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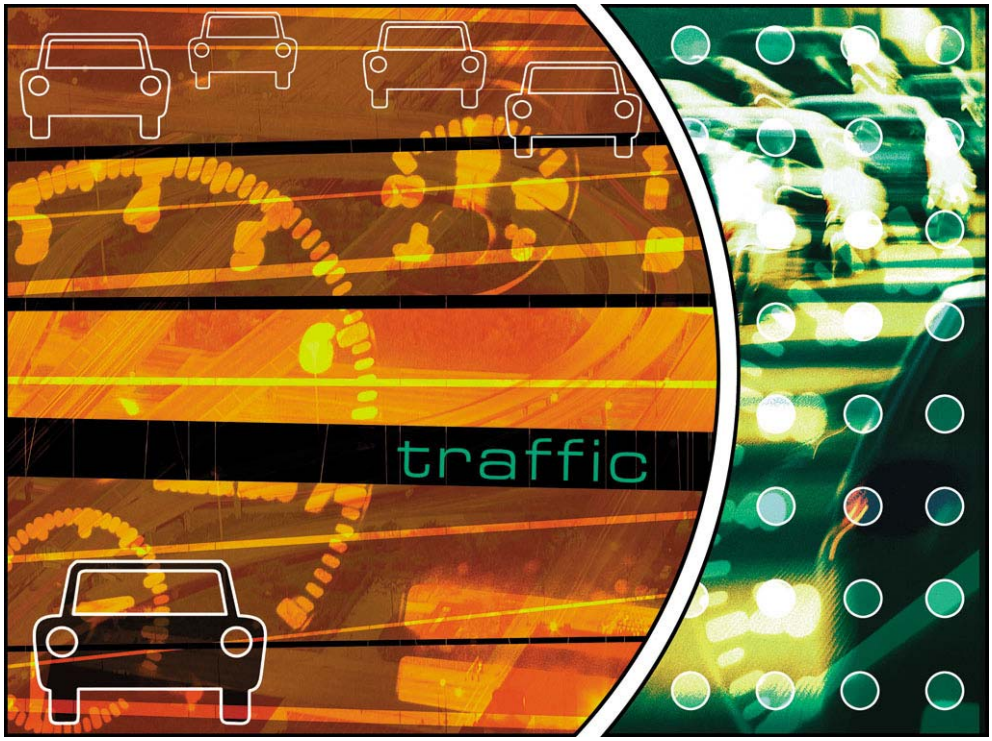
Research paper

11 February 2003



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A cost recovery system for speed and red-light cameras ~ two year pilot evaluation

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Prepared for: Department for Transport, Road Safety Division

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Key definitions used

Personal Injury Accident - An accident involving personal injury occurring on the public highway (including footways) in which a road vehicle is involved and which becomes known to the police within 30 days of its occurrence. One accident may give rise to several casualties. Damage-only accidents are not included in these figures.

Killed - Human casualties who sustained injuries that caused death less than 30 days after the accident.

Serious Injury - An injury for which the person is detained in hospital as an in-patient, or any of the following injuries whether or not the casualty is detained in hospital: fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident.

Slight Injury - An injury of a minor character, such as a sprain, bruise or cut, which is not judged to be severe, or slight shock requiring roadside attention. This definition includes injuries not requiring medical treatment.

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EXECUTIVE SUMMARY

In April 2000, a cost recovery system for speed and red-light cameras was introduced in eight pilot areas in England, Wales and Scotland. The eight areas were selected to represent a range of geographies, casualty reduction strategies and enforcement technologies. In the first two years of operations, the following results have been achieved:

- **Speed is down** – Based on a large number of speed surveys vehicle speeds have dropped following the introduction of both fixed site and mobile speed cameras (see section 2.4 for definitions). The reduction in speed has been greatest in urban areas.
- **Casualties are down** – Where cameras were introduced, there has been a statistically significant reduction in casualties[1]. The greatest reduction has been in killed and serious casualties. The number of pedestrian casualties has also fallen significantly. In the last two years, killed and serious casualties at camera sites have fallen by 35% compared to the long-term trend. In terms of enforcement technology, fixed site cameras have had the greatest impact (65% reduction), and mobile speed cameras have also proved effective (29% reduction). Cameras appear to be equally effective in urban and rural areas.
- **Public reaction has been positive –** Public attitude surveys indicated that the majority of the public support targeted camera enforcement. There has been significant demand locally for enforcement.

In the two years of the pilot operation there have been important lessons learned that should inform future decisions on camera enforcement. In this report, we set out the results from the pilot areas and assess the implications for speed and red-light camera enforcement in the future.

Background

Speed and red-light enforcement cameras (referred to collectively as "safety cameras") were first deployed in the early 1990s. A large number of research studies have been conducted both in the UK and abroad. These have proved that cameras can be an effective means of reducing speed and casualties. One research study, conducted by the Home Office in 1996[i], concluded that, whilst cameras were effective at reducing casualties, the full benefits were not being realised due to budgetary constraints. The same study noted that these constraints could be removed by allowing local road safety groups to recover enforcement costs from fine income. At the time, all fine income was transferred to the Treasury consolidated fund.

In 1998, the Department for Transport (DfT then the DETR) and other Government Departments took a policy decision to allow local partnerships, subject to strict Treasury criteria, to recover the costs of speed enforcement.

In order to understand fully the policy implications of this decision, DfT decided to pilot the system in eight areas. The pilots were launched in April 2000 and were originally envisaged to run for two years. However, results from the first year were so encouraging that the Government took the decision to extend the system nationally, subject to meeting certain criteria. Legislation was introduced to allow this in the form of the Vehicles (Crime) Act 2001.

This report presents an analysis of the results in the eight pilot areas for the first two years of operation.

Approach

In 1999, a national project board was set up to oversee the introduction of the cost recovery system. This included representatives from the Association of Chief Police Officers (ACPO), the Home Office, Department for Transport (DfT), Lord Chancellor's Department (LCD), the Scottish Executive, National Assembly for Wales, Crown Prosecution Service (CPS), Her Majesty's Treasury (HMT), the Highways Agency, the County Surveyors Society (CSS) and the Local Government Technical Advisors Group (TAG).

All areas were invited to submit bids to be part of the pilot exercise. From 13 bids, the project board selected eight areas that represented a good mix of demographics, enforcement experience and strategies. The eight areas also were using different types of enforcement technologies

[1] All statistical tests in this study were undertaken at the 5% significance level

including fixed site, mobile and digital cameras. A wide range of approaches was selected in order to identify best practice.

The eight areas selected were Thames Valley, South Wales, Strathclyde (Glasgow), Nottingham (City), Essex, Lincolnshire, Cleveland and Northamptonshire.

In order to set up the system, each of the eight pilot areas was required to form a local partnership. Core membership included local authorities, Magistrates' courts, the Highways Agency and the police. Treating road casualties represents a significant cost to the Health Service and some pilot areas also actively involved their local NHS Trusts.

In terms of timing, this report covers the period from April 2000 to the end of March 2002. In June 2002 the Government introduced stricter criteria on camera signing and visibility, however, this falls outside of the two-year period and does not form part of the analysis presented here.

Performance measurement

In terms of evaluation, the pilot could be considered a success if there was:

1. A significant reduction in speed and casualties in areas where cameras are operating
2. General public acceptance of the road safety benefits
3. Satisfactory working of the funding and partnership arrangements.

Since April 2000, each of the pilot areas has been providing regular monitoring information to the national project board. This report is based on an independent analysis of this data by University College London (UCL) and PA Consulting Group.

Speeds dropped at target sites

As part of the pilot, each area was asked to conduct speed surveys at camera sites before installation and then periodically after. This was to assess the immediate and long-term impacts on vehicle speed.

Over 1000 speed surveys have been conducted. Specifically, these show that:

- The vast majority of sites surveyed have demonstrated a reduction in speed. Average speed across all sites dropped by around 10% or 3.7mph
- The reduction in speed is more noticeable at fixed camera sites. At these sites the number of vehicles exceeding the speed limit dropped by 67%, compared to 37% at mobile sites
- The reduction in vehicle speed was particularly noticeable in urban areas (with 30mph and 40mph limits). Average speed fell by 12-13%
- At camera sites, excessive speeding (defined as the proportion of vehicles exceeding the speed limit by more than 15mph) has virtually been eliminated. This fell by 96% at fixed camera sites and by 55% at mobile camera sites
- This demonstrates that speed cameras, of all types, reduce vehicle speed. There is strong evidence that these reductions have been sustained over time.

There have been significant reductions in casualties

UCL developed a statistical model (details attached in Appendix H) to assess the impact on casualties compared to the long-term trend on a site-by-site basis. This compared results from the first two years in the eight pilot areas with the rest of Great Britain. Where possible, results were compared for different enforcement technologies, in urban and rural conditions, and for different enforcement strategies. Overall, 599 sites have contributed to the analysis.

The following statistically significant results were found:[2]

- In the six pilots, there was a 35% reduction compared to the long-term trend of the number of people killed or seriously injured (KSI) at camera sites during the first two years. This equates to around 280 fewer KSI casualties

[2] During the study period there was a change in the recording of serious casualties in South Wales and Thames Valley and so their casualty results have been analysed separately to the other six pilots.

- In the same six pilots, there was a 14% reduction compared to the long-term trend in the number of personal injury accidents at camera sites. Taking into account all eight pilot areas the overall reduction in accidents was about 6% at camera sites. This means there were about 510 fewer accidents in the first two years
- In the six comparable pilot areas (the whole partnership areas not just at camera sites) the annual number of killed and serious injuries has fallen to 4% *below* the long-term trend. In this respect, the six areas have outperformed the rest of Great Britain. This means that across the six pilot areas there were about 530 fewer people killed or seriously injured. A little over half of this reduction occurred at camera sites
- There were reductions in casualties at both fixed and mobile camera sites. The former appeared to be the most effective – on average, killed and serious casualties fell by 65% at fixed and 28% at mobile sites. This was consistent with results from the speed surveys
- Cameras appear to work equally well in urban and rural areas. The reductions in KSI casualties for fixed and mobile cameras were broadly consistent with the 35% in the six pilot areas
- The reduction in the number of pedestrian KSI casualties per annum is highly encouraging. At camera sites, there was a 56% reduction
- On current trend the pilot areas are making good progress to meet their 2010 road safety targets.

The majority of the public accept targeted enforcement

As part of the evaluation, the pilots were encouraged to conduct independent surveys to monitor public attitudes towards cameras. In all cases, these have demonstrated that the majority of the public supported the approach to speed enforcement in the pilot areas. All pilot areas have put significant effort into communicating the dangers of excess speed and the rationale for the introduction of speed and red-light cameras.

- The level of public support for the use of cameras has been consistently high with 80% of people questioned agreeing with the statement that 'cameras are meant to encourage drivers to keep to the limits not punish them'.

Fine income is now being used to target local priority sites and routes

The introduction of the cost recovery system has been a good example of joined-up government at both a national and at a local level. The process has enabled a more consistent and rigorous approach to enforcement. It has freed up resource to focus on local target routes.

- All of the eight pilots have had their accounts independently audited and have received clear audit certificates. This means that the funds are being used for the purpose intended – to reduce speed and to reduce casualties.

In total, the system has released around £20m of additional funds for local partnerships to spend on speed and traffic signal enforcement and raising public awareness of the dangers of speeding. This money would have normally been returned to the Treasury. The benefits to society, in terms of the value of casualties saved, are estimated to be in the region of £112m in the first two years.

Conclusions

In terms of speed and casualty reduction, and public acceptability, it can be concluded that the system has been extremely successful. The cost recovery system has worked well at both a national and at a local level.

Following the success of the pilot, the system is now being introduced nationally. At the time of writing, the project board have approved 33 areas[3] to join the system and more are expected to join during the 2003/4 financial year.

[3] The 33 areas that have been approved to join are: Avon & Somerset, Bedfordshire, Cambridgeshire, Cleveland, Derbyshire, Devon & Cornwall, Dorset, Dyfed-Powys, Essex, Fife, Gwent, Grampian, Hampshire, Hertfordshire, Kent-Medway, London, Lincolnshire, Leicestershire, Lancashire, Nottinghamshire, Northamptonshire, Norfolk, North Wales, Staffordshire, Strathclyde, South Wales, South Yorkshire, Sussex, Thames Valley, Warwickshire, Wiltshire, West Yorkshire and West Midlands. Cheshire has been approved for an April 2003 start.

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1. INTRODUCTION

Road safety strategies involve a number of differing elements, broadly based around a balance of education, engineering, and enforcement measures. Although education and engineering have an important role to play, this report focuses on the impact of camera enforcement. Specifically, it examines results from a system that allows local partnerships to recover the costs of camera enforcement (and associated public awareness activity) from fixed penalties imposed on offenders.

1.1 CONTEXT OF THE SYSTEM

In 2000, there were 3,108 fatal, 32,499 serious and 198,122 slight accidents reported in Great Britain. These resulted in 3,409 fatal, 38,155 serious and 278,719 slight casualties. In cost-benefit terms the value of prevention of these 233,729 injury accidents is estimated to have been £12,170m based on 2000 prices and values. In addition, there were an estimated 3.5m damage-only accidents valued at a further £4,789m. **The total value of prevention of all road accidents in 2000 was therefore estimated to have been £16,959m[ii].**

In 2000, the Government published the 10-year road safety strategy[iii]. This set out casualty reduction targets for 2010. These were:

"By 2010 we want to achieve (compared with the average for 1994-98):

- *40% reduction in the number of people killed or seriously injured in road accidents*
- *50% reduction in the number of children killed or seriously injured*
- *10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres"*

The road safety strategy set out a wide range of initiatives to achieve these targets. One initiative was to introduce a cost recovery element for speed and red-light camera enforcement.

"Cameras have proved their effectiveness in enforcing speed limits and reducing speed-related accidents and casualties at accident hot spots. They are costly to install, operate and maintain, but these enforcement costs cannot be directly recovered by the police and local authorities where a fixed penalty notice is used. Only where cases are heard in court may the police and others claim their costs. To address this funding problem the Government now accepts that those responsible for installing and operating cameras should be able to retain some of the fine revenue from offences detected by camera, to cover their costs. This would enable better use to be made of existing cameras and for additional cameras to be introduced for road safety purposes. The next generation of cameras will be digital, offering greater capacity and flexibility at lower cost.

"We are developing a funding system with effect from April 2000 to enable local authorities, the police, magistrates' courts committees and other agencies involved in the enforcement process to have some of their camera enforcement costs refunded from a proportion of the fine revenue. *A scheme to pilot a new funding system is being planned and, if successful, will become available country-wide."*

The funding system, referred to in the strategy, was introduced in eight pilot areas in April 2000 and is now being introduced nationally. This report evaluates the success of the pilot after two years.

1.2 HISTORY OF CAMERA ENFORCEMENT

Automatic enforcement cameras were first deployed in Great Britain in the early 1990s and a number of independent research studies have demonstrated their effectiveness. A 1996 Home Office research report demonstrated that they can be a valuable road safety tool, however, the full benefits were not being realised because of budgetary constraints.

In December 1998, the then Department for the Environment, Transport and the Regions (DETR), now the Department for Transport (DfT), strongly supported by other Government Departments, took a policy decision to allow fine revenue from enforcement cameras to be used to refund the costs of their installation and maintenance. This would be the first self-financing road safety system in Great Britain and would, in turn, free up resources to be spent on other local priorities, such as engineering and education.

The process of allowing agencies involved in camera enforcement to recover their costs is sometimes termed 'netting-off' or 'hypothecation', but the term 'cost recovery' is more generally understood and will be used in this report.

Her Majesty's Treasury criteria to allow fines and penalties to be recovered are:

- Will performance against policy objectives, e.g. crime-fighting and prevention, be likely to be improved?
- Are arrangements in place which will ensure that the activity will not lead to the abuse of fine and penalty collection as a method of revenue raising and that operational priorities will remain undistorted?
- Will revenues always be sufficient to meet future costs, with any excess revenues over costs being surrendered?
- Can costs of enforcement be readily identified and apportioned without undue bureaucracy, and with interdepartmental and inter-agency agreement where necessary?
- Can savings be achieved through the change and are adequate efficiency regimes in place to control costs, including regular efficiency reviews?

Because of the complexity of the arrangements required to introduce the system, it was decided to pilot the approach in eight areas. The aim was to develop a system that delivered real road safety benefits but was paid for by offending drivers, rather than through taxation. To manage the pilot system, a national project board was set up which included representatives from the Association of Chief Police Officers (ACPO), the Home Office, Department for Transport (DfT), Highways Agency, Lord Chancellor's Department (LCD), the Scottish Executive, National Assembly for Wales, Crown Prosecution Service (CPS), Her Majesty's Treasury (HMT), the County Surveyors Society (CSS) and the Local Government Technical Advisors Group (TAG).

In order to set up the system, the eight pilot areas had to form local partnerships. These comprised representatives from local police forces, highway authorities, and Magistrates' courts and, where appropriate, the Highways Agency. Some of the areas also involved other local agencies recognising that a reduction in casualties has wider benefits to society. A reduction in road casualties would have great positive knock-on effects and also be beneficial to the health, ambulance and fire services.

The pilot was scheduled to last for two years, but the evidence of casualty reduction after one year was so compelling that an early decision was made to introduce the system to other areas. At the time of writing, 33 areas have been accepted onto the programme and most areas of Great Britain are expected be accepted on to the system in 2003/4. There are also plans to introduce the system in Northern Ireland.

This report focuses on the performance of the eight pilot areas during the first two years of the system.

1.3 REPORT STRUCTURE

This report is divided into seven chapters with supporting evidence in the Appendices.

Chapter two ~ background to the pilots and description of the process

Chapter three ~ summary of the impact cameras have had on vehicle speed

Chapter four ~ impact the cameras have had on casualties and accidents

Chapter five ~ findings from local public attitude surveys

Chapter six ~ costs and benefits of the system to date

Chapter seven ~ conclusions and recommendations

2. BACKGROUND TO THE PILOT STUDY

Before discussing some of the results from the pilot areas, we describe the process by which the eight areas were selected, the evaluation criteria, the range of enforcement technology used and the mechanism for cost recovery.

2.1 PILOT AREA SELECTION

The pilot system was designed to test the workability and benefits of enabling local agencies to recover the costs associated with camera enforcement.

All areas were invited to submit bids to the camera project board. From the 14 expressions of interest and 13 applications received, the project board selected eight areas to pilot the system. One of the objectives of the pilot was to identify best practice and areas were selected that had differing enforcement strategies, demographics and technologies. The eight areas also represented a broad range of experience in using camera enforcement.

The map below shows the eight areas that began piloting the system in April 2000. These were:

- Strathclyde (Glasgow only)
- Cleveland
- Nottingham City
- Lincolnshire
- Northamptonshire
- Thames Valley
- Essex
- South Wales

In terms of experience, four of the pilots (Essex, Thames Valley, Strathclyde and South Wales) had already used cameras extensively whilst the four others (Cleveland, Nottingham, Northamptonshire and Lincolnshire) had relatively little experience.

Strathclyde (Glasgow) and Nottingham were the most urban areas and Lincolnshire was the most rural, with the remaining areas being a mix of both urban and rural.

2.2 EVALUATION CRITERIA

The purpose of the pilot was to establish the workability, effectiveness and acceptability of a cost recovery system. This report is based on two full years of data, and principally addresses the following three questions:

- Has there been a demonstrable reduction in speed and casualties where the cameras were operating?
- Has there been general public acceptance of the road safety benefits?
- Have the cost recovery arrangements worked in practice?

2.3 THE COST RECOVERY MECHANISM

The main principle behind the introduction of a cost recovery system is that the fine income from the conditional offer of fixed penalties imposed for speeding and red-light running could be reinvested by local partnerships rather than paid direct to HMT.

However, it was not straightforward to pass money collected by the courts, in the form of penalties, to the police and local authorities involved. There were important issues of legality, accountability and timing that needed to be resolved – not least of which was the need to maintain a clear audit trail. This was necessary to ensure that the system did not distort operational priorities, for example using the system to generate revenue rather than address a specific problem.

Existing legislation (Justices of the Peace Act 1997) required Magistrates' Courts to pass all fine and fixed penalty revenue to the LCD. There was, therefore, no opportunity to recycle funds locally without them being passed through a central Government Department. The system for recovering penalty revenue that was set up in England and Wales is shown in figure 1.

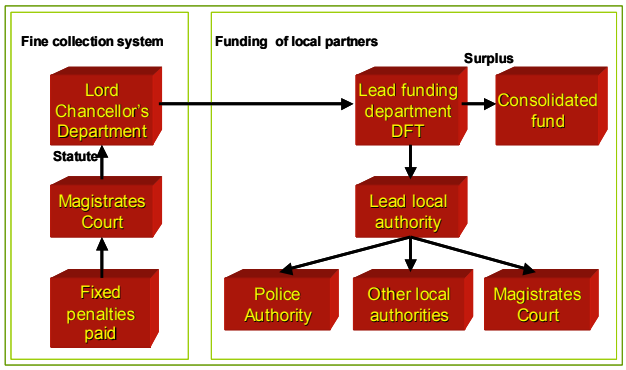


Figure 1 *Description of the cost recovery process*

The key points to make regarding the cost recovery mechanism are:

- All receipts from the fines generated from enforcement cameras are passed from Magistrates Courts to the LCD, which passes funds to the lead policy Department. This is the DfT as cameras are a policy instrument used to further its road safety objectives
- The DfT passes the funds for the partnership to a local authority who acts as treasurer to redistribute the funds to each of the partners (police, Magistrate's Courts, other local authorities) to cover their camera enforcement costs
- At the end of year there is a reconciliation and audit to prove that the receipts were used for the primary purpose which, in this case, is to improve road safety
- According to HMT rules, the partnerships can only recover the costs of enforcement. Any surplus is returned to the HMT consolidated fund.

Funding arrangements in Scotland are slightly different in that all receipts from the conditional offer of fixed penalty notices generated from cameras are passed to the Scottish Executive who forward income to local partnership treasurers.

The project board also set out a number of additional rules that the pilots were expected to adhere to. These were set out in a handbook, a summary of which is given in Appendices A and B. Key aspects include:

- Areas should prioritise enforcement at sites with the worst casualty and speed problems
- Each area involved in the process was required to subject its accounts to an independent audit each year
- Each area should sign a service level agreement that committed each member of the partnership for a minimum one-year period
- Areas were expected to prepare a detailed communications and driver education strategy
- To ensure fairness, areas were strongly encouraged to follow-up on people who did not pay the fines and deal with follow-up enquiries from other forces
- Areas were expected to appoint a data analyst, whose role was to ensure that enforcement was targeted at the priority sites where most accidents occur. Every quarter, each pilot had to submit a return to the DfT detailing traffic speed, casualty and accident data. Over time, these would allow more detailed analyses into the long-term effects.

To continue in the system, an operational case must be submitted to the national project board on an annual basis. This includes the sites planned for enforcement (including casualty history and recent speed surveys), a communications strategy, detailed costings and the service level agreement.

The mechanism to recycle fine income described above has worked well, especially considering the large number of organisations involved.

