National Roads Authority
An tÚdarás um Bóithre Náisiúnta

RS 472

Traffic Calming of Towns and Villages on National Roads

Evaluation of Schemes Implemented from 1997 to 2002

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Road Safety Engineering

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TABLE OF CONTENTS

page

FIGURES AND TABLES

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FOREWORD

This report is the second in a series and examines the effectiveness of all traffic calming schemes that were completed between 1997 and 2002.

It evaluates effectiveness by comparing collisions over four year periods both before and after construction of each scheme.

A previous report “Evaluation of Traffic Calming Schemes Constructed on National Roads 1993-1996” covers schemes implemented before the period examined in this report.

EXECUTIVE SUMMARY

In July 1998 the Government published "The Road to Safety", its strategy for road safety over the period 1998 – 2002, followed by a further strategy in 2004 for 2004 - 2006. A third Road to Safety document has recently been published setting out the government's strategy for road safety over the period 2007 – 2012, with a target to reduce fatalities by 20% to 250 per year, and to reduce injuries by 25%. Under the terms of all strategies, the National Roads Authority has been charged with undertaking a number of specific tasks. In each of the strategies one of the tasks for NRA has been the implementation of traffic calming at towns and villages on the network of national roads and the evaluation of the effectiveness of these schemes. This evaluation will enable NRA to prioritise the future programme of traffic calming by assessing the effectiveness of implemented schemes and identifying the successes of previous programmes.

This report examines traffic calming schemes constructed between 1997 and 2002. It describes the principle behind traffic calming in reducing speed 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. It lists the schemes undertaken in each of the six years from 1997 to 2002 and summarises the performance of these schemes. The report measures the effectiveness of the programmes based on collision data for a 4 year before period and a 4 year after period for each scheme.

The objective of the traffic calming programme is to reduce the number and severity of collisions occurring in the treated towns and villages by reducing speed at these locations. It has achieved that objective, reducing the overall number of collisions by 13%. Moreover the number of fatal collisions was reduced by 52%, thus lowering the overall severity of crashes at traffic calming locations. The number of serious and minor injury collisions decreased by 9%.

Between 1997 and 2002 there were 94 traffic calming schemes completed at towns and villages on the national roads. 91 of these were evaluated and a summary of the results is shown below.

Summary Table

Year of Completion	No. of Schemes	Cost of Construction €	Reduction in Collisions (4 years, adjusted)			Cost saving in Collisions per year, €	Yearly Rate of Return
			Fatal	Serious	Minor		
1997	12	€3,024,600	6	-6	1	€2,655,300	88%
1998	14	€1,852,900	2	-2	-1	€865,600	47%
1999	18	€5,369,900	3	5	14	€2,177,500	41%
2000	9	€1,882,000	-1	-4	6	-€1,034,500	-55%
2001	23	€3,881,400	6	-4	25	€3,587,700	92%
2002	15	€3,446,600	1	1	-7	€641,800	19%
All Years	**91**	**€19,457,200**	**16**	**-10**	**37**	**€8,893,400**	**46%**

The above table shows that comparing the four year period before with the four year period after each scheme and, allowing for the overall decrease in collisions over the same period nationwide at similar sites, there was an overall reduction of 43 collisions. Fatal collisions reduced by 16 and minor injury collisions by 37, while serious injury collisions increased by 10. The cost (in 2002 market prices) of all the schemes constructed between 1997 and 2002 was just under €19.5 million and the overall annual cost saving in collisions nearly €8.9 million. The Yearly Rate of Return of each year's programme varied quite considerably but averaged at 46%. In cost benefit terms the schemes effectively paid for themselves within 2 years and are still creating annual savings of €9m every year into the future.

1 INTRODUCTION

1.1 Scope of Report

In July 1998 the Government published "The Road to Safety", its strategy for road safety over the period 1998 – 2002, followed by a further strategy in 2004 for 2004 - 2006. The primary target of each of these was to reduce fatalities from road crashes; by 20% from 1997 levels by 2002 and by 25% from average 1998 - 2003 levels by 2006. A third Road to Safety document has recently been published setting out the government's strategy for road safety over the period 2007 – 2012, with a target to reduce fatalities by 20% to 250 per year and to reduce injuries by 25%.

Under the terms of all strategies, the National Roads Authority has been charged with undertaking a number of specific tasks. In each of the strategies one of the tasks for NRA has been the implementation of traffic calming at towns and villages on the network of national roads and the evaluation of the effectiveness of these schemes. This evaluation will enable NRA to prioritise the future programme of traffic calming by assessing the effectiveness of implemented schemes and identifying the successes of previous programmes.

This report examines traffic calming schemes constructed between 1997 and 2002 under the NRA programme of traffic calming for towns and villages located on national routes.

1.2 Background to Traffic Calming

Traffic calming is a way of reducing vehicle speeds by self-enforcing traffic engineering methods. In Ireland two main types of traffic calming are used:-

a) Traffic calming applied on national roads and other busy inter-urban roads to manage the speed of traffic passing through towns and villages located on these routes.

b) Traffic calming on local urban and residential streets to manage both speed and volume of traffic on a number of streets within an area.

Type a) is the form of traffic calming examined in this report.

1.3 Traffic Calming on National Routes

In towns and villages on the national road network reducing speed is the primary goal of traffic calming. Posting of speed limits alone does not result in a significant reduction in speed (2005 Survey of Free Speeds, NRA) since drivers typically drive at the speed they perceive as being safe. A driver's perception of what is safe is related to the design of the road, which includes lane width, curvature, corner radii and available stopping-sight distance. Traffic calming essentially reduces vehicle speeds by changing these elements of the road's design and thus drivers' perceptions of the road ahead.

The transition zone between the high speed road approaching the village and the low speed street inside the village represents a difficult safety management problem. In Ireland the problem first became apparent over twenty-five years ago with the proliferation of improved road sections with hard shoulders on the national roads. Where these improved sections adjoined towns and villages, approach speeds increased and the sections showed higher collision rates than rural sections.

Many towns and villages are positioned on national roads. Drivers travelling the national routes at speeds appropriate to through routes are often still travelling at those high speeds when entering towns and villages, and maintain those speeds as they travel through the urban area. Inside towns and villages the

national road usually functions as a typical main street, with shops, pubs, housing, school and church and their accompanying pedestrian and parking activity. These types of activities would be more safely carried out in an environment where low speed prevails. At higher speeds drivers have less time to react and are able to process less information in their field of view, and the severity of injury is higher when a collision does occur. For a pedestrian struck by a vehicle travelling at 64km/h the likelihood of them being killed is 85%, at 48km/h the likelihood is 45% and at 32km/h it is 5% (ETSC, Reducing Traffic Injuries Resulting From Excess and Inappropriate Speed, 1995).

Figure 1.1 Approach to a typical village on national primary route

Figure 1.2 Typical wide entry into a town on national route

Figure 1.3 Typical wide open town centre with undefined road edge

1.4 Collisions

The objective of the traffic calming programme is to reduce the number of collisions occurring in the treated towns and villages by reducing the speed of vehicles travelling through these locations. In the four years before this programme of traffic calming started, between 1994 and 1997, nearly half of the 9956 injury collisions on national roads occurred in urban areas. Table 1.1 shows the breakdown of collision severity between rural and urban areas. All areas where the speed limit at the time was 40mph or below were taken as “urban”.

Table 1.1 Collisions between 1994 and 1997 inside and outside urban areas

Severity	Urban National Roads	Rural National Roads	All National Roads
Fatal	161	531	692
Serious Injury	851	1573	2424
Minor Injury	3475	3365	6840
Total	**4487**	**5469**	**9956**

2 TRAFFIC CALMING SCHEMES

2.1 Criteria for Selection

The criteria used for selection of towns and villages for traffic calming are set out in detail in the NRA document "Guidelines On Traffic Calming For Towns And Villages On National Routes". This was first published in 1999 and was updated in 2004.

For the traffic calming programme over the years studied in this report (1997 – 2002) the criteria used to select sites for inclusion in the programme were those laid down in the Guidelines. The period of implementation covered in this report starts in 1997, which was before the publication of the Guidelines. However the principles were already in operation within the NRA Road Safety Group, and the selection of sites in the early part of this period followed more or less the same process as the later ones.

The main criterion was the collision history in and on approach to the village, but data on all the following were collected when considering a location:

- Collisions,
- Traffic flow,
- Speed,
- Geometry,
- Future infrastructural developments.

Collisions

The Guidelines states that selection based on collisions should take account of not just the simple collision numbers, but should assess both risk per unit of travel and risk per head of population in the town or village. In order to do this assessment a table was drawn up in 1999 listing these two risk categories for all towns and villages on national roads and ranking them according to a combination of the two categories. The resulting table for national primary roads is reproduced in Appendix A, but for illustration the 15 top ranking towns and villages on national primary roads are shown in Table 2.1. These 15 sites were all treated in the early years of the traffic calming programme; 12 of them are among those examined in this report, 3 were implemented before 1997 and were assessed in the preceding report to this.

Table 2.1 Ranking of towns & villages on national primary routes

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 Million VehKm	Collisions per year per 1000 Population	Combined Collision Rate
N17	BALLINDINE	232	5058	0.587	8	14.8	6.90	6.40
N25	KILRANE	214	5310	2.255	10	4.6	9.35	5.59
N08	LITTLETON	566	5598	0.591	10	16.6	3.53	5.08
N11	ASHFORD	500	12768	1.352	19	6.0	7.60	5.01
N01	JULIANSTOWN	450	14270	1.146	16	5.4	7.11	4.63
N05	FRENCHPARK	272	2994	0.805	11	25.0	8.09	4.52
N02	COLLON	335	6164	0.626	7	9.9	4.18	4.08
N18	KILCOLGAN	500	9565	0.483	9	10.7	3.60	3.93
N08	WATERGRASSHILL	250	13706	0.985	8	3.2	6.40	3.85
N01	CASTLEBELLINGHAM	762	10983	1.891	20	5.3	5.25	3.68
N08	RATHCORMACK	500	11807	1.158	11	4.4	4.40	3.08
N09	DUNGARVAN	500	3261	0.28	4	24.0	1.60	2.80
N04	DROMOD	250	3598	0.59	3	7.7	2.40	2.75
N20	CHARLEVILLE	3000	9655	1.988	12	3.4	4.00	2.69
N25	LEMYBRIEN	222	6471	0.918	4	3.7	3.60	2.54

Using the method of combining the two collision risk categories meant that small villages where there had been only a few collisions, such as Dungarvan on N9 or Dromod on N4 ranked as highly as large towns with long lengths of national road and a higher number of collisions such as Charleville on N20. Thus several small villages where the actual collision numbers were low were given high priority in the traffic calming programme because the risk to road users from high speed traffic was comparatively high, whereas many large towns with very much bigger numbers of actual collisions did not get priority.

Speed

Selection is also based on the speed of vehicles in the towns and villages considered. If speeds through a certain location were already low then that town or village was not given priority in the traffic calming programme. Often this assessment would result in only one approach to a town or village being treated as described in section 3.2.

Geometry

The other major criterion was the geometry of the road within the town or village considered. If the separate physical elements that make up a traffic calming scheme, especially that of narrowing the carriageway, could not be applied to a certain location then a traffic calming scheme could not be fully implemented. However several schemes were indeed implemented in towns and villages where the road width was already narrow prior to construction of the scheme. These schemes often consisted of only signs and road markings; this is discussed further in section 3.3.

Other Factors

It must be acknowledged that several of the towns and villages assessed within this report did not have a collision history and did not have any record of high speeds before implementation of the traffic calming. These sites were often selected for traffic calming because general road improvement work was scheduled at this location and traffic calming elements were incorporated into the work. In some cases sites were selected solely on the basis of the perception of risk by residents and their representatives.

2.2 Traffic Calming Measures

The measures used as part of traffic calming break down into the four separate zones travelled through on approach to a town or village;

- the transition zone,
- the gateway at the speed limit signs,
- the zone inside the gateway,
- the village centre.

In small villages with a short length of national road there is usually no distinction between the last two zones, but in the larger villages and towns there is often a zone which is inside the speed limited area yet cannot be described as a town centre. These zones typically have either low density housing with off-street parking or warehouse-type commercial premises with sparsely spaced accesses.

Transition Zone

The principle behind traffic calming design is to change the driver's perception of the surrounding environment.

Figure 2.1 Transition zone approaching village

The "optical width" perceived by the driver 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 hedges, walls or fences which form the boundaries. In urban streets, the height of the buildings 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.

Traffic calming aims to create a narrow optical width on the approach into towns and villages by using a combination of carriageway narrowing, landscape treatment and the introduction of vertical elements such as signs, lighting columns and trees. Typically transition zone signs consist of a pair of "Traffic Calming Ahead" signs 400m from gateway and a pair of "Do Not Pass" signs at 200m from the gateway.

Gateway

The Gateway is placed at the start of the speed limited zone. It should mark a definite change in the character of the surrounding area from rural to urban. Therefore it needs to be conspicuous and the most prominent element in the transition zone. The tall signs positioned close to the driving lane narrow the optical width.

The guidelines recommend that where a town or village has two zones of speed limits, first a 60km/h on the outskirts and then a 50km/h limit for the main body of the town, the gateway should be placed at the change from 60km/h to 50km/h. This is because usually the 50km/h limit has been placed at the edge of the properly built up area and the 60km/h zone covers the approach into the town where development is much less dense. The design engineer can however choose to place the gateway at the 60km/h if surrounding development and environment are appropriate for this. This has been done in a few of the cases examined.

Figure 2.2 A gateway

Gateways fall into two distinct groups, those with a solid kerbed central island and those with no island. Early results from the first batch of traffic calming schemes constructed indicated that the presence of a central island at the gateway was a determining factor in the success of the scheme, and the evaluation in this document confirms this. The central island greatly increases the visual narrowing effect and the central lighting column, signs and bollards are directly in the centre of the driver's field of view.

The gateway is always lit to a high standard, with special gateway lanterns that shine directly onto the gateway signs. This is not only effective in the dark; during daylight hours the presence of lighting columns enhances the narrow optical width and is often noted subconsciously by the driver as an indication of an urban area.

Inside Gateway

Treatment of the stretch of road between the gateway and the village centre is an important aspect of traffic calming. The narrowing introduced at the gateway is continued so that the speed reduction occurring at the gateway is maintained on the driver's journey through the town.

