

PFR: Project feasibility report

Preliminary evaluation

PFR

1 Evaluator(s) _____
 Reviewer(s) _____
 Approved organisation name _____
 Project/package name _____
 Your reference _____
 Project description _____
 Describe the problem to be addressed _____
 Brief description of location _____
 Describe the do minimum _____
 Summarise the options assessed _____

2 Time zero (assumed construction start date) 1 July
 Expected duration of construction (months) _____
 Date economic evaluation completed (mm/yyyy) _____
 Base date for costs and benefits 1 July
 Road type (circle one) urban arterial/urban other/rural strategic/rural other
 Travel time cost (TT) – from table 1 _____ \$/h Posted speed limit _____ km/h
 AADT at time zero _____ veh/day

Variable	Do minimum (M)		Option (P)		
	A		B		
PV cost					
Length	LM		LP		km
Mean vehicle speed	MSM		MSP		km/h
Base cost (CB) – from Table 2	CBM		CBP		¢/km
Average roughness (IRI or NAASRA counts)					
Roughness cost (CR) – from Table 3	CRM		CRP		¢/km
Average vehicle speed (VS)	VSM		VSP		km/h
Annual maintenance costs (MC)	MCM		MCP		\$/yr

3 Calculations

VOC savings = $\{[LM \times (CBM + CRM)] - [LP \times (CBP + CRP)]\} \times AADT \times 3.6$ = \$ _____ **C**
 Travel time savings = $(LM / VSM - LP / VSP) \times AADT \times TT \times 365$ = \$ _____ **D**
 Comfort benefits from sealing = $LM \times 0.10 \times AADT \times 365$ = \$ _____ **E**
 PV accident cost savings (from PFR accident cost savings worksheet) = \$ _____ **F**
 Maintenance cost savings = $(MCM - MCP) \times 8.6$ = \$ _____ **G**

4 Benefits = $(C + D + E) \times 9.3 + F$ = _____ **Y**
 Costs = $B - A - G$ = _____ **Z**
 Provisional BCR = Y / Z = _____

PFR: Project feasibility report

Accident analysis

PFR

Do minimum		Severity			Non-injury
		Fatal	Serious	Minor	
1	Number of years of typical accident rate records				
2	Number of reported accidents over period	fatal + serious			
3	Fatal/serious severity adjustment	0.15	0.85	1.0	1.0
4	Number of reported accidents adjusted by severity (2) × (3)				
5	Accidents per year = (4)/(1)				
6	Under-reporting factors	1.0	2.0	3.0	10
7	Total estimated accidents per year = (5) × (6)				
8	Accident cost (table 4)				
9	Accident cost per year = (7) × (8)				
10	Total cost of accidents per year (sum of columns in row (9) fatal + serious + minor + non-injury) \$				
Option					
11	Percentage accident reduction				
12	Percentage of accidents 'remaining' [100 - (11)]				
13	Predicted accidents per year (7) × (12)				
14	Accident cost (table 4)				
15	Accident cost per year = (13) × (14)				
16	Total cost of accidents per year (sum of columns in row (15) fatal + serious + minor + non-injury) \$				
	Annual accident cost savings = (10) - (16) \$				
	PV accident cost savings = (17) × DF (table 5) \$				

F

Transfer PV of accident cost savings, **F** to **F** on preliminary evaluation worksheet PFR

Worksheet 1: Evaluation summary

Evaluation summary

Worksheet 1

1 Evaluator(s) _____

Reviewer(s) _____

2 Project/package details

Approved organisation name _____

Project/package name _____

Your reference _____

Project description _____

Describe the predominant
type of problem _____

3 Location

Brief description of location _____

4 Alternatives and options

Describe the do minimum _____

Summarise the alternatives
considered _____

Summarise the options
assessed _____

5 Timing

Earliest construction start date (mm/yyyy) _____

Expected construction start date (mm/yyyy) _____

Expected duration of construction (months) _____

6 Economic efficiency

Date economic evaluation completed (mm/yyyy) _____

Time zero _____

1 July

Base date for costs and benefits _____

1 July

PV cost of do minimum _____

\$

PV net cost of preferred option _____

\$

PV net benefits of preferred option _____

\$

7 BCR _____

8 FYRR _____ %

9 Non-monetised impacts _____

10 National strategic factors _____

Worksheet 2: Summary of benefits and costs

Summary of benefits and costs

Worksheet 2

1 Project (do minimum or option)

Benefit or cost component (2)	Time		Reference	Estimate (4)	Year of estimate (5)	Growth rate (6)
	From	To				
Benefits						
Travel time cost savings			WS A2, A3 & A4			
VOC savings			WS A3 & A5			
Accident cost savings			WS A6			
Vehicle emissions reductions			WS A9			
Reduced driver frustration			Appendix A7			
Monetised external impacts (list)			WS A8			
Costs						
Investigation						
Design						
Property						
Construction/implementation (including preconstruction)						
Maintenance						
Renewal						
Operating						
External impact mitigation			WS A8.2			
Risk management			WS A13			
Project contingency costs			Explanation sheet			

Worksheet 3: Benefit cost analysis

Benefit cost analysis

Worksheet 3

	Benefits	PV of benefits as calculated				PV of net benefits (PV option – PV do min benefits)		
		Do min	Option A	Option B	Option C	Option A	Option B	Option C
1	Travel time savings							
2	VOC savings							
3	Accident cost savings							
4	Vehicle emission reductions							
5	Reduced driver frustration							
6	Monetised external impacts (list)							
7	PV total net benefits							
	Costs	PV of costs as calculated				PV of net costs (PV option – PV do min costs)		
8	Investigation							
9	Design							
10	Property							
11	Construction/ implementation (incl. preconstruction)							
12	Maintenance							
13	Renewal							
14	Operating							
15	External impact mitigation							
16	Project contingency							
17	Risk management							
18	PV total net costs							
19	BCR = (7)/(18) =							

