

The Social Cost of Road Crashes and Injuries

June 2010 update

Prepared by Financial and Economic Analysis Team, Ministry of Transport
ISSN 1173-1370

ANNUAL UPDATE
OCTOBER 2010



Overview

This is an annual update of the Social Cost of Road Crashes and Injuries published by the Ministry of Transport.

The social cost of road crashes and injuries is a measure of the total cost of road crashes to the nation. It includes loss of life and life quality, loss of productivity, medical, legal and court, and property damage costs.

This report provides estimates, at June 2010 prices, of:

- average social cost per injury and per crash
- total social cost of road crashes and injuries in 2009
- annual total social cost of road crashes and injuries for the years from 2000 to 2009.

The social cost information provided in this report helps to ensure consistent assessment of the safety benefits from the prevention of road crashes and injuries.

Average social cost per injury and per crash

The average social costs per crash and per injury, by cost component and severity, at June 2010 prices, are summarised in Tables S1 and S2. These estimates have not been adjusted for the level of non-reporting.

Table S1: Average social cost per crash and per injury, by cost component

Per crash (Note)	June 2010 prices (\$)		
	Fatal	Serious	Minor
Loss of life/permanent disability	4,163,200	417,900	18,000
Loss of output (temporary disability)	700	1,700	300
Medical	13,600	16,300	1,100
Legal and court	16,400	3,800	600
Property damage	10,300	6,500	5,200
Total	4,204,200	446,100	25,200
Per injury (Note)	Fatal	Serious	Minor
Loss of life/permanent disability	3,559,400	355,900	14,200
Loss of output (temporary disability)	0	1,300	300
Medical	6,200	13,700	800
Legal and court	13,100	3,100	500
Property damage	5,600	4,000	4,100
Total	3,584,400	378,100	20,000

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have NOT been adjusted for the level of non-reporting.

Table S2: Average social cost per property damage-only crash

Per PDO crash (Note)	June 2010 prices (\$)		
	All areas	Rural	Urban
Property damage only	2,600	2,800	2,500

Note: These estimates have NOT been adjusted for the level of non-reporting.

Table S3 summarises the average social costs per reported crash and per reported injury, at June 2010 prices, by severity and area. These costs are after adjusting for the level of non-reporting. The slight differences between the estimates for rural and urban areas are due to the differences in the average crash severity, and the average number of injuries involved in these crashes.

Table S3: Average social cost per injury crash and per injury

Per reported crash <i>(Note)</i>	June 2010 prices (\$)		
	All areas	Rural	Urban
Fatal	4,204,000	4,308,000	3,925,000
Serious	765,000	829,000	708,000
Minor	83,000	88,000	80,000
Per reported injury <i>(Note)</i>	All areas	Rural	Urban
Fatal	3,584,000	3,584,000	3,584,000
Serious	632,000	640,000	625,000
Minor	63,000	62,000	63,000

Note: These estimates have been adjusted for the level of non-reporting.

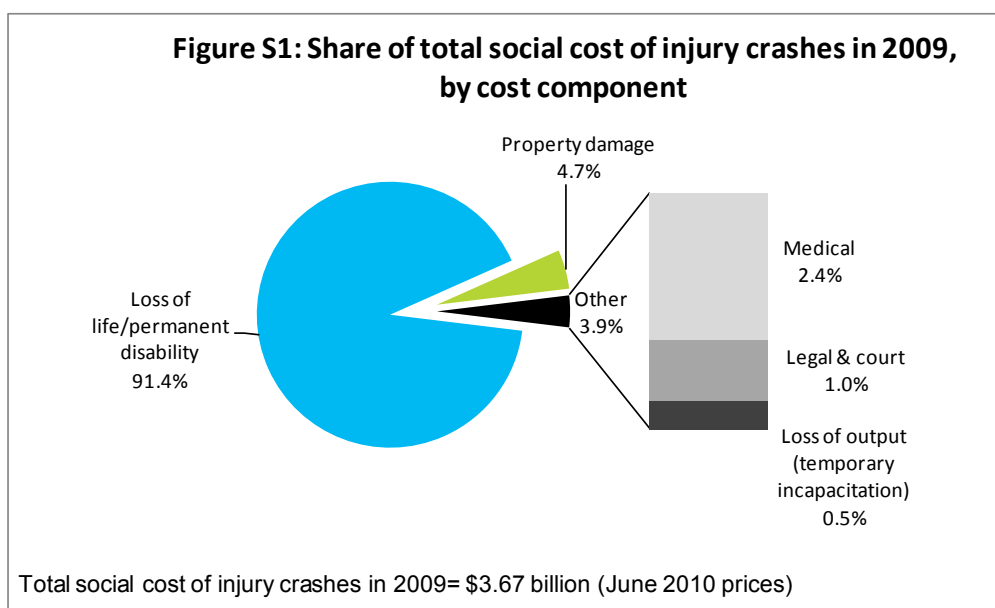
Total social cost of road crashes and injuries in 2009

The total social cost of motor vehicle **injury crashes** in 2009 is estimated at approximately \$3.67 billion (down from \$3.72 billion in 2008) at June 2010 prices. This estimate includes both reported and non-reported casualties.

The breakdowns by injury severity are:

- \$1.38 billion for fatalities (up from \$1.31 billion in 2008)
- \$1.53 billion for serious injuries (down from \$1.61 billion in 2008)
- \$0.76 billion for minor injuries (down from \$0.80 billion in 2008).

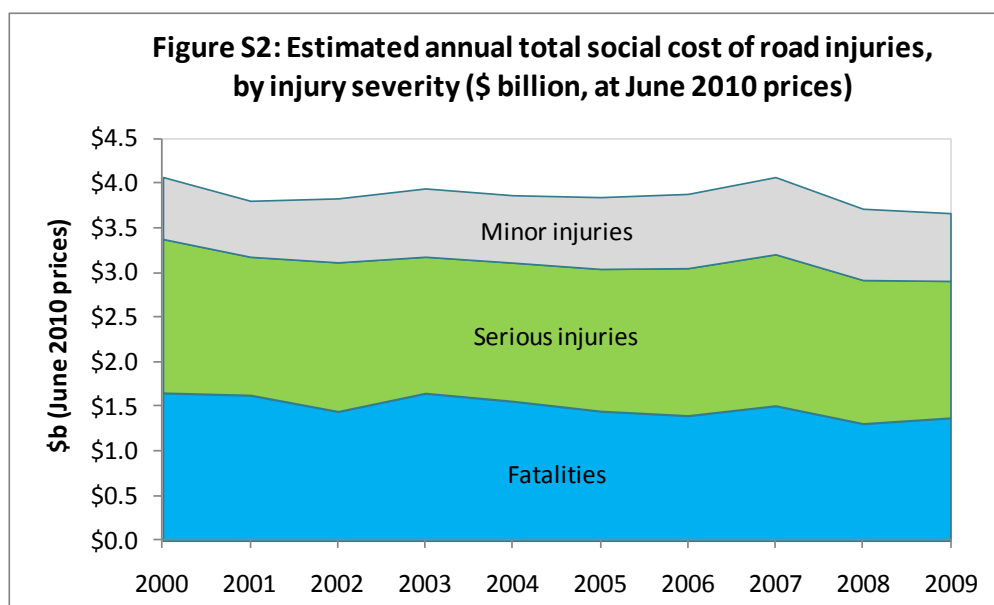
Figure S1 shows loss of life and/or life quality due to permanent impairments accounted for approximately 91 percent of the total social cost of injury crashes. Property damage accounted for around five percent, and other cost components made up the remaining four percent.



