TRANSPORT AND INFRASTRUCTURE COUNCIL

Australian Transport Assessment and Planning Guidelines

Worked Examples: W4 Active Travel

4.1 Pedestrian / cycle signalised crossing or overpass

May 2018

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1. Problem description

Pedestrians and cyclists presently cross a major sub-arterial road that represents a break in an off-road pedestrian cycle 'shared path'. The crossing is not presently signalised but has protection in the form of a pedestrian refuge in the roadway median. Annual average daily traffic (AADT) is 5,000 vehicles growing at 2% pa. On an average day, 150 walkers and 100 cyclists use the crossing, making an average of two crossings per day per person. Active travel trips are growing at 2% pa. When allowance is made for public holidays, transport trips (trips with a transport purpose, that is, not recreational) comprise 60% of all active travel trips.

2. Options

This example examines two project case options in addition to the base case.

Base Case

Option 0: Do Nothing: The base case is a 'do nothing' scenario as there are no proposals to alter the road or related infrastructure in ways that would affect traffic levels and vehicle speeds.

Project Case options

Option 1: Provide signals at the crossing to allow active travellers to cross safely.

Option 2: Provide a pedestrian and cycle overpass.

3. Benefits and costs

Table 1 lists the benefits and costs and whether they have been monetised.

Table 1 Monetised and non-monetised benefits and costs

	Monetised	Non-monetised
Benefits		
Travel time savings (disbenefit)	✓	
Crash cost savings	✓	
Residual value	✓	
Costs		
Construction costs	✓	
Maintenance costs	✓	

4. Inputs and assumptions

Base year and price year: 2015

Real discount rate: 7%

Construction period years: 2016

Construction cost:

Construction cost Option 1: $250,000

Construction cost Option 2: $4,250,000

Asset (economic) life:

- Option 1 assets: 30-year life
- Option 2 (overpass): 40-year life

Appraisal period: construction period plus 30 years of operation

Residual value:

Residual value of overpass in option 2: $1,062,500, shown as a benefit in the final year of appraisal.

Based on: straight line depreciation method, 10 years of 40-year life remaining at end of appraisal period (40 – 30)

Maintenance costs:

The incremental annual maintenance costs compared with the Base Case are estimated to be:

- Option 1: $4,000 per year
- Option 2: $25,000 per year

Crashes: There has been one fatal and one serious injury crash (impacting active travellers) at the crossing in the last 10 years.

Delays:

Active travellers and road vehicles are expected be delayed as follows (based on broad traffic engineering experience):[1]

- Base Case:
  - *Active travellers*: zero delay – the road traffic volume is low enough in this example (5,000 vehicles per day) that there will nearly always be a safe gap for active travellers to cross the road

[1] These delays are in addition to the time taken to physically cross the road.

  - *Cars*: zero delay
- Option 1 (signalised crossing):
  - *Active travellers*: average delay of 45 seconds
  - *Cars:* a delay of 20 seconds for each vehicle stopped by the signals. However, only a small proportion of vehicles will be stopped, with an expected average delay across all vehicles of 3 seconds
- Option 2 (overpass):
  - *Active travellers*: an average delay of 45 seconds spent ascending and descending the overpass ramps
  - *Cars*: zero.

In cases of higher volume roads, one would expect: non-zero active traveller delays in the Base Case; and higher car delays in option 1 (signalised crossing). In the base case, this may involve active travellers seeking an alternative crossing nearby.

Growth rate: Active travel and road traffic are both expected to grow 2% per annum over the appraisal period.

Other assumptions

Travel time benefits for active travellers are calculated only for ‘transport trips’, which includes journeys to work, shopping, entertainment destinations (e.g. the movies). Recreational trips are assumed to have a zero value of time savings. Recreational active travel trips are those made as part of leisure purely for fun, stress release or health.

Levels of walking and cycling in this community are already considered high so the proponent does not expect either of the options to increase active travel. This assumption means there are no health benefits (over and above crash effects) from this initiative. The only exception might be that the small extra time taken to cross the road would slightly cut into the time budget for exercise, but this effect will likely be very small.

Table 2 lists other inputs and assumptions.

