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Obstruction of the railway by road vehicles

Report of the Working Group
set up by the Health and Safety Commission

Chair: Richard Clifton

February 2002



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FOREWORD

To: Bill Callaghan
Chair
Health and Safety Commission

REPORT OF THE WORKING GROUP ON OBSTRUCTION OF THE RAILWAY BY ROAD VEHICLES

I am pleased to present the report of the Commission's Working Group on the obstruction of railway lines by road vehicles. The Commission set up the group at the request of the Deputy Prime Minister following the tragic accident at Great Heck, near Selby. The introductory section of the report describes the circumstances in which the Group was established and our working methods.

I am grateful to my predecessor, Alan Cooksey, for his role in the earlier phase of the Group's work. I am immensely grateful to all of the Group's members for the expertise they brought to the subject and the time and effort they put in to our work.

There are others we need to thank, and their names are mentioned in the report.

The Working Group brought together people with great expertise in road and rail transport, in transport economics and in transport engineering issues. I believe the report sets out a sensible agenda for action in the light of an analysis of the low probability of this type of accident occurring and the mitigatory steps that can be taken. It is important that necessary action is taken, but it is also important that this should be targeted at the locations where there are more significant risks rather than being widely spread, that it is proportionate and that it is not at the expense of measures that might yield a better safety benefit.

Stepping slightly outside our brief, I would like to say that there are significant safety lessons from the Great Heck crash not directly related to the need to take action on vehicles obstructing railway lines. These concern road safety and driver behaviour, in particular a basic, everyday risk - the danger that arises when people drive vehicles while

fatigued. The danger that results is mainly a danger to road users rather than to the railways.

The Group's work has been taken forward alongside that of the Group established by the Highways Agency to consider the provision of nearside safety fences on major roads. There has been some common membership of the two Groups. I am pleased that the two Groups have reached compatible and complementary conclusions.

I commend the report to the Commission and look forward to its publication. The Commission will doubtless want to forward the report to Ministers.

RICHARD CLIFTON

Director, Railways Directorate, HSE

February 2002

Obstruction of the Railway by Road Vehicles

Report of the Working Group set up by the Health and Safety Commission

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SUMMARY

On 28 February 2001, ten people died in the accident at Great Heck, near Selby in Yorkshire, in which a Land Rover towing another vehicle left the M62 motorway, obstructed the railway line, and caused a serious train accident.

This is the report of the Working Group set up by the Health and Safety Commission at the request of the Deputy Prime Minister to look at the circumstances of incidents where road vehicles have blocked railway lines and whether there were features in common that might have been preventable.

The Working Group included representatives of the authorities responsible for road and railway safety, a nominee from the Institution of Civil Engineers, and an independent expert in transport safety. We met during the summer and autumn of 2001, and considered the following principal questions, around which we have structured our report:

1. What is the scale of the risks we are addressing? In particular, was the Great Heck tragedy a freakishly rare event or something we should anticipate occurring regularly unless something is done about it, or something in between?
2. What is the nature of the risks? What do we know about the various risk factors that could help us find effective ways to reduce it?
3. How are these risks managed today? What goes on, who is responsible for it, and how are the interfaces handled?
4. What options have we got for reducing the risks? What in principle could we do about it and which possibilities are more or less likely to be effective?
5. What are the practicalities of making improvements? What recommendations can we make that will work best in practice?

We concluded that the risk, though small in relation to other road and railway risks, is not negligible and requires a programme of action. The risk is spread across many thousands of sites, most of which we consider likely to present low risk. Blanket measures at all locations where roads run over, or close to, railways would thus waste large amounts of time and effort that could be used to achieve much greater safety improvements elsewhere on the roads and railways.

We concluded that preventing road vehicles getting onto the railway, rather than preventing trains hitting them once they are there, is likely to be the best approach to reducing the risk.

Our recommendations call for:

1. Development of tools and data to help road and railway professionals determine which locations where the road runs near the railway are higher, and which are lower, risk.
2. Making sure both road and rail characteristics of relevant accidents and incidents are collected in accident reports.

3. Adaptation of railway safety management information systems to permit this accident information to be stored and analysed.
4. A programme of risk assessment work to cover all locations where road vehicles can get onto railways, whether by accident or through vandalism, and to classify such locations into higher risk, where an assessment of improvement measures should be made, and lower risk, where no further action is needed; and action based on the risk assessment.
5. Development of guidance on good practice as to the best measures to take at higher risk locations, depending on the circumstances of each location.
6. Development of a protocol for apportioning responsibility for and costs of improvements between rail and road organisations.
7. Longer term, once this protocol is in place, a review of progress and of the arrangements for governance and management of safety risks at all interfaces between roads and railways.

Lead parties are identified in the individual recommendations.

INTRODUCTION

1. Shortly after 06.00 on 28 February 2001 a Land Rover towing another vehicle on a trailer left the M62 motorway on the approach to the bridge which carries the motorway over the East Coast Main railway line at Great Heck, near Selby. The vehicle and trailer travelled for some distance alongside the motorway before running down the railway-cutting slope and onto the railway line, where an express passenger train struck it. The collision derailed the leading bogie of the passenger train, which was then struck by a freight train travelling in the opposite direction. Six passengers and four staff on the trains were killed; 76 people were taken to hospital.
2. Following the accident the Deputy Prime Minister asked the Health and Safety Commission to set up a working group to look at the circumstances of incidents where road vehicles have blocked railway lines and whether there were features in common that might have been preventable. In parallel the Highways Agency established another working group to review its standards for safety barriers.
3. This is the report of the Working Group set up by the Health and Safety Commission. It covers
 - the remit, membership, scope and approach of the Group
 - what we know or can infer about the risks we are dealing with
 - how those risks are currently managed
 - options for reducing the risks
 - our conclusions about the risks and what reductions are feasible, and
 - our recommendations for better managing the risks.

THE WORKING GROUP AND ITS REMIT AND SCOPE

Remit

4. The Health and Safety Commission asked us to look at the circumstances of incidents where road vehicles have blocked railway lines and whether there were features in common that might have been preventable. In particular, after analysis of the available data, we were asked to develop a set of potential improvement options and action proposals. We were asked to analyse the practicalities of the options in order to identify recommendations having consideration of the costs and benefits.

Membership

5. The members of the Working Group were:

Mr Graham Bessant	Institution of Civil Engineers
Sally Brearley	Railway Safety
Prof Andrew Evans	University College London Centre for Transport Studies
Mr Aidan Nelson	Railway Safety
Mr Alan Pickett	Highways Agency
Mr Andrew Sharpe	Railway Safety
Mr Kim Teager	Railtrack PLC, in Railway Administration (referred to henceforth as “Railtrack”)
Ms Marilyn Waldron	Department of Transport, Local Government & the Regions
Mr Alan Cooksey	HSE, Chairman (to 5 October 2001)
Mr Richard Clifton	HSE, Chairman (from 6 October 2001)
Ms Sharan Bains and Ms Anne Gloor	HSE, Secretariat
Mr Ciaran McDonald	
Mr Nik Tsirtou	
6. Brian Barton of the Highways Agency also contributed considerably to the work of the group. Tony Taig of TTAC Limited assisted by collating the evidence collected and drafting the report following the change of Chairman. We are very grateful to them for their help.

Scope of Issues Addressed

7. We discussed the wider context and full scope of obstructions to the railway that may create risks to rail users. We concentrate on the most important issues not being addressed elsewhere.
8. Obstruction of the railway by road vehicles can happen because a road vehicle, of any of a number of types, gains access to the railway in any of four ways:

- a) from bridges crossing over the railway or adjacent to it
 - b) from roads running alongside railways
 - c) from adjacent property, and
 - d) at level crossings.
9. We agreed with the Health and Safety Commission that our scope should be as follows in order to maximise the usefulness of this work:
- a) We included risks of death or injury both to rail users, by which we mean railway staff and passengers and to people in road vehicles that obstruct the railway
 - b) Accidents at level crossings are already the subject of vigorous research and safety improvement activity¹, so we agreed with HSC not to consider them in this report.
 - c) Deliberate acts of vandalism, as well as accidents on the road or other property adjacent to the railway, are an important cause of vehicles obstructing railway lines. On a similar principle to that applied to level crossings, we have counted incidents attributable to vandalism within our scope but have not addressed the wider railway plans and actions to tackle vandalism².
 - d) We included in our scope accidents where obstruction of the railway was caused by any part of road vehicle, or its load, or by any part of the infrastructure dislodged in an accident³
 - e) We excluded accidents involving railway contractors' vehicles.

Our Approach

10. The essence of our approach has been:

first: to understand the scale and context of the risk we are considering - was the Great Heck tragedy a freakishly rare event, something we should anticipate occurring regularly unless something is done about it, or something in-between?

second: to understand the nature of the risk - what do we know about the various risk factors that could help us find effective ways to reduce it?

third: to examine how these risks are managed today – what goes on, who is responsible for it, and how are the interfaces handled?

fourth: to consider options for reducing the risk – what in principle could we do about it? Which possibilities are more or less likely to be effective?

fifth: to consider the practicalities of making improvements – what recommendations can we make that will work best in practice?

¹ The protection arrangements at level crossings are set out in the HSE publication 'Railway Safety Principles and Guidance' Part 2 Section E Guidance on Level Crossings.

² Plans to tackle vandalism are described in the current Railway Group Safety Plan (available from Railway Safety), and Railtrack PLC Safety and Environment Plan.

³ The statistics later in this report include only incidents involving vehicles and their loads, not dislodged infrastructure. We do not consider that this affects our conclusions or recommendations in any way.

11. Working Group members have undertaken considerable research and analysis to contribute to this report in addition to their attendance at meetings and discussions on emerging conclusions. We have also commissioned various pieces of work to support us in our task, and have drawn on several other sources in developing our report. The main items, the issues they have helped us to understand, and where to read more about them in this report, are summarised in Table 1.

