Road Safety Engineering

Evaluation
of
Traffic Calming Schemes
Constructed on National Roads
1993-1996

RS 460

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Foreword

In July 1998 the Government published "The Road to Safety", its Strategy for road safety over the period 1998 – 2002. The primary target of the strategy is to reduce fatalities by 2002 by a minimum of 20% on their 1997 level (472) and to achieve a similar reduction (at least 20%) in the number of serious injuries from road accidents (2,182 in 1997).

Under the terms of the Strategy, the Authority is required to undertake a number of specific tasks including the finalisation of a five year programme for traffic calming on the network of National Roads.

Traffic calming is one important application in the road safety management of national routes which pass through towns and villages. In the first instance, speed is reduced by altering the appearance of the road on the approach to the town/village through the use of "gateways" and by further traffic management measures within the town itself.

The National Roads Authority Guidelines on Traffic Calming for Towns and Villages on National Routes were published in October 1999 and will contribute to a national uniformity of design for traffic calming schemes. In the period 1993 to 1996, 21 such schemes were completed on National Roads. Sufficient time has now elapsed to assess the success of these schemes, particularly in the field of accident reduction. This report presents an evaluation of effectiveness for the schemes concerned which has been undertaken by Finbarr Crowley and Anne MacDermott of the National Roads Authority.

Executive Summary

- This report is the first in a planned series, and deals solely with the effectiveness of traffic calming schemes constructed in the period 1993 to 1996.
- Between 1993 and the end of 1996, 21 traffic calming schemes were completed, at a total cost of €3.63m (€4.14m at year 2000 prices).
- The schemes undertaken during this period preceded the publication, in October 1999, of the NRA Guidelines on Traffic Calming for Towns and Villages on National Routes.
- The number of accidents 'before' and 'after' installation of traffic calming schemes was studied.
- For locations with traffic calming on both approaches there has been an annual average accident reduction of 1.5 fatal accidents, 1.3 serious injury accidents and 2.8 minor injury accidents. A statistical test shows that these reductions are statistically significant.
- For locations with traffic calming on one approach only there has been an annual average accident reduction of 1.0 serious injury accidents and an average annual accident increase of 0.4 minor injury accidents. No fatal accidents were recorded during either the 'before' or 'after' period. The sample is too small for formal statistical significance testing. Nevertheless, the reduction in the number of fatal and serious injury accidents and the slight increase in the number of minor injury accidents suggest a reduction in accident severity at these locations.
- The Average Annual Rate of Return (AARR) for locations with traffic calming on both approaches is 293%. For locations with traffic calming on one approach, the AARR is 48%.
- Speed measurements relating to the situation prior to the completion of traffic calming measures are available for two of the 21 schemes completed before the end of 1996: N2 Collon, Co. Louth, and N8 Watergrasshill, Co. Cork. 85%ile speed reductions of approximately 10mph have been achieved at Collon after the traffic calming was installed. In Watergrasshill the average speeds at the northern approach were reduced by between 1mph and 5mph depending on the location. Speeds on the southern approach have increased. This may be due to a pavement improvement scheme in 1994.

- The main changes in accident types after installation of the traffic calming schemes are:
    - Pedestrian accidents decreased in all categories, particularly fatal accidents
    - Single vehicle accidents increased very slightly in number, but there was a reduction in severity
    - Head-on accidents decreased in number and severity
    - Rear-end accidents decreased in number and severity

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Background.

1.1 DEVELOPMENT OF TRAFFIC CALMING ON NATIONAL ROADS.

Two kinds of problem in relation to traffic speed are recognised by road safety engineers: excess speed, which is speed in excess of the legal limit, and inappropriate speed, which is speed which is deemed too high relative to the operating conditions. Both these problems are encountered on National Roads at the interface between rural and urban sections, and within the urban areas themselves.

Traffic calming is a way of reducing vehicle speeds by self-enforcing traffic engineering methods and is commonly applied in urban and residential road safety management and in the road safety management of through routes in towns and villages.

The transition zone between a high speed and a low speed road presents a difficult safety management problem. These transition zones usually occur on the approaches to towns and villages. In Ireland there are many improved sections of roads with hard shoulders on the National Roads. Where these sections adjoin towns and villages, approach speeds have been high and accident rates have been higher than on rural sections.

'Optical width' is dependent on the width between the boundaries of the road relative to the height of the adjoining vertical elements. Generally, in rural sections, the width between fences is many times greater than the height of the ditches/fences which form the boundaries. In urban streets, the height of the buildings etc is generally greater than the width. A driver's perception of the appropriate driving speed is influenced by this relationship. Speeds are lower where the height of the vertical elements is greater than the width of the road. This effect can be created using a combination of carriageway narrowing, landscape treatment and the introduction of vertical elements.

The transition zone between rural and urban sections should be engineered so that there is a gradual change from one environment to the other. The transition should culminate in a 'Gateway' which forms an entrance to the town or village.

