national highways

Smart motorways stocktake

Fourth year progress report: December 2024

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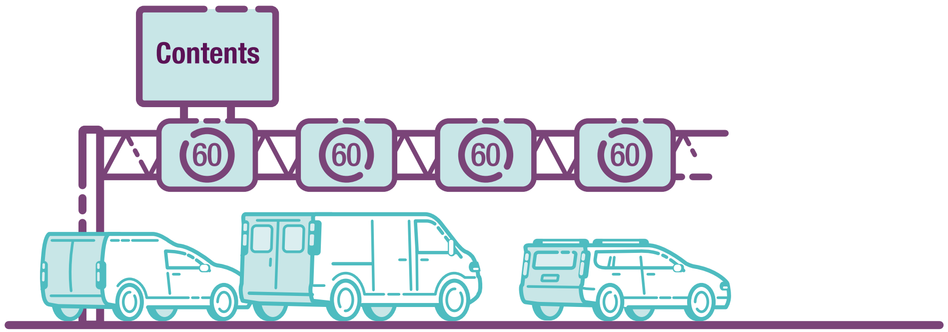


Foreword

Our ambition is that no-one should be harmed while travelling or working on our roads, which means that safety continues to be our number one priority.

Nick Harris
National Highways Chief Executive

This is a considerable ambition, and we are working with our stakeholders more closely and collaboratively than ever before to make this happen. This means leading the way on road safety, facilitating the work of government, our partners, including public bodies, emergency services, local authorities, road safety organisations and the roadside recovery industry, while also better understanding the needs of everyone using our roads.

The analysis of our smart motorway network over the past four years has helped us develop a detailed understanding of road safety, not just on smart motorways but across the whole strategic road network. This knowledge is helping us to improve safety for drivers up and down the country, supporting our ambition that no one should be harmed while travelling on the strategic road network.

I am pleased to say that our work delivering the actions set out by the previous government in 2020 to further improve safety on smart motorways is now complete. This includes installing more than 700 additional signs informing drivers of the distance to the next place to stop in an emergency, and upgrading enforcement cameras on smart motorways to enable them to be used to detect vehicles passing under a Red X or entering a lane beyond a Red X. We have also put radar stopped vehicle detection (SVD) in place on every all lane running (ALR) motorway.

This report closes our action to issue an annual safety performance report specifically monitoring smart motorways. Going forward we will include smart motorway safety performance analysis in our annual ***Road safety performance overview report*** which will consider the performance of all our roads.

We are now beginning to see the results of the actions we have completed. These include faster traffic officer attendance times and SVD technology being in place on all ALR motorways so that our control centres can set warning signs and Red X lane closures within minutes. We have started the process to assess and understand the impact of the actions on safety outcomes and are

Our latest analysis continues to show that overall, in terms of deaths or serious injuries, smart motorways remain our safest roads

undertaking further analysis now that the first full year of data (2023) is available.

This is because most of our actions were completed during 2022 and into 2023, including the action to rollout SVD technology onto all operational ALR schemes by the end of September 2022. With further years' data we will be able to build a comprehensive understanding of safety trends.

Our latest analysis continues to show that overall, in terms of deaths or serious injuries, smart motorways remain our safest roads. This is in line with the findings of our *Second year* and *Third year progress report*s. However, I am aware some people remain concerned about driving on motorways without a hard shoulder. We are continuing to develop a deeper understanding of drivers' perceptions of different journey types, to allow us to support road users in travelling confidently and safely across the whole of our network.

SVD technology on ALR motorway

We will continue to evolve and develop our network, making the most of opportunities presented by new technologies, innovations and insight.

Every road death is a tragedy and we want everyone who travels on our roads to get home safely to their friends and families. We cannot achieve this in isolation, so working alongside our partners and the government we will continue our work to do the right thing for all our road users.

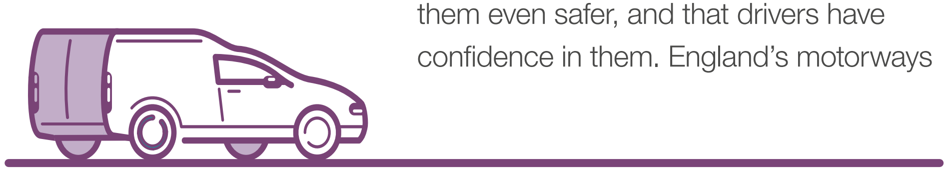
Nick Harris
Chief Executive

Executive summary

Introduction:

As an organisation National Highways is committed to providing safer and reliable journeys and creating a road network for today and the future. We must focus on the needs of drivers, their passengers and the communities who live alongside our roads. Safety is, and will always be, our number one priority and our purpose remains to connect the country. The strategic road network (SRN) is the backbone of the British economy and a crucial piece of national infrastructure. The 4552 miles of SRN enables the movement of people, public transport and goods. It creates jobs, supports economic growth, and connects regions and cities across the country.

The strategic road network is the backbone of the British economy and a crucial piece of national infrastructure



Smart motorways were introduced as they increase capacity without the disruption and environmental impact of physically widening the road. As of 2022, the 446 miles of smart motorway network carried around a third of all motorway traffic in England.

With millions of people using our roads, it's imperative that we continue making them even safer, and that drivers have confidence in them. England's motorways and major A-roads are some of the safest in the world. Motorways are England's safest roads, and overall, in terms of deaths and serious injuries, smart motorways remain our safest roads.

In our annual reports, of which this is the fourth, we have detailed our continued progress in delivering the actions set out in the previous government's *Smart motorway safety evidence stocktake and action plan*[1] and analysis of the safety data on smart motorways. Moving forward, our continued safety analysis of smart motorways will be included in our annual *Road safety performance overview report*[2].

We have welcomed the continued scrutiny around the design and operation of smart motorways. The Government will not roll out new smart motorways.

We know some concerns remain about being able to find a safe place to stop

We have completed our upgrades to improve the performance of technology to detect stopped vehicles on ALR motorways

in an emergency on all lane running (ALR) motorways. We have listened to the public and our stakeholders and reacted to the challenges presented. We continue to deliver £900 million in further safety improvements on existing smart motorways. This includes constructing over 150 new emergency areas before the end of March 2025[4]

In addition, we have completed our upgrades to improve the performance of technology to detect stopped vehicles on ALR motorways.

The Office of Rail and Road (ORR) announced[5] in December 2023 that, following fixes we implemented by June 2023, the targets for detection rates were now being met.

Stocktake action update

We have remained focused on completing the actions set out in the 2020 Stocktake and all of these actions are now complete. The publication of this report closes our action to issue an annual safety performance report specifically monitoring smart motorways. Future years' monitoring will be included in a wider report that considers the performance of all our roads.

Emergency telephone

Most stocktake actions were designed to reduce the risks associated with live lane stops and address concerns about motorways without permanent hard shoulders.

We had previously completed the action to put radar stopped vehicle detection on all operational ALR schemes by the end of September 2022. When it opened in December 2024, the M6 junctions 21a to 26 was the final scheme to have this technology in place[6], fully completing our final action.

Safety headlines

The analysis of our smart motorway network over the past four years has helped us develop our detailed understanding of road safety, not just on smart motorways, but across the whole strategic road network. To gain further confidence in our analysis, ORR has continued to undertake additional independent assurance of our work.

Smart motorways continue to be better than conventional motorways for those safety metrics which consider deaths or serious injuries and that no one type of motorway, smart or conventional, is ranked best against every safety metric

The findings of this report are consistent with our previous progress reports that overall, all three types of smart motorway continue to be better than conventional motorways for those safety metrics which consider deaths or serious injuries, and that no one type of motorway, smart or conventional, is ranked best against every safety metric.

The majority (96%) of collisions on our network involve only moving vehicles and the risk of being killed or seriously injured in this type of collision continues to be highest on A-roads followed by motorways with a permanent hard shoulder.

The minority (4%) of collisions on our network involve stopped vehicles, and the risk of being killed or seriously injured in this type of collision continues to be highest on A-roads followed by motorways without a permanent hard shoulder. These types of collision happen on all roads whether there is a hard shoulder or not.

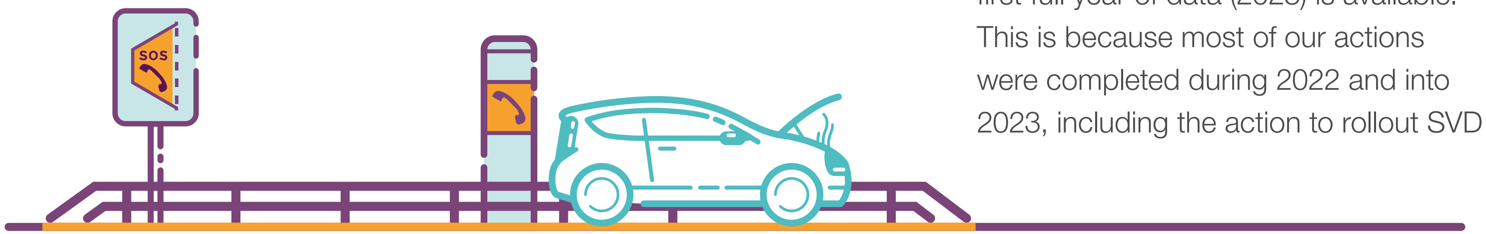
The hard shoulder is perceived to be a place of safety but, in reality, it does not provide a completely safe place to stop. Between 2018 and 2022 one out of every 18 motorway deaths resulted from a vehicle entering, leaving or being on a hard shoulder. There have been no deaths resulting from a vehicle entering, leaving or being in an emergency area.

With the stocktake actions complete, drivers are beginning to benefit from the additional safety measures put in place. We have started the process to assess and understand the impact of the actions on safety outcomes and are undertaking further analysis now that the first full year of data (2023) is available. This is because most of our actions were completed during 2022 and into 2023, including the action to rollout SVD onto all operational ALR schemes by the end of September 2022. We will also need further years' data to ensure we have a comprehensive understanding of trends. Our wider safety performance analysis will incorporate this.

'Before' versus 'after'

Our analysis also includes scheme by scheme data, showing how safety compares on smart motorway sections before and after they were upgraded. In 2023, we published a *Smart motorway safety scheme 'Before' verses 'after' assessment*[7] which included STATS19 data up to 2021. This year's analysis updates that with the 2022 data. This shows that in most cases smart motorways are safer than the roads they replaced.

Based on the latest available data, the updated analysis undertaken for this progress report shows that most ALR, dynamic hard shoulder (DHS) and controlled motorway schemes (25 out of 39) have seen a reduction in personal injury collision (PIC) rates after



they were constructed both against the before and the counterfactual. Most schemes (37 out of 39) have also seen a reduction in fatal and weighted injuries (FWI) rates. This has also been the case for most schemes (27 out of 39) for killed or seriously injured (KSI) rates.

In this update, we have also included data for the most recent five-year period (2018-2022), where schemes have been open long enough that it does not overlap with the after period. This allows us to assess current performance for older schemes. This shows that all qualifying schemes had lower PIC rates in the recent period compared to both the before and after periods, and most schemes saw reductions for FWI and KSI rates.

Building on previous reports

Each year, to get an increasingly comprehensive picture of smart motorway safety, we have expanded the depth and range of evidence presented in our progress reports.

In the updated safety evidence section of this report, for the first time, we have included:

- comparisons of European motorway road deaths and traffic data
- further analysis of the confidence of drivers and riders on smart motorways
- additional analysis on contributory factors, those factors which contribute to fatal and serious incidents and aligned them to a new set of road safety factors to ensure best practice
- further operational performance data for our smart motorway technology and how we operate it

ALR motorway, West Yorkshire

To gain further confidence in our analysis, ORR has continued to undertake additional independent assurance of our work

Conclusion

While we have made significant progress over the past four years, there is always room for improvement. We will continue to analyse the safety performance of all our roads, including smart motorways, and we will act wherever needed, on motorways and A-roads, to help provide drivers with safer and reliable journeys.

We will continue to analyse the safety performance of all our roads

We remain committed to working closely with drivers and our partners, including the Department for Transport (DfT) and the Office for Rail and Road (ORR) as we continue to deliver roads for the future.

Emergency area and sign

Smart motorway features

Smart motorways were introduced to provide extra capacity on some of our busiest and most congested sections of motorway. There are three types of smart motorway.

To further enhance safety, stopped vehicle detection technology is in place on all ALR motorways

Controlled motorways apply variable mandatory speed limits to a conventional motorway to control the speed and smooth the flow of traffic and retain a permanent hard shoulder. Overhead electronic signs display messages to drivers, such as warning of an incident ahead.

Dynamic hard shoulder (DHS) motorways apply variable mandatory speed limits to control the speed and smooth the flow of traffic and temporarily increase capacity by using the hard shoulder as a running lane at the busiest times. Electronic signs and signals instruct drivers when the hard shoulder is available to use for live traffic. When the hard shoulder is operating as a live lane, the speed is set at a maximum of 60mph. DHS motorways feature emergency areas, which are places to stop in an emergency.

All lane running (ALR) motorways add variable mandatory speed limits to control the speed and smooth the flow of traffic and increase capacity by permanently converting the hard shoulder into a live lane. ALR motorways also feature emergency areas. To further enhance safety, stopped vehicle detection technology is in place on all ALR motorways.

At the end of 2022 there were 239 miles of ALR, 63 miles of DHS and 144 miles of controlled motorways, representing 9.8% of the 4,552 miles of the SRN.

A car in an emergency area

Smart motorway features

Feature and description	Controlled motorways	Dynamic hard shoulder motorways	All lane running motorways
MIDAS (motorway detection and automatic signalling) which identifies queuing traffic or congestion by monitoring traffic speed and flow.	✓	✓	✓
Overhead electronic signs and signals to display variable mandatory speed limits, RedX lane closures and information to drivers, such as warning of an incident ahead.	✓	✓	✓
Enforcement cameras to deter the minority who break speed limits and ignore Red X signs.	✓	✓	✓
CCTV cameras that National Highways operators are able to move and zoom to monitor and manage congestion and incidents, when notified.	✓	✓[8]	✓[9]
Places to stop in an emergency such as hard shoulders or emergency areas.	✓	✓	✓
Stopped vehicle detection technology which can identify a stopped vehicle and alert National Highways control rooms, at the same time setting a sign to warn of a report of obstruction whilst the alert is verified by an operator.	✗	✗	✓
Increased capacity Drivers benefit from additional lanes being available. For a three-lane motorway, each additional lane represents 25% additional capacity.	✗ Only on roads which have also been widened	✓ Only when the hard shoulder is being used as a running lane	✓
Speed National speed limit maintained.	✓	✗ Maximum 60mph when the hard shoulder is being used as a running lane	✓

Stocktake action summary

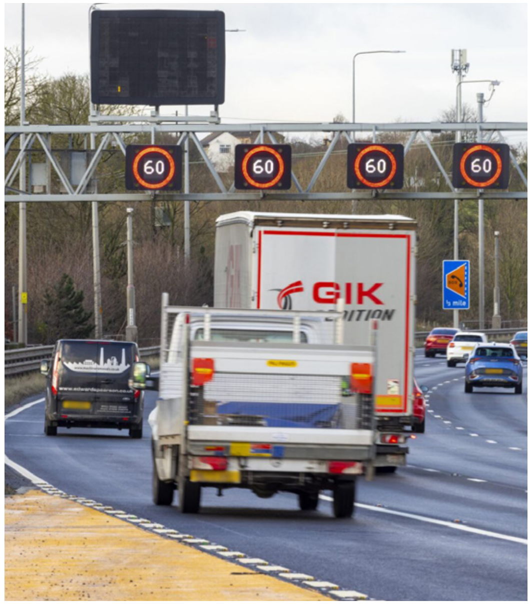
In March 2020, DfT published the *Smart motorway safety evidence stocktake and action plan*[1].

These reports detail our continued progress in delivering the stocktake actions and provide a comprehensive summary of the safety of smart motorways

This action plan sought to further improve smart motorway safety. In April 2021, we published the first of four progress reports. These reports detail our continued progress in delivering the stocktake actions and provide a comprehensive summary of the safety of smart motorways. In our first year progress report[10] we committed to a number of additional actions. All actions are grouped under three themes:

- Giving clarity to drivers
- Finding a safe place to stop
- Being safer in moving traffic

We have now delivered all the measures in the action plan. Most stocktake actions were designed to reduce the risks associated with live lane stops and address concerns about motorways without permanent hard shoulders. We have started the process to assess and understand the impact of the actions on safety outcomes and are undertaking further analysis now that the first full year of data (2023) is available. This is because most of our actions were completed during 2022 and into 2023, including the action to rollout SVD onto all operational ALR schemes by the end of September 2022. We will also need further years' data to ensure we have a comprehensive understanding of trends. Our wider safety performance analysis will incorporate this.



DHS motorway with 60mph signals set

Stocktake actions

Giving clarity to drivers

Description	Status (December 2024)	Completed and Assured
End the use of DHS smart motorways, so that all existing DHS smart motorways would be converted to ALR by the end of March 2025.	Cancelled (following the previous government's announcement in April 2023 cancelling plans for all new smart motorways)	N/A
Work closer with the recovery industry to work safely on our network in a standardised way.	Complete	September 2020
Work with fleet operators to influence the driving behaviour of drivers.	Complete	October 2020
Work with DfT and DVSA to update The Highway Code to provide more guidance for motorists driving on high-speed roads, including smart motorways.	Complete	March 2022
More communication with drivers through an additional £5 million for national and targeted communications campaigns.	Complete	March 2023
DfT to review use of red flashing lights by recovery vehicles.	Complete (led by DfT)	October 2023
Monitor smart motorway performance and annual issue of safety performance report.	Complete	March 2025

Finding a safe place to stop

Description	Status (December 2024)	Completed and Assured
Make emergency areas more visible.	Complete	March 2020
Review existing emergency areas where the width is less than the current standard, if feasible and appropriate.	Complete	October 2020
Commit to a new standard for spacing of places to stop in an emergency.	Complete	November 2020
Share information with sat nav companies that show places to stop in an emergency on sat navs.	Complete	March 2021
Install 10 additional emergency areas on the M25 and monitor their impact on the level of live lane stops.	Complete	March 2022
Consider, by April 2022, a national programme to install more emergency areas on existing smart motorways where places to stop in an emergency are more than one mile apart.	Complete	March 2022
Install clearer, easier to understand and more frequent approach signs showing the distance to the next place to stop in an emergency.	Complete	March 2023

Being safe in moving traffic

Description	Status (December 2024)	Completed and Assured
Work with the Society of Motor Manufacturers and Traders (SMMT) to jointly understand the range of eCall and bCall functions in newer cars, and to communicate the benefits to drivers.	Complete	November 2020
Complete a large-scale trial of CCTV analytics.	Complete	December 2020
Look further at clusters of incidents on sections of the M6 and M1 smart motorways.	Complete	September 2021
We committed to use the Driving for Better Business programme to raise awareness of the benefits of using Advanced Driver Assistance Systems (ADAS), with a particular focus on Advanced Emergency Braking (AEB) systems.	Complete	February 2022
Faster attendance by National Highways traffic officer patrols where emergency areas are more than a mile apart.	Complete	September 2022
Automatically display a ‘report of obstruction’ message on electronic overhead signs on the motorway, to warn approaching drivers of a stopped vehicle ahead.	Complete	December 2022
Upgrade enforcement cameras by September 2022 to support improved compliance with Red X signals.	Complete	July 2023
Put radar SVD technology in place on all existing ALR schemes by September 2022 and ensure that no new schemes open without it.	Complete	December 2024

Most stocktake actions were designed to reduce the risks associated with live lane stops

Stocktake actions - remaining work:

Monitor smart motorway performance and annual issue of safety performance report

Future smart motorway safety analysis will be included in our wider safety performance reporting encompassing all road types. As agreed by DfT and ORR, this fourth year progress report completes the action to issue an annual smart motorway safety performance report. This is the final annual review solely focused on smart motorways.

Faster rollout of stopped vehicle detection

Most stocktake actions were designed to reduce the risks associated with live lane stops and address concerns about motorways without permanent hard shoulders.

We had previously delivered the action to rollout SVD technology on all operational ALR schemes by the end of September 2022. When the M6 junction 21a to 26 scheme opened in December 2024, it fully completed our final commitment that new ALR schemes would open with SVD in place. Whilst the previous government cancelled plans for new smart motorways in April 2023, the M6 junction 21a to 26 scheme was to be completed as it was already over three quarters constructed.

The M6 between Warrington and Wigan includes more than double the originally planned places for drivers to stop in an emergency with 12 new emergency areas included in the scheme, in addition to the original 10 bringing the total to 22.

By June 2023 we completed our upgrades to improve the performance of technology to detect stopped vehicles on ALR motorways. ORR announced[5] in December 2023 that following the fixes we had implemented, the targets for detection rates were now being met.

Red X signal set for lane closure

Incident and infrastructure investigations report actions

In September 2021 we published the *independent investigation reports*[11] into safety performance on specific sections of the M1 and M6 smart motorways where clusters of incidents had previously been identified. We are continuing to finalise the remaining actions which were identified as part of the completed reports.

In summer 2022 we published an update on the actions being progressed on the M1 and M6. Two of the independent investigation reports (M6 junctions 5 to 6 (Bromford viaduct) and the M1 junctions 10 to 13) are on sections of DHS motorway. The previous government's April 2023 announcement[3] cancelling plans for new smart motorways affected the scope and timing of some of our actions on these two sections, as they were originally envisaged to be addressed as part of the upgrade from DHS to ALR motorway.

We therefore reviewed these actions and where appropriate, have put in place plans to deliver them without any upgrade to ALR

We have now completed all the actions identified for the M1 junctions 30 to 35, M1 junctions 39 to 42 and M6 junctions 5 to 6. The remaining actions to upgrade digital roadside signs and improve the southbound entry slip-road merge on the M1 junctions 10 to 13 are on track to be completed by the end of March 2025. They are being carried out as part of the project, which began in January 2024, to further enhance the safety of this DHS section of motorway.

Going further – 2021 Transport Select Committee report

In November 2021, the Transport Select Committee (TSC) reported[12] on the roll out and safety of smart motorways and made nine recommendations, which the previous government agreed to take forward in its response published in January 2022[13].

Actions we have been taking to support delivery of the recommendations include:

- progressing the constructon over 150 additional emergency areas by March 2025
- assessing potential alternative operating regimes for DHS motorways to reduce the potential for driver confusion
- completing a full impact assessment, a safety risk assessment and a stakeholder consultation on the emergency corridor concept.

The following actions have also been undertaken by DfT during this period:

- conducted a review, with the support of an expert panel, to consider whether changes to the design and operation of the SRN should depend on a formal health and safety assessment by ORR. National Highways has been taking action to further strengthen existing processes in response to the findings

- commissioned ORR to independently evaluate the effectiveness of SVD technology and other systems in place, and to evaluate how successful the actions in the 2020 Stocktake have been. In December 2023, ORR published its *Second annual assessment of safety performance on the SRN*[5]. The report concluded that National Highways had responded positively to the concerns ORR raised in its 2022 safety report. The 2023 report noted that targets for detection rate, false detection rate, and time to detect are now being met. It also noted that National Highways was now implementing a plan to upgrade operational technology on ALR motorways, with an aim of 97% availability for key assets by the end of the road period

- published its *smart motorway comparison*[14] report in December 2022. We will support DfT as it continues to collect further evidence about the safety and performance of smart motorways

- commissioned Transport Focus to undertake further research to provide greater road user insight on safety perception. This work has been completed and published in Transport Focus' *Safety perceptions on smart motorways: the driver view report*[15]. The insight from this research has been used to inform this report

Traffic officer parked in emergency area

Updated safety evidence

This section of the report outlines safety performance across smart motorways. It provides comparisons to international and European road networks, analyses the safety of different road types, their performance according to different safety metrics, how roads perform before and after schemes have been in place and looks at the perceptions of safety on all roads.

The latest safety data continues to show that, overall, all three types of smart motorway are safer than conventional motorways in terms of deaths or serious injuries

Safety headlines

- The findings of the fourth year progress report are consistent with previous progress reports
- The latest safety data continues to show that, overall, all three types of smart motorway are safer than conventional motorways in terms of deaths or serious injuries
- No one type of motorway, smart or conventional, is ranked best against every safety metric

To support the safety conclusions of this report, we have worked closely with ORR, who undertook additional independent assurance for the supporting analysis. As part of this assurance ORR found that:

- Where new data and analysis are included in this report, this is relevant to the wider report and the conclusions drawn are appropriate
- There are relatively few methodological changes compared to last year's report. Where we have made changes, these are appropriate and are explained in the latest report
- We have continued to follow appropriate analytical assurance processes to ensure the reliability of our analysis
- We should continue to review how we can robustly apply more sophisticated statistical methods to support us in making firmer conclusions about smart motorway safety

Strategic road network safety

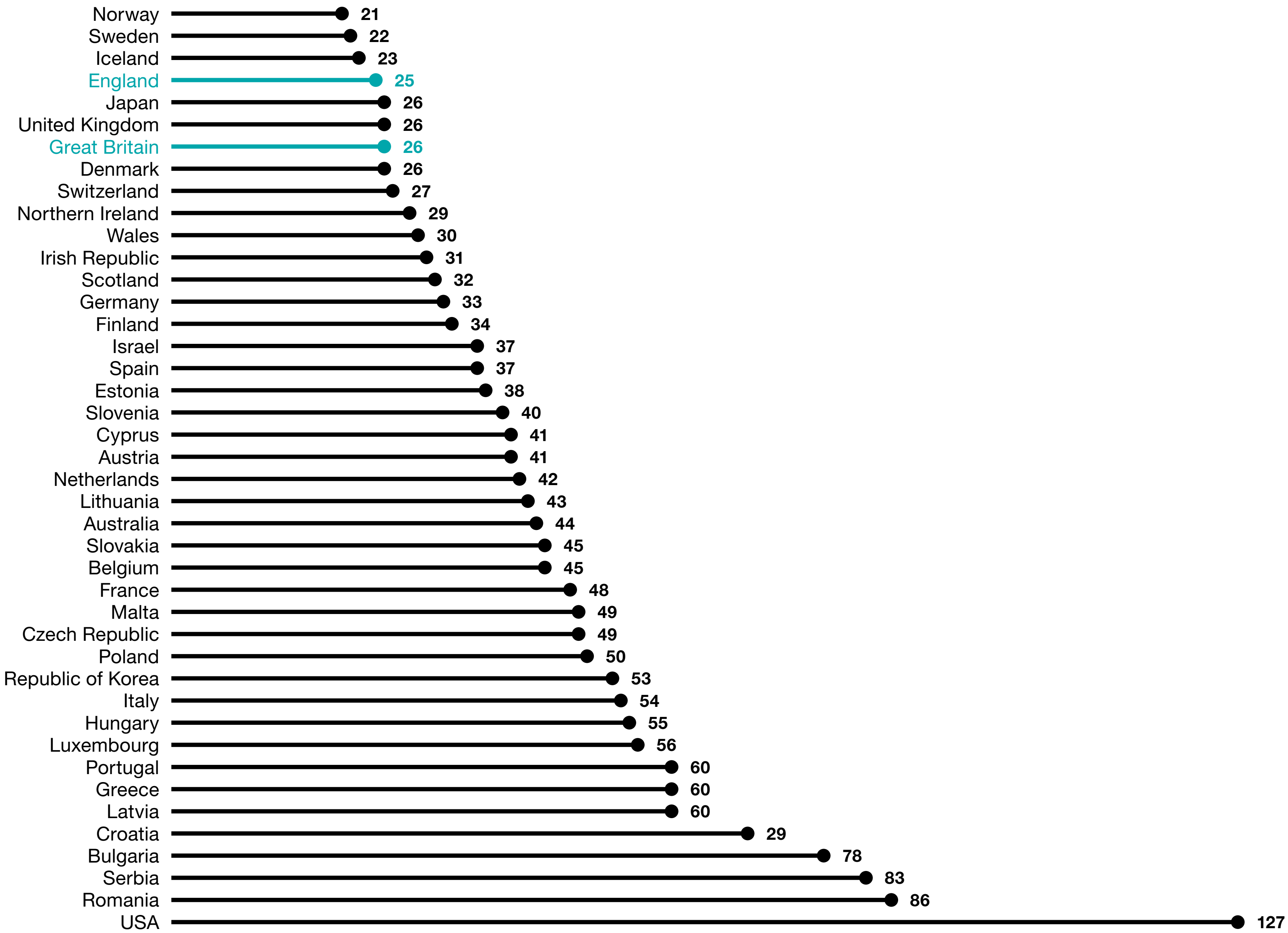
As with our previous reports, before comparing the safety performance of different road types, it is useful to first understand the latest data in relation to the overall safety of England's roads. This information is reported for the most recent calendar year for which data is available, in this case 2022. Across all road classifications, England has some of the safest roads in the world. According to the latest international safety data consolidated by DfT, only Norway, Sweden and Iceland perform better than England by population.