In addition, there are an estimated 242,800 property damage-only crashes valued at a further \$0.6 billion. This means the total social cost of **all motor vehicle crashes** in 2009 is estimated to have been \$4.3 billion (down from \$4.5 billion in 2008).

Annual total social cost of road crashes and injuries for the years from 2000 to 2009

Figure S2 and Table S4 show the trend of the estimated annual total social cost of injury crashes for the years from 2000 to 2009. This trend shows the total social cost of road injuries has been relatively static between 2001 and 2007. The reduction in the total social cost for 2008 was attributable to a reduction in the number of fatalities from 422 in 2007 to 366 in 2008. While there were further reductions in the number of serious and minor injuries in 2009, these reductions were offset by the increase in the number of fatalities to 384.



Note: This chart includes allowances for non-reported injuries.

Table S4: Total social cost of road crashes and injuries, at June 2010 prices

Year	Injuries (\$b June 2010 prices)			Crashes (\$b June 2010 prices)			
	Fatal	Serious	Minor	Fatal	Serious	Minor	Property damage only
2000	1.66	1.72	0.69	1.61	1.67	0.61	0.54
2001	1.63	1.55	0.63	1.66	1.49	0.56	0.49
2002	1.45	1.67	0.72	1.53	1.64	0.65	0.57
2003	1.65	1.53	0.76	1.70	1.48	0.71	0.62
2004	1.56	1.55	0.75	1.58	1.52	0.71	0.62
2005	1.45	1.59	0.80	1.43	1.58	0.76	0.66
2006	1.40	1.65	0.83	1.46	1.65	0.76	0.68
2007	1.51	1.69	0.86	1.58	1.64	0.82	0.72
2008	1.31	1.61	0.80	1.39	1.61	0.79	0.67
2009	1.38	1.53	0.76	1.42	1.50	0.73	0.64

Note: This table includes allowances for non-reported cases.

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1. Introduction

1.1 Background

The social cost of road crashes and injuries is a measure of the total cost of road crashes to the nation. It includes loss of life and life quality, loss of productivity, medical, legal and court and property damage costs. Social cost information ensures consistent assessment of the safety benefits from the prevention of road crashes and injuries.

1.2 Objective

This report provides estimates of average social costs per injury and per crash, after accounting for inflationary effects and any changes in the levels of non-reporting. It also accounts for any changes in the mix of crashes by area and severity, and the average number of injuries involved in a crash. The analysis is based on crash and injury data from 2007 to 2009. Unless otherwise indicated, all social cost estimates are expressed in June 2010 prices.

This report also provides estimates of the annual total social cost of road crashes and injuries in New Zealand, from 2000 to 2009. These estimates do not necessarily represent the actual total costs incurred as a result of road crashes. This is because the total social cost of road crashes and injuries depends on the number of cost components estimated and the estimation methods adopted. More importantly, the total social cost also depends on the level of adjustments (the size and their valuation) required to account for the non-reported cases. This report provides the best estimates based on the information available.

1.3 The update

This report is organised as follows:

- Section 2 gives a brief explanation of the methodologies used for estimating the total numbers of injuries and crashes, and the average social cost per injury and crash
- Section 3 provides some guidance on the application of the average social cost estimates
- Section 4 provides estimates of average social costs per injury and per crash.

Some technical details are given in Appendix A. Appendix B provides estimates of the total number of crashes and injuries and the price indices used in the update.

2. Methodology

Estimation of the social cost of road crashes and injuries requires two stages of analysis. The first stage involves estimating the total number of crashes and injuries, because not all crashes are reported and recorded in the official Traffic Crash Reports (TCRs). Counting the reported¹ numbers alone would underestimate the road safety risks and the potential benefits that might be achieved through road safety improvements.

The second stage involves calculating the impacts in monetary terms, taking into account the non-reported incidents. The average social cost obtained after adjusting for the level of non-reporting is referred to as the average social cost per reported incident.

2.1 Estimation of the number of injuries and crashes

Annual crash and injury data, hospitalisation data and Accident Compensation Corporation (ACC) new claims data from the Motor Vehicle Account were used to work out the best estimates of the total numbers of road crashes and injuries.

Injury and crash conversion factors (defined as the ratio of estimated to reported numbers of injuries or crashes) were developed for estimating the total number of incidents, taking into account the level of non-reporting. To allow for any regional variations, regional conversion factors were developed for serious injuries and crashes. Due to the lack of data, separate regional conversion factors for minor and property damage-only (PDO) crashes could not be determined. For more details, please refer to Appendix A.

Annual total numbers of reported injuries and estimated numbers of non-reported injuries for the years from 2000 to 2009 are shown in Table 2.1. The estimated total numbers of crashes and injuries for the years 2007 to 2009 are given in Table B1 (Appendix B).

Table 2.1: Annual total number of reported and non-reported injuries

Year	Road deaths	Reported serious injuries	Reported minor injuries	Estimated non-reported serious injuries *	Estimated non-reported minor injuries *
2000	462	2,243	8,719	2,312	25,972
2001	455	2,435	9,933	1,660	21,405
2002	404	2,600	11,318	1,813	24,513
2003	461	2,578	11,794	1,462	26,420
2004	436	2,469	11,351	1,633	26,369
2005	405	2,519	11,906	1,691	28,280
2006	391	2,627	12,526	1,738	29,056
2007	422	2,664	13,389	1,818	29,829
2008	366	2,531	12,643	1,720	27,104
2009	384	2,425	12,116	1,631	25,843

* Estimates have been updated using latest data from Accident Compensation Corporation (ACC), New Zealand Health Information Services (NZHIS) and Traffic Crash Reports (TCRs).

¹ Reported injuries or crashes refer to injuries or crashes that have the associated TCRs.

2.2 Estimation of injury and crash costs

The social cost of a road crash or a road injury is defined as the total cost that occurs as a result of the road crash or injury. Its value depends on the number of cost components estimated and the estimation methods adopted.

In New Zealand, the social cost of a road crash or a road injury includes the following components:

- loss of life and life quality
- loss of output due to temporary incapacitation
- medical costs
- legal costs
- property damage costs.

Most of these social cost components are either measurable or can be estimated in dollar terms. A 'willingness-to-pay' valuation technique is used to express pain and suffering from loss of life or life quality in dollar terms. Various methodologies have been developed to estimate the value of other social cost components (see Appendix A).

The average social cost per **reported** incident is worked out by dividing the estimated total social cost by the corresponding number of reported incidents. Assuming everything else remains constant, an increase in the number of reported incidents will decrease the average social cost per reported incident (since a smaller allowance for non-reported incidents is required).

The price indices used in updating the social cost components are included in Table B2 (Appendix B).

3. Guidance on using the social cost estimates

3.1 Adjustment for non-reported incidents

Tables 4.1a and 4.1b on page 9 provide the estimates of average social costs per crash and per injury, without adjustment for under-reporting. These estimates are suitable only for cases where we know the total number of crashes and injuries.

