Accidents on Rural Roads: Single Carriageway 'A' Class Roads

Cambridgeshire County Council

AA Foundation for Road Safety Research

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Accident
An incident involving personal injury occurring on the public highway (including footways) in which a road vehicle is involved and which becomes known to the Police within 30 days of its occurrence. No records are kept by Cambridgeshire County Council of incidents involving damage to property only.

Cars
Includes three-wheel cars, four-wheel cars, taxis and invalid tricycles.

Casualty
A person killed or injured in an accident. Casualties are sub-divided into killed, seriously injured and slightly injured.

Fatal accident
One in which at least one person dies, within 30 days, from injuries sustained in the accident (excludes suicides, deaths by natural causes while in control of a motor vehicle, and deaths occurring on roads within the jurisdiction of British Transport Police i.e. accidents at railway crossings).

Forward visibility
Parameter used by engineers in the design of roads. Forward visibility is sub-divided into **Good, Fair** and **Poor.** **Good** is where the forward visibility is greater than 580 metres: **Fair** is where forward visibility is between 215 metres and 580 metres, and **Poor** is where forward visibility is less than 215 metres.

HORT7
Form completed by a Police Officer at the scene of an accident.

Heavy goods vehicles
All lorries which, when fully laden, weigh more than 3.5 tonnes.

KSI
Accidents: those involving death or serious injury. Casualties: people killed or seriously injured.

Light goods vehicles
All vans and lorries weighing up to 3.5 tonnes fully laden.

Major road
The road to which is assigned a permanent priority of traffic movement over that of the other road or roads.

Minor road
The road which has to give priority to the major road.

Motor cycles
Mopeds, motor scooters, motor cycles and motor cycle combinations.

Odds
Of an accident type: is the probability of an accident being of a particular type divided by the probability of an accident being of any other type.

Pedestrian
Includes persons wheeling or holding a bicycle; a driver or passenger who has alighted from a vehicle; a person herding animals.

Public road junction
Any junction maintained by the highway authority. These include T and staggered junctions, cross roads, Y-junctions and multiple junctions.

Private access
Any junction not maintained by the highway authority. This junction group incorporates the entrances to farms and fields, private houses, roadside petrol filling stations, restaurants and cafes.

Rural roads
Roads with a speed limit in excess of 40 miles/h.

Serious accident
One in which at least one person is seriously injured but no person (other than a confirmed suicide) is killed.

Serious injury
An injury in which a person is detained in hospital for any of the following: fractures, concussion, internal injuries, crushing, severe cuts or lacerations, severe general shock requiring medical treatment, injuries causing death 30 or more days after the accident.

Severity
Of an accident: is the severity of the most severely injured casualty (either fatal, serious or slight).

Slight accident
One in which at least one person is slightly injured, but no person is killed or seriously injured.

Slight injury
One in which a casualty receives an injury of a minor character, such as a sprain, bruise or cut.

Stacking accident
An accident involving rear end shunt or evasion due to a breakdown in the flow of traffic.

STATS19
An accident reporting form which is completed by the Police for road accidents on the public highway which involved human injury or death.

Urban roads
Roads with a speed limit less than or equal to 40 miles/h.

The AA Foundation for Road Safety Research

The AA Foundation for Road Safety Research was formed by the AA in December 1986 as part of its continuing efforts in the road safety field and as a major contribution to European Road Safety Year.

Registered as a charity (number 295573), the objectives of the Foundation are:

> to carry out, or procure, research into all factors affecting the safe use of public roads;
>
> to promote and encourage the safe use of public roads by all classes of road users through the circulation of advice, information and knowledge gained from research; and
>
> to conceive, develop and implement programmes and courses of action designed to improve road safety, these to include the carrying out of any projects or programmes intended to educate young children or others in the safe use of public roads.

Control of the Foundation is vested in a Council of Management under the chairmanship of Kenneth Faircloth OBE with day to day activity being the responsibility of the Foundation Management Committee. The Research Advisory Group, members of which include academics, road safety practitioners and health and transport industry professionals, recommends topics worthy of research to the Management Committee.

Sponsors

Support for the Foundation's research programmes is encouraged through sponsorship from companies and other bodies that have a concern for and an interest in road safety. The Foundation continues to seek sponsors in order to ensure its research programme can continue beyond the year 2000. Since 1986, the Foundation has enjoyed sponsorship from many companies; those supporting our activities in 1996 are:

> The AA, Amery-Parkes, BBS Productions, The Caravan Club, Coopers & Lybrand, Europcar (UK), Fennemores, Herbert Smith, ICL, MSM Engineering Services, NWS Bank, Private Patients Plan, The Society of Motor Manufacturers and Traders, as well as the following insurance companies:
>
> AGF, Bishopsgate, Commercial Union, Corinthian Policies, Cornhill, Drake, Eagle Star, Economic, GAN, Guardian, Norman, Orion Personal, UAP Provincial and St Paul International.

Chapter 1 Introduction

1.1 Background

In 1991, the AA Foundation for Road Safety Research approached Cambridgeshire County Council with a view to setting up a medium term research project to examine the problem of traffic accidents on rural roads. The project commenced in 1993 with a review of the general accident situation on the rural roads of Cambridgeshire. The initial findings were published in 1994 in the report titled 'Accidents on Rural Roads' (Hughes 1994).

Several areas of concern presented themselves in the review report. These were:

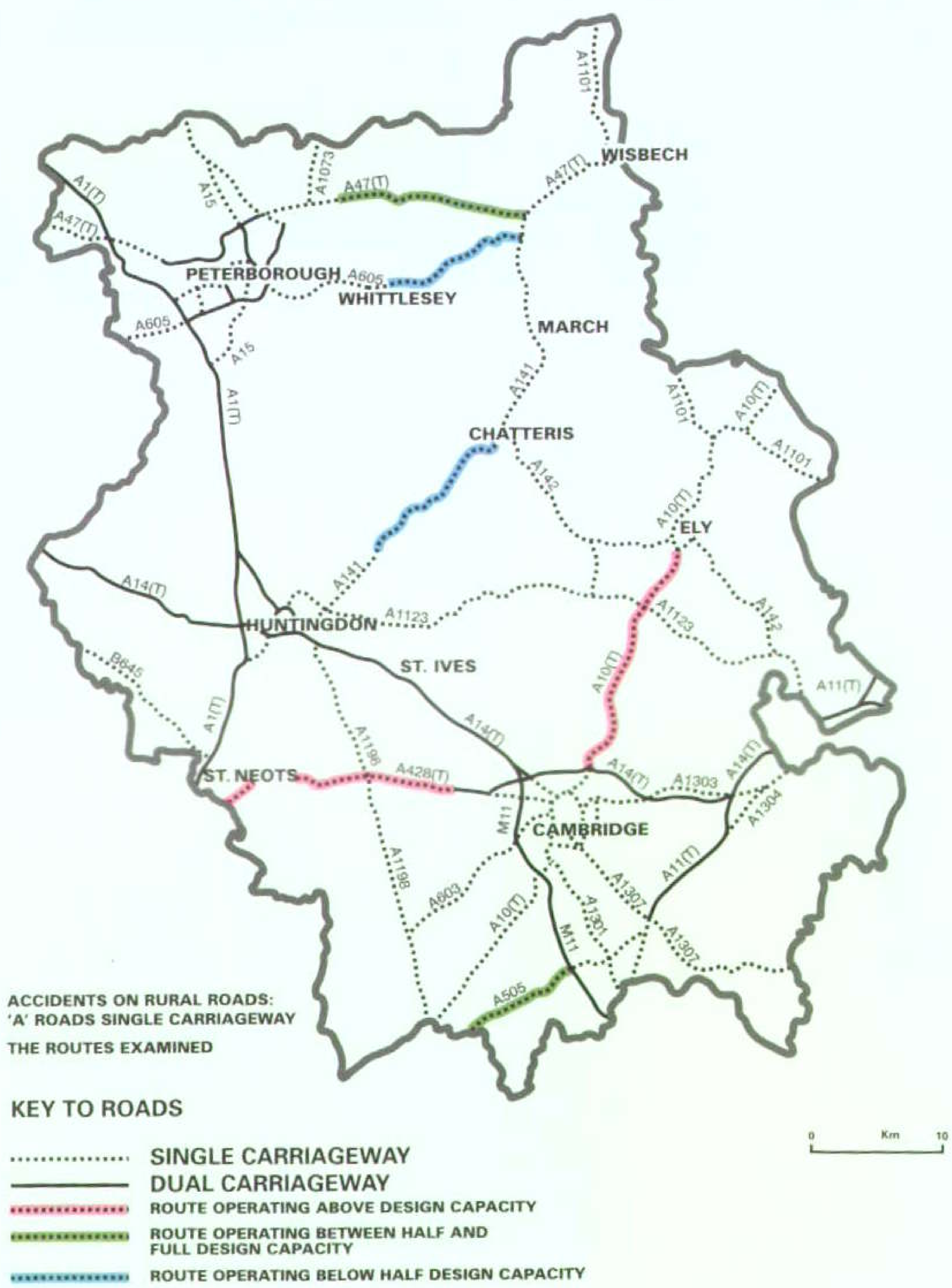
a. car occupants form the majority of casualties
b. traffic accident trends are being dictated by an increasing number of slight accidents
c. 'A' class roads were the scene of the majority of accidents
d. heavy goods vehicles had their highest involvement on 'A' class roads

Of the above findings, most notable was the predominance of accidents on the 'A' class, single and dual carriageway road network. Two thirds of all accidents occurred on these roads despite them forming less than a quarter of the entire route length in the County. A decision was taken that subsequent phases of the project would concentrate on these roads.

1.2 Study outline

This report presents the results of an examination of traffic accidents on **single carriageway,** 'A' class rural roads using data from the period between 1988 and 1994. Six routes are examined with route selection being determined on the basis of traffic volume and the physical geography of the route. These are the A428(T), A10(T), A505, A47(T), A141 and A605. All fall within the boundary of Cambridgeshire (Figure I.1).

Figure I.1 Map of Cambridgeshire showing strategic road network



Road environment information was collected for each route length by video and site observation. This information included details of road markings, hedges and trees, kerbing, bends, driver aspect and unobstructed forward visibility. Additional information was collected for accidents which occurred at junctions. This included noting the presence or absence of solid islands, junction signing and the measurement of visibility splays from the minor road.

Driver input into the accident equation was obtained through a driver questionnaire which was sent out to drivers who had been involved in accidents on the six selected routes in 1993 and 1994. The survey, which was carried out by the Transport Research Laboratory on behalf of the project, was completed in June 1995.

The road environment and driver response information was appended to the STATS19 information collected by Cambridgeshire Constabulary, and statistical models were developed which examined interactions between the three data sources. The implications of the interaction results are discussed and accident remedial measures suggested.

1.3 Report content

The report is structured so that the general characteristics of accidents on each of the six routes are introduced at the beginning. This is followed by more detailed, location-specific accident and questionnaire information, and the report ends with the output from the statistical models. A more specific list of content follows.

The criteria adopted for individual route selection and the methodologies and procedures followed in collecting the road environment and questionnaire data are presented in **Chapter 2 – Methodology**.

Chapter 3 – Traffic flow and accident characteristics examines the distribution of accidents on each of the selected roads relative to traffic flow. Temporal associations between accidents and traffic flows are examined as well as the distribution of accidents between the links, public road junctions and private accesses. For public road junctions, a measure of the accident rate per junction type is established for each of the six roads, while a similar exercise establishes an accident rate per private access type. The incidence of wet and dry skidding in accidents on each of the six roads is examined, along with the interaction of accident occurrence and conditions of road surface, weather and light. The chapter ends with accident and casualty severity being used to determine a cost to society of traffic accidents on the above roads.

Chapter 4 – Accident types, drivers and vehicles involved presents a breakdown of the vehicles involved in the accidents and their distribution among accidents involving different vehicle numbers. For two-vehicle accidents, a matrix is presented which examines the types of vehicles coming into conflict. Details are also presented on the drivers of the vehicles involved in the accidents. The drivers of all vehicle types are examined on the basis of gender and driver age, the latter being cross-tabulated with the manoeuvres being effected by each vehicle group. The chapter ends with an examination of the association between accident type and the numbers of vehicles involved in the accident.

The effect of different locations on the occurrence of accidents is examined in **Chapter 5 – Links, junctions and accesses**. The analysis of each accident location follows the methodologies presented in preceding chapters, commencing with an examination of the attendant circumstances of road surface condition, time of accident occurrence, accident severity and the incidence of wet and dry skidding. The analysis then proceeds with an examination of the vehicles and drivers involved, and ends with an examination of the association between accident types and the numbers of vehicles involved in the accident.

The general response to the questionnaire sent out to drivers who had been involved in accidents on the six selected routes in 1993 and 1994 is presented in **Chapter 6 – What the drivers say**. The chapter begins with an examination of the representativeness of the respondent driver sample compared to all drivers approached. It then proceeds to examine the responses returned by analysing personal details, driving habits and experience, and the factors which contributed to the accident. In establishing the factors which contributed to an accident, drivers were asked to respond to questions about their own driving and the driving of the other drivers. Furthermore, an extensive list of road environment factors was also presented for their consideration along with questions about the role of traffic volume and nature of traffic.

The input of road environment factors into the accident equation is examined in **Chapter 7 – Accidents and the road environment** beginning with the quantification of the key road environment features of each route. Statistical models are developed which isolate those factors having greatest bearing on the occurrence of accidents at T-junctions and on the links between junctions.

The findings of the entire report are summarised in **Chapter 8 – What are the main conclusions?** The implications of the findings are discussed, and suggestions are proposed for ways of reducing the number of traffic accidents occurring on single carriageway 'A' class rural roads through possible changes in traffic engineering, design standards and driver education.

Chapter 2 Methodology

This chapter introduces the methodologies developed for the collection of the accident, road environment and driver questionnaire data.

2.1 Route selection and traffic flows

The principal criterion used in selecting the single carriageway routes to be used in this study was the ratio of the Average Annual Daily Traffic (AADT) relative to the current design capacity standard for single carriageway roads. The current standard, as specified in the Design Manual for Roads and Bridges ((DMRB) TD20/85 – Traffic Flows and Carriageway Width Assessment) is based on **a maximum AADT of 13,000 vehicles**. Two routes were selected for each of the following categories:

Category 1. routes operating at over capacity.
Category 2. routes operating between half capacity and capacity.
Category 3. routes operating at, or below half capacity.

A further factor which came into route selection was the dichotomous physical geography of Cambridgeshire. To the north-east of the County, the landscape of the Fens is flat and substantial vegetation is sparse. This results in straight roads with long horizons of visibility. In contrast, the south and west of the County are more undulating but, even so, could not be said to be hilly. There is more substantial road-side vegetation in the form of trees, and hedges provide drivers with a more enclosed aspect. In order to avoid a terrain bias, an attempt was made to ensure that no two routes in each category were from the same region of the County.

The routes selected by category are described below and an idea of their horizontal and vertical alignment can be established from *Figures II.1 A to G.*

Category 1

1. A 20.3 km stretch of the A428(T) (formerly A45) between the end of dualling near Cambridge and the railway bridge at St. Neots in the west (County boundary with Bedfordshire – Figure II.1A). For most of its length, this route traverses a broad plateau which separates the flood plains of the Great Ouse in the West and the Cam to the east. Horizontally, this route has a bendiness (Department of Transport COBA 9 Manual 1986) of 28 degrees per kilometre.
2. An 18.3 km stretch of the A10(T) to the north of Cambridge between Milton roundabout (not included) and the first roundabout on the approach to Ely (not included) – Figure II.1B. For most of the period under study, a short length of dualling existed on this road near Waterbeach. Though modified to single lane dualling in 1994, this section of road is not examined in this study. Bendiness value: 34 degrees per kilometre.

Category 2

1. A 10.4 km stretch of the A505 between the end of dualling near Royston, Hertfordshire in the west of the county and the start of dualling near its grade-separated junction with the M11 to the east (adjacent to the Imperial War Museum at Duxford) – Figure II.1C. Bendiness value: 21 degrees per kilometre.
2. A 13.1 km stretch of the A47(T) between the eastern end of the Eye by-pass near Peterborough, to just before its junction with the B1187 at Guyhirn in the east – Figure II.1D. The length of road through the intervening village of Thorney is not included as it is subject to a speed limit of less than 40 miles/h. All of this route crosses the Fens in the north of the County. Bendiness value: 10 degrees per kilometre.

Category 3

1. A 12.4 km stretch of the A141 bewteen the roundabout at Chatteris (not included), and its T-junction with the B1040 road to the south of Warboys – Figure II.1E. Once again, most of this road crosses the peat Fens and lies at or below sea level, but to the west near Warboys, the road increases in elevation to over 30 metres above mean sea level as it rises off the Fens (Figure II.1G). A high bendiness value for this road (37 per kilometre) has the effect of disguising the presence of a 4.5km length of straight road.
2. A 9.9 km stretch of the A605 in the north of the County, between the village of Coates and the junction with the A141 – Figure II.1F. Similar to the A47, all of this route crosses the Fens but this road has a higher degree of bendiness (33 degrees per kilometre) as the route follows property boundaries rather than crosses them. Nevertheless, the high bendiness value disguises the presence of some long straight sections along the length of this route.

Figures II.1 Simplified route maps showing horizontal alignment of (A) A428(T), (B) A10(T), (C) A505, (D) A47(T), (E) A141, (F) A605 and (G) vertical alignment of all routes.

Figure II.1A A428(T)

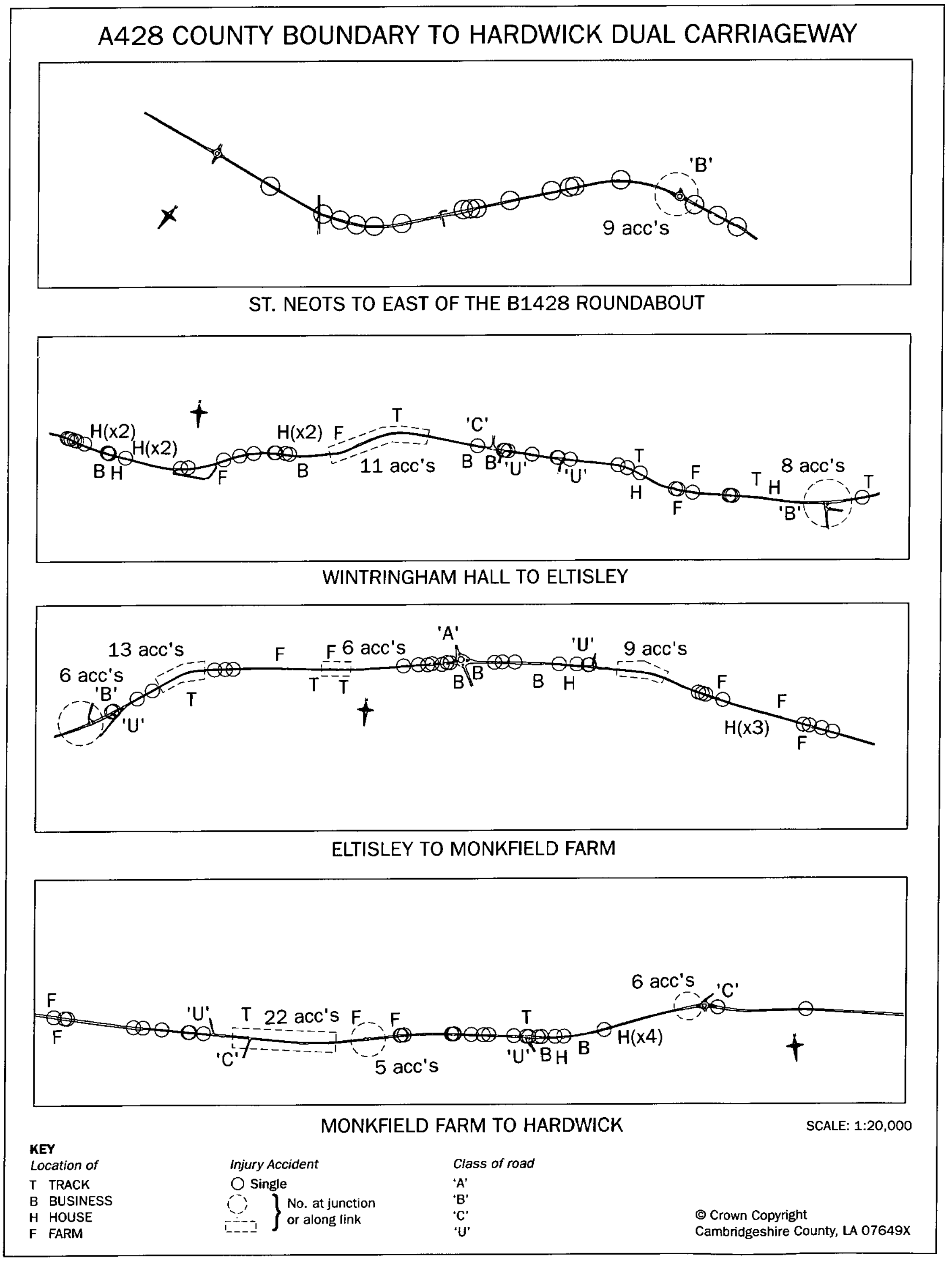


Figure II.1B
A10(T)

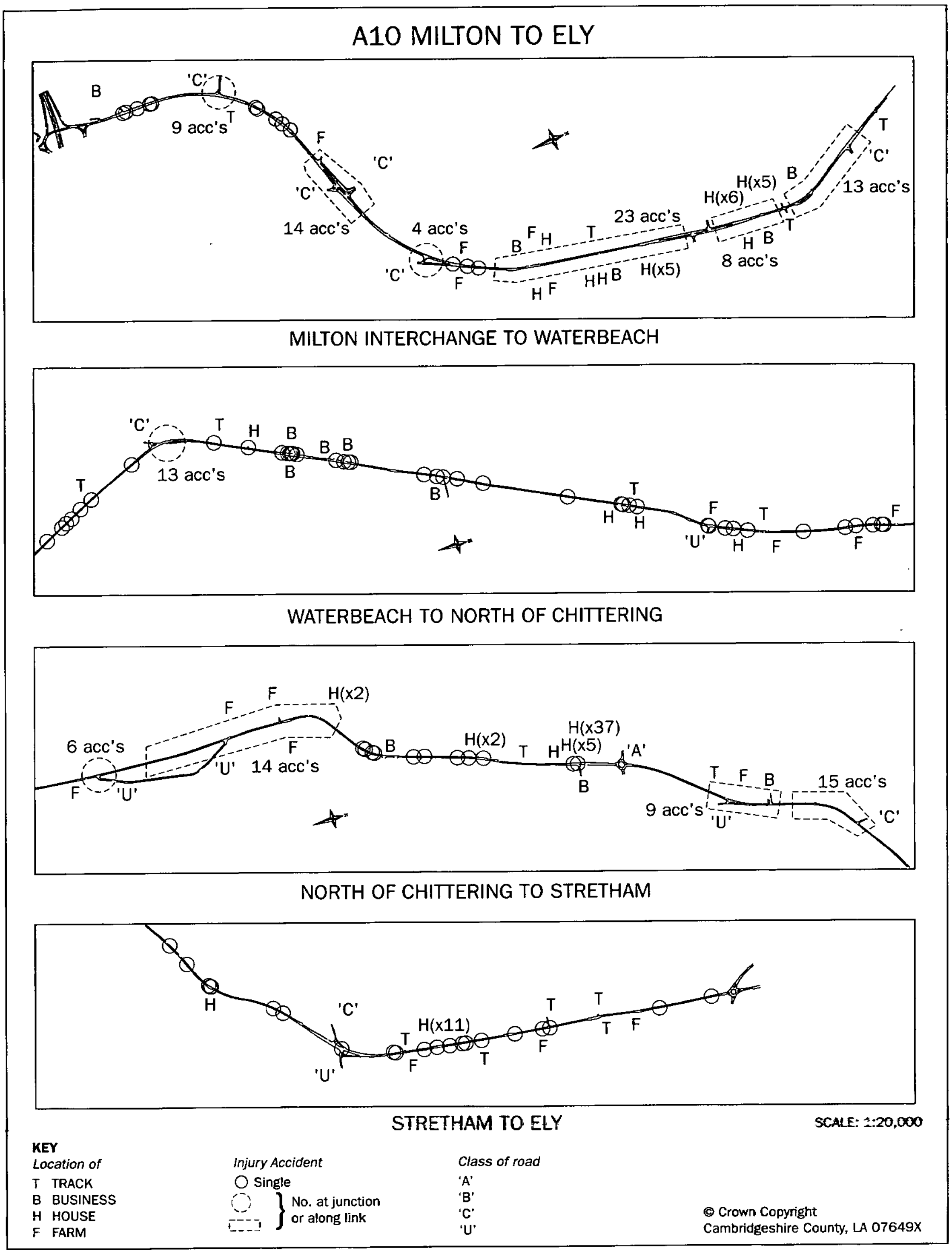


Figure II.1C
A505

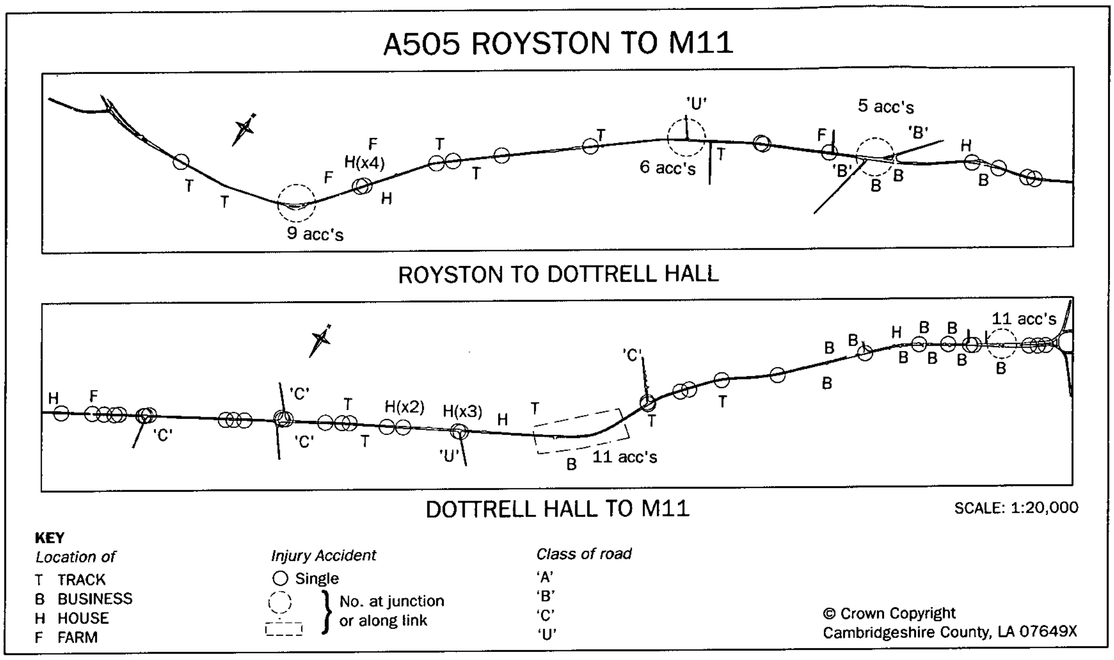


Figure II.1D
A47(T)

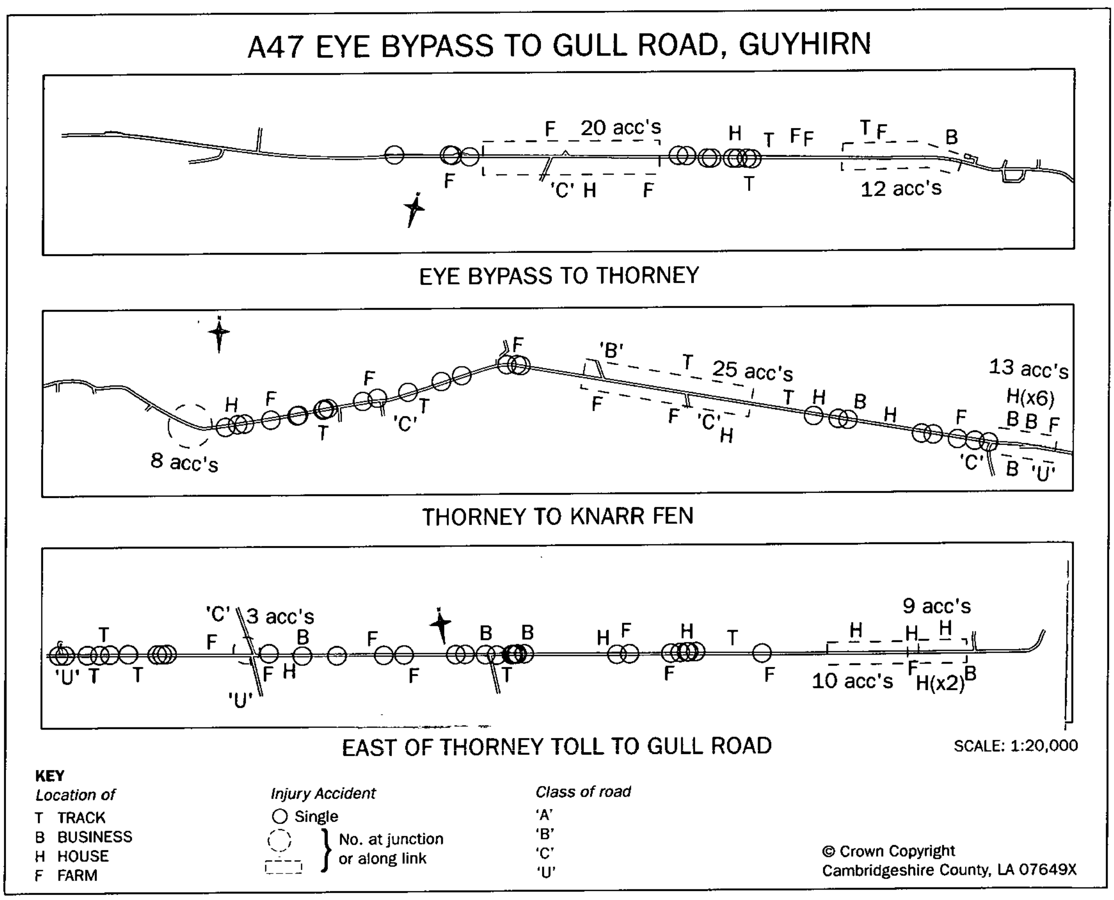


Figure II.1E
A141

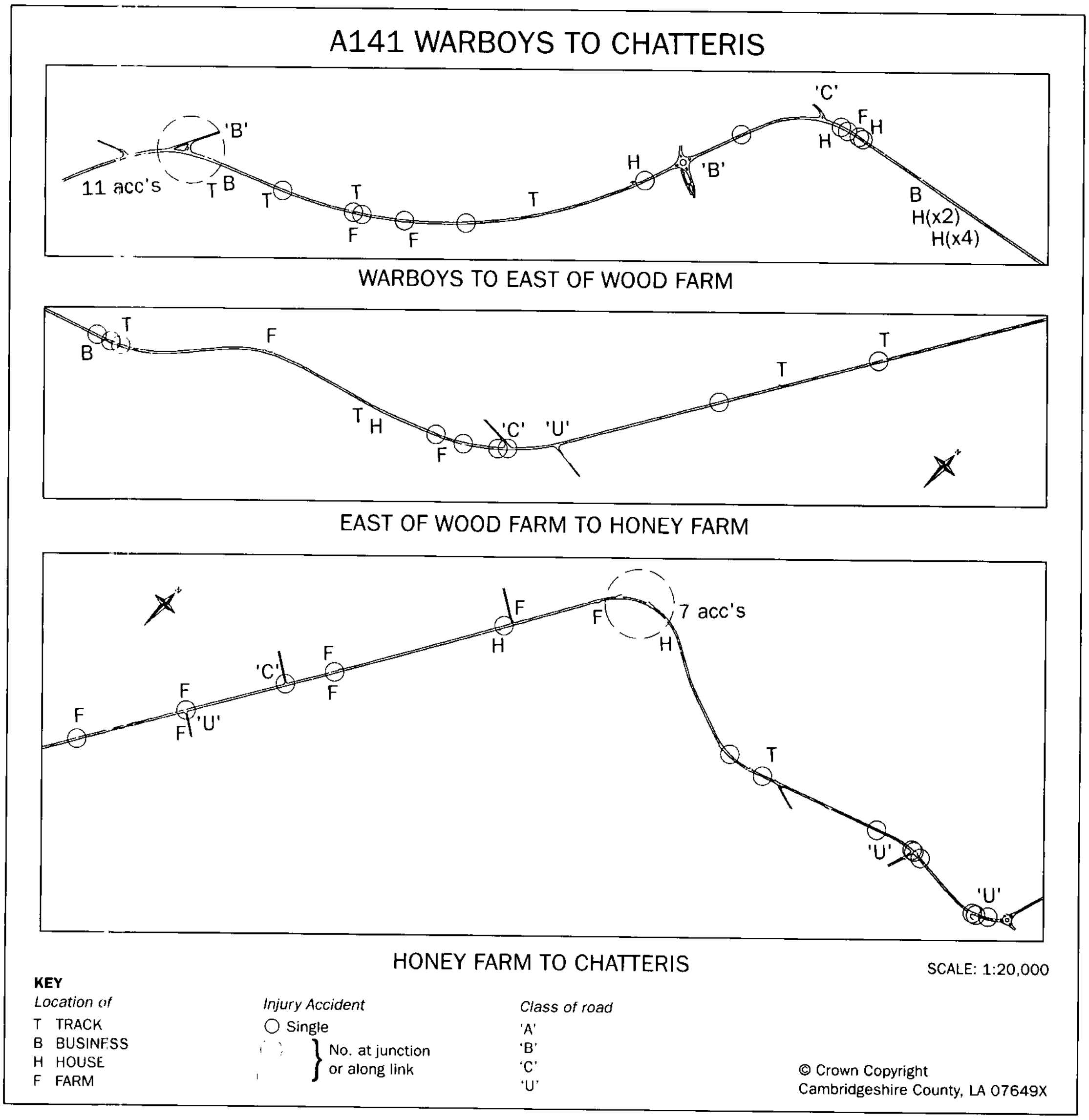


Figure II.1F
A605

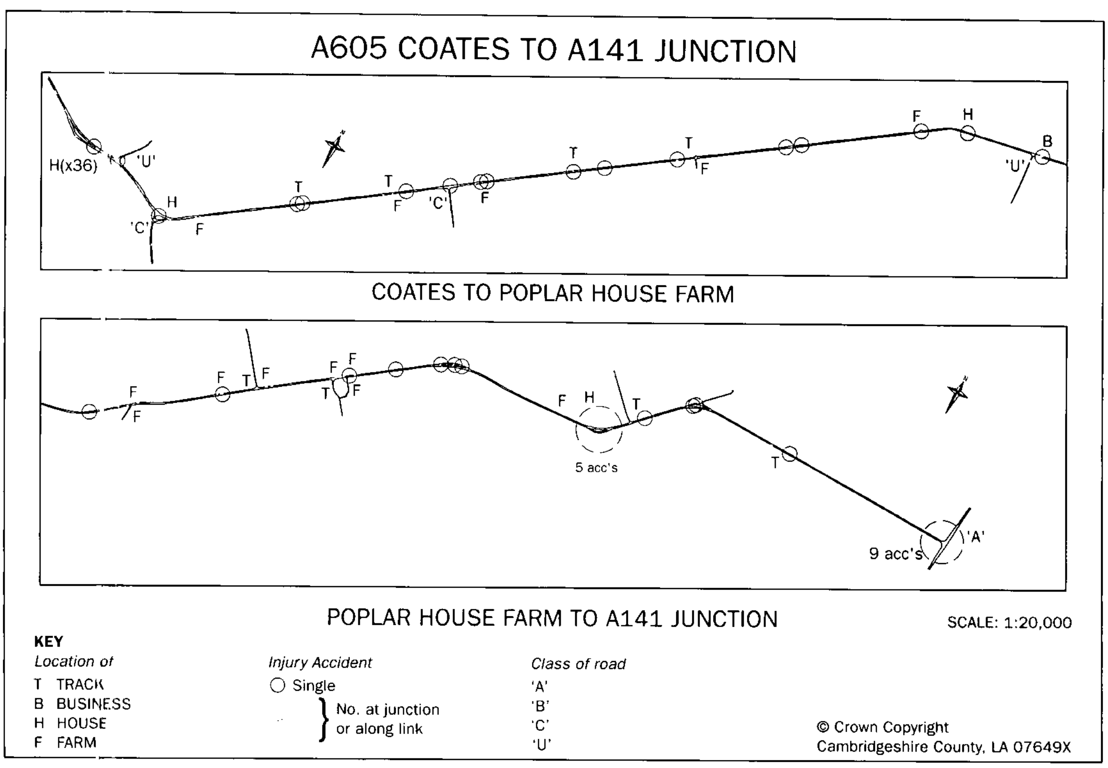
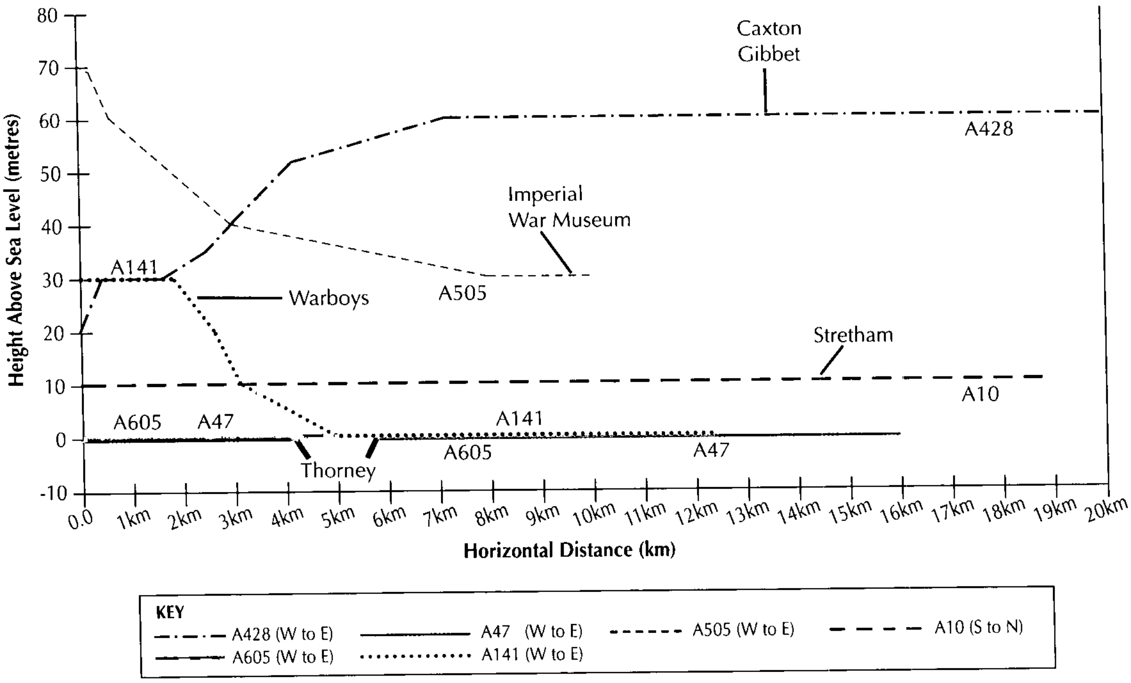


Figure II.1(G) Simplified vertical alignments



Traffic flow data used for route selection were 16 hour Average Annual Weekday Flows (AAWF). These figures are generally accepted to be equivalent to the Average Annual Daily Traffic Flow (AADT) (Traffic Monitoring Report – Cambridgeshire County Council, 1994).

