THE ROAD SAFETY TRUST

Making Roads Safer

How effective is reducing speed limits on rural roads?

Phase 1 final report

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RESEARCH SERVICES

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Contents

Acknowledgements

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Executive Summary

BACKGROUND

Rural roads are a road safety priority as defined in the Department for Transport's Road Safety Statement (Road Safety Statement, 2019) with much higher proportions of serious and fatal collisions occurring on these roads than would be expected, based on traffic levels. There is overwhelming evidence that high speeds are a significant influence on these collision rates and reducing overall speeds on high-risk roads has been a priority for road authorities for decades.

The national speed limit on single carriageway rural roads in England and Wales is 60mph for cars, motorcycles, car-derived vans, and motorhomes, but 50mph for all other vehicles[1]. It has been common practice for these limits to be lowered on many of the country's rural roads by means of a traffic regulation order, supported by speed limit repeater signs. This has been the case in Surrey, which is the study area for this report. Surrey County Council have a desire to see appropriate speed limit put in place on all its rural roads and this study aims to support them in achieving this.

The implementation of new speed limits on rural roads in Surrey has taken place gradually over many years, with limits lower than the national speed limit regularly put in place. This has most commonly been the case in the Tandridge, Reigate and Banstead, and Mole Valley Districts on roads south of the M25. The rural roads broadly south of Dorking, Redhill and Oxted are largely 40mph limits, with larger 'A' roads sometimes set to 50mph. Other roads in west Surrey, including the Surrey Hills Area of Outstanding Natural Beauty have remained at 60mph, although these roads are often different in nature with lower traffic levels on more winding, narrow roads. To the north of Surrey, increased urbanisation means the roads are infrequently 'rural' in nature with only short sections of country roads connecting the urban areas to the north of Guildford.

FINDINGS

This report details the findings of the first phase of a two-phase project, funded by the Road Safety Trust to understand the impact of lower speed limits on rural roads in Surrey. Using speed and casualty data alongside stakeholder and public feedback, this first phase assesses this information in relation to those limits which have previously been reduced. The purpose of this phase is to gain an understanding of compliance, safety, and the perception of safety of incremental speed reductions. The second phase will involve similar analysis but after widespread speed limit reductions across the county.

Although this report looked at 'rural roads' in the sample collectively, it is clear that there is need for a better sub-classification of these roads using multiple attributes that define the characteristics of rural road 'types'. Road classifications can provide a hierarchy but there is a growing need for a functional hierarchy that explains what the road is used for, and which road users can expect to access it safely. Within the sample roads, there were busy dual carriageways forming part of the major road network, high-traffic single carriageways linking large towns, similar roads but with less traffic between large villages, plus many smaller, narrow roads used predominantly by local traffic, cyclists, pedestrians, and equestrians.

The report firstly considered the evidence available on lower speeds on rural roads. Speed management as part of a Safe System approach with appropriate road engineering and other measures, can have a

[1] Dual carriageways are included in the analysis and the default speed limits on these roads is 70mph (but 70mph roads were not analysed).

large influence on collision rates. Speeds on rural roads should be appropriate for the type of road users expected to be present, and especially where there are vulnerable road users facilities should be provided to separate them from high-speed vehicles. Combined interventions covering engineering, enforcement, and education will be more effective in achieving compliance with speed limits than speed limit changes alone.

A large part of the evidence used to understand the impact of speeds and speed limits on collisions in Surrey came from geospatial data. The availability of new sources of information on road attributes such as carriageway width, speed limit, average and 85th percentile speeds, and traffic flows, has allowed for a comprehensive review of selected rural roads without requiring manual surveys.

As speed limits have been changed across Surrey's rural roads over time, there are some inconsistencies in speed limit allocation for roads that have the same nature. By this we mean roads that would be identified by road users as being very similar in terms of traffic patterns, road widths, sinuosity, and gradient. It could therefore be the case that driver behaviour on some 60mph roads is indistinguishable from many of those subject to 40mph limits.

Collision densities were highest on our sample of 50mph road sections, and lowest on our 60mph sections and the regression models showed that this difference in collision densities was statistically significant. If vehicles' speeds matched the posted speed limit, then this result would be unexpected, but the evidence shows that speeds on our sample of 60mph roads were frequently much lower than the limit. Collision density also doesn't take into account the traffic using those roads. More traffic would normally be expected to result in more collisions on roads that are similar in nature. Whilst the role of congestion was not included in this analysis, phase 2 will compare morning and evening peak traffic flows and speeds with free-flowing periods, to explore the relationship between congestion and observed speeds.

Comparing the nature of the roads with different speed limits we did not find significant differences overall in average road width or sinuosity, but it emerged that a larger proportion of 50mph roads were dual carriageways. There were also some 60mph dual carriageways within the sample where speed limits will have been set by a traffic regulation order, rather than being at the national speed limit for that road classification.

Although the results suggested that roads with 60mph speed limits have lower collision densities and risk rates than those with 50mph speed limits, this did not imply that higher speeds could be safer for road users. Further analysis of our sample showed that, in fact, roads with 60mph speed limits tend to have lower average and 85th percentile speeds than those parts of the network that have 50mph speed limits.

When the posted speed limit is removed from the analysis and differences in road carriageway type are accounted for, it has been possible to examine the effect of differences in speed driven (in 1mph bands) on casualty densities on our sample of roads using a number of metrics. As previously shown in the literature, this analysis demonstrated clear increases in collision densities when speeds were higher. This was even more prominent when 85th percentile speeds increased by one mile per hour. Higher speeds on roads that are similar in nature result in more collisions per mile. The most serious collisions involving a KSI casualty were even more greatly influenced by increases in speeds.

The results for collision rates were not as consistent. Changes of one mile per hour in 85th percentile speeds resulted in significant increases in collision rates and increases in average speeds resulted in significant increases in fatal and serious collisions. Increases in average speeds were associated with a reduction in collisions of all severity. There are a number of possible explanations for this result. It could

be that some of the roads with lower speeds are associated with junctions and complex road sections where risk could be higher. It is likely that the roads that can sustain the highest speeds and flows have received greater investment in road safety engineering measures and may also receive more frequent maintenance.

Overall, the analysis of the evidence relating to the selected rural roads demonstrated a clear relationship between travelled speed and the frequency of collisions, especially for the most serious collisions. The complex nature of the road environment makes comparisons between roads more difficult, especially where blanket changes across an area have not been implemented. Reviewing data for similar roads in other counties would perhaps deepen our understanding of the relationships.

Two consultations were undertaken with members of the public and with representatives of specific road user groups. These showed that, although understanding of the national speed limit was not perfect, most respondents agreed that higher speeds made them feel less safe. Reductions in speed limits were well supported although there was concern that other road users would not obey them.

There is little difference between the residents of East and West of Surrey and their speed limit perceptions and attitudes. This could be a result of changes in the west of Surrey being implemented incrementally over a series of years and perhaps the drivers and road users who travel regularly between regions and have become accustomed to the changes.

Most user group respondents said that speed-limit reductions are not enough on their own and need to be accompanied by additional enforcement, education and awareness of road safety and responsibility when driving on rural roads.

The findings are in line with previous studies which have shown that mean speed and speed variance are more important than speed limit in determining safety and that reducing speed limits on their own, without other supporting measures, is unlikely to have a significant impact on speed and safety.

NEXT STEPS

Phase 2 of the study will explore how roads are selected for speed limit reductions and will review the effects of these reductions. It will examine the effect on speeds and public perception of widespread speed limit reductions, and the role of publicity and enforcement on compliance with lower limits.

It will extend some of the analyses undertaken in this first Phase, to explore the effect of congestion on average and 85th percentile speeds. This first Phase explored the effect of sinuosity and road width on the different speed limits, and, in Phase 2, the sinuosity measure will be used to identify whether lowering the speed limit has an effect on speed in sharp bends. Whilst it would also be useful to understand whether speed limit reductions result in reduced speeds at intersections (which pose a safety problem where there are inappropriate speeds), the dataset used for this analysis is comprised of junction-to-junction nodes, with long lengths of roads. Without point data, or data for shorter lengths of roads, it will be difficult to isolate junction speeds.

CONCLUSIONS

Phase 1 sought to meet a number of research objectives. In some cases, the results are unexpected but provide useful insights into the implications of reducing speed limits on rural roads.

- To determine if the collision rate on rural roads with lower speed limits is lower than on rural roads with higher speed limits

Collision rates on rural roads with lower average and 85th percentile speeds are lower than roads with higher average and 85th percentile speeds. However, our sample of rural roads with lower speed limits did not necessarily have lower collision rates than roads with higher speed limits. Driver speed choice is influenced by road environment (sinuosity and road width, for example) and the incremental speed limit reductions in Surrey have resulted in an inconsistency in the characteristics of rural roads with lower limits.

- To determine if the mean speed of vehicles on rural roads with lower speed limits is lower than on rural roads with higher speed limits

  Likewise, the mean speed on our sample of rural roads with lower speed limits is not lower than on that on our rural roads with higher speed limits. As with the first objective, the relationship between posted speed and travelled speed is complex and is related to a range of factors, including road type and the presence of junctions.

- To determine if perceptions of safety are higher amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits

  There did not seem to be a difference in perceptions of safety between those living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits. However, there were differences in perceptions of safety by age (from the survey) and user group (from the interviews).

- To determine if attitudes towards compliance with speed limits are more positive amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits

  There also did not seem to be more positive attitudes towards speed limit compliance amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits. Encouragingly, most respondents exhibited positive attitudes towards speed compliance, regardless of which side of the county they live in.

This report has identified and confirmed that higher speeds result in increases in collisions and that the public are generally supportive of lower speeds. It also notes that changing limits on their own may not necessarily achieve compliance. However, driven speeds on many rural roads are already much lower than the posted speed limit.

The analysis does not indicate that further reductions in speed limits will increase harm if the new limits are selected in response to actual average and 85th percentile speeds. There will, therefore, be some roads where greater reductions in speed limit can be implemented compared to other roads. Phase 2 will explore the impact of these reductions and how compliance can be maximised through supporting measures.

Introduction

This report is the first output from this project, summarising the findings of Phase One of the research.

PROJECT SUMMARY

History

Over recent years, many single-carriageway rural roads in the east of Surrey that would normally have been subject to the national speed limit (60mph for cars and motorcycles, 50mph for goods vehicles) have seen traffic regulation orders (TRO) put in place reducing the limit to 40mph or 50mph. Meanwhile, similar roads in the west of Surrey are still largely subject to the national speed limit of 60mph.

Within Surrey, decisions over setting local speed limits are delegated to local committees of elected members. There are 11 committees in total, one for each District or Borough. Each local committee are provided with an annual budget for highway improvements, which can be used to amend speed limits within the bounds set by the overarching countywide policy. Over time, the Tandridge Local Committee, the Reigate and Banstead local committee and the Mole Valley Local Committee (covering the eastern side of Surrey) have chosen to invest part of their annual highway improvement budgets to reduce the 60mph national speed limit on their rural roads south of the A25, and to the east of the A24. This has happened incrementally over the past two decades, and mostly in response to public lobbying to reduce speeds on the roads where they live, rather than in any strategic area-wide review.

Over time, the countywide policy on speed limits has evolved to follow updates to national guidance on setting speed limits. Consequently, the reductions in speed limits have usually been undertaken with careful reference to the existing prevailing speeds, as well as taking into account the function and use of the road. Therefore, for the most part, most new lower speed limits have been set at a level close to, or just below, the speed that many drivers would already be travelling at, so that the new speed limit would be mostly 'self-enforcing'. Where even lower speed limits are desired, the council's latest policy requires that additional supporting engineering measures need to be implemented (and budgeted for), for the new lower speed limit to work.

As well as the incremental reduction in speed limits described above, there was a centrally funded project in the early 2000s called 'Strategic Traffic Action in Rural areas' (STARs), which included an area wide reduction in speed limits in a rural area referred to as the 'Dorking Box'. This was a roughly rectangular area bounded by the A25 in the north, A24 in the west, the A217 in the east, and the county boundary to the south, mostly within the Mole Valley District area, and partially within the Reigate and Banstead Borough area.

Although other local committees in Surrey have also invested in some rural speed limit reductions, the Guildford and Waverley Local Committees in the south and west of Surrey have not done so to the same extent as Mole Valley, Reigate and Banstead, and Tandridge, and therefore most of the speed limits on rural roads to the southwest of the country remain set at the 60mph national speed limit.

New limits

Surrey County Council has considered the possibility of rolling out lower speed limits more widely and, together with Agilysis, discussed the opportunity to review the impacts of lower speeds, before following the usual consultation and implementation process to do this. The research proposal was

submitted to the Road Safety Trust in October 2020 and work began on gathering the evidence in March 2021.

This project provides an opportunity, before implementation, to understand the effect of the previous changes in limit on rural roads in part of the county, looking at speed compliance and casualty rates in the two areas. It also offers an opportunity to understand public attitudes to rural speed limits, looking at if, and how, perceptions of risk and compliance differ in the two halves of the county. This research takes the usual consultation period further by analysing in depth existing intervention and control routes and looking at how they are perceived locally. The second phase will follow the implementation of new speed limits and will involve follow up analysis of speeds and traffic flows, alongside revisiting public perception.

The objective, therefore, is to understand the impact widespread rural speed limit reductions have on safety, and perceptions of safety amongst those using the roads. The research findings will be relevant to other UK road authorities who are looking to introduce widespread rural speed limit reductions, through the provision of quantitative and qualitative data into the effects. This is important as firstly, we know that rural roads have the highest rates of fatal and serious collisions, and secondly, lower speeds result in lower severities of injury. The majority of road deaths in Great Britain in 2019 occurred on rural roads (57%), whilst only 43% of traffic travels on these roads (Department for Transport, 2020). Speed affects traffic collisions and injury in several ways. Firstly, the higher the speed of the vehicle, the shorter the time the driver has to be able to stop and avoid a collision. “An increase in average speed of 1km/h typically results in a 3% higher risk of a crash involving injury, with a 4-5% increase for crashes that result in fatalities” (World Health Organisation, 2004, p. 1). The severity of impact is also increased by vehicle speed with the likelihood of death 20 times higher for car occupants in a crash with an impact speed of 80 km/h than at 30 km/h. “The relationship between speed and injury severity is particularly critical for vulnerable road users such as pedestrians and cyclists.” (World Health Organisation, 2004, p. 1)

FUNDING

This project has been funded by a substantial contribution from Surrey Police to cover the costs of speed limit reductions, including signing and lining changes, consultation, traffic management and the production of Traffic Regulation Orders. In-kind costs are borne by Surrey County Council for the implementation of the speed limit reductions and from supporting the research elements. The latter includes data provision, speed limit mapping and support with the survey and stakeholder interviewers. The final costs are consultancy costs for the independent research presented in this request. This covers the software required to analyse collision and speed compliance rates and survey hosting, plus consultant time in undertaking the analysis; designing, disseminating and analysing the survey; undertaking the interviews and analysing the output; project management and report production time. These final costs have been covered by a research grant awarded by the Road Safety Trust.

PROJECT OBJECTIVES

There are a number of key objectives for this research:

- To determine if the collision rate on rural roads with lower speed limits is lower than on rural roads with higher speed limits
- To determine if the mean speed of vehicles on rural roads with lower speed limits is lower than on rural roads with higher speed limits

- To determine if perceptions of safety are higher amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits
- To determine if attitudes towards compliance with speed limits are more positive amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits

The research outputs will be used to inform the implementation of lower speed limits on other rural roads across Surrey and the public education and police enforcement required to make them effective. The results will be disseminated across local highways authorities to inform those considering implementing widespread speed reductions, providing guidance as to whether it should be done, and where and how it should be done.

PROJECT OUTPUTS

There are a number of outputs which will be delivered throughout this project, namely:

- Phase 1 report (this document): This report includes detailed analysis comparing east and west Surrey on casualty and speed metrics, including collision rates and collision density. It also includes analysis into public perception and the views of interest groups across the county. This provides insight into how rural speed limits and rural safety is perceived and provides guidance as to the most effective way to implement the new speed limit changes.
- A stakeholder workshop to present the findings to partners.
- Phase 2 report: The report will include detailed speed and collision analysis by speed limits post-implementation. It will also include a repetition of the public survey to see if perceptions have changed after the wider implementation of a lower limit.
- A webinar for road safety professionals will be hosted
- Appropriate sector conferences will be attended to share the findings.

METHODOLOGY

The first phase looks at changes in risk and speed, together with public perceptions of risk and compliance.

Quantitative data regarding speeds has traditionally been collected through the use of automatic traffic counters (ATC) which are either placed permanently or temporarily by road authorities. This data source is typically very detailed and offers vehicle-by-vehicle analysis, often summarised by time of day, vehicle class, and offers comprehensive speed profiles including vehicle speed distributions. The drawback of this methodology is that is requires significant expenditure and planning to ensure sufficient data is available for a research project of this nature. Surrey County Council provided hundreds of outputs from these types of surveys to the Agilysis team for reference purposes, but they were not sufficient to carry out a comprehensive analysis of vehicles speeds across the county. For the purposes of clarification, where this data is referenced in the analysis it is cited as ‘spot speed’.

The increase of in-vehicle tracking technologies over the last decade has allowed companies to monitor speeds of individual vehicles whenever they are moving. As well as having benefits for those managing vehicle fleets, there are potential applications for use in the road safety sector. There are many different technologies being used to collect this data including sat-nav systems, telematics insurance equipment, fleet monitoring devices, and stolen vehicle trackers. These are in turn kept in separate data silos owned by different companies with no collaboration to compile a larger dataset of vehicle movements.

In 2018, Ordnance Survey began to distribute data from two third party datasets for vehicles speeds and speed limits, matched to their comprehensive *MasterMap Highways* network (Ordnance Survey, 2021). The vehicle speed data was sourced from a single telematics provider (Teltrac Navman) and combined with national speed limit map (Insight Warehouse) by specialist mapping company Basemap.

The speed data is updated annually based on financial years, with speed limits updated quarterly. Raw vehicle data is coded to the road network, link-by-link, journey-by-journey resulting in around 14 billion link-journeys per year. The same data has been used historically by the DfT and local authorities for road congestion and travel time statistics. For the purposes of clarification, where this speed data is referenced in the analysis it is cited as 'link speed' as it represents the time over distance calculation used to provide figures for average and 85th percentile speeds.

Although no official UK speed limit map exists, local authorities are contributing to datasets that are in use by both the public and private sector. Surrey County Council provided information on recent speed limit changes as a part of this project. Separately this data was then used to ensure that in the future this evidence is retained within the GB dataset.

The combination of these two data sources has been used to compare speed limits and speeds on roads in Surrey to detect if there are significant differences in speed and compliance in existing rural limits. STATS19 data[2] on reported collisions, together with modelled traffic flow (obtained from raw vehicle counts and known ATC data) was used to assess collision density and collision rate on the selected rural roads.

In addition to the use of quantitative data, it is also important to understand how local residents perceive risk and compliance. The Surrey situation presents a unique opportunity to understand how safe residents feel and what their attitudes to risk and compliance might be. The questions were predominantly closed and focused on collecting quantitative data, using existing questions from tools like the DfT Question Bank (Department for Transport, 2017), where appropriate. Surrey County Council also identified interest groups and stakeholders for interviews, ensuring representation across the county. Virtual interviews were held to understand in more detail how local road users feel about safety and compliance on rural roads.

In Phase two, the available post-implementation data will be reviewed, with the project team hoping to make use of data from multiple sources. Collision data will be considered although it may not be possible to carry out a robust analysis with limited post-implementation data.

[2] STATS19 forms the basis of the UK's Department for Transport's road casualty annual statistics. STATS19 collisions are those reported to the police and provide details about collisions which occurred on public roads and resulted in at least one participant being injured (Department for Transport, 2013).