Table 1: Work Carried Out for the Road-Rail Working Group

Work Carried Out	How it helped us	Report Paras
Analysis of relevant HSE rail accident records held in RIDDOR database (Mr K Ennis, HSE)	Extracted additional information about relevant accidents since 1990	16, 37-44
Site visits, reports and collection of video and photographic data from previous accident sites (Mr J Doolan and Mr A Harvey, HSE)	Understand factors associated with relevant accidents	36
Analysis of casualties in relevant accidents (Prof A Evans, UCL)	Provides direct estimate of the scale of the relevant risk	16-19
Analysis and reconciliation of railway Safety Management Information System & RIDDOR relevant accident records (Ms J Frank, Mr S Hudson and Mr A Small, Railway Safety)	Extracted additional information about relevant accidents, particularly for those since 1997	16-19, 37-44
Analysis of possible accident consequences using Railway Safety Risk Model (Mr C Dennis, Railway Safety)	Maximise use of limited data to make a best estimate of the scale of relevant risk	18-19
Review of relevant railway standards in the UK and Europe (HMRI and Railway Safety staff)	Identify ideas that might be applicable in the UK	73-75
Stakeholder workshops (chaired by Mr A Cooksey; Mr R Gifford, of PACTS, facilitated the first workshop)	Assess the significance of the risk from different people's viewpoint, and develop improvement ideas	30
Hazard Identification Workshop (led by consultants Arthur D Little Ltd)	Understand key risk factors for different types of road-rail intersection	48-50

12. In addition, we used published road and railway accident statistics to help us place the risks we were considering in context (Section 3.2). We took legal advice on the different legal frameworks applying to roads and to railways (Sections 4 & 6). These various sources of information and advice were accessed for us by Working Group members, and we are extremely grateful to all who assisted us in this way.

THE SCALE AND SIGNIFICANCE OF THE RISK

13. This section of the report addresses two vital questions:
- How big is the risk associated with road vehicles obstructing the railway? Was the Great Heck tragedy a freakishly rare event or something we should anticipate occurring regularly unless something is done about it, or something in-between?
 - Given the scale and nature of the risk, how significant is it in the context of other road and rail safety issues? How do people feel about it, and where should it rank in society's priorities for improving road and rail safety?

14. We focus mainly on the risks of death for road and rail users, which are the main concern of the incidents we are addressing. We also refer on occasion to risks of "casualties", which includes serious and minor injuries as well as deaths, and to risks of various types of accident or incident. We use the term "risk" in this report to mean the frequency with which we expect specific harmful events or consequences to occur, for example, when we talk about

deaths *we measure risk in* deaths per year

casualties *we measure risks in* casualties per year

accidents *we measure risks in* accidents per year

and so on, in each case being careful to define the specific set of circumstances we are considering.

15. The sequence of events and associated risks we are interested in here is as follows:
- a) A road vehicle deliberately or accidentally leaves the carriageway or other proper place for it to be, and
 - b) it then gets onto railway property, and
 - c) it may then obstruct one or more railway lines, and
 - d) may then be hit by a train, and
 - e) may then derail or otherwise damage the train, which
 - f) may then strike another train or lineside structure.

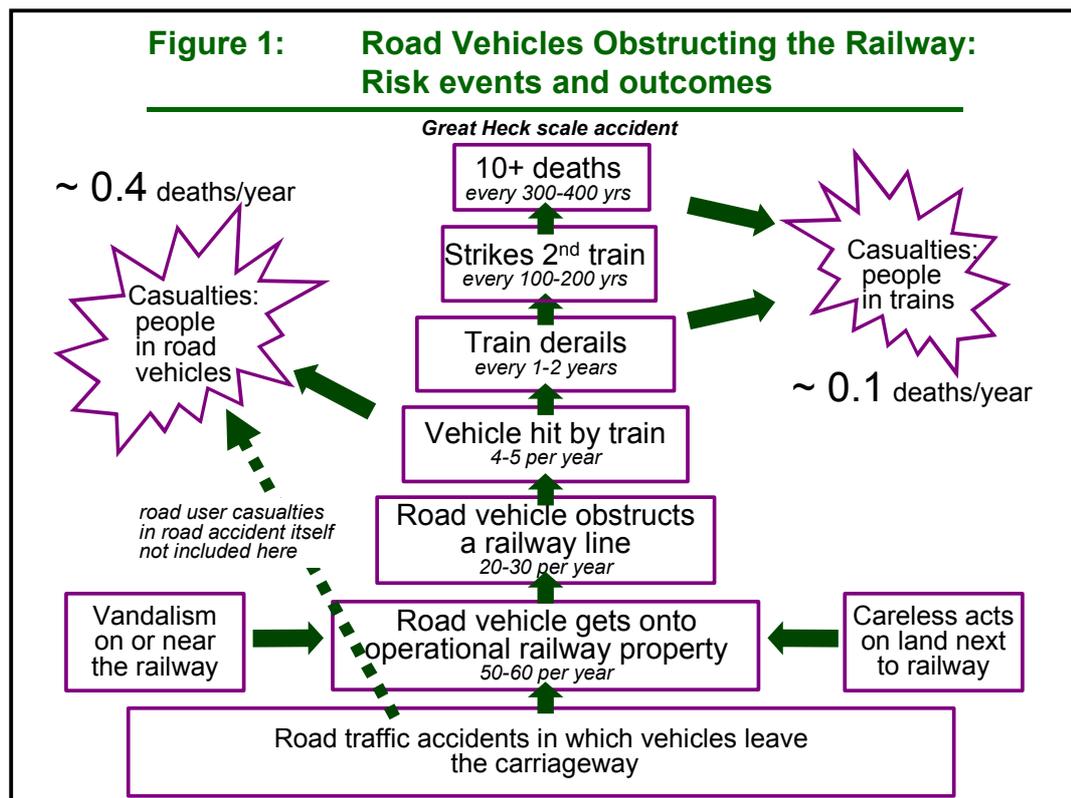
Each of these steps may cause damage to road vehicles and property and result in casualties for road vehicle occupants. Our interest in this report is in casualty outcomes from step d) onward, for both road and rail vehicle occupants. That is, we are not addressing here the road user casualties in a road accident itself, but only any the casualties that result if a road vehicle is struck by a train. The following sections present in turn our collected findings on the scale and the significance of the risk.

How big is the risk?

16. Our estimate of the frequency of events as at 15 a) to f) above, all of which are relevant to understanding the risk of a Great Heck type incident, is as follows:

- Hundreds of thousands of road vehicles leave the carriageway each year as a result of road traffic accidents. There are thousands of acts of vandalism on and around the railway each year. There are uncounted vehicle movements each year on land adjacent to the railway. As a result of all this underlying activity,
- about 50-60 road vehicles per year get onto railway property⁴ of which
- about 20-30 each year then obstruct one or more railway lines, of which
- about 4-5 each year are hit by a train, of which we would expect⁵
- one or two out of every ten to derail the train (i.e. about 1 derailment every 1-2 years), of which we would expect⁵
- about one in a hundred then to be struck by another train (i.e. about 1 derailment with secondary train-train collision every 100-200 years; we would expect⁵ an event on the scale of the Great Heck Accident about every 300-400 years)

These events and the casualty outcomes we would expect on average per year are illustrated in Figure 1 below.



⁴ Somewhere along the 20,000 miles or so of operational railway lines, via one of the many thousands of locations at which roads pass over the railway and roads or other locations with vehicular access run close to the railway

⁵ Based on predictive models of railway risk which incorporate information about many other types of accident and apply it to accidents resulting from the causes in which we are interested

17. Professor Evans reviewed historic evidence of fatalities in collisions between trains and road vehicles to estimate how many deaths might be expected in an average year, assuming past experience was applicable to future circumstances. That experience is summarised in Table 2. In the 34¼ years from 1967 to 2000/01 there were 11 recorded, fatal collisions between trains and road vehicles not at level crossings. However, none of these date from before 1976, so it is sensible to disregard the early part of the period as possibly incomplete, and estimate the average frequency of such accidents as about 4 every 10 years. In all fatal collisions between trains and road vehicles, including those at level crossings, the average number of deaths per accident was about 1.2 to road users and about 0.2 to rail users. Combining the average accident frequency with these consequences leads us to expect the following numbers of fatalities in collisions not at level crossings:
- about 4 deaths of people in road vehicles (when hit by a train as in step 15d. above) every ten years, and
 - about 1 death of a rail user every ten years (unevenly spread, over many years with no deaths and a few in which large accidents occur).
18. Because these estimates of casualties are affected by rare accidents, they are subject to considerable statistical uncertainties. To improve our confidence in the estimates, Railway Safety applied their Safety Risk Model to predict how many casualties we should expect from the events 16d to 16f above. The Safety Risk Model is a method for estimating the risks of rare railway accidents. The Model incorporates a larger volume of evidence about many other railway risks in order to predict things on which direct statistical evidence is not available for accidents where trains strike road vehicles, for example
- how likely a derailed train is to turn on its side
 - how many people on average would be hurt when this happens
 - how likely it is that a derailed train will obstruct another line
 - how likely, if so, it is that it will be struck by a second train.
19. The Safety Risk Model predictions on expected average annual casualties agreed closely with the direct statistical estimates made by Professor Evans. This strengthens our confidence that history (as in para 17) is a reasonable guide to the future. The Safety Risk Model was also used to estimate how often we might expect an accident of the type and of the scale of Great Heck – about once every 300 or 400 years.
20. We conclude, having considered the evidence of experience of past accidents where road vehicles obstructed railway lines, and the best predictions of risk we can make using currently available risk assessment methods, that
- C1.1. We would expect, on average over a number of years, about
- 0.1 deaths** per year for railway passengers and staff, and
 - 0.4 deaths** per year for the occupants of road vehicles due to road vehicles being struck by trains at places other than level crossings.

- C1.2. We would expect an accident on the scale of Great Heck about once every 300 to 400 years.
- C1.3. These numbers are the best estimates we can make, but remain subject to uncertainty. We would be surprised if the actual risk were more than 2-3 times different from these estimates. We are confident in the conclusion that the risk to road vehicle occupants is significantly greater than the risk to railway users.