Tables 4.3a to 4.3c on page 11 provide the estimates of average social costs per reported crash and per reported injury, after adjusting for the level of non-reporting. If a programme is expected to reduce the number of injuries, but not the number of crashes, use the estimates from Table 4.3c. Otherwise, use the estimates from Tables 4.3a and 4.3b on page 11, depending on data availability and the purpose of the analysis.

3.2 Estimates for rural and urban areas

The estimated average social cost per crash for rural areas tends to be higher than that for urban areas. This is because rural crashes tend to be more severe and often result in a larger number of fatal and serious injuries. If a road safety improvement affects only one area type (either rural or urban), the corresponding social cost estimates should be used.

Table 4.2 on page 10 shows the estimated average social cost per crash by area and severity, without any adjustment for non-reported incidents. All other tables with estimates by area include adjustments for under-reporting.

3.3 Estimates by region and vehicle movement

Table 4.4 on page 12 provides estimates of the average social cost per reported crash by vehicle movement, using crash data from 2005 to 2009. These estimates have been adjusted for the level of non-reporting and are suitable for analysing policies or programmes that focus on specific vehicle movement classifications (eg head-on crashes).

Due to differences in physical locations, sizes of regions, the availability of facilities, and for other reasons, the proportions of injury crashes that are reported to the police differ across regions. The mix of rural and urban crashes also differs across regions. As a result, there are regional variations in the average social costs per reported injury and per crash.

Tables 4.5a and 4.5b on pages 13 to 16 provide the regional average social costs per reported crash and per reported injury respectively, using crash data from 2007 to 2009. These estimates have been adjusted for the level of non-reporting and are useful for the evaluation of regional programmes or policies. Table 4.5c on pages 17 and 18 provides the regional average social costs per reported injury, excluding the associated property damage costs. These estimates have been adjusted for the level of non-reporting and are useful for estimating the social cost of injuries associated with pedestrians and cyclists at the regional level.

Historical regional estimates using year-specific crash and injury conversion factors are incorporated into the Ministry's Crash Analysis System and are available upon request.

3.4 Estimates for an increase in risk

While the majority of safety programmes or projects intend to reduce crash or injury risk, some programmes or projects could result in an increase in risk but produce other benefits. In this situation, the estimate of social cost for an increase in risk should be based on those derived from the willingness-to-accept (WTA)-based value of statistical life (VOSL). The WTA-based value represents the amount of money the public would need to receive or save in exchange for an increase in risk. In a value of safety study conducted in 1997/98, the WTA-based value was found to be around three to five times the willingness-to-pay (WTP)-based value (Guria et al., 2003).

Tables 4.6a to 4.6c on page 19 provide the estimates with WTA-based VOSL at three times the WTP value. These estimates have been adjusted for the level of non-reporting and are useful for analysing any programme that may result in an increase in risk of crash or injury to road users.

3.5 Estimates for infrequent events

Some of the social cost estimates in this document include estimates for a combination of crash or injury types: fatal and serious, serious and minor, and all three. These estimates are useful for assessing safety risks that could cause severe injury to road users but have a low probability of occurrence (eg in situations where the crash or injury numbers are small).

4. Cost estimates

Average social cost per injury

The updated value of statistical life is \$3.56 million per fatality, at June 2010 prices. This gives an updated average social cost per fatality of \$3,584,000. For non-fatal injuries, the updated average social cost is estimated at \$632,000 per reported serious injury and \$63,000 per reported minor injury. These estimates include an adjustment for the level of non-reporting.

Average social cost per crash

In per-crash terms, the updated average social cost is estimated at \$4,204,000 per fatal crash, \$765,000 per reported serious crash and \$83,000 per reported minor crash. These estimates include an adjustment for the level of non-reporting.

Total social cost of road injuries in 2009

The total social cost of motor vehicle injury crashes in 2009 is estimated at approximately \$3.67 billion (down from \$3.72 billion in 2008), at June 2010 prices. In addition, there are an estimated 242,800 property damage-only crashes, valued at a further \$0.6 billion. Therefore, the total social cost of all motor vehicle crashes is estimated to have been \$4.3 billion (down from \$4.5 billion in 2008). These estimates include both reported and non-reported cases.

The total social cost of road injuries, at \$3.67 billion in 2009, can be broken down by injury severity as follows:

- fatalities : \$1.38 billion (up from \$1.31 billion in 2008)
- serious injuries : \$1.53 billion (down from \$1.61 billion in 2008)
- minor injuries : \$0.76 billion (down from \$0.80 billion in 2008)

The social cost loss of life and/or life quality due to permanent impairments accounted for approximately 91 percent of the total social cost of injury crashes, with property damage accounting for around five percent and other cost components making up the remaining four percent (see Figure 4.1).

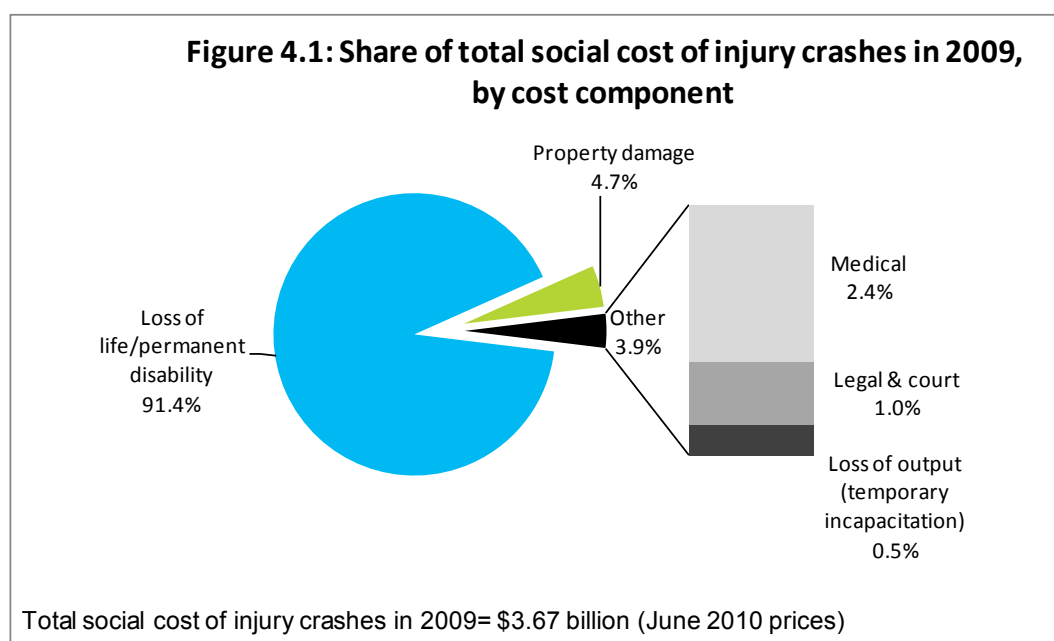


Figure 4.2 shows the trend in social costs of road injuries by injury severity for the years from 2000 to 2009.

