MONASH
UNIVERSITY
ACCIDENT RESEARCH CENTRE

INDICATIVE BENEFIT/COST ANALYSIS OF ROAD TRAUMA COUNTERMEASURES

INTERIM REPORT FOR DISCUSSION

by

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[This document has been created through Optical Character Recognition by Glenda Cairns. Every attempt has been made to correct any recognition errors, and we apologise if any have been missed.]

Contents

EXECUTIVE SUMMARY

At the request of its Board of Management, the Monash University Accident Research Centre conducted a project to estimate the benefits and costs of road trauma countermeasures which could be introduced or escalated in Victoria.

Where possible, the economic worth of each project was calculated in three ways:

1. Community benefit/ cost ratio where the benefits to the community were divided by the costs to the Government and the community.

2. Government benefit/ cost ratio where the community benefits minus the community costs were divided by the Government costs, and

3. Net Present Value which is defined as net benefits minus net costs to community and Government.

Where an estimate of effectiveness of the measure was not available a calculation was made about the level of effectiveness required for the program to break even.

Some community costs and benefits could not be quantified at this stage. Where they were considered to be substantial they were described and listed as unquantified benefits and costs.

The results from this assessment have been summarised in a table which shows estimated benefit/cost ratios ranging from less than one to 43:1. Countermeasures with high benefit/ cost ratios include the speed camera program, legalising footpath bicycling, rural and urban roadside hazard management, pedestrian facilities, skid resistance overlays, installation and remodelling of traffic signals and improved delineation of rural roads.

Wherever possible the calculations used effectiveness values for each countermeasure obtained from a limited number of other studies which were assumed to apply to similar future programs, so the results depend on the validity of those studies. In some cases, studies relevant to a specific countermeasure were not available and calculations were made on the basis of professional judgement of effectiveness and cost. Further studies are now being carried out to try and improve some of the assumptions and values used. Until these become available it is recommended that the estimated benefit/cost ratios reported in this study be taken as indicative and used with caution.

INDICATIVE BENEFIT /COST ANALYSIS OF ROAD TRAUMA COUNTERMEASURES

INTRODUCTION

At the request of its Board of Management, the Monash University Accident Research Centre has conducted a project to estimate the benefits and costs of a limited number of countermeasures which could be introduced or escalated in Victoria. The project covers:

- potential new road trauma countermeasures
- countermeasures already implemented but with the potential to expand
- existing countermeasures with significant on-going costs.

Well accepted legislative countermeasures with small on-going costs, such as compulsory seat belt use, motorcycle helmet wearing and the 0.05 BAC limit have not been analysed. Other measures for which no meaningful data were available were also not considered.

PROCEDURES

The attached pages represent the initial phase of this project. Readily available data has been analysed for a limited number of projects to provide estimates of costs and likely benefits. Where possible, the economic worth of each countermeasure has been calculated in three ways:

1. Community Benefit/cost ratio
    - defined as the safety benefits to the community divided by the costs to the Government and community.
2. Government Benefit/ cost ratio
    - defined as the community safety benefits minus community costs, divided by the Government costs
3. Net Present Value
    - defined as safety benefits minus costs to the community and Government

All programs, regardless of their expected life span have ratios expressed in present value terms. This is done in recognition of the fact that the costs and benefits do not always flow at an even rate over the life of the program and that money has a time value; a sum of money received ten years in the future is not as valuable as a sum of money received today. In a similar way a cost incurred in 10 years is less onerous than a cost sustained today. A discount rate is used to make future cash inflows and outflows comparable at a common point in time. The discount rate used in this analysis is 4% as recommended by the Department of Management and Budget. A higher discount rate would give less weight to costs and benefits that occur over long time periods.

The benefits that are valued in monetary terms are essentially safety benefits only because some community benefits (and costs) of countermeasures cannot be quantified at this stage. Where these are considered substantial, they are listed as unquantified benefits and costs. Unquantified benefits include reductions in other social problems (eg alcoholism) and unquantified costs could include lost mobility, reduced social amenity, and objections to regulation. Costs which represent a transfer from one sector of society to another without net gain or loss have not been included. This means that fines from traffic infringements, which are a transfer from the private to the public sector are excluded. these fines would not alter the Net Present Value of a project but it is recognised that they would influence the community and Government ratios if they were included.

Each of these measures requires an estimate of the effectiveness of the countermeasure. In some cases the level of effectiveness is unknown, so only the break-even level which would justify the countermeasure in economic terms was calculated. The break-even level has been reported in two ways:

1. Percentage reduction in costs of accidents or injuries to the target group of the countermeasure which is necessary.

2. Reduction in casualty accidents or personal injuries which is necessary to re-pay the cost of the countermeasure

The financial benefits of countermeasures are calculated by using the average costs per person killed or injured produced by the Federal Bureau of Transport and Communication Economics (BTCE) (but with the 4% discount rate calculations shown in the appendix rather than 7% reported in the main body of the text), indexed to 1991 prices.[1] The average costs per casualty accident, for urban and rural accidents separately, were based on guidelines for the Traffic Management Services Program produced by the Road Traffic Authority, indexed to 1991 prices.[2] These average costs were in turn based on the BTCE estimates.[3] No account is taken of the community's "willingness to pay" more than historical costs to prevent future accidents and personal trauma. This method would yield mu.ch higher values, especially in cases of accidents involving children or large numbers of persons killed or injured simultaneously.

The baseline accident data on which the calculations are based are generally the five year average 1985-1989. When other data sets are used they are described in the text.

The benefits have been estimated for each countermeasure being implemented alone. In some cases: different countermeasures affect the same target group and therefore the combined effect of more than one of these measures would probably be less than the sum of the individual effects. The scope of this project has not allowed the development of a method to deal with these possible interactions.

Two important points should be noted:

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[1] Steadman, L.A, Bryan, R.J. (1988) Cost of Road Accidents in Australia. Occasional Paper 91 Bureau of Transport and Communications Economics. Canberra: AGPS

[2] Road Traffic Authority (1988) 1988/89 Traffic Management Services Program Project Selection Guidelines.

[3] Thorensen, T. Personal Communication

- it is implicit in the approach that the treatment is appropriate to the site or area treated, .and the crash patterns applicable. In other words, the benefits estimated there are only achievable where the particular countermeasure is applicable, and

- the benefit cost calculations are valid in the context of the methodology developed for this study; a benefit cost calculation for any specific site or program would need to consider the actual conditions applying to that application.

Wherever possible the calculations used effectiveness values for each countermeasure obtained from al limited number of other studies which were assumed to apply to similar future programs, so the results depend on the validity of those studies. In some cases, studies relevant to a specific countermeasure were not available and calculations were made on the basis of professional judgement of effectiveness and cost. Further studies are now being carried out to try and improve some of the assumptions and values used.

Until these become available it is recommended that the estimated benefit/cost ratios reported in this study be taken as indicative and used with caution.

RESULTS

The results of the assessments of countermeasures are summarised in the tables which follow. The tables give a brief description of the existing or proposed countermeasure and the target group to which the countermeasure is directed. Table One also shows the community benefit/ cost ratio and the net present value of the countermeasure where sufficient information has been found to make these calculations. In cases where the effectiveness of the program is unknown Table Two shows a break even calculation. A more detailed description of the calculations and the assumptions on which they are based can be found in the appendices to this paper.

SUMMARY ASSESSMENT OF COUNTERMEASURES

TABLE ONE. COUNTERMEASURES WITH ESTIMATED BENEFIT/COST RATIOS

COUNTERMEASURE	SPECIFIC TARGET	COMMUNITY BCR	GOVERNMENT BCR	NET PRESENT VALUE (over life of program)
A. ROAD USERS Bassinet loan scheme	Infants under six months in cars	0.5:1	-0.3:1	-$2.9m (6 yrs)
Forbidding carriage of persons not in approved seats	Passengers in load areas of car derivatives	3:1	11:1	$5.2m (5 yrs)
$20 rebate for child seats	Unrestrained child passengers	0.65:1	-0.5:1	-$0.36m (8 yrs)
Protective headgear	Head injuries to vehicle occupants	1.2:1	4:1	$2.8 (10 years)
Speed cameras to deter excessive speeding	Drivers exceeding speed limit by 25kmh	12:1	12:1	$749m (5 yrs)
Increase legal drinking age to 21	18-20yr olds with a positive BAC	7:1	7:1	$11.7 (p.a.)
Training in responsible serving of alcohol in licensed premises	Drivers and pedestrians who drink in hotels	5:1	7:1	$54.9m (5 yrs)

COUNTERMEASURE	SPECIFIC TARGET	COMMUNITY BCR	GOVERNMENT BCR	NET PRESENT VALUE (over life of program)
Fitting of ignition interlock	Drivers over .05 BAC who have a previous drink drive conviction	1.5:1	13:1	$13.5m (1 group of drivers for 6 yrs)
Curfew for drivers aged 18	Novice driver night time accidents between 11pm - 5am	5:1	5:1	$5.5m (p.a.)
Zero BAC for all motorcyclists	Motorcyclists with a positive BAC	3:1	3:1	$4.2m (p.a.)
Legalise footpath cycling	Bicyclists riding on roads	43:1	43:1	$52.4m (7 years)
B VEHICLE MEASURES Driver air bags	Major head, face or chest injuries to car drivers	1.7:1	-	$133 per car fitted (15 Years) ($295m if all cars fitted)
Promotion of retro-fitting of high mounted rear brake lights	Rear end accidents in which the vehicle was braking	1.8:1	11:1	$4.8m (7 years)

COUNTERMEASURE	SPECIFIC TARGET	COMMUNITY BCR	NET PRESENT VALUE (for specified amounts of treatment)
C ROADS AND TRAFFIC Rural roadside hazard management program	Hit fixed object crashes in rural areas.	18:1	$34m (for treatment of 350 km)
Urban roadside hazard Management (poles)	Crashes involving striking a pole	13:1	$18m (for treating 150 sites)
Roundabouts	Cross intersection accidents	7.5:1	$30.1m (for treating 200 sites)
Road duplication/ provision of median on rural roads	Undivided State highways	5:1	$4m (for nominal capital program of $1m)
Rural overtaking lanes	Undivided State highways	5:1 to 10:1	$4m to $9m (for nominal capital program of $1m)
Rural road sealed shoulders	Head-on & single vehicle crashes on rural roads.	22:1	$147m (for treatment of 350 km)
Pedestrian facilities	Crashes involving pedestrians on arterial roads	9:1	$19.2m (for nominal capital program of $1m)

COUNTERMEASURE	SPECIFIC TARGET	COMMUNITY BCR	NET PRESENT VALUE (for specified amounts of treatment)
Skid resistance overlays (rural roads)	Wet weather crashes on rural roads and outer urban arterials.	16:1	$3.6m (for treatment of 40 sites)
Installation of traffic signals	Crashes at intersections without signals or roundabouts.	8:1	$118.6m (for treatment of 70 sites)
Remodelling of traffic signals (esp. right turn phase)	Right-turn-against crashes at traffic signals.	22:1	$281m (for treatment of 300 sites)
Conversion of rural cross intersections with staggered Tee	Crashes at rural cross intersections.	1.7:1	$4.2m (for treatment of 25 sites)
Improved delineation on rural highways	All rural crashes	14:1	$13m (for nominal capital program of $1m)

TABLE TWO. COUNTERMEASURES WITH BREAK EVEN CALCULATIONS (EFFECTIVENESS NOT KNOWN)

COUNTERMEASURE	SPECIFIC TARGET	% EFFECTIVENESS TO BREAK EVEN	No. OF CASUALTIES TO BREAK EVEN (p.a)
Promotion of the use of coin operated breath testers	Drivers and pedestrians who drink in hotels	3.9%	2 fatalities 18 serious injuries
Passenger restrictions for 18 yr old drivers	Novice driver accidents whilst carrying passengers	2%	1 fatality 7 serious injuries 17 other injuries
Promotion of conspicuity devices for pedestrians	Lack of conspicuity as a factor in night time pedestrian accidents	18%	7 fatalities 39 serious injuries 29 other injuries
Extended restriction on carriage of pillion passengers by motorcyclists	Motorcycle accidents involving pillion passengers	18.6%	2 fatalities 7 serious injuries 6 other injuries
Compulsory wearing of protective clothing by motorcyclists	Motorcyclist injuries involving abrasions, contusions and lacerations.	2.5%	20 serious injuries 30 other injuries
Enforcement of bicycle lighting regulations	Bicycle lighting regulations	9%	1 fatality 7 serious injuries 11 other injuries

COUNTERMEASURE	SPECIFIC TARGET	% EFFECTIVENESS TO BREAK EVEN	No. OF CASUALTIES TO BREAK EVEN (p.a)
Traffic Safety Education	All road users	0.27%	2 fatalities 25 serious injuries 59 other injuries
Random Breath Testing	Drivers over .05 BAC	1.6%	3 fatalities 44 serious injuries 104 other injuries

DISCUSSION AND CONCLUSION

A project has been conducted to provide estimates of the benefits and costs of a range of existing and proposed countermeasures. A number of difficulties were encountered in the course of the project:

1. In the area of road user behaviour a major obstacle has been the lack of reliable, valid and readily obtainable studies of the effectiveness of a wide range of countermeasures. This has meant that a number of assumptions have had to be made. These assumptions have been documented as fully as possible to allow readers to make their own judgements about the reliance that can be placed on individual assessments.