Table 2: Fatal train accidents involving road vehicles: Great Britain: 1967-2000/01

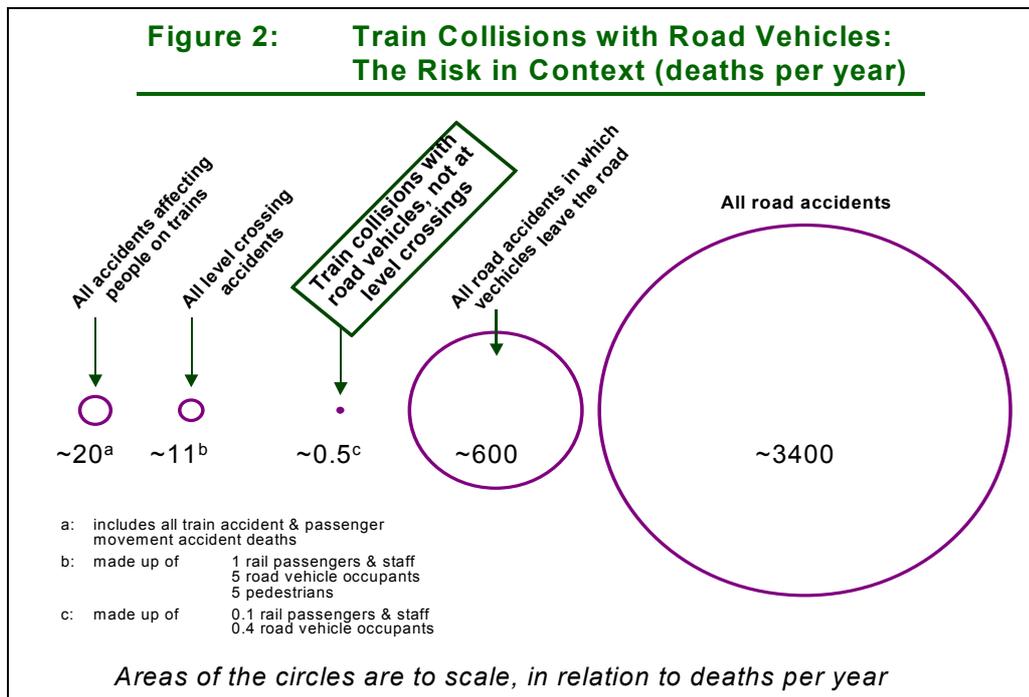
Date	Location	Nature of accident	Fatalities		
			Train Occs	Road Veh Occs	All
<i>Fatal collisions not at level crossings</i>					
28. 2.01	Great Heck	Car from M62/pass/freight train collision	10	0	10
8. 6.97	Burbage Wharf	Car fell from bridge; hit by freight train	0	1	1
10. 3.95	Balcombe Tun Jc	Car fell from M23; hit by pass train	0	1	1
21. 8.93	Stourbridge	Car fell down bank; hit by train	0	1	1
6.12.91	Four Ashes	Car fell after RTA; hit by freight train, fire	0	1	1
3. 8.87	Dunhampstead	Car fell from bridge; hit pass train	0	2	2
4. 4.86	North Wembley	Car driven through fence; hit by ECS	0	2	2
? . ? .81	Not known	Car crashed through fence; hit by train	0	1	1
24.10.79	Walkeringham	Car fell from bridge; hit by freight train	0	2	2
19. 4.77	Cleland	Van driven thro' fence; hit by freight train	0	2	2
15. 3.76	Annan	Lorry fell from bridge; hit by pass train	2	1	3
Total	11 accidents		12	14	26
<i>Fatal collisions at level crossings with at least one train occupant fatality</i>					
26. 7.86	Lockington	Pass train/van collision	8	1	9
1. 3.79	Naas	Pass train/lorry collision	2	1	3
3.12.76	Chivers No 1	Pass train/lorry collision in fog	1	0	1
? . ? .73	Dymchurch	Stolen car hit RHDR train	1	0	1
15. 7.70	Shalmsford St	ECS/lorry collision	1	1	2
? . ? .70	Chivers Decoy	Pass train/lorry collision in fog	1	0	1
6. 1.68	Hixon	Pass train/transporter collision	11	0	11
Total	7 accidents		25	3	28
<i>Fatal collisions at level crossings without train occupant fatalities (summary)</i>					
Total	148 accidents		0	176*	176
<i>All fatal collisions between trains and road vehicles</i>					
Total	166 accidents		37	193	230
Source: Extracted from <i>Railway Safety</i> (HSE, annual) or HMRI fatal train accident database					
Abbreviations: RTA = road traffic accident; ECS = empty coaching stock; RHDR = Romney Hythe and Dymchurch Railway (narrow gauge).					
*Includes 1 fatality to a staff member who was involved in a collision but not a vehicle occupant.					

How Significant is the Risk?

21. We consider here both how the risk we are addressing compares with other road and railway risks and other factors such as how strongly people feel that something should be done to reduce it.

The Risk in Context

22. Figure 2 below shows the approximate scale of the risk in relation to
- similar road/rail accidents at level crossings
 - other railway accidents that affect people on trains
 - other road accidents where vehicles leave the carriageway but do not go onto railways, and
 - all other road accidents.



23. Clearly, this risk is small in comparison with other railway risks and tiny in comparison with the other more everyday risks of people driving off the roads.
24. We also considered the question of trends in the risks; are they increasing or decreasing as time progresses? In relation to the upper railway parts of the accident pyramid in Figure 1, accidents involving vehicles obstructing railway lines are thankfully so few that there is too little statistical data for us to estimate trends over time in the events leading from road vehicles entering onto railway property and causing harm to people.
25. In relation to the road accident base of the pyramid in Figure 1, some inferences might be made from the trends in other accidents where road vehicles leave the road, but do not go onto railway property. We note from the analysis carried out by the Highways Agency Working Group on Standards for Nearside Fences that the trend in serious accidents where vehicles travelling on main roads leave the carriageway is, if anything, downward (HA Report Table A4.4.10).

26. However, the number of slight accidents has increased, so the base of the pyramid in figure 1 remains much the same. We do not believe there is sufficient evidence to argue that the trend in risk from accidents like Great Heck is downward. There are many other factors on the railway side of the equation (for example increasing traffic and reducing headway between trains), which would if anything push the trend the other way. Overall, we do not think there is any significant evidence of a trend one way or the other.

Public Expectations

27. Public concerns over railway safety have been heightened by recent accidents. The public demands and expects high standards of safety from those who run railways and provide a public transport service. However, the working group does not consider a death on the roads any less of a tragedy than a death on the railways, but we are aware that greater concerns are often expressed about rail than about road safety.
28. We share the sense of public horror and concern that arose after the Great Heck Accident. However, after an initial wave of grief and concern, most people seem to recognise that Great Heck involved an unusual combination of circumstances for which there was no obvious and immediate remedy.
29. Although the risk we are examining is small and there is no sense of public outrage driving immediate action, we do not regard the risk as insignificant. Our initial view, having considered the scale of the risk, was that this issue merited serious efforts to explore effective means of risk reduction. But we felt, in view of its small overall place in the transport risk picture, it should not automatically “leapfrog” above the other railway and road safety issues vying for attention.
30. We wished to test this view (and other aspects of our thinking) with the wider road and railway communities, including transport users, employees, safety experts and other interested parties. To this end we held two “stakeholder workshops” during the summer of 2001. We used these as an opportunity to test our views on a wide range of issues relevant to our inquiries. The workshops substantially reinforced our developing views that
- the risk involved in these accidents is small, but
 - it is not negligible in relation to other railway risks, therefore
 - consideration should be given to ways of reducing it, while recognising
- that good ideas for reducing this risk should not leapfrog over other road and rail safety schemes which might yield much greater safety benefits – they should be implemented in proportion to the expected safety benefits.
31. We wish to explain what we mean by “giving priority to measures to tackle this risk in proportion to their effectiveness in risk reduction”. A widely used way of doing this, in both road and rail transport planning, is to work out the safety benefits (lives and injuries saved) and the costs (in monetary terms) of alternative measures available. By prioritising the measures that give the highest savings in lives and injuries per £ spent, the maximum safety improvement can be achieved for any given investment. Such cost-benefit assessment is used to provide a rough

guide; there are often other important benefits and disbenefits besides safety improvement and monetary cost that need to be taken into account in planning decisions.

32. To give an indication of where such an approach might place risks associated with trains hitting road vehicles at places other than level crossings, Professor Evans estimated the value (in £) of the available safety benefit if all such casualties could be eliminated. He applied the official road and rail planning guidance values of preventing fatalities and injuries in use at the time, which involved the use of different figures for roads and railways, reflecting a premium attached to rail casualties⁶. On this basis, the value of eliminating all casualties with which our report is concerned would be about £1 million per year. Of this, about one third relates to train occupants and two thirds to road vehicle occupants.
33. To place this in perspective, the corresponding value of preventing all road casualties would be about £11,600 million per year⁷. We do not wish to imply that we believe that lives can be equated directly to money. What we are saying, though, is that if time and effort are spent on measures to reduce this risk, which would otherwise have been used to save considerably more lives, then more people will die than would have done otherwise. Disproportionate use of resources to tackle the risks addressed in this report could thus have the effect of increasing death and injury, if less effective risk reduction measures here were allowed to leapfrog over other schemes that could save more lives elsewhere.
34. We conclude, having considered the scale of the risk in comparison with other road and rail safety issues, the lack of discernible trends in the risk and the broad consensus we have observed as to where this risk should rank in society's scale of safety priorities, that
 - The risk is small in relation to other railway risks and tiny in relation to other road risks
 - Although small, the scale of the risk in relation to other railway risks nonetheless warrants consideration of possible means of reducing it
 - Any good ideas resulting from such consideration should be given a priority proportionate to their effectiveness in risk reduction
 - Schemes to reduce the risks of road vehicles obstructing the railway should not leapfrog other road and rail safety initiatives that would yield bigger safety improvements; they should ideally reinforce such initiatives.

⁶ See Railway Group Safety Plan 2001/2002, Page 5

⁷ From DTLR Highways Economics Note No 1: 2000 Valuation of the benefits of prevention of road accidents and casualties, Table 5. Note that the figure quoted is for casualties only; that is, it excludes the value of damage and other accident losses.

