Economic Benefits of Cycling Infrastructure at the Program Level

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ECONOMIC BENEFITS OF CYCLING INFRASTRUCTURE AT THE PROGRAM LEVEL

More cycling tackles morbidity, obesity and mental health issues and that means a reduced burden on the public health system. The benefits compound as cycling networks are completed, made denser, or separated from traffic.

We've known about the health benefits of cycling for a long time, but have you ever wondered whether the benefits actually outweigh the capital cost of the infrastructure required to support this activity? Recent research has quantified a range of benefits of cycling and walking which are now encapsulated in the Australian Transport Assessment and Planning (ATAP) Guidelines for Active Transport.

The economic benefits of this type of investment are real, quantifiable and measurable. When the benefits are monetised, and the number of users are taken into account (sometimes through population forecasting) the benefit cost ratios can be greater than 4. In western countries with aging populations, that's of profound interest to policymakers at all levels of government, and should require that the planning and design of this type of infrastructure remains a priority.

This paper details a methodology for determining the economic return on cycling networks based on population data, user profiles and separated/unseparated paths, developed as part of a business case for the Queensland Department of Transport and Main Roads' Cycling Infrastructure Program.

1. Background

1.1 Cycling investment in Queensland

The Queensland Government has made a significant investment towards achieving the *Queensland Cycle Strategy 2011-2021* vision of more cycling, more often on safe, direct and connected routes. Over $200 million has been invested in the last decade on more than 400 projects to deliver over 465 kilometres of network.

There is good evidence to suggest that targeted investment in good quality cycling infrastructure is effective. For example, the Queensland Department of Transport and Main Roads (TMR) and Cairns Regional Council jointly invested $9 million in cycling infrastructure and promotion over a five year period. National Cycling Participation Survey (NCPS) data indicated the proportion of residents that ride a bicycle in a typical week in Cairns grew to 22.7% compared to an average 16.1% for Queensland (Austroads 2015). In the same period, other Queensland towns with limited investment recorded decreases.

Surveys indicate that about 760,000 of Queensland's four million residents ride a bike each week (Austroads 2015) and another 1.53 million would ride if the conditions were right (University of Sydney 2015). Stakeholder consultation highlights strong support for greater investment in cycling infrastructure physically separated from motorised traffic.

Now a new Queensland Cycling Strategy is being developed to set the direction for cycling in Queensland over the next ten years. The new strategy is part of a mature policy, planning and investment framework for cycling in Queensland. Strategy implementation is supported by planning, prioritisation and investment as well as research and technical support as shown in Figure 1.

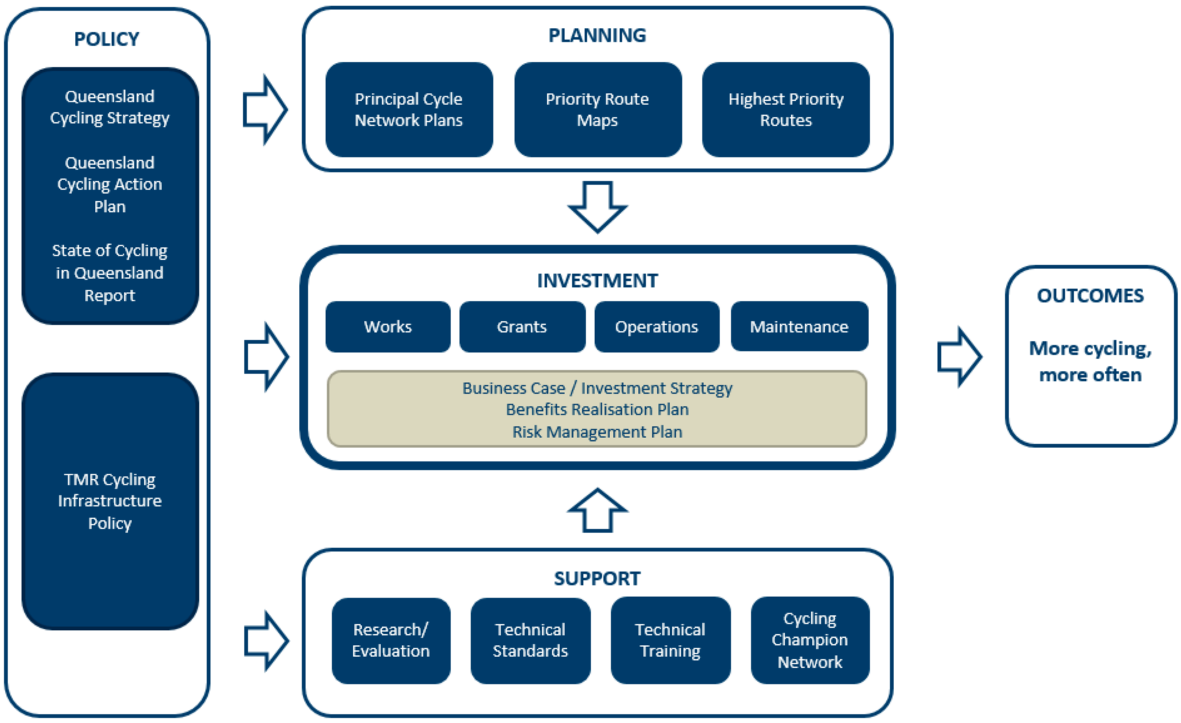

Figure 1 Cycling policy, planning and investment context in Queensland

Within this context, TMR undertook the development of the Queensland Cycling Infrastructure Investment Strategy and Business Case 2016-2026 (business case) to analyse the potential impact of several scenarios for the most cost effective investment in cycling infrastructure over 10 years. This paper describes the economic analysis behind the business case in detail, and how it is being used to reshape the Cycling Infrastructure Program to maximise the benefits of future investment.