Risks on Rural Roads – Review of Evidence

This research explores the effectiveness of reducing speed limits on rural roads in Surrey and therefore a light-touch literature review was undertaken to explore the discourse published with regards to speed compliance, speed limit reductions and the resulting effect on safety and perceptions of safety amongst road users. The relationship between speed and the likelihood and severity of crashes is well established and with around 70% of fatal collisions in the UK occurring on rural roads (The Royal Society for the Prevention of Accidents, 2010), speed management is a crucial issue in increasing road safety. The IRTAD speed and crash risk report of 2018 objectively documented the relationship between speed and crash risk, analysing 11 cases representing either a change in speed limit or a wide implementation of automatic speed enforcement (International Traffic Safety Data and Analysis Group, 2018). Key findings of the research report reinforced the existing literature on speed being an important factor in road crashes, with it affecting the number of crashes as well as crash severity. Using the power model of Nilsson, a 1% change in speed approximately results in a 2% change in injury crash frequency, a 3% change in severe crash frequency, and a 4% change in fatal crash frequency.

The link between speed and collision occurrence was corroborated in another study, which further states that any measure which reduces speeds is likely to have a positive impact on rural road safety (Hamilton & Kennedy, 2005). Analysis of STATS19 data also revealed speed being an important factor in rural road collisions, especially when "loss of control was also a factor which was recorded most often in rural road accidents in 32% of serious and 45% of fatal road accidents" (Stradling, Collins, Eynon, & McLeod, 2010). Loss of control and travelling too fast for given conditions were recorded more often on rural than urban roads.

In the UK and globally, there have been evaluation studies and research papers on the effects of reducing speed limits and the perception of speed limit reductions, with a few common themes and factors which emerge in the literature, and which are briefly summarised in this literature review.

SPEED LIMIT CREDIBILITY AND RISK PERCEPTION

An investigation of the credibility of current speed limits on UK roads bas been undertaken by evaluating road layouts and roadside environments, which included a focus on rural motorways and rural single carriageways (Yao, Carsten, & Hibberd, 2020). Through questionnaires, it was concluded that a speed limit of 60mph was too high on a rural single carriageway with curves in its road design. Respondents preferred a lower speed limit on rural single carriageways with the presence or absence of the curve the main factor affecting speed limit compliance and credibility.

The study explored the relationship between the factors of risk perception, speed limit credibility and speed limit compliance for a given rural single carriageway and roadside environment and concluded that as drivers feel more risk in a given road environment, they might decrease their driving speed and obey the speed limit (Yao, Carsten, Hibberd, & Li, 2019). If the speed limit feels more credible – which is a speed limit that drivers 'consider logical or appropriate' – drivers are more compliant with the speed limit. This research informs local highway authorities of the practical implications of road design when matching credible speed limits to rural single carriageway infrastructure to achieve potential safety improvements for road users. Overall, credibility of speed limit has a positive influence on speed limit compliance and risk perception has a negative influence on speed limit credibility (Yao, Carsten, Hibberd, & Li, 2019).

COMPLIANCE WITH SPEED LIMITS AND ATTITUDES TO SPEED LIMIT CHANGES

A questionnaire was distributed in France, collecting responses on the acceptability of a speed limit reduction from 90kmh to 80kmh (56mph to 50mph) (Eyssartier, Chastenet, & Granie, 2019). The majority of the respondents opposed the measure, who were mainly men and rather young (16 to 24 years old). More than 70% of respondents answered that they intend to comply 'most often' or 'systematically' with the proposed future speed limit – which was largely due to concerned compliance with the highway code and fear of punishment. Those respondents that did not intend to comply with the speed limit provided reasons of road allowance for speed, control of vehicle and being caught in the flow of vehicles. This corroborates previous studies where the impact of infrastructure, overconfidence in driving ability and the behaviour of other drivers influences driver behaviour.

A national survey of community attitudes to road safety was conducted in Australia, which looked at acceptable speed tolerances in rural areas (Petroulias, 2009). The most common view (32%) of respondents was that 110kmh was an acceptable speed to drive in a 100kmh (60mph) zone in rural areas without facing any enforcement consequences.

Reducing the National Speed Limit (NSL) from 60mph to 50mph on high-risk routes in Lincolnshire carried out as part of the Rural Road Safety Demonstration Project (RRSDP) contributed to a 76% reduction in Killed or Seriously Injured (KSI) collisions and an overall 35% reduction in all collisions (King & Chapman, 2010).

ROAD DESIGN AND ENGINEERING

Infrastructure and road design is a key component of how drivers perceive risk and safety and accordingly, the speed limit. RoSPA explored the influence of the road environment on the likelihood and severity of road crashes and casualties in rural areas (The Royal Society for the Prevention of Accidents, 2010). The policy paper emphasised the role of self-explaining roads which can be designed to encourage drivers to reduce speeds without using physical interventions in the road or speed enforcement. Design engineering, like introducing the perception of road narrowing by markings, 'rumble strips', junction design, introduction of quiet lanes, chevrons and vegetation to reduce vehicle speeds by making drivers more aware of their environment and speed by temporarily decreasing the level of driving comfort can be effective. It was further argued that the "safety of rural roads relies heavily on driver behaviour" which can be influenced if drivers are more aware about the function of the road as well as the driving style necessary for safe driving on a particular road network (Lynam, 2007).

The safety effects of speed limit changes in Sweden were studied in research to describe and analyse the long-term traffic safety impacts of increased as well as reduced speed limits, and changes in actual driving speeds (Vadeby & Forsman, 2018). There was a reduction in fatalities on rural roads where the speed limit was reduced from 90 to 80kmh but no significant changes for those seriously injured.

General engineering and enforcement strategies with the aim of reducing collisions have a greater potential for achieving desired outcomes on urban roads than rural roads. On rural roads, speed management measures should target specific problems which are more likely to be cost-effective than 'blanket' measures (Taylor, Lynam, & Baruya, 2000).

YOUNG MALES: ATTITUDES TO RISK AND SPEEDING

Young drivers and passengers are over-represented in collisions compared to their vehicle mileage on all types of roads, with 'faster manoeuvres' such as overtaking on rural single carriageways particularly dangerous (Lynam, 2007).

One study observed that males are less likely to see the connection between increased speed and an involvement in a collision (Petroulias, 2009). They are also more likely to think "speeding is okay if driving safely and less likely to think speed limits are reasonably set". This attitude reduces the credibility of speed limits which, as discussed above, increases the likelihood of non-compliance of the speed limit.

Significantly more male and younger drivers reported exceeding the speed limit in research undertaken to explore the factors contributing to rural road collisions in Scotland (Crinson, Scoons, & Broughton, 2008). Younger male drivers also had high levels of self-confidence and belief in their personal driving abilities which consequently minimised the perception of risk (Collins, et al., 2008). However, risky driving was not perceived as likely to have negative consequences by survey respondents.

Another study similarly noted that age and gender made a statistically significant difference in all comparisons, with "male drivers and younger drivers being less compliant throughout" with adherence to speed limits (Stradling, Collins, Eynon, & McLeod, 2010).

SUMMARY OF RECOMMENDATIONS

The following were recommendations made by the research studied in this literature review to mitigate and manage collisions and improve road safety on rural roads.

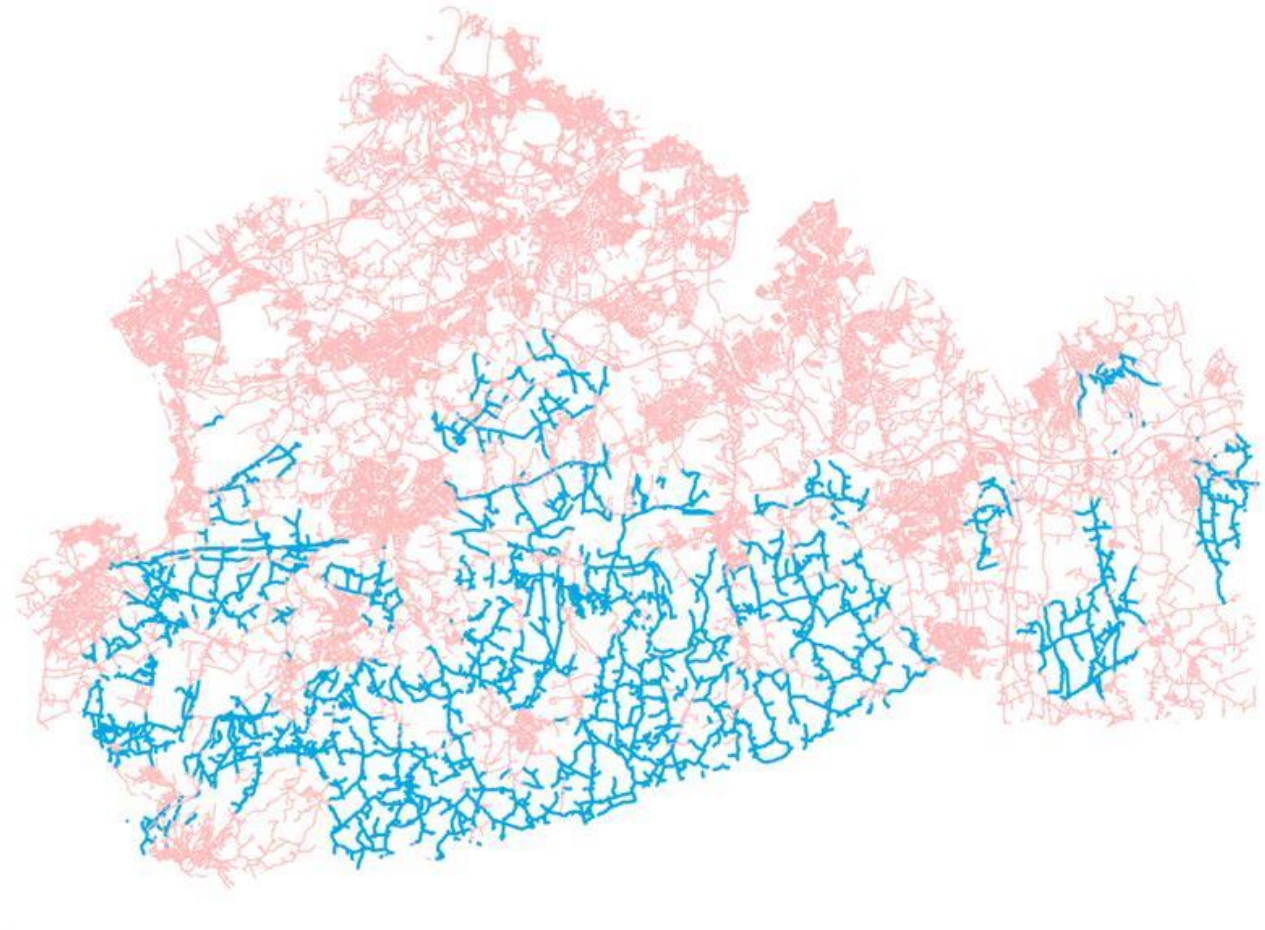
- Educational measures designed for speeding drivers should focus on aspects of their risk perception and risk tolerance. Drivers' understanding of safe speed can be achieved through road engineering and complemented by educational strategies (Yao, Carsten, & Hibberd, 2020).
- Designing self-explaining roads can create a simple and clear road environment, rather than one that is complex or contradictory and adds consistency between road types and function (Lynam, 2007).
- Campaigns must be part of a strategy which includes enforcement and engineering changes together as complements. Education and publicity campaigns should continue to target young drivers who are disproportionately represented in rural road crashes (Hamilton & Kennedy, 2005).
- Similarly, it was recommended that measures taken in isolation are less effective than an integrated speed management approach. For example, automated speed enforcement should be accompanied by important communication efforts as changes in speed limits alone have little effect unless accompanied by measures like enforcement, communication and education (International Traffic Safety Data and Analysis Group, 2018).
- The IRTAD report also recommended that efforts should be maintained over time; when enforcement measures are not maintained, driving speeds become higher again over time (International Traffic Safety Data and Analysis Group, 2018).
- A 'high risk' group are young males, who were significantly prevalent and should be the main target of communications and educational messages about speeding and confidence about specific situations (Collins & Stradling, 2008).
- Defining a network of minor road zones with publicity and information campaigns to encourage drivers to drive at lower speeds than the NSL at 40mph on certain network was recommended. Clearer definition and 'distinctive design' for different networks could lead to drivers modifying their use of minor roads (Lynam, 2007).
- Similarly, the classification of roads into groups 'reflecting road quality' could lead to the development of a 'road hierarchy' on rural single-carriageway roads (Taylor, Baruya, & Kennedy, The relationship between speed and accidents on rural single-carriageway roads, 2002).

Network analysis

SURREY'S RURAL ROAD NETWORK

In order to analyse the available data, it was necessary to define the target roads. This subset of Surrey's road network was used to analyse both collision numbers and vehicle speeds, and their interactions, across Surrey's rural roads. Roads were included in the analysis if they had a 40mph, 50mph or 60mph speed limit, were predominantly rural and have not had a change of speed limit recorded in the past five years. Predominantly rural is defined as being within 50m of a rural LSOA (settlement of under 10,000 people). This differs from the rurality classification used by the DfT. A map of the network used is shown in blue in Figure 1 below.

Figure 1 - Rural road network in Surrey used for analysis



This network consisted of 2,764 individual sections of road, covering a total of 573km and experiencing just over 2 billion vehicle km of traffic each year. Just over half of this network (53%) has 40mph speed limits, with the remaining roads having either a 50mph (12%) or a 60mph (35%) speed limit. Just under 92% of this network is single carriageway road, with just 7% being dual carriageway and nearly 2% another form of way (e.g. junction, roundabout, slip road).

COLLISION ANALYSIS

Collisions from the most recent five-year period (2015 to 2019) were matched to the road network using a combination of proximity and recorded road number and class. The rural road network analysed had an annual average of 261 collisions, of which 63 involved at least one casualty who was killed or seriously injured. Just over half of these occurred on roads with 40mph speed limits (132), as this comprises the majority of the road network, with 65 being matched to 50mph roads and 63 matched to 60mph roads.

Figure 2 below shows the total collision density (per 100km of road) of the network split by different speed limits, as well as for all rural limits combined. The roads that have a speed limit of 50mph have a considerably higher number of collisions per 100km of road, with 60mph roads having the lowest density of collisions.

Figure 2 - Collisions per 100km of road, split by speed limit (2015 - 2019)

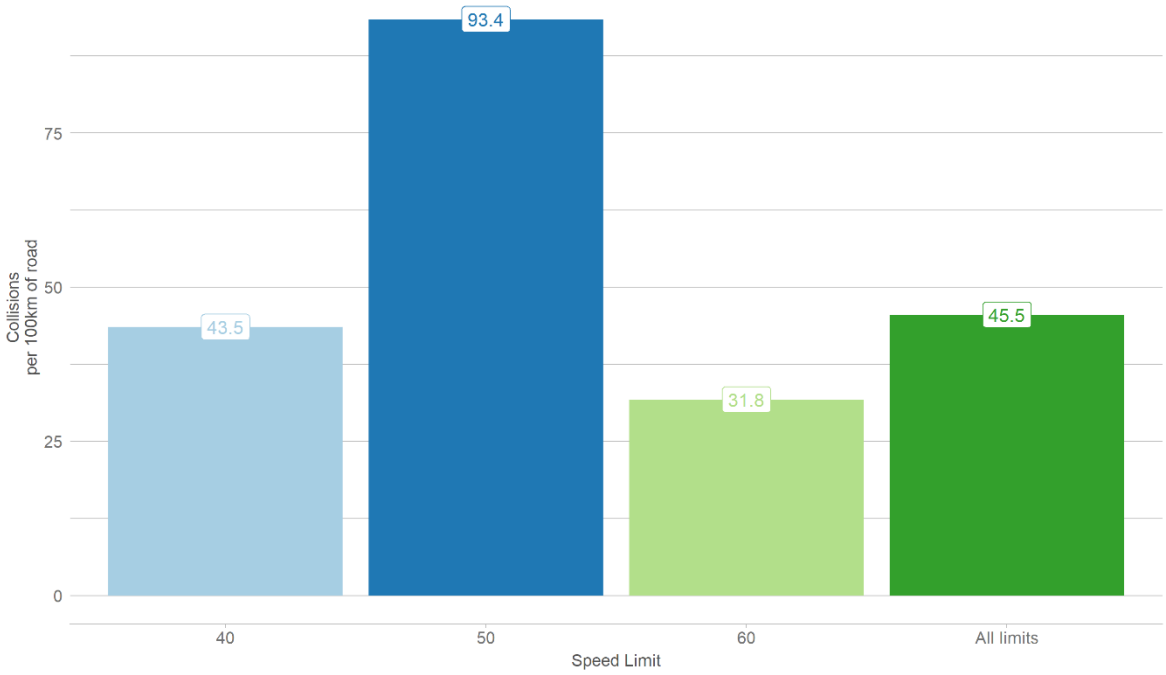
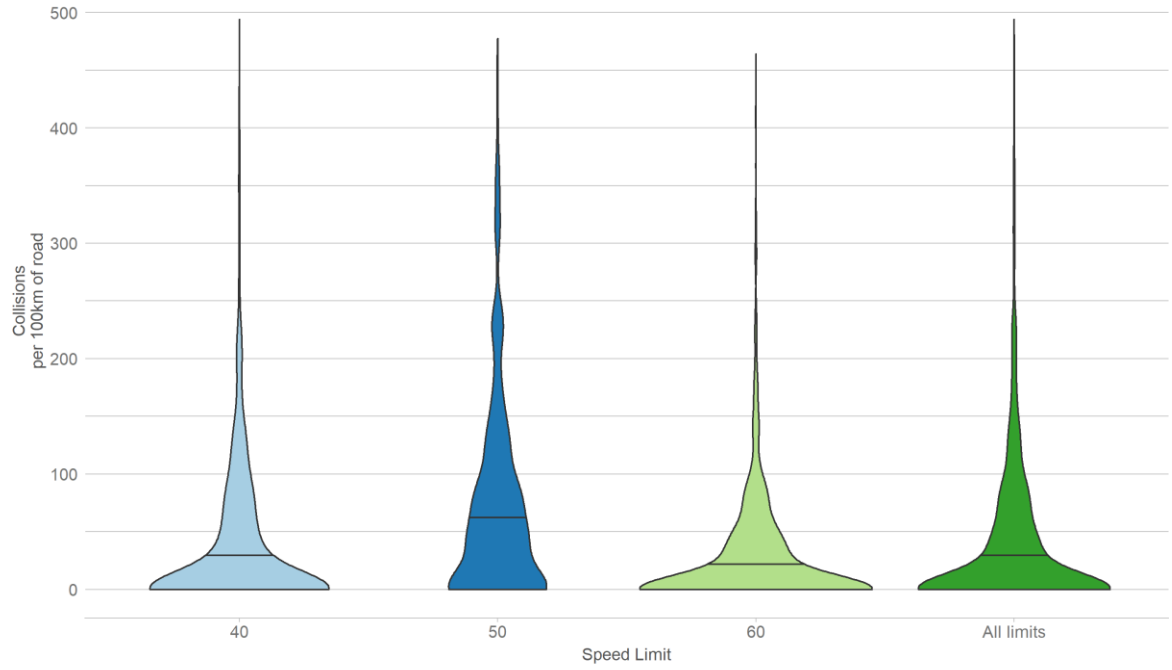


Figure 3 shows the distribution of collision density across all road sections, split by speed limit as well as for all rural limits combined. The wider the area of the chart, the longer the amount of road that has that number of collisions per 100km. The wide bases show that a large amount of the road network did not observe any collisions between 2015 and 2019, although to a lesser extent for roads with 50mph speed limits. The chart also shows that a smaller proportion of 60mph roads have high collision densities compared to 50mph roads.