THE NATURE OF THE RISK

35. Our first step in exploring ways to reduce the risk was to learn as much as we could about its nature. In what circumstances is it greatest? What factors increase the propensity of an accident at a given location? What factors appear to mitigate the risk? We have several sources of relevant information, which we discuss in turn before providing our overall conclusions and observations:
- the HSE survey of selected accident sites carried out by Her Majesty's Railway Inspectorate (part of HSE)
 - HSE and Railway Safety records of incidents jeopardising railway safety
 - Police records of road accidents
 - The Hazard Identification workshop led for us by Arthur D Little Limited (consultants), and
 - A local initiative to assess risks at road bridges over railways, started in the North-East of England and now being tested more widely.

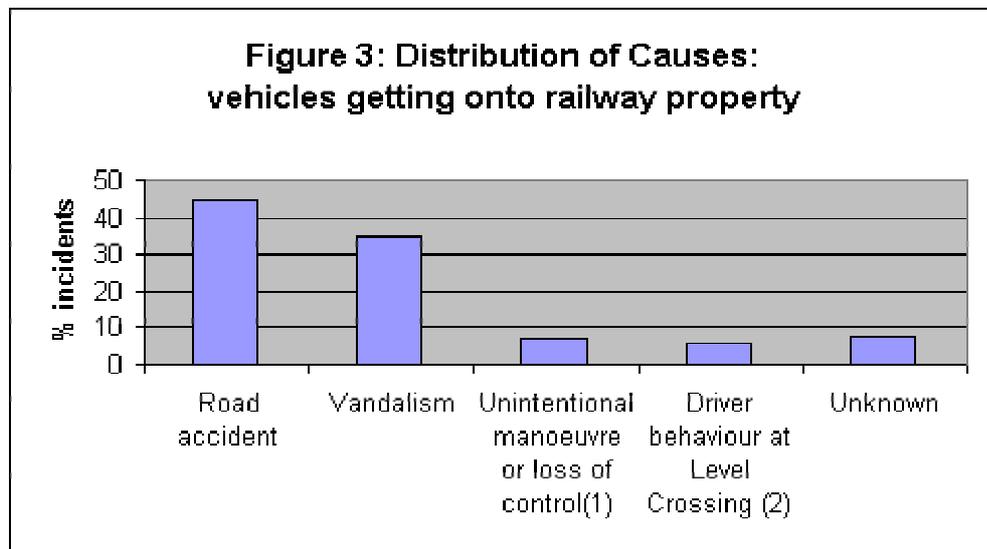
The HMRI Survey

36. The HSE survey of selected accident sites involved personal visits by HMRI Inspectors to 18 sites around the UK. The survey provided qualitative and anecdotal information only, but was valuable in helping us build our understanding of the nature of the issues involved. Sites were selected which had experienced a recent incident, had been the subject of discussion or complaint. Sketches, photographs and video recordings were made at the sites, along with notes and preliminary, subjective assessments of risk as high, medium or low. The survey report corroborated some important observations made during our examination of accident records.
- Vandalism, as well as road accidents, is an important way in which road vehicles get onto railway lines.
 - The Great Heck scenario is not the only accident of major concern; for example a petrol tanker had crashed onto the West Coast Main Line in Cheshire in 1993.
 - Several of the sites involved relatively remote rural locations where roads ran parallel to railways, but rail traffic densities on such lines were relatively low.
 - The feasibility of local risk assessment was being demonstrated by a local initiative, involving County Durham and North Yorkshire Authorities and Railtrack, to assess risk at road bridges over railways.

This final point was substantiated by the experience of London Underground Limited, who had a well-developed risk-based approach to assessment of priorities for works on bridges over and under the railway.

Railway Accident and Incident Records

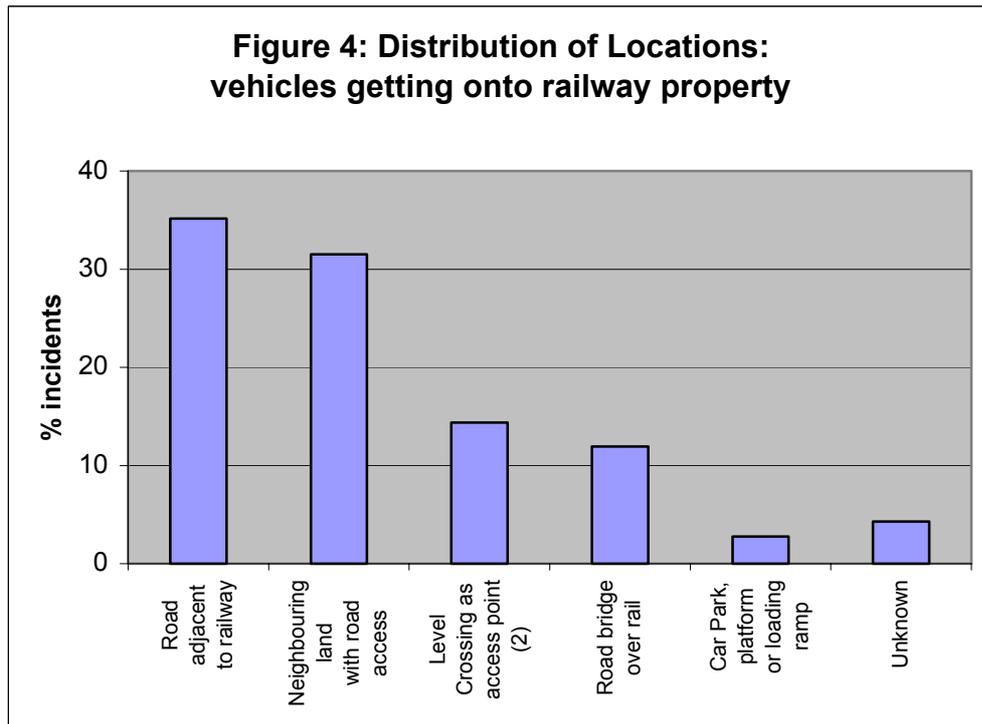
37. Railway accident and incident records are maintained by HSE through their national RIDDOR system for reporting dangerous incidents, and by Railway Safety through their SMIS incident reporting system. These records tell us a good deal about the railway circumstances surrounding accidents, but generally tell us little or nothing about the road conditions or crime circumstances that led to the road vehicle entering onto railway property in the first place.
38. The split of causes for vehicles getting onto railway property (the split for incidents where vehicles obstruct a line is very similar) is shown in Figure 3, which is derived from SMIS records for the years 1990 to 2000. While road accidents are the largest single cause, they account for less than half of all the incidents within our scope. Vandalism is also a major causal factor, while driver behaviour (at level crossings, and in manoeuvring and safeguarding vehicles close to the railway) is also significant.



(1) includes vehicles left ticking over near railway that move off unattended, and farm vehicles tipping over onto railway (about 1% of incidents)

(2) involves drivers turning onto the railway and driving along it; does not include accidents on the crossing itself

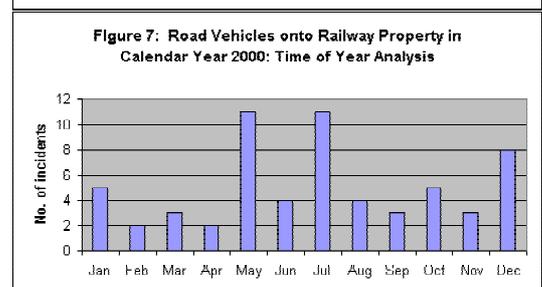
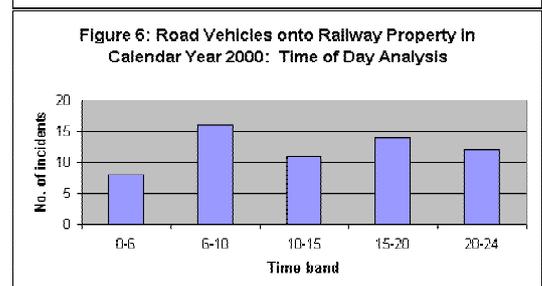
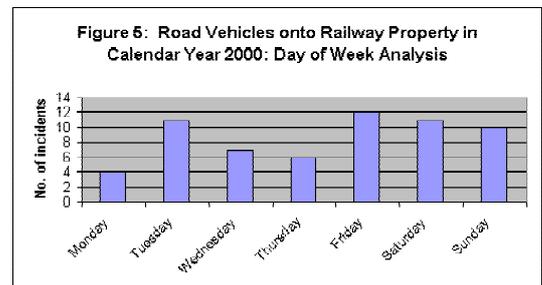
39. Incidents of road vehicles getting onto the railway occur at several different types of location, as illustrated in Figure 4. Situations where railways run close to roads, or to land with easy access to the railway, dominate the numbers of incidents. Access via level crossings (which is entirely attributable to driver behaviour) and via road bridges over the railway (which is almost entirely attributable to accidents on the bridges or the approach to them) are also significant.
40. Figures 3 and 4 show the proportions of all incidents associated with particular causes and locations. Table 2 above, from Professor Evans' review of experience of fatal accidents, suggests that a much higher proportion of the most serious accidents (6 out of the 11 fatal accidents in the table) occur at road bridges over the railway.



(2) see footnote (2) to Figure 3

41. A sample analysis of the distribution of incidents across days of the week, time of the day and month of the year for the 61 incidents during calendar year 2000 is shown in Figures 5, 6, and 7. The sample is too small to reveal any significant trends, but is broadly compatible with the pattern of other serious road accidents (see para 47 below).

42. Despite the relative infrequency of these incidents, our analysis revealed several places where multiple incidents had occurred over a ten year period. Clustering of vandalism incidents is a well-known phenomenon, but we also found a number of locations that had experienced 3 or 4 incidents due to road accidents over the period from 1990 to 2000⁸.



⁸ Of 9 locations that had experienced 4 or more events of road vehicles getting onto railway property during the period, 2 were associated with multiple instances of vandalism, while 7 had experienced 3 or more accidents on adjacent roads leading to vehicles ending up on railway property.