Worksheet 4: Incremental analysis

Incremental analysis

Worksheet 4

1 Target incremental BCR (from appendix A12.4)

Step	Option	Base option for comparison		Next higher cost option		Incremental analysis				
		Costs	Benefits	Option	Costs	Benefits	Incremental costs	Incremental benefits	Incremental BCR	Base option for next step
	(2)	(3)	(4)	(5)	(6)	(7)	(8) = (6) - (3)	(9) = (7) - (4)	(10) = (9) - (8)	(11)

12 Preferred project option

13 Rationale for selection

14 Results of sensitivity testing of target incremental BCR

Worksheet 5: First year rate of return

First year rate of return

Worksheet 5

- 1 Preferred project option _____
- 2 Present value of total net costs _____
- 3 Mid point of first year of benefits (relative to time zero) _____
- 4 Discount factor (SPPWF) for first year of benefits _____

Benefit	Annual benefits of preferred option (5)	Annual benefits of do minimum (6)	Net annual benefit (at time zero) (7)	Growth rate (decimal) (8)	PV of benefits in first year (9)=[1.0+(3)x(8)]x(4)x(7)

- 10 Sum of present value of benefits in first year _____
- 11 First year rate of return [(8)/(2) × 100] _____

Worksheet 6: Sensitivity analysis

Sensitivity analysis

Worksheet 6

- 1 Preferred project option
- 2 BCR

Variable (3)	Basic assumptions (4)
Maintenance costs	
Traffic volumes	
Travel times or speeds	
Road roughness	
Accident reduction	
External impacts	
Others (list)	

Variable (3)	Base case	Lower bound		Upper bound	
	Value (5)	Value (6)	BCR (7)	Value (8)	BCR (9)
Maintenance costs					
Traffic volumes					
Travel times or speeds					
Road roughness					
Accident reduction					
External impacts					
Others (list)					

Worksheet 7: Checklist for project evaluations

Checklist for project evaluations

Worksheet 7

Project name _____

Preferred option _____

Component of the evaluation:		Has this component been checked for:			Comments
		Accuracy of calculations (1)	Completeness of information (2)	Validity of assumptions (3)	
Project capital costs	Do-minimum				
	Option				
Maintenance costs	Do-minimum				
	Option				
Travel time savings	Do-minimum				
	Option				
VOC savings	Do-minimum				
	Option				
Accident cost savings	Do-minimum				
	Option				
Monetised external impacts					
Time stream of costs and benefits					
Discounting	Benefits				
	Costs				
BCR					
Incremental analysis					
First year rate of return					
Transport model validation					
Sensitivity analysis					

General comments _____

Worksheets 8: Transport modelling checks

Coarse check on transportation model outputs

Worksheet 8.1

1 Project name _____

	Do minimum		Project option		Savings	
	First year	Future year	First year	Future year	First year	Future year
2 Road section travel time (mins)						
3 Intersection delay (mins)						
4 Total time (mins)						

	First year	Future year
5 Daily travel time benefit (\$)		
6 Daily traffic (vehicles)		
7 Travel time savings (min/vehicle)		
8 Travel time benefits (\$/vehicle)		

9 Comment _____

Worksheets 8: Transport modelling checks

A General information

Tick if a model specification statement has been included for the following:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | 1. Type of model used, together with reasons for selecting that model |
| <input type="checkbox"/> | 2. Geographic area covered by the model study area and density of zones |
| <input type="checkbox"/> | 3. Network detail (eg, motorways/arterials/minor streets, number of links) |
| <input type="checkbox"/> | 4. Time periods modelled (eg, AM peak 7:30 – 9:00am, interpeak 9:00am – 4:30pm) |
| <input type="checkbox"/> | 5. Vehicle types included (eg, car, light, heavy commercial vehicles) |
| <input type="checkbox"/> | 6. How external trips are handled (eg, external or cordon zone system) |
| <input type="checkbox"/> | 7. Other (please specify) |

B Data sources

Tick if a description of the data source and the source's reliability (eg, errors, biases, consistency) have been provided for the following:

- | | |
|--------------------------|--|
| <input type="checkbox"/> | 1. Network data (eg, link lengths, free flow speeds, capacities, posted speed limits, number of lanes, intersection types) |
| <input type="checkbox"/> | 2. Travel data and collection methods (eg, traffic counts, speeds, origin-destination surveys) |
| <input type="checkbox"/> | 3. Interface with external demand modelling (eg, outputs from a sub-regional model) |
| <input type="checkbox"/> | 4. Other (please specify) |

C Matrices

Tick if a statement of the following has been provided:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | 1. Description of each step in the assembly of the base year trip matrices, including methods, assumptions and factors applied (eg, derivation from external demand model, ME2 matrix estimation procedures) |
| <input type="checkbox"/> | 2. Matrix fit to observed data (eg, screenlines, comparison with independent origin and destination flows). Note: if the ME2 estimation procedure is used to estimate matrices from traffic counts, an independent validation will only be obtained if different counts are used to validate the model. |
| <input type="checkbox"/> | 3. If variable matrix methods or growth constraint techniques have been used, a statement of the method and parameters adopted, and justification of the approach |
| <input type="checkbox"/> | 4. Other (please specify) |

