Evaluation of the Sixth Av Bicycle Lanes (Maroochydore)

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 bicycle improvements along a 2.2 km corridor along Sixth Avenue and the Esplanade from Aerodrome Road to First Avenue in Maroochydore. The project consisted of on-road bicycle lanes with green surface treatments at unsignalised intersections and bicycle awareness zone road markings. The estimated outturn cost is around $975,000.

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 from Tuesday 7 November to Monday 13 November 2017, and
- intercept surveys with path users undertaken on two weekdays and two weekend days (Thursday 3 May to Sunday 6 May 2018).

The counts were undertaken along Sixth Avenue near Beach Parade and the intercept surveys were undertaken around 280 m north at the corner of King Street and Cotton Tree Parade

The key results of this evaluation were as follows:

- Average daily traffic between 5 am and 8 pm on Sixth Avenue was around 135 riders per day, of which over half were riding prior to 9 am.
- Around half of trips on weekdays were for fitness or recreation, increasing to 71% on weekends. Most of the remainder were for commuting (on weekdays) or visiting cafes or restaurants.
- The average transport trip duration was 34 minutes over 8.5 km, compared to 75 minutes over 23 km for recreation trips.
- The bicycle lane has had limited behavioural impact; around 11% would otherwise have made their trip by car, 7% by public transport and 2% would not have travelled at all.
- Just over half of bicycle riders travelling for transport indicate they have access to a car (55%), and most had access to public transport (92%), although for most of the latter public transport would have taken longer.
- A large majority of riders indicated that the bicycle lanes had improved their feelings of comfort.
- The cost-benefit analysis suggests the project represents marginally positive value for money with a benefit-cost ratio of 1.1 for a discount rate of 7%. Most of the benefits accrue from health benefits to those who divert from car or public transport, with much lesser benefits attributable to the safety benefit to existing riders.
- The cyclist level of service has significantly improved for both confident and cautious riders; we estimate the level of service has improved from F to D for cautious riders and from C to A for confident riders during the peak hour.

1 Introduction

1.1 Background

CDM Research was commissioned by the Queensland Department of Transport and Main Roads (TMR) to undertake an evaluation of on-road bicycle lanes installed along Sixth Avenue and King Street in Maroochydore from Aerodrome Road to Cotton Tree Road, and 250 m along Cotton Tree Road to the Esplanade (Figure 1.1). A number of different treatments have been applied over a number of years:

- Sixth Avenue from Aerodrome Road to Beach Parade: on-road bicycle lanes with green pavement treatment at unsignalised side streets installed early 2014
- Sixth Avenue – King Street – Cotton Tree Parade from Beach Parade to Third Avenue: on-road bicycle lanes with green pavement treatment at unsignalised side streets installed in mid-2016, and
- The Esplanade from Third Avenue to First Avenue: bicycle awareness zone (BAZ) markings in middle of lane.

The project cost was estimated at $975,000 and was jointly funded by TMR and Sunshine Coast Council as part of the Principal Cycle Route Improvement Program (PCRIP). It is understood the original project scope included a hook turn treatment turning right from Aerodrome Road into Sixth Avenue, although this had not been implemented at the time this evaluation was undertaken.

1.2 Methodology

This evaluation used the cost-benefit analysis (CBA) methodology adopted nationally as part of the Australian Transport Assessment and Planning (ATAP) guidelines established by the state road agencies. The approach has been adapted for TMR and implemented as an online tool (CDM Research 2016). [1] The methodology requires a number of inputs, of which the most important are:

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

The latter refer to the proportion of demand that:

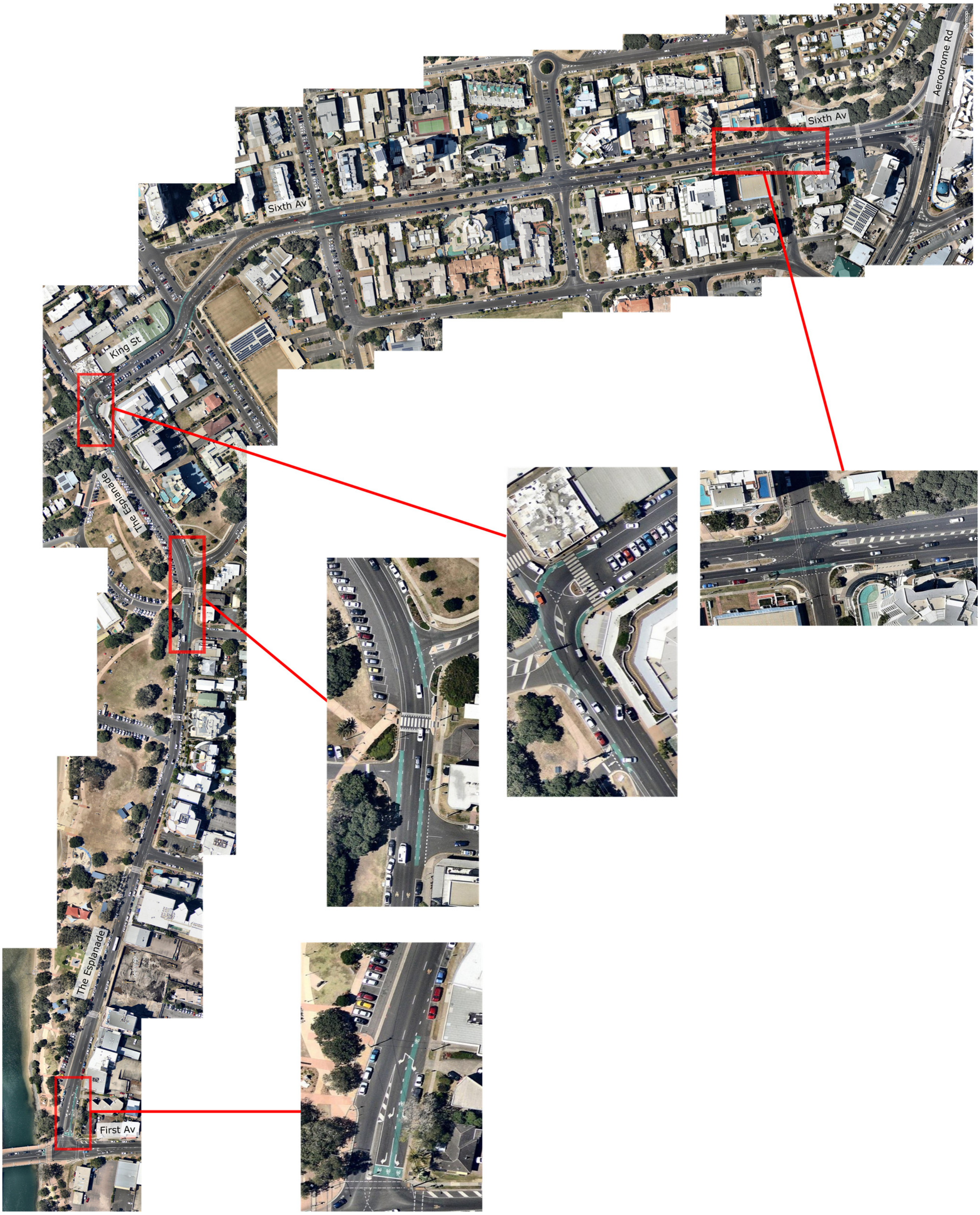
- was already riding before the project, and have changed their route to use the project,
- have diverted from other transport modes (e.g. private car, public transport), and
- all-new trips that would not have otherwise occurred in the absence of the project.