The characteristic 16 hour AAWF for each of the selected routes, as averaged over the seven years of this study, are shown in Table 2.1. Where only a single traffic flow measurement was available for the selected length of road – as in the case of the A605, the figure presented in Table 2.1 is the seven year traffic flow average. In other instances where several traffic flow measurements were available at different points along the route, a weighting process was used to obtain a representative seven year traffic flow average.

Table 2.1 Selected routes: 16 hour Average Annual Weekday Flows averaged over the seven years between 1988 and 1994

Road	Category	16 hour AAWF	% Capacity	% Heavy Goods
A428	1	16,300	125	18
A10	1	13,800	106	13
A505	2	12,100	93	16
A47	2	11,700	90	21
A141	3	5,100	39	16
A605	3	4,500	35	15

2.2 Accident data

The seven year period between **1988** and **1994** was chosen for this study. This yielded a total of 812 accidents for the six roads being examined.

The accident data used in this study were collected and recorded on STATS19 forms by Cambridgeshire Constabulary and stored on the Traffic Accident Recording System (TARS) of Cambridgeshire County Council's Transportation Department. Some of the data formats were changed for use in the study and some new variables added to record additional information.

A full list of these variables is contained in Appendix A.

One of the new variables was called 'ACCTYPE'. It was introduced in order to enable each accident to be classified into an accident type related to the manoeuvres of the vehicles which came into conflict. Numerous accident types were identified (see Appendix D) though it became possible to consolidate them into one of six accident type categories.

The categories were:

- accidents which involved a loss of control
- turning accidents
- overtaking accidents
- stacking accidents
- accidents where a vehicle crossed the centre line
- other (pedestrian accidents)

Stacking accidents were those which occurred when vehicles collided with, or took evasive action to avoid contact with, the rear of the vehicle in front. A variety of circumstances can give rise to these accidents including queuing at junctions, slow moving traffic and bunching due to an improper overtaking manoeuvre. Accidents where a vehicle crossed the centre line are distinguished from loss of control type accidents by the fact that no loss of control was involved.

The STATS19 definition of a junction accident is an accident occurring within 20 metres of a junction. Pickering *et al.* (1986) recognised that this restrictive definition could be rejecting accidents which were being influenced by events at a junction but were occurring further than 20 metres from the junction. In view of the queue lengths which can arise on some of the busier single carriageway routes, further variables were introduced to identify those accidents occurring between 20 and 200 metres of a junction or private drive serving a business.

2.3 Environment data

Collection of the environmental data took place over a period of several months during the summer of **1995** and entailed video surveys of each route, field surveys of all public road junctions on each route, and the construction of strip maps showing the location of each accident on a 1:10,000 Ordnance Survey base map. Most of the environment data was added to an overlay map of each road. The information collected for bends included the angle of curvature and bend length. The presence or absence of warning signs, chevrons and marker posts was also noted. Bend radii were calculated and collated to one of four bend categories. These categories related to critical curve radii which influence safe overtaking on a road with a design speed of 100 km/h (62 miles/h) – ((DMRB) TD9/93 – Highway Link Design):

- less than 510 metres radius
- between 510 and 1020 metres radius
- between 1020 and 2880 metres radius
- greater than 2880 metres radius.

2.3.1 Field data

Most of the field data were collected by driving each route. Typically, a car-based survey was adequate for collecting information on carriageway markings, kerbing and roadside furniture.

While a car-based survey was adequate for collecting data about junction signing on the major and minor roads and other features of each junction, other data had to be physically measured. These data included (if they were present) ghost island length, width and length of turning lanes, and the length of merging/diverging lanes. This inventory was collected for all public road junctions on the routes in question.

2.3.2 Video data

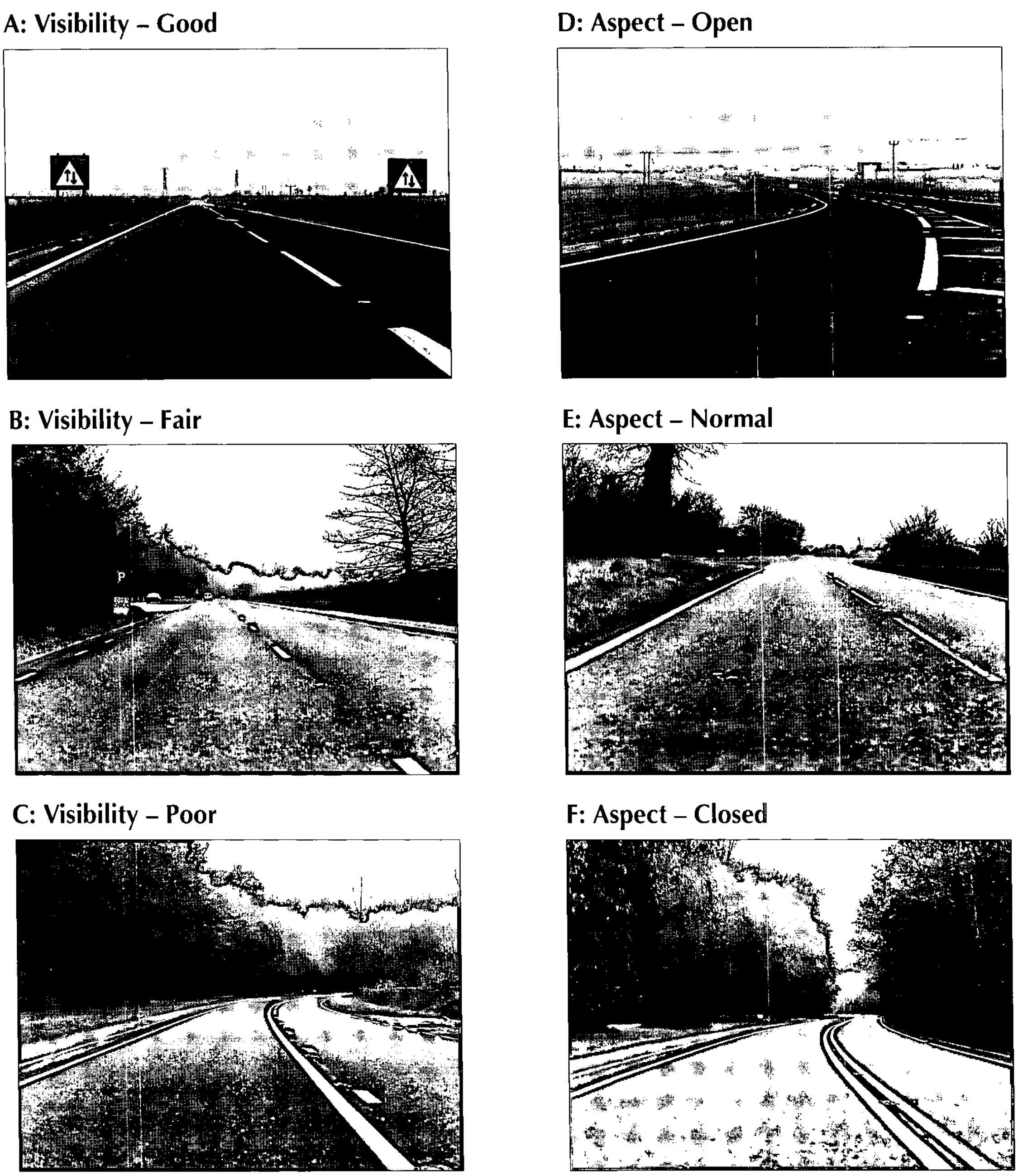
In view of the logistical difficulty and costs involved in gathering in-situ information on verge width, forward visibility and the nature of hedge and trees, it was necessary to extract these data from the video surveys. An idea of a driver's perception of aspect was also extracted from the videos (see below). One problem with working from videos is that the measurements are necessarily subjective. However, this can be partly offset by comparing against reference data collected in the field. A degree of consistency was introduced by having only one person interpreting the videos. Each of the variables specified above was recorded at 100 metre intervals.

Forward visibility was classified into one of three categories based around certain critical distances associated with a road designed to carry traffic at a maximum speed of 100 km/h – ((DMRB) TD9/93 – Highway Link Design). These categories were:

- good – full overtaking sight distance (≥580 metres)
- fair – greater than 215 metres and less than 580 metres
- poor – desirable minimum stopping distance (≤215 metres)

Illustrations of forward visibility categories are: good (Figure II.2A), fair (Figure II.2B) and poor (Figure II.2C). Checked against the videos, measurements were taken from a scaled template which was moved over an Ordnance Survey map of each route. Where a measurement was borderline, the visibility measurement was always marked down to the lower distance range. It should be noted that the true view forward seen through the video camera lens is not strictly that seen by the driver ie a driver may have a greater ability to see past vehicles and objects ahead of his own vehicle.

Figure II.2 Photographs showing examples of forward visibility and aspect



Methodology

The most difficult and most subjective variable to quantify was the driver's perception of ***aspect***. It is initially very difficult to gauge correctly the depth of field seen by the naked eye and to assess the relative contribution of objects in the near distance, middle distance and far distance to an overall image. It is also the case that the image seen through a video camera is 'tunnelled' compared to that seen by the naked eye and does not make allowances for peripheral vision.

In order to simplify the task at hand, aspect was classified into one of three categories:

- open
- normal
- closed

At the extremes, an open aspect (Figure II.2D) would be one where there was little vegetation, and the distant horizon would be long and broad with a considerable proportion of sky. In contrast, a closed aspect (Figure II.2F) would be one where there was a sinuous road bordered by high trees to reduce the amount of vision. A typical normal aspect (Figure II.2E) could be one where a road has wide verges and low hedges, with intermediate forward visibility.

As aspect is a visual parameter, not only is it direction of travel related, it may also vary between either side of the carriageway. For this reason, the nearside and offside aspect were collected separately.

Hedges *and* ***trees*** were categorised as *high* where they could not be overlooked by a driver, *low* where they could be overlooked, or *none* present. They were recorded for both sides of the road.

Verge width was also recorded for both sides of the road and coded as either *narrow* or *wide*. ***Kerbing*** was coded as *full, splay* or *half*, or *none* and measured in a similar manner.

It is important to note that the characteristics recorded represent those present during the summer of 1995. While records are available which document episodes of road maintenance, it is impossible to make provisions for natural changes to the tree and hedge environment over the seven year interval of this study.

2.3.3 Maintenance data

In addition to the video camera, other physical information about each route was collected. This information included data on carriageway widths, the wearing course material and the wet road skidding resistance of each route. It was possible, after some manipulation, to superimpose the relevant information onto an overlay map on the base map, and from that to determine the data pertinent to each accident.

Examining specific pieces of information, carriageway width data is generally stored as the average width of a 100 metre segment of carriageway – with smaller intervals near to junctions. Each width measurement is accompanied by details of the wearing course material in use on the segment. The three categories of wearing material are:

- hot rolled asphalt
- surface dressing
- other

Information about the wet skidding resistance of each route was provided in the form of **SCRIM** data. SCRIM is an acronym for the Sideway-Force Coefficient Routine Investigation Machine which measures wet skidding resistance. The SCRIM data available for use in this study were collected in 1993 and represent the mean of three or more SCRIM readings taken between May and September 1993. This is the mean summer SCRIM coefficient (MSSC). This study concentrates on the **SCRIM deficiency** measured for each route. This is the difference between MSSC and the intervention SCRIM level in place at the time of measurement at a given location. Negative values point towards a deficiency in skidding resistance. Care was used in the way this information was applied, for many factors influence the wet road skidding resistance of a road ((DMRB) HD28/94 – Skidding Resistance). This parameter is known to vary throughout the seasons, from a peak during the winter months, to a low in summer (when SCRIM is generally measured). Changes in the amount of traffic using a route are also known to influence skidding resistance.

2.4 Questionnaire data

A detailed accident survey of a road is, on its own, a very powerful tool for use in identifying areas of concern. However, it is important not to lose sight of 'driver input.'

To obtain this 'driver input', the Transport Research Laboratory (TRL) was commissioned to help with designing a postal questionnaire, administering the survey, and collating the returned data into a database. The questionnaire specifically targeted the drivers of vehicles involved in rural road traffic accidents. In addition to the standard questions inquiring about personal details, others questions were designed to accumulate information about the circumstances leading up to the accident (in terms of familiarity with road and vehicle); the factors which contributed to the accident (feelings prior to accident, faults with road, weather, own driving and the driving of other drivers), and driving habits and driving history of the participant. The responses to the questionnaire are presented in Appendix B.

The list of drivers who qualified for inclusion in the survey was drawn from the STATS19 accident data of the routes in the study, with names and addresses extracted from the HORT7 forms of Cambridgeshire Constabulary. Only accidents which occurred in **1993** and **1994** could be used in the survey, as Cambridgeshire Constabulary are unable to retain data which is more than two years old (other than for fatal accidents).

The confidential nature of the information being requested and the need to protect the interests of the Police and avoid causing distress to the families of individuals killed in traffic accidents, led to the adoption of a list of protocols which had to be strictly followed for each accident (Appendix C). It is similar to that implemented by Carsten *et al.* 1989 in the Leeds urban traffic accident study.

Between 1993 and 1994, a total of 217 accidents occurred on the six 'A' class single carriageway roads in question, which involved 495 participants. These were involved as:

488	Vehicle drivers
3	Pedestrians
4	Pedal cyclists

Of the 495 participants, protocol disqualified all drivers who had been involved in a fatal accident and, in view of the logistics, no foreign driver was approached. Pedestrians and pedal cyclists, due to their small involvement in these accidents, were also not approached. In addition, a certain number of 'un-coded' drivers could not be included in the study – these being drivers who failed to stop at the scene of the accident but whose vehicles are recorded by the Police as having contributed to the accident. In all, 86 drivers, or just under 17 per cent of the sample, could not be approached.

Prior to analysis, the appropriate STATS19 data and environmental information were appended to the questionnaire data so that the driver's perception of the factors which contributed to an accident could be compared to earlier findings about the road environment.

2.5 Summary

Methodology

- Six 'A' class, single carriageway routes were chosen to be studied based on the ratio of the Average Annual Daily Traffic Flow relative to the current design capacity standard for this type of carriageway.
- The six routes were assigned to one of three categories relating to a road operating at over-capacity, a road operating at between half capacity and capacity and a road operating at or less than half design capacity.
- The accident data for each route were derived from STATS19 data.
- The environment data for each route were collected in the field via a combination of car survey, video survey and physical measurement.
- The input of drivers into the accident equation was obtained through a postal questionnaire which was sent to drivers who had been involved in accidents on the six routes in question during 1993 and 1994.

Chapter 3 Traffic flow and accident characteristics

3.1 Accidents and traffic flow

The seven year Average Annual Weekday Traffic Flow (AAWF) used for the process of route selection evens out important differences between the traffic flow trends on individual routes. Accidents, when expressed as a rate per kilometre, varied on each route from year to year and bore little relation to traffic flow (Figure III.1). **It does not follow that the routes carrying the heaviest flow of traffic had the worst accident records in terms of the accident rate per kilometre of road.** Indeed, when averaged over the whole period, the A47 (Category 2 route) had the worst record of all, averaging 1.9 accidents per kilometre over the last seven years (Table 3.1).

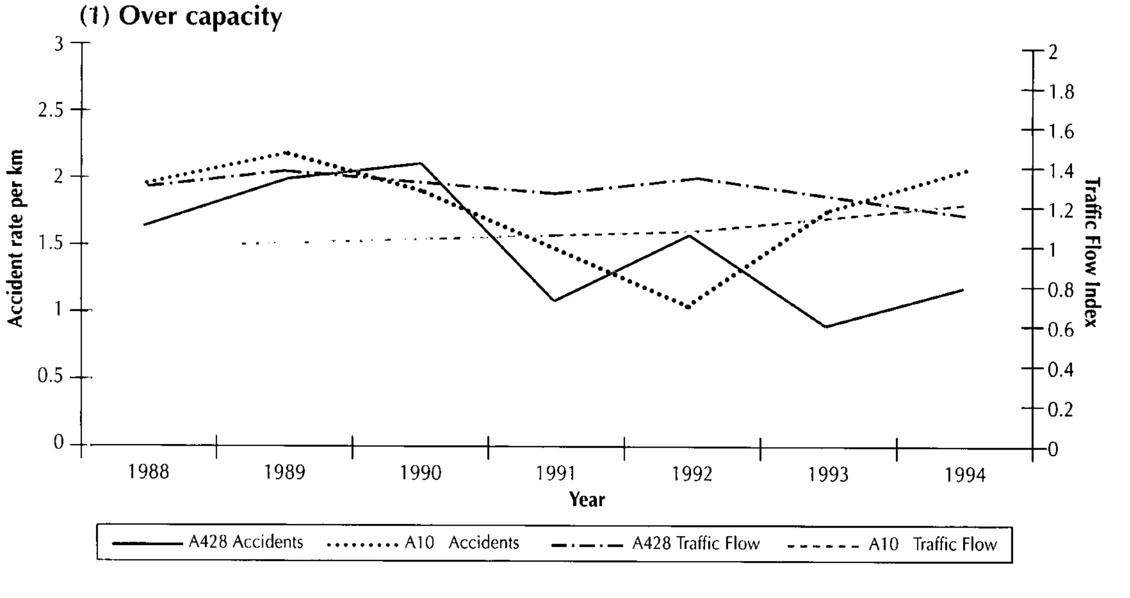
Table 3.1 Accident rates (1988–1994)

Category	Route	Accidents	Road Length (km)	(a)	(b)	(c)
1 Over capacity	A428	214	20.3	1.51	25.3	-17.6%
	A10	226	18.3	1.76	34.9	+13.7%
2 Between half capacity and capacity	A505	96	10.4	1.32	29.8	-2.9%
	A47	176	13.1	1.92	44.7	+45.9%
3 Under half capacity	A141	56	12.4	0.65	34.7	+13.0%
	A605	44	9.9	0.63	38.6	+25.8%

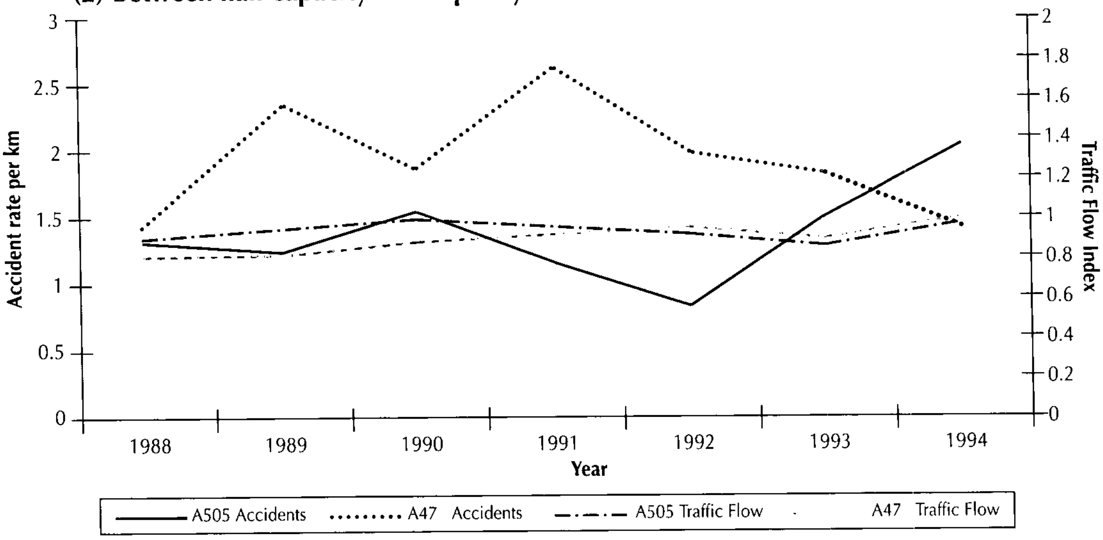
(a) Accidents per kilometre per year
(b) Accident rate per 100 million vehicle kilometres
(c) Deviation from Great Britain accident rate of 30.7 accidents per 100 million vehicle kilometres (single plus dual carriageways)

No clear relationship exists between traffic volume and accidents: therefore other factors must exert an influence on the occurrence of traffic accidents on these roads. For example, the A47 (Category 2 route) had a 16 hour AAWF of some 11,700 vehicles, and had the highest accident rate per 100 million vehicle kilometres of all the route categories (Table 3.1). It was nearly 46 per cent higher than the accident rate per 100 million vehicle kilometres for Great Britain (combined single and dual carriageways – Department of Transport 1995(1)). Road environment features may be critical factors – a hypothesis which is examined in Chapter 7.

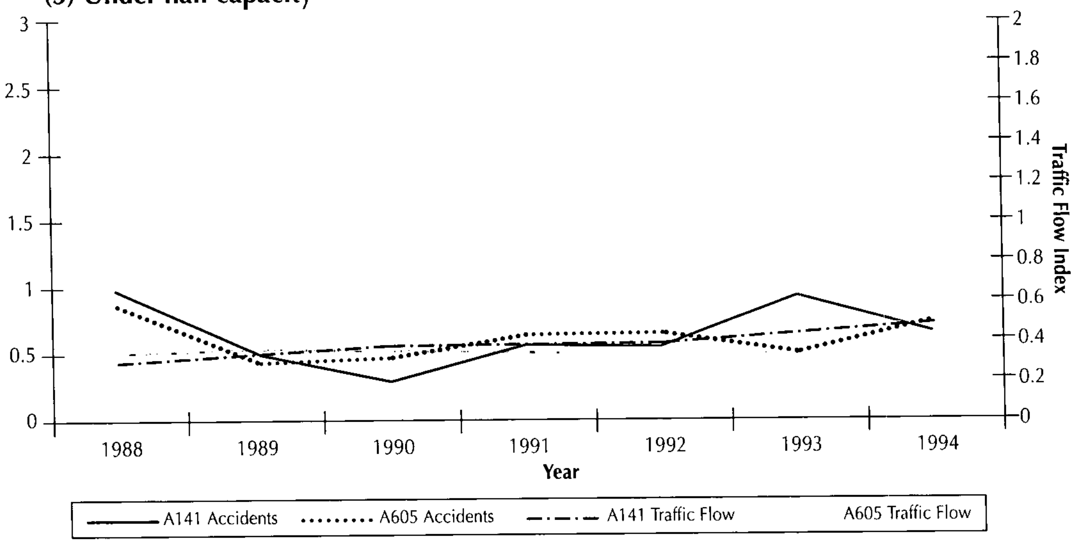
Figure III.1 Traffic flow and accident rate per kilometre trends



(2) Between half capacity and capacity



(3) Under half capacity



Notes
1. *Traffic flow index is the ratio of 16 hour Average Annual Weekday Flow to Design Capacity Standard*

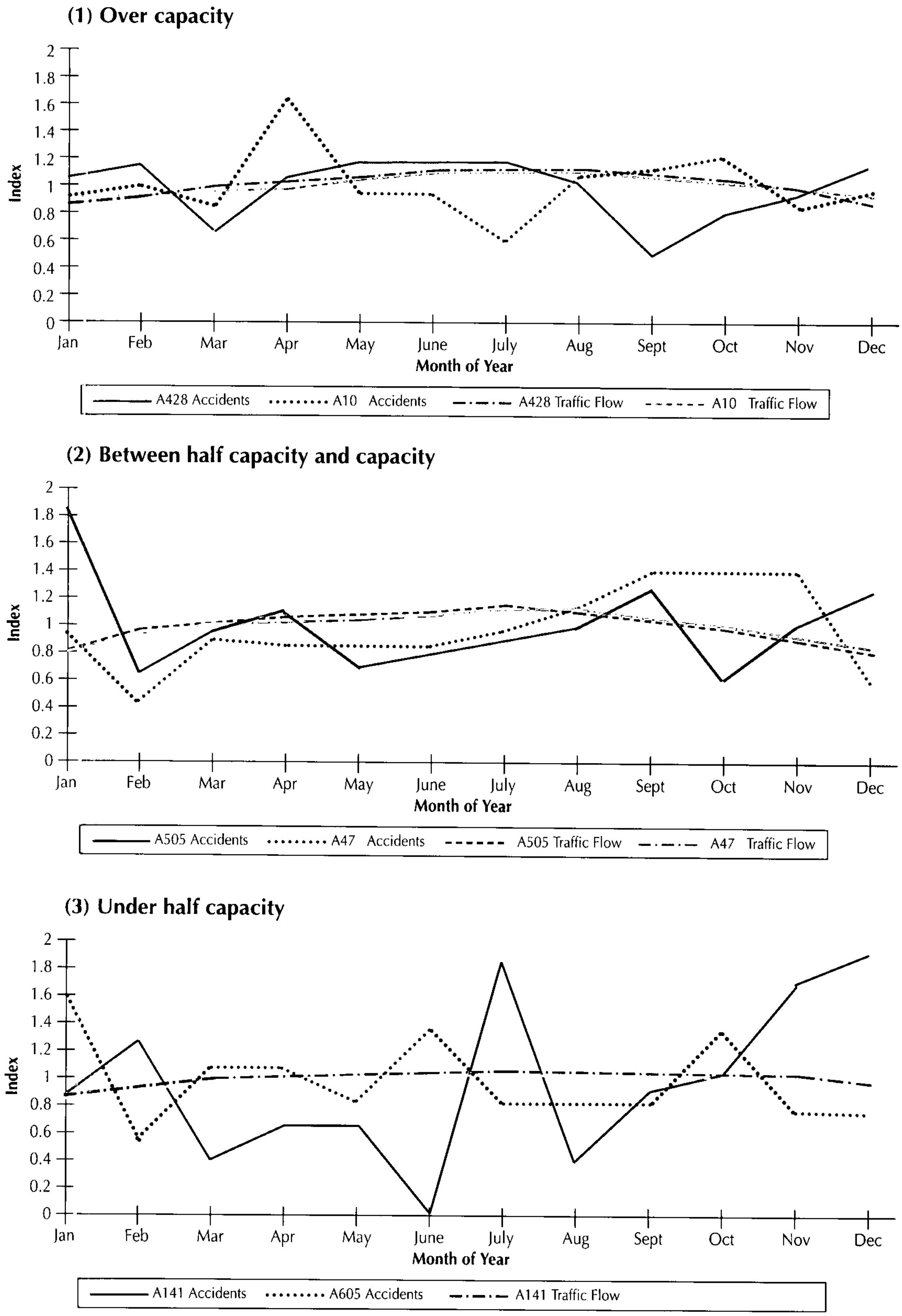
The relationship between traffic flow and accidents is examined further in Figures III.2 to III.4 over successively shorter time intervals. Traffic flow figures relate to 1993 values, and were obtained from a combination of automatic traffic counters and manual counts.

Monthly variations in accidents and traffic flow

An index was created by dividing each count by the Average Annual Daily Traffic Flow specific to each counter. No data were available for the A605. Traffic flows for the A141 and A47 were determined from automatic traffic counters located on these roads, but outside the route area being examined. Accident indices for each road were obtained by dividing the accident total for each month by the average monthly figure calculated from the seven year total.

The monthly variation in traffic flow is similar for each of the routes, peaking in the summer months of May to September and bottoming out in January (Figure III.2). **The accident profiles are different, with no two routes showing a similar pattern of variation.**

Figure III.2 Monthly variation in accidents and traffic flow



Daily variation in accidents and traffic flow

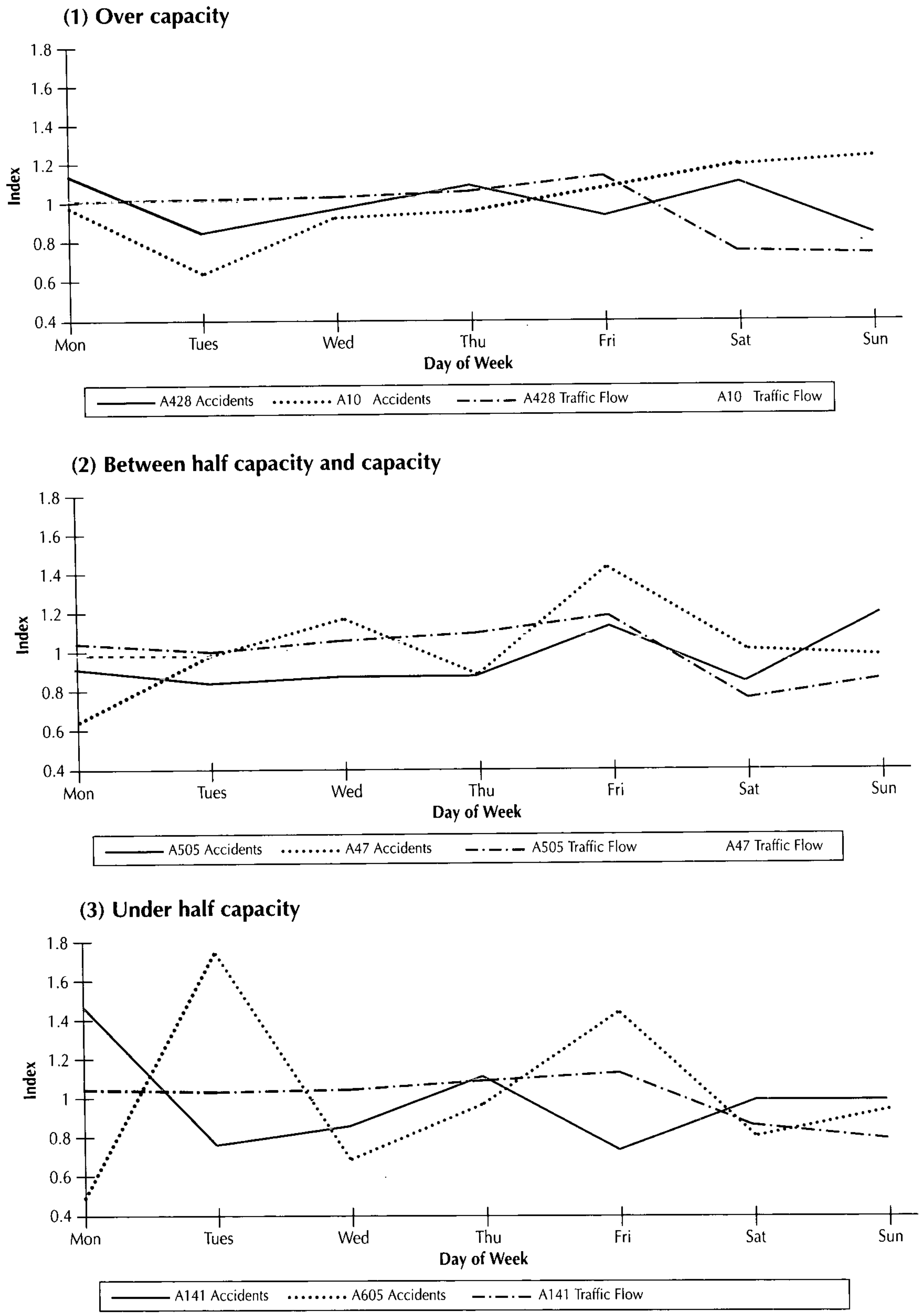
The daily variation in accidents and traffic flow is shown in Figure III.3. Traffic flow figures relate to 1993 values, and were obtained from records of the same automatic traffic flow counters used in the preceding exercise. No data were available for the A605.

Accidents on Rural Roads: Single Carriageway 'A' Class Roads

Data were extracted for a typical average month (March), and the daily traffic flow was determined for each day of the week. The index for each route was established by dividing the traffic flow of each day by the average daily traffic flow of March. The accident index for each road was calculated by dividing the accident total of each day by the average daily accident figure calculated from the seven year total.

The standard traffic flow pattern for all routes increases during the working week towards a peak on Fridays, and decreases to a low on Sundays (Figure III.3). **However, as with the monthly data, the accident index profile does not tie in with the traffic flow data.**

Figure III.3 Daily variation in accidents and traffic flow



Hourly variations in accidents and traffic flow

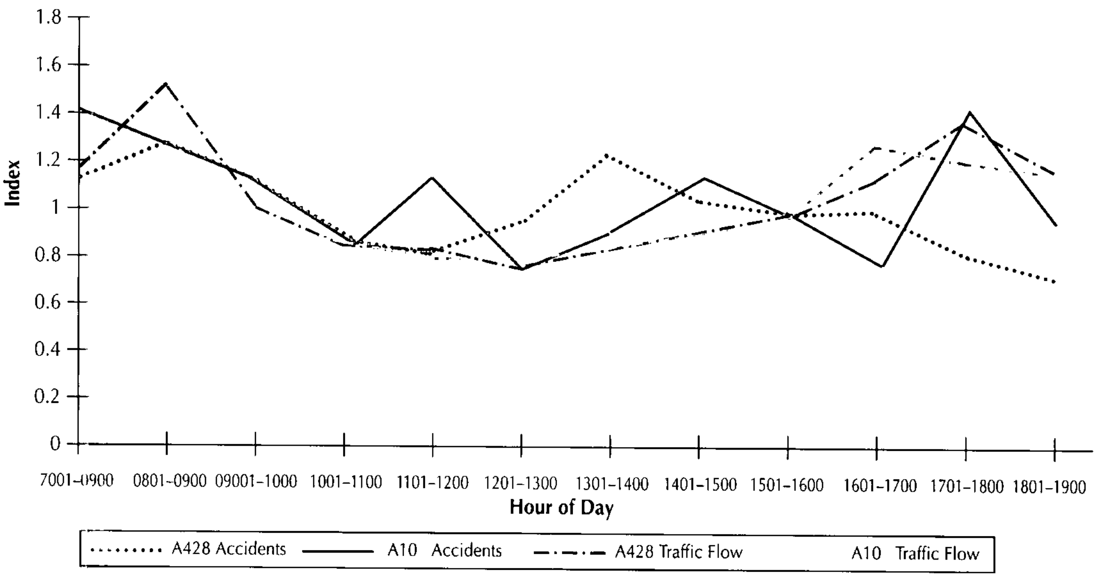
The hourly variations in accident and traffic flow over the 12 hour interval between 0700 and 1900 are shown in Figure III.4.

Traffic flow data were obtained from weekday manual counts which are carried out annually on five of the six routes. Figures for the A10 were obtained from automatic traffic count data. Twelve hour traffic flows were extracted from the data of a weekday which fell within the confines of the counting season used for other routes. The traffic flow index was calculated by dividing the hourly traffic flow by the average hourly traffic flow in the 12 hour period. Only accidents falling within the 12 hour period of the traffic count were considered for comparison, the accident index being calculated by dividing the number of accidents occurring in each hour by the average hourly number of accidents calculated from the 12 hour accident total.

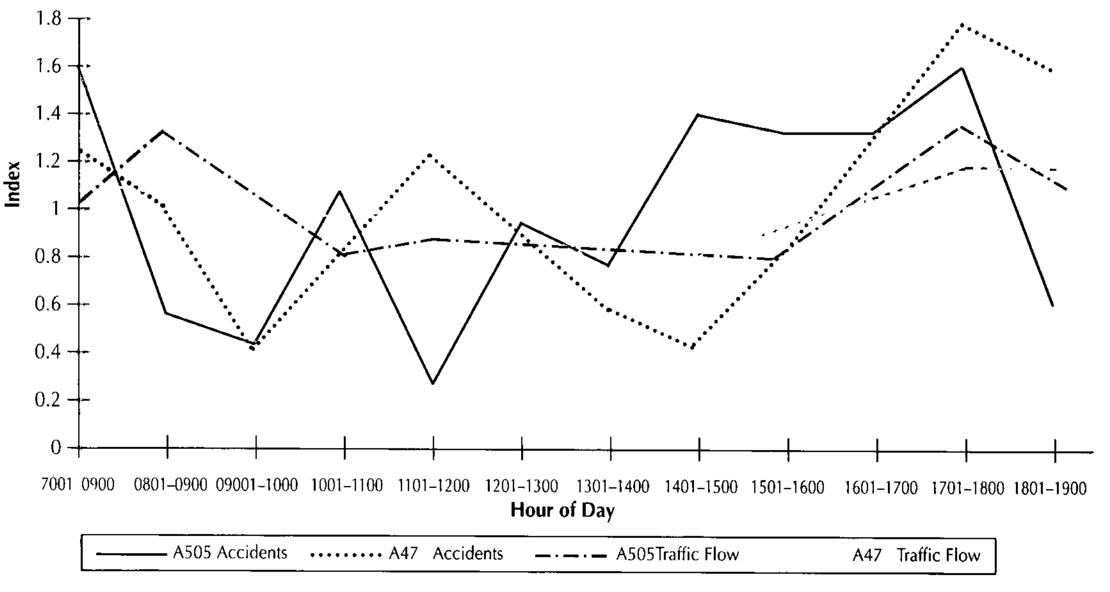
An unsurprising finding for all routes is a peak in traffic flow during the morning and evening rush hours (Figure III.4), though these peaks do not fall within the same hour for all roads. **Once again, it can be seen that differences exist between the traffic flow and accident profiles of each route.**

Figure III.4 Hourly variation in accidents and traffic flow

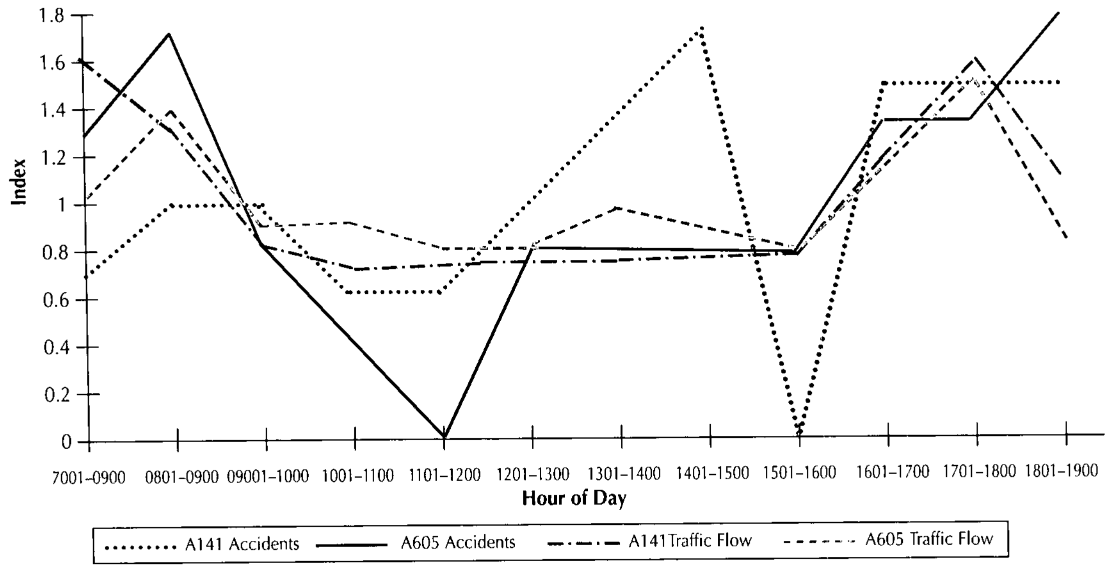
(1) Over capacity



(2) Between half capacity and capacity



(3) Below half capacity



3.2 Accident location

A simple distribution of accidents along each of the selected routes is presented in Table 3.2. 35 per cent of all the accidents occurred at public road junctions and private accesses, but the actual proportion varied between routes. On the A47, these locations contributed just 29 per cent of all accidents. Clearly, the high accident rates on the A47 are not directly attributable to junctions, with 71 per cent occurring on the inter-junction links.

In contrast, 41 per cent of accidents on the A141 route occurred at junctions. The countywide distribution of accidents occurring on single carriageway 'A' class roads shows a more even distribution between public road junctions and the links. However, these figures do not take into account the number of junctions along each route.