43. We believe that the reporting of incidents where road vehicles obstruct a railway line is quite reliable. We consider it significant that we can learn little of the road circumstances surrounding vehicles leaving the road and entering railway property from railway accident records, while road accident records are available only for a fraction of road accidents that result in a road vehicle obstructing the railway⁹.
44. A good example of an issue where better recording and reporting would directly help target improvements is in the timing of accidents. If there is a long time interval between the road vehicle obstructing the line and a train hitting it, there is significant opportunity to reduce risk through measures to get information more quickly to the train driver. If this time interval is generally short, then there is little point exploring such measures.
45. For accidents recorded by HSE or the railways in SMIS or RIDDOR, we generally have an accurate record of the time at which the train hit the obstacle. For accidents recorded by the police on STATS-19¹⁰, we may have an accurate record of the time at which the road accident occurred. The problem is that there is only a STATS-19 record if someone in the road vehicle is injured and the police have decided that is appropriate to record it on STATS-19. This means that the majority of incidents of vehicles blocking the railway never have factors recorded such as
- the type of road on which the initial accident occurred
 - the circumstances of the road accident, or
 - the time of the road accident.

We therefore cannot tell, even by exhaustive attempts to match RIDDOR, SMIS and STATS-19 records, the time that was available to have stopped trains before they reached the road accident scene.

Police Road Accident Statistics

46. We cannot directly analyse the base of the accident pyramid in Figure 1 because (apart from specifically targeted research studies) there is no system for reporting and recording road accidents that do not lead to casualties. Any road traffic accident that involves casualties is reportable by the police on a STATS-19 form and is logged onto a central database though there is substantial underreporting of some types of accidents. There are many thousand such incidents a year in which one or more vehicle leaves the road. The STATS-19 data thus provides a very large sample of accidents that might provide pointers to the types of driver behaviour and road circumstances that make driving off the road more likely. Extensive analysis of STATS-19 data for trunk roads and motorways was made by the Highways Agency Working Group.

⁹ This is because road accidents are only reportable when a road user casualty is involved and even then there may be under-reporting if the injury occurs off the road and on the railway, and the do not consider it appropriate for STATS-19.

¹⁰ STATS-19 is the name of the form used by the police to capture information about road accidents involving injury to one or more road users. The STATS-19 data is collected and held on databases by the Department of Transport, Local Government and the Regions and other authorities.

47. We examined, though not in detail, a sample of STATS-19 data for fatal road accidents in which a vehicle had left the carriageway. This corroborated some of the important general observations that apply to road accidents, some of which were also evident in the Highways Agency Working Group analysis for trunk roads, including:
- they are concentrated later in the week and at weekends in comparison with the first half of the week
 - they are more likely, in proportion to the traffic on the road, to occur late at night
 - drink driving and driver inattention, error or recklessness are major factors
 - they relatively frequent among younger, male drivers
 - they are distributed approximately 20:80 between trunk roads and locally managed roads.

Hazard Identification Exercise

48. We established early in our work that the risk was small and localised in some situations rather than others. We commissioned the consultants Arthur D Little Ltd to facilitate a workshop for us to identify the features of a location that would affect the local risk of road vehicles leaving the road and obstructing a railway line. The workshop was held on 27 June 2001 and involved representatives of the British Transport Police, fire services and the Driving Standards Agency as well as Working Group members and colleagues from their organisations.
49. For each type of location which our analysis of accident records had revealed was significant, the workshop identified specific hazards that could lead to obstruction of the railway. For each of these hazards, factors were identified that would make a specific location a) more vulnerable to vehicles leaving the road, and b) more vulnerable to vehicles reaching and blocking a railway line if they did leave the road. The types of location, and the hazards identified at each, are shown in Table 3.
50. Our conclusion from this exercise was that it should be feasible to develop risk assessment methods and data to help people assess the risk of road vehicles obstructing the railway at specific locations. This development should be co-ordinated to avoid duplication of time and effort establishing the effects of various features and factors locally, and to provide the largest sample of relevant accidents from which to deduce the strength of the various influences.

Table 3: Hazards Identified at the Workshop

Geographical Feature	Hazards
Road bridge over the railway	<ul style="list-style-type: none"> • Incident/accident on approach to a bridge • Incident/accident on bridge itself • Act of vandalism <ul style="list-style-type: none"> – deliberate toppling of vehicle from bridge – pushing of vehicle from approach road – dumping of vehicle on or near bridge • Deliberate trespass onto railway line, e.g. suicide
Road parallel to or alongside the railway	<ul style="list-style-type: none"> • Incident/accident on parallel road • Act of vandalism, e.g. deliberate pushing of vehicle from road
Car park adjacent to railway	<ul style="list-style-type: none"> • Driver loses control or unintentionally manoeuvres onto railway property • Collision causes one driver to lose control • Shunt by another vehicle, e.g. by an HGV
Neighbouring land with road access	<ul style="list-style-type: none"> • Driver loses control or unintentionally manoeuvres onto railway property • Vehicle left ticking over close to railway and moves off unaided • Act of vandalism, e.g. deliberate dumping of vehicle on a railway line
Agricultural land	<ul style="list-style-type: none"> • Driver loses control of farm vehicle or unintentionally manoeuvres onto railway • Farm vehicle tips over in vicinity of railway • Incident/accident on a field-to-field crossing • Incident/accident on nearby bridge due to agricultural activity feeding onto roads
Platforms and loading ramps	<ul style="list-style-type: none"> • Driver loses control while manoeuvring • Incident during loading/unloading on motor rail/car transporter • Act of vandalism, e.g. deliberate dumping of vehicle on the railway line
Level crossings as an access point for road vehicles	<ul style="list-style-type: none"> • Driver makes a turn at level crossing onto the railway line

Local Bridge Assessment Initiative

51. Durham and North Yorkshire County Councils were particularly concerned, following the Great Heck accident, at the significant numbers of road bridges over East Coast Main Line for which they were responsible. As a result, these two authorities became part of a local initiative¹¹ in the north east of England, which has developed a risk ranking model for road over rail bridges. This model can help to identify bridges of concern, where local risk assessment by qualified railway and highway engineers is needed to decide if improvement action at specific bridges is necessary. Several of the Working Group members have been actively involved in developing the risk assessment method, which provides an overall priority ranking for further local risk assessment by qualified highway and railway engineers to decide improvement action at specific bridges if necessary.
52. The risk ranking model has now been extensively applied in County Durham and North Yorkshire, and is being piloted for wider application by Local Authorities in Norfolk, Kent and Lancashire. This initiative, and parallel work undertaken by London Underground Limited over several years, confirms our view that the factors that influence the risk at specific locations are amenable to systematic analysis to help establish priorities for improvement measures.

Conclusions

53. Our principal conclusions as to the nature of the risk, to guide our exploration of possible risk reduction measures, are as follows:
 - C2.1. The risk is widely distributed across geographic locations, but is higher at some locations than at others. Blanket application of risk reduction measures at all locations where roads and railways come together would waste a lot of resources on lower risk locations.
 - C2.2. In relation to the risk to railways, road traffic accidents and vandalism are about equally important as contributory causes. Effective railway risk reduction needs to tackle both issues.
 - C2.3. Road bridges over railways, and places where railways run close to roads or to land with road access, are equally important as locations where this risk arises
 - C2.4. The factors that influence risk at specific locations are amenable to structured risk assessment, but we have been frustrated in our attempts to assess the importance of many factors by the lack of mechanisms for consistent reporting of both the road and the rail aspects of relevant incidents.

¹¹ The initiative was carried forward by representatives from North Yorkshire County Council, Durham County Council, the County Surveyors Society, Railtrack Plc, Railway Safety and HMRI.

HOW THE RISK IS CURRENTLY MANAGED

54. We consider in this section who owns and manages railways and roads, and the legal context in which they work. We then describe briefly the range of arrangements which are in place today relevant to the control of the risk of road vehicles obstructing the railway, and who is involved in them. We comment throughout on the issues that arise at the interfaces between roads and railways.

Ownership and Management

55. Trunk roads (motorways and all purpose trunk roads) are managed by the Highways Agency, acting on behalf of the Secretary of State for Transport, Local Government and the Regions. All other public roads are managed by Local Authorities on behalf of locally elected Councils. There are also many private roads. We refer to the Highways Agency and to local authorities, in their capacity as managers of roads, collectively as “highway authorities”. The design, construction, inspection and maintenance of roads are largely carried out by private sector companies on behalf of the relevant highway authority. Under the private finance initiative, the private sector is becoming increasingly involved in the financing of roads as well as in engineering matters.
56. The main line railway infrastructure of England, Scotland and Wales is owned and managed by Railtrack. Various local and metropolitan railways, of which London Underground is much the largest, also own railway infrastructure. As for the roads, design, construction, inspection and maintenance are heavily contracted out to the private sector, though these arrangements are rather more recent than for the roads.
57. Ownership where roads and railways meet is not consistent. For example, Railtrack own some road bridges over the railway while highways authorities or private owners are responsible for others. At a typical Railtrack-owned bridge, Railtrack maintain the bridge structure but the highway authority maintains the road over it. Boundaries can be difficult to demarcate.

Legal Context

58. All road users have a responsibility for, and the opportunity to improve, road safety. Highway authority responsibilities and powers are established in various Acts of Parliament including the Trunk Roads Acts 1936 and 1946, Special Roads Act 1949, Highways Acts 1959 and 1980 and Road Traffic Acts 1972 and 1988. Scotland has its own specific legislation, which broadly parallels that in England and Wales. Highway law has its roots in common law, which is why, for instance, there is no strict definition of what constitutes a “highway”. The public has a general right to pass and repass on the highway, the only exception being motorways, where access is denied to pedestrians, cyclists and certain other classes of motor vehicle or road user.
59. The only specific safety duties on highway authorities of which we are aware are those placed on local authorities under Section 39(3) of the Road Traffic Act 1988. This requires local authorities to study road traffic accidents on their roads and take whatever measures they consider appropriate to prevent such accidents. In

general, highways legislation gives highway authorities powers rather than imposing duties upon them. Thus for example the Highways Act 1980 enables highway authorities to install whatever measures they consider appropriate to protect the safety of persons using the highway. But it does not place a duty on them to do this, nor to take action to safeguard persons or property adjacent to the highway.