Worksheets 8: Transport modelling checks

D Assignment

Tick if a specification statement has been provided for the following:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | 1. Description of how the network was constructed |
| <input type="checkbox"/> | 2. Assignment method (eg, incremental, equilibrium) |
| <input type="checkbox"/> | 3. Generalised cost function used for routing |
| <input type="checkbox"/> | 4. Volume-delay functions (eg, equations, coefficients, calibration) |
| <input type="checkbox"/> | 5. Basis of intersection delay modelling (lane-by-lane, approach-based, SIDRA computations) |
| <input type="checkbox"/> | 6. Other (please specify) |

E Forecasting

Tick if a specification statement has been provided for the following:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | 1. Comparison of forecast year growth rates with historical trends (may include land use, household size, car ownership, traffic volumes, commercial vehicle volumes) |
| <input type="checkbox"/> | 2. Checks of average growth across selected screenlines to ensure local growth is reasonable |
| <input type="checkbox"/> | 3. Comparisons with other forecasts |
| <input type="checkbox"/> | 4. Other (please specify) |

F Project models that include strategic demand elements

If travel demand (including mode choice) is modelled within the project model, rather than in an external demand model, the demand elements of the project model should be validated in accordance with part C of worksheet 8.5

Worksheets 8: Transport modelling checks

A Link and screenline flows

Tick if the following validation information has been provided:

- | | |
|--------------------------|--|
| <input type="checkbox"/> | 1. Link volume plots (mandatory) |
| <input type="checkbox"/> | 2. Scatter plots of observed and modelled flows (mandatory) |
| <input type="checkbox"/> | 3. GEH statistic for critical screenline flows and individual link flows (recommended) |
| <input type="checkbox"/> | 4. Percentage root-mean-square error (recommended) |
| <input type="checkbox"/> | 5. Comparison of modelled vehicle kilometres travelled with observed values (optional) |
| <input type="checkbox"/> | 6. Other (please specify) |

B Intersection flows and delays

Tick if the following validation information has been provided:

- | | |
|--------------------------|--|
| <input type="checkbox"/> | 1. Intersection turning flow plots (mandatory) |
| <input type="checkbox"/> | 2. Intersection approach delays (optional) |
| <input type="checkbox"/> | 3. Intersection queue lengths (optional) |
| <input type="checkbox"/> | 4. Other (please specify) |

C Journey times and speeds

Tick if the following validation information has been provided:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | 1. Corridor travel time plots (mandatory) |
| <input type="checkbox"/> | 2. Cumulative travel time plots (recommended) |
| <input type="checkbox"/> | 3. Link speed plots (optional) |
| <input type="checkbox"/> | 4. Other (please specify) |

Worksheets 8: Transport modelling checks

Base year assignment validation

Worksheet 8.4, continued

D Assignment convergence and stability

1 Project name _____

2 Assignment software and version _____

3 Type of assignment _____

Do minimum

	Run year	Base	Forecast			
			Year 1	Year 2	Year 3	Year 4
4	Convergence achieved at iteration number					
5	Percentage change in total generalised user cost (mandatory)					
6	Proportion of links with flows changing <5% (recommended)					
7	Normalised gap δ (recommended)					
8	Other convergence measure (optional)					

Option

	Run year	Base	Forecast			
			Year 1	Year 2	Year 3	Year 4
4	Convergence achieved at iteration number					
5	Percentage change in total generalised user cost (mandatory)					
6	Proportion of links with flows changing <5% (recommended)					
7	Normalised gap δ (recommended)					
8	Other convergence measure (optional)					

Worksheets 8: Transport modelling checks

Strategic demand model checks

Worksheet 8.5

A Is there a precedent of approval (reviews or audits) for the demand or sub-regional model used to generate matrices?

- Yes (no further documentation needs to be supplied)
- No (proceed to part B below)

B Does Land Transport NZ agree that a full model review is not feasible for the project?

- Yes (provide evidence of a check that the incoming data from the strategic demand model is reasonable; no further review is required)
- No (proceed to part C below)

C Full model review

Tick if the following validation information has been provided:

1. A description of the model, including:
- the model type and reasons for choosing the model
 - the zoning system and geographic coverage of the study area
 - time periods used in the model
2. A specification of data sources, including:
- travel surveys: sample sizes, biases and validation
 - transport network data: digital maps, inventory surveys, timetables, etc.
 - demographic and employment data
3. A report of the model specification and estimation, including:
- variables, equations and coefficients
 - outputs of statistical estimation procedures
4. Evidence of validation, including:
- fit to independent data
 - comparison with other models
 - sensitivity tests/elasticities
5. Record of model applications – ideally includes evidence of a successful history of model application
6. Other (please specify) _____

Worksheets A1: Discounting and update factors

Discounting and updating factors

Worksheet A1.2

1	Project option				
2	Base date				
3	Time zero				
4	Type of benefit or cost				
5	Year of estimate (1 July 20__)				
	6 Single payment				
	(a) Amount				
	(b) time, n				
	(c) SPPWF for time n				
	(d) PV time zero (a) x (c)				
	6 Single payment				
	(a) Amount				
	(b) time, n				
	(c) SPPWF for time n				
	(d) PV time zero (a) x (c)				
	7 Uniform series				
	(a) annual amount				
	(b) start time, s				
	(c) end time, e				
	(d) USPWF for s years				
	(e) USPWF for e years				
	(f) PV time zero (a) x [(e) - (d)]				
	8 Arithmetic growth				
	(a) initial amount (time zero)				
	(b) arithmetic growth rate				
	(c) start time, s				
	(d) end time, e				
	(e) USPWF for s years				
	(f) USPWF for e years				
	(g) AGPWF for s years				
	(h) AGPWF for e years				
	(i) PV time zero (a) x [(f) - (e) + (b) x {(h) - (g)}]				
	9 Total PV time zero				
	10 Update factor for year of estimate				
	11 Total PV time zero at base date (9) x (10)				

