

M60 junction 8 to M62 junction 20 smart motorway

One-year post-opening project evaluation



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Foreword

As Chief Customer and Strategy Officer, I want to know whether developments on our network are meeting their objectives and making a difference for our customers – the four million people that use the Strategic Road Network every day. Evaluation is a key function in the safe running of the Strategic Road Network (SRN) and we carry out POPE¹ evaluations at set points during a major enhancement scheme's lifetime to enable us to take stock and make any necessary interventions. POPEs provide an early indication if the scheme is on track to deliver the benefits over 60 years as set out in the business case appraisal.

This report evaluates the M60 junction J8 to M62 J20 all lane running (ALR) smart motorway scheme one year after its opening in 2018 following conversion from a conventional three lane motorway.

This report will be followed by a five years after report which will provide more robust data and analysis. The report includes an understanding of the safety and environmental impacts of a scheme, as well as how traffic has changed due to a scheme being in place.

There are three types of smart motorway, all lane running (ALR), dynamic hard shoulder (DHS) and controlled motorway. ALR and DHS motorways create more space on some of the most congested sections of the SRN by using hard shoulder as a running lane either permanently or only at busy times. They create extra capacity with less disruption to road users and fewer environmental impacts than physically widening the road, along with reduced carbon emissions associated with construction.

Although the performance of individual scheme is important at a local level, drawing together findings at a programme level helps us to understand patterns and trends across our network.

Safety remains our number one priority and the five-year POPEs published to date (representing approximately a quarter of those in operation) demonstrate that smart motorways are delivering safety benefits in line with or above those originally forecast, with most schemes evaluated having lower collision rates than would have been expected on the conventional motorways they replaced. Where it has been possible to assess changes to the severity of such collisions, the evidence shows those collisions have been less severe.

The published five-year POPEs show that smart motorways are broadly on track to realise their envisaged environmental objectives. With further planned mitigation these will be fully met.

The five-year ALR and DHS POPEs published to date for smart motorways also show that the schemes are delivering much needed capacity with schemes accommodating up to almost a quarter (22%) more traffic than before they were converted into smart motorways. The reports indicate that many of the motorway

¹ Post Opening Project Evaluation (POPE)

sections would have been unable to cater for today's traffic (at the busiest times) if they had not been converted into smart motorways.

According to the reports, the schemes are currently on course to deliver benefits, but will not deliver all the originally expected benefits within the 60-year appraisal period. There has been lower traffic growth than was expected when these schemes were appraised, due to the 2008 financial crisis and lower population growth than originally forecast (this will impact all transport schemes, built around this time). This means fewer drivers are benefiting today from smart motorway schemes than originally anticipated. Five-year POPEs also show that traffic on some smart motorway sections is not travelling as quickly as was forecast at the appraisal stage. Together these factors have resulted in the value for money for all schemes with five-year appraisals, over the 60-year appraisal period, currently being lower than anticipated at this stage when compared with the original appraisal. This is, however, a forecast and there is the opportunity to take further action to improve benefits.

We have therefore examined these results in detail and have identified specific actions to further improve the performance of schemes, including:

- Standardised operating procedures for DHS schemes
- Technology improvements
- Optimisation of the algorithms that set speed limits
- Investigating physical constraints off the network that impact performance

We will continue to monitor schemes in operation, enabling us to track their benefits and take further action if required to ensure these schemes deliver an improved experience for our customers.

Elliot Shaw

Chief Customer and Strategy Officer

September 2023

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1. Executive summary

The M60 and M62 are key strategic routes in England. The M60 forms a ring road around Manchester whilst the M62 links Liverpool, Manchester, Leeds, and Hull. The M60 junction 8 to M62 junction 20 project is approximately 16 miles in length and opened to traffic in July 2018 following four years of construction.

Prior to project implementation, the route was suffering from frequent congestion, with many sections of the route seeing average daily traffic volumes in excess of 80,000 vehicles. The aim of the project was to provide additional capacity through utilising existing infrastructure within the existing highway boundary, alongside reducing congestion and improving journey time reliability.

The M62 junctions 18 to 20 (five miles) was converted to an all lane running² smart motorway. This provided an additional lane of capacity through conversion of the hard shoulder to a running lane, which is permanently open for use, with upgraded variable messaging signs and emergency areas provided at regular intervals. The M60 junctions 8 to 18 (twelve miles) was converted to a controlled motorway, applying technology to control the speed of traffic and retaining a permanent hard shoulder, but providing no additional capacity.

The project aimed to achieve no worsening of safety performance of the network; this means that collision numbers and severity ratio after the project was implemented will be no greater than before the project. The safety trends available at one-year after evaluation indicate the smart motorway is on track to achieve these objectives. The analysis will be revisited in later years before we are sure that the change is significant. It will require a longer timeframe to determine if these initial positive findings are a real trend or natural fluctuation.

We considered two routes: one route travelling clockwise/northbound (M60 junctions 8 to 18 and M62 junctions 18 to 20) and one travelling anti-clockwise/southbound (M62 junctions 20 to 18 and M60 junctions 18 to 8). We found customers were experiencing improvement in journey times and reliability for the morning peak in the clockwise/northbound direction, compared to before the project was constructed. For all other time periods, journey times have increased. The scheme overall has not reduced congestion (noting that the majority of the scheme was for a controlled motorway with no added capacity), with low speeds in certain congestion hotspots.

Comparison of performance against the forecasts made to support the investment business case will be undertaken at the next evaluation stage. Consequently, the environmental evaluation dependent on this will also be undertaken at that stage.

² All lane running (ALR) motorways apply technology to control speeds, and permanently convert the hard shoulder to a running lane. Emergency areas are available at regular intervals providing places to stop in an emergency.

2. Introduction

What is the project and what was it designed to achieve?

The M60 junction 8 to M62 junction 20 corridor is a strategically important route which suffered from frequent congestion in both the clockwise/northbound and anticlockwise/southbound directions. This route forms part of the Trans-European Road Network and is an integral part of the main east-west transport corridor in the Northwest of England, linking Merseyside in the West with Yorkshire and Humberside in the East.

Prior to the project the route consisted of standard motorways with three or four lanes plus a hard shoulder in each direction. The route experienced particularly heavy congestion during the weekday morning and afternoon peak hours. The route also contains several closely spaced junctions which results in short distance junction to junction journeys. These types of journeys often involve significant levels of lane weaving and frequent acceleration and deceleration, both of which impact traffic flows and contribute to congestion.

The M60 junction 8 to M62 junction 20 corridor was first identified in a 2008 study as a potential priority location for a smart motorway project, with treatment of the whole route likely to provide additional journey time efficiencies. This project was officially committed as part of the 2010 Government Spending Review³, which aimed for construction to commence during the 2014/15 financial year. This project formed part of National Highways' programme to add capacity to the existing strategic road network, supporting economic growth and maintaining mobility.

The mobilisation works for the scheme began in July 2014, with the main construction works, which included mandatory 50mph speed limits on the main carriageways, starting in November 2014. The project opened to traffic in July 2018 and consisted of the following smart motorway types (also shown schematically in Figure 1):

- Controlled motorway⁴, which involved upgrading existing and installing additional variable messaging signs, on the M60 junctions 8 to 18. The hard shoulder was retained but the variable speed limits are mandatory.
- All lane running motorway⁵, which converted the hard shoulder to a permanent running lane with emergency areas at regular intervals, providing additional capacity and variable mandatory speed limits, on the M62 junctions 18 to 20.

During scheme development, assessments were undertaken to determine the suitability of providing an all lane running smart motorway on the M60. However, the environmental aspect of this assessment concluded this improvement would likely result in increased vehicle volumes and a resultant detrimental impact on the

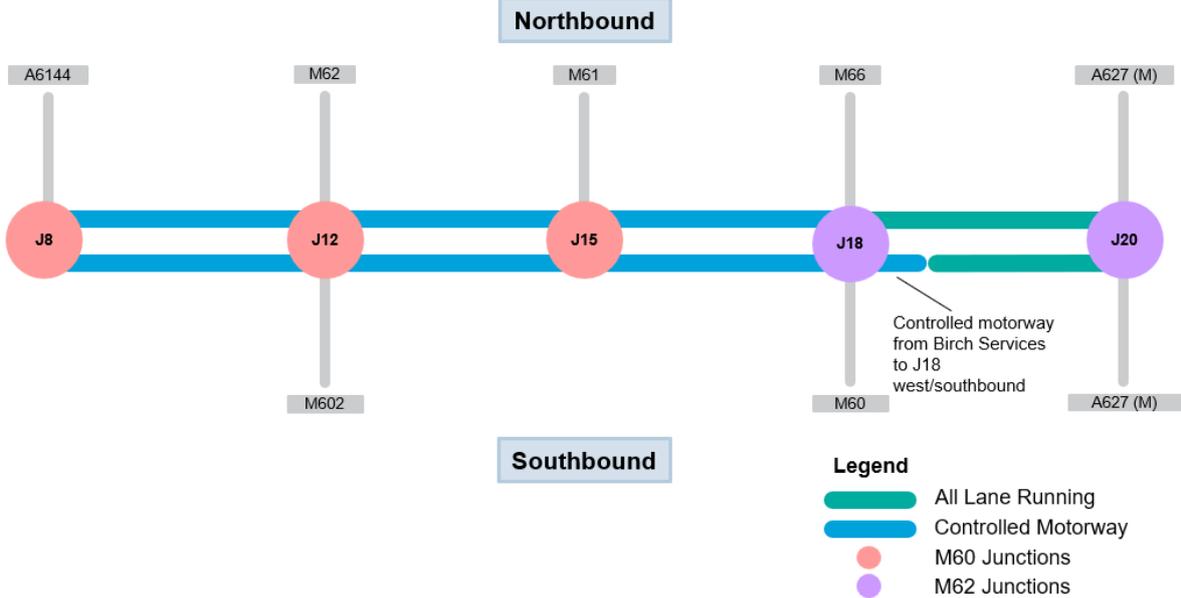
³<https://webarchive.nationalarchives.gov.uk/ukgwa/20120217082810/http://www.dft.gov.uk/publications/investment-in-highways-transport-schemes>

⁴ A controlled motorway applies technology to control speeds, but retains a permanent hard shoulder

⁵ All lane running (ALR) motorways apply technology to control speeds, and permanently convert the hard shoulder to a running lane. Emergency areas are available at regular intervals, providing places to stop in an emergency.

local air quality. Due to this, all lane running on the M60 was removed from the project design.

Figure 1 – M60 junction 8 to M62 junction 20 All Lane Running Upgrade Schematic



Intermediate junctions on the M60 are not included on this schematic.

Upgraded variable messaging signage was introduced across the length of the scheme. This feature allows reduced speed limits to be set, incident management to take place (lane closures and diversions) and additional information to be provided to road users. For example, a lane may be closed using the “Red X” sign if there is an obstruction, with the remaining lanes in that location set to a lower speed limit and advanced notice of the hazard displayed to forewarn road users.

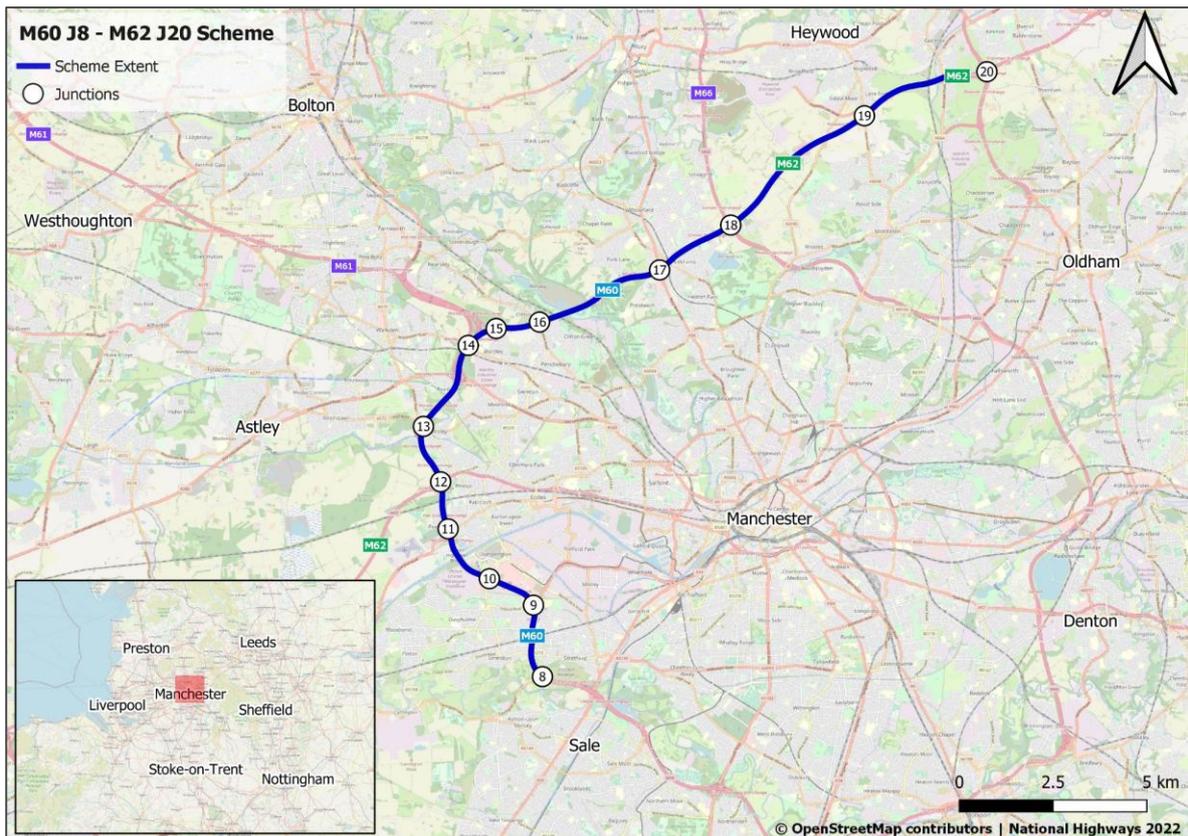
Project location

Both the M60 and the M62 are located within the Greater Manchester Area. The M60 extends for approximately 35 miles forming a ring road around Manchester, which benefits from direct connections to several motorways (M56, M61, M62 and M67) and A-roads on the strategic road network (A6, A34, A56 and A62).

The M62 is a key corridor connecting Liverpool, Manchester, Leeds and Hull, via the M60. The motorway is approximately 107 miles in length (including a section of M60 connecting to two sections of M62) and has direct connections with the A1(M), M1, M18, M6, M60, M61 and M66.

The scheme is located entirely within the Greater Manchester area and is approximately 16 miles in length connecting to the A6144 at Ashton-upon-Mersey (M60 junction 8) and the A627(M) at Rochdale (M62 junction 20). The scheme location is shown in Figure 2 below.

Figure 2 – M60 junction 8 to M62 junction 20 All Lane Running upgrade project location



Source: Open Street Map contributors and National Highways, 2022.

How has the project been evaluated?

Post-opening project evaluations (POPEs) are carried out for major projects to validate the accuracy of expected project impacts which were agreed as part of the business case for investment. They also seek to determine whether the expected project benefits are likely to be realised. They provide opportunities to learn and improve future project appraisals and business cases too. And are important for providing transparency and accountability for public expenditure, by assessing whether projects are on track to deliver value for money.

