Ilam Road Cycle Facility
Design, Performance and Safety Review

Prepared for Christchurch City Council

December 20134

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Alix Newman	Mike Smith

PREPARED BY		
Mike Smith / Glen Koorey	…………………………………………	……/……/……
CHECKED BY		
Glen Koorey / Mike Smith	…………………………………………	……/……/……
REVIEWED BY		
	…………………………………………	……/……/……
APPROVED FOR ISSUE BY		
Mike Smith / Glen Koorey	…………………………………………	……/……/……

CHRISTCHURCH
Hazeldean Business Park, 6 Hazeldean Road, Addington, Christchurch 8024
PO Box 13-249, Armagh, Christchurch 8141
TEL +64 3 366 7449, FAX +64 3 366 7780

REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file). Prepared by	Checked by	Reviewed by	Approved by

Christchurch City Council

Ilam Road Cycle Facility

Design, Performance and Safety Review

CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 Introduction

Christchurch City Council is looking at the Safety and Operations of the recently constructed cycle facilities on Ilam Road. With the recent completion of the construction (subject to some minor remedial and finishing works), it is now proposed to undertake a review of the performance of the design, with a goal to identify any safety or operational issues that could not be readily identified during the design phase, and to document the learning outcomes for all future designs of cycle facilities as the cycle network develops over the city's road network.

The purpose of this study is to:

- Comment on the design development process (whilst noting that this project was not originally a conventional cycleway project)
- Undertake a site assessment of the design and compatibility of the system in the road environment,
- Undertake a safety review to identify any road safety issues that may have developed as a result of the construction,
- Document any changes that would improve future designs of similar networks from a safety and operational perspective,
- Assist with the development of a cycle operational and cycle specific safety review methodology for all future audits of new or existing cycle facilities,
- Present the findings to the Major Cycleway Routes (MCRs) design teams through a continual learning process

This post construction review will be undertaken to ascertain the actual vs desired results for the cycle facility improvement scheme applied to Ilam Road, between Kirkwood Avenue and Maidstone Road.

The safety review will use as a basis the NZTA *Road Safety Audit Procedures* (NZTA 2013); however, the review allows scope for consideration of operational aspects of the new cycle facility, and the influence it has on the operation of the road. The safety review will look at all aspects of the design and operation of the facility, with a wider brief than a conventional Safety Audit. The inspections will comprise of both daytime and night time inspections looking at form, function, operational aspects and user safety.

In accordance with the request from CCC, the scope of work is to comment on the suitability of the applied design for application to other streets, any changes that may be required to accommodate safe and efficient use, and applicability of the design to roads and corridors throughout Christchurch, as part of the design and implementation of the MCR network.

Items considered include (but are not limited to):

- Cycling movement and amenity
- Motor vehicle movement and amenity
- Pedestrian movement and amenity
- Bus use and supporting bus facilities
- Interaction between the different road users
- Parking controls
- Street furniture (and other street physical features)
- Use by Service Vehicles (e.g. street cleaning)
- Design flexibility
- Mobility
- Lighting
- Ongoing Maintenance

As requested by CCC, the audit has been undertaken by a team comprising of experienced Road Safety practitioners and cycle designers.

2 Site Assessment Methodology

2.1 Route Safety Review

A Route Safety Review, for the purpose of this report, is defined as a merging of the policies and processes of both the Safety Inspection and the Road Safety Audit procedures.

The format previously developed for the Christchurch City Council, and applied to many route safety reviews and audits, utilises the procedures for Road Networks in respect of Safety Inspections and the NZTA (formally Transfund) procedures "Safety Audit of Existing Roads" in respect of the Road Safety Audit.

Frequently Safety Inspections and Safety Audits are undertaken as totally separate tasks. Previous work for CCC was developed through a desire of the Council to establish the road safety status of the Road System in respect of the road environment and the level of safety deficiency, measured against a common set of recognised standards. The developed methodology integrates the two procedures as one field and reporting exercise, with the findings and recommendations integrated. This, therefore, is the method that has been adopted for the Ilam Road project.

2.2 Non Motorised Road User

Principles of road audits for Non-Motorised Road Users (NMU's), as defined in the document *"Non-Motorised User Review Procedures"* (LTNZ 2006) have been applied to the review process.

NMUs have the same basic concerns as any transport user and roading project designs should reflect this. For routes to be viable for NMUs, they should be:

- **Connected** - link origins and destinations without detours or delays in a legible, continuous and consistent manner.
- **Attractive** - in terms of the built and natural environment and the interaction with other road users.
- **Safe** - not give rise to road safety or personal security concerns.
- **Accessible** - designs fit for purpose for all NMUs, and in particular vulnerable NMUs such as sensory or mobility impaired users, and people with children and pushchairs.

This approach is similar to the "Five Main Cycling Requirements" of Cohesion/Coherence, Directness, Safety, Attractiveness and Comfort, espoused by Dutch best practice (CROW 2007).

2.3 End Users Perspective

The process applied to the review of the new Ilam Road layout has taken into account both the desires of CCC for the constructed environment, and the desires and needs of the end users.

Specific note was taken of the interaction of various road users, including:

I. Pedestrians
II. Cyclists
III. Mobility/Vision Impaired Users
IV. Drivers of Motor Vehicles (including service vehicles)
V. Drivers of Large vehicles (including buses)

A clear understanding of the interaction between the various road users is essential to monitor and gauge the performance of the constructed street format, and to identify any potential safety deficiency as a result of the design or construction.

3 Review Tasks

3.1 Site Inspections

Three separate inspections were undertaken of the site:

1. A morning inspection (8.00-9.30am) during university term time (Tue 8th Oct 2013). It should be noted that this was during school holidays. The weather was rainy.
2. A morning inspection (8.00-9.30am) during school term time (Wed 27th Nov 2013). It should be noted that this was during university holidays. The weather was rainy.
3. A night inspection (9.30-10.30pm) on Wed 27th Nov 2013. The weather was cool but clear, although it had been recently raining.

The site inspections included both walk-overs and cycling the route. Various photos were also taken.

3.2 Examination of design and lessons learnt

The Ilam Road project straddles part of two planned Major Cycleway Routes (MCR's) across Christchurch ("University to City" and "Western Orbital"). The works undertaken therefore comprise some of the first of the new design for these routes, as espoused more recently in the *Christchurch Cycle Design Guidelines* (CCC 2013).

The team undertook an examination of the specific design for Ilam Road to determine the elements of the design that were done well, the elements that have minimal impact, and the elements that should be changed for future designs. The review took into consideration best practice guidelines for cycleway planning and design from New Zealand (LTNZ 2004) and Australasia (Austroads 2011). The review also incorporated the feedback from post-construction inspections undertaken to date by the City Council.

A discussion forum was held with the project designers on Mon 2nd Dec 2013, to better understand the parameters that were utilised in the design, and to allow a clearer understanding of the design process.

3.3 Consultation with Public Stakeholders

The team had some informal discussions with users of the facilities (including Spokes Canterbury and the Automobile Association), and representatives of the adjacent University of Canterbury and Ilam School. A blog post was also published on the *Cycling in Christchurch* website (***http://cyclingchristchurch.co.nz/***) and via social media to elicit further comments from users of the facility.

3.4 Present Study Findings and Workshop

The study findings will be presented in a workshop to CCC project owners and designers seeking feedback for future cycleway projects.

4 General Planning and Design Issues

4.1 Cycleway Project History & Objectives

In discussion with the project designers, it was noted that the genesis for this project was originally as a pedestrian crossing safety project, with initial planning for it starting back in 2009 (in fact, there have been earlier designs for pedestrian facilities along Ilam Road since the early 2000's). With the introduction of the Major Cycleways programme, an opportunity was seen to provide a modern cycleway as well, particularly with the support of major stakeholders like the University of Canterbury.

While it is laudable that the opportunity was taken to improve cycling provision as part of this project, it appears that full consideration of the potential issues with the cycleway design and implementation (e.g. as discussed in this report) were not fully thought through. Moreover, the budget limitations of the project meant that the resulting cycling facilities had to be "low-cost" (e.g. minimal kerbing and pavement changes).

Many of the projects that the findings of this report will apply to will be dedicated MCR projects, and thus will have an explicit focus on providing a high-quality cycling experience. However, it is equally likely that other transport projects will come up where there are opportunities to incorporate aspects of the MCR network as part of them. If cycleway provision is not a key objective of the project however, there is a danger that the final design will be compromised due to other project constraints.