Worksheets A2: Traffic data

Surveyed average annual daily traffic (AADT)

Worksheet A2.3

1 Road section/movement _____

A Calculating AADT from individual surveys

Date of survey (2)	Week (3)	Week factor (4)	ADT (5)	AADT (6) = (4) × (5)

B Averaging AADT from all surveys combined

7	Year				
8	AADT				
9	Average				

Worksheets A2: Traffic data

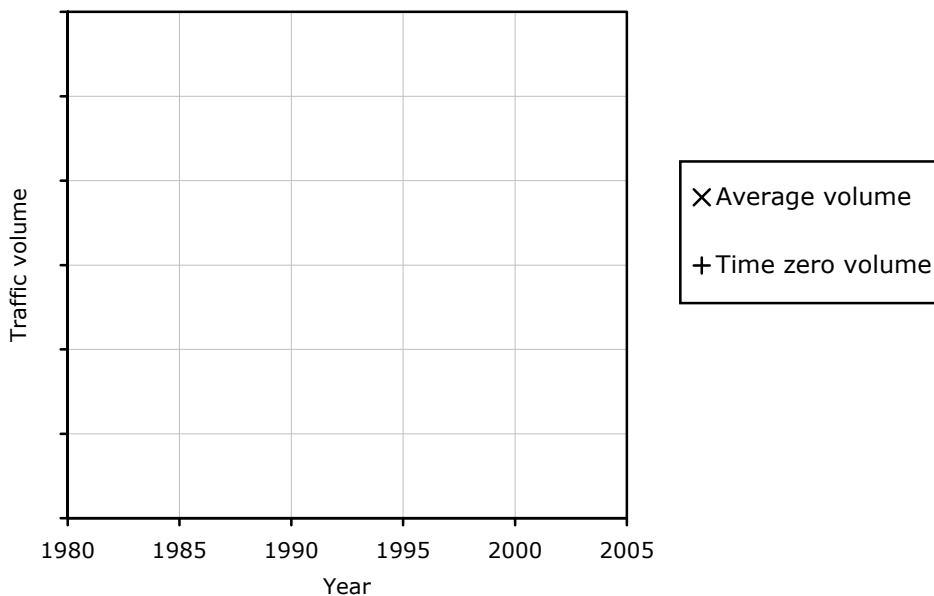
Time zero traffic volume and growth rates

Worksheet A2.4

- 1 Project option _____
- 2 Road section/movement _____
- 3 Time period _____

Year (4)	AADT or average volume (5)

Regression output		
6	Constant	
7	X coefficient	
8	R squared	



- 9 Time zero _____
- 10 Time zero traffic volume _____
- 11 Growth rate at time zero _____

Worksheets A3: Travel time estimation

Peak interval traffic for a given time period

Worksheet A3.1

1 Project option (do minimum or option) _____

2 Road section/movement _____

3 Time period _____

4 Length of time interval (in minutes) _____

5 Number of intervals in time period _____

6 Traffic volumes by interval

Interval time	Traffic volume
Total traffic volume in all intervals:	

7 Average time period traffic intensity
(vehicles per interval of x minutes) _____

8 Peak interval start time _____

9 Peak interval end time _____

10 Length of peak interval (minutes) **(9) - (8)** _____

11 Peak interval traffic volume (vehicles) _____

12 Peak interval traffic intensity (vehicles/hour) _____

Worksheets A3: Travel time estimation

Multilane roads travel time

Worksheet A3.3

-
- 1** Project option (do minimum or option) _____
- 2** Road section/movement _____
- 3** Time period _____
- 4** Section length _____ m
- 5** Posted speed limit (km/h) _____ km/h
-

Characteristics of a multilane road		Appendix A3.5		
6	Basic free speed			km/h
			Reduction	
7	Dividing median present?		Yes / no	km/h
8	Lane width		metres	km/h
9	Lateral clearance		metres	km/h
10	Number of access points per km		per km	km/h
11	Sum of basic free speed reductions (7) + (8) + (9) + (10)			km/h

- 12** Adjusted free speed **(6) - (11)** _____ km/h
- 13** Free speed travel time $60/(\mathbf{12})$ _____ min/km
- 14** Capacity Appendix A3.10 _____ veh/hour/lane
- 15** Volume to capacity ratio Appendix A3.17 _____
- 16** Peak interval additional travel time Appendix A3.18 _____ min/km
- 17** Time period additional travel time Appendix A3.18 _____ min/km
- 18** Bottleneck delay Worksheet A3.5 _____ mins
- 19** Speed change cycle travel time Worksheet A3.6 _____ mins
- 20** Time period total average travel time Appendix A3.22 _____ mins
- (4) × [(13) + (16) + (17)] + (18) + (19)**

Worksheets A3: Travel time estimation

Two-lane rural road travel time

Worksheet A3.4(b)

1	Project option (do minimum or option)		
2	Road section		
3	Time period		
4	Section length		km
5	Total traffic volume in time period	Worksheet A3.4(a)	
6	Proportion of traffic in peak direction		%
7	Free speed travel time	Worksheet A3.4(a)	min/km