2. A particular problem that arose in assessing road and traffic countermeasures was the value to be placed on marginal benefits and costs. Most of the road and traffic countermeasures are already in place to some degree and benefit/ cost ratios have been calculated on existing works; the difficulty arises when judgements have to be made on the point at which returns will diminish.

Possible actions, to overcome these problems are:

- A more extensive literature search to locate overseas studies of effectiveness.

- Demonstration projects or trial implementation on a small scale.

- Additional benefit/ cost calculations at different stages of implementation of programs to establish marginal returns.

- Additional studies of the benefits and costs of specific countermeasures which have been implemented in recent years.

- Further work could also be conducted to assess the likely barriers to implementation of measures which have high safety benefit/ cost ratios but unknown acceptability to the public. The development of measures to estimate the value placed by the community on mobility and access would be helpful in this regard.

APPENDIX A

ROAD USER COUNTERMEASURES

PREAMBLE

The causes of road crashes consist of a combination of three elements - human factors, vehicle factors and road and traffic factors. The behaviour of road users has been reported to be .a contributing factor in over 90% of road accidents.[1]

In a typical year 68% of road users killed are vehicle occupants, 17% are pedestrians, are 11% motorcyclists and 4% bicyclists. For serious injuries the proportions are 72% vehicle occupants, 13% pedestrians, 9% motorcyclists and 3% bicyclists. The following pages in this appendix describe programs designed to modify road user behaviour to enhance road safety.

1.0 VEHICLE OCCUPANTS

GENERAL COUNTERMEASURE TARGET:

Passenger motor vehicle occupants are the largest group of accident involved road users, typically they comprise 68% of persons killed on the roads and 71% of hospital admissions. For the five years 1986-1990 the average numbers involved were 454 fatalities 6,392 seriously injured and 18,356 minor injuries.

The following countermeasures are primarily aimed at changing the behaviour of vehicle occupants, other measures which are intended to enhance the safety of the vehicle are listed in a following section.

- seat belt enforcement, promotion and public education
- Bassinet Loan Scheme
- regulation to forbid the carriage of persons not seated in approved seats
- child seat subsidy scheme
- promotion of protective head gear for vehicle occupants

1.1 PROPOSED COUNTERMEASURE:

Publicity and enforcement campaign directed towards increased seat belt wearing by passenger vehicle occupants with higher than average risk of accident involvement.

SPECIFIC TARGET FOR EVALUATION:

Accident data suggests that vehicle occupants who are involved in accidents have lower seat belt wearing rates than non accident involved. It can be assumed that 30% of killed and 20% of seriously injured passenger vehicle occupants were not wearing seat belts.[1]

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[1] Johnston, I.R. (1984) Road User Behaviour - Myths and Realities. Proceedings. National Road Safety Symposium. Canberra: AGPS

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

$135.7m	141 fatalities @ $962,115
$ 81.8m	1205 seriously injured @ $67,874
$217.5m	

EXPECTED COUNTERMEASURE EFFECT:

Effect of publicity on this target group (the accident involved non seat belt wearer) unknown.

Assume seat belts 40% effective in reducing injury severity.[1]

EXPECTED BENEFITS:

Unquantified

Permanent changes in seat belt use resulting from on going campaigns.

EXPECTED COSTS:

Quantified

Promotion $2.0m

Enforcement $2.0m

BREAK EVEN: 2.6 fatalities and 22.4 serious injuries or 1.8% effective in reducing trauma costs.

1.2 EXISTING COUNTERMEASURE (CONTINUATION PROPOSED):

Bassinet Loan Scheme (substantial capital cost investment to replace 12,500 of the 17,200 bassinets is required soon).

SPECIFIC TARGET FOR EVALUATION:

Infants under six months in passenger motor vehicles. There has been a 26% decrease in annual fatalities and a 37% decrease in annual casualties since the introduction of the scheme.

TOTAL POTENTIAL REMAINING BENEFITS PER ANNUM ($) (if measure could be 100% effective and prevent the casualties which are still occurring)

$1.9m	2 fatalities @ $962,115
$0.4m	6 serious injuries @ $67,874
$0.2m	15 other injuries @ $12,060
$2.5m	

Assumes the cost of accidents is the same for infants as adults

TOTAL POTENTIAL BENEFITS PER ANNUM BEFORE COUNTERMEASURE INTRODUCED ($):

$2.9m	3 fatalities @ $962,115
$1.0m	19 hospital admitted or medically treated injuries @ $51,139
$3.9m	

[1] Fildes, B.N., Lane, J.C., Lenard, J. Vulcan, A. P. (1991) Passenger Cars and Occupant Injury. Canberra: FORS

ACTUAL COUNTERMEASURE EFFECT:
Surveys show a usage rate of 94% for this age group.[1] 56% of the observed bassinet restraints come from a loan scheme.[1] Therefore 56% of the change in casualties can be attributed to the loan scheme. Note: the introduction of the loan scheme coincided with the availability, for the first time in Victoria, with bassinet restraints approved by the Standards Association. Use of the unapproved restraints that had been available before that time was very low, in the order of 12%.[2] In addition, subsequent to the introduction of the scheme a regulation was introduced that made it mandatory for children under one to be restrained in suitable approved restraints.

KNOWN BENEFITS:
Quantified
These calculations are based on 56% of observed changes in the average number of casualties three: years before and five years after the introduction of the scheme.
0.36 fatalities 1@ $962,115
$0.3m 3.92 casualties @ $51,139 (Average cost for type of casualties prevented) $0.2m
Total $0.5m p.a. for six years discounted to present values $2.9m
(the value of tile total change in annual average casualties is $l.0m p.a.)
Unquantified
Introduces children to a lifetime of restraint use.
Educates parents in correct restraint use and provides them with a relatively low cost way of complying with legislation related to the carriage of infants.
Creates a market for improvements in restraint design.
Encouraged other parents to buy a bassinet rather than hire from the BLS

KNOWN COSTS PER ANNUM:
Quantified
Initial capital costs $lm ($825,000 Gov., $175,000 donation from Ford Aust.)
VIC ROADS annual costs (assuming 1990/91 was a typical year)

salaries and on costs	$80,000
printing	$21,300
testing and consultants	$18,000

capital equipment/ replacement bassinets $100,000 (this cost was lower in earlier years when fewer bassinets needed replacing)
Total $0.22m p.a. for six years at present values $1.2m
Cost to parents: council charges range from $0 to $80 average around $20
17,200 bassinets x two hirings a year = $688,000 six years PV $3.6m
Total PV of costs $5.8m
Note: around 12,500 of the original capsules are nearing the end of their usable life, if they were to be replaced at a cost of around $95 (recommended retail price is $117) each, it would cost $1.2m. For the last three years a sample of the older bassinets have been tested to ensure that the remaining bassinets are still suitable for use, this process which costs $18,000 per annum will continue until the original bassinets are replaced.[3]

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[1] Smith, P.M., Drummond, A E. (1988) Infant and Child Restraint Use Survey. Melbourne: MUARC

[2] Addicoat, D., Barling, N. (1986) Baby Safety Bassinet Loan Scheme: First Eighteen Months of Operation. GR/86/18 Melbourne: Road Traffic Authority

[3] Bowler, M., Adams, J. VIC ROADS personal communication

Unquantified
costs to municipalities not recovered by hire fees

BENEFIT/COST RATIO: Notes: 1. These ratios do not recognise the fact that society is likely to value the life of a child higher than an adult, particularly when years of potential life saved are taken into account. 2. The ratio would improve if the usable life of a bassinet proves to be longer than originally thought.
Community Benefit/cost ratio 0.5:1
Government Benefit/cost ratio -0.3:1

NPV (BENEFITS - COSTS) -$2.9m

BREAK EVEN: .75 fatalities and 4.7 casualties p.a.

Note: The capital cost of the initial supply of bassinets (not including costs of additional bassinets purchased by municipalities) which resulted in savings of $2.87 million over 6 years was only $lm. This shows that the bassinets are cost beneficial if some lower cost arrangements can be put in place for ensuring they are used a total of at least 5 times (benefits= 5/12 x 2.87 = $1.2 million). The oldest bassinets now in use have been hired between 10 and 12 times.

1.3 PROPOSED COUNTERMEASURE:

Regulation to forbid carriage of persons not seated in approved seats

SPECIFIC TARGET FOR EVALUATION:
Passengers in the load areas of car derivatives average 85 casualties a year and in trucks 20 casualties.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

$1.9m	2 fatalities @ $962,115
$2.7m	40 serious injuries @ $67,874
$0.5m	43 other injuries @ $12,060
$1.7m	20 truck casualties @ $84,000
$6.8m	

EXPECTED COUNTERMEASURE EFFECT:
Assume 50% compliance with legislation.
Assume seat belts and seats will reduce injury severity by 50%.
Net effect 25%.

EXPECTED BENEFITS:
Quantified
Assume five year life of countermeasure when applied to existing fleet. This time period has been chosen because it is assumed that persons buying new cars in future will make allowance for the number of passengers they intend to carry and purchase a vehicle of appropriate carrying capacity.
$1.7m p.a. discounted over a period of five years totals $7.6m

EXPECTED COSTS:
Quantified
Publicity (year one) $100,000.
Assume 4940 vehicles in Victoria at present carrying passengers in load areas

(extrapolated from surveys).[1]
If 50% fit extra seats (with seat belts) @ average cost of $750 for seat and engineers report.[2]
Seats (year one) $1.9m
enforcement $100,000 p.a. for five years discounted to present values = $450,000
PV of costs $2.4m
Unquantified
Costs for new vehicles coming into fleet after regulation (assumed to be in same order of magnitude).
Loss of mobility.
Costs to persons who have to buy additional or larger vehicle.

BENEFIT/COST RATIO:
Community Benefit/cost ratio 3:1
Government Benefit/cost ratio 11:1

NPV (BENEFITS - COSTS): $5.2m

BREAK EVEN: 0.14 fatalities, 2.83 serious injuries, 3.18 other injuries, 1.4 truck occupant injuries p.a. or 7% effective.

1.4 PROPOSED COUNTERMEASURE:

$20 rebate to encourage purchase of child seat.

SPECIFIC TARGET FOR EVALUATION:
The target group is unrestrained child passengers aged between 6 months and four. Surveys suggest that 16% of passengers under 8 are unrestrained, (including those who have restraints available) figures are assumed to be in the same order for under 5. There are around 70 children in this age group killed or seriously injured each year whilst passengers in motor cars.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
If child restraints are 50% effective and 16% of children are unrestrained it can be assumed that 27.6% of the deaths and injuries are to unrestrained children.

$531,000	0.55 deaths @ $962,115
$244,000	3.59 serious injuries @ $67,874
$183,000	1:5.18 other injuries @ $12,060
$958,000	

EXPECTED COUNTERMEASURE EFFECT:
Assume child restraints will reduce injuries by 50%.[3] Assume 20% of parents of unrestrained children will accept offer (based on experience in Bendigo)[4]. Assume 8 year

[1] Ove Arup Transportation Planning (1989) 1989 Rural Town Restraint Use Survey GR/90-4 Melbourne: VIC ROADS

[2] cost estimated by VIC ROADS, Vehicle Safety Standards

[3] Aldman, B., Gustafsson, H., Nygren, A., Tingvall, C. (1987) Child Restraints. Paper no. 2, Acta Paedriatrica Scandinavica, Supplement 339, 1987

[4] McDonald, M. VIC ROADS, Road Safety Officer, Bendigo, personal communication

use of restraint based on an average of two children per family. Assume 300,000 in age group.