1.2 Network planning and prioritisation

The first and most important step in being able to undertake the business case was cycle network planning. TMR has published seven Principal Cycle Network Plans (PCNPs) identifying a future 10,237km of network covering 48 local government areas and 98.9% of the Queensland population. PCNPs are indicative and used to guide further planning and investment.

TMR has also worked with local governments to prepare Priority Route Maps (PRMs) for each PCNP. These identify the highest priority routes (HPRs) – the core routes connecting important origins and destinations in each community – that were considered feasible to construct within the next 10 years. For the purposes of business case analysis, 552km of HPRs and 1,722km of Next Highest Priority Routes (NHPRs) were identified and costed.

The next section summarises the methodology used for business case development.

2. Assessing the costs and benefits of cycling infrastructure

2.1 Methodology

Queensland's cycling business case was underpinned by development of a cost benefit analysis (CBA) model in order to conduct economic appraisals of funding scenarios. The scenarios were based on the capital cost of the HPRs and NHPRs, for 10 years from 2016 to 2026.

The model assessed the net economic benefits of individual program funding scenarios, but was not a detailed project evaluation model and was not based on transport modelling. The objective of the model was to determine which particular investment funding profile was likely to produce the largest economic returns and the highest rate of return on funds invested. The model:

- estimated the likely net economic benefit for each program scenario;
- compared returns from each program option on a consistent basis;
- assessed the robustness of these estimates through sensitivity analysis and Monte Carlo analysis.

The approach adopted was developed to conform to economic appraisal guidance within the Australian Transport Assessment and Planning (ATAP) Guidelines for Active Transport (formerly National Guidelines for Transport System Management (NGTSM)). Specifically, the ATAP Guidelines were used to develop key concepts regarding benefit streams for this analysis, along with a series of cycling infrastructure studies that had been prepared by TMR. In addition, the CBA adopted key elements from the CBA guidelines within the Queensland Government's Project Assessment Framework (PAF).

Figure 2 shows the model build process.

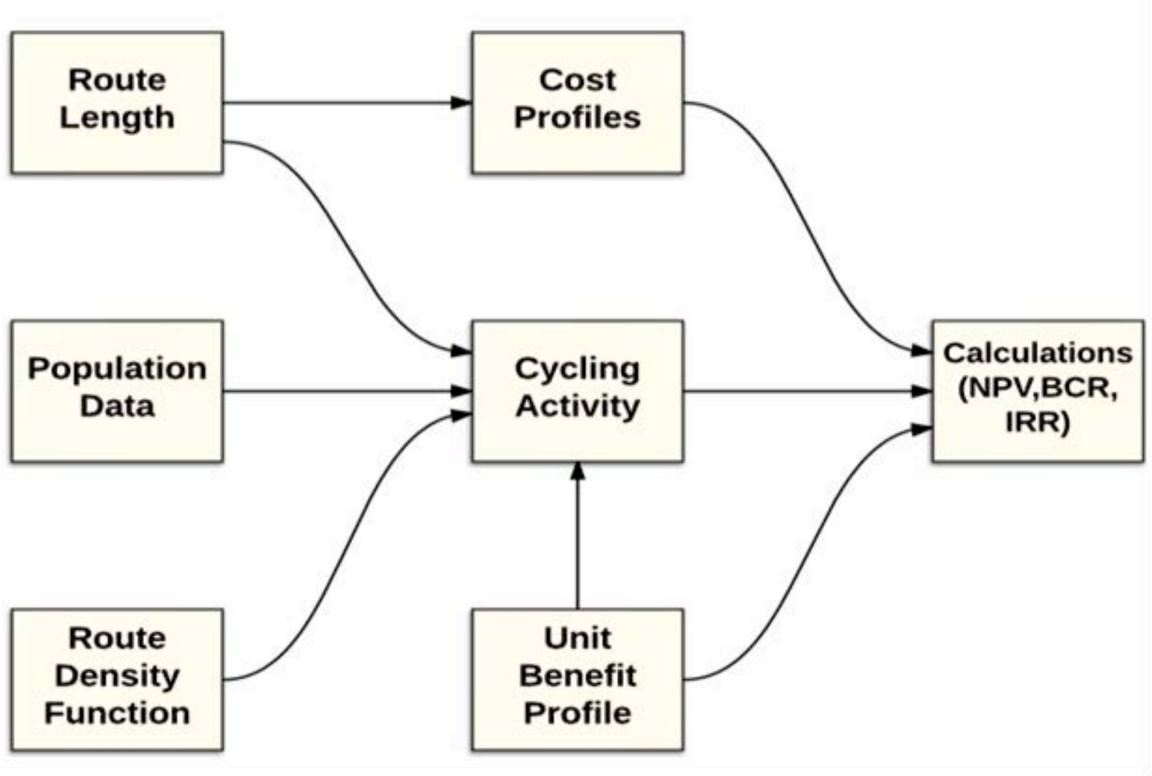

Figure 2 CBA Model Build Process

These model components are described as follows:

- Route Length – calculates route lengths to develop year-by-year cost profiles;
- Population Data – Australian Bureau of Statistics (ABS) population data and projections;
- Route Density Function – estimation of a 'density uplift' factor;
- Cost Profiles – base data for year-by-year profiles of costs of each funding scenario;
- Cycling Activity – estimation of baseline cycling activity and response to proposed infrastructure;
- Unit Benefit Profile – estimation from NGTSM values and creation of a benefit application matrix; and
- Calculations – derivation of costs and benefits, estimation of Net Present Value (NPV) and Benefit Cost Ratio (BCR).

2.2 Key assumptions

Key assumptions underpinning model development were as follows:

- For the purposes of economic modelling, and in accordance with standard practice, contingency values were excluded from the streams of costs and benefits;
- Base year – the base year for the analysis and discounting of all values was the financial year ending 30 June 2017;
- Valuation year – values are expressed in real terms in 2016-17 dollars;
- Real discount rates – the 7% discount rate was the core rate in the analysis;

- Period of analysis – a 30 year period of analysis was adopted (2016-17 to 2045-56). This period of analysis is consistent with the approach to appraisal of transport infrastructure;
- Forward estimates – the first four years of the capital expenditure profile match the current Queensland state forward allocations;
- Economic lives of assets – a 50-year economic life was assumed for all new cycling facilities;
- Residual value – a residual value representing the remaining useful life of cycling facilities was added in the final year (2046) of the appraisal. Depending on when the relevant capex is spent, the residual value ranges from 40% to 60% of the value of the cycling facilities;
- Cycling operation costs – costs associated with managing the program and supporting the roll out of new infrastructure were assumed to be the same across all funding scenarios. The first four years match the forward estimates;
- Maintenance costs – annual maintenance costs were applied to new cycling facilities over the evaluation period. Maintenance costs were estimated to be 2% of the capital expenditure required to construct each cycling facility. Annual maintenance costs were assumed to increase over the first ten years of the program as additional cycling facilities are built in each of those years. Following final construction, maintenance levels were maintained across Years 11 to 30 in the appraisal;
- Design costs – design costs were applied to new cycling facilities in the year that the facility is constructed. These costs are estimated to be 10% of the value of the relevant capital expenditure. The profile of design costs mirror the capital expenditure profile for cycling facilities. No design costs were therefore considered in Years 11 to 30 in the appraisal;
- Cycling activity lag – cycling activity in response to new cycling facilities was lagged by a year from the year in which construction occurred. New infrastructure is not expected to attract cycling activity in the year it is constructed;
- Cycling activity ramp – a ramp to full cycling activity values was included in the first four years of the model (2016-17 to 2019-20). This accounted for a gradual increase in the patronage of new facilities.

2.3 Model inputs

2.3.1 Capital costs

Strategic level costs were developed by utilising an average of actual past project construction costs (unit rates). The unit rates used are presented in **Error! Reference source not found.**.

Table 1 Unit Rates used for the Priority Route Network

Unit Cost Rates per Region			
	On-road (bi-directional)	**Off-road (bi-directional)**	**Structures**
Brisbane metropolitan area	$441 / linear metre for 1.5m wide bicycle lanes	$1,572 / linear metre for 3m wide paths	$2,000/m²
Other SEQ	$340 / linear metre for 1.5m wide bicycle lanes	$295 / linear metre for 3m wide paths	$2,000/m²
Outside SEQ	$248 / linear metre for 1.5m wide bicycle lanes	$410 / linear metre for 3m wide paths	$2,000/m²

Source: Queensland Department of Transport and Main Roads (unpublished report)

Of note, inside SEQ, the on-road unit rate was marginally more expensive than the off-road rate, due to particular construction constraints present over a representative sample of projects. Overall however, off-road facilities are usually more expensive.

2.3.2 Population

Population catchments within the PCNPs were used to estimate the number of cyclists using the existing network and those who would use the additional kilometres of network under each scenario tested. The population data used was only for the 48 local governments that fall within the state-wide expansion area. This filter captured 98.9% of the population over 42% of the area of Queensland. A reduction of 10% was made for infrastructure estimated to have already been built.

Population data, including the forward projection of population levels, provided key baseline information upon which estimates of cycling activity were developed. The ABS medium projection for Queensland Estimated Resident Population was used. It covers the period 2011 to 2031. The growth implied by this period was projected from 2031 to the end of the 30 year appraisal period in 2046.

2.3.3 2015 National Cycling Participation Survey for Queensland

Data from the 2015 National Cycling Participation Survey for Queensland was drawn upon to formulate patronage data for the model for the population within PCNP areas, specifically to determine the number of trips and trip length made by new cyclists, as follows:

- The ABS population data was moderated according to 16% of the population who had ridden 3.2 times in the last week. These trips were multiplied by 2, assuming they were return trips, and multiplied by 52. This yielded an annualisation factor of 333 trips per cyclist per annum.
- Based on national data, each trip duration was assumed to be an average of 30 minutes. Assuming an average speed of 15km/hr, each trip length was therefore 7.5km.