Table 2 Other initiative inputs and assumptions

	Base case	Option 1	Option 2
Trip type – active travellers	transport and recreation	transport and recreation	transport and recreation
Number of crossing trips/day − walkers 2015 (A)	300	300	300
Number of crossing trips/day − cyclists 2015 (B)	200	200	200
Active travel transport trips as % of all their trips (C)	60%	60%	60%
AADT 2015 (vehicles) (D)	5,000	5,000	5,000
% private car	80%	80%	80%
% business car	15%	15%	15%
% commercial	5%	5%	5%
Delay averaged across all walkers/cyclists (E)	0	45 secs	45 secs
Delay averaged across all vehicles (F)	0	3 secs	0 secs
Days per year (H)	365	365	365
Average crash cost – fatal – 2013 values (I)	$7,573,412	$7,573,412	$7,573,412
Average crash cost – serious injury – 2013 values (J)	$526,606	$526,606	$526,606
Crash cost reduction factor relative to median refuge (K)		61%	77%
Fatal crashes per year (L)	0.1	0.039	0.023
Serious injury crashes per year (M)	0.1	0.039	0.023
Weighted average value of travel time - vehicles (N)	$31.34 per hr	$31.34 per hr	$31.34 per hr
Average value of travel time – active travellers (O)	$14.99 per hr	$14.99 per hr	$14.99 per hr
CPI June 2013 (P)	102.8	102.8	102.8
CPI June 2015 (Q)	107.5	107.5	107.5
Growth rate (R)	2%	2%	2%

Table note:

1. Where a crash record does not exist for the crossing, an exposure-based approach can be used, in which benefits are calculated according to reductions or increases per kilometre of travel – see ATAP Part M4 Section 5.5 discussion.

5. Benefit and cost time streams

Annual benefit streams are shown in Table 3 Annual benefit streams - $000, undiscounted3. Figures 1 to 6 show time streams for both benefits and costs.

Table 3 Annual benefit streams - $000, undiscounted

	Option 1				Option 2			
Year	Crash reduction	Travel time savings - active travellers	Travel time savings - cars, trucks	Total benefits	Crash reduction	Travel time savings - active travellers	Residual value	Total benefits
2017	520	-22	-52	446	655	-22	0	632
2018	530	-23	-53	455	668	-23	0	645
2019	541	-23	-54	464	681	-23	0	658
2020	552	-24	-55	473	695	-24	0	671
2021	563	-24	-56	482	708	-24	0	684
2022	574	-25	-57	492	723	-25	0	698
2023	585	-25	-58	502	737	-25	0	712
2024	597	-26	-60	512	752	-26	0	726
2025	609	-26	-61	522	767	-26	0	741
2026	621	-27	-62	533	782	-27	0	756
2027	634	-27	-63	543	798	-27	0	771
2028	646	-28	-64	554	814	-28	0	786
2029	659	-28	-66	565	830	-28	0	802
2030	672	-29	-67	576	847	-29	0	818
2031	686	-29	-68	588	864	-29	0	834
2032	700	-30	-70	600	881	-30	0	851
2033	714	-31	-71	612	899	-31	0	868
2034	728	-31	-73	624	916	-31	0	885
2035	742	-32	-74	636	935	-32	0	903
2036	757	-33	-76	649	954	-33	0	921
2037	772	-33	-77	662	973	-33	0	939
2038	788	-34	-79	675	992	-34	0	958
2039	804	-35	-80	689	1012	-35	0	977
2040	820	-35	-82	703	1032	-35	0	997
2041	836	-36	-83	717	1053	-36	0	1,017
2042	853	-37	-85	731	1074	-37	0	1,037
2043	870	-37	-87	746	1095	-37	0	1,058
2044	887	-38	-89	761	1117	-38	0	1,079
2045	905	-39	-90	776	1140	-39	0	1,101
2046	923	-40	-92	791	1162	-40	0	2,185