EXPECTED BENEFITS:
20% x (50% of $958 p.a.) for 8 years discounted to present values totals = $645,000

EXPECTED COSTS:
300,000 x 16% x 20% x $80 parent cost = $768,000 PV of society costs
Gov. costs 9,600 x $20 + $40,000 publicity =PV $232,000
total $1m

BENEFIT/COST RATIO:
Community Benefit/cost ratio 0.65:1
Government Benefit/cost ratio -0.5:1

NPV (BENEFITS - COSTS): -$355,000

BREAK EVEN: 13% effective or 0.07 fatalities, 0.46 serious injuries, 1.96 other injuries p.a.
Note: these estimates are based on retail prices, a bulk purchase may cost less.

1.5 PROPOSED COUNTERMEASURE:

Promotion of the wearing of protective headgear by passenger motor vehicle occupants.

SPECIFIC TARGET FOR EVALUATION:
Head injuries are present in 65% of all vehicle occupant deaths.[1] Approximately 10% of these fatalities are due primarily to the head injury.[2] 13% of car occupants admitted to hospital suffer brain injuries.[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

$28.9m	30 fatalities @ $962,115
$56.4m	831 serious injuries @ $67,874
$85.3m	

Note: $67,874 is the average value for a serious injury and maybe too low for a serious head injury but is used here for consistency.

EXPECTED COUNTERMEASURE EFFECT:
The effectiveness of suitable protective headgear should be at least 25%. Bicycle helmets have been shown to be between 50-80% effective in reducing the severity of head injuries.[3]
Assume one tenth of the population will buy, and subsequently wear, headgear.
Assume 10 year life for headgear.

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[1] McLean, A.J., Simpson, D.A., Cain, C.M. S., McCaul, K A, Freund, J. R., Ryan, G.A. (1987) Head and Neck Injuries in Passenger Cars: A Review of the literature. Canberra: FORS

[2] Road User and Trauma Advisory Committee. Briefing Paper. 29 July 1987

[3] Dorsch, N., Woodward, A., Somers, R. Do Bicycle Safety Helmets Reduce Severity of Head Injuries in Real Crashes? Acc. Anal. & Prev. 1987 183-197

EXPECTED BENEFITS:
Quantified
$85.3m x 0.1 x 25% p.a. for ten years at present values = $17.3m
EXPECTED COSTS:
Quantified
$1m publicity
$13.5m for 450,000 helmets @ $30

BENEFIT/COST RATIO:
Community Benefit/ cost ratio 1.2:1
Government Benefit/ cost ratio 4:1

NPV (BENEFITS - COSTS): $2.8m

BREAK EVEN: .51 fatalities and 22.4 serious injuries p.a.

2.0 SPEED

GENERAL COUNTERMEASURE TARGET:

Prior to the speed camera program some 2% of drivers exceeded the speed limit by 25 km/h (excessive speeding). This behaviour is associated with an elevated accident risk.[1]1

2.1 EXISTING COUNTERMEASURE NOT FULlY IMPLEMENTED:

Speed camera program : publicity and enforcement

SPECIFIC TARGET FOR EVALUATION:
Drivers exceeding the speed limit by 25km/h or more.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
An estimated 14% of reported accidents and 21% of deaths or serious injuries before speed cameras involved excessive speed, in relation to the speed limit.

$137.6m	143 fatalities @ $962,115
$129.6m	1910 seriously injured @ $67,874
$ 37.5m	3107 other injuries @ $12,060
$304.7m	

ESTIMATED COUNTERMEASURE EFFECT:[2]
Based on speed surveys the percentage of drivers exceeding the speed limit by 25 km/h or more has reduced from around 2% to 0.63%.[3] If the results of U.S. studies on rural roads can be applied to Victorian Conditions there would be consequent reductions in the incidence and severity of accidents equating to a 12.9% reduction in fatalities and serious injuries and a 7.2 % reduction in other injuries. However, this requires a major assumption

[1] West, L.B., Dunn, J.W. (1971) Accidents, speed deviation and speed limits. *Traffic Engineering*, Vol. 41, No.10

[2] See Attachment for details of these estimates

[3] VIC ROADS speed survey data

and therefore the BCR must be considered indicative only. A detailed study on the effectiveness of speed cameras is currently in progress at MUARC.

ESTIMATED BENEFITS:
Quantified
$183.3m p.a. for five years discounted to present values $816m

Unquantified
Long term change in social acceptability of speeding.
Lower fuel consumption
Lower vehicle maintenance costs

EXPECTED COSTS:
Quantified
$8.2m operation of Traffic Camera Office[1]
$3.5m publicity
$11.7m p.a. discounted over 5 years = $52.1m
$15.4m capital cost [2]
Total PV $67.5m

BENEFIT/COST RATIO: Community Benefit/cost ratio 12:1
(Government Benefit/cost ratio is the same in this case)

NPV (BENEFITS - COSTS): $749m

BREAK EVEN: 1. 0.94% reduction in deaths and serious injuries, 0.57% reduction in other injuries.
2. 218.7 reported casualty accidents resulting in 6.4 fatalities, 86.3 serious injuries and 126 other injuries

[1] Ministry for Police and Emergency Services (1989) A proposal to Significantly Increase the Traffic Offences Detected by the Expanded use of Speed and Red Light Cameras. Unpublished Paper.

[2] Report of the Auditor General on Ministerial Portfolios (1991) Melbourne.

ATTACHMENT TO APPENDIX A

SPEED CAMERAS: ESTIMATED EFFECT

A. Excessive speed reduction

1. MUARC site analysis of VIC ROADS data

60 km/h site: % > 20 km/h above -52% (8.4 - 4.0%)
74 km/h site: % > 15 km/h above -59% (2.7 - 1.1%)
100 km/h site:

2. VIC ROADS analysis (by speed zone, sites pooled)

		Nov 89	May 90 - Feb 91
60 km/h sites:	% > 25/30 above	2.3%	0.70%
75 km/h sites:		1.6%	0.75%
100 km/h sites:		2.5%	0.33%
		----	----
	Simple Average	2.1%	0.59% (-72%)
		----	----
		----	----
	Site-weighted Av.	1.99%	0.63% (-68%)
		----	----

3. TACO analysis of "motorists detected speeding"
[i.e. exceeding speed limit + 10% + 3 km/h]
all sites: % speeding (as defined) - 43% (22.8 13%)

B. Accident risk (Research Triangle Institute 1970)

Relative risk:	Exceeding av. speed > 25 km/h	6.9
	> 9 km/h, but < 25 km/h	1.0

	Risk reduction	-86%

C. Injury severity (Cowley 1983)

Fatal accidents	:	12%	25 km/h above limit
Casualty accidents	:	1.6%	25 km/h above limit

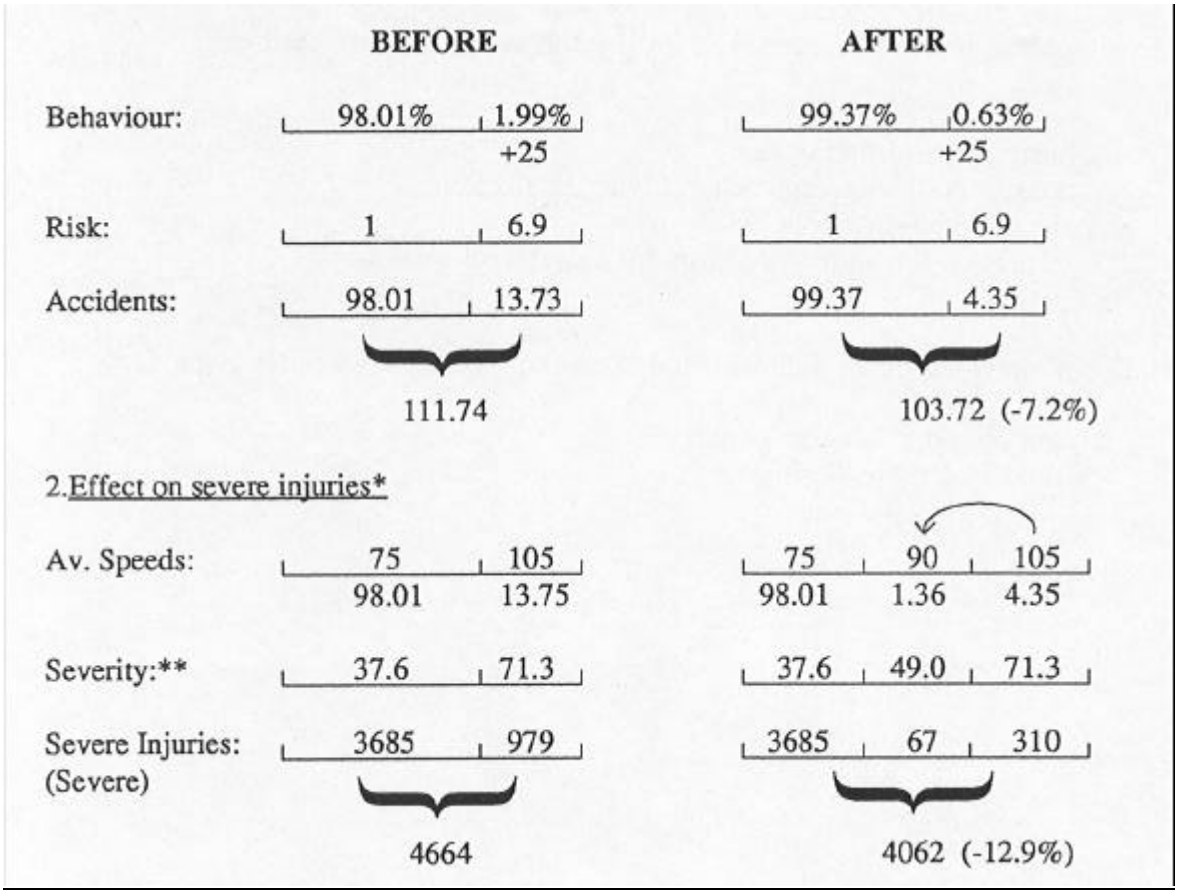
Estimated injury risk reduction from speed reduction

- requires av. speed of > 25 km/h above limit
- and av. speed reduced to by speed camera.

D. Camera effect

Model based on all VIC ROADS survey data

1. Effect based on casualty accident involvement



3. Summary effect

	percentage reduction
Casualty accidents	-7.2%
Other injuries	-7.2%
Serious injuries	-12.9%
Fatal injuries	-12.9%

* At 75km/h speed limit sites, taken as indicative of the overall effect on severe injuries (percentage change)

** Injury severity per 100 crash-involved vehicles at the average speeds shown (from Solomon 1964)

3.0 ALCOHOL

GENERAL COUNTERMEASURE TARGET:

In the years 1983 to 1989 an average of around 20% of drivers admitted to hospital and 30% of those killed in road accidents were over .05 BAC. Drink drivers have twice the risk of accident involvement at a blood alcohol level of .05% BAC compared with sober drivers, the risk rising to a1: least ten times at .15%.[1] Around 24% of hospital admitted adult pedestrians are over .15% BAC. [2]

Benefit/ cost analysis has been undertaken for the following countermeasures:

- raising legal drinking age
- dram shop laws /responsible serving of alcohol
- alcohol ignition interlock
- zero BAC for all motorcyclists (in motorcycle section)

A description is provided of the following measure and a break even point given:

- coin operated breath testers
- Random Breath Testing

3.1 PROPOSED COUNTERMEASURE:

Increase legal drinking age to 21

SPECIFIC TARGET FOR EVALUATION:
37% of 18 to 20 year olds killed and 22% of those seriously injured had a positive blood alcohol level. [3]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
37% of fatalities and 22% injuries to persons involved in accidents where a driver was between 18-20 years old.

$52.0m	54 fatalities @ $962,115
$32.8m	483 seriously injured @ $67,874
$14.0m	1160 other injuries @ $12,060
$98.8m	

EXPECTED COUNTERMEASURE EFFECT:
US study showed 28% reduction in night time fatal accidents to age group affected by the legislation[3]. Assume same for serious casualties. Reduction in Victoria may not be as great

[1] Social Development Committee (1984) First Report upon Road Safety in Victoria. Melbourne: Government Printer

[2] Alexander, K.A., Cave, T ., Lyttle, J. The Role of Alcohol and Age in Predisposing Pedestrian Accidents. GR/90-11 Melbourne: VIC ROADS

[3] VIC ROADS data 1983-1989

because of zero BAC laws already in existence, hence use half of the above: 14% of accidents above.

EXPECTED BENEFITS:
Quantified
$13.8m p.a.
Unquantified
Reduction in other alcohol related social problems to age group.
Possible long term change in behaviour.