2.3.4 Diversion Rates

The introduction of new cycling and walking infrastructure to a network generally results in a degree of mode-shift from other competing modes, such as driving and public transport. Diversion rates for new kilometres of network were adopted from the draft NGTSM as seen in Table 2.

Table 2 Trip diversion rates from Brisbane intercept surveys (Australian Transport and Infrastructure Council, 2015)

Trips from	Diverting to			
	Cycling		Walking	
	Inner city	Other areas	Inner city	Other areas
Car	10%	15%	5%	10%
Public transport	20%	0%	15%	50
Reassign	65%	55%	70%	50%
Induced	5%	30%	10%	40%

Based on the above rates, a series of weighed average diversion rates were used in the model as set out in Table 3.

Table 3 Weighted average diversion rates

Weighted Average Diversion Rates	
Diverted from Car	13%
Diverted from Public Transport	10%
Reassigned to New Route	60%
Induced to New Route	17%

2.4 Estimation of benefit unit values

2.4.1 Key benefits

A benefit transfer method was used to incorporate and assign benefit streams in the economic appraisal of funding options for the business case. The approach built on data estimated and presented in a public consultation draft of the NGTSM for Active Travel as well as a review of unit benefits values applied in similar cycling infrastructure studies.

For the purpose of this cost benefit analysis, this approach is considered reasonable. NGTSM values were expressed in ranges in the draft guidelines. The general approach adopted in the appraisal has been to select a value from each range at the lower end such that the value adopted marks the lower third of each range.

The single largest category of benefits relates to health benefits. It also comprised the greatest absolute value range for unit values of benefits. Adopting a lower third value from that range is considered conservative in the context of this study. Figure 3 highlights the relative significance of each of the unit value benefits.

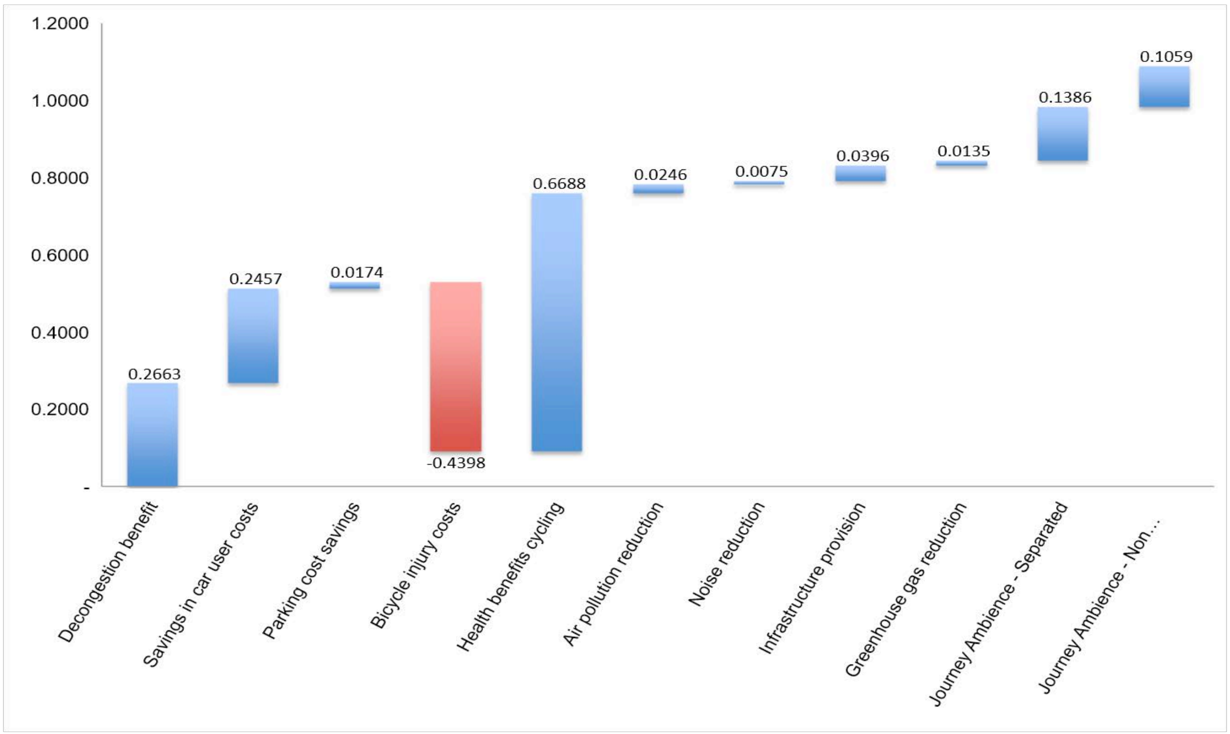

Figure 3 Impacts of benefits ($2016/cycle-km)

2.4.2 Benefit applications

Using the diversion rates from Figure 2, the total estimated volume of new cycling activity was apportioned to four categories: diverted from car, diverted from public transport, diverted from existing routes and induced cycling. This was based on a series of studies conducted for TMR in 2011 (Price Waterhouse Coopers/SKM) to analyse the value of active transport infrastructure projects.