This narrowing can be done by introducing any or all of the following; central islands, footpaths, side kerb buildouts, lining, hatched markings and defined parking bays. A shallow chicane can also sometimes be introduced by alternating side buildouts and parking between the two sides of the road. The objectives are both to keep the driving lanes at no greater than 3.5m width and to give a visual impression to the driver of an urban area.

Only narrowing and horizontal deflections are used as measures in traffic calming installations on national routes. Vertical deflections such as humps or cushions are not appropriate because of the roads' function as main distributors between the major urban areas of the country. Emergency vehicles and buses cannot easily negotiate routes where vertical deflection has been installed.

As every gateway must be provided with lighting to illuminate the signs the infrastructure to supply street lighting needs to be provided at each end of the town or village. It therefore follows that the supply for lighting is usually available over the whole length of the village and lighting is provided over the full length of the scheme from gateway to gateway. In the cases examined there are a few exceptions to this, but even these few villages have street lighting for almost all of their length with only a few short gaps where no lamps are provided.

Figure 2.3 Inside gateway

Town or Village Centre

In the town centre there is often not a need for narrowing works as part of the traffic calming, as parking bays and footpaths may already exist. However in locations where there is a wide road passing through the village centre it is necessary to narrow and define the through route with kerbing. Even in locations where the through route is already well defined with kerbing and parking bays extra measures are usually required at junctions and where pedestrians wish to cross the national road or to cross side roads while walking along the main street.

Typical works in the town centre are:

- definition of the limits of existing parking using kerb buildouts,
- definition of junctions by the use of kerb buildouts,
- provision of either pedestrian crossings or central islands to aid pedestrians in crossing.

The main objective in the centre of the town or village is to provide a safe and pleasant environment that can easily be negotiated by vulnerable road users. Thus it is important to provide safe places to cross where pedestrians are clearly visible to passing traffic and wide footpaths so that pedestrians are not forced to step into the road when passing others. This often necessitates a reduction in the number of on street parking spaces, and it can be difficult to persuade the local residents to accept this. Extra off-street parking may have to be provided as part of the traffic calming scheme. However there is a clear road safety advantage in both providing better facilities for pedestrians and in moving parking to off-street facilities. Quite apart from the pedestrian collisions that result from vehicles reversing in and out of parking spaces and from parked vehicles masking crossing pedestrians as they step out onto the road, many minor material damage collisions occur as vehicles pull in and out of parking spaces on busy through routes.

Figure 2.4 Centre of village

2.3 Amendments to Design in 2004

The Guidelines on Traffic Calming were revised in 2004. Some of the changes made in this revision arose directly from problems encountered during construction and consequent operation of the schemes evaluated here. There were numerous minor amendments but two of the main changes to design are worth noting:-

a) Increase of setback of signs.

The setback distance of the edge of the gateway signs from the kerb was originally specified as 600mm. This width of setback was thought to provide enough clearance for overhanging loads on large vehicles while still giving the visual narrowing effect that was needed for the traffic calming gateway to be effective. However in practice many gateway signs installed to this specification were hit glancing blows by passing large vehicles, especially in areas where there was a significant proportion of agricultural vehicles in the mix of traffic.

Consequently the specification was changed to a setback of 1m from the kerb. So far, this increased width appears to have succeeded in reducing the number of signs damaged by overhanging loads.

b) Increase of "exit" width.

Where a central island is provided at a gateway the island and its signs and lighting column all form an obstruction for any abnormally wide load wishing to pass. Whenever a wide load wishes to use the route through a village with this design of traffic calming the central lighting columns at each gateway must be temporarily disconnected and removed, resulting in much inconvenience and an extra workload for the local authority and electricity supply engineers.

To try to avoid this lengthy process of disconnection and removal an alternative design for gateways was put forward, with extra width on the "exit" half of the gateway, such that the width between edge kerb and central island on the lane for traffic approaching the village remains at the original 3.5m specified, but the corresponding width on the lane for traffic leaving the village could be increased to anything up to 6m. This design manages to keep the narrow optical effect for drivers approaching the village, but provides an alternative route for wide loads, which are guided through the approach to the village on the exit side of the central island.

3 TRAFFIC CALMING SCHEMES 1997 - 2002

3.1 Schemes Implemented over Period 1997 - 2002

Between 1997 and 2002 there were 94 traffic calming schemes completed at towns and villages on the national roads. Three of these schemes could not be evaluated because the collision data in the before period was considered to be unduly influenced by traffic calming on the other approach to the same village that had been implemented before 1997.

The remaining 91 towns and villages have been assessed in this study.

Table 3.1 below gives the number of schemes constructed per year and their costs, Table 3.2 shows the spread across the different counties and Table 3.3 shows the spread across the national routes. Figure 3.1 shows the locations of all the 94 schemes implemented in the period examined. A detailed list of the 91 locations assessed and the measures implemented is given in Appendix B.

Table 3.1 Schemes implemented per year

Year	No of Schemes	Cost € (market prices at time of construction)	Cost €, (2002 prices)	Average Cost per Scheme, € (2002 prices)
1997	12	1,803,000	3,024,500	252,000
1998	14	1,178,800	1,852,900	132,300
1999	18	3,691,800	5,369,900	298,300
2000	9	1,445,200	1,882,000	209,100
2001	23	3,496,400	3,881,300	168,800
2002	15	3,446,600	3,446,600	229,800
TOTALS	**91**	**15,061,800**	**19,457,200**	**213,800**

The number of schemes constructed each year stayed roughly constant, the average being about 15 or 16 per year. There was a slight dip in the number finished in 2000, but there was a corresponding rise the next year. The bulk of construction for most schemes took place within one year, but where schemes carried on into following years it is the final year that is taken as the year of construction.

The average cost per scheme was €214,000 over the six years. All costs in this report are market prices given in 2002 prices. The cost of an individual scheme varies immensely, from €16,000 to €785,000 (See Appendix B), but the measures implemented in each scheme also varied greatly. Some schemes were simply the installation of just 12 signs on approach to a village; others included extensive urban renewal works including the complete restructuring of drainage and electricity supply for the village.

Table 3.2 and Figure 3.1 show a fairly even spread of traffic calming implementation geographically across the country, but it can be clearly seen in Table 3.3 that the majority of schemes implemented were on national primary roads. Of all the schemes examined 81% are on primary routes, and in the early years this division is even more marked, with 88% of schemes implemented in 1997 and 1998 being on primary routes. The fact that mainly primary routes were treated in the early years of the traffic calming programme can be directly attributed to the geometry of the national routes through these towns and villages. Approaches to many urban areas on the primary routes had been realigned and widened during the twenty to thirty years preceding the traffic calming programme, allowing traffic to approach the town or village at increased speed. This increased speed and the consequent increase in collisions then identified these towns and villages as priority sites for traffic calming treatment. On national secondary routes there had not

been such a widespread programme of realignment and widening, and approaches to urban areas have mostly remained narrow. Consequently on national secondary roads speeds are not so high on the approaches to urban areas, collision rates also are not high, and few towns and villages on secondary roads have met the criteria for the traffic calming programme.

Table 3.2 Schemes implemented per year by county

Local Authority	1997	1998	1999	2000	2001	2002	Total
Cavan						1	1
Clare		2					2
Cork	2		3		2	4	11
Donegal	2				2	3	7
Galway		1	3	1			5
Kerry		2					2
Kildare		1					1
Kilkenny	1	1	2		4		8
Laois				2		2	4
Leitrim		1		1			2
Longford					1	1	2
Louth	4				1		5
Mayo	1	1	1		1		4
Meath	1		2		1	1	5
Monaghan		1		1	2		4
Offaly			1		2		3
Roscommon					2		2
Sligo			1	3	1	1	6
South Tipperary		2	1		2		5
Waterford		1					1
Westmeath		1	1	1			3
Wexford	1		2		2	2	7
Wicklow			1				1
Total	**12**	**14**	**18**	**9**	**23**	**15**	**91**

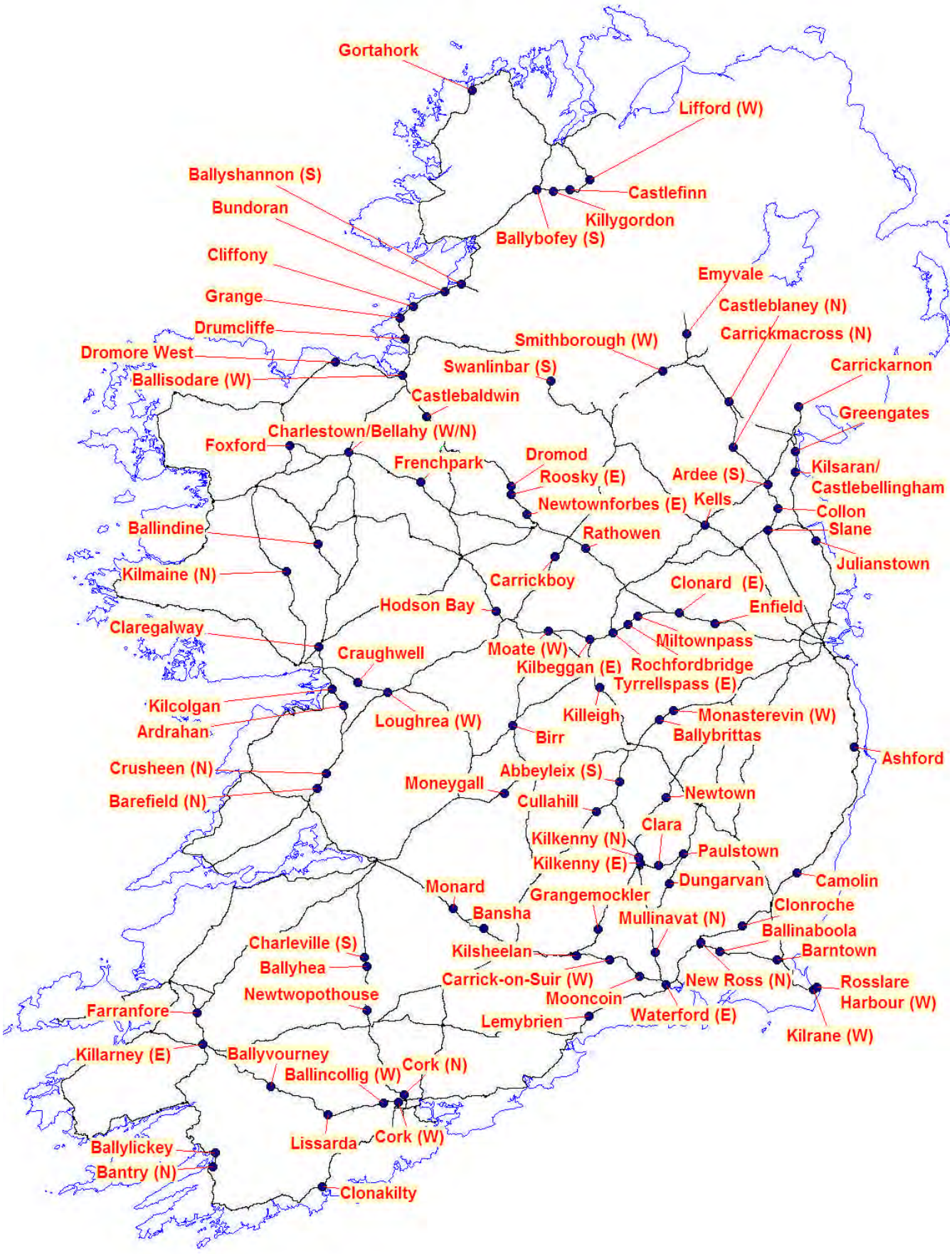

Figure 3.1 Locations of traffic calming schemes 1997 to 2002

Table 3.3 Schemes implemented per year by route

Route	1997	1998	1999	2000	2001	2002	Total
1	2		1		1		4
2	2	1		1	1	1	6
3					1		1
4	1	1	3	1	1		7
5			1		1		2
6		1		2			3
7		1			1	1	3
8				2			2
9			1		2		3
10			1		1		2
11			1			1	2
14					1		1
15	2			2	2	2	8
17	1	1					2
18		2	2				4
20			1		2	1	4
22	1	2	1			2	6
24		2	1		2		5
25	2	1	2		1		6
26					1		1
30					1	1	2
54					1		1
55						1	1
56						1	1
59				1		1	2
61					1		1
62					1		1
66			1				1
71	1		1			1	3
76		1					1
77					1		1
78						1	1
80			1				1
84		1					1
87						1	1
National Primary	**11**	**12**	**15**	**8**	**19**	**9**	**74**
National Secondary	**1**	**2**	**3**	**1**	**4**	**6**	**17**
Total	**12**	**14**	**18**	**9**	**23**	**15**	**91**

3.2 Towns and Villages With Only One End Treated

At 33 of the 94 locations implemented between 1997 and 2002 only one approach to the town or village was treated with traffic calming within this period.

In 8 of these cases the one approach treated was the only entry of that route into a large town or city or into a coastal town where the route ended.

In 6 of these towns and villages the other approach had already been treated in previous years, before 1997, and the second treatment completed the traffic calming for the location. In 3 of these villages it was considered that the first phase of traffic calming would have had an effect on collisions in the very same area that was influenced by the second phase. Thus the "before" data for the second phase of work would not have been usable and it was not possible to evaluate changes in collision data. These are the three locations that have been removed from the evaluation. The other three towns were large enough for the areas of influence from each phase of traffic calming not to overlap and consequently the collision data was not influenced by the first phase.

In 2 towns the traffic calming within the study period 1997 - 2002 was the first phase in a two phase implementation, and the second approach has since been treated in subsequent years. In each of these towns the two areas of influence from the separate phases of work are considered not to overlap, and so these two have been included in the study.

For each scheme the "evaluated area" over which the traffic calming is considered to have had an effect on collisions is described in the scheme details in Appendix B.

In the other 17 cases the decision to treat only one approach was generally taken because the other end of town was not considered a suitable case for traffic calming. The reasons for this were varied but broadly fell into two different categories:

a) An existing feature in the road such as a right angled bend, narrow bridge or a roundabout already acted as a measure to slow approaching traffic, such as the northern approach to Ardee on N2 or the southern approach to Crusheen on N18.

b) Traffic approaching the town or village from this particular direction was observed to be travelling slowly in general and did not need to be slowed further. Usually this was because another nearby town or village had effectively slowed the traffic down and drivers had not yet regained the feel of an open road and speeded up. The western approach from Dromod to Roosky on N4 and the southern approach from Ennis to Barefield on N18 are examples of this.