EXPECTED COSTS:
Quantified
$100,000 publicity campaign
$2m enforcement
Total $2.1m p.a.
Unquantified
Loss of social amenity to affected age group

BENEFIT/COST RATIO: 7:1 (both ratios are the same in this case)

NPV (BENEFITS - COSTS): $11.7m p.a.

BREAK EVEN: 2.1% effective or 1.2 fatalities, 10.2 serious injuries and 24.3 other injuries

3.2 PROPOSED COUNTERMEASURE:

Training in responsible serving of alcohol in licensed premises, supported by Dram Shop Laws (placing legal liability on server of alcohol).

SPECIFIC TARGET FOR EVALUATION:
Around 24%, of adult injured pedestrians are over .15% BAC and around 20% hospital admitted and 30% of killed drivers are over .05% BAC. 58% of killed drunk drivers had been drinking in licensed premises. [1] 30% of injured drunk (over .15% BAC) pedestrians in the R.T.A. Metropolitan Pedestrian Accident Study had been drinking in a hotel. [2] Hence the target is 7.2% of pedestrians killed and injured, 17% of drivers killed and 12% of drivers injured. This assumes that the percentages in the licensed premises applies to other severity categories.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
$56.8m 10 pedestrian & 49 driver fatalities @ $962,115
$37.3m 79 pedestrians & 470 drivers seriously injured @ $67,874
$94.1m
Only includes directly involved drivers and pedestrians; there would also be passengers and occupants of other vehicles; this data is not readily available.

[1] South D. VIC ROADS, Road User Behaviour, personal communication

[2] Alexander, K. A., Cave, T., Lyttle, J. The Role of Alcohol and Age in Predisposing Pedestrian Accidents. GR/90-11 Melbourne: VIC ROADS

EXPECTED COUNTERMEASURE EFFECT:
US study showed that when supported by Dram Shop Law, training reduced number of patrons leaving a licensed premises over .15 BAC by 33% [1]
Assume half of this effect = 16.5% (data for drivers killed is over .05 so effect could not be expected to be as great)

EXPECTED BENEFITS:
Quantified
Benefits for five years subsequent to completion of training program PV$69,067,695
Unquantified
Reduction in other alcohol related social problems

EXPECTED COSTS:
Quantified
Development $347,000
Training for 3000 licensed premises $4.9m
Enforcement for five years after program fully operational $8.9m ($2m p.a.)
Total $14.2m
Unquantified
Level of top-up training required for new staff entering the industry.

BENEFIT/COST RATIO:
Community Benefit/cost ratio 5:1
Government Benefit/cost ratio 7:1

NPV (BENEFITS - COSTS): $54.9m

BREAK EVEN: 1.77 fatalities and 41.8 serious injuries p.a. or 3% effective

3.3 PROPOSED COUNTERMEASURE:

Fitting of an ignition interlock as a condition of relicensing for all convicted drink drivers for six years.

SPECIFIC TARGET FOR EVALUATION:
It is estimated that 9% of fatal accidents and 5% of serious injury accidents involve drivers with a BAC over .05 who have a prior conviction in the previous 6 years. [2]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
Based on all persons in accidents.

$58.7m	61 fatalities @ $962,115
$30.9m	455 serious injuries @ $67,874
$89.6m	

[1] Saltz, R.F. Server Intervention Will it Work? Alcohol, Health and Research World. 1986, vol10 no.4 12-19

[2] South, D. and Key D. (1983) Specific Deterrence and Rehabilitation of Convicted Drinking Drivers - The Accident Reduction Potential as yet Unrealised. Melbourne: Road Safety and Traffic Authority.

EXPECTED COUNTERMEASURE EFFECT:
Assume that 50% compliance with legislation would result in 50% reduction in fatalities and injuries.

EXPECTED BENEFITS:
Quantified
Assume six year penalty
Assume that 12,000 drivers will be treated each year for a constant flow of benefits. This involves an assumption that extra enforcement will deter people driving while unlicensed, and that most of those who lose a licence will apply to get it back.
PV of benefits using the first group of drivers only through a period of six years and assuming one sixth of the benefits which would be expected from a fully operational program $44.8m (÷6)p.a. discounted over six years = $39.1m
Unquantified
Reduction in other alcohol related social problems e.g. crime, domestic violence and health.
Drivers with the device fitted will be able to obtain vehicle insurance for which they would previously have been ineligible. [1]

EXPECTED COSTS:
Quantified
Enforcement $lm p.a. (only one year of enforcement is used in this calculation for ease of analysis. It is assumed that the $lm p.a. enforcement would be a constant figure regardless of the number of drivers with the licence condition applied in anyone year and that enforcement would be most applicable during the first year of their penalty.)
Setting up costs: $80,000 staff and systems, 12,000 drivers x $1000 for device which is written off after 6 years. Note that the current cost of the device is more than this but could be expected to reduce with economies of scale, or $1000 could be regarded as amount written off over 6 years for a more expensive device. The cost of the device would be borne by the driver.
Recurrent costs: 12,000 drivers x $200 for calibration per year for six years.[1]
PV of costs $80,000 + $12m + ($200 x 12,000 p.a. discounted for six years) + $lm = $25.7m
Unquantified
Loss of mobility
Effects on liquor industry

BENEFIT/COST RATIO:
Community Benefit/cost ratio 1.5:1
Government Benefit/cost ratio 13:1

NPV (BENEFITS - COSTS):
$13.5m

BREAK EVEN:
2.9 fatalities and 20.8 casualties amongst the treated group of drivers.

It is likely that this level of effectiveness could be achieved if the law were enforced and compulsory carriage of licences introduced.

3.4 EXTENSION OF EXISTING COUNTERMEASURE:

Random Breath Testing with supporting publicity

SPECIFIC TARGET FOR EVALUATION:
In recent years around 20% of hospital admitted and 30% of killed drivers have been over .05% BAC.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
As a first order approximation it can be assumed that around 30% of the road toll can be attributed to alcohol affected drivers.

$196.3m	204 fatalities @ $962,115
$185.3m	2730 seriously injured @ $67,874
$ 80.3m	6659 other injuries @ $12,060
$461.9m	

ESTIMATED COUNTERMEASURE EFFECT:
In the past RBT operations in Melbourne have reduced serious casualty accidents at night by between 14-23% during operations plus an 11% reduction in surrounding area. [1] In NSW a reduction in casualty accidents of 27% followed the introduction of intensive RBT at the level of 1 million tests per annum.[2] The equivalent for Victoria of 700,000 tests per annum has now been doubled. There is not yet research evidence available to indicate what the optimum combination of hours of testing and number and type of vehicles is. However as the percentage of drivers killed with BAC over .05 dropped from approximately 28% to 25% it may be reasonable to assume that the increase in RBT during 1990, supported by publicity resulted in approximately a further 10% reduction in alcohol related deaths and injuries. However, as the presence of RBT is known to reduce both alcohol and non-alcohol related accidents it is not yet possible to estimate the casualty reductions due to this measure with any degree of accuracy. Further studies are being undertaken at MUARC to disaggregate the factors behind the large reductions in the road toll which have occurred over the last eighteen months.

ESTIMATED BENEFITS:
Quantified
not known
Unquantified
Reduction in other alcohol related social problems.
Possibly reduction in other types of alcohol related crime (to be evaluated).

EXPECTED COSTS:
Quantified
$3.4m p.a. enforcement (including capital cost of booze buses depreciated over 10 years)
Publicity $4m

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[1] Cameron, M.H., Strang, P.M. (1982) Effect of Intensified Random Breath Testing in Melbourne during 1978 and 1979. Proc. 11th ARRB Conf.

[2] Job, R. F. S. (1983) Reported Attitudes, Practices and Knowledge in Relation to Drink Driving: The effects of the Introduction of Random Breath Testing in NSW 9th ADTS Conf. Puerto Rico.

BREAK EVEN: 1.6% effective or 3.2 fatalities, 43.6 serious injuries and 104.3 other injuries.

3.5 PROPOSED COUNTERMEASURE:

Promotion of the use of coin operated breath testers in licensed premises

SPECIFIC TARGET FOR EVALUATION:
Around 20% hospital admitted and 30% of killed drivers are over .05% BAC. 58% of killed drunk drivers had been drinking in licensed premises. [1] The specific target is a reduction in the number of drivers, who drink in licensed premises, exceeding .05% BAC. Note: this is a similar target group to that addressed by dram shop laws so there may be some double counting of potential benefits.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
$47.1m 49 fatalities @ $962,115
$31.9m 470 seriously injured @ $67,874
$80.0m
Only includes directly involved drivers, there would also be passengers and other road users, this data is not readily available.

EXPECTED COUNTERMEASURE EFFECT:
There have not been any large scale studies of devices of this type so it is not possible to estimate a level of effectiveness. The device can inform drivers whether they can legally drive on anyone occasion and also assist them in more correctly assessing their likely BAC on future occasions. The measure could be considered as part of a package of measures directed towards the responsible serving of alcohol.

EXPECTED BENEFITS:
Unquantified
Long term educational effect.
Reduction in other alcohol related social problems.

EXPECTED COSTS:
Quantified
Publicity $100,000
There are 3000 licensed premises in Victoria, the machines cost around $3000 and should last about 5 years.[1] PV (if all machines purchased in year one) $9m.
Machines can be either leased or purchased. A charge of $2 per use is usually sufficient for the licensed premises to cover its expenses for the cost of the machines plus calibration. This corresponds to about $3m p.a.

BREAK EVEN: If the machines are purchased and the costs of use are excluded (as this is a voluntary expense) the break even is 1.2 fatalities and 11.2 serious injuries or 2.4% effective. If the machines are leased and the usage charge included to cover costs, the break even is 3.9% effective or 1.91 fatalities and 18.3 serious injuries.

[1] South, D. R. VIC ROADS Road User Behaviour, personal communication

4.0 EXPOSURE: REDUCTION

GENERAL COUNTERMEASURE TARGET

It seems axiomatic that a reduction in exposure to high risk travel, either by restricting duration, time or mode of transport, will reduce the absolute number of accidents. However, it is not possible to quantify what overall gains could be made by countermeasures of this type.

A description is given of two countermeasures:

- curfews for novice drivers
- passenger restrictions for novice drivers

The encouragement of the use of public transport and rail freight is a potential countermeasure which is also difficult to quantify.

4.1 PROPOSED COUNTERMEASURE

Night time curfew for drivers in the first year of driving, from 11 p.m. to 5 a.m. Police advise that this countermeasure could only be enforced effectively if all drivers are required to carry their licence.

SPECIFIC TARGET FOR EVALUATION

Night time driving is associated with a higher risk of accidents for all drivers but particularly for young drivers and those with less than one year experience. 32% of novice driver night time accidents occur between 11 p.m. and 5 a.m.[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

Fatalities and injuries to 18 year old drivers between 11 p.m. and 5 a.m.

$6.7m	7 fatalities @ $962,115
$5.6m	83 serious injuries @ $67,874
$1.4m	116 other injuries @ $12,060
$13.8m	

Only includes directly involved 18 year old drivers, there would also be some 19 year old drivers in their first year of driving, passengers and other road users, this data is not readily available.

EXPECTED COUNTERMEASURE EFFECT

A range of effectiveness in reducing night time accidents from 25% to 69% has been found in U.S. studies.[2] A 50% reduction is assumed for this analysis.

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[1] Drummond A E., Healy D. J. (1986) The risk of Driver Crash Involvement per Distance travelled in Metropolitan Melbourne, Proc. ARRB/REAAA Combined Conf. Pt. 2 149-160

[2] Preusser D., Williams A.F., Zador, P.L., Blomberg, R.D. (1984) The Effect of Curfew Laws on Motor Vehicle Crashes. Law and Policy Quarterly 6. 115-128

EXPECTED BENEFITS
Quantified
$6.9m p.a.
Unquantified
Drivers will gain experience and skills at low risk travel times.
There are indications that age based curfews lead to later licensing.[1]

EXPECTED COSTS
Quantified
$0.4m promotion
$lm enforcement (undertaken as part of random breath testing)
Unquantified
Social amenity, mobility and equity.
Safety, cost and availability of alternative transport at night.

BENEFIT/COST RATIO: 5:1 (both ratios are the same)

Note: This ratio may be misleading because the unquantified social costs are likely to be highly valued by the persons affected by the restriction.

NET PRESENT VALUE: $5.5m p.a.

BREAK EVEN:
10% effective in reducing deaths or injuries or 0.71 fatalities, 8.3 serious injuries and 11.6 other measures per annum.

4.2 PROPOSED COUNTERMEASURE

18 year old drivers restricted from carrying more than one passenger at any time.
Police advise that this countermeasure could only be enforced effectively if it compulsory carriage of licences is introduced.