Characteristic of rural road (Appendix A3.11)		Adjustment
8	Directional distribution ratio	/
9	Total roadway width	metres
10	PCU equivalent for trucks (based on terrain)	Level/rolling/ mountainous
11	Proportion of trucks	%
12	Truck adjustment factor $1/[1 + (11) \times \{(10) - 1\}]$	
13	Capacity $2800 \times (8) \times (9) \times (12)$	veh/h

14	Capacity of traffic in peak direction (13) x (6)		veh/h
15	Volume to capacity ratio	Appendix A3.17	
16	Percentage of no passing		%
17	Peak interval additional travel time factor	Appendix A3.18	min/km
18	Time period additional travel time	Appendix A3.18	min/km
19	Bottleneck delay	Worksheet A3.5	secs
20	Speed change cycle travel time	Worksheet A3.6	mins
21	Time period total average travel time	Appendix A3.22	mins

Worksheets A3: Travel time estimation

Speed change cycle additional travel time

Worksheet A3.6

-
- 1** Project option _____
- 2** Road section/movement _____
-
- 3** Length of speed change cycle (SCC) section _____ metres
- 4** Free speed _____ km/h
- 5** Curve radius _____ metres
- 6** Free speed travel time (FSTT) for the SCC section _____ min/km
 = FSTT for whole section (from earlier worksheets) × **(3)**
- 7** Time period additional travel time (TPATT) for the SCC section _____ min/km
 = TPATT for whole section (from earlier worksheets) × **(3)**

Vehicle type	$f_1 \times a_1$	a_0	a_2	Ideal travel speed (km/h) $(f_1 \times a_1) \times (4) + a_0 + a_2 / (6)$ (8)	Operating speed for speed change cycle (km/h) $60 / [(6) + (7)]$ (9)	Speed change cycle travel time by vehicle type (appendix A5) (10)
Car	0.5833	45.21	-3892			
LCV	0.4395	54.51	-3337			
MCV	0.4222	51.77	-3245			
HCV I	0.3702	59.16	-3506			
HCV II	0.2807	69.57	-3768			
Bus	0.3702	59.16	-3506			

- 11** Speed change cycle travel time for speed change cycle section _____
 = sum of speed change cycle travel time by vehicle type **(10)**

Worksheets A3: Travel time estimation

Other urban road travel time

Worksheet A3.7

- 1 Project option _____
- 2 Time period _____

Road section /movement (3)	Section length (4)	Design category (5)	Function category (6)	Road classification (7)	Free speed (km/h) (8)	Free speed travel time (mins) (8)/60 × (4) (9)

Worksheets A3: Travel time estimation

Traffic signal delay

Worksheet A3.8

- 1** Project option (do minimum or option) _____
- 2** Road section/movement _____
- 3** Time period _____

4	Approach						
5	Lane width						
6	Number of lanes						
7	Approach grade						
8	Parking manoeuvres						
9	Locality type						
10	Signal type						
11	Lane width factor						
12	Approach grade factor						
13	Parking factor						
14	Locality factor						
15	Saturation flow rate $2000 \times \mathbf{(11)} \times \mathbf{(12)} \times \mathbf{(13)} \times \mathbf{(14)}$						
16	Arrival type						
17	Delay adjustment factor						
18	Time period average delay						

- 19** Total time period delay (sum **(18)** for all approaches) _____ minutes
- 20** Traffic volume for the intersection _____ vehicles per time period
- 21** Average delay per vehicle **(19)/(20)** _____ minutes per vehicle

Worksheets A3: Travel time estimation

Priority intersection and roundabout delay

Worksheet A3.9

- 1** Project option (do minimum or option) _____
- 2** Road section/movement _____
- 3** Time period _____

4	Approach								
5	Priority								
6	Movement and control								
7	Average speed (<60 or ≥ 60 km/h)								
8	Conflicting traffic volume during peak interval								
9	Critical gap								
10	Minimum headway in conflicting flow (either 2.0 secs or 0.5 secs)								
11	Follow up headway $0.2 \times (9) + 2.0$								
12	Capacity (veh/h) $[3600/(11)]$ $\times \exp[-(8) \times (9)/3600]$								
13	Volume to capacity ratio $(8)/(12)$								
14	Peak interval average travel time								

- 15** Total time period average travel time for the
section (sum of **(14)** for all approaches) _____ minutes
- 16** Traffic volume for the intersection _____ vehicles per time period
- 17** Average delay per vehicle $(15)/(16)$ _____ minutes per vehicle

Worksheets A6: Accident cost savings

Accident by accident analysis - do minimum

Worksheet A6.2

Project option			
Movement category	Vehicle involvement		
1 Do minimum mean speed	Road category		
Posted speed limit	Traffic growth rate		

Do minimum	Severity			Non-injury
	Fatal	Serious	Minor	
3 Number of years of typical accident rate records				
4 Number of reported accidents over period				
5 Fatal/serious severity ratio (tables A6.19(a) to (c))				
6 Number of reported accidents adjusted by severity (4) × (5)				
7 Accidents per year = (6)/(3)				
8 Adjustment factor for accident trend (table A6.1(a))				
9 Adjusted accidents per year = (7) × (8)				
10 Under-reporting factors (tables A6.20(a) and (b))				
11 Total estimated accidents per year = (9) × (10)				
12 Accident cost, 100 km/h limit (tables A6.21(a) to (d))				
13 Accident cost, 50 km/h limit (tables A6.21(e) to (h))				
14 Mean speed adjustment = ((1) - 50)/50				
15 Cost per accident = (13) + (14) × [(12) - (13)]				
16 Accident cost per year = (11) × (15)				
17 Total cost of accidents per year (sum of columns in row (16) fatal + serious + minor + non-injury)	\$			