To obtain these input parameters two fieldwork activities were undertaken:

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

1. video-based manual counts classified by mode, direction of travel and time of day from 5 am to 8 pm between Tuesday 7 November and Monday 13 November, 2017 at Sixth Parade near Beach Parade, and
2. intercept surveys with bicycle riders at the corner of King Street and Cotton Tree Parade between Thursday 3 May and Sunday 6 May 2018

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



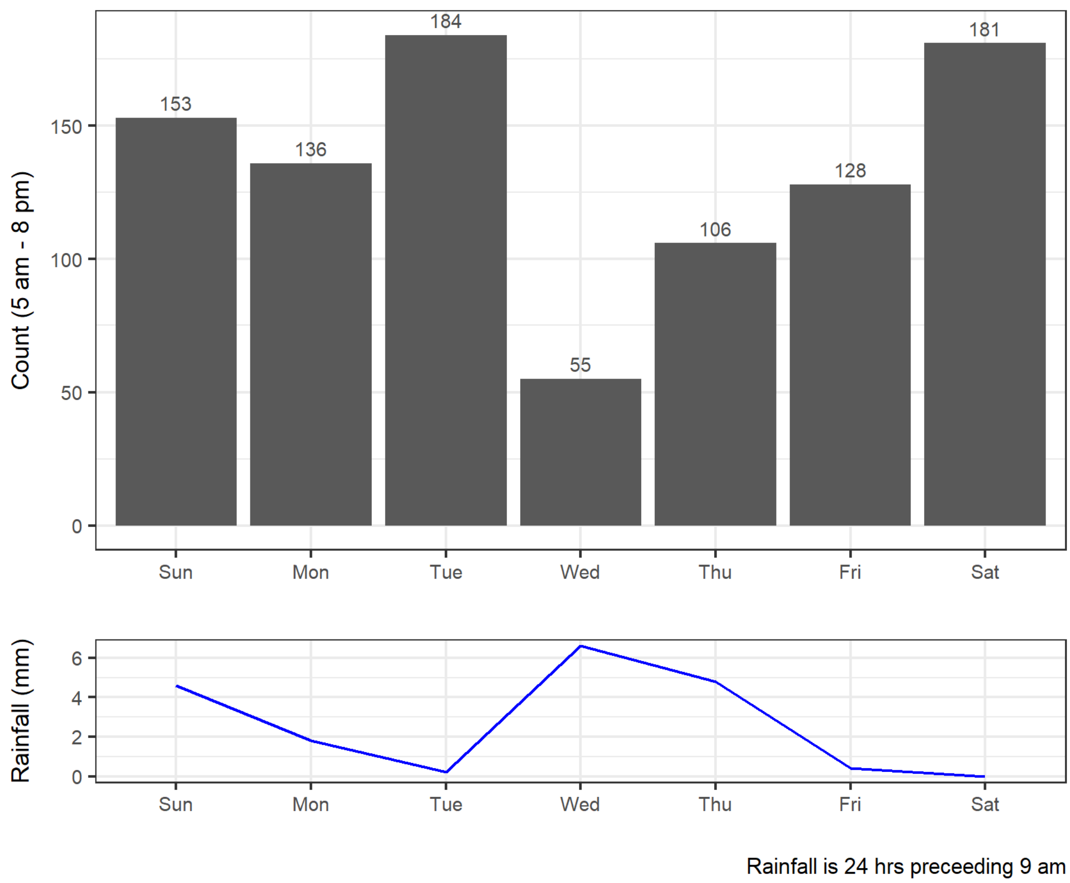
■ **Figure 1.1: Sixth Avenue bicycle lanes**

2 Counts

Video-based manual counts were obtained along Sixth Avenue near the intersection of Beach Parade from Tuesday 7 November to Monday 13 November, inclusive. The counts were obtained between 5 am and 8 pm. The average daily count was 135 riders, with an average of 122 riders on weekdays and 167 riders on weekends (Table 2.1). The daily count varied from 55 on Wednesday 8 November to 184 on Tuesday 7 November 2017 (Figure 2.1). The lower cycling counts on the Wednesday can be attributed to rainfall of just over 6 mm in the 24 hours up to 9 am Wednesday and a further 5 mm in the subsequent 24 hours.