Recommendation:

It is recommended that CCC staff continue to look for opportunities to develop parts of the full cycleway network as part of other projects (e.g. intersection upgrades, street reconstructions). However, the same process as other Major Cycleway projects needs to be used to identify clear objectives. The potential budgetary implications of providing cycling to Major Cycleway standards also need to be considered at the scoping stage to avoid compromises to standards later.

4.2 General Design Principles / Design Philosophy

It appears that the cycling aspects of the project had few general design principles or philosophies that were explicitly provided to the facilities provided. For example, no discussion about the design speed for people cycling the facilities has been noted. Reasonably high (30km/h+) design speeds are often typically used for utility cycling routes, according to Austroads guidelines. The kerbed cycleway chicane southbound near Ilam School is an example of a facility that would not meet these standards (refer to Photo 1). However, there is also a case for considering whether lower cycling speeds should be encouraged at major pedestrian conflict areas.

Similarly, it is not clear what was the thinking behind the cycleway widths provided (other than fitting within the available kerb lines). We understand that 1.8m was a target width, although this has not always been achieved (e.g. south of University Drive) and it is not clear whether this is actually an appropriate target for the conditions (e.g. should overtaking between cyclists be provided for?).

Photo 1: Chicane in southbound cycleway north of Ilam School results in a relatively tight alignment when biking at high speed.

Photo 2: This cycleway width is ambiguous about whether it is designed for overtaking by other riders.

These examples serve to illustrate that the project overall did not really have any clear design principles or guidelines to work from (other than the more conceptual *Christchurch Cycle Design Guidelines*). While is perhaps understandable, given the genesis of this particular project, it will not serve the MCR programme as a whole well (particularly to the public's perception) if they are developed as independent, inconsistent facilities.

Recommendation:

The Major Cycleway programme team should develop and confirm with their elected members a set of Expected Design Standards for MCR elements. These should be used as the basis for future cycleway planning and design. Section 8.2 discusses this concept further.

4.3 Cycleway Separator Design

The Ilam Road design uses a separator between the cycleway and traffic/parking lanes consisting of an angled kerb block profile (the angled side facing the cycleway). Figure 1 shows the cross-section detail for these separators. This has caused considerable concern and discussion by road users and local stakeholders. The relatively low profile and grey colouring has made it relatively unobtrusive and thus prone to be hit by many motor vehicles.

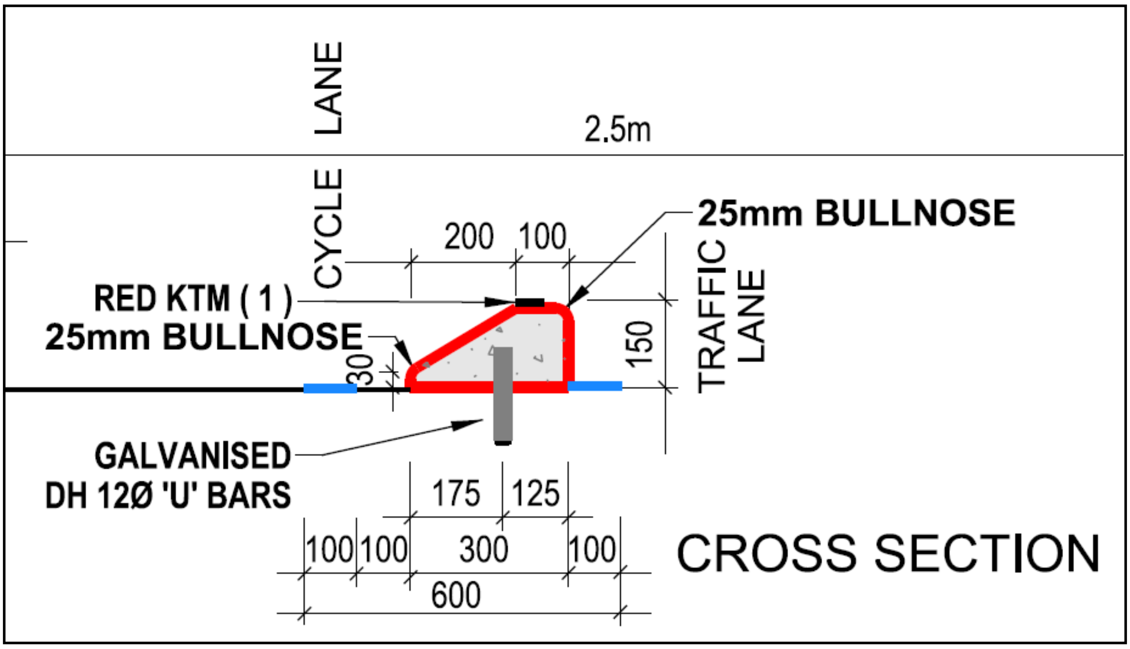

Figure 1: Cross-Section Details of Cycleway Kerb Separators

The SAT's understanding was that the selection of the kerb profile template was a somewhat pragmatic decision making use of an existing standard design for mountable kerbs surrounding traffic islands (CCC 2010). Some discussion had been undertaken with supplier RTL about other separator design options, but it was felt that these were too limited. It is notable that vertical "flexi-posts" used in trials elsewhere around the city (Koorey *et al* 2013) were not considered suitable for in this situation. It is also significant that details about the design for these separators were not presented as part of the public consultation process for the Ilam Road project.

A key issue (identified elsewhere in this report too) was the non-mountable nature of the separators for motor vehicles. Whilst this clearly helped to discourage encroachment into the cycleways, it resulted in significant damage to both vehicle and separator when there was a collision (of which it was evident there were many to date). This goes against the principles of a "forgiving" road environment for all road users, as well as contributing to a high separator maintenance cost.

Photo 3: Concrete kerbs used as separators along Ilam Road.

Photo 4: Typical damage experienced by separator kerbs due to vehicle collisions.

There are many other alternative separator options available, most of which have not been tested in New Zealand, let alone Christchurch. They vary in their visibility, ease of installation, solidity, traversability, and of course cost. No doubt, road users' perceptions of them will also vary and it is unlikely for universal acceptance to be achieved. However, more careful consideration must be made of the implications of future options trialled; that should also include more use of public feedback.

Recommendation:

Alternative cycleway separator designs should be trialled in the next few future separated cycleways with a view to identifying one or two designs to be used as standard throughout the city. Prior assessment of potential options should include public feedback as well as comment from contractors and maintenance operators about any likely practical implications of installing and maintaining the separators.

4.4 Road Cross-section Design

The project was constrained for budgetary reasons to largely retain the existing roadway kerbing (approximately 13.2m in width). While this is understandable, there was the potential for this to compromise the quality of the resulting cycling facility (or the choice of separator) and possibly the traffic and parking lanes too. Our impression is that, in general, this hasn't occurred. However that may not be always the case on another road with a different cross-section, unless clear guidance is developed regarding acceptable cross-section standards.

The (possibly perceived) narrowness of the traffic lanes has a number of effects on operations:

- A slowing of traffic, even in the absence of other traffic (see further discussion in Section 5.1).
- In relation to the adjacent on-street car parking, the tight cross-section also causes potential problems when opening driver-side doors (see Photo 5).
- Traffic waiting to turn into the side roads or enter an adjacent carpark may block traffic behind, causing delays.
- A motor vehicle undertaking a u-turn to enter/leave a car-park may have trouble doing so within the space available (made more difficult by the relative inconspicuity of the concrete separators, as discussed in Section 5.2).

It is notable that these effects largely impact on motor traffic, not cycles. The effects are considered relatively minor in this case, although may be more by accident than design.

It should be noted that the fundamental assumption that cycles, cars (including parking), pedestrians and buses can all be accommodated on the same route to an acceptable LOS is not necessarily the case for future reference. A “Network Operating Plan” in the new *Christchurch Transport Strategic Plan* (CCC 2012) will identify those routes where certain modes will be encouraged and other modes discouraged (by providing alternative routes for the latter elsewhere). Therefore it is reasonable to consider in a more rigorous manner “absolute minimums” for all criteria per mode, below which that mode will not be explicitly accommodated there unless improvements are made.

Photo 5: Car parking immediately next to narrow traffic lanes

Photo 6: Existing kerb lines have been retained while fitting in cycleways

Recommendation:

Clear guidance should be developed to determine acceptable cross-section widths for both Major Cycleway facilities and other adjacent transport facilities (traffic lanes, footpaths, etc).