60. There are many other duties in the road environment, but they rest largely on the users of roads and providers of vehicles rather than on the highway authorities. Many duties have their origins in protecting and enhancing road safety. Those relating to driver behaviour are enforced by the police. Those relating to the design and construction of vehicles are the responsibility of standards bodies and manufacturers. Continuing roadworthiness is maintained and enforced via the DVLA and the MoT test system.
61. The railways are more straightforward because there are far fewer operators and they are all governed in health and safety terms by the Health and Safety at Work (etc) Act 1974 and related regulations (HSWA). The Act imposes a general duty on employers to protect the health and safety not only of their employees but also of others affected by their operations (i.e. including the general public not using railways). Its provisions as they relate to railways are enforced by the Health and Safety Executive (HSE).
62. Implicit in the HSWA, and explicit in the Management of Health and Safety at Work Regulations 1999, is a requirement for every employer to make a suitable and sufficient assessment of risk. This assessment must cover risks to employees and anyone else potentially affected by the conduct of the employer's activities. The purpose is to manage health and safety risks down to the lowest reasonably practicable levels. Additional law specific to railway companies includes:
 - requirements to submit a Railway Safety Case to HSE before a licence to operate can be granted,
 - specific requirements relating to staff carrying out safety-critical tasks
 - requirements to obtain HSE approval for certain new works and equipment.It is not agreed whether section 3 of HSWA, which lays down the responsibilities of undertakings towards those not in their employment but affected by their actions, applies in the respect of the activities of highway authorities concerning road management
63. Railway companies thus have a duty to assess risks and to take any reasonably practicable steps to reduce them. Once necessary actions have been identified through this risk assessment process, railway companies have a legal obligation to carry them out. A general difficulty that arises here is that the railway company may identify action that needs taking outside the railway boundaries, where it has no authority to take action. Other people may not recognise or share its priorities for action, and even if they do, may not have the means to carry them out. This can be a particular issue at interfaces between the railway and the roads.

64. As a corollary of these differences in legal context, the authorities responsible for railways and roads adopt very different approaches to safety management generally. Different people and approaches are also involved in enforcement activity, accident investigation and accident and incident data recording.

Specific Risk Control Arrangements

65. The risk of accidents like Great Heck can be reduced by tackling any of the “building blocks” which make up Figure 1 above. The arrangements currently in place in the UK are described and discussed here under headings corresponding to each of those “building blocks”, and each of the steps by which they can cause harm to people. We start at the base of the Figure, with preventing road vehicles getting onto the railway, then examine mitigating the effects of incidents where this happens. The sequence of topics is thus as follows:

Prevention of Road Vehicles getting onto Railway property:

- a) preventing road vehicles leaving the road
- b) preventing vandalism-related causes
- c) preventing relevant careless behaviours on property next to the railway

Mitigating the Effects of Road Vehicles getting onto Railway property:

- d) preventing vehicles from reaching and obstructing railway lines
- e) preventing vehicles on the line being hit by a train
- f) preventing casualties to people in the road vehicle if hit by a train
- g) preventing impacts with road vehicles from derailing trains
- h) preventing casualties due to the derailment of a single train
- i) preventing a derailment leading on to a secondary collision, and
- j) preventing casualties due to secondary collisions

66. In each case, the arrangements are described loosely in the order of measures focused
- on the vehicle,
 - on the infrastructure, and
 - on the driving of vehicles or operating of transport services.

Preventing Traffic Accidents in which Road Vehicles Leave the Road

67. Many familiar road safety measures are directly relevant to prevention of vehicles from being driven off the road. Important elements, which are familiar to most drivers, include
- vehicle design and roadworthiness standards
 - highway design and maintenance
 - driver qualification and testing
 - speed limits, drink-drive law, road signs, traffic calming, education, promotion and other measures targeting driver behaviour, and
 - enforcement of the driver-related elements by the police.
68. Driver behaviour is the major factor in accidents where road vehicles leave the carriageway. Any measures that tackle the root causes of adverse behaviour, for example the “drink driving”, “speed kills” and “take a break” campaigns, will also assist in reducing the incidents at the basis of our pyramid of accidents (Figure 1) leading onto road vehicles obstructing the railway.

Preventing vandalism

69. Vandalism is a major safety issue for the railways and has been the subject of considerable research and multi-agency action. The main measures currently in place to control and reduce vandalism risks are:
- a) Enabling, for example via collection of incident statistics and targeting of local “hot spots”
 - b) Engineering, e.g. improving fences and barriers, installing closed-circuit TV
 - c) Education, e.g. school visits, distribution of educational resources and targeted promotional campaigns, and
 - d) Enforcement, in particular by the British Transport Police.
70. It is difficult to tackle vandalism through national action. The most effective measures are those targeted locally, where agencies work together to understand and remedy the root causes. Vandalism and other antisocial behaviours such as abandonment of vehicles on the road are significant at many other road locations besides places near railways, and are major issues for the Police. In respect of preventing road vehicles getting onto railway property, though, it is difficult to see how to tackle vandalism other than by starting at the railway locations of greatest concern.

Preventing careless behaviour on property next to the railway

71. There are many different behaviours involved here, from farm workers driving tractors and other farm vehicles through fences, through people leaving engines running in car parks and the vehicles moving off unattended, to drivers turning onto the railway when using level crossings. The principal protective measures are fencing and other types of barrier protecting railway property, crossing design, and public information and education (including signage at specific locations).
72. Railway companies have clear responsibility for the design and maintenance of level crossings. Most accidents at crossings, though, involve a significant element of driver behaviour. Road user behaviour at level crossings is covered by the Highway Code and relies on road safety-related measures and enforcement by the police. As regards access via locations adjacent to the railway, Local Authorities have an important role through their responsibility for planning decisions.

Preventing vehicles getting onto railway property from obstructing lines

73. Once a road vehicle has crossed the property boundary onto the railway, all that can prevent it from obstructing the line are its own lack of momentum, any residual control the driver has, and any physical barriers (ditches, earth banks or other structure) between it and the line. Highway fencing and edge barriers are thus of particular relevance to vehicles leaving the road near railways. Our review of these standards was less extensive than that carried out by the Highways Agency WG. We examined road and rail related standards in Great Britain and railway related European standards.
74. Important points we noted include the following.

- Barrier design is very important; the wrong type of barrier could increase risk for other road users.
- Highway authorities are required to consider the protection of road users. They also consider (though are not specifically required in highway law to do so) the protection of people or property off the road.
- Road standards differ for main roads (trunk roads and motorways) and for locally managed roads; many of the newer standards for the former do not apply to the latter.
- There are many, widely different types of roads, ranging from motorways to country lanes. Road Standards for motorways, or major high-speed roads may not be appropriate for all roads, and while they apply to all new trunk road construction, they are only commended to the local road authorities to be used. Furthermore, many are not applied retrospectively to existing roads infrastructure.
- Road standards define the need for barriers largely in relation to the characteristics of the road and the road traffic using it, not in relation to what is on the other side of the barrier.

75. A particular issue we identified is the practical difficulty in devising and implementing the best engineering solution to provide an effective barrier between road and railway. The appropriate location may not be on railway property. The railways have no power to erect barriers outside their property and do not have the competence to design barriers, which are optimal from the road traffic safety viewpoint. The highway authorities have the capability and the powers to erect barriers on their side of the boundary, but have no specific duty in law or resources to help them do it. In some cases, the best barrier for protecting the railway may not be the best barrier in terms of preserving road safety. Effective co-operation is necessary to achieve the best solution and overcome interface issues. Furthermore, the land on which measures could most effectively be sited may belong to neither the road nor the rail infrastructure owner. So the cooperation of a private landowner will be needed.

Preventing vehicles on the line being hit by a train

76. In the majority of cases where a road vehicle blocks a railway line, it is not struck by a train. This is usually because there are no trains imminent, and if time is available, a message can be passed through to the driver to stop in time. We now consider in turn the different possible ways in which trains can be stopped in time: automated systems, and communication of the hazard ahead to drivers in time for them to stop.
77. In occasional incidents where a road vehicle blocks a railway line, the vehicle bridges the rails and thereby closes the circuits which set the railway signal behind the vehicle to danger. This is very much the exception rather than the rule. Some railway lines at the end of airport runways are protected by tripwire systems, but they are unreliable and the cost of applying them at the road/rail interface would be prohibitive.

78. The principal means by which trains might be stopped in time before hitting a vehicle on the line is by getting information about the obstacle to the driver. This might typically involve
- someone at the accident site dialling 999
 - the police contacting Railtrack or other infrastructure controller
 - getting through to the person controlling that part of the network
 - the police and the railway controller managing to work out exactly where the obstruction is (road and rail descriptions of location often differ) and
 - the railway controller contacting the train driver by radio or train telephone or placing the signals at danger.

This mechanism will fail if either a) there are one or more broken links in the chain of communication, or b) it takes longer than the time until the next train for the chain to be completed. As the statistics show, this is often successful, particularly on lines with low rail traffic. For busy high speed lines such as the East Coast Main line at Selby, however, it is very unlikely that there will be time between trains for this to work, even with communications working perfectly¹².

79. We conclude that the mechanisms for stopping trains ahead of obstacles on the line are of limited effectiveness if there is a train approaching at the time the vehicle obstructs the line. If a road vehicle obstructs the line and a train is coming, then it is likely the road vehicle will be hit.

Preventing casualties to people in the road vehicle if hit by a train

80. The only measures that provide protection for people in road vehicles from impact by a train are
- the crashworthiness of the road vehicle,
 - the ability of the occupants to escape before the train arrives, and
 - the ease with which emergency services can reach the site.

Vehicle crashworthiness is probably important here more as a means of helping maintain the ability for the occupants to escape in the aftermath of a road accident than for protecting against the impact of a train.

Preventing impacts with road vehicles from derailling trains

81. The measures in place here are the design of the wheels and rails themselves, and the provision of obstacle deflectors on some trains. Road vehicles do not incorporate features to make them easy for trains to push out of the way after accidents.
82. The wheel/rail design has to optimise a very wide range of factors including adhesion, braking, preventing wheels slipping or climbing up the rails, ensuring effective operation of the signalling system and so on. The relevant standards aim

¹² It is important to note that trains cannot stop quickly like cars. Improvements in train braking are being introduced all the time, but their large weight, and very small contact area between wheel and rail, means that trains will always take many hundreds of metres (often well over a mile) to stop from normal line speeds. This means that the most obvious protection that applies to road vehicles stranded on the road after an accident, i.e. "Other drivers see it and brake in time", hardly applies at all to vehicles stuck on the railway, if there is a train already approaching.

to minimise the likelihood of derailment under all normal loads, but do not explicitly consider impact with road vehicles.