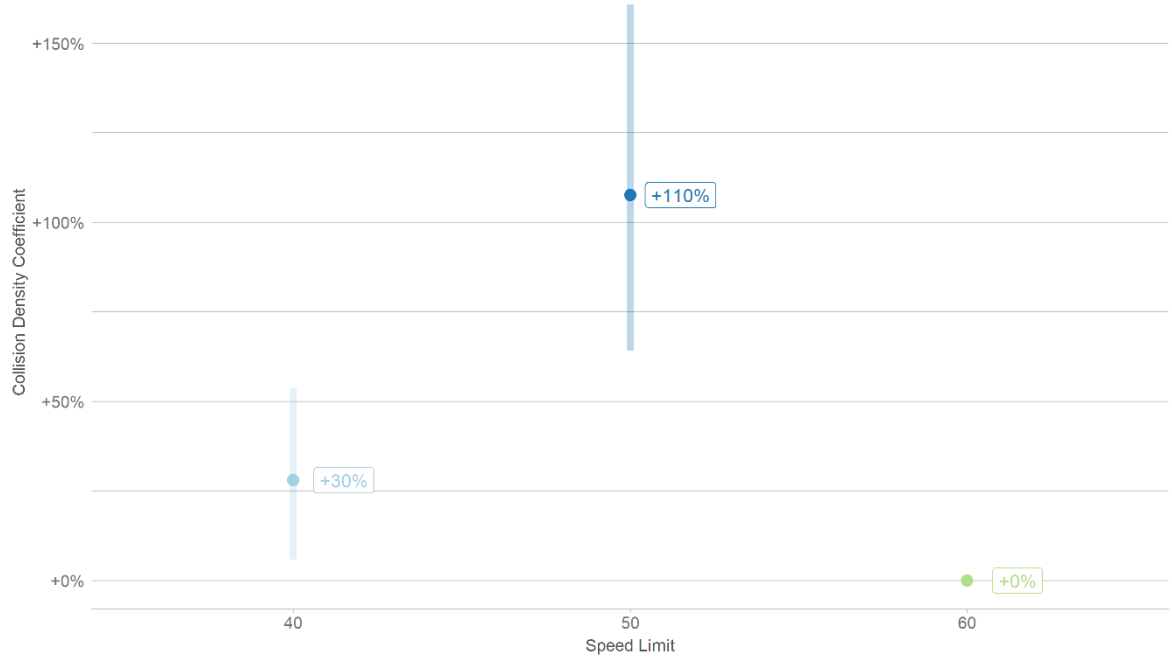
Figure 3 - Distribution of collision densities, split by speed limit (2015 - 2019)



A Bayesian Poisson regression model was constructed to determine the significance of these differences in collision densities for road sections with different speed limits. The model used 60mph speed limits as a baseline, and sampled model coefficients to determine the relative difference between the expected 60mph road's collision density and those of 40mph and 50mph roads. Figure 4 shows the results of this statistical analysis, with points showing the average of the sampled coefficients, and the vertical lines showing the 95% confidence interval around these. The coefficients show that roads with 40mph speed limits tend to have collision densities around 25% higher than those of 60mph speed limits, whilst 50mph speed limits tend to have around double the collision density. Furthermore, the confidence intervals suggest that these differences are statistically significant.

It is worth noting that this model does not suggest a causal link between speed limits and collision densities, only that there are significant differences between these parts of the network. The following section will explore the relationship between vehicle speeds and road risk, to provide some explanation for these observed differences.

Figure 4 - Bayesian Poisson regression coefficients comparing collision densities for different speed limits



Although collision densities provide a metric for determining the relative frequencies of collisions on the road network, they do not account for differences in traffic levels that may influence this frequency. Modelled vehicle traffic taken from telematics data sources was used to calculate collision risk rates (collisions per billion vehicle km travelled). This metric measures the risk to individual road users on Surrey's rural road network.

Figure 5 - Distribution of traffic exposure, split by speed limit

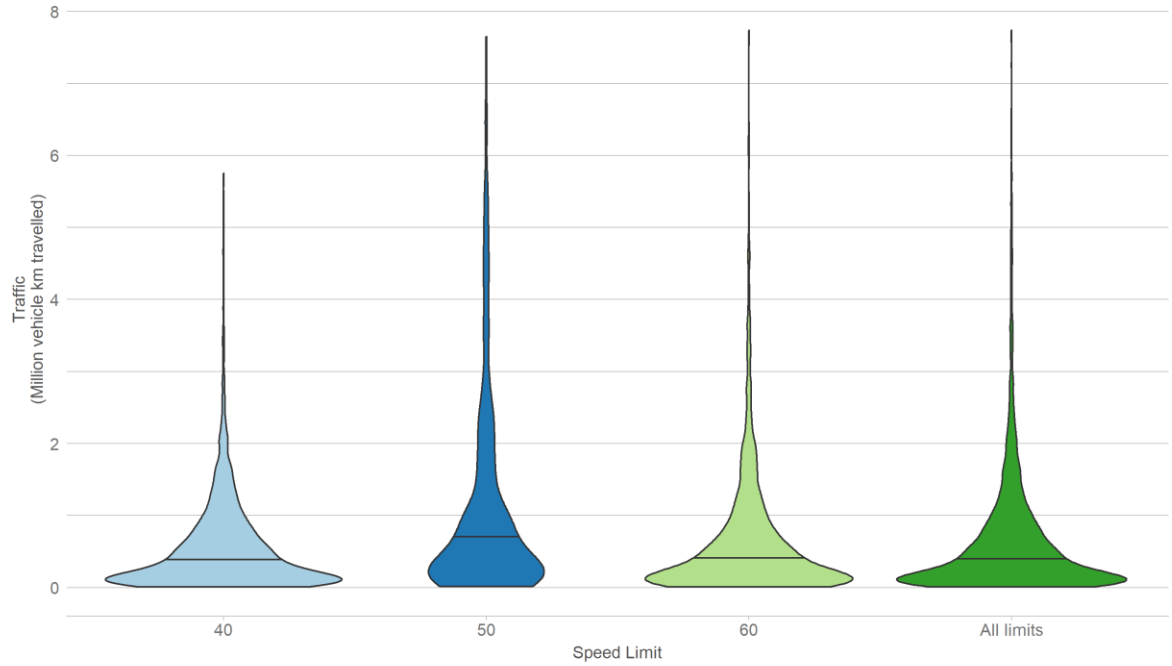


Figure 5 shows the distribution of traffic levels for the sections of road used in the analysis, for each speed limit as well as for the whole rural road network combined. This suggests that 40mph speed limits

cover a large proportion of roads that have relatively low traffic levels, as do 60mph speed limits, although to a lesser extent. Meanwhile 50mph speed limits cover fewer low-traffic road segments and have a higher proportion of high-traffic segments.

Figure 6 shows the combined collision rates per billion vehicle km travelled for each speed limit separately, as well as for all rural speed limits. Roads with 40mph speed limits have the highest collision rates, with just over 150 collisions per billion km travelled by vehicles, and this is most likely the result of having low traffic levels as seen in Figure 5 above. This is followed closely by 50mph roads, with a collision rate of 138 collisions per billion vehicle km travelled. Roads with 60mph speed limits have the lowest combined collision rate (91) despite also having relatively low traffic levels.

Figure 6 - Collisions per billion vehicle km travelled, split by speed limit (2015 - 2019)

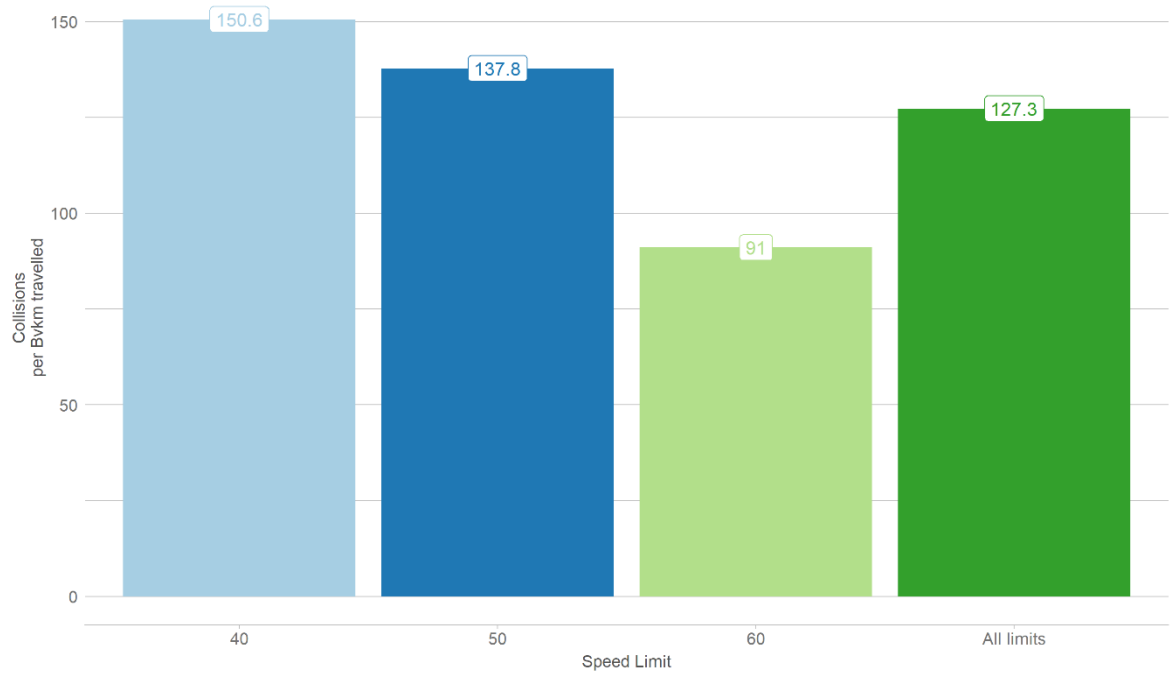
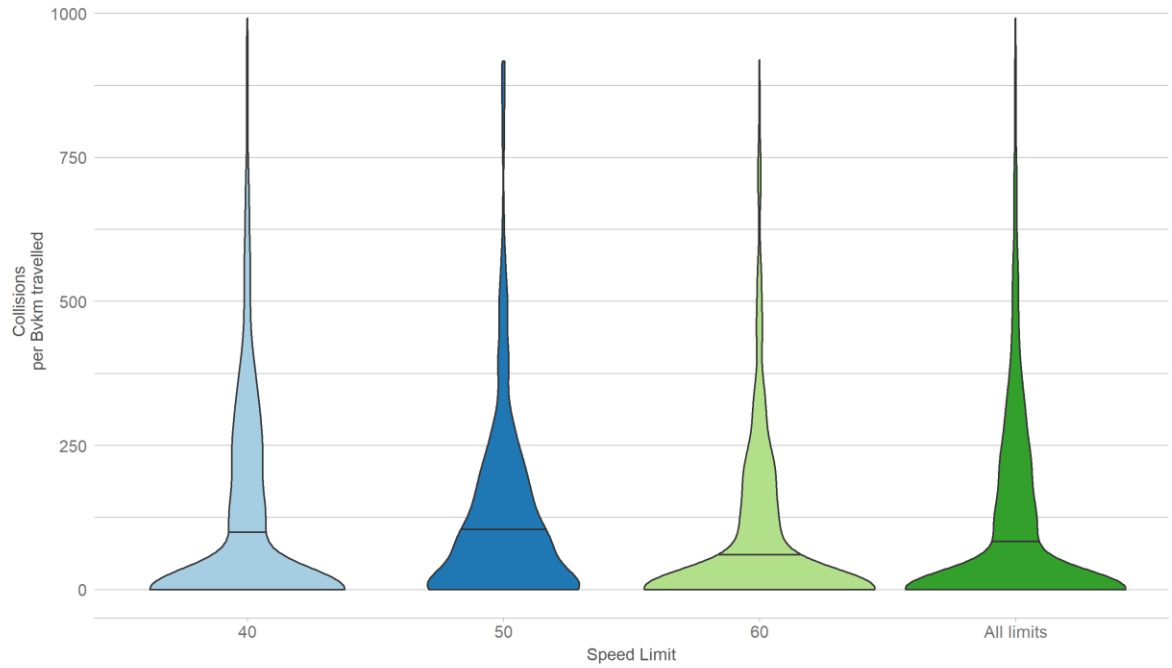


Figure 7 shows the distributions of collision rates for sections of roads with different speed limits. This shows that there was a larger proportion of roads with 40mph speed limits that have high collision rates when compared to 50mph and 60mph roads, most likely the result of collisions occurring on low traffic roads. The distribution of collision rates for roads with 50mph speed limits is much wider around 50 to 200 collisions per billion vehicle km, indicating that these roads have more consistently high collision rates.

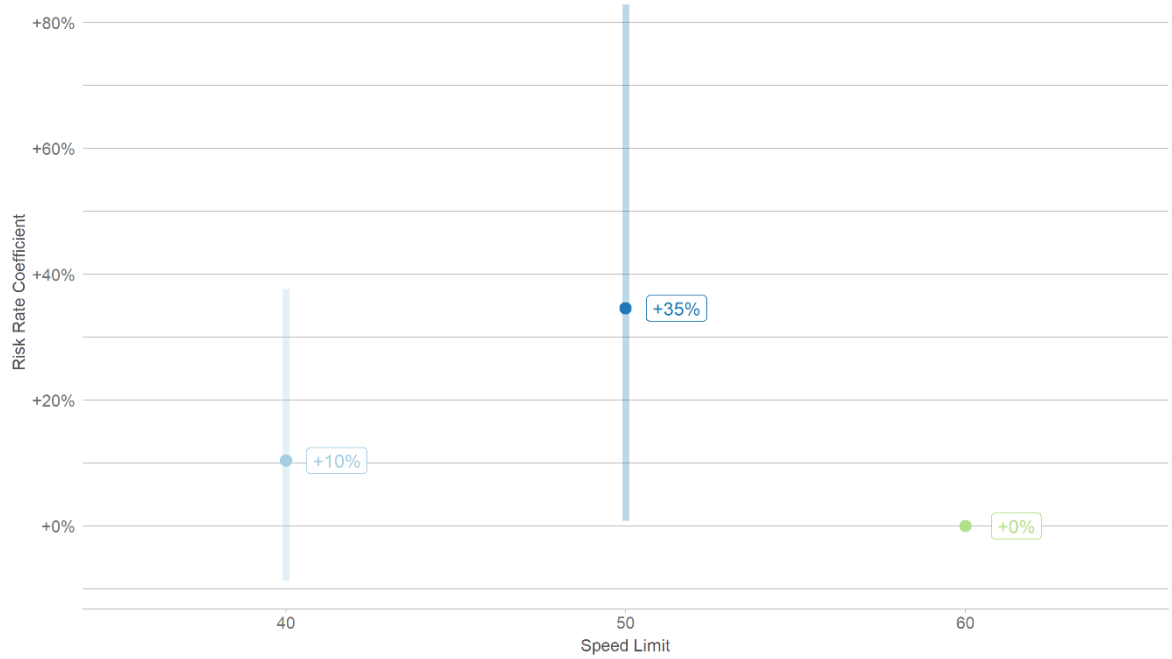
Figure 7 - Distribution of risk rates, split by speed limit (2015 - 2019)



As before, a Bayesian Poisson regression model was used to determine the significance of these differences. The model used 60mph speed limits as a baseline, and sampled model coefficients to determine the relative difference between the expected 60mph road's collision rate and those of 40mph and 50mph roads. Figure 8 shows the results of this statistical analysis, with points showing the average of the sampled coefficients, and the vertical lines showing the 95% confidence interval around these. The coefficients and their confidence intervals show that, although roads with 40mph speed limits have a higher combined collision rate, the collision rates of all individual 40mph road sections may not be statistically significantly different than those of 60mph roads. When comparing collision rates of road section with 50mph speed limits to those with 60mph limits, although the model suggests that there is a statistically significant difference, it is uncertain the extent to which 50mph speed limits exhibit higher collision rates. Furthermore, these differences may not be significant at a higher threshold of significance (e.g., 99%).

Again, it is important to note that this model does not suggest a causal link between speed limits and collision rates, only that there are some significant differences between different parts of the network. An exploration of the relationship between vehicle speeds and road risk in the following section aims to provide some explanation for these observed differences.

Figure 8 - Bayesian Poisson regression coefficients comparing risk rates for different speed limits



SPEED DATA ANALYSIS

As seen in the previous section, roads with different speed limits appear to exhibit different levels of road risk, and some of these differences are statistically significant. An analysis of link speed data for Surrey's rural road network was carried out to determine whether there are observable differences in driver behaviours on roads with different speed limits, and whether these differences likely resulted in the differences in road risk.

As outlined in the methodology section earlier, speed data provided by Ordnance Survey (OS) and taken from a telematics data source, was used for this analysis to ensure coverage of as much of the network as possible. This link speed data was supplemented with an additional 775 traffic surveys containing spot speeds provided by Surrey County Council, which were batch processed and spatially matched to the road network, to enable comparisons between the telematics-based link speed data and spot speeds collected by more traditional measurement techniques. Although the OS speed data is available for several different time periods, evening speeds were used in this analysis as they were found to be the most representative of all day average speeds.

Figure 9 below shows a comparison of average speed values for the two sources of speed data, whilst Figure 10 shows a comparison of 85th percentile speeds. As these charts show, although there is good correlation between the two data sources, the OS link speed data does tend to have suppressed speed values. The suppression of link speeds from telematics data sources is most likely a result of differences in the way data is collected, rather than reporting error. Whilst traditional speed surveys often measure spot speeds at a free-flowing point on the road, telematics data covered speeds across the whole stretch of road, including areas where traffic is not free flowing (e.g. where vehicles may be slowing down as they approach junctions or crossings). On average, average speeds differ by around 3.3mph, whilst 85th percentile speeds differ by around 3.5mph. These differences should be borne in mind throughout the remainder of the analysis.

Figure 9 - Comparison of average speed between OS link data and spot speed survey data

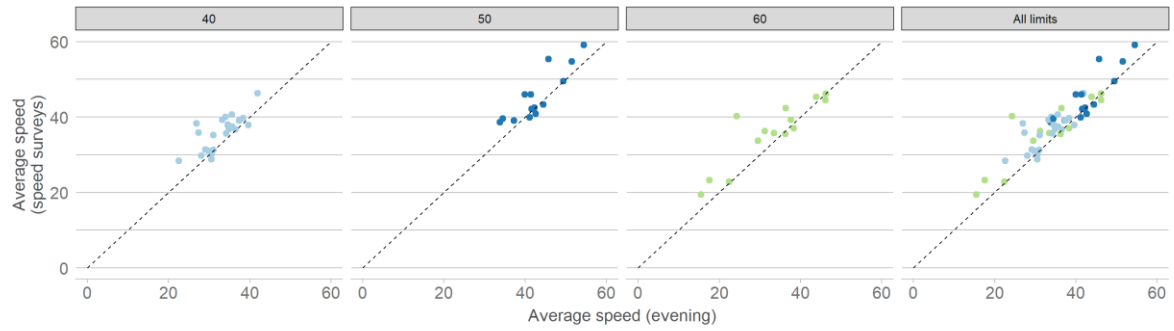
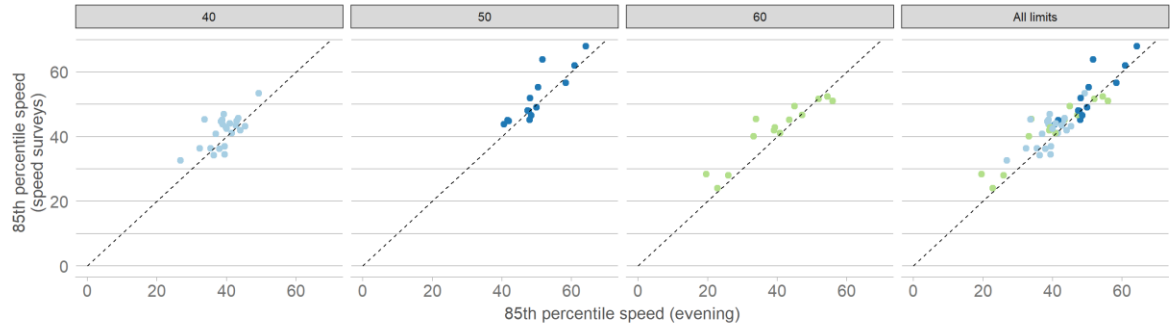


Figure 10 - Comparison of 85th percentile speed between OS link data and spot speed survey data



The following analysis exclusively uses the link speed data following the validation exercise above. Figure 11 shows the distribution of link average speeds for road sections on Surrey's rural road network, split by speed limit. Both 40mph and 50mph speed limits show similar distributions, with the majority of roads having good speed compliance, despite some having average speed above the speed limit. However, average vehicle speeds on 60mph roads appear to be much lower than the speed limit, with a large proportion between 25mph and 35mph.