Recommendation:

Early identification is needed for each MCR project as to whether the existing road cross-section is capable of accommodating all road user requirements to a satisfactory standard. If this is not the case, then the project team must consider either (a) reconfiguring the kerb lines to achieve the necessary widths, or (b) relocating one or travel modes to an alternative route. The budgetary implications of both of these options must be fully considered at an early stage.

5 Safety and Security Issues

5.1 Speed Environment

A 40km/h speed limit along Ilam Road was proposed with this project; this was to improve the relative safety of road users (particularly active modes) along this section. Note that this will also supersede the existing 40 km/h part-time speed limit that previously applied in front of Ilam School at the start and end of the school day.

The consultation and gazetting process for introducing a new speed limit takes some time and thus the formal 40km/h limit will be introduced at a later date. In the interim, temporary 40km/h speed limits (i.e. 40 km/h posted signs with a supplementary “TEMPORARY” plate) have been installed along the route. Whilst a somewhat unconventional context for using temporary speed limits, it does seem to be a generally pragmatic and effective approach to communicating the intent of the final speed limit ahead of the official gazetting.

However, we note that, technically, this method is not allowed under the Setting of Speed Limits Rule (NZ Govt 2003) as a temporary speed limit must be *“at least 20 km/h less than the permanent speed limit”* (Clause 5.2(2)(b)). As the permanent speed limit on Ilam Road is still currently 50 km/h, a temporary speed limit no greater than 30 km/h would be required..

Some relatively informal speed surveys were undertaken by Canterbury University students as part of a recent traffic engineering course.

Table 1 summarises the key results:

Table 1: Preliminary Speed Survey Results for Ilam Road (Sep 2013)

Section	Northbound		Southbound	
	Mean Speed	85^{th} percentile Speed	Mean Speed	85^{th} percentile Speed
Montana Ave – University Drive	38.6 km/h	45 km/h	35.9 km/h	40 km/h
University Drive – Ilam School	40.5 km/h	47 km/h	43.7 km/h	50 km/h

These initial speed surveys indicate reasonable compliance with the lower speed limit. It is notable that the more constrained northern part of the project has resulted in the lowest observed speeds.

5.2 Visibility of Cycleway & Separators

As discussed in Section 4.3, the new cycleway separators have experienced regular damage since their introduction. It is suspected that the relative inconspicuity of the separators has contributed to this (in conjunction with the unfamiliarity of road users to the new facilities). This appears to be due to:

- the low profile of the separator kerbs
- the dull grey colour of the kerbs, similar to the adjacent road surface
- the lack of coloured surfacing on the adjacent cycleway
- fairly small and infrequent reflectors on the separators to delineate them at night (with many of these being subsequently knocked off, thus further reducing the visibility)

The physical damage to both separators and vehicles has caused considerable concern from stakeholders. Given the desire to obtain widespread support for these facilities from the general public, the design of these separators does not appear to have helped.

Recommendation:

The visibility of any future MCR design elements needs to be fully considered, both for day-time and night-time situations. This includes the relative height, colour/contrast, and reflective elements of any devices.

5.3 Crossing Sight Distance

The design has resulted in the formation of a series of differing crossing points along the route. These include:

- Formal pedestrian crossings
- Informal pedestrian crossings with refuge
- Cycle crossing points

Observations on site reveal that the formal pedestrian crossing points are generally well done, and have clear intervisibility sight lines available to the pedestrian. However, the final result of the pedestrian crossings has raised a number of issues that should have been addressed during construction that would have resulted in an improved safety performance.

Specifically these include:

1. Pedestrian sight line blocked by shuttering effect created by lamp post and hazard marker post (refer to Photo 7 and Photo 8)
2. Sight lines blocked or restricted due to new planting (adjacent trees etc) Refer Photo 9)

In both of these respects, an assessment at the time of installation (even during design) would have resulted in the identification of the issue, and would have allowed the corrective action to have been undertaken immediately.

Photo 7: Pedestrian Sight line reduced by shuttering effect created by pedestrian lighting pole and post.

Photo 8: Hazard marker could have been mounted lower (refer to arrow), eliminating sight line obstruction.

Photo 9: Pedestrian Sight line reduced by shuttering effect created by pedestrian lighting pole and post.

Photo 10: Hazard marker could have been mounted lower (refer to arrow), eliminating sight line obstruction.

During the design phase the species of plants to be planted it is often specified. However, often the plants are juvenile and have a low form, reliant on them growing over many years to full height. The use of juvenile plants often results in lower limbs of the tree being in the road user's eye line.

This results in blocked sight lines and potential masking of vulnerable road users at critical locations such as pedestrian crossing and cycle crossings.

Where possible, planting should be specified as being of sufficient size to eliminate the problem of blocked sight lines, and a specific site assessment undertake to allow selective pruning / clearing work to be undertaken.

It was observed at a number of the cycle crossing hold box locations that the adjacent marked parking bays resulted in poor sight lines from the hold points. Refer to Photo 10. In reviewing the length of on street car parking it was observed that in many instances that the parking bays had been marked, and then some bays had been removed (blacked out and remarked with no stopping) where they had affected the sight lines of pedestrians. This has resulted in an unbalanced approach, with one sight line (pedestrian crossing) improved, and the cycle crossing still compromised. A redistribution of the location of the car parking would have resulted in a more balanced and safer approach. Cycle crossing points should have similar treatments as that required for pedestrian crossings (i.e. no stopping lines either side of the crossing hold point.

Recommendation:

Intervisibility sight lines should form a specific item to be checked in the design phase, and parking, planting and roadside objects should be positioned to avoid sight line restrictions.

Recommendation:

CCC should also develop a standard template for the requirements for cycle crossing points similar to that for pedestrian crossings

5.4 Night-time Lighting & Security

A night time assessment of the facility was undertaken on 27th November 2013. The weather conditions were overcast and raining.

The SAT undertook a cycle through the facility in each direction, and on the approaches to the facility at each end. The cycle through generally followed the normal path that a cyclist would take, however the SAT also followed the on-road route past the bus set down areas.

It was noted that the lighting along the route generally comprised of upgraded LED lighting heads on high outreach arms from the back of the footpath. In a number of locations the effectiveness of the overhead lighting was restricted due to adjacent trees and vegetation, resulting in locations of darkness. In some locations the areas of darkness on the facility also corresponded to areas of dense vegetation or poor lighting from the adjacent land use. Examples include behind the bus stops adjacent to the Ilam Homestead and the foot path alongside Rutherford and Rochester Halls on Ilam Road.

It was considered by the team that the nature, location and extent of dark areas could mask users of the facility, and present a personal security issue to users. It is understood that the principles of CPTED design are followed as part of the design process. However the transference of that design to construction is critical to create a safe environment.

Recommendation:

It is essential that all constructors have a good knowledge of the principles of CPTED, and that they identify site specific issues such as shading and at risk areas during construction, and that these issues are identified to the design team for immediate corrective action.

Photo 11: Large areas of darkness alongside extensive vegetation that form a personal security risk and result in poor illumination of the shared use off road cycle facility.

Photo 12: Example of new lighting heads installed in a tree canopy resulting in poor lighting of the cycle facility.

6 Road User Operations Issues

6.1 Pedestrian and Cyclists Interaction

The University is one of the busiest suburban locations for pedestrian and cyclist use, and hence Ilam Road is the setting for a high number of interactions between these users. This is particularly prominent in the locations where the two user groups have to cross each other (e.g. at pedestrian crossings) or have to share space (e.g. near bus stops).

The applied design incorporates features that transfer cyclists from on road to off road and back. This places a strong need for adequately marked and formed shared facilities. This transition and shared facility use places the cyclist and pedestrian at conflict in locations.

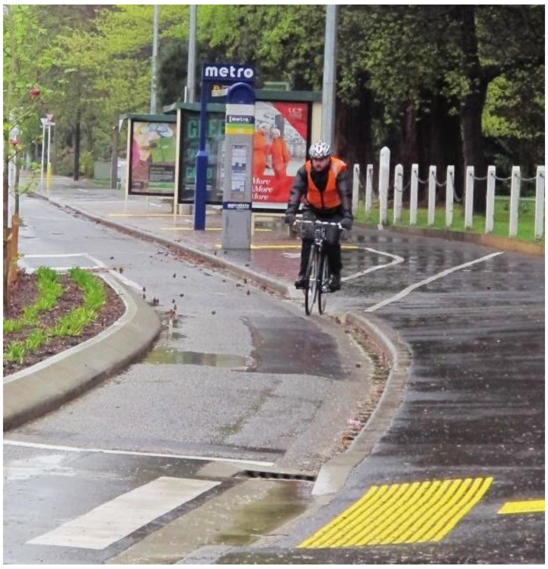

Photo 13: Photo of Cycle use of off – road facility (opposite University Drive). Note obstruction to inter-visibility caused by advertising and bus shelters.