Since 1993 various forms of traffic calming have been put in place on the approaches to some of the towns and villages on the National Road network. In order to achieve a uniform approach to the matter, a Traffic Calming Working Group was set up in 1995 made up of members from both the National Roads Authority and the local authorities. In 1999 the National Roads Authority Guidelines on Traffic Calming for Towns and Villages on National Routes were published. Schemes completed since publication broadly comply with the Guidelines, and earlier schemes are being modified to conform to practices set up in the Guidelines.

Schemes completed by the end of 1996 have a sufficient 'after' period to allow for a rudimentary evaluation. These comprise 21 schemes, and are the subject of this report. In all, by the end of the year 2001, traffic calming had been installed in 80 towns and villages on the National Road network. In some cases the traffic calming was installed at different times on the different approaches to a town or village.

Chapter 2. Selection of Locations.

2.1 PRINCIPLES.

The Guidelines on Traffic Calming for Towns and Villages on National Routes give general principles for the selection of traffic calming locations.

The primary selection criterion is the number of accidents. The Guidelines recommend that selection based on accidents should take account of both risk per unit of travel and risk per head of population in the town or village under consideration. At the time of writing the Guidelines, accident rates per unit of travel within speed limit zones varied between 0.1 and 25.0 PIA/10^6 vkm (personal injury accidents per million vehicle kilometres of travel). Accident rates per thousand head of population per annum varied between 0.1 and 9.35 PIA/1000 pop/annum (personal injury accidents per thousand population per year. For location selection purposes, rates in excess of 5 PIA/10^6 vkm and 2 PIA/1000 pop/annum are deemed significant. The cost of the scheme relative to accident risk should also be taken into account to ensure that schemes providing best value for money are assigned a higher priority.

Other criteria for selecting locations for traffic calming are:

- **Quality Pavement Projects:** Experience shows that where quality pavement improvement projects are undertaken, operating speeds and accident risk may increase in towns and villages on the resurfaced section. It is recommended that traffic calming measures should be considered in tandem with such projects.
- **Bypasses:** Where a town is being bypassed, the need for traffic calming measures on the original route should be assessed and, if warranted, included as part of the overall scheme.
- **Planning Considerations:** Major new developments in an area may give rise to increased traffic volumes or changes in traffic make-up and type. Traffic calming may be appropriate in addressing such issues, and where appropriate, should be considered as part of the planning process.

2.2 THE PRESENT TRAFFIC CALMING PROGRAMME.

In July 1998 the Government published "The Road to Safety", its strategy for road safety over the period 1998 – 2002. The primary target of the strategy is to reduce road fatalities by the end of 2002 by a minimum of 20% on their 1997 level and to achieve a similar reduction (at least 20%) in the number of serious injuries from road accidents.

Under the terms of the strategy, the National Roads Authority is required to undertake a number of specific tasks including a five year programme for traffic calming on the National Route network.

The present traffic calming programme has been developed by compiling lists of accident rates per thousand head of population per annum and accident rates per million vehicle kilometres of travel for towns and villages along the national routes. Any locations exceeding the thresholds outlined in the Guidelines (5 PIA/10^6 vkm and 2 PIA/1000 pop/annum) are included in the programme unless they are unsuitable locations for traffic calming. They are prioritised in order of accident rates, and those with the highest rates will be the first to have traffic calming. Any other locations suggested by the local authorities are also individually assessed for suitability.

Chapter 3. Evaluation/Monitoring of Schemes.

3.1 SCOPE

The Guidelines on Traffic Calming for Towns and Villages on National Routes strongly promote the importance of monitoring and evaluating the effectiveness of completed schemes: "The primary purpose of traffic calming is to reduce the number of accidents by reducing vehicle speed. It is essential that the extent of the speed reduction and the impact of this reduction on accidents be systematically evaluated for each installation." A 'Traffic Calming Data Summary Sheet' is included in the Guidelines and must be filled in by the relevant local authority for all new schemes. It must also be updated annually to include speed measurements and accident information for the first five years after construction of the schemes. This sheet is contained in the Appendix.

The objective of this report is to quantify the reductions in speed and accidents achieved as a result of the provision of traffic calming in towns and villages. This report is the first in a series and deals solely with schemes constructed between 1993 and 1996. These schemes predate the introduction of the Traffic Calming Data Summary Sheet. Some descriptive statistics and an evaluation of effectiveness are presented.

3.2 SCHEMES COMPLETED 1993 TO 1996

A total of 21 schemes were installed between 1993 and 1996. There is considerable variation in design within this group due to the absence at that time of an established standard/guideline. The total cost of these schemes was €4.14m at year 2000 prices.

The Traffic Calming Data Sheet was not in existence before the publication of the Guidelines in 1999 and speed measurements before installation are not available for many of the older schemes. Therefore, for the majority of schemes under consideration in this report, evaluation of effectiveness is only possible with reference to accident rates. Subsequent reports should gradually involve more assessment of the effects on speed.

The schemes have been divided into two groups for analytical purposes. Group 1 consists of those schemes where traffic calming was installed on the National Road on both approaches to the town/village. Group 2 consists of those schemes where traffic calming was installed on the National Road on only one approach.