Figure 1

Data: Road deaths per million population in 2022

Description: England is amongst the top performing countries internationally in terms of road safety

Source: Visualisations from National Highways. Data based on IRTAD (OECD), ETSC, EUROSTAT and CARE (EU road accidents database)



European motorway road deaths and traffic data is published by IRTAD[16] which produces data on motorway deaths per billion vehicle kilometres for 10 European countries, including Great Britain. English motorways rank below Danish motorways (and Great Britain overall) but are better than motorways in the other seven European countries that motorway data is published for, including Germany and France[17].

While England's road network continues to be among the best performing road networks internationally, we strive to continue to improve the safety of our roads. There were 1,443 road deaths in England in 2022. This was an increase of 114 from 1,329 in 2021[18], as traffic continued to increase following the end of the Covid-19 pandemic restrictions in spring 2021.

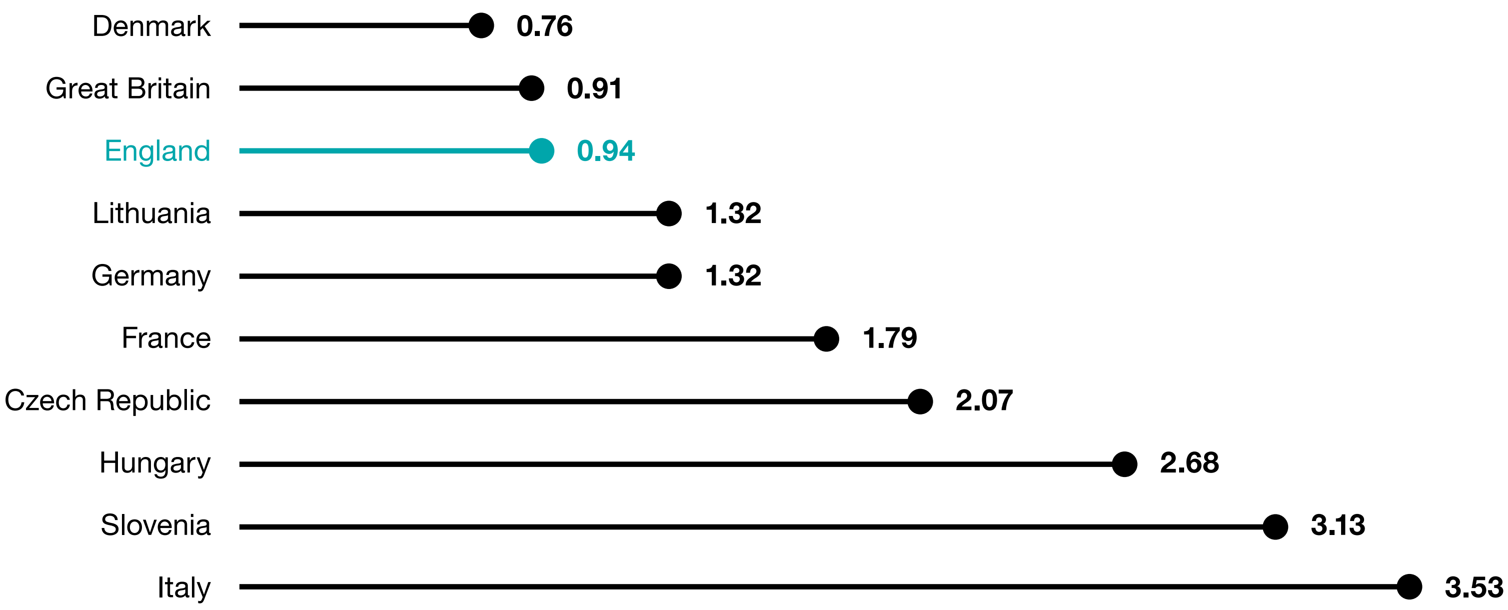
Traffic officer vehicle in emergency area

Figure 2

Data: Motorway deaths per billion vehicle kilometres

Description: English motorways are amongst the safest in Europe to travel on

Source: Visualisations from National Highways. Data based on IRTAD (OECD), ETSC, EUROSTAT and CARE (EU road accidents database), DfT traffic, DfT[19] motorway data, traffic and road class road death data[20]



Of the 1,443 road deaths in England, 1,224 deaths (84.8%) took place on the road network managed by local authorities. Compared with 2021, this represented an increase of 117 deaths (10.6%) on local authority roads. The SRN had a slight decrease in road deaths from 222 in 2021 to 219 in 2022, a decrease of three (1.4%). Road deaths on the SRN in 2022 represented 15.2% of all road deaths in England[21]. The reduction in road deaths on the SRN in 2022 was in the context of increased SRN traffic (12.6%)[22], and an increase in road deaths on local authority roads. We will continue our work to further reduce road deaths on the SRN now and in the longer term.

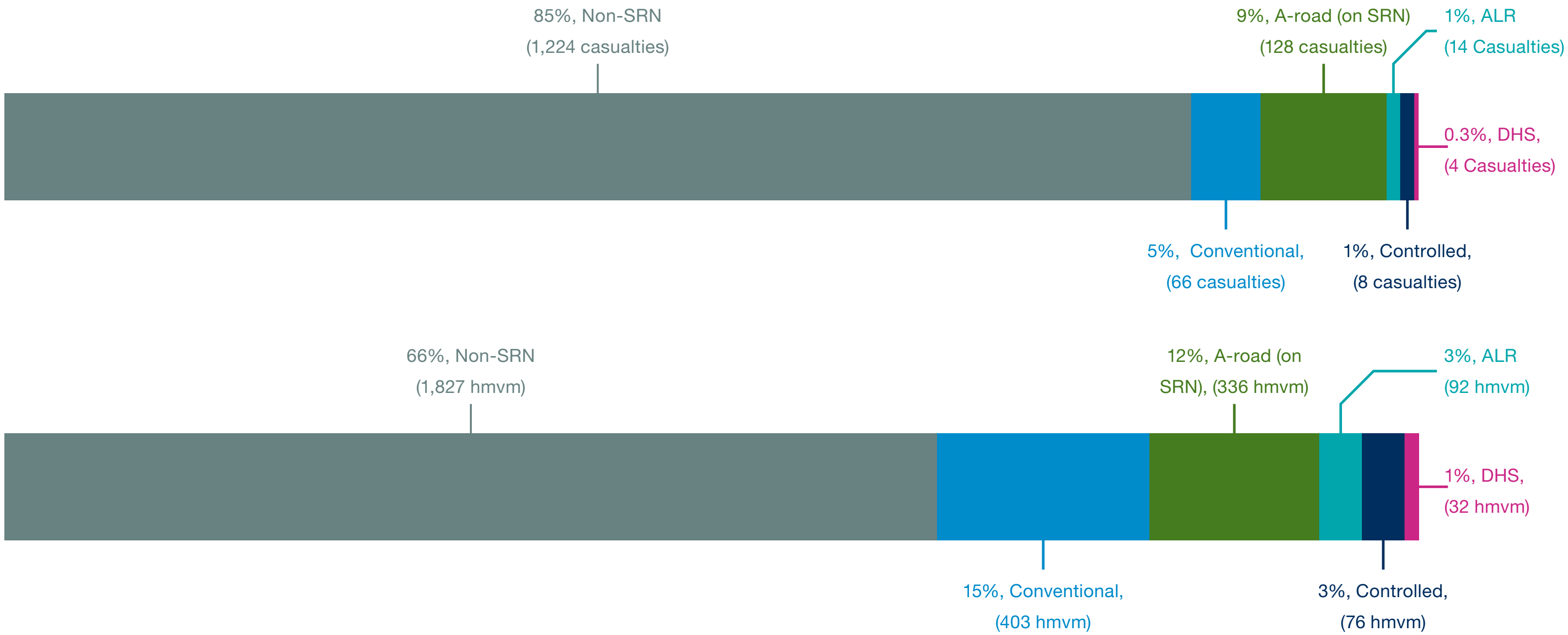
To reduce casualties on our network we work with a range of stakeholders and delivery partners following the Safe System approach. The Safe System approach to road safety focuses on achieving zero harm through five areas: safer roads, safer vehicles, safer speeds, safer users and safer post-collision response.

Figure 3

Data: Percentage of road deaths in England in 2022 by type of road and the percentage of traffic in England by type of road

Description: The strategic road network carries 34.0% of traffic in England and 15.2% of road deaths occurred on those SRN roads

Source: Visualisation from National Highways. DfT road length and road traffic statistics



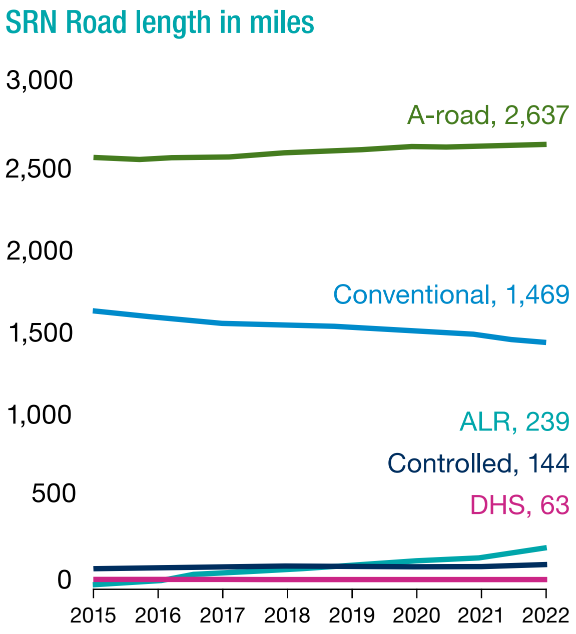
On SRN A-roads, the number of deaths decreased from 142 in 2021 to 128 in 2022 (8.9% of total road deaths in England). On SRN motorways, the number of deaths increased from 80 in 2021 to 91 in 2022 (6.3% of total road deaths in England), of which 18 (1.2% of total road deaths in England) occurred on ALR and DHS motorways. SRN A-roads are the longest parts of the SRN but carry the second largest traffic flows after conventional motorways. SRN motorways carried 21.8% of all England's road traffic in 2022)[23] of which 4.5% was carried on ALR and DHS motorways.

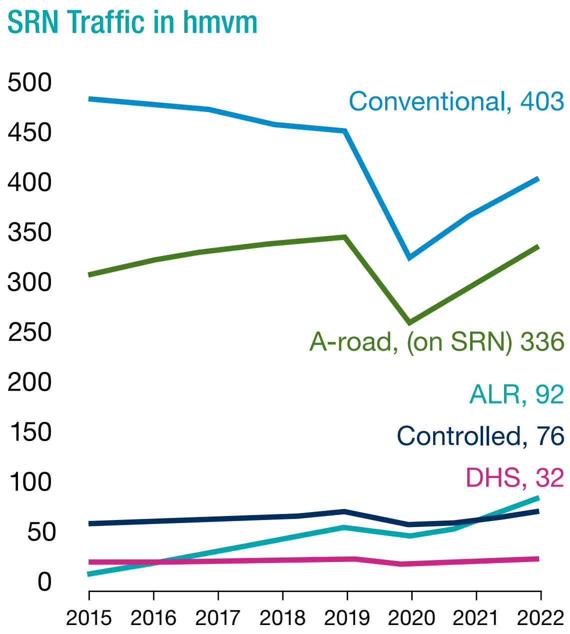
Figure 4

Data: SRN road types by total length in miles and total traffic flows in hundred million vehicle miles (hmvm)

Description: As of 2022, controlled, ALR and DHS smart motorways make up 23.3% of SRN motorways and carry 33.2% of SRN motorway traffic

Source: Visualisation from National Highways. DfT road length and road traffic statistics





Smart motorway safety

No one type of motorway, smart or conventional, is ranked best against every safety metric.

The latest safety data continues to show that overall, all three types of smart motorway are better than conventional motorways for those safety metrics which consider the most significant impacts, such as deaths or serious injuries (KSI and FWI). The safety metrics which we have used in this report are consistent with those used in the previous two progress reports.

- Personal injury collisions (PIC) rates: reflects collisions where at least one person was injured but does not include any consideration of whether more than one person has sustained an injury or the severity of the injuries
- Killed and seriously injured (KSI) rates: places equal emphasis on deaths and serious injuries by giving no weighting between the two
- Fatal and weighted injuries (FWI) rates: places greater emphasis on deaths and serious injuries by giving a death 10 times the weighting of a serious injury and a serious injury 10 times the weighting of a slight injury

The Covid-19 pandemic and associated travel restrictions affected road safety data in 2020 and 2021. For example, due to varying restrictions across regions, and therefore varying traffic across roads, certain safety comparisons between road types may not be like-for-like. While this report considers year-on-year safety data, to reflect trends over time it considers rolling five-year PIC, KSI and FWI rates described above. This means that safety data between 2015 and 2019 is compared with the safety data between 2016 and 2020 and so on up to the present 2018-2022 period. To some extent this reduces the impact from external events, such as Covid-19.

No one type of motorway, smart or conventional, is ranked best against every safety metric

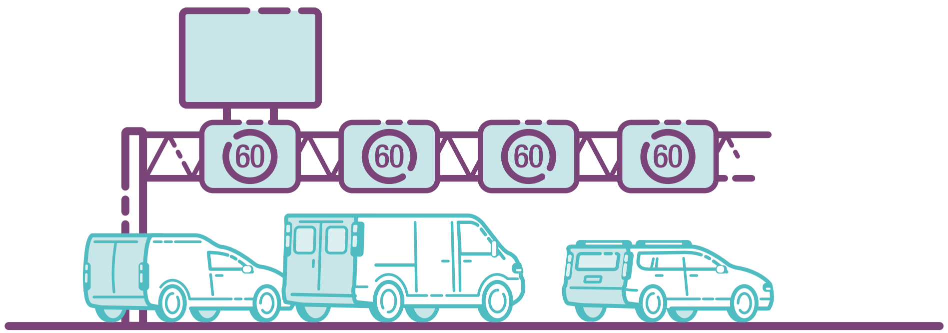


Figure 5

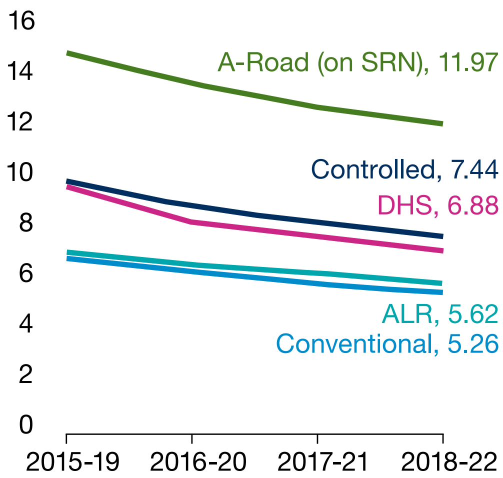
Data: Headline five-year PIC, KSI and FWI metric rates (2018-2022) injury-adjusted per road type

Description: Across all collisions, all three types of smart motorway perform as well as or better than conventional motorways for those metrics which consider the most significant impacts, such as deaths or serious injuries

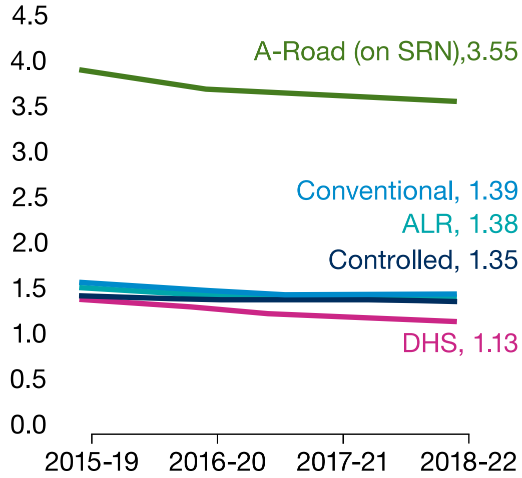
Source: Analysis from National Highways. Data based on STATS19 with minor amendment

West Midlands DHS motorway junction

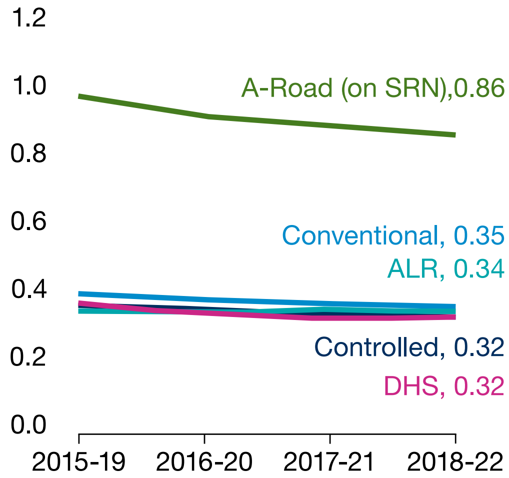
PIC Rate per hmvm: All collisions



KSI Rate per hmvm: All collisions



FWI Rate per hmvm: All collisions



Emergency area

As with previous progress reports, PIC are higher on all three types of smart motorways than on conventional motorways, but a collision on a conventional motorway is more likely to involve a death or serious injury than a collision on any of the three types of smart motorway. This is due to PIC rates being lower on conventional motorways, but their FWI and KSI rates being higher compared to smart motorways.

Across all safety metrics, all roads have continued to see relatively stable or improving long-term trends. Over time DHS motorways have shown the most notable improvement in PIC, FWI and KSI rates. DHS motorways are notably lower than other motorways in respect to KSI rates, but more like other motorways for FWI rates. This suggests that motorways currently operating as DHS motorways are experiencing fewer serious casualties than other motorway types.

The findings regarding the performance of DHS motorways should be treated with a degree of caution as DHS is the least common motorway type in both length and vehicle miles travelled (see Figure 4). A smaller sample size makes the calculation of rates, especially the casualty focused rates (KSI and FWI), more sensitive to individual collisions occurring on those roads or the number or severity of people injured in those collisions. On DHS motorways, it is also important to note that when the hard shoulder is operating as a live lane, the speed is set at a maximum of 60mph.

For each metric's detailed year-on-year rates, please see Annex C – Detailed tables.

We have also undertaken statistical significance testing, which helps us understand whether a difference in numbers is likely to be due to random variation. Simply put, as the numbers are low and similar to each other, statistical significance testing helps explain whether the numbers are statistically different to each other. This helps make some of the comparisons between different road types more meaningful.

Statistical significance testing is only viable where the measure being tested is an observed whole number data point, for example an event such as a collision or a specific outcome such as an injury from a collision. The FWI and KSI rates do not meet the criteria and cannot be tested at this time. We understand that all police forces will eventually move to injury-based reporting systems and when that change has occurred severity adjustments will no longer be necessary. This will allow us to undertake statistical testing of KSI rates from that point onwards, starting with one year of data.

DHS motorway in opperation

The PIC rate for conventional motorways is 5.26 and for ALR motorways is 5.62. Based on the statistical significance testing, there is strong evidence that these two figures are statistically different to each other, and that the conventional motorway PIC rate is statistically lower than the ALR PIC rate. The PIC rates for both conventional and ALR motorways are statistically lower than the PIC rates for DHS motorways (6.88) and controlled motorways (7.44).

Reducing the number of collisions is an integral part of further improving safety on our roads. This makes it a concern for all road types. We continue to monitor safety across our network to help identify appropriate and targeted actions towards halving the number of people killed and seriously injured on our roads by the end of 2025[24]. For more information, please see Annex B – Methodology.

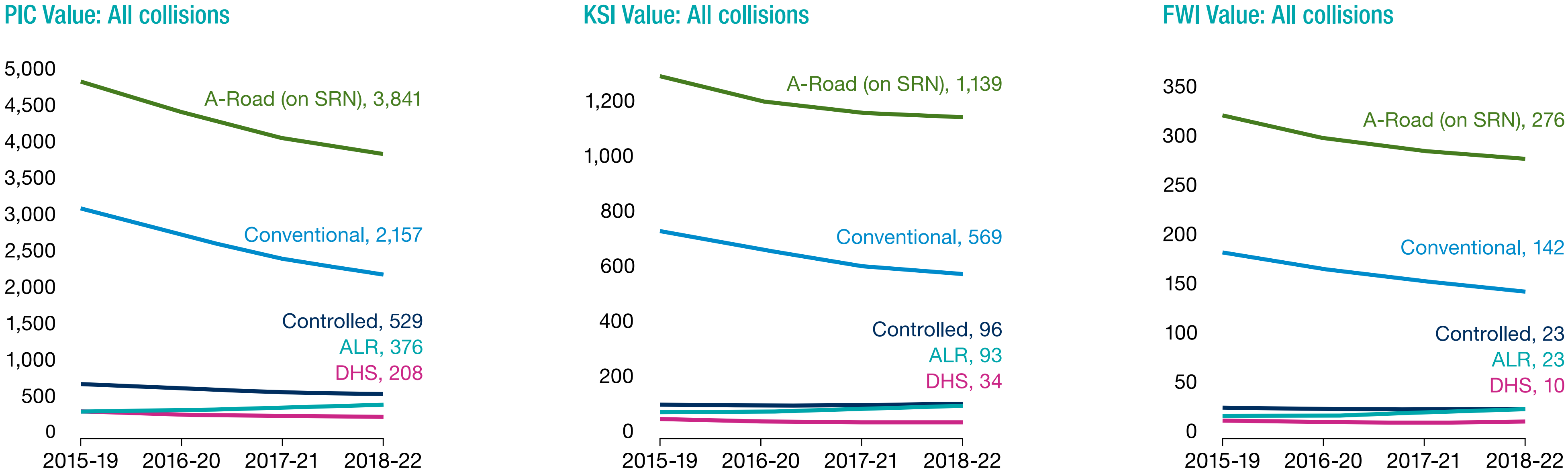


Figure 6

Data: Five-year weighted annual average[25] PIC, KSI and FWI metric totals (2018-2022) injury-adjusted per road type

Description: Total collision and casualty numbers have increased on ALR over time as conventional motorways and one controlled motorway have been converted to ALR – see Figure 4. Controlled and DHS totals have remained relatively stable

Source: Analysis from National Highways. Data based on STATS19 with minor amendment

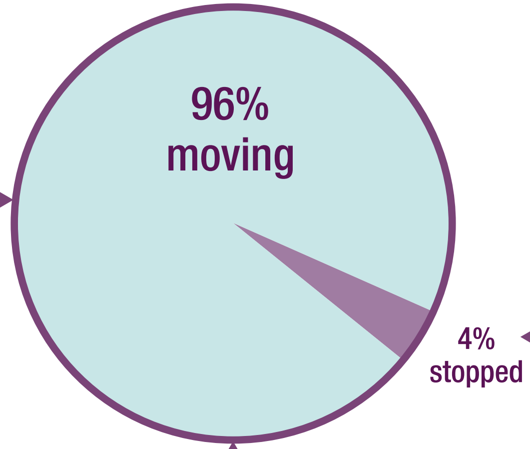
Weighted absolute averages

In previous years we have provided PIC, KSI and FWI absolute values as weighted[26] averages. Absolute values are a less reliable way to make safety comparisons because the least used roads may appear to be the safest roads. However, for transparency, it is appropriate to also present absolute values.

Collisions and casualty numbers across the SRN are decreasing or are at stable levels across most road types, with the exception of ALR motorways. As of the end of 2022, there were 121 more miles of ALR smart motorway than in 2018 and 110 miles fewer of conventional motorways, which have mostly been converted to ALR motorways. The increase in collisions and casualty numbers on ALR motorways is largely a result of there being more miles of ALR

Moving vehicle personal injury collisions on different road types (rate hmvm)

A-roads (SRN)	11.45
Controlled motorway (CM)	7.25
Dynamic hard shoulder (DHS)	6.65
All lane running (ALR)	5.33
Conventional	5.07



Stopped vehicle personal injury collisions on different road types (rates per hmvm)

A-roads (SRN)	0.51
All lane running (ALR)	0.29
Dynamic hard shoulder (DHS)	0.22
Controlled motorway (CM)	0.19
Conventional	0.19

96% of Personal injury collisions in 2018-2022 occurred in moving vehicle collisions

Figure 7

Data: Moving and stopped vehicle collisions (2018-2022) as a percentage of SRN collisions and associated personal injury collision rates by road type

Description: A-roads have the highest personal injury collision rates on the SRN for both moving and stopped vehicle collisions

Source: Analysis from National Highways. Data based on STATS19 with minor amendment

motorways opening than a decrease in their safety. This is supported by Figure 5 which shows that PIC, KSI and FWI rates have decreasing or stable trends over time. Collision and casualty rates, which factor in the amount of traffic and miles of road that traffic is using, are the best metrics to measure the performance of a road network or when comparing different road types.

Moving and stopped vehicle collisions

The vast majority (96%) of collisions across the SRN are single vehicle collisions or collisions involving two or more moving vehicles. The rest of the collisions, which form a small proportion of all SRN collisions (4%), involve moving vehicles colliding with stopped vehicles.

Both types of collisions occur on all types of roads.

Moving vehicle collisions

Moving vehicle collisions are those which involve only moving vehicles, this includes single vehicle collisions and collisions between two or more vehicles. These collisions make up around 96% of collisions that occur on the SRN.

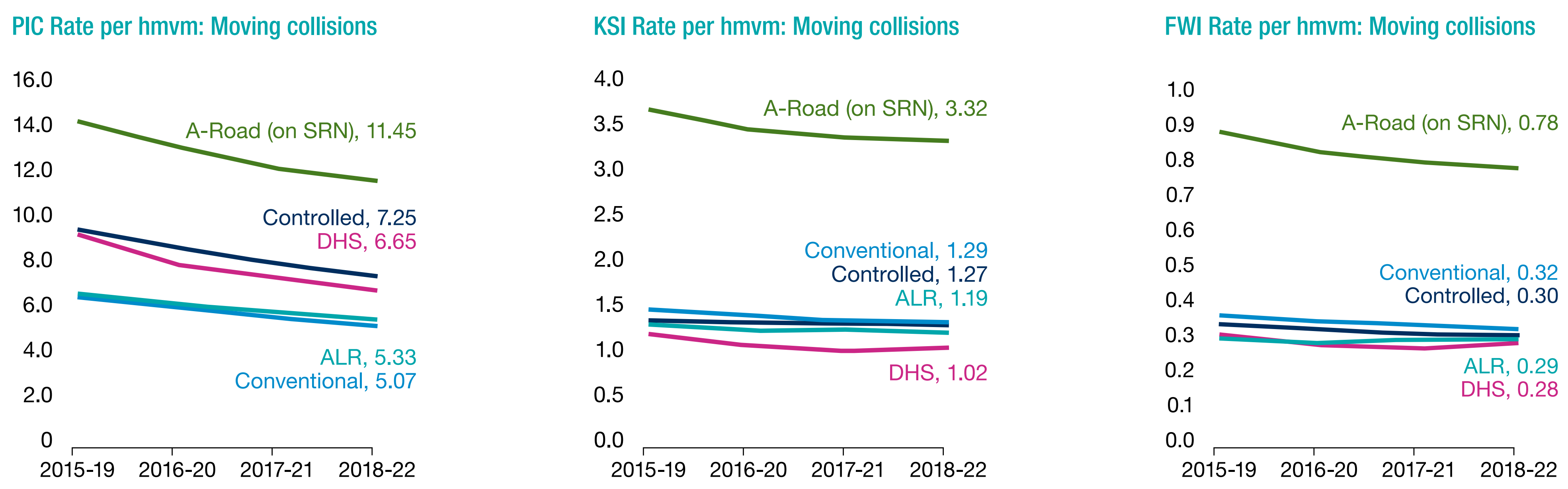


Figure 8

Data: Moving vehicle five-year average (2018-2022) injury-adjusted metrics per road type

Description: Moving vehicle FWI and KSI rates are the lowest on DHS motorways

Source: Analysis from National Highways. Data based on STATS19 with minor amendment

For collisions involving only moving vehicles, all types of smart motorway perform better than conventional motorways in terms of FWI and KSI rates. DHS motorways have the lowest FWI and KSI rates. This is consistent with the *Second year*[27] and *Third year progress reports*[28]. The DHS motorway KSI rate of 1.02 is notably lower than all other motorway types, which range from 1.19 to 1.29. In contrast, the DHS motorway FWI rate of 0.28 is closer to the other motorway types, which range from 0.29 to 0.32. This means that when moving vehicle collisions occur on DHS motorways fewer serious casualties result from those collisions. This is further supported by DHS motorways having both lower KSI and FWI rates than other motorway types, but a higher PIC rate than conventional or ALR motorways.