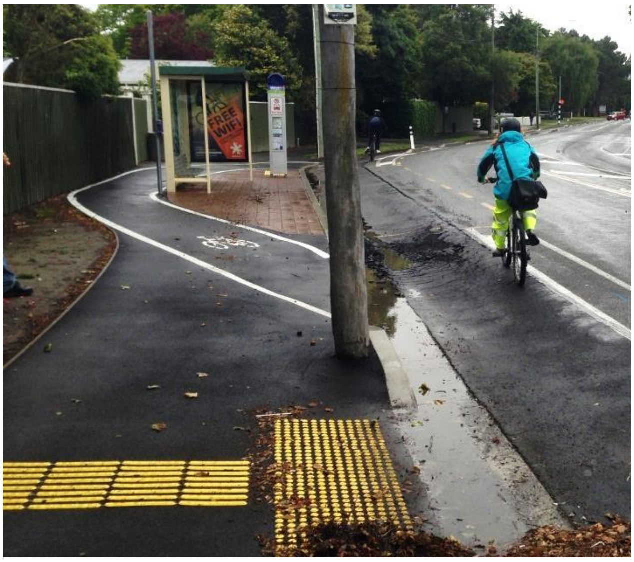

Photo 14: Photo of Cycle use of off – road facility (South of Montana Ave). Note obstruction to inter-visibility caused by advertising and bus shelters.

It was identified that there are a number of locations where the cyclist and pedestrian have conflicts in the vicinity of pedestrian crossings. The pedestrian crossing opposite the Ilam Primary School has a cycle off road entry installed leading directly into the waiting area of the pedestrian crossing. It was observed that many school children and parents use this as a way of accessing the pedestrian crossing. It is noted that this pedestrian crossing is manned by the school (teachers / parents) and is established as a kea crossing before and after school times. A number of conflicts were observed between cyclist and pedestrian, especially with school children, who lack the cognitive skills to identify a potential conflict.

Where there is conflict adequate consideration should be given to inter-visibility between the two user groups. Specific consideration to the interaction between cyclist and pedestrian in the vicinity of high conflict points such as bus stops and pedestrian crossings. Where such conflicts are identified, mitigation measures should be taken to ensure that:

1. The conflict is removed through relocation to separate spaces,
2. Where separated spaces are not possible, then appropriate speed reductions are installed.

Recommendation:

Pedestrian / cyclist conflicts should be a specific point of focus during the design phase. All possible actions should be taken to separate the spaces required for each user group, minimising conflicts. Where separation is not possible, all care should be taken to ensure that sight lines and inter-visibility is maximised, and that appropriate speeds are imposed.

6.2 Bus Stop Operations

As commented in Section 6.1 above, the interaction of pedestrian and cycle movement in the vicinity of the existing bus stops can lead to conflicts. Given that many of the bus drop-off and set-down times correspond to the same times of heavy cycle demand (to and away from University / School), the risk of conflict is high.

The off road facilities around the existing bus stops has may locations where people milling around waiting for buses are masked from sight by the cyclist by the bus shelters. The bus shelters installed have advertising on the return ends, obstructing inter-visibility between the cyclist and the pedestrian. There is a risk that pedestrians from the bus could walk direct into the path of cyclists, unaware of approaching cycles travelling at speed. Refer to Photo 13 and Photo 14 below.

The transition of cyclists from on road to off road in the vicinity of the bus shelters is marked by shared use marking (pedestrian / cycle symbols).

The team took time to observe the operation of the bus stops at night, as an appreciation of the facility during the short winter days and darkness. It is understood that there may be fewer people using the bus stops at these times, and that traffic flow may be lower. However, this time of day also corresponds to the time when cyclists are less visible due to their presence being lost in the headlights of vehicles.

It was observed that there was generally good lighting around the bus shelter, but often reduced lighting on the shared facility behind the bus shelter (refer also to comments in Section 5.4)

Recommendation:

Bus stop form should be a specific point of focus during the design phase. All possible actions should be taken to ensure that the bus stops designed minimise conflicts.

That lighting at bus shelters is sufficient for both the bus shelter and the shared facilities alongside.

6.3 Intersection Performance

The change in the road cross-section design along Ilam Road has narrowed the traffic lanes along the route. To ensure the continuity of the facility along the route, the road has generally remained narrowed at intersections.

There are a number of bus routes that run along Ilam Road, with certain bus routes turning into and out of the University. It was observed that exiting buses generally had difficulty remaining in their own lane upon exit, and resulted in the front of the bus traversing into the opposing traffic lane. The use of tag axle buses compounds this issue due to the wider sweep path.

Photo 15: Photo of Bus use at University Drive.

Photo 16: Example of bus crossing over the centre line

In general, most buses that access the University are single axle buses. The utilisation of a tag (twin) axle bus at the intersections may cause a significant safety concern with vehicles crossing into the opposing traffic lane.

This element can easily be checked at the design stage through the use of vehicle tracking software to confirm that the movement of the typical bus (or heavy vehicle) can be undertaken.

Recommendation:

Vehicle tracking software should be utilised to confirm the safe movement of the expected vehicle types at intersections.

6.4 Parking Manoeuvres

Providing car parking on only one side increases the likelihood of U-turn manoeuvres to access and depart from parking spaces. During the site inspections it was observed that many of these U-turn manoeuvres were being undertaken by parents of the children being dropped off at the Ilam Primary School.

The pedestrian crossing in the vicinity of the Ilam Primary School has two parking spaces installed to the south, outside the dairy. Refer to Photo 17 and Photo 18.

Photo 17: On street parking in close proximity to Ilam School pedestrian crossing. Note limited space ahead of parking for on-road to off-road transition.

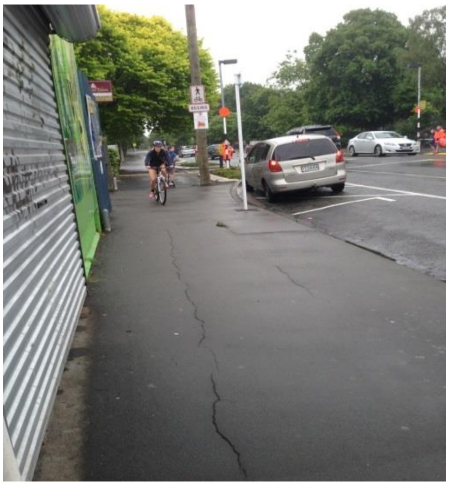

Photo 18: Difficulty in accessing car parks has led to poor parking discipline.

It was observed that these parking spaces are difficult to access, with the southernmost car park only able to be used with a reverse in movement due to the square end at the kerb island. This results in many people not using the car park, and parking over the cycle facility transition. (Refer to Photo 18)

In practical terms this southern car park is problematic for use – vehicles attempting to occupy it are required to commence a reversing movement from within the lane and the on-street cycle facility. This could be hazardous during peak times where school children are arriving at school, and during peak traffic times. The complexity of the location in close proximity to the pedestrian crossing adds a further level of risk to the situation.

Recommendation:

Cycleway design should fully consider the accessibility of the parking spaces and potential manoeuvring of vehicles to ensure that conflicts are minimised, and access is maximised.

Vehicles occupying the parallel parking spaces along the new facility typically undertake a reverse in movement to occupy the parking space. Refer to Photo 19 and Photo 20.

Photo 19: On street parking alongside the cycle facility. Note poor parking discipline with drivers trying to avoid separators.

Photo 20: Parking in close proximity to cycle crossing facilities can lead to poor sight lines.

The provision of a separated facility has generally eliminated the risk of this reversing manoeuver being done while cyclists are in the traffic lane. This is to be commended.

The provision of a painted median alongside the facility (Refer to Photo 19) has provided a buffer zone for cyclists where a passenger would open their door to exit. This space allows the cyclist to stay within their lane, and the passenger to alight into a safe zone with little risk of impact with a cyclist.