Figure 1 Annual total benefits time streams – Option 1

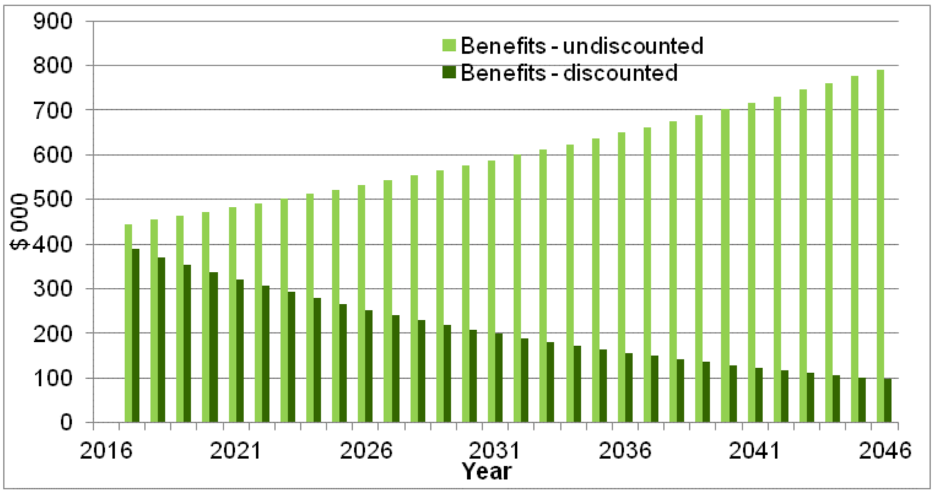


Figure 2 Annual total costs time streams – Option 1

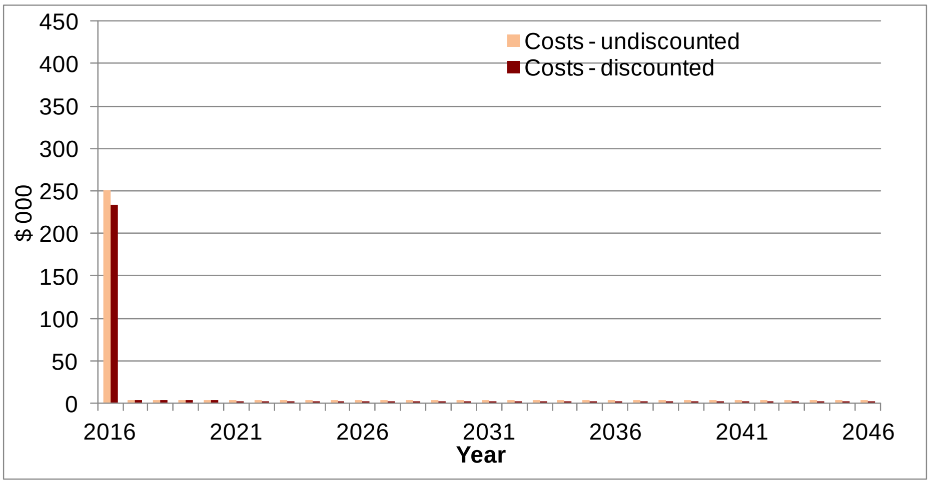


Figure 3 Annual net benefits and cumulative net benefits time streams – Option 1

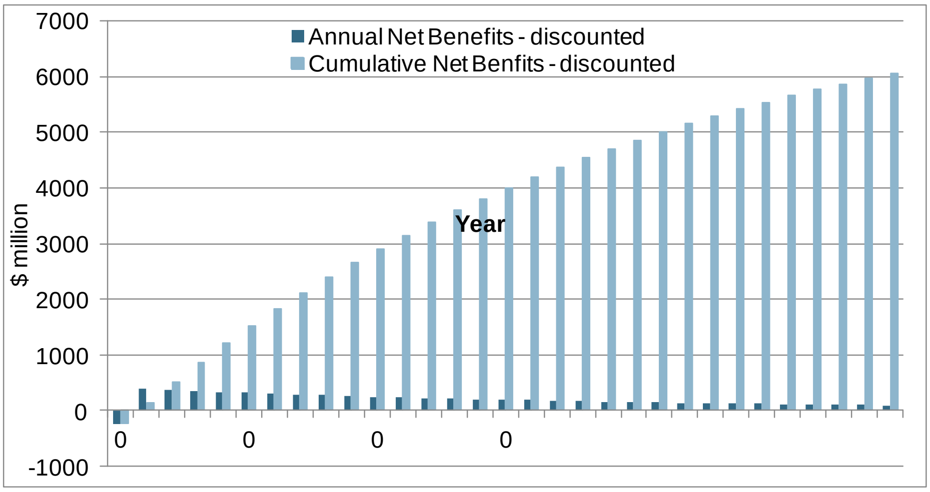


Figure 4 Annual total benefits time streams – Option 2