This enabled the development of the benefit application matrix detailed in Table 4 to ensure there was an appropriate, realistic and transparent attribution of benefits. Diversion rates are shown as percentages at the head of each column.

As an example, cyclists that divert from existing routes are not expected to achieve additional health benefits, although this represents 60% of cycling activity in the model. Similarly, where responses to changes in cycling cost are identified, the perceived benefit can range between nearly zero and full unit value of that benefit. In those instances, the ‘rule of half’ is applied to that activity as shown in Table 4.

Table 4 Benefit Application Matrix

	Diverted from Car (13%)	Diverted from Public Transport (10%)	Diverted from Existing Routes (60%)	Induced Cycling (17%)
Decongestion benefit	1.0	1.0	1.0	1.0
Savings in car user costs	0.5	-	0.5	0.5
Parking cost savings	0.5	-	0.5	0.5
Bicycle injury costs (disbenefit)	1.0	1.0	1.0	1.0
Health benefits of cycling	1.0	1.0	-	1.0
Air pollution reduction	1.0	1.0	1.0	1.0
Noise reduction	1.0	1.0	-	-
Infrastructure provision savings	1.0	1.0	-	-
Greenhouse gas reduction	1.0	1.0	-	-
Journey ambience – separated cycling facilities	1.0	1.0	1.0	1.0
Journey ambience – non separated cycling facilities	1.0	1.0	1.0	1.0

2.5 Other key elements

2.5.1 Network Density

United States (US) research (Schooner and Levinson, 2014) suggests that it is possible to predict a relationship between network completeness and bicycle commuting. Linear regression modelling has revealed that connectivity and directness are important factors in predicting the level of commuting after controlling for demographic variables and the size of the city.

The research demonstrates a positive correlation between network density and increased ridership. In the model, this has been reflected with the use of an uplift factor to represent increased network usage. This uplift factor is based on regression analysis that shows a 77% increase in cycling activity based on network effects when other factors for cycling activity are controlled. This occurs where additional kilometres of route-length are constructed in existing square kilometre areas where network already exists.

The economic appraisal model assumes investment to improve network density will occur for 25% of the total length constructed under each funding scenario.

2.5.2 Physically separated cycling infrastructure

Cyclists are often faced with a choice of using cycling infrastructure that may be physically separated (either off-road or on-road) or non-separated on-road infrastructure such as bike lanes. Research consistently demonstrates that for most cyclists, the former is preferred because of the improved safety and amenity outcomes. Estimates were made to take into account changes in the composition of assets constructed.

Baseline estimates of cycling activity were based on an assumed 60/40 split between separated and non-separated infrastructure. Applying this baseline figure to a higher quality network build could understate the additional cycling response, as the model calculates an average per kilometre response to new infrastructure.

The University of British Columbia Cycling in Cities Research Program conducts significant research into opinions about cycling activity, including detailed analyses of responses by cyclists to different types of cycling facilities. It identified 16 archetypal styles of bike path construction that reflect different separated and non-separated facilities.

Responses to separated and non-separated facilities were estimated from this analysis, providing a general indication of how the propensity to cycle is affected by the quality of cycling facilities. An average 80% positive response to off-street paths (separated facilities) was contrasted against a 70% response to multi-use/on-street (non-separated) cycle paths.

This is based on the most significant response rates. For the economic appraisal, an uplift factor of 1.14 was developed from this to adjust the average route cycling response where a proposed funding scenario is intended to improve the proportion of separated facilities constructed above 60/40. This provides a general network response about the average level of cycling activity. If the facilities on average are better, a higher level of cycling activity can be expected.

Wardman et al. (2007) constructed a logit model to ascertain the proportion of potential riders who would choose off-road separated higher quality paths over non-separated paths. The results revealed a 21% response to separated cycleways and 14% response to non-separated cycleways.

From Wardman et al (2007), a 50% uplift is implied if a switch occurs from non-separated to separated. This has been applied to the cycling kilometres notionally reassigned from 40% non-separated in the Business as Usual (BaU) case in the CBA model to 80% separated, in each scenario case (introduced in Section 3 below).

2.5.3 Safety

In a significant Canadian study for the University of British Columbia, Teschke et al (2012) concluded that separated cycle infrastructure reduced cyclist injuries, with the use of cycle tracks (that is, separated cycling facilities) presenting a lower risk of injury to cyclists than non-separated infrastructure, for example on-road cycle lanes adjacent to parking lanes.

The research indicated that a 40% reduction in accident rates could be expected by switching from non-separated to separated cycle infrastructure.

The CBA model contains a factor which, for every new kilometre of separated facility, reduces the value of the crash disbenefit, reflecting the improvement to safety that separated facilities offer. It takes the maximum value for bicycle accident rates which is applied to kilometres cycled under the current ratio of separated to non-separated cycle infrastructure.

Accident costs are reduced proportionately as more separated infrastructure is constructed. The effect is that where the proportion of route length that is separated increases by 20%, an 8% reduction in total bicycle accident costs is estimated.