<u>Recommendation:</u>

Where possible, a safety zone should be created alongside the cycle facility to accommodate the opening of the passenger's door, and to provide a safe refuge for passengers to alight from the vehicle.

6.5 Transitions On / Off Road

The transition on / off road was varied in standard for the Ilam Road facilities. The transitions in all instances were formed at an acute angle, and required the cyclist to traverse over the drainage channel. Refer to Photo 21 and Photo 22.

This transition over a drainage feature has resulted in two undesirable elements. These are:

1. The lip of the drainage channel is high enough, and at a shallow angle and could cause a cyclist to lose control (Refer to Photo 21)
2. The drainage channel is flat in longitudinal profile and causes ponding within the transition (Refer to Photo 22)

In the instance of 1) above, it was observed on site (during wet conditions) that there was a reluctance for the cyclist to traverse through the channel when there was deep free water in the channel. In this instance, cyclists were staying on the footpath and looking for a secondary area that was free of (or less) water. This adds to the conflict on the footpath, away from the designated shared facilities

In a number of instances, the transition from on road to off road was in the vicinity of a conflict zone such as an intersection or accessway. At these locations, the driver has a task of determining a gap in the traffic, and may be unaware of a cyclist that will cut in towards them as they are trying to traverse out. (Refer to Photo 23)

Transitions on and off road should be designed to avoid any elements that could cause a cyclist to lose control, or deter them from a transition due to water etc.

<u>Recommendation:</u>

On road / off road transitions should be designed to eliminate elements that would cause safety issues for the cyclist. The location of these transitions should be carefully considered to minimise conflicts with other road users at locations such as intersections and accessways.

Photo 21: On street parking alongside the cycle facility. Note poor parking discipline with drivers trying to avoid separators.

Photo 22: Parking in close proximity to cycle crossing facilities can lead to poor sight lines.

Photo 23: Example of transition in conflict zone at intersection.

Photo 24: An acute angle of approach and lip on channel can cause a cyclist to lose control

6.6 Road User Education

The Ilam Road street works include relatively novel facilities (for New Zealand), including separated cycleways and bus-stop bypasses. Observation of operations, review of feedback elsewhere, and discussion with stakeholders has revealed a lack of understanding about the purpose and use of many of these facilities. The damage of the separators also suggests a lack of awareness of the presence of the new facilities.

It is significant that no public information has been produced to explain the project and its elements to road users and other stakeholders (other than the standard pre-project consultation). By way of comparison, when the Tennyson St Cycleway (Beckenham) was constructed in 2002, a pamphlet was produced that explained their operation for residents and road users.

Recommendation:

Publicity material should be developed (printed and/or online) for all new cycleway treatments, both specific to individual projects and for the Major Cycleways in general. The material should provide information for different audiences, including cyclists, drivers, pedestrians, bus-drivers, residents and business-owners.

7 Construction and Maintenance Issues

7.1 Early Contractor Involvement

No evidence that any contractors were involved in design discussions or that the successful contractor had discussions with the designers regarding what is a relatively novel design for Christchurch. Without this involvement it is sometimes difficult to match the desire of the design to the final construction method.

Early involvement will allow the identification of construction related issues during the design, and minimise compromises to the design once construction commences.

In the instance of the Ilam Road facility, it is understood that there were a number of issues that that could have easily been improved at the design phase with this type of involvement. These include:

1. Profile of the separators
2. Road delineation / separator delineation (stick on v's inset)
3. Location of posts / planting / vehicles within the sight line
4. Removal of old pavement markings

Recommendation:

Where practical, early contractor involvement should be undertaken to ensure that the final design is constructible and does not require design variations during construction.

7.2 Cycleway Surfacing

A key feature of the final cycleway design is the green coloured surfacing provided at key conflict points such as side-road crossings, transitions on/off the road, and entry points to the cycleway. However, to date this surfacing has not yet been installed. Given that the bulk of the work was completed by last June, this gives the impression that this surfacing was not intended. Yet it is a critical part of the delineation of the new facility; the auditors feel that its absence has exacerbated some of the issues regarding cycleway/separator visibility mentioned elsewhere.

It is understood that the coloured markings has been delayed due to issue with supply.

Recommendation:

It is imperative that the coloured markings are installed at the time of construction, and that where this is not possible, temporary signage / guidance is installed to assist with the conflict points.

7.3 Pavement Markings / Guidance

An inspection was undertaken along the whole of the route during daytime and night time conditions. At the time of the inspections the road was wet.

The design and construction has required the removal of old markings, and the installation of new markings in accordance with the final design. It was observed that a number of the old markings have been water / sand blasted off to eliminate confusing marks. This is a good approach for the permanent removal of old / obsolete markings.

During the site inspections in the wet, and at night in the wet, it was observed that the removal of the markings was "clean" to the edge of the old markings. This means that the markings only were removed, and under dark / wet conditions they hold their original form and shape.

This results in the removed markings still being visible as a reflected image of the removal as shown in Photo 25. This could lead to confusion by the driver as to what markings are correct.

Recommendation:

A best practice for the removal of old markings should be detailed that requires the operator to feather out the edges of the old markings so that sharp edge lines are not created, eliminating the risk of confusion.

Photo 25: Pedestrian Crossing at Roundtree Road intersection. Note old pavement markings showing through on road surface as a result of following exactly old edges.

Photo 26: Transition from on-road to off-road (Ilam Road Pedestrian Crossing @ Roundtree). Confusion with multiple markings showing and cross over in from of parking space.

The design specifies that the coloured surfacing should be installed at major on – off road transitions, and at locations where the cycle lane leads into and away from key areas of conflict, as required in best practice design.

There were a number of locations where there seemed to be confusing or incorrect pavement markings and symbols. In a number of instances these were in areas of conflict that could lead to cyclist / cyclist and cyclist / pedestrian collisions due to confusing information. Examples include:

1. Cycle / cycle markings on a shared path (marked for removal) – should be cycle / pedestrian
2. Narrow cycle box at intersections (vehicles park over, facility too narrow to accommodate cycle movement into the box),
3. Give Way symbols missing from cycle facilities (Montana Avenue).

Many of these issues could have been picked up at the design stage, or identified at the construction stage, eliminating any potential for confusion and conflict.

Photo 27: Incorrect cycle markings requiring removal and replacement of pedestrian symbol on shared facility. .

Photo 28: Give Way symbol required for cycle path on Montana Ave junction. Note temporary white triangle marking. Area of high conflict between pedestrians and cyclists.

Recommendation:

The design process should incorporate a specific pavement marking layout plan to ensure that the contractors have a clear source of information. Any changes during construction should be done in consultation with the design lead for the project.

7.4 Pavement Reconstruction

The project has involved a number of pavement reinstatements and construction processes to achieve the final design. It was noted that there are a number of various pavement treatment locations where:

1. New Kerb was laid to achieve the desired road widths and layouts;
2. A narrow section of pavement was reconstructed alongside the existing kerb (it is assumed that this is a result of pavement shoving against the existing kerb and flat channel as a result of the earthquakes);
3. Reconstruction of wide sections of pavement alongside of the existing kerb and flat channel.

It is understood that this project did not require the reconstruction of the whole pavement, and that isolated and localised pavement repairs / improvements were undertaken to ensure that the new design matched into the existing road layout as needed.

It is noted that many of the longitudinal seal joints are located in the cycle lane (Refer to Photo 29 below). This joint is often associated with a change in road profile. At locations along the route it was noted that there were isolated areas of joint failure, and the use of bitumen crack sealing has created areas with a slick road surface.

Often there was a difference of some 300 mm between having the joint in the cycle lane, and the joint being located alongside or in the dividing median between the cycle lane and the car parking facility.

Recommendation:

Future designs should incorporate the formation of the construction joint into the central median. This should be a key review element during design and / or construction and will eliminate a potential safety issue for cyclists (especially in the wet).

Photo 29: Seal join is within the trafficable cycle lane. Displacement to the median would eliminate seal joint in a demand area.

Photo 30: Transition to on-road facility. Note mixture of surface types and joints within cycle path .

The bus stop in the vicinity of the curve south of Montana Avenue has been reconstructed with what appears to be new footpaths, kerb and channel and pavement. During the site inspection it was noted that the pavement in this location has suffered rapid failure, and is unsafe for use. This are of pavement failure is within the cycle lane and in the location of the bus stop. Refer to Photo 31 and Photo 32.