Table 3.2 Accident distribution by location (excluding roundabouts) – (1988–1994)

Category	Route	Location			
		Not at junction	Public Road Junctions	Private Accesses	SUM
1	A428	151	47	16	214
	Row %	*70.6*	*22.0*	*7.5*	*100.0*
	A10	131	62	33	226
	Row %	*58.0*	*27.4*	*14.6*	*100.0*
2	A505	58	19	19	96
	Row %	*60.4*	*19.8*	*19.8*	*100.0*
	A47	125	24	27	176
	Row %	*71.0*	*13.6*	*15.3*	*100.0*
3	A141	33	15	8	56
	Row %	*58.9*	*26.8*	*14.3*	*100.0*
	A605	26	14	4	44
	Row %	*59.1*	*31.8*	*9.1*	*100.0*
	All	524	181	107	812
	Row %	***64.5***	***22.3***	***13.2***	***100.0***
	County	3538	3011	644	7193
	Row %	***49.2***	***41.9***	***9.0***	

3.2.1 Public road junctions

The effect of junction frequency on the magnitude of accidents at public road junctions is shown in Table 3.3. Their distribution on each road is shown in Figure II.1. The accident data are presented in terms of the annual average accident rate per junction. The eight T / staggered junctions on the A428 had the highest accident rate per junction type (0.8 accidents per junction), while the eight on the A141 had the lowest annual accident rate (0.3 accidents per junction) – Table 3.3. However, a direct comparison of the two should be viewed with caution because of the large differences between the traffic flows of these routes.

A countywide comparison of accidents at different junctions is possible for most junction types but, in the case of roundabouts, STATS19 does not distinguish between accidents occurring at roundabouts on dual carriageways and those occurring on single carriageway roads. For this reason, accidents occurring at roundabouts are not considered in this study even though some roundabouts are present on three of the six roads.

From Table 3.2 it is clear that the higher absolute accident numbers on Category 1 routes was, in part, a result of a higher annual average number of accidents per junction. Category 1 routes experienced an average of 0.8 accidents per junction per year (Table 3.3), whereas Category 2 routes experienced an average of 0.5, and Category 3 routes averaged 0.3 accidents per junction per year.

In addition the number of junctions per kilometre on these routes was also not uniform, ranging from 0.5 per kilometre on the A428, A605 and A505 to 0.8 per kilometre for the A141. The high junction rate per kilometre for the A10, combined with the high annual average accident rate per junction for the A10 points to junctions contributing a large proportion of the accidents on this route.

Table 3.3
Public road junctions: junction frequency and average number of accidents per junction

Category	Route	T-staggered Junctions		XYM Junctions		Average accidents per junction	Junctions per kilometre
		No.	Acc./Jcn.	No.	Acc./Jcn.		
1	A428	8	0.84			0.84	0.49[1]
	A10	10	0.52	2	0.71	0.74	0.77[1]
2	A505	5	0.54			0.54	0.51
	A47	6	0.50	1	0.43	0.49	0.71
3	A141	8	0.27			0.27	0.81[1]
	A605	5	0.40			0.40	0.51

Acc/Jcn = Annual Accident Rate per junction.
X,Y,M Crossroads, Y-junctions and Multiple junctions.
[1] *Junction date include two roundabouts for each route.*

It was noted earlier in section 3.2 that the A47 had the lowest proportion of total accidents at public road junctions. Since the average number of accidents per junction does not appear to differ markedly from the average for all routes, and there are an above average number of junctions per kilometre, this points to a problem on the links.

3.2.2 Private accesses

Private accesses are rarely engineered to the same standard as public road junctions, but can contribute as many, if not more, accidents to the total on individual routes. On the A505, public road junctions and private accesses each contributed 20 per cent of all accidents, while private accesses on the A47 contributed 15 per cent compared with 14 per cent at public road junctions.

The general definition of a private access includes general service areas such as petrol stations and roadside cafes, and the entrances to farms, fields, and business depots such as haulage companies. However, an accident can only be coded against a private access if it was being used at the time of the accident. This general definition of a private access explains why the frequency of this type of junction is much higher than public road junctions (Table 3.4). However, the definition might preclude serious consideration of tackling the accident problem at this type of junction, especially when it emerges that the accident rates per access are much lower than those of public road junctions (Table 3.4).

It was decided to examine further traffic accidents at private accesses in order to find out if any one access type had a poor accident record. To test this hypothesis, all private accesses occurring on each of the routes were recorded and classified according to the nature of the properties involved. The classifying groups were: 'Farms', 'Private Houses', 'Business' areas (to include garden nurseries, petrol services, roadside eating establishments, Sunday market locations and tourism spots), and 'Field Tracks'. The latter group were established from Ordnance Survey maps. No additional attempt was made to establish the access points to fields adjacent to the carriageway. All farm entrances were classified as 'Farms'. The entrances to homes were coded as private houses, though some may have been operating a business from their premises which could generate extra traffic – for example Bed and Breakfast establishments. The distribution of private accesses on each route can be found in Figure II.1.

Table 3.4
Private accesses: junction frequency and average number of accidents per access

Route	Business		Farms		Tracks		Private Houses		Average accidents per access	Accesses per kilometre
	No.	Acc/Jcn	No.	Acc/Jcn	No.	Acc/Jcn	No.	Acc/Jcn		
A428	10	0.13	13	0.07	9	0.01	18	0.01	**0.04**	**2.5**
A10	12	0.24	15	0.05	15	0.01	83	0.01	**0.03**	**6.8**
A505	10	0.27	4	-	11	-	11	-	**0.07**	**3.5**
A47	10	0.20	21	0.05	12	0.05	20	0.01	**0.06**	**4.8**
A141	4	0.11	12	0.05	9	0.02	12	-	**0.03**	**3.0**
A605	1	0.14	12	0.02	8	0.02	3	-	**0.02**	**2.4**

Acc/Jcn = Annual Average Accident Rate per Junction

The results of the survey of each route are presented in Table 3.4, with the accident data expressed as an annual accident rate per access type. The overall annual accident rate per access was low and was similar for all routes. The A505 and A47 had the highest annual accident rate per access, with one accident for every 14 and 17 accesses respectively.

On the whole, accidents were not evenly distributed between all types of private access (Table 3.4). 'Tracks' and 'Private Houses' had the lowest accident rates per access, followed by the entrances to farms. The highest annual accident rate per junction was experienced at the accesses to 'Business' areas (Table 3.4). On the A505, this rate was as high as one accident for every four business type accesses. **Clearly, the private access problem is focused towards those accesses which generate more traffic movement.**

3.3 Conditions of road surface, light and weather

3.3.1 Road surface and light

On average, the majority of accidents occurred when the road surface was dry (56 per cent – Table 3.5). Less than four per cent occurred on a snow or ice covered road surface.

Table 3.5
Accident distribution by road surface and light

Category	Route	Road surface %			SUM
		Dry	Wet/Flood	Snow/Ice	
1	A428	55.6	42.1	2.4	**214**
	A10	57.5	37.6	4.9	**226**
2	A505	58.3	38.5	3.1	**96**
	A47	55.7	41.5	2.9	**176**
3	A141	53.8	42.9	3.6	**56**
	A605	54.5	38.6	6.8	**44**
	All	**56.3**	**40.1**	**3.5**	**812**
	Day	*60.7*	*36.1*	*3.2*	*596*
	Dark	*44.0*	*51.4*	*4.6*	*216*
	County	**58.7**	**39.0**	**2.3**	**7193**

In daylight, on average, 36 per cent of all accidents occurred on a wet road surface (Table 3.5). During the hours of darkness, the corresponding figure was 51 per cent. This may be due to roads remaining wet for longer when it is dark.

3.3.2 Skidding

The average skidding rate was nearly 70 per cent among accidents which occurred on snow or ice covered roads (Table 3.6).

The dry skidding rate was generally lower than the wet skidding rate, averaging 35 per cent of dry surface accidents against 49 per cent in wet surface accidents. Variations in the dry skidding rate observed between routes may be due to differences in the condition of the wearing course and general road cleanliness. Vehicle speed may also be a factor.

With water on the road surface, skidding rates are generally much higher – more than 50 per cent of wet surface accidents on the A141, A10 and A428 involved at least one vehicle skidding. Wet skidding rates are generally worse on carriageways where the wearing course has become smooth and / or polished.

That the wet skidding rate for the A505 was lower than the dry skidding rate may in part be a reflection of better road drainage. This route is not only built on chalk, but is also hillier than the other routes.

Table 3.6
Skidding accidents by road surface

Category	Route	% Skid by Road Surface			
		Dry	Wet/Flood	Snow/Ice	ALL
1	A428	39.5	55.5	80.0	47.2
	A10	31.5	55.3	72.7	42.5
2	A505	39.3	32.4	66.7	37.5
	A47	35.7	41.1	60.0	38.6
3	A141	26.7	54.2	50.0	39.3
	A605	25.0	47.1	66.7	36.4
	Mean	34.8	49.1	69.0	41.2
	County	**24.2**	**43.6**	**60.2**	**32.6**

3.3.3 Weather conditions

Over three quarters of the accidents occurred in fine weather, with a further 15 per cent when it was raining (Table 3.7). Less than four per cent occurred in fog (Table 3.7). The small number of accidents which occurred in snowy weather were not examined separately. Higher proportions of accidents on the busier Category 1 and 2 routes occurred in fog or wet weather. Six per cent of accidents on the A428 occurred in fog.

Table 3.7 Accidents by weather condition

Category	Route	Weather Condition %			SUM
		Fine	Rain	Fog	
1	A428	73.9	15.0	6.5	214
	A10	73.4	19.5	1.3	226
2	A505	78.1	14.5	4.2	96
	A47	76.7	18.2	3.4	176
3	A141	78.5	12.5	-	56
	A605	81.9	11.4	-	44
	Mean	**77.1**	**15.2**	**3.9**	**812**
	County	**76.9**	**16.9**	**2.1**	**7193**

3.4 The human and financial cost

3.4.1 Accidents

Category 3 routes had the smallest proportion (less than 30 per cent) of fatal and serious (KSI) accidents, and averaged approximately one fatal or serious accident per year for each five kilometres of road.

The proportion of fatal and serious accidents on the Category 1 and 2 routes exceeded 30 per cent and was as high as 43 per cent for the A505 (Table 3.8). These routes had, on average, a rate of approximately one KSI accident per year for each kilometre length of road.

Table 3.8 Accident severity (1988–1994)

Category	Route	Accident Severity %			Accident Nos.	KSI[1] (%)
		Fatal	Serious	Slight		
1	A428	10.7	24.8	64.5	**214**	**35.5**
	A10	4.4	32.3	63.3	**226**	**36.7**
2	A505	8.3	34.4	57.3	**96**	**42.7**
	A47	6.8	27.8	65.3	**176**	**34.6**
3	A141	5.4	14.3	80.4	**56**	**19.7**
	A605	4.5	25.0	70.5	**44**	**29.5**
	Mean	**7.1**	**28.0**	**64.9**	**812**	**35.1**
	County	**3.2**	**24.5**	**72.2**	**7193**	**27.7**

KSI[1] = Percentage killed plus seriously injured

At June 1994 prices (Department of Transport 1995(2)), accidents on the 84.4 km of 'A' class single carriageway road being studied cost society an average of £12.8 million annually (Table 3.9), or £0.15 million per kilometre of carriageway. On individual routes, accident costs per kilometre were as high as £0.21 million for both the A428 and A47.

Table 3.9 Accident costs (June 1994 prices – rural roads)

Category	Route	Average Cost of Accidents per Year (million pounds)				
		Fatal	Serious	Slight	All Injury Accidents	Cost per kilometre
1	A428	3.16	0.91	0.24	4.31	**0.21**
	A10	1.37	1.26	0.25	2.88	**0.16**
2	A505	1.10	0.57	0.10	1.77	**0.17**
	A47	1.65	0.85	0.20	2.70	**0.21**
3	A141	0.41	0.14	0.08	0.63	**0.05**
	A605	0.27	0.19	0.05	0.51	**0.05**
	Mean	**7.97**	**3.92**	**0.92**	**12.81**	**0.15**
	County	**31.89**	**30.47**	**9.09**	**71.45**	**0.14**

3.4.2 Casualties

Table 3.10 shows the number of casualties per accident for each route categorised by severity. KSI accidents gave rise to more casualties than slight accidents on the six routes, (2.3 per accident compared to 1.5 per accident). The pattern holds true countywide. However, when comparing routes, it is noticeable that a higher proportion of all the casualties in KSI accidents on the quieter Category 3 routes were killed or seriously injured (greater than 71 per cent).

Table 3.10 Casualty severity

Category	Route	Casualties in KSI Accidents		Casualties in Slight Accidents	All Casualties	
		Number per Accident	% KSI of all Casualties	Number per Accident	Number	% KSI
1	A428	2.37	64.4	1.49	**386**	**30.0**
	A10	2.24	66.7	1.48	**399**	**31.1**
2	A505	2.24	63.0	1.45	**172**	**33.7**
	A47	2.41	59.9	1.46	**315**	**27.9**
3	A141	2.36	80.8	1.58	**97**	**21.6**
	A605	2.38	71.0	1.52	**78**	**28.2**
	Mean	**2.32**	**64.8**	**1.49**	**1447**	**29.6**
	County	**2.00**	**69.0**	**1.43**	**11492**	**27.6**

3.5 Summary

- Accident rates on the six routes varied between 0.6 accidents per kilometre on the A605 and 1.9 accidents per kilometre on the A47.
- No clear relationship exists between traffic volume and accidents, therefore other factors must exert an influence on the occurrence of accidents on these roads.
- Accident numbers were not evenly distributed between links, junctions and accesses, and marked variations existed between routes in the same category.
- Accident distributions at public road junctions were not simply a function of junction frequency. However, there was some indication of higher accident rates per junction on the busier routes.
- Private accesses cater for all types of access onto main roads other than public road junctions. However, problems mainly reside with 'Business' type accesses which include the entrances to roadside eating establishments, petrol filling stations, garden nurseries, Sunday market locations, tourism spots and depots.

Chapter 4 Accident types, drivers and vehicles involved

The vehicles and drivers involved in accidents on the six routes are examined in the following sections. The involvement of vehicles in these accidents is examined from the viewpoint of vehicle numbers, types and conflicts. Drivers are examined from the perspective of age and gender, the vehicles they were driving and the manoeuvres being completed at the time of their involvement in an accident. The chapter ends with an accident classification exercise in order to ascertain the predominant accident types. All accidents, irrespective of the route on which they occurred, have been pooled together.

4.1 Vehicle characteristics

Some 1732 vehicles were involved in the 812 accidents being examined, with 1292 cars representing the highest vehicle component (75 per cent of the total – Table 4.1). Heavy goods vehicles were the next most commonly involved (11 per cent) but their involvement was less than the proportion of heavy goods vehicles on the roads (13 to 21 per cent of traffic – Table 2.1). Light goods vehicles follow with 7 per cent and motor cycles with 4 per cent. Pedal cycles and public service vehicles accounted for less than 3 per cent of the total – (Table 4.1). From mid-1989, tractors and a few other vehicle types were given their own categories on the STATS19 form to allow them to be distinguished from other vehicles in the general 'other non-motorised' and 'other motorised' vehicle categories. Five of the sixteen 'other' vehicles in Table 4.1 were tractors, two were other slow moving plant and one was a milk float.

Table 4.1 Vehicles involved in accidents

	Vehicle Type							
	Pedal Cycle	Motor Cycle	Car	Bus	Light Goods	Heavy Goods	Other	ALL
Numbers	20	72	1292	21	116	195	16	**1732**
Row %	*1.2*	*4.2*	*74.6*	*1.2*	*6.7*	*11.3*	*1.0*	***100.0***

Table 4.2 Accidents by numbers of vehicles involved

	Number of vehicles							
	1	2	3	4	5	6	>6	ALL
Numbers	208	399	135	44	15	7	4	**812**
Row %	*25.6*	*49.1*	*16.6*	*5.4*	*1.8*	*0.9*	*0.5*	***100.0***

Forty nine per cent of the accidents involved two vehicles (399 accidents), with single vehicle accidents accounting for a further 26 per cent; three vehicle accidents for 17 per cent and four vehicle accidents for a further five per cent. Only three per cent of all the accidents involved more than four vehicles – Table 4.2

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4.2 Vehicles involved – conflicting vehicles

Table 4.3 shows the representation of vehicle classes in single vehicle accidents. Cars predominate (75 per cent)).

Table 4.3 Single vehicle accidents – vehicles involved

Vehicle Type	Numbers	%
Heavy Goods	11	5.6
Public Service	3	1.5
Light Goods	13	6.6
Car	149	75.2
Motor Cycle	19	9.6
Pedal Cycle	3	1.5
TOTAL	**198**	**100.0**

Table excludes 10 accidents which involved pedestrians.

Table 4.4 Accidents involving two vehicles – vehicles in conflict

	OM	HGV	PSV	LGV	Car	MC	PC
Other Motor (OM)							
Heavy Goods (HGV)	1 (0.3)	3 (0.8)					
Public Service (PSV)		1 (0.3)					
Light Goods (LGV)		12 (3.0)	1 (0.3)	6 (1.5)			
Car	5 (1.3)	61 (15.3)	5 (1.3)	30 (7.5)	214 (53.6)		
Motor Cycle (MC)		5 (1.3)		2 (0.5)	35 (8.8)	1 (0.3)	
Pedal Cycle (PC)		4 (1.0)	1 (0.3)	1 (0.3)	9 (2.3)	1 (0.3)	

For clarity, Table excludes one accident between other non-motor vehicle and a car.

In accidents involving two vehicles, the predominant vehicle combination was that of a car coming into conflict with another vehicle, accounting for 90 per cent of all two vehicle conflicts (Table 4.4).

Table 4.5 Multiple vehicle accidents – vehicle conflicts

Three Vehicle Conflict	No.	%	Four Vehicle Conflict	No.	%
Car (3)	68	50.4	Car (4)	23	52.3
Car (2)-HGV	25	18.5	Car (3)-LGV	4	9.1
Car (2)-LGV	10	7.4	Car (2)-HGV (2)	4	9.1
Car-LGV-HGV	8	5.9	Car (3)-HGV	3	6.8
Car-HGV-HGV	4	3.0	Car (3)-MC	2	4.5
Car-HGV-MC	3	2.2	Car-HGV (3)	2	4.5
Car (2)-PSV	3	2.2	Other	6	13.7
Car-HGV-Other	3	2.2			
Other	11	8.1			
Total	*135*	*100.0*	*Total*	*44*	*100.0*
Five Vehicle Conflict	**No.**	**%**	**Six Vehicle Conflict**	**No.**	**%**
Car (5)	7	46.6	Car (6)	3	42.8
Car (4)-HGV	4	26.6	Car (5)-LGV	1	14.3
Car (4)-LGV	1	6.7	Car (5)-HGV	1	14.3
HGV (4)-Car	1	6.7	Car (4)-LGV-HGV	1	14.3
Car (3)-HGV-LGV	1	6.7	HGV (4)-Car-LGV	1	14.3
Car (3)-HGV-MC	1	6.7			
Total	*15*	*100.0*	*Total*	*7*	*100.0*
Seven Vehicle Conflict	**No.**	**%**	**Eight Vehicle Conflict**	**No.**	**%**
Car (7)	1	33.3	Car (8)	1	100.0
Car (5)-HGV (2)	1	33.3			
Car (4)-LGV (2)-HGV	1	33.3			
Total	*3*	*100.0*	*Total*	*1*	*100.0*

In accidents involving three or more vehicles, most of the accidents once again involved conflicts between cars.

4.3 Driver characteristics

Seventy nine per cent of the vehicles involved in the 812 accidents had male drivers at the controls. This proportion increases when individual vehicle groups are examined – males form a higher proportion of the drivers among those vehicle groups associated with a more male-orientated occupation/pursuit. For example, males accounted for more than 90 per cent of all motor cyclists, bus drivers, and the drivers of light and heavy goods vehicles involved in these accidents. The proportion of female drivers was highest among car drivers (27 per cent) and pedal cyclists (26 per cent) – Table 4.6.

Table 4.6
Gender of drivers by vehicles driven

	Gender		
	Male	Female	SUM
Pedal Cyclists	14	5	**19**
Row %	*73.7*	*26.3*	***100.0***
Motor Cyclists	70	2	**72**
Row %	*97.2*	*2.8*	***100.0***
Car	923	335	**1258**
Row %	*73.3*	*26.6*	***100.0***
Bus	19	2	**21**
Row %	*90.5*	*9.5*	***100.0***
Light Goods	109	5	**114**
Row %	*95.6*	*4.4*	***100.0***
Heavy Goods	182	1	**183**
Row %	*99.5*	*0.5*	***100.0***
Other	15	1	**16**
Row %	*93.7*	*6.3*	***100.0***
COLUMN TOTAL	**1332**	**351**	**1683**
Row %	***79.0***	***21.0***	***100.0***

Excludes 48 drivers whose gender was not specified.

In recognising that different skills are required to ride a motor cycle compared to driving a car or heavy goods vehicle, this section examines the involvement of different vehicle groups in accidents from the perspective of driver gender, age group and the manoeuvre being carried out when the accident occurred. Only motor cycles, cars, light goods vehicles and heavy goods vehicles are considered.

For most vehicle groups, the data are indicative of the actions of male drivers as their gender predominates. The role of gender is only considered for car drivers, where separate tables are given.

4.3.1 Motor cycles

The age distribution of motor cycle riders is heavily biased towards the younger motor cyclist, with 66 per cent of riders falling within the 17 to 29 age group (Table 4.7). With the inclusion of riders aged between 30 and 39, the cumulative proportion covers 84 per cent of all motor cyclists involved in accidents.

An overtaking manoeuvre features highly, accounting for more than 30 per cent of manoeuvres by motor cyclists.

Less than 5 per cent of motor cyclists involved in accidents were carrying out a turning manoeuvre at the time.

Table 4.7
Motor cycle manoeuvres in accidents – driver age

Manoeuvre	Age of Motor Cycle Rider					All
	17–29	30–39	40–49	50–59	60 +	
Right turn	3					**3**
Column %	(6.5)					**(4.3)**
Overtaking	16	5		1		**22**
Column %	(34.8)	(38.5)		(33.3)		**(31.4)**
Left bend	4					**4**
Column %	(8.7)					**(5.7)**
Right bend	3	1	1	1		**6**
Column %	(6.5)	(7.7)	(14.3)	(33.3)		**(8.6)**
Going ahead	20	7	6	1	1	**35**
Column %	(43.5)	(53.8)	(85.7)	(33.3)	(100.0)	**(50.0)**
All manoeuvres	**46**	**13**	**7**	**3**	**1**	**70**
Row %	***(65.7)***	***(18.6)***	***(10.0)***	***(4.3)***	***(1.4)***	***100.0***

4.3.2 Cars

Tables 4.8 and 4.9 show the manoeuvres being carried out by cars driven by males and females respectively. Only those manoeuvres with a greater than 5 per cent representation in the ALL column are shown. At just under 10 per cent, the proportion of cars in the process of overtaking was lower than the comparable figure of 31 per cent for motor cycles.

Table 4.8
Car manoeuvres in accidents – driver age (male)

Manoeuvre	Age of Car Driver					All
	17–29	30–39	40–49	50–59	60 +	
Held up/Stopping/ Starting	48	31	20	18	15	**132**
Column %	(13.3)	(16.3)	(12.8)	(18.8)	(13.8)	**(14.4)**
Right turn	26	12	17	7	23	**85**
Column %	(7.2)	(6.3)	(10.8)	(7.3)	(21.1)	**(9.3)**
Overtaking	44	22	10	6	9	**91**
Column %	(12.1)	(11.6)	(6.4)	(6.3)	(8.3)	**(9.9)**
Left bend	23	15	7	3	4	**52**
Column %	(6.3)	(7.9)	(4.5)	(3.1)	(3.7)	**(5.7)**
Right bend	34	7	13	6	3	**63**
Column %	(9.4)	(3.7)	(8.3)	(6.3)	(2.8)	**(6.9)**
Going ahead	160	87	77	49	47	**420**
Column %	(44.1)	(45.8)	(49.0)	(51.0)	(43.1)	(45.9)
All manoeuvres	**363**	**190**	**157**	**96**	**109**	**915**
Row %	***(39.7)***	***(20.8)***	***(17.2)***	***(10.5)***	***(11.9)***	***100.0***

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Table 4.9
Car manoeuvres in accidents – driver age (female)

Manoeuvre	Age of Car Driver					All
	17–29	30–39	40–49	50–59	60 +	
Held up/Stopping/ Starting	26	14	10	3	1	**54**
Column %	(16.6)	(17.2)	(18.6)	(13.6)	(5.0)	**(16.2)**
Right turn	18	4	5	3	5	**35**
Column %	(11.5)	(4.8)	(9.3)	(13.6)	(25.0)	**(10.5)**
Overtaking	12	7	5	1	3	**28**
Column %	(7.6)	(8.6)	(9.4)	(4.5)	(15.0)	**(8.4)**
Left bend	6	5	1	2		14
Column %	(3.8)	(6.2)	(1.9)	(9.1)		(4.2)
Right bend	10	5	5		1	**21**
Column %	(6.4)	(6.2)	(9.3)		(5.0)	**(6.3)**
Going ahead	76	36	26	11	8	**157**
Column %	(48.4)	(44.4)	(48.1)	(50.0)	(40.0)	**(47.0)**
All manoeuvres	**157**	**81**	**54**	**22**	**20**	**334**
Row %	***47.0***	***24.3***	***16.2***	***6.6***	***6.0***	***100.0***

There is a significant association between car driver age and manoeuvre. There is no significant difference in this effect between males and females, but the age distribution of drivers involved does vary between the sexes.

The main difference in manoeuvres between age groups is that 22 per cent of car drivers (male and female) aged 60 or over were turning right at the time of their accident compared to an overall average of 8 per cent for other age groups. Other features of the tables are that 8 per cent of 17–29 year olds were negotiating a right hand bend and 11 per cent of 17–39 year olds were overtaking; the comparable figures for other age groups are 5 per cent and 7 per cent respectively.

Considering age distribution of drivers involved by gender, there were proportionally more younger females and fewer older females compared to males. This may be a reflection of differences in the age of the two driving populations.

4.3.3 Heavy Goods Vehicles

Viewed as a whole, heavy goods vehicle drivers encountered most of their problems as they were going ahead (59 per cent – Table 4.10). The most common vehicle manoeuvres after going ahead for a heavy goods vehicle involved in an accident were those of stopping, held up or starting off (10 per cent) and negotiating a right bend (8 per cent).

There is a significant association between heavy goods vehicle driver age and manoeuvre. For example, with the going ahead manoeuvre, there is considerable variation between age groups, ranging from 44 per cent for drivers aged 30 to 39 rising to 75 per cent for drivers aged 60 or more (Table 4.10).

In an examination of manoeuvres by age groups, the following associations were found (Table 4.10). Compared to other ages:

1. Turning right seems to be a greater risk relative to other manoeuvres for heavy goods vehicle drivers aged between 17 and 29.
2. Held up, stopping or starting seems to be a greater risk relative to other manoeuvres for heavy goods vehicle drivers aged between 30 and 39.

Accident types, drivers and vehicles involved

The difference in the distribution of accident-related vehicle manoeuvres being carried out by heavy goods vehicles compared to cars points towards **heavy goods vehicles having a greater problem when they are actually on the main road rather than as they are entering or leaving it. Only young heavy goods vehicle drivers seem to have a problem when entering or leaving the main road. This may be an indication of inexperience.**

Table 4.10 Heavy goods vehicle manoeuvres in accidents – driver age

Manoeuvre	Age of Heavy Goods Vehicle Driver					All
	17–29	30–39	40–49	50–59	60 +	
Held up/Stopping/ Starting	2	9	2	5		**18**
Column %	(4.0)	(27.3)	(4.2)	(13.5)		**(10.1)**
Right turn	6		3	1		**10**
Column %	(12.2)		(6.3)	(2.7)		**(5.6)**
Overtaking	2	1	2	3	1	**9**
Column %	(4.1)	(3.0)	(4.2)	(8.1)	(8.3)	**(5.1)**
Left bend	6	2	2	2	1	**13**
Column %	(12.2)	(6.1)	(4.2)	(5.4)	(8.3)	**(7.3)**
Right bend	2	3	6	4		**15**
Column %	(4.1)	(9.1)	(12.5)	(10.8)		**(8.4)**
Going ahead	31	14	33	18	9	**105**
Column %	(63.3)	(44.1)	(68.8)	(48.6)	(75.0)	**(58.7)**
All manoeuvres	**49**	**33**	**48**	**37**	**12**	**179**
Row %	***27.4***	***18.4***	***26.8***	***20.7***	***6.7***	***100.0***

4.3.4 Light Goods Vehicles

There is no significant association between age and manoeuvre for light goods vehicle drivers (Table 4.11). However this may be due to the small numbers in most of the table cells.

Table 4.11 Light goods vehicle manoeuvres in accidents – driver age

Manoeuvre	Age of Light Goods Vehicle Driver					All
	17–29	30–39	40–49	50–59	60 +	
Held up/Stopping/ Starting	4	3	2	1		**10**
Column %	(8.6)	(12.5)	(11.1)	(7.7)		**(9.3)**
Right turn	7	3	3	4	1	**18**
Column %	(15.2)	(12.5)	(11.1)	(30.8)	(16.7)	**(16.8)**
Right turn waiting	1		1	1	1	**4**
Column %	(2.2)		(5.6)	(7.7)	(16.7)	**(3.7)**
Overtaking	6	1				**7**
Column %	(13.0)	(4.2)				**(6.5)**
Left bend	2	1	1	1	1	**6**
Column %	(4.3)	(4.2)	(5.6)	(7.7)	(16.7)	**(5.6)**
Right bend	3	3	2		1	**9**
Column %	(6.5)	(12.5)	(11.1)		(16.7)	**(8.4)**
Going ahead	23	12	10	6	2	**53**
Column %	(50.0)	(50.0)	(55.6)	(46.2)	(33.3)	**(49.5)**
All manoeuvres	**46**	**24**	**18**	**13**	**6**	**107**
Row %	***43.0***	***22.4***	***16.8***	***12.1***	***5.6***	***100.0***

4.4 Accident types

All the accidents which occurred on each of the six routes in the seven year period of this study were classified into one of six accident type categories. Each category was composed of several sub-categories which effectively described each accident (see Appendix D). The categories were:

- accidents which involved loss of control
- turning accidents
- overtaking accidents
- stacking accidents
- accidents where a vehicle crossed a centre line;
- other (pedestrian accidents)

Stacking accidents are those which occurred when vehicles collided with, or took evasive action to avoid contact with, the back of the vehicle in front. A variety of circumstances can give rise to these accidents including queuing at junctions, slow moving traffic and bunching due to improper overtaking.

The results are presented in Table 4.12 and can be summarised as:

1. Accidents involving a single vehicle were characterised by a loss of control in 80 per cent of cases. Overtaking related accident types accounted for a further 8 per cent of single vehicle accidents. All these accidents were of the type where the vehicle lost control or evaded oncoming traffic while in the process of overtaking.
2. The accident types associated with two vehicle accidents were altogether different and were distributed across more of the accident types. The predominant accident type for two vehicle accidents was turning (33 per cent). This was followed by overtaking (27 per cent) and stacking (23 per cent) type accidents. Most stacking type accidents were rear-end shunts (76/92) with right turn entering accounting for most of the turning accidents (82/132). Loss of control or evasion while overtaking accounted for nearly as many accidents as the whole loss of control accident type category.
3. In accidents involving three or more vehicles, stacking type accidents predominated. Their proportion increased progressively with the involvement of more vehicles: from 58 per cent for three vehicle accidents to 91 per cent for accidents involving six or more vehicles. Rear end shunts accounted for most of the accident types within each group. An increase in the number of vehicles involved in individual accidents saw a decrease in the number of overtaking, turning and loss of control type accidents (Table 4.12).

Table 4.12 Number of vehicles involved in accidents by accident type

Accident Type	Number of Vehicles					
	1	2	3	4	5	6+
LOSS OF CONTROL						
Left bend	30	5	2			
Right bend	52	12	4	1		
Other	85	19	9	3	1	
Section total	**167**	**36**	**15**	**4**	**1**	
% of column total	**(80.3)**	**(9.0)**	**(11.1)**	**(9.1)**	**(6.7)**	
TURNING						
Right leaving		22	4	1		
Right entering						
Nearside		23	2			
Offside		59	5		1	
Left entering						
Offside		7	3			
Other		2				
Junction overshoot	4	6				
U-turn		13				
Section total	**4**	**132**	**14**	**1**	**1**	
% of column total	**(1.9)**	**(33.1)**	**(10.4)**	**(2.3)**	**(6.7)**	
OVERTAKING						
Head-on		33	7	5	1	
Loss of Control/Evasion	17	32	3	1		
Right turn		29	5			
Multiple		7	4	1		
Other		5	2			
Section total	**17**	**106**	**21**	**7**	**1**	
% of column total	**(8.2)**	**(26.6)**	**(15.6)**	**(15.9)**	**(6.7)**	
STACKING						
Rear-end shunt		76	62	26	7	8
Queue evasion	8	14	17	3	5	2
Shunt on minor		2				
Section total	**8**	**92**	**79**	**29**	**12**	**10**
% of column total	**(3.8)**	**(23.1)**	**(58.5)**	**(65.9)**	**(80.0)**	**(90.9)**
CROSSED CENTRE LINE						
Bend	1	13	1	1		
Other	1	20	5	2		1
Section total	**2**	**33**	**6**	**3**		**1**
% of column total	**(1.0)**	**(8.3)**	**(4.4)**	**(6.8)**		**(9.1)**
OTHER						
Other	10					
Section total	**10**					
% of column total	**(4.8)**					
ALL ACCIDENTS	**208**	**399**	**135**	**44**	**15**	**11**

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Accident types were examined from the perspective of accidents involving the main vehicle types explored earlier. 40 per cent of accidents involving heavy goods vehicles were stacking type accidents, compared to 30 per cent of accidents involving cars. Only 16 per cent of heavy goods vehicle accidents involved loss of control.

33 per cent of accidents involving motor cycles were turning type accidents. It was shown in Section 4.3 that very few motor cycles were actually turning at the time of their accident. So, in the turning accidents of Table 4.3, vehicles other than motor cycles must have been carrying out the turning manoeuvre.

Table 4.13 Accident types involving different vehicle types

Accident type	Motor Cycle	Car	Light Goods	Heavy Goods	ALL
Stacking	12	212	35	67	326
Column %	(17.1)	(29.5)	(32.7)	(39.6)	(28.3)
Turning	23	145	12	20	200
Column %	(32.9)	(20.2)	(11.2)	(11.8)	(18.7)
Overtaking	21	134	23	35	213
Column %	(30.0)	(18.7)	(21.5)	(20.7)	(18.7)
Loss of Control	11	181	28	27	247
Column %	(15.7)	(25.2)	(26.2)	(16.0)	(27.5)
Crossed Centre Line	3	40	8	17	68
Column %	(4.3)	(5.6)	(7.5)	(10.1)	(5.6)
Other		6	1	3	10
Column %		(0.8)	(0.9)	(1.8)	(1.2)
COLUMN TOTAL	**70**	**718**	**107**	**169**	**1064**

4.5 Summary

Vehicles

- Cars represented 75 per cent of all vehicles involved in accidents. Heavy goods vehicles had the next highest representation at 11 per cent of all vehicles.
- Nearly 50 per cent of accidents involved two vehicles and just over 25 per cent of accidents involved just one vehicle.
- Cars represented three quarters of vehicles involved in single vehicle accidents with motor cycles accounting for a further 10 per cent.
- In accidents involving two vehicles, conflict between two cars accounted for over half of accidents, with car-heavy goods vehicle conflicts representing a further 15 per cent of all accidents.
- Conflicts exclusively between cars accounted for the majority of multiple vehicle accidents.

Accident types, drivers and vehicles involved

Drivers

- Of drivers, 79 per cent were male with female drivers only really featuring among drivers of cars (27 per cent).
- 66 per cent of motor cycle riders were aged between 17 and 29.
- Over 31 per cent of all motor cycles were overtaking when they were involved in an accident. Less than 5 per cent of motor cycle accident-related manoeuvres involved turning off or onto the main road.
- The distribution of accident-related manoeuvres was similar for both male and female car drivers. Turning right was the third most common manoeuvre, but is a riskier accident-related manoeuvre for drivers aged 60 or over. Overtaking was a more common accident-related manoeuvre for male drivers aged less than 40.
- Heavy goods vehicle drivers appeared to encounter most of their problem on the main road and not as they were attempting to enter or leave it. Only drivers aged between 17 and 29 experienced this problem – a factor which may come down to driving inexperience.

Accident types

- Accident types varied according to the number of vehicles involved in the accident.
- Single vehicle accidents were characterised by loss of control type accidents (81 per cent) and overtaking accidents (8 per cent).
- Accidents involving two vehicles were characterised by turning accidents (33 per cent), overtaking accidents (27 per cent) and stacking accidents (23 per cent).
- In accidents involving three or more vehicles, stacking accidents were predominant, ranging from 58 per cent for three vehicle accidents to 91 per cent for accidents involving six or more vehicles. 40 per cent of all heavy goods vehicle accidents involved stacking.

Chapter 5 Links, junctions and accesses

Collectively, the 812 accidents on the six single carriageway routes being examined were distributed between different locations as follows:

Section 5.1	Public road junctions:	181 accidents	(22.3 per cent)
Section 5.2	Private accesses:	107 accidents	(13.2 per cent)
Section 5.3	Inter-junction links:	524 accidents	(64.5 per cent)

Each of these locations will be examined for the parameters which were looked at in Chapters 3 and 4.

5.1 Accidents at public road junctions

High accident numbers within 20 metres of public road junctions emerged as one of the areas of concern in the first report – 'Accident on Rural Roads' (Hughes 1994), and is examined further in this section. A summary of the accidents at these locations is presented in Table 5.1. Roundabouts have been included for information. At face value, roundabouts emerge with the highest accident rate per year of all junction configurations. However, it has been proven elsewhere that where priority junctions have been replaced by roundabouts, remarkable accident savings – as high as 100 per cent – have been achieved (Cambridgeshire County Council 1996). Hughes (1994) also demonstrated that roundabouts have the lowest proportion of fatal and serious accidents of all junction configurations.

Table 5.1 Accident rates per junction type by classification of joining road

	Classification of joining road									
	A		B		C		U		ALL	
Junction type	Number of junctions	Rate/yr	Number of junctions	Rate/yr	Number of junctions	Rate/yr	Number of junctions	Rate/yr	Number of junctions	Rate/yr
Roundabout	2	1.0	1	0.57	1	1.00			**4**	**0.96**
T/staggered	1	1.43	7	1.02	22	0.41	19	0.34	**49**	**0.49**
XYM					2	0.79	1	0.29	**3**	**0.62**
Column %	**3**	**1.24**	**8**	**0.96**	**25**	**0.47**	**20**	**0.34**	**56**	**0.53**

X, Y and M are cross roads, Y-junctions and multiple junctions respectively.

Roundabouts are not examined any further in this study, and the small incidence of Y-junctions, multiple junctions and cross roads preclude their inclusion. Only the 168 accidents which occurred at T-junctions are examined in this section.

Table 5.2 Accident severity at T-junctions

	Accident Severity				
	Fatal	**Serious**	**Slight**	**Total**	**KSI (%)**
Numbers	5	47	116	**168**	**31.0**
Column %	*3.0*	*28.0*	*69.0*	*100.0*	

KSI (%) – percentage of fatal and serious accidents

Only 3 per cent of accidents occurring at T-junctions were fatal (Table 5.2) compared to 10 per cent on the inter-junction links (Table 5.27). Most T-junction accidents (75 per cent) occurred between 0800 and 2000 hours when the roads were busiest. The highest proportion of T-junction accidents occurred between 1200 and 1600 hours (27 per cent).

Table 5.3 T-junction accidents by hour of day

	Hour of day						
	0000–0400	0401–0800	0801–1200	1201–1600	1601–2000	2001–2359	ALL
Number	1	21	38	45	44	19	**168**
Row %	*0.6*	*12.5*	*22.7*	*26.7*	*26.1*	*11.4*	*100.0*

Compared to the average for links (54 per cent – Table 5.29), 64 per cent of accidents at T-junctions occurred when the road surface was dry (Table 5.4).

