Evaluation of the Mooloolaba to Minyama Separated Bikeway, Stages 1, 3 and 4a

Prepared for Queensland Department of Transport and Main Roads

CDM RESEARCH

Contents

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Executive Summary

The Department of Transport and Main Roads (TMR) commissioned CDM Research to undertake an evaluation of the Mooloolaba to Minyama Separated Bikeway Stages 1, 3 and 4a from Neerim Road to Culbara Street (390 m), across Tuckers Creek and along Bindaree Crescent (250 m). The bi-directional cycleway is physically separated from the roadway and includes path priority crossings of Neerim Drive and Elanora Avenue.

Two fieldwork activities were undertaken to obtain input data for the evaluation:

- video-based manual counts classified by mode, direction of travel and time of day over a sequential 7-day period (Saturday 8 October 2016 to Friday 14 October 2016), and
- intercept surveys with bikeway users undertaken over three weekday AM periods and two weekend days.

The data was input into a cost-benefit analysis to estimate the monetary project benefits. The key results of this evaluation were as follows:

- Average cyclist traffic at Elanora Avenue was 324 riders between 5 am and 7 pm, with most (96%) using the cycleway over the footpath. Demand was much higher on weekends (430 riders per day) than weekdays (281 riders).
- Most bicycle riders were using the cycleway for recreation (69% on weekdays and 89% on weekends). On weekdays, the other main uses were commuting (18%) and travel to education (8%)
- Most bicycle riders would have ridden irrespective of the presence of the bikeway (57% of transport and 79% of recreation riders). Around 21% of transport riders would have taken a bus and a similar proportion would have driven a car (either as a driver or passenger) if the bikeway were not present. Around 10% of recreation riders would not have travelled in the absence of the bikeway.
- The average recreation cycling trip was about 17 kilometres over 51 minutes, compared to 7 kilometres over 30 minutes for transport.
- The user catchment is almost exclusively from the adjoining suburbs of Mooloolaba, Warana and Minyama.
- Observations of bicycle riders at Elanora Avenue suggested that while the likelihood of encountering a motorist was low (around 3.5%), when an interaction did occur the motorist gave way to bicycle riders in 73% of cases and 77% of cases with pedestrians. In just under half (47%) of bicycle rider interactions the rider did not need to adjust their speed or trajectory, compared to 80% of interactions involving pedestrians.
- In our view the intersection of Elanora Avenue performs to a satisfactory level of safety, although we suggest consideration be given in future designs to specifying a ramp grade of at least 1:10 and ideally closer to 1:6 and to position the give way linemarking on the main street at the outer kerb.

- The cost-benefit analysis suggests the project represents fair value for money; the BCR for the central discount rate of 7% was around 1.5. The benefits accrued primarily from health benefits for recreational bicycle riders who would not otherwise have travelled, or transport riders who would otherwise have driven a car or taken a bus. The benefits significantly outweigh the injury disbenefits.
- Bikeway users were positive towards the path. Suggested improvements were to improve pedestrian compliance and the design of uncontrolled intersections such as at Elanora Avenue.

1 Introduction

1.1 Background

CDM Research was commissioned by the Queensland Department of Transport and Main Roads (TMR) to undertake an evaluation of the Mooloolaba to Minyama Separated Bikeway from Neerim Drive to Bindaree Crescent. The bi-directional cycleway extends over around 760 m and consists of three sections:

- Stage 1: 4 m wide shared path bridge over Tuckers Creek alongside Brisbane Road (completed in 2012),
- Stage 3: 3 m wide cycleway from Neerim Drive to Culbara Street (completed in 2015), and
- Stage 4a: 3 m wide cycleway along Bindaree Crescent (completed in 2015).

In the longer term it is intended that the cycleway will extend northwards to the beach across Mayes Canal and along River Esplanade, and south to Nicklin Way. The total project cost to date has been $8.252 m. This project cost includes on-road bicycle lanes on parts of Brisbane Road which are not captured within this evaluation. Nonetheless, most of the project cost can be attributed to the bridge and path construction.

■ **Figure 1.1: Mooloolaba to Minyama separated bikeway (aerial image: Nearmap, 22 September 2016)**

1.2 Methodology

This evaluation adopted a cost-benefit analysis (CBA) methodology as developed previously for TMR (CDM Research 2016). The CBA tool is implemented online[1]. The methodology requires a number of inputs, of which the most important are:

- average daily pedestrian and cyclist counts,
- average distances walked/ridden, and
- diversion rates and induced travel proportions.

The latter refer to the proportion of demand that:

- was already walking/riding before the project, and have changed their route to use the project,
- have diverted from other transport modes (e.g. private car, public transport), and
- all-new trips that would not have otherwise occurred in the absence of the project.

In order to obtain these input parameters two fieldwork activities were undertaken:

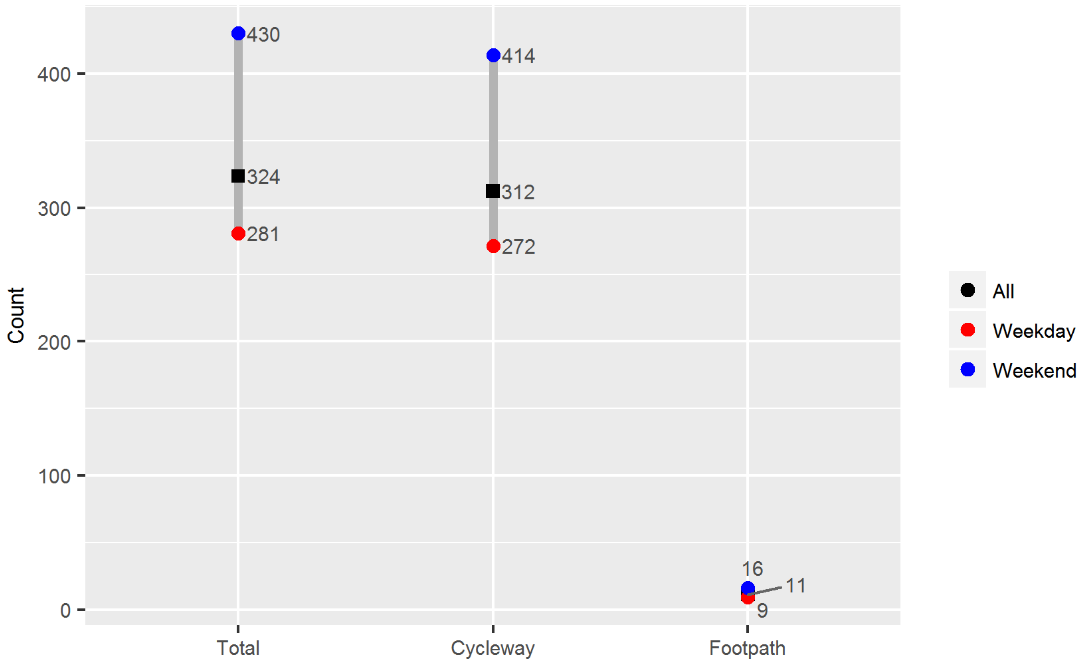
1. video-based manual counts classified by mode, direction of travel and time of day from 5 am to 7 pm between Friday 7 October 2016 and Thursday 13 October 2016 at the intersection with El, and
2. intercept surveys with bikeway users undertaken between 8 am and 11 am on Wednesday 16 November, Friday 18 November, Sunday 20 November, Friday 25 November and Saturday 26 November 2016.

This report first presents the summary data obtained from the fieldwork activities before then providing the output of the cost-benefit analysis.

[1] https://cdmresearch.shinyapps.io/ActiveTravelBenefits/

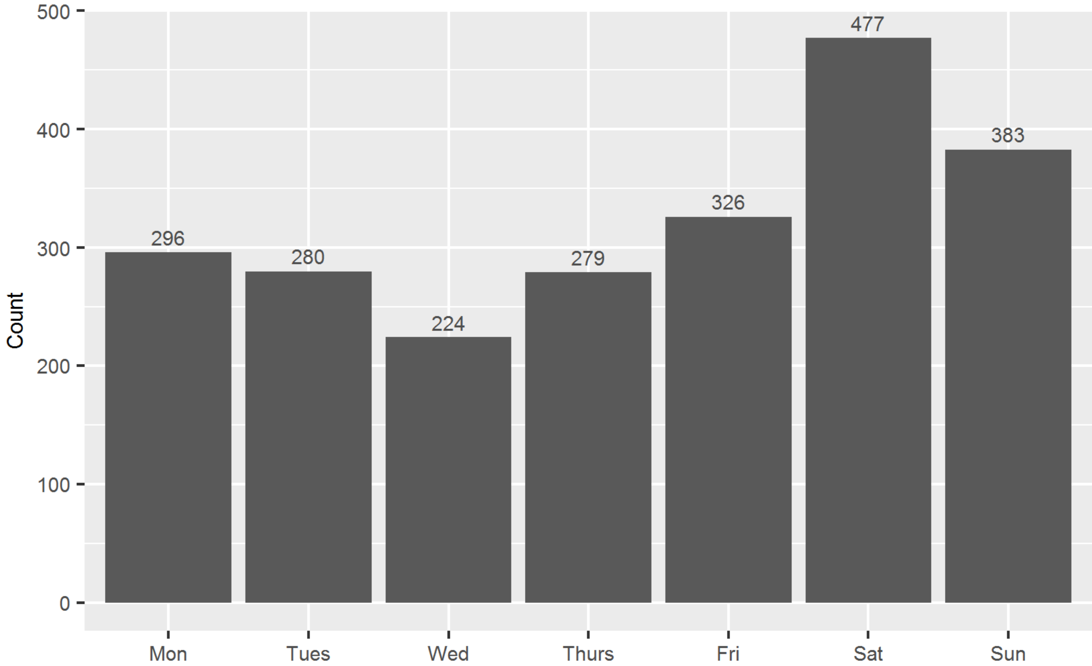
2 Counts

Bicycle rider counts were obtained immediately south of Elanora Avenue on both the cycleway and footpath. On a typical day there were 324 bicycle riders at this location, increasing to 430 on weekends (Figure 2.1). A clear majority (96%) of riders chose to use the cycleway. Of those who used the footpath most were children accompanied by walking parents or guardians.