Tables 1 & 2 show the distribution of the 21 completed schemes by County.

Table 1: Schemes by County – Group 1

County	**No. of Schemes**
Cork	1
Galway	1
Laois	1
Leitrim	1
Limerick	2
Louth	1
Meath	2
Offaly	1
North Tipperary	1
Westmeath	1
Wexford	1
Wicklow	1

Table 2: Schemes by County – Group 2

County	**No. of Schemes**
Cork	1
Donegal	1
Meath	1
Monaghan	1
Westmeath	3

Tables 3 & 4 show the distribution of schemes by route.

Table 3: Schemes by Route – Group 1

Route	No. of Schemes
N2	1
N3	2
N4	2
N6	2
N7	2
N8	3
N11	2

Table 4: Schemes by Route – Group 2

Route	No. of Schemes
N2	2
N6	3
N8	1
N15	1

Tables 3 & 4 show that all schemes under consideration in this report are on National Primary routes. Since 1996, several schemes have been constructed on National Secondary routes and will be included in future evaluations.

Tables 5 & 6 show the cost of each scheme, both at the time of installation and at year 2000 prices.

Table 5: Cost of Schemes – Group 1

Route	Town/Village	County	Start Date	Completion Date	Actual (A) or Estimated (E) Cost *	Cost at Time of Installation (€)	Cost at year 2000 Prices (€)
8	Watergrasshill	Cork	94	94	E	317,000	368,000
6	Kilreekill	Galway	94	94	A	72,000	84,000
7	Borris-in-Ossory	Laois	95	96	E	381,000	426,000
4	Annaduff	Leitrim	95	95	E	25,000	29,000
7	Daly's Cross	Limerick	95	96	A	83,000	91,000
8	Kilbeheny	Limerick	93	93	E	190,000	226,000
2	Collon	Louth	96	96	E	127,000	142,000
3	Carnaross	Meath	94	94	E	32,000	37,000
3	Dunshaughlin	Meath	95	95	E	63,000	72,000
6	Horseleap	Offaly	94	94	E	190,000	221,000
8	Littleton	Tipperary (NR)	94	95	A	318,000	368,000
4	Ballinalack	Westmeath	94	94	E	318,000	368,000
11	Oilgate	Wexford	94	95	E	381,000	432,000
11	Kilmacanogue	Wicklow	96	96	E	127,000	142,000
						2,624,000	**3,006,000**

*** Note:** Actual costs have been included where available.
Estimated costs have been used where actual costs are not available.

Table 6: Cost of Schemes – Group 2

Route	Town/Village	County	Start Date	Completion Date	Actual (A) or Estimated (E) Cost *	Cost at Time of Installation (€)	Cost at year 2000 Prices (€)
8	Rathcormac - S appr	Cork	96	96	E	317,000	354,000
15	Ballyshannon N appr	Donegal	96	96	E	95,000	107,000
2	Ashbourne N appr	Meath	96	96	E	76,000	85,000
2	Castleblaney S appr	Monaghan	96	96	E	190,000	212,000
6	Kilbeggan - W appr	Westmeath	94	95	E	83,000	94,000
6	Moate - E appr	Westmeath	94	94	E	159,000	184,000
6	Tyrrellspass - W appr	Westmeath	94	94	E	83,000	95,000
						1,003,000	**1,131,000**

*** Note:** Actual costs have been included where available.
Estimated costs have been used where actual costs are not available

3.3 STATISTICAL EVALUATION.

Tables 7 & 8 show the accident numbers at each location before and after traffic calming was installed. The 'before' and 'after' time periods are listed for each location. The totals for each category of accident are shown in Tables 9 & 10, as are the average 'before' and 'after' periods.

Table 7: Accident Nos. 'Before' and 'After' - Group 1

Route	Town/Village	County	Fatal before	Serious before	Minor before	No of years before	Fatal after	Serious after	Minor after	No of years after
8	Watergrasshill	Cork	0	2	2	6	0	0	2	5
6	Kilreekill	Galway	0	0	3	6	0	1	1	5
7	Borris-in-Ossory	Laois	3	1	2	7	0	1	0	3
4	Annaduff	Leitrim	0	0	0	7	0	0	0	4
7	Daly's Cross	Limerick	2	1	3	7	0	0	2	3
8	Kilbeheny	Limerick	0	1	5	5	0	0	2	6
2	Collon	Louth	2	5	4	8	0	2	1	3
3	Carnaross	Meath	0	1	3	6	1	0	1	5
3	Dunshaughlin	Meath	3	5	3	7	0	2	7	4
6	Horseleap	Offaly	0	1	1	6	0	0	2	5
8	Littleton	Tipperary (NR)	0	0	11	6	0	0	0	4
4	Ballinalack	Westmeath	0	0	2	6	0	0	0	5
11	Oilgate	Wexford	0	0	0	6	0	1	1	4
11	Kilmacanogue	Wicklow	1	2	10	8	0	0	1	3