Worksheets A6: Accident cost savings

Accident by accident analysis - option

Worksheet A6.3

Project option _____

Movement category _____ Vehicle involvement _____

2 Option mean speed _____ Road category _____

Posted speed limit _____

Option	Severity			Non-injury
	Fatal	Serious	Minor	
18 Percentage accident reduction				
19 Percentage of accidents 'remaining' [100 - (18)]				
20 Predicted accidents per year (11) x (19)				
21 Accident cost, 100 km/h limit (tables A6.21(e) to (h))				
22 Accident cost, 50 km/h limit (tables A6.21(a) to (d))				
23 Mean speed adjustment = $((2) - 50)/50$				
24 Cost per accident = $(22) + (23) \times [(21) - (22)]$				
25 Accident cost per year = $(20) \times (24)$				
26 Total cost of accidents per year (sum of columns in row (25) fatal + serious + minor + non-injury) \$				

Worksheets A6: Accident cost savings

Accident rate analysis

Worksheet A6.4

Project option	_____
Posted speed limit	_____
Traffic growth rate	_____
Road category	_____
Time zero	_____

Accident prediction model	
1	Table used
2	Parameter b_0
3	Parameter b_1
4	Parameter b_2
5	Lowest or sideroad AADT, Q_{minor}
6	Highest or primary AADT, Q_{major}
7	Typical accident rate (accidents per year), A_T (appendix A6.5).

Go to step 8

Exposure-based accident prediction equation	
1a	Table used
2a	Coefficient b_0 (/10 ⁸ veh-km or /10 ⁸ vehicles)
3a	Cross-section adjustment factor from table A6.13 (1.0 for no adjustment)
4a	Adjusted coefficient (2a) x (3a)
5a	Exposure at time zero (10 ⁸ veh-km or 10 ⁸ vehicles)
7	Typical accident rate (accidents per year), A_T (4a) x (5a)

- 8** Accident trends factor for adjusting typical accident rate (appendix A6.4 method B) _____
- 9** Adjustment factor for accident trend (1 + **(8)** x (time zero year - 2006) (appendix A6.4 method B) _____
- 10** Typical accident rate per year adjusted for accident trends, A_T **(7) x (9)** _____
- 11** Cost per reported injury accident (table A6.22) _____
- 12** Total accident cost per year **(10) x (11)** _____

Worksheets A6: Accident cost savings

Weighted accident procedure – do minimum

Worksheet A6.5

Project option	_____	Traffic growth rate	_____
Posted speed limit	_____	Time zero	_____
Road category	_____		

Site specific accident rate	
1	Number of years of accident records
2	Number of reported injury accidents over period
3	Number of accidents per year (2)/(1)
4	Trend adjustment factor (table A6.1(a))
5	Site-specific accident rate (accidents per year), A_s (3) x (4)
Accident prediction model	
6	Table used
7	Parameter b_0
8	Parameter b_1
9	Parameter b_2
10	Lowest or sideroad AADT, Q_{minor}
11	Highest or primary AADT, Q_{major}
12	Typical accident rate (accidents per year), $A_{T,dm}$ (formula from appendix A6.5)

Go to step 13

Exposure based accident prediction equation	
6a	Table used
7a	Coefficient b_0 ($/10^8$ veh-km or $/10^8$ vehicles)
8a	Cross-section adjustment factor from table A6.13 (1.0 for no adjustment)
9a	Adjusted coefficient (7a) x (8a)
10a	Exposure at time zero (10^8 veh-km or 10^8 vehicles)
12	Typical accident rate (accidents per year), $A_{T,dm}$ (9a) x (10a)
13	Accident trend factor for adjusting typical accident rate, f_t (appendix A6.4 method B).
14	Adjustment factor for accident trend $(1 + \mathbf{(8)}) \times (\text{time zero year} - 2006)$ (appendix A6.4 method B).
15	Typical accident rate per year adjusted for accident trends, $A_{T,dm}$ (12) x (14)*
Weighting factor	
16	k value (appendix A6.5)
17	Reliability of accident history, α_x (default is 1.0)
18	Reliability of accident prediction model or equation, α_M (default is 1.0)
19	Weighting factor, w , (17)² x (16) / ((17)² x (16) + (18)² x (15))

20 Do minimum weighted accident rate, $A_{W,dm}$ **[(19) x (15)] + [1 - (19)] x (5)**

21 Cost per reported injury accident (table A6.22)

22 Total do minimum accident cost per year **(20) x (21)**

* For all mid-block analyses, the typical accident rate **(15)** must be divided by the mid-block length (in km).