■ **Figure 2.1: Average count by mode and day of week (5 am – 7 pm)**

The counts by day of week fluctuated as shown in Figure 2.2. The Wednesday was the quietest day (224 riders) while the Saturday was the busiest (477 riders). The time of day profile suggests demand is strongest during mornings (Figure 2.3).



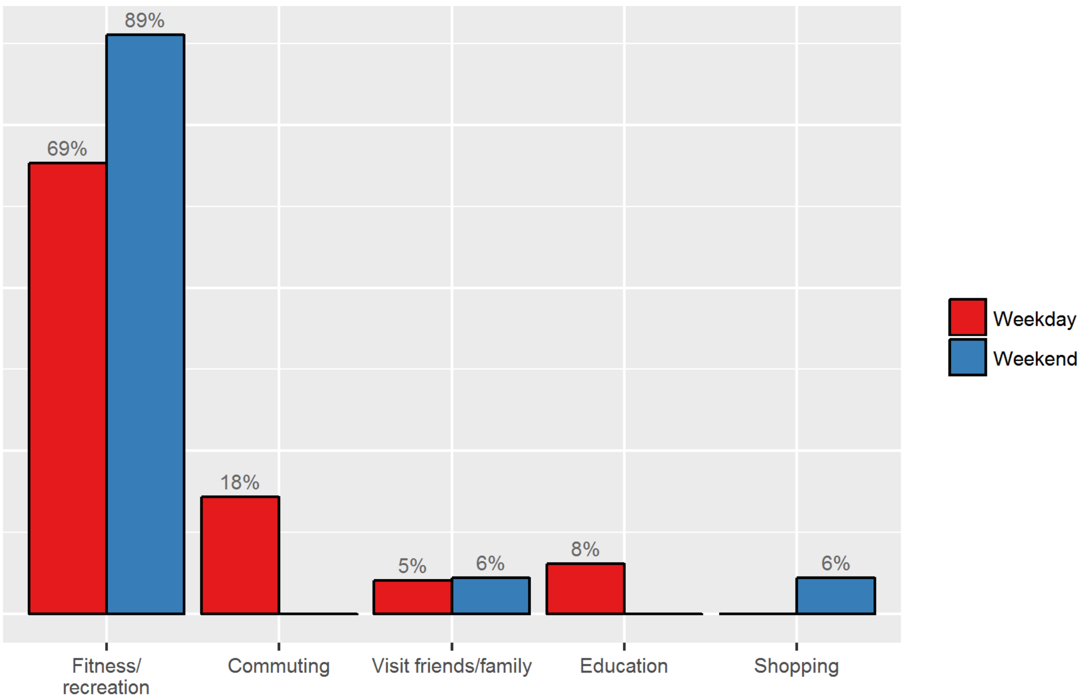
■ **Figure 2.2: Bicycle riders by day of week by mode (both cycleway and footpath)**

■ **Figure 2.3: Bicycle riders by time of day by day of week (hourly bins) (both cycleway and footpath)**

3 Intercept surveys

Intercept surveys were conducted with bikeway users immediately south of Elanora Avenue over five days in November 2016. A total of 57 complete interviews were obtained.

Around two thirds of bicycle riders on weekdays and 89% on weekends were travelling for recreation (Figure 3.1). On weekdays, most transport riding trips were for commuting (18%) or education (8%).



■ **Figure 3.1: Trip purpose by day of week**

The average bicycle trip for recreation had a duration of 51 minutes (Figure 3.2) over 17 kilometres (Figure 3.3). Transport cycling trips were shorter on average (30 minutes over 7 kilometres).

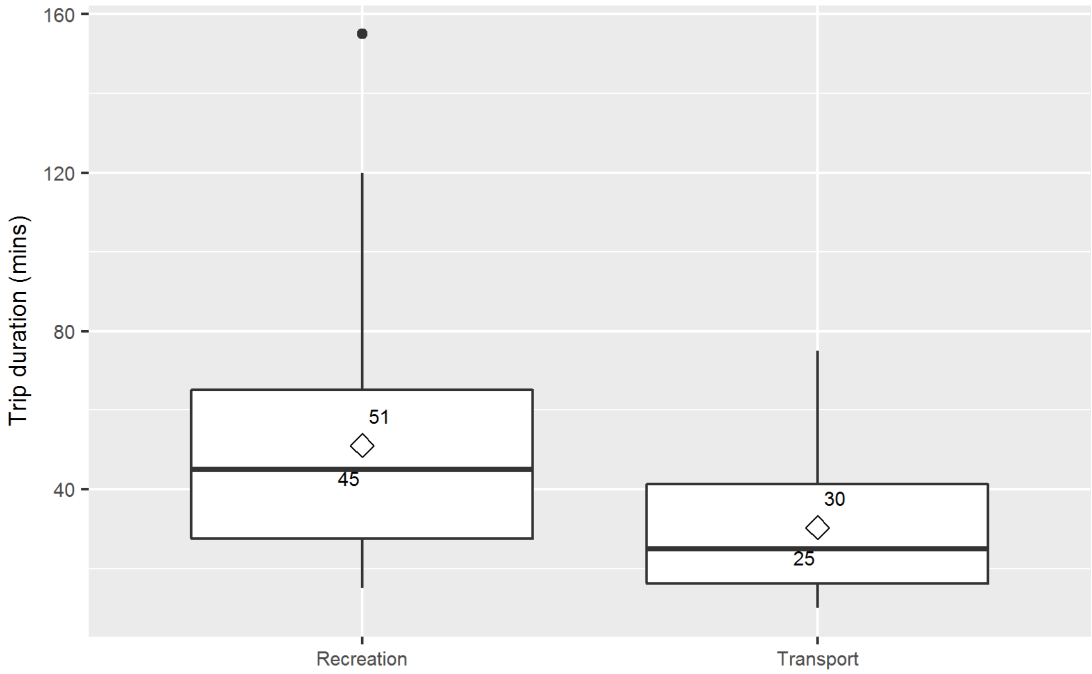


Figure 3.2: Trip duration by mode and purpose (diamonds are means, lines are medians)

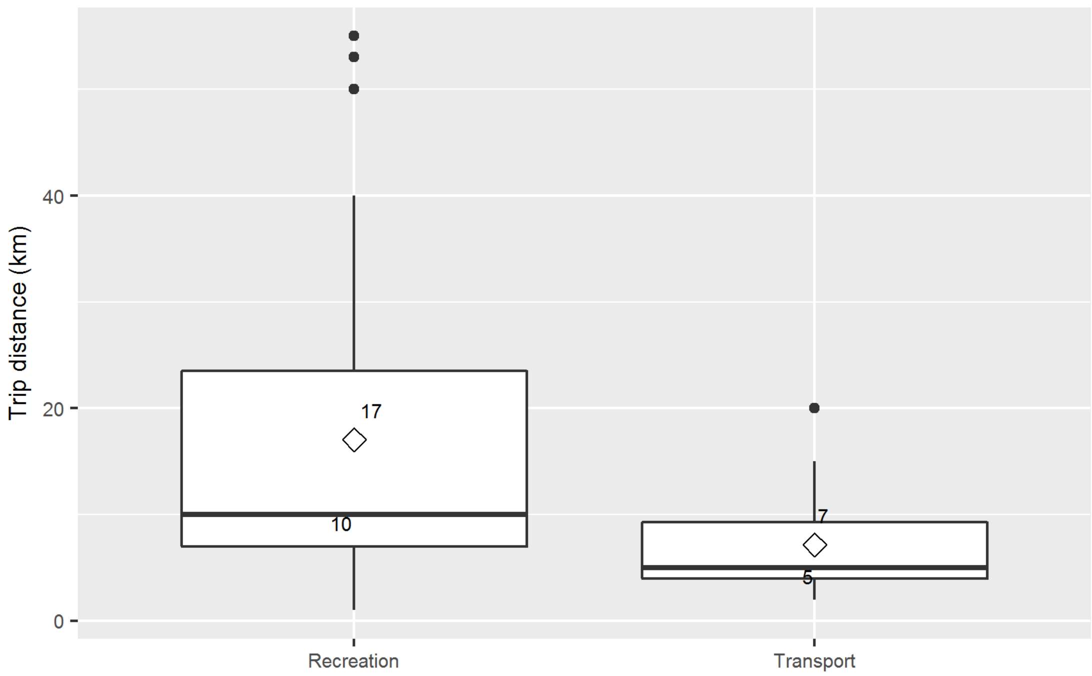


Figure 3.3: Trip distance by mode and purpose (diamonds are means, lines are medians)

The trip origin and destination suburbs by purpose for cycling trips are illustrated in Figure 3.4 for recreation trips and Figure 3.5 for transport trips. The predominant trip flows are as follows:

- Around 35% of recreation cycling trips started and finished in Mooloolaba, followed by Warana (11%) and Minyama (9%) (Figure 3.4).
- The majority of transport cycling trips were from Warana to Mooloolaba, Warana to Maroochydore and Mooloolaba to Mountain Creek (each 14%) (Figure 3.5).