Table 8: Accident Nos. 'Before' and 'After' - Group 2

Route	Town/Village	County	Fatal before	Serious before	Minor before	No of years before	Fatal after	Serious after	Minor after	No of years after
8	Rathcormac - S app	Cork	0	4	4	8	0	0	1	3
15	Ballyshannon N app	Donegal	0	0	0	8	0	0	0	3
2	Ashbourne N app	Meath	0	0	1	8	0	1	0	3
2	Castleblaney S app	Monaghan	0	1	0	8	0	0	0	3
6	Kilbeggan - W app	Westmeath	0	0	1	6	0	0	1	4
6	Moate - E app	Westmeath	0	4	2	6	0	0	0	5
6	Tyrrellspass - W app	Westmeath	0	0	1	6	0	0	4	5

Table 9: Annual Average Accident Nos. 'Before' and 'After' - Group 1

	Fatal Accs Before	Serious Injury Accs Before	Minor Injury Accs Before	Avg no of years before	Fatal Accs After	Serious Injury Accs After	Minor Injury Accs After	Avg no years after
Totals	11	19	49	6.5	1	7	20	4.2
Annual Average Accident Nos	1.7	2.9	7.5		0.2	1.7	4.7	

Table 10: Annual Average Accident Nos. 'Before' and 'After' - Group 2

	Fatal Accs Before	Serious Injury Accs Before	Minor Injury Accs Before	Avg no of years before	Fatal Accs After	Serious Injury Accs After	Minor Injury Accs After	Avg no years after
Totals	0	9	9	7.1	0	1	6	3.7
Annual Average Accident Nos	0.0	1.3	1.3		0.0	0.3	1.6	

The statistics indicate that, for locations with traffic calming on both approaches, there has been an Average Annual Reduction of:

1.5 fatal accidents

1.3 serious injury accidents

2.8 minor injury accidents.

For locations with traffic calming on one approach the Average Annual Reduction has been:

1.0 serious injury accidents

–0.4 minor injury accidents.

No fatal accident was recorded in either the before or after period for these schemes.

The percentage of accidents in each category before and after installation of traffic calming schemes is shown in Table 11. It can be seen that, for both groups, the severity of the accidents has reduced since traffic calming was installed.

Table 11: Percentage Fatal, Serious Injury and Minor Injury Accidents – Groups 1 & 2

	Group 1		Group 2	
	Before	**After**	**Before**	**After**
Fatal %	14	4	0	0
Serious Injury %	24	25	50	14
Minor Injury %	62	71	50	86

Tables 12 & 13 show the total number of fatal and serious injury accidents occurring in the vicinity of the traffic calming schemes in the years immediately before and immediately after the installation of the schemes.

To test whether the implementation of the traffic calming schemes is associated with the reduction in the number of fatal and serious injury accidents, a t-test has been run on the difference in the averages of the 'before' and 'after' periods.

The results show, to a 95% level of confidence, that Group 1 schemes were 'successful', ie. were associated with a reduction in the average number of fatal and serious injury accidents per year. However, at the same confidence level, this cannot be said about the Group 2 schemes. The number of Group 2 schemes (7) is too small to produce a statistically significant result. Nevertheless, since the average number of fatal and serious injury accidents per year in the 'before' period is higher than in the 'after' period, it appears reasonable to suggest that it is possible, or even likely, that the implementation of these schemes has been associated with a reduction in the average number of fatal and serious injury accidents per year.

Table 12: Fatal (F) and Serious Injury (SI) Accidents for Group 1 Schemes

	F before	SI before	F and SI Before	No of years before	F after	SI after	F and SI After	No of years after	F+SI per year before	F+SI per year after	Difference in means
Watergrasshill	0	2	2	6	0	0	0	5	0.3	0.0	0.3
Kilreekill	0	0	0	6	0	1	1	5	0.0	0.2	-0.2
Borris-in-Ossory	3	1	4	7	0	1	1	3	0.6	0.3	0.2
Annaduff	0	0	0	7	0	0	0	4	0.0	0.0	0.0
Daly's Cross	2	1	3	7	0	0	0	3	0.4	0.0	0.4
Kilbeheny	0	1	1	5	0	0	0	6	0.2	0.0	0.2
Collon	2	5	7	8	0	2	2	3	0.9	0.7	0.2
Carnaross	0	1	1	6	1	0	1	5	0.2	0.2	0.0
Dunshaughlin	3	5	8	7	0	2	2	4	1.1	0.5	0.6
Horseleap	0	1	1	6	0	0	0	5	0.2	0.0	0.2
Littleton	0	0	0	6	0	0	0	4	0.0	0.0	0.0
Ballinalack	0	0	0	6	0	0	0	5	0.0	0.0	0.0
Oilgate	0	0	0	6	0	1	1	4	0.0	0.3	-0.3
Kilmacanogue	1	2	3	8	0	0	0	3	0.4	0.0	0.4
			30	Avg 6.5			8	Avg 4.2			