2.4 SPEED AND RED-LIGHT CAMERA TECHNOLOGY

The eight pilot areas were selected to have a range of strategies – this included the use of different types of enforcement technology.

Under the provisions of Section 20 of the Road Traffic Offenders Act (1988) certain police equipment for traffic law enforcement has to be type approved before evidence from it can be used in court proceedings.

To gain Home Office type approval, the police must first be satisfied that the device in question is a technical advance or the introduction of which would inspire greater competition amongst market rivals. The Police Scientific Development Branch (PSDB) of the Home Office then, in conjunction with independent laboratories, carries out rigorous testing to ensure the device in question is robust, reliable and can produce accurate readings or images under a variety of extreme conditions. The PSDB have published handbooks for manufacturers regarding the procedures for type approval, outlining the requirements and specifications for automatic traffic enforcement systems.

Once PSDB is satisfied that any particular device fully meets the specifications, a type approval order is drawn up and signed by a Home Office Minister. The order includes the date from which the device is approved for police use. The type approval process provides a public assurance of any equipment's accuracy and reliability.

This report is based on a total of 599 camera sites. A brief description of these four enforcement methods is as follows:

- **Fixed** camera speed enforcement. These cameras are usually unmanned and installed in camera housings. When the camera detects a speeding vehicle, two images are captured to verify the speed. These cameras normally enforce road lengths with clusters of accidents, usually up to 1km in length. A standard fixed camera housing is shown to the right. The advantage of fixed sites over mobile enforcement is that they have an effect 24 hrs a day.

- **Mobile** speed enforcement. This camera is set up by the roadside and is attended by a police officer or civilian enforcement officer (see right). The camera is either video based or uses wet film and monitors traffic along a stretch of road. This type of enforcement is often used when casualties are spread along longer lengths of road, rather than at specific sites, or when casualties occur at particular times of day or times of the year. These are also used in conjunction with fixed sites to discourage motorists slowing down only at these locations.
- **Red-light** enforcement. Red-light cameras take images of vehicles that pass through traffic lights whilst they are on red. They operate in a similar way to fixed site speed cameras.
- **Digital** camera speed enforcement. These cameras measure speed of vehicles between two fixed points and can cover large distances. They are usually suited to urban high-speed roads with serious accident histories. This camera system is the most expensive in terms of initial capital outlay and was first used by Nottingham in the first year of the pilot. An image of a digital camera is shown in the picture to the right.

Most pilots developed an enforcement strategy based on both fixed and mobile cameras. Cleveland was the only pilot area to adopt a strategy that relied solely on mobile cameras. Thames Valley was the only pilot to rely solely on existing camera sites. The Nottingham strategy focused on the use of digital camera technology.

There is a large number of factors that can affect the speed and casualty rate in an area, and there can be a number of explanations why casualty rates could increase or decrease. Care must be taken in interpreting the results that are presented in the following sections.

Having said this, the number of sites involved makes this one of the largest research studies into the effect of cameras of different types on both speed and casualties.

Unfortunately, due to the small number of red-light and digital cameras available to this study, little can be said with confidence about their impact on casualties or accidents. This is because the sample size is not large enough for effects to be detected with statistical significance.

The following two chapters summarise the effects that speed cameras have had on both vehicle speed and casualties in the first two years of the pilot.

3. RESULTS (1) IMPACT ON SPEED

In this section, we present results from a large number of speed surveys that show there has been a reduction in speed at fixed and mobile camera sites. There is strong evidence that these reductions have been maintained over time. Headline figures are:

- Average speed at speed camera sites was down by 10% or 3.7 mph.
- There was a 13% reduction in 85th percentile speed at all camera sites, a reduction of 5.2mph.
- The percentage of vehicles exceeding the speed limit was down by 67% at fixed camera sites and down by 37% at mobile camera sites
- The number of vehicles exceeding the speed limit by more than 15mph was down by 96% at fixed camera sites and down by 55% at mobile camera sites.

3.1 INTRODUCTION

A large number of research studies have established that there is a relationship between a reduction in speed and casualties. A generally accepted relationship is that each 1mph reduction in speed should result in around a 5% reduction in accidents[iv]. This section reviews the relative performance of three different types of camera enforcement (fixed, mobile and digital) in reducing speed at camera sites. The analysis is based on more than 1,000 speed-readings taken periodically throughout the pilot.

Some areas conducted speed surveys at regular intervals over the two-year period and, for these, it is possible to make an assessment regarding the long-term impact of enforcement.

To measure changes in speed and compliance with speed limits the following measures were used:

- Average (mean) speed
- 85th percentile speed (the speed at or below which 85% of vehicles are travelling)
- Percentage of vehicles exceeding the speed limit
- Percentage of vehicles exceeding the speed limit by more than 15mph.

We compared the speed survey results to answer the following three questions:

1. What was the scale of the changes in speed at camera sites?
2. Were changes in speed maintained over time?
3. Which type of camera enforcement was the most effective in reducing speeds?

3.2 METHODOLOGY

The first part of the analysis was to assess the overall change at speed camera sites after the start of the pilots. In most cases, for each camera type (fixed, mobile and digital), an average of the most recent three speed survey results was compared with the 'before' speed surveys. These results are summarised in the table below and provide a conservative estimate of the true scale of speed reduction because:

- Average values have been used rather than end values, that are typically lower
- Some sites have very few readings and these were taken soon after enforcement and are therefore unlikely to reflect the full effect of camera enforcement.

The second part of the analysis was to establish whether changes in speed were one-off or whether there was a sustained reduction over time. Finally, we compared results for different speed limits.

More detailed analyses for fixed and mobile sites are presented at Appendix D.

3.3 SUMMARY

Table 1 sets out a summary of changes in speed at camera sites, post enforcement. It shows that when taken together, there have been significant reductions in speed at camera sites. Taken as a whole, there has been on average a 56% reduction in the number of vehicles exceeding the speed limit and an 89% reduction in the number of vehicles exceeding the speed limit by more than

15mph. Taken together, average speed was down by 3.9mph and 85th percentile speed (the speed at or below which 85% of vehicles are travelling) was down by 5.2mph.

Table 1 *Summary of changes in speed at camera sites ('before' compared to an average of last three surveys)*

Pilot	Change in average speed		Change in 85th percentile speed		% change in vehicles exceeding the speed limit	% change in vehicles exceeding the speed limit by more than 15mph
	mph	%	mph	%		
Nottingham digital	**-8.0**	**-17.4%**	**-4.0**	**-10%**	-[4]	**-**
Lincolnshire	-2.7	-6.5%	-9.6	-18%	-73%	-94%
Northamptonshire	-7.5	-22.2%	-7.6	-18%	-81%	-98%
Essex	-5.7	-16.3%	-7.0	-17%	-78%	-92%
Thames Valley	-	-	-5.7	-16%	-65%	-98%
South Wales	-7.9	-22.7%	-7.1	-20%	-56%	-97%
Strathclyde	-3.3	-10.1%	-2.3	-6%	-61%	-61%
Fixed	**-4.5**	**-12.2%**	**-6.8**	**-17%**	**-67%**	**-96%**
Cleveland	-5.1	-13.4%	-4.2	-10%	-46%	-65%
Nottingham	-0.3	-0.9%	-0.2	-1%	-	-6%
Essex	-0.3	-1.0%	-0.6	-2%	-24%	-44%
South Wales	-1.0	-2.5%	2.0	+4%	-	-
Mobile	**-3.4**	**-6.9%**	**-1.2**	**-3%**	**-37%**	**-55%**
All cameras	**-3.7**	**-10.0%**	**-5.2**	**-13%**	**-56%**	**-89%**

3.4 CHANGES IN SPEED BY SPEED LIMIT

Table 2 below shows that in relative terms the greatest reductions in speed were at 40mph speed limit sites (13.4% reduction) and that, in general, there were smaller reductions in speed at higher speed limits. In absolute terms the greatest reduction was at 40mph sites (5.0mph reduction) whilst there was a comparatively small reduction at 70mph sites (2.4 mph reduction).

Table 2 *Change in average speed, by speed limit ('before' compared to an average of last three surveys)*

Speed limit	Number of sites	Number of surveys	Reduction in average speed (mph)	Average % change in speed
30 mph sites	119	856	-3.9	-11.9%
40 mph sites	18	146	-5.0	-13.4%
50 mph sites	4	21	-1.9	-4.7%
60 mph sites	17	100	-2.8	-5.6%
70 mph sites	9	54	-2.4	-3.8%

3.5 CONCLUSIONS

We conclude that both fixed and mobile cameras have been effective in reducing speed and in maintaining high levels of compliance with speed limits. Fixed cameras have proved more effective than mobile cameras in reducing speed. From areas that have conducted speed surveys over a sustained period, we conclude that the reductions were not just "one-off" but were sustained over time.

[4] Due to the differences in recording methods some areas were unable to supply complete data before and after – these are left blank in the table.

4. RESULTS (2) IMPACT ON CASUALTIES

In this section, we set out the results from a statistical analysis of casualties at 599 camera sites and in the wider pilot area. Compared to the long-term trend, the following statistically significant results were found[5]:

1. At camera sites:
   - There was a 35% reduction in people killed or seriously injured (KSIs); and
   - There was a reduction in Personal Injury Accidents (PIAs) of 6%[6]
2. In the wider pilot areas:
   - There was a 4% reduction in KSI casualties below the long-term trend
3. KSI casualties fell by 65% at fixed camera sites
4. Pedestrian KSI casualties at all camera sites fell by 56%

4.1 INTRODUCTION

One of the main tests of the pilot was whether it would deliver fewer road accidents and road casualties. Throughout this report we use two widely accepted measures for counting road accidents and road casualties. For accidents we refer to personal injury accidents (PIAs) – this is a road accident that resulted in at least one casualty. To measure casualties we refer to people who were killed or seriously injured as a result of a road accident (KSI).

To assess the impact of the pilots on road safety the following three questions were considered as part of the analysis:

1. What was the change in PIAs and KSIs at the **enforcement sites** relative to what would have occurred in the absence of the pilot?
2. Has there been an effect on PIAs and KSIs in the **wider pilot area** that could in part be attributed to increased enforcement and related educational activities?
3. Were the changes attributable to enforcement rather than some other more general effect?

It was also anticipated that after two years of enforcement it might have been possible to identify the most effective strategies and this is considered at the end of this section.

4.2 METHODOLOGY

There is a general tendency for more accidents to occur at certain times of year than at others with the frequency increasing progressively with each quarter of the year. There is also a national downward trend in the number of killed or seriously injured casualties of about 4.5% per annum. This was taken into account in the analysis.

The combined quarterly and long-term temporal effects result in the frequency of occurrence of casualties in the first quarter of the year (January to March) being about 12% less than during the period October to December. These effects were taken into account in the statistical model used for the analysis of the data. The model and details of the analysis are given in Appendix H.

To act as a control for the relevant background and seasonal changes, the trends in road accidents and injuries were identified for the rest of the country (excluding the eight pilot areas). The accident and injury records of the pilot camera sites were then compared to identify any further reduction over and above seasonal and national trends.

Table 3 over the page summarises the number of sites contributing to the study and the enforcement strategy. The data used in the analysis was provided for sites at which cameras were installed or operated during the pilots.

[5] All statistical tests in this study were undertaken at the 5% significance level

[6] Excluding the changes in Thames Valley and South Wales the reduction in PIAs would have been 14% below long-term trend (see table 5).

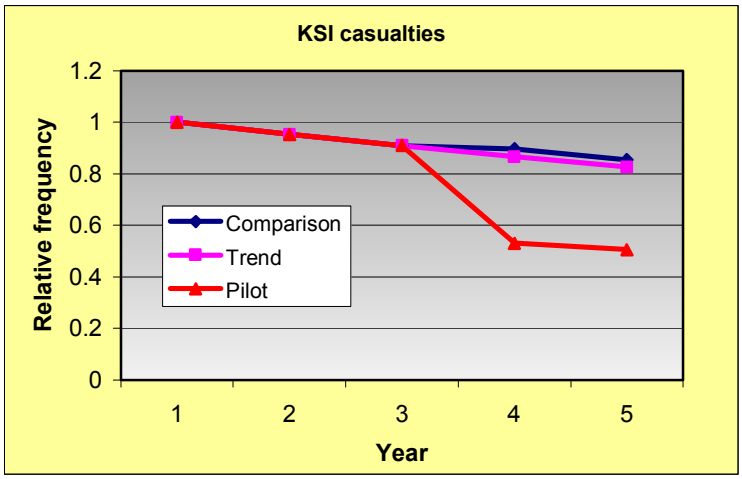
Table 3 *Summary of enforcement strategies and datasets in the eight pilots*

Pilot area	Number of sites contributing to data KSI/PIA	Camera types included in the analyses	Enforcement strategy
Nottingham	26/28 of which 2 digital sites	Digital, mobile, red-light	Digital system and supporting mobile and red light cameras.
Northants	49/50	Fixed, Mobile	Mix of fixed and mobile cameras.
Essex	40/46	Mobile	Increase in the level of enforcement of existing mobile cameras.
Strathclyde	28/28	Fixed	Increase in the number of fixed sites [we only analysed fixed] and four red-light cameras.
Cleveland	33/31	Mobile	Planned to increase mobile capacity.
Lincolnshire	42/44	Fixed	Predominantly fixed camera strategy.
South Wales	96[7]	Fixed, Mobile	Increase in the number of new fixed and mobile cameras and increased use of existing cameras.
Thames Valley	276	Fixed, Mobile	The strategy was not to purchase more equipment but to make more intensive use of existing camera sites. All camera sites in the Thames Valley area were included.

4.3 OVERALL IMPACT ON KSIs AND PIAs

To assess the effectiveness of the additional enforcement on accidents and casualties, results from the eight pilots in the first two years of the system were compared with corresponding ones from the rest of Great Britain. This analysis showed that prior to the start of the pilots there was a downward trend of about 4.5% per annum in the number of people killed or seriously injured. This trend continued in large conurbations and in six of the pilots during the first two years of cost recovery. However, the diminishing trend did not continue in the rest of the country. In particular, it ceased in the uninvolved shire counties that formed the comparison areas for the analysis presented here, and also ceased in the shire counties that bid unsuccessfully for pilot status. Because of this, the changes cited here for the whole of the *After* period, which are calculated relative to the long-term trend, would be increased in magnitude by about 3.5% if they were calculated relative to the comparison areas in the same period. This is illustrated in Chart 1 for the case of KSI casualties at camera sites.

Chart 1 *Trends in KSI casualty numbers*



- Pilot camera sites have performed well compared to the rest of the GB – even taking into account long-term trend
- It will be seen later that there are encouraging signs that the effect extends beyond the immediate vicinity of the cameras
- This indicates that participation in the pilots has produced beneficial effects, not only in the camera sites, but also in the wider partnership area.

[7] Results for South Wales and Thames Valley are for personal injury accidents only due to a change in recording practices in the study period.

Chart 2 *Change in KSI casualties in six pilot areas (whole area)*

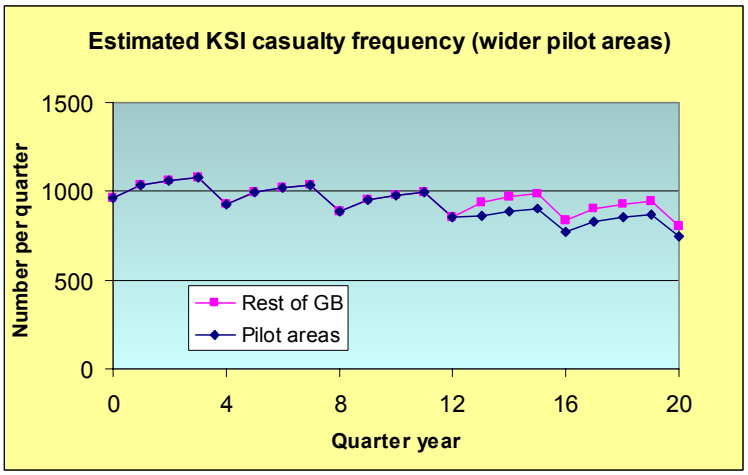


Chart 2 shows the estimated frequency of KSI casualties in six of the pilot areas in the thirteen quarters prior to cost recovery and in the eight quarters afterwards. It shows that the frequency of KSIs in the pilot areas was down by around 5% relative to the long-term trend, and that in the comparison areas there was only a small change in KSI casualties.

Chart 3 *Change in KSI casualties at camera sites in six pilot areas*

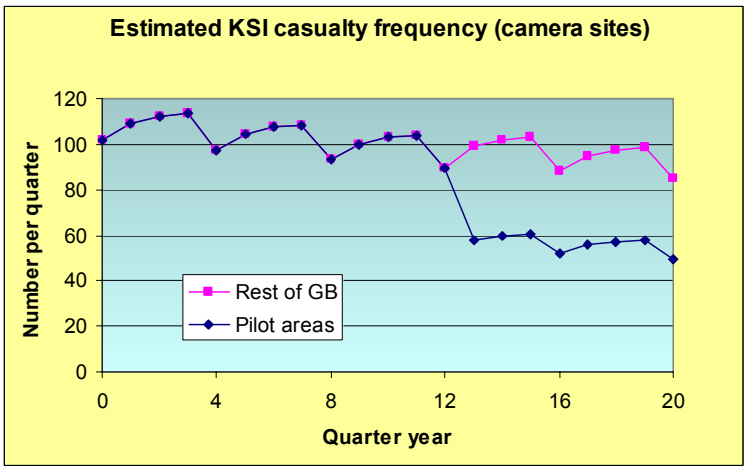


Chart 3 compares KSI frequency at camera sites in the pilot areas in the thirteen quarters prior to the pilot and in the eight quarters afterwards. The chart shows that, since the increase in enforcement funded under cost recovery (start of quarter 13) there has been a substantial reduction (35%) in the frequency of KSI casualties at camera sites compared to the long-term trend.

Because the pilots have only been operational for two years, care must be taken when analysing the results to take into consideration long-term trends and seasonal effects - especially at an area level. The results, however, are extremely encouraging.

4.3.1 Impact of camera types

Table 4 shows the difference between different types of cameras[8] on the frequency of KSI and PIA casualties. All results quoted are statistically significant.

Table 4 *Summary of the change in KSI casualties and PIAs at fixed and mobile sites*

Camera type	KSI Change relative to long-term trend in after years 1 & 2 together	PIA Change relative to long-term trend in after years 1 & 2 together
Fixed	-65%	-5%
Mobile	-29%	-9%
All cameras	**-35%**	**-6%**

[8] There were insufficient red-light and digital sites in the study to draw any firm conclusions about the statistical significance of any change in casualties at these sites. These do contribute to the 'all cameras' analysis.

4.3.2 Impact by area

Table 5 below summarises the impact on KSIs and PIAs in the areas where the cameras were operating and in the wider pilot areas (2 year figures). A more detailed analysis can be found in Appendix E. A description of the statistical model and the methodology is given in Appendix H. Only results that were found to be statistically significant are presented here. Those that were found to be not significant are shaded grey.

Table 5 *Summary of the changes in KSI casualties and PIAs at camera sites and KSIs in the wider pilot area (due to changes in recording in the study period, Thames Valley and South Wales are presented for PIA data only)*

Pilot Area	At camera sites		In the wider pilot area
	KSI	PIA	KSI
	Change relative to long-term trend in after years 1 & 2 together	Change relative to long-term trend in after years 1 & 2 together	Change relative to long-term trend in after years 1 & 2 together
Cleveland	-53%	-45%	+5% [c]
Lincolnshire	-62%	-39%	-12%
Northants	-39%	-14% [b]	-9%
Nottingham	-31%	+1% [b]	-3% [c]
Strathclyde	-67%	-64%	-14%
Essex	+15% [a]	-5% [b]	+4% [c]
Six areas	**-35%**	**-14%**	**-4%**
South Wales	-	-16%	-
Thames Valley	-	+14%	-
All areas	**-**	**-6%**	**-**

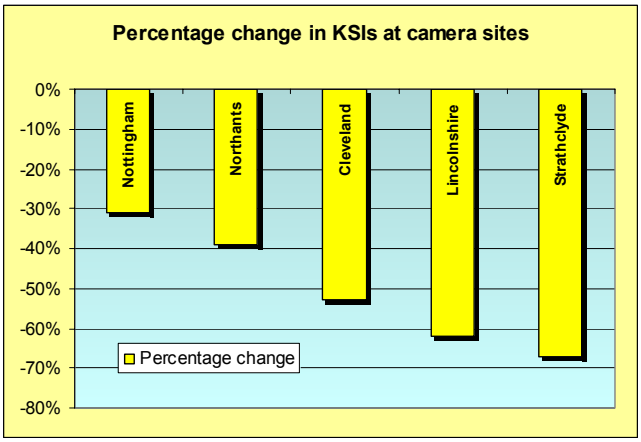


Chart 4 *Summary of the statistically significant changes in KSI at camera sites, by pilot area*

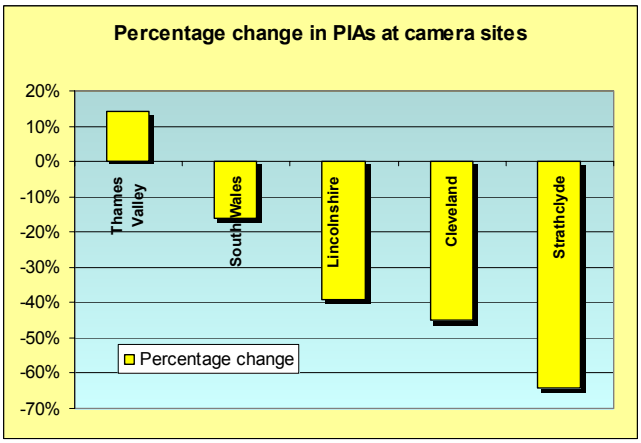


Chart 5 *Summary of the statistically significant changes in PIA at camera sites, by pilot area*

[a] Insufficient data to establish a statistically significant increase, but significantly greater than the general effect of -35%
[b] Insufficient data to establish a statistically significant difference from the general effect of -14%
[c] Insufficient data to establish a statistically significant difference from the long-term trend

4.4 RELATIVE EFFECTIVENESS OF ALTERNATIVE STRATEGIES

Results show that although, as a whole, the eight pilots can demonstrate a reduction in casualties there were differing levels of performance between areas. These are summarised in Table 6.