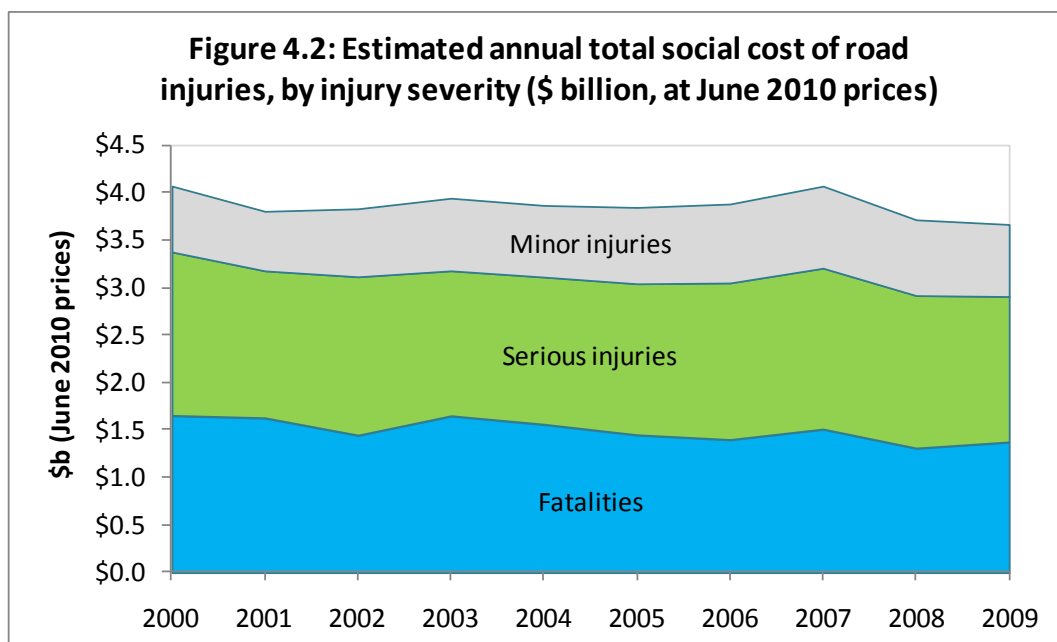


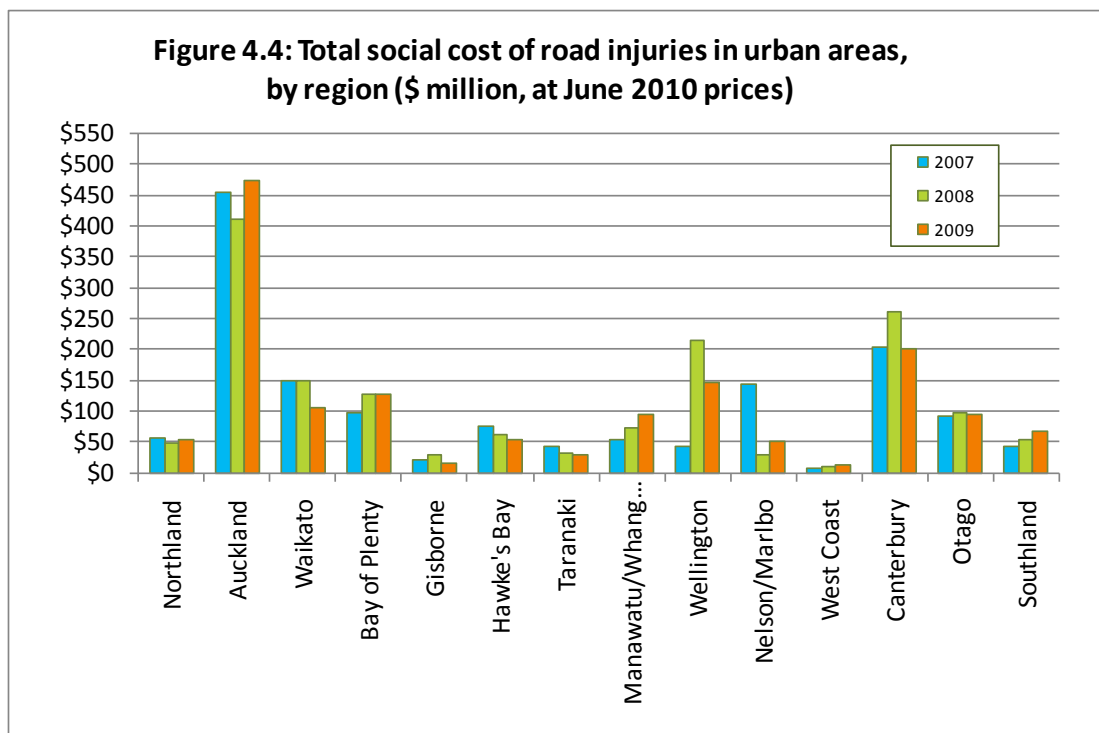
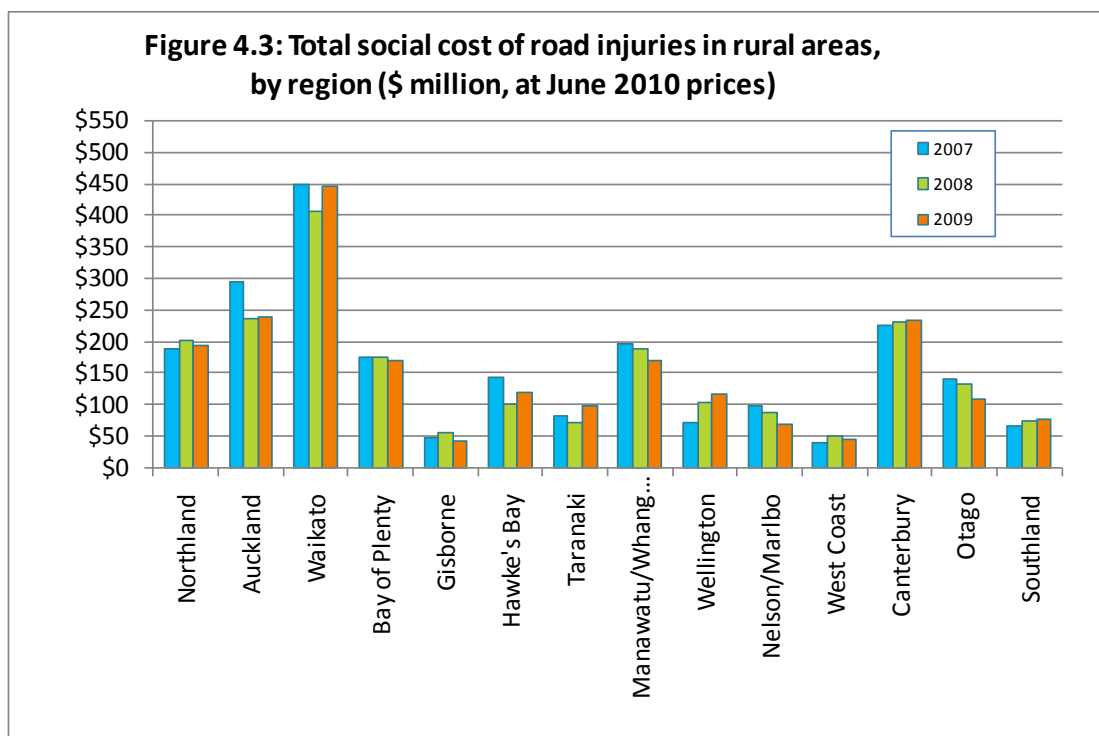
Table 4.0 summarises the estimated total social cost of road crashes and injuries from 2000 onwards, using year-specific crash and injury conversion factors.