SPECIFIC COUNTERMEASURE FOR EVALUATION:
A study of young driver accidents found that novice drivers had a much higher proportion (23.2% c.f. 12.1'%) of their accidents while carrying two or more passengers than did 21-25 year olds.[2]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective)
Deaths and injuries to 18 year old drivers and their passengers in vehicles with 2 or more passengers.

$22.1m	23 fatalities @ $962,115
$22.3m	328 serious injuries @ $67,874
$ 9.1m	757 other injuries @ $12,060
$53.5m	

[1] Williams A.F., Lund, A, Preusser, D. (1985) Night Time Driving Curfews in New York and Louisiana: Results of a Questionnaire Survey. Acc. Anal. & Prev. 17(6) 461-466

[2] Drummond, A.E. Torpey, S.E. (1984) Young and/or Inexperienced Driver Accident Study: Interim Report of the Expert Working Group. Melbourne: Road Traffic Authority

EXPECTED COUNTERMEASURE EFFECT
Unknown

EXPECTED BENEFITS
Unquantified
Reduction in deaths and injuries to target group.

EXPECTED COSTS
Quantified
$200,000 publicity
$lm enforcement (as part of random breath testing)
Unquantified
An unknown number of passengers will drive themselves and may be to exposed to accident risk.

BENEFIT/COST RATIO: unknown

NPV (BENEFITS -COSTS) unknown

BREAK EVEN: 2.2% effective or .51 fatalities, 7.4 serious injuries and 16.9 other injuries.

5.0 PEDESTRIANS

GENERAL COUNTERMEASURE TARGET:
The annual average (1986-1990) of pedestrians reported to the police as being killed is 136, an additional 1095 are seriously injured and 1221 suffer other injuries. Pedestrians represented 17% of fatalities in 1990. Programs which are intended to reduce the incidence of speeding and drunk driving may have indirect benefits in reducing pedestrian accidents. In addition, the Responsible Serving of Alcohol programs described in the alcohol section have intoxicated pedestrians as one of their direct targets.

There are a number of pedestrian programs in the process of implementation which have not yet been evaluated. They include:

- Safe Routes to School
- Walk with Care (an elderly pedestrian program)

The School Crossing Supervisor Scheme has been endorsed by a Parliamentary inquiry and is not considered further in this paper .

A description of one other measure is given below:

- conspicuity enhancing devices

5.1 PROPOSED COUNTERMEASURE:

Promotion of conspicuity enhancing devices for pedestrians

SPECIFIC TARGET FOR EVALUATION:
The 1986-1990 average of pedestrian accidents between the hours of 8 pm and 6 am is 42 deaths, 222 seriously injured and 169 other injuries. This ratio of serious injuries and

deaths to other injuries demonstrates that pedestrian accidents are usually of higher severity than other accident types. Lack of conspicuity was found to be a factor in night time pedestrian accidents in the Pedestrian Accident Study but its effect could not be quantified.[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

$40.4m	42 fatalities @ $962,115
$15.1m	222 serious injuries @ $67,874
$ 2.0m	169 other injuries @ $12,060
$57.5m	

EXPECTED COUNTERMEASURE EFFECT:
Conspicuity enhancing devices in the form of retro-reflective vests, strips of material stuck on clothing or retro-reflective dangles (as used in Scandinavia) could make pedestrians more visible. However, it is not possible to estimate how many night time pedestrians (particularly the alcohol effected ones) would be prepared to wear these items, nor how effective they would be. Further, it requires that people have planned to be walking in poor visibility conditions and have the devices with them.

EXPECTED BENEFITS:
Unknown

EXPECTED COSTS:
Quantified
$200,000 publicity campaign
Unquantified
Around $10 per head for retro-reflective material, or a total of around $10,000,000 if purchased by the 1 million Victorians most likely to go out at night.

BREAK EVEN: An 18% reduction in night time pedestrian accidents if all the benefits are to be realised in one year. The material may last longer than this. 7.4 fatalities, 39.1 serious injuries and 28.7 other injuries.

[1] Struik, M., Rogerson, P. (1988) Methodology and General Results. Pedestrian Accident Study, Report No. 5 Melbourne: Road Traffic Authority

6.0 MOTORCYCLISTS

GENERAL COUNTERMEASURE TARGET:
Motorcycles are a high risk form of transport. Ten percent of the people who died on Victoria's roads in 1990 were motorcyclists but only 1 % of vehicle travel is by motorcycle. The five year average is 63 killed and 940 seriously injured p.a.

The countermeasure proposals that have been analysed are:

- zero BAC for all motorcyclists
- extension of the current one year restriction on the carriage of pillion passengers to three years, with supporting enforcement
- protective clothing

Existing countermeasures previously demonstrated to be cost beneficial and not further analysed are:

- compulsory helmet wearing
- 260 cc restriction for novice motorcyclists
- motorcycle licensing program

Other countermeasures with unquantified benefits are:

- premium restructuring to improve cost recovery
- compulsory skill training
- development of new criterion for a high powered motorcycle restriction
- occupant protection measures for motorcyclists such as air bags and leg protection.
- driver awareness campaigns
- daylight use of motorcycle headlights

6.1 PROPOSED COUNTERMEASURE:

Zero BAC limit for all motorcyclists

SPECIFIC TARGET FOR EVALUATION:
Accident data indicates that motorcyclists' riding skills are affected by lower levels of alcohol than passenger car drivers. 42% of riders killed have a BAC .01 or over. [1] A similar percentage is assumed for seriously injured riders.

[1] VIC ROADS (1991) Submission to Social Development Committee Inquiry into Motorcycle Safety in Victoria.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
Based on 42% of average number of accidents
$25.0m 26 fatalities @ $962,115
$26.8m 395 seriously injured @ $67,874
$51.8m
Note: This may be an overestimation of the potential benefits because it includes those over .05 who are currently breaking the law.

EXPECTED COUNTERMEASURE EFFECT:
Assume 25% compliance leads to a 50% reduction in accidents to compliant group
Net effect 12.5%

EXPECTED BENEFITS:
Quantified
$6.5m in first year

EXPECTED COSTS:
Quantified
$2m enforcement as part of an increased RBT campaign
$300,000 publicity campaign
Unquantified
Loss of mobility to motorcyclists

BENEFIT/COST RATIO: 3:1
(both ratios are the same in this case)

NPV (BENEFITS - COSTS): $4.2m

BREAK EVEN: 1.1 fatality and 17.6 serious injury accidents or 4% effective

6.2 PROPOSED COUNTERMEASURE:

Extension of restriction on carriage of pillion passengers from one year to first three years of motorcycling.

SPECIFIC TARGET FOR EVALUATION:
9.5% of motorcycle accidents involve a pillion passenger. In addition the severity of injury to the rider is usually greater when a pillion passenger is carried (the ratio of fatal to injured riders alone is 1:40 but when passengers are carried it is 1:25).[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
Riders in the first three years of motorcycling carrying pillion passengers
$1.9m 2 pillion passenger deaths @ $962,115
$2.5m 37 pillion passengers seriously injured @ $67,874
$0.5m 37 pillion passenger other injuries @ $12,060
$1.8m 2 riders seriously injured instead of killed (see above)
$6.7m

[1] VIC ROADS (1991) Submission to Social Development Committee Inquiry into Motorcycle Safety in Victoria.

EXPECTED COUNTERMEASURE EFFECT:
unknown

EXPECTED BENEFITS:
Unquantified
Additional skills gained during the three years may lead to safer pillion carrying after restriction lifted

EXPECTED COSTS:
Quantified
$250,000 publicity
$1m enforcement
Unquantified
loss of mobility for pillion passengers

BREAK EVEN: 18.6% effective or 1.9 fatalities, 6.9 serious injuries, 6.3 other injuries, 0.36 riders seriously injured instead of killed.

6.3 PROPOSED COUNTERMEASURE:

Compulsory wearing of protective clothing by motorcyclists and pillion passengers.

SPECIFIC TARGET FOR EVALUATION:
The most common injuries sustained by motorcyclists in road accidents are lacerations, contusions; and abrasions.[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
$54.2m 799 serious injuries @ $67,874
$14.6m 1209 other injuries @ $12,060
$68.8m
Note: This: may be an overestimate because it is unlikely that protective clothing could be 100% effective in preventing injuries.

EXPECTED COUNTERMEASURE EFFECT:
Protective clothing particularly leather gloves, jackets and trousers significantly reduce soft tissue injury. [1] Assume that protective jackets are already worn by the majority of motorcyclists. Assume that protective trousers and gloves are worn by 50% of the riders of the 68,100 registered motorcycles. Assume that 50% of the remainder would comply with the regulation. Assume that that clothing will last for 3 years.[2]

EXPECTED BENEFITS:
unknown

EXPECTED COSTS:
17,025 sets of trousers and gloves @ $300[2] = $5.1m
publicity $,100,000 total PV $5.2m

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[1] Social Development Committee (1984) First Report upon on Road Safety in Victoria. Melbourne: Government Printer

[2] Estimate based on experience of VIC ROADS Motorcycle training and testing officers.

BREAK EVEN:
20 serious injuries and 30 other injuries p.a. or 2.5% effective.

7.0 BICYCLISTS

GENERAL COUNTERMEASURE TARGET:
Bicyclists represent 3% of fatalities and 5% of serious injuries. The five year average 1986-1990 was 23 killed, 524 seriously injured and 1228 minor injuries.

Break even calculations are provided for:

- enforcement of bicycle lighting
- footpath cycling

The Regulatory Impact Statement prepared for the introduction of mandatory bicycle helmet use argued that it would have a positive benefit/ cost ratio. It is too soon after the introduction of the regulation to assess its effectiveness.

7.1 PROPOSED COUNTERMEASURE:

Increased enforcement of bicycle lighting regulations

SPECIFIC TARGET FOR EVALUATION:
While only a small number of night-time bicycle accidents occur each year, an over-riding characteristic of such accidents is that the motorist did not appear to have seen the cyclist. There are indications that bicycle lighting regulations are rarely observed by cyclists and infrequently enforced by police.[1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
Night time bicycle accidents
$5.8m 6 fatalities @ $962,115
$5.0m 73 serious injuries @ $67,874
$1.4m 123 other injuries @ $12,060
$12.2m

EXPECTED COUNTERMEASURE EFFECT:
Unknown

EXPECTED BENEFITS:
Unquantified
Fewer night time bicycle accidents

EXPECTED COSTS:
Quantified
$100,000 publicity
$lm enforcement
Unquantified
Purchase of bicycle lights for previously unequipped bicycles

[1] RTA (1988) unpublished supporting document for 1988 Road Safety Strategy

BREAK EVEN: 0.53 fatalities, 6.64 serious injuries and 10.9 other injuries or 9% effective.

7.2 PROPOSED COUNTERMEASURE:

Legalise footpath cycling

SPECIFIC TARGET FOR EVALUATION:
Cycling on the road is more dangerous than cycling on the footpath in the ratio 2.5:1. 65% of exposure is currently on the road. [1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
All reported bicycle accidents whether on the road or footpath.

$22.1m	23 fatalities @ $962,115
$36.2m	533 serious injuries @ $67,874
$15.0m	1247 other injuries $12,060
$73.3m	

EXPECTED COUNTERMEASURE EFFECT:
A trial of footpath cycling is currently underway. Until it is concluded it is not possible to estimate what proportion of cyclists will switch to footpath cycling. Assume that one quarter switch to the footpath. Saving would be 12.2%. A better value for this figure and overall effectiveness of the countermeasure will be available when the results of current footpath cycling trials become available.

EXPECTED BENEFITS:
Quantified
$8.9m p.a. for 7 years discounted to present values $53.7 (based on expected life of signs)

EXPECTED COSTS:
Quantified
$250,000 Publicity
$lm signs
Unquantified
Increased accidents to pedestrians. Estimated to be a minor problem.[2]

BENEFIT/COST RATIO: 43:1
(both ratios are the same in this case)

NPV (BENEFITS - COSTS): $52.45m

BREAK EVEN: 0.12 fatalities, 0.72 serious injuries or 0.1% effective

[1] Drummond, A E., lee, F. M. (1988) The Risks of Bicyclist Accident Involvement. Melbourne: MUARC

[2] Drummond, A. E. Pedestrian Casualties resulting from Collisions with Cyclists on Footpaths. Melbourne: MUARC

8.0 OTHER ROAD USER MEASURES

GENERAL COUNTERMEASURE TARGET:
The five year average 1986-1990 road toll is 680 killed, 9099 seriously injured and 22195 other injuries.