3.3 Different Designs of Scheme

As traffic calming schemes are made up of all the different elements described in section 2.2 there is a very large number of variations possible, but the 91 schemes examined can be broadly divided into 10 different types as follows:-

A Gateway with side buildouts and central island. Definition inside village using central islands and narrowing with kerbs.

B Gateway with side buildouts and central island. Definition inside village using narrowing with kerbs but no islands.

C Gateway with side buildouts and central island. Definition inside village using line marking only.

D Gateway with side buildouts and central island. No definition inside village.

E Gateway with side buildouts only. Definition inside village using central islands and narrowing with kerbs.

F Gateway with side buildouts only. Definition inside village using narrowing with kerbs but no islands.

G Gateway with side buildouts only. Definition inside village using line marking only.

H Gateway signs only. Definition inside village using line marking only.

I Gateway signs only. No definition inside village.

J No gateway. Definition inside village using narrowing with kerbs but no islands.

Table 3.4 shows the number of schemes in each category and whether the traffic calming was done at both ends of the town or village or whether it was installed only at one end. Towns and villages where traffic calming was constructed at only one end are indicated in Figure 3.1 and in the appendices lists by (W), (N), (E) or (S) following the town name.

Table 3.4 Types of traffic calming schemes

Type	Treatment	no. of villages	both ends	one end
A	Central island gateway, central islands & narrowing with kerbs inside	39	29	10
B	Central island gateway, narrowing with kerbs & no islands inside	8	3	5
C	Central island gateway and lining	5	5	
D	Central island gateway and nothing else	1		1
E	Simple gateway, central islands & narrowing with kerbs insides	10	5	5
F	Simple gateway, narrowing with kerbs & no islands inside	11	10	1
G	Simple gateway and lining	5	2	3
H	Gateway signs and lining	3	3	
I	Gateway signs and nothing else	8	6	2
J	No gateway, narrowing with kerbs & no islands inside	1	1	
Total		**91**	**64**	**27**

The largest single category is type A, with a gateway with side buildouts and central island, with a string of central islands through the village approach and in the centre, and also narrowing from the side with kerb buildouts through the approach and centre. Most of the 39 schemes in this category give the full impression of a village at the point of passing the gateway and most have footpaths throughout the scheme from gateway to gateway. They all have street lighting through the entire scheme.

Another 14 sites have the full gateway with a central island and side buildouts but do not have such extensive works inside the village. These fall into categories B, C and D. Types A, B, C and D are generally on national primary routes, very few are on secondary routes. Figure 3.2 illustrates a typical gateway into such a village, where the wide carriageway is narrowed by kerbing the hard shoulder and inserting a central island.

Figure 3.2 Typical gateway for types A, B, C and D

The next two biggest single categories are type E, with 10 schemes, and type F, with 11 schemes. These types, along with type G, have a gateway that has no central island, but which does narrow the road using kerbed buildouts at the side of the road, usually in the hard shoulder. Types E, F and G were installed at towns where the width of the approach into town was wide enough to warrant traffic calming, but was less than the 15.7m minimum needed to accommodate central island, signs and cycle bypass. Types E, F and G have varying degrees of definition work inside the village similar to types A, B and C. Figure 3.3 illustrates a typical gateway into such a village, where the wide carriageway is narrowed by kerbing the hard shoulder but there is no central island.

Types H and I do not have physical works at the gateway at all. Typically there is no hard shoulder at these sites and the gateway signs and transition zone signs are simply installed on the verge. In type H schemes some visual narrowing has been implemented inside the village using line markings and hatching, but in type I there is nothing done other than installation of the gateway and transition zone signs. The one scheme that was installed on a dual carriageway approach to a city falls into the category of type H. Figure 3.4 illustrates a typical gateway into such a village, where there is no narrowing or kerbs installed, just signs placed in the verge.

Figure 3.3 Typical gateway for types E, F and G

Figure 3.4 Typical gateway for types H and I

One scheme examined in this report had neither gateway signs nor transition zone installed. However extensive works were done in the centre of the small village to narrow the carriageway and define the parking areas behind kerbs. This village does not fall into any the other categories and is the only type J in the study.

For the purposes of examining results types A, B, C and D can be grouped together as a “Central Island Gateway” category, types E, F and G can be grouped together as a “Simple Gateway” category and types H and I can be grouped together as a “Signs Only” category.

Table 3.5 shows the incidence of each type of traffic calming scheme on each national routes. Although there is a wide spread of types across all roads, it can be seen that types A, B, C and D are mostly on the national primary roads while types H and I are largely on the national secondary routes and those sections of national primaries where widening has not taken place.

Table 3.5 Types of traffic calming schemes by route

Route	Type of Scheme										
	A	B	C	D	E	F	G	H	I	J	No in Study
1	1	1	1			1					4
2	4				1	1					6
3	1										1
4	2	3	1			1					7
5	1					1					2
6	1					2					3
7	1		1				1				3
8	2										2
9	1						2				3
10		1				1					2
11	1				1						2
14	1										1
15	4					1	1	2			8
17	1				1						2
18					2		1			1	4
20	3								1		4
22	2	1		1	1	1					6
24	2					1			2		5
25	5				1						6
26									1		1
30	1					1					2
54	1										1
55								1			1
56									1		1
59	2										2
61	1										1
62			1								1
66									1		1
71			1		1				1		3
76									1		1
77					1						1
78	1										1
80		1									1
84		1									1
87					1						1
National Primary	**34**	**6**	**3**	**1**	**7**	**11**	**5**	**2**	**4**	**1**	**74**
National Secondary	**5**	**2**	**2**		**3**			**1**	**4**		**17**
Total	**39**	**8**	**5**	**1**	**10**	**11**	**5**	**3**	**8**	**1**	**91**

4 EFFECTIVENESS IN REDUCING COLLISIONS

4.1 Collisions Before and After Scheme Implementation

Collision numbers were measured at each of the 91 locations for the 4 years before and 4 years after implementation of each individual scheme. The “after” period was taken as beginning in the year after the final year of construction, as the full effect of the scheme would not be noticeable during construction works. Details of the collision data for each site are given in Appendix C, but summary tables are given in this chapter.

4.2 Area of Influence of Traffic Calming Works

Collision numbers for both before and after data were taken from the map-based NRA Collision Database. Only collisions taking place on the national routes were considered, and any collision that was located within the length of road influenced by the traffic calming was included in the data. This area of influence extended to 200m outside each gateway in order to take account of the effect of the transition zone. Where only one side of a village was treated, the area taken was from the gateway to the centre of the town. Where an existing traffic calming feature existed within the speed limited zone on the entry into a town, such as a sharp bend or a narrow bridge, the area of influence was assumed to extend only as far as that feature. Descriptions of the area of influence for each location are given in the detailed list of locations in Appendix B

4.3 Control Data

This report takes account of the main confounding factors affecting these statistics. Collision numbers in general on Ireland’s national roads have decreased throughout the before and after periods for these schemes and the assessment makes allowances for this trend. Changes in traffic volume, in patterns of traffic flow, in population distribution, in Garda enforcement and in attitude to road safety have all had an effect on collision rates on national roads in towns and villages whether or not traffic calming has been installed. This effect is accommodated by adjusting the before and after data in line with a comparison group, the collisions in each 4 year before and after period within all similar sized towns and villages on all national roads.

The general trend nationwide within all towns and villages in the control group has been a drop in collisions of roughly 15% between before and after periods. However the reduction varies markedly between the different collision rates, fatal collisions have reduced by a similar percentage to the general trend, but serious injury accidents have reduced by over 40% and minor injuries have reduced by only about 10%. All reductions in collisions at the sites assessed in this study have to be compared against this general nationwide trend of a shift from serious injury to minor injury.

The effect of “regression to mean” is more difficult to make allowances for in this study. The random nature of road crashes tends to cause collision frequencies at specific locations to fluctuate. The selection of towns and villages for treatment on the basis of their past collision record can introduce a source of potential bias in measuring the effectiveness of the scheme. This arises because the selection process tends to pick sites at the peak of their fluctuations in collision frequencies, and such sites might well have experienced reductions in collision rate in following years even if no treatment had been applied (Rune Elvik, 2002).

To allow for the effect of regression to mean the change in collision rates at treated sites would need to be compared with a number of similar untreated control sites. This could not have been done in the case of the traffic calming programme as no such control sites exist. Whenever a town or village with a collision history was identified it was put on the programme for treatment with traffic calming; it would have been considered unacceptable to leave the location untreated simply for the purposes of research.

4.4 Effect on Collision Occurrence

Table 4.1 shows for each year's programme of traffic calming schemes the collisions over the 4 years before and after each scheme.

Table 4.1 Collisions before and after scheme implementation for each year's programme

Year	No of Schemes	4 Years Before				4 Years After			
		Fatal	Serious	Minor	Total	Fatal	Serious	Minor	Total
1997	12	10	16	52	78	3	15	51	69
1998	14	5	8	31	44	2	6	30	38
1999	18	5	23	54	82	1	8	36	45
2000	9	2	4	27	33	3	6	19	28
2001	23	10	13	95	118	3	12	59	74
2002	15	4	8	41	53	3	5	40	48
Total	**91**	**36**	**72**	**300**	**408**	**15**	**52**	**235**	**302**

The reduction in collisions for each year's programme is shown in Table 4.2, as is the adjusted reduction allowing for the general drop in collisions over the study years in the control group of other similar sites. Table 4.3 shows these adjusted drops in annual terms and in percentages.

All this data for each individual scheme can be seen in Appendix C.

There is considerable fluctuation in results between each year's programme of traffic calming, so it is best to concentrate on the overall figures for the entire six years.

Over all 91 sites there was a drop of 106 collisions from 408 to 302.

When adjusted for the general nationwide fall in collisions on similar sites this gives a total drop of 43.3 collisions, or 10.8 per year.

This is a 13% reduction on the collision numbers before implementation of the schemes.

Table 4.2 Collision reductions for each year's programme

Year	No of Schemes	4 Year Reduction				4 Year Reduction, Adjusted			
		Fatal	Serious	Minor	Total	Fatal	Serious	Minor	Total
1997	12	7	1	1	9	5.5	-6.4	0.6	-0.3
1998	14	3	2	1	6	1.8	-2.0	-1.2	-1.5
1999	18	4	15	18	37	3.0	5.0	14.0	22.0
2000	9	-1	-2	8	5	-1.4	-3.6	5.9	0.8
2001	23	7	1	36	44	6.5	-3.7	24.6	27.4
2002	15	1	3	1	5	1.1	0.7	-7.1	-5.2
Total	**91**	**21**	**20**	**65**	**106**	**16.4**	**-10.0**	**36.8**	**43.3**

Table 4.3 Annual collision reductions for each year's programme

Year	No of Schemes	Annual Drop in Collisions, Adjusted				Percentage Drop in Collisions			
		Fatal	Serious	Minor	Total	Fatal	Serious	Minor	Total
1997	12	1.4	-1.6	0.1	-0.1	65%	-74%	1%	-0%
1998	14	0.5	-0.5	-0.3	-0.4	47%	-51%	-4%	-4%
1999	18	0.7	1.3	3.5	5.5	75%	39%	28%	33%
2000	9	-0.4	-0.9	1.5	0.2	-88%	-55%	24%	3%
2001	23	1.6	-0.9	6.2	6.9	68%	-44%	29%	27%
2002	15	0.3	0.2	-1.8	-1.3	27%	13%	-21%	-12%
Total	**91**	**4.1**	**-2.5**	**9.2**	**10.8**	**52%**	**-24%**	**14%**	**13%**

While collisions of all severity types at the examined locations have reduced in actual numbers, the decrease in serious injury collisions at these sites has not followed the general trend nationwide over this period on national roads, which have experienced a particularly large decrease in serious injury collisions. When allowing for the trend in the control data the actual reduction of 20 serious injury collisions in a 4 year period translates to a relative increase of 10 collisions.

Looking at each individual severity type the adjusted reduction in fatal collisions is 16.4, or 4.1 per year, and that in minor injury collisions is 36.8, or 9.2 per year. The adjusted change in serious injury collisions is an increase of 2.5 per year. These numbers represent a 52% drop in fatal collisions, a 14% drop in minor injury collisions and a 24% rise in serious injury collisions.

The implementation of traffic calming has clearly had a much more marked effect on fatal collisions than on other injury collisions, resulting in a lowering of the severity of collisions overall. Table 4.4 below shows for each year each severity category as a percentage of overall collisions in the 4 years before implementation and the 4 years after implementation. It can be seen that in general for each year's programme, except for year 2000, the proportion of fatal collisions has roughly halved, the proportion of serious collisions has stayed much the same, while that of minor collisions has slightly increased. Looking at the entire six years' programme, in the four years before implementation of each traffic calming scheme fatal collisions constituted 9% of all collisions in these towns and villages while serious and minor injury collisions were 18% and 73% of the total respectively. In the four years after implementation fatal collisions decreased to 5% of all collisions, serious reduced very slightly to 17% and minor rose to 78%.

Table 4.4 Severities as a percentage of all collisions for each year's programme

Year	No of Schemes	Percentage of all Collisions, 4 years before			Percentage of all Collisions, 4 years after		
		Fatal	Serious	Minor	Fatal	Serious	Minor
1997	12	13%	20%	67%	4%	22%	74%
1998	14	11%	18%	71%	5%	16%	79%
1999	18	6%	28%	66%	2%	18%	80%
2000	9	6%	12%	82%	11%	21%	68%
2001	23	8%	11%	81%	4%	16%	80%
2002	15	8%	15%	77%	6%	11%	83%
Total	**91**	**9%**	**18%**	**73%**	**5%**	**17%**	**78%**

It can therefore be concluded that implementation of these traffic calming schemes has not only reduced the number of collisions overall but has also reduced the average severity of those collisions that did occur.

4.5 Statistical Significance

Statistical significance is difficult to achieve with locations that have such small numbers of individual collisions. However the chi squared test was used to compare the results with the control data and the overall result for all sites indicates an 80% confidence level, meaning that there is a 20% chance that the observed reduction in collisions is due to mere random fluctuation.

4.6 Collision Costs and Economic Evaluation

Collision costs are calculated using figures from the Goodbody report on Cost-Benefit Analysis of Transport Projects, 2004. The "Willingness To Pay" method of economic assessment has been used, dividing the collisions into the separate categories of fatal, serious injury and minor injury. Table 4.5 lists the cost savings per year and Table 4.6 compares these with construction costs to give an average yearly rate of return for each year's programme of traffic calming.