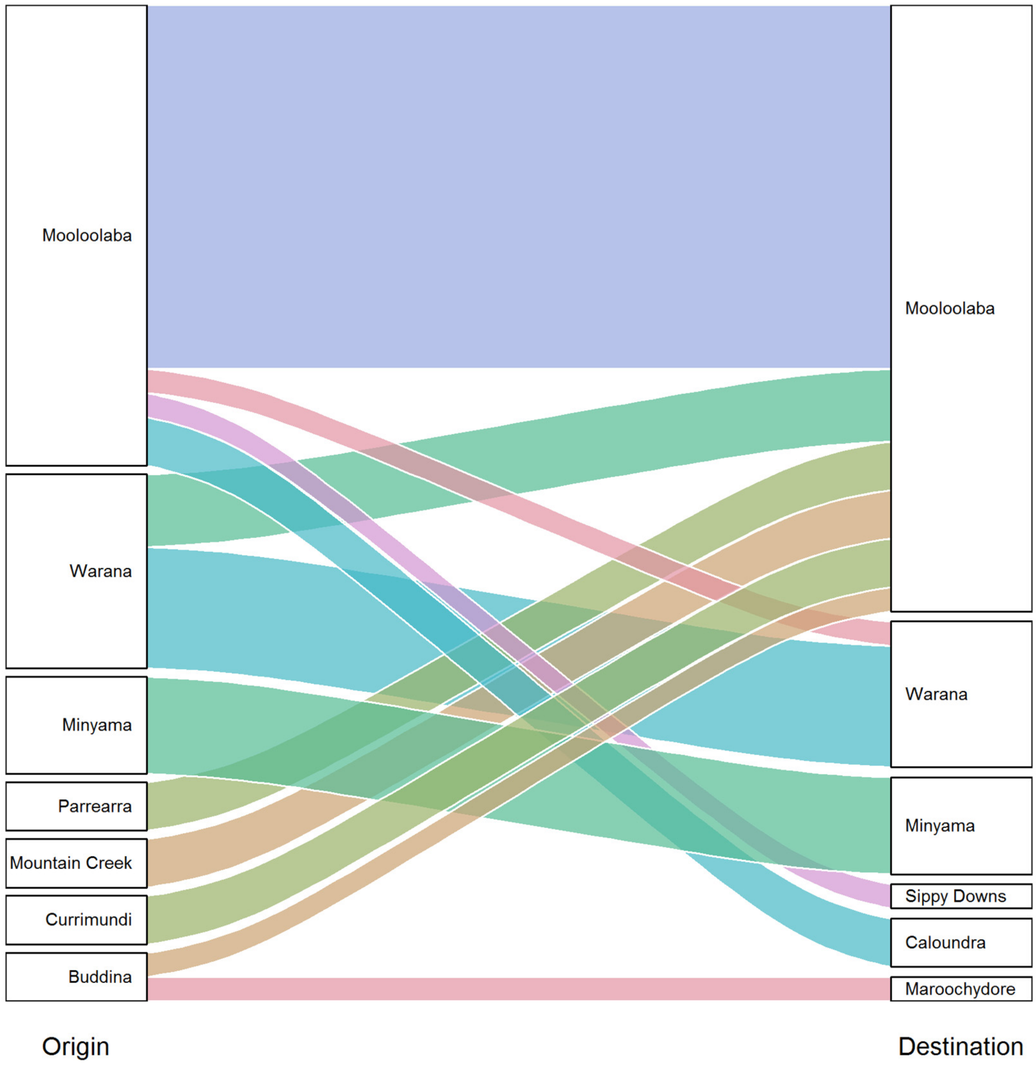


Figure 3.4: Origins and destinations of cycling trips for recreation (n=43)

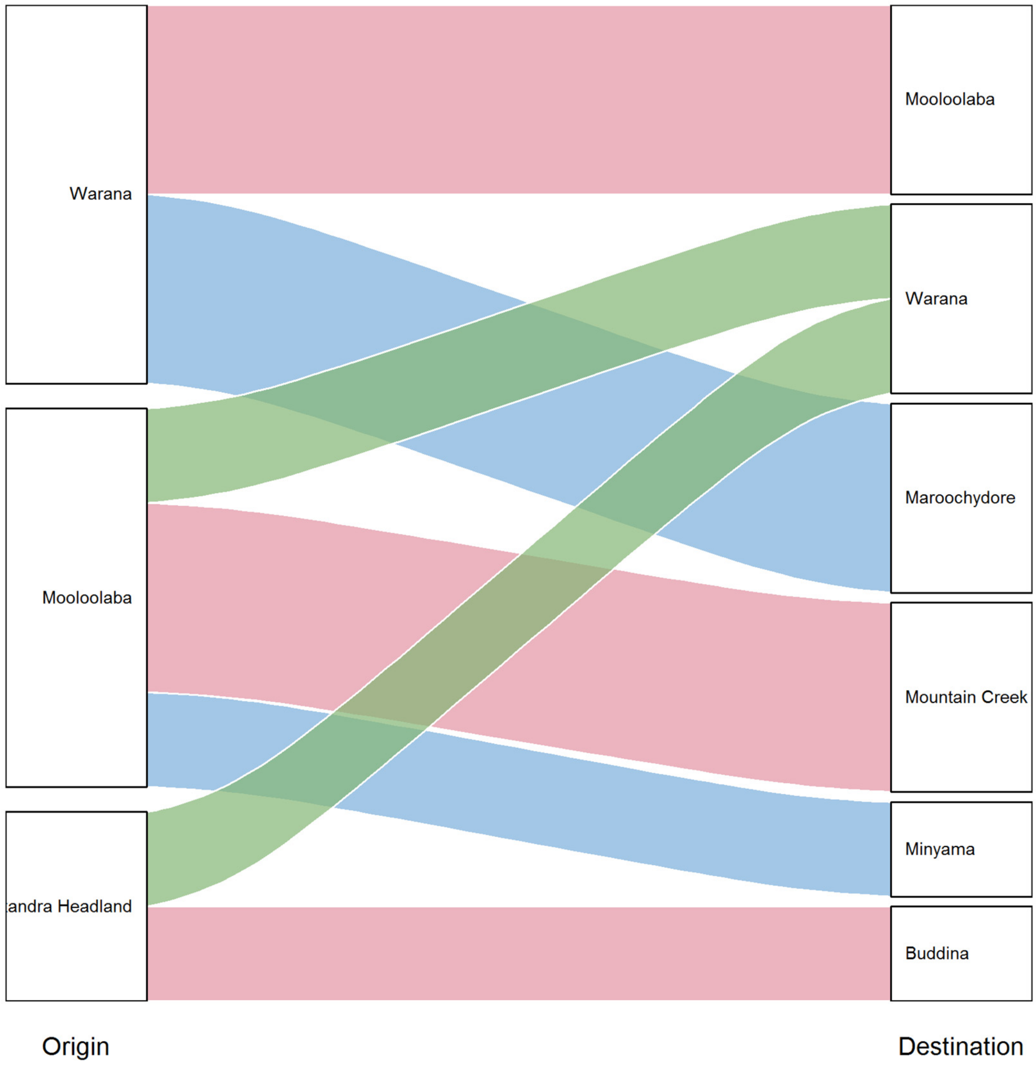


Figure 3.5: Origins and destinations of cycling trips for transport (n=14)

Respondents were asked what they would have done for their trip if the bikeway were not present. Around 57% of those travelling for transport and 79% of those travelling for recreation would have taken a different route, presumably along Brisbane Road itself (Figure 3.6). Among those riding for transport 21% would otherwise have taken a bus and a further 21% would have driven a car. Among recreation riders 10% would not have travelled in the absence of the bikeway.