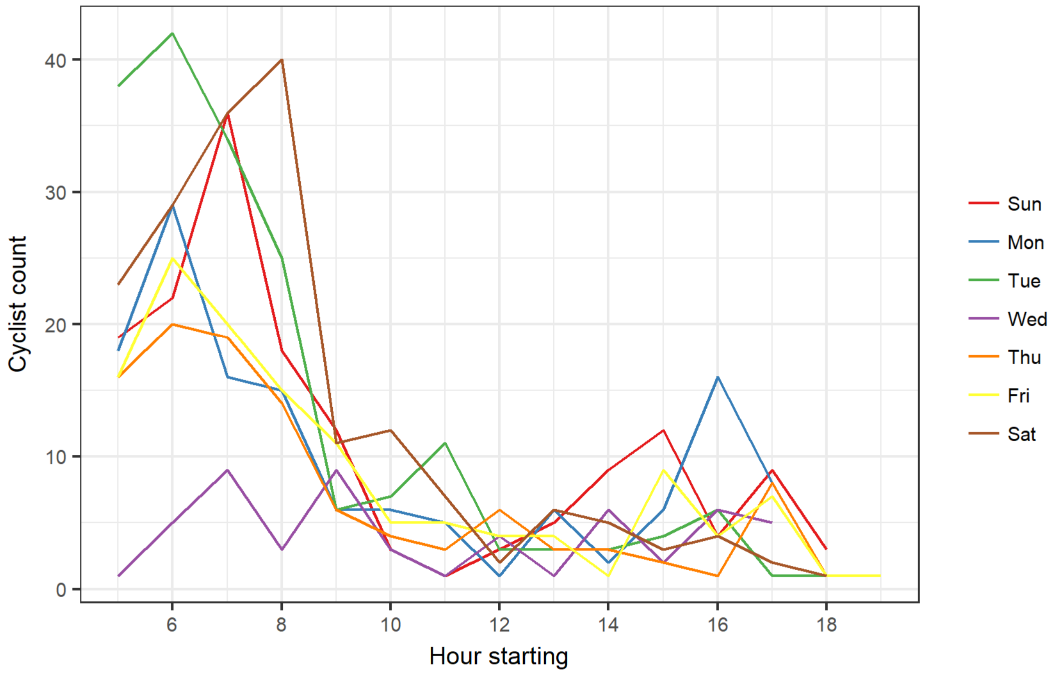
■ **Table 2.1: Average daily cyclist count**

Day of week	Count (5 am – 8 pm)
All days	135
Weekdays	122
Weekends	167



■ **Figure 2.1: Cyclist count by day of week**

Most of the demand is cycling demand is concentrated in the early morning period, often from groups of training cyclists (Figure 2.2).



■ **Figure 2.2: Hourly count by day of week**

3 Level of service

The project had the design intent of improving the level of service for bicycle riders as well as improving safety. The level of service was assessed using the counts and a cyclist level of service model developed for TMR based on rider surveys (CDM Research 2013). This model takes into account the traffic volume, composition (light and heavy vehicles), speed, presence of on-street parking and the type of bicycle facility (if any). Riders are divided into "cautious" and "confident" based on their stated preference towards taking the shortest route possible (irrespective of traffic) or preference for more circuitous, but quieter, routes.

The results from this analysis are shown in Table 3.1. The motor traffic volumes are unknown, but for the purposes of this analysis they are assumed to be around 400 vph in each direction during the peak hour[2]. The level of service for cautious riders is estimated as an unsatisfactory F prior to treatment, improving to a marginal D after installation of the bicycle lane. For confident riders the level of services is estimated to have improved from C to A with the bicycle lane. These results accord with our general expectation insofar that:

- cautious riders prefer very low traffic volume streets, and painted bicycle lanes are seen as only marginally effective *vis a vis* physical segregation from traffic, and
- confident riders would find the moderate traffic volumes tolerable under the base condition and find the bicycle lanes a more than satisfactory improvement.

Notably, the level of service for cautious riders improves to C at 360 vph, B at 250 vph and A at 180 vph.

■ **Table 3.1: Level of service calculation**

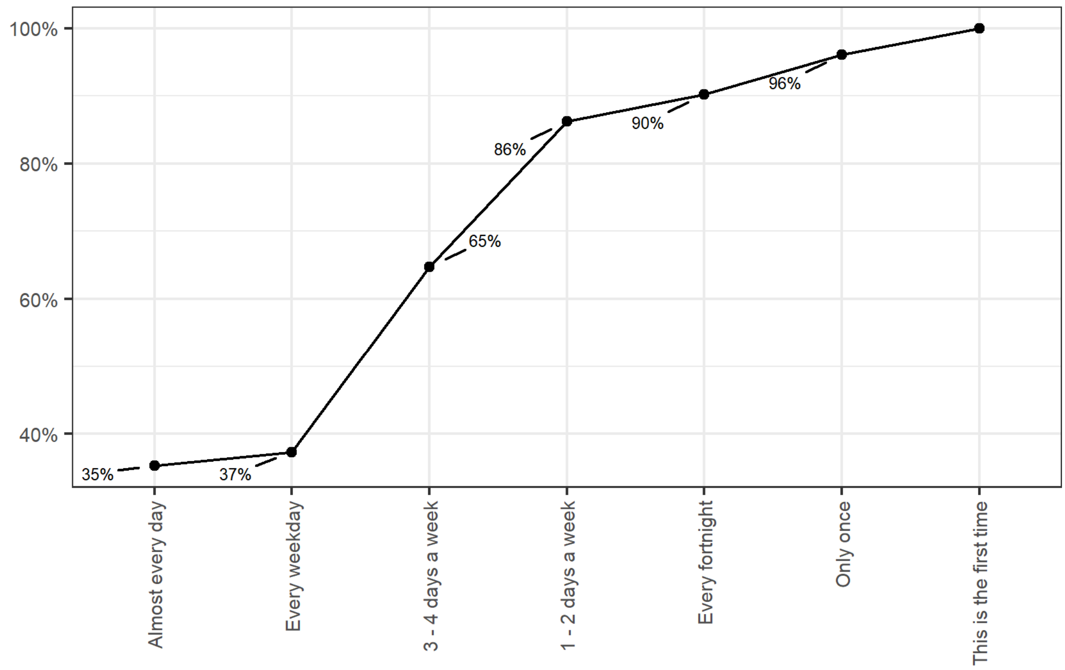
	Scenario	
Rider type	**No bicycle lane**	**Bicycle lane**
Cautious	F	D
Confident	C	A

[2] Assuming crudely that 15% of traffic is in the peak hour this is roughly 5,300 vpd.

4 Intercept surveys

Intercept surveys were conducted with bicycle riders at the corner of King Street and Cotton Tree Parade. This location was chosen as a location central to the corridor and where riders and motorists are tending to travel slowly, making it a relatively safe and convenient location to interview riders. A total of 51 complete interviews were obtained over a four-day period from Thursday 3 May to Sunday 6 May 2018. Weather conditions were fine and mild over the four-day period. Just over half (59%) of interviews were conducted on weekdays.