In a similar way to the headline PIC rates, we have undertaken statistical testing for PIC rates for moving and stopped vehicle collisions. This helps make some of the comparisons between different road types more meaningful.

The moving vehicle PIC rate for conventional motorways is 5.07 and for ALR motorways is 5.33. Like the headline PIC rates, there is some statistical evidence that these figures are different to each other and that the conventional motorway moving vehicle PIC rate is

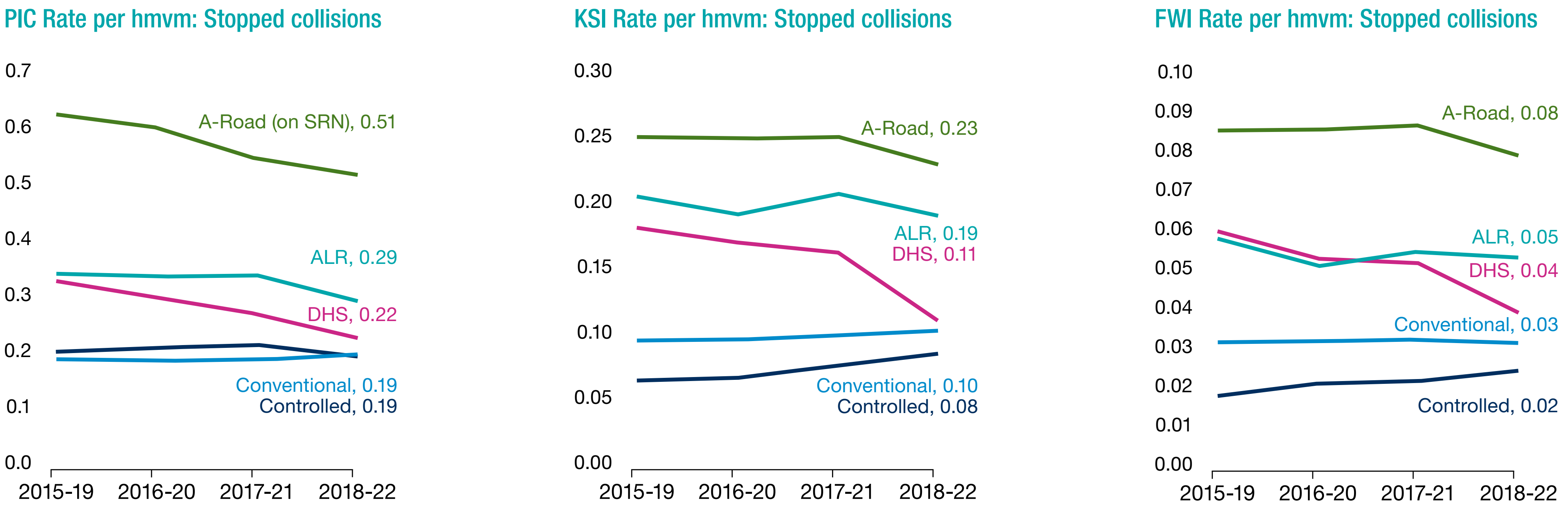


Figure 9

Data: Stopped vehicle five-year average (2018-2022) injury-adjusted metrics per road type

Description: Stopped vehicle FWI and KSI rates are lowest on controlled motorways. Stopped vehicle collisions are 4% of all collisions across the SRN

Source: Analysis from National Highways. Data based on STATS19 with minor amendment

statistically lower than the ALR moving vehicle PIC rate. The PIC rates for both conventional and ALR motorways are statistically lower than the PIC rates for DHS motorways (6.65) and controlled motorways (7.25). For more information, please see Annex B – Methodology.

Stopped vehicle collisions

Stopped vehicle collisions are those where at least one vehicle involved in the collision was stopped at the time the collision occurred. These often involve the front of a vehicle striking the rear of a stopped vehicle. Stopped vehicle collisions are a small proportion of all collisions and happen on all types of roads, including SRN A-roads and non-SRN roads. We recognise that this type of collision, especially on high-speed motorways, is a point of concern for some road users.

For those collisions involving a stopped vehicle, controlled motorways have the lowest FWI and KSI rates of any road type, with the same PIC rate as conventional motorways. Over time, the KSI and FWI rates for controlled motorways have increased slightly bringing them closer to those of conventional motorways.

DHS motorway rates for all three metrics have decreased and are performing close to, albeit slightly above, conventional motorways. As noted earlier, DHS motorways, being the least common motorway type, are more susceptible to the influence of individual data points than other motorway types. This is even more pronounced with stopped vehicle collisions due to them being a small subset of the overall data. In recent years, there have been fewer multiple serious casualty collisions on DHS motorways, which is a welcome development. However, it is therefore unknown if the decrease in DHS motorway KSI rates is due to a true improvement in safety or coincidence (what may be referred to here as regression to the statistical mean[29].

DHS operates differently to other smart motorways in that the number of lanes available to use by drivers is dependent on the volume of traffic. During the Covid-19 affected years of 2020 and early 2021, it is highly likely that the traffic level threshold for opening the hard shoulder to live traffic was reached on a less frequent basis. In such scenarios, DHS motorways operates like a three-lane controlled motorway supplementing the hard shoulder with emergency areas at typically no more than 0.6 miles apart.

The ALR motorway PIC rate for stopped vehicle collisions has decreased compared with previous five-year periods, however, KSI and FWI rates for ALR motorways remain relatively consistent with some year-to-year fluctuation. Stopped vehicle collision FWI rates for ALR are similar, albeit slightly higher, than DHS motorways. However, the stopped vehicle collision KSI rate for DHS, which was previously more similar to ALR, is now more similar to controlled motorways.

Similar to the headline and moving vehicle metrics, we have also undertaken statistical significance testing for stopped vehicle metrics. Stopped vehicle collisions are a much smaller dataset than moving vehicle collisions and this means that there is a higher level of uncertainty in the stopped vehicle PIC rates than moving vehicle PIC rates.

The statistical testing suggests that we can be confident that the stopped vehicle PIC rates for conventional motorways (0.19) and controlled motorways (0.19) are lower than that of ALR (0.29). However, the evidence for statistical differences between other motorway types is not as strong. For more information, please see Annex B – Methodology.

Stopped vehicle collisions are a much smaller dataset than moving vehicle collisions

DHS motorway, West Yorkshire

Contributory factors

As with previous progress reports, we have undertaken contributory factor analysis to help us further understand which factors are involved in collisions on the SRN. In previous years we have grouped contributory factors into Driver, Vehicle and Environment factors, but have updated this analysis to six groupings, to better align with road safety analysis best practice. These groupings are: Behaviour, Speed, Distraction / Impairment, Road, Vehicles, and Non-motorised Users. For every collision the investigating police officer can assign between zero and six contributory factors from a list of 78 factors which they believe influenced the collision occurring.

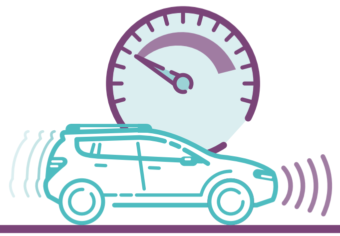
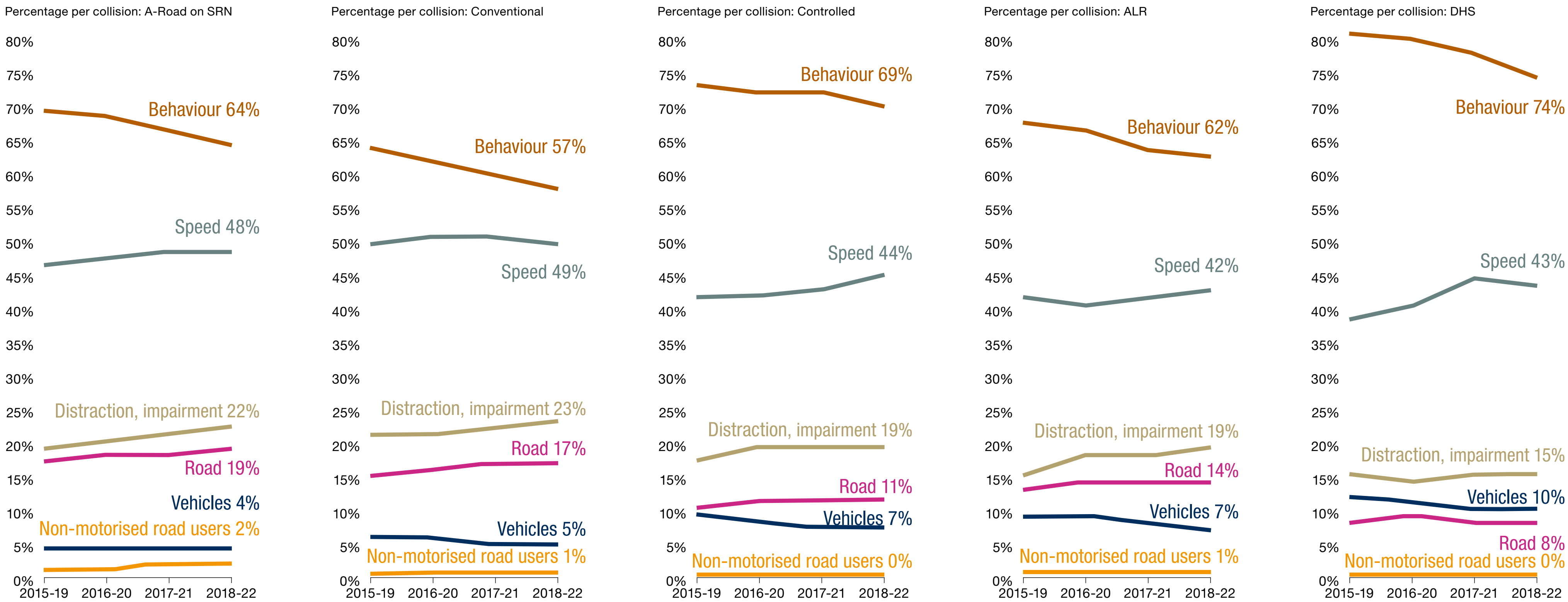


Figure 10

Data: Percentage of personal injury collisions by contributory factor group by road type between 2018-2022

Description: Across all roads, the most prominent collision factors are driver behaviour-related and speed-related factors increase on most roads

Source: Analysis from National Highways. Data based on STATS19



Driver behaviour factors are most prominent across all road types with the most common issues being driver observation, either through failing to look properly or failing to judge the path or speed of another road user. Over time, the number of collisions in which these and other behaviour factors are being recorded are decreasing for all road types.

Speed-related factors are the second most common category of contributory factors and over time there is a trend of a stable or slightly increasing percentage of collisions involving speed factors across all SRN road types. Drivers losing control is the most common type of speed factor on A-roads, conventional motorways and ALR motorways, but is less common on controlled motorways and DHS motorways. Loss of control collisions are decreasing on most road types except DHS motorways, which has remained relatively steady from a lower baseline. Unsafe or careless driving is the second most common speed factor across most road types except ALR motorways, where close following is more common. Unsafe or careless driving has increased over time on all road types except ALR motorways, which has increased recently after a period of decline.

Distraction and Impairment factors are slightly lower on smart motorways than they are on A-roads or conventional motorways, with fatigue recorded on conventional motorways more than any other road type or factor. Road-related factors, such as poor or defective road surfaces, are lower on smart motorways than A-roads and conventional motorways which have a higher percentage of slippery road surfaces recorded than smart motorways. Smart motorways have a higher percentage of vehicle factors recorded than conventional motorways or A-roads, with vehicle blind spots more common on smart motorways.

We will continue to develop and deliver appropriate campaigns, working with enforcement agencies and other partners to provide more information to road users to help improve their understanding, confidence and safety when driving on all road types, including smart motorways.

National Highways traffic officers

Feelings of safety and confidence

We know some people remain concerned about driving on motorways without a hard shoulder. We are continuing to develop a deeper understanding of drivers' perceptions of different journey types to allow us to support road users in travelling confidently and safely across the whole of our network.

Recent Transport Focus research[30] found that safety is not often considered during the driving experience, unless prompted by specific risks or events. More frequently though, negative safety perceptions can arise when not driving, including from discussions with others, which may be influenced by individual views and exposure to relevant news stories. Drivers may particularly feel anxious when considering 'what if' emergency scenarios. These concerns mean that drivers' actual experience when driving on smart motorways and their overall feelings about them may differ.

An earlier piece of Transport Focus research[31] has suggested that for smart motorways in particular, improving compliance with the rules, such as Red X signals, is likely to help increase drivers' confidence when lanes are closed as they did not feel that "behaviours such as ignoring the Red X are currently viewed with the same seriousness as, say, going through a red traffic light".

Within National Highways, we have a Customer Experience Tracker survey which has considered 30,002 responses from adults in England in the calendar year 2023, including drivers and riders who do not travel on the SRN and who may not travel in parts of the country where smart motorways are located. All reported subgroup findings are statistically significant.

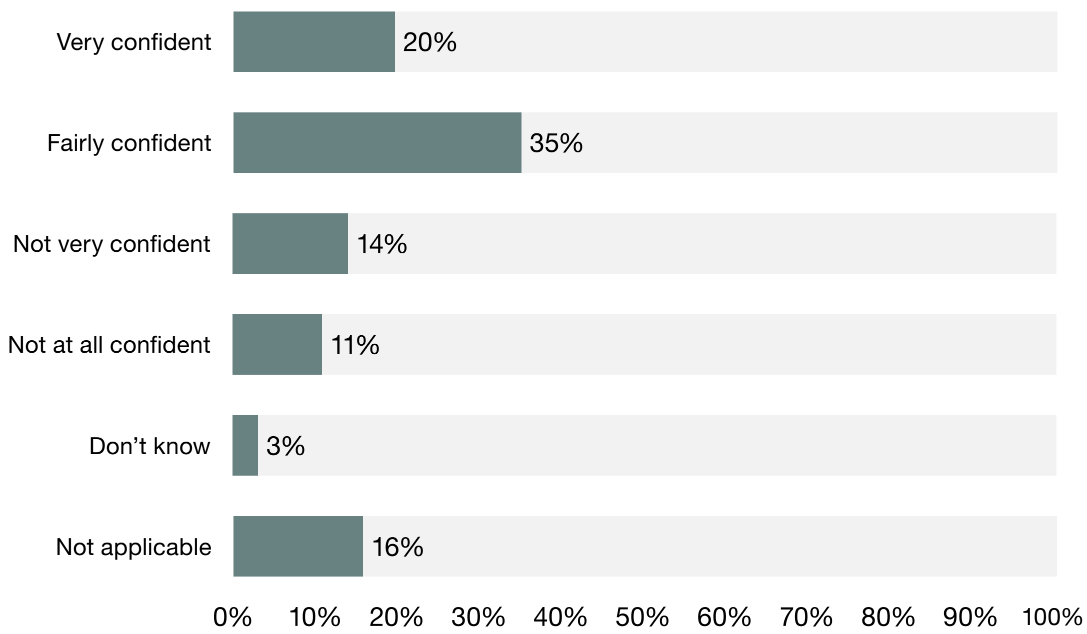


Figure 11

Data: Self-reported confidence when travelling on smart motorways among adults in England

Description: 55% percent of respondents said they are very or fairly confident when travelling on smart motorways in the last 12 months

Source: National Highways Customer Experience Tracker survey, sample size of 30,002 respondents

55% percent of respondents said they were very or fairly confident when travelling on smart motorways

Between January and December 2023, 55% percent of respondents said they were very or fairly confident when travelling on smart motorways (20% said very confident and 35% said fairly confident). This compared with a smaller proportion, 25%, who said they were not very or not at all confident (14% said not very confident and 11% said not at all confident) and 3% said they did not know. Some 16% responded not applicable to indicate that they did not travel on smart motorways[32]. The following groups were more likely than average to say they felt very or fairly confident when travelling on smart motorways compared to the 55% overall.

- Those aged 16-24 (58% compared with 55% overall)
- Ages 25-34 (70%) and 35-44 (68%)
- Men (64%)
- Respondents in work (64%)
- Respondents in ABC1 social grades[33] (62%)

This represents some overlap with the groups who drove or rode on the SRN frequently (at least once a week in the past 12 months), and who knew a great deal or fair amount about smart motorways – for example, respondents aged 25-34 and 35-44, men, those in work and respondents in ABC1 social economic grades.

As above, people aged 16-24 were more likely than average to say they felt very or fairly confident when travelling on smart motorways. However, they were among the groups most likely to say they had either never heard of smart motorways or had heard of but knew nothing about them. Respondents aged 16-24 were also the most likely to say they had not travelled on the SRN as a the past 12 months.

The following groups were more likely than average to say they felt not very or not at all confident when travelling on smart motorways compared to 25% overall.

- Those aged 55-64 (35%)
- Ages 65-75 (35%)
- Women (29%)
- Respondents who are not in work (30%)
- Respondents in C2, D and E social grades[34] (26%)

These were also the subgroups who were most likely to drive or ride on the SRN infrequently or not at all. Some (but not all) of these subgroups were also more likely than average to say they did not know about smart motorways before completing the survey – this is the case for women, respondents who are not in work and those in C2DE social grades. However, this was not the case for respondents aged 55-64 and 65-75, who were no more likely than average to say they had not heard of smart motorways (but were more likely than average to say they know just a little).

In November 2023, a one-off survey module was conducted on the Customer Experience Tracker which asked questions about smart motorways, including different types of smart motorway and the technologies which are used on these roads. The survey questions were posed to all respondents who had travelled on the SRN as a driver, rider or passenger in the past 12 months before completing the survey (2,295). Almost six out of 10 respondents (59%) said they have travelled on at least one type of smart motorway in the last 12 months.

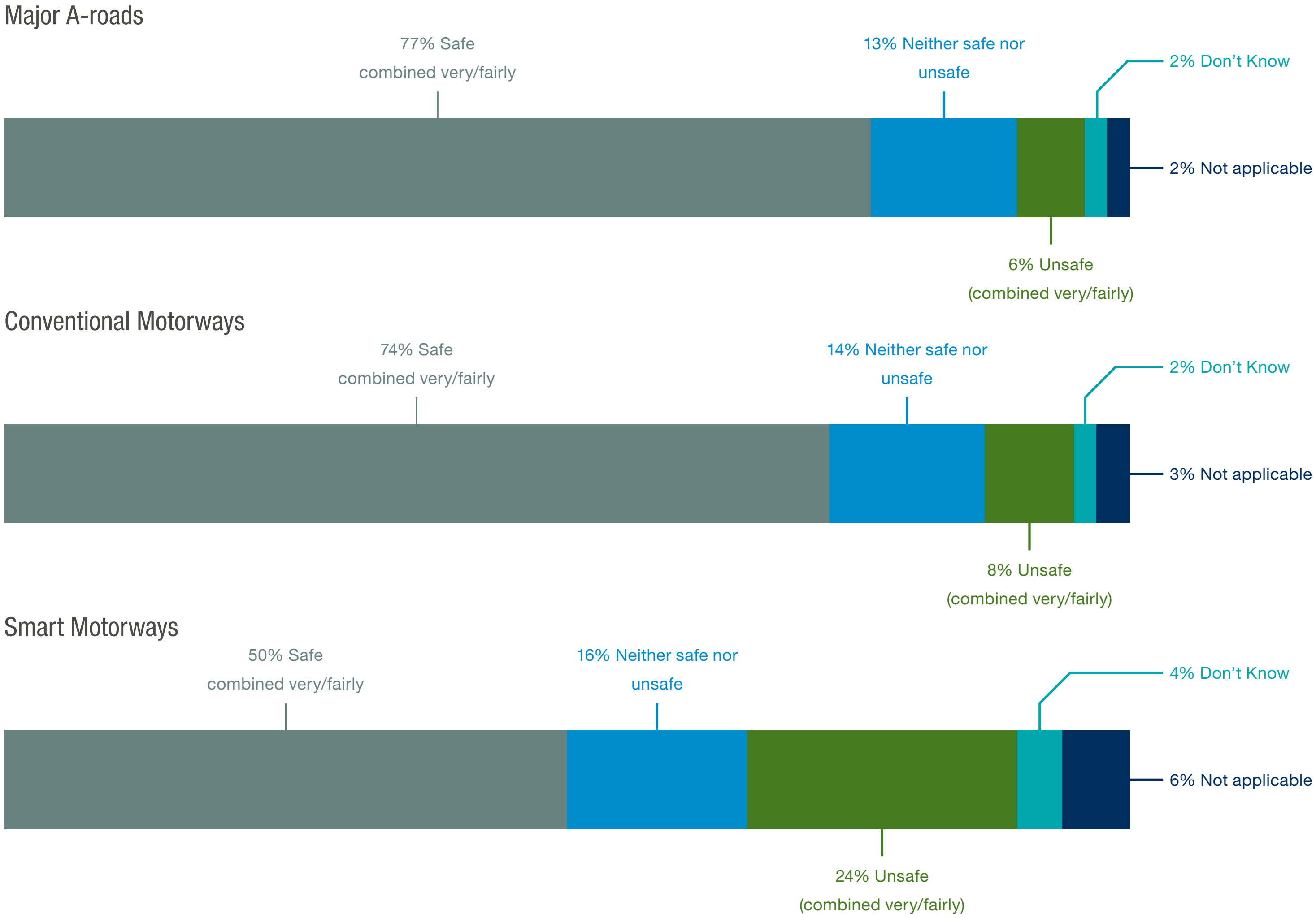


Figure 12

Data: Self-reported feelings of safety when travelling on A-roads, conventional motorways and smart motorways

Description: More drivers felt safe on A-roads and conventional motorways than on smart motorways in the last 12 months

Source: National Highways Customer Experience Tracker, sample size of 2,295

Respondents were significantly less likely to say they feel very or fairly safe travelling on smart motorways compared with conventional motorways or major A-roads. Half of respondents (50%) said they feel safe travelling on smart motorways, compared with 16% who said they feel neither safe nor unsafe and 24% who said they feel unsafe.

By comparison, over three quarters of respondents (77%) said they feel safe travelling on major A-roads (13% said neither safe nor unsafe and 6% said they feel unsafe). Nearly as many (74%) said they feel safe travelling on conventional motorways (14% said neither safe nor unsafe and 8% said they feel unsafe).

Demographic subgroup analysis shows that the groups most likely to say they feel unsafe travelling on smart motorways compared to the overall group of 24% were:

- respondents aged 55-64 (34%)
- respondents aged 65-75 (35%)
- women (27%)
- respondents not in work (30%)

As in the above analysis on confidence in smart motorways, all of these groups were also more likely than average to say they do not feel confident when travelling on smart motorways.

The groups more likely than average to say they feel safe travelling on smart motorways overlap with those who were confident travelling on them and who said they knew a great deal about smart motorways before completing the survey:

- respondents aged 25-34 (65% feel safe compared with 50% overall)
- respondents aged 35-44 (64%)
- men (56%)
- respondents in work (57%)
- respondents in ABC1 social economic grades (54%)
- respondents travelling on the SRN at least once a week as a driver in the past 12 months (58%)
- respondents travelling on the SRN at least once a week as a rider in the past 12 months (74%)

The same survey found that drivers' own skill was considered the most influential factor in keeping people safe on smart motorways (45% selected this from a list of factors), followed by other drivers' skills (40%) and the road conditions (39%).

Self-reported awareness of rules and principles regarding smart motorways

The Customer Experience Tracker survey also asked all respondents, including those who did not regularly drive on smart motorways, how aware or not they were of specific rules and principles regarding smart motorways, before completing the survey. Of those surveyed between January and December 2023:

- 24% said they were not aware that broken white lines between all lanes means there is no hard shoulder and all lanes are available to traffic
- 21% said they were not aware that drivers should not stop in the hard shoulder when speed limits are displayed above this lane
- 20% said they were not aware that solid white lines indicate there is a hard shoulder which drivers should not drive in, unless otherwise indicated by speed limit signs
- 19% said they were not aware that emergency areas are provided at regular intervals where there is no hard shoulder, or where the hard shoulder can be used as an extra lane
- 11% said they were not aware that speed limit signs with a red ring are mandatory and must be obeyed
- 10% said they were not aware that a Red X means the lane is closed.

For each of the above rules and principles asked about, the proportion of respondents who said they were fully aware is greater than the proportion who said they were partially aware.

Speed cameras

Knowledge of smart motorway technology

In the November one-off survey module, respondents were also asked about their knowledge of smart motorway technology. We found that knowledge about the technology on smart motorways varies, with more than four out of 10 (45%) saying they knew a great deal or a fair amount, and five out of 10 (50%) saying they knew not very much or nothing at all.

Overhead electronic signs and signals, emergency areas and SVD technology (where these exist on the relevant smart motorway types) were also more likely than other technologies (such as enforcement and CCTV cameras) to make respondents feel safer.

Overhead electronic signs and signals in particular were considered by respondents the most effective technology type in ensuring smooth traffic flow on different types of smart motorway. Keeping traffic moving smoothly helps prevent the build-up of congestion and associated road traffic collisions.

Summary

- Drivers' actual experience when driving on smart motorways and their overall feelings about them may differ
- Improving compliance with the rules, such as Red X signals, is likely to help increase drivers' confidence
- There is some overlap between the groups that are most likely to drive or ride on the SRN frequently and those who are more likely than average to say they feel very or fairly confident when travelling on smart motorways
- There is some overlap between the groups that are most likely to drive or ride on the SRN infrequently or not at all and those who are more likely to say they feel not very or not at all confident when travelling on smart motorways
- More drivers felt safe on roads which analysis of collision data shows are less safe, with drivers feeling safer on A-roads and conventional motorways
- We continue to gather information on drivers' and riders' feelings of safety and confidence. This will help us to understand how we can provide drivers and riders with further information to enhance their experience of travelling across the whole of the strategic road network.

Safety specific considerations

Hard shoulder and emergency areas

We recognise the importance of being able to stop in a place of relative safety in an emergency. The hard shoulder is perceived to be a place of safety but, in reality, it does not provide a completely safe place to stop. In 2022 there were eight deaths resulting from six fatal crashes, where a vehicle is recorded as entering, leaving or being on a hard shoulder. These figures represent the most deaths and fatal crashes related to the hard shoulder since 2016.

The hard shoulder is perceived to be a place of safety but, in reality, it does not provide a completely safe place to stop

Between 2018 and 2022 there were 23 deaths (out of a total of 407 deaths on motorways) resulting from a vehicle entering, leaving or being on a hard shoulder, which is one out of every 18. Of these deaths, 20 occurred on conventional motorways and three on a controlled motorway. For more information, please see Annex C – Detailed tables. National Highways Operational data, which is not validated to the same standard as STATS19, indicates that there were two additional deaths on DHS motorways which occurred when the hard shoulder was operating as a live lane. Between 2018 and 2022 there continued to be no deaths in emergency areas on ALR and DHS motorways.

Live lane and non-live lane stops

Between 2018 and 2022, there were more than 362,000 stops recorded on live lanes across all road types. Slightly more than four in 10 took place on conventional motorways and slightly more than three in 10 occurred on ALR and DHS motorways. During the same period, more than 746,000 vehicles are recorded to have stopped on a non-live lane location, such as a hard shoulder or an emergency area. This is more than double the number of recorded live lane stops.