Degrees of freedom: 13.00
t-value: 2.27
significance (2-tailed): 0.04

Table 13: Fatal (F) and Serious Injury (SI) Accidents for Group 2 Schemes

	F before	SI before	F and SI Before	No of years before	F after	SI after	F and SI After	No of years after	F+SI per year before	F+SI per year after	Difference in means
Rathcormac - S app	0	4	4	8	0	0	0	3	0.50	0.00	0.50
Ballyshannon N app	0	0	0	8	0	0	0	3	0.00	0.00	0.00
Ashbourne N app	0	0	0	8	0	1	1	3	0.00	0.33	-0.33
Castleblaney S app	0	1	1	8	0	0	0	3	0.13	0.00	0.13
Kilbeggan - W app	0	0	0	6	0	0	0	4	0.00	0.00	0.00
Moate - E app	0	4	4	6	0	0	0	5	0.67	0.00	0.67
Tyrrellspass - W app	0	0	0	6	0	0	0	5	0.00	0.00	0.00
			9	Avg 7.1			1	Avg 3.7			

Degrees of freedom: 6.00
t-value: 1.08
significance (2-tailed): 0.32

3.4 ECONOMIC EVALUATION.

Using the reduction achieved in the average annual number of accidents and the scheme costs, the Average Annual Rate of Return for each category of scheme has been calculated. The 'Willingness to Pay' method has been used. This costs fatal, serious injury and minor injury accidents separately, and is taken to be the most appropriate economic evaluation tool since it takes into account benefits arising from reductions in accident severity as well as reduction in frequency.

From Tables 14 & 15, it can be seen that the Average Annual Rate of Return (AARR) for locations with traffic calming on both approaches is 293%, while the AARR for those locations with traffic calming on one approach is 48%.

Table 14: Average Annual Rate of Return – Group 1

	Reduction in Average no of Accidents	**Average Cost per Accident (€) 2000 prices**	**Average Annual Saving (€)**	**Total Cost of Schemes (€) 2000 prices**	**Cost of Schemes per year (4.2 yrs average 'after' period)**	**Average Annual Rate of Return %**
Fatal	1.5	1,237,170	1,855,755			
Serious Injury	1.3	153,530	199,589			
Minor Injury	2.8	14,710	41,188			
			2,096,532	3,006,000	715,714	**293**

Table 15: Average Annual Rate of Return – Group 2

	Reduction in Average no of Accidents	Average Cost per Accident (€) 2000 prices	Average Annual Saving (€)	Total Cost of Schemes (€) 2000 prices	Cost of Schemes per year (3.7 yrs average 'after' period)	Average Annual Rate of Return %
Fatal	0.0	1,237,170	0			
Serious Injury	1.0	153,530	153,530			
Minor Injury	-0.4	14,710	-5,884			
			147,646	1,131,000	305,676	**48**

These rates of return, while not as high as those recorded in the Low Cost Remedial Measures Programme (Crowley and Vigors, 2001), show that the Traffic Calming Programme is making a valuable contribution to improving safety on the National Road network.

3.5 SPEED REDUCTION EVALUATION.

This report aimed to study the order of magnitude of speed reductions achieved at specific schemes. Unfortunately, speed measurements before and after installation are available for only two of the schemes studied in this report:

N2 Collon, Co. Louth
N8 Watergrasshill, Co. Cork

Speed measurements at Collon show that 85%ile speeds at the approaches to the speed limits have been reduced by approximately 10mph at both ends of the village. Similar reductions can be observed at the crossroads in the village. 85%ile speed is the speed below which 85% of vehicles travel. These speed reductions are much larger than would generally be expected as a result of a traffic calming scheme and show that this scheme has been particularly successful at achieving speed reductions.

Speed measurements at Watergrasshill show that the average speeds at the northern approach to the town have been reduced by between 1mph and 5mph depending on the location. Speeds on the southern approach have increased. This may be due to a combination of a pavement improvement scheme in 1994 and the relatively limited nature of the traffic calming measures that were introduced at this end of the village.

Detailed speed measurements for the two locations are given in Tables 16 & 17.

Table 16: N2 Collon, Co. Louth – Speed Measurements

Location	1988 (Before) mph	1995 (Just after installation) mph	1996 (1 year after installation) mph
North approach to 30mph speed limit	52.19	42.72	43.51
Crossroads in village (northbound)	45.04	36.73	34.73
Crossroads in village (southbound)	45.17	36.25	35.92
South approach to 30mph speed limit	60.77	51.15	48.60

Speeds are 85%ile speeds.

Table 17: N8 Watergrasshill, Co. Cork – Speed Measurements

Location	1992 (Before) mph	1999 (After) mph
North approach to 30mph speed limit	43.03	42.11
5th traffic island – most southerly (northbound)	38.73	33.77
5th traffic island – most southerly (southbound)	39.74	34.60
Outside Fir Tree Bar (northbound)	36.37	32.57
Outside Fir Tree Bar (southbound)	35.16	32.57
Outside Volvo Garage (northbound)	41.99	44.93
Outside Volvo Garage (southbound)	41.53	41.89
South approach to 30mph speed limit	40.01	44.77

Speeds are average speeds.