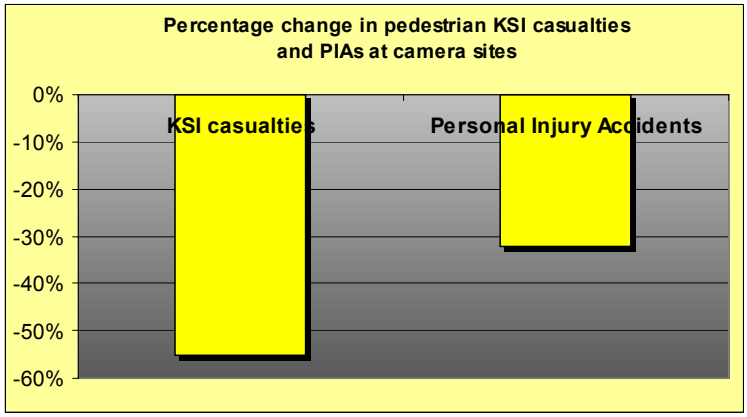
Table 6 *Relative effectiveness of pilot strategies in reducing casualties and accidents*

Area	Strategy	Effectiveness of strategy
Cleveland	Cleveland had a solely mobile enforcement strategy. Nearly all the enforcement took place in 30mph zones. Cleveland did not have much enforcement prior to the start of the pilots in April 2000.	KSI casualties and PIAs have dropped dramatically in areas where cameras were operating. KSIs in the wider partnership area have not changed by a statistically significant amount.
Lincolnshire	Lincolnshire had mostly fixed camera sites. About half of the sites were on roads with a speed limit of 60mph or 70mph. Lincolnshire did not have much enforcement prior to the start of the pilot.	Lincolnshire has been one of the most successful pilots. KSI casualties fell by 62% and PIAs by 39% at camera sites. There was also a statistically significant reduction in the wider partnership area of 12%.
Northants	Northamptonshire had five fixed camera sites and 45 mobile camera sites. Mobile enforcement tended to take place on long stretches of roads known as red routes. Enforcement took place at 10 sites where the speed limit was 60mph or 70mph. The area was also comparatively new to camera enforcement.	In Northants, KSI casualties fell by 39% at camera sites and by 9% across the pilot area as a whole. These are statistically significant results. There has been a reduction in PIAs at camera sites of 14%, though was not found to be statistically significant.
Nottingham	Nottingham had two digital camera sites on its ring road. Mobile enforcement also took place at seven mobile sites and 19 red-light sites. Most enforcement took place in 30mph zones. The partnership had comparatively less experience of camera enforcement.	KSI casualties fell by 31% at camera sites. All other changes were not found to be statistically significant. Results from the digital and red-light cameras indicated that there was a reduction in casualties, but these were not significantly different from the general effect.
Strathclyde	Strathclyde had 28 fixed camera sites, nearly all of which were in 30mph zones. In terms of enforcement history, the partnership was one of the more experienced.	Strathclyde performed the best of all of the pilot areas. KSI casualties at camera sites were down by 67% and down by 14% in the city as a whole. PIAs were down by 64% at camera sites. All the results were statistically significant.
Essex	Only mobile data for 46 sites for the two-year period was provided by the Essex partnership. There was also a planned increase in the enforcement of existing fixed camera housings and some new fixed camera sites. All mobile enforcement took place in urban areas. Essex has a long history of camera enforcement and casualty reduction.	The change in KSI casualties and PIAs at camera sites were not found to be statistically significant, but the increase in KSIs at camera sites of 15% is significantly different from the general reduction of 35%. Over the two years of the study, KSI casualties across Essex increased by 4% but this was not found to be significant. In the second year of the pilot period, Essex undertook a comprehensive review of their enforcement strategy. The new strategy was implemented in October 2002.
Thames Valley	Thames Valley had 226 existing fixed camera sites and 50 mobile sites and had a strategy that focused on increasing levels of enforcement at these sites. Most of the sites (204) were in 30 mph zones. Thames Valley has a long history of camera enforcement and an extensive fixed camera network. These already had had some effect on reducing casualties.	PIAs at existing camera sites increased by 14%. Due to a change in recording in 1999, no comment can be made regarding KSIs. In the second year of the pilot period Thames Valley also undertook a comprehensive review of their enforcement strategy. This was implemented in April 2002.
South Wales	South Wales had 70 fixed camera sites and 26 mobile camera sites. The strategy was to increase the number of new fixed and mobile camera sites and also to increase enforcement at some existing sites. South Wales was one of the more experienced partnerships.	PIAs at camera sites in South Wales were down by a statistically significant 16%. Due to a change in recording in the study period, no comment can be made regarding KSIs.

4.5 EFFECT ON PEDESTRIAN KSIs AND PIAs

Four areas were able to provide details of the number of pedestrian casualties before and after enforcement. The analysis shows a statistically significant reduction in pedestrian KSI casualties of 56% below the long-term trend during the *after* period as a whole. The results for pedestrian personal injury accidents were also substantial and statistically significant. As a whole the frequency of occurrence of pedestrian PIAs at camera sites was about 30% lower than the long-term trend.

Chart 6 *Percentage change in pedestrian KSI casualties and PIAs in camera sites in four pilot areas*



4.6 EFFECTS IN URBAN AND RURAL AREAS

As part of the analysis, we compared results from cameras that operated in urban and rural areas to see if there were differences in their effectiveness. We found that casualty reductions were broadly similar and were not statistically different to the general effect of 35% reduction in KSIs. We conclude that cameras have been equally effective in urban and rural areas.

4.7 LONG-TERM EFFECT OF CAMERAS IN URBAN AREAS

As part of this study, we obtained casualty data from 209 fixed site cameras in London that have been operational for three years. We compared the reduction in KSI accidents in the three years before with the three years after implementation. By a simple comparison, the greatest reduction in KSI accidents was found in areas that had the greatest problem beforehand (see Appendix G). This is consistent with the Government policy of site prioritisation.

4.8 CONCLUSIONS

Results show that, overall, the number of killed and serious injuries and road accidents was reduced at camera sites and in the wider pilot areas. These reductions were greater than the long-term trend and those in the comparison areas. Some pilots recorded better results than others, and this may in part be due the enforcement strategy adopted.

- Due to the small number of sites and data available it was not possible to comment on the effectiveness of red-light or digital cameras, although early results were encouraging
- Some of the best strategies involved a combination of both fixed and mobile camera equipment
- Fixed camera sites were approximately twice as effective as mobile cameras, although both reduce casualties significantly in certain conditions
- Areas that focused predominantly on existing sites performed less well compared to areas that introduced new cameras
- In general, we found some older sites were chosen on the basis of limited analysis of the accident history, which may have reduced their potential impact. We consider that the site analysis is the most critical element of the process.

Results from the pilot have resulted in two areas (Thames Valley and Essex) conducting a comprehensive review of their enforcement strategies. This was implemented in 2002. Lessons learned from the first two years of the pilot study will be used to inform future enforcement strategies in other areas.

5. RESULTS (3) PUBLIC ACCEPTANCE

In this section, we consider results from independent surveys that have been conducted in the pilot period. There have been a number of national surveys and a number of the pilot areas have also commissioned their own research. This confirms that the majority of the public find speed and red-light cameras acceptable if used appropriately.

The pilots have adopted an open and transparent approach to camera enforcement, with areas using a range of media to communicate why and where camera enforcement is taking place. Throughout the two years of the system, a number of the pilot areas undertook public attitude surveys and monitored articles in the local press.

There is considerable media and public interest in road safety. Each pilot area allocated a proportion of its approved budget for public awareness and communication programmes.

5.1 NATIONAL SURVEYS

In addition to surveys carried out at regular intervals by the pilots, a number of independent national surveys were carried out. A survey by MORI on behalf of Direct Line in July 2001[v] (15 months after the pilots started) questioned 2,000 individuals across the country about their attitude towards cameras. The results of these surveys were that:

- 70% of people questioned thought that well placed cameras were a useful way of reducing accidents and saving lives
- Only 21% of people thought that speed cameras were an infringement of civil liberties and only 16% thought they were a waste of time and money
- 89% of respondents said that cameras made them think more carefully about how fast they were driving
- 72% thought that speeding in a 30mph limit was a very serious offence.

A separate national survey published by the RAC in January 2002 (21 months after the pilots started), revealed that 45% of drivers cited driving too fast as the main cause of accidents on the road compared to just 9% who identified drink driving as a main cause of road accidents. The vast majority of drivers (78%) stated that speed cameras were a good way of deterring people from speeding and did not consider them to be an infringement of their personal liberty and 76% of drivers supported having more cameras at traffic lights to catch red-light runners.

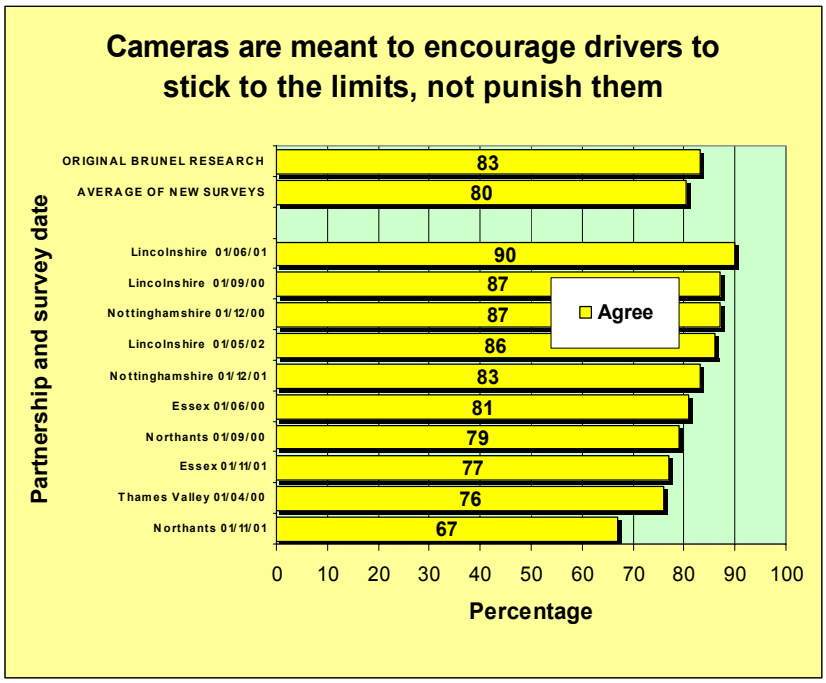
5.2 ATTITUDE SURVEYS IN PILOT AREAS

One of the objectives of the pilot was to reassure the public that the primary motivation behind additional enforcement activity was to improve road safety. To this purpose each partnership committed resources to ensure that the public was made aware of the dangers of speeding and red-light running and that offenders would be caught.

A number of areas commissioned independent research, in which four standard questions were asked. Results were compared to a previous research study in 1998[vi]. Road safety is an important local issue and response rates to questionnaires were high.

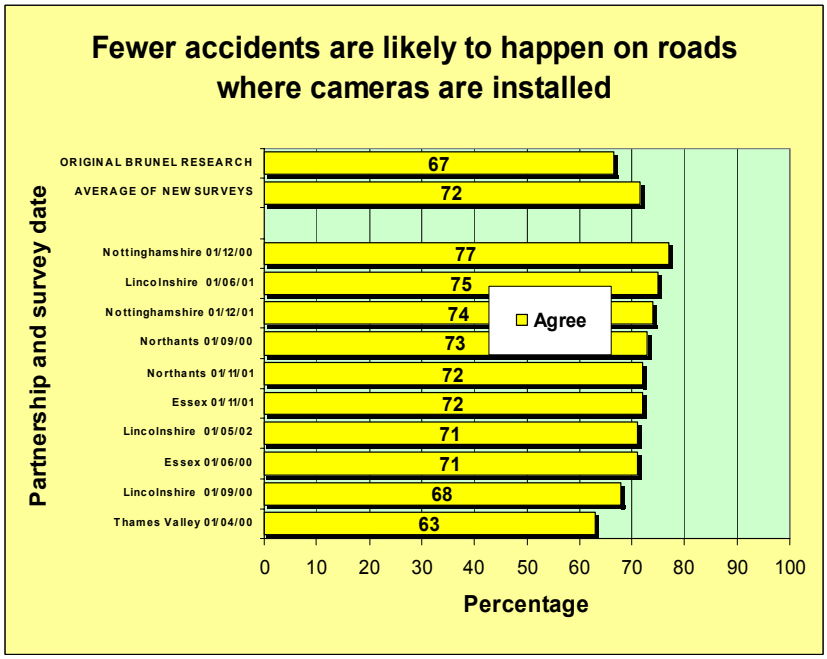
Charts 7 to 10 below indicate that there is still a consistently high level of public support for the objectives of camera enforcement. Generally, public attitude surveys in the pilot areas reflect a similar level of public acceptance compared to Corbett's original 1998 study. In particular, there was no change in the percentage of people who thought that cameras were an easy way of making money from drivers whilst there was a slight increase in the percentage of people who thought that fewer accidents are likely to happen on roads where cameras are installed.

Chart 7 *Percentage agreement with the statement 'Cameras are meant to encourage drivers to stick to the limits...'*



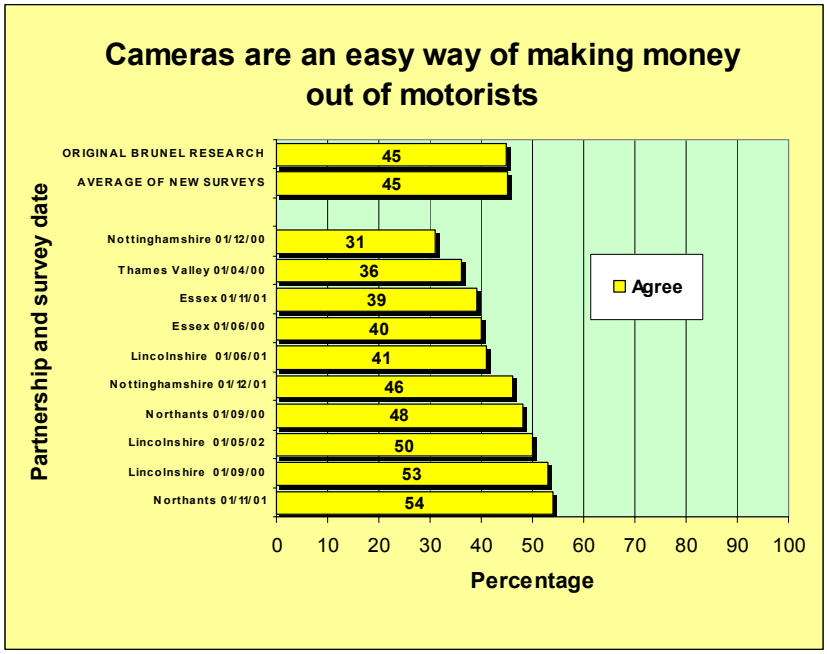
- Although there was a wide variation in the responses, a significant majority of respondents agreed with the statement that the primary purpose of cameras was to encourage compliance with speed limits, rather than to punish motorists
- Broadly this is in line with the previous survey in 1998, prior to the introduction of the cost recovery scheme
- We conclude that attitudes have not changed significantly since the 1998 survey and the public believes that cameras encourage drivers not to speed.

Chart 8 *Percentage agreement with the statement that fewer accidents are likely to happen on roads where cameras...'*



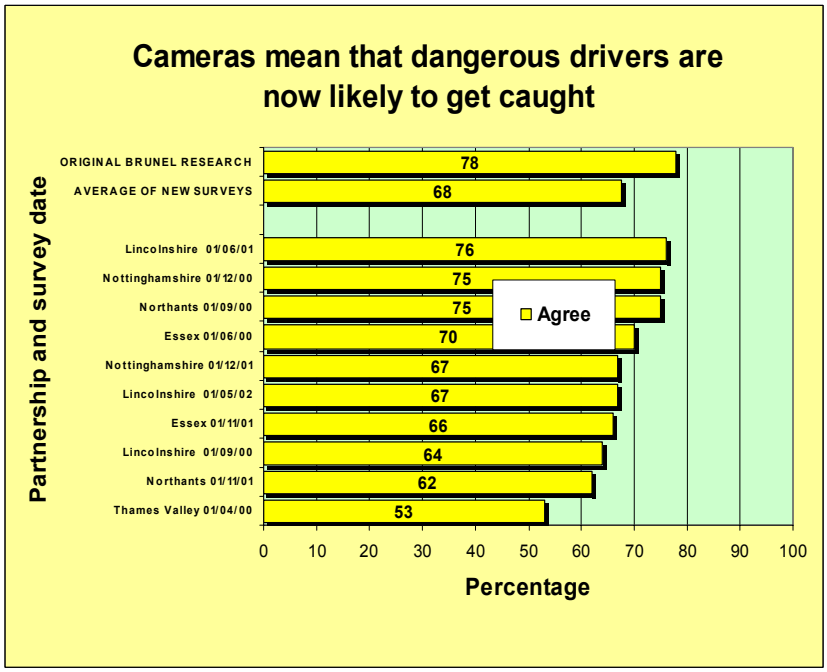
- In the original Corbett research in 1998, two-thirds of respondents agreed that there was a link between cameras and a reduction in accidents
- In most cases, the results from the cost recovery areas are at least as high as this, if not higher
- This result reflects experience in the pilot areas where there was often more demand for camera enforcement than could be supplied
- We conclude that the public, in general terms, continues to accept that there is a link between cameras and casualty reduction.

Chart 9 *Percentage agreement with the statement 'Cameras are an easy way of making money out of motorists'*



- A high proportion of respondents (45%) in Corbett's study agreed with the statement that cameras were an easy way of making money out of motorists
- There was concern that this proportion would rise with cost recovery
- However, on average, this has not occurred – although there are variations
- Taken together with the responses to the other questions, we can conclude that the public remains generally positive.

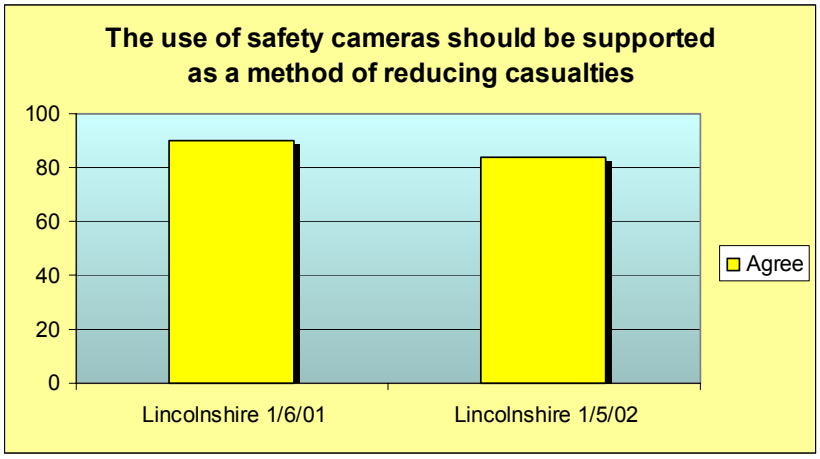
Chart 10 *Percentage agreement with the statement 'Cameras mean that dangerous drivers are more likely to get caught'*



- In Corbett's research over three quarters (78%) agreed that cameras meant that dangerous drivers are more likely to get caught
- If anything, this has declined slightly, although it still remains high - on average (68%)
- In all surveys, the majority of the public generally accepts that cameras increase the probability of catching dangerous drivers
- We conclude, on balance, that attitudes have not changed radically following the introduction of the cost recovery system, although this should be kept under review.

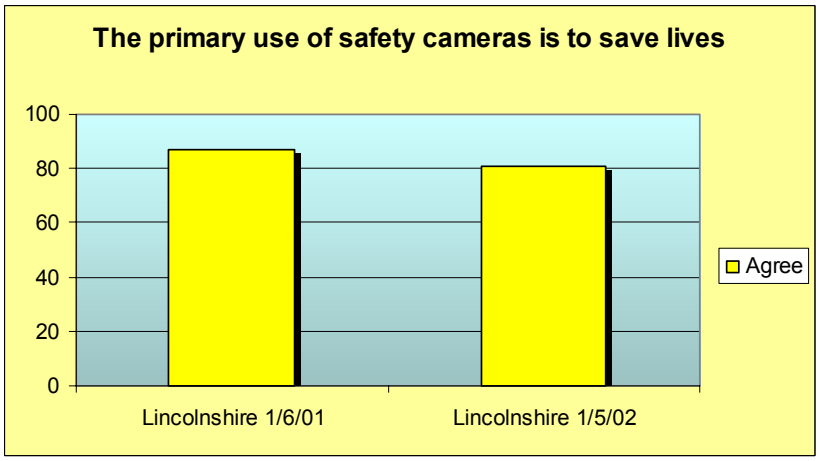
Lincolnshire asked a further three questions. The results are presented below in charts 11 to 13.

Chart 11 *Proportion of people agreeing with the statement that 'The use of safety ...*



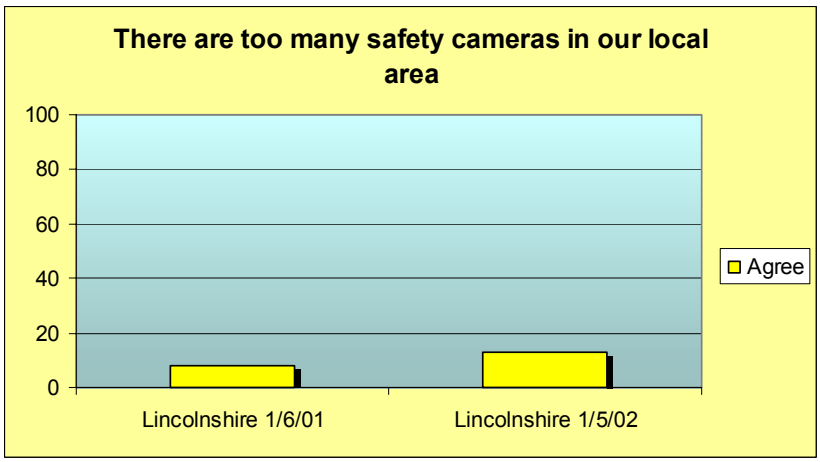
- The majority of respondents supported the use of safety cameras as a method of reducing casualties
- In Lincolnshire, where the survey was repeated, public support remained high

Chart 12 *Proportion of people agreeing with the statement that 'The primary use …*



- The majority of respondents acknowledged the primary use of safety cameras was to save lives

Chart 13 *Proportion of people agreeing with the statement that 'There are too ...*



- Only a small number of respondents thought that were too many safety cameras in their area - although this increased slightly in the second year
- The vast majority (in excess of 80%) thought that there should be more

In summary, we conclude:

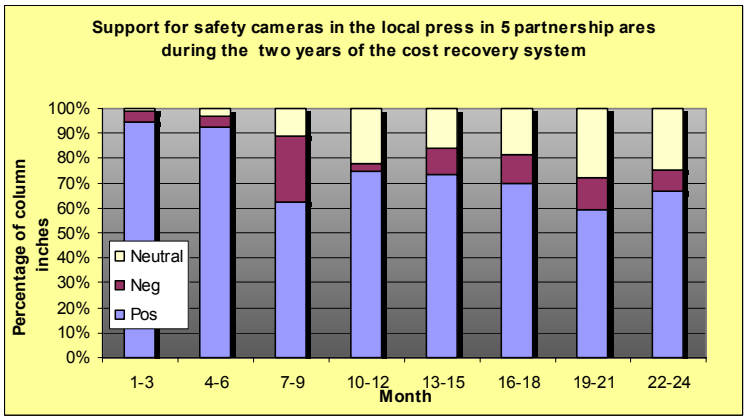
- A number of surveys confirmed that the public support the use of safety cameras for casualty reduction
- The surveys confirmed that the public believe safety cameras reduce the risk of accidents
- There remain some concerns about the revenue-raising potential of cameras.