A POPE compares changes in key impact areas⁶ by observing trends on a route before a project is constructed (baseline) and tracking these after it has opened to traffic. The outturn impacts are evaluated against the expected impacts (presented in the forecasts made during the appraisal) to review the project's performance. For more details of the evaluation methods used in this study please refer to the POPE methodology manual on our website.⁷

⁶ Key impact areas include safety, journey reliability and environmental impacts.

⁷ <https://nationalhighways.co.uk/media/exypgk11/pope-methodology-note-jan-2022.pdf>

3. Delivering against objectives

How has the project performed against objectives?

All our major projects have specific objectives which were defined early in the business case when project options were being identified. The project had several key objectives, primarily related to improving journey times, maintaining safety for road users, and supporting wider government transport policy. These benefits are appraised to be realised over 60 years; a one-year evaluation provides early indication if the project is on track to deliver the benefits.

Table 1 summarises the project’s performance against each of the objectives, using evidence gathered for this study.

Table 1 Objectives and Evaluation summary

Objective	One-year evaluation
<p>Support and enhance the role of the current M60 and M62 as a major national and inter-urban regional transport artery.</p>	<p>Conversion to all lane running on the M62 junctions 18 to 20 has increased the capacity, supporting this motorway’s role as a major transport artery.</p> <p>The introduction of upgraded variable messaging signs on the M60 and M62 enhanced the control and management of traffic on the route.</p>
<p>Make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances.</p>	<p>Utilisation of the hard shoulder on the M62 junctions 18 to 20 (in both directions) created an additional traffic lane and increased the overall capacity of the route.</p>
<p>Reduce congestion and develop solutions that provide additional capacity, increase journey time reliability, and ensure the safe and economic operation of the motorway.</p>	<p>Customers experienced more reliable journeys while travelling clockwise/northbound (towards Leeds) at some times of day. However, despite additional capacity provided on the M62, overall the project has not reduced congestion or improved journey time reliability. However, additional capacity has been provided on the M62 through the conversion to all lane running.</p>
<p>Improve journey time reliability, by improving and better managing traffic flow conditions.</p>	
<p>Deliver the minimum scope required to achieve no worsening of safety performance of the network using Smart Motorway techniques.</p>	<p>The safety trends indicate that these objectives are on track to be achieved.</p>
<p>Achieve a safety objective under which the “after” accident numbers (per annum) are no greater than</p>	

Objective	One-year evaluation
those in the “before” and the severity ratio is not increased.	
Improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.	There is additional signage throughout the length of the scheme providing road users with higher quality and more regular information.
Deliver the scheme in a way which; supports the delivery of the Government’s transport policy objectives.	Completion of this smart motorway supported the Government’s objective to increase capacity on the existing road network.
Address the transport and safety problems identified in the Challenges and Issues section of the Client Scheme Requirements document.	Collision causation is outside the scope of this evaluation and as such it is not possible to comment on the progress of this objective.

4. Customer journeys

Summary

The project increased capacity, supporting this motorway's role as a major transport artery. The introduction of upgraded variable messaging signs on the M60 and M62 enhanced the control and management of traffic on the route and provide road users with higher quality and more regular information.

Although journey time reliability improved during periods of the day in the clockwise/northbound direction, the scheme overall has not reduced congestion nor improved journey time reliability, with low speeds in certain congestion hotspots, where capacity has not increased.

Average journey times have increased across the main time periods except for the morning peak in the clockwise/northbound direction. The afternoon peak average journey time in the clockwise/northbound direction increased by over ten minutes, whilst the two peaks in the reverse direction both increased by over five minutes. Overall, this shows the project route is continuing to suffer from congestion, likely worsened by the increase in vehicle volumes in some locations.

Average speeds across the route were consistent and smooth in the morning peak and daytime period in the clockwise/northbound direction. However, M60 junctions 8 to 11 in the afternoon peak suffered from very low speeds. Variable speed limits are also set most frequently in this section of the route, particularly in the peak periods. This further supports the suggestion that this section of the route is a congestion hotspot. The congestion is likely due to this section of the route only having three lanes and being capacity constrained relative to the remainder of the route. The impact of the neighbouring M62 junctions 10 to 12 smart motorway scheme undergoing construction may have also had an impact.

In the anti-clockwise/southbound direction the morning peak and daytime period both show low speeds around M60 junctions 17 to 14, whilst the afternoon peak has fairly smooth speeds. This indicates the project route has a tidal nature with more congestion southbound in the morning peak and congestion northbound in the afternoon peak. Variable speed limits were in use over 70% of the time in the morning peak between M62 junction 20 to M60 junction 10 and area commonly used throughout the day between M60 junctions 16 to 13, supporting the suggestion that the anti-clockwise/southbound direction suffers from more congestion.

How have traffic levels changed?

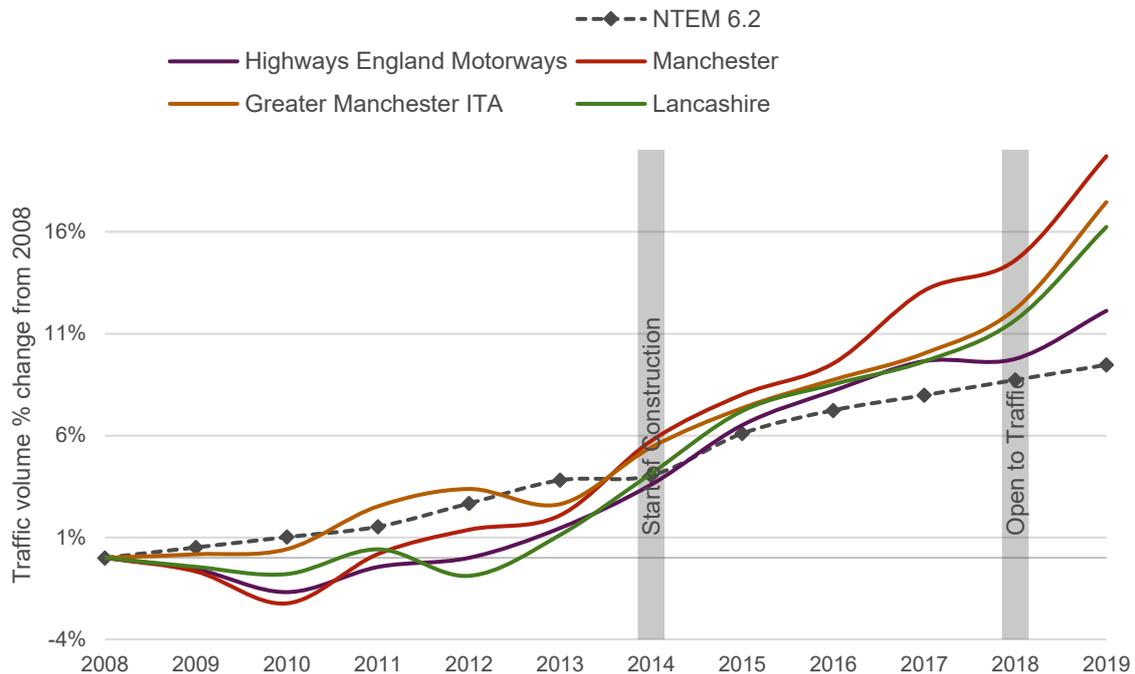
Smart motorways are built on stretches of motorway which experience high levels of congestion and/or are expected to see traffic levels increase significantly in future years. The following sections examine how traffic levels changed between the pre-construction period and one year after period.

National and regional

To assess the impact of the project on traffic levels, it is useful to understand the changes within the context of national and regional traffic. We use the background trends as a relative baseline from which to measure a project's impact on traffic

volumes. We attribute any growth observed on roads in the study area which is above background trends to the project.

Figure 3 - National, regional, local and NTEM (National Trip End Model) traffic trends



Sources: Department for Transport, Road traffic statistics (TRA8904), 2022: [Road traffic statistics - GOV.UK \(www.gov.uk\)](https://www.gov.uk/road-traffic-statistics), Department for Transport, National Trip End Model (NTEM) version 6.2: [National Trip End Model \(NTEM\) - data.gov.uk](https://data.gov.uk/national-trip-end-model-nTEM)

Figure 3 shows that traffic volumes have increased since 2008⁸ at a local (Manchester and Greater Manchester), county (Lancashire) and national (National Highways Motorways) level. Between 2013 (the baseline for this study) and 2019 (one year after the project opened), traffic volumes rose by 17% in Manchester, 14% in Greater Manchester ITA (Integrated Transport Authority) and 15% across Lancashire. Overall, local traffic in and around the Manchester area saw notably higher increases in volume, compared to motorway traffic (11%), over the same period.

Figure 3 also includes the National Trip End Model (NTEM) traffic trendline. This model was used during the project’s appraisal to account for future traffic growth in the forecasts. As can be seen, from 2014 onwards it forecast less growth than was observed.

Nearby projects

It should be noted that at the time of the one year after data collection there was a neighbouring project under-construction:

- **M62 junctions 10 to 12 smart motorway improvement⁹**, which connects directly to the M60 junction 12, began construction in March 2018. During summer 2019 the main carriageways had three narrow lanes per direction, a mandatory 50mph speed limit, constrained slip roads, intermittent temporary contraflows, and slip road closures for select periods. It is reasonable to assume that one year after traffic flows at the M60 junction 12 may have

⁸ The data is presented from 2008 as this is the base model year in the Greater Manchester SATURN Highway Assignment Model used in the appraisal of the scheme.

⁹ <https://nationalhighways.co.uk/our-work/north-west/m62-junction-10-to-12-smart-motorway/>

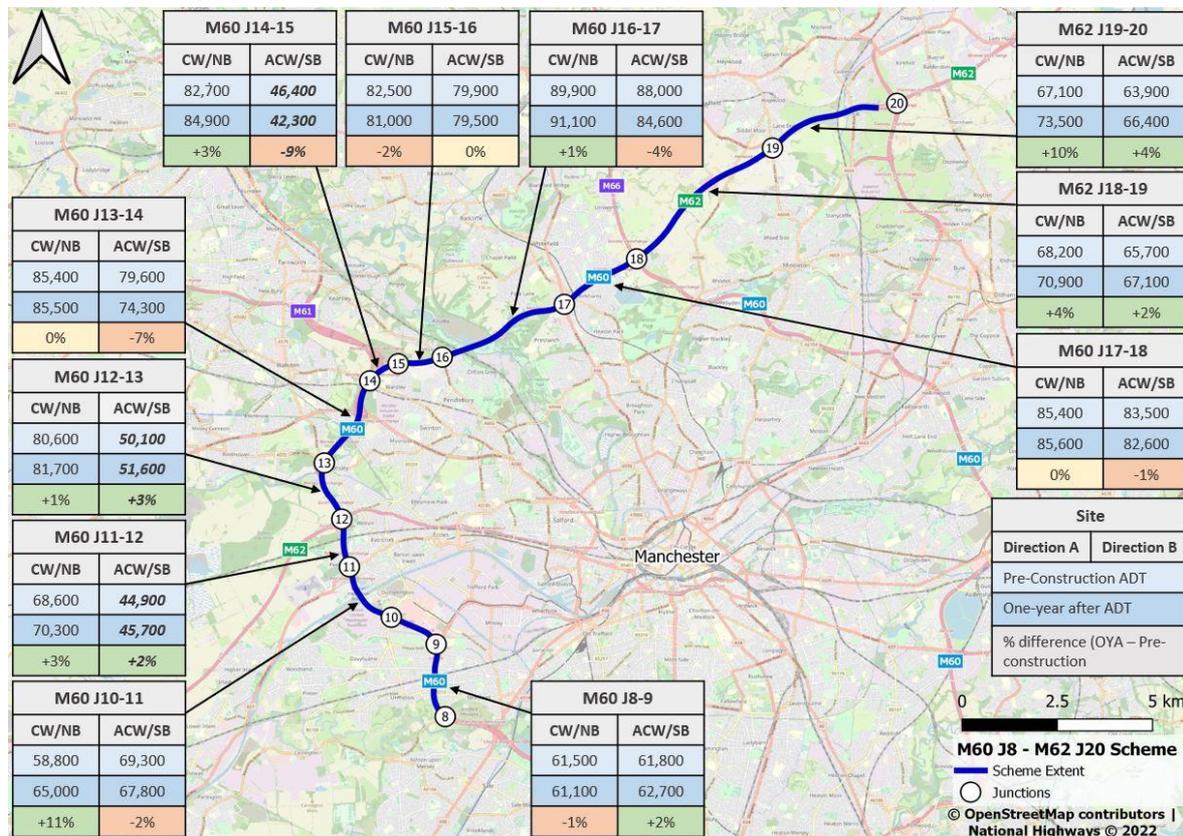
been impacted by the construction of this scheme, potentially resulting in reduced traffic volumes and speeds, with increased journey times through the junction and immediate vicinity.

How did traffic volumes change?

We assessed the changes in traffic along the length of the project, considering whether the magnitude of change is in line with the observed local and county level changes.

Figure 4 compares the pre-construction (2013) and one-year after (2019) average daily traffic (ADT) volumes and the associated percentage changes across the length of the scheme. The ADT flows are also shown in Figure 4.

Figure 4 – Comparison of before and after average daily traffic



Source: National Highways WebTRIS (September to October 2013 and September to October 2019)

Note: Figures shown in italics represent through junction volumes, which have been taken where inter-junction volumes are not available. Through junction volumes should not be directly compared with inter-junction volumes. No comparable sites were available for J9-10.

Values rounded to the nearest 100.

Traffic volumes increased by between 2–10% on all sections of the M62, with the clockwise/northbound direction showing a higher percentage increase than the anti-clockwise/southbound carriageway. This project converted the M62 junctions 18 to 20 to all lane running, adding a permanent running lane and increasing capacity by a third, without which there may not have been sufficient capacity to enable the level of growth observed.

The M60 junctions 8 to 18 were operating at or close to capacity prior to the scheme implementation. This stretch of motorway did not gain an additional lane as part of this scheme. Due to this lack of available additional capacity the

observed changes in traffic volume from 2013 pre-construction to 2019 one year after are generally minimal on the majority of sections with data available.

Comparison of performance against the traffic forecasts made to support the investment business case will be undertaken in the next evaluation stage, when we undertake the environmental evaluation

Relieving congestion and making journeys more reliable

Smart motorways are implemented on the busiest routes, to ease congestion and ensure journey times are more predictable. These routes are often where we anticipate congestion will increase and the smart motorway seeks to limit this.

Analysis of journey times and speeds indicate the impact of the smart motorway on congestion. The extent to which journey times vary from the expected average journey time indicates how reliable a journey is.

This section evaluates how the scheme impacted journey times and the reliability of journeys.

Did the scheme deliver journey time savings?

We found customers were experiencing improvement in the morning peak in the clockwise/northbound direction, compared to before the project was constructed. For other time periods, journey times have increased.

We considered two routes: one route travelling clockwise/northbound (M60 junctions 8 to 18 and M62 junctions 18 to 20) and one travelling anti-clockwise/southbound (M62 junctions 20 to 18 and M60 junctions 18 to 8). We considered the same time periods as the Traffic Forecasting Report produced to support the investment decision¹⁰.

Comparing the peak average journey times by direction indicates that the route has a tidal nature, with more congestion anti-clockwise/southbound in the morning peak and clockwise/northbound in the afternoon peak. Average journey times during the daytime period are slightly slower in the anti-clockwise/southbound direction.

¹⁰ TomTom move GPS (Global Positioning System) data, https://www.tomtom.com/en_gb/. Pre-construction 2013 and one year after 2019. Morning (AM) peak 0700 – 1000. Daytime (IP) 1000 – 16000. Afternoon (PM) peak 1600 – 1900.