8.1 EXISTING COUNTERMEASURE:

VIC ROADS program of Traffic Safety Education in Schools.

SPECIFIC TARGET FOR EVALUATION:
An extensive range of Traffic Safety Education (TSE) materials have been developed by VIC ROADS and other organisations. There are curriculum units designed for all ages from preschool to VCE. The intention of these units is to both increase the safety of the children during their school years and also to prepare them for a lifetime of safe road use. Theoretically, then, the target group for TSE is the total road toll.

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):

$654.2m	680 fatalities @ $962,115
$617.6m	9099 serious injuries @ $67,874
$267.7m	22195 other injuries @ $12,060
$1.54b	

EXPECTED COUNTERMEASURE EFFECT:
TSE programs are seen as being incremental, cumulative in effect and long term. [1] It is therefore, difficult to isolate the effects of TSE from other road safety measures that are current at the time. Individual curriculum units have been found in some studies to have a favourable effect on intermediate variables like knowledge, attitudes and behavioural intentions.

EXPECTED BENEFITS:
Unquantified
Short term gains in child road safety and long term gains in adult behaviour.

PRESENT COSTS:
Quantified
VIC ROADS employs 1 Manager, Education Programs, 3 Co-ordinators, 2 Curriculum Writers and 28 Consultants. The budget for 1991/92 is around $4.2m. [2] Note: 1. Because the program has both long and short term goals no attempt has been made to disaggregate costs by the target group of particular units e.g. Teenagers, Alcohol and Road Safety.
2. Costs of other TSE providers such :as the Victoria Police have not been included.
Unquantified
Class room teacher time. Because the material is designed for flexible application and can used at different year levels and in various subject areas it is very difficult to quantify teacher time. In addition because the material has general educational objectives outside of

[1] Organisation for Economic Co-operation and Development, Scientific Expert Group (1986) The Effectiveness of Road Safety Educational Programs. Paris: Author

[2] VIC ROADS unpublished papers

its road safety content it would not be appropriate to cost all of the class room time as being due solely to road safety education.

BREAK EVEN: 0.27%, effective or 1.7 fatalities, 24.8 serious injuries and 59.2 other injuries p.a.

APPENDIX B

VEHICLE COUNTERMEASURES

PREAMBLE:

Vehicle factors are associated with the cause of only around 10% of accidents. However passenger motor vehicle occupants are the largest single group of killed and injured road users. There is therefore a need to develop vehicle countermeasures that will reduce the severity of crashes when they occur .

The development of Benefit/cost ratios for a range of measures for passenger car occupant protection is complicated. It may be undertaken as a contract for the Federal Office of Road Safety commencing in the near future, hence the work in this area of the project is deferred, at this stage. The air bag estimate has been included as an illustrative example but it needs refinement.

Other potential measures for occupant protection which have not been assessed are:

- padded steering wheels
- seat belt tighteners
- webbing clamps
- improved seat belt geometry
- seat improvements to prevent submarining
- knee bolsters
- padding of windscreen header and door surrounds
- improvements to dashboard, instrument panel and parcel shelf areas to absorb energy on contact

One accident avoidance measure, retrofitting of high mounted rear brake lights, has been analysed. Other potential measures for accident prevention that have not been assessed are:

- speed limiters on trucks
- speed limiters on other vehicles
- roadworthiness checks
- anti-skid brakes
- fatigue monitors
- daytime use of motorcycle headlights

1.1 PROPOSED COUNTERMEASURE:

Fitting of mechanical sensor driver air bags to new cars and car derivative vehicles as they enter the fleet (illustrative example of a vehicle countermeasure).

SPECIFIC TARGET FOR EVALUATION:
57% of drivers who suffer major injuries in frontal impacts sustain major or minor head, face or chest injuries = 2169 driver claims on TAC p.a. [1]

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective):
$192.1m 2169 injuries at AIS levels 2-6 @ $88,580 (average injury level of TAC claims of this type)

EXPECTED COUNTERMEASURE EFFECT:
Studies have shown a 50% reduction in costs of injuries when air bags are deployed for non seat belt wearers and perhaps 25% for wearers. [2] Assume all new passenger cars in fleet are fitted. The average vehicle life is 15 years.[3]

EXPECTED BENEFITS:
$192.1m x (20% x 50% + 80% x 25%) = $64m p.a. if all vehicles fitted.
Benefits per car $30 p.a. over 15 year life which is equivalent to $333 in present values.

EXPECTED COSTS:
Quantified
Estimated costs of air bag installation vary widely but are known to be reducing with mass production. Assume mechanical sensor air bags can be fitted for $200 per car and last for 15 years. Costs of replacement air bags have not been included.

BENEFIT/COST RATIO: 1.7:1 per car fitted

NPV (BENEFITS - COSTS): $133 per car

BREAK EVEN: 14.6% reduction in the cost of claims which is equivalent to 304 drivers injured per year.

GENERAL COUNTERMEASURE TARGET:

Rear end accidents

1.2 PROPOSED COUNTERMEASURE:

Promotion of retro-fitting of high mounted rear brake lights.

SPECIFIC TARGET FOR EVALUATION
Rear end accidents in which the vehicle is braking.

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[1] Planath, I. (1987) The Potential for Driver Side Air Bags in Australian Cars - A Preliminary Cost Benefit Analysis RN/87/14 Melbourne: Road Traffic Authority

Road Traffic Authority (1988) Submission to Social Development Committee Inquiry into Vehicle Occupant Protection. Table C.2

[2] Haberl, J. personal communication with M.H. Cameron, during visit to Daimler-Benz AG, Stuttgart, on 7 July 1988

[3] Malisani, M. VIC ROADS Vehicle Safety Standards, personal communication

TOTAL POTENTIAL BENEFITS PER ANNUM ($) (if measure 100% effective)

$22.1m 23 fatalities @ $962,115
$35.7m 525 serious injuries @ $67,874
$37.9m 3139 other injuries @ $12,060
$95.6m

Note: This estimate may be too high because there is some doubt that fatalities would be affected. Also there is only potential to prevent rear end accidents in which the struck vehicle was braking, not all rear end accidents.

EXPECTED COUNTERMEASURE EFFECT:

A reduction of around 20% in relevant rear end accidents was reported after fitting to new cars in the U.S. [1] All cars and station wagons sold after July 1989 are fitted with high mounted brake lights. Assume that following promotion an additional 10% of vehicles will fit lights. Net effect 2%.

EXPECTED BENEFITS:

Quantified

$1.9m p.a. discounted over 7 years (average remaining life of vehicle) = $11.5m

EXPECTED COSTS:

Quantified

207,620 x $30 = $6.2m Cost assumes fitted commercially, if the vehicle owners fit the lights themselves the cost would be lower. This estimate is based on the lower range of charges for the devices, maintenance costs have not been included.[2]
$500,000 publicity

BENEFIT/ COST RATIO:

Community Benefit/cost ratio 1.8:1
Government Benefit/cost ratio 11:1

NPV (BENEFITS - COSTS): $4.8m

BREAK EVEN: 1% effective or 1.6 fatalities, 36.5 casualties and 216.6 other injuries

[1] Kahane C.J. (1989) An Evaluation of Centre High Mounted Stop Lamps Report No. H5807 442. Washington: National Highway Traffic Safety Administration

[2] VIC ROADS, Vehicle Safety Standards Branch, personal communication

APPENDIX C

ROAD AND TRAFFIC FACTORS

There are major conceptual and practical difficulties in assessing road and traffic countermeasures on the same basis as the educational, enforcement, education, and other measures outlined elsewhere in this report. These include:

- the measures, by their nature, apply to a specific part of the road network (e.g. a site such as an intersection, a length of road, or an area such as a local traffic precinct), so cannot apply to the road system as a whole,
- effectiveness can only be assessed on the basis of previous studies, and these in some cases show results that differ by a considerable amount,
- the effectiveness of a particular measure may decrease as the size of the program is increased to cover sites of lower priority, i.e. there may be diminishing returns from the program over time,
- in many cases, the application and effectiveness of a countermeasure may be known for some applications or environments, but not others, and it is perhaps invalid to extrapolate the results (e.g. staggered tee intersection treatments are effective in some cases, but not in others),
- in many cases, the size of a complete program is difficult to estimate, as it depends more upon priorities for the use of resources than upon the inherent cost of the program itself (e.g. roadside management).

For these reasons, it is not possible to use the same methodology as that used elsewhere in this study. However, the key assumptions (e.g. discount rates, definition of benefit and cost, etc) were identical. Therefore, to fulfil the aims of the study, and to attempt to make the results here as consistent as possible as those elsewhere, the following methodology has been developed:

(a) A brief overview of the reported effectiveness of a range of road and traffic crash countermeasures was undertaken; this was mainly to ensure that the particular study or studies used in (b) below was reasonably representative of a broader set of results.

(b) For a range of countermeasures, one or more studies were sought which reported the effectiveness of the countermeasure in the form of a ratio of accident benefits to costs.

(c) To be consistent with the remainder of the study, this reported ratio was adjusted so that the accident costs (and hence benefits of crash reductions) were on the same 1991 dollar basis as those used elsewhere in the study, and the construction costs were updated to 1991 values.

(d) The outcome of the above was to produce, for each countermeasure, an estimate of the future net benefits per dollar of cost, in 1991 values. Given that it is not meaningful (for the reasons discussed above) to develop a cost estimate for many programs, an estimate of a budget outlay on each program was then selected, for

which it was assumed that the previously estimated benefits per dollar of cost would apply. This estimate was developed as follows:

- Where possible, this estimate was related to a specific crash frequency, based upon Vicroads estimates. The number of sites having more than a prescribed number (usually four) of casualty crashes of the type related to the countermeasure over the previous 5 years was determined from the mass accident data base. It was assumed that about half of these sites would, upon investigation, be amenable to treatment by that countermeasure, and the cost of treating this number of sites was estimated by Vicroads. It is implicitly assumed that these could be treated in one year, except in the case of signalised intersections, where the cost was considered too large to be either budgeted or spent in one year, so one-fifth of the estimate was used, i.e. a five year program is implicitly assumed. If data were available, it would have been desirable to base the analysis on a program over which the assumed effectiveness would hold, but such data are not available at present, so this interim program size was used. It is implicitly assumed that the expected effectiveness would apply to the whole of this interim program.
- In other cases, where this analysis is not possible, an arbitrary budget outlay was assumed, and the output should be read in terms of the return per budget outlay.

On this basis, a net present value of the investment in each program was calculated. This outcome is therefore consistent with that produced elsewhere in the report, with the proviso that the investment level, or outlay, in each is essentially a policy decision.

Finally, it is important to note that the only road and traffic programs considered here were those for which reasonable data on effectiveness were available. There were twelve such programs, as follows:

rural roadside hazard management program
urban roadside hazard management program (utility poles)
roundabouts
road duplication and/or provision of median on rural roads
rural overtaking lanes
rural road sealed shoulders
pedestrian facilities
skid resistant overlays (rural roads)
conversion of rural cross intersection to staggered tee
installation of traffic signals
remodelling of traffic signals (esp to provide right turn phase)
improved delineation on rural highways

There are many other road and traffic countermeasures which have not been considered for this reason. It may be that future extensions of this project will be able to incorporate some of these, and it is likely that some, at least, would be shown to have favourable benefit/ cost returns. A wider range of road and traffic countermeasures might include:

road signs (including warning, STOP, GIVE WAY, and direction signs)
pavement markings
intersection channelisation
railway level crossing devices
improved road geometry (e.g. horizontal curves)

improved sight distance
guard fencing
bridge, culvert and structure treatments
skid resistant pavements at urban intersections
rumble strips
clearways
linked signal systems
parking control
road design standards (e.g. effect of design speed)
road design parameters (e.g. lane width, sight distance, transition curves)
grade separation
roadside rest areas
truck escape ramps
truck routes

Four important points should be noted in respect of the approach described above:

- it is implicit in the approach that the treatment is appropriate to the site or area treated, and the crash patterns applicable. In other words, the benefits estimated here are: only achievable where the particular countermeasure is appropriate.
- The benefit/cost calculations are valid in the context of the methodology developed for this study; a benefit/ cost calculation for any specific site or program would need to consider the actual conditions applying to that application.
- By restricting the analysis to short-term programs and countermeasures for which data are available, the results are more likely to be robust and can be treated with more confidence. The problem of "diminishing returns" is also reduced (i.e. if all the worst sites are treated first, it follows that subsequent years will likely have a lesser effectiveness).
- Safety-related benefits and costs are the only ones considered. Other economic impacts (especially those related to vehicle operating costs and travel time savings) are not considered. This is important to note in the case of some road construction projects (e.g. road duplication) which are essentially undertaken for capacity-related purposes, with safety benefits being often a small part of the total benefit.