Worksheets A6: Accident cost savings

Weighted accident procedure – option

Worksheet A6.6

Project option	_____
Posted speed limit	_____ Traffic growth rate _____
Road category	_____ Time zero _____

Accident prediction model	
1	Table used
2	Parameter b_0
3	Parameter b_1
4	Parameter b_2
5	Lowest or sideroad AADT, Q_{minor}
6	Highest or primary AADT, Q_{major}
7	Typical accident rate (per year), $A_{T,\text{opt}}$ (formula from appendix A6.5)

Go to step 8

Exposure-based accident prediction equation	
1a	Table used
2a	Coefficient b_0 (/10 ⁸ veh-kms or /10 ⁸ vehicles)
3a	Cross-section adjustment factor from table A6.13 (1.0 for no adjustment)
4a	Adjusted coefficient (2a) x (3a)
5a	Exposure at time zero (10 ⁸ veh-kms or 10 ⁸ vehicles)
7	Typical accident rate (accidents per year), $A_{T,\text{opt}}$ (4a) x (5a)
8	Accident trends factor for adjusting typical accident rate (appendix A6.4 method B)
9	Adjustment factor for accident trend (1 + (8)) x (year zero - 2006) (appendix A6.4 method B)
10	Typical accident rate per year adjusted for accident trends, A_T (7) x (9)
Weighted accident rate	
11	Do minimum typical accident rate, $A_{T,\text{dm}}$ (from worksheet A6.5)
12	Do minimum weighted accident rate, $A_{W,\text{dm}}$ (from worksheet A6.5)
13	Option weighted accident rate, $A_{W,\text{opt}}$ (10) x (12) / (11)
14	Cost per reported injury accident (table A6.22)
15	Total option accident cost per year (13) x (14)

Worksheets A6: Accident cost savings

Accident rate analysis - urban routes

Worksheet A6.7

Project option _____
 Posted speed limit _____
 Road category _____

Mid-block road type	AADT range	Length in km	Current AADT	AADT after	Parameter		Do minimum accident rate	Option accident rate	Change in link accident rate	Intersection adjustment factor	Cost per reported injury accident	Accident cost per link type
					b ₀	b ₁						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Local street -commercial land use	< 3,000				2.53 x 10 ⁻⁴	0.98				$A_T = A_L$		
Collector - commercial land use	2,000 to 8,000				2.24 x 10 ⁻⁵	1.08						
Collector - other land use	2,000 to 8,000				3.46 x 10 ⁻⁵	1.08						
2 and 4 lane arterial - commercial land use	3,000 to 24,000				7.66 x 10 ⁻⁶	1.20						
2 and 4 lane arterial - other land use	3,000 to 24,000				1.34 x 10 ⁻⁴	0.88						
Motorway (each direction)	15,000 to 68,000				2.96 x 10 ⁻⁷	1.45				$A_T = A_L$		
4-lane divided rural road (each direction)	15,000 to 68,000				3.55 x 10 ⁻⁷	1.45				$A_T = A_L$		

14 Accident cost saving for urban section per year (sum of column **(13)**) _____

Worksheets A6: Accident cost savings

Accident rate analysis – rural two lane HCV

Worksheet A6.8

Project option _____

Posted speed limit _____

Road category _____

Road section	AADT	Terrain	Length in km	Current HCV AADT	HCV AADT after	Do minimum HCV exposure	Option HCV exposure	Parameter	Do minimum accident rate	Option accident rate	Change in link accident rate	Cost per reported injury accident	Accident cost per link type
(1)	(2)	(table A6.14) (3)	L (4)	T_c (5)	T_d (6)	$X_c = T_c \times L \times 365 / 10^8$ (7)	$X_d = T_d \times L \times 365 / 10^8$ (8)	b_0 (Table A6.14) (9)	$A_c = b_0 \times X_c$ (10)	$A_d = b_0 \times X_d$ (11)	$A_L = A_c - A_d$ (12)	A_z (table A6.22) (13)	$C = A_L \times A_z$ (14)

15 Accident cost saving for urban section per year (sum of column **(14)**) _____

Worksheets A7: Vehicle passing options

Individual passing lane analysis

Worksheet A7.3

Project option			
1 Costs			
Do minimum		\$	A
Project option		\$	B
2 Data			
Passing lane spacing	(5, 10 or 20 km)		km
Terrain type	(See table A7.5)		
Analysis year AADT	(vehicles/day)		
Traffic growth	(per year)		%
% PSD	(proportion)		
Passing lane length			km
Heavy vehicles	(proportion)		C
COV of speed	(proportion)		D
3 Calculations			
Travel time, VOC savings	figure A7.7, adjusted using table A7.9 and table A12.2	\$	E
Driver frustration benefits	figure A7.8, adjusted using table A7.10 and table A12.2	\$	F
Base road user benefits	(E + F)	\$	G
Passing lane length factor	Table A7.11		H
Passing lane length adjustment	(G × H)	\$	I
Heavy traffic adjustment	I × [1 + (C - 0.12)]	\$	J
Adjust for COV of speed	J × [1 + (D - 0.135) × 2.5]	\$	K
Accident cost savings	figures A7.9 to A7.12 adjusted using table A7.12 and table A12.2, or by accident by accident analysis	\$	L
Benefits	(K + L)	\$	Y
Costs	(B - A)	\$	Z
4 Benefit cost ratio	(Y/Z)		

Worksheets A8: External impacts

1 Project option _____

Nature of impact (2)	Description of impacts (3)	Basis for valuing impacts (4)	Value of impacts (5)

6 Annual value of monetised impacts(un-discounted)

7 Present value of monetised impacts (annual value x 10)

Worksheets A8: External impacts

Analysis of environmental mitigation measures

Worksheet A8.2

1 Project option

Description of mitigating measure (2)	Effect being mitigated (3)	Cost of measure (4)	Benefit of measure (5)	BCR (6) = (5) / (4)

Worksheets A9: Vehicle emissions

Component vehicle emissions

Worksheet A9.1

1	Project option (do minimum or option)	_____
	Road section	_____
	Time period	_____
2	Road section length (km)	_____
3	Travel time (min/vehicle)	_____
4	Average road section speed (km/h)	_____
5	AADT	_____
6	% light (Passenger + LCV)	_____
7	% heavy (MCV + HCVI + HCVII + Bus)	_____