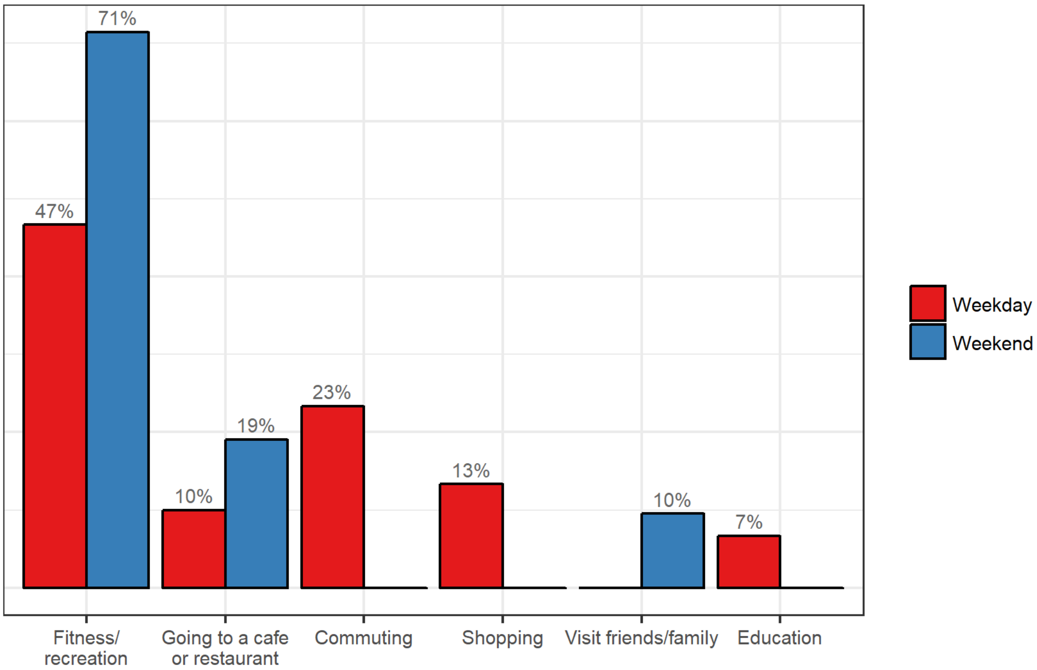
The frequency with which users use the route is shown in Figure 4.1. Around two thirds of riders travel along the corridor at least three times a week, indicating a degree of familiarity.



■ **Figure 4.1: Frequency of use by mode (cumulative totals are shown)**

Half of respondents (51%) were aware the bicycle lanes were new. It is noted that the bicycle lanes have been installed in stages over the past few years such that it seems plausible that respondents will be less likely to recall treatments installed a number of years ago, particularly in an area such as Maroochydore with high population churn.

Around half of cycling trips on weekdays were predominantly for fitness or recreation, increasing to 71% on weekends (Figure 4.2).



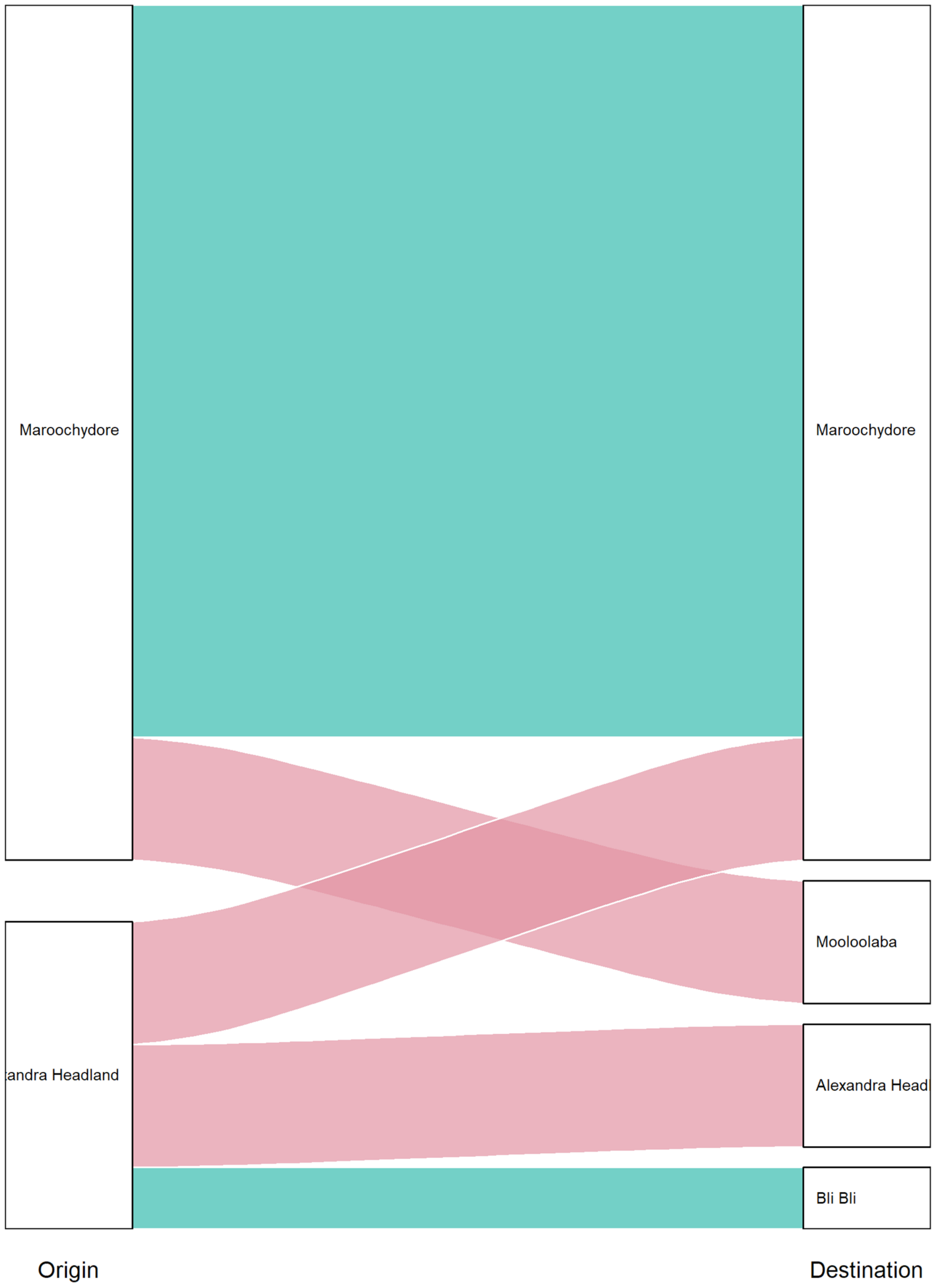
■ **Figure 4.2: Trip purpose by day of week**

The average bicycle trip for recreation took 75 minutes over 22.8 km while transport trips took 34 minutes over a distance of 8.5 kilometres (Table 4.1).