TABULATIONS

The following pages tabulate the results for the twelve road and traffic countermeasures considered in this study. For each, the following information is presented, in as consistent a form as possible with the other treatments considered in this report:

Proposed countermeasure: Description of the treatment.

Specific target for evaluation: Based, where possible, on the number of sites having more than a prescribed number of casualty crashes over the previous five years, as described above. (Note that several countermeasures may be targeted at similar crash types. In application, the most appropriate countermeasure would need to be selected for each case.) These data are not used in the benefit/ cost analysis, but are included merely to indicate the magnitude of the countermeasure target.

Expected countermeasure effect: Crash reduction expected at the sites treated, consistent (as far as possible) with the benefit/ cost calculation. In other words, if a source document indicated a benefit cost effect of X, and this was associated with a crash reduction of Y, that value of y is mentioned here if we based our analysis on X. Once again, the crash reduction estimates are not used directly in the benefit/cost analyses, but are included for information only.

Expected benefit: Based on the ratio of accident benefit to cost, as outlined in the above discussion.

Expected cost: An expenditure, or budget outlay, for each countermeasure is assumed, as discussed above. To be consistent with the work elsewhere in this study, on-going maintenance costs have to be considered as part of the cost, not subtracted (as is more usual) from the accident savings to get a net benefit. This involved, for some programs, estimating the present value of the ongoing maintenance costs, and adding these to the initial outlay.

Benefit/cost ratio: The ratio of accident benefits to government costs (capital plus maintenance); this is equivalent to the "government BCR" used for the other programs analysed in this report. Note that there is no "community BCR" for road and traffic factors, since all costs are assumed to be government costs, and community benefits (e.g. travel time savings) are explicitly excluded from this analysis.

Net present value: Accident benefits less initial project costs less present value of on-going maintenance costs.

1. PROPOSED COUNTERMEASURE:

Rural Roadside Hazard Management Program

SPECIFIC TARGET FOR EVALUATION:
In the five years 1986-1990, there were 293 road segments in Victoria with four or more crashes of the type related to this countermeasure. These sites experienced 1683 casualty crashes. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 150 sites, or about 350 km of rural road.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 18:1 can be achieved with a 10-40 per cent reduction in crashes on road sections treated.

EXPECTED BENEFITS:
Quantified: $36,000,000 over 10 years
Unquantified: labour intensive, so contributes to employment

EXPECTED COSTS:
Quantified: $2,000,000*
Unquantified: aesthetics, roadside environmental concerns

BENEFIT / COST RATIO
18:1

NET PRESENT VALUE
$34,000,000 (for treatment of 350 km of rural road)

* Based on treating 350 km of road.

2. PROPOSED COUNTERMEASURE

Urban Roadside Hazard Management (Poles)

SPECIFIC TARGET FOR EVALUATION:
In the five years 1986-1990, there were 134 sites in Victoria with four or more crashes of the type related to this countermeasure. These sites experienced 768 casualty crashes. This does not include intersections or non-metropolitan sites. It is estimated that the total number of sites potentially amenable to treatment with this countermeasure with this level of effectiveness is approximately 300. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 150 sites.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 13:1 can be achieved with a 40-80 per cent reduction in crashes on road sections treated.

EXPECTED BENEFITS:
Quantified: $19,500,000 over 10 years
Unquantified: aesthetics

EXPECTED COSTS:
Quantified: $1,500,000*

BENEFIT /COST RATIO
13:1

NET PRESENT VALUE
$18,000,000 (for treatment of 150 sites)

* Based on treating 150 sites.

3. PROPOSED COUNTERMEASURE:

Roundabouts

SPECIFIC TARGET FOR EVALUATION
As there is no estimate of the number of treatable sites, calculations have been based upon a nominal program of 200 sites. It is assumed that the effectiveness shown would apply for a program of this size.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 7.5:1 can be achieved with a 60-95 per cent reduction in crashes at intersections treated.

EXPECTED BENEFIT:
Quantified: $34,800,000 (for 200 sites), over 10 years
Unquantified: reduced speeds in local streets, with resulting amenity and security benefits.

EXPECTED COST:
Quantified: nominal program - treatment of 200 sites cost @ $10,000 per site = $2,000,000
present value of ongoing maintenance costs $2,640,000
Present value of total cost = $4,640,000

Unquantified: aesthetics?

BENEFIT/COST RATIO
7.5:1

NET PRESENT VALUE
$30,100,000 (for treatment of 200 sites)

4. PROPOSED COUNTERMEASURE:

Road Duplication and/or Provision of Median on Rural Roads

SPECIFIC TARGET FOR EVALUATION
It is not known what length of road would have the effectiveness shown. For the purposes of calculation, a nominal capital program of $1 million has been used. It is assumed that the effectiveness shown would apply for a program of this size.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 5:1 can be achieved with a 20-50 per cent reduction in crashes on road sections treated.

EXPECTED BENEFIT:
Quantified: $5,000,000 (per $1,000,000 capital program) over 20 years

Unquantified:

- major benefit of duplication is capacity related (reduction in user costs); investment not predicated on accident reduction alone.
- increased level of service to road users
- increased pedestrian safety (pedestrian refuge)
- aesthetics

EXPECTED COST:
Quantified: nominal capital expenditure $1,000,000

BENEFIT/COST RATIO:
5:1 (wide median on rural road)

NET PRESENT VALUE:
$4,000,000 (for nominal capital program of $1,000,000)

5. PROPOSED COUNTERMEASURE:

Rural Overtaking Lanes

SPECIFIC TARGET FOR EVALUATION
It is not known what length of road would have the effectiveness shown. For the purposes of calculation, a nominal capital program of $1 million has been used. It is assumed that the effectiveness shown would apply to a program of this size.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of between 5:1 and 10:1 can be achieved with a 25-30 per cent reduction in crashes on road sections treated, depending upon construction costs, the length of overtaking lane, and the existing crash patterns.

EXPECTED BENEFIT:
Quantified: $5,000,000- $10,000,000 over 15 years

Unquantified: increased road user level of service

EXPECTED COST:
Quantified: nominal capital expenditure $1,000,000

BENEFIT/COST RATIO:
5:1 to 10:1

NET PRESENT VALUE
$4,000,000 to $9,000,000* (for $1,000,000 capital program)

6. PROPOSED COUNTERMEASURE

Rural Road Sealed Shoulders

SPECIFIC TARGET FOR EVALUATION
In the five years 1986-1990, there were 293 road segments in Victoria with four or more crashes of the type related to this countermeasure. These sites experienced 1683 casualty crashes. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 150 sites, or about 350 km of rural road.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 22:1 can be achieved with a 70-75 per cent reduction in crashes on road sections treated.

EXPECTED BENEFIT:
Quantified: $154,000,000 over 8 years

Unquantified: improved road user level of service; reduced pavement maintenance costs

EXPECTED COST:
Quantified: $7,000,000*

BENEFIT/COST RATIO
22:1

NET PRESENT VALUE
$147,000,000 (for treatment of 350 km of rural road)

* Based on treating 350 km of rural road.

7. PROPOSED COUNTERMEASURE:

Pedestrian Facilities

SPECIFIC TARGET FOR EVALUATION
The number of sites for which the effectiveness shown would be applicable is not known. For the purposes of calculation, a nominal capital program of $1 million has been used. It is assumed that the effectiveness shown would apply for a program of this size.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/ cost ratio of 9: 1 can be achieved with a 30-90 per cent reduction in crashes at sites treated. (These treatments include pedestrian fencing, pedestrian refuges, pedestrian-operated signals, etc.)

EXPECTED BENEFIT:
Quantified: $21,600,000 (per $l,000,000 capital program) over 10 years

Unquantified: user amenity

EXPECTED COST:
Quantified: nominal capital expenditure $1,000,000

Unquantified: aesthetics; roadside hazard present value of ongoing maintenance costs $1,400,000

BENEFIT/COST RATIO
9:1

NET PRESENT VALUE
$19,200,000 (for nominal $1,000,000 capital program)

8. PROPOSED, COUNTERMEASURE:

Skid Resistant Overlays (Rural Roads)

SPECIFIC TARGET FOR EVALUATION
In the five years 1986-1990, there were 45 sites in Victoria with three or more crashes of the type related to this countermeasure. These sites experienced 192 casualty crashes. This does not include crashes in dry weather, some of which would be eliminated by this countermeasure. It is estimated that the total number of sites potentially amenable to treatment with this countermeasure with this level of effectiveness is approximately 80. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 40 sites.

EXPECTED COUNTERMEASURE EFFECT:
Previous studies suggest that a benefit/cost ratio of 16:1 can be achieved with a 5-25 per cent reduction in crashes on road sections treated.

EXPECTED BENEFIT:
Quantified: $3,840,000 over 10 years

EXPECTED COST:
Quantified: 240,000*

BENEFIT /COST RATIO
16:1

NET PRESENT VALUE
$3,600,000 (for treatment of 40 sites)

* Based on treating 40 sites.

9. PROPOSED COUNTERMEASURE

Conversion of Rural Cross Intersection to Staggered Tee

SPECIFIC TARGET FOR EVALUATION
In the five years 1986-1990, there were 295 intersections in Victoria with four or more crashes of the type related to this countermeasure. These sites experienced 1791 casualty crashes. 50 of these intersections were in rural areas. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 25 sites.

EXPECTED COUNTERMEASURE EFFECT
Previous studies suggest that a benefit/ cost ratio of 1.7: 1 can be achieved with a 50-80 per cent reduction in crashes on road sections treated.

EXPECTED BENEFITS
Quantified: $10,200,000 over 10 years

EXPECTED COSTS
Quantified: $6,000,000*

BENEFIT/COST RATIO
1.7:1

NET PRESENT VALUE:
$4,200,000

* Based on treating 25 rural sites.

10. PROPOSED COUNTERMEASURE

Installation of Traffic Signals

SPECIFIC TARGET FOR EVALUATION
In the five years 1986-1990, there were 543 intersections in Victoria with five or more crashes of the type related to this countermeasure. These sites experienced 3959 casualty crashes. This does not include non-metropolitan intersections. It is estimated that the total number of sites potentially amenable to treatment with this countermeasure with this level of effectiveness is approximately 700. It is assumed that half of these sites would, upon

investigation, be amenable to treatment by this countermeasure. The target is thus 350 sites, or 70 sites per year for 5 years.

EXPECTED COUNTERMEASURE EFFECT
Previous studies suggest that a benefit/cost ratio of 8:1 can be achieved with a 40-55 per cent reduction in crashes on road sections treated.

EXPECTED BENEFITS
Quantified: $135,500,000 over 10 years

Unquantified: reduction in delay and vehicle operating costs

EXPECTED COSTS
Quantified: initial treatment cost $7,000,000*

present value of ongoing maintenance costs $9,940,000

BENEFIT/COST RATIO
8:1

NET PRESENT VALUE
$118,600,000 (for treatment of 70 sites)

* Based on treating 70 sites.

11. PROPOSED COUNTERMEASURE

Remodelling of Traffic Signals (esp to Provide Right Turn Phase)

SPECIFIC TARGET FOR EVALUATION
In the five years 1986-1990, there were 456 sites in Victoria with four or more crashes of the type related to this countermeasure. These sites experienced 3464 casualty crashes. This does not include non-metropolitan sites. It is estimated that the total number of sites potentially amenable to treatment with this countermeasure with this level of effectiveness is approximately 600. It is assumed that half of these sites would, upon investigation, be amenable to treatment by this countermeasure. The target is thus 300 sites.

EXPECTED COUNTERMEASURE EFFECT
Previous: studies suggest that a benefit/cost ratio of 22:1 can be achieved with a 40-55 per cent reduction in right-turn-against crashes on road sections treated.

EXPECTED BENEFITS
Quantified: $294,000,000 over 10 years

EXPECTED COSTS
Quantified: initial treatment cost: $6,000,000*

present value of ongoing maintenance costs $7,380,000

Unquantified: possibility of reduced intersection capacity, leading to increased delay and vehicle operating costs.

BENEFIT/COST RATIO
22:1

NET PRESENT VALUE
281,000,000

* Based on treating 300 sites.

12. PROPOSED COUNTERMEASURE

Improved Delineation On Rural Highways

SPECIFIC TARGET FOR EVALUATION
It is not known what length of road would have the effectiveness shown. For the purposes of calculation, a nominal capital program of $1 million has been used. It is assumed that the effectiveness shown would apply to a program of this size.