In later years, more extensive speed data will be available and will form a basis for a more comprehensive assessment of the effectiveness of traffic calming measures at reducing vehicle speeds through towns and villages.

3.6 EFFECT OF SCHEMES ON ACCIDENT TYPES

The main changes in accident types after installation of the traffic calming schemes are as follows:

- Pedestrian accidents decreased in all categories, particularly fatal accidents.
- Single vehicle accidents increased very slightly in number, but there was a reduction in severity.
- Head-on accidents decreased in number and severity.
- Rear-end accidents decreased in number and severity.

Chapter 4. Case Studies

4.1 SCOPE

The case studies described below concern traffic calming schemes completed after the study period for this report, but are used as an indication of the type of scheme typically involved.

4.2 N20 BALLYHEA, CO. CORK

Traffic calming was installed at this location in 1999 at a cost of approximately €380,000. There was an accident rate of 6.1 PIA/10^6 vkm which is greater than the threshold of 5 PIA/10^6 vkm recommended in the 'Guidelines on Traffic Calming for Towns and Villages on National Routes'. The location therefore qualified for funding on the basis of accident rates.

The traffic calming measures introduced consist of a gateway with a raised centre island at each end of the village. On the north approach, the cycle paths continue well outside the gateway. On the south approach, they are phased out immediately outside the gateway. Buildouts were used extensively to narrow down the carriageway width. Parking spaces were provided between the buildouts where appropriate. A bus bay was provided in each direction. The junction in the centre of the village is a staggered junction and was lacking definition. Buildouts were used to narrow the carriageway and dedicated right turning lanes were provided. Due to the presence of the staggered junction, it was not possible to provide raised centre islands inside the gateways.

85%ile speeds were measured before and after the scheme was implemented. The results are shown in Table 18.

Table 18: N20 Ballyhea, Co. Cork – Speed Measurements

Location	1996 (Before) mph	2000 (After) mph
North approach to speed limit	55.0	44.2
South approach to speed limit	53.3	45.3
Centre of village	Not measured	41.5

It is too soon to study the effect of the scheme on accident rates, but aspect this will be assessed in later studies.

Photo 1: N20 Ballyhea, Co. Cork – Transition Zone 'after'

Photo 2: N20 Ballyhea, Co. Cork – North Approach 'before'

Photo 3: N20 Ballyhea, Co. Cork – North Approach 'after'

Photo 4: N20 Ballyhea, Co. Cork – South Approach 'before'

Photo 5: N20 Ballyhea, Co. Cork – South Approach 'after'

Photo 6: N20 Ballyhea, Co. Cork – Staggered Junction 'before'

Photo 7: N20 Ballyhea, Co. Cork – Staggered Junction 'after'

Photo 8: N20 Ballyhea, Co. Cork – Buildouts, Parking and Bus Bay 'after'

4.3 N20 CHARLEVILLE (SOUTH SIDE), CO. CORK

Traffic calming was installed at this location in 2001 at a cost of €160,000. There was an accident rate of 4.0 PIA/1000pop/yr which is greater than the threshold of 2 PIA/1000pop/yr recommended in the 'Guidelines on Traffic Calming for Towns and Villages on National Routes'. The location therefore qualified for funding on the basis of accident rates.

The traffic calming measures introduced consist of a gateway with a raised centre island at the south end of the village, a series of buildouts and raised centre islands for a distance of approximately 1km into the town, a signal controlled pedestrian crossing and the tightening of two junction mouths. The gateway has a very wide exit width of 5m to cater for the movement of wide loads from a local factory. Due to this extra width, a cycle path was not provided on the exit side. Cyclists have sufficient width to cycle on the carriageway alongside the vehicular traffic. The raised centre islands are at intervals of between 50m and 100m. Parking is provided between the buildouts, where appropriate. Two existing junction mouths were unnecessarily wide. These were tightened up considerably as part of the traffic calming scheme, providing the dual benefits of regulating the traffic and making the junctions safer for pedestrians to cross.

85%ile speeds were measured before the scheme was implemented. However, the scheme has just been completed and there are no 'after' speed measurements yet. It is also too soon to study the effect of the scheme on accident rates. These will be included in later studies.

Photo 1: N20 Charleville (South), Co. Cork – South Approach 'before'

Photo 2: N20 Charleville (South), Co. Cork – South Approach 'after'

Photo 3: N20 Charleville (South), Co. Cork – Pedestrian Crossing 'before'

Photo 4: N20 Charleville (South), Co. Cork – Pedestrian Crossing 'after'

Photo 5: N20 Charleville (South), Co. Cork – Inside Gateway 'before'

Photo 6: N20 Charleville (South), Co. Cork – Inside Gateway 'after'

Photo 7: N20 Charleville (South), Co. Cork – Inside Gateway 'before'

Photo 8: N20 Charleville (South), Co. Cork – Inside Gateway 'after'

Photo 9: N20 Charleville (South), Co. Cork – Junction Mouth 'after'

Chapter 5. Detailed Results.