Table 2 focuses on the time periods which have the largest differences in average journey time, namely the morning peak, daytime and afternoon peak.

Table 2 Average cumulative journey times (mm:ss) across the full scheme extent

Time Period	Pre-Construction (2013)	One-Year After (2019)	2019 vs 2013	% Difference to Pre-Construction
Clockwise/Northbound				
Morning Peak	19:34	19:20	-00:14	-1%
Daytime period	16:37	17:46	+01:09	7%
Afternoon Peak	24:34	34:47	+10:13	41%
Anti-Clockwise/Southbound				
Morning Peak	33:25	38:57	+05:32	17%
Daytime period	18:02	20:42	+02:40	15%
Afternoon Peak	19:02	24:18	+05:16	28%

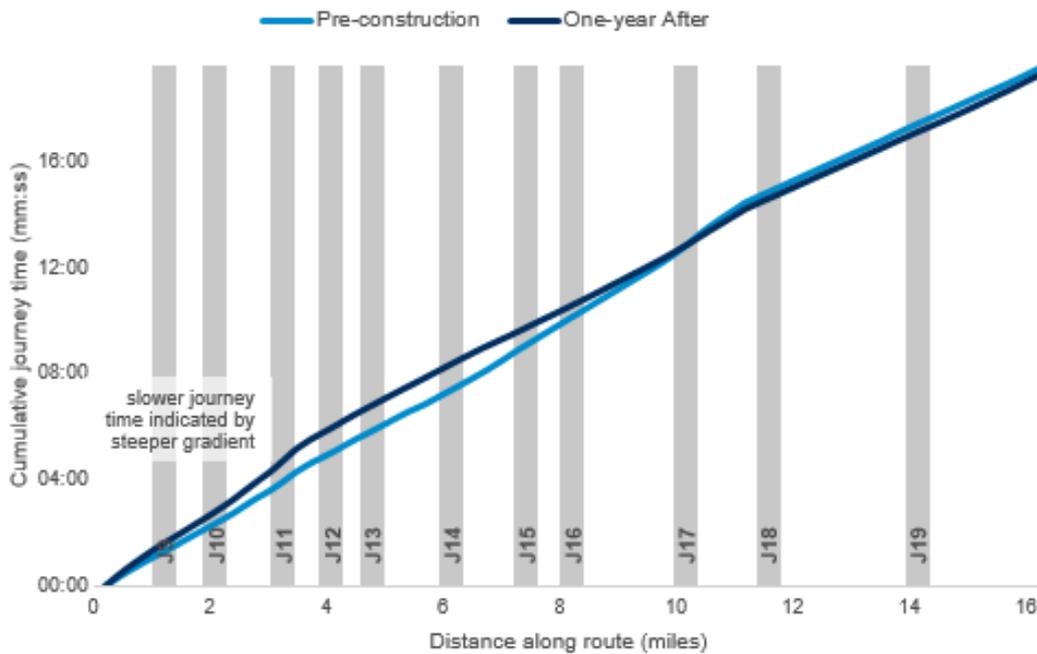
Source: TomTom Move Traffic Statistics, 2013, 2019

In the clockwise/northbound direction average journey times¹¹ increased in the daytime and afternoon peak periods, with the afternoon peak showing the largest journey time increase at over 10 minutes. Although the morning peak average journey time decreased, the change in journey time is minimal at just 14 seconds. In the anti-clockwise/southbound direction all average journey times increased in 2019 compared to 2013. In both the morning and afternoon peaks the total journey time increased by over five minutes, whilst the daytime period increased by over two and a half minutes.

By displaying the average cumulative journey times in a graphical format it is possible to identify the locations where low speed is impacting journey times. Figure 5 and Figure 6 compare the pre-construction and one year after average cumulative journey times in the morning peak in the clockwise/northbound and anti-clockwise/southbound directions respectively. Where the gradient is steeper there are slower speeds.

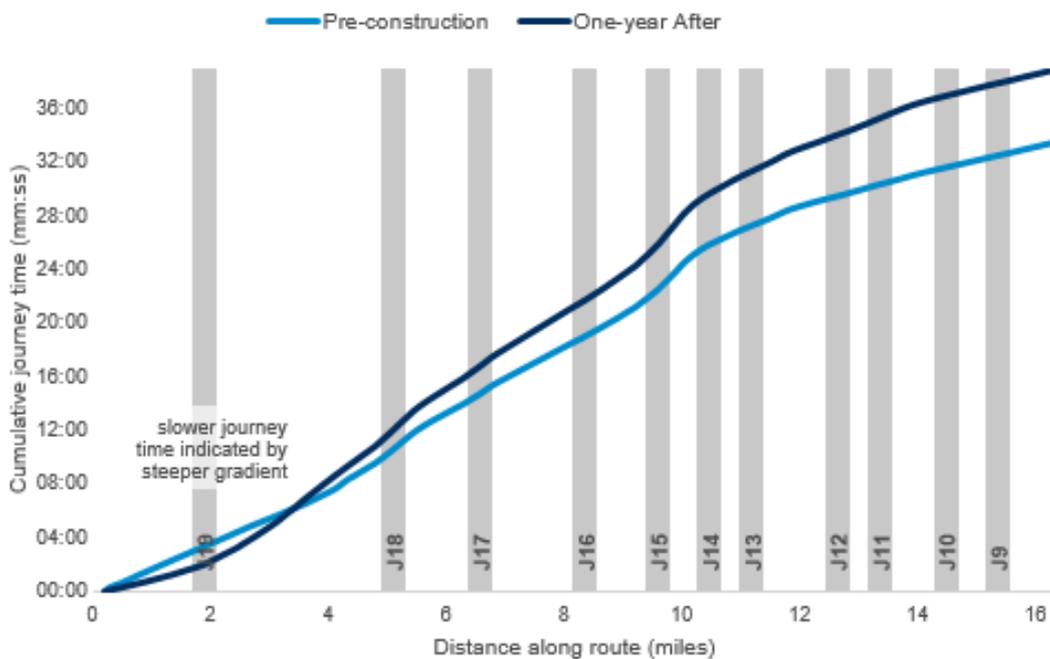
¹¹ we are presenting before and after journey times unadjusted, we have not made a counterfactual estimate of what journey times are likely to have been without the scheme.

Figure 5 – Cumulative journey time comparison in the morning peak (0700 – 0900), clockwise/northbound direction



Source: TomTom Move Traffic Statistics, 2013, 2019

Figure 6 - Cumulative journey time comparison in the morning peak (0700 – 0900), anti-clockwise/southbound direction



Source: TomTom Move Traffic Statistics, 2013, 2019

In the clockwise/northbound direction average cumulative journey times across the full route are very similar, though journey times are slightly longer between M60 junctions 8 to 11 in the one year after period.

However, in the anti-clockwise/southbound direction the one year after average cumulative journey times are longer than those of the pre-construction period by over five minutes. Journey times are faster between M62 junctions 20 to 19 in the

one year after compared to the pre-construction. This section of motorway was converted to all lane running as part of this scheme, increasing the overall capacity of the carriageway by a third. From Figure 4 it is known that vehicle volumes for this section only increased by a maximum of 10%, resulting in an overall reduction in congestion and lower journey times.

Midway between M62 junctions 19 and 18 the one year after average journey time increases to be greater than during the pre-construction period, indicating congestion in this area. M62 junction 18, also known as Simister Island, is a major interchange that connects the M60, M62 and M66, with approximately 90,000 vehicles passing through each day. As a result of these high flows this junction often experiences congestion and poor journey time reliability. Due to this, National Highways is in the process of developing an improvement scheme¹² with the aim of facilitating smoother traffic flows between connected motorways.

It is likely that some of the congestion shown around junction 18 in Figure 6 is the result of tailbacks on the southbound exit slip road. This slip road consists of two lanes with the signage informing drivers to move to the left most lane to exit beginning one mile further north, just south of the Birch service station. Due to pre-construction data being unavailable on the exit slip road it is not possible to determine if the overall number of vehicles exiting is higher in the one year after period, which would further contribute to the congestion.

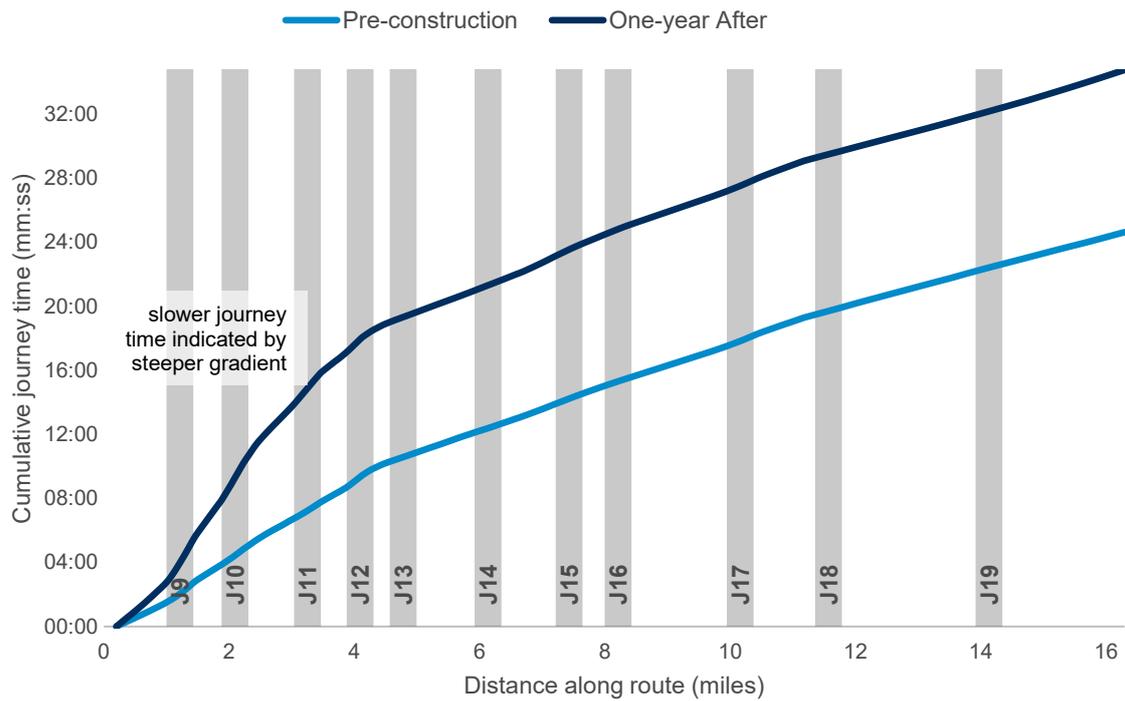
After junction 18 the average cumulative journey time for one year after period remains slower than for the pre-construction period. As discussed in Section 2, the M60 section of the scheme was operating at capacity in 2013 and did not benefit from all lanes running capacity increases as part of the scheme. Therefore, any growth in traffic volumes along this stretch is likely to have resulted in congestion and subsequently increased journey times.

In both directions the one year after daytime period average cumulative journey times are slower in the one year after period compared to the pre-construction period.

The afternoon peak shows the highest increase in average cumulative journey time across all time periods, with the clockwise/northbound direction seeing a 41% increase and the anti-clockwise/southbound 28%, compared to the pre-construction values (refer to Figure 7 and Figure 8).

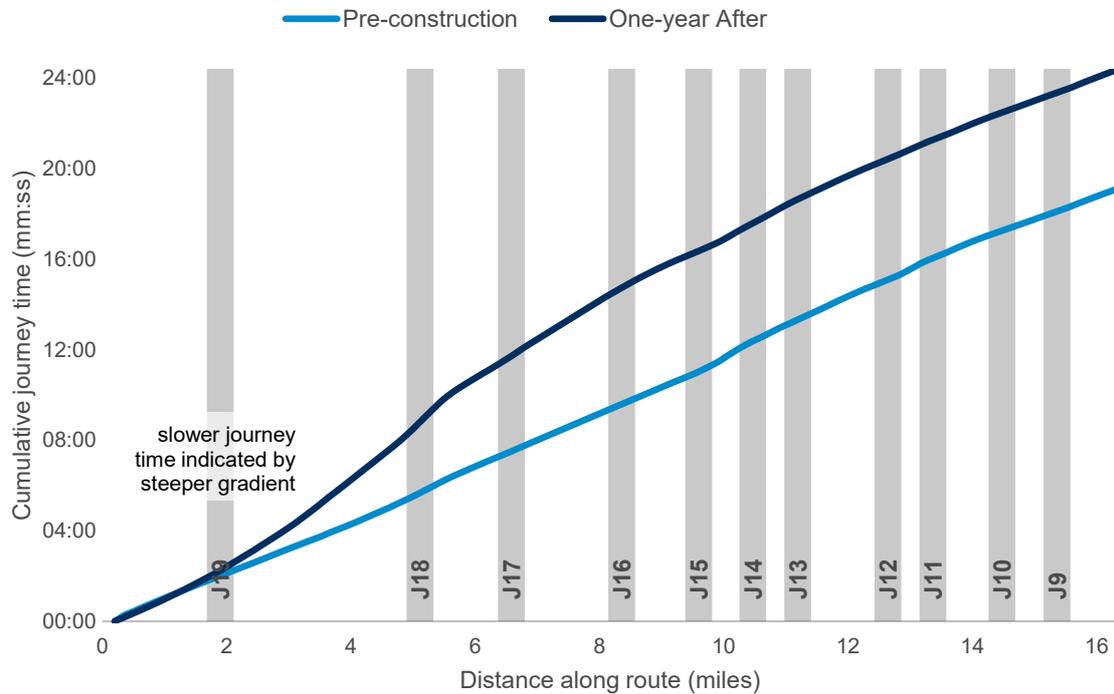
¹²<https://nationalhighways.co.uk/our-work/north-west/m60-junction-18-simister-island-interchange/>

Figure 7 - Cumulative journey time comparison in the afternoon peak (1500 – 1800), clockwise/northbound direction



Source: TomTom Move Traffic Statistics, 2013, 2019

Figure 8 - Cumulative journey time comparison in the afternoon peak (1500 – 1800), anti-clockwise/southbound direction



Source: TomTom Move Traffic Statistics, 2013, 2019

The clockwise/northbound direction displays a sharp rise in journey times between M60 junctions 8 and 12 indicating heavy congestion in this area during the afternoon peak. The M60 junctions 9 to 12 consists of three lanes plus a hard shoulder. The M60 junctions 10 to 11 width is constrained by the bridge over the

Manchester Ship Canal and not having a hard shoulder, resulting in this section of the route having reduced capacity compared to the remainder of the scheme. In addition, M60 junctions 10 to 11 saw an 11% increase in traffic volumes between the pre-construction and one year after period, whilst junctions 11 to 12 saw a 3% increase.