■ **Table 4.1: Trip distances and durations**

	Recreation	Transport	All
Trip distance			
Average	22.8 km	8.5 km	16.6 km
Median	12 km	4 km	7 km
Trip duration			
Average	75.0 mins	34.1 mins	57.4 mins
Median	60 mins	15 mins	60 mins

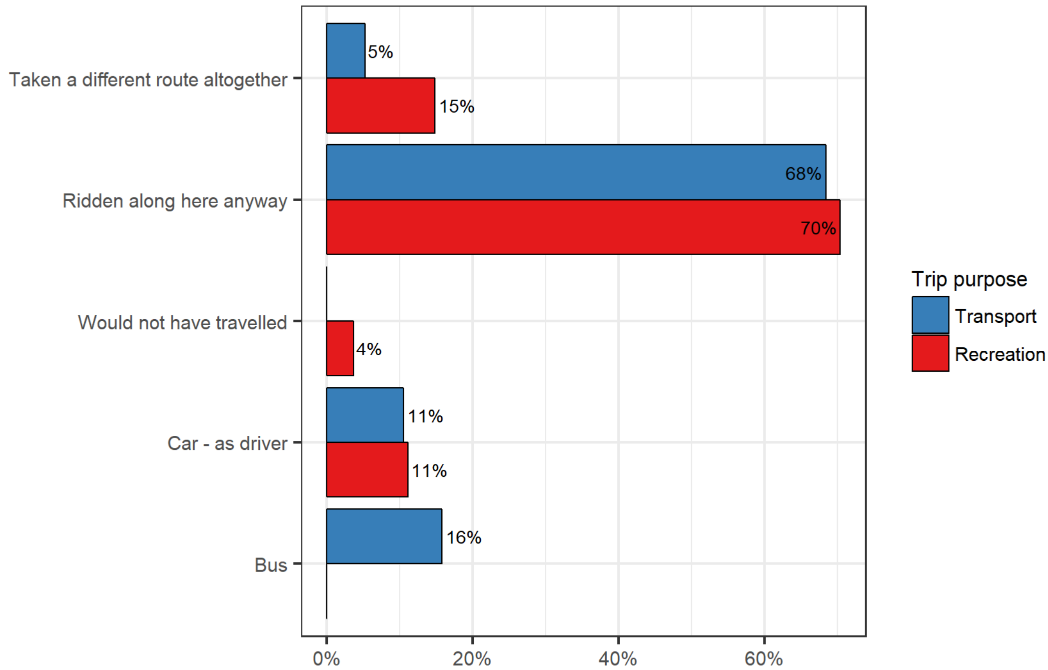
The trip origin and destination suburbs for recreation and transport trips is illustrated in Figure 4.3 and Figure 4.4. Around 52% of recreation trips and 55% of transport trips started and finished in Maroochydore.



- **Figure 4.3: Origins and destinations of cycling trips for transport (n=22)**

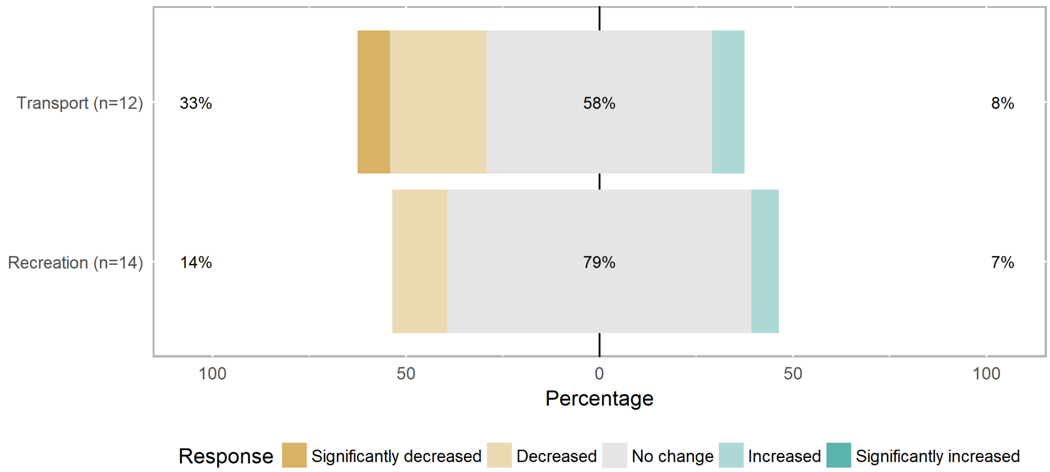
■ **Figure 4.4: Origins and destinations of cycling trips for recreation (n=29)**

Respondents were asked what they would have done for their trip if the bicycle lanes were not present. Most indicated they would have ridden along Sixth Avenue irrespective (Figure 4.5). Some indicated they would have driven; we interpret the proportion who would have driven for recreation as indicating they would have driven with their bicycle to start their ride elsewhere. Around 16% of those riding for transport indicated they would otherwise have taken a bus, and 4% of those riding for recreation would not have ridden at all in the absence of the bicycle lane.