Figure 11 - Distribution of link average speeds, split by speed limit

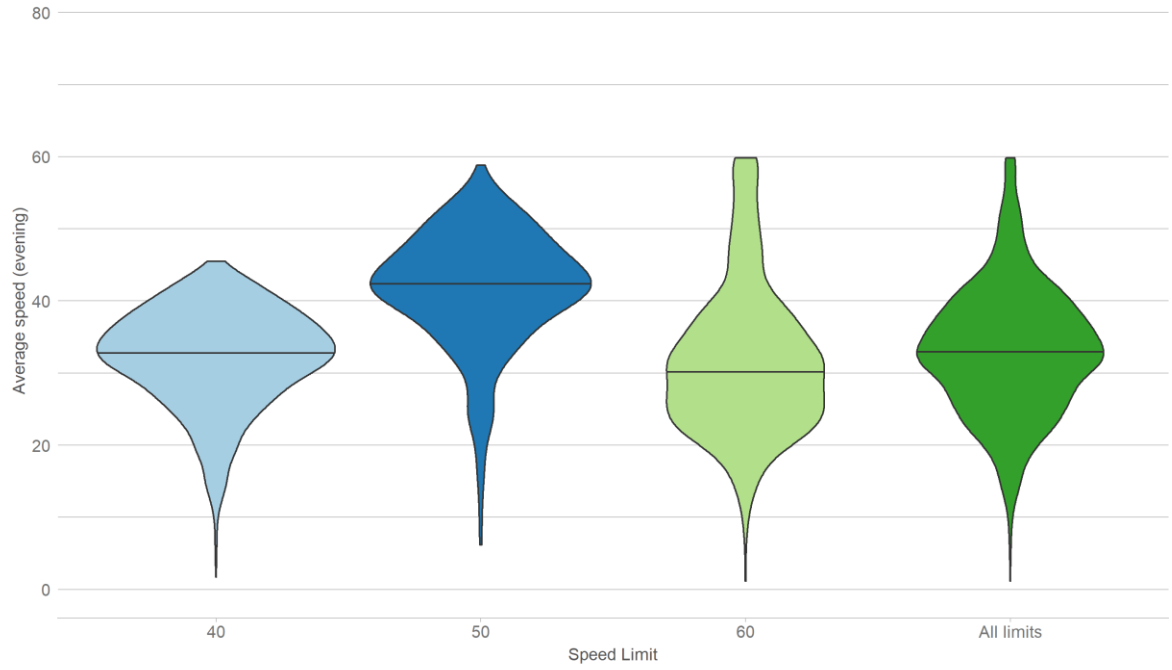
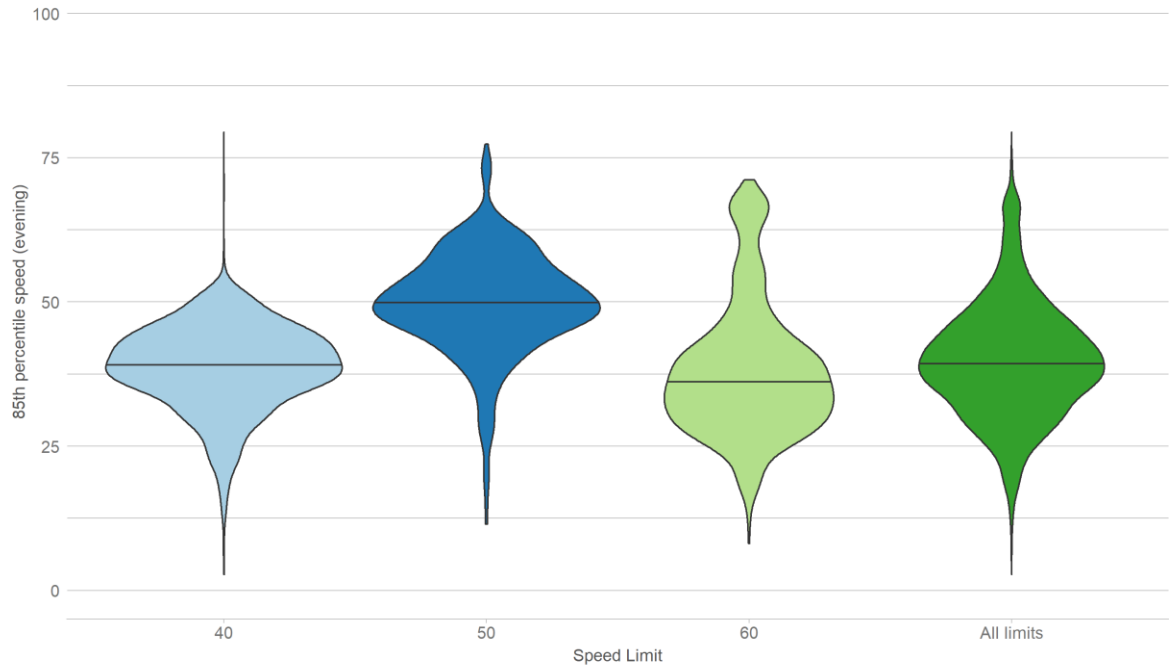


Figure 12 - Distribution of link 85th percentile speeds, split by speed limit



The distributions of 85th percentile speeds are shown in Figure 12. As with average speeds, 85th percentile speeds on 60mph roads appear to be much lower than the speed limit, with a large proportion between 30mph and 40mph. Roads with 40mph and 50mph limits, on the other hand, appear to have more similar distributions, with just under half of road sections having non-compliance levels of over 15%.

Figure 13 - Distribution of link average speeds, split by speed limit (ATC data)

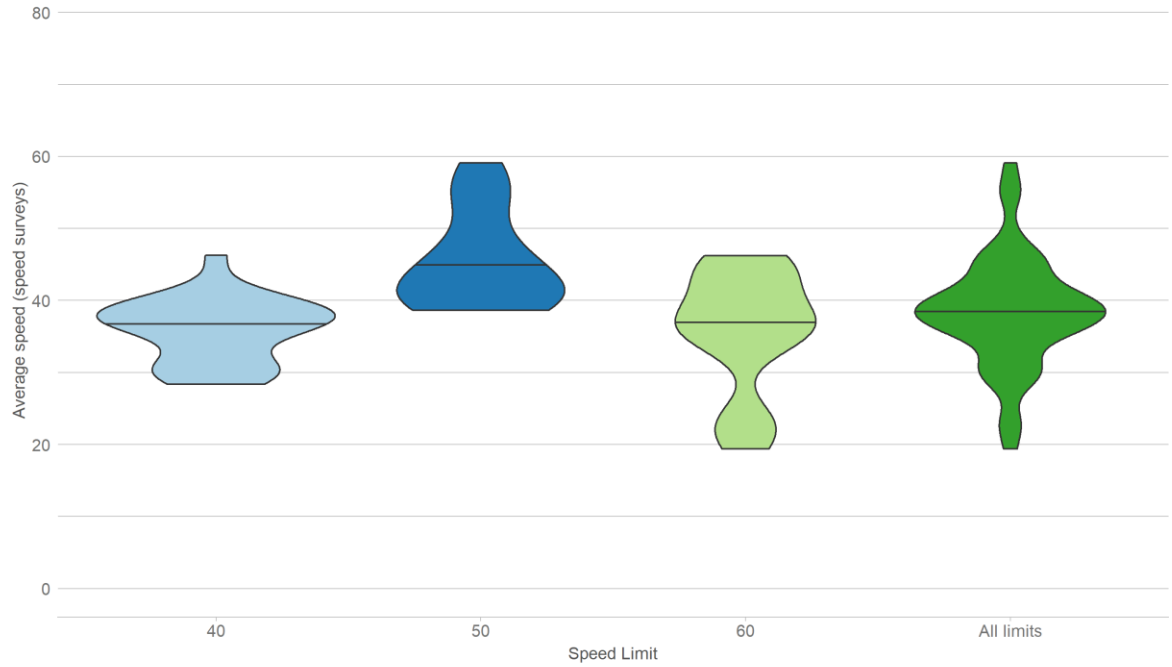


Figure 14 - Distribution of link 85th percentile speeds, split by speed limit (speed survey data)

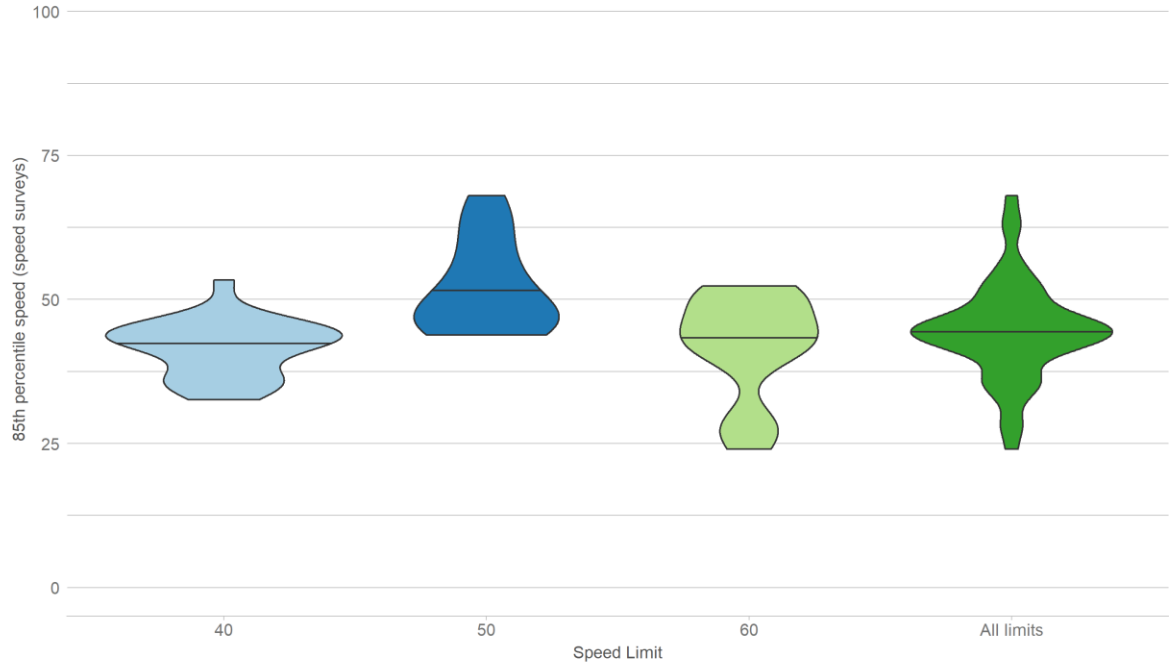


Figure 13 and Figure 14 above show the distributions of average speeds and 85th percentile speeds respectively taken from Surrey County Council's ATC surveys. Aside from the slight differences in speed

values one would expect when looking at this alternative data source, these both show a similar picture to what was observed in the OS speed data. It is therefore unlikely that the lower speeds on 60mph roads are the result of recording errors in the data and are instead a sign of normal driver behaviour.

There are several factors considered below that may contribute to recorded vehicle speeds on roads being significantly lower than the speed limit: narrower road widths; higher sinuosity (curvature); and undivided carriageways.

One potential factor that influences the speed at which drivers choose to travel at is the width of road. Narrower roads allow less room for error and may result in drivers feeling less safe at higher speeds. Drivers tend to drive faster on wider roads, possibly because they perceive less risk of running into roadside objects (iRAP, 2010). Narrow roads make it feel more uncomfortable to drive in excess of the legal or recommended speed (Global Road Safety Partnership, 2008) Figure 15 and Figure 16 below show the distributions of both average and minimum road widths for sections of road with different speed limits. These show that average road widths do not vary significantly between parts of the network with different speed limits, and so is unlikely to be leading to reduced speeds on roads 60mph limits in general.

Figure 15 - Distribution of average road widths, split by speed limit

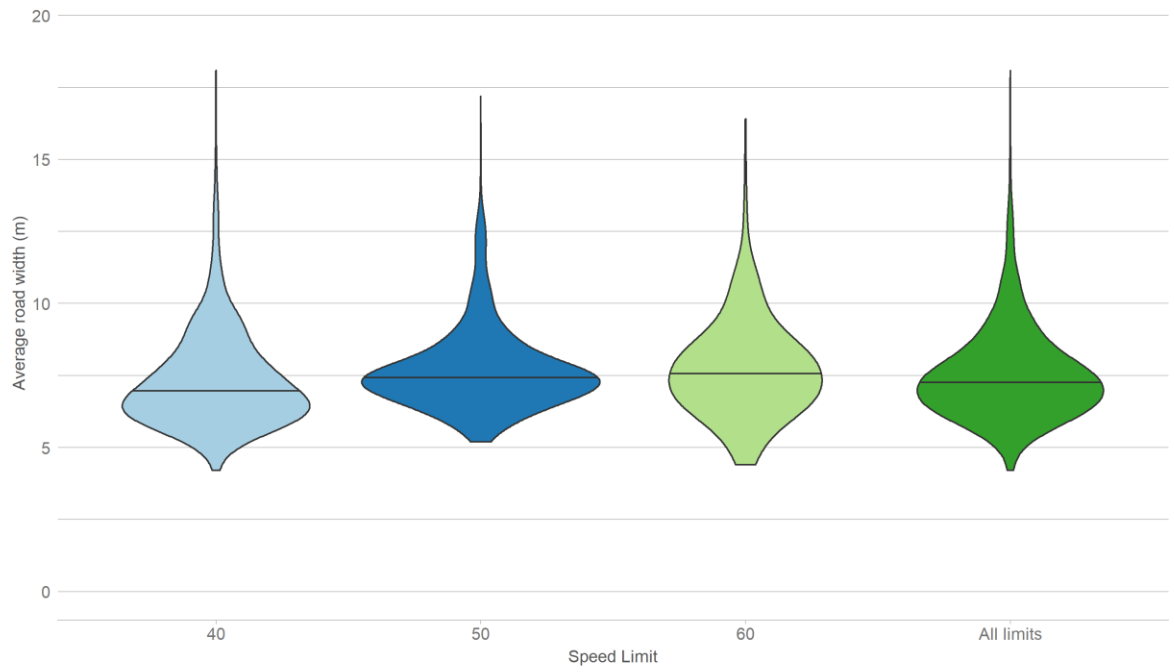
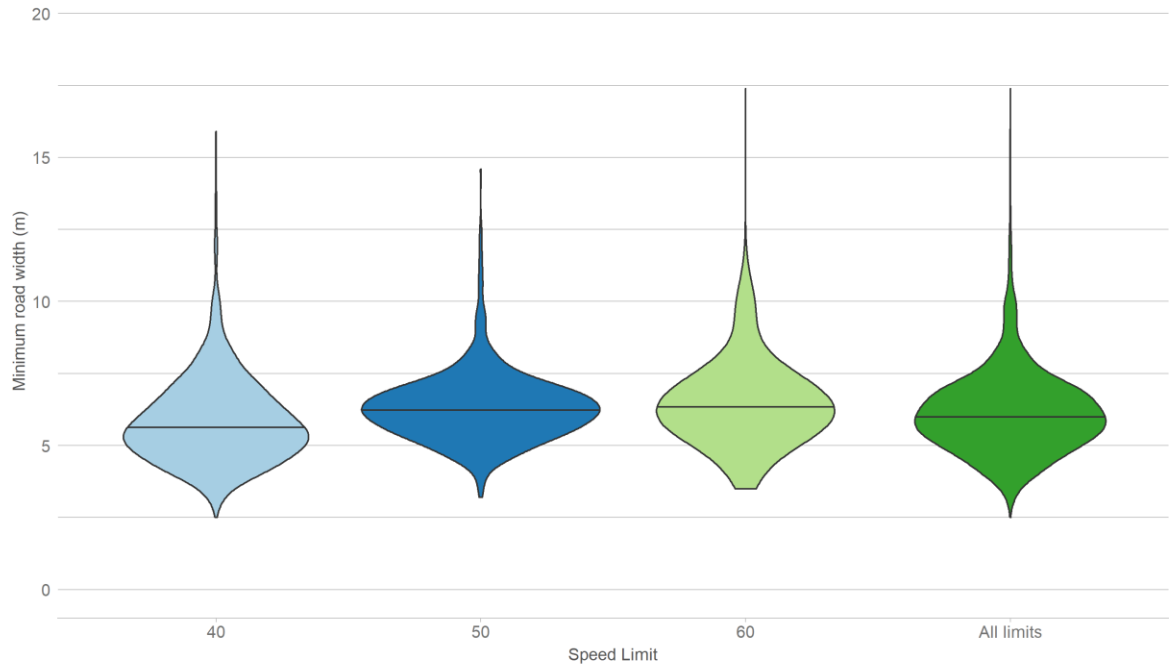


Figure 16 - Distribution of minimum road widths, split by speed limit



Another factor that may influence the speed at which drivers choose to travel at is the sinuosity of road (both the curvature of the road and the number of curves). More sinuous roads, with sharper or more frequent turns, may have reduced visibility and require more concentration from the driver, leading to lower driving speeds. Sinuosity was calculated spatially for each road section as the ratio between the distance travelling along the road and the straight-line distance from start to finish.

Figure 17 shows a comparison of average speeds to the sinuosity of road links, with a dashed line showing the result of a linear model fit to the data. This shows that, although there is a large amount of variation in sinuosity values, there is a clear trend: the higher the sinuosity of the road, the lower the average speeds are likely to be. However, as Figure 18 shows the distributions of sinuosity for each speed limit, there is little difference across parts of the network with differing speed limits. It is therefore unlikely that sinuosity alone is resulting in lower speeds on 60mph roads.

Figure 17 - Comparison of road sinuosity to link average speed, with line of best fit