83. We were concerned early in our work to hear from Railway Safety members of the Working Group of the debate currently going on in European standards committees over the provision of obstacle deflectors. These are currently mandatory for British trains using the Railtrack network. But train standards are being harmonised across European markets to promote interoperability and create a larger single market for trains. There is no current TSI (the term used for European technical standards) relating to obstacle deflectors, which would have meant that Railtrack or other UK organisations might not have been able in future to insist on their fitment. Since we began our work, though, agreement has been secured that the next generation of TSIs will now incorporate this provision and our concern has been allayed.

Preventing casualties due to the derailment of a single train

84. The severity of casualties in a derailment depends on factors such as:
- whether the train stays upright,
 - whether the train stays within the safe “envelope” of space around it, and if not
 - what structures (bridges, tunnels, lineside structures) might get in its way, and
 - the crashworthiness of the train

While the suspension and wheels of trains are designed to maximise stability, the most important of these is train crashworthiness. This has improved steadily over the past few decades but can only reduce, not eliminate, the risk of casualties. It is already the subject of specific proposals and recommendations arising from Lord Cullen’s inquiry into the Ladbroke Grove accident.

Preventing a derailment leading on to a secondary collision

85. The points made in paragraphs 76-79 above all apply here. The big difference is that once the first train has stopped, trained railway staff are on hand. If they are not disabled by an accident, the first thought of any driver or guard is to protect his train and its occupants from other trains. Measures laid down in the railway Rule Book include the driver or guard:

- informing the network controller via telephone or train radio
- protecting any adjacent lines that are obstructed, by physically operating the track circuit and thus setting signals to danger
- providing additional protection by putting out detonators or using visual signals on the line behind the train (or on adjacent lines ahead of the train)

If all else fails, train staff will generally go to heroic lengths to warn any approaching trains, if necessary by themselves running up or down the line to warn approaching train drivers.

86. The key factor in all of this is time – if there is a good interval between the initial impact and other trains arriving then there is a good chance of stopping approaching trains. On a busy main line such as the East Coast Main line, there is far less opportunity to do this; at Great Heck there was none at all.

Preventing casualties due to secondary collisions

87. The measures are exactly the same as those described in paragraphs 81-83 for mitigating the effects on the second train and protecting it from further trains.

Conclusions

88. Our principal conclusions as to the current arrangements for managing the risk of road vehicles obstructing the railway are as follows.

- C3.1. Ownership of and responsibility for railways and roads are distributed between railway infrastructure controllers (principally Railtrack and London Underground Limited), highway authorities (the Highways Agency for trunk roads and Local Authorities for local public roads) and private road owners. Road and rail organisations manage risk in different ways according to their different legal duties and powers.
- C3.2. Railway companies have duties and obligations for protecting the railway which they cannot discharge without the co-operation of highway authorities, who have no specific corresponding duties to safeguard the railway.
- C3.3. A significant proportion of the risk to people in trains is attributable to vandalism and to vehicles getting onto the railway from places other than the roads. Highway authorities have little involvement in controlling these aspects of the risk, though Local Authorities have a role through crime and disorder partnerships and similar anti-vandalism measures. Leadership in this area thus relies largely on the railways (Railtrack in particular) to identify, prioritise and control risks as appropriate.
- C3.4. Measures are available for almost all aspects of prevention and mitigation of the effects of road vehicles obstructing railway lines, but once a vehicle is on the railway track there is little that can be done if a train is already approaching.
- C3.5. Most of the measures in place for preventing cars driving off the road in the first place are part of a much wider set of road safety arrangements. Measures to combat driving whilst not fit to do so, and to curb excess or inappropriate speed, are highly relevant to the reduction of the risk of road vehicles getting onto the railway.
- C3.6. There are potential barriers to improving the management of risk from road vehicles getting onto railways, associated with the different road and rail duties and powers. In particular these are:
 - a) reporting and recording of accident and incident information, and
 - b) devising and putting in place the optimum engineering measures to prevent vehicles which leave the road from getting onto the railway.

OPTIONS FOR IMPROVEMENT

89. We concluded in Section 3 that blanket application of measures at all locations where roads and railways meet would be ineffective and inappropriate. Our aim in this section is to look across the range of possibilities and identify, for those locations assessed as higher risk, what sort of measures are likely to be more and less effective in reducing risk. We will then consider the practicalities of putting those measures in place in Section 6 before reaching our final conclusions and recommendations.
90. We were greatly assisted in developing our ideas as to possible risk reduction measures by the site visits carried out by HSE, and by the stakeholder workshops held in the summer of 2001 (as described in Table 1 and para 30 above).
91. The first and most general opportunities we see for improvement are those that would help better to rank the specific local risk and identify any worthwhile improvement actions. The main opportunities here are:
- to improve the reporting and recording of incidents where road vehicles get onto railway property, enabling both rail and road details for each incident to be accessed, and
 - to rank in terms of risk locations throughout Great Britain where railways and roads meet, in order to divide such locations into those where no action should be considered (which we would expect to be the great majority) and those where risk reduction options should be explored and actioned as appropriate.
92. Specific options for tackling the different parts of the accident and event pyramid in Figure 1 are summarised below, with our comments and observations. We have used the same framework of headings as was used to describe the current arrangements in the previous section. In each case we have considered opportunities both a) to improve the application and effectiveness of existing measures, and b) to introduce new or different measures.
93. **Preventing road traffic accidents in which vehicles leave the road:** Vehicle design and condition are not significant factors in most accidents where road vehicles leave the road. The focus here should be on driver behaviour. National level initiatives already in place to curb excessive speeds and to prevent people from driving whilst incapacitated by drugs, alcohol and fatigue are all highly relevant to reducing this risk. Local initiatives at higher risk locations should focus on measures that will significantly reduce the risks a) of drivers leaving the road through inattention or fatigue, and b) of drivers entering the location at excessive or inappropriate speeds. Possible measures to consider include
- warning signs, lighting and markings on the road
 - textured road surfaces to alert drivers to a hazard or of the road edge
 - reduced speed limits
 - traffic calming measures to encourage lower speeds

94. **Preventing vandalism leading to vehicles obstructing railway lines:** Opportunities here are to build on current national anti-vandalism campaigns, in particular:
- to identify higher risk locations through analysis of past incidents, using railway and British Transport Police vandalism incident records (these record thousands of incidents each year, not just the handful that involve a vehicle being placed or left on railway property),
 - to deter and, in conjunction with relative agencies and adjacent landowners, prevent access to railway property, using an appropriate mix of (for example) fencing, earthworks to make it harder to push a vehicle onto the line, lighting, closed circuit TV, and
 - to increase enforcement activity at higher risk locations.
95. **Preventing other careless or wilful behaviour on property next to the railway leading to vehicles obstructing the line:** This is a very widely and thinly distributed problem, where action is only likely to be warranted when a particularly high risk location has been identified. Public education aimed, for example, at farm vehicle drivers would be unlikely to be effective as the behaviour being targeted is so rare. The best opportunity here is probably at half barrier level crossings, where it may be worth considering further warnings, signs and deterrents in situations where a road vehicle driver could more easily turn onto the railway line and drive along it.
96. **Preventing vehicles from reaching and obstructing railway lines:** For high risk locations, we believe that engineering solutions should be considered which optimise the likelihood of stopping a road vehicle before it reaches the railway line, regardless of where the exact boundary lies between railway and highway property. “Optimise” here means taking into account the effect on other road users and access to the railway, as well as the usual engineering considerations of achieving the best use of resources to reduce the risk.
97. **Preventing vehicles on the line being hit by a train:** We have received a number of interesting ideas in this category, involving either a) modifications to the signalling system, or b) enhancing communication between accident scene and train drivers. Having considered the tripwire type system used in France and various ideas suggested for automating the supply of visual information to train drivers, we rule out large-scale retrospective introduction of new systems for setting signals to danger when road vehicles get onto a railway line. This is because we consider that the reliability and effectiveness of such measures would be very limited, while the disruption, cost and other risks of their adoption could be very substantial. Such measures may be worth considering in special “new build” cases.
98. At higher risk locations, it may be worth considering ways to improve communication to train drivers, for example by ensuring the telephone number for the local railway network controller is prominently displayed at the site. Experience with level crossing telephones suggests that it is better to provide access to telephone numbers than to provide dedicated telephones, which quickly

get vandalised so are ineffective. This approach, though, is unlikely to achieve major risk reductions for busy high speed railway lines.

99. **Preventing casualties to people in the road vehicle if hit by a train:** With so many other more important factors driving improvements in road vehicle crashworthiness, improvements for this specific purpose should not be considered.
100. **Preventing impacts with road vehicles from derailing trains:** We note the significance of preventing the removal of the standard requiring obstacle deflectors on British trains when European rolling stock standards are introduced in the UK. We are now largely satisfied that this has been addressed.
101. **Preventing casualties due to the derailment of a single train and due to secondary collisions:** The most important type of measure here is crashworthiness of the train, the requirements for which should be established in light of the entire spectrum of collision and derailment risks faced by trains, to which this scenario is one small contributor.
102. **Preventing a derailment leading on to a secondary collision:** See paragraph 85. Further measures to enable train staff to protect the train in the event of derailment are not warranted in respect of this particular risk, which is a very small contributor to the more general requirements for train staff response to accidents.
103. On the basis of the above discussion, our conclusions as to the measures likely to prove more effective for improving the management of the risk of road vehicles obstructing railways (before having considered the practicalities of implementation) are as follows:
 - C4.1. Improvements in the recording and reporting of incidents where road vehicles get onto railway property, so that road and rail attributes are available for all relevant incidents
 - C4.2. Development of tools, methods and data to enable risk ranking and subsequent detailed onsite risk assessments to be made at local level as quickly, easily and reliably as possible
 - C4.3. At higher risk locations, measures to prevent road vehicles getting onto the railway line in the first place are likely to offer more opportunity for effective risk reduction than measures to mitigate the risk of such obstructions, once the road vehicle is on the line.
 - C4.4. The first consideration at higher risk locations should be of measures that would improve driver performance and behaviour so as to ensure the driver stays on the road.
 - C4.5. The second consideration at higher risk locations should be of engineering measures to prevent vehicles leaving the road from reaching the railway. These should be optimised without regard to the location of the boundary between road and railway property.
 - C4.6. The clear corollary of asking for risk reduction to be considered at high risk locations is that risk should be assessed for all locations where roads and railways meet, in order to separate the low and high risk locations and to prioritise higher risk locations for assessment of risk reduction possibilities.