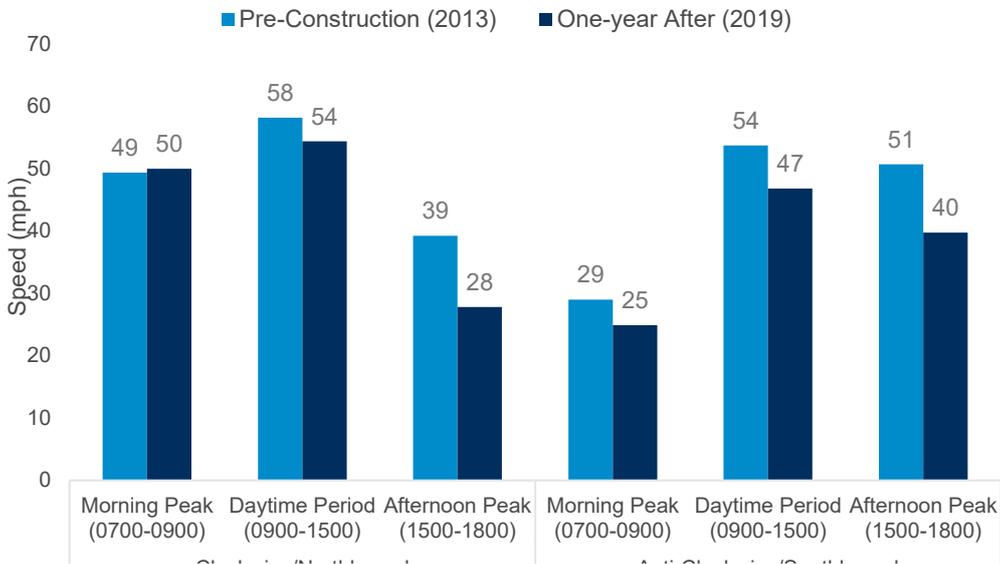
The M60 was operating at capacity during the pre-construction phase and has not gained significant additional capacity. Therefore, the increase in vehicle volumes observed is a likely cause of congestion between M60 junctions 10 and 12, which during busy periods of the day, such as during the afternoon peak, could tailback to affect M60 junctions 9 to 10, resulting in increased journey times.

As with traffic volumes, comparison of performance against the forecasts made to support the investment business case will be undertaken in the next evaluation stage.

How did the project impact speed?

We analysed speeds along the length of the project at different times of the day to understand the impact on journey times in more detail. Figure 9 compares average speeds in the pre-construction and one year after periods across the full length of the scheme route. As would be expected from the average cumulative journey time graphs, the one year after speeds are notably lower than the pre-construction speeds in the clockwise/northbound afternoon peak and the anti-clockwise/southbound morning peak.

Figure 9 – Comparison of average speeds across the full scheme extent.



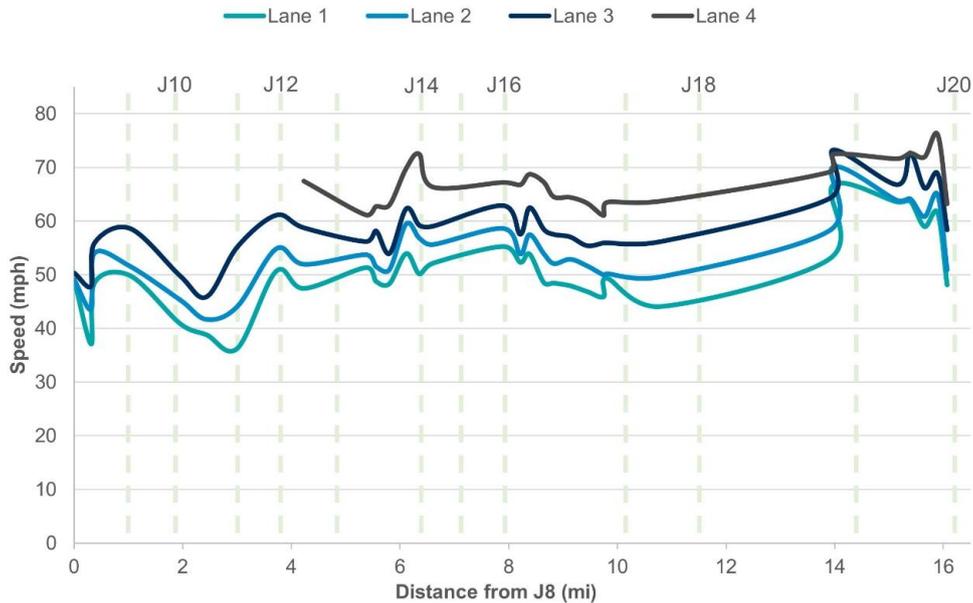
Source: TomTom Move Traffic Statistics, 2013, 2019

Inconsistent speeds are likely to be more stressful for road users. Consistent speeds are more likely to provide a pleasant driver experience, although this needs to be balanced against the frustration with increased journey times if speeds are consistently low. To assess the consistency of average speeds across the route, MIDAS data¹³ has been analysed and is presented in Figure 10 to Figure 15 below.

¹³ [MIDAS Data \(midas-data.org.uk\)](http://midas-data.org.uk) - Motorway Incident Detection and Automatic Signalling, a sensor based network designed to collect traffic data and automatically display variable messaging, including variable speed limits.

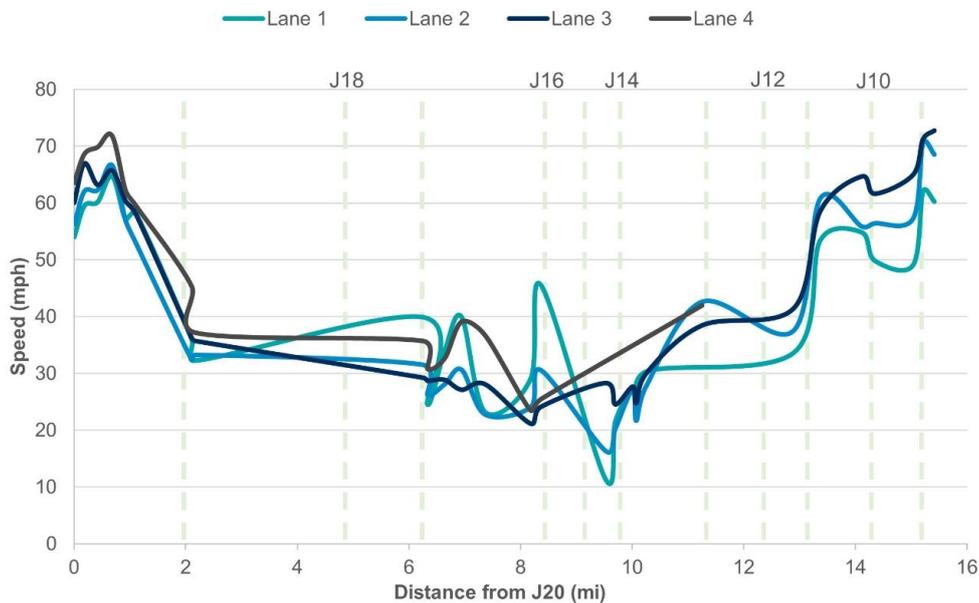
These figures show the average speeds per lane, not including through junction counts. It should be noted that limited data was available between M60 junction 17 and M62 junction 19, resulting in the graphs displaying overly consistent average speeds over this route section.

Figure 10 – Average weekday speed per lane in the morning peak (0700 – 0900) clockwise/northbound direction



Source: MIDAS data, 2019 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

Figure 11 – Average weekday speed per lane in the morning peak (0700 – 0900) anti-clockwise/southbound direction



Source: MIDAS data, 2019 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

In the morning peak the clockwise/northbound direction average speeds are lowest between M60 junctions 9 to 12. Alongside the previously mentioned capacity constraints, it is known that there are many short distance, junction to junction movements on this stretch of the scheme route. Vehicles undertaking these movements tend to have reduced speeds as they build up speed after joining and

slow before exiting. This can also introduce high levels of weaving, with many vehicles change lanes within a particular area.

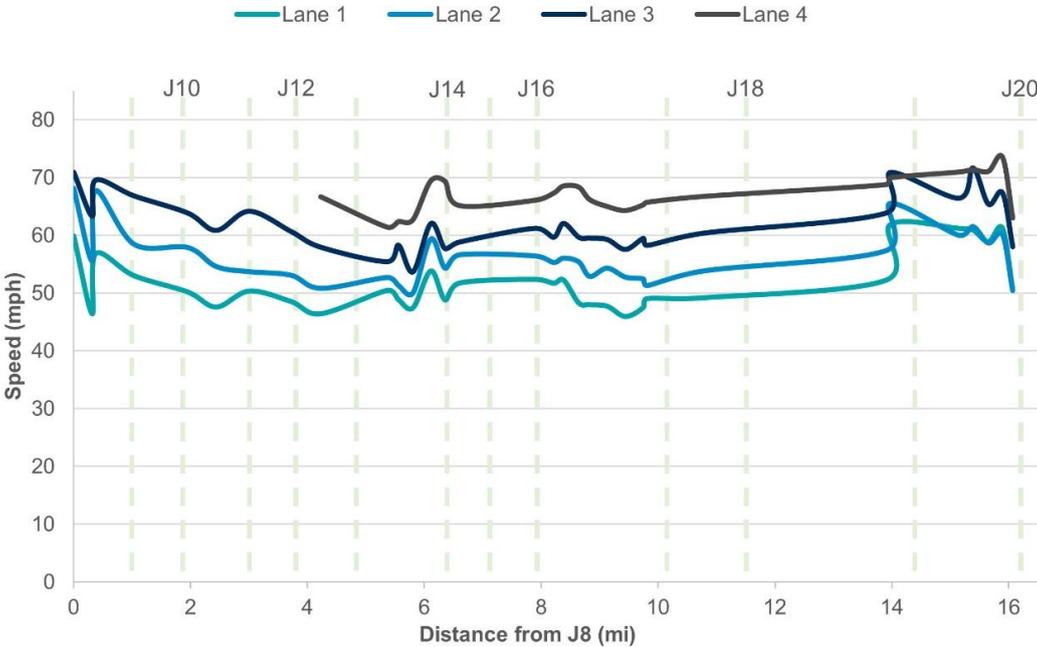
The M60 junction 12 is a significant interchange connecting to the M62 and experiences a high volume of vehicles passing through daily. On the approach to this junction, vehicles wishing to exit the M60 will move into lane one, weaving through the vehicles wishing to remain on the M60, before then slowing down to take the slip road. At the time of the one year after data, slip roads at M60 junction 12 were constrained due to the neighbouring M62 junctions 10 to 12 scheme, resulting in reduced vehicle flows and speeds.

The highest average speeds in the morning peak clockwise/northbound direction are between M62 junctions 19 to 20. This section of the route gained additional capacity as part of the scheme through conversion to all lane running but did not experience a proportionate increase in vehicle flows, resulting in spare capacity.

The average speeds in the anti-clockwise/southbound direction are notably lower than those in the clockwise/northbound direction. Speeds are particularly variable around M60 junctions 17 to 14 area. This section of the scheme route comprises four junctions within approximately 3.5 miles. This proximity of junctions will result in traffic weaving, as vehicles change lanes after joining and prior to exiting. Of note is M60 junction 15, which is a major interchange with the M61 and experiences a high daily flow of vehicles.

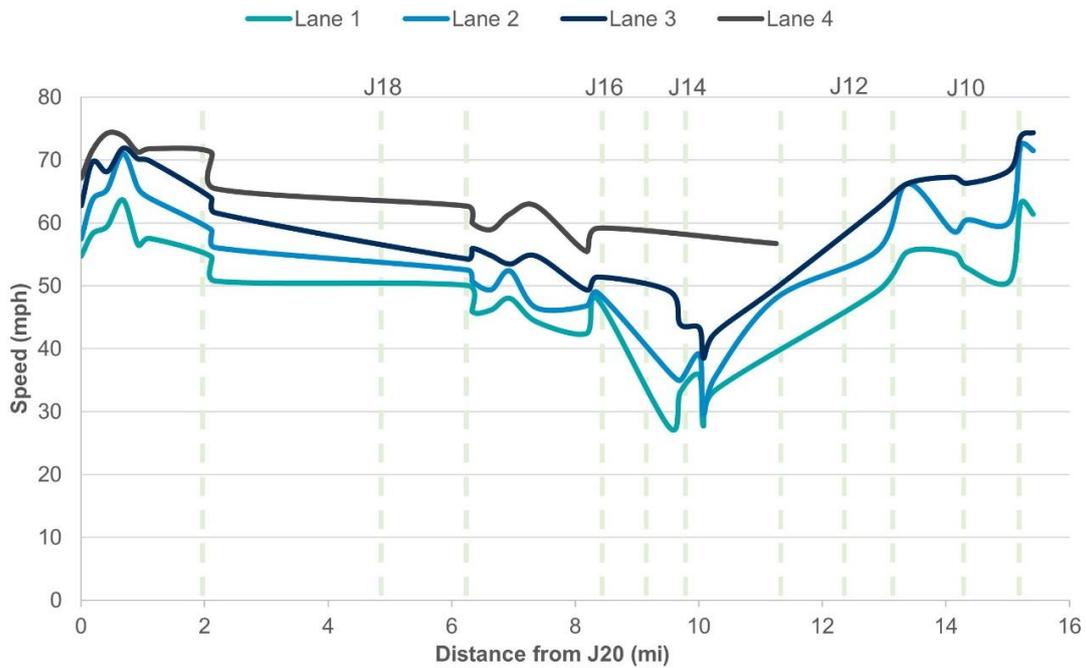
Despite the M60 junctions 12 to 8 only having three lanes, average speeds increase once vehicles have passed through the busy interchanges (M60 junctions 17 to 12).

Figure 12 – Average weekday speed per lane in the daytime period (0900 – 1500) clockwise/northbound direction



Source: MIDAS data, 2019 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

Figure 13 - Average weekday speed per lane in the daytime period (0900 – 1500) anti-clockwise/southbound direction

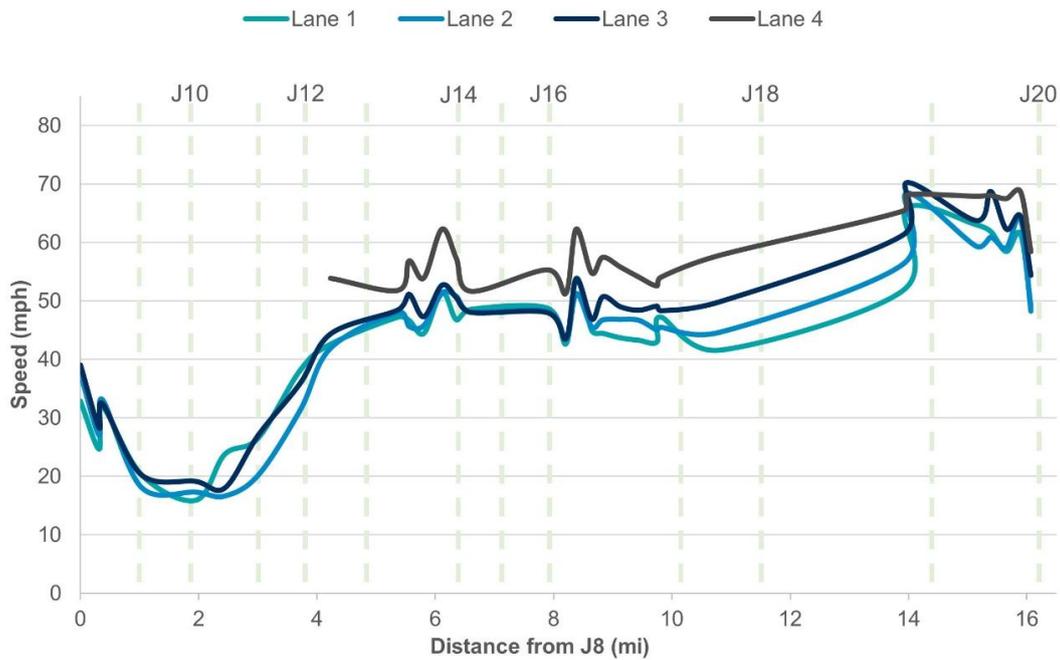


Source: MIDAS data, 2019 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

The daytime period average speeds are fairly consistent across the length of the scheme in the clockwise/northbound direction. Lane one speeds are lower than lanes two to four, which is attributable to the accelerating/decelerating vehicles entering/exiting via slip roads and the higher proportion of heavy goods vehicles. Heavy goods vehicles are speed limited to 60mph on motorways and are required to drive in lanes one and two, which will reduce the average speeds recorded compared to lanes three and four.