Table 5.4 T-junction accident distribution by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
Numbers	107	58	3	**168**
Row %	*63.7*	*34.5*	*1.8*	*100.0*

A more important difference emerges when the accidents are examined relative to road surface conditions and skidding. **A much higher proportion of the dry surface accidents at T-junctions involved a vehicle skidding (44 per cent – Table 5.5)** compared to the equivalent dry skidding rate for link accidents of 26 per cent – Table 5.30. This may reflect an association with vehicle speed.

The proportion of T-junction accidents in which a vehicle skidded on a wet road surface (47 per cent) is similar to that for links (48 per cent – Table 5.30).

Table 5.5 T-junction accidents which involved a vehicle skidding by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
All T-junction accidents	107	58	3	**168**
Skidding accidents	47	27	2	**76**
% Skid	**43.9**	**46.6**	**66.7**	**45.2**

5.1.1 Vehicle characteristics

Compared to the links (Table 5.31), **accidents at T-junctions involved a higher proportion of cars (81 per cent)**, and proportionally fewer heavy plus light goods vehicles (12 per cent). The proportional involvement of other road user groups is was similar (Table 5.6).

Table 5.6 Vehicles involved in accidents at T-junctions

	Vehicle Type							
	Pedal Cycle	Motor Cycle	Car	Bus	Light Goods	Heavy Goods	Other	ALL
Number	5	18	299	3	16	29	1	**371**
Row %	*1.3*	*4.9*	*80.6*	*0.8*	*4.3*	*7.8*	*0.3*	*100.0*

The distribution of accidents involving three or more vehicles at T-junctions is similar to the overall picture (Table 5.7). However, **there are proportionally more accidents involving two vehicles (66 per cent)** and fewer single vehicle accidents (12 per cent).

Table 5.7
T-junction accidents by number of vehicles involved

	Number of Vehicles							
	1	**2**	**3**	**4**	**5**	**6**	**> 6**	**ALL**
Number	20	111	25	9	2	0	1	**168**
Row %	*11.9*	*66.0*	*14.9*	*5.4*	*1.2*		*0.6*	*100.0*

5.1.2 Vehicles involved – conflicting vehicles

Cars were involved in 69 per cent of single vehicle accidents at T-junctions (Table 5.8).

Table 5.8
T-junction accidents involving one vehicle

	Vehicle Type			
	Cars	**Motor Cycles**	**Pedal Cycle**	**Light Goods**
Frequency	11	2	2	1
%	68.8	12.5	12.5	6.2

*Excludes 4 accidents between car and pedestrian

Compared to the situation for two vehicle accidents on the links (Table 5.34), those at T-junctions involved proportionally more conflicts between cars, with fewer between cars and heavy goods vehicles (Table 5.9). At least one car was present in 96 per cent of the accidents (Table 5.9).

Table 5.9
T-junction accidents involving two vehicles – conflicts

	HGV	**PSV**	**LGV**	**Car**	**MC**	**PC**
Heavy Goods (HGV)	1 (0.9)					
Public Service (PSV)						
Light Goods (LGV)	1 (0.9)		1 (0.9)			
Car	12 (10.8)	3 (2.7)	9 (8.1)	71 (63.1)		
Motor Cycle (MC)	1 (0.9)			11 (9.9)		
Pedal Cycle (PC)				1 (0.9)	1 (0.9)	

Though conflicts between three cars accounted for 52 per cent of all three vehicle accidents at public road junctions, at least one car was involved in 96 per cent of the accidents (Table 5.10). Heavy goods vehicles were involved in nine of the 25 accidents (36 per cent). In T-junction accidents involving four or more vehicles, conflicts occurring exclusively between cars accounted for ten of the 12 accidents.

Table 5.10
Multiple vehicle accidents at T-junctions – conflicts

Three Vehicle Conflict	**No.**	**%**	**Four or More Vehicle Conflict**	**No.**	**%**
Car (3)	13	52.0	**Car (4)**	7	58.3
Car (2)-HGV	4	16.0	**Car (5)**	2	16.7
Car (2)-LGV	2	8.0	**Car (3)-HGV**	1	8.3
Car-HGV-MC	2	8.0	**Car-HGV (3)**	1	8.3
Car-LGV-HGV	1	4.0	**Car (8)**	1	8.3
Car (2)-MC	1	4.0			
HGV (3)	1	4.0			
Car-HGV-OTH	1	4.0			
Total	***25***	***100.0***	***Total***	***12***	***100.0***

5.1.3 Driver characteristics

Male drivers predominated in accidents at T-junctions – Table 5.11, but the proportion of female drivers was slightly higher than the female driver involvement in overall accidents (Table 4.6) accounting for 25 per cent of the population of vehicle drivers.

Table 5.11 Gender of drivers involved in T-junction accidents

	Gender		
	Male	Female	SUM
Number	273	92	**365**
Row %	***73.6***	***24.8***	*100.0*

The gender of six drivers was uncoded

There is a significant association between driver age and type of vehicle driven. The differences in age distribution between vehicle types are similar for T-junctions, private accesses and inter-link junctions.

It can be seen from Table 5.12 that 61 per cent of motor cycle riders involved in accidents at T-junctions are in the 17-29 age group, whereas for heavy goods vehicle drivers, the corresponding figure is only 25 per cent. Heavy goods vehicle driver involvement is greatest in the 40-59 age group.

It was shown in Table 4.1 that 7 per cent of vehicles involved in the accidents under consideration are light goods vehicles and 11 per cent are heavy goods vehicles. For accidents at T-junctions, the proportions are smaller at 4 per cent and 8 per cent respectively.

Table 5.12 T-junction accidents by age of driver and vehicle type

Vehicle Type	Age of Driver					
	17–29	30–39	40–49	50–59	60 +	ALL
Motor Cycle	11	4	2	1		**18**
Column %	(61.1)	(22.2)	(11.1)	(5.6)		(100.0)
Car	126	66	47	25	31	**295**
Column %	(42.7)	(22.4)	(15.9)	(8.5)	(10.5)	(100.0)
Light Goods	10	1	5			**16**
Column %	(62.5)	(6.3)	(31.3)			(100.0)
Heavy Goods	7	4	8	7	2	**28**
Column %	(25.0)	(14.3)	(28.6)	(25.0)	(7.1)	(100.0)
All Vehicles	**156**	77	**68**	**34**	**33**	**368**
Row %	**(42.4)**	**(20.9)**	**(18.5)**	**(9.2)**	**(9.0)**	**(100.0)**

Excludes Age Uncoded – 5

Vehicle manoeuvres by vehicle types

Turning accounted for over a quarter of all accident-related manoeuvres, with the turning right manoeuvre accounting for 23 per cent by itself. The proportional distribution of manoeuvres is not uniform between the different vehicle types (Table 5.13).

Over 40 per cent of motorcycles involved in T-junction accidents were carrying out an overtaking manoeuvre – this compares to just 6 per cent for all vehicles. 14 per cent of cars were caught up in accidents when they were either stopping, held up or starting off. No other vehicle group has any appreciable involvement in this manoeuvre.

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Turning right was more of an accident-related problem for cars and light goods vehicles compared to motor cycles and heavy goods vehicles. Nearly 44 per cent of light goods vehicles involved in accidents at T-junctions were turning right at the time compared to 23 per cent of other vehicles.

Over 65 per cent of heavy goods vehicles were going ahead when the accident in which they were involved occurred. The comparable proportion for all vehicles was 45 per cent.

Table 5.13 Vehicle manoeuvres in T-junction accidents

Manoeuvre	Vehicle Type				
	Motor Cycle	Car	Light Goods	Heavy Goods	ALL
Held up/Stopping/Starting		42		1	**43**
Column %		(14.0)		(3.4)	**(11.6)**
Left turn		16			**16**
Column %		(5.4)			**(4.3)**
Left turn waiting		6			**6**
Column %		(2.0)			**(1.6)**
Right turn	2	70	7	4	**86**
Column %	(11.1)	(23.4)	(43.8)	(13.8)	**(23.2)**
Right turn waiting		17		1	**18**
Column %		(5.7)		(3.4)	**(4.9)**
Overtaking	7	12	1	2	**20**
Column %	(41.2)	(4.0)	(6.3)	(6.9)	**(5.9)**
Right bend	2	3	1	1	**7**
Column %	(11.1)	(1.0)	(6.3)	(3.4)	**(1.9)**
Going ahead	7	133	7	**19**	**169**
Column %	(38.9)	(44.0)	(43.8)	**(65.5)**	**(45.4)**
COLUMN TOTAL	**18**	**299**	**16**	**29**	**371**
Row %	**(4.8)**	**(80.6)**	**(4.3)**	**(7.8)**	**(100.0)**

5.1.4 T-junction accidents by accident type

Of the 20 single vehicle accidents which occurred at T-junctions, half involved loss of control (Table 5.14). Their proximity to a T-junction might have had no bearing on the occurrence of the accident. Fog was a factor in some of the junction overshoot accidents.

Considering two vehicle accidents, 68 per cent involved turning. It is notable that 51 of the accidents involved a right turning vehicle entering the main road, 39 of which came into conflict with a vehicle approaching from the right. Only six accidents involved a left turning vehicle entering the main road coming into conflict with another vehicle approaching from their right. This represents a ratio of nearly nine right turn accidents to every one left turn accidents for vehicles entering the main road. (Table 5.14).

14 per cent of two vehicle accidents involved overtaking (Table 5.14). A right turn manoeuvre featured in two thirds of these overtaking accidents. A futher 16 per cent of two vehicle accidents were stacking type accidents, most of which involved a rear end shunt.

In T-junction accidents involving three or more vehicles, stacking type accidents predominated, accounting for at least 48 per cent all types – most involved a rear end shunt.

Table 5.14
Number of vehicles involved in T-junction accidents by accident type

Accident Type	Number of Vehicles					
	1	2	3	4	5	6+
LOSS OF CONTROL						
Left bend						
Right bend	3	1				
Other	7		1			
Section total	**10**	**1**	**1**			
% of column total	**(50.0)**	**(0.9)**	**(4.0)**			
TURNING						
Right leaving		12	1	1		
Right entering						
Nearside		12	2			
Offside		39	4			
Left entering						
Offside		6	3			
Other		2				
Junction overshoot	4	4				
Section total	**4**	75	**10**	**1**		
% of column total	**(20.0)**	**(67.6)**	**(40.0)**	**(11.1)**		
OVERTAKING						
Head-on		1				
Loss of control/evasion	1	2				
Right turn		10	0			
Multiple						
Other		2	2			
Section total	**1**	**15**	**2**			
% of column total	**(5.0)**	**(13.5)**	**(12.0)**			
STACKING						
Rear-end shunt		14	9	7	2	1
Queue evasion	1	2	3	1		
Shunt on minor		2				
Section total	**1**	**18**	**12**	**8**	**2**	**1**
% of column total	**(5.0)**	**(16.2)**	**(48.0)**	**(88.9)**	**(100.0)**	**(100.0)**
CROSSED CENTRE LINE						
Bend						
Other		2				
Section total		**2**				
% of column total		**(1.8)**				
OTHER						
Section total	**4**					
% of column total	**(20.0)**					
ALL ACCIDENTS	**20**	**111**	**25**	**9**	**2**	**1**

5.2 Accidents at private accesses

Private accesses differ from public road junctions in several respects. Firstly, the onus on maintaining the private access is on the owner, and not on the local authority. No special provision is made for these junctions, and the majority are unsigned. Secondly, most of the junctions were not designed, but are remnants from the pre-road pavement history of the route. As such, many are inadequate for the vehicle mix which they experience. Despite these important differences, the accident histories of both junction types are similar in many respects.

There is no significant difference in severity between accidents at private accesses (Table (5.15) and those at T-junctions (Table 5.2).

Table 5.15 Accident severity at private accesses

	Accident Severity				
	Fatal	Serious	Slight	Total	KSI (%)
Numbers	1	29	77	**107**	**28.0**
Column %	*0.9*	*27.1*	*72.0*	*100.0*	

KSI (%) – percentage of fatal plus serious accidents

As seen with T-junction accidents, most private access accidents occur when the roads are busiest – between the hours of 0800 and 2000 hours (83 per cent – Table 5.16).

Table 5.16 Accidents at private accesses by hour of day

	Hour of day						
	0000–0400	0401–0800	0801–1200	1201–1600	1601–2000	2001–2359	ALL
Number	1	11	23	27	39	6	**107**
Row %	*0.9*	*10.3*	*21.5*	*25.2*	*36.4*	*5.7*	*100.0*

The proportion of accidents at private accesses which occurred on a wet road surface (Table 5.17) is not significantly different from that at T-junctions (Table 5.4).

Table 5.17 Accident distribution at private accesses by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
Numbers	64	42	1	**107**
Row %	*59.8*	*39.3*	*0.9*	*100.0*

As was the case with accidents at T-junctions, the proportion of vehicles which skidded in a private access accident is high for both dry and wet road surfaces (Table 5.18). Once again, this may be an indication of vehicle speed.

Table 5.18 Accidents at private accesses which involved a vehicle skidding by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
All private access accidents	64	42	1	**107**
Skidding accidents	36	23	0	**59**
% Skid	***56.3***	***54.7***	***0.0***	***55.1***

5.2.1 Vehicle characteristics

The distribution of vehicle types involved in accidents at private accesses (Table 5.19) was more like that of links (Table 5.31) than T-junctions (Table 5.6), with proportionally more light and heavy goods vehicle involvement at private accesses than at T-junctions.

Table 5.19 Vehicles involved in accidents at private accesses

	Vehicle Type							
	Pedal Cycle	Motor Cycle	Car	Bus	Light Goods	Heavy Goods	Other	ALL
Numbers	1	12	197	4	17	29	3	**263**
Row %	*0.4*	*4.6*	*74.9*	*1.5*	*6.5*	*11.0*	*1.1*	*100.0*

Single vehicle accidents at private accesses were rare. This is because accidents at private accesses are only recorded if the access is in use at the time. As seen for junctions, most accidents involved two vehicles (66 per cent) though just over a fifth of the accidents involved three vehicles (Table 5.20).

Table 5.20 Accidents at private accesses by number of vehicles involved

	Number of Vehicles							
	1	2	3	4	5	6	>6	ALL
Numbers	1	71	24	7	4			**107**
Row %	*0.9*	*66.4*	*22.4*	*6.5*	*3.7*			*100.0*

5.2.2 Vehicles involved – conflicting vehicles

Nearly two thirds of all accidents at T-junctions and private accesses involved conflict between two vehicles. There is no significant difference in the mix of conflicting vehicles between the two junction types.

Table 5.21 Accidents at private accesses involving two vehicles – conflicts

	OMV	HGV	LGV	Car	MC
Other Motor Vehicles (OMV)					
Heavy Goods (HGV)		1 (1.4)			
Light Goods (LGV)		3 (4.2)			
Car	2 (2.8)	10 (14.1)	5 (7.0)	37 (52.1)	
Motor Cycle (MC)		1 (1.4)	1 (1.4)	9 (12.7)	

Table excludes one accident between a car and a PSV

In private access accidents involving three vehicles, at least one car was involved in all of the accidents (Table 5.22).

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Table 5.22 Multiple vehicle accidents at private accesses – conflicts

Three Vehicle Conflict	No.	%	Four or More Vehicle Conflict	No.	%
Car (3)	12	50.0	Car (4)	4	36.3
Car (2)-HGV	5	20.8	Car (5)	1	9.1
Car (2)-LGV	3	12.5	Car (4)-HGV	1	9.1
Car (2)-PSV	1	4.2	Car (4)-LGV	1	9.1
Car-HGV (2)	1	4.2	Car (3)-LGV	1	9.1
Car-LGV-HGV	1	4.2	Car (3)-PSV	1	9.1
Car-PSV-Oth	1	4.2	Car (3)-HGV-MC	1	9.1
			Car (2)-HGV (2)	1	9.1
Total	***24***	***100.0***	*Total*	***11***	***100.0***

5.2.3 Driver characteristics

The proportion of female drivers involved in private access accidents (Table 5.23) is, at 18 per cent, similar to that on links (Table 5.36), but slightly lower than at T-junctions (Table 5.11).

Table 5.23 Gender of drivers involved in private access accidents

	Gender		
	Male	Female	SUM
Numbers	211	48	259
Row %	*81.5*	*18.5*	*100.0*

The gender of four drivers was uncoded

As outlined in Section 5.1.3, the association between driver age and type of vehicle driven is similar for accidents at private accesses, T-junctions or on the inter-junction links. The figures for private accesses are shown in Table 5.24.

Table 5.24 Age of drivers involved in private access accidents – by vehicles driven

Vehicle Type	Age of Driver					
	17–29	30–39	40–49	50–59	60 +	ALL
Motor Cycle	10		2			**12**
Column %	(83.3)		(16.7)			**(100.0)**
Car	76	34	35	23	24	**192**
Column %	(39.6)	(17.7)	(18.2)	(12.0)	(12.5)	**(100.0)**
Light Goods	7	2	2	5	1	**17**
Column %	(41.2)	(11.8)	(11.8)	(29.4)	(5.9)	**(100.0)**
Heavy Goods	8	7	2	9	2	**28**
Column %	(28.6)	(25.0)	(7.1)	(32.1)	(7.1)	**(10.0)**
All Vehicles	**104**	**45**	**42**	**38**	**28**	**257**
Row %	**(40.5)**	**(17.5)**	**(16.3)**	**(14.8)**	**(10.9)**	**(100.0)**

Vehicle manoeuvres by vehicle type

The relative proportions of accident related manoeuvres which characterise private access accidents are similar (Table 5.25) to those seen for T-junctions (Table 5.13).

Table 5.25
Vehicle manoeuvres in private access accidents

Manoeuvre	Vehicle Type				
	Motor Cycle	Car	Light Goods	Heavy Goods	ALL
Held up/Stopping/Starting		26		4	**30**
Column %		(13.2)		(13.8)	**(11.4)**
Right turn	1	47	8	5	**63**
Column %	(8.3)	(24.0)	(47.1)	(17.2)	**(24.0)**
Right turn waiting		18	4	2	**24**
Column %		(9.1)	(23.5)	(6.9)	**(9.1)**
Overtaking	3	16		2	**21**
Column %	(25.0)	(8.1)		(6.9)	**(8.0)**
Going ahead	7	81	5	12	**110**
Column %	(58.4)	(41.1)	(29.4)	(41.4)	**(41.8)**
ALL MANOEUVRES	**12**	**197**	**17**	**29**	**263**
Row %	**(4.6)**	**(74.9)**	**(6.5)**	**(11.0)**	**(100.0)**

Only those manoeuvres with a greater than five per cent representation in the ALL column are shown.

Table 5.26
Private access accidents by accident type and number of vehicles involved

Accident Type	Number of Vehicles					
	1	**2**	**3**	**4**	**5**	**6+**
TURNING						
Right leaving		9	2			
Right entering						
Nearside		10				
Offside		17	1		1	
Left entering						
Offside		1				
Junction overshoot		2				
U-turn		1				
Section total		**40**	**3**		**1**	
% of column total		**(56.3)**	**(12.5)**		**(25.0)**	
OVERTAKING						
Head-on						
Loss of control/evasion	1					
Right turn		15	4			
Multiple						
Other		3				
Section total	**1**	**18**	**4**			
% of column total	**(100.0)**	**(25.4)**	**(16.7)**			
STACKING						
Rear-end shunt		12	15	7	1	
Queue evasion		1	2		2	
Shunt on minor						
Section total		**13**	**17**	**7**	**3**	
% of column total		**(18.3)**	**(70.8)**	**(100.0)**	**(75.0)**	
ALL ACCIDENTS	**1**	**71**	**24**	**7**	**4**	

5.2.4 Private access accidents and accident type

The distribution of accident types at **private accesses is similar to that seen for T-junctions. Right turning problems are heavily implicated** in accidents involving two vehicles – especially those involving vehicles entering the main road, and those vehicles being struck by an overtaking vehicle as they were leaving the main road. In multiple vehicle accidents, stacking is once again the predominant accident type.

5.3 Accidents on the links

Away from junctions, the severity of accidents worsens (Table 5.27). Fatal and serious accidents account for 37 per cent of accidents compared to 31 per cent at T-junctions (Table 5.2).

Table 5.27 Accident severity on the links

	Accident Severity				
	Fatal	Serious	Slight	Total	KSI (%)
Numbers	52	144	328	**524**	**(37.4)**
Column %	*9.9*	*27.5*	*62.6*	*100.0*	

The distribution of link accidents throughout the day (Table 5.28) also differs slightly from junction accidents (Table 5.23) in that a higher proportion of the accidents occurred in the early hours of the day between 0000 and 0400 hours.

Table 5.28 Accidents on links by hour of day

	Hour of day						
	0000–0400	0401–0800	0801–1200	1201–1600	1601–2000	2001–2359	ALL
Number	34	67	121	112	128	62	**524**
Row %	*6.5*	*12.8*	*23.1*	*21.4*	*24.4*	*11.8*	*100.0*

Table 5.29 shows the accident distribution on the links by road surface condition. As outlined in Section 5.1, the proportion of wet road accidents is greater on the links than at junctions.

Table 5.29 Accident distribution on the links by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
Numbers	281	219	24	**524**
Row %	*53.6*	*41.9*	*4.5*	*100.0*

Table 5.30 Accidents on the links which involved a vehicle skidding by road surface

	Road Surface			
	Dry	Wet/Flood	Snow/Ice	ALL
All link accidents	281	219	24	524
Skidding accidents	73	105	17	195
% Skid	***26.0***	***47.9***	***70.8***	***37.2***

Proportionally fewer link accidents involved a vehicle skidding compared to T-junction and private access accidents, but **unlike junctions and private accesses, there is a marked difference between the proportion of dry skid (26 per cent) and wet skid accidents (48 per cent). These figures may indicate a problem with the road surface on the inter-junction links.**

5.3.1 Vehicle characteristics

As outlined in Section 5.1.1, cars were involved in proportionally fewer accidents on the links (Table 5.31) than at junctions (Table 5.6), with proportionally more involvement from heavy and light goods vehicles.

Table 5.31 Vehicles involved in accidents on the links

	Vehicle Type							
	Pedal Cycle	Motor Cycle	Car	Bus	Light Goods	Heavy Goods	Other	ALL
Numbers	14	40	774	13	80	136	12	**1069**
Row %	*1.3*	*3.7*	*72.4*	*1.2*	*7.5*	*12.7*	*1.1*	*100.0*

Table 5.32 Accidents on the links by numbers of vehicles involved

	Number of Vehicles							
	1	2	3	4	5	6	>6	ALL
Number	186	208	84	27	9	7	3	**524**
Row %	*35.5*	*39.7*	*16.0*	*5.2*	*1.7*	*1.3*	*0.6*	*100.0*

Accidents involving three or more vehicles accounted for a similar proportion of all accidents on the links (Table 5.32) as they did for all accidents at T-junctions and private accesses (Tables 5.7 and 5.20 respectively). However, in contrast to T-junction and private access accidents, proportionally fewer link accidents involved two vehicles (40 per cent) **while proportionally more involved a single vehicle (35 per cent)** – Table 5.32.

5.3.2 Vehicles involved – conflicting vehicles

There is no significant difference between the distribution of vehicle types involved in single vehicle accidents on the links (Table 5.33) and that at junctions (Table 5.8).

Table 5.33 Accidents on the links involving single vehicles

	Vehicle Type					
	Cars	Motor Cycles	Light Goods	Heavy Goods	PSV	Pedal Cycle
Frequency	136	17	12	11	3	1
%	(75.5)	(9.4)	(6.7)	(6.1)	(1.7)	(0.6)

Number excludes accidents between pedestrians and cars (2), light goods vehicles (1) and heavy goods vehicles (3).

In link accidents involving two vehicles (Table 5.34), conflicts occurring exclusively between two cars represented a smaller proportion of the two vehicle accident total (49 per cent) than T-junctions (63 per cent – Table 5.9). However, nearly 19 per cent of all link accidents involving two vehicles occurred between a car and a heavy goods vehicle (Table 5.34) compared to only 11 per cent at T-junctions (Table 5.9). Pedal cycles were involved in over 5 per cent of link accidents involving two vehicles.

Table 5.34 Accidents on the links involving two vehicles – conflicts

	HGV	LGV	Car	MC	PC
Heavy Goods (HGV)	1 (0.5)				
Light Goods (LGV)	9 (4.3)	5 (2.4)			
Car	39 (18.8)	14 (6.7)	103 (49.5)		
Motor Cycle (MC)	3 (1.4)	1 (0.5)	13 (6.3)	1 (0.5)	
Pedal Cycle (PC)	3 (1.4)	1 (0.5)	7 (3.4)		

For clarity, this table excludes three accidents which involved a PSV and five accidents which involved an 'other' motor vehicle.

Table 5.35 Multiple vehicle accidents on the links – conflicts

Three Vehicle Conflict	No.	%
Car (3)	42	50.0
Car (2)-HGV	15	17.9
Car-LGV-HGV	6	7.1
Car (2)-LGV	5	6.0
Car-HGV (2)	3	3.5
Car-HGV-Oth	3	3.5
Car (2)-PSV	2	2.4
Car-LGV (2)	2	2.4
Car (2)-PC	1	1.2
Car (2)-MC	1	1.2
MC (2)-LGV	1	1.2
MC-Car-HGV	1	12
Car (2)-Oth	1	1.2
HGV (2)-PSV	1	1.2
Total	***84***	***100.0***

Four Vehicle Conflict	No.	%
Car (4)	11	40.7
Car (3)-LGV	3	11.1
Car (2)-HGV (2)	3	11.1
Car (3)-HGV	3	11.1
Car (3)-MC	2	7.4
Car (2)-PSV (2)	1	3.7
Car (2)-HGV-Oth	1	3.7
Car-PSV-LGV-HGV	1	3.7
Car-PSV-HGV (2)	1	3.7
Car-LGV-HGV-Oth	1	3.7
Total	***27***	***100.0***

Five or More Vehicle Conflict	No.	%
Car (5)	4	21.0
Car (4)-HGV	3	15.8
Car (5)-HGV	1	5.3
Car (5)-HGV (2)	1	5.3
Car (4)-LGV-HGV	1	5.3
Car (3)-HGV-LGV	1	5.3
Car (6)	3	15.8
Car (7)	1	5.3
Car (5)-LGV	1	5.3
Car (4)-LGV (2)-HGV	1	5.3
Car-HGV (4)	1	5.3
Car etc	1	5.3
Total	***19***	***100.0***

Percentages may not equal 100% due to rounding.

In multiple vehicle accidents on the links, at least one car was involved in virtually all the accidents (Table 5.35).

5.3.3 Driver characteristics

Less than 20 per cent of drivers involved in accidents on the links were female (Table 5.36). This is similar to private accesses (Table 5.23), but slightly lower than T-junctions (Table 5.11).

Table 5.36 Gender of drivers involved in accidents on the links

	Gender		
	Male	**Female**	**SUM**
Numbers	**827**	**203**	**1030**
Row %	*80.3*	*19.7*	*100.0*

The gender of 39 drivers was uncoded

The proportional distribution of drivers between different age groups once again shows marked variation between individual vehicle types (Table 5.37) but is little different when compared against the equivalent distribution presented for the drivers of vehicles involved in T-junction (Table 5.12) and private access accidents (Table 5.24).

Table 5.37 Age of drivers involved in accidents on the links by vehicles driven

Vehicle Type	Age of Driver					
	17–29	**30–39**	**40–49**	**50–59**	**60 +**	**ALL**
Motor Cycle	24	9	4	2	1	**41**
Row %	(60.0)	(22.5)	(10.0)	(5.0)	(2.5)	**(100.0)**
Car	313	170	123	68	73	**747**
Row %	(41.9)	(22.8)	(16.5)	(9.1)	(9.8)	**(100.0)**
Light Goods	31	21	12	8	5	**77**
Row %	(40.3)	(27.3)	(15.6)	(10.4)	(6.5)	**(100.0)**
Heavy Goods	33	23	39	22	8	**125**
Row %	(26.4)	(18.4)	(31.2)	(17.6)	(6.4)	**(100.0)**
All Vehicles	**415**	**232**	**187**	**103**	**89**	**1026**
Row %	**(40.4)**	**(22.6)**	**(18.2)**	**(10.0)**	**(8.7)**	**(100.0)**

Vehicle manoeuvres

Away from junctions and private accesses, not surprisingly, the proportion of accident-related manoeuvres which involved turning decreases markedly (Table 5.38). That turning manoeuvres still manifest themselves is an indication of accidents occurring at lay-bys (these are not coded as junctions or private accesses on STATS19).

Compared to T-junctions and private accesses, a similar proportion of vehicles involved in link accidents were stopping, held up or starting off (14 per cent), **but a higher proportion were overtaking (12 per cent) – especially motor cycles (30 per cent)**. The prominence of vehicles stopping, held up or starting off within the accident-related manoeuvre list of link accidents suggests that stacking is once again a feature of these accidents.

In the absence of any noticeable accident-related turning component in link accidents (Table 5.38) compared to T-junction (Table 5.13) and private access (Table 5.25) accidents, **this proportion of the accident-related manoeuvres is taken up for link accidents by a higher proportion of vehicles simply going ahead (51 per cent) and vehicles negotiating a left (8 per cent) or right bend (10 per cent).**

61 per cent of heavy goods vehicles were simply going ahead when the accident occurred. At 4 per cent, the proportion of heavy goods vehicles overtaking is smaller than the figure of 13 per cent for other vehicle types.

Table 5.38
Vehicle manoeuvres in accidents on the links

Manoeuvre	Vehicle Type				
	Motor Cycle	Car	Light Goods	Heavy Goods	ALL
Held up/Stopping/Starting		116	12	14	**147**
Column %		(15.0)	(15.0)	(10.3)	**(13.7)**
Right turn		3	2	2	**1**
Column %		(0.4)	(2.5)	(1.5)	**(0.1)**
Right turn waiting		6			**7**
Column %		(0.8)			**(0.7)**
Overtaking	12	102	8	5	**128**
Column %	(30.0)	(13.3)	(10.0)	(3.7)	**(11.9)**
Left bend	2	64	5	13	**85**
Column %	(5.0)	(8.3)	(6.3)	(9.5)	**(8.0)**
Right bend	4	79	9	14	**106**
Column %	(10.0)	(10.2)	(11.1)	(10.3)	**(9.9)**
Going ahead	22	371	43	83	**548**
Column %	(55.0)	(48.0)	(53.8)	(61.0)	**(51.1)**
COLUMN TOTAL	**40**	**774**	**80**	**136**	**1069**
Row %	**(3.7)**	**(72.4)**	**(7.5)**	**(12.7)**	**(100.0)**

5.3.4 Accidents on the links and accident type

In nearly 84 per cent of cases, single vehicle accidents on the links were loss of control type accidents. The majority of these accidents did not occur at bends, but on the straight link segments (Table 5.39).

The situation is different for link accidents which involved two vehicles. A third of accidents were of the overtaking type consisting roughly equally of head-on overtaking accidents and loss of control while overtaking accidents. A further 28 per cent of two vehicle accidents were of the stacking type (predominantly rear-end shunts), with loss of control type and crossed centre line type accidents accounting for a further 16 per cent and 15 per cent of accidents respectively (Table 5.39). In link accidents involving three or more vehicles, stacking type accidents predominate (generally greater than 48 per cent in each vehicle number band), followed by overtaking accidents.

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Table 5.39 Link accidents – by accident type and number of vehicles involved

Accident Type	Number of Vehicles					
	1	2	3	4	5	6+
LOSS OF CONTROL						
Left bend	30	4	2			
Right bend	48	10	4	1		
Other	78	19	8	3	1	
Section total	**156**	**33**	**14**	**4**	**1**	
% of column total	**(83.9)**	**(15.9)**	**(16.7)**	**(14.8)**	**(11.1)**	
TURNING						
Right leaving		1	1			
Right entering						
Offside		1				
Nearside						
U-turn		12				
Section total		**14**	**1**			
% of column total		**(6.7)**	**(1.2)**			
OVERTAKING						
Head-on		32	7	5	1	
Loss of control/evasion	15	30	3	1		
Right turn		2	1			
Multiple		7	4	1		
Other						
Section total	**15**	**71**	**15**	**7**	**1**	
% of column total	**(8.1)**	**(34.1)**	**(17.8)**	**(25.9)**	**(11.1)**	
STACKING						
Rear-end shunt		50	39	11	5	8
Queue evasion	7	9	9	2	2	1
Shunt on minor						
Section total	**7**	**59**	**48**	**13**	**7**	**9**
% of column total	**(3.8)**	**(28.4)**	**(57.1)**	**(48.1)**	**(77.8)**	**(90.0)**
CROSSED CENTRE LINE						
Bend	1	13	1	1		
Other	1	18	5	2		1
Section total	**2**	**31**	**6**	**3**		**1**
% of column total	**(1.6)**	**(14.9)**	**(7.2)**	**(11.1)**		**(11.1)**
OTHER						
Section total	6					
% of column total	**(3.8)**					
ALL ACCIDENTS	**186**	**208**	**84**	**27**	**9**	**10**

Links, junctions and accesses

5.4 Summary

The main findings of this chapter are:

Public road T-junctions and private accesses

- Accidents at T-junctions and private accesses were similar in terms of accident type.
- Vehicle speed appeared to be a factor in the accidents.
- Most accidents involved two vehicles where one vehicle was turning right and entering the main road. Another common accident type involved a vehicle turning right and leaving the main road in collision with an overtaking vehicle. Motor cycles are particularly susceptible to overtaking into a turning vehicle.
- In accidents involving three or more vehicles, most were stacking type accidents on the major road. Heavy goods vehicles had a high involvement in these accidents.
- Cars were involved in more than 81 per cent of accidents at both locations and had a high involvement in all accident types. Older car drivers (both male and female) had a high involvement in turning type accidents – especially as the drivers of the vehicles effecting the turning manoeuvre.

Inter-junction links

- Skidding on wet road surfaces appears to be a factor in these accidents.
- Compared to T-junctions and private accesses, a higher proportion of accidents on the links occurred at night.
- Over a third of link accidents involved just one vehicle. Most single vehicle accidents involved loss of control (84 per cent).
- As seen for junctions and accesses, stacking accidents predominated among accidents involving three or more vehicles, and heavy goods vehicles had a high involvement.
- Heavy goods vehicles had a higher involvement in accidents involving two vehicles when compared to the same accidents at private accesses and T-junctions. The number of two vehicle accidents was fewer than seen at junctions and private accesses, and more of these accidents on the links were of the overtaking, stacking and crossed centre line type.
- A high proportion of motorcycle accidents involved overtaking.

Chapter 6 What the drivers say

This chapter presents the responses received to a postal questionnaire which was sent out to drivers who had been involved in accidents during 1993 and 1994 on the six roads under study. A more extensive survey of drivers from preceding years was not possible as Cambridgeshire Constabulary only retains a complete accident record for a period of two years after an accident has occurred.

A total of 495 individuals qualified for inclusion in the study, their involvement in the 217 qualifying accidents categorised as:

488	Vehicle Drivers
4	Pedal Cyclists
3	Pedestrians

In all, a total of 409 drivers were sent a questionnaire in which they were asked to respond to a series of questions on their general driving habits and the circumstances surrounding their accident.

The large volumes of data generated from the questionnaire responses would create confusion if it were presented in the main body of this sub-section. Data values discussed in this section which are not accompanied by a table or chart can be traced to Appendix B at the rear of this report, where the answers received are presented in the sequence they appeared in the questionnaire.

6.1 Those sent a questionnaire

Table 6.1 Postal questionnaire response rates and drivers approached

		Frequency	Percentage of all	Percentage of approached
Respondents	Returned	208	42.3	50.8
	Sub-total	*208*	*42.3*	*50.8*
Non-respondents	Not returned	176	35.5	43.0
	No contact	16	3.2	3.9
	Refusal	9	1.8	2.2
	Sub-total	*201*	*40.9*	*49.1*
Not approached	Pedestrians	3	0.6	
	Cyclists	4	0.8	
	Drivers in fatal accidents	46	9.3	
	Foreign drivers	8	1.6	
	'Un-coded'	25	5.1	
	Sub-total	*86*	*16.8*	
	TOTAL	**495**	**100.0**	**100.0**

Of the 495 participants involved in the 217 qualifying accidents, an early decision was taken that a certain number could not, or would not be approached. No driver was approached who had been involved in a fatal accident, and foreign drivers were omitted. Pedestrian and pedal cyclists were not approached because of their small numbers. In addition, a certain number of 'uncoded' drivers could not be included in the study – these being drivers who failed to stop at the scene of the accident but whose vehicles were recorded by the Police as having contributed to the accident. Within this group were ten drivers involved in two accidents which were unfortunately overlooked. In all, 86 drivers, or 17 per cent of the sample were not approached.

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Of the 409 drivers who were approached, 16 could not be contacted at the address provided. A further nine drivers either refused to complete the questionnaire, did not complete their questionnaire because they were not directly involved in the accident, or the driver had since passed away. These make up the 'refusal' category. 36 per cent of the sample was not returned.

Since 86 of the drivers were not approached, the 208 questionnaires returned represents a response rate of 51 per cent.

6.2 Returned questionnaires

As only 51 per cent of the approached sample returned their questionnaires, it was important to assess how different the 208 respondents were from:

1. the non-respondent element of the sample
2. the non-respondent and not approached driver sample

6.2.1 Age

The proportional distribution of respondent, non-respondent and the whole of the 1993-1994 driver sample is shown in Table 6.2 by age.

Table 6.2 Postal questionnaire – response by age distribution

	Approached Drivers		
Age	**Respondent (%)**	**Non-respondent (%)**	**Whole sample (%)**
17-29	34.5	44.9	38.6
30-39	18.4	20.1	20.3
40-49	15.9	15.1	15.7
50-59	18.8	11.6	15.0
60 or over	12.1	7.6	10.4
TOTAL	**207**	**198**	**472**
Age unknown	1	3	20

Note: The total includes those not approached

Nearly 39 per cent of the 1993–1994 driver sample was aged between 17 and 29. The proportional involvement of the drivers decreases with age, with drivers aged 60 or more figuring in 11 per cent of the sample. The sample is slightly biased towards the older driver, but **overall the proportional distribution of drivers in the respondent sample is not statistically different from the non-respondent and whole sample.**

6.2.2 Gender

The proportional distribution of respondent, non-respondent and the 1993-1994 driver sample by gender is presented in Table 6.3. The respondent sample has a slightly higher component of female drivers in it compared to the non-respondent and whole sample, but this does not significantly affect the representativeness of the respondent sample.

Table 6.3 Postal questionnaire – response by gender

	Approached Drivers		
Gender	**Respondent (%)**	**Non-respondent (%)**	**Whole sample (%)**
Male	75.4	78.6	78.0
Female	24.6	21.4	22.0
TOTAL	**207**	**201**	**478**
Gender unknown	1		14

6.2.3 Other comparisons

Further comparisons were made between the respondent, non-respondent and whole sample of drivers for vehicle type and accident location. In all cases, no statistical differences emerged between the samples. The respondent sample of drivers is therefore considered representative of the whole 1993-1994 driver population at this **main effect** level of comparison. Of the 182 accidents whose drivers were approached, a complete response from all drivers was only obtained for 47 (Table 6.4).

Table 6.4 Completeness of driver responses for accidents

Response	Number	Percentage
Complete	47	25.8
Partially complete	85	27.5
No response	50	46.7
Accident total	**182**	**100.0**

6.3 Personal details

Questions 48 to 52

6.3.1 Marital Status

Most drivers were married (55 per cent), single (29 per cent) or living as married (8 per cent). Just over 5 per cent of the drivers whose marital status was single had a child in their household. 78 per cent of the drivers with one or more children in their household was married.