3. Scenarios Tested

3.1 Network quality

A key consideration for the funding scenario development was the safety and quality of the infrastructure to be provided. Through best practice research, consultation undertaken via the PCNPs and more recently via consultation for the Queensland Cycling Strategy, people have typically indicated:

> *"If you want me to cycle, or cycle more, what I want is safe infrastructure that is physically separated from motor vehicle traffic".*

As a result, and in order to achieve the uplift in cycling numbers required, the funding scenarios have assumed that the majority of new infrastructure provided as part of the Cycling Infrastructure Program will be physically separated from traffic. Examples of the range of types of infrastructure that this could incorporate are shown in Figure 4.

Figure 4 Examples of separated cycle paths

3.2 Scenarios

The scenarios tested in the CBA model, including BaU, are presented in Table 5.

Table 5 Funding Scenarios Analysed

Scenario	Length over 10 years (kms)	CAPEX [2] ($m)	Standard of Infrastructure [3]	HPR (% constructed)	NHPR (% constructed)	PCNP[4] (% constructed)
Business As Usual [1]	521	$518	60/40	94%	0	5.1%
A. HPR	552	$648	80/20	100%	0	5.4%
B. HPR plus 10% NHPR	724	$906	80/20	100%	10%	7.1%
C. HPR plus 30% NHPR	1,068	$1,420	80/20	100%	30%	10.5%

(1) Business As Usual scenario – existing funding plus year 4 funding continued in years 5-10.

(2) CAPEX refers only to cost to construct route length (real, undiscounted dollars).

(3) Standard refers to the proportion of route built to separated/unseparated standards.

(4) Total PCNP assumed to be 10,200km in length.

3.2.1 Business as Usual

As a baseline comparator for the modelling of alternative funding levels, a BaU scenario was formulated. The BaU profile is an important part of the economic appraisal. It reflects the most likely situation in the absence of a significant investment decision. This profile is best characterised as preserving the approach delivered to date.

In effect, BaU is a small, slow roll out of the PCN. An estimated 521kms of HPR (core routes connecting important origins and destinations in each community across Queensland) would be delivered over a 10-year period under BaU. This comprises just 5.1% of the PCN.

3.2.2 Scenario A - HPR

Scenario A was developed as a profile of funding if 100% of the HPR network was constructed over 10 years, with a safer standard of facility; that is with a greater proportion of separated facilities than those assumed under BaU. Scenario A consists of:

- 552km of cycling routes State-wide (5.4% of the total PCN);
- an additional 31km of cycle paths over and above BaU;
- a higher proportion of safe cycle facilities, with 80% assumed to be physically separated;
- first four years of program to be set as the current 4 year forward allocations;
- an additional $27.4 million per annum State average spend over and above BaU in Years 5-10 (including a 5% escalation).

3.2.3 Scenario B - HPR + 10% NHPR

The next funding scenario proposed construction of more of the PCN. It assumes that all of the HPR network is constructed plus an additional 10% of the NHPR network is constructed (that is an additional 170kms) which are the next highest priority core routes in the network. Scenario B would achieve:

- 724km of cycling routes state-wide (7.1% of the PCN);
- an additional 203km over and above BaU;
- higher proportion of safe cycle facilities, with 80% assumed to be physically separated;
- first four years of program to be set as the current 4 year forward allocations;
- an additional $73.3 million per annum average State spend over and above BaU in Years 5-10 (including a 5% escalation).

3.2.4 Scenario C - HPR + 30% NHPR

Scenario C proposed construction of more of the network with all of the HPR and 30% of the NHPR networks (that is 518kms of the NHPR). Scenario C would achieve:

- 1,068km of cycling routes state-wide (10.5% of the PCN);
- an additional 547km over and above BaU;
- higher proportion of safe cycle facilities, with 80% assumed to be physically separated;
- first four years of program to be set as the current 4 year forward allocations;
- an additional $165 million per annum average State spend on BaU in Years 5-10 (including a 5% escalation).

4. Scenario findings

4.1 Business as Usual

The BaU scenario produced an NPV of $1,590 million and a BCR of 4.29 at a discount rate of 7% over a 30 year appraisal period. The net economic benefit is equivalent to $53 million a year in present value terms for 30 years.

One implication of not completing construction of the HPRs within the first ten years is that over the 30-year appraisal period, these benefits simply do not occur.

4.2 Scenario A - HPR

The HPR scenario produced an NPV of $2,311 million and a BCR of 4.97 at a discount rate of 7% over a 30 year appraisal period. The net economic benefit is equivalent to $77 million a year in present value terms for 30 years.

In completing the highest priority routes, significant economic benefits are generated, some $721 million over the appraisal period. The basis of these gains are examined in further detail in a sensitivity analysis below.

4.3 Scenario B - HPR + 10% NHPR

The HPR + 10% NHPR scenario produced an NPV of $2,955 million and a BCR of 4.78 at a discount rate of 7% over a 30 year appraisal period. The net economic benefit is equivalent to $99 million a year in present value terms for 30 years. An estimated $644 million in net economic benefits accrues from undertaking an additional 10% of the high priority routes compared to HPR. This is at an additional economic cost of $168 million.