PRACTICALITIES AND RECOMMENDATIONS

104. So far in this report we have:

- examined the scale and significance of the risk of road vehicles obstructing the railway
- learnt all we could about the risk to guide us towards ways to manage and reduce it
- examined how the risk is managed today, and
- identified the most likely opportunities for improvement.

We now consider the practicalities of making such improvements happen and develop our recommendations as to how best to effect those improvements.

105. We shall consider in turn the chronology of events implied in our conclusions to the previous section, that is

- enabling risk assessment of places where roads and railways meet
- assessing risk at places where roads and railways meet nationwide
- assessing improvement options at relatively high risk locations, and
- making those improvements happen.

In our recommendations below we set out some indicative timescales. These assume rapid acceptance of the report, enabling a quick start to be made.

Enabling Risk Assessment

106. The north east of England and London Underground initiatives to develop and apply an assessment methodology for road bridges over railways has demonstrated the feasibility of assessing at local level the comparative risks of sites. We applaud these developments of practical tools by and for highway and railway professionals, but see two main difficulties in extending this work more widely (i.e. to nationally managed roads and to situations other than road bridges over railways):

- a) the risk assessment tools and methods will require significant further work, and
- b) the information to enable such assessments may be difficult to gather because of the difficulties recording and reporting the details of relevant incidents.

107. The effort involved in developing and validating risk assessment tools and models is considerable. This task should be managed, led and funded centrally in the interests of efficiency and of the quality and coherence of the risk assessments to be carried out.

Recommendation 1: DTLR should lead, with the involvement of relevant interested parties, the development of tools and data for use at local level by highway and railway professionals to carry out comparative assessments of the risks of road vehicles obstructing the railway at specific sites.

The tools should be useable for both locally and nationally managed roads, and for locations including road bridges over railways, locations where roads

and railways run close together as well as locations where road vehicles can gain access to the railway via adjoining land. The tools should recognise the large numbers of assessments to be carried out and the large numbers of sites likely to be low risk. They should provide the simplest and fastest possible way to separate low risk sites from those requiring further assessment. The aim should be to complete this work within a year of acceptance of the report.

108. The current arrangements for reporting and recording of incidents in which road vehicles obstruct the railway is an obstacle to better management of this risk. Relevant incidents are recorded in SMIS and other railway incident recording systems, but include little or no information about the road characteristics. Road accidents are recorded via STATS-19 forms only if road vehicle occupants are killed or injured, and then not reliably for cases where the injuries take place on railway premises rather than on or adjacent to the road.
109. Extending the scope of coverage of STATS-19 is attractive, but there are many changes that could be made to STATS-19 that are likely to have a higher priority in road safety terms. The cost of making changes to STATS-19 is very considerable. Even for a small change in STATS-19, many thousands of police personnel need to be retrained and supervised in introducing and using the changed form in order for the information to be obtained reliably and consistently.
110. The railway incident recording systems could relatively easily record all relevant information about the road circumstances of incidents in which road vehicles get onto railway property. The problem in this is that the managers of the railway databases have no access to relevant police information. Our recommendation here is thus for steps to be taken to enable railway incident databases to become the repository for, and resource for analysis of, all information about incidents in which road vehicles get onto railway property.

Recommendation 2: DTLR should lead a collaborative initiative involving HSE, railway infrastructure controllers and relevant police authorities to ensure that relevant information in respect of both rail and road aspects of any incident (broadly equivalent to that contained in SMIS and STATS-19 data fields) is collected as far as practicable for all incidents in which road vehicles get onto railway property. The aim should be to complete this work by April 2002.

Recommendation 3: Railway Safety, London Underground and other railway infrastructure controllers should adapt their incident recording systems to enable collection and analysis of all such relevant information. The aim should be to complete this work by April 2003.

Carrying Out Risk Assessments

111. There are many thousands of locations nationwide to be assessed, so the ease of application and use of the tools developed under Recommendation 1 is critical. We anticipate that the main steps in carrying out risk assessments will be
- identifying locations to be assessed
 - applying a quick “first pass” tool to filter out the low risk locations

- applying the “main” tool to assess the remaining locations.

Locally and nationally managed roads, the national and other railways, different types of location and deliberate as well as accidental causes all need to be addressed in order to deal with all the significant elements of the risk. There is thus potentially a lot of work to be done here by already busy and stretched organisations.

Recommendation 4: Those responsible for road and rail infrastructure, listed below, should lead programmes of risk assessment work to achieve coverage of those sites identified by application of the tools required by Recommendation 1, as requiring further attention. The parties should collectively establish a consistent basis for classifying locations into higher risk (those where an assessment of options for improvement should be made) and lower risk (those where no action need be taken). At many locations there may be no reasonably practicable measures to be taken beyond what is already in place. Where reasonably practicable measures are identified, they should normally be implemented within two years of identification. DTLR should maintain general oversight of this programme.

Table 4: Principal Parties for Risk Assessment Programme

Cause/Location	Locally managed roads	Nationally managed roads
Road traffic accidents – road bridges over railway	Local Authorities	Highways Agency, Scottish Executive, National Assembly for Wales
Road traffic accidents – roads alongside railway	Local Authorities	Highways Agency, Scottish Executive, National Assembly for Wales
Accidents on private roads or land adjoining railway	relevant railway infrastructure controller or premises controller	
Vandalism	relevant railway infrastructure controller	

Determining An Appropriate Response to the Risk Assessment

112. We have concluded (C4.3) that preventing road vehicles getting onto the railway in the first place offers a more attractive general way forward than mitigating the effects once they are there. There remains, though, a long menu of possible measures to be explored, aimed both at keeping drivers and their vehicles on the road in the first place, and at preventing them reaching the railway line if they leave the road. It would be inefficient for local assessors independently to carry out from first principles an evaluation of the measures available, and which is best for their circumstances, for each individual location.
113. There also remains the considerable practical problem that the solutions available to Railtrack and other railway infrastructure controllers to discharge their duty of care to protect the railway are sub-optimal. This is because the infrastructure

controllers on their own have no power to carry out works beyond the boundary of railway property, while highway authorities have no specific legal duty to cooperate in finding the best ways to stop errant vehicles reaching the railway.

Recommendation 5: DTLR should lead, in collaboration with HSE, railway infrastructure controllers and the highway authorities, the development of guidance on the proportionate application of available measures suited to different circumstances for the management of risk at specific locations where roads meet, cross or run close to railways. This initial work should be developed to the status of good practice guidance, paying particular regard to ensuring that the practices recommended are those, which are appropriate and provide the most effective control of risk for a given use of resources, regardless of which party will then carry responsibility for implementation. The aim should be to have the main elements in an initial suite of guidance available by April 2003 and refined in the light of experience.

114. Assessment is very important, but unless it is followed by action it is a waste of time and energy. The road/rail interface is a good example of a situation where assessment could be followed by inaction unless it is clear who is responsible for doing what, which is not the case at the moment. Changes in law would be time-consuming and would involve many other, bigger issues than the impact of road accidents on the railway. But this should not be an excuse for allowing the status quo to continue, where in respect of road traffic accidents Railtrack has a duty of care to protect the railway, but highway authorities have no reciprocal specific duty of care to prevent people and property off the road from accidents on it.

Recommendation 6: DTLR should lead, in collaboration with HSE and others with a relevant interest, the development of a protocol for apportioning responsibility and costs of improvements made at locations where roads meet, cross or run close to railways. The aim is to have this developed by April 2003.

115. We are aware of many instances of successful road/railway collaboration despite the absence of specific legal duties on highway authorities to consider risks to people off the road as part of their road safety obligations. Notwithstanding such examples, though, and our Recommendation 6 above, we consider it inconsistent with good governance that the duties and responsibilities of highways and of railway organisations should differ so significantly in respect of the duties of the parties for the management of risk at their interface.

Recommendation 7: Once the protocol recommended above (Recommendation 6) is in place and action on the other recommendations in this report is underway, DTLR should conduct a review of progress to determine that the response is proportionate to risk and to see what further action (if any) is required. This should include review of arrangements for governance and management of safety risks at interfaces between roads and railways. The review should consider the nature and scale of the risks involved, alternative possible models for governance of those risks, and the effectiveness of the protocol developed in response to Recommendation 6.

GLOSSARY

DTLR	DEPARTMENT FOR TRANSPORT, LOCAL GOVERNMENT AND THE REGIONS
DVLA	DRIVER AND VEHICLE LICENSING AGENCY
ECS	EMPTY COACHING STOCK
HGV	HEAVY GOODS VEHICLE
HMRI	HER MAJESTY'S RAILWAY INSPECTORATE
HSC	HEALTH & SAFETY COMMISSION
HSE	HEALTH & SAFETY EXECUTIVE
HSWA	HEALTH AND SAFETY AT WORK ETC ACT 1974
MoT	MINISTRY OF TRANSPORT
PACTS	PARLIAMENTARY ADVISORY COMMITTEE ON TRANSPORT SAFETY
RHDR	ROMNEY HYTHE AND DYMCHURCH RAILWAY (NARROW GAUGE)
RIDDOR	REPORTING OF INJURIES, DISEASES AND DANGEROUS OCCURENCES REGULATIONS
RTA	ROAD TRAFFIC ACCIDENT
SMIS	SAFETY MANAGEMENT INFORMATION SYSTEM
STATS-19	FORM USED BY POLICE TO RECORD DATA ABOUT ROAD ACCIDENTS
TSI	TECHNICAL SPECIFICATION FOR INTEROPERABILITY
UCL	UNIVERSITY COLLEGE LONDON



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