5.3 LOCAL PRESS COVERAGE

Five pilot areas recorded the amount of local press coverage (in column inches) relating to the pilot during the first two years of the system and monitored whether coverage was positive, negative or neutral. This data was provided on a monthly basis during the two years of the pilots in Essex, Lincolnshire, Northamptonshire, Nottingham and Thames Valley.

Chart 14 shows the overall level of support for camera enforcement in the pilot areas in the first two years.

Chart 14 *Local press coverage for camera enforcement in five of the partnership areas over two years*



The analysis shows that in the first six months of the pilots press coverage was overwhelmingly supportive (more than 90% of column inches devoted to cameras supported camera enforcement). After the first six months of the system the percentage of column inches that were in support of camera enforcement remained at around 70%. On average over the first two years of the system, 76% of press coverage was supportive of camera enforcement, 14% was neutral and 10% was negative.

Chart 15 *Coverage of the pilot in local press in five of the partnership areas over two years*

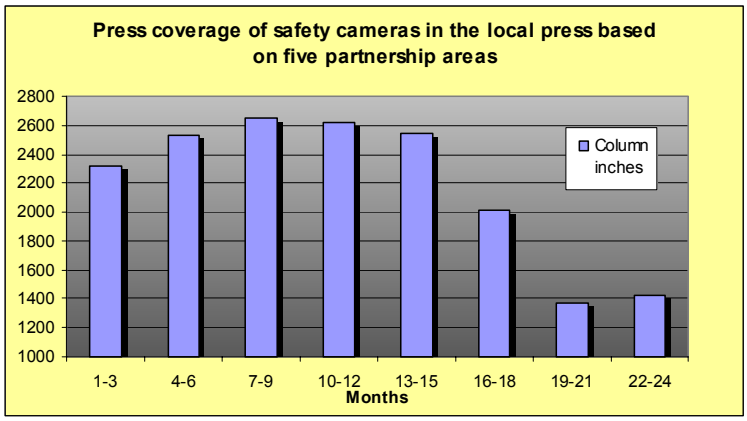


Chart 15 shows the total amount of local press coverage (in column inches) in five of the pilot areas in relation to the pilot.

It shows that press interest peaked in the third quarter of the system and has reduced significantly in the last three quarters of year 2.

5.4 CONCLUSIONS

The majority of people questioned in local surveys believe that cameras are meant to encourage drivers to keep to speed limits rather than to punish them. On average, over the first two years of the pilot, 76% of local press coverage in the pilot areas was supportive.

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6. RESULTS (4) COSTS AND BENEFITS

Over two years the eight pilots spent £21m on camera enforcement from a total of around £27m in fixed penalty income. During this period there were around 280 fewer people killed or seriously injured at camera sites and around 530 fewer people killed or seriously injured in road accidents in the six pilot areas as a whole. The value of saving casualties at camera sites equates to a saving of around £58m and to a saving of around £112m across the six pilot areas as a whole.

6.1 COSTS AND INCOME

Under the rules of cost recovery, all eligible costs associated with camera enforcement and the processing of fixed penalty notices are recoverable by members of the partnership (police, local authorities, Magistrates' Courts). Any surplus over and above these costs is returned to HMT's consolidated fund. At the end of each year partnerships are required to submit audited accounts showing that only costs relating to camera enforcement have been claimed and only when a clear audit certificate has been issued does a partnership receive final payment to cover its costs. To date all partnerships have received 'clean' audit certificates.

In total over two years, the eight pilots have spent around £21m on camera enforcement, whilst the Lord Chancellor's Department has received around £27m in fixed penalty income with around £6m being returned to HMT. A detailed breakdown of costs and income for each of the pilots is provided in Appendix F.

6.2 ECONOMIC BENEFITS

The annual cost of road accidents in Great Britain is around £17bn a year. Table 7 below gives a breakdown of the value of preventing a fatality or serious road accident casualty based on DfT values for the costs associated with road injuries. It shows that, on average, the cost of a fatality is around £1m and that, on average, the cost of a serious injury is around £128,000[9].

Table 7 *Average value of prevention of a KSI*

Injury severity	Lost output	Medical and ambulance	Human costs	Total
Killed	£393,580	£670	£750,640	**£1,144,890**
Serious	£15,150	£9,190	£104,300	**£128,650**

It was expected that the pilots would bring about a reduction in accidents and casualties and this in turn would also bring about a cost saving in social and human costs. There were around 280 fewer people killed or seriously injured at camera sites in six of the pilot areas compared to what would otherwise be expected on the basis of previous years.

Table 8 below shows that the total cost saving of casualties at camera sites over two years was around £58m.

Table 8 *Estimated cost savings of KSI casualties at camera sites in six pilot areas*

Injury severity	Lost output	Medical and ambulance	Human costs	Total[10]
KSI casualties	£12,576,633	£2,309,305	£42,811,751	**£57,700,186**

Table 9 below, shows the total value of casualty reduction across six of the pilot areas as a whole, not just at camera sites. There was a 4% reduction in six of the areas, outperforming both the long-term trend and the comparison areas. As a result of this reduction in road casualties, the total

[9] These costs only relate to injury costs and therefore do not include accident costs such as property damage, police and insurance costs.

[10] This uses DfT values for the prevention of road fatalities and serious injuries to calculate the likely cost saving of casualty reductions on the basis of a weighted average for the split of killed and serious injuries. It was estimated that 6% of KSIs saved at camera sites were fatalities on urban roads and 13% of KSIs saved were fatalities on rural roads.

benefit to society over two years based on a weighted average for the split of killed and serious injuries is estimated to be around £112m.

Table 9 *Estimated cost savings of killed and serious injuries in total pilot areas*

Injury severity	Lost output	Medical and ambulance	Human costs	Total
KSI casualties	£24,320,989	£4,465,788	£82,790,371	**£111,581,977**

6.3 CONCLUSIONS

Conservative estimates indicate that there have been significant savings in social and human terms in the pilot areas. Just taking the reduction in KSIs in six of the pilot areas (not including the reduction in PIAs) indicates savings in the region of at least £112m. As strategies improve and areas become more sophisticated in camera enforcement the benefits to society could be even greater.

7. CONCLUSIONS AND RECOMMENDATIONS

The introduction of the cost recovery system has brought about immediate benefits in terms of speed and casualty reduction. The system has also proved to be a workable means of recycling the fine income in a way that has not distorted operational priorities. Overall, support for camera enforcement has remained high over the two years of the pilot operation. There are a number of lessons learned that will be useful for newer areas joining the system.

7.1 CONCLUSIONS

Analysis of monitoring information from the pilot areas has shown that the introduction of cameras has reduced speeding and accidents and that overall public attitude has remained supportive. Detailed conclusions from this analysis are that:

- As a result of camera enforcement in six of the pilots, there was a 35% reduction in KSIs at camera sites. This equates to around 280 fewer people killed or seriously injured at camera sites
- Whilst the annual number of people killed or seriously injured in the rest of the country remained little changed, there was a 4% reduction in the pilot areas over and above the long-term trend. This equates to around 530 fewer people killed or seriously injured
- Taken together at camera sites in all eight pilots, PIAs were down by 6% below long-term trend. This equates to around 510 fewer PIAs at camera sites compared to previous years
- There has been a reduction in speed at camera sites – average speed is down by around 10% or 3.7mph and the numbers of vehicles exceeding the speed limit is down by 67% at fixed sites and 37% at mobile sites
- The value of casualties saved by the pilot system in its first two years of operation was around £58m at camera sites and £112m across the pilot areas as a whole
- Fixed cameras appear to be more effective in terms of getting greater levels of compliance with the speed limit and eliminating the problem of excessive speed, although there are operational benefits in terms of flexibility and wider coverage provided by mobile cameras
- Cameras appear to be equally effective on rural and urban roads
- The level of public support for the use of cameras has remained high over the first two years of the system.

7.2 RECOMMENDATIONS

The pilot has worked well, and others are now joining the eight areas as part of national roll-out. All areas will continue to be monitored. Our recommendations are that:

- The strategy of targeting sites with the worst casualty history seems to produce the best results and should be adopted by other areas joining the system. Priority sites should be ranked according to the number of casualties per km per annum (both KSI and PIA)
- Each area should review its sites at least on an annual basis
- New areas joining the system should aim to allocate a proportion of the income (say at least 5%) from speed and red-light cameras to fund public awareness and communication programmes
- All areas should appoint a dedicated communications officer
- All areas joining the system should endeavour to measure the impact the system is actually having on the NHS, for example by monitoring the number of hospital bed-days required for people injured in road traffic accidents.

APPENDIX A: HANDBOOK SUMMARY

Prior to the start of the pilots a handbook was developed which gives guidance about how the cost recovery system should operate. As the pilots progressed, and more was learned about best practice, this guidance has been strengthened. These are summarised in the table below.

Guidelines for pilot areas	Current guidelines for national rollout
1. The effects on speed and casualties must be monitored	
Camera sites must be located where there is a history of speed related accidents. Cameras cannot be located for political and / or revenue generating purposes. All sites must be monitored for before and after speeds in areas where the cameras are operating.	Prior to approval, partnerships must prioritise sites and have quantified evidence that those selected have the greatest casualty problems. Broadly, these should follow the guidelines in Table 10 below although there is some flexibility. In total, enforcement should aim to cover at least 10% of KSIs in an area and ideally more. Partnerships must collect data on child and pedestrian casualties and hospital bed data. Partnerships must have conducted speed surveys in advance of case approval to demonstrate that excess speed is a problem at the priority sites.
2. Public perception must be actively managed	
All areas have to produce a robust strategy as to how they are handling local education and communication issues	All partnerships are required to have a dedicated communications manager. The cameras should be well signed and highly visible. The location of the cameras should be published in local papers, local radio and on web-sites.
3. Partnerships must include all relevant local organisations	
Partnerships must include police, highway's authorities and magistrates' courts. All parties must sign up to a Service Level Agreement – this committed each partnership at a senior level for the duration of the project.	Should also involve local health authority, CPS and Highways Agency. Each partnership should have a dedicated project manager. All local authorities in an area should be part of the partnership.
4. Financial protocols	
All capital and revenue expenditure has to be directly attributable to *additional* speed and red-light camera enforcement – these were detailed in a handbook which set out the rules of the system	*All* costs attributable to speed and red-light cameras are recoverable rather than additional costs.
Each partnership had a treasurer who kept the accounts	No change.
Partners were paid on the basis of receipts for expenditure incurred.	No change.
At the end of the financial year, these accounts were audited by the District Auditor against rules set out by the Audit Commission (for England and Wales - Accounts Commission in Scotland)	No change. Revised guidelines are produced in conjunction with the Audit Commission (and Accounts Commission) following the end of year audit.
Failure to receive a clear audit certificate would result in the privilege to 'net off' receipts' to be withdrawn.	No change.
5. Benchmarking	

Guidelines for pilot areas	Current guidelines for national rollout
Partnerships should produce benchmark costs that proved that unit costs are reducing	Partnerships must compare favourably in efficiency with existing partnerships before being accepted on to the system. The use of new technology to reduce manual processes and, in particular, police intervention is encouraged. Chasing non-payers and making out of force enquiries is mandatory.
6. Signing and visibility	
Partnerships ensured that signing arrangements comply with Traffic Signs Regulations and General Directions appropriate for various circumstances.	Fixed speed camera housings in all but exceptional circumstances should be yellow. All camera housings (existing and new) should be visible to road users and not hidden behind bridges, signs, trees or bushes. The minimum visibility distance should be 60 metres where the speed limit is 40 mph or less and 100 metres for all other limits. For mobile cameras, camera operatives at the mobile camera sites should wear fluorescent clothing and abide by all Health and Safety requirements, and vehicles should be clearly marked as camera enforcement vehicles. Camera warning and speed limit reminder signs must be placed in advance of fixed or mobile speed enforcement taking place. Ideally these should be placed within 1 km of fixed camera housings and at the beginning of a targeted route for mobile enforcement sites. Signs must only be placed in areas where camera housings are present or along routes where mobile enforcement will be targeted.

Table 10 provides a summary of the guidance issued to local partnerships to assist in prioritising sites for enforcement. It is at the discretion of the local partnerships as to the proportion of enforcement that is allocated to these priority sites. Some discretion is allowed to enforce at sites where there is genuine public concern about speeding and also at roadworks.

Table 10 *Site selection guidelines*

Criteria	Fixed	Mobile	Digital	Red-light
1. Site length	Between 400-1500 metres	Between 400 and 3000 metres (can be linked into a longer route strategy if more than three stretches satisfy the criteria)	Between 3000 and 10000 metres	50 metres
2. Number of killed and serious accidents (KSI)	At least 4 KSI per km in last three calendar years (**not** per annum)	At least 2 KSI per km in last three calendar years (**not** per annum)	At least 5 KSI per km in last three calendar years along a minimum 3km stretch of road (**not** per annum). At least 4KSIs in previous three calendar years in each subsequent km (**not** per annum).	2 KSI at junction (+/- 50m) in last three years (**not** per annum)
3. Number of personal injury accidents (PIA)	At least 8 PIA per km in last three calendar years	At least 4 PIA per km in last three calendar years	At least 10 PIA per km in last three calendar years (min 3km). At least 8 PIA in previous 3 calendar years in each subsequent km.	At least 4 PIA at junction (+/- 50m)
4. Causation factors	Causation factors indicate that speeding was a contributory factor in some or all of the accidents – sites that are clearly **not** speed-related have been de-selected			Red-light running is a causation factor in some or all of the accidents (including child and pedestrians)
5. 85th percentile speed at (or approach to) accident hot spots	85th percentile speed at least 10% above speed limit plus 2mph - i.e. 35mph in a 30 zone) for free-flowing traffic (excluding any rush-hour periods)			N/A
6. Percentage over the speed limit	At least 20% of drivers are exceeding the speed limit			N/A
7. Site conditions are suitable for the type of enforcement proposed	Loading and unloading the camera can take place safely	Location for mobile enforcement is easily accessible, there is space for enforcement to take place in a visible and safe manner	Loading and unloading the camera can take place safely	Loading and unloading the camera can take place safely
8. Distribution of accidents	Accidents are clustered close together around a single stretch of road or junction	Accidents are more likely to be evenly distributed along a route	High density of accidents distributed evenly along a stretch of road	Accidents are clustered at a road junction (with traffic lights!)
9. No other engineering solutions are appropriate	There has been a site survey by a qualified road safety engineer and there are no obvious viable measures to improve road safety along this stretch of road			
10. Camera visibility	Enforcement cameras are well signed and highly visible in line with DfT guidelines			

APPENDIX B: ALLOWABLE EXPENDITURE

B.1 LEGISLATIVE PROVISION

Section 38 of the Vehicles (Crime) Act 2001 contains the primary legislation which enables the Secretary of State to make payments to local partnerships for speed and red-light camera enforcement.

(1) The Secretary of State may make payments in respect of the whole or any part of the expenditure of a public authority in relation to:

- *a. the prevention or detection of offences to which subsection (2) applies; or*
- *b. any enforcement action or proceedings in respect of such offences or any alleged such offences.*

(2) This subsection applies to offences under:

- *a. section 16 of the Road Traffic Regulation Act 1984 (c. 27) which consist in contraventions of restrictions on the speed of vehicles imposed under section 14 of that Act;*
- *b. subsection (4) of section 17 of that Act which consist in contraventions of restrictions on the speed of vehicles imposed under that section;*
- *c. section 88(7) of that Act (temporary minimum speed limits);*
- *d. section 89(1) of that Act (speeding offences generally);*
- *e. section 36(1) of the Road Traffic Act 1988 (c. 52) which consist in the failure to comply with an indication given by a light signal that vehicular traffic is not to proceed.*

(3) Payments under this section shall be made to:

- *a. the public authority in respect of whose expenditure the payments are being made; or*
- *b. any other public authority for payment, in accordance with arrangements agreed with the Secretary of State, to, or on behalf of, the public authority in respect of whose expenditure the payments are being made.*

(4) Payments under this section shall be paid at such times, in such manner and subject to such conditions as the Secretary of State may determine.

(5) In this section "public authority" means:

- *a. any highway authority (within the meaning of the Highways Act 1980 (c. 66));*
- *b. any police authority established under section 3 of the Police Act 1996 (c. 16), the Metropolitan Police Authority or the Common Council of the City of London in its capacity as a police authority;*
- *c. any responsible authority (within the meaning of section 55 of the Justices of the Peace Act 1997 (c. 25)) or the Greater London Magistrates' Courts Authority; and*
- d. *any body or other person not falling within paragraphs (a) to (c) and so far as exercising functions of a public nature*

B.2 ALLOWABLE EXPENDITURE - ENFORCEMENT EQUIPMENT

- Speed and red-light cameras that are Home Office type approved
- Fixed (digital and wet-film) and mobile camera systems, including housings, alarms, dummy equipment, 'permanent' mobile sites and signs
- Analysis, design, planning, installation, test and set-to-work costs are allowable (in order to be accepted onto the scheme, partnerships must demonstrate that cameras will be operating in areas where there is a history of both collisions and speeding)
- Signing in order to comply with DfT guidance on camera conspicuity.

B.3 ALLOWABLE EXPENDITURE – SUPPORTING EQUIPMENT

- IT and communication systems
- Speed monitoring equipment
- Office equipment
- Film processing and viewing
- Printing, scanning, copying and mailing
- Filing and archiving
- Vehicles (only those required for the purpose of enforcement and not patrol vehicles)
- Collision mapping and recording systems.

B.4 ALLOWABLE EXPENDITURE – REVENUE COSTS

- Partnership staff salaries and on-costs (training, national insurance, etc.) but not, for example, shared management costs
- Police officer and civilian staff costs
- Camera and system maintenance – only those directly associated with camera activity
- Camera and system lease costs
- Communication and education programmes directly related to this system
- Reasonable IT and communication systems maintenance associated with camera activity
- Vehicle maintenance and running costs (including fuel) – only for vehicles solely employed on camera activity or pro-rata
- Speed and casualty analysis (including that required to build up the operational case)
- Consumables and ancillary costs (stationery, film, print etc.)
- Leased accommodation (including office and IT equipment if applicable).

APPENDIX C: THE ENFORCEMENT PROCESS

THE ADMINISTRATIVE PROCESS

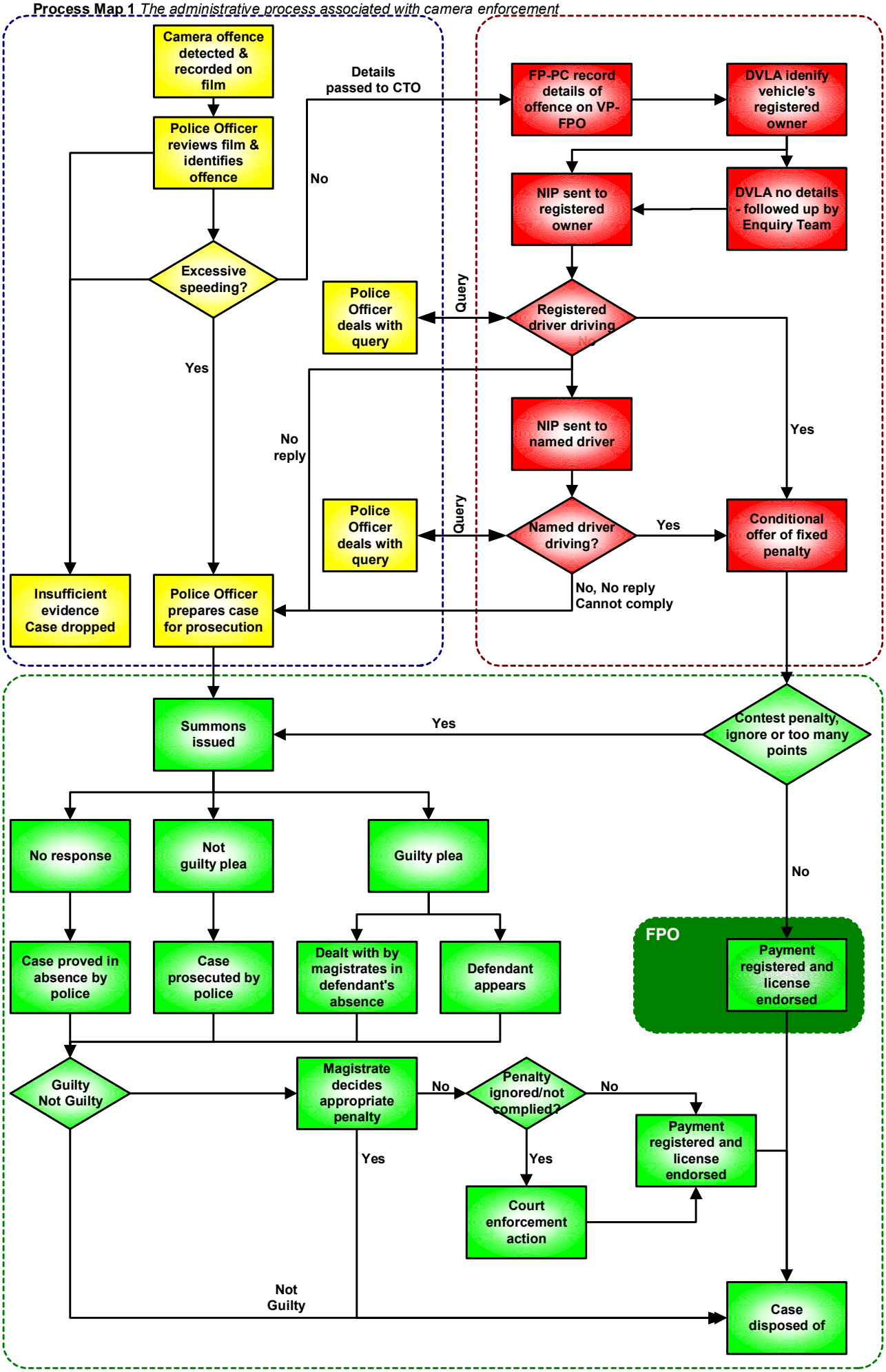
Partnerships were allowed to keep some of the fixed penalty revenue from speeding drivers (or drivers passing through red-lights) to pay for the costs associated with processing the associated conditional offer fixed penalty notices. There are a number of stages in this process and these are explained below.

The key elements of the enforcement process are as follows:

- A Notice of Intended Prosecution (NIP) is sent to the registered vehicle keeper. This identifies that the vehicle was recorded on film committing a speeding or red-light offence and that the registered keeper is required to provide the full name and address of the driver at the time of the alleged offence. The law states that in order for a prosecution to proceed the NIP needs to be served to the registered keeper within 14 days of the alleged offence taking place
- Where the registered keeper does not reply to the NIP or does not identify the driver, The Central Ticket Office (CTO) notifies the enforcement officer who recorded the alleged offence. This enforcement officer reviews the video evidence and seeks to interview the registered vehicle keeper with a view to preparing a file for prosecution by the police
- Where the registered vehicle keeper replies that they were not the driver at the time of the alleged offence, they are required to notify the CTO who was. A NIP is then sent to the driver identified
- Once the driver at the time of the alleged offence is identified, the CTO sends a Conditional Offer of a Fixed Penalty. The driver then has the opportunity to pay a fixed penalty fine (£60) and accept 3 penalty points or they may contest the offence in a Magistrates' Court. Where they accept the Conditional Offer, the driver is required to present the required monies and their driving licence to the Fixed Penalty Office (usually by post)
- If a driver contests the offence or fails to pay the fine, the police prepare a file for prosecution in the courts. In any case where the addition of Penalty Points will lead to a ban (for example where a driver has already amassed 9 or more points), the case is dealt with via the local Magistrates' Court.