Detailed results from the first phase of the Traffic Calming Programme in Ireland are available in the published thesis by Liam Harrington "Traffic Calming on Inter-Urban Roads" (2000). It is proposed in this chapter to give a summary of findings from the thesis.

5.1 SPEED REDUCTIONS IN TRAFFIC CALMED AREAS

Three separate sections of the road through the traffic calmed area were examined to assess motorists' driving behaviour as they approach and drive through a town or village. These sections were:

- The first section of the transition zone, from the Traffic Calming Ahead sign to the Do Not Pass sign.
- The second section of the transition zone from the Do Not Pass sign to the gateway.
- Inside the built-up area.

5.2 THE FIRST SECTION OF THE TRANSITION ZONE

At the start of the transition zone, ie. at the 'Traffic Calming Ahead' sign, the measured 85%ile speeds varied between 90 and 100km/h. At the 'Do Not Pass' sign it was found that the 85%ile speeds were reduced by approximately 6 – 8 km/h relative to those at the 'Traffic Calming Ahead' sign. These are statistically significant speed reductions. The level of speed reduction was found to be primarily dependent on the length of the transition zone and the 85%ile approach speed at the 'Traffic Calming Ahead' sign.

Speed reductions at four approaches to non-traffic calmed locations were also examined over similar approach lengths to the lengths of the transition zones. It was found that the registered reductions of 2 – 3 km/h in 85%ile speeds approaching the non-traffic calmed areas were not statistically significant. This suggests that the provision of traffic calming signs at the beginning of the transition zone encourages speed reduction.

A regression model was proposed to estimate the expected 85%ile speed at the 'Do Not Pass' sign. The model was found to be accurate for transition zones of between 300m and 500m length. Also, it was observed that the geometric alignment of the approach road affects vehicular speeds and, subsequently, the accuracy of the model.

5.3 THE SECOND SECTION OF THE TRANSITION ZONE

With traffic calming schemes the largest speed reduction is achieved at the gateway. The effectiveness of a gateway at encouraging speed reduction is influenced by the presence of a raised traffic island. It was observed that typical 85%ile speed reductions of 14km/h relative to those recorded at the 'Do Not Pass' sign were achieved at gateways with raised islands. Gateways without raised islands typically achieved a reduction of 10km/h.

The ratio of effective lane width to overall carriageway width at the gateway was found to affect the speed reduction achieved at the gateway. This factor encouraged greater speed reduction at gateways with raised traffic islands than at those without raised traffic islands. Gateways with a ghost island created using thermoplastic markings were found to achieve similar speed reductions to those achieved at gateways with no island, ie. 10km/h.

A control group of locations was examined to compare the speed reductions achieved at posted speed limit locations of non-traffic calmed locations with those achieved at traffic calming gateways. Generally, the speed reductions achieved at posted speed limits were similar to those achieved at gateways with no raised island, ie. 10km/h. However, the overall 85%ile speed reductions achieved through the transition zones of the traffic calmed locations were approximately 6 – 10 km/h greater than those achieved over similar distances in the non-traffic calmed locations, depending on the presence of a raised island at the gateway.

Again, the geometric alignment of the approach road was found to affect the speed reductions achieved at the gateway.

Two regression models were proposed to estimate the reduction in 85%ile speed at (i) gateways with raised traffic islands and (ii) gateways without raised traffic islands. These were found to have high coefficients of correlation with the measured results.

5.4 INSIDE THE BUILT-UP AREA

This is the most important section of the traffic calming scheme in terms of protecting the vulnerable road user, ie. cyclists and pedestrians.

Typically traffic calming schemes use raised traffic islands and footpath build-outs inside the built-up area as the principal traffic calming measures. Where the existing width of the carriageway does not allow for the construction of central islands, then road markings are used as the main traffic calming measure. It was found that motorists decelerate at a faster rate if the distance between the first raised traffic island and the gateway is approximately 60 – 70m. The 85%ile speed achieved at the first raised traffic island is maintained, though not reduced further, throughout the built-up area by the provision of 'repeater' raised traffic islands.

Inside the reduce speed limit zone, typical 85%ile speed reductions of 6 – 8 km/h were achieved relative to the location of the gateway. However, motorists continue to travel at high residual speeds inside the built-up traffic calmed areas. This suggests that the current restrictions imposed on motorists by the traffic calming devices are not sufficiently effective to encourage driving at or below the reduced speed limit of the area.

In non-traffic calmed areas, little, if any, deceleration was recorded over the first 150m inside the reduced speed limit area. These rates of deceleration were not statistically significant and were found to be, on average, seven times less than those measured inside the built-up traffic calmed areas.

A regression model for estimating the 85%ile speed at the first raised traffic island was proposed. This had a high coefficient of correlation with the observed results, but was only tested on three schemes.

5.5 BEFORE AND AFTER SPEED REDUCTIONS

A comparison of 'before' and 'after' speeds at Collon and at Watergrasshill was carried out. Details of the measured speed at both locations are given in section 3.4 of this report.