Table 4.5 Collision and cost saving for each year's programme

Year	No of Schemes	Drop in Annual Collisions, adjusted			Annual Cost Saving from Drop in Collisions. €, 2002 prices			
		Fatal	Serious	Minor	Fatal	Serious	Minor	Total
1997	12	1.4	-1.6	0.1	3,138,300	-487,300	4,300	2,655,300
1998	14	0.5	-0.5	-0.3	1,029,900	-155,000	-9,200	865,600
1999	18	0.7	1.3	3.5	1,689,100	383,100	105,200	2,177,500
2000	9	-0.4	-0.9	1.5	-800,900	-277,800	44,200	-1,034,500
2001	23	1.6	-0.9	6.2	3,681,900	-278,700	184,600	3,587,700
2002	15	0.3	0.2	-1.8	638,100	56,800	-53,100	641,800
Total	**91**	**4.1**	**-2.5**	**9.2**	**9,376,400**	**-759,100**	**276,100**	**8,893,400**

The annual cost saving from the drop in collisions over all 91 schemes is calculated to be approximately €8.9 million. Most of this saving comes from the drop in fatal collisions, which is the group with the most significant fall proportionately, a drop of 4.1 per year from 7.9 per year (both figures adjusted for the control data).

Table 4.6 Yearly rate of return

Year	No. of Schemes	Annual Collision Cost Saving, €, 2002 prices	Cost of Constr. €, 2002 prices	Yearly Rate of Return
1997	12	2,655,300	3,024,600	88%
1998	14	865,600	1,852,900	47%
1999	18	2,177,500	5,369,900	41%
2000	9	-1,034,500	1,882,000	-55%
2001	23	3,587,700	3,881,400	92%
2002	15	641,800	3,446,600	19%
Total	**91**	**8,893,400**	**19,457,200**	**46%**

The average yearly rate of return for each year's programme varies between 92% and a negative return of 55%, but the average rate of return over all six years is 46%.

4.7 Results by Type of Scheme

Tables 4.7 and 4.8 show the collision savings organised into the 10 different types of scheme and their groupings. As guidance a description of the different types and groupings is repeated in Table 4.9.

Once the 91 schemes are divided up into types the individual numbers of collisions and schemes become too small to give a reliable statistical result, but a few facts are worth noting:-

a) **Types A, B, C and D** are all having a positive effect on the number of collisions. These all have a gateway with a central island and varying degrees of physical works inside the speed limited zone.

Taken together as a group, types A to D have a clearly positive result, with on average 1.1 collisions per town or village saved over a 4 year period.

b) **Types E, F and G** taken together do not have such a clear result.
The 10 locations in category E experienced an average increase of nearly 1 collision over a 4 year period, with collisions in all severity categories increasing, while type G has a better result and appears to be performing nearly as well as types A to D. Taken together as a group, these schemes that have physical narrowing but no central island at the gateway seem to have had little effect on collision occurrence.

c) **Types H and I** stand out as both having had no success at all, with on average an increase of 1.2 collisions at each town or village over a four year period.

Type H and type I are the very simplest types of scheme, with no physical works done either at the gateway or throughout the village. Gateway signs and transition zone signs were installed, and in type H some lining was done through the village to define a narrow carriageway.

Type I has usually been installed at villages where the road width was already narrow before implementation, and neither further narrowing nor physical works could be done at these locations. This is reflected in the low number of collisions at these sites before implementation, 14 over 8 sites which comes to roughly 2 collisions per site. At other sites the average number of collisions per site before implementation was generally much higher than this. The overall average across all 91 sites was approximately 5 collisions per site.

d) Interestingly the one scheme alone in **Type J** appears to have worked. This scheme had extensive kerbing and footpath works done at the centre of the small village to define the road edge and the central junction. Footpaths and lighting were installed throughout the village from one speed limit to the other and there is a clear physical narrowing at the speed limit signs, but no gateway signs or transition zone signs were installed so there is no narrowing in optical width on approach. However, as there is only one scheme in this category no real conclusions can be drawn about this design.

Table 4.7 Drop in collisions by type of scheme

Type	No. in Study	All colls, 4 years before	Drop in collisions (4 years, adjusted)					Annual cost saving, €	
			Fatal	Serious	Minor	Total	Tot per site	Total	Per site
A	39	171	4.9	-1.9	34.7	37.7	1.0	2,913,300	74,700
B	8	31	3.2	-1.2	7.8	9.8	1.2	1,772,300	221,500
C	5	42	-0.2	1.3	8.0	9.1	1.8	42,600	8,500
D	1	8	-0.2	1.0	2.6	3.4	3.4	-40,800	-40,800
E	10	48	-1.1	-2.2	-5.6	-9.0	-0.9	-867,800	-86,800
F	11	55	5.8	-3.5	-4.9	-2.6	-0.2	2,985,200	271,400
G	5	20	2.5	-0.9	2.8	4.3	0.9	1,354,000	270,800
H	3	13	1.0	-3.7	-5.5	-8.2	-2.7	260,900	87,000
I	8	14	0.7	0.1	-5.9	-5.1	-0.6	366,800	45,900
J	1	6	0.0	1.1	2.7	3.8	3.8	106,600	106,600
Total	**91**	**408**	**16.4**	**-10.0**	**36.8**	**43.3**	**0.5**	**8,893,400**	**Avge 97,700**

Table 4.8 Grouping type of scheme by type of gateway

Type	No. in Study	All colls, 4 years before	Drop in collisions (4 years, adjusted)					Annual cost saving, €	
			Fatal	Serious	Minor	Total	Tot per site	Total	Per site
Central Island Gateway	53	252	7.6	-0.8	53.2	60.0	1.1	4,687,600	88,400
Simple Gateway	26	123	7.1	-6.7	-7.7	-7.3	-0.3	3,471,500	133,500
Signs Only	11	27	1.7	-3.6	-11.4	-13.3	-1.2	627,800	57,100
Type J	1	6	0.0	1.1	2.7	3.8	3.8	106,600	106,600
Total	**91**	**408**	**16.4**	**-10.0**	**36.8**	**43.3**	**0.5**	**8,893,400**	**Avge 97,700**

Table 4.9 Types of scheme and their groupings

Type	Treatment	Group
A	Central island gateway, central islands & narrowing with kerbs inside	Central Island Gateway
B	Central island gateway, narrowing with kerbs & no islands inside	
C	Central island gateway and lining	
D	Central island gateway and nothing else	
E	Simple gateway, central islands & narrowing with kerbs insides	Simple Gateway
F	Simple gateway, narrowing with kerbs & no islands inside	
G	Simple gateway and lining	
H	Gateway signs and lining	Signs Only
I	Gateway signs and nothing else	
J	No gateway, narrowing with kerbs & no islands inside	No Gateway

4.8 Results By Type of Collision

Table 4.10 shows the before and after collisions each year for the three main types of collision, pedestrian, single vehicle and head on. The drop shown in the table is an adjusted figure, and is relative to the decrease in each of these types of collision in the control data throughout all similar towns and villages on national roads over the period examined.

The results show that pedestrian collisions decreased overall by about 8 from a figure of 69 and head-on type collisions have decreased by about 14 from 45. These are quite significant decreases, of about 13% and 29% respectively. However there has been effectively no change in single vehicle collisions, only a very small increase of negligible percentage change.

Table 4.10 Type of collision

Year	No of Schemes	All collisions, 4 years before			Drop in collisions (4 years, adjusted)		
		ped	single veh	head on	ped	single veh	head on
1997	12	7	15	8	-7.0	-0.3	0.9
1998	14	3	3	7	-1.9	-3.4	-0.1
1999	18	18	13	7	9.3	5.9	1.3
2000	9	5	6	4	0.1	-2.0	1.2
2001	23	24	14	16	4.9	-1.0	13.2
2002	15	12	12	3	2.0	0.6	-3.0
Total	**91**	**69**	**63**	**45**	**7.5**	**-0.2**	**13.5**
				Total Percentage Drop:	**13%**	**-0%**	**29%**

The greatest decrease is in head-on type collisions. Head-on collisions are not a particularly significant proportion of all collisions within these towns and villages and before implementation of the traffic calming they constituted only about 11% of all of collisions. However the reduction of 13.5 collisions over four years represents a 29% drop in this type of collision compared with figures before implementation, which is a significant result. This decrease can be directly attributed to the fundamental design of traffic calming, in which the two directions of flow are divided by central kerbed islands and central hatched areas.

Pedestrian collisions have also decreased. Pedestrian collisions were about 19% of all collisions within these towns and villages, and the drop of 13% in pedestrian collisions is much the same as the general drop of 13% in collisions overall within the treated towns. Although this is a good result, in that pedestrian collisions have decreased in treated towns and villages 13% more than they have decreased in other similar locations, it is not as good as was expected. It was assumed that the inherent “pedestrian friendly” nature of traffic calming, with provision of footpaths and pedestrian crossings would have a comparatively greater effect on pedestrian collisions. Examination of the individual collisions in the after period suggests that the increases in pedestrian collisions are occurring in only about a dozen of the 91 towns and villages, and that half of these dozen have 3 or more pedestrian incidents in the four year after period. There appears to be no correlation with the provision of a pedestrian crossing as part of the traffic calming scheme. A more detailed study of these locations is needed to investigate pedestrian collisions further and to ascertain whether there is any link between the provision of either pedestrian crossings or footpaths and the decrease in pedestrian collisions.

Single vehicle collisions have not changed at all in relation to the general decrease in single vehicle collisions in all similar towns and villages. Single vehicle collisions are those involving only one vehicle. Usually in single vehicle incidents the vehicle leaves the driving lane of the road and collides with a roadside object.

Occasionally there is no collision with a roadside object but because of the difference in levels between road and surrounding ground the occupants are injured when the vehicle comes to a halt. The lack of any significant change in the occurrence of single vehicle collisions could possibly be explained by the fact that implementation of traffic calming introduces many new objects into the roadside space and reduces the available width within the driving lane. Thus when a driver does stray from the correct path there is less forgiveness in the roadside environment and the chances of leaving the defined driving lane or striking an object is increased. The general decrease in collisions at traffic calming sites due to the reduced speed is offset by this increased chance of hitting a roadside object, which has thus resulted in no change in the incidence of these types of collisions.

4.9 Results for Towns and Villages Treated at One End Only

At 27 of the 91 locations only one end of the town or village was treated with traffic calming. In 8 of these cases these were entries into a large town or city or into a coastal town where the route ended, at the remaining 19 locations there was a through route but only one half of the village was treated. Table 4.11 shows the results arranged according to whether or not both ends of the town were treated.

The previous report on traffic calming constructed between 1993 and 1996 concluded that villages which had traffic calming at only one end did not perform in evaluation as well as those where both ends were treated. The results shown below repeat this phenomenon. At the 27 locations where only one end of the town or village was treated collisions reduced only by an average of 8%, while at the other 64 locations, where both ends were treated, the reduction in collisions was 14% on average.

When the 8 “single entry” locations are separated out it can be seen that these treatments worked better than the other 19 one-end towns and villages. This can perhaps be explained by the fact that these 7 locations were put in place to reduce the speed of vehicles approaching the outskirts of large towns or cities, and their effect is only required to act within the environs of the traffic calming works. Once past the traffic calming scheme the traffic enters a congested network where speed is not a concern. For these 8 sites it was only the short length immediately around the traffic calming works was that was evaluated in the study.

Table 4.11 Division of schemes according to whether both ends were treated

Type	No. in study	All colls, 4 years before	Drop in collisions (4 years, adjusted)					Percentage drops			
			Fatal	Serious	Minor	Total	Total per site	Fatal	Serious	Minor	Total
Both Ends	64	310	13.0	-7.6	31.1	36.4	0.6	52%	-24%	15%	14%
Single Entry	8	31	0.6	0.8	4.7	6.1	0.8	38%	29%	22%	23%
Half	19	67	2.9	-3.2	1.1	0.8	0.0	59%	-41%	3%	1%
All One-end	27	98	3.5	-2.4	5.8	6.9	0.3	54%	-22%	9%	8%
Total	**91**	**408**	**16.4**	**-10.0**	**36.8**	**43.3**	**0.5**	**52%**	**-24%**	**14%**	**13%**

5 CASE STUDIES

5.1 Comparison of Types of Traffic Calming Schemes

The results indicate that schemes that have a central island at the gateway, types A,B, C and D as described in section 3.3, are more effective at reducing collisions than those schemes that do not have central islands. Four schemes on N15 were chosen to illustrate the typical differences between these types of scheme so that the layout of a scheme that has succeeded in collision reduction can be compared with one that has not.

The schemes illustrated, all on N15 and in County Donegal, are:
Ballyshannon,
Ballybofey,
Killygordon,
Castlefinn.

Schemes With Central Island Type Gateways

Ballybofey and Castlefinn are schemes of type A, having a gateway with both side buildouts and central island. Inside the village or town this definition is continued using central islands and narrowing with kerbs.

Both of these sites have experienced a reduction in collisions as the figures for 4 year before and after periods show. Castlefinn particularly has had a notable reduction, very much larger than the average of 13% for all the sites in this study.

Town/Village	collisions before	collisions after	% reduction (adjusted)
Ballybofey	9	6	16%
Castlefinn	4	1	72%

Schemes With Signs Only at Gateways

Ballyshannon and Killygordon are schemes of type H, having only signs and no physical works at the gateway. Definition inside the town or village is given only by using road markings.

None of these sites has experienced any significant reduction in collisions; as the 4 year figures below show. These locations have had a slight increase in collisions relative to the general decrease in collisions across all similar towns and villages in the control data.

Town/Village	collisions before	collisions after	% reduction (adjusted)
Ballyshannon	7	6	-4% (increase)
Killygordon	2	2	-9% (increase)

Comparison of Ballyshannon and Ballybofey

Ballyshannon and Ballybofey are similar sized towns and before traffic calming was introduced had similar approaches. In both towns the speed limit extends a long way outside the centre of town and the road was wide on these approaches. Both towns have busy town centres with narrow streets where vehicle speeds are not particularly high; but in the zone between gateway and town centre high speeds were a problem and were addressed by traffic calming.

While Ballyshannon had no central island constructed at the gateway and was treated with only signs and line marking on these approaches, Ballybofey was treated with a kerbed central island, kerbs and footpaths to narrow the road, and a string of further central islands between the gateway and the centre of town. Figures 5.1 and 5.2 below illustrate this.