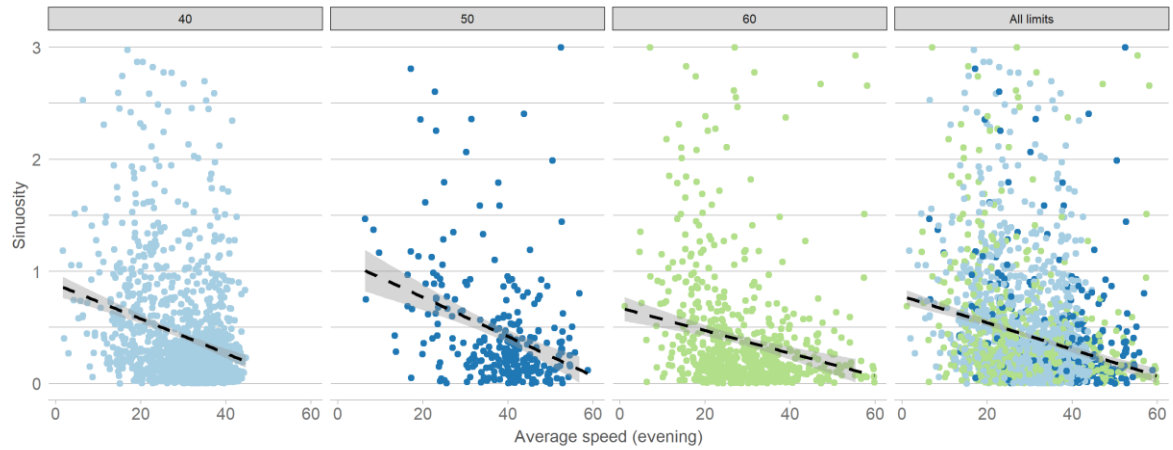


Figure 18 - Distribution of road sinuosity, split by speed limit

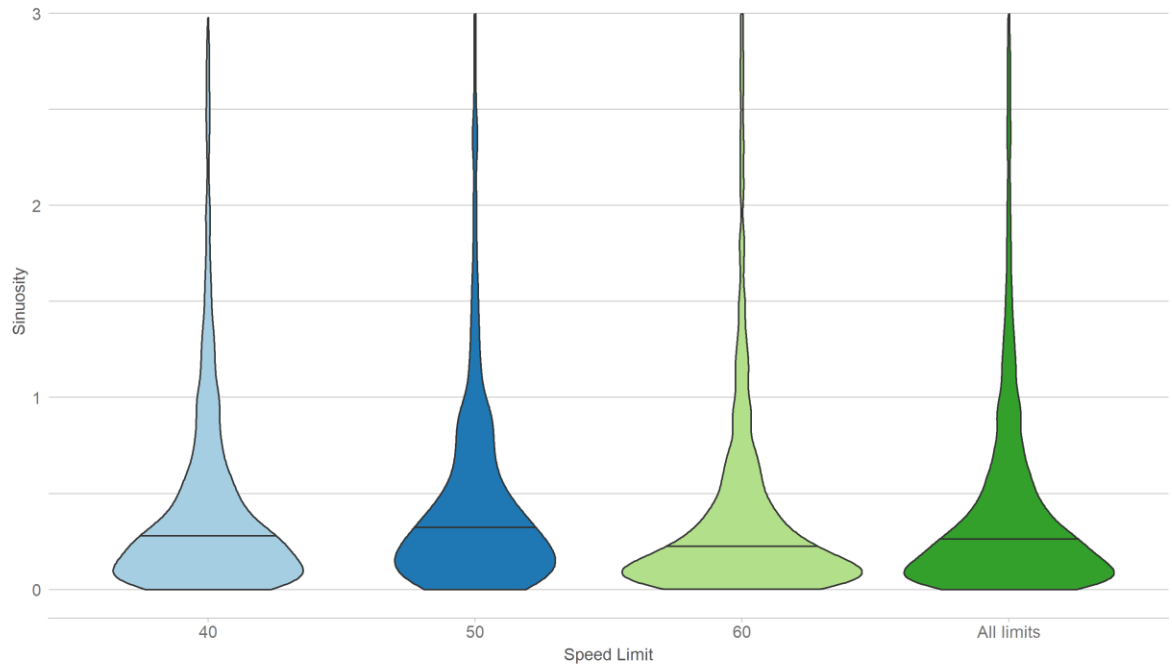
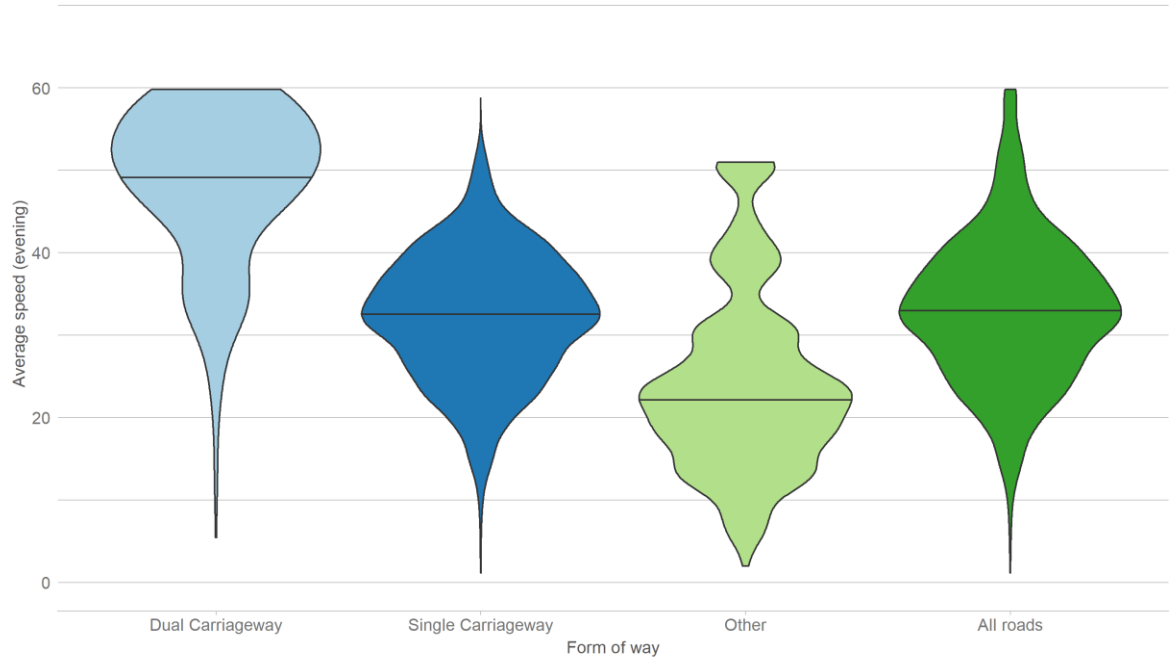


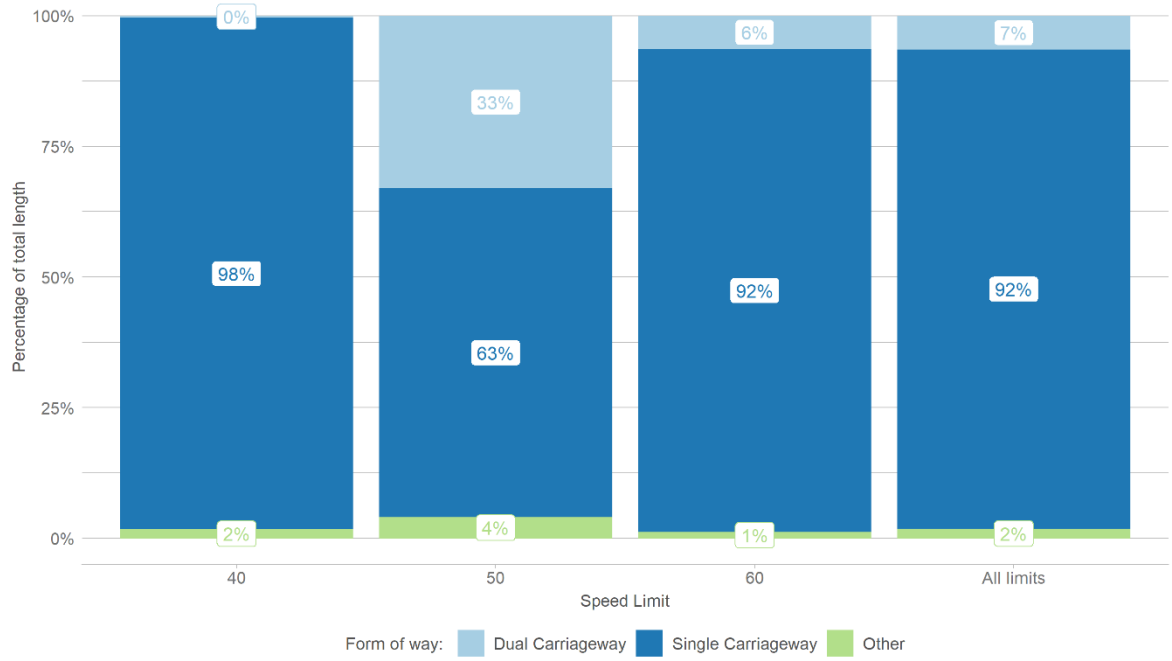
Figure 19 – Link average speed distributions by form of way



One further factor that might impact on average vehicle speeds is carriageway type, or form or way as represented in the OS dataset. Undivided carriageways offer less protection with dual carriageways commonly featuring barriers separating oncoming vehicles. This may therefore influence the speed at which a driver feels it is safe to drive. Indeed, Figure 19 below shows that average speeds tend to be considerably lower for single carriageway roads compared to dual carriageways. Figure 20 then demonstrates that a higher proportion of 50mph roads are dual carriageway, when compared against the proportions for 40mph and 60mph roads. This suggests that the higher proportions of single

carriageway roads could be partly responsible for the lower average speeds observed on the parts of the road network that have 40mph and 60mph speed limits.

Figure 20 - Speed limits broken down by form of way



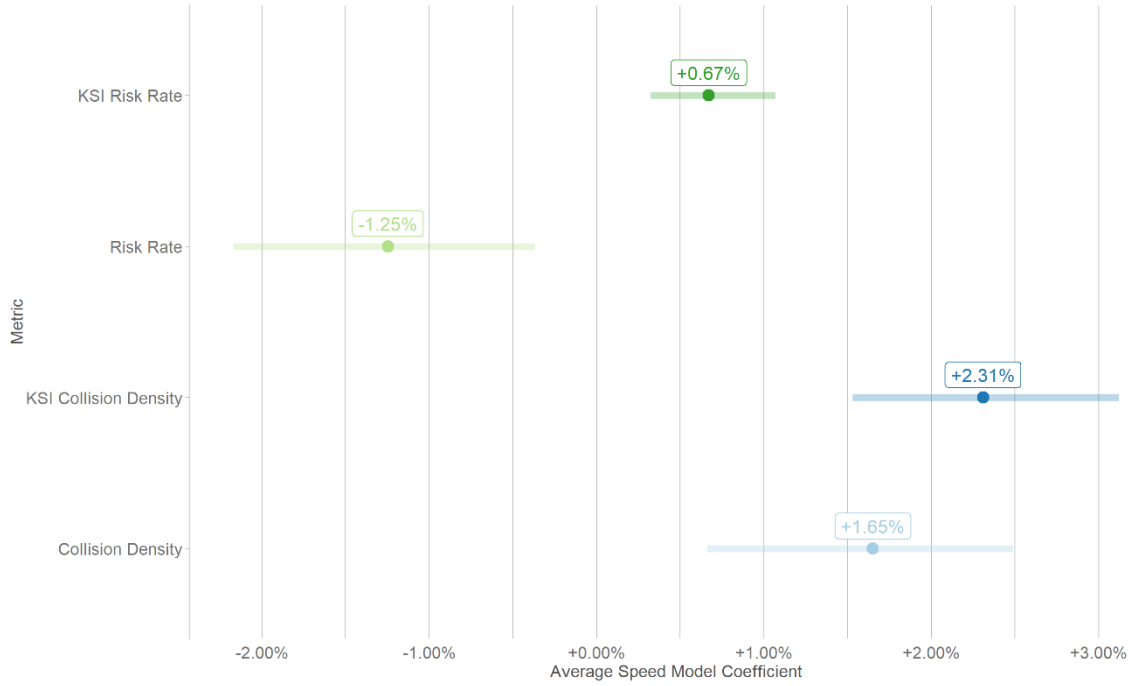
SPEED AND RISK RELATIONSHIP

The data analysis showed that there is not a clear relationship between the posted speed limit and the speed of vehicles on 60mph roads. The 85th percentile speeds for both 40 and 50 mph roads are on average very close to the limit itself, but for 60mph roads these values are close to 40mph. The final analysis in this section therefore examines the relationship between travelled speed and collisions.

Bayesian Poisson regression models were used to determine the relationship between average and 85th percentile speeds on rural roads and four different risk metrics: Collision density, the number of collisions per 100km of road; KSI collision density, the number of collisions in which at least one casualty was killed or seriously injured per 100km of road; risk rate, the number of collisions per billion km travelled by vehicles; and KSI risk rate, the number of collisions with a killed or seriously injured casualty per billion vehicle km travelled.

These models account for differences in road carriageway type, and the coefficients sampled from the models show the expected effect on risk metrics from an increase in speeds of 1mph. Figure 21 shows the model coefficients resulting from increases in average speed of 1mph, with 95% confidence intervals. Figure 22 shows these coefficients when considering the impact of increasing 85th percentile speeds by 1mph.

Figure 21 - Bayesian Poisson regression coefficients showing the impact on risk metrics from increases in average speed

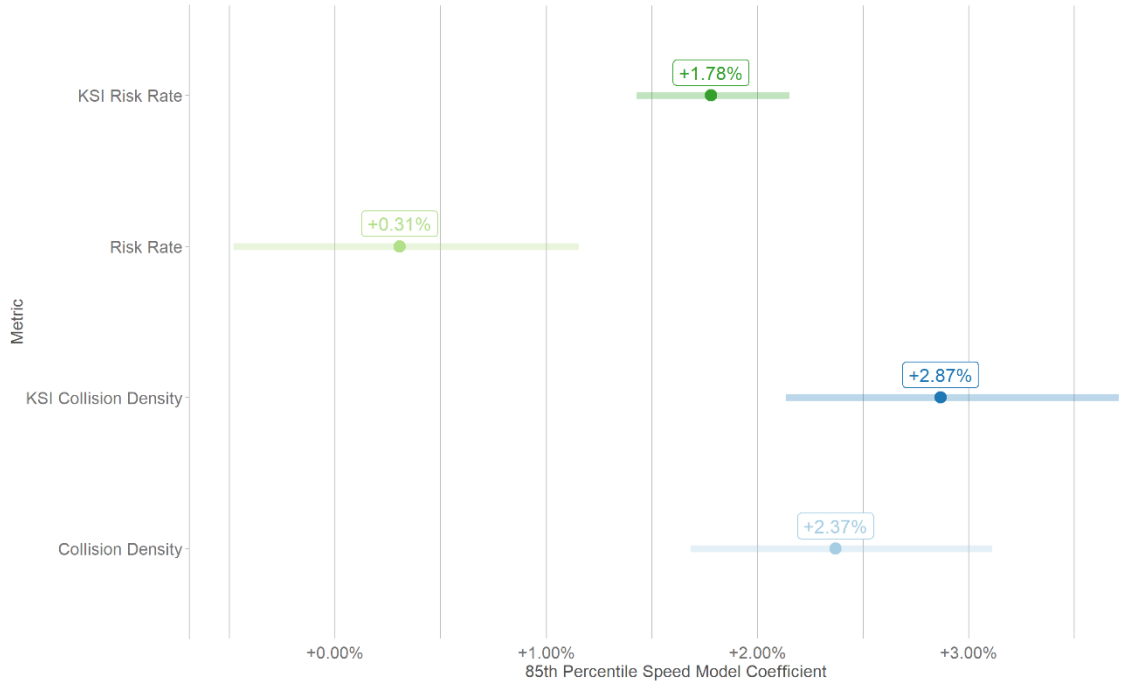


This modelling shows that an increase in average speeds of 1mph is expected to raise collision densities by 1.7%, and KSI collision densities by 2.3%. Likewise, an increase of 1mph in 85th percentile speeds is expected to raise collision densities by 2.4%, and KSI collision densities by 2.9%. This shows that increasing speeds, particularly high-end speeds, leads to an increase in collisions.

When considering traffic-based collision rates, the relationship between risk and speed becomes more complicated. Modelling suggests that an increase in average speed of 1mph leads to an expected reduction in risk rates of 1.3%, but an increase of 1mph in 85th percentile speeds is expected to increase risk rates by 0.3%, although the confidence intervals suggest that this may not be statistically significant. However, KSI risk rates are expected to increase by 0.7% for every 1mph increase in average speeds,

and by 1.8% for increases in 85th percentile speeds. This suggests that greater speed differentials at the high-end is the biggest contributor to elevated risk, and that higher speeds tend to result in more severe collisions. The reduction on the total casualty rate is unexpected and is discussed later in this report.

Figure 22 - Bayesian Poisson regression coefficients showing the impact on risk metrics from increases in 85th percentile speed



Road user perspectives

PUBLIC PERCEPTION SURVEY

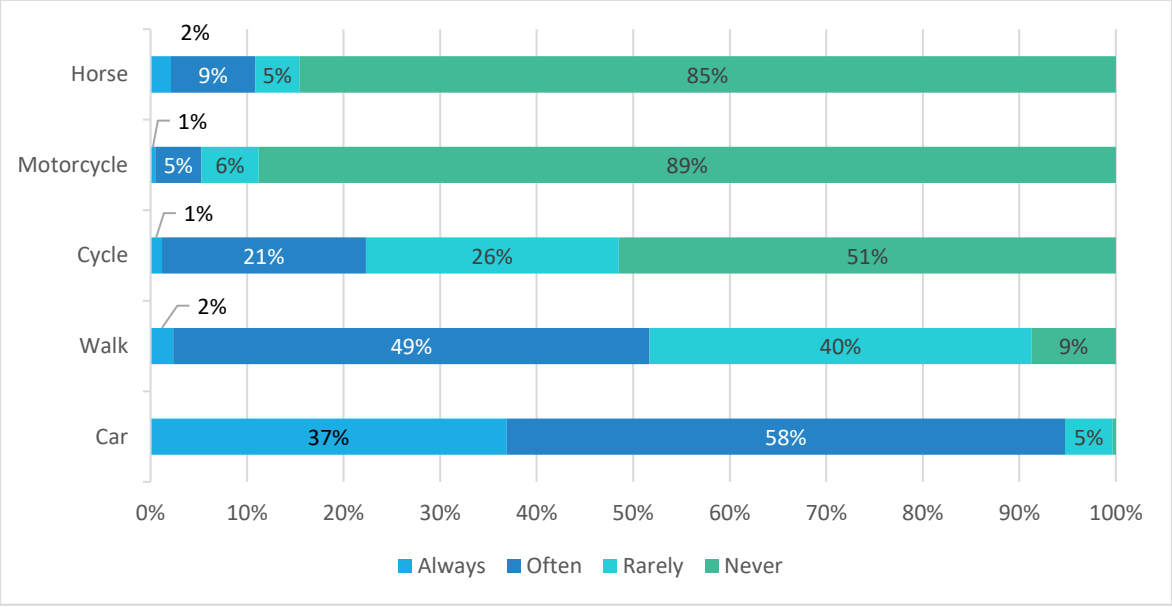
Introduction

An online survey was designed by Agilysis and disseminated by Surrey County Council through their social media channels. The aim and purpose of the survey was to understand local residents' perceptions towards potential reductions in rural road speed limits, and attitudes towards risk and compliance. Over the last couple of decades many rural roads in the east of Surrey have been reduced to 40mph or 50mph whereas the west of Surrey still has the national speed limit of 60mph. This survey helps in informing the consultation process on implementing speed limit reductions for elsewhere in Surrey.

There was a total of 1,935 responses collected, of which 52% identified as male and 47% as female. The largest age group of the respondents was 57-66 years of age, with almost 25% of total respondents, with 47-56 years at 23% and 67-76 years at 22%. The younger age group between the years of 17 and 36 years totalled just 9%.

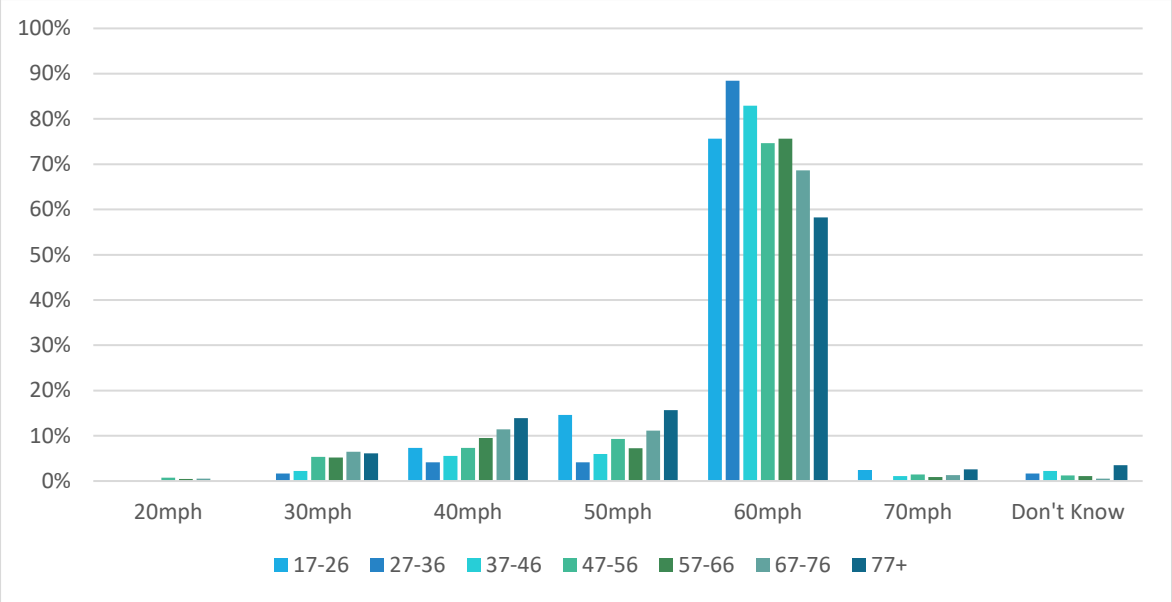
Of the respondents, 46% live in the west of Surrey and 32% in the east of Surrey. There was 17% of the respondents who were not sure which area of the county they lived in, with 5% living outside of Surrey.