5.6 ACCIDENT REDUCTIONS IN TRAFFIC CALMED AREAS

The average pre-scheme accident rate inside the built-up areas of the traffic calming schemes was 8 accidents/year. Since the installation of the traffic calming measures this rate reduced to 3.5 accidents/year. The average accident rate involving pedestrians also decreased considerably from a pre-scheme value of 0.26 accidents/year to 0.13 accidents/year post-scheme. The figures suggest that the measures are achieving the primary traffic calming objective, which is to improve the level of safety for vulnerable road users in built-up areas.

The current method of prioritising schemes is based on the number of accidents per ten million vehicle kilometres and the number of accidents per thousand head of population per year. It is suggested that the method of priority ranking should also take specific account of the following:

- Number of accidents involving pedestrians.
- Number of accidents in the proposed transition zone.
- Perceived risk among vulnerable road users.

5.7 COMPARISON WITH EUROPEAN COUNTRIES

Many European countries are further advanced than Ireland in the area of traffic calming. Countries such as The Netherlands, Germany and Denmark have been implementing traffic calming measures since the 1970s. However, little accident information is available for schemes on inter-urban roads. In the early 1980s, the Danish Road Directorate conducted an experiment on traffic calming in three pilot towns. These towns (population 1000-4000) had low traffic volumes and were traversed by major roads, a situation similar to many Irish towns and villages. The results from this experiment indicated that a reduction in mean speed of between 8km/h and 10km/h was achieved. This is similar to that observed on Irish Traffic Calming schemes.

In England a study of twenty four traffic calming schemes was commissioned in 1991 to investigate the effectiveness of traffic calming measures. Eight of these traffic calming schemes were similar to those implemented on inter-urban routes in Ireland. Results indicated that schemes incorporating gateways and traffic calming devices inside the built-up area yielded a reduction in the 85%ile speed by as much as 14km/h at the gateway. This is similar to that observed on Irish inter-urban routes.

The reduction in accident rate recorded in the English traffic calming schemes was not statistically significant, with an overall reduction of 14% in injury accident frequency after the implementation of the measures. This is considerably lower than the accident reduction being achieved inside the built-up traffic calmed areas on Irish inter-urban routes. A possible reason for this difference is that only three of the twenty four English schemes incorporated raised traffic islands inside the built-up area which, from observation of the Irish traffic calming schemes, appear to benefit accident reduction.

Appendix

Traffic Calming Data Summary Sheet

County:	
Town/Village:	
Route Number:	**Date of proposed installation:**

Traffic Volumes							
Gateway	**AADT**	HCV	Buses	Light Goods	Cars	Motor Cycles	Pedal Cycles
A							
B							

Gateway A at approach from_____ _____m from Marker Plate_____in direction____
Gateway B at approach from_____ _____m from Marker Plate_____in direction____
(1 = positive chainage, 2 = negative chainage)

Approach Geometry	**Gateway A**		**Gateway B**	
Horizontal Alignment				
Vertical Alignment				
Optical Width				
Geometry at Gateway	Existing	Proposed	Existing	Proposed
Right of Way width	m	m	m	m
Paved width	m	m	m	m
Carriageway width	m	m	m	m
Gateway Design Type				

Treatment of Section between Gateway and Town/Village Centre				
	Gateway A		**Gateway B**	
Cost of Installation	Estimate	Actual	Estimate	Actual
Carriageway				
Kerbing and Paving				
Drainage				
Lining				
Signs				
Furniture				
Landscaping				
Public Lighting				
Other				
Total				

Traffic Calming Data Summary Sheet (page 2)

Rumble Strips Y/N	**Type used**

Accident Details:	**Total Accidents on Through Route**			**Total Pedestrian or Pedal Cyclist Accidents**			**Population**
	Fatal	Serious	Minor	Fatal	Serious	Minor	
5 Years prior to opening of the scheme							
Subsequent to opening of scheme							
Year 1							
Year 2							
Year 3							
Year 4							
Year 5							

Speed Measurement						
		After				
Gateway A	**Before**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Approaches						
At existing speed limits						
200m inside existing speed limits						
Midway between Gateway and town/village centre						
		After				
Gateway B	**Before**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Approaches						
At existing speed limits						
200m inside existing speed limits						
Midway between Gateway and town/village centre						

Public Reaction	

Signed _____ **Grade EE/SEE**

Date _____

References.

Department of the Environment, (1996).	A Guide to Road Safety Engineering in Ireland.
Department of the Environment, (1998).	"The Road to Safety" Government Strategy for Road Safety, 1998-2002.
Liam Harrington, B.E., (2000).	Traffic Calming on Inter-Urban Roads.
Local Government Computer Services Board, (1999).	Map Accident.
National Roads Authority, Dublin, (1999).	Guidelines on Traffic Calming for Towns and Villages on National Routes.
National Roads Authority, Dublin, (2001).	The Low Cost Remedial Measures Programme Evaluation of Programme 1.