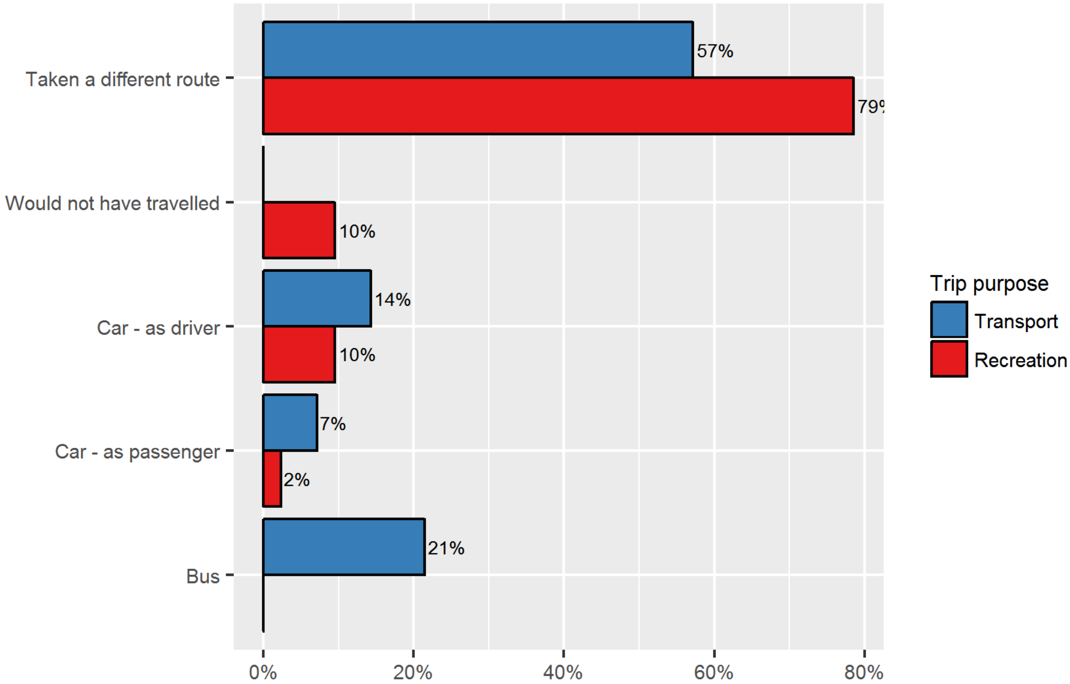


Figure 3.6: What would you have done if this bikeway was not here?

Bicycle riders were asked what they would have done if they could not have used their bicycle for their trip. The most frequent response among those riding for recreation was that they would have used a car (51%), followed by walking (23%) and would not have travelled (21%) (Figure 3.7). We suggest that among at least a proportion of those who would otherwise have driven for recreation they would have driven to a location from where they could undertake some other form of physical activity. Among transport riders most would either have driven a car or been a passenger in a car (42%) or taken a bus (36%). These findings are broadly consistent with Figure 3.6 and suggest both that there are significant physical activity benefits and mode shift occurring from private car.

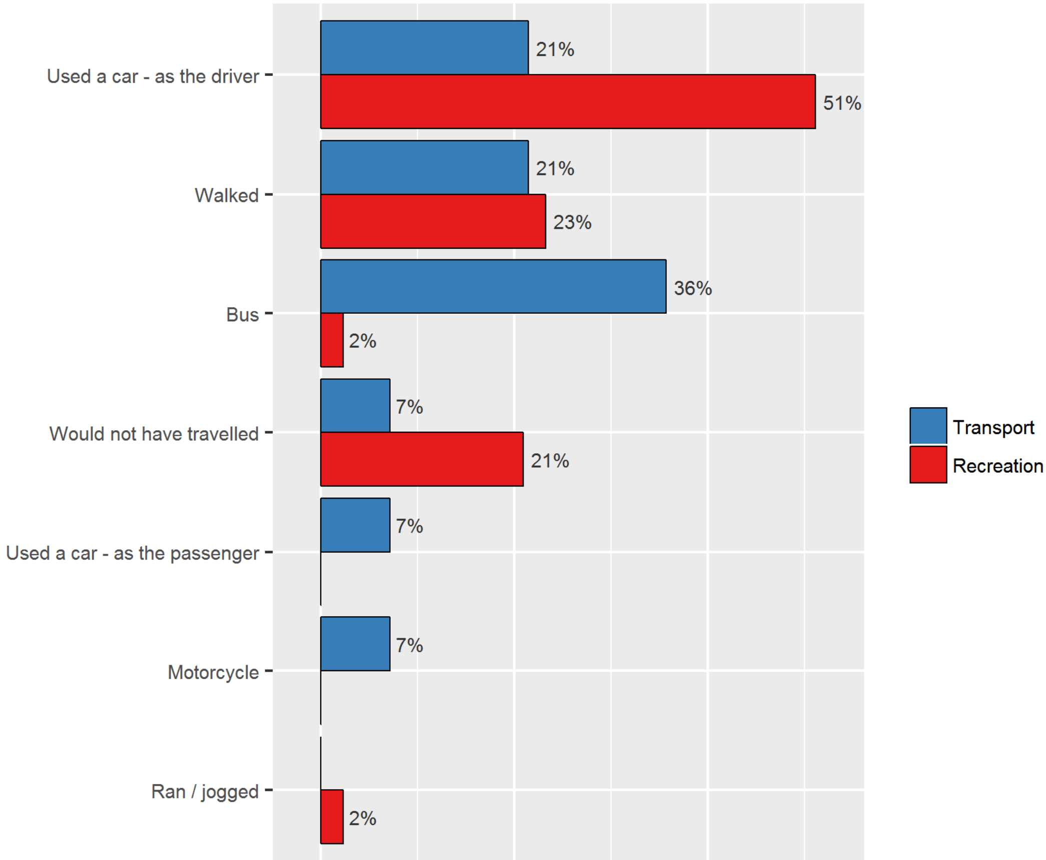
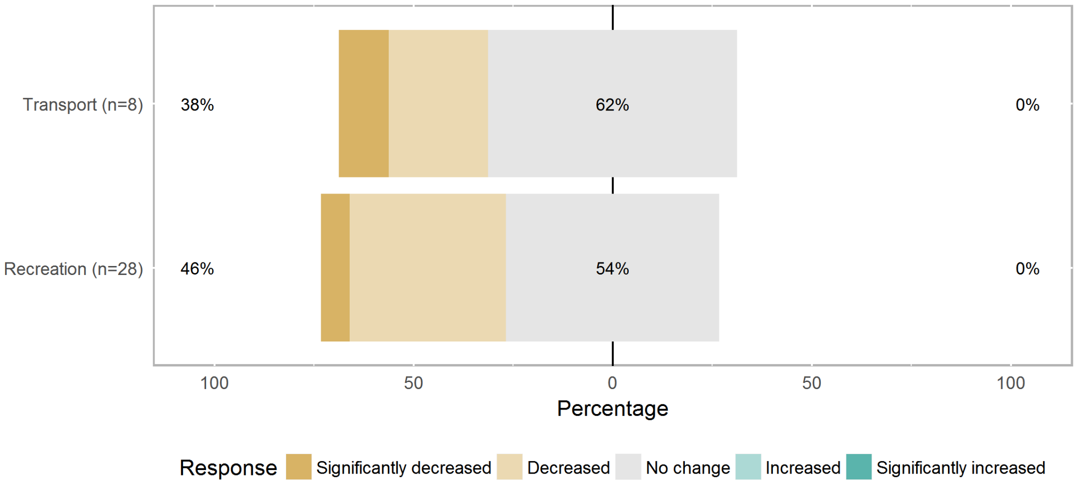


Figure 3.7: What would you have done if your bicycle was not available for this trip?

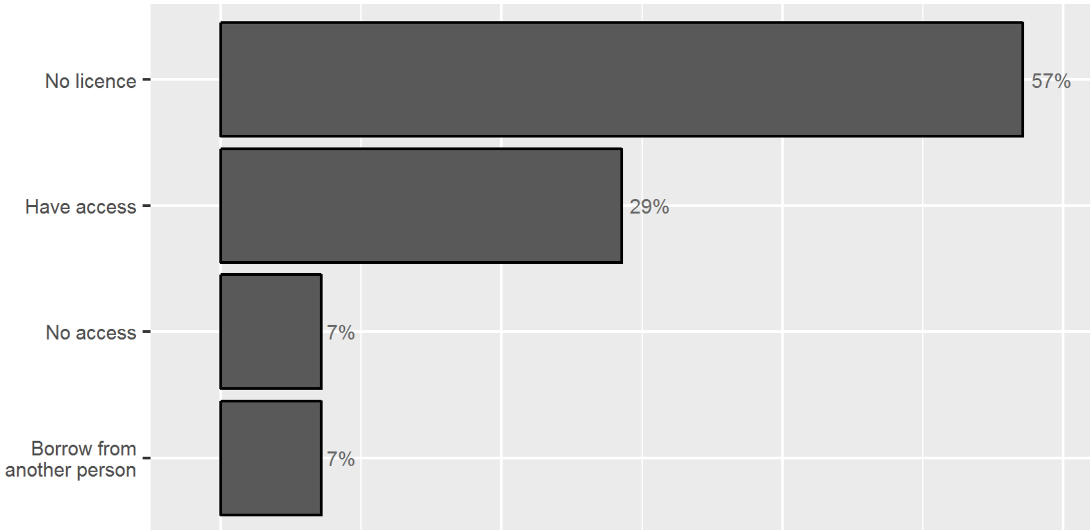
Respondents were asked whether the path had changed the amount of riding they'd done over the past month. The intention of this question was to elicit whether the bikeway had led to increased cycling, and presumably therefore physical activity. However, just over half of both transport and recreation riders indicated the bikeway had not changed the amount of riding they'd undertaken, and in both cases a sizeable minority indicated the bikeway had decreased their riding duration. Why this would be the case is not entirely clear, and is contrary to most other locations where this survey has been undertaken. It seems unlikely the bikeway would reduce riding travel times, as it presumably takes a similar amount of time to ride along Brisbane Road as it does the cycleway. Furthermore, a sizeable minority of riders indicated they had diverted from private car or bus to use the bikeway, and some recreation riders would not have travelled at all (Figure 3.6). We can only speculate as to the explanation for this survey finding, but suggest either respondents or interviewers misinterpreted the question.