Figure 23: Travel on rural roads by type of transport



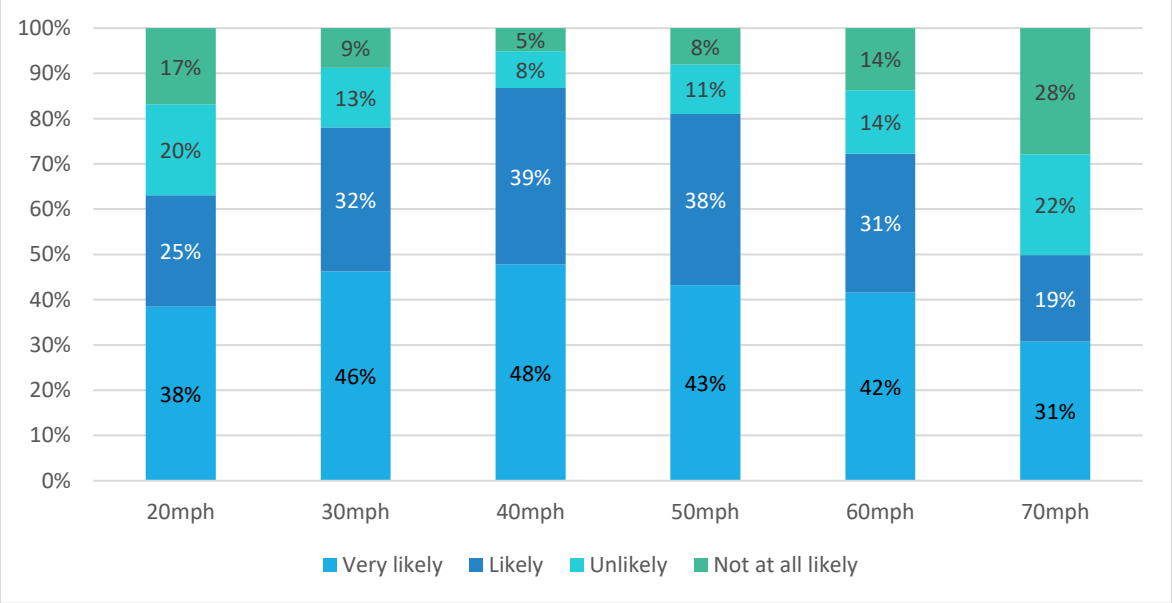
Cars were the most commonly used mode of transport on rural roads, with 37% 'always' using cars and 58% 'often'. Motorcycles and horses were the least common mode of transport among survey respondents.

Figure 24: Age group perception of speed limit on rural roads by age group



Of the total respondents, 75% answered correctly when asked what the national speed limit for cars and motorcycles on a rural single carriageway road in a non-built-up area is, with 60mph. The youngest age group of 17–26-year-olds also answered correctly with 76%.

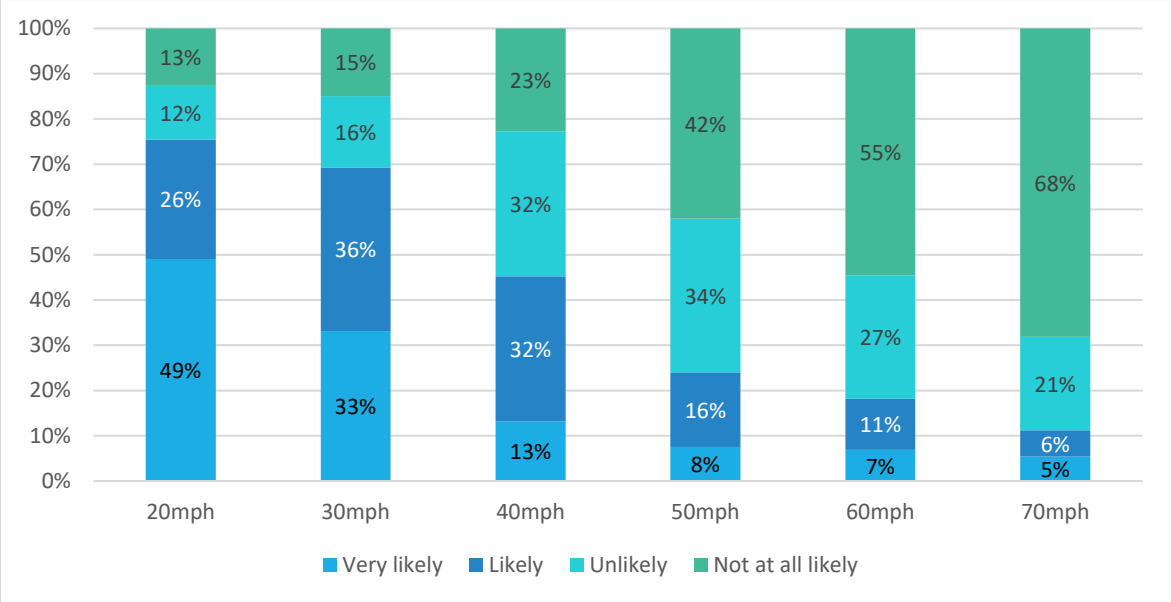
Figure 25: Likelihood to travel by car on main rural roads given various speed limits



Respondents were asked how likely they were to use different modes on rural roads if different speed limits were in place.

Car users were most likely to drive on rural roads if the speed limits were 40mph. Car drivers were likely and very likely to drive at all speed limits, however at 70mph the proportion of those not at all likely increased to 28%. At 40mph, respondents were most likely or very likely to travel by car than at any other given speed on rural roads, at 87%.

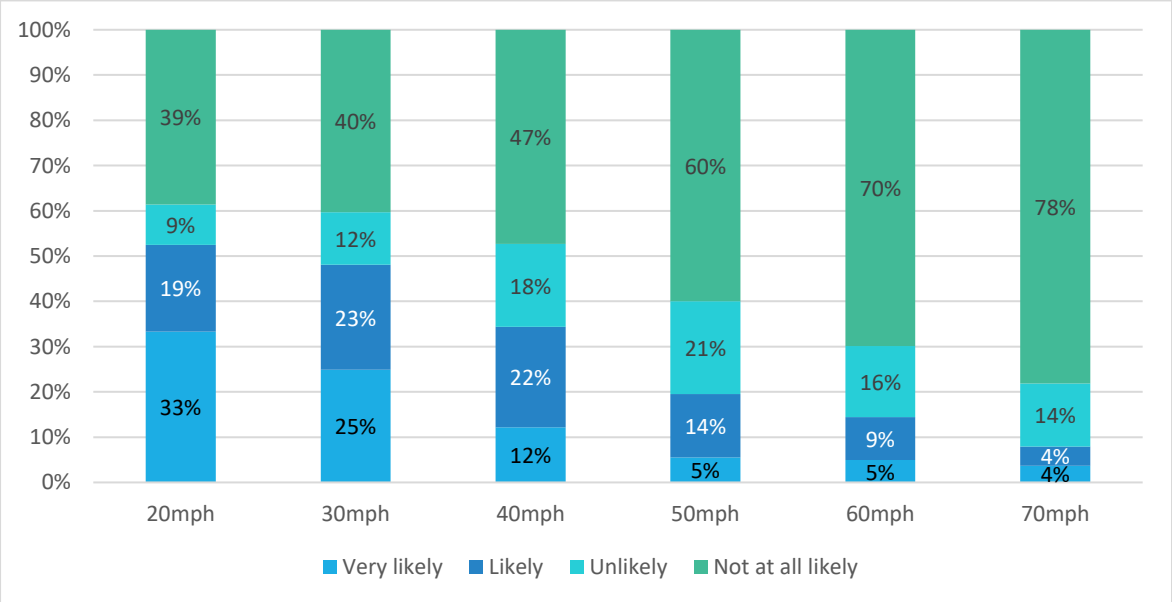
Figure 26: Likelihood to walk on main rural roads given various speed limits



Respondents' likelihood to walk was highest at 20mph speed limit on rural roads, with 49% very likely and 26% likely to walk on rural roads at this lower limit. At 50mph, 42% of respondents were not at all likely to walk on rural roads, which increased to 55% for 60mph and 68% for 70mph.

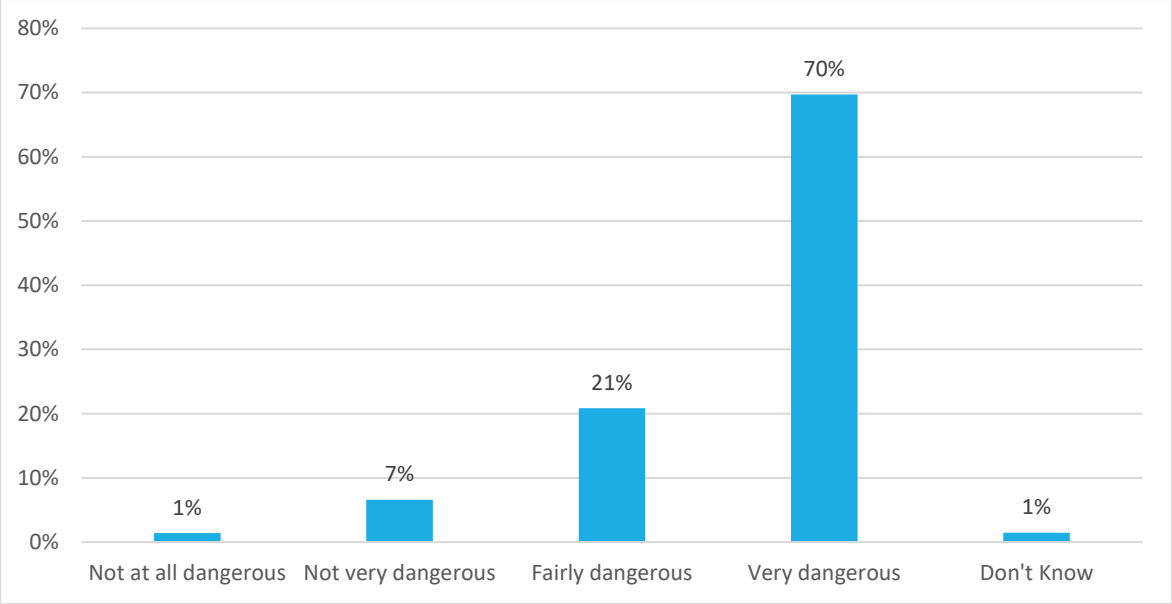
Pedestrians' perception of personal safety and likelihood to walk has an inverse relationship with the speed limit. The higher the speed limit, the less likelihood to walk on rural roads, and vice versa.

Figure 27: Likelihood to cycle on main rural roads given various speed limits



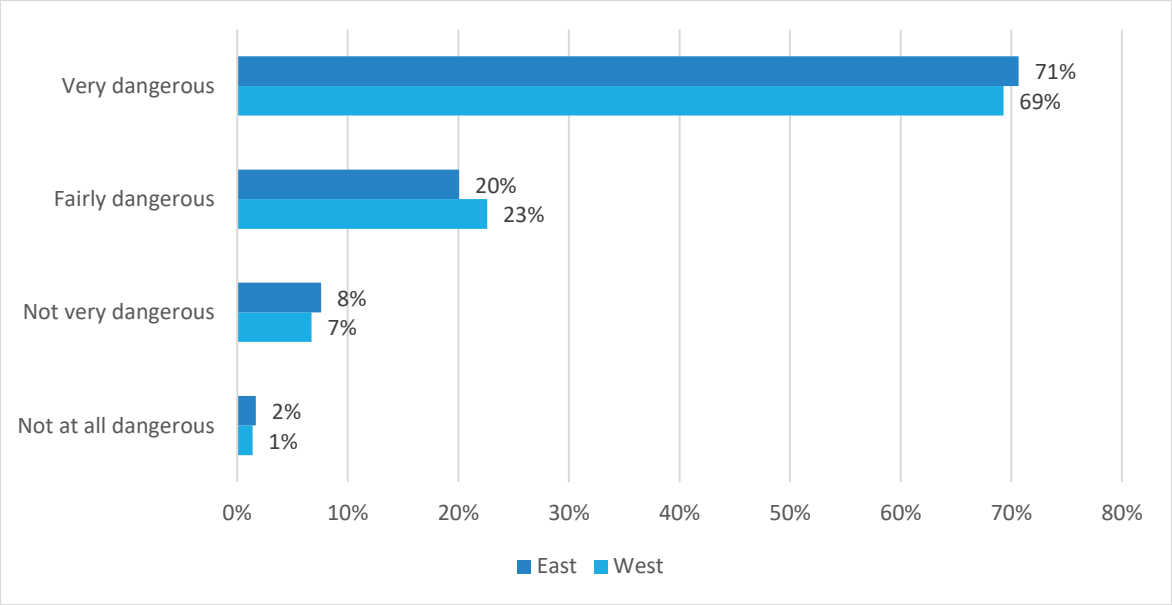
Likelihood to cycle is also inversely related to speed limit on main rural roads, with 33% of respondents very likely to cycle and 19% likely to cycle at 20mph and 78% not at all likely to cycle on a 70mph road. Over a third of respondents (39%) are not all likely to cycle at a 20mph speed limit on rural roads, with higher speed limits acting as a further deterrent to cycling.

Figure 28: Perceptions of dangerous it is to exceed the national speed limits (60mph) on rural roads



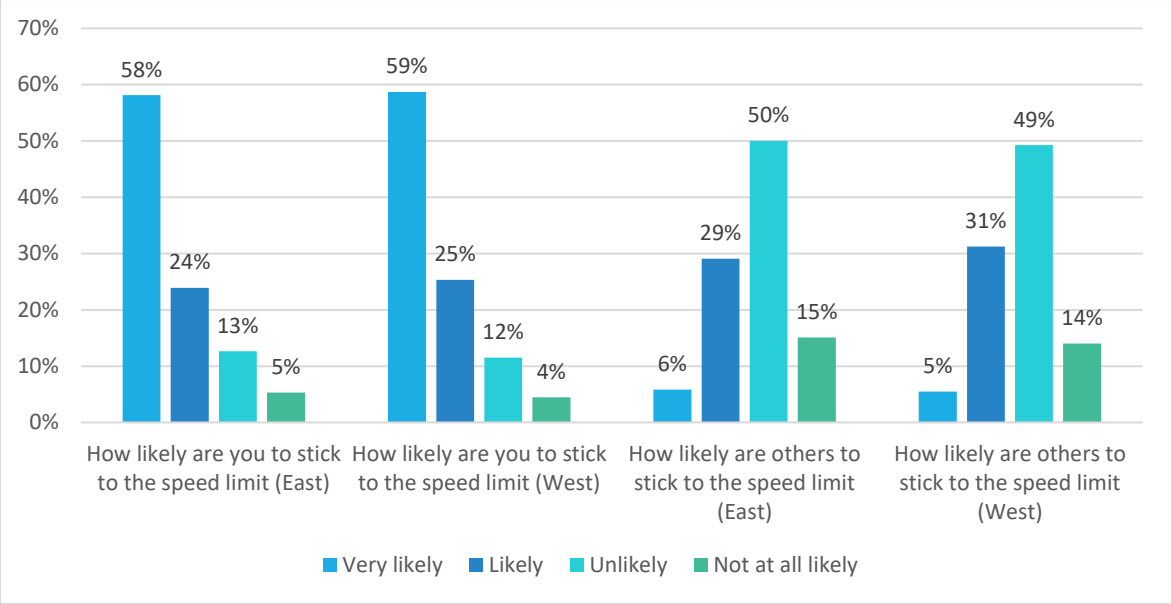
The majority (70%) of respondents perceive exceeding national speed limits on rural roads as 'very dangerous' and 21% agree with fairly dangerous.

Figure 29:Perception of exceeding national speed limit on rural roads by area of Surrey



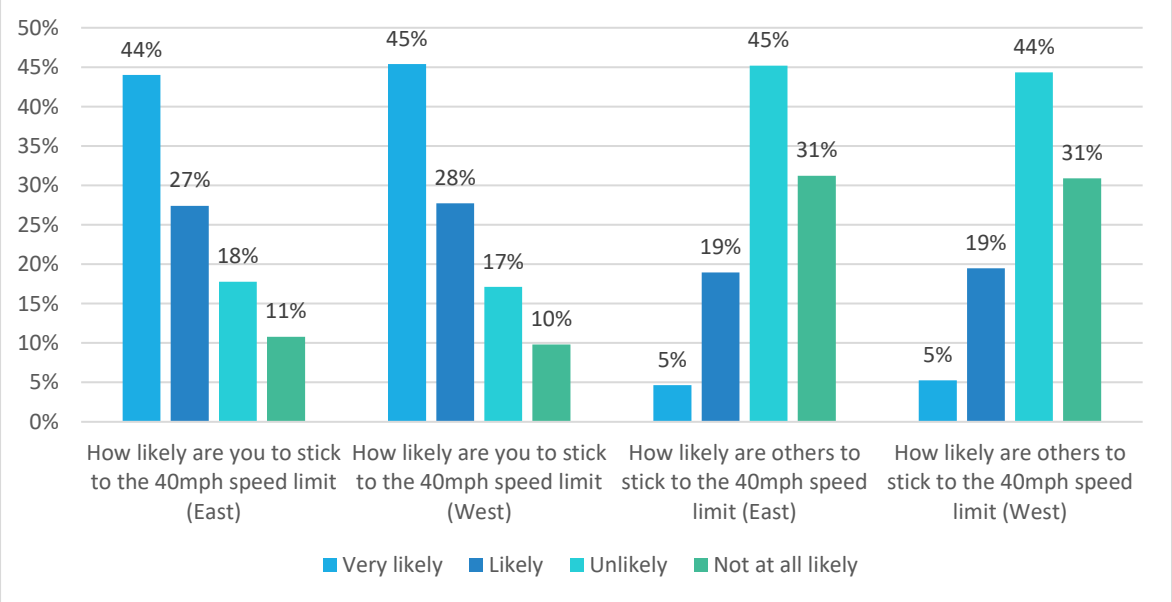
Most respondents agree that exceeding national speed limits on rural roads is 'very dangerous' with 71% in the east and 69% in the west of Surrey. Attitudes to speeding do not vary largely by home location between the east and west of Surrey

Figure 30:Likelihood to follow speed limit of 50mph on main single carriageways on rural roads by locality



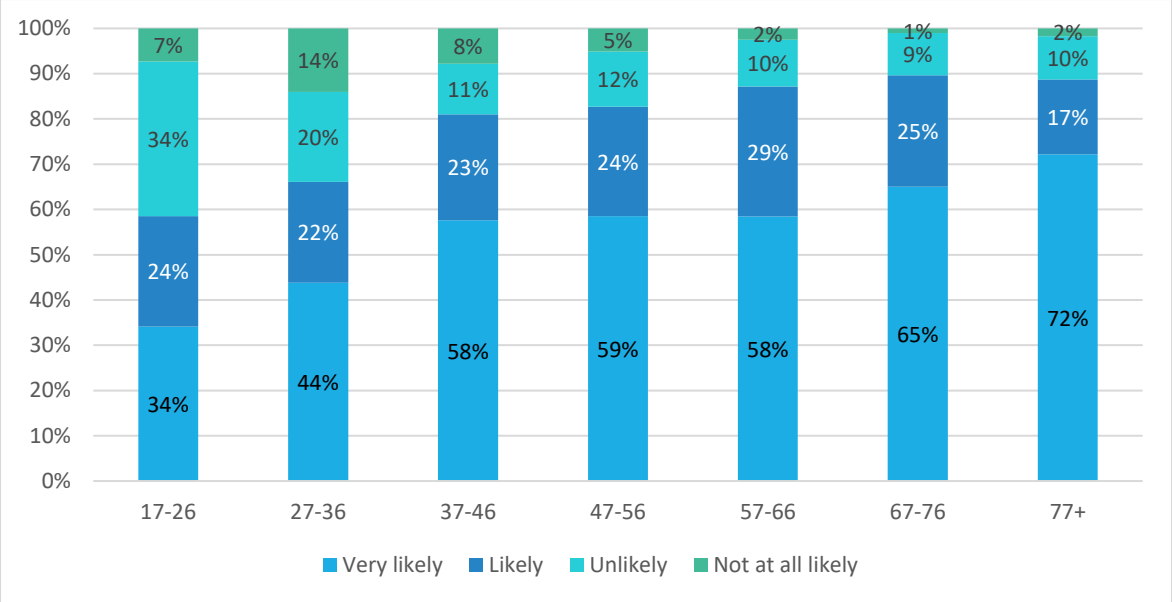
Respondents report that they are very likely to comply with a reduction in speed limit, but they also think that others are unlikely to comply. Overall, there was little difference between residents of the east and west of Surrey in the likelihood to follow a speed limit reduction of 50mph on main single carriageways on rural roads.