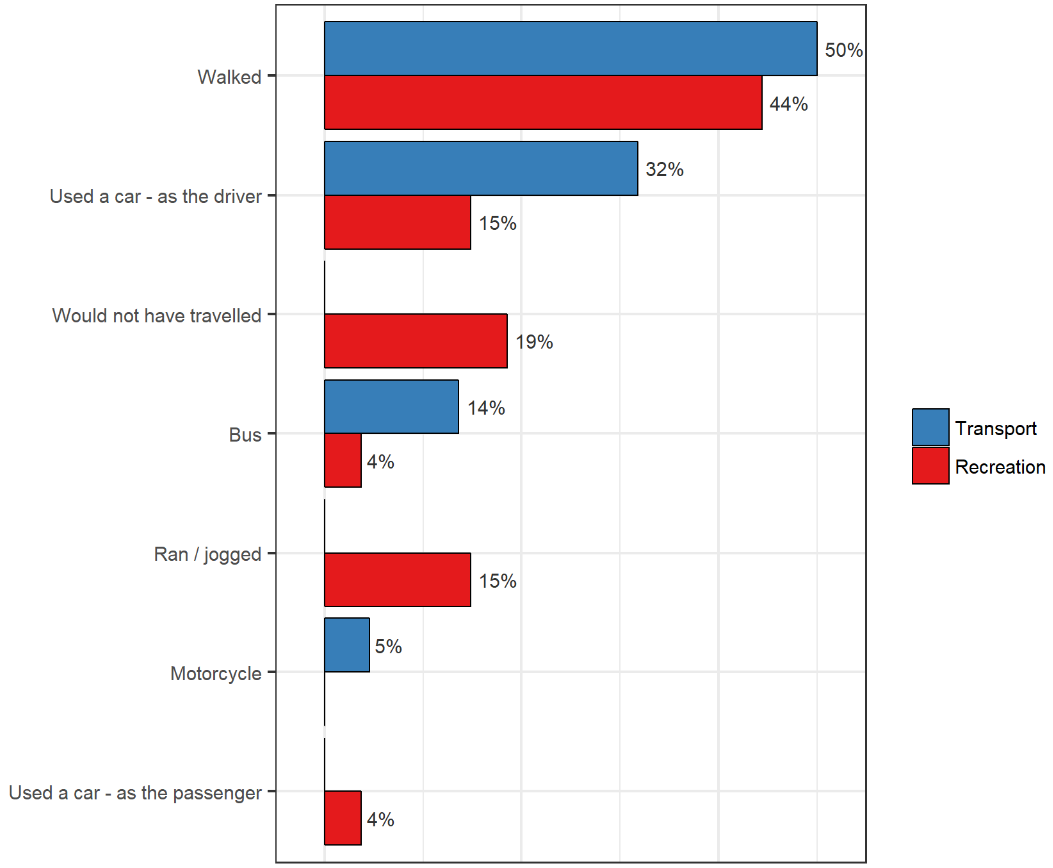
■ **Figure 4.5: What would you have done if the bicycle lanes were not here?**

While the self-reported shifts from other modes, and of all-new cycling trips for recreation, are suggestive of potential health benefits arising from additional physical activity the self-reported changes in riding time attributable to the project are less clear cut (Figure 4.6). More transport and recreation riders indicated they have ridden less than more often over the past month as a result of the bicycle lanes. It is difficult to conclusively reconcile this with the mode shift evidence, particularly as the bicycle lanes would not be expected to have affected cyclist travel times along the corridor. We suggest one possible explanation may be that riders are being attracted to Sixth Avenue from longer, more circuitous routes. Irrespective of the explanation, it is noted that the sample sizes are very small for these groups such that this evidence is far from definitive.



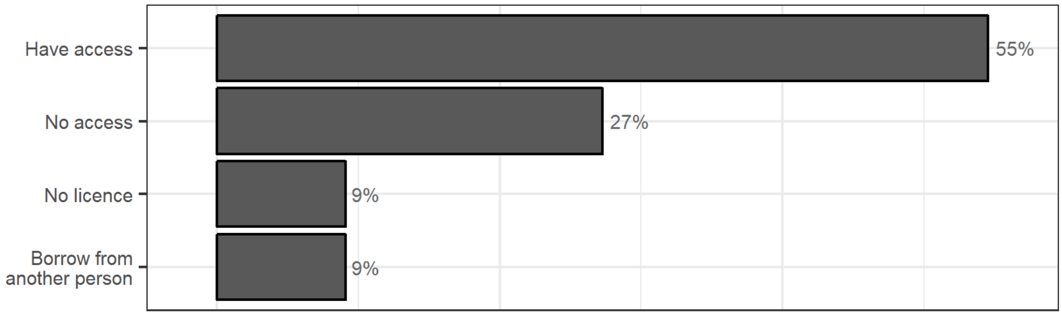
- **Figure 4.6: Has the project changed the amount of time you've spent riding over the past month?**

Respondents were also asked what they would have done if they could not have used their bicycle for their trip. Around 50% of those travelling for transport would otherwise have walked, as would 44% of those riding for recreation (Figure 4.7). Around a third of those travelling for transport would otherwise have driven, suggesting there are wider benefits to transport cycling insofar as they reduce the demand for car parking within the precinct.

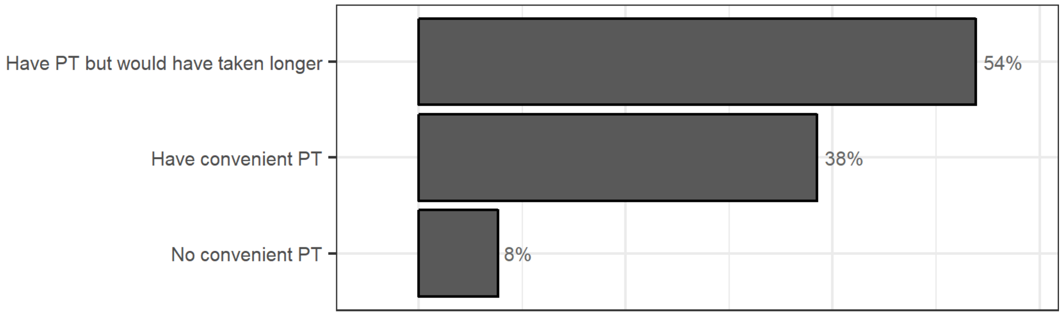


■ **Figure 4.7: What would you have done if your bicycle was not available for this trip?**

Of those travelling for transport just over half indicated they had access to a car for their journey (Figure 4.8), and a similar proportion had access to public transport (but it would have taken longer) (Figure 4.9).