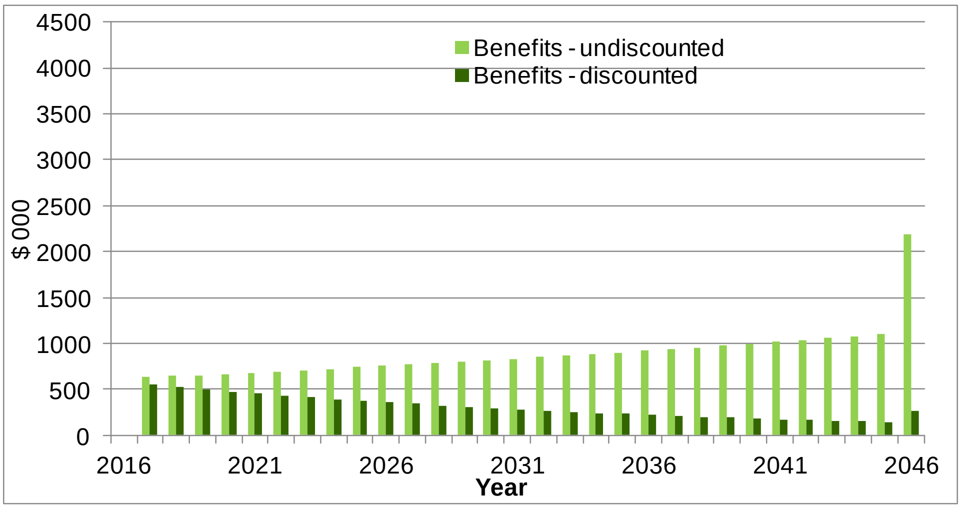


Figure 5 Annual total costs time streams – Option 2

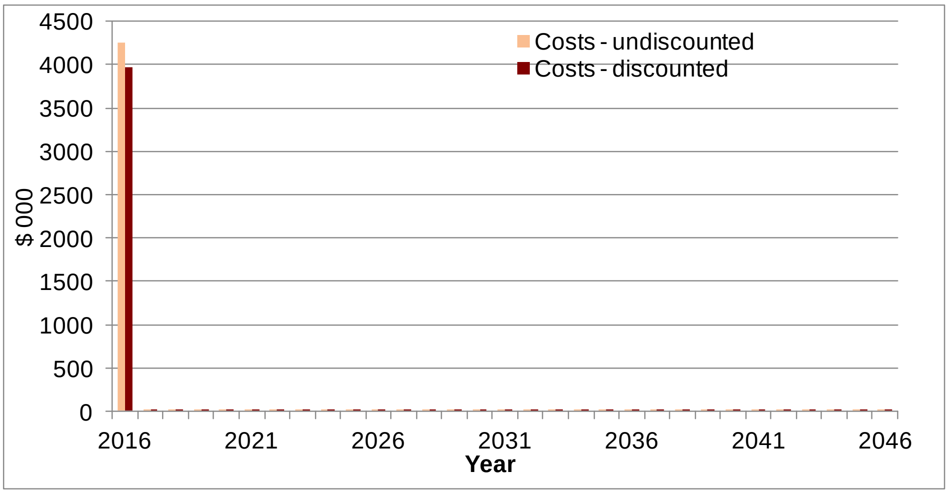
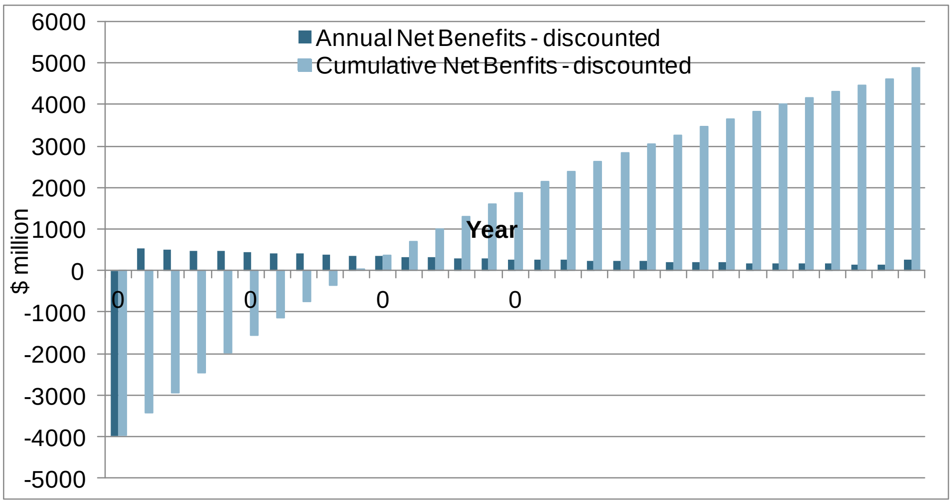


Figure 6 Annual net benefits and cumulative net benefits time streams – Option 2



6. Results summary

Table 4 Benefit and cost results – Central assessment (7% discount rate, input value best estimates)