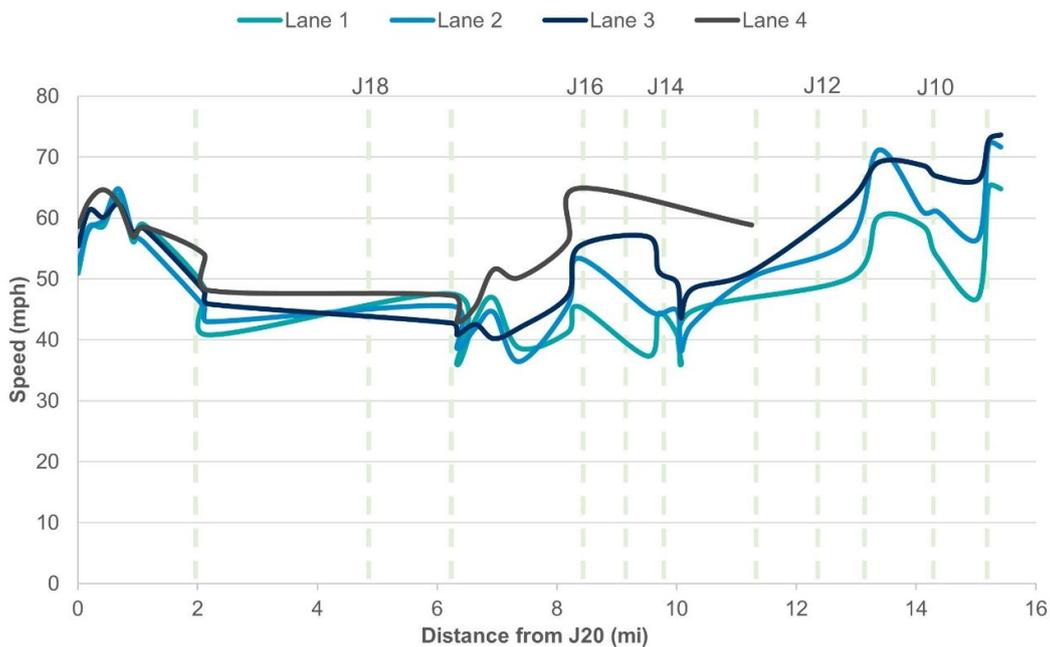
In the anti-clockwise/southbound direction the daytime average speeds follow the same trend as in the morning peak, though the reduced speeds in the middle of the scheme route, where there are a number of junctions in quick succession, are less pronounced.

Figure 14 - Average weekday speed per lane in the afternoon peak (1500 – 1800) clockwise/northbound direction



Source: MIDAS data, 2 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

Figure 15 - Average weekday speed per lane in the afternoon peak (1500 – 1800) anti-clockwise/southbound direction



Source: MIDAS data, 2019 - [MIDAS Data \(midas-data.org.uk\)](https://midas-data.org.uk)

The clockwise/northbound afternoon peak shows slow average speeds, under 30mph, between M60 junctions 9 and 11 which increase to over 40mph by junction 12. Given the tidal nature of the route, it is reasonable that the additional vehicle volumes in the afternoon peak could overwhelm the smooth flow of traffic on this section, resulting in low average speeds. The graph shows that average speeds remain above 40mph north of junction 12, suggesting the additional lane (starting after junction 12) and associated capacity is enough to mitigate against severe congestion.

The afternoon peak in the anti-clockwise/southbound direction shows more consistent average speeds. This is likely due to the lower vehicle flows experienced as a result of the tidal nature of the route.

As with traffic volumes and journey times, comparison of performance against the forecasts made to support the investment business case will be undertaken in the next evaluation stage. Consequently, the environmental evaluation dependent on this will also undertaken at that stage.

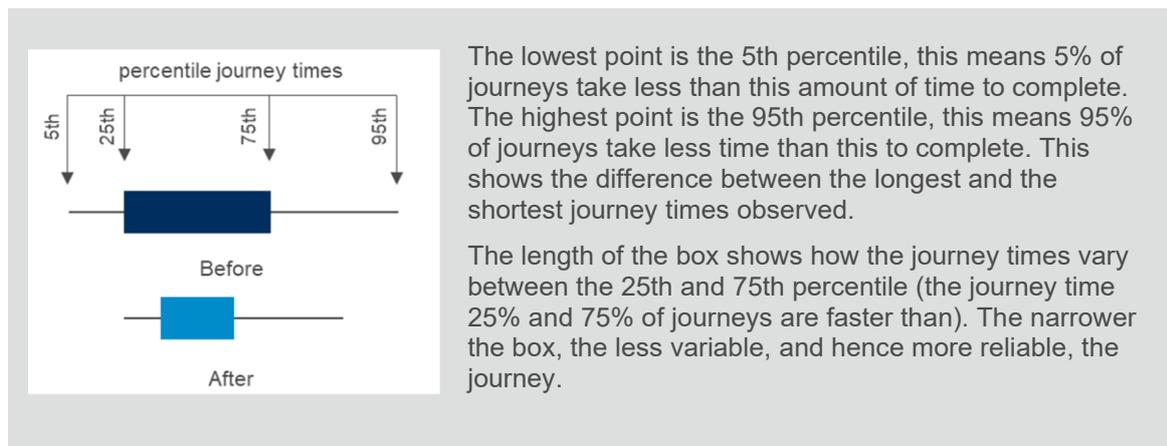
Did the project make journeys more reliable?

Congestion can make journey times unreliable. If the time taken to travel the same journey each day varies, journey times are unreliable, and the road user is less confident in planning how long their journey will take them. If journey times do not vary, the road user can be more confident in the time their journey will take and allow a smaller window of time to make that journey.

At one year after, customers experienced more reliable journeys while travelling clockwise/northbound (towards Leeds) at certain times of the day. However, overall the project has not improved journey time reliability.

To determine if journey time reliability changed, we plotted box and whisker diagrams as explained in Figure 16.

Figure 16 – What does a box and whisker plot show?

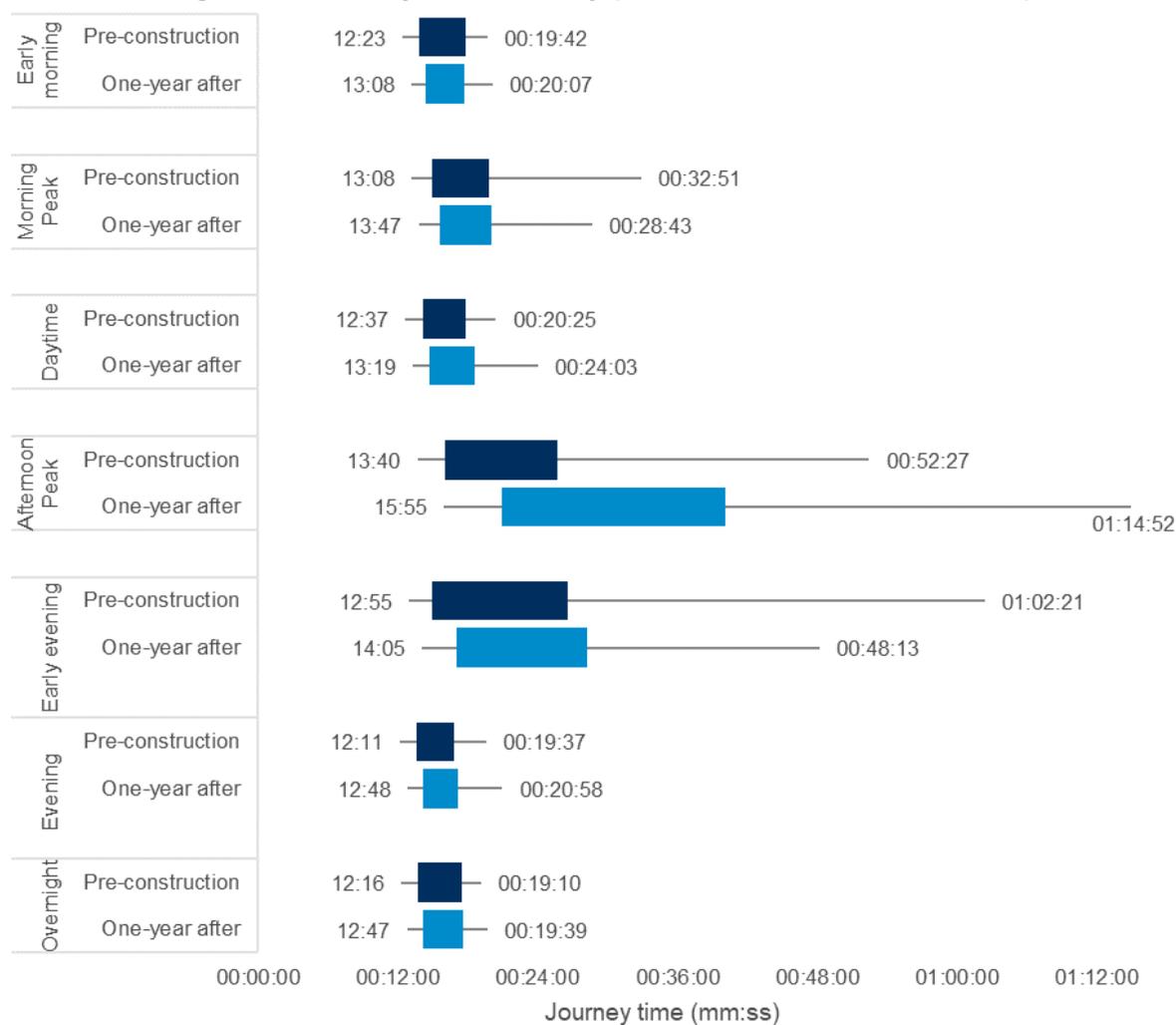


Despite customers experiencing longer journey times in most of the time periods in the clockwise/northbound direction, changes to the variability of journey times were small, except for the afternoon peak.

Outside of the afternoon peak, journeys were either consistent or improved compared to before. The worst journeys (represented by the 95th percentile journey time) were also consistent or improved in these time periods, except the daytime (0900 – 1500) period, where the journeys were slightly less reliable.

The afternoon peak was less reliable. This fits with the tidal pattern observed earlier in this section. High volumes of traffic, combined with capacity constraints, can result in variable journey times, with any disruption to the smooth flow of traffic impacting more customers. For example, when there are high levels of flow, there is less spare capacity for drivers to overtake a vehicle which brakes and the impact magnifies in a way which does not happen on uncongested road.

Figure 17 - Journey time reliability (clockwise/northbound direction)

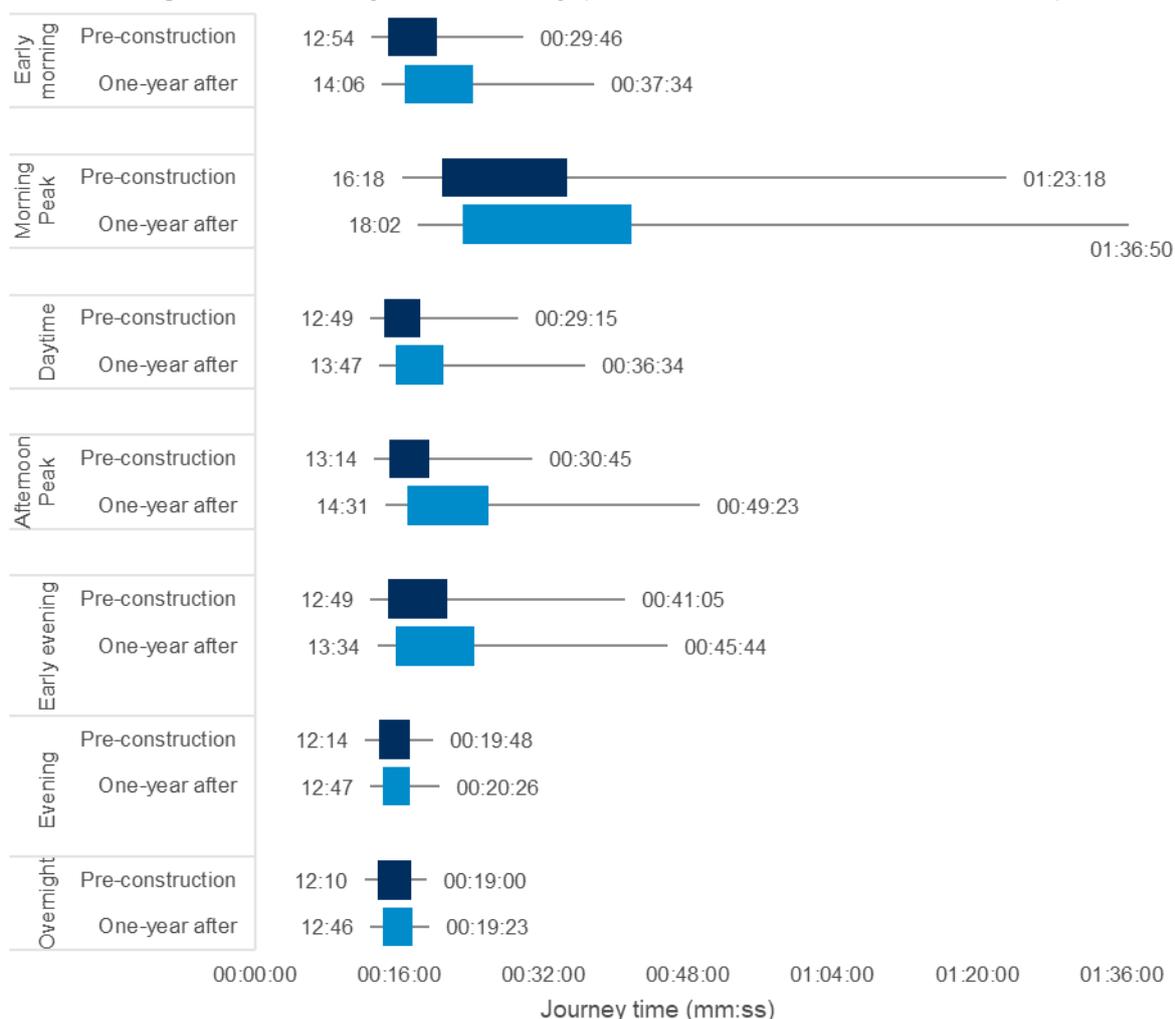


Source: TomTom Move Traffic Statistics, 2013, 2019

In the anti-clockwise/southbound direction, the average journey times increased in all of the time periods. In this direction journey time variability also increased for most time periods, with reliability improving only marginally in the evening and overnight periods.

In all time periods the longest journey times had increased compared to the pre-construction period. The morning peak sees an increase in the longest journey time of over 13 minutes, whilst the afternoon peak increases by over 18 minutes. Overall, these results suggest that the anti-clockwise/southbound direction suffers more from congestion and is also less reliable.

Figure 18 - Journey time reliability (anti-clockwise/southbound direction)



Source: TomTom Move Traffic Statistics, 2013, 2019

In both directions, it is interesting to note that the quickest journeys have slowed slightly, which may be due to the increased technology on the scheme making drivers more conscious of the speed limits.