6.3.2 Profession

Retired people constituted 7 per cent of the driver population who responded to the questionnaire, with individuals who looked after the home, students and the unemployed representing a further 5 per cent (Table 6.5). Among those individuals in employment, drivers employed in managerial, administrative or clerical posts (senior or junior) formed 32 per cent of the sample, compared to only 23 per cent for drivers in skilled or semi-skilled manual employment. Drivers in professional employment had the highest individual representation (24 per cent).

Table 6.5 Work situation of respondents around time of accident

Employment Groups	Percentage	Number
Professional	**23.9**	49
Senior managerial / administrative	**12.2**	25
Junior managerial, administrative or professional, supervisory and clerical	**19.5**	40
Skilled manual	**18.5**	38
Semi-skilled or unskilled manual	**4.4**	9
Student, looking after home / family, unemployed	**4.9**	10
Retired	**6.8**	14
Other	**9.8**	20
	100.0	205

Question not completed by three drivers

6.4 Driving habits and experience

Questions 36 to 47

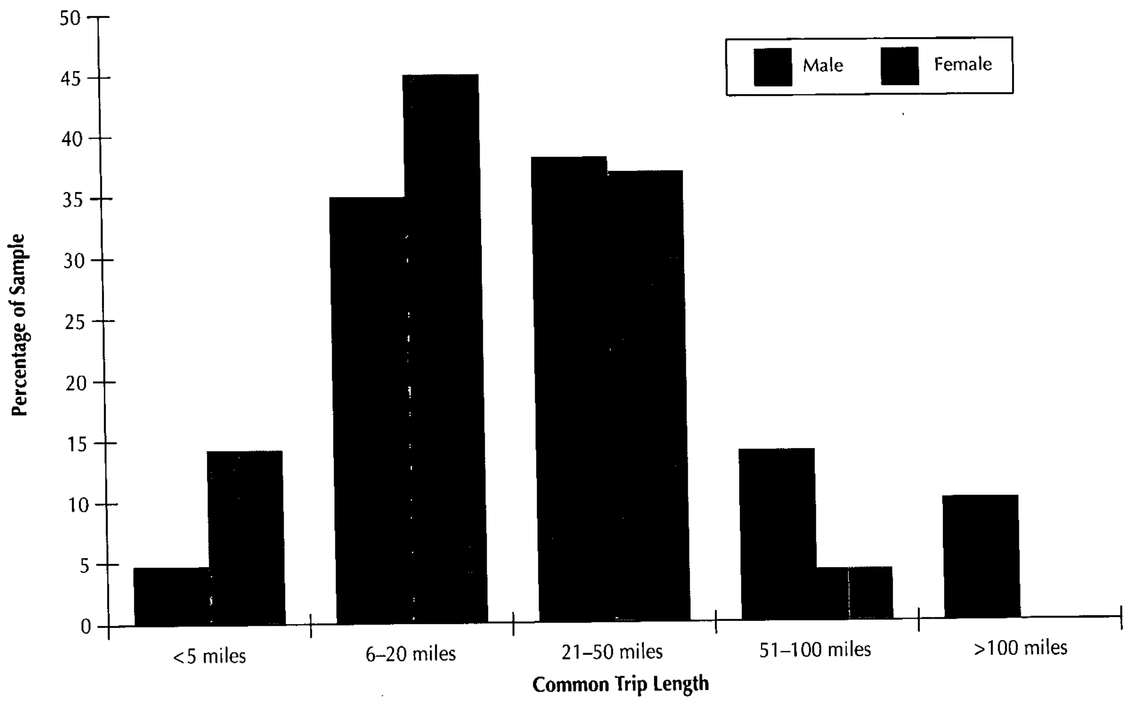
6.4.1 Driving history

Only one of the 208 drivers was driving on a provisional driving licence when they had their accident. All heavy goods vehicle drivers held the appropriate full licence.

Few were inexperienced. Firstly, only 13 per cent of the sample had held a full driving licence for less than four years (Question 37). Secondly, 99 per cent drove with a frequency in excess of once a week (Question 40). When individuals did drive, 93 per cent drove in excess of six miles, with 15 per cent driving in excess of 100 miles. 83 per cent of heavy goods vehicle drivers had common trips in excess of 100 miles.

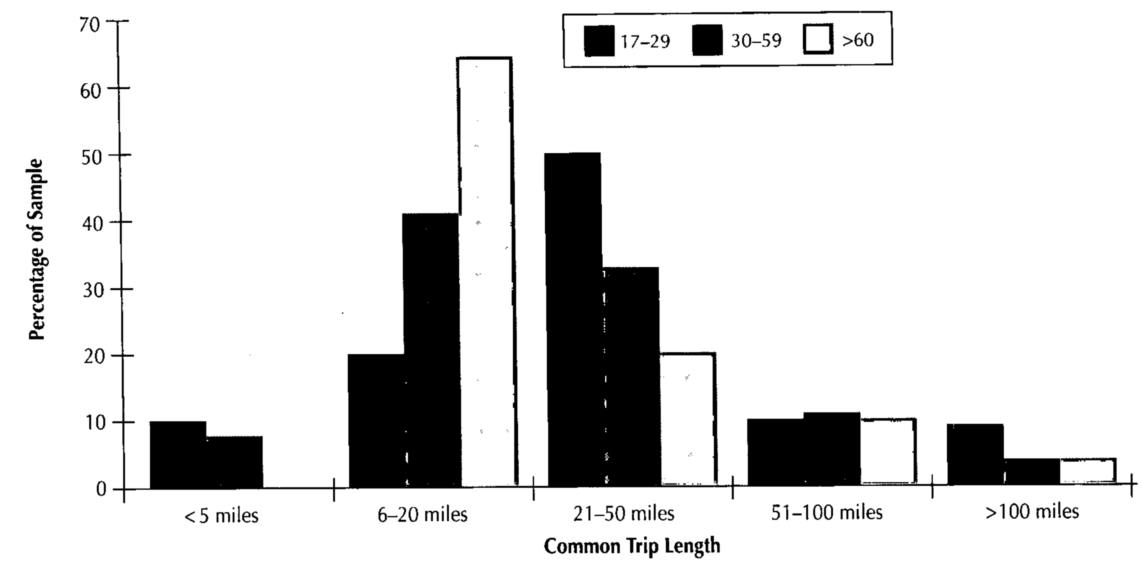
Figure 6.1 compares the common trip lengths for the drivers of cars by gender. Female car drivers generally drive shorter trip lengths than male car drivers – the median trip length for female drivers lies between six and 20 miles compared to a median trip length which falls between 21 and 50 miles for male drivers (Figure VI.1). Just under 14 per cent of trips by female drivers were less than five miles compared to 4 per cent of trips by male drivers. All common trip lengths in excess of 100 miles were made by male drivers.

Figure VI.1 Common trip lengths in cars by gender



In addition to gender, the most common trip length varies by age group. The median trip length for drivers aged 60 or more is between six and 20 miles (Figure VI.2). 65 per cent of trips made by this age group were in this interval, with none in the less than five miles interval. The median trip lengths of other age groups fall between 21 and 50 miles. That a high proportion of car drivers have common trip lengths between six and 50 miles may be a reflection of distances between settlements.

Figure VI.2 Common trip lengths in cars by age group

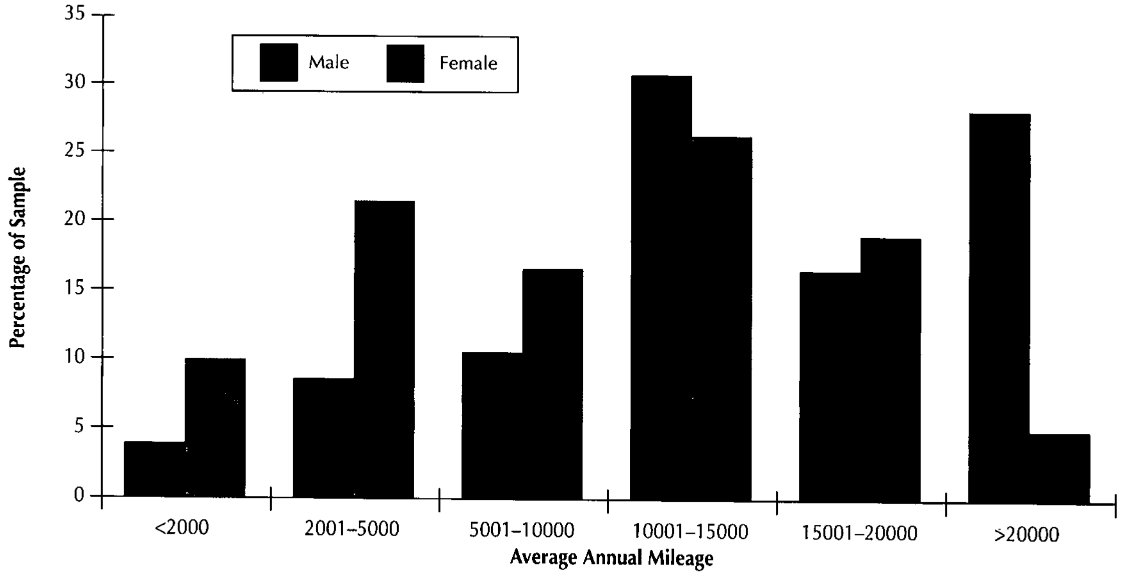


What the drivers say

The third fact to counteract any claims of inexperience is the amount of average annual mileage travelled. Just under 83 per cent of the drivers had an average annual mileage greater than 5,000 miles, with nearly 28 per cent travelling in excess of 20,000 miles.

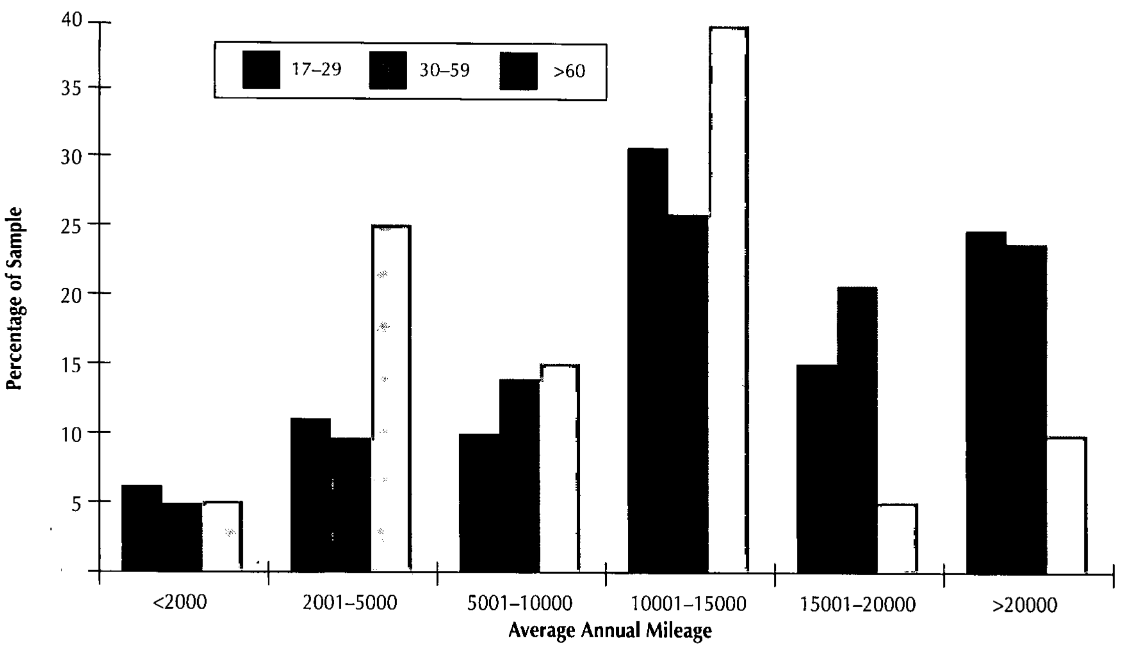
A comparison of average annual mileage for car drivers reveals further differences between male and female drivers (Question 39). 77 per cent of male drivers travel in excess of 10,000 miles a year (Figure VI.3). The distribution of average annual mileage for female drivers has a peak at 2,001 to 5,000 miles and another in the 10,001 to 15,000 annual mileage group. The lower peak might reflect driving habits that largely involve shopping trips, taking children to school etc. However, the upper peak demonstrates that female drivers are getting a greater exposure to driving akin to that of male drivers.

Figure VI.3 Average annual mileage of car drivers by gender



The median annual mileage of all car driver age groups falls within the 10,001 to 15,000 mileage category but the distribution varies between car driver age groups – Figure VI.4. For drivers aged between 30 and 59, the distribution is skewed towards higher mileages. An important note is that the average annual mileage of drivers aged 60 or more shows peaks in two separate categories (2,001-5,000 miles and 10,001-15,000 miles). The lower is not unexpected, but the upper peak demonstrates that the older car driver is still active on the roads, travelling long distances annually.

Figure VI.4 Average annual mileage of car drivers by age



Younger drivers, also travelled long distances annually, with 71 per cent of drivers in this age group travelling in excess of 10,000 miles.

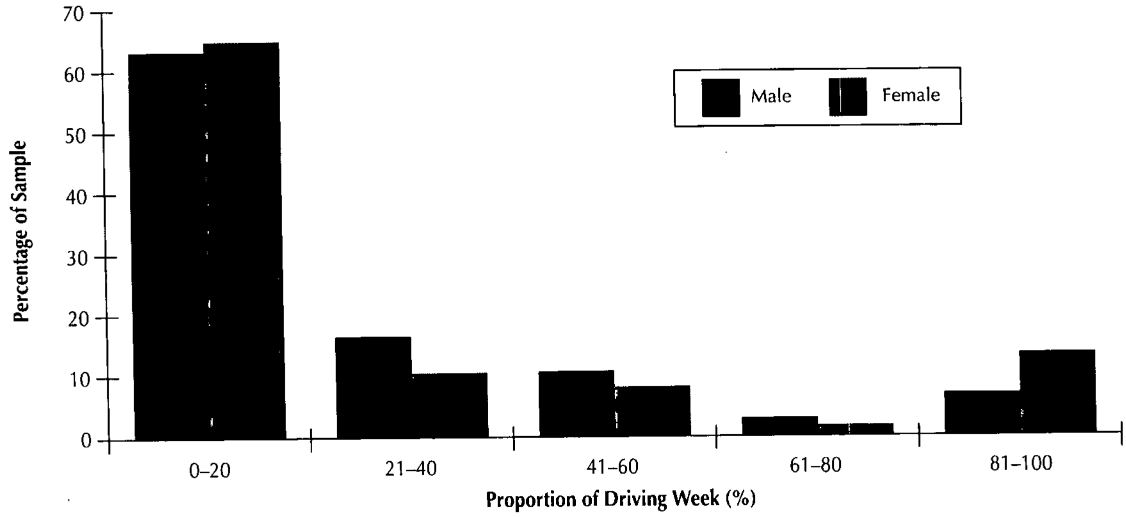
83 per cent of heavy goods vehicle drivers travelled in excess of 20,000 miles annually.

6.4.2 Driving habits

Drivers were asked to specify to the nearest 5 per cent, the proportion of time they spent driving at weekends, during the hours of darkness, and in the morning and evening rush hours (Questions 42 and 43). This was in order to obtain an insight into the driving habits of respondents, and their experience of different road and environmental conditions. Responses relate to the period around the time of the accident.

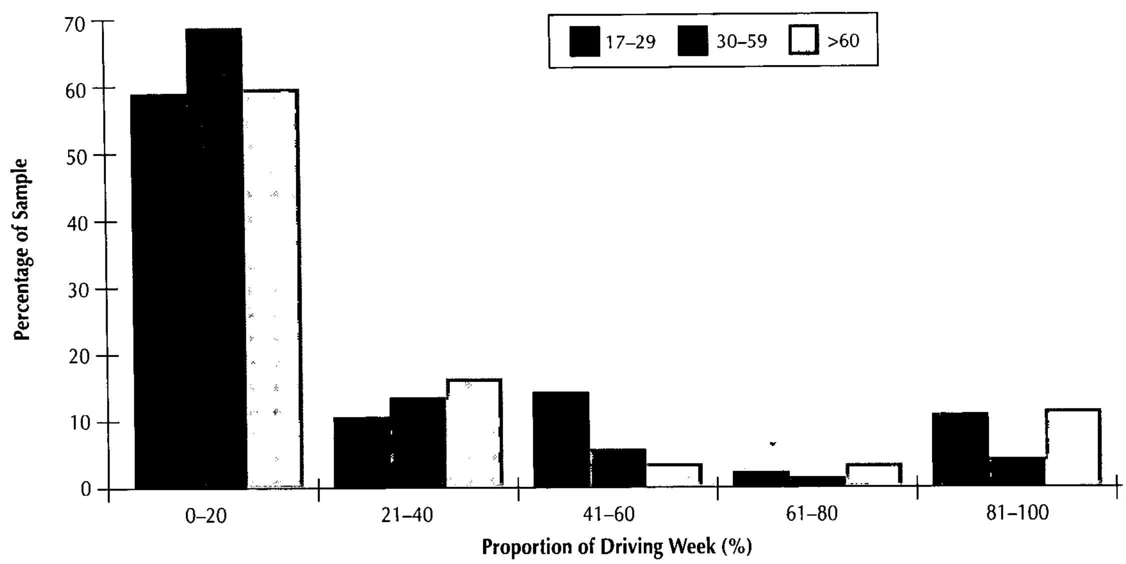
At weekends
19 per cent of the male drivers and 24 per cent of the female drivers spent more than 40 per cent of their driving week driving at weekends (Figure VI.5).

Figure VI.5 Proportion of time driving at weekends by gender



A common myth that weekend accidents are caused by elderly 'weekend' drivers who emerge onto the roads on Saturdays and Sundays is not supported by the driver responses. The majority of drivers aged 60 or more (77 per cent) did less than 40 per cent of their driving at weekends – similar to the drivers in other age groups (Figure VI.6). Though 18 per cent of drivers aged 60 or more did more than 60 per cent of their driving at the weekend, this figure is only representative of four drivers.

Figure VI.6 Proportion of time driving at weekends by age

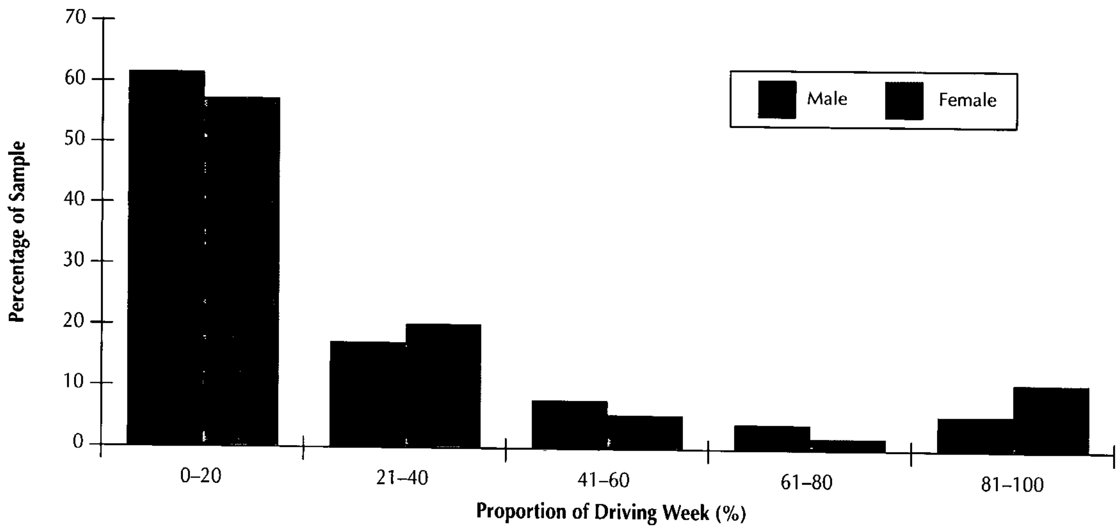


What the drivers say

During the hours of darkness

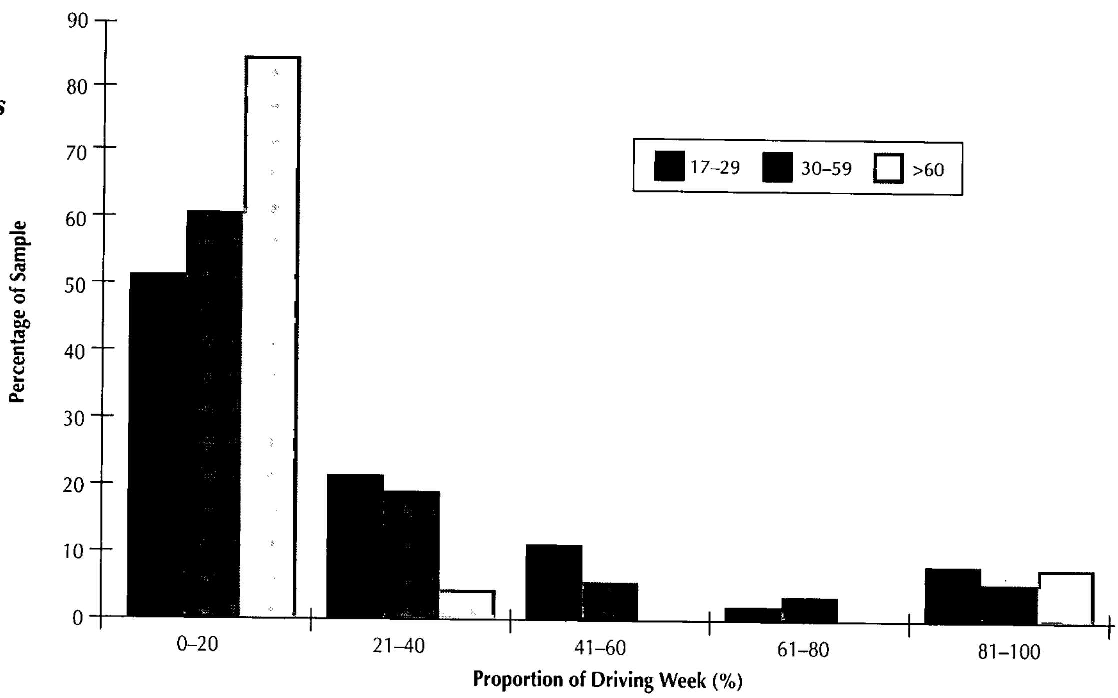
The median proportion of driving time spent by female drivers travelling during the hours of darkness was the same as that of male drivers (Figure VI.7).

Figure VI.7 Proportion of time driving during darkness by gender



When driving during darkness hours is examined by age, the proportional distribution of time is similar to that seen in Figure VI.7 with the exception of drivers aged 60 or more (Figure VI.8). 86 per cent of drivers falling into this age group spent less than 20 per cent of their driving time travelling during the darkness hours.

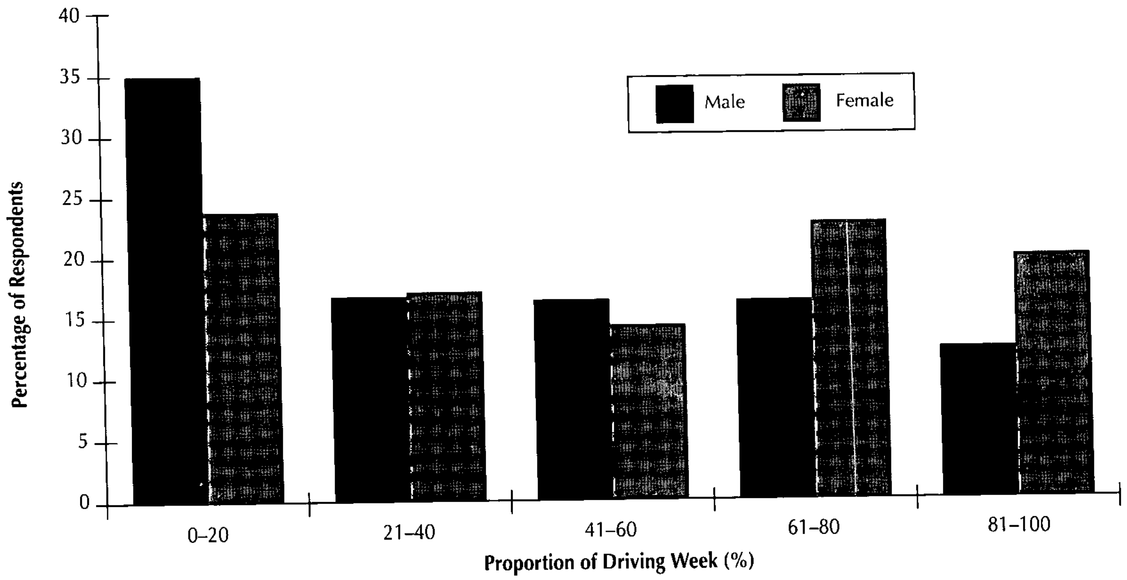
Figure VI.8 Proportion of time driving during darkness by age



During the rush hour periods

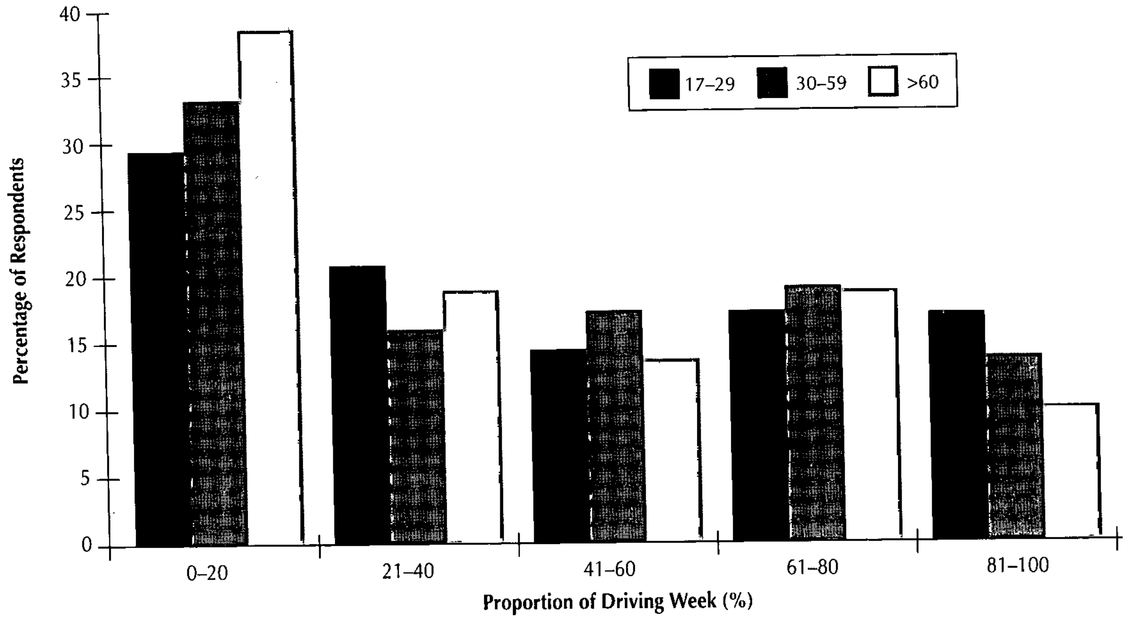
44 per cent of female drivers spent more than 60% of their time driving in rush hour periods compared to 30% of males (Figure VI.9). At the other extreme, 35 per cent of male drivers and 24 per cent of female drivers spent less than 20 per cent of their time driving in the rush hour periods. To gain some idea of their relative rate of exposure to rush hour driving, it would be necessary to ascertain some idea of average trip duration. For example, heavy goods vehicle drivers who regularly travel all day may well have only spent about 15 per cent of their travelling time in the rush hour period, but their exposure in the rush hour periods would be the same as for those drivers who spent all their travelling time on the roads during the rush hour periods. This information is unfortunately not available.

Figure VI.9 Proportion of time driving during rush hour periods by gender



Despite an absence of exposure information, it is interesting that the amount of time spent travelling in the rush hours by **drivers aged 60 or over** is skewed towards the smaller proportions (Figure VI.10). Over a third of these drivers spent **less than 20 per cent of their travelling time in the rush hour periods.**

Figure VI.10 Proportion of time driving during rush hour periods by age

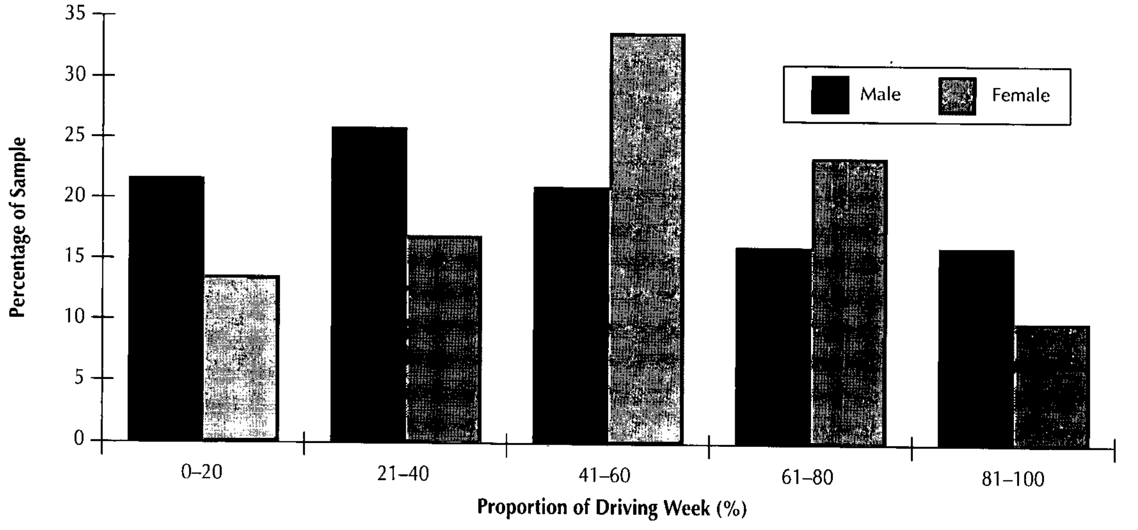


Time spent driving on rural roads

Most of the drivers (both male and female) who had accidents on rural roads were familiar with driving on them. Less than 14 per cent of female drivers spent under 20 per cent of their driving time travelling on rural roads. Just over 18 per cent of female drivers and 31 per cent of male drivers spent more than 60 per cent of their driving time on rural roads (Figure VI.11).

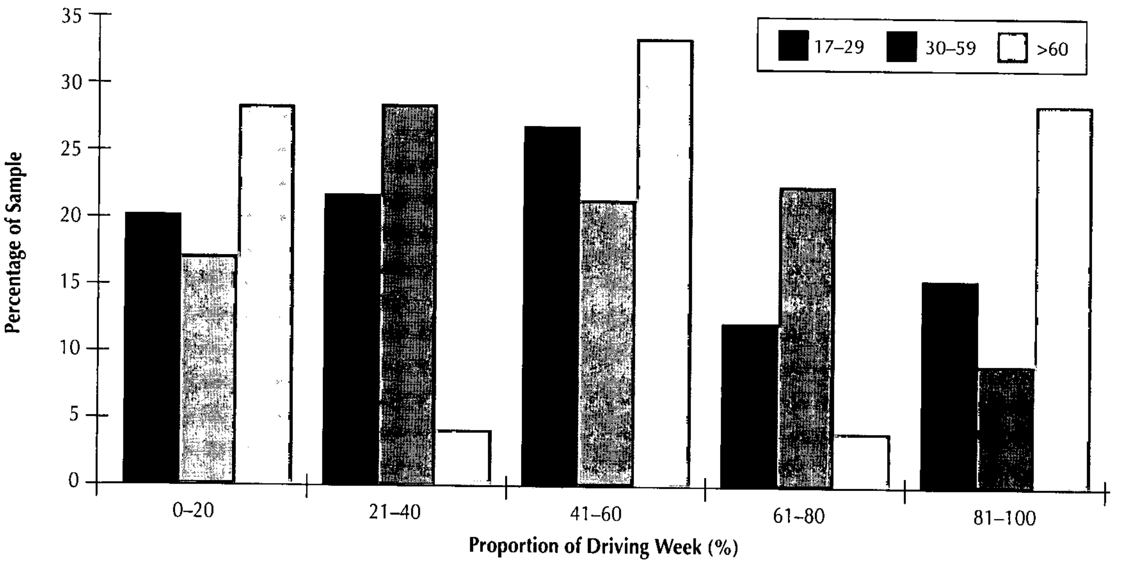
What the drivers say

Figure VI.11 Proportion of time spent driving on rural roads by gender



A similar pattern emerges when the distribution is examined by driver age (Figure VI.12). Only the category of drivers aged 60 or over stands out – 29 per cent did more than 80 per cent of their driving on rural roads – a proportion which is higher than for any of the other age groups.

Figure VI.12 Proportion of time spent driving on rural roads by age



Previous accidents and offences

Just over a quarter of the sample (52 drivers) revealed that they had been involved in an accident in the previous five years (Question 44). Eleven drivers had had more than one accident. Sixteen of the accidents resulted in injury.

Thirty two drivers (15 per cent) had been prosecuted for speeding in the five years leading up to their accident, eight (4 per cent) for careless or inconsiderate driving, and one for drink driving (Question 46).

6.4.3 The act of driving

In order to glean further information on how easy or difficult drivers rate different tasks, respondents were asked to rate certain driving tasks against a five point rating scale (Question 47). The scale rated tasks in order as very hard (1), hard (2), OK (3), easy (4) and very easy (5). This information is presented in the following tables as the percentage who found each task easy or very easy. This approach was adopted as the numbers rating a response of either hard or very hard were generally small, making it less easy to pick out trends in the data.

Table 6.6 Rating of driving tasks by gender

Task	Percentage easy or very easy		
	All	Males	Females
Judging speed in darkness	27	31	16
Judging distance in darkness	28	34	10
General driving in darkness	46	50	36
Overtaking	51	58	31
Joining main road from a slip road	57	60	48
Turning right at junctions	62	66	52
Driving on motorways	62	68	47
Allowing a vehicle onto main road from a slip road	63	66	56
Judging speed in daylight	64	67	54
Negotiating a roundabout	67	70	61
Judging distance in daylight	70	73	61
Turning left at a junction	70	73	62
Daylight driving	76	77	75

Driving tasks which take place in darkness were considered the most difficult of all. Only 22 per cent of drivers found judging speed in darkness easy or very easy. The easiest task was rated as general driving in daylight (76 per cent). For tasks pertaining to the safe negotiation of junctions, turning right at a junction was considered the most difficult (Table 6.6).

Female drivers rated all tasks as being that much more difficult than male drivers (Table 6.6). For general daylight driving, the difference is small, but is more pronounced for darkness driving tasks. The proportion of males rating judging distance in darkness as easy or very easy was three times greater than the corresponding proportion of females. Overtaking is another task where there was a large difference between male and female driver responses. That a difference exists for all the tasks points towards a basic attitude difference between male and female drivers.

Apart from judging distances in darkness, there is no significant difference between how each age group rates the various tasks (Table 6.7). However, a separate analysis using a younger driver sample of 17 to 25 year old drivers did find a higher confidence factor among younger drivers.

Table 6.7 Rating of driving tasks by age

Task	Percentage easy or very easy			
	All	17-29	30-59	>60
Judging speed in darkness	27	28	25	41
Judging distance in darkness	28	29	23	50
General driving in darkness	46	49	43	57
Overtaking	51	54	48	57
Joining main road from a slip road	57	64	52	57
Turning right at junctions	62	65	59	68
Driving on motorways	62	70	56	67
Allowing a vehicle onto main road from a slip road	63	68	59	67
Judging speed in daylight	64	68	61	65
Negotiating a roundabout	67	75	61	73
Judging distance in daylight	70	74	66	71
Turning left at a junction	70	71	69	74
Daylight driving	76	72	80	74

What the drivers say

6.5 The accident

In section one of the questionnaire (Questions 1 to 35), drivers were asked about the circumstances leading up to their accident, the accident itself, and the various factors which may have contributed to the accident.

6.5.1 Vehicle characteristics and familiarity

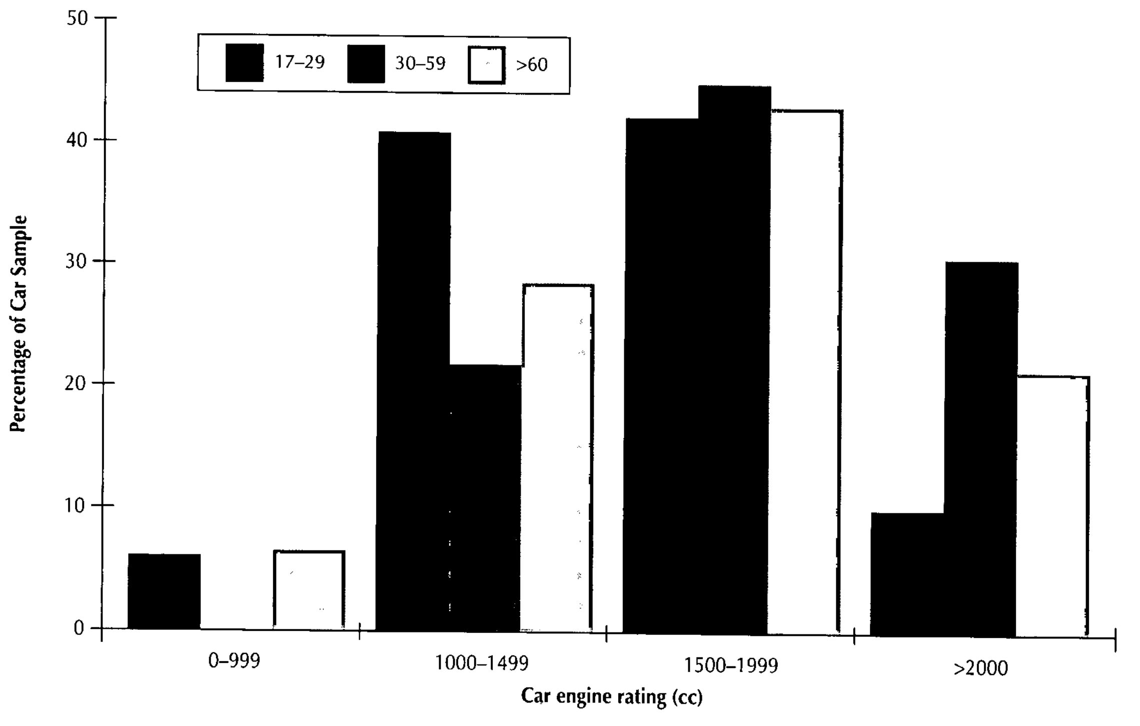
Most of the respondent drivers were travelling in a car at the time of their accident (167 vehicles (80 per cent)). Nineteen heavy goods vehicles were being driven (9 per cent), 12 light goods vehicles (6 per cent) and seven motorcycles (3 per cent).

In 93 per cent of cases (Question 10), the vehicle being driven in the accident was the one the respondent normally drove. Most drove the vehicle on a daily to several times a week basis (90 per cent – Question 11)).

Vehicle engine specifications

All heavy goods vehicles were powered by engines in excess of 2000 cc, whereas no motorcycle engine exceeded 1000 cc (Question 9). The median car engine size fell within the 1500 to 2000 cc category. For the younger driver, engine size is skewed towards the smaller engine sizes compared to the older driver. Nevertheless, 43 per cent were driving more powerful cars (1500 to 1999 cc) at the time of their accident (Figure VI.13).

Figure VI.13 Engine specifications of vehicles driven in accident by age of driver



6.5.2 The journey

Though familiar with driving on rural roads, 25 per cent of the drivers drove along the road on which they had their accident with a frequency of less than once a month (Question 11). Just under 8 per cent of the drivers had never travelled the route previously (Table 6.8).