Figure 31: Likelihood to follow speed limit of 40mph on minor single carriageways on rural roads by locality



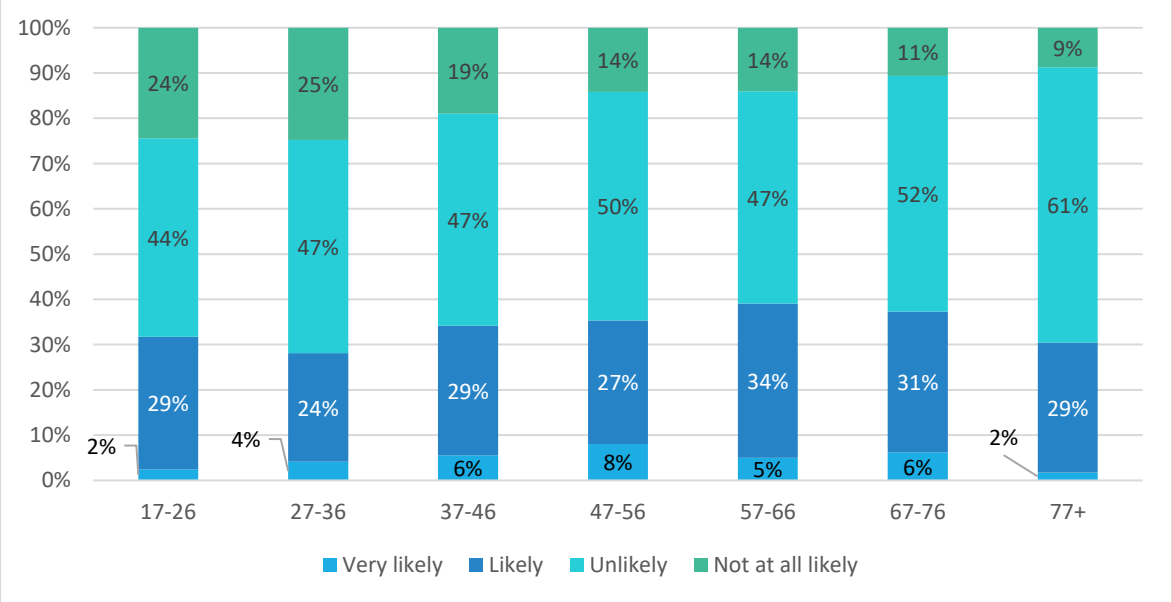
Attitudes and likelihood of a speed limit of 40mph on minor single carriageways on rural roads followed similar trends between residents of the east and west of Surrey. Respondents from the west were more 'likely' and 'very likely' to stick to the speed limit (73%), compared to respondents from the east (71%).

Figure 32: Likelihood to personally follow speed limit of 50mph on main single carriageways on rural roads by age



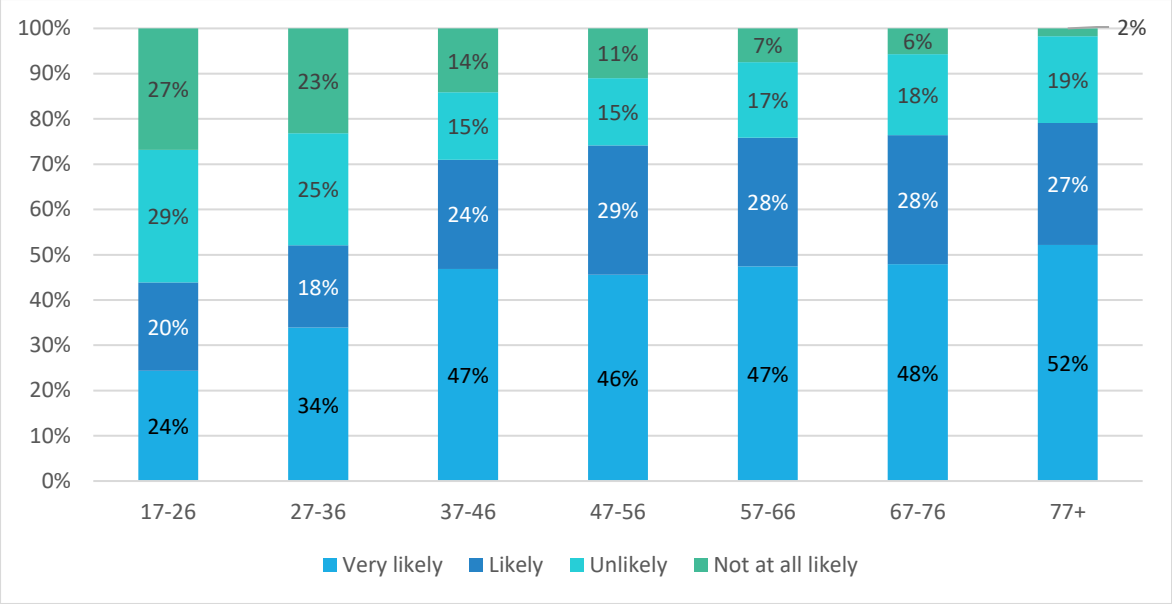
Likelihood to personally obey speed limits of 50mph on main single carriageways on rural roads vary considerably by age group. For those aged 17–26-year-old, 34% are 'unlikely' to obey – the largest percentage from all age groups. The oldest age group of 77+ years is 'very likely' to stick to the speed limit at 72%, with 37–66-year-olds averaging at 58% 'very likely' to adhere to the speed limit.

Figure 33: Likelihood of others to follow speed limit of 50mph on main single carriageways on rural roads by age



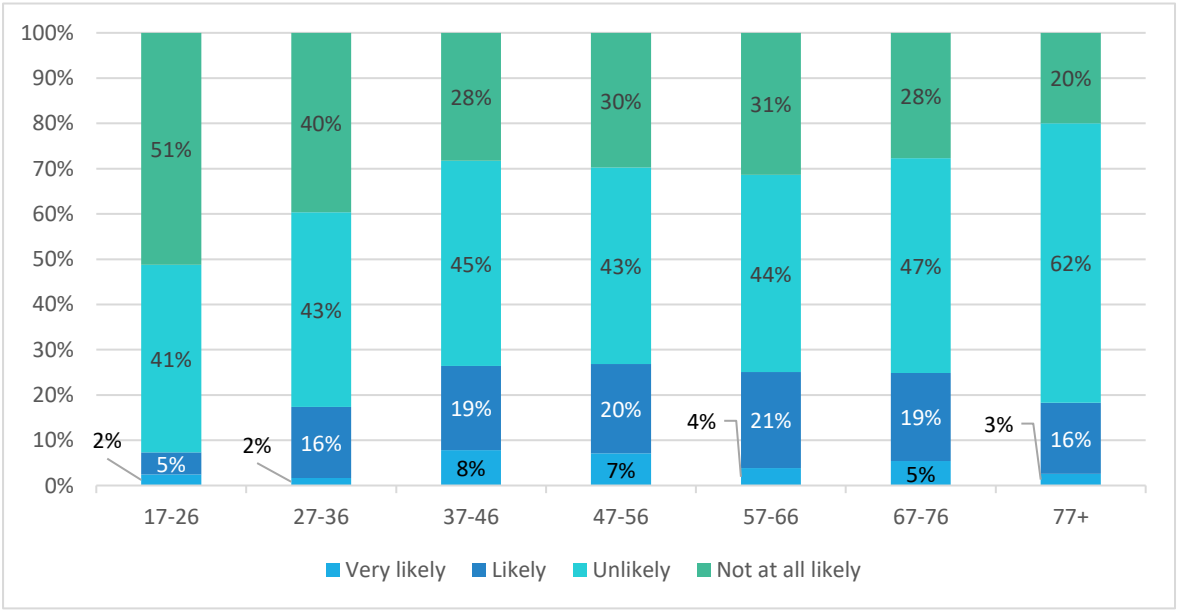
Respondents, however, perceive others as more 'unlikely' or 'not at all likely' to stick to following 40mph (79%) than 50mph (66%) on rural roads.

Figure 34: Likelihood to personally follow speed limit of 40mph on minor single carriageways on rural roads by age



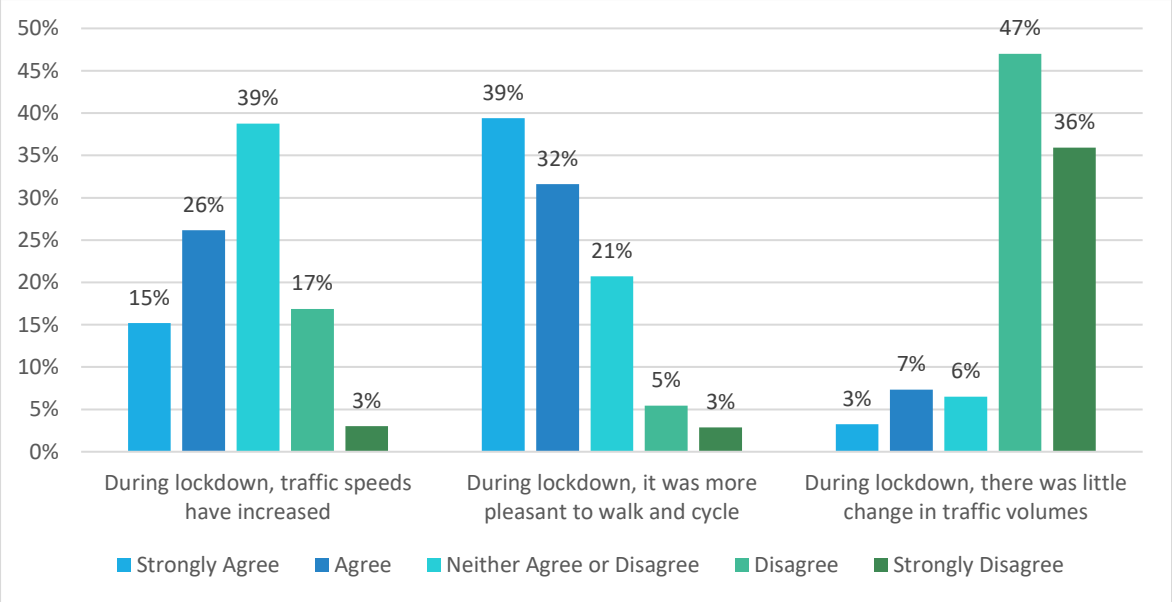
Respondents are generally less likely to personally follow a speed limit of 40mph on minor single carriageways on rural roads, compared to 50mph on major single carriageways. Respondents aged between 17 and 26 years of age are 56% 'unlikely' or 'not at all likely' to follow with, even the oldest age groups of 67-76 years and 77+ years responding at 24% and 21% 'unlikely' or 'not at all likely' respectively.

Figure 35: Likelihood of others to follow speed limit of 40mph on minor single carriageways on rural roads by age



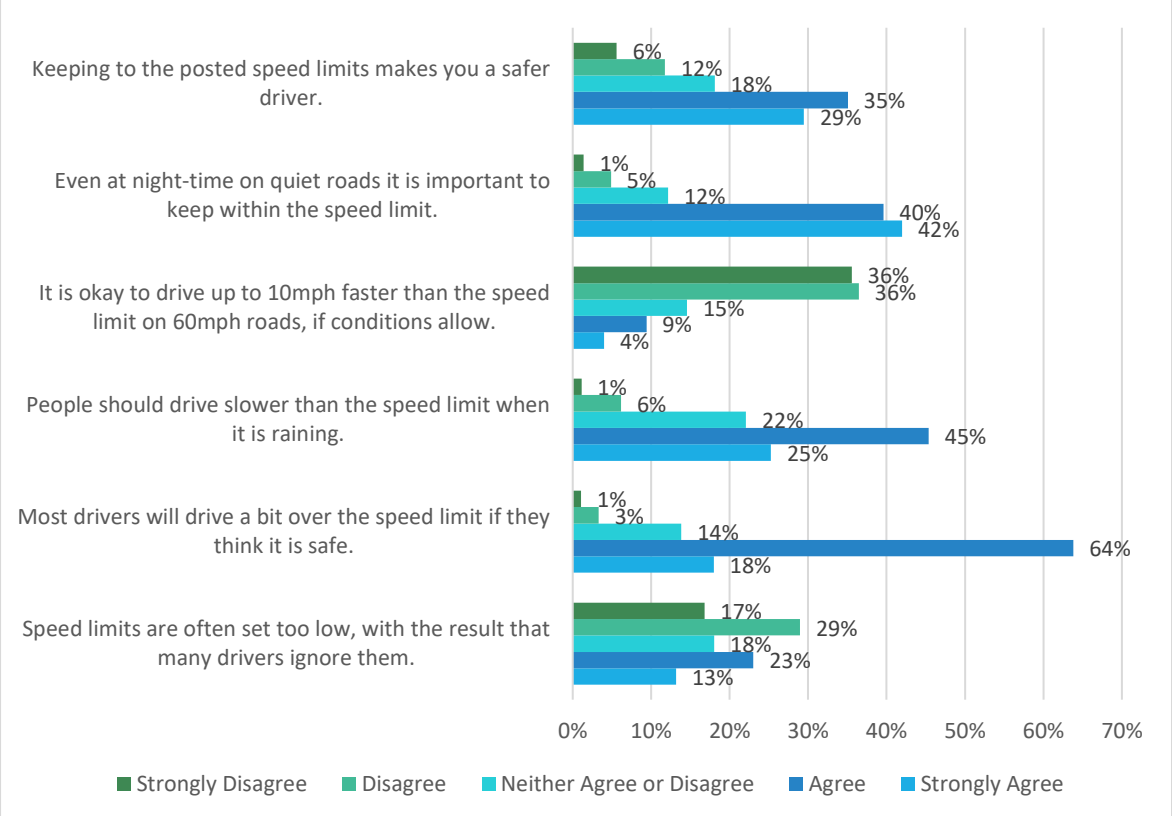
Respondents aged between the ages of 37 and 66 have similar responses over the likelihood of others to follow 40mph speed limits on minor single carriageways on rural roads at an average of 44% 'unlikely'. The youngest age group between 17 and 26, however, answered that 51% of others were 'not at all likely' and 41% 'unlikely' to obey this speed limit.

Figure 36: Lockdown changes



Of the total respondents, 71% 'strongly agree' or 'agree' that during lockdown it was more pleasant to walk and cycle. Given that a total of 83% 'disagree' and 'strongly disagree' that there was little change in traffic volumes during lockdowns, it suggests that low traffic volumes encourage pedestrians and cyclists on roads as modes of active travel and exercise. Thinking about traffic speeds and whether they increased during lockdown, 41% 'agree' or 'strongly agree' that they increased and 39% of respondents 'neither agree nor disagree' with the statement. This is important as respondents' perception of traffic speeds on roads informs personal safety decisions.

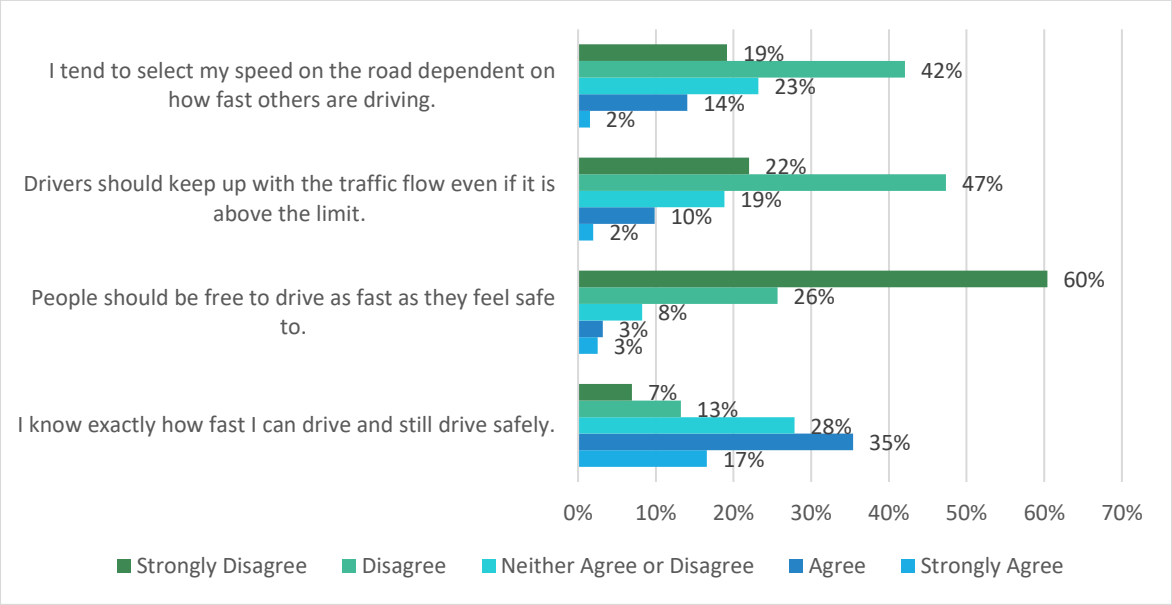
Figure 37:Agreement with attitudes about speed limit compliance



Attitudes to speed compliance were generally positive. A majority (82%) of respondents 'strongly agree' or 'agree' that even at night-time on quiet roads, it is important to keep within the speed limit. Similarly, 70% 'agree' or 'strongly agree' that people should drive slower than the speed limit when it is raining. There were also high levels of agreement with the statement 'keeping to the posted speed limits makes you a safer driver' and high levels of disagreement with 'it is okay to drive up to 10mph faster than the speed limit on 60mph roads, if conditions allow'. This implies a positive relationship with speed limit compliance and an awareness of road and driving conditions influencing driving speed.

However, when asked if most drivers will drive a bit over the speed limit if they think it is safe – 64% 'agree' and 18% 'strongly agree' with the statement. When asked if speed limits are set too low leading to drivers ignoring them, there was a split in responses with 46% responding to 'strongly disagree' and 'disagree' and 36% 'strongly agree' and 'agree'.

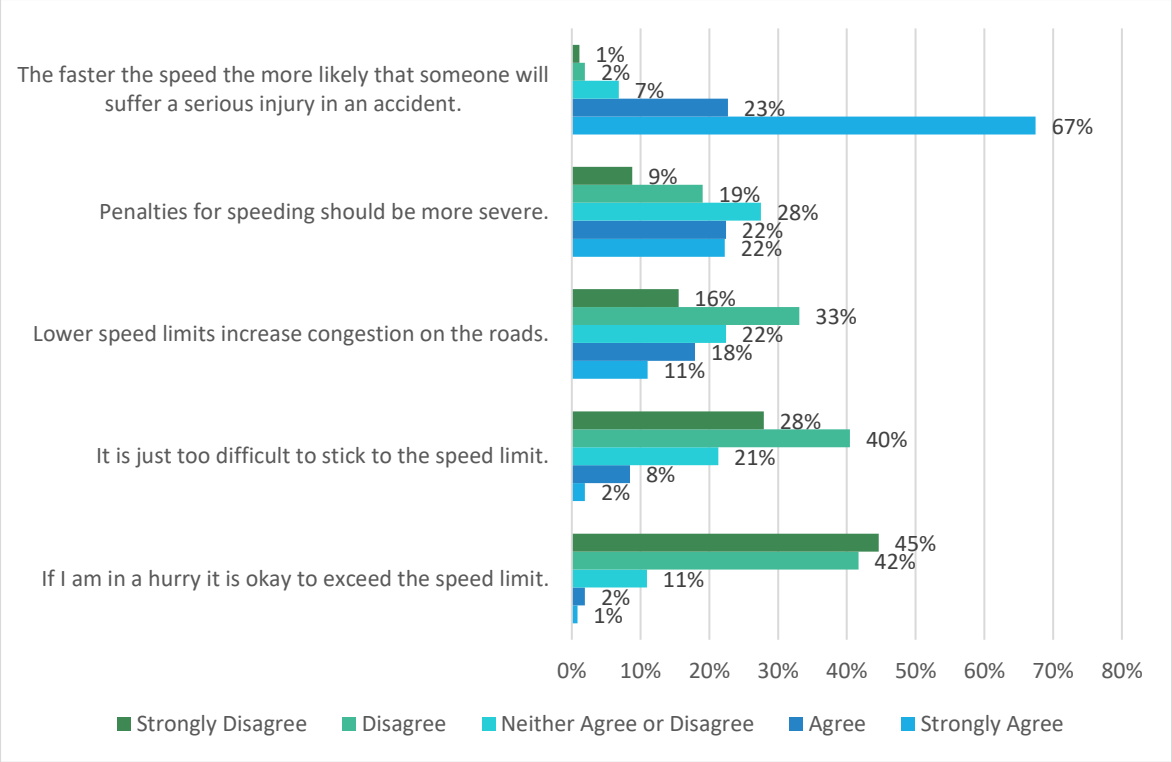
Figure 38: Agreement with statements about speeding



In this section, respondents were asked their agreement levels with statements related to personal safety and the driving attitudes of other drivers on the road. The majority (86%) of respondents 'strongly disagree' or 'disagree' with the statement that people should be free to drive as fast as they feel safe to, whilst 52% of respondents 'agree' or 'strongly agree' with the statement that they know exactly how fast they can drive and still drive safely. This indicates an increasing confidence in respondents' own driving ability and how they judge personal safety, compared to their perception of the abilities of other drivers.