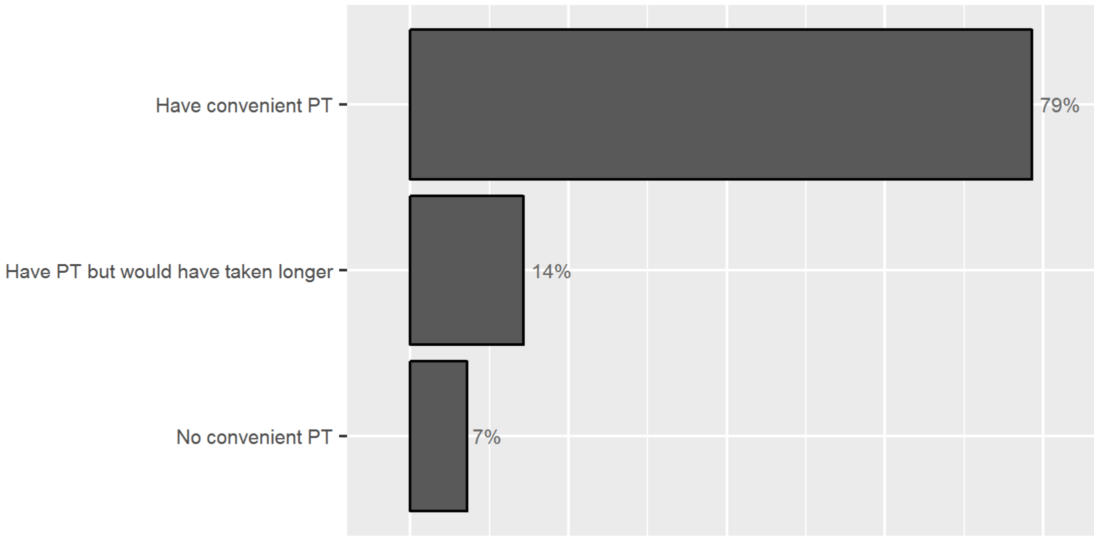
■ **Figure 3.8: Has the path changed the amount of time you've spent riding over the past month?**

Respondents who were travelling for transport purposes (e.g. commuting, education, shopping) were asked whether they could have used a motor vehicle for their trip. In considering these results, it should be noted that the sample size is small (n=14). Just over half of bicycle riders had access to a motor vehicle (Figure 3.9). Of the sample that could have used a car 60% indicated a car would have been quicker, while a further 20% indicated a car would have taken more time than riding. This result is notable insofar as it suggests these active transport users are choosing these modes despite the longer travel times. This is contrary to the typical assumption in transport appraisal practice where it is assumed travellers want to minimise their travel time. Clearly, there are other intrinsic benefits to active travel which travellers consider to more than compensate for the additional travel time.

Respondents were also asked about the available of a public transport alternative for their trip; 79% of bicycle riders indicated they had a viable public transport option (Figure 3.10).



■ **Figure 3.9: Car availability for transport trip purposes**



■ **Figure 3.10: Public transport availability for transport trip purposes**

Respondents were invited to offer any other thoughts at the completion of the survey. Respondents almost universally indicated strong support for the path (Appendix B). The most frequently cited concerns were about pedestrians walking along the bikeway and the intersection of Elanora Avenue.

4 Intersection analysis

4.1 Introduction

The bikeway has road crossovers at Neerim Drive (signalised), the entry to the service road opposite Akeringa Place, Elanora Avenue and a small car park opposite Pangarinda Place. The intersection at Elanora Avenue is most likely to represent the location where uncontrolled interactions may occur between road and path users. The intersection is a bent-out path priority design with the crossing setback 7 m from Brisbane Road (Figure 4.1). The bikeway is 3 m wide and coloured green from 17 m behind the intersection to the north and 33 m to the south. The footpath crossing is sand coloured concrete. The crossing itself is raised to footpath grade on a ramp.

■ **Figure 4.1: Elanora Avenue intersection aerial view (source: Nearmap, 22 September 2016)**

The priority crossing design is unusual in Queensland, and this is the first such crossing on the Sunshine Coast. However, such crossings have been present for a number of years in NSW and Victoria and do not appear – in general - to present undue safety hazards (CDM Research 2015). However, the varying contexts in which these intersections have been introduced, combined with the novelty of the design on the Sunshine Coast, warrant some form of further evaluation. This section presents an observational evaluation of road and path user behaviours at the intersection to provide some indication of the possible safety and design implications.

4.2 Methodology

The video footage obtained for the counts was used to identify interactions between motorists turning into or out of Elanora Avenue while a bicycle rider or pedestrian was present. An interaction was defined where one or both users needed to adjust their speed or trajectory to avoid conflict. In the vast majority of interactions we would expect minimal stress, discomfort or surprise to be experienced by the path and road users as they gently adjust their trajectory or speed.

The interactions were classified by mode, direction of travel and an interaction severity score. This score was a subjective assessment of the severity of the interaction, and was judged primarily upon the likely level of surprise or confusion experienced by one or both users (Table 4.1).

■ **Table 4.1: Interaction severity scale**

Score	Title	Description
1	No incident	Path user does not need to alter course or speed. Motorist yields and allows cyclist to pass without incident or apparent stress on behalf of either party.
2	Minor adjustment required	Path user may need to alter course slightly to allow for a comfortable passing distance, or (in the case of cyclists) gently brake or alter pedalling rhythm. The situation is unlikely to be perceived as unsafe, but may be perceived as inconvenient or somewhat confusing. Similarly, a motorist may need to brake or alter course gently and be somewhat confused as to who will take priority. There is unlikely to be any sense of surprise or fright on behalf of either party, but there may be some level of confusion.
3	Major adjustment required	Path user and/or motorist may need to significantly alter course or adjust speed to avoid a collision. There is a heightened level of stress from one or both parties, and likely surprise or fright. However, this adjustment by either party readily avoids a collision.
4	Near collision	A rapid change of course or speed is required by the path user, motorist or both parties to avoid imminent collision. A significant degree of fear and fright is likely. The parties may gesture to one another.
5	Collision	There is physical contact between the parties.

4.3 Results

Over the seven days for which observations were available, consisting of 98 hours of footage, there were 143 interactions observed. Of these, 55% involved bicycle riders and motorists and the remaining 45% involved pedestrians or runners and motorists. This equates to an average chance a rider will encounter a motorist at the intersection of around 3.5%. Just over two thirds of interactions involved motorists emerging from Elanora Avenue (Table 4.2).

■ **Table 4.2: Interactions by mode and direction of travel**

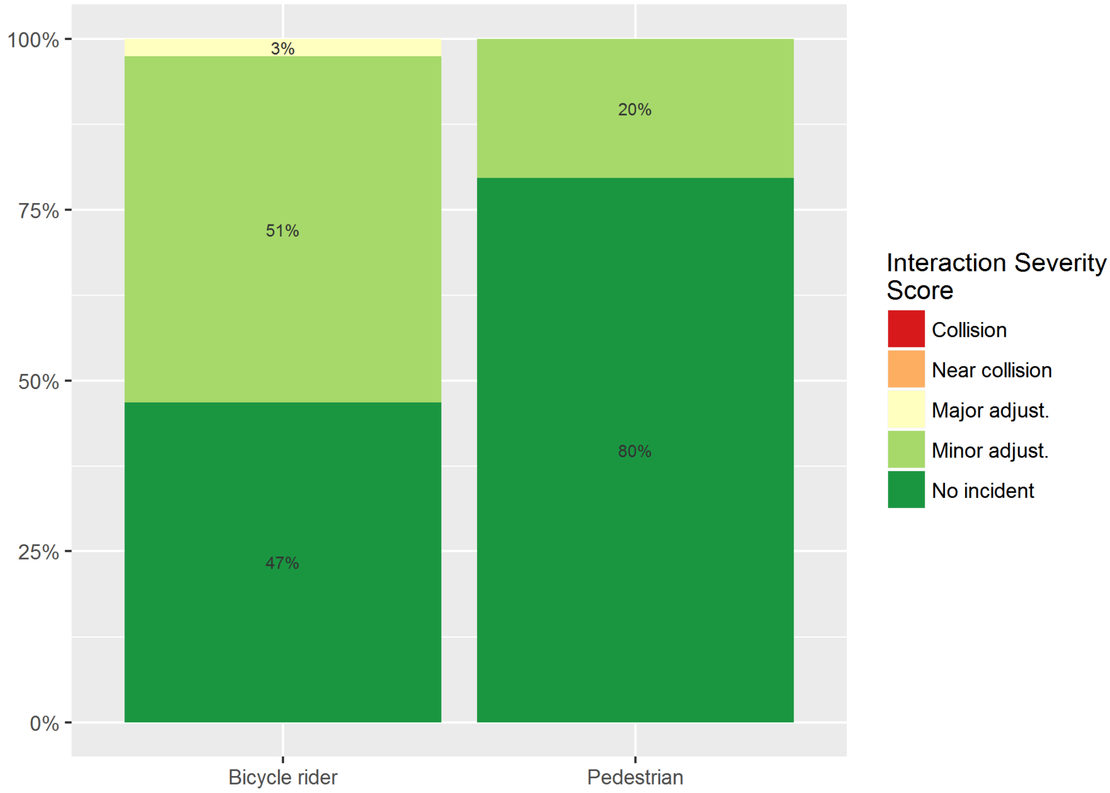
	Path user direction of travel	Motorist direction of travel			
		Into Elanora Av		Out of Elanora Av	
Bicycle rider	North	13		30	
	South	9		27	
	Subtotal	*22*	*(48%)*	*57*	*(59%)*
Pedestrian	North	19		23	
	South	5		17	
	Subtotal	*24*	*(52%)*	*40*	*(41%)*
TOTAL		**46 (32%)**	**(100%)**	**97 (68%)**	**(100%)**