Table 6.8 Familiarity with road on which accident occurred

	Number	Percentage
Daily or nearly every day	69	**33.2**
Once a week	39	**18.8**
Once a month	31	**14.9**
Less than once a month	53	**25.5**
Never before	16	**7.7**
TOTAL	**208**	**100.0**

Reason for journey and passenger details

Less than 5 per cent of drivers stated that they were travelling or going on holiday (Question 5) when their accident happened (Table 6.9). Most drivers were on journeys related to work (44 per cent) but an equally high proportion (if 'other' are included) were social/domestic trips.

Table 6.9 Purpose of journey

	Number	Percentage
Travelling to/from work	45	**21.6**
Business/part of job	47	**22.6**
Visiting friends	34	**16.3**
Other social/domestic reason	31	**14.9**
Other reason	23	**11.1**
Shopping	16	**7.7**
Travelling/going on holiday	10	**4.8**
School trip	2	**1.0**
TOTAL	**208**	**100.0**

In 57 per cent of cases, the driver was unaccompanied (Question 6). Where passengers were reported, 47 per cent were adult members of their family, 23 per cent were friends and 18 per cent were children.

6.5.3 Physical and mental state of the driver

The majority of drivers were healthy (Question 23) with only 13 drivers (6 per cent) reporting to be taking any medicines for a medical condition. Just under a third of the drivers (68 drivers) were required to wear glasses or contact lenses for driving (Question 21 and 22), and all but one were wearing them when they had their accident.

State of mind

The small proportion of drivers who reported feeling angry, frustrated or in a hurry at the time of their accident (Question 25) indicates that 'road rage' was not a major component in the accidents (Table 6.10). One component may have been complacency, as the most common state of mind reported by drivers was a feeling of being relaxed (49 per cent) and contented (49 per cent). Less than 5 per cent of drivers reported feeling tired or fatigued.

Table 6.10 State of mind at time of accident

	Number	Percentage
Relaxed	102	**49.0**
Contented	101	**48.6**
Happy	57	**27.4**
Distraction	11	**5.4**
Tired/Fatigued	10	**4.8**
Angry/Annoyed/Frustrated	7	**3.4**
In a hurry	8	**3.8**
Bored	5	**2.4**
Depressed or sad	2	**1.0**

Categories are not mutually exclusive

6.5.4 Driving actions

Just 3 per cent of the drivers stated that they were travelling at speeds in excess of the national 60 miles/h speed limit for single carriageway roads when the accident happened (Question 16). For just under 64 per cent of the drivers, their stated speed was less than 40 miles/h, the maximum national speed limit for urban roads.

What the drivers say

Most drivers stated that they were going straight ahead (46 per cent) when the accident happened (Question 13), and 13 per cent were stationary (waiting to go ahead). A further 11.5 per cent of drivers were waiting to turn, or in the process of turning right and 19 were overtaking (9 per cent).

In a specific question targeted at those drivers who were effecting a turning manoeuvre (Question 14), 55 per cent (11) turned ahead of a car. A similar question targeted at the drivers who were overtaking (Question 15) revealed that 54 per cent of vehicles being overtaken were cars (12).

Vehicle visibility to other road users

Just under 48 per cent of the vehicles had their lights switched on at the time of their accident (Question 17) – three quarters were showing dipped headlights (Question 18). A further 15 per cent of vehicles had their side lights on. Only five vehicles had their fog lights on, and three were showing full beam.

In addition to the vehicle's main lights, drivers were asked if they were giving any signals to other road users. Seventy two drivers (36 per cent) reported giving a signal, but none involved hazard lights. Of the vehicles giving a signal, 44 drivers (61 per cent) were using their right indicator and three (4 per cent) were using their left indicator. Only 29 vehicles from the whole sample (14 per cent) were showing their brake lights when the accident happened.

6.5.5 Who was to blame?

Having established the circumstances which led up to the accident from the perspective of each driver, each was then asked to respond to questions about their own driving when the accident occurred; the condition of their vehicle; the driving of the other driver(s) involved in the accident, and to assess whether some pre-specified factors relating to the road environment and traffic played a part in the accident.

What was their own role in the accident?

When questioned about their own role in the accident (Question 26), 74 per cent of the drivers attributed no fault to their own driving (Table 6.11). This low recognition of 'own' fault is worrying in view of the high accident numbers which continually recur on rural roads.

Table 6.11
Which of the following applied to you?

	Number	Percentage
None	151	**74.4**
Misjudging speed or distance of other road users/objects	21	**10.3**
Other	16	**7.9**

Categories are not mutually exclusive

Of the drivers who did respond, the more common faults recognised were those of misjudging distance (10 per cent) or driving too close to the vehicle in front (4 per cent). Sixteen drivers added other statements to those presented above but only three stated that they were driving too fast for the prevailing conditions.

What was the role of the other driver(s)?

The driver sample found it a lot easier to find fault with the other drivers (Question 28) involved in their accident (Table 6.12). Only 15 per cent found no deficiencies in the driving of the other driver(s). Misjudgment of speed or distance was the most common fault (36 per cent), but in contrast to their own driving, 26 per cent considered that the other driver(s) were driving too fast for the conditions. 26 per cent of drivers cited additional statements about the driving of the other driver(s).

Table 6.12
Which of the following applied to the other driver(s)?

	Number	Percentage
Misjudging speed or distance of other road users/objects	65	**36.3**
Other	46	**25.7**
Driving too fast for the conditions	50	**27.9**
Driving too close to the vehicle in front	41	**22.9**
Improper overtaking	34	**19.0**
None	27	**15.1**
Failing to give way at a junction	14	**7.8**

Categories are not mutually exclusive

6.5.6 What was to blame?

Was the road layout a factor in the accident?
72 per cent of drivers (Question 6.13) did not feel that road layout had been a factor in their accident (Question 30).

Table 6.13
Road layout as a factor in the accidents

	Number	Percentage
None	147	**72.1**
Unsigned/concealed entrances	18	**8.8**
Misleading road ahead	15	**7.4**
Lack of right turn facility	15	**7.4**
Lack of overtaking opportunities	15	**7.4**

Categories are not mutually exclusive

Was the road pavement a factor in the accident?
Drainage problems or a slippery road surface were cited by 9 per cent of drivers as having been a factor in their accident (Question 31). Problems with the edge of road environment were cited by a further 4 per cent, but for 87 per cent of drivers none of the listed factors was considered to have contributed to the accident (Table 6.14).

Table 6.14
Road pavement as a factor in the accidents

	Number	Percentage
None	183	**87.3**
Edge of carriageway factors	9	**4.4**
Poor drainage/slippery road surface	18	**8.8**

Categories are not mutually exclusive

Was there anything about the road which restricted visibility and that could have been a factor in the accident?
Only 19 per cent of drivers cited problems with visibility in the road environment (Question 32) as having been a possible factor in their accident (Table 6.15). Poor street lighting / poorly lit road works was cited as a factor by 6 per cent of drivers. Problems with visibility were suggested by 11 per cent of drivers.

Table 6.15
Restricted visibility as a factor in the accidents

	Number	Percentage
None	169	**81.3**
Restricted visibility	23	**11.5**
Poor street lighting/lit road works	12	**6.0**

Categories are not mutually exclusive

What the drivers say

Was the weather a factor?

Of all the statements presented to drivers as potential contributory factors to their accidents, the prevailing weather (Question 33) was cited as one of the more common factors – in particular rain (20 per cent – Table 6.16). A glaring sun was cited as a factor by 4 per cent of drivers, and snow and ice by 6 per cent of drivers.

Table 6.16 Factors in their accidents: weather

	Number	Percentage
None	137	**67.2**
Rain	41	**20.1**
Snow/Ice	13	**6.4**

Categories are not mutually exclusive

Was the amount or nature of the traffic a factor?

The prevailing traffic conditions were cited by 45 per cent of drivers (Question 34) as having been a factor in their accident (Table 6.17). This Table is perhaps the most revealing of all for it presents to the engineer facts which are not routinely available from STATS19 accident information. Of the factors presented, the most common aspect of the prevailing traffic conditions which is cited as having been a factor in accidents is unexpected slow traffic/queues, slow moving vehicles or heavy traffic (31 per cent). Slow moving farm vehicles were cited as a possible factor by under 2 per cent of drivers.

Table 6.17 Accident factors: prevailing traffic conditions

	Number	Percentage
None	115	**56.7**
Unexpected slow or heavy traffic/queues	63	**31.0**
Light/no traffic	15	**7.4**
Restricted visibility – other vehicle	15	**7.4**

Categories are not mutually exclusive

It is interesting that 15 drivers considered that the absence of traffic, or light traffic conditions was a factor in their accident (Table 6.17).

It is clear that most drivers were comfortable with their driving acumen and were unaware of the external influences which could have contributed to their accident.

6.6 Perception relative to involvement

In this Section a comparison is made of drivers' perceptions of the difficulty of different manoeuvres with the relative involvement of those manoeuvres in accidents.

Table 6.18 shows, within age group, the number and percentage of questionnaire respondents finding each of three specific tasks easy or very easy (and hard / very hard).

Table 6.18 Perception of questionnaire respondents (1993 and 1994 accidents)

Manoeuvre	**Age 17-29**		**Age 30-59**		**Age 60+**		**Total including unknown age**	
	Easy or very easy	Hard or very hard	Easy or very easy	Hard or very hard	Easy or very easy	Hard or very hard	Easy or very easy	Hard or very hard
Turning right	47	3	64	6	15	1	126	10
	65%	4%	59%	6%	68%	5%	62%	5%
Turning left	51	1	75	0	14	0	140	1
	71%	1%	69%		74%		70%	0.5%
Overtaking	39	5	52	8	13	1	104	14
	54%	7%	48%	7%	57%	4%	51%	7%
Average number of respondents	**72**		**109**		**21**		**204**	

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Given the small number of respondents who were undertaking these specific manoeuvres at the time of their accident, comparisons were made with the distribution of manoeuvres of all drivers involved in accidents on the six roads during the seven year study period. These are summarised in Table 6.19.

Table 6.19 Driver involvement in accidents on the six roads (1988 to 1994)

	Age 17-29		Age 30-59		60+		Total including unknown age	
Manoeuvre	No.	%	No.	%	No.	%	No.	%
Turning right	62	8.8	65	7.5	31	20	164	9.2
Turning left	14	2.0	11	3	2	1.3	27	1.5
Overtaking	82	11.6	65	7.5	13	8.4	174	9.7
Total	**704**		**864**		**155**		**1790**	

There are no significant differences, between age groups, in the proportion of respondents who perceive the tasks (considered separately) to be easy or very easy (or hard / very hard). However, considering Table 6.19, at 20 per cent, the proportion of drivers in the 60+ age group who were turning right at the time of their accident is significantly greater than the corresponding figure of 8 per cent for other age groups. Also, there is a significant difference, between age groups, in the proportion of drivers who were overtaking, with 17-29 year olds having a higher involvement than others.

This shows that the two groups who experience greater relative involvement (17-29 year olds overtaking and those aged 60+ turning right) do not perceive the relevant task to be any more difficult (or easy) than other age groups.

6.7 Summary

The main findings of this chapter are summarised below:

Driver experience

- Most of the individuals (both male and female) involved in the 1993-1994 accidents examined were experienced drivers, who were familiar with driving on rural roads. Only a third used the road on which the accident occurred less than once a month.
- Male drivers generally travelled greater distances when they drove compared to female drivers. The most frequent trip length for heavy goods vehicle drivers was in excess of 100 miles.
- The journeys of older drivers (aged 60 or over) were commonly shorter than those of other age groups. They also drove less at night, but their exposure to weekday driving was the same as for other age groups.
- 44 per cent of female drivers spent more than 60% of time driving in rush hour periods compared to 30% of males.
- Just under half of the journeys which ended in an accident were work related. A similar proportion of the journeys were for social/domestic reasons.

Driver perception

- Compared to males, female drivers rated various driving tasks as harder. This was particularly the case for driving in darkness.
- Drivers who experienced greater relative involvement (17-29 year olds overtaking and those aged 60+ turning right) did not perceive the relevant task to be any more difficult (or easy) than other age groups.

What the drivers say

The accident

- Few drivers were showing the symptoms of 'road rage'. Most were relaxed and contented when they had their accident – possibly a sign of complacency.
- Few drivers found fault with their own driving – they were more readily prepared to find fault with the driving of other drivers in the accident.
- Less than 2 per cent of drivers cited slow moving agricultural vehicles as a factor in their accident, but congestion was mentioned by 31 per cent of drivers.
- It is clear that most drivers were comfortable with their driving acumen and were unaware of the external influences which could have contributed to their accident.

Chapter 7 Accidents and the road environment

This chapter contributes to the profile of traffic accidents on single carriageway rural roads established in previous chapters by examining what influence, if any, individual or combinations of road environment features have on accident frequency and accident types observed for the inter-junction links and at public road junctions. Section 7.1 compares the road environment characteristics of each route. Sections 7.2 and 7.3 examine the accident and environment interactions for public road junctions and links respectively.

7.1 Road environment characteristics

Presentation of the road environment characteristics is in two parts. Section 7.1.1 introduces quantitative features of the road structure and layout. More qualitative aspects of the road environment are introduced in Section 7.1.2.

7.1.1 Quantitative features of road geometry and layout

The road geometry and layout variables introduced in this section are :

1. Bendiness
2. Carriageway width
3. Kerbing
4. Forward visibility
5. Centre line markings
6. Edge of carriageway markings
7. Wet Skidding Resistance (SCRIM)

Bendiness

The dichotomous physical geography of Cambridgeshire does not readily manifest itself in overall route bendiness. Admittedly, the A47 Fenland route emerges with the lowest bendiness value of 10 degrees per kilometre, but the A141 which is another Fen route, has the highest bendiness value of 37 degrees per kilometre. However, this latter figure is biased by one or two severe bends which cancel out the effect of a 4.5 km length of straight road (Table 7.1).

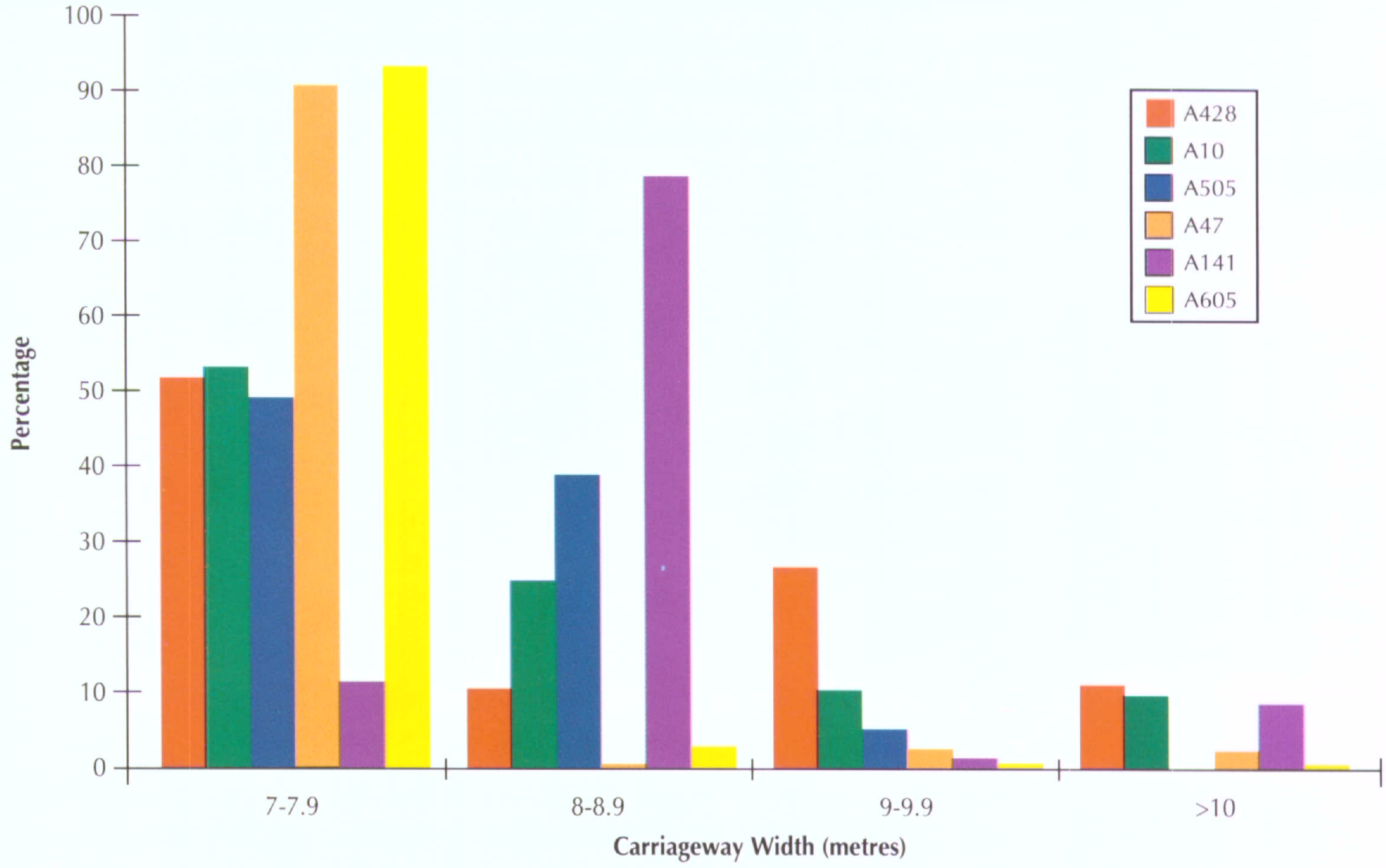
Table 7.1 Bend characteristics

Route Number	Bendiness (Degrees/km)	No. of Bends	Bend Angle Low/High
A428	28	30	2°/45°
A10	34	29	2°/51.5°
A505	21	13	7.5°/37.5°
A47	10	9	4°/31°
A141	37	11	11°/90°
A605	33	11	5.5°/65°

Carriageway widths

Carriageway information supplied by the Trunk Road Maintenance Unit of WS Atkins (East Anglia) Ltd presented the average carriageway width per 100 metre length of road for each of the six routes. Figure VII.1 presents a histogram of the carriageway width distribution of each route.

Figure VII.1 Carriageway width distribution

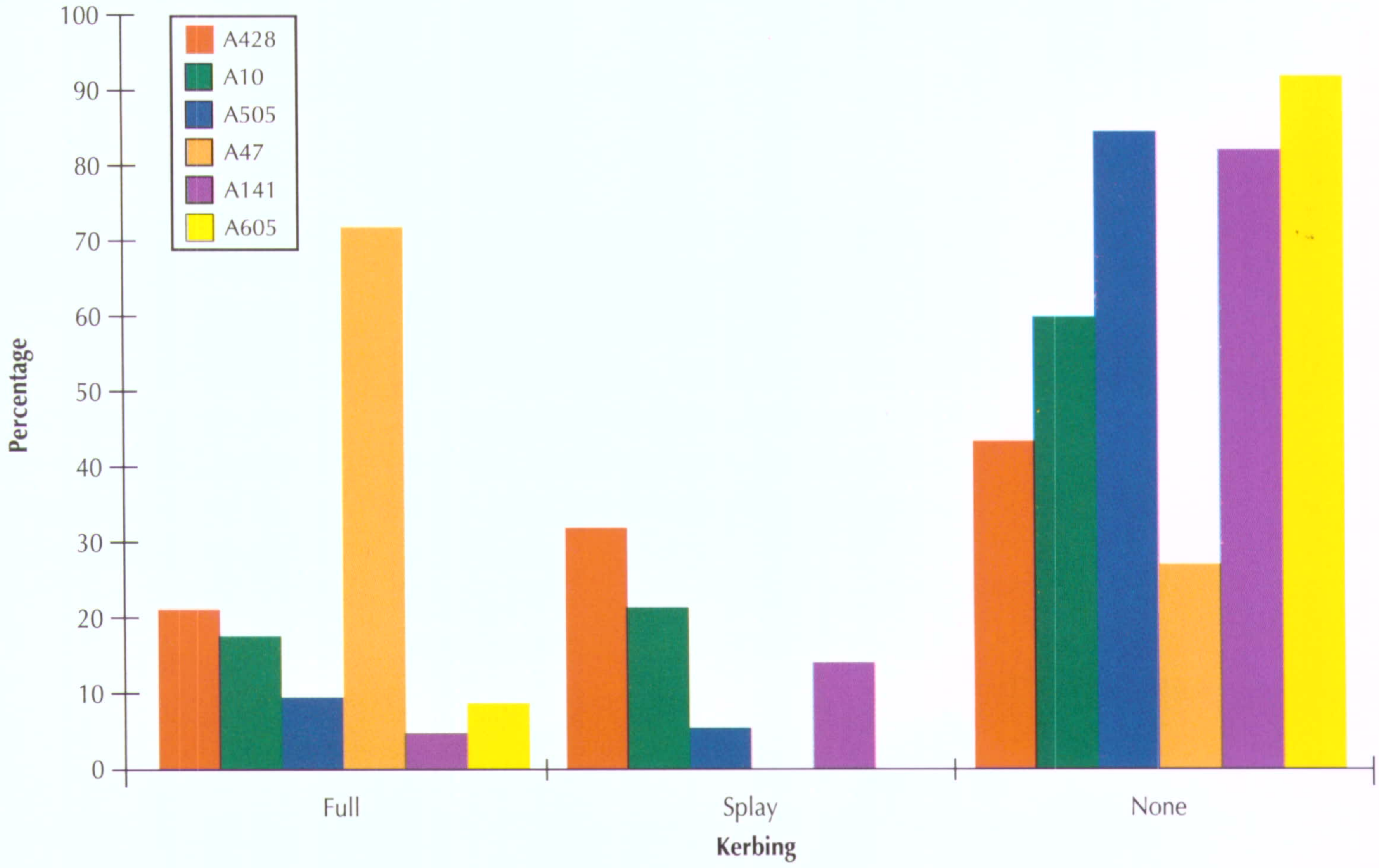


It is clear from Figure VII.1 that the distribution of carriageway width varies between routes. The median carriageway width for the A141 lies between eight and 8.9 metres, whereas the median carriageway width for the other routes lies between seven and 7.9 metres. For the A47, nearly 94 per cent of the route is between seven and 7.9 metres wide. This proportion is only surpassed by the A605. The A428 has the highest proportion of wide carriageway – 36 per cent of the route is over nine metres wide. Large carriageway width variations between routes, and along individual routes, demonstrates the evolutionary nature of road developments.

Roadside kerbing

Kerbing was divided into three categories relating to full kerbing, half or splay kerbing and flush or no kerbing. The proportion of each kerb type was established by summing over both sides of the carriageway. Changes took place to the kerbing on the A428 during the study period. This was overcome by averaging the percentage of kerbing over time as well as distance.

Figure VII.2 Roadside kerbing



Once again, differences emerge between routes. 72 per cent of the A47 route is bounded by a full kerb, whereas most other routes have no kerbing. Where full kerbing is present on these routes it is generally at junctions, but even in these circumstances, it is more often splay kerbs which are present. These differences in kerb usage generally reflect different qualifying circumstances. For example, full kerbs on the A47 serve a dual role: they are used to stabilise weak haunches which are built on peat and they also serve to separate footpaths adjoining the route from the main carriageway. That the other routes which traverse the Fens are not similarly bounded is partly a reflection of cost, but the qualifying circumstances are also different.

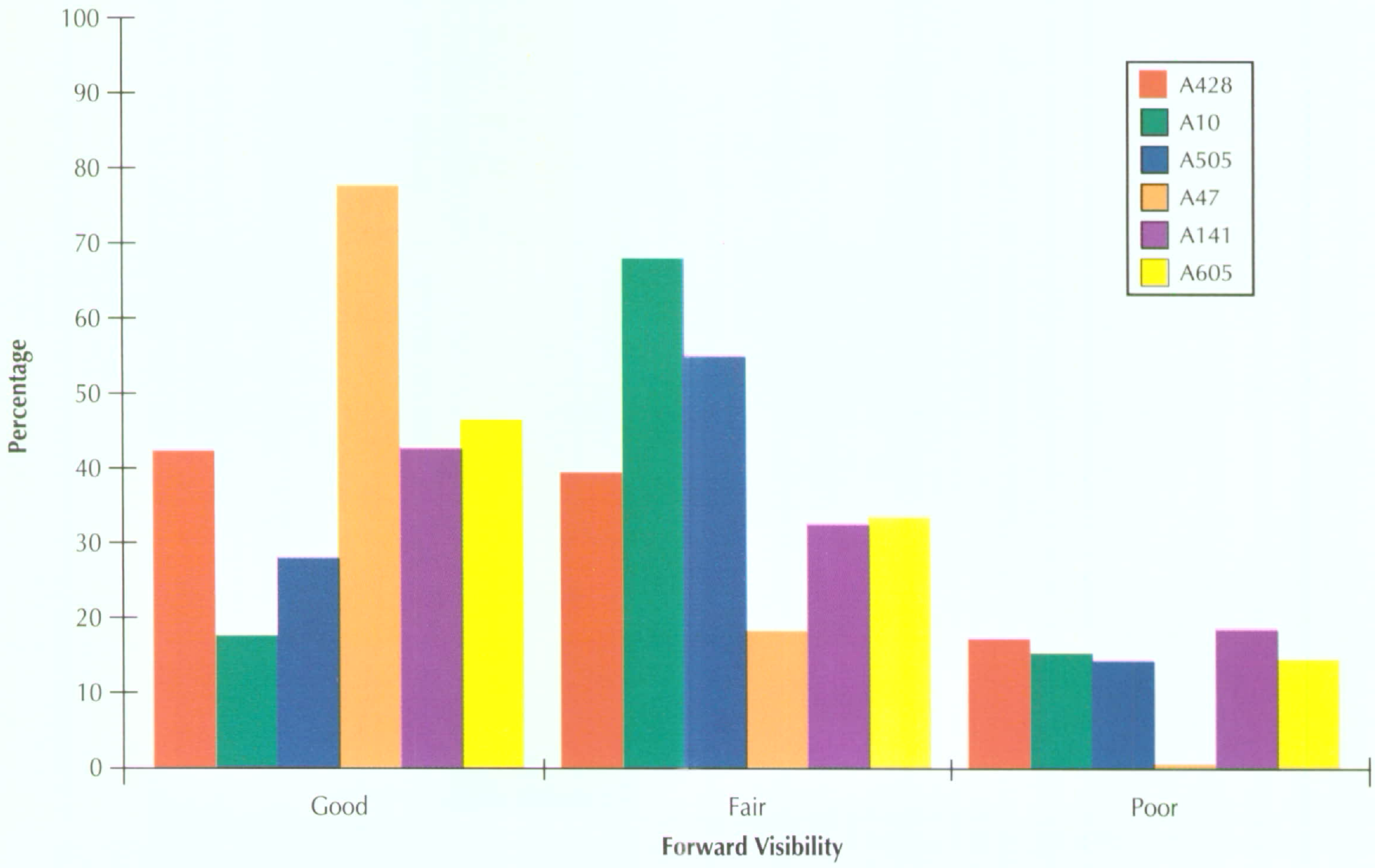
Forward visibility

Forward visibility was originally coded into three categories based around certain critical distances associated with a road designed to carry traffic at a maximum speed of 100 km/h (62 miles/h) – (Design Manual for Roads and Bridges TD9/93 – Highway Link Design). These distances were:

- full overtaking sight distance (580 metres)
- desirable minimum stopping sight distance (215 metres)

Forward visibility was considered **good** when the distance was in excess of 580 metres, **fair** when it was between 215 metres and 580 metres, and **poor** when it was less than 215 metres. The proportion of each forward visibility is based on the sum of forward visibility in both directions on each of the six routes and is presented in Figure VII.3.

Figure VII.3 Unobstructed forward visibility

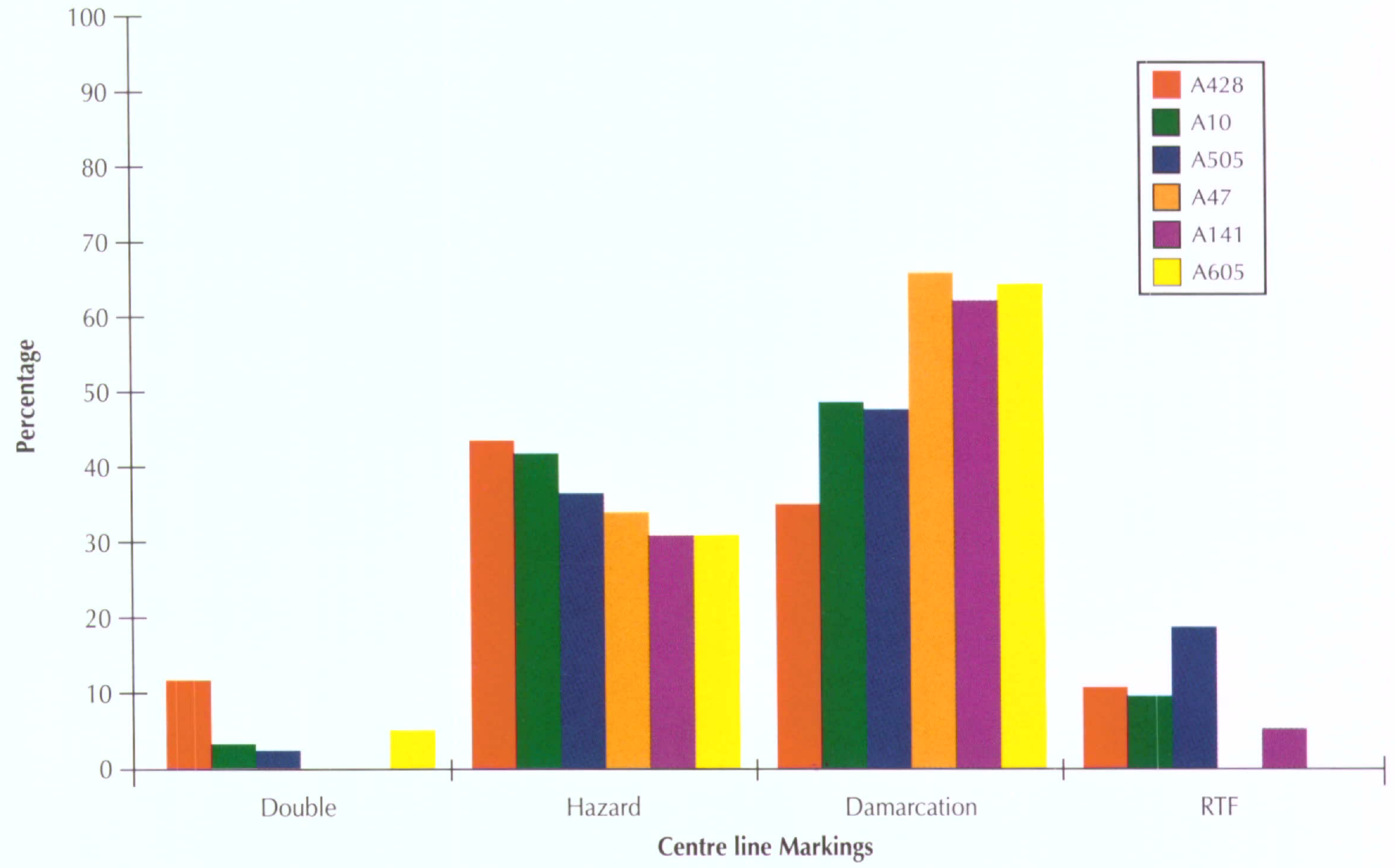


The proportion of good forward visibility is highest among those routes which cross the Fens. 78 per cent of the A47 has good forward visibility – a testament to the fact that for most of its length, this is a long straight road. Only 1 per cent of this route has poor forward visibility. The A141 and A605 which also cross the Fens also have proportionally more good forward visibility than fair or poor (Figure VII.3). However, 19 per cent and 15 per cent of these respective routes have a poor forward visibility, due to the severe bends mentioned earlier. The presence of two roundabouts on the A141 also has the effect of increasing the proportion of poor visibility as they are approached. An increase in the number of bends and a more undulating vertical profile explain why the median forward visibility for the A10 and A505 lies within the fair forward visibility category.

Centre line markings

Centre line markings were originally classified into eight types, but some of these were only present on a small proportion of the roads considered. The original categories were therefore collapsed into four new categories: **carriageway demarcation, hazard markings, double line systems** which include double white lines (permissive and prohibitive) and one metre centre hatching, and **right turn facilities** (RTF) which include full and sub-standard right turn facilities, and solid central islands. The distribution of these carriageway markings on each of the six routes is shown in Figure VII.4. As for kerbing, changes to road markings which took place during the period of this study are accounted for by averaging the percentages over time as well as distance.

Figure VII.4
Centre line markings



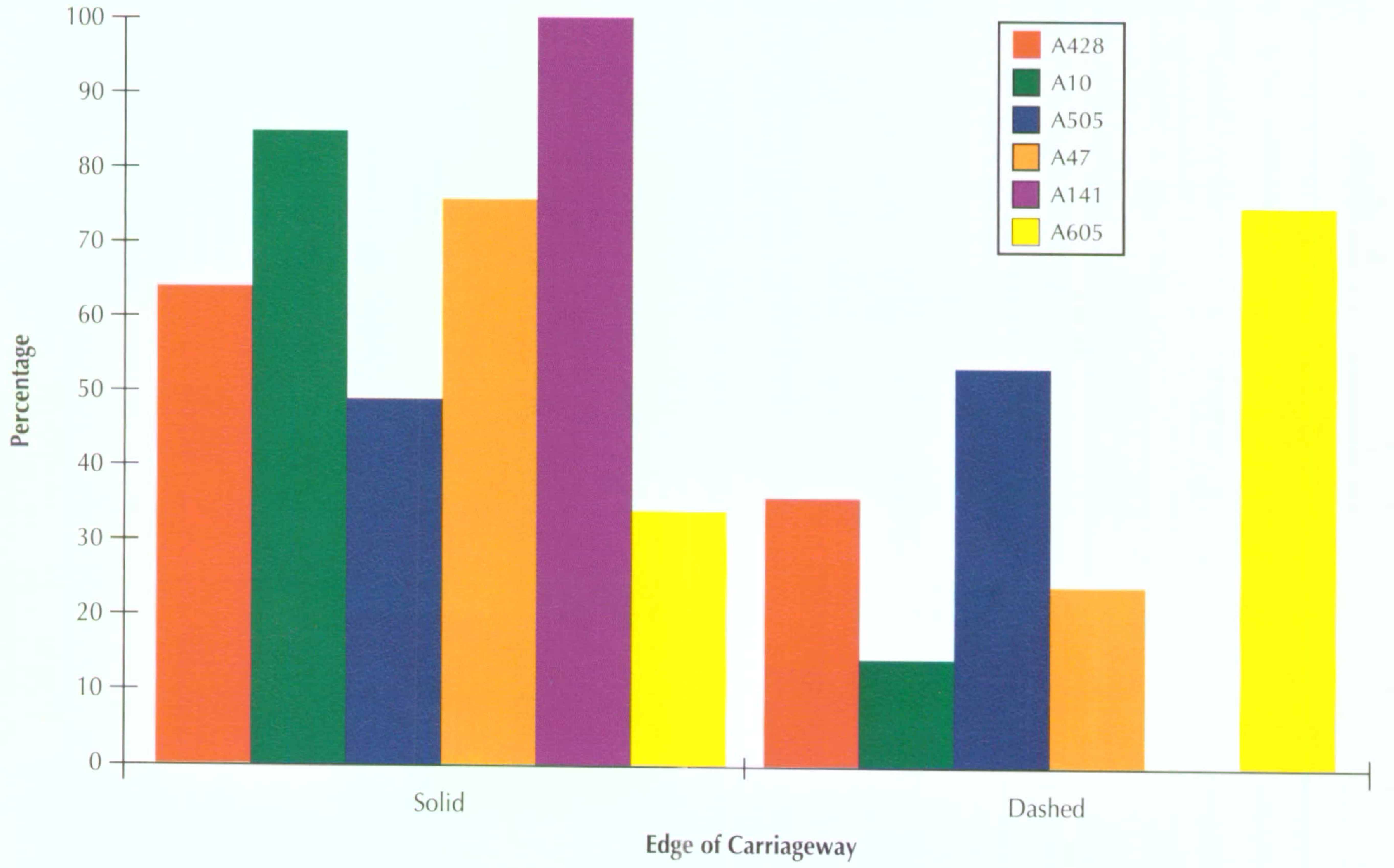
Variation between routes in the amount and type of centre line markings can be explained by different qualifying circumstances. For example, forward visibility must fall below 160 metres before double white lines can be considered for use on a road. The highest proportion of markings in the double category was on the A428 (12 per cent). However, only a small proportion of this percentage was double white lines – most were one metre centre hatch markings. Right turn facilities are only found at public road junctions and, exceptionally, at busy private accesses. None of the junctions on the A47 had a right turn facility in the period of this study. By contrast, 16 per cent of the road markings on the A505 were right turn facility markings.

Differences between the routes traversing the Fen areas compared to those elsewhere in the County are further highlighted by a much higher proportion of carriageway demarcation markings compared to other centre line marking types. Long straight roads with good visibility preclude the need to use hazard markings, other than adjacent to junctions or at bends.

Edge of carriageway markings

Edge of carriageway markings were originally coded to one of five groups, but once again, consolidation to two categories was necessary because some were present for only short lengths, and only on some of the roads. The two groups were **solid** which incorporated a continuous white line, single yellow line and vibraline, and **dashed** which included just carriageway demarcation markings. The proportional distribution of edge of carriageway markings on each of the six routes was obtained by summing over both directions and is presented in Figure VII.5.

Figure VII.5
Edge of carriageway markings



The proportions of dashed and solid edge of carriageway markings are different for each route. The dashed edge of carriageway marking normally accompanies the carriageway demarcation centre line marking, but this is not always the case. The A141 is bounded by a solid white edge of carriageway line along its entire length.