How was the smart motorway operated?

Variable mandatory speed limits are a feature of both controlled and all lane running motorways. Typically, they are set during periods of congestion, or when a hazard is present. The speed limits are most commonly set between 60mph and 40mph, moving in 10mph intervals, and are often enforced through speed cameras. To understand the frequency at which mandatory speed limits are being set along the scheme route, variable messaging sign data¹⁴ has been extracted and analysed.

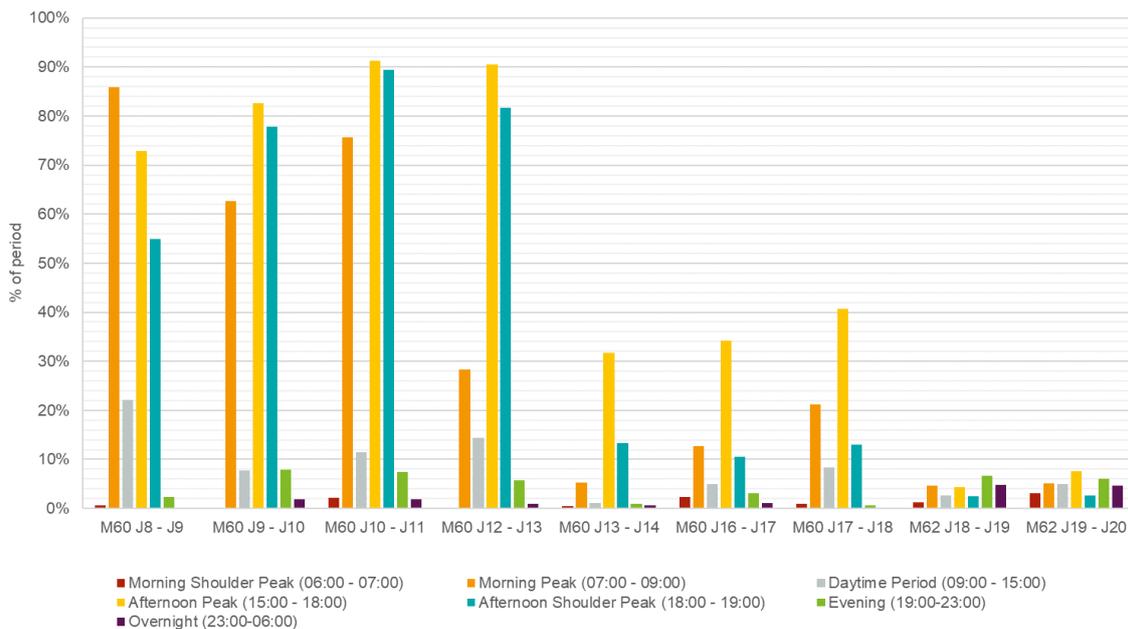
Figure 19 shows the percentage of time, per time period, that a 60mph or lower variable speed limit was set for each junction in the clockwise/northbound direction. In the morning peak variable speed limits were set over 60% of the time between M60 junctions 8 to 11, with the remainder of the route (M60 junctions 11 to 18 and M62 junctions 18 to 20) setting variables less than 30% of the period. However, in the afternoon peak and afternoon shoulder peak variable speed limits between

¹⁴ [HALOGEN AMI Signal Setting information - data.gov.uk](https://data.gov.uk)

M60 junctions 9 to 13 are being set 78% to 90% of the time, a near constant reduction in the maximum permitted speed.

Further analysis in appendix A1 shows that when variable speed limits are displayed in the afternoon peak, the majority between the M60 junctions 8 to 11 are set at 40mph, with a small amount at 50mph. The M60 junctions 12 to 13 mainly shows 50mph speed limits. This aligns with our earlier analysis suggesting heavier congestion through M60 junctions 8 to 11, which lessens through junctions 12 to 13.

Figure 19 - Speed limit set at or below 60mph, per junction, in the clockwise/northbound direction

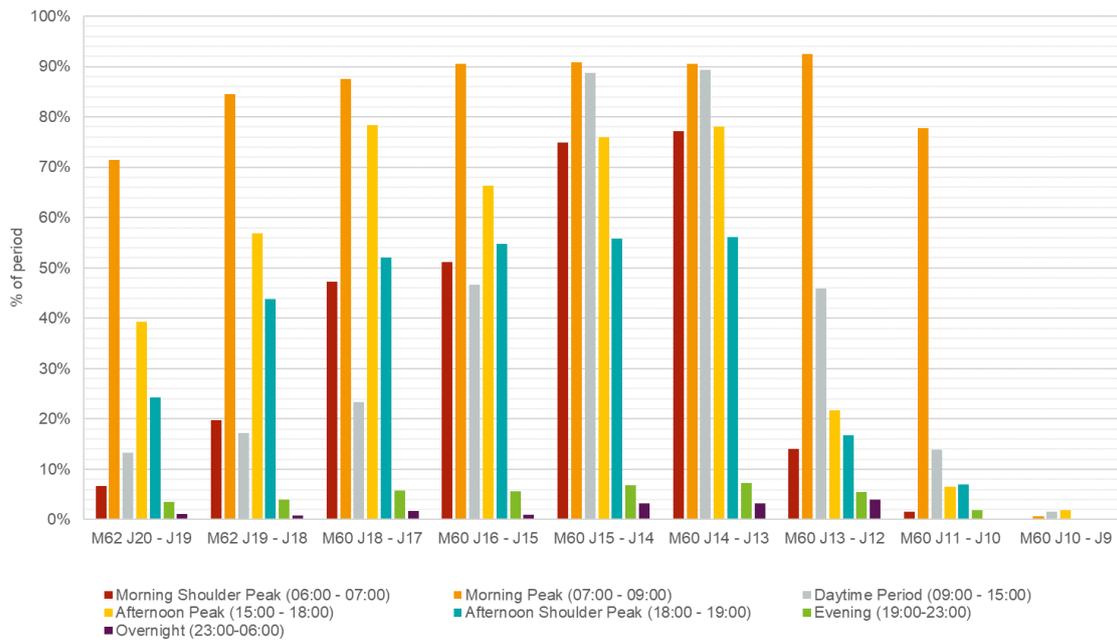


Source: National Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](https://www.dft.gov.uk/halogen)

Figure 20 shows the percentage of time, per time period, that a 60mph or lower variable speed limit was set for each junction in the anti-clockwise/southbound direction. In the morning peak variable speed limits were set over 70% of the time, across the majority of the scheme length (M62 junctions 20 to 18 and M60 junctions 18 to 10). From further analysis in appendix A1 shows that in the morning peak the majority of speed limits displayed between M62 junctions 19 to 18 and M60 junctions 16 to 13 are 40mph. Overall this data corroborates with the average speed data to suggest that the AM anti-clockwise/southbound peak suffers from congestion across the whole route, with the middle of the scheme route (M60 junctions 16 to 13) showing the heaviest levels of congestion.

Figure 20 also shows that the anti-clockwise/southbound direction has variable speed limits set throughout the day, with M60 junctions 15 to 13 having limits in place for over 50% of each time period between the morning shoulder peak to the afternoon shoulder peak. Only the evening and overnight time periods show minimal use of variable speed limits. This further suggests that the anti-clockwise/southbound direction suffers more from congestion than the reverse direction.

Figure 20 - Percentage of time period with the speed limit set at or below 60mph, per junction, in the anti-clockwise/southbound direction



Source: National Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](https://www.dft.gov.uk/halogen)

5. Safety evaluation

Summary

The key safety objective for this smart motorway was to achieve no worsening of safety performance. The number and rate per million vehicle miles of personal injury collisions were analysed to track a change over time. In the first year of the smart motorway being operational, there has been a reduction in the rate and number of personal injury collisions compared with the annual average for the five years before the scheme was built.

A further safety objective was that post-opening accident numbers (per annum) were no greater than those pre-construction. During the first 12 months of the smart motorway being open there were 57 personal injury collisions compared with an average of 92 per year before the scheme was constructed. If the road had not been converted to a smart motorway, we estimate that the number of personal injury collisions would have changed to between 59 and 109.

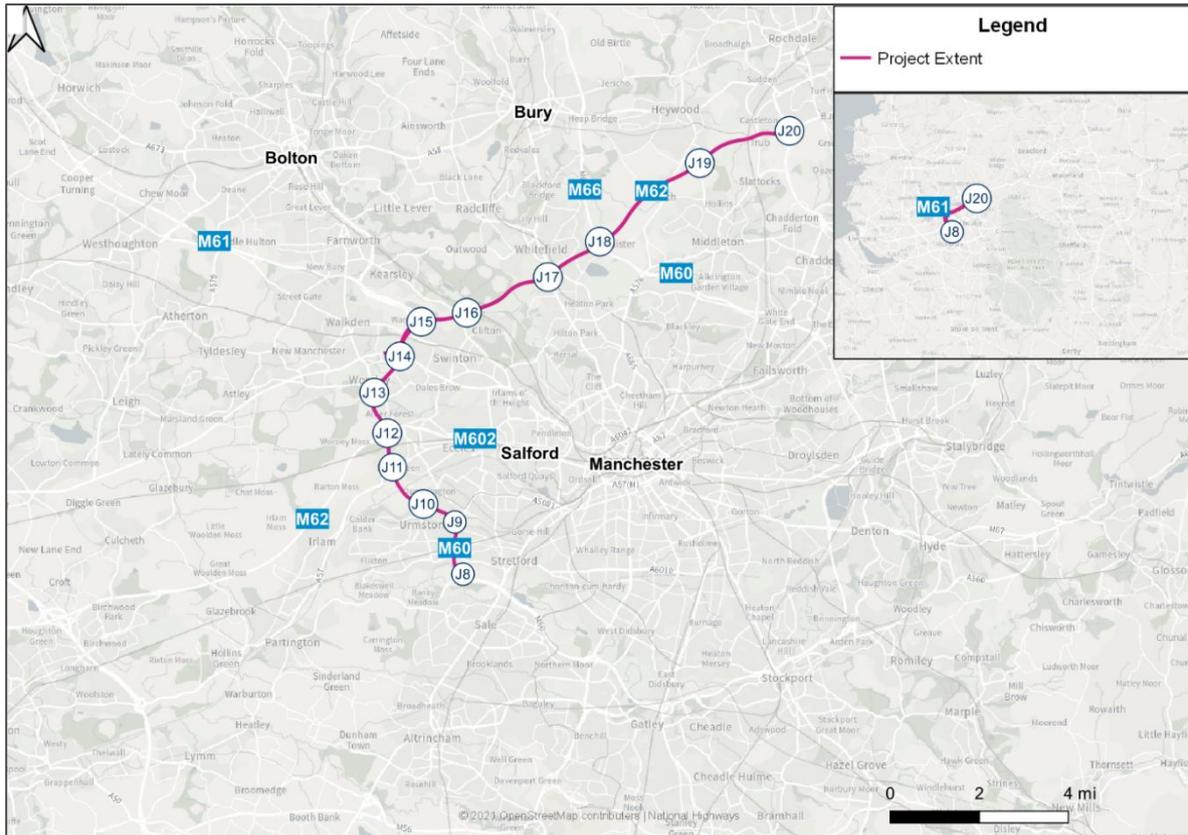
It is outside the scope of this one-year after evaluation to consider the objective relating to the severity ratio. This will be considered at the next evaluation stage when further data will be available to enable analysis of collisions by their severity category. Consideration of collision causation is also outside the scope of this study.

In the context of other findings in this report these are positive early signs. Traffic levels are set to increase in later years, however, and so results at the follow up evaluation will be helpful to check if this trend continues. It will require a longer timeframe to determine if these initial positive findings are a real trend or natural fluctuation.

Safety study area

The safety study area is shown in Figure 21. This area was assessed in the appraisal supporting the business case for the project to check any potential wider implications of the intervention. This information was then used with other projections around the potential impact of the scheme such as by how much traffic may grow. We have therefore replicated the appraisal study area to understand the emerging safety trends.

Figure 21 – Safety study area



Source: National Highways and OpenStreetMap contributors

What were the emerging safety trends in the first 12 months?

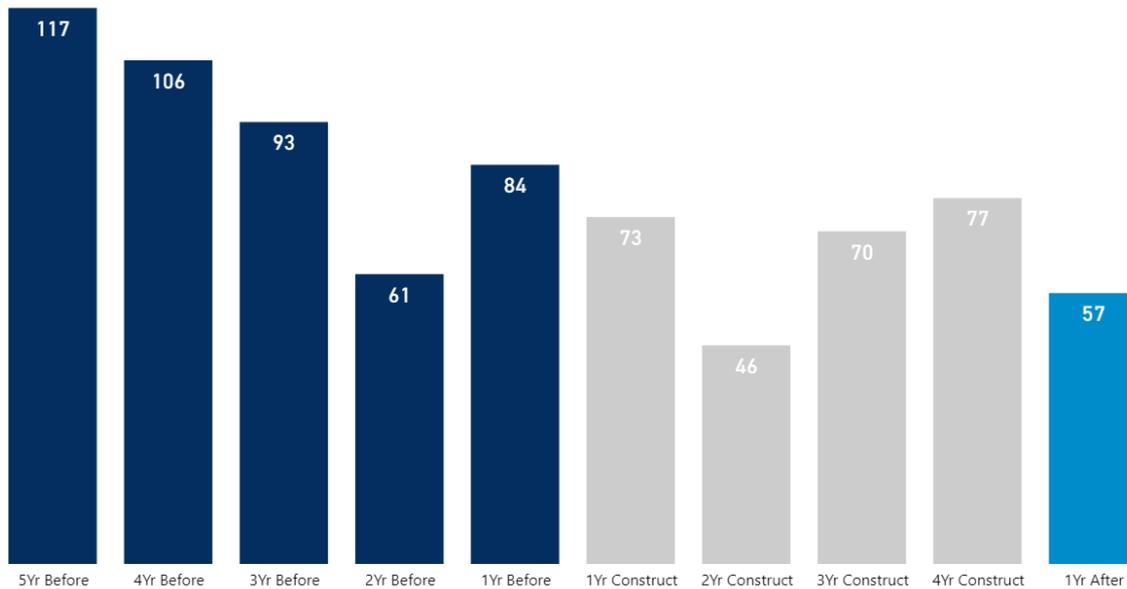
Safety data for this evaluation was obtained from Department for Transport Road Safety Data. This records incidents on public roads that are reported to the police. This evaluation considers only collisions that resulted in personal injury.

The safety analysis has been undertaken to assess changes over time, looking at the trends in the five years before the scheme was constructed to provide an annual average. We have then assessed the trends from the first 12 months after the smart motorway was operational and open for road users. This provides an early indication of safety trends, but this will be monitored over a longer timeframe before conclusions can be drawn about the safety impact of the scheme across the following time periods:

- Pre-construction: 1 July 2009 - 30 June 2014
- Construction: 1 July 2014 - 30 June 2018
- Post-opening: 1 July 2018 - 30 June 2019

The early indications are that the number of personal injury collisions for the first year of the smart motorway are lower than the period before construction began. The annual number of personal injury collisions can be seen in Figure 22 and we can see this has reduced from an annual average of 92 to 57 personal injury collisions during the first 12 months of the smart motorway being open for road users. Safety trends can vary each year and we will monitor this trend over a longer timeframe before drawing conclusions about the safety impact of the smart motorway.