A review of the cross section of the road at this location reveals that the side slope of the shoulder is excessive, and may be a contributing factor to the pavement failure. In this instance, the axle load of buses would be towards the left wheel set, and would create high lateral shear.

It was observed that cyclists travelling along this section would undertake a rapid "pop-out" movement, into the traffic lane. Drivers approaching from behind would not be prepared for this movement, and could be slow to react to the cyclist. The issue is complicated with the location of the central pedestrian refuge immediately north of the bus stop and area of pavement failure. There is an extreme risk of rear end collisions with the cyclist.

Photo 31: Large areas of pavement failure at Bus stop on Ilam Road near Montana Ave. Note steep slope of shoulder and sharp edge of joint. High risk to cyclists in this location.

Photo 32: Large areas of pavement failure at Bus stop on Ilam Road near Montana Ave. Failure is within cycle path and is not traversable by cyclists.

At face value it would appear that the design of the road cross section has been undertaken from a two dimensional design, and has not identified areas such as this that would cause a dramatic change in road profile. In this instance, the area of failure also corresponds to an area of ponded water within the drainage channel, indicating a length of channel that has minimal longitudinal fall.

Recommendation:

Future designs should incorporate specific consideration of road cross section and side slopes to ensure that an appropriate facility is constructed.

7.5 Cycleway Cleaning & Refuse Collection

As described in sections above, the site inspections were undertaken in wet conditions. This allowed the team to observe the site under some adverse conditions, and allow the team to observe issues such as cycleway cleaning.

In all the site inspections, undertaken weeks apart, there was observed many issues with respect to the cleanliness and debris within the cycleway. Much of the debris was vegetation and rubbish. Refer to Photo 33 and Photo 34.

Photo 33: Drainage facilities prone to blockage due to adjacent vegetation. Regular cleaning of the sumps and drainage paths is required to prevent flooding of facility.

Photo 34: Debris within the cycle path that can lead to loss of control for cyclist due to slippery / greasy surface. Note lack of space for a vehicle within the cycle path. Standard street cleaners will not be suitable for the design of the facility.

All of the observed cleaning issues revolved around the ability of maintenance operations to maintain the new facilities to the desired standards. Failure to clean the facilities will deter cyclists from using the cycle paths and result in them occupying the traffic lane, contrary to the desire to provide a separated facility.

Discussions with the design and project staff within CCC indicate that normal street cleaning plant would not be able to effectively clean the new design on a regular cyclic program. There is also a concern that the specific maintenance required for cycleways might be seen as a “special extra” not covered under the existing Council maintenance budgets and practices.

Recommendation:

The Maintenance and Operations section of Council should ensure that an effective cleaning and maintenance process is developed prior to any further similar cycle facilities are constructed.

Recommendation:

A separate budget item should be provided in future Council operational budgets to cover the ongoing maintenance of cycleways, and this should be adjusted to match the relative amount of total cycleways as they are constructed.

Ilam Road has very few residential houses along the installed cycle facility, however the small number of houses present have highlighted an issue of the safe operation for refuse collection.

Most side arm collection vehicles are able to reach across the width of the cycle facilities, enabling the refuse bins to be collected. This operation would result in the outreach arm extending across the cycle facility, with the potential for a cyclist to run into the outstretched arm.

The relocation of bins to the road side of the cycle facility would minimise the risk of a cyclist impacting into the arm, but would create a further problem of bins creating a hazard within the cycle path.

The relocation of the bins to the road side of the parking lane would eliminate the risk to the cyclist using the cycleway, but would impact on road users in the through lane.

There is no one-size-fits-all solution for the issue of refuse collection. The idea solution will be dependent on many variables such as street form, density of housing, and maintenance and operations contractual conditions.

Recommendation:

Any future design and operation should take into account elements such as refuse collection, with a safe and effective process developed for implementation across all new cycle facilities as they come on line.

8 Conclusion and Recommendation Summary

8.1 Project Flow Process

In undertaking this review, and following discussion with the design and project teams, it is determined that a clear process flow has not been established for the Ilam Road facility.

Discussions with the design team indicated that research has been undertaken into various elements of the design, and that "best practice" was considered to be established. Through the discussions it became apparent that a number of design and construction elements may have been considered, but the lack of a process has meant that some elements have potentially fallen through the cracks.

The establishment of a detailed process flow through the project life is essential to ensure that the right considerations and design elements are followed to enable a safe and effective facility to be implemented. To assist the project teams a draft process flow (Figure 2) has been developed for consideration.

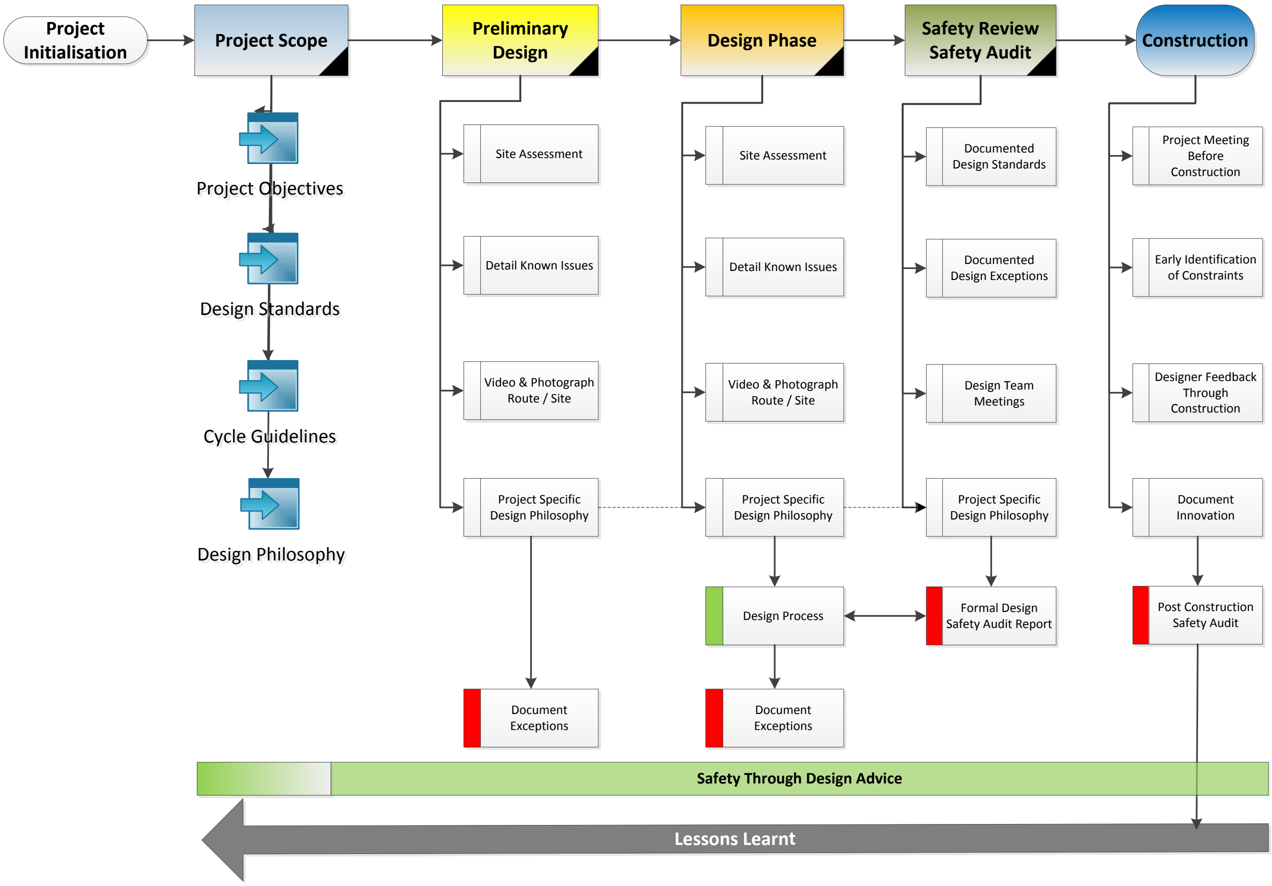

Figure 2: Draft Process Flow for Cycle Facilities

Recommendation:

The draft Process Flow presented should be developed further through a multi team workshop of appropriate representatives from the design, safety, construction and maintenance teams to ensure that the final document incorporates all elements through the life of the project.