A map of the administrative processes associated with camera enforcement is shown overleaf.

Process Map 1 *The administrative process associated with camera enforcement*



APPENDIX D: DETAILED SPEED ANALYSIS

D.1 CAMERA TECHNOLOGY AND CHANGES IN AVERAGE SPEED

Table 11 shows that if all camera sites are taken together, average speed fell by 10% or 3.7mph. Average speed is down by 6.9% or 3.4mph at mobile sites compared to a 12.2% or 4.5mph reduction at fixed camera sites.

At fixed sites, Northamptonshire and South Wales had the greatest impact in speed reduction (a 22% and 23% reduction in average speed respectively). In terms of mobile sites, Cleveland recorded a greater reduction in average speed (13% reduction) compared to Nottingham and Essex both of which recorded a reduction of around 1%. The digital camera sites in Nottingham recorded a reduction in average speed of 17%, although this is based on a small data set.

Table 11 *Comparative changes in average speed at camera sites*

Pilot	Number of sites	Number of visits	Average speed before (mph)	Average speed after (mph)	Change in average speed (mph)	% change in average speed
Nottingham digital	***1***	***2***	***46.0***	***38.0***	***-8.0***	***-17.4%***
Lincolnshire	38	206	42.4	39.6	-2.7	-6.5%
Northamptonshire	9	37	33.9	26.4	-7.5	-22.2%
Essex	6	12	34.8	29.2	-5.7	-16.3%
South Wales	19	174	34.8	26.9	-7.9	-22.7%
Strathclyde	23	144	32.6	29.3	-3.3	-10.1%
All fixed	***95***	***573***	***37.2***	***32.7***	***-4.5***	***-12.2%***
Cleveland	30	509	37.9	32.8	-5.1	-13.4%
Nottingham	6	15	32.2	31.8	-0.3	-0.9%
Essex	11	22	31.9	31.6	-0.3	-1.0%
South Wales	25	58	38.1	37.1	-1.0	-2.5%
Mobile	***72***	***604***	***36.6***	***33.1***	***-3.4***	***-6.9%***
All cameras	**168**	**1179**	**37.0**	**33.3**	**-3.7**	**-10.0%**

Chart 16 below shows that there was a sharp initial reduction in average speed at mobile camera sites and that reductions in speed were maintained over time. Chart 17 shows that there was a more gradual reduction in average speed at fixed camera sites and that the trend continued downwards over time.

Chart 16 *Changes in average speed at mobile camera sites*

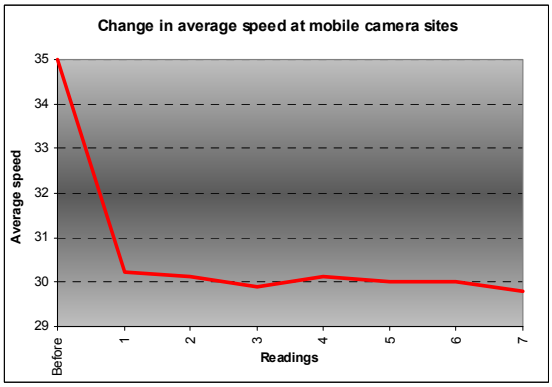
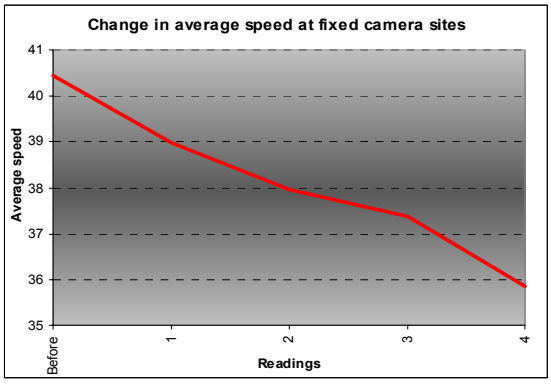


Chart 17 *Changes in average speed at fixed camera sites*



D.2 CHANGES IN 85TH PERCENTILE SPEED

The speed at which 85% of vehicles are travelling at or below is defined as the 85th percentile speed. Table 12 below shows the change in 85th percentile speed in the six pilots that undertook speed enforcement at fixed camera sites and at four of the pilots that provided data for mobile camera sites. The table shows that larger reductions in 85th percentile speeds were recorded at fixed camera sites (17% reduction) compared to mobile camera sites (3% reduction). On average, across all camera sites 85th percentile speed was down by 13%. At digital sites, 85th percentile speed was down by 10%, although this is based on a small dataset.

The table shows that 85th percentile speed is down on average by around 6.8mph across all of the fixed camera sites. In absolute terms the greatest reductions in 85th percentile speed at fixed camera sites were recorded in Lincolnshire (9.6mph) Northamptonshire (7.6mph) and South Wales (7.1mph) and the smallest reductions were recorded in Thames Valley (5.7mph) and Strathclyde (2.3mph).

Across all mobile camera sites 85th percentile speed is down by 1.2mph. In Cleveland where there was a policy of only deploying mobile speed cameras there was a reduction in 85th percentile speed of 4.2mph compared to a reduction of 0.6mph in Essex and 0.2mph in Nottingham. On the basis of a set of speed readings taken soon after enforcement began, there was an increase of 2.0mph at mobile sites in South Wales.

Table 12 *Changes in 85th percentile speed at camera sites*

Pilot	Number of sites	Number of visits	85th percentile before (mph)	85th percentile after (mph)	Change in 85th percentile speed (mph)	Change in 85th percentile (%)
Nottingham digital	**1**	**3**	**42.0**	**38.0**	**-4.0**	**-10%**
Lincolnshire	46	242	52.7	43.1	-9.6	-18%
Northamptonshire	13	51	41.5	33.9	-7.6	-18%
Essex	6	12	40.3	33.3	-7.0	-17%
Thames Valley	44	88	36.3	30.6	-5.7	-16%
South Wales	46	236	35.9	28.7	-7.1	-20%
Strathclyde	23	165	35.3	33.0	-2.3	-6%
Fixed	**178**	**794**	**40.8**	**34.0**	**-6.8**	**-17%**
Cleveland	30	526	40.6	36.4	-4.2	-10%
Nottingham	6	12	39.0	38.8	-0.2	-1%
Essex	12	24	36.8	36.2	-0.6	-2%
South Wales	25	72	45.0	47.0	+2.0	+4%
Mobile	**73**	**634**	**41.4**	**40.2**	**-1.2**	**-3%**
All cameras	**252**	**1431**	**41.0**	**35.8**	**-5.2**	**-13%**

Charts 18 and 19 below show that at both mobile and fixed camera sites there was a steady decline in 85th percentile speed and that over time these reductions have begun to level-off – although overall gains in speed reduction have been maintained.

Chart 18 *Change in 85th percentile speed at mobile camera sites*

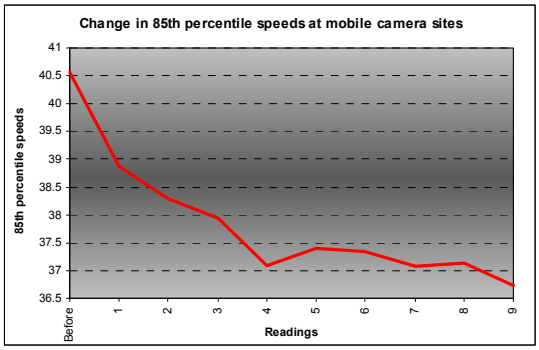
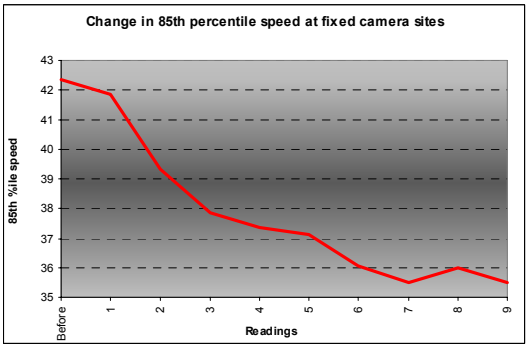


Chart 19 *Change in 85th percentile speed at fixed camera sites*



D.3 CHANGE IN PERCENTAGE OF VEHICLES EXCEEDING THE SPEED LIMIT

Table 13 below compares the changes in the percentage of vehicles exceeding the speed limit at fixed and mobile camera sites. The table shows that in absolute terms there has been a 67% reduction in the number of vehicles exceeding the speed limit at fixed camera sites compared to a 37% reduction at mobile camera sites. Across all camera sites, the percentage of vehicles exceeding the speed is down from 47% to around 20%.

It shows that around 41% of vehicles exceeded the speed limit at fixed camera sites prior to the introduction of the cameras compared to around 14% afterwards. In relative terms, the largest reductions in the number of vehicles exceeding the speed limit at fixed camera sites were in Northamptonshire (81%) and Essex (78%) and the smallest reduction was in South Wales (56%). In absolute terms, following the introduction of cameras, Lincolnshire had the fewest vehicles exceeding the speed limit at fixed camera sites (6%) and South Wales the most (33%)

At mobile camera sites around 60% of vehicles exceeded the speed limit prior to the system compared to 37% afterwards. In relative terms there was a reduction of around 47% in the numbers of vehicles exceeding the speed limit at mobile camera sites in Cleveland compared to a reduction of around 24% in Essex.

Table 13 *Change in the percentage of vehicles exceeding the speed limit at camera sites*

Pilot	Number of sites	Number of visits	% > speed limit before	% > speed limit after	% change in vehicles exceeding speed limit
Lincolnshire	46	227	23.6	6.4	-73%
Northamptonshire	9	37	42.1	8.1	-81%
Essex	6	12	56.5	12.3	-78%
Thames Valley	44	87	49.9	17.5	-65%
South Wales	8	16	74.2	32.6	-56%
Strathclyde	6	24	59.4	23.2	-61%
Fixed	**119**	**398**	**40.8**	**13.6**	**-67%**
Cleveland	32	573	65.3	35.2	-46%
Essex	11	24	44.1	33.5	-24%
Mobile	**43**	**597**	**59.6**	**34.1**	**-37%**
All cameras	**162**	**995**	**46.8**	**20.5**	**-56%**

Charts 20 and 21 below show that there has been a steady decline in the number of vehicles exceeding the speed limit over time at both mobile and fixed camera sites, although overall levels of compliance was greater at fixed camera sites.

Chart 20 *Percentage of vehicles exceeding the speed limit at mobile camera sites*

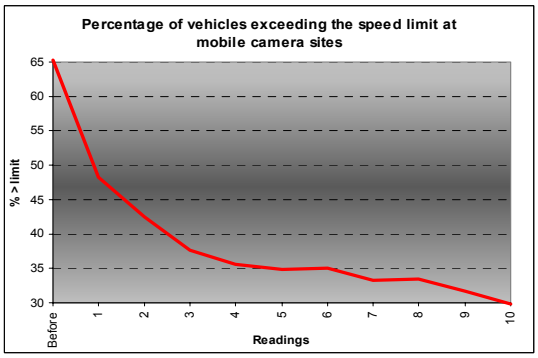
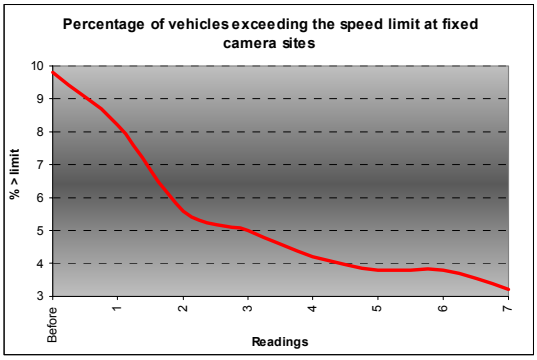


Chart 21 *Percentage of vehicles exceeding the speed limit at fixed camera sites*



D.4 PERCENTAGE CHANGE IN VEHICLES EXCEEDING THE SPEED LIMIT BY MORE THAN 15MPH

At each camera site pilots were requested to record changes in the numbers of vehicles travelling at more than 15mph over the speed limit. Table 14 below shows that at fixed camera sites 7.4% of vehicles exceeded the speed limit prior to enforcement compared to around 0.3% afterwards. At mobile camera sites the percentage of vehicles exceeding the speed limit is down from 3.4% to 1.6%. Across all camera sites, the percentage of vehicles exceeding the speed limit by more than 15mph is down by 89%.

Overall, at fixed camera sites the number of vehicles travelling at more than 15mph is down by 96%. With the exception of Strathclyde all other fixed sites recorded a reduction of more than 90% in the number of drivers exceeding the speed limit by more than 15mph.

At mobile camera sites the number of vehicles travelling at more than 15mph over the speed limit is down by 55%. Cleveland recorded the greatest reduction in the number of vehicles travelling more than 15mph over the speed limit with a reduction of around 65%.

Table 14 *Change in vehicles exceeding the speed limit by more than 15mph at camera sites*

Pilot	Number of sites	Number of visits	% > speed limit by 15mph or more (before)	% > speed limit by 15mph or more (after)	% change in vehicles exceeding speed limit
Lincolnshire	26	269	2.9	0.2	-94%
Northants	7	22	4.3	0.1	-98%
Essex	4	8	1.3	0.1	-92%
Thames Valley	27	81	19.0	0.3	-98%
South Wales	6	16	30.7	0.8	-97%
Strathclyde	6	24	3.2	1.3	-61%
Fixed	**76**	**420**	**7.4**	**0.3**	**-96%**
Cleveland	21	324	4.0	1.4	-65%
Nottingham	6	13	2.8	2.7	-6%
Essex	5	15	1.8	1.0	-44%
Mobile	**32**	**352**	**3.4**	**1.6**	**-55%**
All cameras	**108**	**772**	**6.1**	**0.7**	**-89%**

Charts 22 and 23 below show that at both fixed and mobile camera sites there have been sustained reductions in the number of vehicles exceeding the speed limit by more than 15mph over time. At fixed camera sites there was a sharp reduction (to almost zero) in drivers exceeding the speed limit by more than 15mph in a short period of time. There was also a sharp initial drop in the number of vehicles exceeding the speed limit by more than 15mph at mobile camera sites, after which the percentage of vehicles exceeding the speed limit by more than 15mph has remained at around 1%.

Chart 22 *Percentage of vehicles exceeding the speed limit by more than 15mph at mobile camera sites*

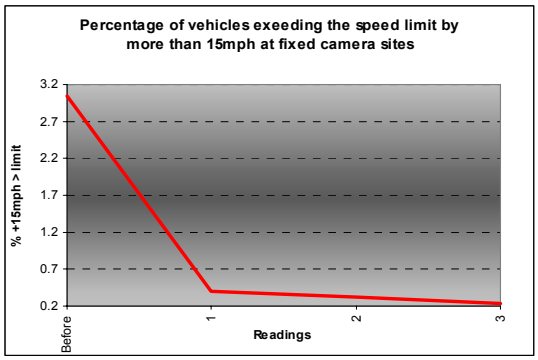
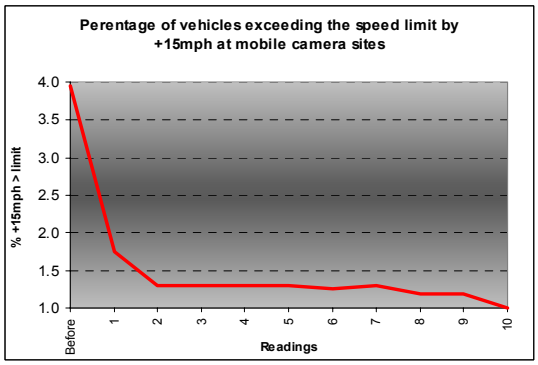


Chart 23 *Percentage of vehicles exceeding the speed limit by more than 15mph at fixed camera sites*

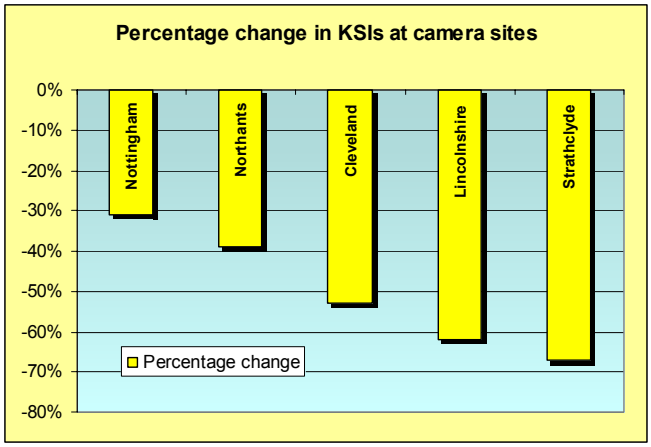


APPENDIX E: DETAILED CASUALTY ANALYSIS

E.1 EFFECT ON KILLED AND SERIOUS CASUALTIES (KSI)

E.1.1 Effect on KSIs at all camera sites

Chart 24 *Percentage change in KSI casualties at camera sites*



It was anticipated that if enforcement were made more frequent there would be a reduction in accidents and casualties at accident hotspots where cameras were located. Results for camera sites in years one and two of the pilot system, have been compared with results in the previous three years taking into account long term trend and seasonal effects[11]. The changes reported here were calculated relative to the long-term trend, which is used to provide a conservative estimate of what would have occurred in the pilot areas in the absence of treatment.

Chart 24 above shows the percentage change in KSIs at all camera sites in the five of the pilot areas where results when taken on their own were found to be statistically significant. It shows that reductions in KSIs at camera sites during the first two years of the pilot ranged from around 31% in Nottingham to around 67% in Strathclyde.

Table 15 below provides a breakdown of changes in KSI casualties at camera sites for each of the first two years. It shows that when all of the results are taken together, there was a large and statistically significant reduction of 35% in killed and serious injuries at camera sites in six of the pilot areas. This equates to about 280 fewer people killed or seriously injured in the two years of the pilot.

Table 15 *Change in KSI casualties at camera sites*

Pilot Area	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Cleveland	-67%	NS	-53%	Yes
Lincolnshire	-84%	NS	-62%	Yes
Northants	NS	-37%	-39%	Yes
Nottingham	-26%	-35%	-31%	Yes
Strathclyde	NS	-74%	-67%	Yes
Essex	NS	+50%[12]	NS	No
Six Areas	**-37%**	**-32%**	**-35%**	**Yes**

In order to compare these results with the comparison area and thus to obtain a relative 'after' result, 3.5% should be subtracted from these values (thus increasing the magnitude of negative values).

E.1.2 Effect on KSIs in wider partnership area

Another hypothesis was that as a result of increased enforcement at camera sites and increased driver awareness of the dangers of speeding, there might be a more general reduction in KSIs across the area as a whole. In order to investigate whether or not this effect was present, KSIs in

[11] Because of the changes in reporting of serious injuries in South Wales and Thames Valley, casualty results from these partnerships are shown separately.

[12] It is understood that the increase in KSI at the mobile camera sites in Essex in year 2 coincided with a decrease in frequency of enforcement at these sites

the six pilot areas were compared with results from the rest of the country, again taking into account long-term trend and seasonal effects.

Table 16 below shows that there was a reduction in KSIs of about 4% relative to the long-term trend. This compares favourably to the rest of the country where the number of KSIs remained broadly unchanged.

Performance varied across the pilots, with Strathclyde and Lincolnshire recording KSI reductions of around 14% and 12% through to Cleveland, Nottingham and Essex where the reduction in KSI casualties was not significantly different from the long-term trend. As a whole, there was a 4% reduction in KSI casualties in pilot areas relative to the long-term trend. This equates to about 530 fewer people killed or seriously injured than might otherwise have been expected in the two years of the pilot.

Table 16 *Change in KSI casualties in the wider pilot area*

Pilot Area	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Cleveland	NS	NS	NS	No
Lincolnshire	-17%	NS	-12%	Yes
Northants	NS	-15%	-9%	Yes
Nottingham	NS	NS	NS	No
Strathclyde	-14%	-13%	-14%	Yes
Essex	NS	+11%	NS	No
Six Areas	**-5%**	**NS**	**-4%**	**Yes**

E.1.3 Effect on KSIs by camera type

In terms of identifying the most effective means of camera enforcement, part of the analysis was to compare changes in KSI casualties using different camera types (mobile and digital)[13]. The results of this analysis are shown in Table 17 below.

This shows that KSI casualties were down by 65% at fixed camera sites and down by 29% at mobile camera sites relative to long-term trend. In numerical terms, this equates to a reduction of around 52 KSIs at fixed camera sites and a reduction of around 165 KSIs at mobile camera sites. This means that was an average reduction of 0.4 KSI casualties per year at each fixed site and 0.7KSI casualties per year at each mobile camera site. The larger number for mobile camera sites may in part be explained by the fact that mobile camera sites tend to cover greater lengths of road than fixed ones.

Table 17 *Change in KSI casualties by camera type*

Camera type	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Fixed	-69%	-62%	-65%	Yes
Mobile	-31%	-26%	-29%	Yes
All cameras	**-37%**	**-32%**	**-35%**	**Yes**

[13] No comment could be made as to the effectiveness of red-light and digital cameras from the data available

E.2 EFFECT ON ALL PERSONAL INJURY ACCIDENTS (PIA)

E.2.1 Effect on PIAs at camera sites

The previous section reviewed the effectiveness of cameras in reducing killed and serious injuries at camera sites. The following sections compare the effectiveness of cameras in reducing the number of personal injury accidents occurring at camera sites. The approach undertaken was the same as that used to measure changes in KSI casualties.

Chart 25 shows the change in personal injury accidents at camera sites where results on their own were found to be statistically significant. The chart shows that results ranged from a 14% increase in PIAs at camera sites in Thames Valley, relative to the long-term trend, through to a reduction of more than 60% in Glasgow (Strathclyde).

Chart 25 *Change in PIAs at camera sites*

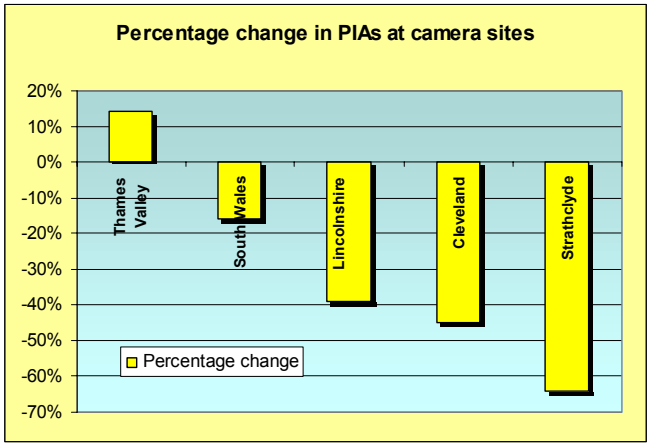


Table 18 provides a breakdown of changes in PIAs at camera sites for each of the pilots for the first two years. It shows that when eight of the pilots are taken together there was a statistically significant reduction in PIAs at camera sites of 6% relative to the long-term trend. If results are compared for the six pilots where KSI data was usable, (i.e. not including South Wales and Thames Valley), there was a reduction of 14% in the number of PIAs recorded at camera sites. This equates to about 510 fewer personal injury accidents at camera sites in these six pilot areas.