Table 4.0: Total social cost of road crashes and injuries, at June 2010 prices

Year	Injuries (\$b June 2010 prices)			Crashes (\$b June 2010 prices)			
	Fatal	Serious	Minor	Fatal	Serious	Minor	Property damage only
2000	1.66	1.72	0.69	1.61	1.67	0.61	0.54
2001	1.63	1.55	0.63	1.66	1.49	0.56	0.49
2002	1.45	1.67	0.72	1.53	1.64	0.65	0.57
2003	1.65	1.53	0.76	1.70	1.48	0.71	0.62
2004	1.56	1.55	0.75	1.58	1.52	0.71	0.62
2005	1.45	1.59	0.80	1.43	1.58	0.76	0.66
2006	1.40	1.65	0.83	1.46	1.65	0.76	0.68
2007	1.51	1.69	0.86	1.58	1.64	0.82	0.72
2008	1.31	1.61	0.80	1.39	1.61	0.79	0.67
2009	1.38	1.53	0.76	1.42	1.50	0.73	0.64

Note: This table includes allowances for non-reported cases.

On average, around 60 percent of the total social cost of road injuries relates to crashes that occurred in rural areas. The regional distributions by area are plotted in Figures 4.3 and 4.4.



The average social costs by cost component, area, severity and region are given in the following sections. Apart from those shown in Tables 4.1a, 4.1b and 4.2 on pages 9 and 10, all estimates have been adjusted for the level of non-reporting.

4.1 Average social cost by cost component

Table 4.1a: Average social cost per crash, by cost component

Cost components	Crash type		
	Fatal	Serious	Minor
	June 2010 prices (\$)		
Loss of life/permanent disability	4,163,200	417,900	18,000
Loss of output (temporary disability)	700	1,700	300
Medical –			
Hospital/medical	7,800	9,900	200
Emergency/pre-hospital	3,900	1,500	800
Follow-on	1,900	4,900	100
Legal and court	16,400	3,800	600
Property damage	10,300	6,500	5,200
Total	4,204,200	446,100	25,200

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have not been adjusted for the level of non-reporting.

Table 4.1b: Average social cost per injury, by cost component

Cost components	Injury type		
	Fatal	Serious	Minor
	June 2010 prices (\$)		
Loss of life/permanent disability	3,559,400	355,900	14,200
Loss of output (temporary disability)	0	1,300	300
Medical –			
Hospital/medical	3,500	8,500	100
Emergency/pre-hospital	2,800	1,000	600
Follow-on	0	4,200	100
Legal and court	13,100	3,100	500
Property damage (<i>Note 3</i>)	5,600	4,000	4,100
Total	3,584,400	378,100	20,000

Notes:

1. Figures may not sum to totals due to rounding.
2. These estimates have not been adjusted for the level of non-reporting.
3. Estimates of total property damage cost by crash severity were apportioned to all injuries caused by the same crash severity, to generate the average cost per injury by severity. Since serious crashes resulted in more injuries than minor crashes, but the cost of vehicle damage did not increase proportionately, the estimated average property damage cost per minor injury is slightly higher than that for a serious injury.

4.2 Average social cost by area and severity

Table 4.2: Average social cost per crash and per injury, by area and severity

Crash severity	June 2010 prices (\$)				
	Average per crash			Average per injury	
	All areas	Rural areas	Urban areas	Include property damage cost	Exclude property damage cost
Fatal	4,204,200	4,308,400	3,925,400	3,584,400	3,578,800
Serious	446,100	469,200	423,600	378,100	374,100
Minor	25,200	27,000	24,300	20,000	15,900
Serious and minor	69,400	87,400	58,500	54,500	50,400
Fatal and serious	782,800	956,000	599,300	648,200	644,000
Fatal, serious and minor	111,700	169,400	76,000	85,500	81,400
Property damage only	2,600	2,800	2,500		

Note: These estimates have not been adjusted for the level of non-reporting.

4.3 Average social cost per reported incident, by severity

Table 4.3a: Average social cost per reported crash, by severity

Crash severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	4,204,000	4,308,000	3,925,000
Serious	765,000	829,000	708,000
Minor	83,000	88,000	80,000
Serious and minor	208,000	256,000	177,000
Fatal and serious	1,262,000	1,539,000	969,000
Fatal, serious and minor	327,000	479,000	228,000

Table 4.3b: Average social cost per reported injury, by severity

Injury severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	3,584,000	3,584,000	3,584,000
Serious	632,000	640,000	625,000
Minor	63,000	62,000	63,000
Serious and minor	157,000	180,000	141,000
Fatal and serious	1,026,000	1,170,000	849,000
Fatal, serious and minor	243,000	326,000	180,000

Table 4.3c: Average social cost per reported injury, excluding associated property damage costs, by severity

Injury severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	3,579,000	3,579,000	3,579,000
Serious	626,000	632,000	618,000
Minor	49,000	48,000	51,000
Serious and minor	145,000	167,000	129,000
Fatal and serious	1,019,000	1,163,000	843,000
Fatal, serious and minor	231,000	314,000	168,000

4.4 Average social cost per reported injury crash, by vehicle movement

Table 4.4: Average social cost per reported injury crash (fatal, serious and minor), by vehicle movement

Vehicle movement classification	June 2010 prices (\$)		
	All	Rural	Urban
Overtaking or lane change	457,000	530,000	346,000
Head-on, not overtaking	903,000	1,204,000	397,000
Lost control, straight roads	342,000	373,000	296,000
Cornering	374,000	416,000	292,000
Collision with obstruction	217,000	299,000	187,000
Rear-end collision	146,000	179,000	124,000
Turning versus same direction	218,000	352,000	158,000
Crossing, no turns	258,000	648,000	209,000
Crossing, vehicle turning	236,000	477,000	169,000
Vehicles merging	191,000	309,000	170,000
Right turn against	228,000	435,000	192,000
Vehicle manoeuvring	220,000	435,000	183,000
Pedestrian crossing road	316,000	1,038,000	295,000
Pedestrian other	556,000	1,310,000	404,000
Miscellaneous	618,000	758,000	505,000

4.5 Average social cost by local government region

Table 4.5a: Average social cost per reported injury crash, by local government region