As reported in previous progress reports, it is still the case that live lane stops which occur on ALR and DHS motorways are identified more extensively compared to other road types. There are many reasons that may influence our knowledge of live lane stops on different roads.

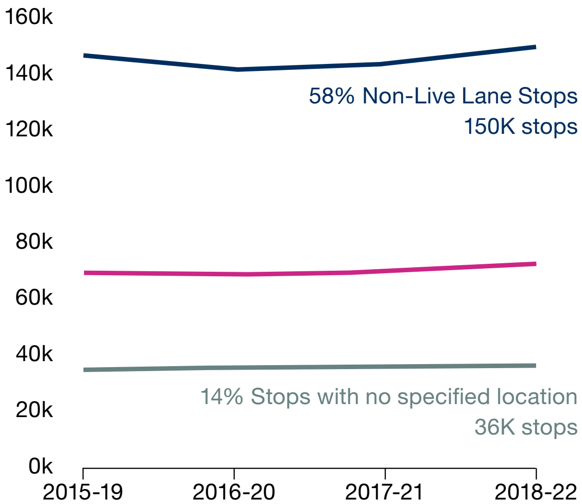
Figure 13

Data: Average incidents per year rounded to nearest 1,000 on SRN roads recorded as having involved a stopped vehicle

Description: Stopped vehicle incidents split by stop location

Source: National Highways operational data

Percentage (and number) of Control Works Stop Events - SRN Motorways



DHS motorway on the M62 in West Yorkshire

For example, ALR motorways include SVD technology, which identifies and then alerts control room operators of vehicles which have stopped in a live lane or an emergency area. ALR, DHS and controlled motorways have additional technology which helps our operators better manage traffic flows and incidents when they are notified. Stopped vehicles, whether in a live lane or non-live lane, occur across our network including locations where this technology is not present or roads which are not routinely patrolled by traffic officers. The bias in this data means that comparisons of the number of stopped vehicles recorded on different road types are inappropriate and are not a reliable indicator of actual safety. For more information, please see Annex B – Methodology.

Smart motorway operational data

The operation of roadside technology on our ALR motorways is given high priority. We monitor the operational performance of smart motorway technology, and how we operate it, using a range of metrics/performance indicators. Data for the 2023 calendar year for each of these metrics/performance indicators is summarised below.

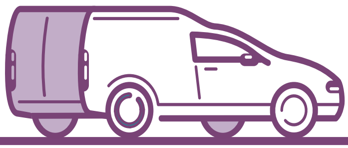
SVD technology: Availability of this technology exceeded the 95% target every month, with availability between 98% and 99% each month.

CCTV availability: Performance exceeded the 95% target in 10 out of 12 months.

Warning signs availability: Performance was below our 95% target each month, with eight months between 90% and 92% with the lowest reporting month being 88%.

Speed control signals availability: We have met or been close to achieving the 95% target most months with performance exceeding 94.5% in 10 of the 12 months. We are working to restore the target as soon as possible. Some 146 advanced motorway indicators (AMIs) are planned to be installed next year.

Time to set electronic signs: We achieved in 11 months, the 95% target to set signs within 90 seconds of an alert.



Red X and lane closure sign in use on ALR motorway

Set speed signs: We have achieved our target of the median time to set speed signs being no more than three minutes, achieving this every month in 2023. Our level of performance has typically been between two minutes and two and a half minutes.

Traffic officer attendance time on ALR motorways: Each month we achieved our target of an average attendance time of 10 minutes to assist a stopped vehicle where emergency areas are more than a mile apart.

Stopped vehicles identified in a live lane on an ALR motorway by SVD technology: The number of stopped vehicle alerts verified by a control room operator has ranged between 1,500 and 2,600 each month with typical months exceeding 2,000. There is not a target for this measure and other means are also used to identify stopped vehicles on ALR motorways including in emergency areas.

We recognise that our roadside technology is not performing to the level we would want it to be, or our road users would expect. We recognise the importance of our traffic management systems and roadside technology in controlling and operating our network, responding to incidents and helping keep people safe and informed.

We have therefore committed £105m over the final two years of the second road investment period to meet our intent to improve the availability of warning signs (signs), speed control signs (signals), CCTV and MIDAS on ALR sections to 97%. We are committed to going even further and will ensure future funds are focused on improving our operational technology systems, allowing our Operators in our Regional Operations Centres to have reliable and well performing tools, and to improve road user confidence.

Recognising that no technology is 100% reliable, we have well-rehearsed plans to mitigate for planned or unplanned events, which include lowering speed limits, increasing patrols by our traffic officers, enhanced monitoring of CCTV, and using pre-positioned vehicle recovery to speed up attendance and clearance of stranded vehicles. We are exploring a range of improvement initiatives to improve performance and speed up repairs, reducing the safety risk to our Traffic Officers, road workers and improving the road user experience, helping them feel safer.

‘Before versus after’ report

In early 2020, we published the *Smart Motorway All Lane Running Overarching Safety Report 2019*[35], which compared the safety of nine ALR motorway schemes before their construction and after their opening.

The ORR 2021 *Quality assurance of all lane running motorway data*[36] report recommended updating the 2019 report and to include DHS motorway schemes. In the *ORR Quality Assurance of All Lane Running Motorway Data - Highways England Response to ORR Key Findings & Recommendations*[37], we committed to undertake this analysis. The outcome of this was the *Smart motorways scheme safety -*

Smart motorway technology

'Before' versus 'after' assessment[7], commonly referred to as the 'before versus after' report. This report went beyond the commitment in response to the ORR's report and assessed a total of 37 smart motorway schemes[38].

In this progress report, we have updated the analysis in the before versus after report to incorporate the 2022 safety data and some minor methodological improvements. In addition to this, two more ALR schemes now have at least one year's worth of 'after' data, bringing the total to 39 schemes covered. This includes 17 ALR, seven DHS and 15 controlled motorway schemes.

Our analysis compares five years' worth of safety data before the schemes' construction started and up to five years after opening and helps us to understand how each scheme's safety compares between before each scheme was constructed and after. More than two-thirds of all smart motorway schemes and just under a half of ALR motorways have five years' worth of after data.

Due to differences in the amount of data available per scheme, any direct comparisons between scheme safety should be made with significant caution.

Where appropriate, we have also calculated the counterfactual, meaning a hypothetical, after-period, estimating what could have happened if the specific locations had not been converted to smart motorways. This gives an indication as to whether changes in safety data may be due to a scheme or to other external factors. In this progress report, we have undertaken this counterfactual only in relation to PIC rates.

As highlighted in the ORR 2021 *Quality assurance of all lane running motorway data report*[36], when schemes are constructed over different time periods the counterfactual is specific to each scheme. Because collisions fluctuate from year-to-year, the counterfactual can be very sensitive to the precise years chosen. This is particularly the case for FWI rates, which place greater emphasis on deaths and serious injuries, and KSI rates, which place equal emphasis on deaths and serious injuries. Both of these metrics are influenced by the STATS19 adjustment factors, whereas PIC rates are not. For this reason, we have chosen not to calculate the counterfactual for FWI and KSI rates.

Based on the available data to date, the updated analysis undertaken for this progress report shows that most ALR, DHS and controlled motorway schemes (25 out of 39) have seen a reduction in PIC rates after they were constructed both against the before and the counterfactual. Most schemes (37 out of 39) have also seen a reduction in FWI rates. This has also been the case for most schemes (27 out of 39) for the KSI rates.

In our 2023 *before versus after report*[7], we took a conservative approach to conducting and presenting the analysis. Following feedback from, and discussions with, DfT and ORR, we explored several options for further methodological improvement in the updated analysis presented in this progress report.

Most ALR, DHS and controlled motorway schemes have seen a reduction in PIC rates after they were constructed

One of these changes has been to include data for the most recent five-year period (2018-2022), where schemes have been open long enough that it does not overlap with the after period. This allows us to compare older schemes' current performance with the before and after periods.

Data for the most recent five-year period has been included for 12 schemes, including four DHS and eight controlled motorway schemes. Our analysis showed that all 12 schemes saw reductions in PIC rates in the recent period, compared to both the before and after periods. The recent FWI and KSI rates, where there is more variability in the data, showed improvements for 10 and 9 out of the 12 schemes respectively. For more information on the changes made to the methodology see Annex B - Methodology.

Emergency area with free flowing traffic

Safety reviews and assessments

Safety reviews are reports that recommend safety improvements within a scheme through in-depth STATS19 analysis, as well as from other sources such as operational data. As part of our response to the 2020 Stocktake, we completed detailed safety reviews for the M1 junctions 30 to 35, M1 junctions 39 to 42 (ALR motorways), M1 junctions 10 to 13 and M6 junctions 5 to 6 (DHS motorways)[39].

As reported in our *Third year progress report*[28], as part of our business-as-usual activities, we have already undertaken safety reviews of all of the ALR and DHS motorways which had not already been subject to safety reviews following the 2020 Stocktake. We have done the same for the M60 junctions 8 to 18 (controlled motorway) scheme.

The detailed safety reviews led to a list of recommended actions to further improve safety, such as removing vegetation potentially obscuring traffic signs and introducing measures to prevent pedestrians accessing the network. These actions have been discussed with the relevant regional operations teams, who are currently working through the recommendations.

As the results of the 2023 *before versus after report*[7] analysis began to emerge, we also undertook desktop safety assessments to understand the latest safety data (if available) and to better understand why some locations in their after period show increased rates compared to the before period (counterfactual - PIC, actual - FWI and KSI). We completed both the safety reviews and desktop safety assessments in Autumn 2023.

The conclusions of the safety assessments report were consistent in recommending no further safety reviews are required. For more information on the results of the safety assessments and the conclusions, please see Annex B - Methodology.

We will continue to monitor the safety of sections where the after period has improved compared to the before period. We will also continue to monitor and evaluate the safety of our network over the coming years as more data becomes available, including for recently opened ALR schemes.

Emergency area sign

Action plan monitoring and evaluation progress summary

Now that the stocktake actions are complete, the evaluation is moving from planning into initial analysis. It is looking, in turn, at the three activity areas:

- Giving clarity to drivers
- Finding a safe place to stop
- Being safer in moving traffic.

During the autumn of 2023, we examined data with a baseline of 2016 to 2018 against periods of time after stocktake action implementation. The results were inconclusive, showing slight reductions in live lane stops on sections where the rate had previously been high, but with some increase in rates elsewhere, leading to no statistically significant difference overall. Further analysis of road safety data concluded that given the relative rarity of stopped vehicle collisions, it was too early to judge if the stocktake actions had impacted on these. Further, multiple-year data would be needed.

Following on from this analysis, a more detailed examination of the data has been commissioned. This will re-examine the choice of baseline years and consider sub-groupings of smart motorways by different types and user groups to pick up trends masked by analysing them as a single population. This work is being coordinated with the evaluation of the national programme to install additional emergency areas on ALR motorways, which may further influence the rate of live lane stops on smart motorways.

Work on the other areas continues, with planning for the evaluation of Red X compliance and the impact of SVD technology.

Traffic officer vehicle

Conclusion

Our work in delivering the 2020 Action Plan is now complete. While this report closes our action to issue an annual safety performance report specifically monitoring smart motorways, going forward we will include smart motorway safety performance analysis in our annual *Road safety performance overview report*[2]. This wider analysis will consider the performance of all our roads, including smart motorways, giving an even more comprehensive picture.

We will continue to measure the safety performance of our roads and we will act wherever needed, to help provide drivers with safe and reliable journeys

The analysis of our smart motorway network over the past four years has helped us further develop our detailed understanding of road safety, not just on smart motorways but across the whole strategic road network.

The findings of our fourth year progress report are consistent with our previous progress reports. No one type of motorway, smart or conventional, is ranked best against every safety metric.

The latest safety data continues to show that overall, all three types of smart motorway are safer than conventional motorways for those safety metrics which consider the most significant impacts, such as deaths or serious injuries.

Whilst we have made significant progress over the past four years, there is always room for improvement. Going forward, we will continue to measure the safety performance of our roads and we will act wherever needed, on motorways and A-roads, to help provide drivers with safe and reliable journeys.

We remain committed to working closely with drivers and our partners, including the DfT and ORR, as we continue to deliver roads for the future.

Annex A – Smart motorways map

(correct as of December 2024)

ALR motorway

- 3 M1 Junction 13 - 16
- 4 M1 Junction 16 - 19
- 6 M1 Junction 24 - 25
- 8 M1 Junction 28 - 31
- 10 M1 Junction 32 - 35a
- 11 M1 Junction 39 - 42
- 12 M3 Junction 2 - 4a
- 14 M4 Junction 3 - 12
- 16 M5 Junction 4a - 6
- 17 M6 Junction 2 - 4 (i)
- 22 M6 Junction 11a - 13
- 23 M6 Junction 13 - 15
- 24 M6 Junction 16 - 19
- 25 M6 Junction 21a - 26
- 26 M20 Junction 3 - 5
- 28 M23 Junction 8 - 10
- 30 M25 Junction 5 - 6
- 35 M25 Junction 23 - 27
- 37 M27 Junction 4 - 11
- 41 M56 Junction 6 - 8
- 43 M62 Junction 10 - 12
- 44 M62 Junction 18 - 20

i) M6 Junction 3a to 4 **Controlled motorway**

ALR schemes cancelled

- 13 M3 Junction 9 - 14
- 33 M25 Junction 10 - 16
- 38 M40 - M42 interchange
- 45 M62 Junction 20 - 25

DHS motorway conversion to ALR cancelled

- 2 M1 Junction 10 - 13 (ii)
- 15 M4 - M5 interchange (iii)
- 18 M6 Junction 4 - 5 (iv)
- 19 M6 Junction 5 - 8 (v)
- 20 M6 Junction 8 - 10a
- 39 M42 Junction 3a - 7
- 46 M62 Junction 25 - 30 (vi)

ii) M1 Junction 11a to 12 **DHS infrastructure**, short link with motorway service area slip roads and no hard shoulder for part of link

iii) M4 Junction 19 to 20 M5 Junction 16 - 17

M5 Junction 15 to 16 **Controlled motorway**

iv) M6 Junction 4 to 4a southbound **Controlled motorway**

v) M6 Junction 7 to 8 **DHS infrastructure**, short link with no hard shoulder

vi) M62 Junction 25 to 26 **DHS infrastructure**, short link with motorway service area slip roads and no hard shoulder

M62 Junction 28 to 29 **Controlled motorway**

M62 Junction 29 to 30 **DHS infrastructure**, short link with no hard shoulder (westbound only)

Controlled motorway

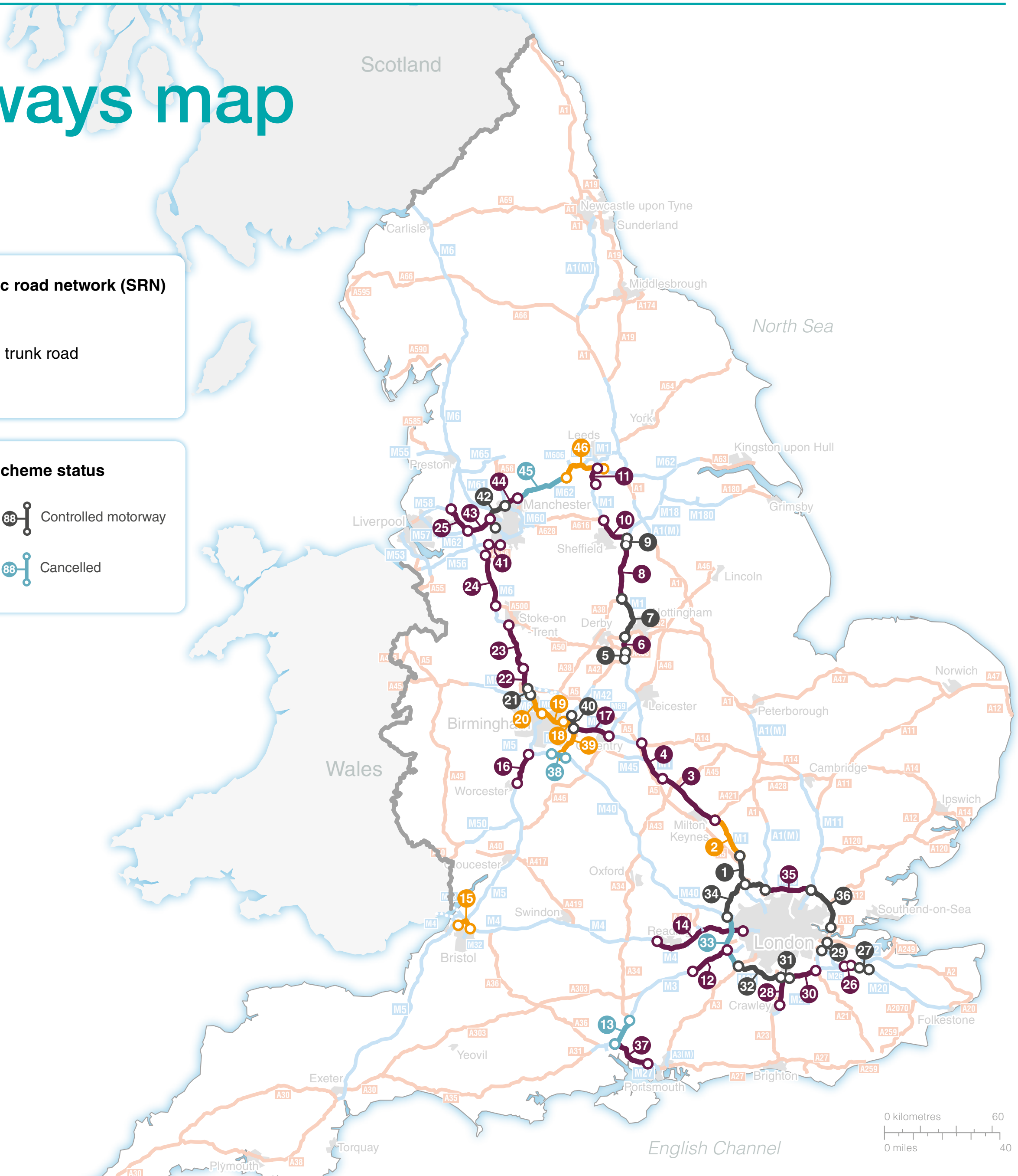
- 1 M1 Junction 6a - 10
- 5 M1 Junction 23a - 24
- 7 M1 Junction 25 - 28
- 9 M1 Junction 31 - 32
- 21 M6 Junction 10a - 11a
- 27 M20 Junction 5 - 7
- 29 M25 Junction 2 - 3
- 31 M25 Junction 6 - 7
- 32 M25 Junction 7 - 10
- 33 M25 Junction 10 - 16
- 34 M25 Junction 16 - 23
- 36 M25 Junction 27 - 30
- 40 M42 Junction 7 - 9
- 42 M60 Junction 8 - 18

England's strategic road network (SRN)

- Motorway
- All purpose trunk road
- Toll roads

Smart motorway scheme status

- 88 ALR motorway
- 88 Controlled motorway
- 88 DHS motorway
- 88 Cancelled



National Highways creative BHM22_0037. Information correct as of **December 2024**
This map is intended to provide a high level representation of the smart motorway network and there may be local variations

Annex B – Methodology

Assurance

As with the third progress report, this analysis has been subject to five levels of assurance.

The first level is undertaken by the suppliers delivering the analysis to identify and address any material issues with the inputs, calculations, outputs and supporting methodology.

The second level is undertaken by the team commissioning the analysis within National Highways and includes, but is not limited to, replicating inputs and calculations using the same methodology as the supplier to reach the same results, so called ‘dual running’ of the analysis.

The third level is undertaken by a team within National Highways who have not been part of the analysis and can provide a degree of independence. This step highlights potential issues or concerns on the overall approach, specific analysis or supporting methods.

The fourth level is undertaken by DfT who review the analysis, its supporting methods and presentation to gain confidence in the results.

The fifth level is undertaken by the ORR to gain further confidence in the safety conclusions of this report.

Data sources

Road injury data in Great Britain is collected via the STATS19 process. These statistics are collected by police forces, either through officers attending the scene of incidents, from members of the public reporting the incident in police stations after the incident, or more recently online and then validated and published annually by DfT in the autumn. This provides details of the previous calendar year (for example, DfT published the 2022 calendar year dataset at the end of September 2023). The safety analysis presented here is developed by National Highways using STATS19 data (unless stated otherwise).

Injury data can change considerably from year to year, depending on circumstances in any given year. Injury rates can be sensitive to small changes in the absolute number of injuries. Such changes can be more prominent for

Free flowing motorway traffic

Every injury is important. The STATS19 database is a collection of all collisions that resulted in a personal injury and were reported to the police

specific schemes or parts of the SRN, and less so for wider geographical areas (for example the full SRN or Great Britain). Volatility is an issue as it can obscure more meaningful conclusions that can be drawn from the data. When considering injury statistics, looking at the average over a recent set of years reduces the impact of volatility and helps identify trends. This report uses the last eight years of available data (2015-2022).

STATS19 data as provided by DfT reflects the situation at the time the annual statistics are produced. Subsequently, further information may become available which may suggest that some incidents should have been either in or out of scope.

Every injury is important. The STATS19 database is a collection of all collisions that resulted in a personal injury and were reported to the police within 30 days of the incident. The analysis supporting this report reflects the same threshold of 30 days. One smart motorway death has historically been omitted from STATS19. This was manually added in the 2020 Stocktake, and previous progress reports and will continue to be added in subsequent overall smart motorways reporting. This means that while this is added in summary tables, detailed analysis (such as contributory factor analysis) excludes this incident as the supporting information is not available on STATS19. To reflect this, relevant table clarifications and footnotes have been added throughout this report.

Live lane stop data (unless stated otherwise) reflects stops recorded on National Highways' Incident Management system (ControlWorks). This system records stops that National Highways has been informed of and its primary purpose is to enable operational teams to manage these incidents.

National Highways adopted ControlWorks in September 2016, replacing the previous incident management system. Previous reports such as the first- and second-year progress reports also referred to live lane breakdowns.

Live lane stops can include stops over and above live lane breakdowns, such as medical episodes. The safety analysis in this report has been updated to reflect all reasons for live lane stops.

Over time we have observed that live lane stops which occur on ALR and DHS motorways are identified more extensively compared to other road types. There are many reasons that may influence our knowledge of live lane stops on different roads. For example, ALR motorways include increased use of technology which help our operators manage traffic flows and incidents and detect stopped vehicles faster.

This means that ALR motorways are likely to have more and/or better information captured for stops compared to other road types. This means that comparisons on vehicle stop data per road type should be made with caution, as ALR and DHS motorways are likely to have considerably better reporting.

Vehicle stops can take place both on live lanes and non-live lane locations, such as a hard shoulder or emergency area. Live lane stops are all stops recorded on ControlWorks where the location has been categorised as being in a live lane. Vehicle stops where the location is not specified or recorded as not being in a live lane, are excluded. The methodology used to provide the data in this report and its subsequent outputs may differ to methodologies used in different analyses at different points in time. This is due to continuous improvements of data mapping, capture and quality, as well as changes in reporting, for example updating the data extraction method to reflect live lane stops rather than live lane breakdowns. As these factors evolve over time any comparison with earlier data or data from other sources, should be interpreted with caution.

Mapping process

To ensure that the report reflects the most up-to-date and accurate available version of the National Highways network, each collision was spatially matched to a link in a modified version of the National Traffic Information Service network model (NTIS) which reflects the conventional and smart motorway network based on junction-to-junction sections. This modification was necessary because scheme start and end points do not always coincide exactly with the extent of NTIS links. This is published as Annex G - Network shape file for collision mapping.

Spatial matching was based on proximity, then verified by cross checking other collision variables including road number and direction of travel. It also took proximity to roads managed by other authorities into account, using the OS Highways layer.

ALR motorways are likely to have more and/or better information captured for stops compared to other road types

Lane one closure for traffic officer customer assitance

This methodology differs in detail from that used in previous reports. The process was changed because this approach is the optimal way of reflecting the actual extent of the National Highways network with precision, given currently available data.

National Highways provided our supplier with a lookup table which matched modified NTIS links to smart motorway schemes. Attributes of each scheme included its start and end dates, and categorised it as one of three types: controlled, dynamic hard shoulder, or all lane running. The assignation of links to schemes was derived from the same scheme start and end locations used in previous reports. The overall effect of using the modified NTIS links improved accuracy, because of the inherently greater fidelity of the NTIS network.

This table was used to assign each collision to a smart motorway scheme. This process compared collision dates to scheme dates, ensuring that the classification of each collision reflected the carriageway features present at the time. Collisions matched to motorway NTIS links which were not part of a scheme when the collision occurred were classified as conventional motorway collisions.

Mitigation for Methodology Changes

Because a different network model was used for collision matching in previous years, there was some inconsistency with collision scheme assignments published in annexes of previous reports for collisions before 2022. For this reason, total collisions for each scheme type in those years do not tally exactly with previously published data.

To mitigate this, assignment of collisions to scheme types in 2015 to 2021 were directly compared to historic assignment of the same collisions in previous reports. To minimise any possibility of smart motorway collisions being inadvertently excluded, a ‘Safety First’ approach was adopted for collisions with different outcomes between current and previous methodologies, prioritising their inclusion in smart motorway analysis.

Therefore, any discrepancy between the methodologies would result in over rather than under estimation of smart motorway collisions.

Based on this comparison, the assignment of collisions to smart motorway scheme types where discrepancies arose was refined as follows:

- All collisions matched to smart motorway schemes using the current methodology were included as smart motorway collisions, even if they had not been matched to smart motorway schemes by previous reports
- All collisions matched to smart motorway schemes in previous reports which did not match the National Highways Motorway network under the current methodology were retained as smart motorway collisions
- All collisions matched to different smart motorway scheme types using the current methodology from their assignations in previous reports were included under their new types
- All collisions matched to the National Highways Motorway network but not to smart motorway schemes using the current methodology were counted as conventional motorway collisions, even if previous reports had assigned them to a smart motorway scheme.

This process of refinement was conducted objectively, using quality assured programmatic processes. Agilysis did not make any manual adjustments to which scheme, and therefore which smart motorway type, each collision was assigned.

Following this process, the overall 2015 to 2021 collision totals for each scheme type was compared to previous reports. The observed variation was small, which indicates that improvements made to the methodology did not substantively change the overall picture. In total over seven years of collision data 298 (0.5%) collisions between 2015 to 2021 were attributed to a different road type compared to the third-year progress report methodology. The largest impact was on 168 collisions which were previously attributed to conventional motorways now being attributed to controlled motorways. These changes in attribution are reflected in Annex D which shows individual collisions along with casualty information, the road type they were attributed to in this report and the road type they were attributed to in the third-year progress report.

Headline safety metrics

The ORR suggested in its 2021 ***Quality assurance of all lane running motorway data report***[36] that 'a smaller number of 'headline' metrics should be used to communicate safety'. In discussions with the ORR review team, it was acknowledged that selecting a single safety metric may be subject to challenge as each metric will have its own limitations. For this reason, this report uses a set of headline metrics which were used on the previous two progress reports.

This report uses a set of headline metrics which were used in previous progress reports

Personal injury collisions (PIC) – These are the number of collisions which have resulted in a person sustaining an injury. PICs do not reflect the number of people injured in each collision (casualties). This metric has certain benefits, such as not including uncertainty from (i) random effects, for example a coach accident leading to multiple injuries (casualties) and (ii) non-random effects on vehicle type and vehicle occupancy, such as socio-demographic effects. On the other hand, collisions do not reflect the number of injured people involved.

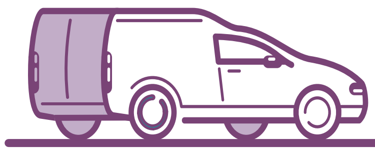
PIC rates accounting for traffic flow – A rate calculated using the number of PICs and the total miles travelled on a road section or type. This metric allows roads with heavy traffic or which span a long distance to be compared against roads which carry less traffic or which span a shorter distance. The rate is presented as the number of collisions per hundred million vehicle miles (hmvm), which is an established way of assessing rates across the road sector.