Comparison of figures 5.1 and 5.2 shows that the optical width has been considerably narrowed in Ballybofey, whereas the effect is not so marked in Ballyshannon. Figures 5.3 and 5.4 show how in Ballybofey this narrowing is continued on for the 600m between gateway and town centre, reinforcing the slowing down effect that drivers experienced at the gateway.

The differences in design of the approaches to these towns may possibly account for the differences in collision occurrence after traffic calming implementation.

Figure 5.1 Ballyshannon south approach

Figure 5.2 Ballybofey south approach

Figure 5.3 Ballybofey south zone inside gateway

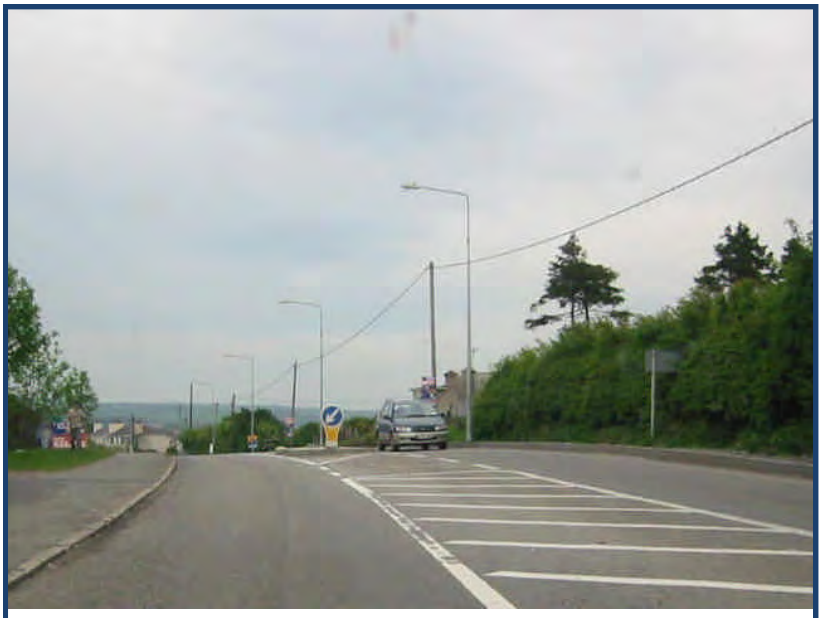

Figure 5.4 Ballybofey south zone inside gateway

Comparison of Killygordon and Castlefinn

Killygordon and Castlefinn are located within 6km of each other on the most northern section of N15, with a much lower traffic volume than either Ballybofey or Ballyshannon. The N15 along this section in general has a narrower cross section without hard shoulders.

Killygordon is a small village and had narrow approaches even before implementation of the traffic calming, and the low collision rate before implementation reflects this. The minimal treatment to this village under the traffic calming programme did little to change the collision occurrence. Castlefinn is a larger village and before implementation its approaches were wider than those to Killygordon. The number of collisions in Castlefinn before implementation was twice that in Killygordon. The construction of a kerbed central island, kerbs and footpaths to narrow the road, and a further central island at the centre of the village has evidently had an effect on collisions, which have now reduced to numbers below that in Killygordon. Figures 5.5 and 5.6 below illustrate the differences between the two villages at the gateway, while Figures 5.7 and 5.8 illustrate the changed look of the centre of Castlefinn as a result of traffic calming construction.

Figure 5.5 Killygordon west approach

Figure 5.6 Castlefinn west approach

Figure 5.7 Castlefinn centre before traffic calming

Figure 5.8 Castlefinn centre after traffic calming

Figure 5.9 Approach to a village similar to Grange before traffic calming

5.2 Successful Schemes

N15 Grange

Grange has had one of the greatest reductions in collisions in this study.

Collisions in 4 years before	9
Collisions in 4 years after	2
% reduction (adjusted)	75%

Grange is on a busy section of N15 in County Sligo. It is a medium sized village with shops, pubs, petrol station, police station, church and a few dozen dwelling houses all with frontage onto the national road. It has two busy junctions with local primary distributor roads leading to a moderately populated hinterland; in the summer the population increases significantly with holidaymakers visiting the coastal area.

Traffic calming was installed in 2000. Before this the approaches to the village were wide with hard shoulders and this cross section continued through the length of the town. On entering the village from the north the length within the built up area approaching the centre is downhill, so that drivers would need constant concentration and awareness of their speed to achieve a reduction in speed and to maintain that reduction on this approach. From the south there is also a downhill approach, but outside the built up area, so that speeds approaching the start of the speed limited zone were high.

Although an appropriate photograph of Grange before construction of the traffic calming is not available, the photograph below of a similar sized village on N24 with similar road widths is shown below in Figure 5.9.

Grange was treated with kerbed central islands at each gateway, kerbs and footpaths to narrow the road, and a string of further central islands between the two gateways. Driving lanes in each direction are now a constant 3.5m throughout the village. A signalised controlled pedestrian crossing was also constructed at the centre of the town. There are now footpaths for the entire length of village between gateways and as well as the controlled crossing there are several locations where pedestrians can cross the road with the aid of the central island refuges. Figures 5.10, 5.11 and 5.12 below illustrate the works.

In the years since traffic calming was implemented further housing, an industrial estate and commercial sites have been constructed in the vicinity. Traffic volumes turning at the junction have increased substantially.

Figure 5.10 Gateway at Grange with central Island – Viewed from inside the village

Figure 5.11 Approach to Grange village centre from the north

Figure 5.12 Grange village centre

In the four years before construction of traffic calming there were roughly 2 collisions each year in the village. Four of the nine collisions were single vehicle incidents and two were pedestrian collisions, both involving pedestrians attempting to cross the road. Skidding occurred in six of the nine collisions, which is an unusually large proportion and suggests that there was a high incidence of sudden braking from high speeds.

In the four years after implementation of the scheme there have been only two collisions, one in the village centre where the rear of a parked vehicle was hit, and one single vehicle loss of control incident on the south approach to the village.

N20 Newtwopothouse

Newtwopothouse has also had a significant reduction in collisions in this study.

Collisions in 4 years before	4
Collisions in 4 years after	0
% reduction (adjusted)	100%

Newtwopothouse is on a busy section of N20 in County Cork. It is a tiny settlement on a staggered junction with only a pub/cafe and a shop/post office having frontage onto the national road. The bulk of the housing in the area is along the two side roads stretching a few hundred metres down each road, and on the eastern side road there is a school about 100m from the N20. Before construction of the traffic calming it did not appear to the passing driver on N20 as if there were a village at all, merely a crossroads. However there was a fairly large volume of traffic turning to and from the two side roads and pedestrian traffic across the N20 between housing and school.

Before implementation of traffic calming the road on approach to and through the location was wide, being a standard 7m single carriageway with 3m hard shoulders. Figures 5.13 and 5.15 show the location before traffic calming was installed.

Figure 5.13 Approach to Newtwopothouse from north before traffic calming

Figure 5.14 Approach to Newtwopothouse from north

Traffic calming was implemented in 2001. Similarly to Grange, Newtwopothouse was treated with kerbed central islands at each gateway, kerbs and footpaths to narrow the road, further central islands between the two gateways and a signalised controlled pedestrian crossing in the centre. Driving lanes in each direction are now a constant 3.5m throughout the scheme and there is now lighting for the entire length between gateways and footpaths in the central stretch around the junction and bus stops. Figures 5.14 and 5.16 below illustrate the works by showing the same locations as shown in Figures 5.13 and 5.15.

Figure 5.15 Crossroads at Newtwopothouse before traffic calming

Figure 5.16 Crossroads at Newtwopothouse, with pedestrian crossing

In the four years before construction of traffic calming there were 4 collisions at this location, all of which involved turning at the junction.

In the four years after implementation of the scheme there have been no collisions.

6 CONCLUSIONS

6.1 Reduction in Collisions

Between 1997 and 2002 there were 94 traffic calming schemes completed at towns and villages on the national roads.

Over all the 91 studied locations, comparing the 4 years before each scheme with the 4 years after, there was a reduction of 106 collisions, made up of 21 fatal collisions, 20 serious injury collisions and 65 minor injury collisions.

6.2 Reduction in Comparison with Control Data

When comparing with the control data and allowing for the general decrease in collisions overall on national roads during this time period this translates to a reduction of 43.3 collisions. This is made up of a reduction of 16.4 fatal collisions and 36.8 minor injury collisions and an increase of 10.0 serious collisions.

These figures represent a 13% reduction in all collisions, with fatal collisions reduced by 52%. Serious and minor injury collisions together reduced by 9%.

6.3 Reduction in Severity of Collisions

The implementation of traffic calming has therefore had the effect of reducing the number of crashes within the geographical areas of their influence. Its more significant effect is in reducing the severity of collisions. The percentage of all collisions that were fatal dropped from 9% in the 4 years before implementation to 5% in the 4 years after. The percentage of minor injury collisions rose by a corresponding amount.

6.4 Cost Benefit Analysis

Using the “Willingness to Pay” method of evaluation the average yearly rate of return over all the years evaluated is 46%.

6.5 Effects of Different Types of Schemes

Traffic Calming Schemes that have a central island in the Gateway and continue this effect with solid central islands throughout the village are more effective in reducing collisions than those that do not.

Schemes that consisted of only signs and had no physical works did not have any effect at all in reducing collisions.

Traffic Calming Schemes where both ends of the town or village were treated were more effective in reducing collisions than those where only one was treated.

7 RECOMMENDATIONS

There are eight main recommendations that emerge from this study.

1. The programme of traffic calming of towns and villages on national roads should be continued.

2. The programme should be restricted to only towns and village where traffic calming is likely to have an impact.

3. An updated priority list should be produced to identify those towns and villages where traffic calming is likely to have an impact.

4. Prioritised towns and villages should have
   a) an injury collision record over the past 5 years that is higher than average,
   b) 85 percentile speeds that are above the posted speed limit,
   c) a physical layout that is possible to treat with traffic calming.

5. Where traffic calming is implemented it should include a central island at the gateway and should include physical narrowings throughout the town or village. No scheme should consist of just signs and road markings.

6. At any location where traffic calming is being considered the existing vehicle speeds through the village must be surveyed.

7. After each traffic calming scheme has been implemented the revised vehicle speeds through the village must be surveyed as soon as possible.

8. A further study should examine in more detail the single vehicle accidents and pedestrian accidents that been identified in this study in treated villages and towns.

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APPENDIX A

Ranking of Sites According to Primary Criteria for Selection for Traffic Calming

National Primary Routes Only

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 million vehkm	Collisions per year per 1000 Population	+Combined Collision Rate
N17	BALLINDINE	232	5058	0.587	8	14.8	6.90	6.40
N25	KILRANE	214	5310	2.255	10	4.6	9.35	5.59
N08	LITTLETON	566	5598	0.591	10	16.6	3.53	5.08
N11	ASHFORD	500	12768	1.352	19	6.0	7.60	5.01
N01	JULIANSTOWN	450	14270	1.146	16	5.4	7.11	4.63
N05	FRENCHPARK	272	2994	0.805	11	25.0	8.09	4.52
N02	COLLON	335	6164	0.626	7	9.9	4.18	4.08
N18	KILCOLGAN	500	9565	0.483	9	10.7	3.60	3.93
N08	WATERGRASSHILL	250	13706	0.985	8	3.2	6.40	3.85
N01	CASTLEBELLINGHAM	762	10983	1.891	20	5.3	5.25	3.68
N08	RATHCORMACK	500	11807	1.158	11	4.4	4.40	3.08
N09	DUNGARVAN	500	3261	0.28	4	24.0	1.60	2.80
N04	DROMOD	250	3598	0.59	3	7.7	2.40	2.75
N20	CHARLEVILLE	3000	9655	1.988	12	3.4	4.00	2.69
N25	LEMYBRIEN	222	6471	0.918	4	3.7	3.60	2.54
N11	KILMACANOGE	763	26721	0.692	13	3.9	3.41	2.47
N25	GLOUNTHAUNE	500	17499	0.802	17	6.6	6.80	2.36
N07	MONEYGALL	344	6350	0.576	4	6.0	2.33	2.36
N09	MULLINAVAT	283	3858	0.925	7	10.7	4.95	2.31
N08	KILBEHENY	500	6897	0.863	6	5.5	2.40	2.30
N02	CASTLEBLAYNEY	2938	4154	3.525	21	7.9	1.43	2.29
N07	BORRIS IN OSSORY	500	7848	1.141	7	4.3	2.80	2.26
N15	BUNDORAN	1463	7275	2.371	17	5.4	2.32	2.24
N24	KILSHEELAN	435	4924	1.027	5	5.4	2.30	2.23
N02	ARDEE	3604	7019	2.394	24	7.8	1.33	2.23
N05	CHARLESTOWN	712	2956	1.25	5	7.4	1.40	2.19
N11	CAMOLIN	293	5192	1.125	4	3.8	2.73	2.12
N06	CRAUGHWELL	232	7669	1.558	4	1.8	3.45	2.09
N24	MONARD	500	5735	0.392	3	7.3	1.20	2.06
N22	FARRANFORE	500	7614	1.093	6	4.0	2.40	1.99
N21	ABBEYFEALE	1501	9982	3.287	39	6.5	5.20	1.95
N15	GRANGE	500	6352	1.427	6	3.6	2.40	1.93
N24	CARRICK ON SUIR	5143	4924	2.903	20	7.7	0.78	1.92
N04	COLLOONEY	612	8617	0.864	12	8.8	3.92	1.86
N18	BAREFIELD	500	5852	1.087	5	4.3	2.00	1.86
N17	CLAREGALWAY	500	11128	1.66	7	2.1	2.80	1.82
N20	BALLYHAY	500	7440	0.364	3	6.1	1.20	1.81
N14	CASTLEFINN	692	6024	0.846	5	5.4	1.45	1.80
N26	FOXFORD	974	1928	1.915	9	13.4	1.85	1.80
N18	ARDRAHAN	500	6650	0.413	3	6.0	1.20	1.80
N02	ASHBOURNE	4411	10840	2.792	30	5.4	1.36	1.77
N08	ABBEYLEIX	1299	8083	1.778	11	4.2	1.69	1.69
N02	CARRICKMACROSS	3341	11436	2.989	27	4.3	1.62	1.67
N11	OILGATE	262	6332	0.393	2	4.4	1.53	1.64
N04	BALLINAFAD	500	3199	0.239	2	14.3	0.80	1.63
N02	CASTLESHANE	250	5338	0.875	5	5.9	4.00	1.59
N02	SLANE	699	6064	1.885	13	6.2	3.72	1.55
N02	ANNAYALLA	500	5338	0.655	6	9.4	2.40	1.54
N30	ENNISCORTHY	7655	3972	0.565	6	14.6	0.16	1.50
N10	PAULSTOWN	234	4858	0.753	2	3.0	1.71	1.45