Region	Crash severity					
	Fatal	Serious	Minor	Serious and minor	Fatal and serious	Fatal, serious and minor
June 2010 prices (\$)						
All areas						
Northland	4,044,000	1,067,000	86,000	295,000	1,723,000	507,000
Auckland	4,111,000	592,000	81,000	144,000	1,006,000	209,000
Waikato	4,368,000	723,000	85,000	212,000	1,515,000	429,000
Bay of Plenty	4,409,000	1,199,000	85,000	371,000	1,686,000	548,000
Gisborne	4,866,000	1,539,000	83,000	363,000	2,173,000	558,000
Hawke's Bay	4,078,000	785,000	82,000	222,000	1,334,000	369,000
Taranaki	3,828,000	853,000	84,000	232,000	1,320,000	357,000
Manawatu-Whanganui	4,272,000	696,000	81,000	224,000	1,371,000	430,000
Wellington	4,144,000	827,000	78,000	205,000	1,155,000	277,000
Nelson-Marlborough	3,792,000	716,000	81,000	200,000	1,021,000	273,000
West Coast	3,878,000	757,000	89,000	256,000	1,287,000	433,000
Canterbury	4,143,000	729,000	82,000	220,000	1,116,000	324,000
Otago	4,392,000	628,000	90,000	197,000	967,000	277,000
Southland	4,316,000	786,000	89,000	237,000	1,220,000	355,000
New Zealand	4,204,000	765,000	83,000	208,000	1,262,000	327,000
Rural areas						
Northland	4,068,000	1,070,000	92,000	321,000	1,812,000	590,000
Auckland	4,263,000	642,000	85,000	153,000	1,387,000	279,000
Waikato	4,482,000	752,000	89,000	241,000	1,700,000	549,000
Bay of Plenty	4,552,000	1,280,000	92,000	434,000	1,920,000	704,000
Gisborne	4,994,000	1,503,000	88,000	471,000	2,376,000	846,000
Hawke's Bay	4,157,000	820,000	89,000	290,000	1,522,000	553,000
Taranaki	3,870,000	866,000	89,000	273,000	1,475,000	478,000
Manawatu-Whanganui	4,361,000	739,000	86,000	266,000	1,519,000	555,000
Wellington	4,484,000	881,000	85,000	261,000	1,404,000	414,000
Nelson-Marlborough	3,827,000	747,000	89,000	244,000	1,246,000	401,000
West Coast	3,931,000	728,000	90,000	271,000	1,262,000	468,000
Canterbury	4,197,000	787,000	87,000	289,000	1,459,000	547,000
Otago	4,532,000	656,000	95,000	221,000	1,239,000	385,000
Southland	4,329,000	818,000	93,000	279,000	1,267,000	426,000
New Zealand	4,308,000	829,000	88,000	256,000	1,539,000	479,000

Table 4.5a continued

Urban areas		Average social cost per reported crash June 2010 prices (\$)				
Region	Fatal	Serious	Crash severity		Fatal and serious	Fatal, serious and minor
			Minor	Serious and minor		
Northland	3,905,000	1,060,000	79,000	245,000	1,450,000	341,000
Auckland	3,959,000	574,000	79,000	141,000	854,000	184,000
Waikato	3,866,000	667,000	81,000	173,000	1,091,000	260,000
Bay of Plenty	4,067,000	1,113,000	80,000	317,000	1,404,000	410,000
Gisborne	3,973,000	1,598,000	81,000	279,000	1,768,000	316,000
Hawke's Bay	3,779,000	735,000	77,000	170,000	1,021,000	223,000
Taranaki	3,589,000	832,000	79,000	191,000	1,023,000	228,000
Manawatu-Whanganui	4,043,000	629,000	77,000	179,000	1,117,000	294,000
Wellington	3,687,000	795,000	76,000	183,000	995,000	221,000
Nelson-Marlborough	3,676,000	693,000	76,000	177,000	822,000	202,000
West Coast	3,592,000	940,000	87,000	212,000	1,437,000	322,000
Canterbury	3,987,000	692,000	80,000	192,000	859,000	229,000
Otago	3,692,000	604,000	87,000	180,000	697,000	199,000
Southland	4,297,000	742,000	87,000	198,000	1,151,000	286,000
New Zealand	3,925,000	708,000	80,000	177,000	969,000	228,000

Table 4.5b: Average social cost per reported injury, by local government region

Region	Fatal	Serious	Injury severity			Fatal and serious	Fatal, serious and minor
			Minor	Serious and minor			
June 2010 prices (\$)							
All areas							
Northland	3,584,000	848,000	62,000	207,000	1,385,000	353,000	
Auckland	3,584,000	498,000	63,000	114,000	834,000	162,000	
Waikato	3,584,000	571,000	62,000	156,000	1,161,000	304,000	
Bay of Plenty	3,584,000	967,000	64,000	271,000	1,339,000	393,000	
Gisborne	3,584,000	1,138,000	65,000	277,000	1,560,000	407,000	
Hawke's Bay	3,584,000	622,000	62,000	169,000	1,037,000	272,000	
Taranaki	3,584,000	703,000	62,000	170,000	1,097,000	259,000	
Manawatu-Whanganui	3,584,000	573,000	61,000	170,000	1,090,000	315,000	
Wellington	3,584,000	715,000	63,000	165,000	987,000	220,000	
Nelson-Marlborough	3,584,000	608,000	63,000	157,000	859,000	211,000	
West Coast	3,584,000	597,000	62,000	180,000	1,027,000	301,000	
Canterbury	3,584,000	633,000	63,000	169,000	959,000	247,000	
Otago	3,584,000	516,000	62,000	138,000	779,000	191,000	
Southland	3,584,000	633,000	61,000	163,000	969,000	240,000	
New Zealand	3,584,000	632,000	63,000	157,000	1,026,000	243,000	
Rural areas							
Northland	3,584,000	838,000	63,000	217,000	1,435,000	394,000	
Auckland	3,584,000	494,000	63,000	115,000	1,047,000	203,000	
Waikato	3,584,000	567,000	61,000	169,000	1,247,000	368,000	
Bay of Plenty	3,584,000	948,000	63,000	287,000	1,408,000	454,000	
Gisborne	3,584,000	1,086,000	65,000	338,000	1,648,000	572,000	
Hawke's Bay	3,584,000	615,000	61,000	199,000	1,122,000	365,000	
Taranaki	3,584,000	694,000	62,000	187,000	1,193,000	322,000	
Manawatu-Whanganui	3,584,000	570,000	60,000	186,000	1,140,000	372,000	
Wellington	3,584,000	702,000	63,000	190,000	1,095,000	293,000	
Nelson-Marlborough	3,584,000	598,000	62,000	174,000	986,000	276,000	
West Coast	3,584,000	596,000	62,000	190,000	1,034,000	324,000	
Canterbury	3,584,000	624,000	62,000	206,000	1,150,000	383,000	
Otago	3,584,000	511,000	61,000	147,000	935,000	248,000	
Southland	3,584,000	631,000	61,000	182,000	967,000	272,000	
New Zealand	3,584,000	640,000	62,000	180,000	1,170,000	326,000	

Table 4.5b continued

Urban areas		Average social cost per reported injury				
		June 2010 prices (\$)				
Region	Fatal	Serious	Injury severity		Fatal and serious	Fatal, serious and minor
			Minor	Serious and minor		
Northland	3,584,000	877,000	62,000	185,000	1,219,000	258,000
Auckland	3,584,000	500,000	63,000	113,000	736,000	146,000
Waikato	3,584,000	579,000	63,000	136,000	932,000	200,000
Bay of Plenty	3,584,000	992,000	64,000	255,000	1,240,000	325,000
Gisborne	3,584,000	1,234,000	65,000	221,000	1,365,000	247,000
Hawke's Bay	3,584,000	634,000	63,000	140,000	873,000	181,000
Taranaki	3,584,000	721,000	63,000	151,000	898,000	180,000
Manawatu-Whanganui	3,584,000	579,000	63,000	150,000	990,000	240,000
Wellington	3,584,000	724,000	64,000	153,000	906,000	184,000
Nelson-Marlborough	3,584,000	617,000	63,000	146,000	732,000	167,000
West Coast	3,584,000	605,000	63,000	148,000	994,000	228,000
Canterbury	3,584,000	639,000	63,000	152,000	792,000	181,000
Otago	3,584,000	521,000	62,000	130,000	602,000	144,000
Southland	3,584,000	637,000	62,000	143,000	972,000	205,000
New Zealand	3,584,000	625,000	63,000	141,000	849,000	180,000