8.2 Suggested Structure of Design Standards Guidance

When assessing provision for cycling along the planned MCRs (at the Project Scope stage and subsequent design phases), route planning/design decisions should be based on achieving at least certain minimum expected standards where possible. To aid in this planning process, the development of a series of design standards for different MCR features is suggested. Appendix A gives an example of how this might work; note that the actual values suggested are indicative only and subject to further consideration.

As well as identifying a desirable “Expected Standard”, a minimum “Tolerable Standard” is also identified, as well as a possible “Excellent Standard”. Where cycle demand or conflict is unusually high along a cycleway route, it may be prudent to shift to the “Excellent Standard” as the base requirement.

The suggested standards also indicate what would be considered an “Insufficient Standard”, below which is usually unacceptable for a Major Cycleway. Design exceptions to these standards should only be granted where it is considered highly technically infeasible or prohibitively expensive to meet at least the “Tolerable Standard", or by political veto (seek prior agreement of these standards from Council to minimise the latter). Consideration of such design exceptions should also review options to change either the route of the cycleway or that of other transport modes.

To ensure a reasonable level of consistency, it is suggested that a maximum proportion of any MCR route (e.g. no more than 20%) should fall below Expected Standards in any attributes, and a much smaller proportion of any route should be allowed to have design exceptions. In the long-term, plans should be made to improve these sub-standard sections.

These standards could be used for both design/construction of new routes and auditing/upgrading of existing routes.

8.3 Training of Relevant Staff (Council / Consultants / Contractors)

The development of the Major Cycleway network will require some new design treatments and the consideration of practical issues that have not generally been encountered before in Christchurch. While the purpose of this report is to highlight and learn from some of the issues identified along Ilam Road, it is accepted that only some of the proposed treatments or expected issues around the city feature along this route. Therefore there will be an ongoing need for those involved in the planning, design and implementation of future facilities to obtain ongoing training and exchange of ideas.

It is envisaged that best-practice Major Cycleway facilities will be achieved by practitioners with a combination of:

- Background training in transport facility design, particularly in planning & design for cycling (e.g. the “Fundamentals of Planning/Design for Cycling” course or similar as a basic pre-requisite).
- Regular targeted training opportunities to introduce more advanced cycle planning/design techniques.
- Formal investigation and research of the effects of new cycle facilities in Christchurch (possibly with assistance from university researchers), as well as review of overseas evidence, and the dissemination of the key findings and recommendations.
- Discussion between planning/design/operations teams about problems faced or solutions found when developing each cycleway project, so as to learn from each other. This should include “lessons learned” from each project, as done in this report.
- Suitable high-level review of relatively innovative untried facilities prior to their introduction.

The potential aspects that may need to be addressed include the same variety of topics covered in this report, i.e. planning & design, operations & safety, responses of different road users, maintenance, etc. This suggests that a reasonably broad range of people need to be represented in any review group. The aim should be for all partners to learn from each other and previous best practice to ensure that

> ***Recommendation:***
>
> *A “Cycle Facility Panel” should be established to oversee the development of best practice for the MCR programme. This should include representatives from each of the commissioned consultant design teams, key Council MCR planning staff, other Council operations staff (e.g. CTOC), and representatives from key contractors involved in construction and maintenance.*

8.4 Summary of Recommendations

Table 2 summarises the recommendations made throughout the report. Cross reference to the section is provided to enable the reader to understand the full context of the issue and the recommendation.

Table 2: Recommendation Listing

Section	Recommendation	Design Response
4.1	It is recommended that CCC staff continue to look for opportunities to develop parts of the full cycleway network as part of other projects (e.g. intersection upgrades, street reconstructions). However, the same process as other Major Cycleway projects needs to be used to identify clear objectives. The potential budgetary implications of providing cycling to Major Cycleway standards also need to be considered at the scoping stage to avoid compromises to standards later.	
4.2	The Major Cycleway programme team should develop and confirm with their elected members a set of Expected Design Standards for MCR elements. These should be used as the basis for future cycleway planning and design. Section 8.2 discusses this concept further..	
4.3	Alternative cycleway separator designs should be trialled in the next few future separated cycleways with a view to identifying one or two designs to be used as standard throughout the city. Prior assessment of potential options should include public feedback as well as comment from contractors and maintenance operators about any likely practical implications of installing and maintaining the separators.	
4.4	Clear guidance should be developed to determine acceptable cross-section widths for both Major Cycleway facilities and other adjacent transport facilities (traffic lanes, footpaths, etc).	
4.4	Early identification is needed for each MCR project as to whether the existing road cross-section is capable of accommodating all road user requirements to a satisfactory standard. If this is not the case, then the project team must consider either (a) reconfiguring the kerb lines to achieve the necessary widths, or (b) relocating one or travel modes to an alternative route. The budgetary implications of both of these options must be fully considered at an early stage.	
5.2	The visibility of any future MCR design elements needs to be fully considered, both for day-time and night-time situations. This includes the relative height, colour/contrast, and reflective elements of any devices.	
5.3	Intervisibility sight lines should form a specific item to be checked in the design phase, and parking, planting and roadside objects should be positioned to avoid sight line restrictions.	
5.3	CCC should also develop a standard template for the	

	requirements for cycle crossing points similar to that for pedestrian crossings	
5.4	It is essential that all constructors have a good knowledge of the principles of CPTED, and that they identify site specific issues such as shading and at risk areas during construction, and that these issues are identified to the design team for immediate corrective action.	
6.1	Pedestrian / cyclist conflicts should be a specific point of focus during the design phase. All possible actions should be taken to separate the spaces required for each user group, minimising conflicts. Where separation is not possible, all care should be taken to ensure that sight lines and inter-visibility is maximised, and that appropriate speeds are imposed.	
6.3	*Vehicle tracking software should be utilised to confirm the safe movement of the expected vehicle types at intersections.*	
6.4	*Cycleway design should fully consider the accessibility of the parking spaces and potential manoeuvring of vehicles to ensure that conflicts are minimised, and access is maximised.*	
6.4	*Where possible, a safety zone should be created alongside the cycle facility to accommodate the opening of the passenger's door, and to provide a safe refuge for passengers to alight from the vehicle.*	
6.5	*On road / off road transitions should be designed to eliminate elements that would cause safety issues for the cyclist. The location of these transitions should be carefully considered to minimise conflicts with other road users at locations such as intersections and accessways.*	
6.6	*Publicity material should be developed (printed and/or online) for all new cycleway treatments, both specific to individual projects and for the Major Cycleways in general. The material should provide information for different audiences, including cyclists, drivers, pedestrians, bus-drivers, residents and business-owners.*	
7.1	*Where practical, early contractor involvement should be undertaken to ensure that the final design is constructible and does not require design variations during construction.*	
7.2	*It is imperative that the coloured markings are installed at the time of construction, and that where this is not possible, temporary signage / guidance is installed to assist with the conflict points.*	
7.3	*A best practice for the removal of old markings should be detailed that requires the operator to feather out the edges of the old markings so that sharp edge lines are not created, eliminating the risk of confusion.*	
7.3	*The design process should incorporate a specific*	

	pavement marking layout plan to ensure that the contractors have a clear source of information. Any changes during construction should be done in consultation with the design lead for the project.	
7.4	*Future designs should incorporate the formation of the construction joint into the central median. This should be a key review element during design and / or construction and will eliminate a potential safety issue for cyclists (especially in the wet).*	
7.4	*Future designs should incorporate specific consideration of road cross section and side slopes to ensure that an appropriate facility is constructed.*	
7.5	*The Maintenance and Operations section of Council should ensure that an effective cleaning and maintenance process is developed prior to any further similar cycle facilities are constructed.*	
7.5	*A separate budget item should be provided in future Council operational budgets to cover the ongoing maintenance of cycleways, and this should be adjusted to match the relative amount of total cycleways as they are constructed.*	
7.5	*Any future design and operation should take into account elements such as refuse collection, with a safe and effective process developed for implementation across all new cycle facilities as they come on line.*	
8.1	*The draft Process Flow presented should be developed further through a multi team workshop of appropriate representatives from the design, safety, construction and maintenance teams to ensure that the final document incorporates all elements through the life of the project.*	
8.3	*A "Cycle Facility Panel" should be established to oversee the development of best practice for the MCR programme. This should include representatives from each of the commissioned consultant design teams, key Council MCR planning staff, other Council operations staff (e.g. CTOC), and representatives from key contractors involved in construction and maintenance.*	