Fatal and weighted injuries (FWI) – A metric which weights and aggregates the number of people that have been injured in collisions. It gives a fatality 10 times the weighting of a serious injury, and a serious injury 10 times the weighting of a slight injury. This is calculated as follows: Fatal and Weighted Injuries = Fatal + Serious injuries * 0.1 + Slight injuries * 0.01. In its 2021 *Quality assurance of all lane running motorway data*[36] report, the ORR highlighted that 'the methodology was derived from that used by the Rail Safety and Standards Board (RSSB). RSSB has since adopted new weightings for calculating FWI, but we consider that the weightings used by Highways England were appropriate'. These weightings continue to be largely aligned with the 'average value of prevention per casualty' set out by DfT's Transport Analysis Guidance data book. While FWI recognises all injuries, it acknowledges that not all injuries are equal.

FWI rates accounting for traffic flow – A rate calculated using the aggregate FWI and the total miles travelled on a road section or type. This metric allows roads with heavy traffic or which span a long distance to be compared against roads which carry less traffic or which span a shorter distance. The rate is presented as the aggregate FWI per hundred million vehicle miles, which is an established way of assessing rates across the road sector.

ALR motorway, West Yorkshire

Millions of drivers use our network, and fortunately collisions which result in injuries are rare



Killed and seriously injured (KSI) – The severity-adjusted number of people killed and seriously injured in collisions. KSIs are a simple aggregation of fatal and serious injuries, ie no weighting applied to either. While this means that the metric's methodology is simple, KSIs do not account for slight injuries. Therefore reporting only this metric may undermine the importance of slight injuries.

KSI rates accounting for traffic flow – A rate calculated using the number of people who are killed and seriously injured, and the total miles travelled on a road section or type. This metric allows roads with heavy traffic or which span a long distance to be compared against roads which carry less traffic or span a shorter distance. The rate is presented as the severity-adjusted number of KSIs per hundred million vehicle miles (hmvm), which is an established way of assessing rates across the road sector.

Adopting all the above metrics means that safety can be assessed both in absolute and relative terms (considering both number of collisions and injuries and rates normalised per traffic flows). Rates may be more meaningful for safety comparisons compared to absolute values as they avoid certain issues, such as suggesting that the least used roads are the safest roads.

Averages

Millions of drivers use our network, and fortunately collisions which result in injuries are rare. As a result, the number of collisions, and the number of deaths or injuries resulting from those collisions, are subject to a degree of fluctuation, particularly when reviewed at a localised level, such as on specific schemes. To be more certain that the differences, if any, that we see are due to a change in safety rather than within what could be seen as the normal range of fluctuation, it is preferable to capture as many data points as possible. A minimum of three years of data is required to be considered sufficiently robust to assess the safety on different parts of the network.

Data for a single year or averages over shorter periods, such as three-year averages, are likely to be impacted more by external rare systemic events, such as Covid-19. Such events can skew the data and increase analytical uncertainty. For example, if a three-year average was selected, then the three-year average between 2019 and 2021 would be even more impacted due to traffic flows being lower in 2020 and 2021. This would make comparison between this three-year period with other three-year periods even more difficult.

Instead, using a wider data range such as the five-year average selected in this report, helps to reduce the impact of rare systemic events, such as Covid-19, and make some comparisons more meaningful.

The average used in this and previous reports, such as the 2020 Stocktake and the previous three progress reports, takes into account the relative importance of traffic flows (weighted average). This is calculated as the sum ([PIC/FWI/KSI] for calendar year * HMVM traffic for that year)/sum (HMVM traffic for five-year period). A weighted average is sometimes more accurate than a simple average, as it accounts for changes in traffic flows over a period of time.

Considering a five-year average, rather than an average for all available years, means that in the future this analysis will evolve to reflect the five-year rolling average metrics which is in line with good reporting practices.

Road length and traffic statistics

This analysis uses DfT road length and traffic statistics with inputs provided by National Highways. This report reflects minor changes in road lengths over time due to detailed information added at a scheme level.

Traffic statistics are usually published by DfT as an annual average. In line with the 2020 Stocktake and previous three progress reports, DfT has apportioned the road lengths and traffic flows depending on the month and year that each scheme opened. Additionally, the traffic statistics produced for this report reflect the SRN at the end of each calendar year. This year DfT has made some minor changes both for 2022 and historical road length and traffic statistics as more detailed information has become available. For more information, please see Annex C – Detailed tables.

Covid-19 effect

The STATS19 dataset for both 2020 and 2021 collisions is heavily influenced by the rare event of the Covid-19 pandemic, which caused three national lockdowns and various regional restrictions throughout that period of time.

The peak impact of the pandemic saw a significant reduction in traffic in April 2020 compared to the same period the year before (see the Vehicle speed compliance statistics for Great Britain: July to September 2021 published by DfT). Over more than a year, traffic across the SRN fluctuated as there were three major lockdowns. By June 2021, overall road traffic levels had returned to levels close to those seen before the pandemic.

The peak impact of the pandemic saw a significant reduction in traffic

This is likely to have impacted collisions and casualties in two ways: (i) rates per hmvm are likely to have been influenced by changes in traffic flows and (ii) less congestion on various roads may have impacted driver behaviour. The former is reflected in this report and mitigated through the use of five-year average metrics, i.e. two out of five years are

Since 2012, many police forces have changed the way they collect STATS19 data

impacted by Covid-19. The latter is not considered within the scope of this report.

Injury based reporting in STATS19 data

Since 2012, many police forces have changed the way they collect STATS19 data[40]. These changes mean casualty severity is now categorised automatically based on the most severe injury, rather than the judgement of an attending police officer. Police forces using the new systems, called injury-based severity reporting systems (also known as CRaSH and COPA), report more serious injuries than those which do not.

These changes make it particularly difficult to monitor trends in the number of people killed and seriously injured over time, or between areas overseen by different police forces.

In response to these challenges, DfT and the Office for National Statistics (ONS) have developed an approach to adjust the data collected from those police forces not currently using injury-based reporting systems. These adjustments are estimates for how the severity of an injury may have been recorded had the new injury-based reporting system been used. These adjusted estimates apply retrospectively from 2004 and adjust historical data to show casualty severity as if this had been recorded under the new injury-based system. This enables better comparisons across police forces and increases the confidence in safety data captured by police officers.

Until all police forces have started using the new systems, these historical adjustments will continue to be updated every year. Using these adjusted totals allows for more consistent and comparable reporting when tracking severity over time, across a region, or nationally. While there is no impact on collisions, total injuries and deaths, these adjustments do impact serious and slight injuries.

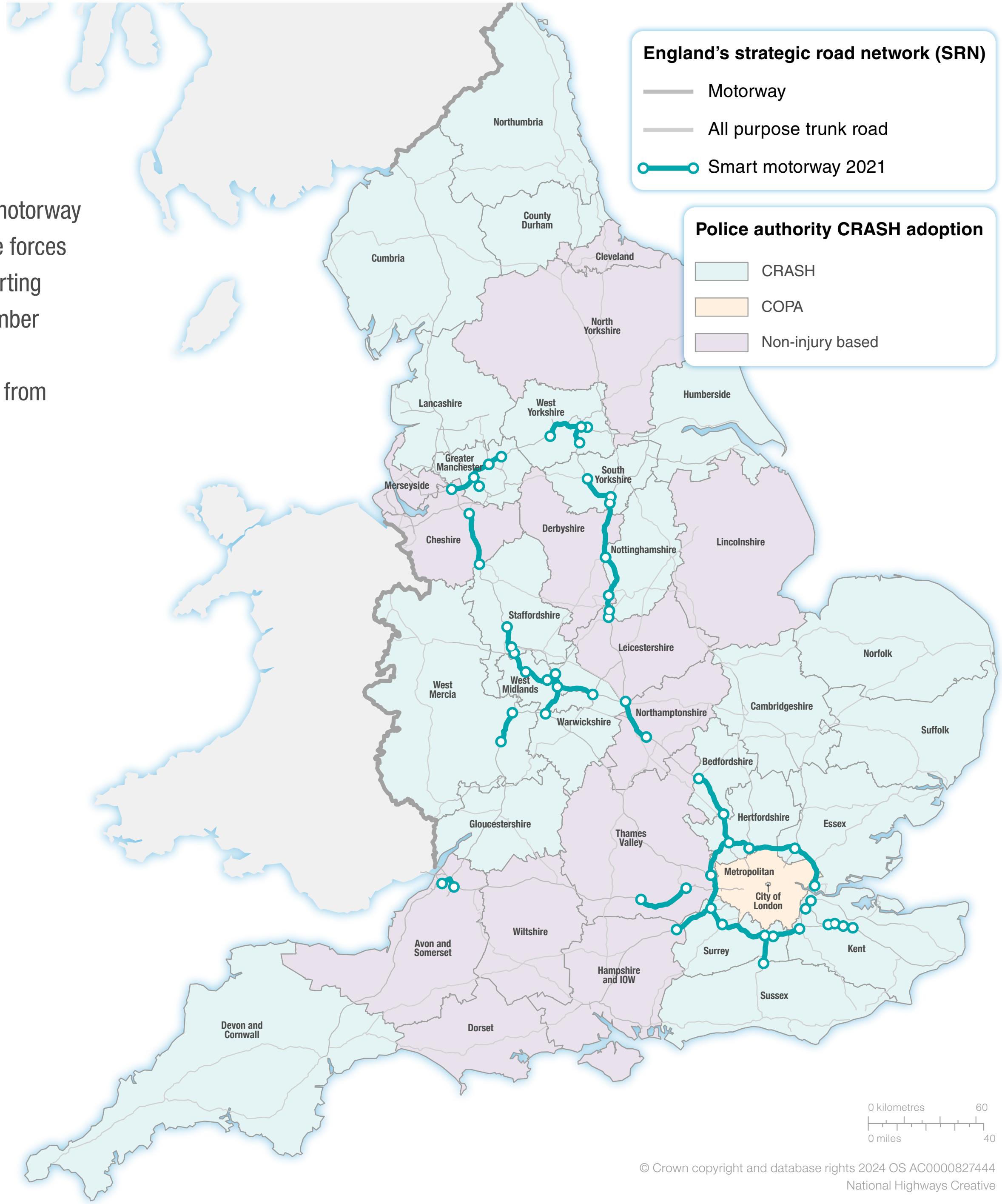
DfT analytical guidance was updated in October 2021 to strengthen advice on including injury-based adjusted figures where possible. Following the same approach as in the second-year progress report, this means that the injury figures reported in the main part of the report are adjusted, ie KSI and FWI, but not PIC as the latter is not influenced by these adjustments. For more information, please see the ***Guide to severity adjustments for reported road casualties Great Britain***[40] published by DfT.

This map shows the smart motorway network as of 31 December 2022. It highlights non-injury-based reporting police forces, CRaSH (Collision Reporting and Sharing) reporting forces and the Metropolitan Police area which has adopted COPA (Case Overview Preparation Application). This map outlines the variances in the collection and reporting of data across individual police forces and highlights the need for a consistent comparison, supporting the application of injury-based reporting adjustments.

Figure 14

Description: Smart motorway network across police forces per injury-based reporting status as of 31 December 2022

Source: Visualisation from National Highways



Contributory factors

As part of the most recent STATS19 review by DfT, a decision was made that contributory factors would be replaced by a new set of road safety factors, designed to reflect the priorities of the Safe System. The planned road safety factors are categorised into six groups, namely Behaviour or Inexperience, Distraction or Impairment, Non-motorised road users, Road, Speed, and Vehicles.

In previous years we have grouped contributory factors into Driver, Vehicle and Environment factors. We have adopted the road safety factor groupings and aligned current contributory factors to their future road safety factor groupings to align with best practice, in accordance with the DfT's STATS19 review 2018[41].

The review decided that some current contributory factors will be deleted. In these cases, we have aligned them to the road safety factor grouping to which they most closely correspond.

For more information, please see Annex C. The outcomes of the review are published in the *STATS19 review: final recommendations*[42], including an annex listing the new road safety factors by grouping and the deleted contributory factors.

Statistical significance testing

The ORR 2021 *Quality assurance of all lane running motorway data*[36] report noted that: (i) 'undertaking significance testing on the headline figures in future would help explain the levels of uncertainty around the results. We recommend that this is developed' and (ii) 'including information about the level of uncertainty associated with the high-level statistics, through statistical significance testing, would add important context to any conclusions'.

Red X signal closing lane one

For the second-year progress report, we developed methods to compare road traffic collision and casualty rates using confidence intervals and hypothesis tests. We invited feedback on the methods and their use from the wider statistical community and have now finalised them.

We are still limited in the high-level statistics with which these methods can be used. Therefore, in this report, we provide the conclusions of applying these methods to the headline five-year average personal injury collision (PIC) rates and five-year average all casualty rates (using data from 2018 to 2022). We have also applied these methods to moving and stopped five-year average PIC rates and five-year average all casualty rates.

As in previous progress reports, we report p-values[43] as they are calculated and interpret them on a continuous scale from zero to one, rather than only in comparison to a threshold. This reflects current best practice guidelines.

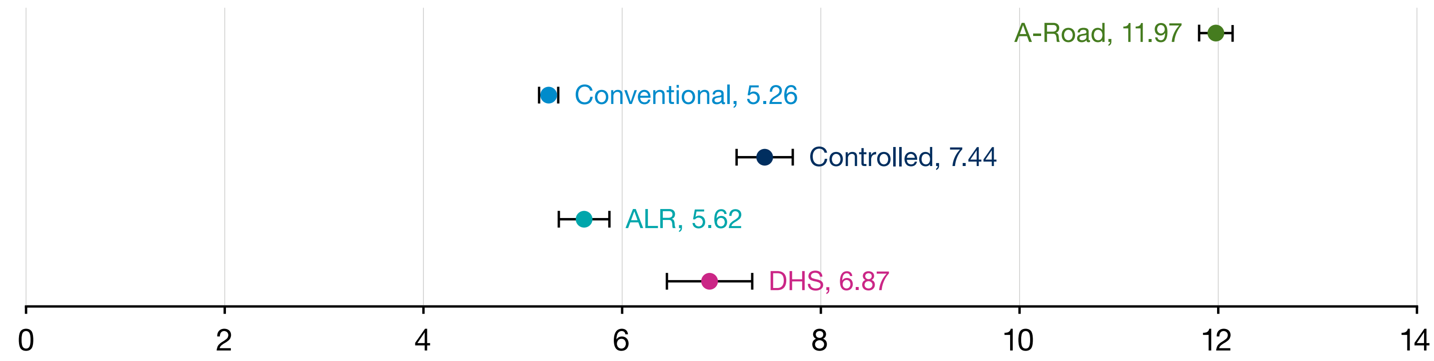
Statistical hypothesis testing can only identify statistical differences. With large volumes of data, very small differences can result in small p-values.

Therefore, statistical differences should not be misinterpreted as important or meaningful differences. Confidence intervals and hypothesis testing are statistical methods that do not take into account the subject matter, nor what is an important difference in collision and casualty rates. That consideration requires subject matter expertise instead of statistics.

Personal injury collision (PIC) rates

We have compared the PIC rates for all road types using a maximum likelihood test. In brief, we have anticipated that road traffic collisions occur according to a non-homogeneous Poisson process with underlying rate dependent on the measured road traffic. From this assumption, we use maximum likelihood techniques to calculate confidence intervals and to formally compare the underlying collision rates through a p-value calculated using a Monte-Carlo approach[44].

PIC Rate: confidence intervals for all road types



The location and size of the 95% confidence intervals of the underlying PIC rates are visually different. This suggests that there is variation in the underlying PIC rates of the different road types. We formally test this hypothesis in subsequent sections. The confidence interval for conventional motorways is narrower than other road types. This is due to the higher traffic volumes on conventional motorways.

PIC rates for all road types

We formally consider whether there is sufficient evidence to suggest that the PIC rates among all roads are different by testing the following hypothesis:

H^0: Underlying PIC rates are the same for all road types

H^1: Underlying PIC rates are not the same for all road types

The computed p-value is 0.000, shown to three decimal places: very close to zero. Therefore, we confidently reject the null hypothesis (H0) and conclude that the underlying PIC rates are not the same for all road types. Comparing all road types in this way is not particularly informative. Given the spread of the locations of the confidence intervals it is not surprising that the formal hypothesis test suggests some differences.

The largest difference in PIC rates is due to the relatively high PIC rate for A-roads. The smallest differences in PIC rates are observed between ALR and conventional motorways, followed by controlled and DHS motorways. We conduct those two formal hypothesis tests to understand how the observed differences in these specific pairs of PIC rates contribute to the small overall p-value.

The confidence intervals give us confidence that the underlying ALR PIC rates are lower than the DHS and controlled motorway PIC rates, and that the underlying conventional motorway PIC rates are lower than the DHS and controlled motorway PIC rates. For this reason, we considered there was no need to formally test these comparisons.

PIC rates for ALR and conventional motorways

We test whether there is a difference in the underlying PIC rate for ALR and conventional motorways with the following hypothesis:

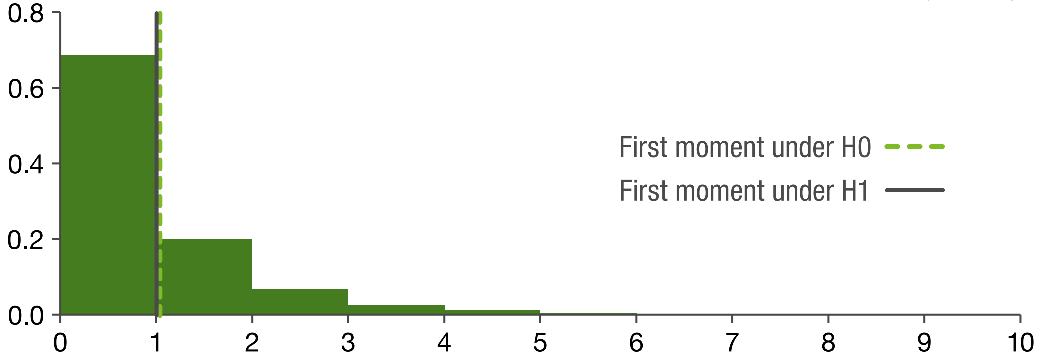
H^0: Underlying PIC rates are the same for ALR and conventional motorways

H^1: Underlying PIC rates are not the same for ALR and conventional motorways

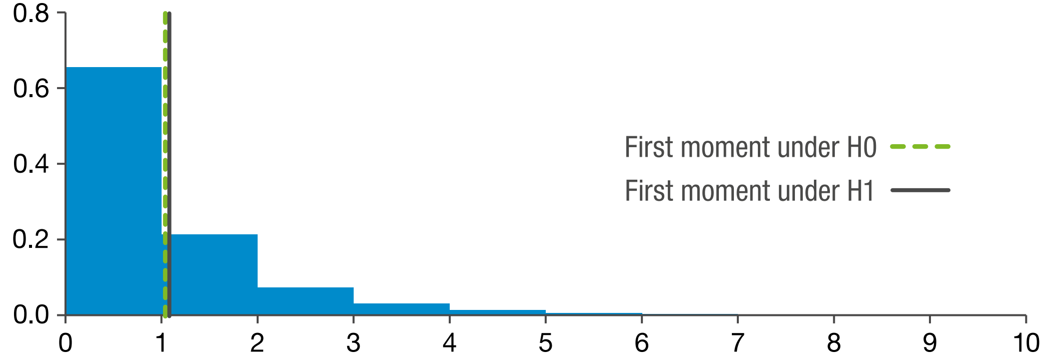
The computed p-value is 0.010, shown to three decimal places. Assuming there is zero difference in PIC rates between the selected roads, one would obtain

Number of casualties per collision - relative frequency

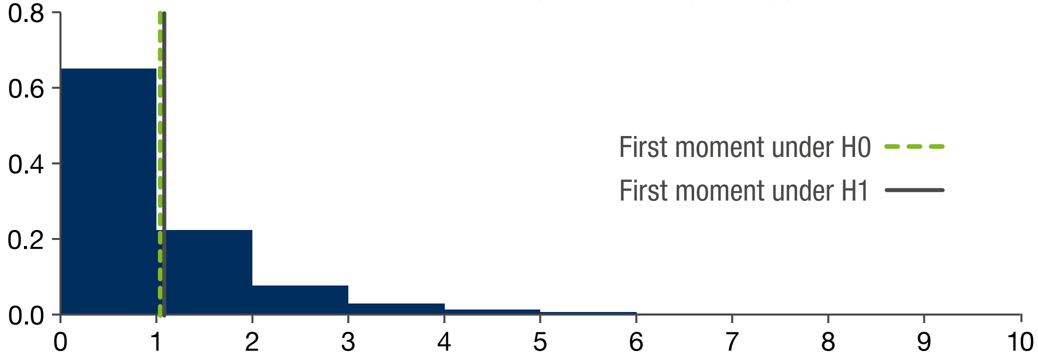
Difference in mean of number of casualties per collision by road type: A Roads (on SRN)



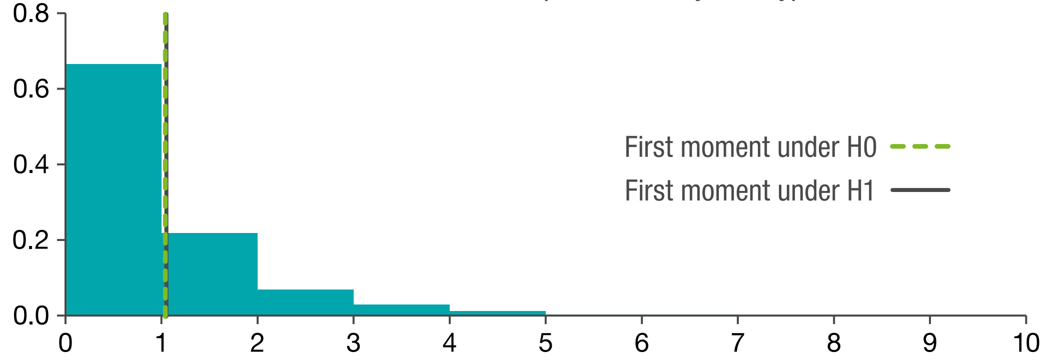
Difference in mean of number of casualties per collision by road type: Conventional



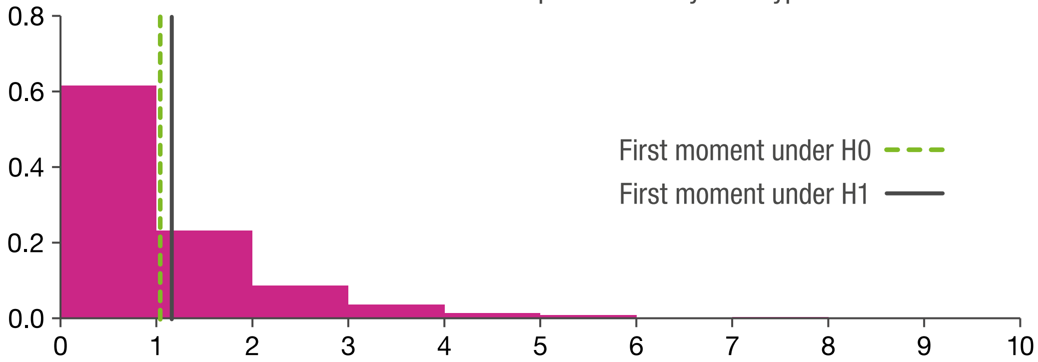
Difference in mean of number of casualties per collision by road type: Controlled



Difference in mean of number of casualties per collision by road type: ALR



Difference in mean of number of casualties per collision by road type: DHS



the sample effect, or larger, in 1.0% of studies because of random error.

This suggests that there is strong evidence that the underlying PIC rates differ between ALR and conventional motorways, with conventional motorways showing a lower rate.

PIC rates for controlled and DHS motorways

Here, we formally test whether there is a difference in the underlying PIC rate for controlled and DHS motorways with the following hypothesis:

H^0: Underlying PIC rates are the same for controlled and DHS motorways

H^1: Underlying PIC rates are not the same for controlled and DHS motorways

The computed p-value is 0.031, shown to three decimal places. Assuming there is zero difference in PIC rates between the selected roads, one would obtain the sample effect, or larger, in 3.1% of studies because of random error.

This suggests that there is strong evidence for a difference in PIC rates between controlled and DHS motorways, with DHS motorways showing a lower rate.

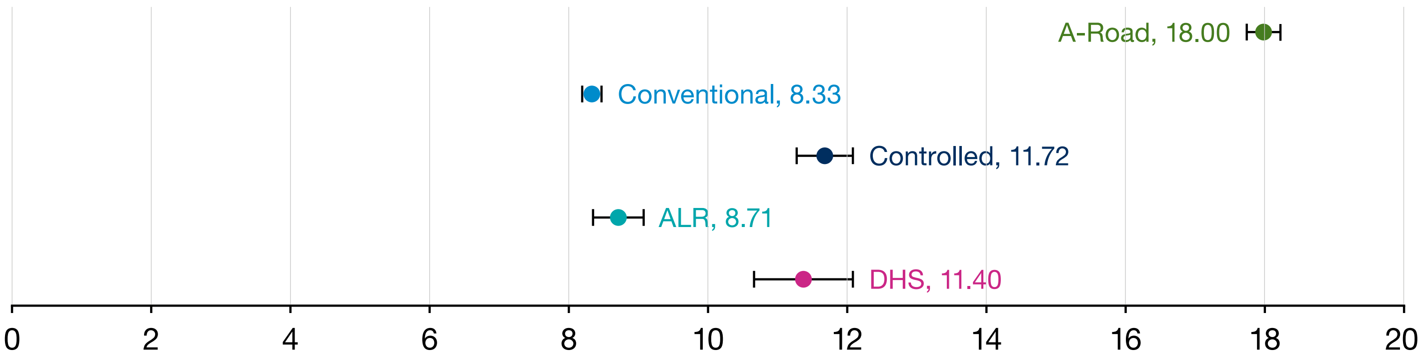
Casualty rates

The number of casualties is dependent on both the total number of personal injury collisions and the number of casualties that result from each collision.

Casualty rate confidence intervals

We compare the underlying casualty rates for all road types by calculating confidence intervals. We use a two-step process to reflect the dependence on the number of collisions and the casualties resulting from those collisions. The number of casualties is simulated by first simulating the number of personal injury collisions from a Poisson distribution and then the number of casualties per collision by sampling from the observed distribution.

Casualty Rate: confidence intervals for all road types



The confidence intervals on the underlying casualty rates are larger than the confidence intervals for the PIC rates due to the additional variability arising from the two-step process.

The variation in the location of the confidence intervals suggests that the underlying casualty rates vary between road types. The confidence interval for the underlying casualty rate for ALR motorways is close to that of conventional motorways, and the DHS confidence interval contains that of controlled motorways. We consider differences in these underlying casualty rates in the next sections. The confidence intervals for the other road types are so visually different we do not formally test any other comparisons.

There are similar shaped histograms for the number of casualties that result from each PIC, truncated at 10. The mean number of casualties per collision observed on each road type is shown by the solid black vertical line in the charts, and the mean across all road types is shown by the dashed green vertical line. Collisions resulting in more than 10 casualties are rare (15 events in 5 years).

In the following sections, we formally test for a difference in the first moment (mean) of the number of casualties per collision amongst the road types. We then combine the results with those obtained previously to determine whether there is sufficient evidence to suggest that the underlying casualty rates vary between the road types.

Casualty rates for all road types

To determine whether there is sufficient evidence to suggest that the underlying casualty rates are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision are the same for all road types

H^1: First moments of the distribution for the number of casualties per collision are not the same for all road types

The computed p-value is 0.000, shown to three decimal places. The p-value is very close to zero. Therefore, we confidently reject the null hypothesis and conclude that the first moment of the number of casualties per collision is not the same for all road types. Combining the conclusions from the PIC rate analysis and first moment of the distribution for the casualties per collision, we confidently conclude the underlying casualty rates are not the same for all road types.