In 75% of interactions the motorist gave way to the path user in accordance with the design intent. The proportion of motorists failing to give way to bicycle riders (27%) and pedestrians (23%) were not significantly different. Among interactions between bicycle riders and motorists where the motorist did not give way the bicycle rider was only observed to clearly "let" the motorist through on one occasion (5%). However, when a motorist did not give way to a pedestrian in almost all instances the pedestrian gestured to the motorist to proceed ahead of them (93%). This deference of pedestrians towards motorists was also evident in numerous instances where the pedestrian would be observed to break stride upon seeing a motorist, and regular waving to acknowledge waiting motorists.

In 13% of interactions some hesitation was observed on the part of one or both the path user and motorist. Usually this hesitation seemed to arise because both parties intended to give way, or in some instances the path user appeared to be unsure whether the motorist was intending to give way. The proportions were not significantly different for interactions between motorists and pedestrians (14%) and motorists and bicycle riders (11%).

The interaction severity was almost always rated "minor adjustment" or below, with interactions involving bicycle riders generally having high interaction severity than those involving pedestrians (Figure 4.2). We attribute the higher interaction severity involving bicycle riders to two factors:

- the relatively unusual situation which reduces the expectancy that motorists have have to look and see bicycle riders, and
- that bicycle riders will, generally, be travelling faster than pedestrians and so be more difficult for motorists to detect and judge their speed correctly.



■ **Figure 4.2: Interaction severity score**

4.4 Discussion

In our assessment, the priority intersection appears to perform satisfactorily from a safety standpoint. We base this conclusion based on the following rationale:

- most road and path users are travelling slowly through the intersection, thereby allowing them to slow or stop as necessary and –should a collision occur – the consequence of a collision is unlikely to be severe,
- Elanora Avenue is a minor local street with low traffic volume such that the likelihood of a path user encountering a motorist is about 1 in 28, and
- the likelihood of incurring an interaction that involves significant surprise or concern is low (even in the unlikely event an interaction does occur).

We would note the first of these comments as particularly important to a fault tolerant design[2]; it must be recognised that – no matter how rare – there will be instances where near-conflict interactions will occur. The challenge is to both minimise the frequency of

[2] Fault tolerance is central to the Safe System principles which underpin Queensland's Road Safety Strategy.

these interactions, which we suggest the design has largely achieved, and minimise the risks once they do occur.

Despite our general comfort with the design we recognise that the unusual nature of the intersection in a Queensland context does present an additional burden upon motorists to carefully scan the intersection for path users. Furthermore, the cultural context suggests that at least some path users are reluctant to "claim" priority over motorists. This deference was exhibited by a tendency for pedestrians to slow, stop or gesture to motorists to proceed ahead of them – even when it was clear from the video footage that the motorist had seen and was slowing to give way. Further, even when a pedestrian did cross ahead of a motorist it was common for the pedestrian to break their stride, walk faster or wave acknowledgement to the motorist. While somewhat confusing these interactions appeared more to reflect a negotiation between the parties as to whom would go first. Motorist speeds and the defensive behaviours exhibited by both road users do not suggest these interactions are unsafe.

4.5 Design improvements

We suggest the following design improvements may be considered, not necessarily for Elanora Avenue, but for future intersections of this type:

- the ramp grades should be at least 1:10 and ideally closer to 1:6 to reduce motorist speeds,
- give way linemarking at the minor street exit onto the major road should be at the outer kerb blister rather than at the gutter, and
- consideration be given to using a pedestrian (zebra) crossing of the bikeway to the pedestrian signals immediately south of Elanora Avenue.

We describe these improvements further below.

4.5.1 Ramp grades

We suggest that low speeds are critical to the safe operation of all intersections, and particularly uncontrolled intersections such as at Elanora Avenue. The efficacy of raised cycleway crossings has been demonstrated in the Netherlands (Schepers et al. 2011), where it was found that raised platforms or associated speed reducing measured halved the cyclist crash risk compared to crossings without such measures. Observationally, we would suggest the ramp grade is at or below 1:12 (a typical ramp grade). At these grades a motorist would reach 0.5 g of vertical acceleration at a speed of 20 km/h (Pratt, McGarrigle, and Turner 2015). This acceleration threshold is approximately the comfort threshold; between 0.5 and 0.7 g the motorist would be expected to slow down considerably to avoid uncomfortable deflection. We would suggest that the design speed for these crossings for motorists should be around 20 km/h, such that grades of *at least* 1:10 are warranted, with

1:6 to 1:5 being desirable to ensure this design speed is achieved. This range is consistent with the 1:6 grade (16.6%) recommended in TMR Technical Note 128.[3]

4.5.2 Give way linemarking

The design at Elanora Avenue has the ramp and associated piano key markings around 3 m setback from the outer kerb along the blister at the corner (Figure 4.3). In our view, it would be preferable to extend the platform around 3 m towards Brisbane Road to reduce the tendency for motorists emerging from Elanora Avenue to stop across the bikeway. This is illustrated in Figure 4.4. While representing an inconvenience to riders, this behaviour can also present a safety hazard. At another similar bent-out crossing in Sydney at least two collisions have been observed between riders travelling in opposite directions colliding immediately behind a stationary motorist.[4] In those observed crashes it appeared the stationary motorist obscured the forward visibility of the riders such that they did not see one another until immediately prior to the collision. The risk of conflict was higher because the rider travelling in the contraflow direction had to drift to the right of the bikeway to avoid the motorists, thereby placing them in the path of the oncoming rider. An example of this situation is shown in Figure 4.5 – although we note that both riders managed to see and negotiate past one another in this example. Moreover, we suggest motorists emerging onto Brisbane Road will have better visibility of traffic on the main street if they are positioned as far out towards the traffic lane as possible.

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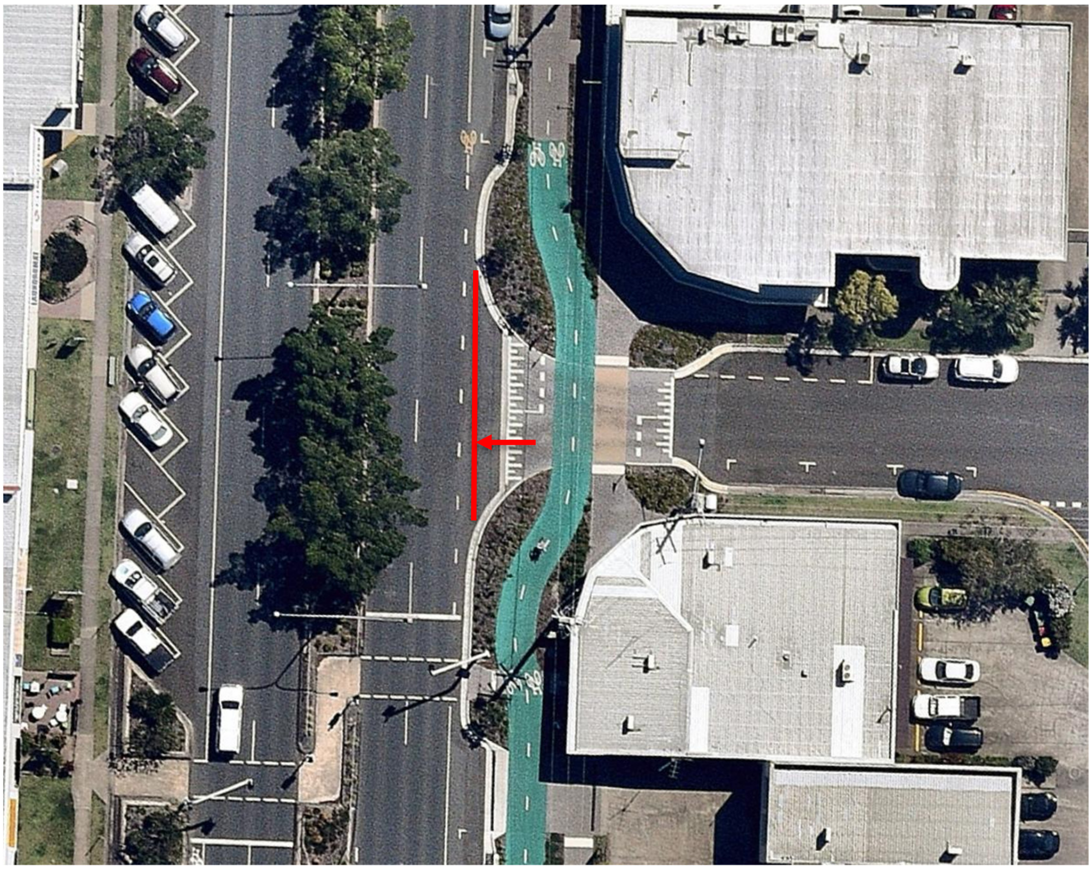
[3] http://tmr.qld.gov.au/~/media/busind/techstdpubs/Technical%20notes/Traffic%20engineering/TN128.pdf.