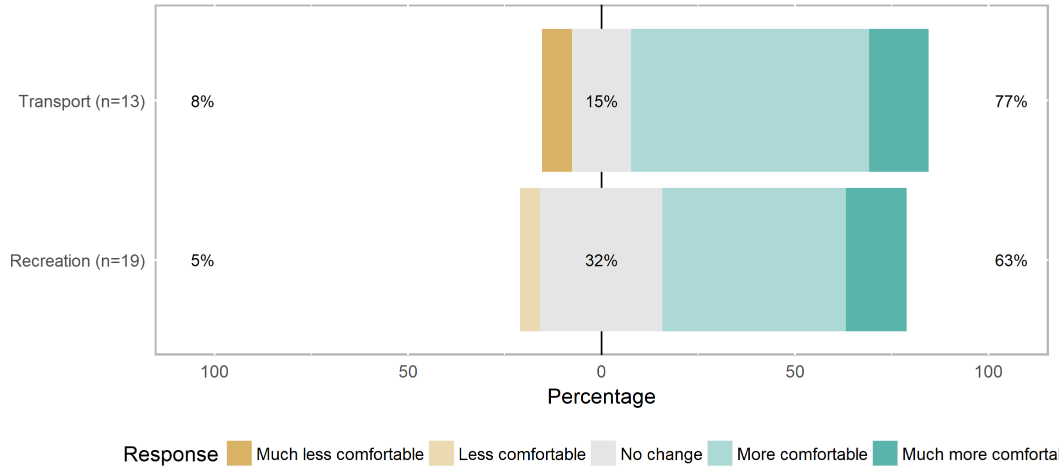


- **Figure 4.8: Which of the following best describe how easily you could have used a car for this trip?**



- **Figure 4.9: Which of the following best describes how easily you could have made this trip by public transport?**

Respondents who recalled that the bicycle lanes were new indicated overwhelmingly that they felt more comfortable riding along Sixth Avenue with the bicycle lanes present (Figure 4.10).



■ **Figure 4.10: How would you say your comfort riding along here has changed after the bicycle lanes were installed?**

Respondents were asked after the survey if they had any other comments about the project. Five respondents offered the following comments:

- more bicycle lanes in the town centre are warranted,
- bicycle lanes are safer when riding with children,
- bicycle lanes are great, only rides on roads where there are bicycle lanes,
- bicycle lanes are not safe for children – kids should be taught in learn-to-ride programs about riding on bicycle lanes,
- there should be more bicycle lanes (no specific location mentioned).

5 Cost-benefit analysis

The cost-benefit analysis framework followed the framework recommended in ATAP Part M4[3] and described in CDM Research (2016). 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,
- 75% of bicycle travel in the area occurs on-road without provision, 10% 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. The estimated project cost of $975,000 was provided by TMR and is assumed to be 2017 prices.

[3] https://atap.gov.au/mode-specific-guidance/active-travel/index.aspx

■ **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	23 km/h	Typical speed from automatic counters is 23 km/h
Effective average PT speed	15 km/h	Estimate
Bicycle riders		
Opening year demand (AADT)	135	Video counts
Average trip distance	16.6 km	Intercept surveys
Diversion: PT	7%	Intercept surveys
Diversion: car	11%	Intercept surveys
Diversion: reassign	80%	Intercept surveys
Diversion: induced	2%	Intercept surveys
Transport purpose split	43%	Intercept survey
Trip time savings	None	Assume travel time is unchanged
Facility		
Length	2.2 km	Total length of project
Type	On-road bicycle lanes	
Diverted motor vehicle travel time by period	Busy: 5% Medium: 15% Light: 80%	Assume low levels of traffic congestion
Investment		
Capital cost	$975,000	TMR
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 1.1, and the BCR only declines to be below 1.0 when the higher 10% discount rate is applied.

Table 5.2: Economic assessment

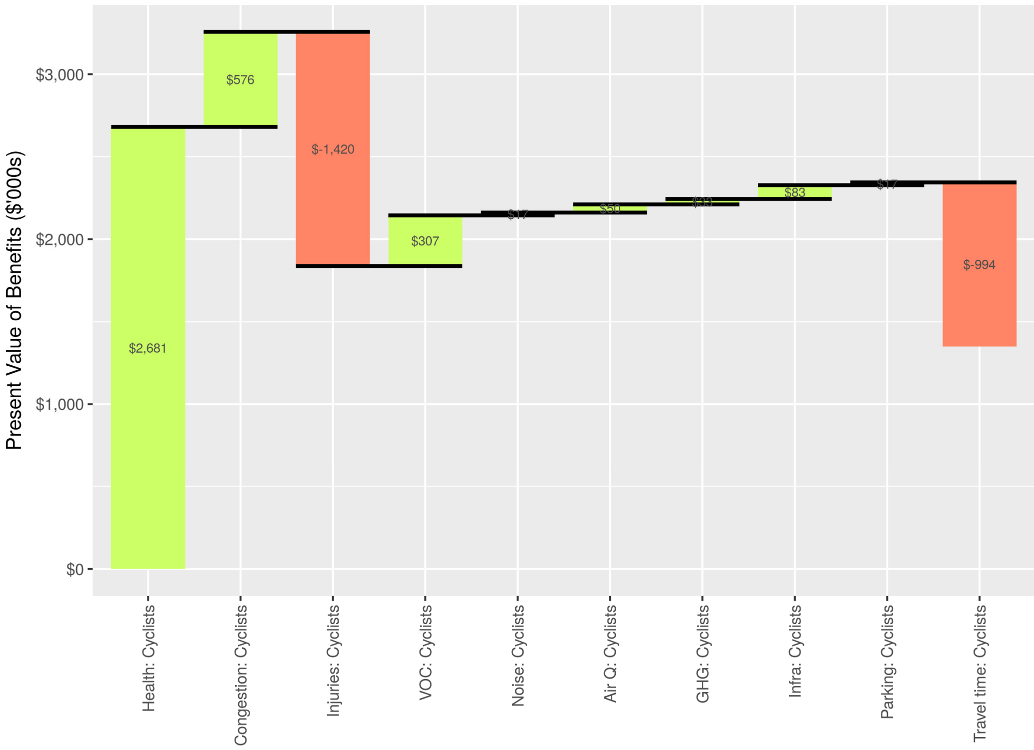
	Discount rate		
Parameter	**4%**	**7%**	**10%**
Benefit-Cost Ratio (BCR)	1.6	1.1	0.7
Likelihood BCR < 1.0	0%	0%	100%
Net Present Value (NPV)	$817,000	$75,000	-$353,000
Internal Rate of Return (IRR)	4.0%	0.5%	-3.4%
Present Value of Benefits (PVB)	$2.09 m	$1.35 m	$0.92 m
Present Value of Costs (PVC)	$1.27 m	$1.27 m	$1.27 m

All values are 2017 prices and values.