Table 18 *Change in PIAs at camera sites*

Pilot Area	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Cleveland	-46%	-44%	-45%	Yes
Lincolnshire	-29%	-50%	-39%	Yes
Northants	-85%	NS	NS	No
Nottingham	NS	NS	NS	No
Strathclyde	-52%	-71%	-64%	Yes
Essex	NS	NS	NS	No
Six areas	**-11%**	**-17%**	**-14%**	**Yes**
South Wales	-36%	-14%	-16%	Yes
Thames Valley	+13%	+13%	+14%	Yes
Eight Areas	**NS**	**-8%**	**-6%**	**Yes**

E.2.2 Effect on all PIAs in wider pilot area

It could be anticipated that the greatest impact on PIAs would be in the immediate areas where the cameras were operating. To assess whether or not this effect extended to the wider pilot area, the model has estimated the effects on PIAs relative to the long-term trend. Results of this analysis are presented in Table 19 below.

Table 19 *Change in PIAs in wider pilot area*

Pilot Area	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Cleveland	-10%	-11%	-10%	Yes
Lincolnshire	NS	NS	NS	No
Northants	NS	-14%	-6%	Yes
Nottingham	NS	NS	NS	No
Strathclyde	-7%	-11%	-8%	Yes
Essex	NS	NS	NS	No
Six Areas	**NS**	**-4%**	**NS**	**No**
South Wales	-4%	NS	NS	No
Thames Valley	NS	-4%	NS	No
Eight Areas	**NS**	**-3%**	**NS**	**No**

E.2.3 Effect on PIAs by camera type

Table 20 below shows the average change in the number of personal injury accidents according to the type of camera enforcement in all eight pilot areas. This shows that at fixed camera sites there was a 5% reduction in the number of personal injury accidents at fixed camera sites and a 9% reduction at mobile camera sites.

The estimates of the reductions at sites of digital cameras were not significantly different from zero and so cannot be used reliably and are not shown in the table. There were not enough red-light camera sites to draw any specific conclusions as to their effectiveness. This data is included, however, in all cameras analysis.

Table 20 *Change in PIAs by camera type*

Camera type	Change relative to long-term trend in after year 1	Change relative to long-term trend in after year 2	Change relative to long-term trend in after years 1 & 2 together	Is the result statistically significant?
Fixed	-	-7%	-5%	Yes
Mobile	-9%	-9%	-9%	Yes
All cameras	**NS**	**-8%**	**-6%**	**Yes**

APPENDIX F: COSTS AND INCOME

Table 21 below shows the costs incurred by the eight pilots in the first two years. The table shows that the pilots incurred costs of around £21m, whilst around £27m was passed to the Lord Chancellor's Department and over £6m returned to Treasury. Due to significant capital costs associated with setting up in year one, Nottingham and Essex carried forward small deficits into year 2.

Table 21 *Costs and income for eight of the pilots in the first two years*

YEAR ONE		
Pilot area	**Costs**	**Penalties paid @ £40**
Thames Valley	£1,825,639	£2,239,120
South Wales	£1,330,277	£1,567,000
Strathclyde	£204,330	£408,200
Essex	£1,846,480	£1,843,480
Northamptonshire	£1,702,404	£2,167,840
Nottingham	£622,371	£556,360
Lincolnshire	£512,721	£627,000
Cleveland	£771,901	£898,960
Year one total costs	***£8,816,123***	***£10,307,960***
YEAR TWO	**Costs**	**Penalties paid @ £40**[14]
Thames Valley	£2,617,031	£4,672,880
South Wales	£1,749,573	£1,876,240
Strathclyde	£740,896	£1,161,880
Essex	£3,003,763	£3,524,120
Northamptonshire	£2,247,838	£2,967,640
Nottingham	£778,536	£812,640
Lincolnshire	£516,818	£1,059,680
Cleveland	£486,891	£855,480
Total year two estimates	***£12,141,346***	***£16,930,560***
Total costs (Yrs 1 & 2)	***£20,957,469***	***£27,238,520***

F.1 CONCLUSIONS

Costs and income increased in year two and this may in part be due to the fact that many pilots were not fully operational until then. In the second half of year two the numbers of fixed penalties paid started to plateau and this may be due to greater compliance with speed limits.

[14] The penalty was increased to £60 during the study period. From April 2003, all participating partnerships – including the eight pilot areas - can recover their costs up to the full £60.00.

APPENDIX G:VALIDATION OF THE SITE SELECTION CRITERIA

As part of the site selection process, each pilot area was required to produce evidence that they were targeting enforcement at accident hotspots. As part of this review, we also obtained data from 209 fixed sites in London that have been operational for at least three years. Prior to camera installation, they had a range of serious casualty problems. London has a long history of fixed site speed enforcement and has some of the most dangerous roads in Great Britain.

A simple comparison, looking at levels of KSI accident three years before and after fixed sites were introduced shows, perhaps not surprisingly, that the greatest reduction in percentage occurs where the greatest problem was before. This is what would be expected intuitively. Furthermore, it is a greater percentage of a larger number, so in absolute terms the net effect is also higher.

G.1 SITE SELECTION GUIDELINES

Site selection guidelines require that, in most cases, pilots should enforce at sites that meet the following criteria:

- Digital cameras ~ 5 or more KSI accidents per km in the most recent three years
- Fixed cameras ~ 4 or more KSI accidents per km in the most recent three years
- Mobile cameras ~ 2 or more KSI accidents per km in the most recent three years.

There is also some flexibility to allow enforcement to take place at sites where communities have concerns about speeding and at temporary roadworks.

G.2 VALIDATION OF THE SELECTION CRITERIA

To illustrate the effect of applying site selection criteria based on camera history, Chart 26 to the right groups 209 camera sites in London according to the number of accidents where at least one person was killed or seriously injured (KSI) in the three years prior to enforcement. A comparison is then made with the number of accidents in the three years after introduction of the cameras.

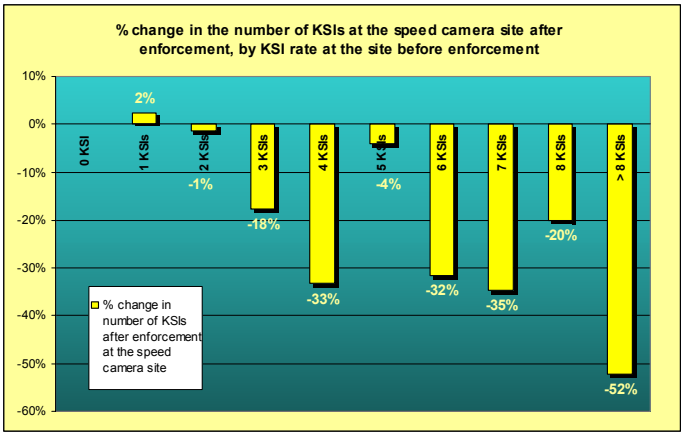


Chart 26 *Percentage change in KSI accidents at camera sites in London grouped by numbers of KSI prior to enforcement*

The chart shows that, in general, sites with the largest number of KSI accidents prior to enforcement, recorded the greatest reduction in killed or serious accidents after enforcement took place.

For example, at fixed sites that recorded 1 KSI in the 'before ' period there was on average a 2% increase in killed and serious accidents after enforcement. This compares to sites where 8 or more KSIs had been previously been recorded and which on average showed a -52% reduction in killed and serious accidents after enforcement.

This means that at sites where there were fewer than 2 killed and serious accidents in the before period, there were 55 *more* killed and serious accidents recorded in the most recent three years after enforcement took place. This compares with a reduction of 117 killed and serious accidents at sites with three or more KSI accidents.

G.3 CONCLUSIONS

The results of this analysis show that a strategy of identifying and targeting accident hotspots is likely to be the most effective use of camera resources and is likely to bring about the greatest reduction in fatal and serious casualties over time.

APPENDIX H: TECHNICAL DETAILS OF CASUALTY ANALYSIS

H.1 BACKGROUND

This work has been undertaken to provide a statistical analysis of road accident and casualty data in the eight pilot areas. The data that are investigated here relate to road accidents that occurred during the 2-year period following the introduction of the cost recovery system. These are compared with corresponding data from the previous 3-year period.

In view of the long-term general downward trend in frequency of accident and casualty occurrence, the impact is estimated here in a way that reflects this trend.

To undertake this investigation, data for killed and seriously injured casualties (KSI), and data for personal injury accidents (PIA) from all areas of Great Britain were used (with a few exclusions that are detailed later).

Five types of area were identified as being appropriate for comparison in the analysis:

- Shire authorities that did not bid to become pilot areas,
- Metropolitan authorities,
- Areas that bid to be part of the pilot but were unsuccessful,
- Pilot areas in their entirety,
- Camera sites in pilot areas

The questions to be addressed here are:

1. What is the impact in KSI casualties and PIAs at the pilot camera sites and in pilot areas, after taking into account relevant background reductions in PIAs and KSI casualties?
2. Is there a regression to mean, migration or other effect that will counteract this apparent effectiveness, *i.e.* are the changes that have occurred in the pilot area camera sites a fair reflection of the consequences of introducing this kind of road safety measure?

The first of these questions was addressed by identifying separately the national trends and road safety developments in areas outside the pilot areas. The accident record of the individual pilot areas was then compared to this to quantify any further reduction that has occurred that can be attributed to the introduction of camera enforcement.

The second question was addressed by investigating the accident record of the entire pilot areas to see whether participation in the pilot is associated with widespread benefits that could arise from non-local benefits of cameras operating under this regime, and would not arise if large-scale migration occurred. The accident record of those areas that bid to become part of the pilots but were unsuccessful was investigated and compared with non-bidders and with the successful bidders to see if any effect could be associated with bidding as opposed to participation.

The approach of the investigation is twofold:

1) To fit a statistical model to the road accident and casualty record of individual sites that accounts explicitly for the effects associated with their treatment, and
2) To fit a statistical model to the road accident and casualty record of the entire pilot areas.

This approach includes the road accident record of several kinds of comparison areas over the same period of time so that national trend and seasonal variations are taken into account. These comparison groups are: other police force areas that bid unsuccessfully for pilot status, similar areas that did not bid at all, and metropolitan authorities. This structure therefore corresponds to two before-after investigations of treatment-associated road safety effects. The resulting models provide information about the expected effects of enforcement cameras over all sites of the specified types; the effects at individual sites will generally differ from these.

H.2 DESCRIPTION OF THE DATA

Eight areas took part in the trial. These are known in this section as the *pilot areas*. These were:

- Cleveland
- Lincolnshire
- Northamptonshire
- Nottingham (City)
- Strathclyde (Glasgow)
- South Wales
- Thames Valley
- Essex

The data supplied for the analysis by the eight areas were the numbers of Killed and Seriously Injured casualties (KSI) and Personal Injury Accidents (PIA)

Accident and data for each site was split according to the following time periods:

1. Within a certain distance of a camera site during 36 months starting from the beginning of January 1997 to the end of December 1999 (known as the *Before period*).
2. For a camera site during 12 months starting from the beginning of April 2000 to the end of March 2001 (known as the *After 1 period*).
3. For a camera site during 12 months starting from the beginning of April 2001 to the end of March 2002 (known as the *After 2 period*)

The fixed camera sites were generally the section of road within 0.5 Km of the location of the camera itself.

Table 1a below summarises the number of sites contributing to the study and the stated enforcement strategy and the camera types in the study data. Details of the number of sites of various kinds for which data were available are shown in Tables 1b and 1c. The data used in the present analysis are those provided for some subset of the sites at which cameras were installed or operated as part of the pilot. Some sites could not be used in the analysis because of missing data in the datasets.

Table 1a: *Summary information of the pilot areas.*

Pilot area	Number of sites contributing to data KSI/PIA	Cameras types provided in study data	Enforcement strategy
Nottingham (City)	26/28 of which 2 are Digital	Digital, Mobile, Red light	Digital system and supporting mobile and red light cameras.
Northamptonshire	49/50	Fixed, Mobile	Mix of fixed speed and red-light cameras and mobile cameras.
Essex	40/46	Mobile	Increase in the level of enforcement by increasing the use of permanent fixed housings and mobile and red light cameras.
Strathclyde (Glasgow)	28/28	Fixed	Increase in the number of fixed sites and cameras and also investment in mobile cameras and use of four red-light cameras.
Cleveland	33/31	Mobile	Planned to increase mobile capacity and one additional red-light camera.
Lincolnshire	42/44	Fixed	Predominantly fixed camera strategy
South Wales	96 PIA only	Fixed, Mobile	Increase in the number of new fixed and mobile cameras and increased use of existing cameras.
Thames Valley	276 PIA only	Fixed Mobile	The strategy was not to purchase more equipment but to make more intensive use of existing camera sites (fixed and red-light). All camera sites in the Thames Valley area were included in the pilot

Table 1b: *Number of sites with KSI data by camera type and speed limit*

	Speed limit							*All*
Cleveland	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Fixed	0	0	0	0	0	0	0	0
Mobile	24	6	0	0	2	0	1	33
Red Light	0	0	0	0	0	0	0	0
All	**24**	**6**	**0**	**0**	**2**	**0**	**1**	**33**
Lincolnshire	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Fixed	8	9	3	0	17	0	5	42
Mobile	0	0	0	0	0	0	0	0
Red Light	0	0	0	0	0	0	0	0
All	**8**	**9**	**3**	**0**	**17**	**0**	**5**	**42**
Northamptonshire	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Fixed	5	0	0	0	0	0	0	5
Mobile	13	4	2	1	14	1	9	44
Red Light	0	0	0	0	0	0	0	0
All	**18**	**4**	**2**	**1**	**14**	**1**	**9**	**49**
Essex	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Fixed	0	0	0	0	0	0	0	0
Mobile	40	0	0	0	0	0	0	40
Red Light	0	0	0	0	0	0	0	0
All	**40**	**0**	**0**	**0**	**0**	**0**	**0**	**40**
Nottingham	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Digital	1	1	0	0	0	0	0	2
Fixed	0	0	0	0	0	0	0	0
Mobile	7	0	0	0	0	0	0	7
Red Light	17	0	0	0	0	0	0	17
All	**25**	**1**	**0**	**0**	**0**	**0**	**0**	**26**
Strathclyde	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Fixed	27	1	0	0	0	0	0	28
Mobile	0	0	0	0	0	0	0	0
Red Light	0	0	0	0	0	0	0	0
All	**27**	**1**	**0**	**0**	**0**	**0**	**0**	**28**
TOTAL (six areas)	***30***	***40***	***50***	***50/60***	***60***	***60/40***	***70***	
Digital	1	1	0	0	0	0	0	2
Fixed	40	10	3	0	17	0	5	75
Mobile	84	10	2	1	16	1	10	124
Red Light	17	0	0	0	0	0	0	17
All	**142**	**21**	**5**	**1**	**33**	**1**	**15**	**218**

Table 1c: *Number of sites with PIA data by camera type and speed limit*

	Speed limit							
Cleveland	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	0	0	0	0	0	0	0	0
Mobile	24	6	0	0	0	0	1	31
Red Light	0	0	0	0	0	0	0	0
All	**24**	**6**	**0**	**0**	**0**	**0**	**1**	**31**
Lincolnshire	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	8	9	3	0	17	0	5	42
Mobile	0	0	0	0	2	0	0	2
Red Light	0	0	0	0	0	0	0	0
All	8	9	3	0	19	0	5	44
Northamptonshire	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	5	0	0	0	0	0	0	5
Mobile	13	4	2	1	15	1	9	45
Red Light	0	0	0	0	0	0	0	0
All	**18**	**4**	**2**	**1**	**15**	**1**	**9**	**50**
Essex	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	0	0	0	0	0	0	0	0
Mobile	46	0	0	0	0	0	0	46
Red Light	0	0	0	0	0	0	0	0
All	**46**	**0**	**0**	**0**	**0**	**0**	**0**	**46**
Thames Valley	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	173	29	11	0	13	0	0	226
Mobile	31	8	1	0	10	0	0	50
Red Light	0	0	0	0	0	0	0	0
All	**204**	**37**	**12**	**0**	**23**	**0**	**0**	**276**
South Wales	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	64	6	0	0	0	0	0	70
Mobile	23	0	0	0	0	0	3	26
Red Light	0	0	0	0	0	0	0	0
All	**87**	**6**	**0**	**0**	**0**	**0**	**3**	**96**
Nottingham	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Digital	1	1	0	0	0	0	0	2
Fixed	0	0	0	0	0	0	0	0
Mobile	7	0	0	0	0	0	0	7
Red Light	17	2	0	0	0	0	0	19
All	**25**	**3**	**0**	**0**	**0**	**0**	**0**	**28**
Strathclyde	**30**	**40**	**50**	**50/60**	**60**	**60/40**	**70**	**All**
Fixed	27	1	0	0	0	0	0	28
Mobile	0	0	0	0	0	0	0	0
Red Light	0	0	0	0	0	0	0	0
All	**27**	**1**	**0**	**0**	**0**	**0**	**0**	**28**
TOTAL (8 areas)								
Digital	1	1	0	0	0	0	0	2
Fixed	277	45	14	0	30	0	5	371
Mobile	144	18	3	1	27	1	13	207
Red Light	17	2	0	0	0	0	0	19
All	**439**	**66**	**17**	**1**	**57**	**1**	**18**	**599**

In the present analysis, the data for the different sites were not all for periods of identical duration. Table 2a and 2b shows the number of site-months for each pilot area by camera type and speed limit for KSI casualties and PIAs respectively. Fixed and mobile cameras were each used by

several of the pilot areas. However, red light and digital cameras were used only in Nottingham. Strathclyde used only fixed cameras, whilst Cleveland and Essex used only mobile ones. The other pilot areas each used a range of camera types, though Lincolnshire KSI data were only available for fixed camera sites.

Table 2a: *Total number of site-months of data available for KSI casualties*

Camera type	Non-partner areas	Cleveland	Lincolnshire	Northants	Nottingham	Strathclyde	Essex	All
-	5520	0	0	0	0	0	0	5520
Fixed	0	0	2515	300	0	1608	0	4423
Mobile	0	1972	0	2112	404	0	2396	6884
Digital	0	0	0	0	117	0	0	117
Red Light	0	0	0	0	986	0	0	986
All	**5520**	**1972**	**2515**	**2412**	**1507**	**1608**	**2396**	**17930**

Table 2b: *Total number of site-months of data available for PIAs*

Camera type	Non-partner areas	Cleve-land	Lincs	Northants	Nottingham	Strathclyde	South Wales	Thames Valley	Essex	All
-	5520	0	0	0	0	0	0	0	0	5520
Fixed	0	0	2516	300	0	1608	3528	13560	0	21512
Mobile	0	1859	120	2151	414	0	1248	3000	2648	11440
Digital	0	0	0	0	120	0	0	0	0	120
Red Light	0	0	0	0	1102	0	0	0	0	1102
All	**5520**	**1859**	**2636**	**2451**	**1636**	**1608**	**4776**	**16560**	**2648**	**39694**

Data on pedestrian accidents and casualties at pilot camera sites were not available from all pilot areas. Because of this, the results of analysis of the effect of the pilot on pedestrian accident involvement are not directly comparable with those from other analyses.

Table 3a shows the number of sites contributing to the datasets used in the analyses and the total casualties for the three year before period for those sites. Table 3b shows the number of sites contributing to the datasets used in the analyses and the total PIAs for the three year before period for those sites. From the tables it is clear that although the datasets for the PIAs and for KSI casualties are, in most cases, broadly similar, they are not identical.

Table 3a: *Number of contributing sites and number of KSI casualties in 3 year before period, by camera type and pilot area.*

Camera type		Cleveland	Lincolnshire	Northants	Essex	Nottingham	Strathclyde	All
Fixed	**Sites**	0	42	5	0	0	28	75
	KSI	--	40	15	--	--	81	136
Mobile	**Sites**	33	0	44	40	7	0	124
	KSI	72	--	544	103	218	--	937
Red light	**Sites**	0	0	0	0	17	0	17
	KSI	--	--	--	--	34	--	34
Digital	**Sites**	0	0	0	0	2	0	2
	KSI	--	--	--	--	84	--	84
All	**Sites**	33	42	49	40	26	28	218
	KSI	72	40	559	103	336	81	1191

Table 3b *Number of contributing sites and number of PIAs in 3 year before period by camera type and pilot area.*

Camera type		Cleveland	Essex	Strathclyde	Lincs	Northants	Nottingham	South Wales	Thames Valley	All
Fixed	Sites	0	0	28	42	5	0	70	226	371
	PIA	--	--	257	179	49	--	1814	1977	4267
Mobile	Sites	31	46	0	2	45	7	26	50	207
	PIA	544	1007	--	18	1520	1086	595	321	5091
Red light	Sites	0	0	0	0	0	19	0	0	19
	PIA	--	--	--	--	--	184	--	--	184
Digital	Sites	0	0	0	0	0	2	0	0	2
	PIA	--	--	--	--	--	444	--	--	444
All	Sites	31	46	28	44	50	28	96	276	599
	PIA	544	1007	257	197	1569	1714	2409	2298	9995

H.3 COMPARISON GROUPS

Five kinds of areas were identified as being appropriate to compare in the analysis:

Shire PFA that did not bid for pilot (Area type 1)

Data were taken from DfT dataset. The following were features of the other shire counties dataset. Data for Nottinghamshire was obtained by subtracting that for Nottingham City from it. A similar process was applied to Strathclyde in relation to Glasgow City.

Metropolitan PFA that did not bid for pilot (Area type 2)

Data were taken from DfT dataset. The Metropolitan areas were:

- Metropolitan Police
- City of London
- West Midlands
- South Yorkshire
- West Yorkshire
- Merseyside
- Greater Manchester
- Tyne & Wear

Tyne & Wear was not a PFA in its own right but included Northumberland (a shire county). Tyne & Wear was split out from the PFA of Northumbria to form two separate regions.

Data for unsuccessful bidders (Area type 3)

Data for these areas were taken from the DfT dataset. It is possible that this group of PFA may have a better casualty reduction record as they have shown an interest in the project, which could be considered as a proxy for having an active road safety programme. These counties are:

- Lancashire
- Warwickshire
- Sussex
- Hampshire
- Hertfordshire
- Staffordshire

Data for entire pilot areas (Area type 4)

Data for the entire pilot area were taken from the DfT dataset and the numbers of camera months of active cameras for the pilot area were added to the data. These areas were:

- Cleveland
- Lincolnshire
- Northamptonshire
- Nottingham (City)
- Strathclyde (Glasgow)
- South Wales
- Thames Valley
- Essex

Nottingham is an LA area and the data taken from DfT was for Nottingham City. The rest of Nottinghamshire is treated as area type 1. Data for the rest of Nottinghamshire was obtained by subtraction of DfT data for Nottingham city from DfT data for Nottinghamshire.