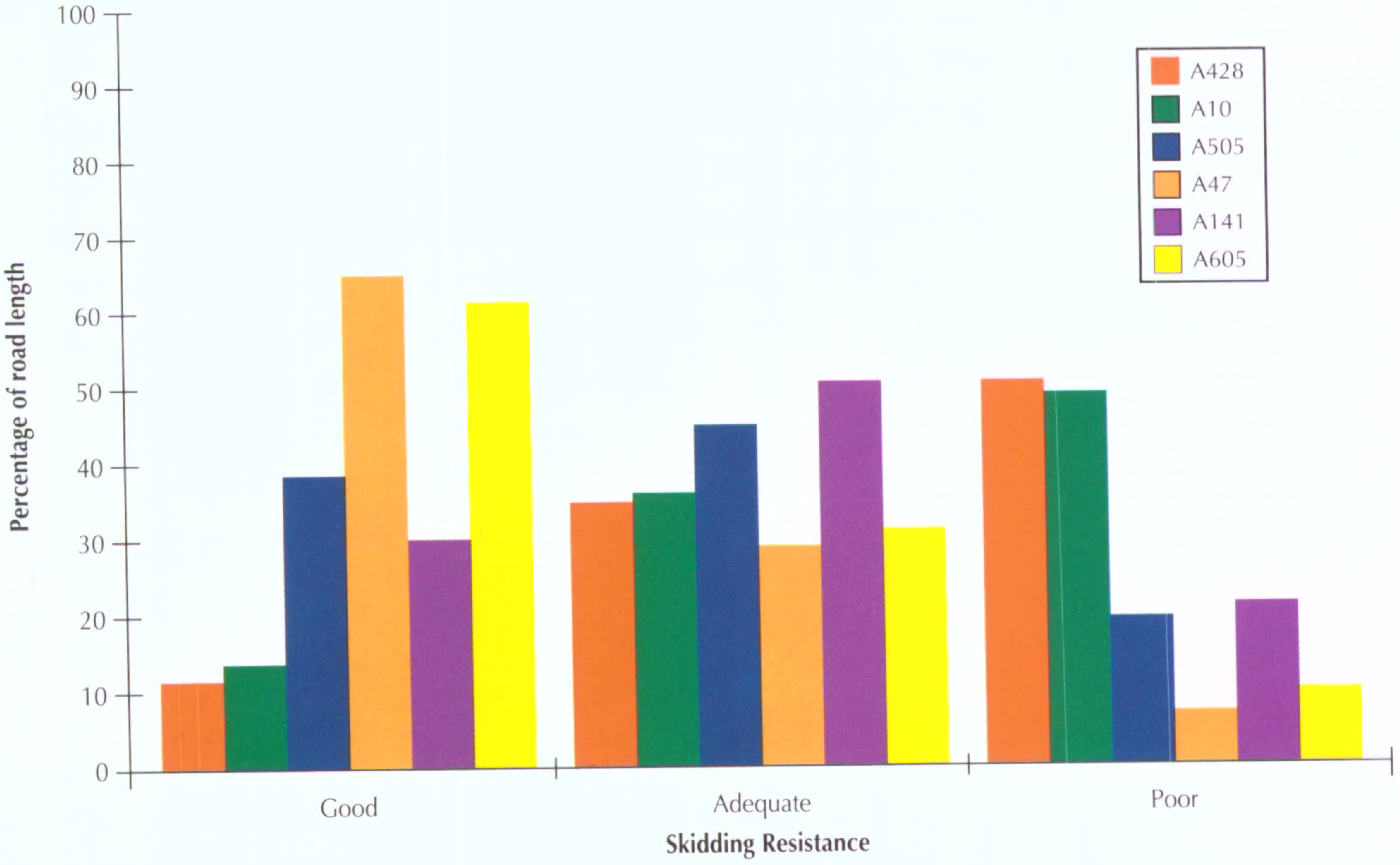
Wet skidding resistance (SCRIM)

A measure of the wet skidding resistance of each route was obtained from SCRIM data – as described in Section 2.3.3. Unfortunately, wet skidding resistance information was only available for the period between 1992 and 1994 with the result that this parameter could not be incorporated into the statistical models which follow. Where available, a measure of skidding resistance in the form of the difference between the measured mean summer SCRIM coefficient and a predetermined intervention level was recorded for each lane of the carriageway. The wet road skidding resistance of a road was considered:

- poor – skidding resistance below the intervention level
- adequate – up to 0.05 coefficient above the intervention level
- good – more than 0.05 above the intervention level

An idea of the skidding resistance offered by each route can be extracted from Figure VII.6.

Figure VII.6
SCRIM deficiency



No skidding resistance information was available for 37 per cent of the A428 road length, and resurfacing episodes within the period of interest negated the use of some skidding resistance information for the A10. Only the available information is shown in Figure VII.6. Clear differences emerge between routes.

Using the categories established for wet skidding resistance, an attempt was made to examine if the incidence of accidents involving skidding on a wet road surface was a function of poor skidding resistance offered by the road. In Table 7.2, it can be seen that the proportion of all wet road accidents involving skidding is highest on a poor road surface.

Table 7.2
Wet skidding – incidence and skidding resistance

	Skidding Resistance		
	Poor	**Adequate**	**Good**
All accidents on wet roads	41	35	22
Wet skid accidents	28	10	9
% of accidents involving a skidding vehicle	**68.3**	**28.64**	**40.9**

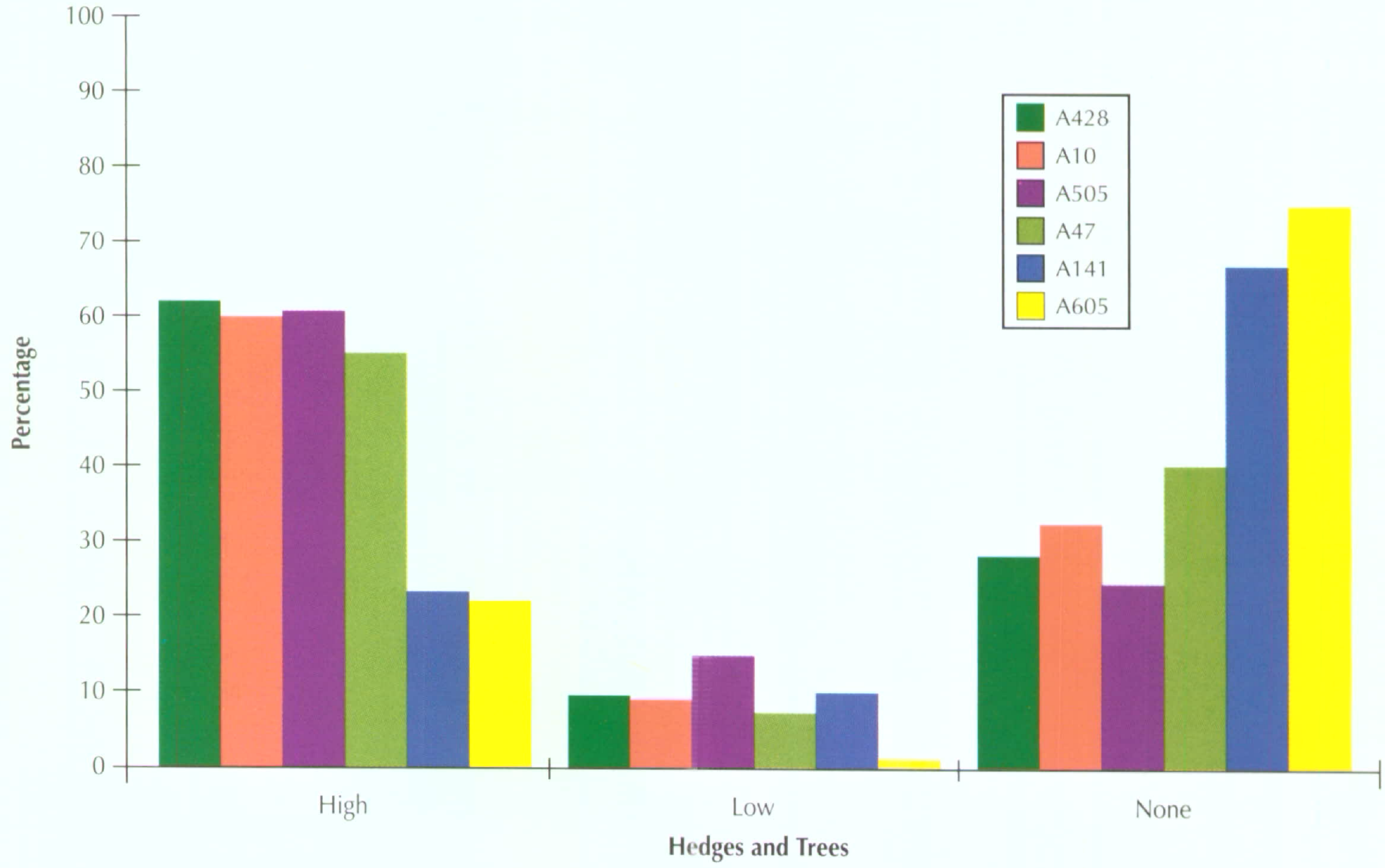
7.1.2 Qualitative features of the road environment

This section presents those features of the road environment which were determined qualitatively from the video surveys. These features are:

1. Hedges and trees
2. Verge width
3. Aspect (nearside and offside)

Hedges and trees
Hedges and trees were coded into one of three categories relating to **none, low** or **high**. Low hedges and trees were those which could be overlooked by the driver. The distribution of these categories along each route was obtained by summing over both directions of travel and is presented in Figure VII.7.

Figure VII.7
Hedges and trees – by route

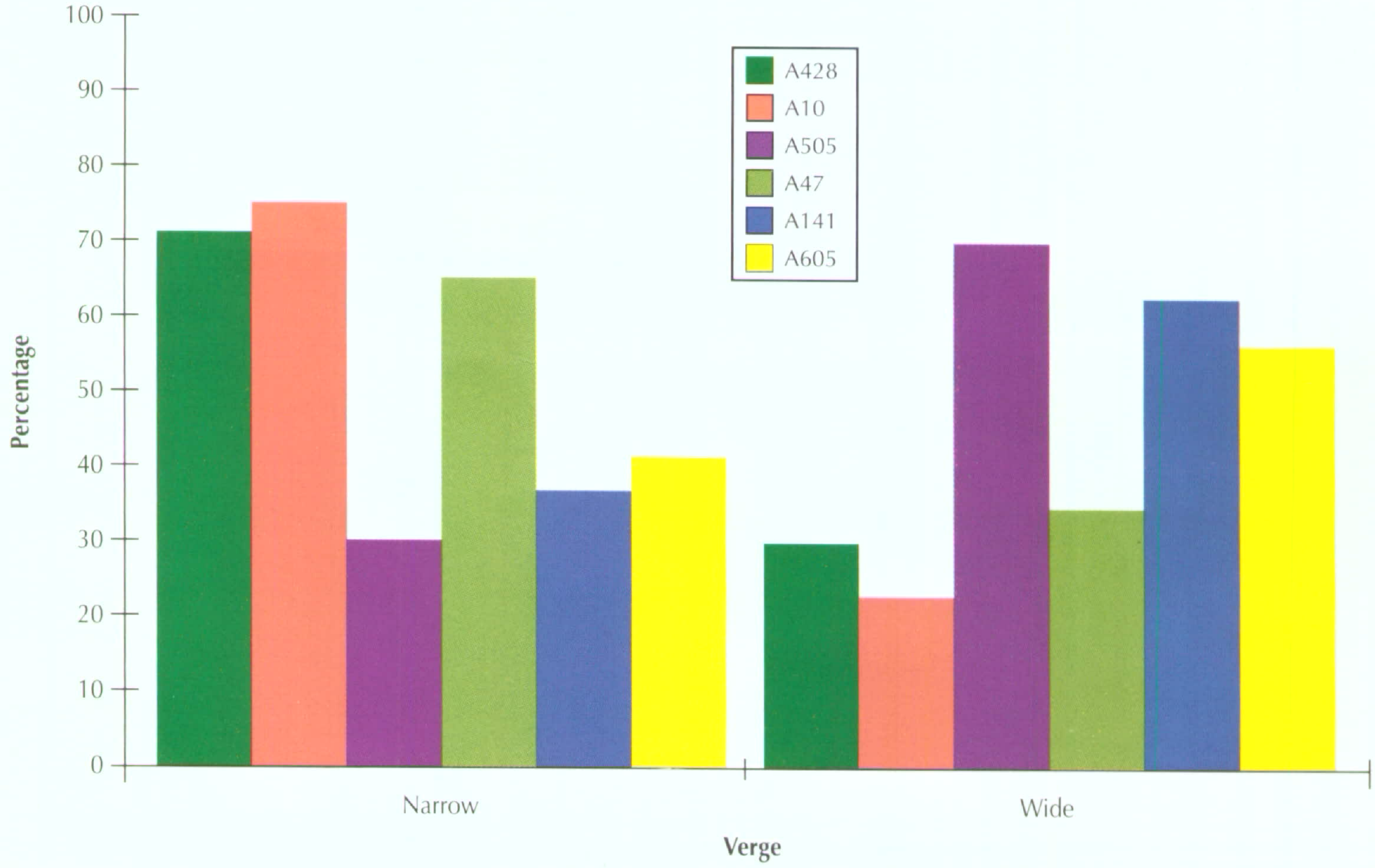


Low hedges and trees only form a small percentage of the roadside vegetation along each route. The A505 has the highest proportion of low hedges along its length (15 per cent). The routes which traverse the Fens have the highest proportion of no tress or hedges, ranging from 40 per cent for the A47 to 75 per cent for the A605. The presence of high trees on these routes is generally restricted to the proximity of farms and dwellings where they act as wind breaks. High trees and hedges form more than 50 per cent of the roadside vegetation along the edges of the other routes.

Verge width

Verge width was grouped into two categories – **narrow** or **wide**. The proportional distribution of verge width for each route was obtained by summing over both directions of travel and is shown in Figure VII.8.

Figure VII.8
Verge width

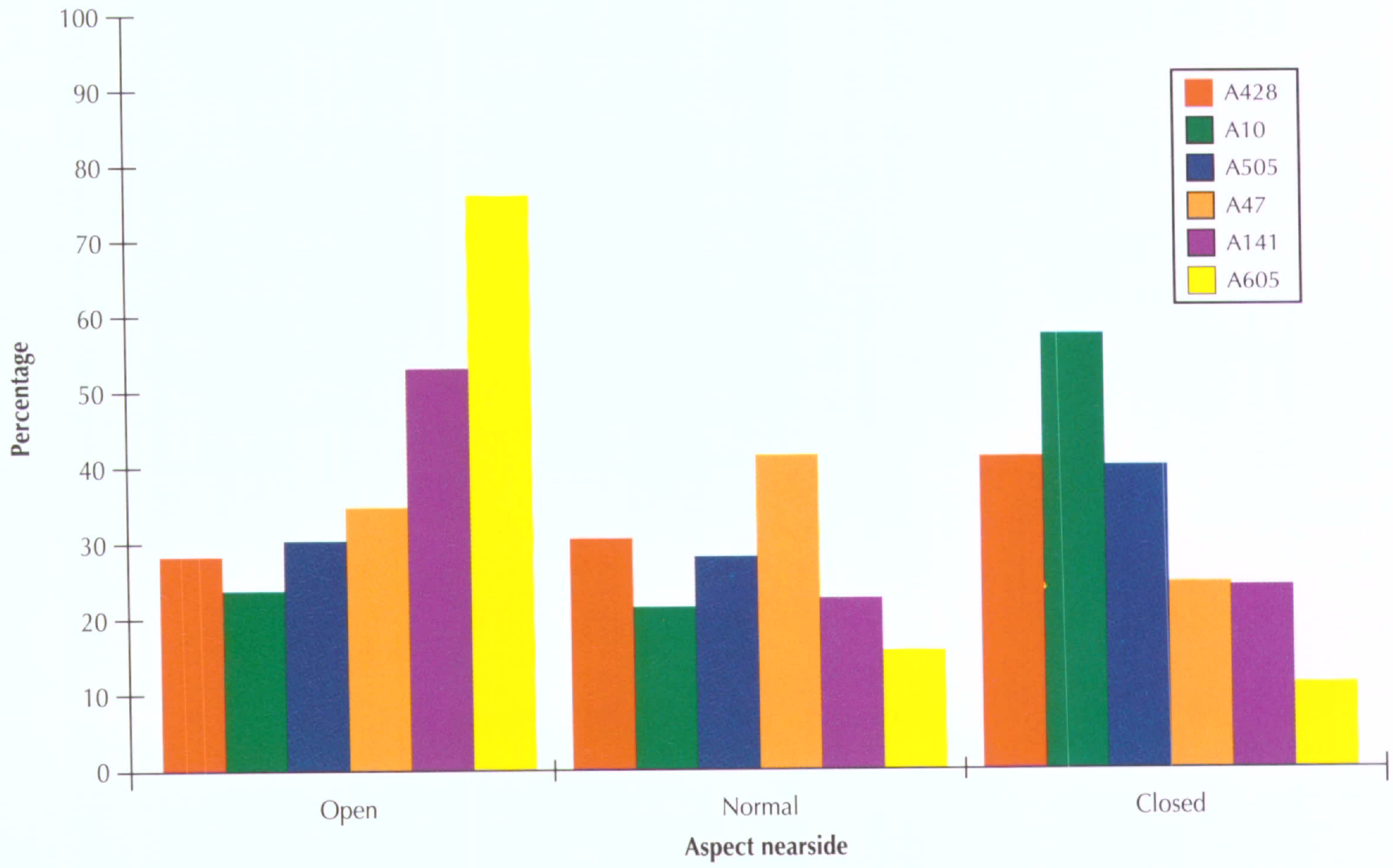


The proportional distribution of verge width by category is a reflection of the different land use adjacent to the carriageway. For the A141 and A605 routes on the Fens, the absence of trees and hedges signifies wide verges which are bounded by drainage ditches. By contrast, road space is at a premium on routes such as the A47, A10 and A428 where the routes are guided along narrow tracts between adjacent properties. The presence of footpaths along the edges of these routes further restricts the width of any verge which might be present.

Aspect

Driver aspect was coded to one of three categories – **open, normal** or **closed**. Nearside and offside driver aspect were considered separately because they are direction of travel related. However, the constructed histograms revealed few differences between them due to the fact that they are highly correlated. Only the nearside aspect histogram is presented in Figure VII.9.

Figure VII.9 Driver perception of aspect – nearside



In general, the presence of high hedges and trees has the effect of creating a closed aspect for the driver which helps to explain the high proportion of closed aspect on the A428, A10 and A505. On the A141 and A605, the opposite effect is true – the absence of high trees gives rise to a higher proportion of open aspect. Only on the A47 is the proportion of normal nearside aspect the highest aspect proportion (40 per cent) – this is despite the fact that 54 per cent of the route is bounded by high trees or hedges. Part of the explanation for this may be that the high hedges and trees on the A47 do not always form a continuous boundary to the route but are intermittently grouped around properties.

7.2 Public road junctions – interactions

The interactions between the road environment parameters and accident frequency and types are examined in the following sub-sections through the use of statistical models. Small accident numbers precluded a separate examination of accidents occurring at private accesses. Only public road junctions and the inter-junction links are examined. Each category is introduced with a brief description of the methodology followed when collecting the road environment information for inclusion in the analysis. Detailed description of the statistical analysis techniques used is avoided here – the interested reader is directed to the separate technical report (Accidents on rural roads – single carriageway 'A' class roads (Technical Annex) – Hughes and Amis (1996)).

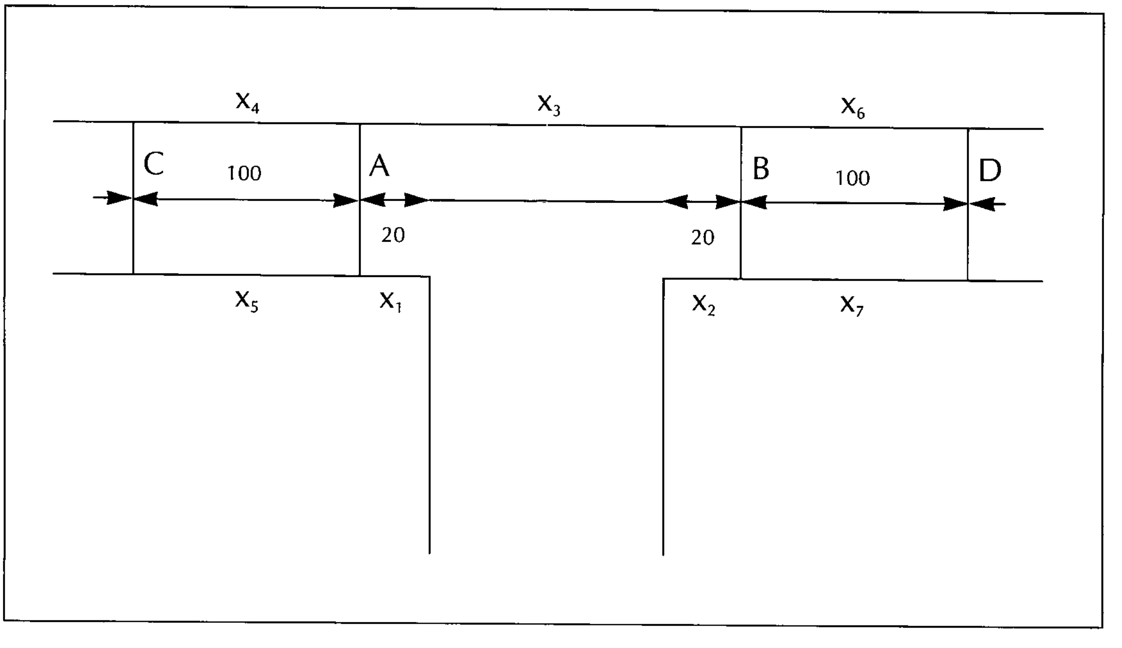
7.2.1 Accident frequency

With only two exceptions, all single carriageway T and staggered junctions on the six roads were considered. This gave 37 T and seven staggered junctions in total. Three of the T-junctions had undergone major work during the period of interest. For these three sites, the periods before and after this work were treated separately. Close examination of the solitary crossroads on the A47 revealed that the accident problem at the junction was associated solely with the northern arm. The southern arm is little used. For this reason, this junction was also considered as a T-junction. Only the A10 junction with the C209 at Landbeach, and the A10 with the multiple junction with the C158 at Little Thetford are fundamentally different from the others. These were excluded from the analysis. For the purposes of this study, staggered junctions were treated as two separate T-junctions. A total of 172 accidents occurred at the junctions between 1988 and 1994.

Methodology

A comprehensive coverage of all major environmental characteristics which could influence the occurrence of accidents on any arm of a T-junction was achieved by collecting the same road environment information at different points about the junction. Hedge, verge and kerb information was collected at one of seven locations surrounding the junction (x1 to x7 – see Figure VII.10) whereas forward visibility and aspect (both nearside and offside) were collected at locations 20 metres (A and B) and 100 metres (C and D) in advance of the junction on both major arm approaches – see Figure VII.10.

Figure VII.10 T-junction layout and road environment data collection points



Additional information included side-ways visibility splays from the minor arm, carriageway markings and junction signing on all approaches to the junction. A more complete description of all the additional variables collected for junctions can be found in Appendix A.

A seven year average, two-way traffic flow measurement was collected for the major road adjacent to each junction. As minor traffic flows were not available for all roads, it had to be coded as a four level categorical variable based on the available count data combined with local knowledge. The four categories are approximately 0–1000 vehicles, 1000–2500 vehicles, 2500–4000 vehicles and 4000–5000 vehicles (all per 16 hour day).

Accidents on Rural Roads: Single Carriageway 'A' Class Roads

A statistical modelling approach was adopted with the aim of explaining differences in accident frequency between junctions in terms of a number of the explanatory variables. Given 72 potential explanatory variables, the objective was to develop a model that would explain as much of the variability as possible using the minimum number of variables. The final model was developed as a generalised linear model in GLIM (NAG 1993), and is reported in the separate technical report.

Results

The final model included just three of the 72 explanatory variables which were considered at the beginning. The following variables were found to have a significant association with the occurrence of accidents at public road junctions. The influence of each variable is over and above that due to other factors in the model.

An association between a particular variable and accident frequency does not, necessarily, imply a 'cause and effect' relationship.

1. **Major road traffic flow**
   Within the major traffic flow range considered in the model (4500 to 17400 vehicles per 16 hour day), an increase of 1000 vehicles per day is associated with a 6 per cent increase in accidents at these types of junctions.

2. **Minor traffic flow**
   An increase in minor traffic flow from one categorical level to the next results in an increase in accident frequency of 87 per cent.

3. **Carriageway width**
   Within the carriageway width range considered in the model (7.0 to 21.2 metres), a one metre increase in carriageway width at a junction is associated with an estimated accident reduction of five per cent.

It must be stressed that the observed effects are not linear (ie doubling the width of a carriageway from seven to 14 metres would not necessarily result in an accident reduction of 35 per cent), and that they are only applicable within the range of the model.

With these terms in the model, no other factors have a significant effect on the total number of accidents at a junction. However, this does not necessarily mean that the factors have no effect. It might be that a small effect could not be detected with the sample size being considered.

7.2.2 Accident types

An examination of T and staggered junction accidents by type was conducted in section 5.1 of Chapter 5. With so many accident types occurring at these locations it is not feasible to examine which environmental factors influence all accident types. This approach will only be applied to the predominant accident types established in Table 5.14. These are summarised in Table 7.3. The accident types of the four accidents which occurred at the cross roads are included in Table 7.3.

Table 7.3
Accident types at T or staggered junctions

	Accident Type	No. of Accidents
1	Rear end shunt/queue evasion to left of minor road	33
2	Rear end shunt/queue evasion to right of minor road	8
3	Vehicle turning right leaving main road hit by approaching vehicle	14
4	Vehicle turning right entering main road hit by vehicle on nearside	15
5	Vehicle turning right entering main road hit by vehicle on offside	43
6	Vehicle turning left entering main road hit by vehicle on offside or rear	9
7	Junction overshoot	8
8	Vehicle turning right leaving main road hit by vehicle overtaking	12
9	Other	30
	All Accidents	**172**

Accidents and the road environment

Methodology

Given the relatively small number of accidents per category, with many junctions having no accidents of a particular kind, it was not possible to analyse each accident type separately using the methodology applied to the 'all accident' total in section 7.2.1.

Instead, logistic regression models were fitted to the data so that those environmental factors associated with an increase or decrease in the odds of an accident of a particular type occurring relative to an accident of another type could be determined. The odds of an accident type are defined as the probability of a given accident being of a particular kind divided by the probability of it being of any other kind.

It is stressed that this approach can only provide estimates of the effect of a variable on accident type. It does not give a measure of the influence on accident frequency. Although a factor may affect the kind of accident, it has already been established that major road traffic, minor road traffic and carriageway width are the only variables to have a significant association with the number of accidents at a junction. Furthermore, the models for each accident type are not independent. The association between a factor and an increase in the odds of one type of accident will be related to an association between that factor and a reduction in the odds of another accident type.

Results

Logistic regression models fitted to the data revealed the following significant effects:

1. **Ghost islands** are related to a reduction in the odds of an accident involving either queuing on the main road (the odds of this type of accident are only 0.27 times as high when a ghost island is present) or accidents involving vehicles being hit by an overtaking vehicle while turning right (x 0.14). However, they are also associated with an increase in the odds (by a factor of 6.8) of accidents involving vehicles being hit on the offside whilst turning right entering the main road.
2. The **presence of a bend** within 100 metres of a junction is associated with an increased odds (x 3.8) of accidents involving vehicles entering the main road and a decreased odds (0.14) of an accident involving a vehicle being overtaken while turning right leaving the main road. A reduction in main road visibility has similar effects as it is correlated with the presence of a bend.
3. **Larger side road flows (greater than 2500 vehicles per day)** are connected with an increase in the odds (x 6.6) of an accident involving vehicles entering the main road.
4. Compared to roads operating at below their design capacity, roads that are **either at or above capacity** are associated with an increased odds (by a factor of the order of 11) for stacking type accidents.

Two junctions had ghost islands installed between 1988 and 1994. One of these had sufficiently long 'before' and 'after' periods to enable a separate analysis of the effect of installing the ghost island. During the four and a half years before installation there were six accidents, only one of which involved a vehicle turning right entering the main road being hit by a vehicle on the offside. During the two and half years after, there were also six accidents, five of which involved this conflict. The observed increase in accident frequency is not statistically significant. The change in accident type is significant at the 10 per cent level giving some indication of a real effect.

7.3. The inter-junction links – interactions

7.3.1 Accident frequency

The examination of the influence of environmental factors on link accidents was effected by dividing the six roads into a total of 89 lengths. No portion of the route falling within 20 metres of a business access or public road junction was included. The main consideration when deciding how to divide up a road was its 'bendiness' which is the average angle turned through per kilometre travelled. A series of 'similar' bends was treated as a single link because, in practice, it was difficult to decide where one bend finished and another started. There would also be a carry over effect from one bend to another. Accidents at public road junctions and business accesses were excluded from the analysis. Other private access type accidents were included. There were 551 accidents in total.

Methodology

A seven year average two-way 16 hour traffic flow measurement was calculated for each road length.

Variables were included for centre markings, aspect, forward visibility, hedges, verge, kerb and edge markings. These were measured for each link following the approach outlined in Section 7.1. For example, there were two factors for verge representing the percentage of narrow and wide verge along each link summed over both directions of travel.

Chevrons, marker posts and bend warning signs were included as an average per bend per seven year period. Road length, road width, number of lay-bys, number of non-business private accesses and the number of bends per link were also recorded. Variables were included to indicate the presence of a public road junction, business access or roundabout within 200 metres of the link.

Analysis of the effects of different road environment variables on the occurrence of accidents on the inter-junction links followed a similar approach to that of Section 7.2.1. Generalised linear models were fitted to the data, full details of which are contained in the technical report.

Results

The main results, obtained from a number of different models, are summarised below. Aspect and forward visibility are more subjective than the other variables and are quantified slightly differently:

As stated earlier, an association between a particular variable and accident frequency does not, necessarily, imply a 'cause and effect' relationship.

1. **Major road traffic effect**

   Within the major traffic flow range considered in the model (4500 to 17400 vehicles per day), an **increase of 1,000 vehicles per day** is associated with a **12 per cent increase** in accidents.

2. **Bendiness**

   Within the bendiness range considered in the model (0 to 163 degrees per kilometre), an **increase in bendiness of one degree per kilometre** is related to a **one per cent increase** in accidents.

3. **Carriageway width**

   Within the carriageway width range considered in the model (7.1 to 11.5 metres), a **one metre increase in carriageway width** is connected with a **19 per cent decrease** in accidents. The wider average carriageway widths often include a junction approach containing a right turn facility (as previously defined).

4. **Double line**

   A **one per cent increase in road length with a continuous double white line or one metre centre-hatching** is associated with a **1.2 per cent decrease** in accidents.

5. **Lay-by/Bus Stop**

   The estimated effect of **one lay-by in a one kilometre length** is an **increase of 11 per cent** in accident frequency.

6. **Forward visibility**

   A length of road with either **poor or good forward visibility** over most of its length is associated with an accident frequency about **1.5 times as high** as a link with mostly **fair visibility**.

7. **Aspect**
   Roads having either mainly normal offside aspect or a combination of normal and open are connected with about twice as many accidents as those with either predominantly open or predominantly closed offside aspect. Because offside and nearside aspect are correlated, only one of them is required in a given model. Offside aspect can be replaced by nearside aspect with similar results. The association between aspect and accident frequency seems to lack an explanatory mechanism, and needs further investigation.

Once again, it must be stressed that the observed effects are not linear.

7.3.2 Accident types on links

All accidents at private accesses and public road junctions were excluded from this part of the analysis. A reminder of the predominant accident types found on the links can be found in Table 7.4.

Table 7.4 Accident types on the inter-junction links

	Accident Type	No. of Accidents
1	Stacking	143
2	Overtaking	109
3	Lost control	209
4	Crossed centre line	43
5	Other	20
	All Accidents	**524**

Logistic regression statistical models were used to analyse the data in a similar way to the junction analysis. The following factors were found to be significant:

1. The presence of an **offside hedge** (compared to no hedge) is associated with an increase (by a factor of two) in the odds of a stacking accident, as is normal or closed offside aspect (compared to open). Hedges and aspect are correlated. **Nearside hedge** and **aspect** variables can be included in the model with similar results.
2. Roads operating at **above design capacity** (compared to under capacity) are associated with a reduction in the odds (x 0.5) of loss of control type accidents.
3. Accidents occurring **within 200 metres of a public road junction or major private access** are connected with an increase in the odds of accidents involving stacking (x 2.2), and a reduction in the odds of accidents involving overtaking (x 0.6) or crossed centre line (x 0.4).
4. **Bends** are associated with a reduction in the odds of stacking and overtaking accidents, and an increase in the odds of a loss of control or crossed centre line type accident. In all cases the effect is greatest for bends of less than 510 metres radius (the tightest ones). For a tight bend, the odds of a stacking or overtaking accident are only about 0.3 times those of a straight length of road, but the odds of a loss of control accident are 4.8 times as great, and the odds of an accident involving crossed centre line are 2.6 times as great.
5. Intuitively, **chevrons** and **marker posts** might be expected to reduce the odds of loss of control type accidents on bends. However, on the roads considered, all of the chevrons and most of the marker posts, perhaps not surprisingly, were on the tightest bends. Within the tightest bend category, the proportion of loss of control accidents is actually greater when chevrons are present (but not significantly so). However, this is misleading because it is likely that chevrons are concentrated at tighter bends within this category. The influence of chevrons would then be confounded with the effect of bend radius.
6. As **forward visibility reduces**, so do the odds of an overtaking type accident, but there is an increase in the odds of a crossed centre line type accident. For roads with poor

visibility, the odds of an overtaking accident are only 0.18 times those of a road with good forward visibility, while the odds of a crossed centre line accident are 3.2 times as large.

7.4 Accident severity on the links between junctions and at junctions

Table 7.5 below records the accidents at public road junctions and links considered in Sections 7.2 and 7.3.2.

Table 7.5 Accidents at public road junctions and on the links – by severity

	Fatal	Serious	Slight	Total
Junctions	5 (3%)	48 (28%)	119 (69%)	172
Links	52 (10%)	144 (27%)	328 (63%)	524

The distribution of accident severity is significantly different on the links compared to junctions. 10 per cent of the link accidents were fatal compared to 3 per cent at junctions.

Table 7.6 Accident types on the links – by severity

	Fatal	Other	Total	% Fatal
Stacking	2	141	143	1.4%
Overtaking	12	97	109	11.0%
Lost control	19	190	209	9.1%
Crossed centre line	19	24	43	44.2%
Other	0	20	20	0
Total	**52**	**472**	**524**	**9.9%**

The distribution of severity among link accidents is presented in Table 7.6 by accident type.

96 per cent of the fatal accidents (50 out of 52) involved overtaking, loss of control or crossing the centre line. The highest fatality rate (the percentage of accidents which were fatal) is found in the 'crossed centre line' group of accidents (44 per cent).

Logistic regression models were used to analyse the effects of environmental variables on severity. The effects on KSI (fatal plus serious) and fatal accidents were considered separately – both for junctions and for links.

No factors were found to have a significant effect on accident severity at public road junctions. This does not necessarily mean that all the factors have no effect. It might be that a small effect could not be detected with the sample size under consideration.

The following factors were found to have a significant association with KSI accidents on links:

1. The presence of a bend with radius less than 510 metres (compared to other bends or no bend) is associated with a reduction of 40 per cent in the odds of a KSI accident.
2. Being within 20 to 200 metres of a public road junction or major private access is connected with a reduction of 43 per cent in the odds of a KSI accident.

Being within 20 to 200 metres of a public road junction is also associated with a reduction of 51 per cent in the odds of a fatal accident.

7.5 Summary

The main findings of this chapter are summarised below:

Road environment

- No two routes share similar road environment characteristics.
- The skidding accident rate on wet roads (the percentage of wet road accidents involving skidding) was highest on roads having a poor level of skidding resistance.

Public road junctions

- Accident frequencies at the T-junctions examined are influenced by major road traffic, minor road traffic and carriageway width. Only an increase in carriageway width is associated with a reduction in accident numbers.
- Right turn facilities are synonymous with wide carriageways, but their effect on the odds of accident types occurring is not always positive. While they are associated with a decrease in the odds of stacking or overtaking type accidents at a junction, they are also associated with an increase in the odds of a right turn accident occurring where a vehicle enters the main road and is struck on its offside.
- The odds of an overtaking type accident occurring increase as forward visibility increases.

Links between junctions

- Accident frequencies on the inter-junction links increase as major traffic flow, bendiness and the number of lay-bys increase.
- Accident frequencies reduce as the proportions of double centre line markings and carriageway width increase.
- Fair forward visibility is associated with fewer accidents than either poor or good forward visibility.
- Roads operating at above design capacity are associated with a decrease in the odds of a loss of control type accident.
- The odds of a stacking accident are increased within 200 metres of a public junction or business type private access, but these locations are associated with reduced odds for an overtaking or crossed centre line type accident.
- The odds of an overtaking type accident increase as forward visibility increases, but the odds decrease in the presence of a bend.
- Bends are associated with an increase in the odds of a loss of control type accident. Bends with radii less than 510 metres are associated with a 40 per cent reduction in the odds of a KSI accident.
- A significantly greater proportion of accidents on the links were fatal compared to public road junctions: these largely occurred when overtaking, loss of control or crossing centre line was involved.

Chapter 8 What are the main conclusions?

This study examined traffic accidents on six 'A' class single carriageway rural roads (speed limits greater than 40 miles/h) in Cambridgeshire. Routes were selected on the basis of the ratio of the Average Annual Daily Traffic Flow relative to the current design capacity for single carriageway roads (13,000 vehicles), and their location relative to the dichotomous physical geography of Cambridgeshire. The A10(T) and A428(T) operate at above capacity; the A505 and A47(T) between half capacity and capacity, and the A141 and A605 at below half capacity.

8.1 Main findings

8.1.1 General characteristics

Traffic flows and volumes
The incidence of traffic accidents on rural single carriageway routes is not a simple function of traffic volume. It does not follow that roads which experience the highest traffic volumes have the highest accident rates. The A47 route which operates at between half capacity and capacity has a higher accident rate per kilometre (1.9) than the A428 (1.5) and A10 (1.8) routes which are operating at above capacity.

In addition to variation between routes, no simple association exists between the distribution of accidents and traffic flow levels on individual routes when the data are examined on an annual, monthly, daily and hourly basis. It is clear that other factors must exert an influence on the occurrence of accidents.

Accident location
The proportional distribution of accidents between public road junctions, private accesses and the inter-junction links varies between routes. For the A47 and A428, more than 70 per cent of accidents occurred away from public road junctions and private accesses – this contrasts with 58 per cent for the A10. 32 per cent of accidents on the A605 route were at public road junctions, while 20 per cent of accidents on the A505 occurred at private accesses.

Differences between routes, in terms of the proportion of accidents that occurred at public road junctions, are not fully explained by differences in junction frequency, though there is some indication of higher average annual accident rates per junction towards the busier routes. The average annual accident rate per junction on the A428 was 0.8 compared to just 0.3 for the A141.

Accidents at private accesses were more prevalent at those locations which generate more traffic movement. In an examination of private access accidents by access type, 'business' accesses (which include garden nurseries, petrol service areas, roadside eating establishments, tourism spots and Sunday market locations) emerged with the worst average annual accident rates. For the A505, the average annual accident rate per 'business' type access (0.3) was equivalent to the rate for public road junctions on the A141.

Accident cost
At 1994 prices, accidents on the 84.4 km of 'A' class single carriageway road being studied cost society an average of £12.8 million annually or £0.15 million per kilometre of carriageway. Accident costs per kilometre were as high as £0.21 million per annum for the A428 and A47.

8.1.2 Accident types, drivers and vehicles involved

Accidents and vehicles
Just over a quarter of accidents involved only one vehicle. Cars represented three quarters of vehicles involved in these accidents, followed by motor cycles (10 per cent).

Accidents on Rural Roads: Single Carriageway 'A' Class Roads

Accidents involving two vehicles accounted for nearly half the accidents examined. Conflict between two cars accounted for over half the accidents, with car-heavy goods vehicle conflicts representing a further 15 per cent. In accidents involving more than two vehicles, conflicts exclusively between cars accounted for the majority of accidents.

On the basis of their prevalence in accidents, it is not surprising that cars represented three quarters of all vehicle types involved. Heavy goods vehicles have the next highest involvement (11 per cent), but this is smaller than the proportion of traffic accounted for by this vehicle group.

Drivers

Of all drivers, 79 per cent were male. Female drivers only really featured among drivers of cars (27 per cent). Considering the age distribution of drivers by gender, there were proportionally more younger females and fewer older females compared to male drivers. This may be a reflection of differences in the age of the two driving populations.

A significant association was found between driver age and the type of vehicle being driven. The motor cycle rider sample examined was generally younger than the car driver sample, which in turn was generally younger than the heavy goods vehicle driver sample examined. These differences in age distribution by vehicle type were similar for the T-junction, private access and inter-junction link locations.

A significant association was also found between car driver age and manoeuvre which was independent of gender. Turning right manoeuvres were found to be riskier for drivers aged 60 or over. 22 per cent of car drivers aged 60 or over were turning right at the time of their accident compared to 8 per cent for other age groups.

Motor cycle riders and heavy goods vehicle drivers appeared to encounter most of their problems on the major road and not as they were attempting to enter or leave it. Only heavy goods vehicle drivers aged between 17 and 29 experienced a problem with turning manoeuvres – a factor which may come down to inexperience. Over 31 per cent of all motor cycles were overtaking when they were involved in an accident.