	Emission (8)	Vehicle (9)	A (10)	B (11)	C (12)	Rate (13)	Weighted (14)
	CO	Light	3.6×10^{-3}	-0.545	25.5		
	CO	Heavy	6.47×10^{-4}	-0.11	7.31		
15	CO	Emission component total			Add light and heavy (14)		
16	CO	Emission rate			(15) x (2) x (5)		
	NOx	Light	2.46×10^{-4}	-0.0287	1.67		
	NOx	Heavy	2.04×10^{-3}	-0.275	17.4		
15	NOx	Emission component total			Add light and heavy (14)		
16	NOx	Emission rate			(15) x (2) x (5)		
	PM10	Light	2.45×10^{-5}	-0.00342	0.153		
	PM10	Heavy	3.82×10^{-4}	-0.0455	2.65		
15	PM10	Emission component total			Add light and heavy (14)		
16	PM10	Emission rate			(15) x (2) x (5)		
	VOC	Light	5.53×10^{-4}	-0.081	3.55		
	VOC	Heavy	3.07×10^{-4}	-0.0584	3.30		
15	VOC	Emission component total			Add light and heavy (14)		
16	VOC	Emission rate			(15) x (2) x (5)		

Worksheets A9: Vehicle emissions

Vehicle emissions summary

Worksheet A9.2

Option (1)	Road section/ movement (2)	Time period (3)	Time periods per year (4)	Vehicle emission (5)	Emission rate (6)	Emission load (7)	Monetised impact (8)

Worksheet A10: National strategic factors

National strategic factors

Worksheet A10

1 Project option _____

Nature of factor (2)	Description of factor (3)	Basis for valuing factor (4)	Value of factors (5)

6 Present value of national strategic factors _____

Worksheets A13: Risk analysis

Summary of benefit risks

Worksheet A13.1

A tick (✓) should be placed alongside any risk which is judged to be either 'low' or 'high'. Where detailed information on risks is unavailable for the sub-categories, an overall assessment should be given in the shaded row for the risk category as a whole.

Low rating	Benefit risks	High rating
	1 Base travel demand	
	1.1 Age of data source	
	1.2 Data scope	
	1.3 Data quantity and statistical reliability	
	1.4 Data validation	
	1.5 Travel composition	
	1.6 Other	
	2 Growth forecasts	
	2.1 High city population growth	
	2.2 Development-related traffic as proportion of scheme traffic	
	2.3 Time series projection	
	2.4 Other	
	3 Assignment	
	3.1 Other future projects	
	3.2 Path derivation method	
	3.3 Routeing parameters	
	3.4 Supply relationships	
	3.5 Convergence	
	3.6 Other	
	4 Accidents	
	4.1 Proportion of benefits accounted for by accidents	
	4.2 observed accident sample size	
	4.3 Judgemental accident reduction risk	
	4.4 Other	

Worksheets A13: Risk analysis

Summary of cost risks

Worksheet A13.1

A tick (✓) should be placed alongside any risk which is judged to be either 'low' or 'high'. Where detailed information on risks is not available for the sub-categories, an overall assessment should be given in the shaded row for the risk category as a whole.

Low rating	Cost risks	High rating
	5 Environmental and planning	
	5.1 Tangata whenua issues	
	5.2 Emissions	
	5.3 Landscape and visual	
	5.4 Ecological effects	
	5.5 Archaeological and historic sites	
	5.6 Social networks and severance	
	5.7 Economic/amenity impacts on land users	
	5.8 Natural hazards	
	5.9 Other	
	6 Land and Property	
	6.1 Property acquisition	
	6.2 Property economic value	
	6.3 Other	
	7 Earthworks	
	7.1 Knowledge of ground conditions	
	7.2 Complex/unpredictable conditions	
	7.3 Road design form	
	7.4 Extent of topographical data	
	7.5 Source and disposal of material	
	7.6 Other	
	8 Other Engineering Costs	
	8.1 Engineering complexity	
	8.2 Other	
	9 Services	
	9.1 Existence, location and condition	
	9.2 Site flexibility	
	9.3 Cooperation of utilities	
	9.4 Other	

Worksheets A13: Risk analysis

Summary of other risks

Worksheet A13.1

A tick (✓) should be placed alongside any risk which is judged to be either 'low' or 'high'. Where detailed information on risks is unavailable for the sub-categories, an overall assessment should be given in the shaded row for the risk category as a whole.

Low rating	Other risks	High rating
	10	
	10.1	
	10.2	
	10.3	
	11	
	11.1	
	11.2	
	11.3	
	11.4	
	12	
	12.1	
	12.2	
	12.3	
	12.4	
	13	
	13.1	
	13.2	
	13.3	
	13.4	
	14	
	14.1	
	14.2	
	14.3	
	14.4	

Worksheets A13: Risk analysis

Identified high risks

Worksheet A13.2(a)

Risk category	Description	Estimated impacts on benefits and costs	Implications	Recommended actions
(a)	(b)	(c)	(d)	(e)

Worksheets A13: Risk analysis

Relative risk indicators

Worksheet A13.2(b)

The identified, quantifiable risks should be summarised with estimated 95% confidence limits on each risk category (expressed as a % of the impact on TOTAL costs or TOTAL benefits)

Risk category	Cost risk	Benefit risk	Programming risk
Overall relative risk indicators	(RC =)	(RB =)	(RBCR =)