Casualty rates for ALR and conventional motorways

To determine whether there is sufficient evidence to suggest that the underlying casualty rates for ALR and conventional motorways are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision are the same for ALR and conventional motorways

Casualties per collision by road type - more than ten per collision

Road type	Number of casualties per collision	Number of times observed
A-road	11	2
A-road	13	2
A-road	20	1
A-road	23	1
ALR	11	1
ALR	13	2
Conventional	11	1
Conventional	12	2
Conventional	13	2
DHS	11	1

H^1: First moments of the distribution for the number of casualties per collision are not the same for ALR and conventional motorways

The computed p-value is 0.222, shown to three decimal places. Assuming there is zero difference in the distribution of casualties per collision between the selected roads, one would obtain the sample effect, or larger, in 22.2% of studies because of random error. This suggests that there is negligible evidence for a difference in the distribution of casualties per collision.

Recall that the computed p-value from the PIC rate analysis is 0.010 and we concluded that there is strong evidence to conclude that the underlying PIC rates for ALR and conventional motorways are not the same. Taking these two conclusions into account, we conclude there is also some evidence of a difference in the underlying casualty rates.

Casualty rates for controlled and DHS motorways

To determine whether there is sufficient evidence to suggest that the underlying casualty rates for controlled and DHS motorways are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision are the same for controlled and DHS motorways

H^1: First moments of the distribution for the number of casualties per collision are not the same for controlled and DHS motorways

The computed p-value is 0.031 shown to three decimal places. Assuming there is zero difference in the distribution of casualties per collision between the selected roads, one would obtain the sample effect, or larger, in 3.1% of studies because of random error.

This suggests that there is strong evidence for a difference in the distribution of casualties per collision, with controlled motorways showing a reduced rate compared to DHS.

Recall that the computed p-value from the PIC rate analysis was 0.031 and that we concluded there is strong evidence suggesting that the underlying PIC rate for DHS motorways is smaller than that of controlled motorways.

Whilst the observed PIC rate for DHS is lower than that of controlled motorways, the observed first moment of the distribution for the casualties per collisions is lower for controlled than DHS motorways. Therefore, these combine to give estimates of the casualty rates that are similar.

Summary

Between all road types, we confidently conclude that there are differences in PIC rates, mean numbers of casualties per collision and casualty rates. There are some differences between particular road types, with varying strengths of evidence.

	Comparison between	p-value	Conclusion
Underlying PIC rates	All road types	0.000	Confidently conclude the rates are not the same between all road types
	ALR and conventional motorways	0.010	Strong evidence that the rates are not the same, suggesting the underlying PIC rate for conventional motorways is lower than on ALR motorways
	DHS and controlled motorways	0.031	Strong evidence that the rates are not the same, suggesting that the underlying PIC rate for DHS is lower than on controlled motorways
Mean number of casualties per collision	All road types	0.000	Confidently conclude the means are not the same between all road types
	ALR and conventional motorways	0.222	Negligible evidence for a difference in the distribution of casualties per collision between ALR and conventional motorways
	DHS and controlled motorways	0.031	Strong evidence for a difference in the distribution of casualties per collision, with controlled motorways showing a lower mean compared to DHS
Underlying casualty rates	All road types	-	Confidently conclude there are differences between all road types
	ALR and conventional motorways	-	Some evidence of a difference
	DHS and controlled motorways	-	Some evidence that they are similar

Personal injury collision (PIC) rates - Moving

We calculate confidence intervals and formally compare the underlying collision rates through a p-value calculated using a Monte Carlo approach.

The location and size of the 95% confidence intervals of the underlying PIC rates are visually different. This suggests that there is variation in the underlying PIC rates of the different road types. We formally assess this hypothesis in subsequent sections. The confidence interval for conventional motorways is narrower than other road types. This is due to the higher traffic volumes on conventional motorways.

PIC rates (moving vehicles) for all road types

We formally consider whether there is sufficient evidence to suggest that the PIC rates (moving vehicles) among all roads are different by testing the following hypothesis:

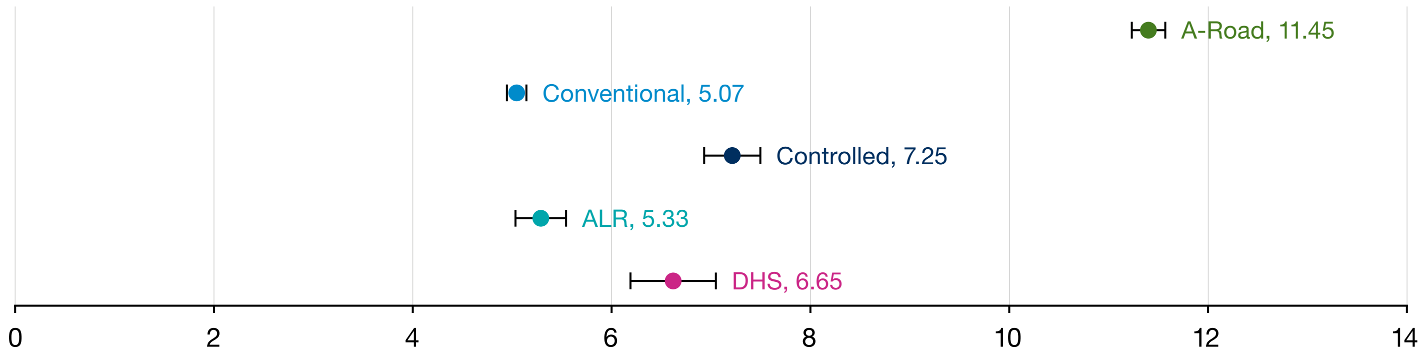
H^0: Underlying PIC rates (moving vehicles) are the same for all road types

H^1: Underlying PIC rates (moving vehicles) are not the same for all road types

The computed p-value is 0.000, shown to three decimal places: very close to zero. Therefore, we confidently reject the null hypothesis (H0) and conclude that the underlying PIC rates are not the same for all road types (moving vehicles). Comparing all road types in this way is not particularly informative; given the spread of the locations of the confidence intervals, it is not surprising that the formal hypothesis test suggests some differences.

The largest difference in PIC rates is due to the relatively high PIC rate for A-roads. The smallest differences in PIC rates are observed between ALR and conventional motorways and controlled and DHS motorways. We conduct those two formal hypothesis tests to understand how the observed differences in these specific pairs of PIC rates contribute to the small overall p-value.

PIC Rate: moving vehicles by road type



The confidence intervals demonstrate that the underlying ALR PIC rates are lower than the DHS and controlled motorway PIC rates, and that the underlying conventional motorway PIC rates are lower than the DHS and controlled motorway PIC rates. For this reason, we considered there was no need to formally assess these comparisons.

PIC rates (moving vehicles) for for ALR and conventional motorways

We test whether there is a difference in the underlying PIC rate (moving vehicles) for ALR and conventional motorways with the following hypothesis:

H^0: Underlying PIC rates (moving vehicles) are the same for ALR and conventional motorways

H^1: Underlying PIC rates (moving vehicles) are not the same for ALR and conventional motorways

The computed p-value is 0.053, shown to three decimal places. Assuming there is zero difference in PIC rates between the selected roads, one would obtain the sample effect, or larger, in 5.3% of studies because of random error. This suggests that there is some evidence for a difference in PIC rates (moving vehicles) between ALR and conventional motorways, with conventional motorways showing a lower rate.

PIC rates (moving vehicles) for controlled and DHS motorways

Here, we formally test whether there is a difference in the underlying PIC rate for controlled and DHS motorways with the following hypothesis:

H^0: Underlying PIC rates (moving vehicles) are the same for controlled and DHS motorways

H^1: Underlying PIC rates (moving vehicles) are not the same for controlled and DHS motorways

The computed p-value is 0.021, shown to three decimal places. Assuming there is zero difference in PIC rates (moving vehicles) between the selected roads, one would obtain the sample effect, or larger, in 2.1% of studies because of random error. This suggests that there is strong evidence that underlying moving vehicle PIC rates differ between controlled and DHS motorways, with DHS showing a lower rate.

Casualty rates (moving vehicles)

The number of casualties is dependent on both the total number of personal injury collisions and the number of casualties that result from each collision.

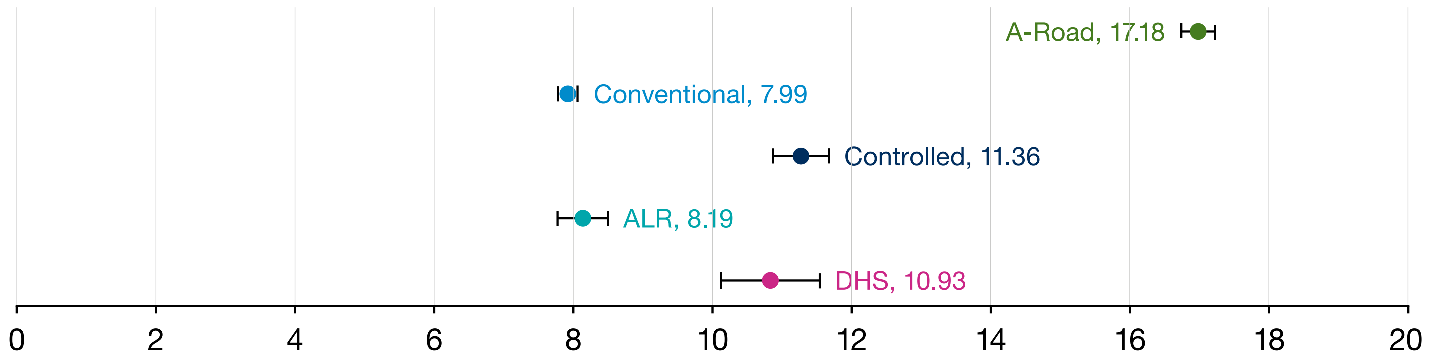
We compare the underlying casualty rates for all road types by calculating confidence intervals. We use a two-step process to reflect the dependence on the number of collisions and the casualties resulting from those collisions. The confidence intervals on the underlying casualty rates are larger than the confidence intervals for the PIC rates due to the additional variability arising from the two-step process.

The variation in the location of the confidence intervals suggests that the underlying casualty rates vary between road types. The confidence interval for the underlying casualty rate for ALR motorways contains that of conventional motorways, and the DHS confidence interval contains nearly all that of controlled motorways. We consider differences in these underlying casualty rates in the next sections. The confidence intervals for the other road types are so visually different we do not formally assess any other comparisons.

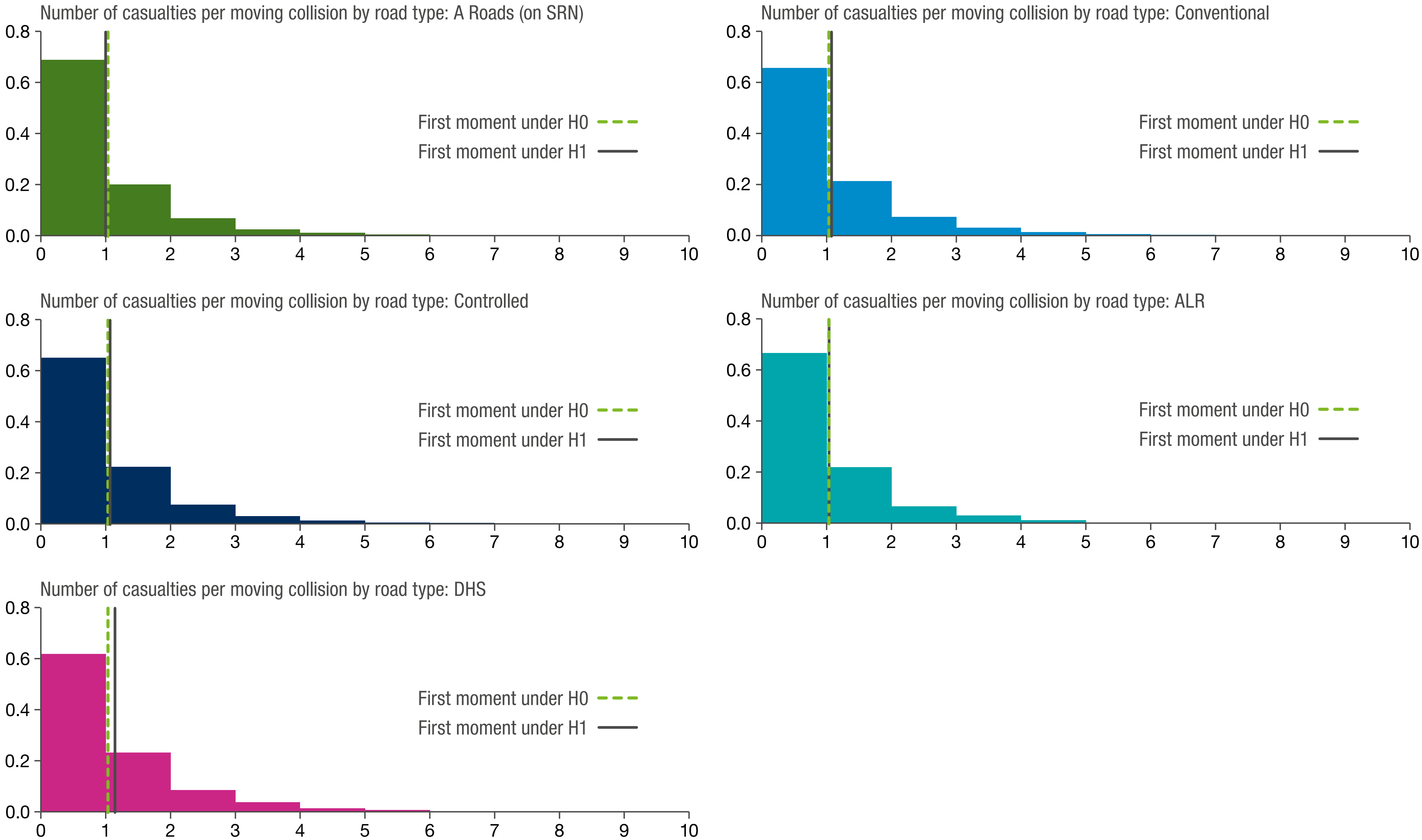
There are similar shaped histograms for the number of casualties that result from each PIC, truncated at 10. The mean number of casualties per collision observed on each road type is shown by the solid black vertical line in the charts below, and the mean across all road types is shown by the dashed green vertical line. Collisions resulting in more than 10 casualties are rare (11 events in five years).

In the following sections, we formally assess for a difference in the first moment (mean) of the number of casualties per collision amongst the road types. We combine the results to determine whether there is sufficient evidence to suggest that the underlying casualty rates vary between the road types.

Casualty Rate: moving vehicles by road type

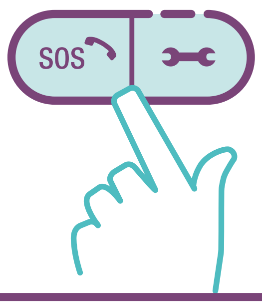


Number of casualties per collision (moving vehicles) - Relative frequency



Casualties per collision (moving vehicles) by road type - more than ten per collision

Road type	Number of casualties per collision	Number of times observed
ALR	11	1
A-road	11	2
A-road	13	2
A-road	20	1
A-road	23	1
Conventional	11	1
Conventional	12	1
Conventional	13	2



Casualty rates (moving vehicles) for all road types

To determine whether there is sufficient evidence to suggest that the underlying casualty rates are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision (moving vehicles) are the same for all road types

H^1: First moments of the distribution for the number of casualties per collision (moving vehicles) are not the same for all road types

The computed p-value is 0.000, shown to three decimal places. The p-value is very close to zero. Therefore, we confidently reject the null hypothesis and conclude that the first moment of the number of casualties per collision (moving vehicles) is not the same for all road types.

Combining the conclusions from the PIC rate (moving vehicles) analysis and first moment of the distribution for the casualties per collision (moving vehicles) we confidently conclude the underlying casualty rates are not the same for all road types.

Casualty rates (moving vehicles) for ALR and conventional motorways

To determine whether there is sufficient evidence to suggest that the underlying casualty rates for ALR and conventional motorways are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision (moving vehicles) are the same for ALR and conventional motorways

H^1: First moments of the distribution for the number of casualties per collision (moving vehicles) are not the same for ALR and conventional motorways

The computed p-value is 0.144, shown to three decimal places. Assuming there is zero difference in the distribution of casualties per collision between the selected roads, one would obtain the sample effect, or larger, in 14.4% of studies because of random error.

This suggests that there is minimal evidence for a difference in the distribution of casualties per collision.

Recall that the computed p-value from the PIC rate analysis is 0.053 and we concluded that there is some evidence to conclude that the underlying PIC rates for ALR and conventional motorways are different. Taking these two conclusions into account, we conclude there is some evidence of a small difference in the underlying casualty rates.

Casualty rates (moving vehicles) for controlled and DHS motorways

To determine whether there is sufficient evidence to suggest that the underlying casualty rates for controlled and DHS motorways are different, we combine the analysis of PIC rates with additional analysis of the following hypothesis:

H^0: First moments of the distribution for the number of casualties per collision (moving vehicles) are the same for controlled and DHS motorways

H^1: First moments of the distribution for the number of casualties per collision (moving vehicles) are not the same for controlled and DHS motorways

The computed p-value is 0.051, shown to three decimal places. Assuming there is zero difference in the distribution of casualties per collision between the selected roads, one would obtain the sample effect, or larger, in 5.1% of studies because of random error.

This suggests that there is some evidence for a difference in the distribution of casualties per collision, with DHS motorways showing a higher mean.

Recall that the computed p-value from the PIC rate analysis was 0.021 and that we concluded there is strong evidence suggesting that the underlying PIC rate for DHS motorways is smaller than that of controlled motorways.

The observed PIC rate for DHS is lower than that of controlled motorways, and the observed first moment of the distribution for the casualties per collisions is lower for controlled motorways than DHS; together this suggests there is insufficient evidence to conclude that the moving vehicle casualty rates are different.

For moving vehicles, between all road types, we confidently conclude there are differences in PIC rates, mean numbers of casualties per collision, and casualty rates. There are some differences between particular road types, with varying strengths of evidence.

Moving vehicles	Comparison between	p-value (shown to 3 decimals)	Conclusion
Underlying PIC rates	All road types	0.000	Confidently conclude the rates are not the same between all road types
	ALR and conventional motorways	0.053	Some evidence to suggest a difference between ALR and conventional motorways, with conventional motorways showing a smaller rate than ALR
	DHS and controlled motorways	0.021	Strong evidence suggesting the rates are not the same, suggesting the underlying PIC rate for DHS motorways is smaller than that of controlled motorways
Mean number of casualties per collision	All road types	0.000	Confidently conclude the means are not the same between all road types
	ALR and conventional motorways	0.144	Minimal evidence suggesting the distribution is not the same
	DHS and controlled motorways	0.051	Some evidence suggesting the means are not the same, suggesting that the underlying first moment of controlled motorways is smaller than that of DHS
Underlying casualty rates	All road types	-	Confidently conclude there are differences between all road types
	ALR and conventional motorways	-	Some evidence to suggest a small difference between ALR and conventional motorways
	DHS and controlled motorways	-	Insufficient evidence to conclude that the casualty rates are different

Personal injury collision (PIC) rates - Stopped

We calculate confidence intervals and formally compare the underlying collision rates through a p-value calculated using a Monte Carlo approach.

The location and size of the 95% confidence intervals of the underlying PIC rates are visually different. This suggests that there is variation in the underlying stopped vehicle PIC rates of the different road types. We formally test this hypothesis in subsequent sections. The confidence interval for conventional motorways is narrower than other road types. This is due to the higher traffic volumes on conventional motorways. Due to the lower sample size, the confidence interval range is much wider than for moving vehicle collisions. There were 1,392 stopped vehicle PICs over five years compared to 33,551 moving vehicle PICs over five years. This means that there is much more of an overlap between road types.

PIC rates (stopped vehicles) for all road types

We formally consider whether there is sufficient evidence to suggest that the PIC rates (stopped vehicles) among all roads are different by testing the following hypothesis:

H^0: Underlying stopped vehicle PIC rates are the same for all road types

H^1: Underlying stopped vehicle PIC rates are not the same for all road types

The computed p-value is 0.000, shown to three decimal places. Therefore, we confidently reject the null hypothesis (H^0) and conclude that the underlying stopped vehicle PIC rates are not the same for all road types. Comparing all road types in this way is not particularly informative; given the spread of the locations of the confidence intervals, we are not surprised that the formal hypothesis test suggests some differences.

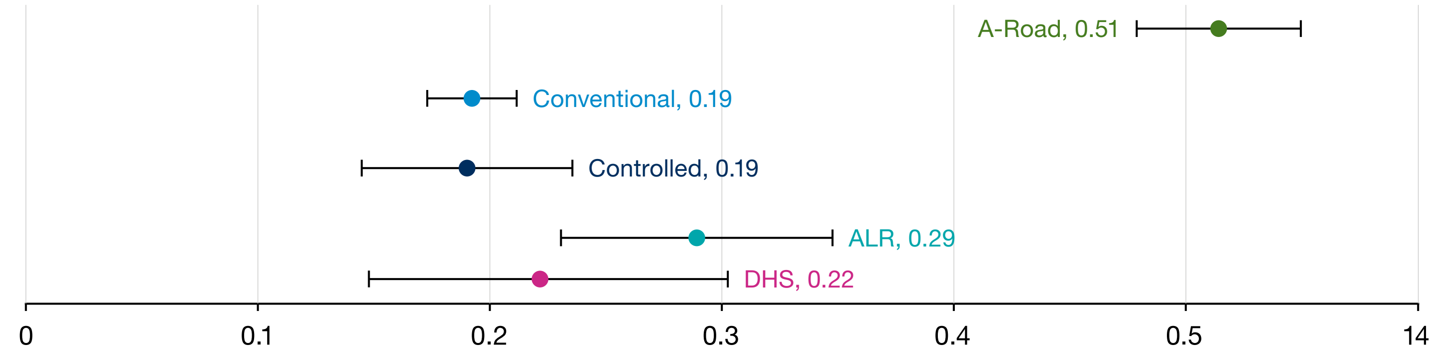
There are overlapping confidence intervals for conventional and controlled motorways (CM), conventional and DHS, CM and DHS, DHS and ALR, and CM and ALR. In the subsequent sections we formally test for differences in these pairs of underlying rates.

The non-overlapping confidence intervals give us confidence that the underlying A-road stopped vehicle PIC rates are higher than all other road types. We considered there was no need to formally test these comparisons.

PIC rates (stopped vehicles) for controlled and conventional motorways

We test whether there is a difference in the underlying stopped vehicle PIC rate for controlled and conventional motorways with the following hypothesis:

PIC Rate: stopped vehicles by road type



H^0: Underlying PIC rates (stopped vehicles) are the same for controlled and conventional motorways

H^1: Underlying PIC rates (stopped vehicles) are not the same for controlled and conventional motorways

The computed p-value is 0.937, shown to three decimal places. Assuming there is zero difference in PIC rates (stopped vehicles) between the selected roads, one would obtain the sample effect, or larger, in 93.7% of studies because of random error.

Therefore, we cannot reject the null hypothesis and it is highly likely that the underlying stopped vehicle PIC rates for controlled and conventional motorways do not differ.

PIC rates (stopped vehicles) for conventional and DHS motorways

Here, we formally test whether there is a difference in the underlying stopped vehicle PIC rate for conventional and DHS motorways with the following hypothesis:

H^0: Underlying PIC rates (stopped vehicles) are the same for conventional and DHS motorways

H^1: Underlying PIC rates (stopped vehicles) are not the same for conventional and DHS motorways

The computed p-value is 0.440, shown to three decimal places. Assuming there is zero difference in PIC rates (stopped vehicles) between the selected roads, one would obtain the sample effect, or larger, in 44% of studies because of random error.

This suggests that there is negligible evidence that underlying PIC rates differ between controlled and DHS motorways and we cannot reject the null hypothesis.

PIC rates (stopped vehicles) for controlled and DHS motorways

Here, we formally test whether there is a difference in the underlying PIC rate (stopped vehicles) for controlled and DHS motorways with the following hypothesis:

H^0: Underlying PIC rates (stopped vehicles) are the same for controlled and DHS motorways

H^1: Underlying PIC rates (stopped vehicles) are not the same for controlled and DHS motorways

The computed p-value is 0.474, shown to three decimal places. Assuming there is zero difference in PIC rates (stopped vehicles) between the selected roads, one would obtain the sample effect, or larger, in 47.4% of studies because of random error.

This suggests that there is negligible evidence that underlying PIC rates differ between controlled and DHS motorways and we cannot reject the null hypothesis.

PIC rates (stopped vehicles) for controlled and ALR motorways

Here, we formally test whether there is a difference in the underlying PIC rate (stopped vehicles) for controlled and ALR motorways with the following hypothesis:

H^0: Underlying PIC rates (stopped vehicles) are the same for controlled and ALR motorways

H^1: Underlying PIC rates (stopped vehicles) are not the same for controlled and ALR motorways

The computed p-value is 0.008, shown to three decimal places. The p-value is close to zero, and we confidently reject the null hypothesis. Therefore, we conclude that the underlying PIC rates for controlled and ALR motorways are different: there is some evidence to suggest the underlying PIC rate (stopped vehicles) for controlled motorways is smaller than that of ALR motorways.

Traffic officer vehicle in emergency area

PIC rates (stopped vehicles) for ALR and DHS motorways

Here, we formally test whether there is a difference in the underlying stopped vehicle PIC rate for ALR and DHS motorways with the following hypothesis:

H^0: *Underlying PIC rates (stopped vehicles) are the same for ALR and DHS motorways*

H^1: *Underlying PIC rates (stopped vehicles) are not the same for ALR and DHS motorways*

The computed p-value is 0.184, shown to three decimal places. Assuming there is zero difference in PIC rates (stopped vehicles) between the selected roads, one would obtain the sample effect, or larger, in 18.4% of studies because of random error.

This suggests that there is negligible evidence that underlying PIC rates differ between ALR and DHS motorways and we cannot reject the null hypothesis.

Casualty rates (stopped vehicles)

The number of casualties is dependent on both the total number of personal injury collisions and the number of casualties that result from each collision. We do not present confidence intervals on the underlying stopped vehicle casualty rates, or formally test for any differences, as the methods used require sufficient observations of collisions for each road type being compared. This is due to the need to have sufficient information about the distribution of casualties per collision for each road type here. The number of stopped vehicle collisions is small for DHS, ALR, and CM motorways, and we do not consider there to be the required amount of information to robustly make comparisons at this stage.

For stopped vehicles, between all road types, we confidently conclude there are overall differences in stopped vehicle PIC rates. There are some differences between particular road types, with varying strengths of evidence.

Emergency area

Stopped vehicles	Comparison between	p-value	Conclusion
Underlying PIC rates	All road types	0.000	Confidently conclude the rates are not the same between all road types
	Controlled and conventional motorways	0.937	Insufficient evidence to suggest that the rates for controlled and conventional motorways are different
	DHS and conventional motorways	0.440	Insufficient evidence to suggest that the rates for DHS and conventional motorways are different
	DHS and conventional motorways	0.474	Insufficient evidence to suggest that the rates for DHS and controlled motorways are different
	ALR and controlled motorways	0.008	Confidently conclude the rate for controlled motorways is smaller than ALR motorways
	ALR and controlled motorways	0.184	Insufficient evidence to suggest that the rates for ALR and DHS motorways are different

Before versus after scheme assessment

Along with the inclusion of a recent period for some schemes, we have amended the counterfactual methodology and statistical testing to more closely align with the approaches taken for other reporting, such as the Post-Opening Project Evaluation (POPE) reports.

Methodology

The methodology used in this analysis is largely the same as the methodology used for the 2023 *before versus after report*[7]. For information about the methodology used in the 2023 analysis, please refer to Annex C of the *before versus after report.*

There are a few changes from the 2023 *before versus after report* methodology. These are introduced here.

Recent data

Some of the schemes analysed in the 2023 *before versus after report* opened a long time ago; the earliest scheme opened in 1995. Therefore, the after period of some schemes includes data that is over two decades old. In this time there are likely to have been changes to the road layout and infrastructure, which may have had an impact on safety performance.

To assess current performance for these schemes, a ‘recent’ period covering 2018-2022 has been included. This has only been included for schemes that have an after period ending before the recent period starts, so that there is no overlap. Twelve schemes have had PIC, FWI and KSI rates calculated for the recent period. The results can be found in Annex F – Before versus after – Detailed tables.