Accident types

Accident types varied according to the number of vehicles involved in the accident. A general pattern which emerged was that accidents involving one vehicle were predominantly loss of control type accidents (80 per cent); accidents involving two vehicles were mainly distributed between turning type accidents (33 per cent), overtaking accidents (27 per cent) and stacking accidents (23 per cent) while accidents involving three or more vehicles were predominantly stacking type accidents (more than 58 per cent). 40 per cent of all heavy goods vehicle accidents involved stacking.

8.1.3 Links, junctions and accesses

T-junctions and private accesses

Few accidents occurring at T-junctions and private accesses were single vehicle accidents. Just over two thirds of accidents at these locations involved two vehicles. Of these, more than half consisted of turning accidents, of which the most prevalent accident type was that where a vehicle was turning right out of the minor road and being struck on the offside. In accidents involving three or more vehicles, stacking type accidents predominated.

Cars represented more than three quarters of the vehicles involved in accidents at T-junctions and private accesses, and had a high representation in all accident types.

A further characteristic of both accident location groups was the high proportion of accidents which involved skidding on a dry road surface. This suggests that vehicle speed may have been a factor in these accidents.

What are the main conclusions?

Links between junctions

Over a third of accidents on the links involved just one vehicle. Most involved a car and loss of control. Though two vehicle accidents were fewer than seen at junctions and private accesses, more of these accidents on the links were of the overtaking, stacking and crossed centre line type. As seen for junctions and accesses, stacking accidents predominated among accidents involving three or more vehicles.

While cars were once again the predominant vehicle type involved in accidents on the links, it is noticeable that heavy goods vehicles had a higher overall involvement compared to that seen for T-junctions.

The skidding characteristics of link accidents were different to those seen at T-junctions and private accesses. The proportion of accidents on a wet road surface in which at least one vehicle skidded was similar to that at T-junctions (48 per cent), but it is noticeable that the proportion of dry skid accidents was much smaller (26 per cent).

8.1.4 What the drivers said

Driver experience

Most of the individuals (both male and female) involved in the 1993-1994 accidents examined were experienced drivers who were familiar with driving on rural roads. Two thirds of drivers used the road on which they had their accident more than once a month.

In general, male car drivers travelled greater distances when they drove compared to female car drivers. The average trip length of heavy goods vehicle drivers was in excess of 100 miles. The journeys of drivers aged 60 or over were commonly shorter than those of other age groups. They also drove less at night. Female drivers rated driving at night as more difficult than male drivers. Female drivers also had a tendency to do more of their driving in the rush hour period than male drivers.

Driver perception and accident involvement

When asked to rate various driving tasks, those which take place in the dark were rated as more difficult than driving tasks taking place in daylight. Turning right was considered the most difficult of all the turning tasks presented. This pattern was the same for all drivers, though female drivers rated all the tasks as harder than male drivers. For the majority of tasks, there was no significant difference in rating between age groups.

In an examination of the turning right and overtaking manoeuvres, no significant difference emerged between how they were rated by different driver/rider age groups, even though a significant difference was apparent between the relative involvement of different driver age groups in these manoeuvres. It emerged that 17-29 year old drivers overtaking and drivers aged 60 or over turning right were not recognising that they had a problem with these particular manoeuvres.

The accident

Only half of the drivers responded that the journey in which they had their accident was related to work. The remainder of journeys were social/domestic trips.

At the time of their accident, most drivers indicated that they were relaxed, happy or contented – few drivers were showing the symptoms of 'road rage'. Most (74 per cent) considered that their driving did not contribute to the accident, but they were more readily prepared to find fault with the driving of other drivers in the accident. Few external road environment factors were cited. Of those highlighted, 31 per cent thought that slow moving vehicles, unexpected traffic queues or heavy traffic may have been a factor, and 20 per cent cited the fact that it was raining as a factor.

8.1.5 Accidents and the road environment

T- junctions

Statistical models showed that accident frequencies at the T-junctions examined are influenced by major road traffic, minor road traffic and carriageway width. Only an increase in carriageway width is associated with a reduction in accident numbers. Other factors are associated with particular types of accident but do not have a significant overall effect on the number of accidents at a junction.

Right turn facilities are synonymous with wide carriageways. While they are associated with a decrease in the odds of a stacking or overtaking type accident at a junction, they are also associated with an increase in the odds of a right turn accident occurring where a vehicle enters the main road and is struck on its offside. The odds of an overtaking type accident increase as forward visibility increases.

Links between junctions

Accident frequencies on the links between junctions increase as traffic flow on the major road, bendiness, and lay-by numbers increase. Accident frequencies reduce as carriageway width and the proportion of double centre line markings increase. Fair forward visibility (sight distance between 215 metres and 580 metres) is associated with fewer accidents than either poor or good forward visibility.

The odds of a loss of control type accident increases for roads operating below design capacity and in the presence of a bend. The area within 200 metres of a public junction or business type private access is associated with an increase in the odds of a stacking type accident, but with a reduction in the odds of accidents involving overtaking or crossing the centre line. The odds of an overtaking type accident once again increase as forward visibility increases, but the odds decrease with the presence of a bend.

8.2 Discussion

Common myths associated with driving on rural roads were not substantiated by this piece of research. While queuing was considered a factor in some of the accidents on the busier routes examined, few of the drivers stated that a tractor or other slow moving agricultural vehicle was the cause of the hold-up. The involvement of foreign drivers was minimal (less than 2 per cent). Little distinction was found between age groups in the proportion of time spend driving at weekends. On average, the older driver was exposed to as much weekday driving as other drivers. Few were truly 'weekend' drivers.

8.2.1 Drivers

Several disconcerting facts have emerged from this study about the driving acumen of drivers involved in accidents on rural roads.

The accident problem is pervasive among the drivers of all age groups but is greatest among young drivers and males, with 17–29 year old male drivers having the greatest involvement.

Secondly, the disparity which exists between what drivers perceive as an easy or difficult task when compared to their actual involvement indicates that drivers in specific age groups are failing to recognise that they have a problem with certain driving tasks, especially turning right and overtaking. This is an important observation, and one which needs addressing urgently, as success in tackling any driving-related problems will only be achieved once a driver recognises his or her driving deficiency.

Thirdly, it is worrying that so many of the drivers were familiar with driving on the road on which they had their accident. Furthermore, with most drivers stating that they were relaxed, contented or happy when their accident occurred, these are all signs that the drivers were not alert, and were failing to 'read' the road environment. Few indicated that they were driving defensively in anticipation of an accident. Most were unaware of a problem until they were involved in the accident.

Taking the example of stacking accidents, these could largely be avoided if drivers stayed alert, and maintained an adequate distance from the vehicle in front instead of simply following. The failure to keep the two second gap distance has long been recognised as a factor in accidents, but previously it has been more associated with accidents on motorways and dual carriageways. Tackling the stacking accident problem should be a priority for the authorities as these accidents are numerous and invariably involve more than two vehicles. More often than not, they result in only slight injury.

One point of encouragement is that the symptoms of road rage were cited by only a minority of drivers in the accidents.

8.2.2 Road environment and engineering issues

T and staggered junctions, and private accesses

It has been recognised previously that the presence of a right turn facility (ghost island) has a beneficial effect on reducing the number of stacking type accidents in the approach lane remote from the minor road (Pickering *et al.* 1986). This study has shown that the odds of stacking type accidents, and accidents where an overtaking vehicle collides with the vehicle turning right while leaving the main road, are reduced when a right turn facility is present. For stacking type accidents, the benefit of a right turn facility lies with the extra width of road and the fact that the turning vehicle is taken out of the main stream of traffic into the turning lane. The effect of a right turn facility in reducing the number of vehicles turning right to leave the major road being struck on the offside by an overtaking vehicle is not as easily explained, but it may be that drivers are mistaking the ghost island road markings as prohibiting overtaking.

What has not been previously recognised is the fact that right turn facilities are associated with an increase in the odds of an accident involving a vehicle turning right while entering the major road coming into conflict with a vehicle approaching on the off-side. This accident problem may have several explanations. One is that drivers emerging from the minor road are being struck on the offside when sitting in the right turn facility while waiting for an adequate gap in traffic in the lane remote from the junction. The second reason may be that the extra carriageway width taken up by the turning lane of the right turn facility is acting like the second lane of a dual carriageway. Traffic in the remote lane is that much further away from, and may not be easily seen by, traffic in the minor road, and may be compounding the misjudgement of speed and distance of other vehicles. The statistical model used in this study demonstrated the benefit of the extra carriageway width on the major road at T-junctions, therefore the road markings may be the source of the problem. One possible, though untested, remedy could be to change the road markings from full right turn facility markings to a sub-standard one metre right turn facility while retaining the extra width. The new road markings might again reduce the amount of overtaking on the major road while simplifying the options and decisions required to be made by drivers turning right into the major road.

Accidents at private accesses were another source of concern to emerge from this study – especially those private accesses forming the entrances to business-type premises associated with heavy turning movements. Though the characteristics of the accidents are similar to those seen at public road junctions, and the accident rates are sometimes comparable, the highway authority has few powers to treat problem accesses. Firstly, the onus on maintaining the private access is on the owner of the access and not on the highway authority. Secondly, few special provisions are ever made for these junctions; the majority are unsigned and many are inadequate for the vehicle mix which use them.

Links between junctions

That stacking accidents occur on the links, and that they are most prevalent close to T-junctions and business type private accesses, is an indication that the latter locations are having an affect on accidents outside the 20 metre distance which defines a junction. That these accidents are most prevalent on the busier roads indicates that public road junctions and business type private accesses are interrupting free traffic flow on the major road. Few business type private accesses have right turn facilities to take turning traffic out of the main stream of traffic on the major road. A clear message from this piece of work is that roads need to be designed and existing roads modified to minimise the instances of queuing or flow breakdown.

While this study found that a one metre increase in carriageway width is connected with a 19 per cent decrease in accidents, in practice it is likely that widening of the carriageway would have the greatest effect at those locations likely to derive greatest benefit from them. An example already mentioned is selective widening at the entrances to busy private accesses.

Similarly, while it was found that a one per cent increase of road length with a continuous double white line or one metre centre-hatching is connected with a 1.2 per cent decrease in accidents, it is unlikely that the blanket laying of these markings would have the desired effect on accident numbers. In practice, it is likely that these markings have been installed at the locations likely to derive greatest benefit from them. Any further laying of these markings should only proceed after careful consideration of the qualifying circumstances.

One association found to be in apparent conflict with current design standards was that of forward visibility. In the design standard, one criteria in the design of a single carriageway road is that there should be sufficient visibility for overtaking on as much of the route as possible. The model used in this study revealed that a length of road with either poor (less than 215 metres sight distance) or good (more than 580 metres sight distance) forward visibility over most of its length is associated with an accident frequency about 1.5 times as high as a link with mostly fair forward visibility (between 215 metres and 580 metres sight distance). The benefit of good forward visibility may need to be re-examined in view of this finding.

Lay-bys give rise to accident types which are similar to those seen at private junctions and accesses. The most common accident types are stacking type accidents in the lane remote from the lay-by entrance. Like junctions and private accesses without right turning facilities, vehicles waiting to turn into the lay-by can cause flow breakdown. While a reduction in lay-by numbers would be expected to reduce accident numbers (as shown by the model), another way would be to prohibit those manoeuvres which give rise to the accident. Solutions already in practise are banning right turning into the lay-bys and restricting drivers to use lay-bys on their side of the carriageway only.

Maintenance

One feature of the road environment which has not been considered, but is of utmost importance, is road maintenance. The importance of proper maintenance is highlighted by the fact that the proportion of accidents involving skidding on a wet road surface is higher on a deficient road surface compared to one with a higher skidding resistance. In addition to these concerns about the wearing course material, it is important that road markings and road signs are maintained in good condition.

Prediction models

The statistical models developed in this study should provide valuable input into prediction models which need to be developed for the links between junctions. Such models already exist for T-junctions, but these need to be modified to allow for the additional environmental variables used in this study.

What are the main conclusions?

One shortcoming of this piece of research was the unavailability of any speed measurements. Another was our inability to find an explanatory mechanism for the association found between aspect and accident frequency. It may be that the observed association is spurious and is a reflection of the subjective way in which this variable was measured. On the other hand, this parameter may be correlated with, and therefore measuring an unobserved variable. Further research is required to resolve this matter. Both these issues have been recognised and are included in the ongoing study of dual carriageways.

8.3 Implications for action

This piece of research has many implications for driver education, road safety and the way in which single carriageway rural roads are designed and engineered. Each is highlighted in turn:

8.3.1 Driver education

Driver education needs to be targeted at all drivers, particularly young males. Several needs were identified in the study.

Firstly, drivers need to be made aware of their exposure to risk so that they can make an informed judgement about their own driving. As stated in the discussion, getting a driver to recognise a driving deficiency is a problem which must be addressed if any educational campaign is to be of benefit.

The second of the identified needs was to sustain the awareness of drivers/riders while driving. This could partly be addressed by making drivers aware of the more common accident types which occur on single carriageway roads so that they can be on the look-out for the tell-tale road environment circumstances which give rise to accidents.

8.3.2 Environment and engineering issues

A clear message to emerge from this study is that new single carriageway rural roads need to be designed, and the existing roads modified, to minimise flow breakdown. It is clear from the busier roads that flow breakdown is resulting in many accidents. One way of minimising flow breakdown would be to widen the carriageway at those locations where flow breakdown occurs.

The standard relating to junctions and its applications also needs to be re-examined in light of the findings on right turn facilities.

The Highways Act contains no explicit powers or requirements for improvements to private accesses. The situation for private accesses needs to be reviewed so that they receive the same attention as public road junctions.

Greater accident benefits would be derived from a whole route approach to any carriageway modification rather than piecemeal junction modification. Individual junctions would probably not all qualify for modification based on accident savings at the junction alone, even though the presence of a junction on a busy route could be giving rise to accidents elsewhere. Consideration should be given to treating or modifying all routes.

Taking the example of the A47, if the average cost of installing a right turn facility is around £50,000, the cost of modifying the 19 public road/business private accesses would be about £1 million. This is the most expensive option.

The findings of this report also have relevance to the application of remedial measures arising from accident investigation on existing roads, and provide new perspectives which should be taken into account in safety audit of new highway schemes.

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Chapter 10 Acknowledgements

The authors are grateful to the AA Foundation for Road Safety Research for their support of this research programme, and to the Transportation Department of Cambridgeshire County Council for permission to present the data contained herein.

The authors are indebted to Barbara Sabey, Technical Advisor to the AA Foundation, and Andrew Walford from the Transportation Department of Cambridgeshire County Council who have been sources of constant advice, ideas and encouragement at all times. Brian Langer, Manager of the AA Foundation for Road Safety Research, is also acknowledged for ensuring the smooth administration of the project and for his many helpful comments which have improved the structure of the final report.

We would like to thank Joan Franklin and Helen Simpson from the Safety and Environment Section of the Transport Research Laboratory for their assistance in devising and administering the driver questionnaire; Superintendent Butters, Inspector Ansell and Ian Crossan of Cambridgeshire Constabulary for allowing access to their confidential driver records, and finally we would like to thank all those respondents who took the time and effort to complete the lengthy questionnaire.

Many of our colleagues in the Traffic Section of Cambridgeshire County Council's Transportation department have made valuable contributions to this piece of research. We would like to acknowledge the following individuals: Judith Banks, John Barnes, Sue Clarkson, Chris Creed, Peter Doggett, Ann Hutchison, Karen Martin, Bob Menzies and Wendy Menzies, Ken Parkin and Sue Parkin, Jenny Sangster, Kevin Seymour and Eileen Woods. The staff of WS Atkins (East Anglia) Ltd are also thanked for supplying traffic monitoring and highway maintenance information.

Last but not least, we would like to thank our wives, Lisa Hughes and Susan Amis, for their support and understanding, and for tolerating those many working weekends.

Appendix A Road environment parameters

Additional Information collected for all junctions

The following information was collected at all junctions but not all these variables were used in the analyses of Chapter 7:

Feature	
Ghost island	
Solid island	**
Street lighting	
Merging lanes	
Diverging lanes	
Separate merging lane	
Separate diverging lane	
Marker posts/bollards	
Bend within 100 metres of junction	
Junction control	
Advanced warning and regulation signs	**
Warning and regulation signs at junction	**
Advanced directional signs	**
Directional signs at junction	**
Tourism or advisory signs	**

Measurements	
Advance sight of junction	*
Aspect	i
Bend angle	
Bend length between transition points	
Bend radius	
Carriageway width	
Centre line markings	i
Edge of carriageway markings	**
Forward visibility	i
Ghost island length	
Ghost island width	
Give way width	
Hedges and trees	i
Kerb	i
Length of diverging lane	
Length of merging lane	
Length of separate diverging lane	
Length of separate merging lane	
Length of turning lane	
Set-back distance of solid island from major road	
Sideways visibility @ 2m (L and R separately)	*
Sideways visibility @ 4.5m (L and R separately)	*
Sideways visibility @ 9m (L and R) separately	*
Solid island length	**
Solid island width	**
Verge width	i

Most of the above features and measurements are self explanatory, but some require further explanation.

Junction length was taken as width of junction plus any contribution from merging and diverging lanes. Junction length is **not** the ghost or solid island length.

The turning lane is the un-hatched portion of a ghost island which stacks vehicles prior to the turning manoeuvre.

For simple junctions with no merging and diverging lanes, or for junctions with separate merging and diverging lanes, the width of the leaving lane is measured along with the width of the give way portion of the junction.

Features marked with an (i) were recorded at more than one location at a junction as outlined in Figure VII.10. Features marked with an asterisk (*) were recorded for the minor road arm of the junction only, whereas features marked with a double asterisk (**) were recorded for all arms of the junction (both major and minor road).

Appendix B Rural road accident survey – responses

Please answer all questions in this questionnaire by either ticking the appropriate box(es) or writing in the required detail. Any information that you give will of course be treated in the strictest confidence.

% may not equal 100 due to rounding

Section 1: Your accident

Q1 On the day of your accident, where were you travelling from and where was your intended destination?

From ______________________________ (Town/City)

To ______________________________ (Town/City)

Q2 On average, how often did you travel along the road on which you had your accident?
Tick One Box

	%	
Daily or nearly every day	69	33.2
Once a week	39	18.8
Once a month	31	14.9
Less than once a month	53	25.4
Never before	16	7.7
Valid cases – 208		

Q3 Up to the moment of the accident, had you driven continuously since the time you started the journey?
Tick One Box

		%
No	52	25.0
Yes	156	75.0
Valid cases – 208		

If No, go to Question 4
If Yes, go to Question 5

Q4 How long was it since you last stopped for a break?
Tick One Box

		%
Less than half an hour	25	52.1
Between half an hour and 1 hour	12	25.0
1–2 hours	7	14.6
2–4 hours	3	6.3
4–8 hours	0	0
Over 8 hours	1	2.1
Valid cases – 48		

Q5 What was the main purpose of your journey?
Tick One Box

		%
Travelling to/from place of work/study	45	21.6
Business or as part of your job	47	22.6
Visiting friends	34	16.3
Travelling or going on holiday	10	4.8
Shopping	16	7.7
School trip	2	1.0
Other social/domestic reason	31	14.9
Other reason	24	11.1
Valid cases – 208		

Q6 Who accompanied you on the journey?
Tick All That Apply

		%
Nobody	118	57.5
Parent(s)	6	2.9
Child/children	16	7.8
Other members of your family	41	20.0
Friend(s)	20	9.8
Work colleague(s)	8	3.9
Hitchhiker(s)	0	0
Family pet(s)	6	2.9
Someone else	6	2.9
Valid cases – 205		
Categories not mutually exclusive		

Q7 What type of vehicle were you driving/riding when the accident happened?
Tick One Box

		%
Motorcycle, moped or motor scooter	7	3.8
Car	163	79.9
Light goods vehicle	14	6.7
Heavy goods vehicle	17	8.1
Bus or minibus	2	1.0
Other type of vehicle	1	0.5
Valid cases – 204		

If you were a MOTORCYCLIST, go to Question 8. Otherwise go to Question 9

Q8 Were you wearing any clothing which would help other road users see you?
Tick One Box

		%
No	6	85.7
Yes	1	14.3
Valid cases – 7		

Q9 What was the make, model and engine size of the vehicle?

Make (eg Ford) ______________________________

Model (eg Escort) ______________________________

Engine size ______________________________ cc

Engine Size		%
<499 cc	3	1.6
500–999 cc	7	4.2
1000–1499 cc	49	26.6
1500–1999 cc	74	38.5
2000–2499 cc	26	14.1
2500–2999 cc	9	4.7
>3000 cc	19	10.4
Valid cases – 187		

Q10 Is this the vehicle you normally drove?
Tick One Box

		%
Yes	187	93.0
No	14	7.0
Correctly completed – 201		

Q11 How often had you driven this vehicle?
Tick One Box

		%
Daily or nearly every day	184	90.2
Once a week	15	7.3
Once a month	2	1.0
Less than once a month	1	0.5
Never before	2	1.0
Valid cases – 204		

Q12 Please describe briefly how the accident happened?

____

____

____

Q13 When the accident happened, were you:
Tick One Box

		%
Stationary (parked)	3	1.5
Stationary (waiting to go ahead)	28	13.9
Going ahead round left hand bend	9	4.5
Going ahead round right hand bend	12	5.9
Going straight ahead	96	47.5
Turning left or waiting to turn left	4	2.0
Turning right or waiting to turn right	24	11.9
U-turning	0	0
Overtaking	19	9.4
Other	7	3.4
Valid cases – 202		

If you were TURNING LEFT or RIGHT AT A JUNCTION (not held up and waiting to turn), go to Question 14

If you were OVERTAKING, go to Question 15

Otherwise, go to Question 16

Q14 What type of vehicle did you turn in front of?
Tick One Box

		%
None	6	30.0
Pedal cycle	0	0
Motorcycle, moped or motor scooter	1	5.0
Car	11	55.0
Light goods vehicle	1	5.0
Heavy goods vehicle	0	0
Bus or minibus	0	0
Other type of vehicle	1	5.0
Valid cases – 20		

Please go to Question 16

Q15 What type of vehicle were you passing?
Tick One Box

		%
Pedal cycle	0	0
Motorcycle, moped or motor scooter	1	4.5
Car	12	54.5
Light goods vehicle	2	9.1
Heavy goods vehicle	4	18.2
Bus or minibus	0	0
Other type of vehicle	3	13.6
Valid cases – 22		

Q16 When the accident happened, how fast were you travelling?
Tick One Box

		%
Not moving	43	21.4
Up to 30 mph	46	22.9
31–40 mph	39	19.4
41–50 mph	35	17.4
51–60 mph	31	15.4
61–70 mph	6	3.0
Over 70 mph	1	0.5
Valid cases – 201		

Q17 When the accident happened, were your vehicle's lights on?
Tick One Box

		%
Yes	95	47.7
No	104	52.3
Valid cases – 199		

If YES, go to Question 18

If NO, go to Question 19

Q18 Which vehicle lights were on?
Tick All That Apply

		%
Side lights	14	15.1
Dipped headlights	71	76.3
Main beam headlights	3	3.2
Fog lights	5	5.4
Valid cases – 93		

Q19 Were you giving other road users any signal at the time of the accident?
Tick One Box

		%
Yes	72	36.2
No	127	63.8
Valid cases – 199		

If YES, go to Question 20

If NO, go to Question 21

Q20 What signal(s) were you giving?
Tick All That Apply

		%
Indicating right	44	21.2
Indicating left	3	1.4
Brake lights	29	13.9
Flashing headlights	0	0
Hazard warning lights	0	0
Other signal	0	0
Please specify:		
Valid cases – 72		

Q21 Do you normally wear glasses or contact lenses for driving?
Tick One Box

		%
Yes	68	33.7
No	134	66.3
Valid cases – 202		

If YES, go to Question 22

If NO, go to Question 23

Q22 Were you wearing glasses or contact lenses when the accident occurred?
Tick One Box

		%
Yes	67	100.0
No	0	0
Valid cases – 67		

Q23 Were you taking any medicine for treatment of a medical condition?
Tick One Box

		%
Yes	13	6.3
No	192	93.7

Valid cases – 205

If YES, go to Question 24

If NO, go to Question 25

Q24 What medicine(s) were you taking?
Tick All That Apply

		%
Antibiotics	0	0
Tranquillisers	0	0
Anti-depressants	0	0
Anti-histamine	2	16.7
Other	10	83.3

Valid cases – 12
Categories are not mutually exclusive

Q25 What were your feelings just before the accident happened?
Tick All That Apply

		%
Depressed/sad	2	0.9
Angry/annoyed	4	1.9
Frustrated	4	1.9
Tired/fatigued	10	4.9
Happy	57	27.8
Contented	101	49.3
Relaxed	102	49.7
Bored	5	2.4
In a hurry	8	3.9
Distracted by thoughts/problems on your mind	5	2.4
Distracted by something inside the vehicle	1	0.5
Distracted by something outside the vehicle	6	2.9

Valid cases – 205
Categories are not mutually exclusive

In the following questions, we want your opinion of the factors which you think played a part in the accident.

Q26 Which of the following applied to **you** just before the accident occurred?
Tick All That Apply

		%
Driving too fast for the conditions	3	1.5
Driving too close to vehicle in front	8	3.9
Misjudging speed or distance of other road users/objects	21	10.3
Improper overtaking	5	2.5
Failing to give way at a junction	4	2.0
Other	16	7.9
None of these	151	74.4

Valid cases – 203
Categories are not mutually exclusive

Q27 Which of the following applied to **your vehicle** just before the accident occurred?
Tick All That Applied

		%
Poorly secured load	0	0
Defective vehicle brakes	1	0.5
Defective vehicle light(s)	1	0.5
Defective vehicle tyre(s)	2	1.0
Other vehicle defect	4	2.0
None of these	194	96.0

Valid cases – 202
Categories are not mutually exclusive

Q28 Were any other vehicles involved in the accident?
Tick One Box

		%
Yes	174	85.3
No	30	14.7

Valid cases – 204

If YES, go to Question 29

If NO, go to Question 30

Q29 In your opinion, which of the following statements applied to the **other driver(s)/rider(s)** involved in the accident?
Tick All That Apply

		%
Driving too fast for the conditions	50	27.9
Driving too close to the vehicle in front	41	22.9
Misjudging speed or distance of other road users or objects	65	36.3
Improper overtaking	34	19.0
Failing to give way at a junction	14	7.8
Other	46	25.7
None of these	27	15.1

Valid cases – 179
Categories are not mutually exclusive

Q30 Was there anything about the **road layout** which may have been a factor in the accident?
Tick All That Apply

		%
Lack of right turn facility	15	7.4
Lack of overtaking opportunities	15	7.4
Confusing signs or road markings	5	2.5
Missing signs or road markings	4	2.5
Unsigned entrances/concealed entrances	18	8.8
Confusing road layout at junctions	6	2.9
Misleading appearance of road ahead	15	7.4
None of these	147	72.1

Valid cases – 204
Categories are not mutually exclusive

Q31 Was there anything about the **road itself** which could have been a factor in the accident?
Tick All That Apply

		%
Raised kerb	1	0.5
Soft verge	3	1.5
Crumbling road verge	4	2.0
Poorly defined road edges	5	2.5
Excessive surface water	11	5.4
Poor drainage	9	4.4
Mud on the road	8	3.9
Potholes	1	0.5
Poor road camber	6	2.9
None of these	178	87.3

Valid cases – 204
Categories are not mutually exclusive

Q32 Was there anything about the road **that restricted visibility** which could have been a factor in the accident?
Tick All That Apply

		%
Restricted sight distance at junction	3	1.5
Restricted visibility due to vegetation	4	2.0
Restricted visibility due to road signs	1	0.5
Restricted visibility due to something else	17	8.5
Please specify:		
Poor street lighting	10	5.0
Poorly signed/lit road works	3	1.5
None of these	169	84.5

Valid cases – 200
Categories are not mutually exclusive

Q33 Was there anything about the **weather** that could have been a factor in the accident?
Tick All That Apply

		%
Rain	41	20.1
Ice/snow	13	6.4
Fog	7	3.5
High winds	3	1.5
Glare from the sun	7	3.5
None of these	137	67.2

Valid cases – 204
Categories are not mutually exclusive

Q34 Was there anything about the **amount or nature of the traffic** that could have been a factor in the accident?
Tick All That Apply

		%
Slow moving pedal cycle	2	1.0
Slow moving moped/motor scooter	0	0
Slow moving heavy goods vehicle	7	3.4
Slow moving bus	1	0.5
Slow moving farm vehicle	3	1.5
Other slow moving vehicle	5	2.5
Heavy traffic	30	14.8
Restricted visibility due to other vehicle	15	7.4
Unexpected slow moving traffic or queue(s)	31	15.3
Light/no traffic	15	7.4
None of these	115	56.7

Valid cases – 203
Categories are not mutually exclusive

Q35 What else was a factor in the accident?
Tick All That Apply

		%
Vehicle fault	9	4.5
Unavoidable event(s)	29	14.3
Something else about the road Please specify:	19	9.4
Something else Please specify:	66	32.5
Nothing else	94	46.3

Valid cases – 201
Categories are not mutually exclusive

Section 2: Driving habits/history

In this section we are interested in your driving habits at the time of the accident.

Q36 At the time of the accident, did you hold a full or provisional driving/motorcycle licence?
Tick One Box

		%
Full	204	99.5
Provisional	1	0.5

Valid cases – 205

If FULL, go to Question 37

If PROVISIONAL, go to Question 39

Q37 How long had you held a full driving/motorcycle licence?
Tick One Box

		%
Less than six months	2	1.0
Six months to one year	5	2.5
1 to 2 years	7	3.5
2 to 4 years	13	6.4
4 to 8 years	26	12.9
8 to 16 years	40	19.8
16 to 32 years	65	32.2
More than 32 years	44	21.8
Valid cases – 202		

If you were driving a LARGE/HEAVY GOODS VEHICLE, did you have a full or provisional licence?

Tick One Box

		%
Full	20	100
Provisional	0	0

IF FULL, go to Question 38

Otherwise, go to Question 39

Q38 How long had you held your large/heavy goods vehicle licence?
Tick One Box

		%
Less than six months	0	0
Six months to one year	0	0
1 to 2 years	0	0
2 to 4 years	0	0
4 to 8 years	3	15.0
8 to 16 years	3	15.0
16 to 32 years	4	20.0
More than 32 years	10	50.0
Valid cases – 20		

Q39 What was your annual average mileage?
(It may help to think of the number of miles you drove in a typical week, multiply this number by 50, and add the mileages of any extra journeys, eg driving on holiday.)
Tick One Box

		%
Up to 2,000 miles	12	6.0
2,001–5,000 miles	22	11.0
5,001–7,000 miles	10	5.0
7,001–10,000 miles	16	8.0
10,001–15,000 miles	51	25.5
15,001–20,000 miles	34	17.0
Over 20,000 miles	58	27.5
Valid cases – 200		

Q40 On average, how often did you drive?
Tick One Box

		%
Daily	189	92.6
More than once a week	13	6.4
Once a week	1	0.5
Once every two weeks	1	0.5
Once a month	0	0
Less than once a month	0	0

Valid cases – 204

Q41 What was the most common length of your trips when you drove your motor vehicle?
Tick One Box

		%
Up to 5 miles	14	6.9
6–20 miles	70	34.5
21–50 miles	67	33.0
51–100 miles	22	10.8
Over 100 miles	30	14.8

Valid cases – 203

Q42 Thinking about *when* you drove, what percentage of your driving time was spent driving: (Write in percentage to nearest 5%)

On Saturdays and Sundays

		%
0–20 per cent	125	64.4
21–40 per cent	29	14.9
41–60 per cent	18	9.3
61–80 per cent	5	2.6
81–100 per cent	17	8.8

Valid cases – 194

In the hours of darkness

		%
0–20 per cent	120	61.9
21–40 per cent	39	20.1
41–60 per cent	15	7.7
61–80 per cent	6	3.1
81–100 per cent	14	6.7

Valid cases – 194

During the morning and evening rush hour peaks

		%
0–20 per cent	62	32.1
21–40 per cent	35	18.1
41–60 per cent	31	16.1
61–80 per cent	36	18.7
81–100 per cent	29	15.0

Valid cases – 193

Q43 Thinking about *where* you drove, what percentage of your driving time was spent driving: (Write in percentage to nearest 5%)

On non-motorway roads with speed limits of 40 miles/h or less

		%
0–20 per cent	92	46.5
21–40 per cent	47	23.7
41–60 per cent	35	17.7
61–80 per cent	10	5.1
81–100 per cent	14	7.1

Valid cases – 198

On non-motoway roads with speed limits of over 40 miles/h

		%
0–20 per cent	39	19.7
21–40 per cent	48	24.2
41–60 per cent	49	24.7
61–80 per cent	35	17.7
81–100 per cent	27	13.6

Valid cases – 198

On motorways		%
0–20 per cent	129	65.2
21–40 per cent	36	18.2
41–60 per cent	13	6.6
61–80 per cent	11	5.6
81–100 per cent	9	4.5

Valid cases – 198

Q44 In the last five years, how many other road accidents have you been involved in as a driver or rider?
Tick One Box

		%
None	154	74.8
One	41	19.9
Two	10	4.9
Three	1	0.5
Four	0	0
More than four	0	0

Valid cases – 206

Q45 How many of these accidents resulted in injury to anyone involved?

Please write in number: ______________________________

Q46 In the last five years, have you ever had any of the following motoring offences against your name?
Tick One Box

		%
Drink driving	1	0.5
Speeding	34	15.9
Careless or inconsiderate driving	7	3.3
Dangerous driving	0	0
Accident related	1	0.5
Vehicle defect related	1	0.5
Other	6	2.8

Q47 Please indicate, by ticking the appropriate box, how you rate the following tasks?

Task	Very Hard	Hard	OK	Easy	Very Easy	Valid Cases
Judging speed in daylight	1	1	72	91	39	204
Judging speed in darkness	3	38	107	40	16	204
Judging distance in daylight	1	1	61	100	43	205
Judging distance in darkness	4	40	102	39	17	202
Daylight driving in general	1	0	47	86	69	203
Darkness driving in general	1	13	94	67	26	201
Turning right at junctions	1	9	66	78	48	202
Turning left at junctions	1	0	59	84	56	200
Joining main road from slip road	2	8	77	67	47	201
Allowing a vehicle onto main road from a slip road	2	7	66	85	43	203
Driving on motorways	2	8	66	78	48	202
Negotiating a roundabout	2	4	60	86	51	203
Overtaking	5	9	86	63	41	204

Q48 What is your date of birth?
(Please write in numerical format – DD/MM/YY)

___ / ___ / ___

Q49 Are you male or female?
Tick One Box

		%
Male	154	75.1
Female	51	24.9

Valid cases – 205

Q50 What was your marital status at the time of the accident?
Tick One Box

		%
Single	59	28.6
Married	114	55.3
Living as married	16	7.8
Divorced/separated	11	5.3
Widowed	6	2.9

Valid in cases – 206

Q51 How many children under 16 were living in your household at the time of the accident?
Tick One Box

		%
None	154	75.1
One	26	12.7
Two	17	8.3
Three	6	2.9
Four or more	2	1.0

Valid cases – 205

Q52 Which most closely describes your work situation at the time of the accident?
Tick One Box

		%
Professional	49	23.9
Senior managerial/administrative	25	12.2
Junior managerial, administrative or professional, supervisory and clerical	40	19.5
Skilled manual	38	18.5
Semi-skilled or unskilled manual	9	4.4
Student, looking after home/family, unemployed	10	4.9
Retired	14	6.8
Other	20	9.3

Valid cases – 205

Appendix C Questionnaire protocols

The study proceeded with the co-operation of the Police, but was nevertheless independent. Certain protocols were applied throughout the study, in order to clarify the relative interests of the parties concerned, and to provide assurances about the confidential nature of the information obtained. The protocols were as follows:

1. No information on extra data obtained or the conclusions reached as to contributory factors on particular accidents would be passed to the police or to anyone else in any circumstances.
2. An interview would only be attempted after the Police had taken any statements they required from an accident participant.
3. Names and addresses of participants in an accident, and the registration numbers of the vehicles involved, would not be recorded on the computer files of accident data, and would not be divulged to third parties.
4. Checks would be made to ensure that no contact was attempted with anyone involved in a fatal accident.
5. Information about individual accidents contributed by the co-operating organisations was regarded as the copyright of those organisations. Copies of any reports would be returned to them, or, with their approval, destroyed at the conclusion of the study.
6. The sole right of the copyright in the results of the research, including any report made, and any data or other information collected specifically for the programme of research, vests (insofar as it is not already the copyright of any third party) in the AA Foundation for Road Safety Research.

Appendix D Accident types by vehicle manoeuvres

Stacking Accidents

@ junctions

Rear end shunt – Minor
Evasion – XCL – Minor
Evasion – nearside – Minor
Rear end shunt – nearside
Rear end shunt – nearside – XCL
Rear end shunt – nearside – nearside
Evasion – XCL – nearside
Evasion – nearside – nearside
Rear end shunt – offside
Rear end shunt – offside – XCL
Rear end shunt – offside – nearside
Evasion – XCL – offside
Evasion – offside – nearside

On the links

Rear end shunt
Rear end shunt – XCL
Rear end shunt – nearside
Evasion – XCL
Evasion – nearside
Rear end shunt – improper overtake

Turning Accidents

Right turn leaving – nearside
Right turn entering – offside
Right turn entering – nearside
Left turn entering – offside

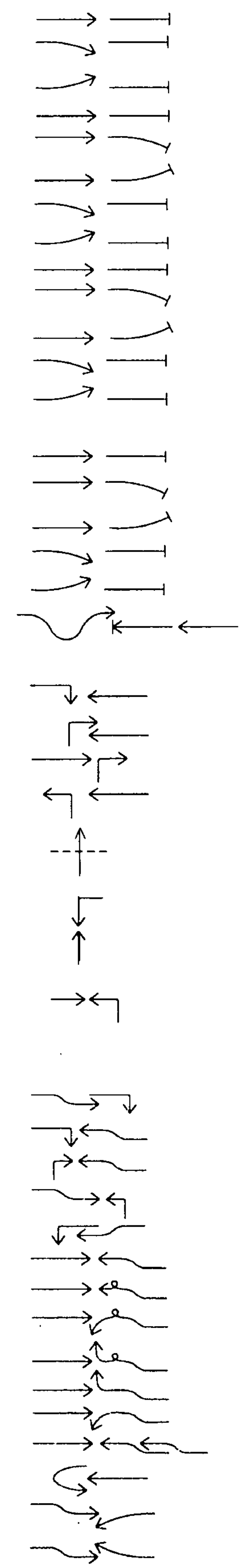
Junction overshoot

Left turn leaving – head on Minor

Left turn entering – head on

Overtaking Accidents

Right turn leaving – overtake – offside
Right turn leaving – overtake – nearside
Right turn entering – overtake – offside
Left turn entering – overtake – nearside
Left turn leaving – overtake – nearside
Overtaking – head on
Overtaking – loss of control
Overtaking – loss of control – nearside
Overtaking – loss of control – offside
Overtaking – evasion – offside
Overtaking – evasion – nearside
Multiple overtake
Improper U-turn
Improper overtake – evasion – nearside
Improper overtake – evasion – offside



Loss of Control
Loss of control – left bend
Loss of control – left bend – XCL
Loss of control – left bend – nearside
Loss of control – left bend – offside
Loss of control – right bend
Loss of control – right bend – XCL
Loss of control – right bend – nearside
Loss of control – right bend – offside
Loss of control – nearside
Loss of control – offside
Loss of control – XCL
Loss of control – right turn entering
Loss of control – right turn leaving
Loss of control – left turn entering
Loss of control – left turn leaving

Crossed Centre Line (XCL)
XCL on left bend
XCL on right bend
XCL

Other
Pedestrian