References

- Austroads (2011), *Cycling Aspects of Austroads Guides*, Austroads Publication No. AP-G88/11. ***www.austroads.com.au/abc/cycling-aspects-of-austroads-guides***
- Christchurch City Council (2010). *Construction Standard Specification (CSS)*, Part 6 – Roads. ***www.ccc.govt.nz/business/constructiondevelopment/constructionstandardspecification.aspx***
- Christchurch City Council (2013). *Christchurch Cycle Design Guidelines*. ***www.ccc.govt.nz/thecouncil/policiesreportsstrategies/transportplan/***
- CROW (Centre for Research & Contract Standardisation in Civil Engineering), (2007). *Design Manual for Bicycle Traffic*. CROW record 25, Ede, The Netherlands.
- Koorey G., Wilke A., Aussendorf J. (2013), "Assessment of the Effectiveness of Narrow Separators on Cycle Lanes", *IPENZ Transportation Group Conference*, Dunedin, 14-16 Apr 2013, 16pp. ***http://conf.hardingconsultants.co.nz/ipenztg2013/programme/***
- Land Transport New Zealand (2004), *Cycle Network and Route Planning Guide*, Wellington. ***www.nzta.govt.nz/resources/cycle-network-and-route-planning/***
- Land Transport NZ (2006). *Non-Motorised User Review Procedures: Interim Guideline – for trial and comment*. ***www.nzta.govt.nz/resources/pedestrian-planning-guide/resources.html***
- New Zealand Government (2003). *Land Transport Rule: Setting of Speed Limits 2003*. Rule 54001. ***www.nzta.govt.nz/resources/rules/setting-speed-limits-2003-index.html***
- New Zealand Transport Agency (2013). *Road Safety Audit Procedures for Projects: Guideline*. Interim release, May 2013. ***www.nzta.govt.nz/resources/road-safety-audit-procedures/***

Appendix A – Suggested Design Standard Format

Minimum Standards for Christchurch Major Cycleway Routes

Here are some proposed standards to help assess provision for cycling along the planned MCRs. Route planning/design decisions should be based on achieving at least the “Expected Standard” where possible.

These standards can be used for both design/construction of **new** routes and auditing/upgrading of **existing** routes.

Where necessary, values should be interpolated between listed speeds/volumes.

Where demand or conflict is unusually high, it may be prudent to shift to the “Excellent Standard” as the base requirement.

Design exceptions to these standards should only be granted where it is considered highly technically infeasible or prohibitively expensive to meet at least the “Tolerable Standard", or by political veto (seek prior agreement of these standards from Council to minimise the latter).

It is expected that **no more than 20%** of any MCR route should fall below Expected Standards in any attributes, and **no more than 10%** of any route should have design exceptions. In the long-term, plans should be made to improve these sub-standard sections.

Design Attribute	**Excellent Standard** *Best-case for MCR where able to be provided easily (or where compensating for other design deficiencies)*	**Expected Standard** *Target for most MCR designs. Start with this and then consider surrounding feasibility*	**Tolerable Standard** *Acceptable where necessary (usually accompanied by corresponding improvement in other standards at same place)*	**Insufficient Standard** *Generally not acceptable for MCRs unless agreed by design exception*
Shared Pathway: Width (peak ped+cyc volumes <200/hr)	≥ 4.0m	≥ 3.0m	≥ 2.5m	≤ 2.4m
Shared Pathway: Width (peak ped+cyc volumes >200/hr)	≥ 5.0m	≥ 4.0m	≥ 3.0m	≤ 2.9m
Shared Pathway: Segregation (peak ped volumes > 200/hr)	Separate Pathways	Mode Separator Line	Directional Centreline	No segregation/control
Shared Pathway: Design Speed for Alignment	≥ 40km/h	≥ 30km/h	≥ 20km/h	<20km/h
Grade Separation or Bridges: Width between walls/rails	≥ 5.0m	≥ 4.0m	≥ 3.0m	≤ 2.9m
Quiet Street: Operating Speed (AADT < 2000 vpd)	≤ 30km/h	≤ 40km/h	≤ 50km/h	≥ 60km/h
Quiet Street: Operating Speed (AADT 2000-4000 vpd)	≤ 20km/h	≤ 30km/h	≤ 40km/h	≥ 50km/h

Design Attribute	**Excellent Standard** *Best-case for MCR where able to be provided easily (or where compensating for other design deficiencies)*	**Expected Standard** *Target for most MCR designs. Start with this and then consider surrounding feasibility*	**Tolerable Standard** *Acceptable where necessary (usually accompanied by corresponding improvement in other standards at same place)*	**Insufficient Standard** *Generally not acceptable for MCRs unless agreed by design exception*
Quiet Street: Treatment at Traffic Management Devices	Restrict Motor Vehicle Access	Separate Bypass on Road	Bypass via Shared Footpath	No Special Provision
Separated Bikeways: Form of Separators (50km/h Road)	Solid Kerbs / Separators	Vertical Posts / Low Kerb Separators	Paint Buffer ≥ 0.5m	No Separators (Painted Line Only)
Separated Bikeways: Form of Separators (60km/h Road)	Separation ≥ 1.0m	Solid Kerbs / Separators	Vertical Posts / Low Kerb Separators	Paint Buffer
Separated Bikeway: Lane Width (with solid separators)	≥ 2.2m	≥ 2.0m	≥ 1.8m	≤ 1.7m
Separated Bikeway: Lane Width (rideable separators)	≥ 2.0m	≥ 1.8m	≥ 1.6m	≤ 1.5m
Separated Bikeway: 2-Way Lane Width	≥ 3.5m	≥ 3.0m	≥ 2.5m	≤ 2.4m
Separated Bikeway: Cycle Right Turns at Intersections	Grade Separation (Underpass / Overbridge)	Separate Cycle Signals e.g. Cycle Barnes Dance	Hook Turn Boxes	Normal Traffic Signals
Separated Bikeway: Treatment at Bus Stops	Avoid Bus Stops on Bikeway Route	Bypass Path behind Bus Stop	Bus Bay to Minimise Encroachment	Normal Kerbside Bus Stop
Separated Bikeway: Side Road / Accessway Treatments	Avoid Side Roads on Bikeway Route	Raised Crossings	Signage and Markings	Normal Side Road
50k Road Crossing: Control or Xing Aids (AADT < 8000 vpd)	Traffic Signals / Grade Separation	Zebra Crossing / Median Island	Kerb Extensions / Raised Platform	No Control or Xing Aids
50k Road Crossing: Control or Xing Aids (AADT > 8000 vpd)	Grade Separation (Underpass / Overbridge)	Zebra Crossing / Traffic Signals	Median Island	Kerb Extensions / Platform

Design Attribute	**Excellent Standard** *Best-case for MCR where able to be provided easily (or where compensating for other design deficiencies)*	**Expected Standard** *Target for most MCR designs. Start with this and then consider surrounding feasibility*	**Tolerable Standard** *Acceptable where necessary (usually accompanied by corresponding improvement in other standards at same place)*	**Insufficient Standard** *Generally not acceptable for MCRs unless agreed by design exception*
50k Road Crossing: Average Xing Delay (AADT < 8000 vpd)	< 5 sec	< 10 sec	< 15 sec	> 15 sec
50k Road Crossing: Average Xing Delay (AADT > 8000 vpd)	< 10 sec	< 15 sec	< 20 sec	> 20 sec
MCRs: Route Directness / km (vs straight line length)	< 120%	< 140%	< 160%	> 160%
MCRs: Maximum Gradients (average/100m & maximum)	Average ≤ 3% / 100m and Maximum ≤ 5%	Average ≤ 5% / 100m and Maximum ≤ 7%	Average ≤ 8% / 100m and Maximum ≤ 10%	Average > 8% / 100m or Maximum > 10%
MCRs: Connections between paths and roads - deviation	Horizontally ≤ 15° and vertically ≤ 4% / no lip	Horizontally ≤ 30° and vertically ≤ 8% / 5mm lip	Horizontally ≤ 45° and vertically ≤ 12% / 10mm lip	Horizontally > 45° or vertically > 12% / 10mm lip
MCRs: Drainage – ponding per 100m after 10mm/hr rainfall	Virtually no ponding	< 5% of length ponding	< 10% of length ponding	> 10% of length ponding
MCRs: Route Lighting (NZS 1158 lighting category std)	P1/P2	≥ P3	≥ P4	< P4