	Present value $000	
	Option 1	Option 2
Benefits		
Crash cost savings active travelers	7,404	9,323
Travel time saving – active travelers	-318	-318
Travel time savings – cars, trucks	-739	0
Residual value	0	130
Costs		
Capital, PVIC	234	3,972
Maintenance, PVOC	46	290
Results		
PVB, $m	6,347	9,135
PVIC, $m	234	3,972
PVOC, $m	46	290
PVC = PVIC + PVOC	280	4,262
NPV = PVB – PVC	6,067	4,874
BCR1 = PVB / PVC	22.66	2.14
BCR2 = (PVB – PVOC) / PVIC	26.97	2.23
FYRR	165%	13%

Table notes:

1. All benefit and cost components are calculated as the incremental change between Base Case and Project (Option) Case
2. PV stands for present value; PVB is the PV of economic, social and environmental benefits, includes residual value, and excludes operating and maintenance costs; PVOC is the PV of operating and maintenance costs; PVIC is the PV of investment (i.e. capital) costs
3. BCR definitions BCR1 and BCR2 are both used by Australian jurisdictions – see ATAP Part T2 Section 10.

Table 5 Sensitivity testing results Option 1 and Option 2

Option 1

	PVB	PVIC	PVOC	NPV	BCR1	BCR2	IRR	FYRR
Central assessment (7% discount rate, input value best estimates)	6,347	234	46	6,067	22.7	27.0	179%	165%
Sensitivity Tests[(4)]								
1. Low discount rate (4%)	9,459	240	67	9,152	30.8	39.1	179%	170%
2. High discount rate (10%)	4,538	227	34	4,276	17.3	19.8	179%	161%
3. Increase capital costs by 25%	6,347	292	46	6,009	18.8	21.6	143%	132%
4. Decrease capital costs by 5%	6,347	222	46	6,079	23.7	28.4	188%	174%
5. Increase maintenance costs by 10%	6,347	234	51	6,062	22.3	26.9	178%	165%
6. Decrease maintenance costs by 10%	6,347	234	42	6,072	23.0	27.0	179%	165%
7. Increase benefits by 10%	6,982	234	46	6,702	24.9	29.7	161%	182%
8. Reduce benefits by 25%	4,760	234	46	4,480	17.0	20.2	134%	123%
9. Reduce crash benefits by 50%	2,645	234	46	2,365	9.4	11.1	75%	68%

Option 2

	PVB	PVIC	PVOC	NPV	BCR1	BCR2	IRR	FYRR
Central assessment (7% discount rate, input value best estimates)	9,135	3,972	290	4,874	2.1	2.2	16%	13%
Sensitivity Tests[(4)]								
1. Low discount rate (4%)	13,735	4,087	416	9,233	3.1	3.3	16%	14%
2. High discount rate (10%)	6,494	3,864	214	2,416	1.6	1.6	16%	13%
3. Increase capital costs by 25%	9,135	4,965	290	3,881	1.7	1.8	13%	11%
4. Decrease capital costs by 5%	9,135	3,773	290	5,072	2.2	2.3	17%	14%
5. Increase maintenance costs by 10%	9,135	3,972	319	4,845	2.1	2.2	16%	13%
6. Decrease maintenance costs by 10%	9,135	3,972	261	4,903	2.2	2.2	16%	13%
7. Increase benefits by 10%	10,049	3,972	290	5,787	2.4	2.5	15%	15%
8. Reduce benefits by 25%	6,852	3,972	290	2,590	1.6	1.7	12%	10%
9. Reduce crash benefits by 50%	4,474	3,972	290	212	1.0	1.1	7%	6%

7. Results discussion

The value of the initiative arises from the savings in crash costs, that is, the safety benefits. This is offset by costs of time delays (negative benefits) for active travellers in both options, and also for road traffic under option 1.

For the central assessment case, both options would be economically viable: option 1 with a BCR1 of around 23 and a NPV of $6.1m; and option 2 with a BCR1 of 2.1 and a NPV of $4.9m.

Each of the options is also economically viable across a range of sensitivity testing scenarios. Given the dominance of safety benefits, the last sensitivity test considers the impact of a significant decrease in those benefits (50%). The effect on the CBA results is significant for both options (and relatively greater for option 1), with both options remaining economically viable. A reduction of 53% would result in BCR1 for option 2 dropping below 1.0. For option 1, a reduction in crash benefits of 82% is required to cause BCR1 to drop below 1.0. Therefore, both options remain viable even with a significant downward correction in the estimation of safety benefits.