Table 4.5c: Average social cost per reported injury, excluding associated property damage costs, by local government region

Region	Injury severity					
	Fatal	Serious	Minor	Serious and minor	Fatal and serious	Fatal, serious and minor
June 2010 prices (\$)						
All areas						
Northland	3,579,000	839,000	49,000	195,000	1,376,000	341,000
Auckland	3,579,000	493,000	50,000	101,000	828,000	150,000
Waikato	3,579,000	565,000	49,000	144,000	1,155,000	293,000
Bay of Plenty	3,579,000	957,000	50,000	258,000	1,330,000	380,000
Gisborne	3,579,000	1,126,000	51,000	263,000	1,549,000	394,000
Hawke's Bay	3,579,000	615,000	49,000	157,000	1,031,000	260,000
Taranaki	3,579,000	696,000	49,000	158,000	1,090,000	247,000
Manawatu-Whanganui	3,579,000	567,000	48,000	159,000	1,084,000	304,000
Wellington	3,579,000	708,000	50,000	152,000	980,000	207,000
Nelson-Marlborough	3,579,000	602,000	50,000	145,000	853,000	199,000
West Coast	3,579,000	591,000	49,000	168,000	1,021,000	290,000
Canterbury	3,579,000	626,000	50,000	157,000	953,000	235,000
Otago	3,579,000	510,000	49,000	126,000	774,000	179,000
Southland	3,579,000	626,000	48,000	151,000	962,000	228,000
New Zealand	3,579,000	626,000	49,000	145,000	1,019,000	231,000
Rural areas						
Northland	3,579,000	828,000	49,000	204,000	1,426,000	381,000
Auckland	3,579,000	488,000	49,000	102,000	1,041,000	190,000
Waikato	3,579,000	561,000	48,000	157,000	1,241,000	356,000
Bay of Plenty	3,579,000	937,000	49,000	273,000	1,398,000	441,000
Gisborne	3,579,000	1,073,000	51,000	324,000	1,637,000	559,000
Hawke's Bay	3,579,000	608,000	47,000	187,000	1,115,000	353,000
Taranaki	3,579,000	686,000	48,000	174,000	1,185,000	309,000
Manawatu-Whanganui	3,579,000	564,000	46,000	174,000	1,134,000	360,000
Wellington	3,579,000	694,000	49,000	177,000	1,087,000	280,000
Nelson-Marlborough	3,579,000	592,000	48,000	161,000	979,000	264,000
West Coast	3,579,000	589,000	48,000	178,000	1,027,000	312,000
Canterbury	3,579,000	617,000	48,000	194,000	1,143,000	371,000
Otago	3,579,000	505,000	48,000	135,000	929,000	236,000
Southland	3,579,000	624,000	47,000	170,000	960,000	261,000
New Zealand	3,579,000	632,000	48,000	167,000	1,163,000	314,000

Table 4.5c continued

Urban areas		Average social cost per reported injury, excluding associated property damage costs				
Region	Fatal	Serious	Injury severity		Fatal and serious	Fatal, serious and minor
			Minor	Serious and minor		
Northland	3,579,000	868,000	50,000	173,000	1,210,000	246,000
Auckland	3,579,000	495,000	51,000	102,000	731,000	134,000
Waikato	3,579,000	573,000	51,000	125,000	926,000	189,000
Bay of Plenty	3,579,000	982,000	51,000	243,000	1,230,000	314,000
Gisborne	3,579,000	1,222,000	52,000	208,000	1,353,000	234,000
Hawke's Bay	3,579,000	628,000	51,000	128,000	867,000	169,000
Taranaki	3,579,000	714,000	51,000	139,000	891,000	169,000
Manawatu-Whanganui	3,579,000	573,000	51,000	139,000	984,000	229,000
Wellington	3,579,000	717,000	51,000	141,000	899,000	173,000
Nelson-Marlborough	3,579,000	611,000	51,000	135,000	726,000	156,000
West Coast	3,579,000	599,000	51,000	137,000	988,000	216,000
Canterbury	3,579,000	633,000	51,000	141,000	786,000	170,000
Otago	3,579,000	516,000	50,000	119,000	597,000	133,000
Southland	3,579,000	630,000	50,000	132,000	965,000	193,000
New Zealand	3,579,000	618,000	51,000	129,000	843,000	168,000

4.6 Average social cost with willingness-to-accept (WTA) based VOSL (three times willingness-to-pay-based (WTP) VOSL)

Table 4.6a: Average social cost per reported crash, with WTA-based VOSL

Crash severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	12,295,000	12,698,000	11,255,000
Serious	2,175,000	2,355,000	2,010,000
Minor	207,000	219,000	200,000
Serious and minor	576,000	707,000	491,000
Fatal and serious	3,616,000	4,426,000	2,765,000
Fatal, serious and minor	929,000	1,356,000	643,000

Table 4.6b: Average social cost per reported injury, with WTA-based VOSL

Injury severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	10,538,000	10,538,000	10,538,000
Serious	1,804,000	1,826,000	1,779,000
Minor	155,000	152,000	157,000
Serious and minor	433,000	494,000	387,000
Fatal and serious	2,948,000	3,367,000	2,437,000
Fatal, serious and minor	683,000	917,000	502,000

Table 4.6c: Average social cost per reported injury, excluding associated property damage costs, with WTA-based VOSL

Injury severity	June 2010 prices (\$)		
	All	Rural	Urban
Fatal	10,533,000	10,533,000	10,533,000
Serious	1,797,000	1,819,000	1,773,000
Minor	142,000	138,000	144,000
Serious and minor	421,000	482,000	375,000
Fatal and serious	2,941,000	3,361,000	2,432,000
Fatal, serious and minor	672,000	904,000	491,000

Appendix A: Technical notes

This appendix should be read in conjunction with Section 2 of this report.

A1 Estimation of the number of injuries and crashes

The estimated total numbers of injuries and crashes for the years 2007 to 2009 are given in Table B1 (Appendix B).

A1.1 Data

Annual crash and injury data, hospitalisation data and Accident Compensation Corporation (ACC) new motor vehicle claims data were used to estimate the total numbers of road crashes and injuries. ACC claims data include claims from both hospitalised and non-hospitalised injuries. Ongoing data-matching exercises² found that around 90 percent of the reported serious injuries and 70 percent of the reported minor injuries were matched with ACC claims data. For the purposes of estimating the average and total social costs of road crashes and injuries, injuries that are neither hospitalised nor reported, and which do not have an associated ACC claim, are excluded.