Figure 22 – Annual Personal Injury Collisions

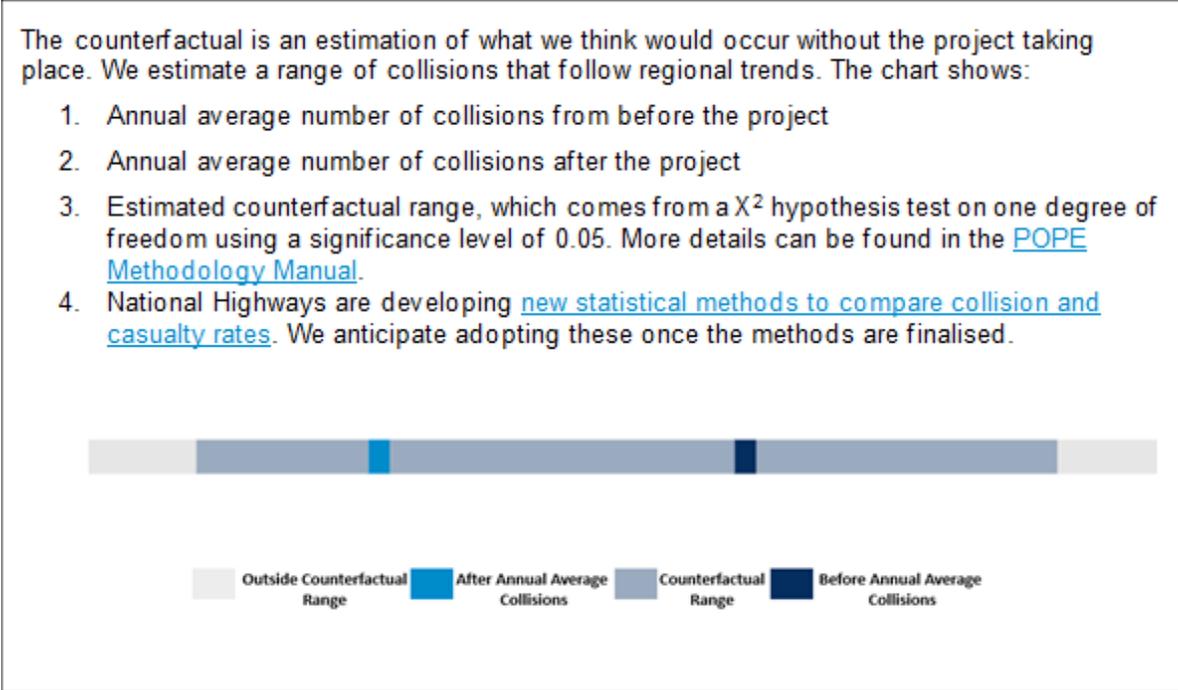


Source: STATS19 1st July 2009 – 30th June 2019

As part of the safety evaluation, we look to assess what changes in personal injury collisions might have occurred due to factors external to the scheme over this timeframe. To do this we estimate the trend in personal injury collisions which might have occurred if the road had remained a conventional motorway. This is referred to as a counterfactual and is based on changes in regional safety trends for conventional motorways with a high volume of roads users¹⁵. This helps us to estimate how the pre-construction safety levels would have changed over the evaluation period if the road had remained a conventional motorway.

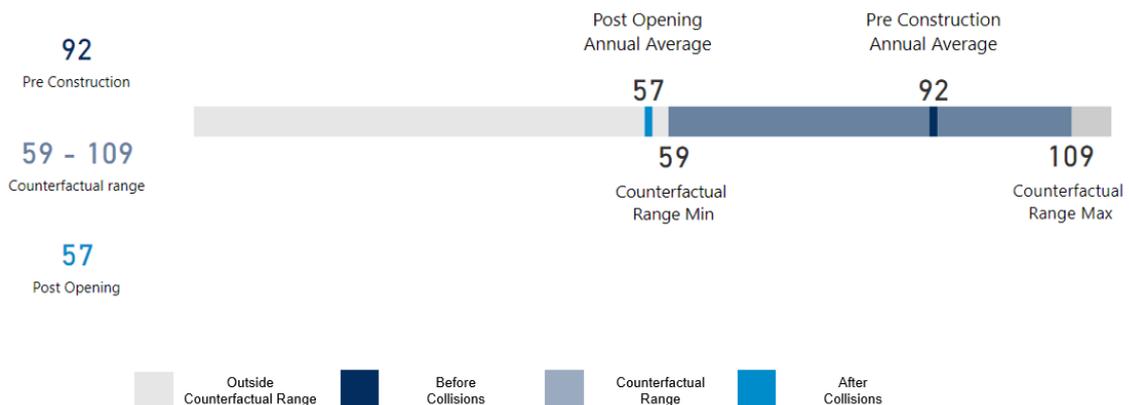
¹⁵ Previously the counterfactual for smart motorways was based on the national trends averaged across all types of motorways, the new method provides information for average conventional motorways and those with higher-than-average traffic levels (which are more comparative to the motorways which were converted to smart motorways). It also allows for differentiation between different types of smart motorways.

Figure 23 - What does the counterfactual show?



Based on this assessment we estimate that if the road had not been converted to a smart motorway the trend in the number of personal injury collisions would have changed over time to between 59 and 109 (Figure 24). As the observed number of collisions is below this range, it indicates that the smart motorway is on its way to achieving the objective to maintain, and where possible, improve safety standards. Another study will be conducted after the smart motorway has been open for a longer timeframe, allowing a more representative time-period, to determine if the safety objective has been achieved.

Figure 24 – Annual average number of personal injury collision on the smart motorway



Source: STATS19 1st July 2009 – 30th June 2019

How had traffic flow impacted collision rates?

Smart motorways are implemented on some of England's busiest routes. It is, therefore, important to contextualise any incidents in the volume of traffic seen on this stretch. To do so a collision rate is calculated as: the number of collisions per hundred million vehicle miles (hmvm).

The average collision rate has decreased to seven per hmvm – this equates to travelling almost 15 million vehicle miles before seeing an incident. Before the scheme this figure stood as ten per hmvm. This is a decrease of three personal injury collisions per hmvm.

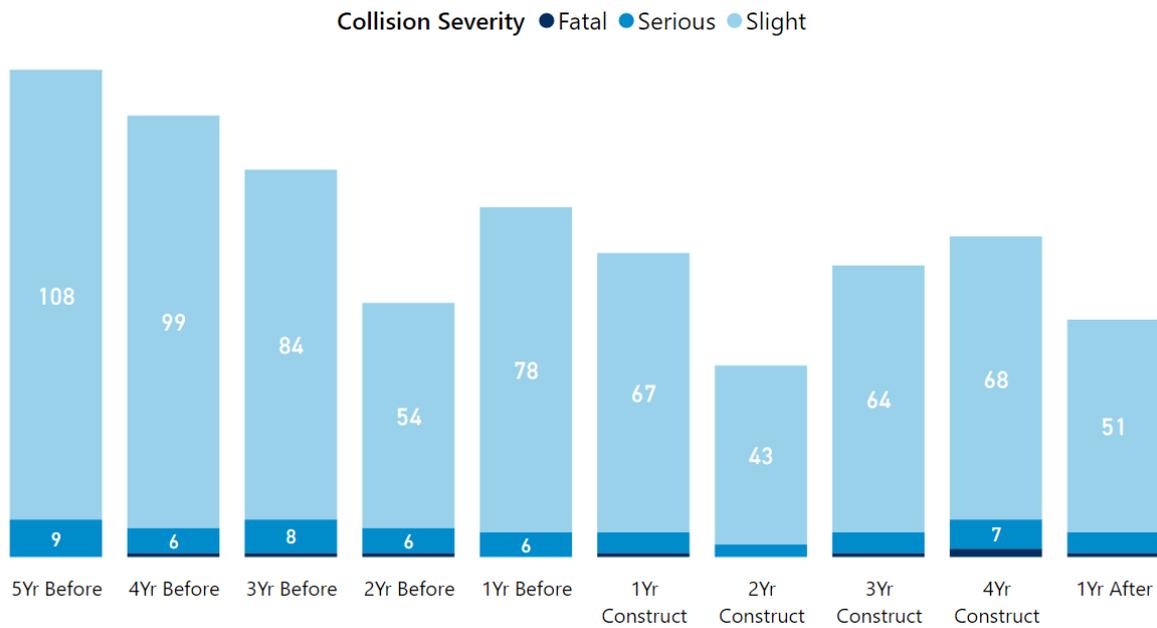
A counterfactual test was undertaken. It found that the collision rate would likely have been eight collisions per hmvm in the counterfactual period; in line with that of the first year after opening the smart motorway.

Similar to collisions, therefore, collision rates are below what we would have expected without the scheme. This is a positive initial indication: even though traffic levels have increased slightly, collisions have reduced. As these are the first year's results, however, we are not yet confident that these initial indications are enough to form a trend. An evaluation will be conducted after the smart motorway has been open for a longer timeframe, allowing a more representative time-period, to establish if early positive findings have continued.

What changes in the severity of collisions did we see?

Collisions which result in injury are recorded by severity as either fatal, severe or slight. The evaluation found, after the project there was an average of 34 fewer collisions resulting in slight injuries per year (the annual average before the project was 85, compared to 51 after), serious incidents have also decreased (as the annual average before the project was seven, compared to five after). There were three fatal accidents in the five years before the project and one in the 12 months after. Figure 25 shows the data we currently have relating to the severity of personal injury collisions. However, the severity objective will be considered at the next evaluation stage when further data will be available, making consideration of collisions by their severity category more robust.

Figure 25 – Severity of personal injury collisions within the project extent



Source: STATS19 1st July 2009 – 30th July 2019

Is the project on track to achieve its safety objectives?

The safety objectives were to achieve no worsening of safety performance and for post-opening accident numbers (per annum) were to be no greater than those pre-construction. The business case forecast a 13% reduction in personal injury collisions as a result of the project, with a saving of 1,684 accidents over the 60-year appraisal period.

Early findings suggest a positive result in this direction, but further analysis is required over the next few years to confirm whether this trend will continue.

A further safety objective, related to the severity ratio¹⁶, will be considered at the next evaluation stage when further data will be available to enable us to analyse collisions by their severity category. Consideration of collision causation is outside the scope of our POPE evaluations.

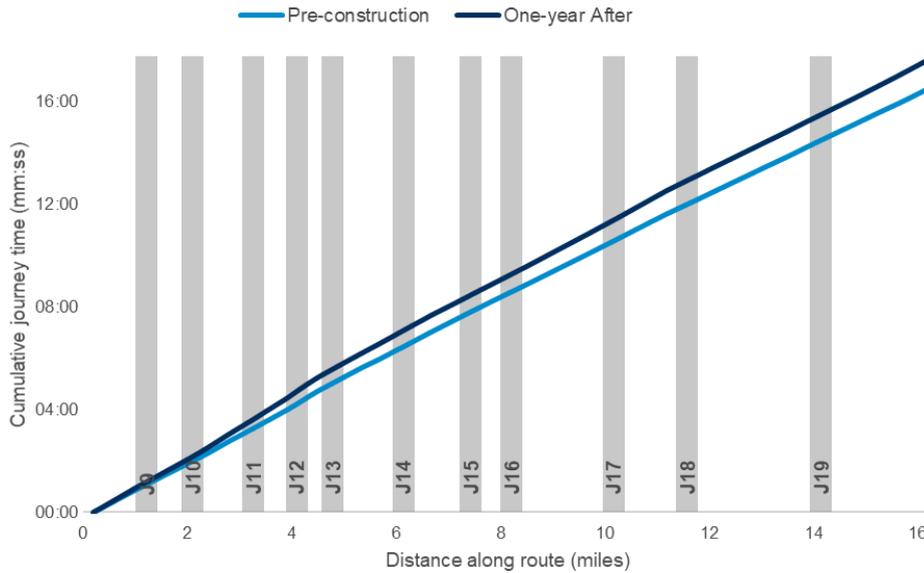
¹⁶ The severity ratio is the number of fatal or serious injury PICs compared against the number of slight PICs.

Appendix A – Further traffic analysis

A1 - Cumulative journey time graphs

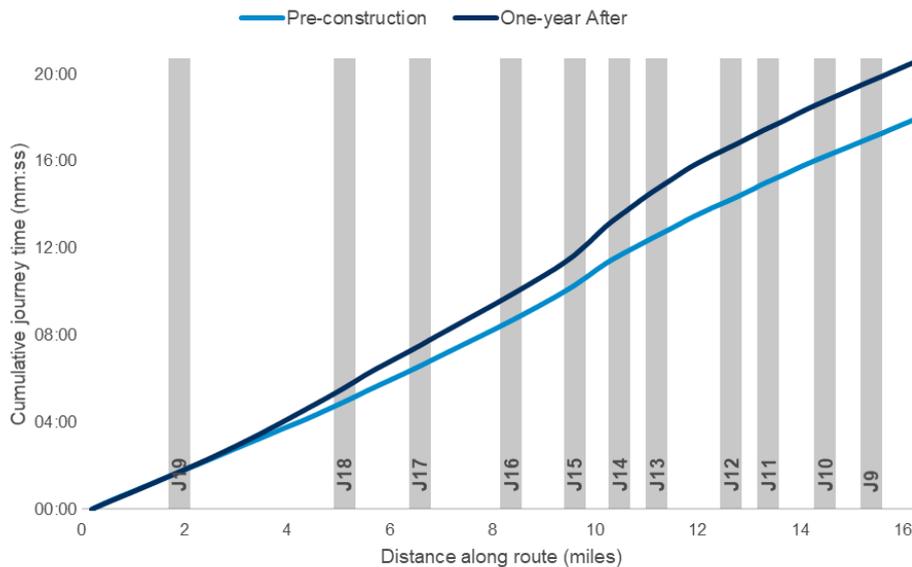
Included in this appendix are the cumulative journey time graphs for the daytime and overnight periods. For the overnight data, weekday and weekend data has been combined.