The pilot took place in Glasgow City only, rather than the whole of Strathclyde. Glasgow City is a LA area and the data for the rest of Strathclyde is treated as area type 1 Data for the rest of Strathclyde was obtained by subtraction of DfT data for Glasgow city from DfT data for Strathclyde.

South Wales and Thames Valley had changes in reporting procedures for KSIs. These reporting changes took place at the beginning of 1999 for Thames Valley and at the beginning of 2000 in South Wales. These changes increased the proportion of serious casualties.

South Wales and Thames Valley KSI data were excluded from the main analysis due to these problems with their data, and data for PIAs was analysed instead.

Data for camera sites in pilot areas (Area type 5)

The pilot areas were:

- Cleveland
- Lincolnshire
- Northamptonshire
- Nottingham (City)
- Strathclyde (Glasgow)
- South Wales
- Thames Valley
- Essex

Of these, all were Police force areas except for Nottingham and Glasgow.

H.4 DATA ISSUES

Cleveland

There were no special features of the Cleveland data.

Lincolnshire

There were no special features of the Lincolnshire data.

Northamptonshire

In Northants some mobile sites were corridors (red routes) rather than a 1km length of road. In some of these cases the speed limit was different in different parts of the corridor. Where these differences spanned urban and rural categories (one case) they were set to 'unknown' for area type 5. They were set to rural for the purposes of calculating the number of months that cameras were active in area type 4. This affected only one site. No analyses were undertaken that compared these two forms of the interpretation of the speed limits.

Some of the mobile camera sites in Northamptonshire were found to include within them fixed camera sites. In order to avoid possible double counting of changes, the fixed sites were removed from the dataset before analysis.

Nottingham City

Nottingham city digital camera sites were on the ring road of the city

Strathclyde

No special features of Strathclyde data were identified.

South Wales

There had been a change in reporting practices in South Wales around the end of 1999 or early on in 2000. The effect of these changes is thought to have increased the recording of KSI casualties.

It was concluded that given the uncertainties with regard to the impact of the reporting changes (and given that the implementation of speed cameras may affect the ratio of KSI to slight casualties) South Wales data were excluded from the analysis of KSI casualties.

Thames Valley

Thames valley KSI data were also excluded from the analysis because, like South Wales, changes in reporting practices in 1999 made the data incomparable with the other KSI data. These data have therefore also been excluded from the KSI analysis. All existing camera sites that were active in the Thames Valley area were included in the pilot and these have been included in the data. This made Thames Valley a large pilot area that accounted for about one half of all the PIA data.

Essex

Some Essex fixed camera site data were taken from an area within a radius of about 1km from the camera, whilst the remainder of the sites used the standard area within a radius of 500m from the camera for recording data.

Other issues affecting all sites

Cameras included were some or all of the following categories in different pilot areas: Red light cameras, fixed speed camera, Mobile speed camera, and Digital cameras. There were only two active digital sites within the pilot areas, and both of these were in Nottingham. Effects for the different camera types have been analysed separately.

In some cases, parts of the data were not available for some sites. These were excluded from the analysis where the missing data would not permit the site to be analysed (*e.g.* missing before data). In cases where some smaller part of the data were not available, due allowance was made for this within the analysis.

In some cases cameras were already installed in the 1997-1999 period and levels of enforcement increased during the trial period. It was not clear from all the datasets which cameras in the dataset were previously installed. All comparisons will be to the 1997-1999 baseline period to avoid potentially misleading trend effects.

Data outside the treated areas were not available for individual sites, but only as area wide totals. It was therefore not possible to identify a regression to mean effect at the site level because the mean could not be estimated for individual sites.

Data provided by the DfT

The DfT provided data from Quarter 1 (Q1) 1997 to Q4 2001 for each of the area types: shire counties that did not bid, metropolitan counties, unsuccessful bidders, and entire pilot areas. As far as is known these data are complete. Raw data were provided on the understanding that they were provisional and may underestimate the position. Whole year data (by quarter) was available so there were no issues relating to asymmetry of seasonal data.

H.5 ANALYSIS

A log-linear modelling exercise was undertaken using the GLiM statistical package (NAG, 1993).

Because the data cannot be disaggregated into separate units of equal duration – and in particular, they are recorded only for 3 years in the before period - the different durations of observation periods for the observations were accommodated by using the GLiM *offset* facility.

We supposed that the data have a Poisson distribution with mean rate to be modelled as follows. The same model form was developed for both KSIs and for PIAs, but with different parameter values fitted for each. The description below is that for KSIs.

$$C_{pt} = D_{pt} \exp(N_0 + P_p + T\ t + Q_{q(t)} + A_{k(p),a(t)}) + \varepsilon_{pt}$$

where

C_{pt} is the recorded number of KSI casualties at site p for period t

D_{pt} is the duration of the observations period t at site p. In all before cases at pilot areas it was 3 years. Cleveland had data for only an 11 month after period and so has the value 11/12, for 3 month data it will be ¼ , and for 1 month data it will be 1/12. This is accommodated using the GLiM *offset* facility using the natural logarithm of D_{pt} .

N_0 is a parameter representing the number of casualties occurring in base condition,

ie at time t=0 for non-involved shire police force areas (PFAs).

P_p is a parameter to allow for the differing number of KSI casualties between sites p due to their sizes, populations and other fixed attributes. Note that in this model, the whole of areas of kind 1, 2, 3 and 4 are treated as single sites. The term *site* is also applied to a local authority area in the few cases where this has been separated from the rest of the PFA.

T is a parameter to represent the general reduction in KSI casualties over time t , which is measured from the start of the study period. This parameter is fitted to the time series of the data.

Q_q is a parameter to represent the seasonal variation in KSI casualties during each year with a value that varies between quarters q .

$q(t)$ is the quarter year into which the observation falls: in cases where the observation spans several quarters, the quarterly effects were averaged.

$A_{k,a}$ represents the difference between the *before* and each of the two *After* KSI rates in areas of kind k .

$k(p)$ is the kind of area p:

$k(p)$= 1 for shire PFAs expressing no interest in the system

$k(p)$= 2 for metropolitan PFAs expressing no interest in the system

$k(p)$= 3 for PFAs bidding but not in the system

$k(p)$= 4 for the entirety of LAs that participated in the pilot

$k(p)$= 5 for the area within 0.5 Km of camera sites.

$a(t)$ is the index of the period into which the observation at time t falls:

$a(t)$= 0 for t in the *before* period

$a(t)$= 1 for t in the *After 1* period

$a(t)$= 2 for t in the *After 2* period.

The before-after effect at the treated sites is represented in this model by the coefficients $A_{5,1}$ and $A_{5,2}$ (treated sites after). Further analysis was undertaken using a single index for the whole of the *After* period to identify the effect of treatment singularly. Because of the way in which the GLiM Software works, the value presented is that of the difference from the rate for the corresponding

After period in a non-volunteer shire county. This can therefore be interpreted in terms of the differential effect of treatment beyond what occurred at sites that are otherwise similar. The size of the treatment effect at sites of kind 5 relative to the long-term trend can therefore be estimated as $\exp(A_{5a} + A_{1a})$ for *after* period *a*. The standard error σ_e of this estimate can be estimated under the assumption of independence of estimates as $\sigma_e = \sqrt{\sigma_{5a}^2 + \sigma_{1a}^2}$. This is used in assessing whether or not the resulting combined effect differs statistically significantly from the long-term trend.

The use of a separate variable P_p for each site p means that comparisons are made between before and after the start of the pilot at each site individually. Use of the temporal term T and the quarterly terms Q_q made due allowance respectively for long-term and seasonal variations. These allowances are especially important in accommodating missing data.

Various after comparisons are possible using this model. Of particular interest are:

- Comparison between treated sites and shire counties that did not bid to participate in the pilot.
- Comparison between entire pilot areas and shire counties that did not bid to participate in the pilot: this can inform on migration from the treated areas and regression effects. This comparison is achieved by inspecting the coefficients $A_{4,1}$ and $A_{4,2}$.
- Comparison between interested but unsuccessful PFAs and shire counties that did not bid to participate in the pilot: this can inform regression effects at a gross scale. This comparison is achieved by inspecting by inspecting the coefficients $A_{3,1}$ and $A_{3,2}$.

H.6 RESULTS

The results are presented separately for the KSI data and the PIA data. We investigated the general effects at treated sites and in entire pilot areas on the basis of the experimental results as a whole. We considered further the performance in the different pilot areas and of different camera types.

We also investigated the KSI data separately for each of the 4 camera types to identify their various effects, and to allow for the differing sizes and characteristics of the sites associated with each of them.

H.6.1 KSI casualties.

The results of fitting the full model described in the previous section to the KSI data are shown in Table 4 and Table 5. The parameter estimates shown in Table 4 describe the general development of KSI casualties during the 5 years of the study period, whilst those in Table 5 describe the differences from the general development that are present in the data for the various kinds of area, including the pilot areas. The content of each of these tables is discussed below.

Table 4: *Parameter estimates ($\hat{\theta}$) for those non-treatment factors that were significant in the Poisson/log-linear model of KSIs together with estimates for upper and lower limits on their 95% confidence intervals, calculated as $\hat{\theta} \pm 1.96\sigma_\theta$. This dataset excludes Thames Valley and South Wales.*

KSI	Estimate	Standard error	95% C.I.	
Factor	$\hat{\theta}$	σ_θ	**Lower**	**Upper**
Time (year)	-0.0478	0.0031	-0.0539	-0.0417
Quarter 1	-0.1393	0.0067	-0.1525	-0.1260
Quarter 2	-0.0622	0.0066	-0.0752	-0.0492
Quarter 3	-0.0234	0.0064	-0.0360	-0.0107
After 1	0.0268	0.0108	0.0057	0.0478
After 2	0.0712	0.0134	0.0450	0.0974
After (1 & 2)	0.0343	0.0101	0.0145	0.0540

Note: In a log-linear model of the kind used here, the proportionate effect of a unit change in variable x that has associated parameter θ is $\exp(\theta) - 1$. Thus for small absolute values of θ (a

few percent) , a unit change in the value of x will result in a proportionate change of approximately θ in the estimated quantity.

The fitted value of the parameter for time shows that the frequency of occurrence of KSI casualties in the whole of GB fell at about 4½ per cent each year during the *before* period. However, the positive parameter estimates for the two *After* periods, which relate to *Area* 1 (shire counties that did not bid for pilot status), effectively cancel this trend. This shows that in *Area* 1, the long-term reduction trend ceased during the first *After* year. The effects for the three quarter-years are referenced to the final quarter of the year, and these show that the frequency of KSI casualties increases progressively from quarter to quarter through the year. The combination of the quarterly effect and the long-term temporal one is that the frequency of KSI casualties during the first quarter of each year (January-March) is about 10 per cent less than that during the last quarter (October-December) of the same year.

Table 5: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for KSI casualties together with standard errors of estimation for the various areas. This dataset excludes Thames Valley and South Wales.*

KSI	***After 1***		***After 2***		***After (1 & 2)***	
Area	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**
2 Mets	-0.0492	0.0134	-0.0768	0.0149	-0.0611	0.0109
3 Bidders	-0.0093	0.0176	-0.0056	0.0194	-0.0028	0.0143
4 Entire PA	-0.0438	0.0212	-0.0534	0.0235	-0.0480	0.0172
5 Pilot sites	-0.4906	0.1001	-0.4510	0.0736	-0.4608	0.0631

The parameter estimates for the various areas given in Table 5 show the differences between these areas and the uninvolved shire counties (*Area* 1), which forms the reference in the present GLiM models. From this, we see that the coefficients in unsuccessful bidders for pilot status (*Area* 3) are small and are not significantly different from zero, so that there is no evidence of difference between the KSI frequency during the *After* period between these areas and those in *Area* 1 that did not bid for pilot status at all. On the other hand, the parameter estimates for the metropolitan counties (*Area* 2) are similar in magnitude but opposite in sign to those of *Area* 1, so that they cancel out, meaning that the long-term trend continued in these areas. The net effect of this is that the long-term trend of about 4.5 per cent annual reduction in frequency of KSI casualties continued in the Metropolitan areas throughout the study period.

During the course of the modelling and analysis, we became aware of a boundary change that affected the *Area 4* data for Essex during the study period. The nature of this boundary change was to include data from the Epping area in the *Area 4* data for Essex during the *After* periods. In order to make due allowance for this, a correction was calculated for the fitted model coefficients on the basis of the numbers of KSIs and PIAs recorded in Epping during the *Before* period that were not included in the model. Thus N_E (311 KSI casualties and 1221 PIAs) were added to the *Before* values N_B for each of Essex (3764 KSIs, 21020 PIAs) and All Partnership Areas (11482 KSIs, 95029 PIAs). The resulting multiplicative correction to the model estimates of effectiveness was then $N_B/(N_B + N_E)$, which can be represented as an additive correction of size $\log_e[N_B/(N_B + N_E)]$ to the fitted parameters. The values of these corrections for the four cases are shown in table 5b below: these corrections are applied where appropriate to the parameter estimates that are shown in the other tables of this Appendix.

Table 5b: *Additive corrections to parameter estimates made in respect of changes to Essex boundary at the end of the Before period.*

Area	***KSI casualties***	***PIAs***
Essex (entire partnership area)	-0.07939	-0.05646
All pilot areas	-0.02673	-0.01277

The parameter estimates for the entire pilot areas (*Area* 4) are similar to those for metropolitan counties (*Area* 2) and opposite to those for the uninvolved shire counties (*Area* 1). Thus the long-

term trend of about 4.5 per cent annual reduction in frequency of KSI casualties continued in the entire pilot areas throughout the study period, unlike the other shire counties whether or not they bid for pilot status. This shows that participation in the pilot was not detrimental to road safety in the area as a whole as might arise if for example it caused migration of accidents from pilot sites to nearby ones. Rather, participation in the pilot is associated with reductions in severe road accident casualties that were not achieved by similar counties that did not participate in the pilot.

The results for *Area* 5 (camera sites in pilot areas) are substantial and show a statistically significant reduction. These show that the frequency of occurrence of KSI casualties at these sites was about 37 per cent lower than the long-term trend during the *After* 1 year, and about 32 per cent lower than the long-term trend during the *After* 2 year (though the difference between these estimates is not statistically significant at the 5% level). A single estimate for the whole of the *After* period is that there was a reduction below the long-term trend of about 35 per cent. Because the comparison *Area* 1 did not follow the long-term trend, this corresponds to a reduction in the range 36 to 39 per cent relative to the frequency of KSI occurrence in the comparison area during the *After* period. This shows that the pilot sites in general had substantially lower serious casualty (KSI) frequencies during the pilot period than would otherwise be expected.

The reduction in frequency of KSI casualties achieved at the pilot sites varied substantially between the six pilot areas. Model estimates of the parameters associated with each area are shown in Table 6 for each of the two *After* years individually and for the whole of the *After* period. This shows that the general reduction of about 35 per cent below the long-term trend was bettered substantially in Lincolnshire and Strathclyde (*After* parameters -1.007 and -1.131 respectively, corresponding to reductions of about 65 per cent). On the other hand, there was an increase at those in Essex, though this was not statistically significant at the 5 per cent level. This shows that the frequency of serious casualty occurrence at pilot sites changed in different ways between pilot areas after commencement of the pilot.

Table 6: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for KSIs together with standard errors of estimation for pilot sites (Area 5) in each of the pilot areas (excluding Thames Valley and South Wales).*

KSI	***After* 1**		***After* 2**		***After* (1 & 2)**	
Area of site	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
Cleveland	-1.134	0.3956	-0.5422	0.3014	-0.7873	0.2529
Lincolnshire	-1.829	0.7171	-0.5608	0.4093	-1.007	0.3686
Northants	-1.492	1.028	-0.5402	0.1091	-0.5323	0.1085
Nottingham	-0.3226	0.1280	-0.5059	0.1481	-0.4018	0.1041
Strathclyde	-0.7946	0.4028	-1.422	0.4226	-1.131	0.3004
Essex	-0.1986	0.2196	+0.3372	0.1804	+0.1058	0.1551
All	-0.4906	0.1001	-0.4510	0.0736	-0.4608	0.0631

The reduction in frequency of KSI casualties achieved within the entirety of the pilot areas also varied substantially between them. Model estimates of the parameters associated with each pilot area are shown in Table 7 for each of the two *After* years individually and for the whole of the *After* period. This shows that the general reduction of about 4½ per cent below the trend in the non-bidding comparison areas included a range from about 15 per cent reduction in Lincolnshire and Strathclyde, through a small increase in Cleveland that is not statistically significant to an increase relative to the non-bidding areas of about 10 per cent in Essex. This shows that the frequency of serious casualty occurrence in pilot areas in their entirety changed in different ways after commencement of the pilot.

Table 7: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for KSIs together with standard errors of estimation for each entire pilot area (Area 4) (excluding Thames Valley and South Wales).*

KSI	*After* 1		*After* 2		*After (1 & 2)*	
Area	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
Cleveland	+0.0330	0.0725	-0.0187	0.0819	+0.0108	0.0595
Lincolnshire	-0.2065	0.0472	-0.1064	0.0504	-0.1616	0.0374
Northants	-0.0535	0.0452	-0.2309	0.0534	-0.1271	0.0376
Nottingham	-0.0288	0.0699	-0.1210	0.0804	-0.0680	0.0574
Strathclyde	-0.1716	0.0570	-0.2019	0.0641	-0.1848	0.0461
Essex	+0.0714	0.0332	+0.1176	0.0361	+0.0919	0.0269
All	-0.0438	0.0212	-0.0534	0.0235	-0.0480	0.0172

In order to investigate the effectiveness of different kinds of camera, analysis was performed for each one separately. The results of this are shown in Table 8. This shows that the fixed cameras reduced the frequency of KSI occurrence by a large proportion (about 65 per cent relative to the long-term trend) whilst the mobile cameras reduced this frequency by a smaller proportion (about 29 per cent relative to the long-term trend). The estimates of the reductions at sites of each of red light and digital cameras were not significantly different from 0 and so cannot be used reliably and are not shown in the table.

Table 8: *Parameter estimates ($\hat{\theta}$) for the effectiveness of different camera types in the After periods that were significant in the Poisson/log-linear model of KSI casualties together with standard errors of estimation for the various areas. This dataset excludes Thames Valley and South Wales.*

KSI	*After* 1		*After* 2		*After (1 & 2)*	
Camera type	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
Fixed	-1.190	0.3277	-1.024	0.2719	-1.088	0.2179
Mobile	-0.3982	0.1192	-0.3704	0.0800	-0.3672	0.0714

Because the mobile camera sites are larger than the fixed ones, the frequency of KSI casualties is greater so that in numerical terms, the reduction in KSI casualties at mobile sites is greater than that at fixed ones. The results of an analysis of the effect on annual numbers of KSI casualties of the model estimate of the reduction due to implementation of each of fixed, mobile, and all cameras is given in Table 9. This shows that applying the model estimated coefficients to the frequency of KSI occurrence during the *before* period yields estimated benefits of about 0.39 KSI casualties per year at fixed camera sites, 0.72 KSI casualties per year at mobile camera sites, and 0.64 KSI casualties per year at all camera sites. The changes estimated directly from the raw data will differ from these model estimates because the coverage of sites during the study period is incomplete and hence is not fully matched between the periods.

Table 9: *Estimates of changes in KSI casualties resulting from camera implementation (fixed, mobile, and all cameras)*

Analysis of KSI numbers at fixed camera sites				Model estimate	
Period	**KSIs**	**Site months**	**Rate (pcm)**	**Coefficient**	**KSI reduction (pa)**
Before	136	2700	0.0504	0	-
After 1	10	828	0.0121	-1.1673	0.42
After 2	15	895	0.0168	-0.9585	0.37
After (1&2)	25	1723	0.0145	-1.0577	0.39
Analysis of KSI numbers at mobile camera sites				**Model estimate**	
Period	**KSIs**	**Site months**	**Rate (pcm)**	**Coefficient**	**KSI reduction (pa)**
Before	937	4464	0.2099	0	-
After 1	84	950	0.0884	-0.3755	0.79
After 2	191	1470	0.1299	-0.3049	0.66
After (1&2)	275	2420	0.1136	-0.3369	0.72
Analysis of KSI numbers at all camera sites				**Model estimate**	
Period	**KSIs**	**Site months**	**Rate (pcm)**	**Coefficient**	**KSI reduction (pa)**
Before	1191	7848	0.1518	0	-
After 1	120	2006	0.0598	-0.4679	0.68
After 2	232	2556	0.0908	-0.3855	0.58
After (1&2)	352	4562	0.0772	-0.4305	0.64

H.6.2 Personal Injury Accident data

The results of fitting the model corresponding to that in the previous section to the PIA data are shown in Table 10 and Table 11. The parameter estimates shown in Table 10 describe the general development of PIAs during the study period, whilst those in Table 11 describe the differences from the general development that are present in the data for the various kinds of area, including the pilot areas. The content of each of these tables is discussed below.

Table 10: *Parameter estimates ($\hat{\theta}$) for those non-treatment factors that were significant in the Poisson/log-linear model of PIAs together with estimates for upper and lower limits on their 95% confidence intervals, calculated as $\hat{\theta} \pm 1.96\sigma_{\theta}$. This dataset includes all 8 pilot areas.*

PIA	Estimate	Standard error	95% C.I.	
Factor	$\hat{\theta}$	σ_{θ}	**Lower**	**Upper**
Time (year)	-0.0074	0.0013	-0.0100	-0.0048
Quarter 1	-0.1380	0.0028	-0.1436	-0.1324
Quarter 2	-0.0966	0.0028	-0.1022	-0.0911
Quarter 3	-0.0813	0.0027	-0.0867	-0.0759
After 1	-0.0014	0.0048	-0.0107	0.0079
After 2	0.0028	0.0059	-0.0087	0.0144
After (1 & 2)	0.0076	0.0044	-0.0011	0.0163

The fitted value of the parameter for time shows that the frequency of occurrence of PIAs in the whole of GB fell by about ¾ per cent each year during the *before* period. In this case, the parameter estimates for the two *After* periods, which relate to *Area* 1 (shire counties that did not bid for pilot status), are small and are not statistically significantly different from 0: thus in *Area* 1 the long-term trend of slight reduction in frequency of PIAs continued unchanged throughout the study period. The effects for the three quarter years shown are referenced to the final quarter of the year, and these show that as in the case of KSI casualties, the frequency of occurrence of PIAs increases progressively from quarter to quarter through the year. The combination of the quarterly effect and the long-term temporal one is that the frequency of PIAs during the first quarter of each year (January-March) is about 12 per cent less than that during the last quarter (October-December) of the same year.

Table 11: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for PIAs together with standard errors of estimation for the various areas. This dataset includes all 8 pilot areas*.