4.4 Scenario C - HPR + 30% NHPR

The HPR + 30% NHPR scenario produced an NPV of $4,246 million and a BCR of 4.61 at a discount rate of 7% over a 30 year appraisal period. The net economic benefit is equivalent to $141 million a year in present value terms for 30 years. An estimated $1,935 million in net economic benefits accrues from undertaking an additional 30% of the high priority routes compared to HPR. This is at an additional economic cost of $539 million.

A summary of key findings of the CBA analysis can be seen in Figure 5.

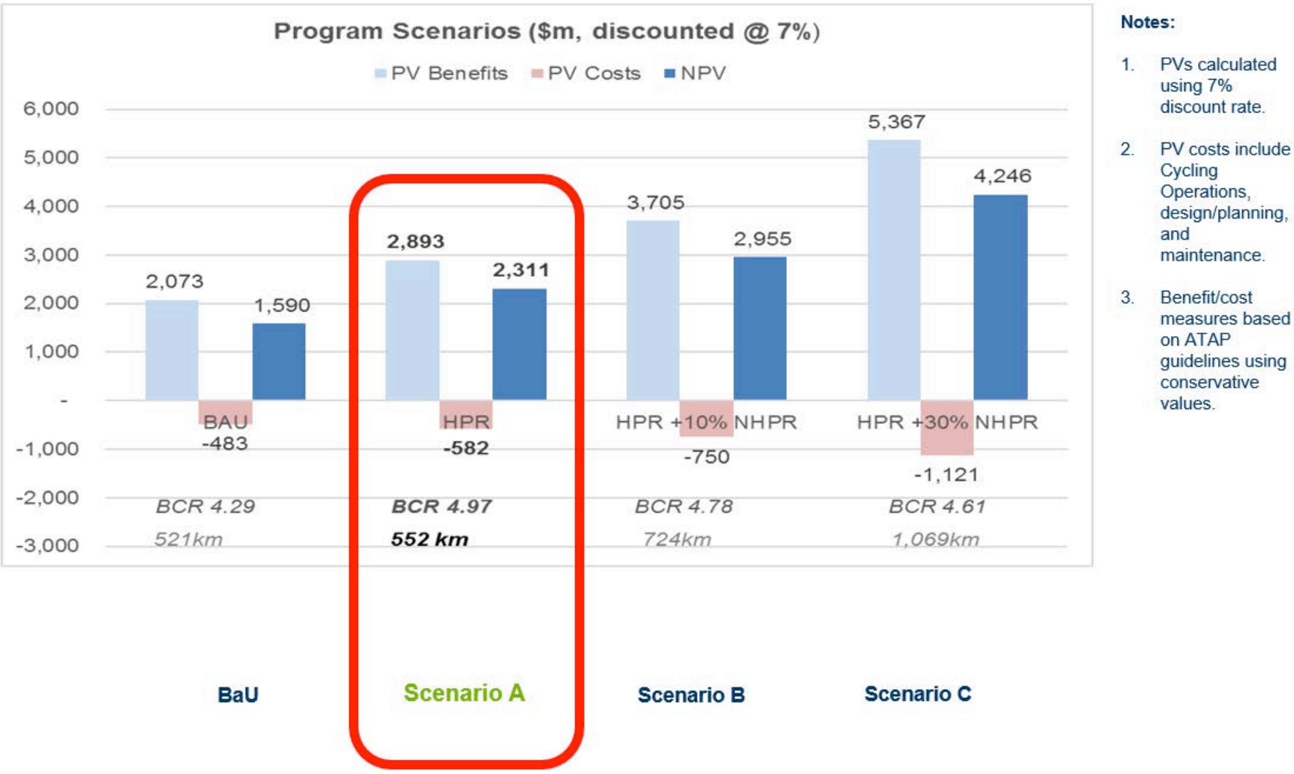

Figure 5 Program Scenario Outcomes

BaU does not complete the HPR network and does not deliver the standard of network required to address safety and increase ridership; its BCR is lowest.

Scenario A was developed as a profile of funding assuming 100% of the HPR network was constructed with a greater proportion of separated facilities than those assumed under BaU. Scenario A completes the HPR network within 10 years, at a higher standard than BaU. Scenario A achieves the highest BCR due to increased ridership, and reduced injury disbenefits, on the mainly separated network.

Scenario B proposed construction of more of the PCN. It assumes that all of the HPR network is constructed plus an additional 10% of the NHPR network, within 10 years. Scenario B achieves the second highest BCR, and would require planning to ensure deliverability under the accelerated rollout of the PCN.

Scenario C proposed construction of more of the network with all of the HPR and 30% of the NHPR networks Scenario C achieves the third highest BCR, and would require significant planning to deliver. The BCR is lower than scenarios A and B because of the higher capital cost compared to the benefits.

4.5 Sensitivity tests

In order to assess the robustness of the results from the economic appraisal, a series of sensitivity tests were applied to key variables, as seen in Table 6 and in Sections 4.5.1 and 4.5.2.

The HPR funding scenario was selected as it marks the smallest, most significant difference from the BaU case, reflecting both more route kilometres constructed and at a higher standard. The other funding scenarios mark an extension of HPR with +10% of NHPR and +30% NHPR.