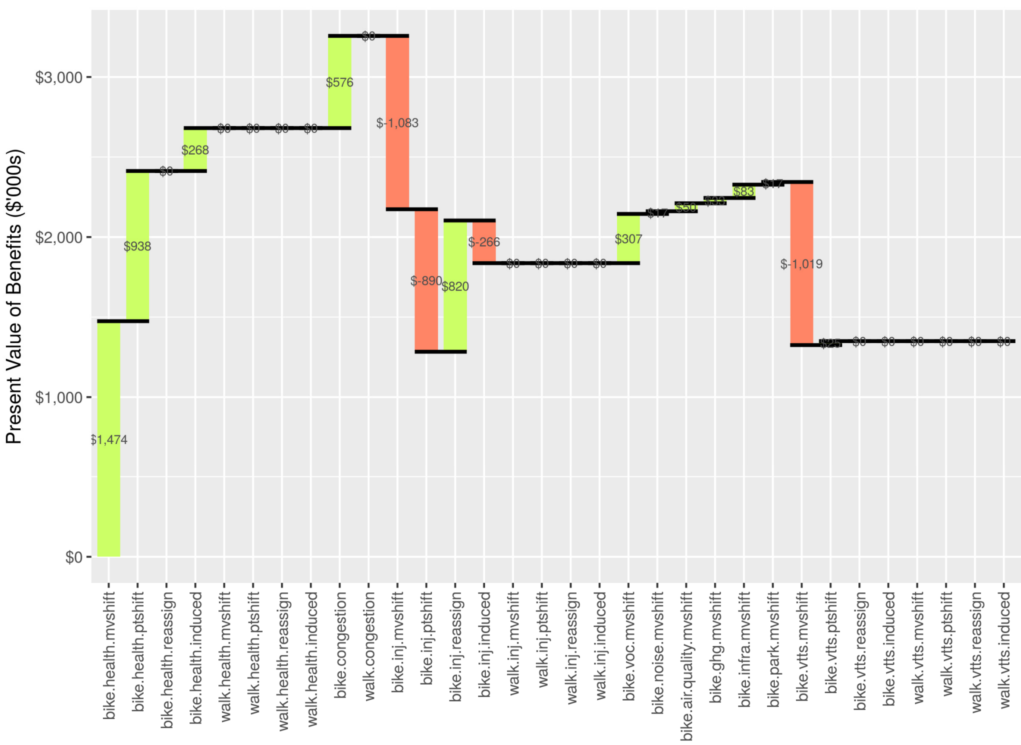
The breakdown of the NPV for the central discount rate is shown in Figure 5.1. Most of the benefits accrue from cyclist health benefits, with minor contributions from traffic decongestion and vehicle operating cost (VOC) savings for those shifting from car to bicycle. Notable, there are disbenefits associated with increased injury costs to riders. This may appear counterintuitive given that the bicycle lanes reduce the injury risk for riders. However, the explanation is found in the detailed breakdown of the benefits by user class shown in Figure 5.2. This figure illustrates that while there are indeed injury benefits to those who were already riding (the “bike.inj.reassign” item) there are injury disbenefits to those who shift from private car or public transport to riding. The reasons for this are twofold:

- the per-kilometre risk of car and public transport are much lower than for cycling, and
- although the project has reduced risk over it’s 2.2 km length most cycling trips are extending over a much farther distance than this – thus new riders are exposed to risks far beyond the treated corridor.

The other main disbenefit is travel time disbenefits to transport riders who have shifted from car travel (“bike.vtts.mvshift”). This is attributable to the faster assumed travel speed of driving (30 km/h) than cycling (23 km/h), which will have the effect of increasing travel time by 23%.



■ **Figure 5.1: Summary breakdown of net present value**



■ **Figure 5.2: Detailed breakdown of net present value**

6 Discussion

The counts along this corridor suggest a reasonable level of cycling activity, and a level that is split fairly evenly between those riding for recreation and for transport. Around 80% of users indicate they were already riding before the bicycle lanes were installed, and most of these were doing so along Sixth Avenue. This group would not be expected to obtain any health benefit from the project, although they would be expected to gain a marginal safety benefit given that it is assumed bicycle lanes reduce crash risks by 50%. However, for the minority that indicate they would otherwise have driven (11%), taken public transport (7%) or not ridden at all there are (potentially) significant health benefits. It is these riders, induced to riding as a result of the treatment, that motivate the vast majority of the benefits of the project.

Notably, the cycling trip distances are such (and the project length sufficiently short) that the safety disbenefits of the project attributable to those who shift from other modes or are new travellers is driven in large part by the exposure to injury *away* from the project corridor. In other words, to obtain large safety benefits it is necessary to ensure as much of the corridor over which riders' travel is as safe as possible, not just a comparatively short section. The cost-benefit analysis suggests that around three quarters of the health benefit is eroded by this safety disbenefit.

While the project is fairly modest in nature the intercept surveys do suggest a reasonable level of mode shift from car. Given the commensurately low project capital cost this is sufficient to generate a slightly positive project benefit-cost ratio. Moreover, and not monetised in the cost-benefit analysis, is that the vast majority of riders reported *feeling* more comfortable riding along Sixth Avenue as a result of the treatment.

References

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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.

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 about the bike lanes. Could you help us?

1. In what suburb did you start your trip, and where will you finish your trip?
    a. Start: ___________
    b. Finish: __________
2. How long will the trip take?
    a. Hours: _____
    b. Minutes ____
3. How far is the trip?
    ____ km
4. 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: _________
5. 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
6. The bicycle lanes are new. Can you recall riding along here before the bike lanes were installed?
    a. Yes
    b. No
7. How would you say your comfort riding along here has changed since the bike lanes were installed?
    a. Much more comfortable
    b. More comfortable
    c. No change
    d. Less comfortable

   e. Much less comfortable

8. How would you have made this trip if the bike lanes weren'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. Bus
   g. Taxi
   h. Don't know
   i. Other: _________
9. What change, if any, would you say the construction of the bike lanes 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. 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. Bus
   f. Taxi
   g. Walked
   h. Ran / jogged
   i. Don't know
   j. 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: _______________