Counterfactual estimation

In the 2023 *before versus after report*[7] we estimated a counterfactual collision rate from the slope of a regional background trend. A Poisson distribution was then used to derive confidence limits, so that the confidence limits for the observed and counterfactual rates could be compared.

In the updated analysis in this report we have made some minor changes to this methodology to align more closely with the counterfactual methodology used in the POPE reports.

The main difference from the previous methodology being that the change between the before and after periods within the same region has been used to calculate the counterfactual and not the slope of the regional trend line. Whilst the use of a slope calculation can be beneficial in smoothing out variation, it can also exclude shorter term trends. In this instance it was preferable to align with other National Highways reporting methodologies.

Using a chi-squared hypothesis test[45], lower and upper ranges have been calculated for the counterfactual, with which we can compare the observed after rates.

The only material difference between the counterfactual calculated here and the POPE report methodology is that the regional background trend is calculated from all 'non-smart' motorways within the same region, whereas the POPE reports use a sample-based approach using roads with similar traffic flow. Assessing 39 schemes in one report made it impractical to apply this approach, hence why a region-wide calculation has been applied here.

Counterfactual lower and upper rates, along with the mean rate, are shown by scheme in the table below. For comparison, the before and observed actual rates are also shown.

If the observed after rate is within the counterfactual range (in brackets below the mean rate), it is not considered statistically significant. If the observed after rate is below the lower value or above the higher value, then it can be said that we have seen a significant change.

More information on the counterfactual methodology used in the POPE reports can be found in Annex C of the *POPE methodology manual*[46].

Before, after and counterfactual rates by scheme

Scheme	Type	After Months	Before	Counterfactual	After
M25 J5-J7	ALR	60	13.39	10.59 (9.06 – 12.24)	10.31
M25 J23-J27	ALR	60	13.55	11.59 (10.10 – 13.17)	11.61
M1 J39-J42	ALR	60	7.48	4.58 (3.23 – 6.17)	6.96
M6 J11a-J13	ALR	60	11.16	6.95 (5.18 – 8.98)	5.37
M1 J28-J31	ALR	60	11.64	4.70 (3.83 – 5.66)	3.32
M1 J32-J35a	ALR	60	12.69	7.36 (5.92 – 8.96)	5.09
M5 J4a-J6	ALR	60	5.90	3.52 (2.48 – 4.75)	3.66
M3 J2-J4a	ALR	60	13.09	8.58 (7.14 – 10.16)	7.78
M1 J16-J19	ALR	48	5.09	2.05 (1.36 – 2.89)	2.97
M62 J18-J20	ALR	48	8.64	5.56 (3.81 – 7.63)	3.63
M1 J24-J25	ALR	36	3.88	1.70 (0.80 – 2.93)	1.43
M6 J16-J19	ALR	36	12.49	8.85 (7.55 – 10.24)	4.18
M6 J2-J4	ALR	24	9.90	5.63 (4.35 – 7.08)	4.63
M20 J3-J5	ALR	24	13.90	9.29 (6.74 – 12.25)	7.67
M23 J8-J10	ALR	24	13.32	8.90 (7.02 – 11.01)	5.03
M62 J10-J12	ALR	12	5.59	4.30 (3.07 – 5.72)	3.91
M4 J3-J12	ALR	12	7.39	4.42 (3.53 – 5.42)	2.62
M25 J10-J15	CM	60	18.68	19.57 (17.80 – 21.43)	19.88
M25 J15-J16	CM	60	12.58	12.42 (10.20 – 14.85)	13.33
M1 J6a-J10	CM	60	58.34	47.18 (43.59 – 50.91)	13.63

Scheme	Type	After Months	Before	Counterfactual	After
M42 J7-J9	CM	60	6.86	5.35 (3.66 – 7.35)	4.91
M25 J7-J10	CM	60	14.70	11.72 (10.33 – 13.19)	13.48
M1 J25-J28	CM	60	14.58	7.17 (5.93 – 8.54)	6.13
M20 J4-J5	CM	60	22.83	18.20 (13.70 – 23.35)	12.42
M20 J5-J7	CM	60	15.11	12.05 (8.58 – 16.10)	16.20
M25 J2-J3	CM	60	19.58	15.69 (11.99 – 19.89)	23.66
M25 J16-J23	CM	60	21.26	16.86 (15.33 – 18.47)	9.08
M25 J27-J30	CM	60	17.20	13.19 (11.55 – 14.94)	8.55
M6 J10a-J11a	CM	60	11.23	6.99 (4.08 – 10.67)	4.38
M1 J31-J32	CM	60	9.85	6.18 (3.97 – 8.88)	5.91
M60 J8-J18	CM	48	10.20	6.35 (5.17 – 7.65)	7.61
M1 J23a-J24	CM	48	7.69	3.32 (1.29 – 6.25)	3.79
M42 J3a-J7	DHS	60	12.95	9.82 (8.15 – 11.66)	6.99
M6 J4-J5	DHS	60	10.73	8.36 (5.90 – 11.24)	8.69
M6 J8-J10a	DHS	60	18.18	13.40 (10.88 – 16.18)	16.36
M1 J10-J13	DHS	60	17.48	13.87 (12.02 – 15.84)	13.88
M62 J25-J30	DHS	60	13.20	9.00 (7.75 – 10.35)	8.63
M4-M5 Interchange	DHS	60	15.54	9.68 (7.46 – 12.18)	7.29
M6 J5-J8	DHS	60	17.45	12.88 (10.74 – 15.20)	13.22

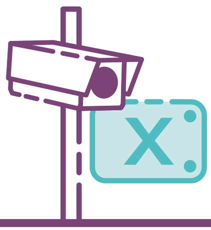
Statistical significance testing

As with the counterfactual methodology, changes have been made to the statistical significance testing to align more closely with the approach taken elsewhere in the progress report. Here we have used a 'bootstrap simulation' method, comparing two collision rates by estimating a p-value. We have also calculated 95% confidence intervals. These are shown in the table below. The confidence intervals are shown in brackets underneath the PIC rates.

As we have already undertaken statistical testing for the counterfactual through the calculation of the lower and upper values, we have not duplicated this in this section by calculating confidence intervals for the counterfactual or p-values for the difference between the counterfactual and observed after rates.

Here, we have tested the null hypothesis that both the before and after datasets are the same and that any differences between them are caused by random variation. These hypothesis tests produce a 'p-value' which indicates the likelihood of these two datasets being the same.

Historically a p-value of less than 0.05 would indicate that they were different and that we can reject the null hypothesis, and a p-value of over 0.05 would indicate that we cannot reject the null hypotheses, meaning that the two datasets are the same. However, current best practice is to not treat the p-value of 0.05 as a fixed cut-off point to determine whether the difference is significant or not.



Emergency telephone

Before and after confidence intervals at 95% confidence

Scheme	Type	After Months	Before	After	p-values after/ before
M25 J5-J7	ALR	60	13.39 (12.10 – 14.70)	10.31 (9.18 – 11.45)	0.000
M25 J23-J27	ALR	60	13.55 (12.35 – 14.78)	11.61 (10.57 – 12.64)	0.017
M1 J39-J42	ALR	60	7.48 (6.05 – 8.99)	6.96 (5.61 – 8.31)	0.606
M6 J11a-J13	ALR	60	11.16 (9.44 – 12.88)	5.37 (4.10 – 6.71)	0.000
M1 J28-J31	ALR	60	11.64 (10.61 – 12.69)	3.32 (2.77 – 3.89)	0.000
M1 J32-J35a	ALR	60	12.69 (11.13 – 14.26)	5.09 (4.10 – 6.08)	0.000
M5 J4a-J6	ALR	60	5.90 (4.87 – 6.93)	3.66 (2.85 – 4.52)	0.001
M3 J2-J4a	ALR	60	13.09 (11.79 – 14.42)	7.78 (6.76 – 8.83)	0.000
M1 J16-J19	ALR	48	5.09 (4.26 – 5.95)	2.97 (2.13 – 3.90)	0.000
M62 J18-J20	ALR	48	8.64 (7.03 – 10.34)	3.63 (2.46 – 4.91)	0.000
M1 J24-J25	ALR	36	3.88 (2.83 – 5.01)	1.43 (0.64 – 2.39)	0.002
M6 J16-J19	ALR	36	12.49 (11.39 – 13.61)	4.18 (3.31 – 5.11)	0.000
M6 J2-J4	ALR	24	9.90 (8.71 – 11.08)	4.63 (3.30 – 6.06)	0.000
M20 J3-J5	ALR	24	13.90 (11.76 – 16.13)	7.67 (5.03 – 10.58)	0.002
M23 J8-J10	ALR	24	13.32 (11.76 – 14.93)	5.03 (3.36 – 6.88)	0.000
M62 J10-J12	ALR	12	5.59 (4.58 – 6.64)	3.91 (1.81 – 6.32)	0.206
M4 J3-J12	ALR	12	7.39 (6.55 – 8.26)	2.62 (1.39 – 4.00)	0.000
M25 J10-J15	ALR	60	18.68 (17.27 – 20.11)	19.88 (18.51 – 21.25)	0.234
M25 J15-J16	CM	60	12.58 (10.84 – 14.39)	13.33 (11.54 – 15.19)	0.559
M1 J6a-J10	CM	60	58.34 (55.38 – 61.30)	13.63 (12.24 – 15.01)	0.000

Scheme	Type	After Months	Before	After	p-values after/ before
M42 J7-J9	CM	60	6.86 (5.46 – 8.35)	4.91 (3.66 – 6.16)	0.048
M25 J7-J10	CM	60	14.70 (13.56 – 15.83)	13.48 (12.40 – 14.55)	0.126
M1 J25-J28	CM	60	14.58 (13.27 – 15.88)	6.13 (5.28 – 6.97)	0.000
M20 J4-J5	CM	60	22.83 (19.00 – 26.67)	12.42 (9.68 – 15.32)	0.000
M20 J5-J7	CM	60	15.11 (12.21 – 18.16)	16.20 (13.33 – 19.21)	0.618
M25 J2-J3	CM	60	19.58 (16.43 – 22.74)	23.66 (20.22 – 27.23)	0.087
M25 J16-J23	CM	60	21.26 (20.00 – 22.55)	9.08 (8.35 – 9.84)	0.000
M25 J27-J30	CM	60	17.20 (15.79 – 18.63)	8.55 (7.63 – 9.50)	0.000
M6 J10a-J11a	CM	60	11.23 (8.37 – 14.29)	4.38 (2.71 – 6.25)	0.000
M1 J31-J32	CM	60	9.85 (7.54 – 12.31)	5.91 (4.09 – 7.88)	0.011
M60 J8-J18	CM	48	10.20 (9.12 – 11.31)	7.61 (6.52 – 8.69)	0.001
M1 J23a-J24	CM	48	7.69 (5.20 – 10.40)	3.79 (1.89 – 5.96)	0.022
M42 J3a-J7	DHS	60	12.95 (11.47 – 14.47)	6.99 (5.97 – 8.04)	0.000
M6 J4-J5	DHS	60	10.73 (8.63 – 12.94)	8.69 (6.83 – 10.55)	0.158
M6 J8-J10a	DHS	60	18.18 (16.00 – 20.36)	16.36 (14.33 – 18.40)	0.232
M1 J10-J13	DHS	60	17.48 (15.97 – 19.04)	13.88 (12.26 – 15.56)	0.000
M62 J25-J30	DHS	60	13.20 (11.99 – 14.44)	8.63 (7.70 – 9.59)	0.000
M4-M5 Interchange	DHS	60	15.54 (13.41 – 17.74)	7.29 (5.93 – 8.71)	0.000
M6 J5-J8	DHS	60	17.45 (15.59 – 19.36)	13.22 (11.71 – 14.78)	0.001

M42 J7-9 changes

The rates calculated for this updated before versus after analysis are almost identical to the rates in the 2023 *before versus after report*[7], for schemes that previously had a full five years of after data. There will be some slight differences due to the use of the updated severity adjustments and minor revisions to traffic data. However, one scheme has had a larger change in rates.

During the 'safety assessment' analysis, it was noted that the PIC rate for the M42 J7-9 scheme increased in the 'recent' period, despite actual collision numbers decreasing by a considerable amount. Going against trends seen elsewhere on the network, traffic on this section of the network appeared to have drastically reduced, resulting in a higher rate of PICs per hundred million vehicle miles. Further investigation and discussion with the DfT traffic statistics team revealed changes to how traffic was being counted along this section over recent years. In particular, some count points that were previously recorded as M42 are now recorded as M6 Toll.

Due to the complex nature of the M42 around junction 8, with the M6 Toll road and M42 running alongside each other, it is difficult to attribute traffic count points to the smart motorway scheme. As a result of this investigation, some count points classified as M6 Toll are now included in the scheme traffic calculations as they contain smart motorway infrastructure. Traffic for this scheme is now much more comparable over time. This has also resulted in calculated PIC, FWI and KSI rates for this scheme differing from the rates in the 2023 *before versus after report*.

Results

Results are broadly the same as they were in the 2023 *before versus after report*, for the schemes that already had five years of after data. The change to the counterfactual methodology has meant that four schemes that previously had an after rate lower than the counterfactual rate are now higher than the estimated after rate. However, these are well within the lower and upper confidence intervals.

Of the 39 schemes analysed, four had a higher PIC rate in the after period and a further ten reduced, but not as much as the estimated counterfactual rate. In total, 25 schemes had a lower PIC rate in the after period, compared to both the before period and the after-period counterfactual.

There were reductions in FWI rate in the after period for 37 of the 39 schemes. This is an improvement on the 2023 analysis where 32 out of 37 improved, driven by the inclusion of the 2022 data for schemes that did not previously have five years of after data.

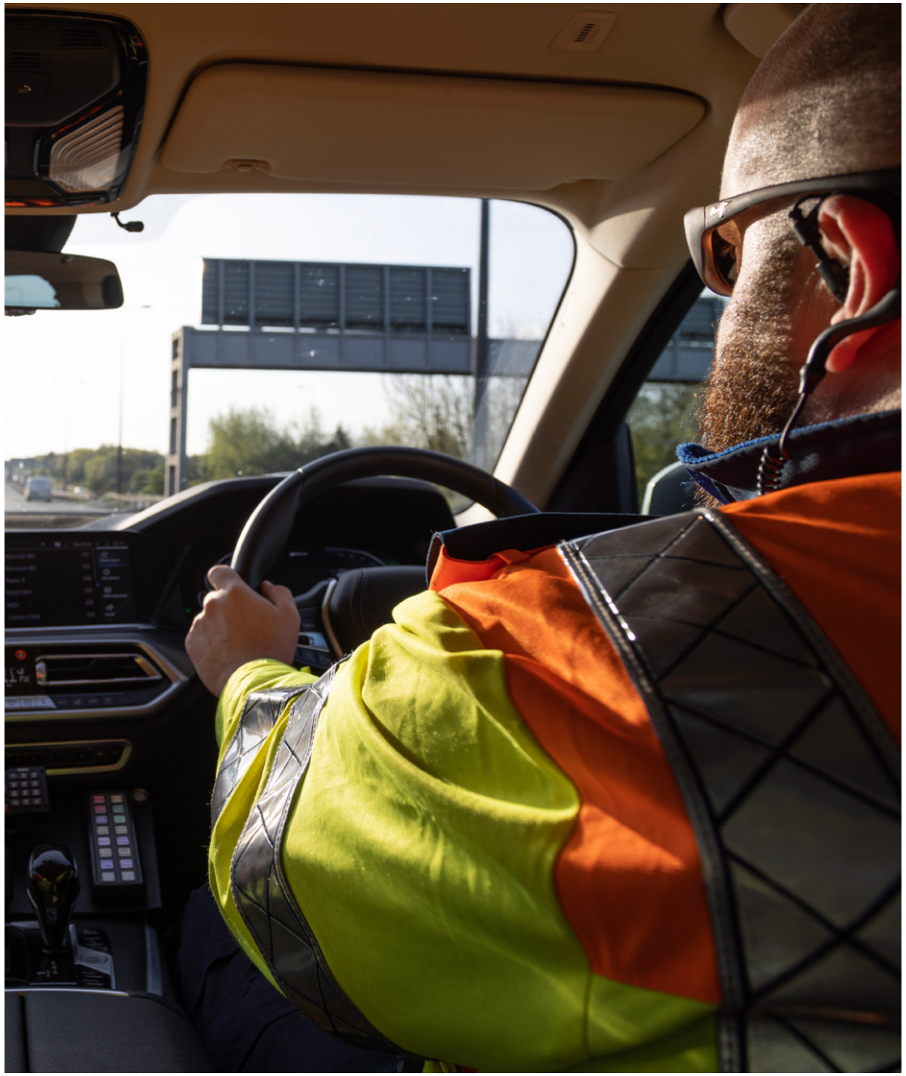
There were 27 schemes out of 39 where the KSI rate reduced in the after period, compared to 29 out of 37 in the 2023 analysis. As with the change in the FWI rates, this is due to the addition of the 2022 STATS19 data. This difference in FWI (improvement) and KSI (worsening) performance is mainly due to a reduction in fatalities and an increase in seriously injured casualties within these schemes, in the 2022 STATS19 data. Fatal and serious casualties are given the same weighting in the KSI rate calculations, but fatal casualties contribute more to the FWI rate, which is why a reduction in fatalities has resulted in improvements in the FWI rate but not the KSI rate.

All 12 of the schemes that had a recent PIC rate calculated saw a reduction compared to both the before and after periods. Compared to either the before or after period, two of the twelve schemes had a higher FWI rate in the recent period, and three schemes had a higher KSI rate. Lower numbers of casualties in the FWI and KSI calculations can lead to greater variability in the rates; a single incident can be the difference between an increase or decrease in rate.

All headline rates (PIC, FWI and KSI), as well as rates for the different collision types, such as stopped/moving, live lane/non-live lane, can be found in Annex E – Before versus after - Detailed tables.

There are some key considerations in using or referring to the results of this report.

- Due to differences in the amount of data available per scheme, significant caution should be taken in making comparisons either between schemes or between before and after periods for schemes that have less than five-year after data.



Traffic officer on patrol

Emergency telephone in use

- Many controlled motorway schemes opened some time ago, with the earliest opening as far back as 1995. Therefore, the after-period rates may not reflect recent safety data. At the moment, it is not appropriate to extrapolate the findings from this analysis to make judgements for the respective road types, especially as they cover different time periods over the last three decades. Data covering the most recent five-year period has been included in this update for older schemes, to enable us to assess current performance. For comparisons between road types across the SRN, please see the safety data in this annual progress report, which considers fixed time periods for all road types.
- While the analysis goes some way to comparing safety data after a scheme was put in place with safety before, it does not explain what has caused the safety changes, such as the smart motorway itself or external factors. Methods such as the counterfactual and statistical significance testing help increase our understanding of any safety changes. With future applications of these methods, additional safety assessments and reviews, we will have even greater understanding of the reasons behind the scheme-level safety changes.

For a full list of the considerations relating to this analysis, please refer to the 2023 *before versus after report*[7].

Safety assessments

The schemes included in the safety assessment are in the table below, along with the PIC, FWI and KSI rates across each period.

The listed schemes all had increased rates in one or more of the metrics in the 2023 ***before versus after report***[7] and had not previously been subject to a detailed safety review.

Please note that the safety assessments were conducted following the completion of the 2023 before versus after analysis results in spring 2023, therefore, before the release of the 2022 STATS19 data later in the year (autumn 2023). This means that the 'recent' period in the safety assessments covers 2017 to 2021. The following table outlines the conclusions and recommendations of the analysis.

Safety assessment metric data summary

Scheme	Metric	Before	After	Counterfactual[47]	Recent[48]
M23 J8-10	PIC	13.32	5.48	10.97	N/A
	FWI	0.43	0.53	N/A	N/A
	KSI	1.51	1.17	N/A	N/A
M25 J10-15	PIC	18.68	19.83	12.05	10.84
	FWI	0.79	0.54	N/A	0.48
	KSI	3.43	2.42	N/A	2.24
M25 J15-16	PIC	12.58	13.33	9.87	2.75
	FWI	0.36	0.88	N/A	0.08
	KSI	1.16	2.37	N/A	0.51
M25 J2-3	PIC	19.58	23.66	17.58	14.17
	FWI	1.12	0.71	N/A	0.51
	KSI	4.96	3.31	N/A	1.39
M25 J7-10	PIC	14.70	13.41	12.76	8.62
	FWI	0.55	0.39	N/A	0.29
	KSI	1.47	1.23	N/A	1.31
M20 J5-7	PIC	15.11	16.06	12.33	10.76
	FWI	0.91	0.80	N/A	0.45
	KSI	3.20	1.88	N/A	1.36
M1 J23a-24	PIC	7.69	3.7	3.33	N/A
M42 J7-9	PIC	5.54	4.63	3.62	6.15[49]
	FWI	0.19	0.24	N/A	0.17
	KSI	1.26	0.86	N/A	0.77

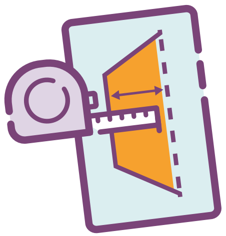
Safety assessment summary of conclusions

Scheme	Type	Conclusion	Recommendation
M23 J8-10	ALR	The FWI rate increase in the after period was skewed by a single fatal collision, unlikely to be related to the change in road design. There is only one year of after data currently available so this scheme will benefit from further monitoring.	No safety review required. Continue to monitor as part of BAU activities.
M25 J10-J15	Controlled	It is likely that there was little impact on the build-up of traffic on this section following change in road design. As such the PIC rate continued to increase. Improvements to the flow of traffic over the years may have resulted in the reduction of the PIC rate.	No safety review required. Continue to monitor as part of BAU activities.
M25 J15-J16	Controlled	It is likely that there was little impact on the build-up of traffic on this section following change in road design. As such the PIC rate continued to increase. Improvements to the flow of traffic over the years may have resulted in the reduction of the PIC rate. Single multi-casualty collision in the after period skewed the FWI and KSI rates.	No safety review required. Continue to monitor as part of BAU activities.
M25 J2-J3	Controlled	It is likely that there was little impact on the build-up of traffic on this section following change in road design, which meant that there was little change in the PIC rate. The PIC rate has reduced but the rate of 'moving front-rear' collisions has not changed, meaning that other collision types have had more of an impact on reducing the PIC rate.	No safety review required. Continue to monitor as part of BAU activities.
M25 J7-J10	Controlled	It is likely that there was little impact on the build-up of traffic on this section following change in road design. As such the PIC rate continued to increase. Improvements to the flow of traffic over the years may have resulted in the reduction of the PIC rate.	No safety review required. Continue to monitor as part of BAU activities.
M20 J5-J7	Controlled	It is likely that there was little impact on the build-up of traffic on this section following change in road design. As such the PIC rate continued to increase. Improvements to the flow of traffic over the years may have resulted in the reduction of the PIC rate.	No safety review required. Continue to monitor as part of BAU activities.
M1 J23a-J24	Controlled	A short section with currently three years of after data available. The PIC rate in the after period was slightly higher than the counterfactual. The FWI rate increase was based on a single serious collision in the after period, which was unrelated to the design of the road. Only three years of after data currently available so this scheme will benefit from further monitoring.	No safety review required. Continue to monitor as part of BAU activities.
M42 J7-J9	Controlled	In the recent five-year period, there has been a large reduction in the FWI rate following a slight increase in the after period. The PIC rate has increased slightly, but this can be attributed to an issue identified in the traffic count data, absolute PIC numbers have reduced.	No safety review required. Continue to monitor as part of BAU activities.

Annex C – Detailed tables

Alongside this report we have published a detailed safety tables spreadsheet[50] to continue providing transparency on the analysis. As per Annex B – Methodology, the figures included in this spreadsheet are the statistics used in this report. These reflect DfT's latest guidance on injury-based reporting ie using adjusted STATS19 data where possible.

We have published a detailed safety tables spreadsheet to continue providing transparency on the analysis



It should be noted that these adjustments influence (i) casualties (but not total collisions reported here) and (ii) serious and slight severities (not fatal). In addition, as these are based on a probabilistic model developed and used by ONS and DfT. Figures not including these adjustments have also been included for completeness. Such figures are categorised as 'unadjusted for injury-based reporting'.

DHS motorway in West Yorkshire

Annex D – Detailed collision data

Alongside this report we have published a detailed collision data spreadsheet[51] to provide greater transparency. This document and accompanying data have been prepared by National Highways with assistance from its consultants (where employed). The document and its accompanying data remain the property of National Highways.

Recipients of this document should not assume that the data is appropriate for their purposes. In the absence of formal contractual agreement to the contrary, National Highways and its consultants (where employed) expressly disclaim any responsibility to you, or any other party who gains access to this data.

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This methodology, and its subsequent outputs may differ from methodologies used in different analyses at different points in time.

This is due to continuous improvements of data mapping, capture and quality. As these factors evolve over time, any comparison with earlier data or data from other sources, should be interpreted with caution.

This dataset will be refreshed when updated information becomes available. We will be interested to hear your thoughts on how to improve this data. If you want to contact us, please email us at roadsafetydivision@nationalhighways.co.uk.

Annex E – Before versus after – Detailed tables

To continue providing transparency on the analysis, alongside this report we have published the detailed safety tables spreadsheet[52] for the updated before versus after analysis.

It should be noted that these adjustments influence (i) injuries (but not total collisions reported here) and (ii) serious and slight severities (not fatal). In addition, as these are based on a probabilistic model developed and used by ONS and DfT, adjusted figures are no longer whole numbers, but are decimal values.

Figures not including these adjustments have also been included for completeness. Such figures are categorised as 'unadjusted for injury-based reporting.'

Emergency area on the M62 ALR motorway

Annex F – Before versus after – Detailed collision data

To provide greater transparency, alongside this report we have published the detailed collision data spreadsheet[53].

This document and accompanying data have been prepared by National Highways with assistance from its consultants (where employed). The document and its accompanying data remain the property of National Highways.

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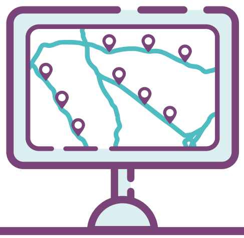
The methodology used to generate the data in this document should only be considered in the context of the analysis in this report.

This methodology, and its subsequent outputs may differ from methodologies used in different analyses at different points in time. This is due to continuous improvements of data mapping, capture and quality. As these factors evolve over time, any comparison with earlier data or data from other sources, should be interpreted with caution.

This dataset will be refreshed when updated information becomes available. We will be interested to hear your thoughts on how to improve this data. If you want to contact us, please use roadsafetydivision@nationalhighways.co.uk.



Traffic officer using hand-held radio

Annex G - CSV file for collision mapping

CSV file of smart motorway schemes used to support the attribution of collisions on the SRN to the different types of smart motorway[54].

Annex H – Customer Experience Tracker (CXT) - Additional findings

The CXT survey findings in this report comprise a summary of insights drawn from a large data set. In some cases, to aid interpretation and ease of reading, findings have been reported at a summary 'top level' and in the form of descriptions of the data – for example, without all percentage figures from the survey data included in the text. The below therefore presents findings in further detail – specifically, percentage figures which are not included in the main body of the report, but where these findings are described.

References to 'significant differences' pertain to statistically significant differences between two percentage figures, for example between a subgroup and the equivalent figure for the total number of respondents answering that particular question. The same is the case for the terms 'more likely' and 'less likely' than overall or average. Again, these refer to a subgroup which is statistically significantly more or less likely than the overall sample average to give a particular response.

Sign and signal in operation on ALR motorway

Self-reported frequency of use of the SRN (drivers and riders)

Over two in five respondents (46%) travelled on the SRN as a driver of a car, van, lorry, minibus, coach or bus, at least once a week in the past 12 months (‘frequent’ SRN drivers).