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 million vehkm	Collisions per year per 1000 Population	+Combined Collision Rate
N08	JOHNSTOWN	422	6063	1.445	4	2.5	1.90	1.45
N07	TOOMYVARA	500	7606	0.69	7	7.3	2.80	1.43
N16	SLIGO	17302	5680	1.796	25	13.4	0.29	1.42
N26	BALLINA	477	5398	1.983	9	4.6	3.77	1.40
N16	GLENFARNE	500	1746	1.846	5	8.5	2.00	1.35
N06	ROCHFORTBRIDGE	721	6202	1.348	5	3.3	1.39	1.35
N24	LIMERICK JCN	250	5735	0.698	4	5.5	3.20	1.35
N22	BALLINCOLLIG	12124	15125	6.303	68	3.9	1.12	1.34
N24	FIDDOWN	500	4588	0.966	6	7.4	2.40	1.34
N01	DROGHEDA	23914	19455	4.526	79	4.9	0.66	1.31
N08	NEWINN	500	7163	0.648	3	3.5	1.20	1.31
N15	STRANORLAR+BALLYBOFEY	2972	3337	3.918	22	9.2	1.48	1.29
N14	LIFFORD	1359	3854	1.151	4	4.9	0.59	1.28
N22	LISSARDA	500	7096	0.696	6	6.7	2.40	1.27
N22	BALLYVOURNEY	500	3636	2.786	8	4.3	3.20	1.23
N06	KILREEKILL	500	9055	0.59	3	3.1	1.20	1.22
N17	BELLAHY+CHARLESTOWN	712	3834	1.103	3	3.9	0.84	1.20
N22	MACROOM	2363	7096	4.588	31	5.2	2.62	1.18
N15	KILLYGORDON	500	6024	0.493	2	3.7	0.80	1.14
N08	HORSE&JOCKEY	500	7607	0.26	3	8.3	1.20	1.13
N18	GORT	1093	7709	2.855	16	4.0	2.93	1.13
N04	CLONARD	500	10570	0.599	3	2.6	1.20	1.12
N02	EMYVALE	479	4073	0.813	4	6.6	1.67	1.08
N05	BELLAVARY	500	5138	0.633	4	6.7	1.60	1.07
N20	PATRICKSWELL	1019	14486	1.742	15	3.3	2.94	1.06
N25	KILMEADAN	500	6177	1.817	7	3.4	2.80	1.04
N24	PALLASGREEN	500	4638	0.747	4	6.3	1.60	1.03
N15	BALLYSHANNON	2838	8955	2.844	13	2.8	0.92	1.02
N21	TRALEE	17225	12840	1.934	40	8.8	0.46	1.00
N03	KELLS	3539	8857	1.737	10	3.6	0.57	0.99
N25	KILLEAGH	347	7244	1.481	5	2.6	2.88	0.98
N24	BANSHA	293	4221	0.855	3	4.6	2.05	0.97
N03	CARNAROSS	500	6683	0.933	5	4.4	2.00	0.94
N02	MONAGHAN	5946	7630	3.588	32	6.4	1.08	0.91
N24	CAHIR	2055	13277	2.528	11	1.8	1.07	0.89
N01	DUNDALK	25843	22685	6.273	153	5.9	1.18	0.89
N06	MILLTOWNPASS	500	6202	0.733	4	4.8	1.60	0.88
N18	NEWMARKET-ON-FERGUS	1583	10584	1.461	13	4.6	1.64	0.87
N17	CURRY	250	4585	0.548	2	4.4	1.60	0.84
N03	CAVAN	5254	11709	2.36	28	5.6	1.07	0.82
N22	KILLARNEY	7275	9731	3.819	19	2.8	0.52	0.82
N09	MOONE+TIMOLIN	500	6720	2.231	6	2.2	2.40	0.82
N11	RATHNEW	1496	12736	1.072	11	4.4	1.47	0.81
N15	DONEGAL	2193	6149	2.053	12	5.2	1.09	0.79
N25	YOUGHAL	5828	7598	5.22	34	4.7	1.17	0.76
N03	DUNSHAUGHLIN	1275	15588	1.458	6	1.4	0.94	0.76
N04	CARRICK ON SHANNON	2500	4257	2.393	10	5.4	0.80	0.74
N06	BALLINASLOE	5812	9582	5.241	37	4.0	1.27	0.72
N21	NEWCASTLE WEST	2500	7975	2.766	16	4.0	1.28	0.72
N20	BUTTEVANT	1125	7440	1.271	7	4.1	1.24	0.72
N15	SLIGO	17302	8932	1.274	14	6.7	0.16	0.71
N15	DRUMCLIFF	500	9726	0.737	2	1.5	0.80	0.71
N25	NEW ROSS	6079	6846	2.424	17	5.6	0.56	0.70

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 million vehkm	Collisions per year per 1000 Population	+Combined Collision Rate
N25	DUNGARVAN	6920	5688	4.649	25	5.2	0.72	0.70
N20	CROOM	1090	5658	1.036	5	4.7	0.92	0.70
N24	PILTOWN	717	4588	1.166	4	4.1	1.12	0.69
N08	MITCHELSTOWN	3090	13395	2.084	19	3.7	1.23	0.68
N07	MONASTEREVIN	2224	11968	1.754	7	1.8	0.63	0.68
N15	CLIFFONEY	292	5089	0.652	2	3.3	1.37	0.67
N09	GOWRAN	477	2517	0.949	2	4.6	0.84	0.67
N08	FERMOY	4462	10622	2.955	23	4.0	1.03	0.66
N04	RATHOWEN	500	5465	0.439	1	2.3	0.40	0.66
N04	NEWTOWNFORBES	250	3711	1.169	2	2.5	1.60	0.65
N30	NEW ROSS	6079	3514	2.126	8	5.9	0.26	0.65
N07	NENAGH	5825	8352	2.422	18	4.9	0.62	0.64
N07	MOUNTRATH	1375	6980	1.827	8	3.4	1.16	0.63
N01	BALBRIGGAN	7724	13451	3.226	33	4.2	0.85	0.63
N15	LISCOOLEY	500	6024	0.423	2	4.3	0.80	0.63
N17	TOBERCURRY	1069	4585	2.168	6	3.3	1.12	0.61
N03	NAVAN	11706	11782	4.695	43	4.3	0.73	0.61
N04	ENFIELD	500	10570	1.127	2	0.9	0.80	0.58
N30	CLONROCHE	500	2786	1.049	2	3.7	0.80	0.57
N09	CARLOW	14027	9020	5.154	37	4.4	0.53	0.57
N16	MANORHAMILTON	995	2393	1.665	3	4.1	0.60	0.56
N24	MOONCOIN	500	8954	1.507	2	0.8	0.80	0.56
N06	LOUGHREA	3271	8389	2.95	15	3.3	0.92	0.56
N06	MOATE	1529	5973	2.482	4	1.5	0.52	0.56
N08	CULLAHILL	500	6063	0.51	1	1.8	0.40	0.55
N08	URLINGFORD	689	6407	1.309	4	2.6	1.16	0.55
N08	CASHEL	2814	7238	2.342	11	3.6	0.78	0.55
N11	GOREY	3840	13253	1.949	16	3.4	0.83	0.55
N11	FERNS	859	5192	0.974	3	3.3	0.70	0.50
N18	ENNIS	16058	13516	7.938	59	3.0	0.73	0.49
N23	CASTLEISLAND	2207	3515	0.727	2	4.3	0.18	0.47
N05	BELLANAGARE	500	2309	0.639	1	3.7	0.40	0.47
N04	KINNEGAD	415	6954	2.589	3	0.9	1.45	0.45
N09	CASTLEDERMOT	741	6112	2.144	4	1.7	1.08	0.44
N11	ARKLOW	7987	12321	3.857	24	2.8	0.60	0.43
N18	CRUSHEEN	500	5852	0.853	1	1.1	0.40	0.42
N03	VIRGINIA	720	6683	1.261	3	2.0	0.83	0.40
N05	BALLAGHADERREEN	1270	4251	2.127	4	2.4	0.63	0.40
N07	BALLYBRITTAS	500	10826	0.524	1	1.0	0.40	0.39
N06	TYRRELLSPASS	376	6707	1.407	1	0.6	0.53	0.38
N11	ENNISCORTHY	7655	7570	1.269	6	3.4	0.16	0.38
N04	SLIGO	17964	15138	3.821	31	2.9	0.35	0.38
N24	TIPPERARY	4963	11547	2.213	12	2.6	0.48	0.38
N26	SWINFORD	1216	1928	1.963	2	2.9	0.33	0.37
N07	BIRDHILL	500	9770	0.702	2	1.6	0.80	0.36
N07	KILDARE	4196	14907	2.763	14	1.9	0.67	0.35
N20	MALLOW	7521	10164	2.681	13	2.6	0.35	0.35
N05	STROKESTOWN	568	2809	2.371	2	1.6	0.70	0.34
N10	KNOCKTOPHER	500	2734	0.841	1	2.4	0.40	0.34
N17	TUAM	5540	10723	3.05	13	2.2	0.47	0.34
N04	EDGEWORTHSTOWN	801	5520	2.094	3	1.4	0.75	0.33
N04	BALLYSADARE	500	8617	0.996	2	1.3	0.80	0.33
N10	STONYFORD	500	3401	0.717	1	2.2	0.40	0.32

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 million vehkm	Collisions per year per 1000 Population	+Combined Collision Rate
N21	CASTLEISLAND	2207	5467	1.873	4	2.1	0.36	0.30
N07	PORTLAOISE	8360	12097	5.01	19	1.7	0.45	0.29
N09	THOMASTOWN	2512	3261	2.244	3	2.2	0.24	0.28
N05	TULSK	500	2220	1.432	1	1.7	0.40	0.27
N25	SWEEP	500	4274	0.755	1	1.7	0.40	0.27
N06	GALWAY	60000	24461	5.106	50	2.2	0.17	0.26
N03	DROLCHEAD NUA	11778	5345	0.4	1	2.6	0.02	0.26
N03	BELTURBET	1223	3316	1.868	2	1.8	0.33	0.26
N08	DURROW	721	7244	1.338	2	1.1	0.55	0.25
N05	WESTPORT	3688	12879	1.194	5	1.8	0.27	0.25
N19	SHANNON	7920	14965	0.5	3	2.2	0.08	0.24
N21	ADARE	500	3348	1.288	1	1.3	0.40	0.23
N07	ROSCREA	4231	7718	3.502	7	1.4	0.33	0.22
N17	KNOCK	440	3958	1.251	1	1.1	0.45	0.22
N10	KILKENNY	17669	7149	3.379	8	1.8	0.09	0.20
N13	STRANORLAR	2972	7141	0.925	2	1.7	0.13	0.20
N20	LIMERICK	75000	20672	6.595	42	1.7	0.11	0.20
N24	CLONMEL	15562	7270	5.907	12	1.5	0.15	0.19
N13	BRIDGE END	500	8153	0.75	1	0.9	0.40	0.19
N05	CASTLEBAR	7648	7442	3.988	7	1.3	0.18	0.18
N17	CLAREMORRIS	1907	5058	1.868	2	1.2	0.21	0.17
N24	OOLA	474	4864	1.937	1	0.6	0.42	0.16
N07	LIMERICK	75000	15709	10.841	41	1.3	0.11	0.16
N21	TEMPLEGLANTINE	819	6759	0.828	1	1.0	0.24	0.16
N17	GALWAY	60000	27843	3.176	20	1.2	0.07	0.14
N05	LONGFORD	6824	6874	4.021	5	1.0	0.15	0.14
N07	DUBLIN	500000	47272	2.387	22	1.1	0.01	0.11
N04	BOYLE	2197	3199	2.036	1	0.8	0.09	0.11
N11	DUBLIN	500000	40055	13.999	95	0.9	0.04	0.10
N04	DUBLIN	500000	29736	9.209	42	0.8	0.02	0.09
N18	LIMERICK	75000	27171	5.095	17	0.7	0.05	0.08
N09	WATERFORD	75000	14883	1.693	3	0.7	0.01	0.07
N50	DUBLIN	600000	18676	12.4	10	0.2	0.00	0.02
N24	LIMERICK	75436	10740	3.098	1	0.2	0.00	0.02
N08	CORK	136000	32213	4.14	2	0.1	0.00	0.01
N22	CORK	136000	25429	3.556	1	0.1	0.00	0.01
N09	BALLYHALE	500	3858	0.867	0	0.0	0.00	0.00
N17	BALLYNACARROW	500	3807	0.798	0	0.0	0.00	0.00
N04	BALLYNALACK	500	5465	0.748	0	0.0	0.00	0.00
N03	BALLYSHANNON	2838	3088	0.899	0	0.0	0.00	0.00
N05	CARRACASTLE	500	2956	1.215	0	0.0	0.00	0.00
N04	CASTLEBALDWIN	500	3199	0.252	0	0.0	0.00	0.00
N18	CLARINBRIDGE	500	9565	1.417	0	0.0	0.00	0.00
N20	CORK	136000	15947	4.267	0	0.0	0.00	0.00
N27	CORK	136000	13277	3.778	0	0.0	0.00	0.00
N01	DUBLIN	500000	28975	4.298	0	0.0	0.00	0.00
N02	DUBLIN	500000	11524	6.397	0	0.0	0.00	0.00
N03	DUBLIN	500000	21436	4.357	0	0.0	0.00	0.00
N06	HORSELEAP	500	6769	0.735	0	0.0	0.00	0.00
N06	KILBEGGAN	617	6707	1.286	0	0.0	0.00	0.00
N14	LETTERKENNY	10726	15411	0.93	0	0.0	0.00	0.00
N17	MILLTOWN	500	5467	0.869	0	0.0	0.00	0.00
N21	PATRICKSWELL	1019	3348	0.274	0	0.0	0.00	0.00