The preferred option from a CBA perspective would depend on the budget constraint.

If the budget is not constrained when choosing between mutually exclusive options, the most economically efficient choice is the option with the higher NPV (T2, section 10.3). Option 2 would therefore be preferred. This is despite option 1 having the much higher BCR value.

In a budget constrained situation, consideration needs to be given to the incremental BCR (IBCR) (T2, section 10.6). The IBCR for option 2 over option 1 could be used as the decision rule:

$$IBCR = \frac{PVB_2 - PVB_1}{PVIC_2 - PVIC_1} = \frac{\$9.13\text{m} - \$6.35\text{m}}{\$3.97\text{m} - \$0.23\text{m}} = \frac{\$2.78\text{m}}{\$3.74\text{m}} = 0.74$$

The IBCR shows that spending an *additional* \$3.74m to construct option 2 over option 1 creates *additional* benefits of \$2.78m, an IBCR of 0.74. Since IBCR is less than 1.0, the additional spending is not justified.[2]

8. Supporting formulas and calculations

The formulas used in benefit calculation are provided below. Some general points to note are:

- The formulas below calculate the benefit in 2017
- Upper case letters in the formulas refer to the items labelled in Table 2
- All the formulas are multiplied by CPI June 2015 / CPI June 2013 (Q/P) to inflate the 2013 unit cost parameter values to the price year of 2015
- For the time disbenefit:
  - The component ' *(1+ Growth rate/100)^2 ' converts the 2015 traffic figures to 2017 figures
  - As the delay is in seconds and the value of time is in hours, the latter has to be divided by 3600 to convert it to a value per second
- Benefits for 2018 and onwards are calculated by increasing from the 2017 number by the growth rate (2%) each year (i.e. multiply by ' (1+ Growth rate/100) for each subsequent year).

Crash reduction benefit in 2017

The crash reduction benefit is the combined cost of fatal and serious injury crashes saved due to the initiative.

Crash reduction benefit = (L*I+M*J)*K*Q/P

= (Fatal crashes per year in base case * Average fatal crash cost in 2013 values
+ Serious injury crashes per year in base case* Average serious injury crash cost in 2013 values)
* Crash cost reduction factor relative to median refuge * CPI June 2015 / CPI June 2013.

[2] In cases where the IBCR is greater than 1.0, whether the higher cost option is preferred depends on the cut-off BCR associated with the constrained budget (see T2, section 10.6). Only when the IBCR is greater than the cut-off BCR is the higher cost option preferred, because the return per extra dollar spent is greater than spending that dollar elsewhere.

For example, the benefit in 2017 for option 1 is calculated as follows:

crash reduction benefit = (0.1 * 7,573,412 + 0.1 * 526,606) * 0.614 * 107.5 / 102.8 / 10^6 = $ 0.52 million

which is then increased by 2% per annum due to traffic growth.

Travel time increase disbenefit in 2017

The initiative introduced delays for active travellers using the shared path as well as for cars, so travel time increases. For active travellers, time savings are only valued for transport trips (see earlier discussion).

Travel time disbenefit, active travellers = (A+B)*C*O*Q/P*E/3600*H*(1+R)^2

= (Number of crossing trips/day by walkers in 2015 + Number of crossing trips/day by cyclists in 2015)
* Active travel transport trips as % of all their trips * Average value of time savings, active travellers
* CPI June 2015 / CPI June 2013 * Increased delay for walkers/cyclists / 3600* Days per year
*(1+ Growth rate)^2

For example, the benefit in 2017 for option 1 is calculated as follows:

Travel time disbenefit = (300 + 200) * 0.6 * 14.99 * 107.5 / 102.8 * 45 / 3600 * 365 * (1.02)^2 / 10^6
= $ 0.022 million

which is then increased by 2% per annum due to traffic growth.

Travel time disbenefit, vehicles = D*F/3600*N*Q/P*H*(1+R)^2

= Vehicles AADT in 2015 * Increased delay for cars/trucks / 3600* Weighted average value of travel time savings, vehicles * CPI June 2015 / CPI June 2013* Days per year *(1+ Growth rate)^2

For example, the benefit in 2017 for option 1 is calculated as follows:

Travel time disbenefit = 5,000 * 3 / 3600 * 31.34 * 107.5 / 102.8 * 365 * (1.02)^2 / 10^6
= $ 0.052 million

which is then increased by 2% per annum due to traffic growth.

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