EXPECTED COUNTERMEASURE EFFECT
Previous studies suggest that a benefit/cost ratio of 14:1 can be achieved with a 20-60 per cent reduction in crashes on road sections treated.

EXPECTED BENEFITS
Quantified: $14,000,000 (per $l,000,000 capital program) over approx. 5 years

Unquantified: reduction in shoulder maintenance; improved road user amenity

EXPECTED COSTS
Quantified: nominal capital expenditure $l,000,000

BENEFIT/COST RATIO
14:1

NET PRESENT VALUE
$13,000,000 (for nominal capital program of $1,000,000)

ATTACHMENT TO APPENDIX C

SOURCES OF BENEFIT COST RATIOS FOR ROAD AND TRAFFIC FACTORS

Three sources of benefit/ cost ratio (as discussed above) were used: Pak Poy and Kneebone Pty Ltd (1988) for rural roads; Corben, Ambrose and Foong (1990) for urban roads, and Croft (1988) for roadside poles. These studies were used because they were relevant, recent, referred to Australian experience, and their calculations or data were sufficiently well explained that their benefit/cost ratios could be recalculated in the manner described above to serve the purposes of this study.

The adjustments to the reported benefit/ cost calculations for each of these sources were as follows:

(a) Pak Poy and Kneebone (1988)

- PPK used an average value of a casualty crash of $41,776 (1987 value), so we need to increase benefits to 1991 value, on the same basis as that used elsewhere in this report. This was based on a 1991 average value of a rural casualty crash of $95,200. (As noted in the introduction, this in turn was based on the value reported in Corben, Ambrose and Foong of $84,000 in 1989, increased by the value of the CPI between 1989 and 1991. The corresponding urban 1991 value was $60,600 based on a 1989 value of $53,500). Note that the difference in the estimated value of a casualty crash is due to a number of factors, but is assumed to include the difference in discount rates used by PPK (10 per cent) and that used in this study and by Corben, Ambrose and Foong (4 per cent). Thus no additional adjustment for the difference in the discount was necessary.

  benefit (rural) increased by 95.2/41.776 = 2.27

- the costs were increased by the change in the CPI from 1987 to 1991:

  (219.7/176.2) = 1.25

- the benefit/cost ratio reported by Pak Poy and Kneebone appeared to have accident benefits in the numerator and treatment cost or construction cost in the denominator (with ongoing maintenance costs assumed negligible), i.e. this ratio was in the form required, so no adjustment was necessary.

(b) Corben, Ambrose and Foong (1990)

- the value of the benefits (i.e. average crash cost) was increased by a factor of 1.13 to increase 1989 values to 1991 values.
- similarly, the cost of treatment was increased by a factor of 1.13.
- the reported benefit/ cost ratios were used, with the denominator in this case being the initial treatment cost plus the present value of ongoing maintenance costs. The ratio of the present value of ongoing maintenance costs to capital cost (initial outlay) was noted, as this will be necessary information in estimating total cost of the program at a later phase of the analysis.

(c) Croft (1988)

- no adjustment to the benefit/ cost ratio was required since this was reported as future benefit divided by initial outlay.
- the benefits were increased by the ratio of the required average urban crash cost ($60,600) to the reported average casualty crash ($31,170) = 1.94
- the costs were increased by 7 per cent to allow for inflation between 1990 and 1991

The discussion below summarises the results for each countermeasure:

1. RURAL ROADSIDE HAZARD MANAGEMENT PROGRAM

Effect

PPK (1988, p 127), based on Sanderson and Fildes (1984): removing a tree eliminates 0.029 crashes per year on average.

Vicroads (1990) (source not cited) reported a 10 per cent crash reduction (trees) and 40 per cent crash reduction (embankments)

Evaluation

PPK (1988, p 19) BCR = 10:1, for 10 years project life

Adjustment

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 10 x 2.27/1.25 = 18

Accident benefit of rural roadside hazard management program = 18 x initial outlay

2. URBAN ROADSIDE HAZARD MANAGEMENT PROGRAM (UTILITY POLES)

Effect

Croft (1988) NSW based on Fox, Good and Joubert (1979): up to 75-80 per cent crash reduction

Vicroads (1990) (source not cited): 40 per cent reduction (poles)

Evaluation

Croft (1990) BCR of 6.8 - 8.1, for 10 year project

Adjustment

take mean value of BCR = 7.4
for crash cost, increase numerator by 1.94
for treatment cost, increase denominator by 1.07

BCR ratio = 7.4 x 1.94/1.07 = 13.4, say 13

Accident benefit of urban roadside hazard management (pole) program = 13 x initial outlay

3. ROUNDABOUTS

Effect

Corben et al (1990): 81 per cent reduction (examination of data shows 74 per cent for local area roundabouts, 77 per cent for provincial city roundabouts, but sample sizes probably not statistically significant)

Nairn (1987, p 41): 57 per cent reduction (SA data)

Miller (1982): 95 per cent reduction on local streets, 59 per cent on urban arterials, 74 per cent average (Melbourne data)

Vicroads (1990) (source not cited): 81 per cent reduction (probably based on Corben et al, 1990)

Evaluation

Corben et al (Appendix 8) reported BCR 7.5:1 ratio of PV of maintenance costs to initial outlay: 1.32

Adjustment

for crash cost, increase numerator by 1.13
for treatment cost, increase denominator by 1.13

BCR = 7.5 x 1.13/1.13 = 7.5

Accident benefit of roundabout program = 7.5 x (initial outlay plus PV of maintenance costs)

4. DUPLICATION AND/OR PROVISION OF MEDIAN ON RURAL ROADS

Effect

PPK (1988, p 130), based on US data: 20-23 per cent reduction in crashes with median

Vicroads (1990) (citing US sources): 28 per cent reduction in crashes

Travers Morgan (1987), based on NSW data: roads with medians 15-29 per cent safer

ARRB (1990): divided arterials up to half crash rate of undivided.

Evaluation

PPK (1988, p 19) BCR = 3:1 (wide median - rural), for 20 (?) years project life

Adjustment

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 3 x 2.27/1.25 = 5.4:1 (say 5:1)

Accident benefit of road duplication/median provision program = 5 x initial outlay

5. RURAL OVERTAKING LANES

Effect

PPK (1988, p 73 ff) and others:

Harwood and Hoban (1987) (US): 25 per cent reduction in crashes with overtaking lane

Hoban (1982) (Australia) 25 per cent reduction

Harwood (1985) (US): 29 per cent reduction in casualty crashes

Rinde (1977) (US): 25-27 per cent reduction

Evaluation

PPK (1988, p 19,78) BCR = 3:1 - 6:1 for 15 years project life

Adjustment

take range of BCR of 3:1 - 6:1

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = (3 to 6) x 2.27/1.25 = 5.4 to 10.8 (say, 5 to 10)

Accident benefit of rural road overtaking lane program = (5 to 10) x initial outlay

6. RURAL ROAD SEALED SHOULDERS

Effect

Armour (1984) (NSW): sealed vs unsealed shoulders: 70 per cent reduction on tangent, 75 per cent reduction on curves

Jorgensen (1978) (US): 22 per cent safer on high volume roads

Armour and McLean (1983) (Aust): 20-50 per cent reduction in crashes after sealing

Vicroads (1990) (based on Sanderson, Cameron and Fildes, 1987) - 30 per cent reduction after sealing

Evaluation

PPK (1988, p 19) BCR = 12:1 for 8 year project life (2 m sealed width, both sides)

Adjustment

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 12 x 2.27/1.25 = 22

Accident benefit of rural shoulder sealing program = 22 x initial outlay

7. PEDESTRIAN FACILITIES

Effect

Nairn (1987, p 36) (SA): 75-88 per cent reduction from pedestrian fencing and refuges

Corben et al (1990) (Vic): 32 per cent reduction in casualty crashes (intersection treatments) and 1 per cent reduction (midblock) (Appendix 5 and 7).

Evaluation

Corben et a1 (Appendix 8) reported BCR 8.8:1 ratio of PV of maintenance costs to initial outlay: 1.40

Adjustment

for crash cost, increase numerator by 1.13
for treatment cost, increase denominator by 1.13

BCR = 8.8 x 1.13/1.13 = 8.8 (say 9:1)

Accident benefit of pedestrian facilities program = 9 x (initial outlay plus PV of maintenance costs)

8. SKID RESISTANT OVERLAYS (RURAL ROAD)

Effect

PPK (1988, p 60, citing Victoria): 6 per cent reduction in crashes

PPK (1988, p 49) (citing US): 14-23 per cent reduction in total crashes

PPK (1988, p 49) (citing NSW): 12 per cent reduction in crashes following selected resealing

Huddart, (1978:) (UK): 35 per cent reduction in casualty crashes

Evaluation

PPK (1988, p 19) BCR = 9:1 for 10 year project life (9 m wide, rural road)

Adjustment

for crash cost, :increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 9 x 2.27/1.25 = 16:1

Accident benefit of rural skid resistant pavement program = 16 x initial outlay

9. CONVERSION OF RURAL CROSS INTERSECTION TO STAGGERED TEE

Effect

Nairn (1987, p 41) (SA): 47 per cent reduction

Nairn (1987, p 41) (WA): 84 per cent reduction

Middleton and Strickland (1983) (Vic): 80 per cent reduction

Evaluation

PPK (1988, p 19) BCR = > 1:1 for 10 year project life

Adjustment

take PPK BCR = 1:1 (conservative)

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 1 x 2.27/1.25 = 1.7:1

Accident benefit of rural tee intersection program = 1.7 x initial outlay

10. INSTALLATION OF TRAFFIC SIGNALS

Effect

Nairn (1987, p 41) (SA): 19 per cent reduction

Nairn (1987, p 41) (WA): 20 per cent reduction

Camkin (1984) (NSW): 17-108 per cent reduction

DoT (1986) (UK): 40 per cent reduction

Corben et al (1990, Appendix 5) (Vic): 53 per cent reduction in casualty crashes

Vicroads (1990) (citing US): 22 per cent reduction

RCA (1983) (Vic): 41-55 per cent reduction

Evaluation

Corben et al (Appendix 8) reported BCR 8.2:1 ratio of PV of maintenance costs to initial outlay: 1.42

Adjustment

for crash cost, increase numerator by 1.13
for treatment cost, increase denominator by 1.13

BCR = 8.2 x 1.13/1.13 = 8.2 (say 8:1)

Accident benefit of traffic signal installation program = 8 x (initial outlay plus PV of maintenance costs)

11. REMODELLING OF TRAFFIC SIGNALS (ESP TO PROVIDE RIGHT TURN PHASE)

Effect

Nairn (1987, p 34) (WA): 41 per cent reduction (right turn phase)

Camkin (1984) (NSW): 10-80 per cent reduction

Corben et al (1990, Appendix 6) (Vic): 38 per cent reduction in casualty crashes

Nguyen et al (1986) (Vic) 38 per cent reduction

Vicroads (1990) (source not cited): 44 per cent reduction

RCA (1983) (Vic): 41-55 per cent reduction

Evaluation

Corben et al (Appendix 8) reported BCR 22:1 ratio of PV of maintenance costs to initial outlay: 1.23

Adjustment

for crash cost, increase numerator by 1.13
for treatment cost, increase denominator by 1.13

BCR = 22 x 1.13/1.13 = 22

Accident benefit of traffic signal remodelling program = 22 x (initial outlay plus PV of maintenance costs)

12. IMPROVED DELINEATION ON RURAL HIGHWAYS

Effect

Nairn (1987, p 47) (SA): 20 per cent reduction in head on and single vehicle crashes with RRPMs.

PPK (1988, p 23 ff) (US):19 per cent reduction with edge lines
37 per cent reduction in casualty crashes with edge lines
(UK): 64 per cent reduction on bends,
58 per cent on tangent with edge lines
(WA): 6 per cent reduction with RRPMs

(Vic): 15 per cent reduction with RRPMs
(US): 68 per cent reduction with RRPMs

Corben et al (1990, Appendix 5 and 7): no reduction with delineation at midblock or intersections

Evaluation

PPK (1988, p 19) BCR = 8:1 for raised reflective pavement markers
BCR = 8: 1 for Post mounted delineators
BCR = 10:1 for painted edge lines based on 5 year project life

Adjustment

take PPK BCR = 8:1 for general delineation

for crash cost, increase numerator by 2.27
for treatment cost, increase denominator by 1.25

BCR = 8 x 2.27/1.25 = 14.5 (say 14)

Accident benefit of delineation program = 14 x initial outlay

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