[4] Bourke Street Cycleway at Devonshire Street, Sydney: https://goo.gl/maps/FuiQTzm3LTu.



■ **Figure 4.3: Proposed extension of platform to outer edge of blisters**

- **Figure 4.4: Riders veer behind motorist stopping at give way line onto Brisbane Road**

■ **Figure 4.5: Motorist waiting ahead of cycleway with riders approaching from both directions**

4.5.3 Pedestrian crossing

Brisbane Road has a signalised pedestrian crossing immediately south of the intersection with Elanora Avenue. TGSIs are provided to guide vision-impaired pedestrians to the crossing in accordance with the relevant design standards. However, priority is provided to bicycle riders through the terminal TGSI treatments and bicycle symbols on the bikeway at the crossing point. Prioritising bicycle riders in this way may have been the design intent. However, we would suggest the prioritisation of the pedestrian movement may be better at this location because:

- pedestrians usually sit higher on the road user hierarchy than bicycle riders, and
- the presence of the signalised pedestrian crossing concentrates pedestrian crossing movements at this location, and
- pedestrians crossing Brisbane Road eastbound and then walking north were often observed to follow a desire line from the crossing then along the bikeway north to Elanora Avenue, rather than crossing to the footpath.

The use of zebra crossings across bikeways is not entirely uncommon, and we suggest can work satisfactorily.[5]

[5] One example on the Bourke Street cycleway in Sydney: https://goo.gl/maps/7mEJdjXTTaA2. This crossing is similar to Elanora Avenue with the exception that the zebra crossing extends across the full roadway, rather than as a signalised pedestrian crossing.

5 Cost-benefit analysis

The cost-benefit analysis framework as described in CDM Research (2016) was used to estimate the monetary benefits against the costs of the project. The key elements of this framework are:

- broad consistency with the current national guidelines (Transport and Infrastructure Council 2016),
- 30-year economic life with no residual value at the end of the appraisal period,
- estimates mortality and morbidity health benefits using a willingness to pay methodology for valuing statistical life,
- no safety in numbers effect,
- 80% of bicycle travel in the area occurs on-road without provision, 5% on-road with bicycle lanes, 10% on off-road shared paths and 5% on footpaths,
- relative risks for bicycle lanes of 0.5, off-road shared paths of 0.3 and footpaths of 1.8 (all relative to on-road with no provision),
- cumulative annual demand growth of 3%,
- rule-of-half applies to the willingness-to-pay component of health costs, vehicle operating and parking costs, PT fares for all users and travel time savings for new users only,
- Monte Carlo simulation to represent parameter uncertainty,
- capital and operating cost estimates to +/-10% at 95% confidence level, and
- demand estimates to +/-20% at 95% confidence level.

The input assumptions to the cost-benefit analysis are summarised in Table 4.1, and are based wherever possible on the survey data.

Table 5.1: Economic assumptions

Parameter	Assumption	Source
General assumptions		
Economic life	30 years	
Discount rate	3%, 7%, 10%	
Health benefit ramp-up period	5 years (linear)	Genter et al. (2009)
Effective average motorist speed	30 km/h	Estimate
Effective average cyclist speed	20 km/h	Estimate
Effective average walking speed	6 km/h	Estimate
Effective average PT speed	15 km/h	Estimate
Bicycle riders		
Opening year demand (AADT)	324	Video counts
Average trip distance	14.6 km	Intercept surveys
Diversion: car	15%	Intercept surveys
Diversion: PT	5%	Intercept surveys
Diversion: walk	0%	Intercept surveys
Diversion: reassign	73%	Intercept surveys
Diversion: induced	7%	Intercept surveys
Transport purpose split	25%	Intercept survey
Change in trip distances	0 km	Assume no change
Facility		
Length	760 m	Full path
Type	Off-road path	
Diverted motor vehicle travel time by period	Busy: 10% Medium: 30% Light: 60%	Guesstimate
Investment		
Capital cost	2012: $3 m 2015: $5.25	TMR estimates
Operating cost	$10,000 p.a.	Guesstimate

The results of the cost-benefit analysis are summarised in Table 5.2. For the central discount rate of 7% the BCR is 1.5, indicating good value for money. At the higher discount rate of 10% the BCR decreases to 0.9, suggesting the project costs marginally exceed the benefits.

Table 5.2: Economic assessment

	Discount rate		
Parameter	**4%**	**7%**	**10%**
Benefit-Cost Ratio (BCR)	2.7	1.5	0.9
Likelihood BCR < 1.0	0%	0%	89%
Net Present Value (NPV)	\$14.79m	\$4.63 m	-\$0.5 m
Present Value of Benefits (PVB)	\$23.36 m	\$13.20 m	\$8.08 m
Present Value of Costs (PVC)	\$8.58 m	\$8.58 m	\$8.58 m

All values are 2013 prices and values.

The breakdown of the NPV for the central discount rate is shown in Figure 5.1. Almost all benefits accrue from health benefits to bicycle riders. These benefits are attributable to transport trips shifted from motor vehicle to bicycle and public transport (bus), and induced (i.e. all new) cycling trips (Figure 5.2). Most disbenefits are associated with an increased injury burden as a result of transport riders shifting from car to bicycle and additional travel times incurred by those choosing to ride for transport instead of taking a car. We would expect there to be additional cycling injuries due to the additional induced travel, and in shifting from car to cycling[6]. Much of the additional cycling exposure will not occur on the bikeway itself but rather on roads leading to and from the bikeway. As many of these roads lack dedicated cyclist provision we may reasonably expect an increased injury burden because of crashes involving motorists and bicycle riders. However, as illustrated in these figures, the health benefits very significantly outweigh the injury disbenefits.

[6] The model assumes, based on the limited crash and exposure data available, that the injury risk associated with riding is greater per distance travelled than driving a motor vehicle.