Figure 26 - Cumulative journey time comparison in the daytime period (0900 – 1500), clockwise/northbound direction



Source: TomTom Move Traffic Statistics, 2013, 2019

Figure 27 - Cumulative journey time comparison in the daytime period (0900 – 1500), anti-clockwise/southbound direction

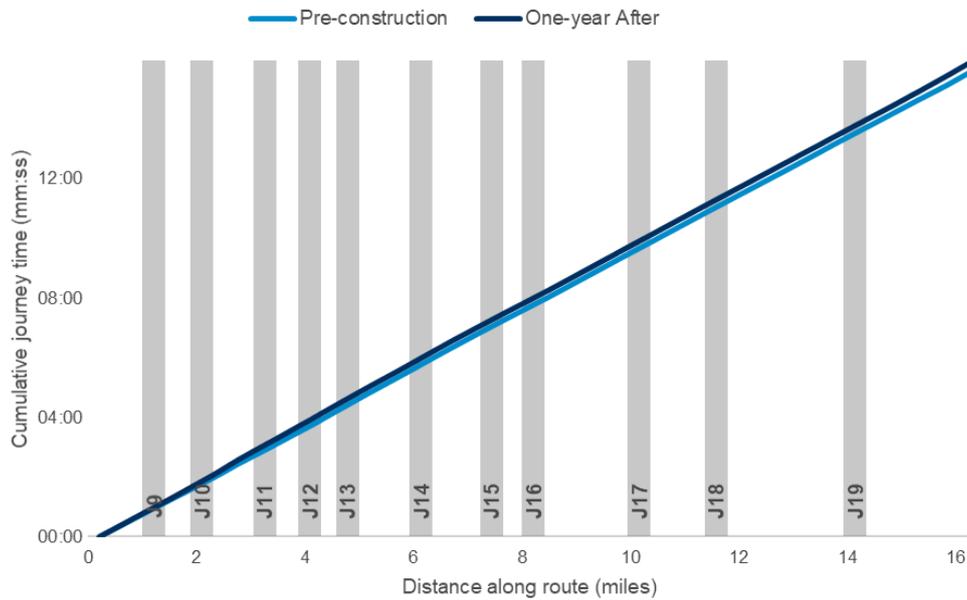


Source: TomTom Move Traffic Statistics, 2013, 2019

In the clockwise/northbound direction the journey times begin to increase around M60 junction 10, gradually increasing across the remainder of the route. In the anti-clockwise/southbound direction, journey times remain consistent between the pre-

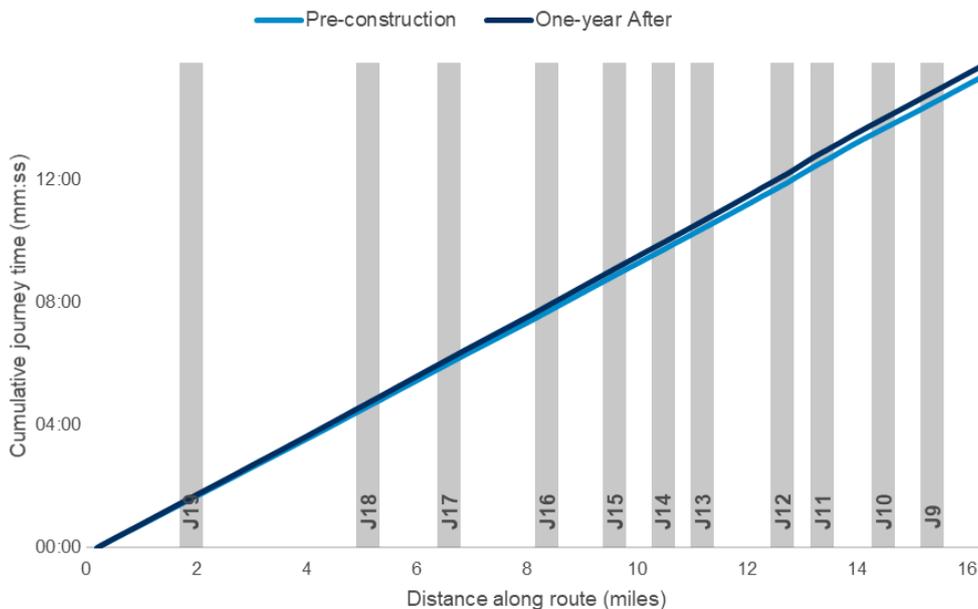
construction and one year after periods for the first ~3.5 miles of the route, before the one year after journey times then increase from M62 junctions 18 to 13. Overnight journey times show little change to before construction, as seen in Figure 28 and Figure 29.

Figure 28 - Cumulative journey time comparison in the overnight period (2300 - 0600 Weekdays, 0000 - 0800 Weekends), clockwise/northbound direction.



Source: TomTom Move Traffic Statistics, 2013, 2019

Figure 29 - Cumulative journey time comparison in the overnight period (2300 - 0600 Weekdays, 0000 - 0800 Weekends), anti-clockwise/southbound direction.

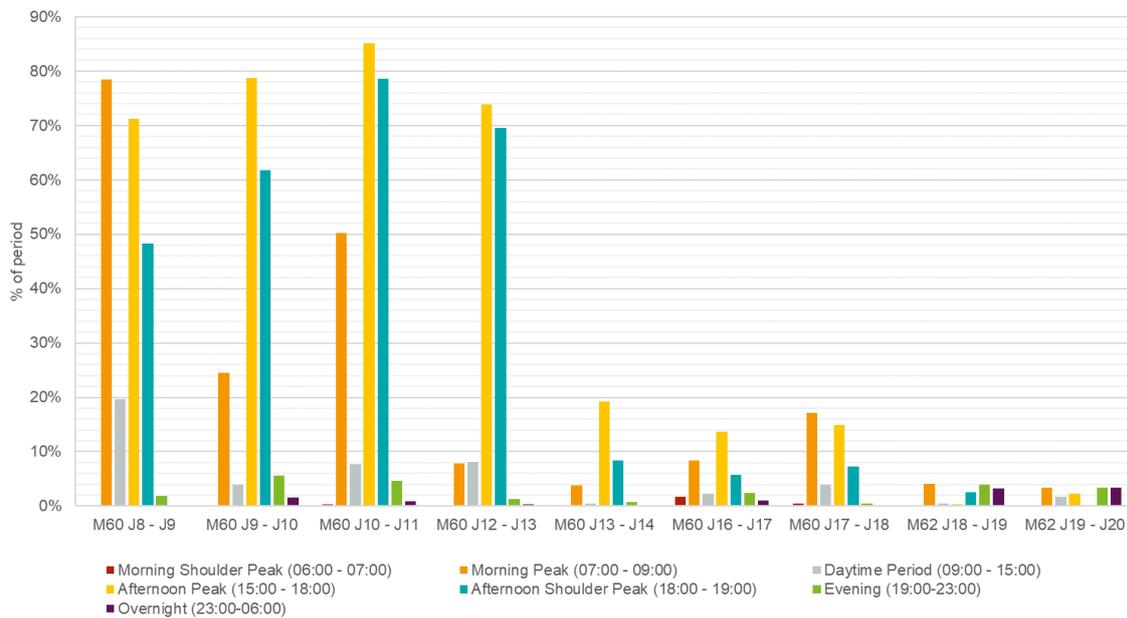


Source: TomTom Move Traffic Statistics, 2013, 2019

A2 – Variable mandatory speed limits

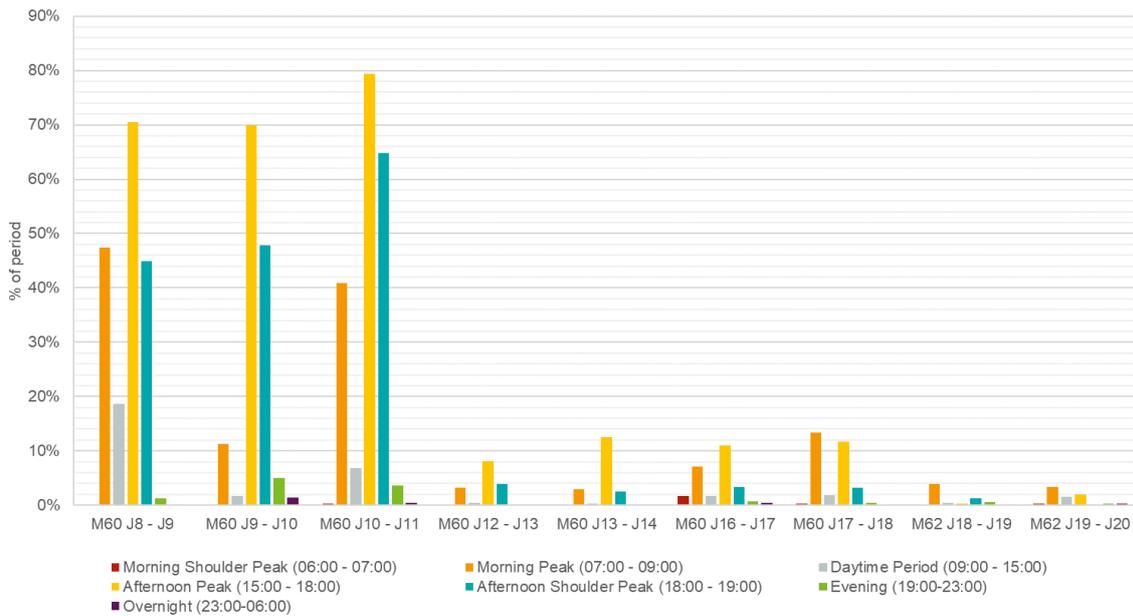
Further to the analysis presented in section 4, Figure 30 and Figure 31 show that of the time where variable speed limits are displayed in the afternoon peak, the majority between the M60 junctions 8 to 11 are set at 40mph, with a small amount at 50mph. The M60 junctions 12 to 13 mainly shows 50mph speed limits, with 40mph shown for less than 10% of the total time period. Overall, this suggests heavier congestion through M60 junctions 8 to 11, which lessens through junctions 12 to 13, matching the trends displayed in the average cumulative journey times and the average speeds.

Figure 30 - Speed limit set at or below 50mph, per junction, in the clockwise/northbound direction



Source: National Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](#)

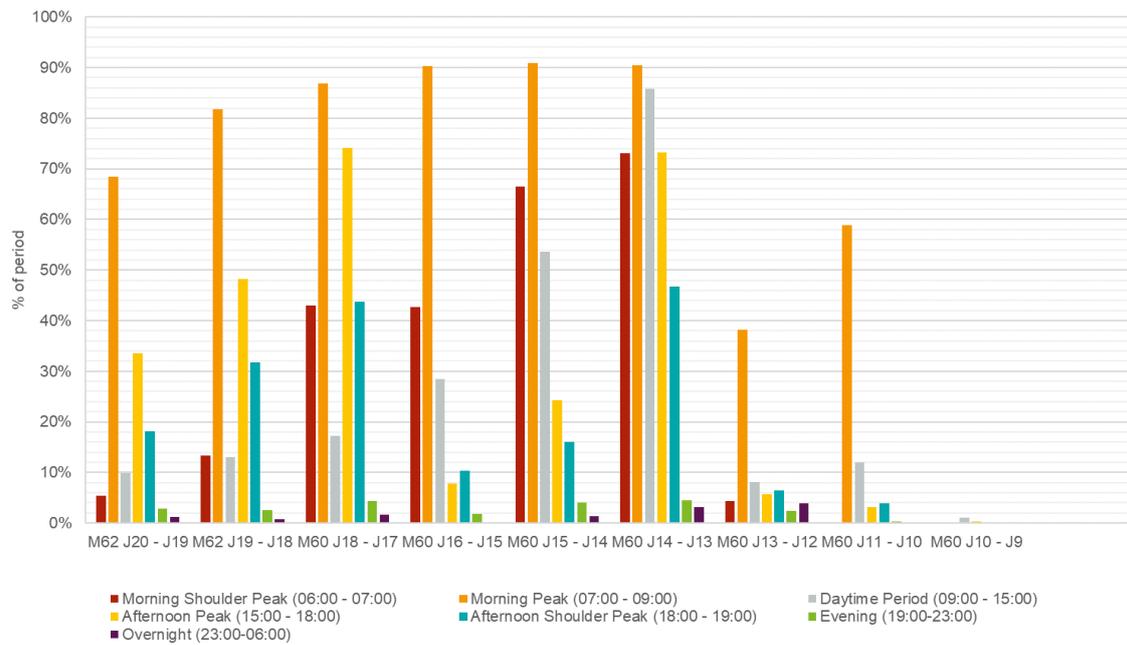
Figure 31 - Speed limit set at or below 40mph, per junction, in the clockwise/northbound direction



Source: National Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](https://www.dft.gov.uk/publications/halogen-national-highways-logging-environment)

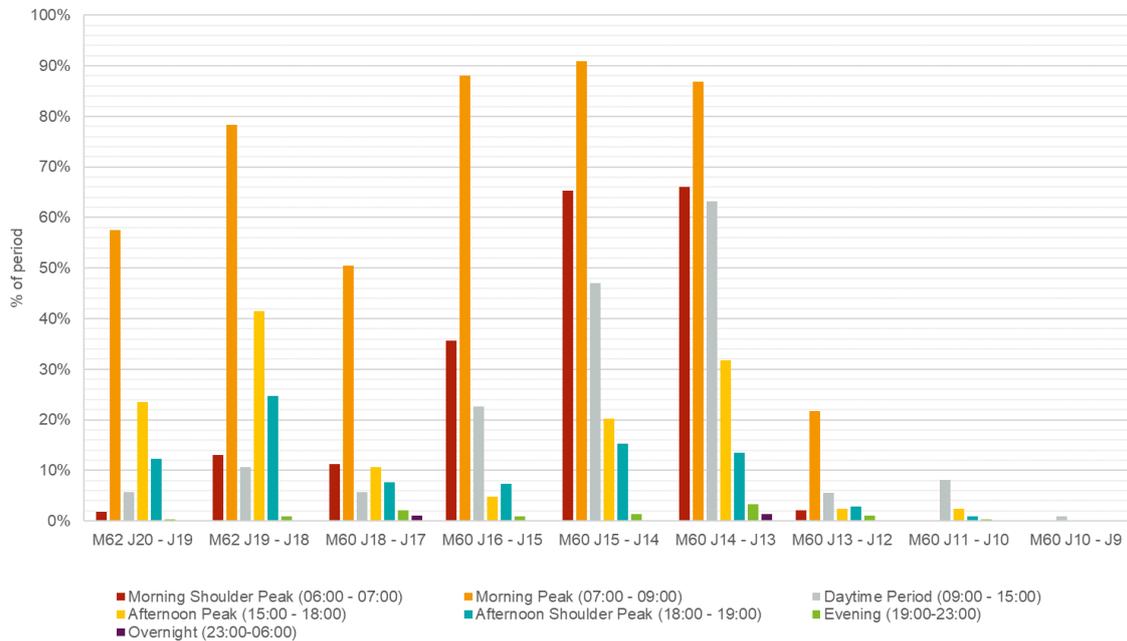
Section 4 described how 60mph or lower variable speed limits were set in the anti-clockwise/southbound direction over 70% of the time in the morning peak, across the majority of the scheme length. From Figure 32 and Figure 33 we can determine that in the morning peak the majority of speed limits displayed between M62 junctions 19 to 18 and M60 junctions 16 to 13 are 40mph. Overall this data corroborates with the average speed data to suggest that the AM anti-clockwise/southbound peak suffers from congestion across the whole route, with the middle of the scheme route (M60 junctions 16 to 13) showing the heaviest levels of congestion.

Figure 32 - speed limit set at or below 50mph, per junction, in the anti-clockwise/southbound direction



Source: National Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](https://www.dft.gov.uk/halogen)

Figure 33 - speed limit set at or below 40mph, per junction, in the anti-clockwise/southbound direction



Source: national Highways HALOGEN Data, 2019 - [Halogen - National Highways Logging Environment \(dft.gov.uk\)](https://www.dft.gov.uk/halogen)

Appendix B - Safety Methodology

B1 - Safety counterfactual methodology

Personal injury collisions on the strategic road network are rare and can be caused by many factors. Due to their unpredictable nature, we monitor trends over many years before we can be confident that a real change has occurred as result of the scheme.

To establish whether any change in collision numbers is due to the scheme or part of wider regional trends we estimate what would have likely occurred to the safety trends if the scheme was not constructed. Prior to 2020, POPEs answered this question by applying the national average trends in personal injury collisions to the baseline observed before the scheme was constructed

During 2020 the methodology has been reviewed and updated to generate a more accurate estimation. The revised method enables us to align the counterfactual with regional rather than national trends in traffic volumes and personal injury collisions.

It also allows for a more granular differentiation of road type. Previously the counterfactual for smart motorways was based on the national trends averaged across all types of motorways, the new method provides information for average conventional motorways and those with higher-than-average traffic levels (which are more comparative to the motorways which were converted to smart motorways). It also allows for differentiation between different types of smart motorways.

We now also report a counterfactual range, rather than an individual figure. This is the likely number of collisions that would occur, at the same post evaluation point, if the smart motorway was not built. The range is based on a 95% confidence interval.

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