PIAs	*After* 1		*After* 2		*After (1 & 2)*	
Area	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
2 Mets	-0.0152	0.0073	-0.0629	0.0085	-0.0360	0.0045
3 Bidders	+0.0120	0.0089	-0.0163	0.0103	-0.0006	0.0062
4 Entire PA	+0.0105	0.0077	-0.0310	0.0087	0.0105	0.0077
5 Pilot sites	-0.0459	0.0260	-0.0905	0.0227	-0.0716	0.0186

The parameter estimates for the various areas given in Table 11 show the differences between these areas and the uninvolved shire counties (*Area* 1), which forms the reference in the present GLiM models. From this, we see that the coefficients in unsuccessful bidders for pilot status (*Area* 3) in each of the two *After* years are small and do not differ significantly from 0 at the 5 per cent level; they have opposite sign with the effect that the coefficient for the whole of the *After* period is not significantly different from zero. Thus there is no strong evidence of difference between the PIA frequency during the *After* period between these areas and those in *Area* 1 that did not bid for pilot status at all. On the other hand, the parameter estimates for the metropolitan counties (*Area* 2) are statistically significant, so that during the *After* period these areas achieved a reduction of about 3½ per cent below *Area* 1, and about 3 per cent below the long-term trend.

The parameter estimates for the entire pilot areas (*Area* 4) are similar to those for the unsuccessful bidders (*Area* 3) with the same effect that there is no significant difference in frequency of PIAs occurring in these areas from that in the uninvolved shire counties (*Area* 1) during the *After* period. This shows that participation in the pilot was not detrimental to road safety in the pilot areas as a whole as might arise if this caused migration of PIAs from pilot sites to nearby ones.

The results for *Area* 5 (pilot sites in all 8 pilot areas) show statistically significant reductions in the *After* 2 year and the *After* period as a whole. These show that the frequency of occurrence of PIAs at these sites was about 7 per cent lower than *Area* 1, and about 6 per cent lower than the long-term trend during the *After* period as a whole.

The reduction in frequency of PIAs achieved at the pilot sites varied substantially between the pilot areas. Model estimates of the parameters associated with each area are shown in Table 12 for each of the two *After* years individually and for the whole of the *After* period. This shows that there was a substantial reduction in Strathclyde (*After* parameters -1.012, corresponding to a reduction of about 63 per cent). Other substantial reductions relative to *Area* 1 were observed in each of Cleveland and Lincolnshire (*After* parameters -0.5971 and -0.5015 respectively, corresponding to reductions of about 45 and 39 per cent).

The change at sites in Nottingham and Essex were not statistically significant at the 5 per cent level. On the other hand, there was a statistically significant increase relative to *Area* 1 of about 13 per cent in the frequency of PIAs at pilot sites in the Thames Valley area. Because of the clearly distinct nature of the changes recorded at pilot sites in the Thames Valley area, an estimate was made of the changes at those in the 7 other pilot areas: this is about 15 per cent reduction relative to *Area* 1 (and about 14 per cent below the long-term trend), which is about the same as for the 6 pilot areas that provided data for the analysis of KSI casualties. The results of each of these analyses are given at the foot of Table 12a. This shows that the frequency of occurrence of PIAs at pilot sites changed in different ways between pilot areas during the two years.

Table 12a: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for PIAs together with standard errors of estimation for pilot sites (Area 5) in each of the 8 pilot areas.*

PIAs	***After* 1**		***After* 2**		***After (1 & 2)***	
Area of site	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
Cleveland	-0.6205	0.1108	-0.5738	0.1089	-0.5971	0.0834
Lincolnshire	-0.3353	0.1638	-0.7002	0.1906	-0.5015	0.1338
Northants	-1.921	0.7204	-0.0988	0.0970	-0.1561	0.0973
Nottingham	+0.0620	0.0477	-0.0751	0.0515	-0.0015	0.0389
Strathclyde	-0.7256	0.2068	-1.253	0.2135	-1.012	0.1542
South Wales	-0.4378	0.1204	-0.1506	0.0438	-0.1778	0.0421
Thames Valley	+0.1236	0.0403	+0.1173	0.0405	+0.1203	0.0322
Essex	-0.1052	0.0713	-0.0313	0.0644	-0.0633	0.0527
All	-0.0459	0.0260	-0.0905	0.0227	-0.0716	0.0186
All except Thames Valley	-0.1468	0.0340	-0.1754	0.0271	-0.1636	0.0228
All except Thames Valley and South Wales	-0.1201	0.0355	-0.1848	0.0313	-0.1568	0.0265

The results for *Area* 4 (entire pilot areas) as a whole show statistically significant reductions only during the *After* 2 year. Thus the differences from *Area* 1 were not statistically significant in either the *After* 1 year or the *After* period as a whole. However, the reduction in frequency of PIAs achieved in the individual pilot areas varied substantially between them. Model estimates of the parameters associated with each area are shown in Table 12b for each of the two *After* years individually and for the whole of the *After* period. This shows that there was a substantial reduction in Cleveland, Glasgow and Northamptonshire (*After* parameters -0.1106, -0.09059 and -0.06732 respectively, corresponding to reductions of about 10, 9 and 7 per cent relative to *Area* 1). Of these areas, Cleveland and Glasgow showed statistically significant reductions in each of the two *After* years individually, whilst Northamptonshire showed a relatively large reduction in *After* year 2 alone. South Wales and Thames Valley each showed a smaller but still statistically significant reduction in one or other of the *After* years, but not in the *After* period as a whole. On the other hand, the frequency of PIAs in Essex as a whole increased statistically significantly (*After* parameter 0.08689, corresponding to an apparent increase of about 7 per cent relative to Area 1 during the *After* period as a whole, and by 9 and 4 per cent in the individual *After* years). This apparent increase can be ascribed to the boundary change described above, and is cancelled by the appropriate correction of –0.-5646 for Essex *Area* 4 PIAs. This shows that the frequency of occurrence of PIAs in entire pilot areas changed in different ways between pilot areas during the two years.

Table 12b: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for PIAs together with standard errors of estimation for entire pilot areas (Area 4) in each of the 8 pilot areas.*

PIAs	***After* 1**		***After* 2**		***After (1 & 2)***	
Area of site	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
Cleveland	-0.1012	0.02882	-0.1229	0.03237	-0.1106	0.02348
Lincolnshire	-0.00373	0.02267	-0.00671	0.02522	-0.005022	0.01852
Northants	-0.00768	0.02476	-0.1509	0.02914	-0.06732	0.02061
Nottingham	0.02853	0.03126	-0.0574	0.03592	-0.007847	0.02588
Glasgow	-0.07046	0.02463	-0.1175	0.02793	-0.09059	0.02018
South Wales	-0.03892	0.01922	0.008605	0.02098	-0.01803	0.01556
Thames Valley	0.02109	0.01286	-0.03901	0.0146	-0.004539	0.0106
Essex	0.08689	0.01434	0.04096	0.01618	0.06722	0.01184
All	0.01047	0.007711	-0.03102	0.008675	-0.007315	0.00633

In order to investigate the effectiveness of different kinds of camera, analysis was performed for each one separately. The results of this for all 8 pilot areas are shown in Table 13a, and the corresponding estimates for the 6 pilot areas that contributed to the KSI analysis (*ie* excluding

Thames Valley and South Wales) are shown in Table 13b. This shows that relative to *Area* 1, the fixed cameras reduced the frequency of PIA occurrence by about 5 per cent over all pilot sites, and by about 50 per cent at those in the 6 pilot areas analysed in Table 13b. The mobile cameras reduced this frequency by about 9 per cent over all pilot sites, and by about 12 per cent at those in the 6 pilot areas analysed in Table 13b. There is some evidence that the two digital cameras in the study also reduced the frequency of PIA occurrence, though this effect was statistically significant only during the *After* 2 period.

Table 13a *Parameter estimates ($\hat{\theta}$) for the effectiveness of different camera types in the After periods that were significant in the Poisson/log-linear model of PIAs together with standard errors of estimation for the various areas. This dataset includes all 8 pilot areas.*

PIAs	***After* 1**		***After* 2**		***After* (1 & 2)**	
Camera type	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**
Fixed	-0.0282	0.0383	-0.07497	0.0320	-0.0560	0.0268
Mobile	-0.0980	0.0392	-0.1004	0.0337	-0.0984	0.0278
Digital	-0.0250	0.0965	-0.2069	0.1037	-0.1111	0.0782

Table 13b: *Parameter estimates ($\hat{\theta}$) for the effectiveness of different camera types in the After periods that were significant in the Poisson/log-linear model of PIAs together with standard errors of estimation for the various areas. This dataset excludes Thames Valley and South Wales.*

PIAs	***After* 1**		***After* 2**		***After* (1 & 2)**	
Camera type	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**	**Estimate $\hat{\theta}$**	**SE σ_θ**
Fixed	-0.5702	0.1264	-1.013	0.1407	-0.7862	0.0992
Mobile	-0.1257	0.0420	-0.1145	0.0339	-0.1242	0.0283
Digital	-0.0250	0.0965	-0.2069	0.1037	-0.1111	0.0782

H.6.3 Pedestrian accidents

We now consider the effect of enforcement camera operation in the pilot on pedestrian casualties and accidents. The pedestrian data cannot be compared directly to the data for all user groups because the data comes from only 4 pilot areas and from only some of the sites within those pilot areas. The results of fitting the model corresponding to that in the previous section to data for pedestrian casualties who were either killed or seriously injured are shown in Table 14 and Table 15. The parameter estimates shown in Table 14 describe the general development of pedestrian KSI casualties during the study period, whilst those in Table 15 describe the differences from the general development that are present in the data for the various kinds of area, including the pilot areas. The content of each of these tables is discussed below.

Table 14: *Parameter estimates ($\hat{\theta}$) for those non-treatment factors that were significant in the Poisson/log-linear model of Pedestrian KSIs together with estimates for upper and lower limits on their 95% confidence intervals, calculated as $\hat{\theta} 1.96\sigma_\theta$. This dataset excludes Thames Valley and South Wales.*

Pedestrian KSI	**Estimate**	**Standard error**	**95% C.I.**	
Factor	$\hat{\theta}$	σ_θ	**Lower**	**Upper**
Time (year)	-0.0552	0.0063	-0.0674	-0.0429
Quarter 1	-0.1345	0.0133	-0.1607	-0.1084
Quarter 2	-0.2043	0.0136	-0.2310	-0.1776
Quarter 3	-0.2589	0.0136	-0.2855	-0.2323
After 1	-0.0043	0.0244	-0.0522	0.0435
After 2	+0.0341	0.0300	-0.0248	0.0929
After (1 & 2)	+0.0011	0.0224	-0.0428	0.0451

The parameter for time shows that the frequency of occurrence of pedestrian KSI casualties in the whole of GB fell by about 5 per cent each year during the *before* period. In this case, the parameter

estimates for the two *After* periods, which relate to *Area* 1 (shire counties that did not bid for pilot), are smaller and are not statistically significantly different from 0: thus the long-term trend of reduction in frequency of killed and seriously injured pedestrian casualties continued unchanged throughout the study period. The effects for the three quarters shown are referenced to the final quarter of the year, and these show that as in the case of Pedestrian KSI casualties, the frequency of occurrence of PIAs dips during the spring and summer, and is greatest during the final quarter of the year.

Table 15: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for pedestrian KSI casualties together with standard errors of estimation for the various areas. This dataset excludes Thames Valley and South Wales.*

KSIs	***After* 1**		***After* 2**		***After* (1 & 2)**	
Area	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
2 Mets	-0.0102	0.0271	-0.0273	0.0306	-0.0175	0.0221
3 Bidders	+0.0485	0.0402	+0.0908	0.0448	+0.0668	0.0327
5 Pilot sites	-1.116	0.2351	-0.6063	0.1783	-0.8050	0.1527

The parameter estimates for pedestrian KSI casualties in the various areas given in Table 15 show the differences between these areas and the uninvolved shire counties (*Area* 1), which forms the reference in the present GLiM models. From this, we see that the coefficients in unsuccessful bidders for pilot status (*Area* 3) in each of the two *After* years are small (the second *After* year is just significantly different from 0 at the 5 per cent level) and have positive sign with the effect that they effectively cancel the long-term trend for these areas during the *After* period. Thus there is no evidence of any reduction below the long-term trend in pedestrian KSI casualties in the unsuccessful bidding areas during the *After* period. The parameter estimates for the metropolitan counties (*Area* 2) are not statistically different from 0 so that the general long-term reducing trend continued throughout the study period in them.

The results for *Area* 5 (camera sites in pilot areas) are substantial and show statistically significant reductions. These show that the frequency of occurrence of pedestrian KSI casualties at these sites during the *After* period as a whole was about 56 per cent lower than the comparison group.

The results of fitting the model corresponding to that in the previous section to data for PIAs in which at least one of the casualties was a pedestrian are shown in Table 16 and Table 17. The parameter estimates shown in Table 16 describe the general development of pedestrian accidents during the study period, whilst those in Table 17 describe the differences from the general development that are present in the data for the various kinds of area, including the pilot areas. The content of each of these tables is discussed below.

Table 16: *Parameter estimates ($\hat{\theta}$) for those non-treatment factors that were significant in the Poisson/log-linear model of Pedestrian PIAs together with estimates for upper and lower limits on their 95% confidence intervals, calculated as* $\hat{\theta} \pm 1.96\sigma_\theta$. *This dataset excludes Thames Valley and South Wales.*

Pedestrian PIAs	**Estimate**	**Standard error**	**95% C.I.**	
Factor	$\hat{\theta}$	σ_θ	**Lower**	**Upper**
Time (year)	-0.0239	0.0031	-0.0300	-0.0179
Quarter 1	-0.1085	0.0066	-0.1214	-0.0956
Quarter 2	-0.1223	0.0067	-0.1354	-0.1092
Quarter 3	-0.1648	0.0066	-0.1777	-0.1519
After 1	-0.0285	0.0120	-0.0520	-0.0050
After 2	-0.0075	0.0147	-0.0363	0.0213
After (1 & 2)	-0.0222	0.0110	-0.0438	-0.0006

The parameter for time shows that the frequency of occurrence of pedestrian PIAs in the whole of GB fell by about 2 per cent each year during the *before* period. In this case, the parameter estimates for the two *After* periods, which relate to *Area* 1 (shire counties that did not bid for pilot status), correspond to further reductions of about the same size as the annual effect and are statistically significantly different from 0: thus the long-term trend of reduction in frequency of PIAs

involving pedestrian casualties continued throughout the study period, with some further reduction appearing during the first *After* year. The effects for the three quarter years shown are referenced to the final quarter of the year, and these show that as in the case of Pedestrian PIAs, the frequency of occurrence dips during the spring and summer, and is greatest during the final quarter of the year; this seasonal variation in frequency of pedestrian PIAs is similar in shape to but less pronounced than that in pedestrian KSI casualties.

Table 17: *Parameter estimates ($\hat{\theta}$) for the After periods in the Poisson/log-linear model for pedestrian PIAs together with standard errors of estimation for the various areas. This dataset excludes Thames Valley and South Wales.*

KSIs	***After* 1**		***After* 2**		***After* (1 & 2)**	
Area	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ	**Estimate** $\hat{\theta}$	**SE** σ_θ
2 Mets	-0.0047	0.0131	-0.0345	0.0147	-0.0175	0.0107
3 Bidders	+0.0316	0.0200	+0.0496	0.0222	+0.0394	0.0163
5 Pilot sites	-0.4881	0.1157	-0.3296	0.0965	-0.3911	0.0796

The parameter estimates for pedestrian PIAs in the various areas given in Table 17 show the differences between these areas and the uninvolved shire counties (*Area* 1), which forms the reference in the present GLiM models. From this, we see that the coefficients in unsuccessful bidders for pilot status (*Area* 3) in each of the two *After* years are small (the second *After* year is just significantly different from 0 at the 5 per cent level) and have positive sign with the effect that when combined with the *Area* 1 *After* effect, they reduce the long-term trend for these areas during the *After* period. Thus there is no evidence for reductions in pedestrian PIAs in the unsuccessful bidding areas during the *After* period, compared with the good progress recorded in the uninvolved shire counties. The parameter estimates for the metropolitan counties (*Area* 2) differ statistically significantly from 0 in the second *After* year, in which there was a reduction of about 3 per cent below the long-term trend in the uninvolved shire counties.

The results for *Area* 5 (camera sites in pilot areas) are substantial and show statistically significant reductions. These show that the frequency of occurrence of pedestrian PIAs at these sites during the *After* period as a whole was about 30 per cent lower than the long-term trend.

H.7 DISCUSSION

We conclude that there was a national reduction in frequency of occurrence of KSI casualties of about 4-5% per annum in areas before the start of the pilot. This long-term trend did not continue in shire counties that either did not express interest in the pilot, or bid to become partners but were unsuccessful: in these areas, the frequency of occurrence of KSI casualties remained approximately constant during the pilot period. The long-term trend of reduction continued in each of metropolitan counties and the entirety of the pilot areas. At the sites where usable KSI data were available (*ie* not Thames Valley or South Wales) there was a large and statistically significant reduction in frequency of occurrence of KSIs of about 36 to 39 per cent over and above the general national reduction (*Area* 1). This improvement varied between pilot areas and according to the camera types.

This study demonstrates a strong association between use of enforcement cameras and changes in the frequency of KSI casualties and PIAs. Estimates of the effectiveness of different types of camera show that fixed cameras save about 0.4 KSI casualties per year, whilst mobile cameras save about 0.7, this larger figure being due in part to the larger route/ site coverage associated with mobile cameras.

There was a smaller, but still substantial, reduction of about 15 per cent (relative to comparison area) in the frequency of occurrence of PIAs at sites in areas where cameras were operating in all pilot areas except for Thames Valley, where there was an increase of about 13 per cent (relative to comparison area). It was recognised from the results from the first year that the original strategy adopted was not as successful as other areas and it is understood that this has now been revised for 2002/3

The smaller size of the general reduction in frequency of PIAs than that in KSIs suggests that operating cameras under this regime is especially effective in reducing the frequency of occurrence of more serious accidents, and hence in reducing the severity of accidents in general. This is

consistent with the mechanism by which they act in that they discourage high speed, which is associated with both frequency of PIAs and the severity of those PIAs that do occur.

H.8 SUMMARY AND CONCLUSIONS

Identification of the effect of enforcement on the mean frequency of personal injury accidents (PIAs), and casualties who are either killed or seriously injured (KSI) is an exacting task. Several particular difficulties arise in this because of difficulties in obtaining data in comparable form for appropriate periods before and after implementation of this experimental measure. Furthermore, the presence of national trends in the occurrence of PIAs and consequent KSI casualties complicates the task. Notwithstanding these difficulties, some worthwhile conclusions are supported by the data that are available and have been analysed.

- During the same 5-year period, the frequency of PIAs in the whole of Great Britain fell by about 3 per cent. The change frequency of PIAs in areas that bid unsuccessfully for participation in the pilot did not differ significantly from other non-participating areas.
- The frequency of occurrence of PIAs at experimental sites in these areas that participated in the pilot fell between the 3-year period immediately before implementation and the two years immediately after. However, this includes a wide range from reduction in most pilot areas to an increase in Thames Valley.
- The frequency of occurrence of PIAs at pilot camera sites in those participating areas other than Thames Valley fell substantially (by about 15 per cent below the comparison area, 14% below long-term trends) between the 3-year period immediately before implementation and the two years immediately afterwards.
- The frequency of occurrence of PIAs at pilot camera sites in the Thames Valley area (which accounted for nearly half of the data for PIAs) increased by about 13 per cent above the comparison area (14% above long-term trend) between the 3-year period immediately before implementation and the two years immediately afterwards.
- The change in areas that bid unsuccessfully for participation in the pilot did not differ significantly from other non-participating shire counties. The model estimate of the reduction in KSI casualties at pilot sites over and above that prevailing in Great Britain was about 37 per cent (this corresponds to a 35% reduction against long-term trends).
- The proportionate reduction in PIAs and KSI casualties was greatest at fixed camera sites, and was also substantial at mobile camera sites. However, because mobile sites are larger than fixed ones and consequently tend to have greater accident and casualty frequencies, the expected reduction of about 0.7 KSI casualties per year at mobile sites is greater than that of 0.4 KSI casualties per year at fixed sites.
- There was a substantial reduction of about 56 per cent below the long-term trend in the frequency of KSI pedestrian casualties at these pilot sites, and a reduction of about 30 per cent in PIAs that involved pedestrian casualties. This suggests that pedestrians benefited especially from enforcement cameras. We note, however, that only 4 pilot areas were able to provide data for this analysis and that within each of these areas, coverage is not complete.
- We could not obtain data for the before period for individual sites other than at camera sites. It was therefore not possible to check fully for regression to the mean at the site level. The results for areas that bid unsuccessfully for participation in the pilot could be used as a comparison for what might have occurred in participating areas if they had not been treated. The PIA and KSI frequencies for these areas do not differ significantly from other similar areas that did not bid for pilot status at all. On this basis, there is no evidence in the present data for any substantial illusory benefit due to the regression to the mean effect.
- Comparison of the pilot areas in their entirety between before and during the pilot indicates that although there was no detectible reduction in PIAs as a whole, there was a greater reduction than the national one in the frequency of KSI casualties in the entirety of these areas. Because of this, the frequency of KSI casualties in the whole of the pilot areas fell faster than the national average at the time of implementation. This suggests that there

was no general increase in frequency of either PIAs or KSI casualties in the pilot areas away from the camera sites. This shows that there is a benefit in the entire pilot area associated with participation in the pilot, and that there is no gross accident migration effect in this case.

In all but one of the pilot areas there were reductions in KSI casualties and PIAs. However, we note that there were increases in PIAs in the Thames Valley area. We conclude that in the majority of pilot areas the reduction in KSI casualties and PIA are substantial and real effects over and above the general national reduction in casualties that has been achieved during the study period. This reduction is particularly notable in the reduction in the frequency of KSI casualties at pilot sites and in participating areas as a whole.

H.9 REFERENCES

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APPENDIX I: GLOSSARY OF TERMS

ACPO	Association of Chief Police Officers (for England and Wales)
CS	Court Service
COFPN	Conditional Offer of a Fixed Penalty Notice
CSS	County Surveyors Society
CPS	Crown Prosecution Service
CTO	Central Ticket Office
DfT	Department for Transport
DTLR	The Department for the Transport, Local Government and the Regions – now Department for Transport (DfT)
DVLA	Driver and Vehicle Licensing Agency
FPO	Fixed Penalty Office
FPN	Fixed Penalty Notice
HA	Highways Agency
HMT	Her Majesty's Treasury
KSI	Killed or Serious Injury
LCD	Lord Chancellor's Department
NHS	National Health Service
NIP	Notice of Intended Prosecution
NS	Not significant
PA	PA Consulting Group
PIA	Personal Injury Accident
PFA	Police Force Area
TAG	Local Government Technical Advisers Group
UCL	University College London
VP-FPO	Vehicle Procedures - Fixed Penalty Office (an IT System)
VRM	Vehicle Registration Mark

APPENDIX J: REFERENCES

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