Most respondents (69%) 'disagree' or 'strongly disagree' with the statement that drivers should keep up with the traffic flow even if it is above the speed limit which coincides with the 61% of respondents who 'disagree' or 'strongly disagree' when asked if they select their driving speed on how fast others are driving.

Figure 39: Agreement to the following statements



Almost all respondents (90%) 'strongly agree' or 'agree' that the faster the speed, the more likely it is that someone will suffer a serious injury in a collision. This indicates that respondents are aware of the risks associated with speeding and the implications of harm. Similarly, 87% of respondents 'strongly disagree' or 'disagree' with the statement that, if in a hurry, it is okay to exceed the speed limit.

It is of note here to mention that when asked if lower speed limits increase congestion on the roads almost half of the respondents (49%) 'strongly disagree' or 'disagree' with the statement, compared to 29% who 'strongly agree' or 'agree'. This can imply that respondents don't associate congestion on roads with lower speed limits and will support potential reductions of speed limits.

Respondents seem to be split on the statement that penalties for speeding should be more severe, with 28% answering 'neither agree nor disagree', 44% 'agree' or 'strongly agree' and 28% 'disagree' or 'strongly disagree'.

STAKEHOLDER INTERVIEWS

Introduction

Interviews were conducted using Zoom and Microsoft Teams online in April 2021. Surrey County Council provided the contact details of representatives of interest groups, who are regularly contacted for consultation and research purposes. The interview questions were kept quite open as the range of people represented a variety of road user groups – motorcyclists, equestrians and cyclists were interviewed. The purpose of these interviews was to understand how local road users and residents feel about rural road safety and speed limits.

There were only two motorcyclists and two horse riders interviewed for this research and therefore it is not possible to determine if the views expressed are representative of other road users from this group. No conclusions can be drawn from their contributions and should be treated as individual opinion.

Motorcyclists

Two motorcyclists were interviewed; they were not residents of Surrey but had driven on Surrey roads and were enthusiastic riders. Differences between 'enthusiast' riders and 'utility' riders were identified, with the latter being more interested in getting from A to B safely and efficiently, compared to enthusiasts for whom safety was not necessarily a priority.

When discussing safety on rural roads, potholes, road surfaces and inappropriate speed were seen as the biggest challenges. The two motorcycle interviewees also identified that there is an emerging problem in villages with large motor vehicles like SUVs speeding at rush hour or creating 'rat runs'. The two motorcyclists expressed concerns around the placement of crash barriers and road furniture and the outcomes for motorcyclists in the event of a crash. However, personal levels of risk vary, with road safety awareness important for motorcyclists generally as they are perhaps more exposed to risk. However, it was argued that a majority of motorcyclists do not like to be refer to themselves as 'vulnerable road users' as it is perceived as a sign of weakness. The interviewees acknowledged that roads are not designed to be 100% safe and that this adds to their personal thrill of riding and the challenge of overcoming risks, rather than riding where no risks exist. Motorcyclists, given the choice, choose to ride on rural lanes which are more challenging than motorways. Educating motorcyclists about the risks involved is important so they can be as safe as possible and not ignore the environment around them.

There was general opposition amongst the motorcyclists to the concept of reducing speed limits from 60mph to 50 or 40mph. A difference between behaviour and competency was identified, with the opinion that it was 'perfectly safe' to ride at 60mph on the majority of rural roads most of the time, whilst accounting for the weather conditions and vulnerable road users. Knowing when to adjust and reduce speeds is more important to them than placing 'blanket' speed limits. The two motorcyclists expressed that lower rural speed limits won't necessarily make people safer as most people will simply ignore the changes. It was argued that there is not enough enforcement and people are aware that not all speed cameras work so there will be no consequences to speeding.

When choosing between a road that is national speed limit (NSL) or a road with a 50mph limit, the motorcyclists responded that they would choose a road that is NSL when planning a route. This would displace the motorcyclists who are part of the problem; improving safety involves improving attitudes and changing the behaviour of those who don't comply with speed limits.

Tolerance, common sense and more education should be promoted with education and engineering working together to improve behaviour. There is a risk of alienating motorcyclists by highlighting their

choice of transport and using messaging which categorises road safety by user group type. Behaviours like speeding are exhibited by all road users and all should be targeted rather than concentrating on specific user groups.

It should be remembered that the views of these two 'enthusiast' motorcyclists are not necessarily representative of a wider sample of motorcyclists.

Equestrians

Two equestrian representatives were interviewed; neither are Surrey residents but have worked locally in the area extensively.

Regarding safety on rural roads, they mentioned that residents in Surrey have reported that they don't feel supported by Surrey County Council. Drivers need to be educated and made aware of how to pass horses – they are either too close and/or too fast, which is intimidating and puts all at risk. Signage which indicates horse activities on the road need to be expanded to include horse crossing areas and increasing enforcement of these measures would create effective change.

The two interviewees would support the reduction of speed limits on rural roads, however, they mentioned that reducing speed limits is not enough on its own; educating drivers on passing horse riders is vital. Messaging used for raising awareness of non-motorised road users like "think bike" for cyclists could be put in place for "think horse-rider" campaigns. Speed limits should reflect the type of road users to make roads safe for all, with a maximum 15mph for passing horses like 20mph limits are applied outside schools to account for children. Localised campaigns, community involvement and national TV advertisements were recommended as methods to reach more people.

It was felt that the campaigns promoting active travel emphasise pedestrians and cyclists but are not considering equestrians. They felt that the Council ought to consider who they want rural roads to be used by; if they are promoting active travel then roads need to be safe and designed for those making journeys by walking, cycling and riding a horse. It was felt that equestrians are easily forgotten, especially if decision makers don't ride themselves or have experience with horses. Working with the British Horse Society (BHS) can lead to collaborative campaigns, safety and awareness.

It should be remembered that the views of these two horse riders are not necessarily representative of a wider sample of horse riders.

Cyclists

Ten cyclists were spoken to with some of the interviewees cycling on rural roads and most stating they avoid town centres and urban environments. Generally, cyclists expressed that they do not feel safe on rural roads when cars are around and avoid them, especially when cycling with families. Attitudes towards rural roads also depended on experience, with the more experienced feeling safer compared to inexperienced cyclists. The cyclists expressed that there is a lack of attention paid by the vehicle driver, with cars being too fast or too close. With roads being narrower, this is even more of an issue, given poor side lines and high hedges on the side.

The biggest challenges identified on rural roads are speed, road surfaces and close passing areas. A dislike of cyclists by motorised vehicle users was identified by cyclists with verbal abuse, general frustrations and conflict resulting from these exchanges. They felt that the worst are "white van" delivery drivers who are under pressure with tight schedules.

For better road safety, segregated paths and 'green lanes' would benefit all. Green lanes are rural roads which are signed as designated for use by pedestrians, cyclists and horse riders, with Suffolk County Council introducing more routes and the scheme could be expanded to Surrey. Motorised vehicle

drivers use rural roads as a short cut if there are roadworks on other routes, which leads to congestion and traffic. Expansion of pavements for dual use (cycling and pedestrians) could create more space for those less competent and confident cyclists. The cyclists expressed concern that as cars are getting bigger and drivers and passengers inside feel too “cocooned” and protected they are no longer paying as much attention to vulnerable road users, who have to be more alert and aware.

Regarding reducing speed limits, cyclists expressed that while lots of roads are being reduced to 40mph, there isn’t much monitoring and enforcement and perhaps there need to be heavier penalties imposed. Reducing speed limits could potentially make it safer, but it depends on the type and condition of roads; if they are straight and with good visibility, it is not necessary and drivers will mostly treat them as minimum speeds or simply not follow them. If there is no risk, it is not fair to reduce the speed limit as most drivers will go over it when driving and if they don’t, they will get tailgated.

Segregated paths were more important to cyclists than reducing speed limits, as without enforcement, reduced limits would have little effect. Interviewed cyclists mentioned that reducing the speed limit reduces the overall average speed as the majority of motorists are averse to breaking the law. As a result, more people will feel safe on speed limited rural roads. However, 40mph is still dangerous if a cyclist is involved in a collision with a car. One interviewee mentioned that if a straight road with wide lanes looks like it is 60mph, the driver will drive at 60mph regardless of what the sign says, which puts cyclists at risk (especially inexperienced cyclists). Some of the cyclists have cycled on rural roads with reduced speed limits of 40mph and have not noticed a dramatic difference. Lowering speed limits could lead to traffic displacement and not discourage drivers, as people will use satellite navigation to calculate the quickest route and this would not solve the problem.

Educating road users on sharing roads and being responsible for personal safety (including cyclists) would help in improving safety. The cyclists suggested a number of solutions, including redesigning roads and engineering them so they naturally make drivers go slower. They also suggested speed bumps with gaps for cyclists, narrower lanes and junctions to discourage speeding and the introduction of green lanes and cycle lanes. Increasing cycle signage and cycle zones so drivers of motor vehicles are aware going into the area could potentially lead to less irritation and more preparedness.

Cycling clubs and forums could promote engagement and embed awareness of issues into the cycling culture and membership, increasing personal responsibility. This could include road positioning for safety, how to increase visibility, the use of lights and situational awareness. On the other hand, increasing the liability on drivers could lead to each group being more aware and responsible for themselves and those around them.

It was felt there is currently inconsistency in messaging, with councils promoting walking and cycling but then providing more carpark spaces, which is counterproductive. A road by road, network approach was also suggested by interviewees to create usable and safe cycling routes.

Conclusions and Discussion

The implementation of new speed limits on rural roads in Surrey has taken place gradually over many years with limits lower than the national speed limit regularly put in place. This has most commonly been the case in the Tandridge, Reigate and Banstead, and Mole Valley Districts on roads south of the M25. The rural roads broadly south of Dorking, Redhill and Oxted are largely 40mph limits, with larger 'A' roads sometimes set to 50mph. Other roads in west Surrey, including the Surrey Hills Area of Outstanding Natural Beauty have remained at 60mph, although these roads are often different in nature with lower traffic levels on more winding, narrow roads. To the north of Surrey, increased urbanisation means the roads are infrequently 'rural' in nature with only short sections of country roads connecting the urban areas north of Guildford.

Figure 40: A22 South Godstone StreetView Image ©Google

Figure 41: Croydonbarn Lane StreetView Image ©Google

Figure 42: Leith Hill Road StreetView Image ©Google

This first phase of the project separates out these rural roads using a standard methodology and then compares the available data to see if the difference in speed limit has resulted in changes in speed and risk. It has also considered the attitudes and experiences of residents towards speeds and risk on rural roads.

REVIEW OF EVIDENCE

The literature review discovered that the nature of the road and the environment through which it runs gives road users clues about how they can use it (The Royal Society for the Prevention of Accidents, 2010). The road environment should provide appropriate visual information for the people using it; this includes different types of road user groups like cyclists, pedestrians and horse riders. The importance of augmenting road engineering with education and information campaigns as complementary strategies (including public consultation before any scheme or project is undertaken) is vital to the success of achieving the aims of road safety (The Royal Society for the Prevention of Accidents, 2010).

Speed management, alongside the implementation of a 'Safe System' framework could increase safety on rural roads with the concept of 'forgiving roadsides' implemented together (Hamilton & Kennedy, 2005). Mitigating injuries for those involved in collisions under a safe road system can be achieved by balancing vehicle speed, potential impact severity and vehicle and road infrastructure design (Lynam, 2007).

Public awareness and understanding behind the speed limit should be emphasized and drivers' understanding of risk regarding road types must be improved. Drivers should understand and recognise that the appropriate speed limit on rural roads "should be 50mph, with 60mph only appropriate on those roads which have been engineered to allow safe driving at this speed" (Lynam, 2007). Changing the perception of speed limits and speed management measures as "implemented to help drivers choose appropriate speeds for the road, not as an artificial restriction" can be beneficial in improving road safety for all using rural roads.

Systematic analysis identified a "combination of interventions" such as improved road markings and signage supported by enhanced police and camera enforcement seemed to have had an effect on speeds, gap separation and collisions in Devon as part of the Rural Road Safety Demonstration Project (King & Chapman, 2010).

DATA ANALYSIS

As speed limits have been changed across Surrey's rural roads over time, there are naturally some inconsistencies in speed limit allocation for roads that have the same nature. By this we mean roads that would be identified by road users as being very similar in terms of traffic patterns, road widths, sinuosity and gradient. It could therefore be the case that driver behaviour on some 60mph roads is indistinguishable from many of those subject to 40mph limits.

Collision densities were highest on 50mph road sections, and lowest on 60mph sections. If vehicles' speeds matched the posted speed limit, then this result would be unexpected, but the evidence shows that speeds on the 60mph roads were frequently much lower than the limit. Collision density also doesn't take into account the traffic using those roads. More traffic would normally be expected to result in more collisions on roads that are similar in nature. Collision rates were higher on the 40 and 50 mph roads than the 60 mph roads. The regression models did show that the difference on 50 mph roads was statistically significant.

One problem with this analysis is that the relationship between collisions and traffic may not be a simple linear function. This report did not examine the precise relationship between vehicle traffic and risk rate as that was out of scope, although it was noted by the analysts that the methodology did lead to very large collision rates on roads with low traffic flows. The presence of a single collision on a very low-flow road would create a very high rate, but similarly there were many road sections with no collisions at all.

Comparing the nature of the roads in different speed limits we did not find significant differences overall in average road width or sinuosity, but it did show that larger proportions of 50mph roads were dual carriageways. There were also some 60mph dual carriageways within the sample where speed limits will have been set by a traffic regulation order, rather than being at the national speed limit for that road classification.

Although the results suggested that roads with 60mph speed limits have lower collision densities and risk rates than those with 50mph speed limits, this did not imply that higher speeds could be safer for road users. Further analysis of our sample showed that, in fact, roads with 60mph speed limits tend to have lower average and 85th percentile speeds than those parts of the network that have 50mph speed limits.

When the posted speed limit is removed from the analysis and differences in road carriageway type are accounted for, it has been possible to examine the effect of differences in speed driven (in 1mph bands) on casualty densities on our sample of roads using a number of metrics. As previously shown in the literature, this analysis demonstrated clear increases in collision densities when speeds were higher. This was even more prominent when 85th percentile speeds increased by one mile per hour. Higher speeds on roads that are similar in nature result in more collisions per mile. The most serious collisions involving a KSI casualty were even more greatly influenced by changes in speeds.

The results for collision rate were not as consistent. Changes of one mile per hour in 85th percentile speeds resulted in significant increases in collision rates and increases in average speeds resulted in significant increases in fatal and serious collisions. Increases in average speeds were associated with a reduction in collisions of all severity. There are a number of possible explanations for this result. It could be that some of the roads with lower speeds are associated with junctions and complex road sections where risk could be higher. It is likely to be that the roads that can sustain the highest speeds and flows have received greater investment in road safety engineering measures and may also receive more frequent maintenance..

Overall, the analysis of the evidence relating to the selected rural roads demonstrated a clear relationship between travelled speed and the frequency of collisions, especially for the most serious collisions. The complex nature of the road environment makes comparisons between roads more difficult, especially where blanket changes across an area have not been implemented. Reviewing data for similar roads in other counties would perhaps deepen our understanding of the relationships.

PUBLIC UNDERSTANDING AND ATTITUDES

It is disappointing to see that one in four residents could not correctly identify the national speed limit for cars. This is more common with older residents as well as young drivers. When explained however, the vast majority said that exceeding the limit would be dangerous. When asked if they would comply with lower rural speed limits results were again very positive, although young drivers reported a lower intention of sticking to a reduced limit. Perceptions of other drivers are poor, however, with the majority thinking that other drivers would not obey lower limits.

There is little difference between the residents of East and West of Surrey and their speed limit perceptions and attitudes. This could be a result of changes in the west of Surrey being implemented incrementally over a series of years and perhaps drivers and road users travel regularly between regions and have become accustomed to the changes.

Lower speed limits are generally well supported, and the public understand the risks of breaking the speed limit or travelling to fast for conditions, but the results indicate that residents believe a speed limit reduction on its own will not automatically lead to compliance with the new limit.

USER GROUP CONSULTATIONS

It should be remembered that only two motorcyclists and two horse riders were spoken to as part of this research and therefore it is not possible to draw conclusions on how representative their views are.

Taken as a whole, however, most interviewees (regardless of user group) agree that speed-limit reductions are not enough on their own and need to be accompanied by additional enforcement, education and awareness of road safety and responsibility when driving on rural roads. Engineering roads so they serve as effective and safe modes of transport for all types of road users is a priority expressed by interviewees, helping to make these roads more inclusive. From the occasional horse-rider to the enthusiast motorcyclist, understanding collective and personal safety and respecting different types of road users is seen as more important than blanket speed-limit reductions. Interviewees believe that perception, behaviour and attitudes won't change without fully understanding the problem. Each road user group felt isolated by other groups, and perhaps a more inclusive and collaborative campaign aimed at improving road safety could be beneficial and support speed limit reductions. Perceptions of personal safety do vary with experience, with the more experienced more comfortable with faster speed limits on rural roads.

STUDY OBJECTIVES

This study set out to meet a number of objectives, which have been explored through the various methodologies. In some cases, the results are unexpected but provide useful insights into the implications of reducing speed limits on rural roads.

- To determine if the collision rate on rural roads with lower speed limits is lower than on rural roads with higher speed limits

  Collision rates on rural roads with lower average and 85th percentile speeds are lower than roads with higher average and 85th percentile speeds. However, our sample of rural roads with lower

speed limits did not necessarily have lower collision rates than roads with higher speed limits. Driver speed choice is influenced by road environment (sinuosity and road width, for example) and the incremental speed limit reductions in Surrey have resulted in an inconsistency in the characteristics of rural roads with lower limits.

- To determine if the mean speed of vehicles on rural roads with lower speed limits is lower than on rural roads with higher speed limits

  Likewise, the mean speed on our sample of rural roads with lower speed limits is not lower than on that on our rural roads with higher speed limits. As with the first objective, the relationship between posted speed and travelled speed is complex and is related to a range of factors, including road type and the presence of junctions.

- To determine if perceptions of safety are higher amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits

  There did not seem to be a difference in perceptions of safety between those living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits. However, there were differences in perceptions of safety by age (from the survey) and user group (from the interviews).

- To determine if attitudes towards compliance with speed limits are more positive amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits

  There also did not seem to be more positive attitudes towards speed limit compliance amongst communities living close to rural roads with lower speed limits than communities living close to rural roads with higher speed limits. Encouragingly, most respondents exhibited positive attitudes towards speed compliance, regardless of which side of the county they live in.

This report has identified and confirmed that higher speeds result in increases in collisions and that the public are generally supportive of lower speeds. It also notes that changing limits on their own may not necessarily achieve compliance. However, driven speeds on many rural roads are already much lower than the posted speed limit. The findings are in line with previous studies which show that average speed and speed variance are more important than the posted speed limit in determining safety.

The analysis does not indicate that further reductions in speed limits will increase harm if the new limits are selected in response to actual average and 85th percentile speeds. There will, therefore, be some roads where greater reductions in speed limit can be implemented compared to other roads.

Phase 2 of the study will explore how roads are selected for speed limit reductions and will review the effects of reductions to different limits. It will examine the effect on speeds and public perception of widespread speed limit reductions, and the role of publicity and enforcement on compliance with lower limits.

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