Table 6 Key Sensitivity Tests

Test	BAU	HPR	HPR +10% NHPR	HPR +30% NHPR
+30% capex	$463M 2.12	$1,081M 2.60	$1,368.M 2.54	$1,916M 2.43
-25% benefits	$314M 1.92	$786M 2.35	$964M 2.33	$1,344M 2.22
5 year delay	$552M 3.18	$1,212M 4.06	$1,642M 4.08	$2,379M 3.95
60/40	$532.8 2.55	$1,302M 3.68	$1,635M 3.53	$2,317M 3.39

4.5.1 Lower weekly cycling participation rates

The analysis assumes that 16.2% of the population cycle on a weekly basis, in line with the 2015 National Cycling Participation Survey for Queensland. Even where that participation rate is cut in half to 8.1%, it still produces an NPV of $864 million and a BCR of 2.49 under the HPR funding scenario.

4.5.2 Shorter program appraisal period

In this test, up to two thirds of the expected benefits were removed by only considering the first ten years of the appraisal period, which matches the life of the program (ten years). This was to test the possibility the proposed funding could be economically viable within the period of asset construction. The model reported an NPV of $219.7 million and a BCR of 1.40. This is strongly suggestive of economic viability even through full benefit realisation is unlikely to have occurred.

5. Conclusions

Consultation conducted by TMR during the development of the new Queensland Cycling Strategy has highlighted a strong preference for separated cycling facilities.

A CBA model was developed at program level, grounded in demographic (medium population forecast for Queensland) cost data and working papers on international practice, to support the implementation of a program of mainly separated cycling facilities. The funding scenarios have assumed that the majority of new infrastructure provided as part of the program will be physically separated from traffic. The model shows credible NPVs and BCRs for such a program.

It can be seen that:

- NPVs increase in accordance with level of investment;
- BCR appears to maximize around HPR and HPR + 10% NHPR, which could be due to current population levels and cycling activity;
- BCR for HPR + 30% is lower because insufficient benefits are recouped for higher cost.

Of the funding scenarios analysed for the HPR/NHPR network, the economically strongest scenario is Scenario A. Key benefits associated with this scenario are as follows:

- Completion of the HPR within a ten year window by completing a further 30 kilometres compared to BaU;
- Compared to BaU, construct additional 20% of new cycling facilities so they are constructed to a separated standard, helping realise higher levels of cycling participation as proposed in the new Queensland Cycling Strategy;
- Related to construction of separated cycling facilities is the reduction in bicycle injuries as a result of improving cycling facility standards.

Overall, this innovative approach to cost benefit analysis and business case development at a program level offers a model for other jurisdictions to adopt and develop further. Future refinements to the methodology will be possible with future iterations of the ATAP guidelines and continuing evaluation of, and research into, the impact of cycle network implementation over time.

6. Practical implications for the Cycling Infrastructure Program

The CBA model results indicate that the Queensland economy could expect almost $5 in economic benefits for every dollar invested in cycling infrastructure. This is a very significant finding and supports the case for additional funding for cycling infrastructure. Based on the business case as a whole, TMR is currently introducing refinements to the program funding guidelines to:

- Prioritise funding towards delivering 552km of HPRs over the next 10 years;
- Gear funding assessment criteria to achieve a higher proportion of physically separated infrastructure;
- Invest more in planning projects on HPRs to drive development of a 10 year pipeline of works;

- Encourage joined up project planning and delivery of high priority routes by TMR and local governments to achieve longer lengths of network more rapidly;
- Incorporate funding for targeted promotion of completed corridors to boost usage.

TMR will continue to monitor and evaluate the impacts of cycling infrastructure investments on achieving the Queensland Government vision of more cycling more often.

7. References

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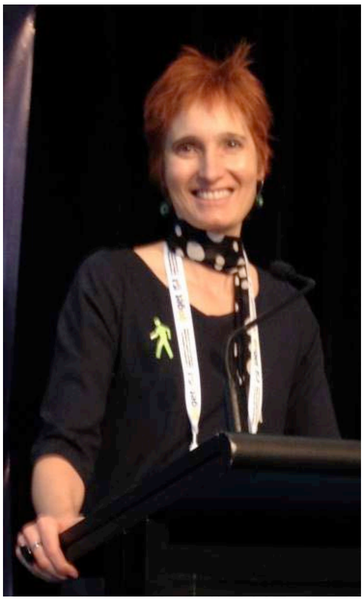
Presenter's Bios and photograph

Robyn Davies manages the cycling program in the Department of Transport and Main Roads in Queensland. She is an urbanist and transport planner with 20 years' experience working in state and local governments in Australia and the UK. She is an advocate for sustainable transport and making cities great places for people.



Ben Vardon is a senior road safety auditor with skills in crash analysis/research, strategic transport planning for cycling and walking, traffic engineering, the application of Crime Prevention Through Environmental Design (CPTED) principles and design for equitable access. He has a particular passion for the latter two and believe that cyclists and pedestrians should be able to reach our urban attractors and transport nodes in complete safety with priority over motorised transport.
Ben has successfully led multidisciplinary project teams in the UK and Australia for the planning and design of bike and pedestrian facilities, streetscaping improvements and planning and design for key modes such as light rail.