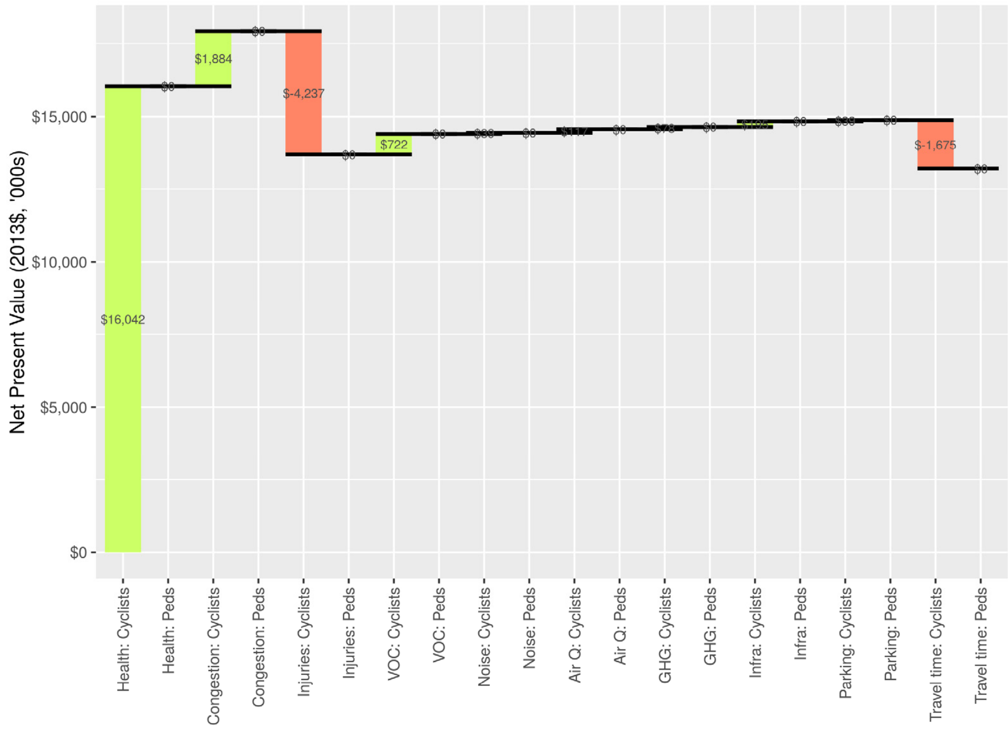


Figure 5.1: Summary breakdown of net present value

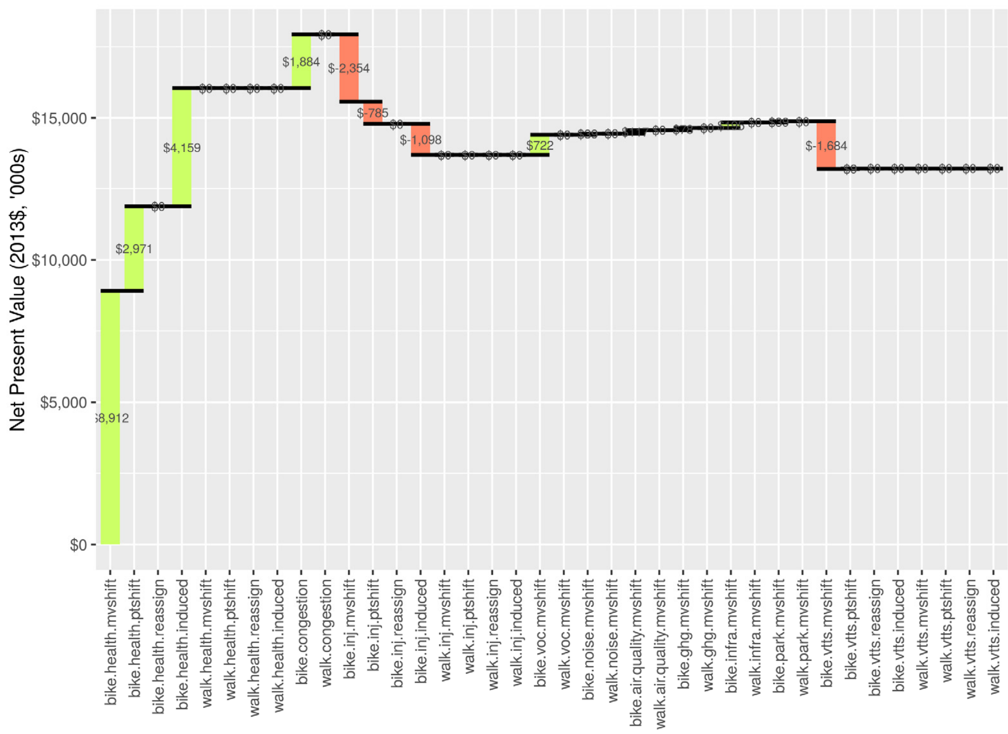


Figure 5.2: Detailed breakdown of net present value

6 Discussion

The user surveys indicated overwhelming support from users for the path. Additionally, the cyclist demand along the path is healthy given that car driving is comparatively easy and cheap along the corridor. The cost-benefit analysis suggests the project represents fair value for money. We attribute the BCR to the following factors:

- good level of cyclist demand,
- the bikeway appears to have encouraged some recreational riding that would not otherwise have occurred (10% of recreational riders would not have travelled in the absence of the path), and
- the bikeway has encouraged some mode shift away from private car and public transport.

However, these positive influences are moderated by the comparatively high project cost for a relatively short section of path. Furthermore, it seems reasonable to suggest that the lack of connectively of the path to Mooloolaba town centre to the north and farther south to residential areas limits the bikeway catchment. Assuming the proposed further stages 2 (southward) and 4b and 5 are completed northward one may expect demand to substantially increase, which may improve the project BCR.[7]

The land use density and mix, with a combination of residential, retail and recreational functions are likely to contribute to the relatively health cycling demand. In addition, the local demographic mix of children and young families, as well as tourists, likely contributes to the cycling demand. Moreover, for much of this demographic Brisbane Road is likely to be perceived as an unattractive alternative for cycling.

It is notable that the path usage cannot be attributable to supply-side constraints on car travel; there is minimal traffic congestion in the area and ample free car parking. This contrasts with the inner suburban areas of larger cities where such constraints are likely to play a role in encouraging riding and walking for transport.

We suggest the positive community sentiment in combination with the fair BCR provide support for investment in the additional stages of the project. The proposed extensions northward will presumably provide particularly significant benefits, although at some cost given the need for an additional waterway crossing.

[7] However, the marginal increase in benefits will be weighed against the marginal costs; the former will need exceed the latter (in discounted terms) for the BCR to increase.

References

CDM Research. 2015. 'Observational Study of Cyclist Priority Crossings at Minor Roads'. Prepared for Queensland Department of Transport and Main Roads.

———. 2016. 'Measuring the Benefits of Active Travel'. Prepared for Queensland Department of Transport and Main Roads.

Genter, J. A., S. Donovan, B. Petrenas, and H. Badland. 2009. 'Valuing the Health Benefits of Active Transport Modes'. Research Report 359. Wellington, N.Z.: NZ Transport Agency.

Schepers, J.P., P.A. Kroeze, W. Sweers, and J.C. Wüst. 2011. 'Road Factors and Bicycle–motor Vehicle Crashes at Unsignalized Priority Intersections'. *Accident Analysis & Prevention* 43 (3): 853–61. doi:10.1016/j.aap.2010.11.005.

Transport and Infrastructure Council. 2016. 'Australian Transport Assessment and Planning Guidelines: M4 Active Travel'. http://atap.gov.au/mode-specific-guidance/active-travel/files/m4_active_travel.pdf.

Appendix A: Intercept survey script

We're completing a quick survey on the path. Could you help us?

1. INTERVIEWER enter mode of travel
    a. Bicycle rider
    b. Pedestrian
2. In what suburb did you start your trip, and where will you finish your trip?
    a. Start: ___________
    b. Finish: __________
3. How long will the trip take?
    a. Hours: _____
    b. Minutes ____
4. How far is the trip?

    ____ km
5. What is the purpose of your trip?
    a. Commuting to or from work
    b. Fitness, recreation or sport
    c. Shopping
    d. School, university or other education activity
    e. Other: _________
6. How often have you walked/ridden here in the past month?
    a. Almost every day
    b. Every weekday
    c. 3 – 4 days a week
    d. 1 – 2 days a week
    e. Every fortnight
    f. Only once
    g. This is the first time
7. This bikeway has only recently been built. Are you aware that it's new?
    a. Yes
    b. No
8. How would you have made this trip if this bikeway wasn't here?
    a. Taken a different route (incl. used the road)
    b. Would not have travelled

c. Car – as driver
d. Car – as passenger
e. Motorcycle
f. Train
g. Bus
h. Ferry
i. Taxi
j. Don't know
k. Other: _________

9. What change, if any, would you say the construction of the bikeway has had on the amount of time you've spent walking/riding over the past month?
   a. Significantly decreased (by at least an hour a week)
   b. Decreased (by less than an hour a week)
   c. No change
   d. Increased (by less than an hour a week)
   e. Significantly increased (by at least an hour a week)
10. IF BICYCLE RIDER: What would you have done if you couldn't ride your bike for this trip?
   a. Would not have travelled
   b. Used a car – as the driver
   c. Used a car – as the passenger
   d. Motorcycle
   e. Train
   f. Bus
   g. Ferry
   h. Taxi
   i. Walked
   j. Ran / jogged
   k. Don't know
   l. Other: ___________
11. IF TRANSPORT PURPOSE: Which of the following best describe how easily you could have used a car for this trip?
   a. I had a car available and could easily have got access to it
   b. I could have got a car from another person where I started my trip (e.g. another household member)
   c. I did not have ready access to a car to make this trip
   d. I do not have a drivers licence
   e. Other: _________

12. IF COULD HAVE USED CAR: Would it have taken more or less time to reach your destination by car?
    a. More time
    b. Same time
    c. Less time
13. IF TRANSPORT PURPOSE: Which of the following best describes how easily you could have made this trip by public transport?
    a. I had a convenient public transport alternative
    b. I had a public transport alternative but it would have taken longer
    c. I did not have a viable public transport alternative
    d. Other: _________
14. IF COULD HAVE USED PUBLIC TRANSPORT: Would it have taken more or less time to reach your destination by public transport?
    a. More time
    b. Same time
    c. Less time
15. INTERVIEWER enter any other comments: _______________

Appendix B: Verbatim comments

Great use it every day
Path keeps you off the road and feel safer
Very safe don't have to ride on road
Money well spent
Great safety
Feel safe on new path
Love the new path
Great idea uses it everyday should be more of these paths
Separate the pedestrians from cyclists
Waste of money
Excellent idea
Just wish that pedestrians would use the pathways provided for them and not the bike path
No pedestrians should be allowed
Should be putting paths where they are needed not on a side road already
Great to see more bike paths being built on the Sunshine Coast
Money well spent
Do find that when it rains the bike path can become a little slippery
Maybe some directional arrows on path to help let riders know what side to stay on
Good beats catching a bus
Great path should be for bikes only no pedestrians
Warning signs required of cars entering and exiting Elanora Av
Safer and great
Maybe some signs on bike path telling cyclist to beware or traffic ahead
Suggests a crossing sign or stop sign prior to Elanora Av
Need to keep pedestrians off bike path
Will be great when finished
Nice to see people out and asking the public questions on how money has been spent on these bike paths
We need more money well spent