A1.2 Conversion factors

Injury and crash conversion factors (defined as the ratio of **estimated** to **reported** numbers of incidents) are derived from the estimated and reported numbers of injuries and crashes.

To minimise the random effect associated with year-to-year variations, the conversion factors for any crash year are based on data for a three-year period centred at the crash year. Due to a lag effect, provisional estimates for the latest year will be based on the most recent three years' data (eg data for 2007-2009 will be used for 2008 as well as for the provisional estimates for 2009), and will be updated during the following year.

Serious injury and crash conversion factors are derived at the regional level. Estimates are then used to derive the conversion factors for rural and urban areas at the national level. Due to a lack of data, we assume that the conversion factors for minor and property damage-only injuries and crashes are the same for all regions and areas.

For the three years to 2009, only about 58 percent of all serious injury crashes and 30 percent of all minor injury crashes are recorded in crash statistics. The estimated numbers of injuries and crashes are given in Table B1 (Appendix B).

² The data matching exercise has been carried out by Dr. Paul Graham of the New Zealand Transport Agency and Ms Jenny Mason of Accident Compensation Corporation.

A2 Estimation of injury and crash costs

A2.1 Cost components

The price indices used in updating the social cost components are included in Table B2 (Appendix B).

(i) *Loss of life and life quality*

The cost of pain and suffering due to the loss of an unidentified life from a road crash is estimated by the amount of money the New Zealand population would be willing to pay for a safety improvement that results in the expected avoidance of one premature death (ie the willingness-to-pay-based value of statistical life or VOSL). The VOSL was established at \$2 million in 1991. This has been indexed to the average hourly earnings (ordinary time) to express the value in current dollars. The updated VOSL is \$3.56 million, at June 2010 prices.

Following the findings of the 1997/98 Value of Safety survey (Guria et al 2003), the updated average loss of life quality due to permanent impairments (including the associated loss of productivity due to long-term impairments) from a serious injury has been estimated at 10 percent of the VOSL (or \$355,600), and 0.4 percent (or \$14,200) for a minor injury.

The values of loss of life and life quality are calculated on a per-injury basis. These values are incorporated into the average cost per crash, considering the average number of injuries (for each injury severity) involved in a crash during the three years to 2009.

(ii) *Loss of output due to temporary incapacitation*

The loss of output due to temporary incapacitation is estimated by the product of average daily earnings per person and the average time loss per injury, and is calculated on a per-injury basis.

The matching of the Traffic Crash Report injury data with the hospitalisation data for the three years to 2009 shows that the mean length of hospital stay is 12.5 days for a reported serious injury and 2.5 days for a reported minor injury. These data are used to approximate the average time loss per injury. Using the average daily earnings distributions by age group and gender, the weighted average daily earnings for the road crash injury population for 2007 to 2009 are estimated at \$107.6 at June 2010 prices.

The cost estimate is incorporated into the average cost per crash by considering the average number of injuries involved in a crash, for each injury severity, during the three years to 2009.

(iii) *Medical costs*

Medical costs include three components: hospital in-patient medical costs, emergency treatment costs and follow-on treatment costs.

The in-patient hospitalisation costs for fatal and minor injury were estimated at 40.5 percent and 1.4 percent of the same costs for a serious injury, respectively (see Guria, 1993). The emergency treatment cost for a serious injury was estimated at 12 percent of its in-patient hospitalisation cost. Emergency treatment costs for fatal and minor injury were estimated at 270 percent and 60 percent of the emergency treatment cost for a serious injury respectively. The follow-on costs for a serious and minor injury were estimated at 49 percent and 2.4 percent of their in-patient hospitalisation costs respectively. There is no follow-on cost for a fatal injury.

Medical costs are calculated for each injury severity type and are incorporated into the average cost per crash, considering the average number of injuries (for each injury severity) involved in a crash. All cost estimates were updated for price changes using the producers' input price index for health and community services.

(iv) Legal and court costs

Legal and court costs include three components: the justice system costs of dealing with traffic offences, the cost of police crash attendance and investigation and the cost of imprisonment.

The legal and court costs for a fatal crash were estimated at 6.92 times those of the cost for a serious crash. For minor crashes and property damage-only crashes, the legal and court costs were estimated at 46 percent and 5 percent of those for a serious crash (see Guria, 1993). Annual budgeted police resources for crash attendance and investigation were obtained from the New Zealand Police's Road Policing Programme. Annual data on convictions and sentencing details were obtained from the Ministry of Justice. The costs of imprisonment for driving causing death and injury (excluding fixed costs as they are preventative costs) were attributed to fatal and serious crashes only.

The average legal costs per injury were estimated by equating the total legal cost of each injury crash type to that for all injuries caused by those crashes. All cost estimates were updated for price changes with the producers' input price index for legal services.

(v) Property damage cost

The average property damage costs by crash type and area were based on those estimated in Guria (1995) and were updated for price changes using the consumer price index under the vehicle servicing and repairs category. The average property damage cost per injury was obtained by equating the total property damage cost of each injury crash type to that for all injuries caused by those crashes.

A2.2 Regional average social cost by year

Historical regional estimates of average social costs per reported crash and per reported injury, by severity and area, using year-specific crash and injury conversion factors are incorporated into the Ministry's Crash Analysis System. These estimates are available upon request.

Appendix B Crash statistics and price indices

Table B1: Reported and estimated number of crashes and injuries from 2007 to 2009

All areas								
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	1,044	1,172	470	523	1,044	1,172	470	523
Serious	6,182	0	7,150	2,695	10,609	0	12,272	4,599
Minor	27,611	0	0	34,930	90,409	0	0	114,377
Total	34,837	1,172	7,620	38,148	102,062	1,172	12,742	119,499
Rural areas								
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	760	872	372	410	760	872	372	410
Serious	2,964	0	3,598	1,633	5,234	0	6,341	2,859
Minor	10,113	0	0	13,449	33,113	0	0	44,038
Total	13,837	872	3,970	15,492	39,107	872	6,713	47,307
Urban areas								
	Reported crashes	Reported injuries			Estimated crashes	Estimated injuries		
		Fatal	Serious	Minor		Fatal	Serious	Minor
Fatal	284	300	98	113	284	300	98	113
Serious	3,218	0	3,552	1,062	5,375	0	5,931	1,740
Minor	17,498	0	0	21,481	57,296	0	0	70,339
Total	21,000	300	3,650	22,656	62,955	300	6,029	72,192

Table B2: Price indices for updating unit costs

Cost components	Indices/measures	Infoshare table references	Period	Indices/values	% change over the 12 months to June 2010
Loss of life and life quality	Average hourly earnings (ordinary time)	QEX001AA	June 2009	\$24.90 (R)	2.2%
Loss of output			June 2010	\$25.45	
Medical cost	Producers price input index – Health and community services	PPI012AA (Base: Dec 1997=1000)	June 2009 June 2010	1319 1318	-0.1%
Legal and court cost	Producers price input index – Legal services: Personal and Corporate	PPI015AA (Base: Dec 1997=1000)	June 2009 June 2010	1617 1649	2.0%
Property damage cost	Consumers price index – Vehicle servicing & repairs	CPI013AA (Base: June 2006 =1000)	June 2009 June 2010	1150 1175	2.2%

Source: Infoshare, Statistics New Zealand. R – revised.

List of references

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