Route	Town / Village	Population	AADT	Length	Colls over 5 yrs	Collisions per 10 million vehkm	Collisions per year per 1000 Population	+Combined Collision Rate
N09	PAULSTOWN	234	6653	0.721	0	0.0	0.00	0.00
N04	ROOSKY	249	3827	0.696	0	0.0	0.00	0.00
N28	SHANBALLY	500	5098	0.506	0	0.0	0.00	0.00
N05	TERMONBARRY	500	3366	0.98	0	0.0	0.00	0.00
N25	WATERFORD	41853	10668	8.427	0	0.0	0.00	0.00
N25	BALLINABOOLA*							
N25	BARNTOWN*							
N07	DALY'S CROSS*							
N18	GORT RD, ENNIS*							
N20	NEWTWOPOTHOUSE*							
N08	RINGASKIDDY*							

+ Combined Collision Rate: [Coll Rate /10mvehkm/yr/5 + Coll Rate /1000pop/yr/2]/2

** These towns and villages were not assessed as funding was already committed.*

APPENDIX B
Scheme Details for All Sites

Scheme	Local Authority	Rte	Both or Half?	Spd Lim	Type	Colls 4 yrs before raw	Colls 4 yrs after raw	Drop in Ann Colls Adj for All Nats	Area Evaluated	Year Finished	Year Started	Year Bypassed	Year Changed	Total Cost in 2002 Prices
Carrickarnon	Louth	1	both	60	F	15	10	0.79	Gate - Gate	2001		2007		109,400
Greengates	Louth	1	both	40	B	8	2	1.30	Gate - Gate	1997		2002		489,900
Kilsaran/Castlebellingham	Louth	1	both	30	A	23	10	2.60	Gate - Gate	1997	1997	2002		255,600
Julianstown	Meath	1	both	30	C	13	10	0.24	Gate - Gate	1999	1999	2003		767,700
Emyvale	Monaghan	2	both	30	F	5	7	-0.65	Gate - Gate	2001				46,500
Castleblaney (N)	Monaghan	2	2nd half	40	A	3	5	-0.73	Gate - Bend	2000	2000	2007		132,300
Carrickmacross (N)	Monaghan	2	half	40	A	7	4	0.08	Gate - Bend	1998	1998	2005		92,500
Ardee (S)	Louth	2	half	30	A	4	9	-1.52	Gate - R170 Jcn	1997	1997			238,300
Collon	Louth	2	both	30	E	6	7	-0.38	Gate - Gate	1997	1996			251,600
Slane	Meath	2	both	30	A	8	5	0.48	Gate - Gate	2002	2001			534,500
Kells	Meath	3	both	30	A	8	8	-0.24	Gate - Gate	2001				730,900
Castlebaldwin	Sligo	4	both	30	A	5	2	0.62	Gate - Gate	1999	1998			547,500
Dromod	Leitrim	4	both	30	B	1	3	-0.52	Gate - Gate	2000	1999	2008		418,300
Roosky (E)	Leitrim	4	half	30	B		1	-0.25	Gate - Centre	1998	1997	2008		123,300
Newtownforbes (E)	Longford	4	1st half	30	F	1	2	-0.28	Gate - Bend	2001			2003	73,800
Rathowen	Westmeath	4	both	30	A	1	1	-0.02	Gate - Gate	1999	1999			369,400
Clonard (E)	Meath	4	half	40	B	1	1	-0.00	Gate - Centre	1997		2006		53,200
Enfield	Meath	4	both	30	C	8	2	1.14	Gate - Gate	1999	1998	2002		73,900
Charlestown/Bellahy (W/N)	Mayo	5	half	30	A	7		1.32	Gates - Centre	1999	1998	2008		523,400
Frenchpark	Roscommon	5	both	30	F	5	3	0.32	Gate - Gate	2001				133,600
Craughwell	Galway	6	both	40	F	6	6	-0.15	Gate - Gate	2000	1999			30,600
Rochfordbridge	Westmeath	6	both	30	A	7	5	0.37	Gate - Gate	1998	1998	2006		199,600
Miltownpass	Westmeath	6	both	40	F	1	1	-0.02	Gate - Gate	2000	2000	2006	2005	248,000

Scheme	Local Authority	Rte	Both or Half?	Spd Lim	Type	Colls 4 yrs before raw	Colls 4 yrs after raw	Drop in Ann Colls Adj for All Nats	Area Evaluated	Year Finished	Year Started	Year Bypassed	Year Changed	Total Cost in 2002 Prices
Moneygall	Offaly	7	both	30	C	2	4	-0.56	Gate - Gate	2001	1997		2002	410,900
Ballybrittas	Laois	7	both	40	A	5	3	0.25	Gate - Gate	2002		2005		197,900
Monasterevin (W)	Kildare	7	half	30	G	4	1	0.64	Gate - Bridge	1998	1998	2005		29,900
Cullahill	Laois	8	both	40	A	1	2	-0.27	Gate - Gate	2000	1999			134,200
Abbeyleix (S)	Laois	8	half	30	A	1	4	-0.77	Gate - Centre	2000	2000			330,700
Mullinavat (N)	Kilkenny	9	half	30	G	6	3	0.57	Gate - Centre	2001				96,600
Dungarvan	Kilkenny	9	both	40	G	1	2	-0.28	Gate - Gate	2001				212,700
Paulstown	Kilkenny	9	both	30	A	2		0.46	Gate - Gate	1999	1998			184,700
Kilkenny (E)	Kilkenny	10	single entry	30	B	10	3	1.33	Gate - Centre	2001				195,200
Claragh	Kilkenny	10	both	60	F	2	2	-0.16	Gate - Gate	1999				206,500
Camolin	Wexford	11	both	30	A	5	1	0.73	Gate - Gate	2002				581,000
Ashford	Wicklow	11	both	30	E	16	7	1.60	Gate - Gate	1999	1998	2004		92,300
Lifford (N & W)	Donegal	14	both	30	A	10	5	0.95	Gate - Gate	2001				70,400
Castlefinn	Donegal	15	both	30	A	4	1	0.63	Gate - Gate	2001				127,500
Killygordon	Donegal	15	both	30	H	2	2	-0.04	Gate - Gate	2002				113,300
Ballybofey (S)	Donegal	15	half	40	A	9	6	0.29	Gate - Centre	2002				246,400
Ballyshannon (S)	Donegal	15	2nd half	40	G	7	6	-0.06	Gate - Bridge	1997	1996	2006		159,700
Bundoran	Donegal	15	both	40	H	9	15	-1.63	Gate - Gate	1997		2006		41,900
Cliffony	Sligo	15	both	30	A	2	1	0.19	Gate - Gate	2001				143,800
Grange	Sligo	15	both	30	A	9	2	1.49	Gate - Gate	2000	1999			172,500
Drumcliffe	Sligo	15	both	30	F	7	5	0.33	Gate - Gate	2000	1999			259,100
Ballindine	Mayo	17	both	30	E	3	6	-0.91	Gate - Gate	1997	1997			106,500
Claregalway	Galway	17	both	30	A	3	7	-1.16	Gate - Gate	1998	1997			328,300
Kilcolgan	Galway	18	both	40	E	8	8	-0.42	Gate - Gate	1999	1999		2003	46,200
Ardrahan	Galway	18	both	30	J	6	1	0.96	Gate - Gate	1999	1999			46,200
Crusheen (N)	Clare	18	half	30	E		1	-0.25	Gate - Bend	1998	1997		2003	251,400
Barefield (N)	Clare	18	half	40	G	2	1	0.21	Gate - Centre	1998	1997	2007		251,400

Scheme	Local Authority	Rte	Both or Half?	Spd Lim	Type	Colls 4 yrs before raw	Colls 4 yrs after raw	Drop in Ann Colls Adj for All Nats	Area Evaluated	Year Finished	Year Started	Year Bypassed	Year Changed	Total Cost in 2002 Prices
Charleville (S)	Cork	20	1st half	30	A	2	2	-0.06	Gate - Ped X	2001			2004	165,400
Ballyhea	Cork	20	both	40	A		1	-0.25	Gate - Gate	1999	1999			784,900
Newtwopothouse	Cork	20	both	40	A	4		0.84	Gate - Gate	2001				165,400
Cork (N)	Cork	20	single entry	40	I	1	2	-0.30	Gate - Ped X	2002				239,700
Farranfore	Kerry	22	both	30	F	4	5	-0.32	Gate - Gate	1998	1998		2003	20,000
Killarney (E)	Kerry	22	single entry	40	D	8	3	0.85	Gate - Rbt	1998	1998			59,900
Ballyvourney	Cork	22	both	30	E	3	6	-0.90	Gate - Gate	2002	2001			570,300
Lissarda	Cork	22	both	40	A	4	4	-0.22	Gate - Gate	2002				333,900
Ballincollig (W)	Cork	22	half	30	B	10	8	0.41	Gate - Rbt	1997	1997	2004		496,300
Cork (W)	Cork	22	single entry	30	A			0.00	Gate - Vic X	1999		2004		193,900
Monard	South Tipperary	24	both	30	I		1	-0.25	Gate - Gate	1998	1998			39,300
Bansha	South Tipperary	24	both	30	I	2	2	-0.04	Gate - Gate	2001				138,400
Kilsheelan	South Tipperary	24	both	30	A	2		0.43	Gate - Gate	1999	1997		2007	194,500
Carrick-on-Suir (W)	South Tipperary	24	2nd half	30	A	3		0.66	Gate - Mini Rbt	2001				211,900
Mooncoin	Kilkenny	24	both	30	F	5	8	-0.88	Gate - Gate	1998	1998			140,000
Lemybrien	Waterford	25	both	40	A	1	1	-0.02	Gate - Gate	1998	1997			165,700
Waterford (E)	Kilkenny	25	single entry	30	A	5	1	0.84	Gate - Rbt	1997	1997			63,900
Ballinaboola	Wexford	25	both	30	A	3	3	-0.24	Gate - Gate	1999	1999			554,100
Barntown	Wexford	25	both	40	A	1	2	-0.37	Gate - Gate	1997	1997			639,000
Kilrane (W)	Wexford	25	half	30	A	4	4	-0.25	Gate - Speed Lim	1999	1998		2004	300,400
Rosslare Harbour (W)	Wexford	25	single entry	15	E			0.00	Gate - Harbour	2001			2004	16,000
Foxford	Mayo	26	both	30	I	6	1	0.83	Gate - Gate	2001				33,300

Scheme	Local Authority	Rte	Both or Half?	Spd Lim	Type	Colls 4 yrs before raw	Colls 4 yrs after raw	Drop in Ann Colls Adj for All Nats	Area Evaluated	Year Finished	Year Started	Year Bypassed	Year Changed	Total Cost in 2002 Prices
Clonroche	Wexford	30	both	30	F	4	2	0.35	Gate - Gate	2001				20,400
New Ross (N)	Wexford	30	both	30	A	2	4	-0.60	Gate - Gate	2002				47,500
Smithborough (W)	Monaghan	54	half	30	A	2	1	0.19	Gate - Centre	2001				56,900
Carrickboy	Longford	55	both	40	H	2	3	-0.37	Gate - Gate	2002				57,100
Gortahork	Donegal	56	both	30	I	1	5	-1.05	Gate - Gate	2002				45,500
Dromore West	Sligo	59	both	30	A	4		0.84	Gate - Gate	2000				156,200
Ballisodare	Sligo	59	both	30	A			0.00	Gate - Speed Lim	2002	1997			142,700
Hodson Bay	Roscommon	61	both	40	A	5		1.12	Gate - Gate	2001				432,500
Birr	Offaly	62	both	30	C	15	9	0.87	Gate - Gate	2001				94,700
Loughrea (W)	Galway	66	single entry	30	I	1	3	-0.52	Gate - N6 Jcn	1999	1999			55,400
Ballylickey	Cork	71	both	40	I	1	2	-0.37	Gate - Gate	1997				228,500
Bantry (N)	Cork	71	half	30	E	5	5	-0.27	Gate - Centre	2002				115,600
Clonakilty	Cork	71	both	30	C	4	1	0.59	Gate - Gate	1999				331,600
Grangemockler	South Tipperary	76	both	30	I	2		0.42	Gate - Gate	1998	1998		2003	51,900
Kilkenny (N)	Kilkenny	77	single entry	30	E	6	8	-0.68	Gate - Centre	2001				195,200
Newtown	Laois	78	both	40	A	5	1	0.73	Gate - Gate	2002				181,400
Killeigh	Offaly	80	both	30	B			0.00	Gate - Gate	1999	1999			97,400
Kilmaine (N)	Mayo	84	half	30	B	1		0.19	Gate - R332 Jcn	1998				99,800
Swanlinbar (S)	Cavan	87	half	30	E	1	1	-0.05	Gate - Centre	2002				39,900

APPENDIX C
Collision Data, Cost Data and First Year Rate of Return for All Sites.

