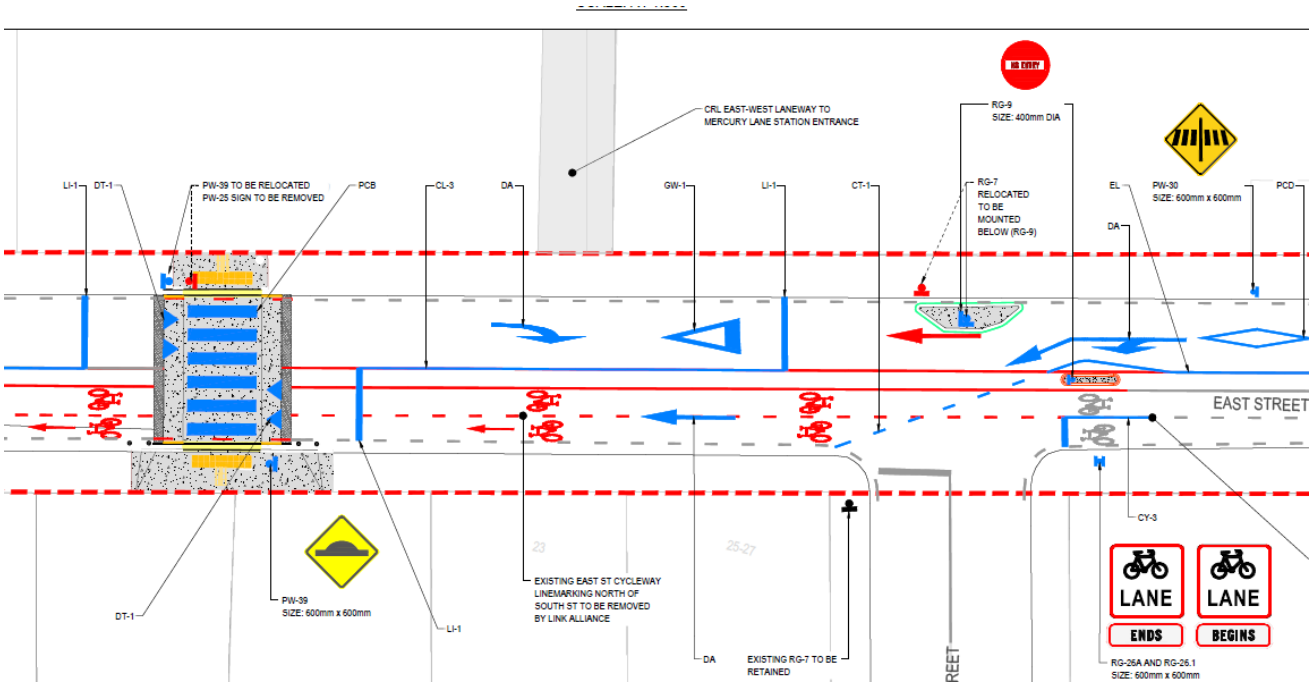

Figure 32: Upper Queen Street / Cross Street intersection

The following concerns were noted:

1 The connectivity for the cycle path between Galatos Street and South Street will be broken. This effectively creates a missing link in a cycle route and places cyclists at a higher risk of a crash with vehicles, especially as there does not appear to be any specific cycling treatments proposed for East Street (e.g., sharrow markings).

2 It is unclear who gives way to whom between downhill traffic turning right into South Street and northbound cyclists departing the cycle lane heading up East Street. The downhill East Street drivers may believe they only need to give way to traffic coming up hill and not check to look for advancing cyclists.

3 When there no downhill traffic is present, cyclists heading up the hill will not believe they need to give way to anyone. They certainly won't be expecting to give way to uphill traffic coming from behind them. This will result in cyclists and vehicles heading for the same road space with vehicles cutting across from the right at a 30 degree (sharp) angle.

Risk Ranking

The safe system audit team has assigned the following risk ranking to this safety concern based on relatively slow speed crashes between cyclists and vehicles on East Street due to the uncommon road layout and increased likelihood of unexpected manoeuvres.

Probability of a crash	Crashes resulting from this safety concern are unlikely.
Severity outcome rating	The predominant outcome of a crash resulting from this safety concern is likely to be minor.
Risk ranking	The safety concern is therefore deemed to be minor.

Recommendations

1 Reconsider the removal of the cycle lane between Galatos Street and South Street. If this is unavoidable consider how the section of East Street between Galatos Street and South Street can be made safer for cyclists and less confusing in terms of who gives way to whom.

2 Install a left turn only lane marking in advance of the STOP marking on South Street.

Decision Tracking

Design team response	
Client safety engineer comment	
Client decision	
Action taken	

7 Conclusions

The project is largely aligned with a Safe System due to the majority of proposed facilities for pedestrians, cyclists, and motorised users being physically separated. However, it could be aligned closer to Vision Zero objectives if the areas where the separated facilities cross or intersect could be more legible and if speed differentials between users could be reduced.

In this respect, there are opportunities to make more use of raised safety platforms, and to accept that shared spaces may be safer in some respects than trying to keep facilities apart in very confined areas, which leads to mixed, cramped, and complex priority-controlled proposals.

8 Safe System Audit Statement

We declare that we remain independent of the design team and have not been influenced in any way by any party during this safe system audit.

We certify that we have used the available plans and have examined the specified roads and streets to assess the Safe System alignment and identified any safety concerns that could be changed, removed, or modified to improve road safety outcomes. The safety concerns identified have been noted in this report.

Signed  Date 22 December 2023

Nick Gluyas, BE (Civil)(Hons) CPEng CMEngNZ
Market Leader, Transportation Delivery, Stantec

Signed  Date 22 December 2023

Keith Weale, BSc(Eng), BEng(Hons), MSc(Eng), CMEngNZ, CPEng
Technical Director – Roads and Highways, Stantec, Auckland

9 Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

9.1 Design Team's Responses

We have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this report and we have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.

Signed _____ Date _____

Name

9.2 Safety Engineer's Comment (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.

Signed _____ Date _____

Name

9.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this report, together with the designer's responses and the comments of the safety engineer (if applicable) and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.

Signed _____ Date _____

Name

9.4 Design Team's Statement

We certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.

Signed _____ Date _____

Name

9.5 Safe System Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, Safe System audit team leader, safety engineer, and project file.

Signed _____ Date _____

Name

10 References

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Stantec New Zealand
Level 4,
105 Carlton Gore Road
Newmarket 1023
Tel +64 9 580 4500

Connect with us

stantec.com/au