Subgroups of the survey sample who are more likely than overall to drive on the SRN frequently (at least once a week in the past 12 months) include:

- Respondents aged 25-34 (56% compared with 46% overall)
- Respondents aged 35-44 (56%)
- Men (55%)
- Respondents in work (57%)
- Respondents in ABC1[33] social grades (54%)

Sixteen percent of respondents travelled on the SRN as a driver less than once a week, but at least once a month, in the past 12 months. Fifteen percent of respondents travelled on the SRN as a driver less than once a month, and these are referred to in the report as ‘infrequent’ drivers. Twenty three percent of respondents did not drive on the SRN at all in the past 12 months.

Subgroups who are more likely than overall to drive on the SRN infrequently (less than once a month) include:

- Respondents aged 55-64 (17% compared with 15% overall)
- Respondents aged 65-75 (21%)
- Women (18%)
- Respondents who are not in work (19%)
- Respondents in C2DE[x] social grades (17%)

Subgroups who are more likely than overall to say they did not drive on the SRN at all in the past 12 months include:

- Respondents aged 16-24 (29% compared with 23% overall)
- Respondents aged 65-75 (26%)
- Women (28%)
- Respondents who are not in work (33%)
- Respondents in C2DE[34] social grades (32%)

Subgroups of the survey sample who are more likely than overall to ride on the SRN frequently (at least once a week in the past 12 months) include:

- Respondents aged 16-24 (21% compared with 13% overall)
- Respondents aged 25-34 (26%)
- Respondents aged 35-44 (22%)
- Men (19%)
- Respondents in work (19%)
- Respondents in ABC1 social grades (17%)

Four percent of respondents travelled on the SRN as a rider less than once a week, but at least once a month, in the past 12 months. Seven percent of respondents travelled on the SRN as a rider less than once a month ('infrequent' riders). Seventy seven percent of respondents did not ride on the SRN at all in the past 12 months.

Subgroups who are more likely than overall to ride on the SRN infrequently (less than once a month) include:

- Respondents aged 16-24 (9% compared with 7% overall)
- Respondents aged 25-34 (8%)
- Respondents aged 35-44 (8%)
- Men (7%)
- Respondents in work (7%)

Subgroups who are more likely than overall to say they did not ride on the SRN at all in the past 12 months include:

- Respondents aged 45-54 (82% compared with 77% overall)
- Respondents aged 55-64 (89%)
- Respondents aged 65-75 (94%)
- Women (83%)
- Respondents who are not in work (87%)
- Respondents in C2DE social grades (82%)

Self-reported knowledge about smart motorways

All respondents in the CXT are asked how much, if anything, they knew about the term 'smart motorways' before taking part in the survey. Between January and December 2023 (inclusive), three quarters of respondents (75%) said they knew at least a little about smart motorways before completing the survey. Among them, 14% of all respondents said they know a great deal, 32% said they know a fair amount, and 30% said they know just a little. Meanwhile, 14% of respondents said they had heard of smart motorways but know nothing about them, 7% had never heard of the term and 3% said they did not know.

It is important to remember that this is self-reported survey data, and it does not tell us about actual knowledge or awareness of smart motorways. Some respondents who say they know a great deal about smart motorways may in fact not, and some who say they know just a little may about smart motorways may indeed have more knowledge about them.

Subgroups who are more likely than overall to say they know a great deal or a fair amount (combined) include:

- Respondents aged 25-34 (48% compared with 45% overall)
- Respondents aged 35-44 (49%)
- Respondents aged 65-75 (47%)
- Men (57%)
- Respondents in work (50%)
- Respondents in ABC1 social grades (51%)

Subgroups who are more likely than overall to say they have heard of the term 'smart motorways' but know nothing about it, and who have never heard of smart motorways (combined) include:

- Respondents aged 16-24 (34% compared with 22% overall)
- Women (27%)
- Respondents who are not in work (26%)
- Respondents in C2DE social grades (27%)

Three quarters of respondents said they knew at least a little about smart motorways

Opinions of the extent to which the presence of different types of technology make respondents feel more or less safe

In the November 2023 wave of the CXT, respondents were asked a set of questions about their views of the technology used on smart motorways. These questions were posed to all respondents who had travelled on the SRN as a driver, rider or passenger in the past 12 months (2,295 respondents). The report refers to the technologies that the survey findings show were more likely than other technologies to make respondents say they feel safer. These findings are as follows:

To what extent does the presence of each of the following types of technology make you feel more or less safe driving on controlled motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 63% say this would make them feel more safe, 4% say it would make them feel less safe
- Overhead electronic signs and signals: 64% say 'more safe', 4% say 'less safe'
- Enforcement cameras: 55% say 'more safe', 6% say 'less safe'
- CCTV cameras: 59% say 'more safe', 5% say 'less safe'

To what extent does the presence of the following types of technology make you feel more or less safe driving on dynamic hard shoulder motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 61% say this would make them feel more safe, 6% say it would make them feel less safe
- Overhead electronic signs and signals: 62% say 'more safe', 5% say 'less safe'
- Enforcement cameras: 53% say 'more safe', 7% say 'less safe'
- CCTV cameras: 58% say 'more safe', 5% say 'less safe'
- Emergency areas: 63% say 'more safe', 9% say 'less safe'

Red X signal closing a lane for traffic officer customer assistance

To what extent does the presence of the following types of technology make you feel more or less safe driving on all-lane running motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 61% say this would make them feel more safe, 7% say it would make them feel less safe
- Overhead electronic signs and signals: 63% say 'more safe', 5% say 'less safe'
- Enforcement cameras: 55% say 'more safe', 7% say 'less safe'
- CCTV cameras: 57% say 'more safe', 6% say 'less safe'
- Emergency areas: 63% say 'more safe', 9% say 'less safe'
- Stopped vehicle detection technology (which recognises if vehicles have stopped in live lanes): 65% say 'more safe', 7% say 'less safe'

Opinions of the extent to which different types of technology are effective at ensuring the smooth running of traffic

In the November 2023 wave of the CXT, respondents were also asked a set of questions about their views of technologies and their effectiveness at smoothing the traffic flow. Again, these questions were posed to all respondents who had travelled on the SRN as a driver, rider or passenger in the past 12 months (2,295 respondents).

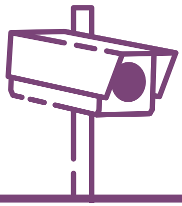
The report refers to the technologies that respondents were more likely to consider the most effective technology type at ensuring the smooth flow of traffic on different types of smart motorway. These findings are as follows:

How effective, if at all, do you think each of the following are in ensuring smooth running of traffic on controlled motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 67% say this would be effective, 16% say it would not be effective at ensuring the smooth running of traffic
- Overhead electronic signs and signals: 75% say 'effective', 16% say 'not effective'
- Enforcement cameras: 61% say 'effective', 26% say 'not effective'
- CCTV cameras: 63% say 'effective', 26% say 'not effective'

How effective, if at all, do you think each of the following are in ensuring smooth running of traffic on dynamic hard shoulder motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 66% say this would be effective, 18% say it would not be effective at ensuring the smooth running of traffic
- Overhead electronic signs and signals: 73% say 'effective', 16% say 'not effective'
- Enforcement cameras: 61% say 'effective', 26% say 'not effective'
- CCTV cameras: 62% say 'effective', 24% say 'not effective'
- Emergency areas: 68% say 'effective', 20% say 'not effective'



How effective, if at all, do you think each of the following are in ensuring smooth running of traffic on all-lane running motorways?

- MIDAS (Motorway Incident Detection and Automatic Signalling): 67% say this would be effective, 17% say it would not be effective at ensuring the smooth running of traffic
- Overhead electronic signs and signals: 75% say 'effective', 15% say 'not effective'
- Enforcement cameras: 61% say 'effective', 26% say 'not effective'
- CCTV cameras: 64% say 'effective', 24% say 'not effective'
- Emergency areas: 68% say 'effective', 21% say 'not effective'
- Stopped vehicle detection technology: 69% say 'effective', 17% say 'not effective'

Stopped vehicle technology

Technical note on survey methodology

On behalf of National Highways, Ipsos UK surveyed around 2,500 adults per month aged 16-75 in England, using Ipsos' online panel. The survey findings reported are part of a large ongoing tracking study.

Fieldwork for the November 2023 survey took place between 23 November and 6 December 2023 inclusive. Fieldwork for all other survey waves (this analysis uses data from the January to December 2023 survey waves) was conducted on similar dates each month.

Quotas and weighting are set at a national level by age and gender (interlocking), Government Office Region, working status and social grade, to generate a representative sample of the adult population of England.

Where figures do not add up to 100%, this is the result of computer rounding or multiple response options.

Technical note on frequency of SRN use

Frequency of SRN use is derived from eight questions asking respondents how often they have used the SRN across different modes:

- Thinking about the last 12 months, on average, how often, if at all, did you personally travel on England's motorways as a…? ...driver of a car, van, lorry, minibus, coach or bus / ...passenger in a car, van, lorry, minibus, coach, bus or motorcycle / ...rider of a motorcycle or moped / ...walker, cyclist or horse rider using pathways, pavements, bridges, cycle lanes or trails which cross or run alongside England's motorways.

60mph speed limit in operation

- Thinking about the last 12 months, on average, how often, if at all, did you personally travel on England's major A-roads as a…? ...driver of a car, van, lorry, minibus, coach or bus / ...passenger in a car, van, lorry, minibus, coach, bus or motorcycle / ...rider of a motorcycle or moped / ...walker, cyclist or horse rider, as well as using pathways, pavements, bridges, cycle lanes or trails which cross or run alongside England's major A-roads.

The response scale is as follows: 5 days a week or more, 3-4 days a week, 2 days a week, about once a week, about once every 2 weeks, about once a month, about once every three months, less often, I did not travel on motorways / major A-roads in this way in the last 12 months.

The questions do not capture the precise number of journeys people have made – it asks them to estimate and choose a category. It also does not ask people how many of the journeys they have made on motorways over this period are part of the same journey they made on major A-roads (if any) and vice versa, or if there are instances of different modes on journeys made.

Different respondents may have travelled at different frequencies on different road types (motorways and major A-roads) and using different modes.

The 'rule' used to classify each respondent's frequency in derived variables which combine road type and/or mode is that the respondent is classified into the response code representing the most frequent mode they selected across the questions.

Sign and signal gantry on the M62 DHS motorway

Glossary

All lane running (ALR) motorways

All lane running motorways add variable mandatory speed limits to control the speed and smooth the flow of traffic and increase capacity by permanently converting the hard shoulder into a running lane. ALR motorways feature emergency areas, which are places to stop in an emergency. Radar stopped vehicle detection (SVD) technology is also in place on all operational ALR motorways.

BAU

Business as usual.

bCall

Some vehicles have a breakdown call button. This button is also known as 'bCall' and connects you to your breakdown service.

Casualty rate

The casualty rate takes the number of casualties and controls for the volume of traffic on the road, more specifically it is defined as the number of casualties per hundred million vehicle miles travelled. CCTV.

Closed-circuit television

The primary users of the traffic cameras are our regional and national traffic operations centre operators. The operators are able to move and zoom the cameras to monitor and manage congestion and incidents, when notified. The cameras give a bird's eye view of what is happening which helps the operator to decide on the support needed.

Controlled motorways

Controlled motorways apply variable mandatory speed limits to a conventional motorway to control the speed and smooth the flow of traffic and retain a permanent hard shoulder. Overhead electronic signs display messages to drivers, such as warning of an incident ahead.

DfT

Department for Transport.

Dynamic hard shoulder (DHS) motorways

Dynamic hard shoulder motorways apply variable mandatory speed limits to control the speed and smooth the flow of traffic and temporarily increase capacity by using the hard shoulder as a live, or running, lane at the busiest times. Electronic signs and signals instruct drivers when the hard shoulder is available to use for live traffic. When the hard shoulder is operating as a live lane, the speed is set at a maximum of 60mph. DHS motorways feature emergency areas, which are places to stop in an emergency.

DVLA

Driver and Vehicle Licensing Agency is an executive agency, sponsored by DfT.

DVSA

Driver and Vehicle Standards Agency is an executive agency, sponsored by DfT.

eCall

Since April 2018, most cars and vans have been fitted with an emergency call system, known as eCall. This built-in safety feature is automatically activated in the event of an incident when the airbags are deployed. This can also be manually activated by the driver or passenger by pressing a button – this button is known as eCall SOS.

Emergency areas

ALR and DHS smart motorways feature emergency areas. They are orange, set back from live traffic lanes and have an emergency phone which connects directly to our control room so help can be arranged. These are spaced regularly on motorways without a permanent hard shoulder and are marked with blue signs featuring an orange SOS telephone symbol.

Emergency areas are for when a driver has no alternative but to stop and it has not been possible to leave the motorway or reach a motorway service area. Other places to stop in an emergency include sections of remaining hard shoulder, such as on slip roads at junctions.

Emergency corridor

This term is used to describe a temporary corridor, used in some European countries but not the UK. It is formed by drivers providing space between the off-side lane and the adjacent lane in slow (ie walking speed) traffic. This enables emergency vehicles to pass slow moving or stationary traffic to reach the scene of an incident (or equivalent emergency) using the gap formed by traffic between two marked lanes.

Fatal and Weighted Injuries (FWI) metric

This gives a fatality 10 times the weighting of a serious casualty, and a serious casualty 10 times the weighting of a slight casualty. Specifically, it is calculated as:

Fatal and Weighted Injuries = Fatal casualties + Serious Casualties * 0.1 + Slight Casualties * 0.01. Fatal and Weighted

Fatal and Weighted Injuries (FWI) rate

The FWI rate takes the FWI metric and controls for the volume of traffic on the road and is more specifically defined as the number of FWI casualties per hundred million vehicle miles travelled.

Fatal casualty

A person who has died from their injuries up to 30 days after the incident.

Journey time

Journey time is how long it takes to make a journey.

Journey time reliability

Journey time reliability is being able to expect that the same journey, on the same stretch of road, at the same time of day, will take a similar amount of time each time it is made.

Killed and seriously injured (KSI) metric

The number of people killed and seriously injured in a road traffic collision.

Killed and seriously injured (KSI) rate

The KSI rate takes the KSI metric and controls for the volume of traffic on the road and is more specifically defined as the number of KSI casualties per hundred million vehicle miles travelled.

Live lane stop

Vehicles that are stationary or parked in any of the live lanes. Previous reports have primarily considered live lane breakdowns, whereas this report considers a larger number of factors as live lane stops – for example breakdown, collisions or medical episodes.

Monitoring

Regional control room incident management and monitoring

Once we are notified of an incident, we can use CCTV and other technology to verify details and determine appropriate actions during the course of the incident. Notification can arise from various sources including the police, public, stopped vehicle detection technology where in place, recovery industry and our traffic officers. Actions in response may include setting signs and signals and deploying resources, such as traffic officers.

When resources allow, we carry out virtual patrolling. This is the proactive use of technology to provide an overview of smart motorway sections, including emergency areas. Virtual patrolling is not a routine activity conducted in our regional control rooms.

Roadworks monitoring

For major scheme upgrades where we have roadworks in place, we typically implement a reduced speed limit and CCTV monitoring within the roadworks. An on-site, 24/7 team use the CCTV to proactively monitor the roadworks section and can arrange to deploy free recovery service to vehicles which stop in the roadworks.

Further monitoring

We also use equipment to monitor areas such as data, air quality and wind speed. The information is gathered periodically.

Motorway Incident Detection and Automatic Signalling (MIDAS)

MIDAS is a system set up to identify queuing traffic or congestion by monitoring traffic speed and flow. Once queuing traffic or congestion is detected, the system automatically sets appropriate messages on variable message signs to warn drivers of conditions of the road ahead. It also automatically sets speed limits displayed on the signs and signals at the roadside and overhead on gantries.

MIDAS can also reduce the risk of secondary incidents in queuing traffic, ie the risk of vehicles colliding with the rear of a queue of traffic. It does this by identifying a queue and then automatically reducing speeds and setting accompanying warning messages.

In addition, on smart motorway sections only, it also includes a congestion management function designed to smooth traffic flow and throughput by reducing traffic speed, allowing more space between vehicles, to try and stop traffic queues forming. This is done by setting signals and message signs upstream of where congestion is detected.

ONS

Office for National Statistics.

Operational data

This is data we have extracted from operational systems (such as, but not limited to, our incident management system, ControlWorks) and analysed to meet the needs of the reporting requirements as agreed with DfT and/or ORR. Due to the reporting not being equivalent to a key performance indicator, this data may not require similar level of assurance.

ORR

Office of Rail and Road.

Personal Injury Collisions (PIC) metric

The number of collisions which have resulted in a person sustaining an injury. PICs do not reflect the number of people injured in each collision (casualties).

Personal Injury Collisions (PIC) rate

The PIC rate takes the PIC metric and controls for the volume of traffic on the road and is more specifically defined as the number of PICs per hundred million vehicle miles travelled.

Places to stop in an emergency

Places to stop in an emergency include motorway services, emergency areas and remaining sections of hard shoulder, such as on slip roads.

POPE

National Highways produces post opening project evaluation (POPE) reports 'one year after' and 'five years after' following the opening of a road scheme for all scheme impacts, including but not limited to safety.

Road investment strategy

The government's five-year strategy for investment in and management of the strategic road network.

Road period

Five-year period aligned to the government's five-year strategy for investment in and management of the strategic road network.

Serious casualties

People sustaining injuries requiring hospitalisation, or any of the following injuries whether or not the individual went to hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the incident.

Slight casualties

People sustaining a minor injury such as a sprain (including neck whiplash), bruise or cut which is not judged to be severe, or slight shock requiring roadside attention. This definition includes injuries not requiring medical treatment.

Smart motorway

Smart motorway is a generic term for a section of motorway that uses traffic management methods to increase capacity and reduce congestion in particularly busy areas. These methods include using the hard shoulder as a running lane and using variable speed limits to control the flow of traffic. There are three types of smart motorway – as defined in this glossary – all lane running, dynamic hard shoulder and controlled.

STATS19

The STATS19 database is a collection of all road traffic accidents (collisions) that resulted in a personal injury (casualty) and were reported to the police within 30 days of the accident. More information can be found on the DfT's Road Safety data webpage.

One collision may give rise to several casualties, which are categorised according to their severity (slight, serious or fatal). In this report we predominantly use the terms 'collisions' and 'casualties'. The term 'injuries' is used particularly in line with widely adopted definitions and metrics or in order to reduce the technical language of the report.

Stopped vehicle

Vehicles that are stationary or parked. This may be due to various reasons, including a vehicle breakdown, collision with another vehicle or medical episode of the driver or passenger.

Stopped vehicle detection (SVD)

Stopped vehicle detection enables the detection of vehicles which have stopped on the carriageway or in an emergency area. Currently a radar-based system, it is in place on ALR sections of smart motorway. When SVD identifies a stopped vehicle, it provides an alert to our regional control room and at the same time automatically sets a message sign on the road to warn of a report of obstruction whilst the alert is verified by an operator. Our operators can then respond quickly to close lanes with a Red X signal, display speed limits and deploy traffic officers. The 'being safer in moving traffic' section of this report sets out the four main requirements that SVD performance is measured against.

Strategic road network (SRN)

In England, the strategic road network is made up of motorways and trunk roads (the most significant A-roads). They are administered by National Highways, a government-owned company.

Transport Focus

Independent watchdog for transport users.

Transport Select Committee

Nominated by the House of Commons to scrutinise the Department for Transport. Its formal remit is to hold ministers and departments to account, and to investigate matters of public concern where there is a need for accountability to the public through Parliament. It is currently chaired by Iain Stewart MP.

Vehicle miles

Traffic statistics are presented in units of vehicle miles (billion or hundred million vehicle miles – bvm or hmvm respectively), which combines the number of vehicles on the road and how far they drive. This is a standard way of presenting traffic volumes.

VRO

Vehicle Recovery Operator.

Endnotes

National Highway is not responsible for third party reports, links or their location.

1 Smart motorway safety evidence stocktake and action plan: https://www.gov.uk/government/publications/smart-motorway-evidence-stocktake-and-action-plan

2 Road safety performance overview report - https://www.gov.uk/government/publications/national-highways-reported-road-casualties-on-the-strategic-road-network

3 DfT news release: All new smart motorways scrapped: https://www.gov.uk/government/news/all-new-smart-motorways-scrapped

4 Details of the extra emergency areas: https://nationalhighways.co.uk/our-work/smart-motorways-evidence-stocktake/national-emergency-area-retrofit/

5 ORR's Second annual assessment of safety performance on the strategic road network: https://www.orr.gov.uk/sites/default/files/2023-12/second-annual-assessment-of-safety-performance-on-the-srn_1.pdf

6 This is the point in time post construction and following initial calibration where SVD alerts begin activating and are responded to within our regional control rooms. During this period we continue to calibrate the SVD system

7 Smart motorway safety scheme 'Before' verses 'after' assessment: https://nationalhighways.co.uk/media/m0hjg0j0/before-vs-after-safety-analysis-for-all-smart-motorways-final.pdf

8 DHS have additional fixed CCTV to enable operators to check the hard shoulder ready for opening and closing as a live traffic lane

9 On ALR the system has the ability to see 100% of the carriageway

10 First year smart motorway progress report: https://nationalhighways.co.uk/media/bb4lpkcp/smart-motorways-stocktake-first-year-progress-report-2021.pdf Referred to as the first year progress report or annual progress reports

11 Incident and infrastructure investigations: https://nationalhighways.co.uk/our-work/smart-motorways-evidence-stocktake/m6-and-m1-safety-reviews/

12 House of Commons Transport Committee, Rollout and safety of smart motorways: https://committees.parliament.uk/publications/7703/documents/80447/default/

13 The role out and safety of smart motorways: Government Response to the Committee's Third Report: https://publications.parliament.uk/pa/cm5802/cmselect/cmtrans/1020/report.html

14 Smart motorway comparison report: December 2022: https://www.gov.uk/government/publications/smart-motorway-comparison-report-december-2022/smart-motorway-comparison-report-december-2022

15 Transport Focus, Safety perceptions on smart motorways: the driver view: https://www.transportfocus.org.uk/publication/safety-perceptions-on-smart-motorways-the-driver-view/

16 International Traffic Safety Data & Analysis Group

17 Comparable motorway data is not currently published for Norway, Sweden or Iceland who perform better than England by population.

18 Ras0402: Reported road collision and casualty numbers and rates by severity, region and country, United Kingdom, ten years up to 2022

19 Tra0202: Motor vehicle traffic (vehicle kilometres) by road class in Great Britain, annual from 1993 & Tra0203: Motor vehicle traffic (vehicle kilometres) by road class, region and country in Great Britain

20 DfT road accident tool for downloading bespoke collision data query results: https://roadtraffic.dft.gov.uk/custom-downloads/road-accidents/reports/9df42b4c-e9b4-41c9-9669-8d80de57ca39

21 Ras0303: Reported road collisions and casualties by severity and road class on the strategic road network, England, 10 years up to 2022

22 TRA4101: Motor vehicle traffic (vehicle miles) by vehicle type on roads managed by National Highways, as at 1 April in each year: England

23 TRA4102: Motor vehicle traffic (vehicle miles) and road length, by road type and road management, as at 1 April in each year: England

24 Against a 2005-2009 average baseline

25 See Annex B - Methodology

26 Weighted by traffic flow to reduce the impact of low traffic years such as 2020

27 Second year smart motorway progress report: https://nationalhighways.co.uk/media/uivj2zem/smart-motorways-stocktake-second-year-2022.pdf

28 Third year smart motorway progress report: https://nationalhighways.co.uk/media/rarb00qi/smart-motorways-third-year-progress-report-final.pdf

29 The tendency for extremely high or extremely low scores to become more moderate (i.e., closer to the mean) upon retesting over time.

30 Safety perceptions on smart motorways: the driver view https://www.transportfocus.org.uk/publication/safety-perceptions-on-smart-motorways-the-driver-view/

31 All-lane running smart motorways. The driver's view December 2020 https://d3cez36w5wymxj.cloudfront.net/wp-content/uploads/2020/12/04163914/All-lane-running-smart-motorways.pdf

32 Includes drivers and riders who do not travel on the SRN or in parts of the country where smart motorways are located.

33 AB Higher and intermediate managerial, administrative and professional occupations and C1 Supervisory, clerical, and junior managerial, administrative and professional occupations. https://www.ons.gov.uk/census/aboutcensus/censusproducts/approximatedsocialgradedata

34 C2: Skilled manual occupations and DE: Semi-skilled and unskilled manual occupations; unemployed and lowest grade occupations https://www.ons.gov.uk/census/aboutcensus/censusproducts/approximatedsocialgradedata

35 Smart Motorway All Lane Running Overarching Safety Report 2019: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872153/SMALR_Overarching_Safety_Report_2019_v1.0.pdf

36 ORR quality assurance of all lane running motorway data report: https://www.gov.uk/government/publications/orr-quality-assurance-of-all-lane-running-motorway-data-report

37 ORR Quality Assurance of All Lane Running Motorway Data, Highways England Response to ORR Key Findings & Recommendations: https://nationalhighways.co.uk/media/nk4jdiwh/ccs0821127562-001_orr_safety_data_review_report_v4.pdf

38 In our response to the ORR 2021 Quality assurance of all lane running motorway data report, we suggested the name of this report would be 'ALR & DHS Overarching Safety Report'. As we increased the scope subsequently to include controlled motorways, we have updated the name of this report to 'Smart motorways scheme safety - 'Before' versus 'after' assessment'

39 The safety review already undertaken combined sections of the M1 J28-31 and J32-35a into a single review of the section M1 J30-35. For schemes M1 J28-J31, M1 J32-J35a and M6 J5-J8 we undertook safety reviews particularly for sections M1 J30-35 and M6 J5-6 as part of the 2020 Action Plan.

40 Guide to severity adjustments for reported road casualties Great Britain: https://www.gov.uk/government/publications/guide-to-severity-adjustments-for-reported-road-casualty-statistics/guide-to-severity-adjustments-for-reported-road-casualties-great-britain

41 DfT's STATS19 review 2018: https://www.gov.uk/government/publications/road-accidents-and-safety-statistics-user-engagement

42 STATS19 review: final recommendations: https://assets.publishing.service.gov.uk/media/60ec379ae90e0764c59382bc/stats-19-review-final-report.pdf

43 The p-value is defined as the probability under the assumption of no effect or no difference (null hypothesis), of obtaining a result equal to or more extreme than what was actually observed

44 A Monte Carlo approach is a model used to predict the probability of a variety of outcomes when the potential for random variables is present

45 A chi-squared test is a standard statistical tool we use to help us to determine whether those differences we find in our comparisons are due to chance or are significant and establish the degree of confidence we place in that significance. We employ the tests to ensure our analyses are robust.

46 POPE methodology manual: https://nationalhighways.co.uk/media/exypgk11/pope-methodology-note-2024-v2.pdf

47 A counterfactual has not been calculated for FWI and KSI metrics. This is due to the uncertainty and variability in the year-on-year KSI numbers. FWI is a weighted index and therefore cannot be estimated. For more information on the counterfactual, please refer to Annex C of the 2023 before verses. after report

48 'Recent' period rates have not been calculated for two schemes (M23 J8-10 and M1 J23a-24), because the 'recent' and 'after' periods entirely overlap.

49 The way in which DfT traffic counts are representing traffic at this location from 2017 has suggested a larger drop in traffic than actually happened. This resulted in a higher rate, despite absolute collision numbers reducing in the most recent five-year period. The unmoderated figure is shown here, but a revised figure based on a modified traffic flow shows a reduction in the recent period to 3.94 PICs per hmvm. FWI and KSI rates were also impacted by this issue, and both reduce when the modified traffic flow is used.

50 Detailed tables: https://nationalhighways.co.uk/smart-motorways-stocktake-fourth-year-progress-report-annex-c

51 Detailed collision data: https://nationalhighways.co.uk/smart-motorways-stocktake-fourth-year-progress-report-annex-d

52 Before versus after - Detailed tables: https://nationalhighways.co.uk/smart-motorways-stocktake-fourth-year-progress-report-annex-e

53 Before versus after - Detailed collision data: https://nationalhighways.co.uk/smart-motorways-stocktake-fourth-year-progress-report-annex-f

54 CSV file of smart motorway schemes used to support the attribution of collisions on the SRN to the different types of smart motorway: https://nationalhighways.co.uk/smart-motorways-stocktake-fourth-year-progress-report-annex-g

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