Location	Rte	Yr	Construction Cost	4 Years Before				4 Years After				Drop in Annual Collisions, adjusted				Cost Saving from Drop in Collision				Yearly Rate of Return
				F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	
Carrickarnon	1	01	109,400	3	1	11	15	1	1	8	10	0.46	-0.09	0.42	0.79	1,047,600	-27,300	12,600	**1,032,900**	944%
Greengates	1	97	489,900	2	1	5	8	0	0	2	2	0.43	0.13	0.74	1.30	969,700	40,900	22,200	**1,032,800**	211%
Kilsaran/Castlebellingham	1	97	255,600	1	5	17	23	1	0	9	10	-0.04	0.67	1.97	2.60	-85,200	204,700	59,000	**178,500**	70%
Julianstown	1	99	767,700	0	3	10	13	1	1	8	10	-0.25	0.17	0.32	0.24	-570,000	53,300	9,500	**-507,200**	-66%
Emyvale	2	01	46,500	0	0	5	5	0	2	5	7	0.00	-0.50	-0.15	-0.65	0	-152,300	-4,500	**-156,800**	-337%
Castleblaney (N)	2	00	132,300	0	2	1	3	0	2	3	5	0.00	-0.21	-0.52	-0.73	0	-62,800	-15,600	**-78,400**	-59%
Carrickmacross (N)	2	98	92,500	0	5	2	7	0	0	4	4	0.00	0.62	-0.54	0.08	0	188,700	-16,100	**172,600**	187%
Ardee (S)	2	97	238,300	1	2	1	4	1	4	4	9	-0.04	-0.73	-0.75	-1.52	-85,200	-222,700	-22,600	**-330,500**	-139%
Collon	2	97	251,600	0	1	5	6	0	3	4	7	0.00	-0.62	0.24	-0.38	0	-187,500	7,200	**-180,300**	-72%
Slane	2	02	534,500	3	2	3	8	0	0	5	5	0.77	0.36	-0.65	0.48	1,761,000	109,400	-19,400	**1,851,000**	346%
Kells	3	01	730,900	0	0	8	8	1	1	6	8	-0.25	-0.25	0.26	-0.24	-570,000	-76,200	7,800	**-638,400**	-87%
Castlebaldwin	4	99	547,500	1	0	4	5	0	0	2	2	0.20	0.00	0.43	0.62	451,800	0	12,800	**464,600**	85%
Dromod	4	00	418,300	0	0	1	1	0	2	1	3	0.00	-0.50	-0.02	-0.52	0	-152,300	-600	**-152,900**	-37%
Roosky (E)	4	98	123,300	0	0	0	0	0	0	1	1	0.00	0.00	-0.25	-0.25	0	0	-7,500	**-7,500**	-6%
Newtownforbes (E)	4	01	73,800	0	0	1	1	0	0	2	2	0.00	0.00	-0.28	-0.28	0	0	-8,400	**-8,400**	-11%
Rathowen	4	99	369,400	0	0	1	1	0	1	0	1	0.00	-0.25	0.23	-0.02	0	-76,200	6,900	**-69,300**	-19%
Clonard (E)	4	97	53,200	0	0	1	1	0	0	1	1	0.00	0.00	-0.00	-0.00	0	0	-100	**-100**	-0%
Enfield	4	99	73,900	1	2	5	8	0	0	2	2	0.20	0.28	0.66	1.14	451,800	86,300	19,700	**557,800**	755%
Charlestown/Bellahy (W/N)	5	99	523,400	1	3	3	7	0	0	0	0	0.20	0.42	0.69	1.32	451,800	129,400	20,800	**602,000**	115%
Frenchpark	5	01	133,600	2	1	2	5	0	1	2	3	0.47	-0.09	-0.06	0.32	1,078,400	-27,300	-1,800	**1,049,300**	785%
Craughwell	6	00	30,600	1	0	5	6	0	0	6	6	0.20	0.00	-0.35	-0.15	454,600	0	-10,400	**444,200**	1,452%
Rochfordbridge	6	98	199,600	0	0	7	7	0	0	5	5	0.00	0.00	0.37	0.37	0	0	11,200	**11,200**	6%
Miltownpass	6	00	248,000	0	0	1	1	0	0	1	1	0.00	0.00	-0.02	-0.02	0	0	-600	**-600**	-0%
Moneygall	7	01	410,900	0	0	2	2	0	2	2	4	0.00	-0.50	-0.06	-0.56	0	-152,300	-1,800	**-154,100**	-38%

Location	Rte	Yr	Construction Cost	4 Years Before				4 Years After				Drop in Annual Collisions, adjusted				Cost Saving from Drop in Collision				Yearly Rate of Return
				F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	
Ballybrittas	7	02	197,900	0	0	5	5	0	0	3	3	0.00	0.00	0.25	0.25	0	0	7,600	**7,600**	4%
Monasterevin (W)	7	98	29,900	1	0	3	4	0	0	1	1	0.19	0.00	0.45	0.64	434,000	0	13,400	**447,400**	1,496%
Cullahill	8	00	134,200	0	0	1	1	1	0	1	2	-0.25	0.00	-0.02	-0.27	-570,000	0	-600	**-570,600**	-425%
Abbeyleix (S)	8	00	330,700	0	0	1	1	0	1	3	4	0.00	-0.25	-0.52	-0.77	0	-76,200	-15,600	**-91,800**	-28%
Mullinavat (N)	9	01	96,600	0	0	6	6	0	0	3	3	0.00	0.00	0.57	0.57	0	0	17,100	**17,100**	18%
Dungarvan	9	01	212,700	0	0	1	1	0	0	2	2	0.00	0.00	-0.28	-0.28	0	0	-8,400	**-8,400**	-4%
Paulstown	9	99	184,700	0	0	2	2	0	0	0	0	0.00	0.00	0.46	0.46	0	0	13,900	**13,900**	8%
Kilkenny (E)	10	01	195,200	0	2	8	10	0	1	2	3	0.00	0.07	1.26	1.33	0	21,600	37,800	**59,400**	30%
Claragh	10	99	206,500	1	1	0	2	0	0	2	2	0.20	0.14	-0.50	-0.16	451,800	43,100	-15,000	**479,900**	232%
Camolin	11	02	581,000	0	1	4	5	0	0	1	1	0.00	0.18	0.55	0.73	0	54,700	16,600	**71,300**	12%
Ashford	11	99	92,300	0	4	12	16	0	1	6	7	0.00	0.32	1.28	1.60	0	96,400	38,400	**134,800**	146%
Lifford (N & W)	14	01	70,400	0	0	10	10	0	0	5	5	0.00	0.00	0.95	0.95	0	0	28,500	**28,500**	40%
Castlefinn	15	01	127,500	0	0	4	4	0	0	1	1	0.00	0.00	0.63	0.63	0	0	18,900	**18,900**	15%
Killygordon	15	02	113,300	1	0	1	2	0	0	2	2	0.26	0.00	-0.30	-0.04	587,000	0	-9,000	**578,000**	510%
Ballybofey (S)	15	02	246,400	0	1	8	9	0	1	5	6	0.00	-0.07	0.36	0.29	0	-21,500	10,700	**-10,800**	-4%
Ballyshannon (S)	15	97	159,700	2	2	3	7	0	1	5	6	0.43	0.02	-0.51	-0.06	969,700	5,700	-15,200	**960,200**	601%
Bundoran	15	97	41,900	0	1	8	9	0	4	11	15	0.00	-0.87	-0.77	-1.63	0	-263,700	-23,000	**-286,700**	-684%
Cliffony	15	01	143,800	0	0	2	2	0	1	0	1	0.00	-0.25	0.44	0.19	0	-76,200	13,200	**-63,000**	-44%
Grange	15	00	172,500	0	1	8	9	1	0	1	2	-0.25	0.15	1.59	1.49	-570,000	44,800	47,800	**-477,400**	-277%
Drumcliffe	15	00	259,100	1	0	6	7	1	1	3	5	-0.05	-0.25	0.63	0.33	-115,400	-76,200	19,000	**-172,600**	-67%
Ballindine	17	97	106,500	1	1	1	3	0	2	4	6	0.21	-0.37	-0.75	-0.91	484,800	-111,400	-22,600	**350,800**	329%
Claregalway	17	98	328,300	0	1	2	3	0	2	5	7	0.00	-0.38	-0.79	-1.16	0	-114,600	-23,600	**-138,200**	-42%
Kilcolgan	18	99	46,200	0	3	5	8	0	1	7	8	0.00	0.17	-0.59	-0.42	0	53,300	-17,800	**35,500**	77%
Ardrahan	18	99	46,200	0	2	4	6	0	0	1	1	0.00	0.28	0.68	0.96	0	86,300	20,300	**106,600**	231%
Crusheen (N)	18	98	251,400	0	0	0	0	0	1	0	1	0.00	-0.25	0.00	-0.25	0	-76,200	0	**-76,200**	-30%
Barefield (N)	18	98	251,400	0	0	2	2	0	1	0	1	0.00	-0.25	0.46	0.21	0	-76,200	13,900	**-62,300**	-25%
Charleville (S)	20	01	165,400	0	0	2	2	0	1	1	2	0.00	-0.25	0.19	-0.06	0	-76,200	5,700	**-70,500**	-43%

Location	Rte	Yr	Construction Cost	4 Years Before				4 Years After				Drop in Annual Collisions, adjusted				Cost Saving from Drop in Collision				Yearly Rate of Return
				F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	
Ballyhea	20	99	784,900	0	0	0	0	0	0	1	1	0.00	0.00	-0.25	-0.25	0	0	-7,500	**-7,500**	-1%
Newtwopothouse	20	01	165,400	1	1	2	4	0	0	0	0	0.24	0.16	0.44	0.84	539,200	48,900	13,200	**601,300**	364%
Cork (N)	20	02	239,700	0	0	1	1	0	0	2	2	0.00	0.00	-0.30	-0.30	0	0	-9,000	**-9,000**	-4%
Farranfore	22	98	20,000	0	0	4	4	0	0	5	5	0.00	0.00	-0.32	-0.32	0	0	-9,700	**-9,700**	-49%
Killarney (E)	22	98	59,900	1	2	5	8	1	0	2	3	-0.06	0.25	0.66	0.85	-136,000	75,500	19,800	**-40,700**	-68%
Ballyvourney	22	02	570,300	0	0	3	3	2	0	4	6	-0.50	0.00	-0.40	-0.90	-1,140,000	0	-11,900	**-1,151,900**	-202%
Lissarda	22	02	333,900	0	1	3	4	0	1	3	4	0.00	-0.07	-0.15	-0.22	0	-21,500	-4,400	**-25,900**	-8%
Ballincollig (W)	22	97	496,300	2	0	8	10	1	0	7	8	0.18	0.00	0.23	0.41	399,700	0	7,000	**406,700**	82%
Cork (W)	22	99	193,900	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	**0**	0%
Monard	24	98	39,300	0	0	0	0	0	0	1	1	0.00	0.00	-0.25	-0.25	0	0	-7,500	**-7,500**	-19%
Bansha	24	01	138,400	1	0	1	2	0	1	1	2	0.24	-0.25	-0.03	-0.04	539,200	-76,200	-900	**462,100**	334%
Kilsheelan	24	99	194,500	1	0	1	2	0	0	0	0	0.20	0.00	0.23	0.43	451,800	0	6,900	**458,700**	236%
Carrick-on-Suir (W)	24	01	211,900	0	0	3	3	0	0	0	0	0.00	0.00	0.66	0.66	0	0	19,800	**19,800**	9%
Mooncoin	24	98	140,000	1	0	4	5	1	1	6	8	-0.06	-0.25	-0.57	-0.88	-136,000	-76,200	-17,200	**-229,400**	-164%
Lemybrien	25	98	165,700	0	0	1	1	0	1	0	1	0.00	-0.25	0.23	-0.02	0	-76,200	7,000	**-69,200**	-42%
Waterford (E)	25	97	63,900	1	1	3	5	0	0	1	1	0.21	0.13	0.49	0.84	484,800	40,900	14,800	**540,500**	846%
Ballinaboola	25	99	554,100	0	2	1	3	0	1	2	3	0.00	0.03	-0.27	-0.24	0	10,100	-8,100	**2,000**	0%
Barntown	25	97	639,000	0	1	0	1	0	0	2	2	0.00	0.13	-0.50	-0.37	0	40,900	-15,000	**25,900**	4%
Kilrane (W)	25	99	300,400	0	2	2	4	0	2	2	4	0.00	-0.22	-0.04	-0.25	0	-66,000	-1,100	**-67,100**	-22%
Rosslare Harbour (W)	25	01	16,000	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	**0**	0%
Foxford	26	01	33,300	0	4	2	6	0	0	1	1	0.00	0.64	0.19	0.83	0	195,400	5,700	**201,100**	604%
Clonroche	30	01	20,400	2	1	1	4	1	0	1	2	0.22	0.16	-0.03	0.35	508,400	48,900	-900	**556,400**	2,727%
New Ross (N)	30	02	47,500	0	0	2	2	0	1	3	4	0.00	-0.25	-0.35	-0.60	0	-76,200	-10,500	**-86,700**	-183%
Smithborough (W)	54	01	56,900	0	0	2	2	0	0	1	1	0.00	0.00	0.19	0.19	0	0	5,700	**5,700**	10%
Carrickboy	55	02	57,100	0	1	1	2	0	1	2	3	0.00	-0.07	-0.30	-0.37	0	-21,500	-9,000	**-30,500**	-53%
Gortahork	56	02	45,500	0	0	1	1	1	0	4	5	-0.25	0.00	-0.80	-1.05	-570,000	0	-24,000	**-594,000**	-1,305%
Dromore West	59	00	156,200	0	1	3	4	0	0	0	0	0.00	0.15	0.69	0.84	0	44,800	20,700	**65,500**	42%

Location	Rte	Yr	Construction Cost	4 Years Before				4 Years After				Drop in Annual Collisions, adjusted				Cost Saving from Drop in Collision				Yearly Rate of Return
				F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	F	S	M	Tot	
Ballisodare	59	02	142,700	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	**0**	0%
Hodson Bay	61	01	432,500	1	0	4	5	0	0	0	0	0.24	0.00	0.88	1.12	539,200	0	26,400	**565,600**	131%
Birr	62	01	94,700	0	3	12	15	0	1	8	9	0.00	0.23	0.64	0.87	0	70,400	19,200	**89,600**	95%
Loughrea (W)	66	99	55,400	0	0	1	1	0	1	2	3	0.00	-0.25	-0.27	-0.52	0	-76,200	-8,100	**-84,300**	-152%
Ballylickey	71	97	228,500	0	1	0	1	0	1	1	2	0.00	-0.12	-0.25	-0.37	0	-35,200	-7,500	**-42,700**	-19%
Bantry (N)	71	02	115,600	0	1	4	5	0	0	5	5	0.00	0.18	-0.45	-0.27	0	54,700	-13,400	**41,300**	36%
Clonakilty	71	99	331,600	0	1	3	4	0	0	1	1	0.00	0.14	0.44	0.59	0	43,100	13,300	**56,400**	17%
Grangemockler	76	98	51,900	1	0	1	2	0	0	0	0	0.19	0.00	0.23	0.42	434,000	0	7,000	**441,000**	850%
Kilkenny (N)	77	01	195,200	0	0	6	6	0	0	8	8	0.00	0.00	-0.68	-0.68	0	0	-20,400	**-20,400**	-10%
Newtown	78	02	181,400	0	1	4	5	0	1	0	1	0.00	-0.07	0.80	0.73	0	-21,500	24,100	**2,600**	1%
Killeigh	80	99	97,400	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	**0**	0%
Kilmaine (N)	84	98	99,800	1	0	0	1	0	0	0	0	0.19	0.00	0.00	0.19	434,000	0	0	**434,000**	435%
Swanlinbar (S)	87	02	39,900	0	0	1	1	0	0	1	1	0.00	0.00	-0.05	-0.05	0	0	-1,500	**-1,500**	-4%
			19,457,200	**36**	**72**	**300**	**408**	**15**	**52**	**235**	**302**	**4.11**	**-2.49**	**9.20**	**10.82**	**9,376,400**	**-759,100**	**276,100**	**8,892,000**	**46%**