national highways

M25 junction 30/A13 corridor congestion relieving project

One-year post-opening project evaluation

Foreword

National Highways – previously known as Highways England when the M25 junction 30/A13 corridor congestion relieving project was delivered – is the Government-owned company that operates, maintains and improves England's motorway and long-distance trunk road network. This project was delivered as part of the government's first, five-year Roads Investment Strategy (RIS 1) to improve the safety and reliability of our network for the millions who depend on it daily.

The M25 and the A13 are important strategic road network (SRN) routes and the M25 Junction 30, also known as the Mar Dyke Interchange, forms a key intersection between the two routes. Historically, this junction and the surrounding sections of the M25 experienced heavy congestion throughout the peak periods and increasingly during other periods. This resulted in lengthy delays and poor journey time reliability.

We carried out the M25 junction 30/A13 corridor congestion relieving project as part the first roads investment strategy. The project aimed to improve journey time reliability, relieve congestion, maintain and where possible improve safety and facilitate future land use change within the Thames Gateway area.

Our post-opening project evaluations provide us with opportunities to understand how effective we are in delivering improvements in our major projects. This report gives an initial indication of the project's performance in the first year of its operation after opening to traffic in March 2017. It forms part of a long-term evaluation study that will review performance during several years.

Our one-year after findings suggest the project was on track to meet its objectives. The additional capacity on the A13 and the new dedicated left turn lanes on the junction had been delivered, supporting more customers, improving the reliability of their journeys and enhancing access to Tilbury and London Gateway. We had reduced the speed limit from 70mph to 50mph on the A13 between the Wennington interchange (to the west of junction 30) and the A1089 interchange (to the east of junction 30) to improve safety. This had slightly increased journey times. And we had implemented measures to mitigate the project's environmental impacts which were found to be broadly in line with expectations.

There were positive signs on the project's safety impacts in the first year after opening to traffic, with a reduction in personal injury collisions. Safety trends can vary each year however, so we will monitor them during the long-term to get a more complete picture.

At National Highways, safety is our top priority. We are committed to reducing the number of road users killed or seriously injured on the SRN by 50% (from the 2005-2009 baseline) by the end of 2025, with a vision of zero harm by 2040.

Elliot Shaw

Executive Director, Customer, Strategy and Communications

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1. Executive summary

1.1. Background

The M25 and the A13 are important strategic road network (SRN) routes and the M25 Junction 30, also known as the Mar Dyke Interchange, forms a key intersection between the two routes. Historically, this junction and the surrounding sections of the M25 experienced heavy congestion throughout the peak periods and increasingly during the inter-peak periods. This resulted in lengthy delays and poor journey time reliability.

The project is located within the Thames Gateway, which is a major regeneration and development area stretching 43 miles east from inner East London on both sides of the River Thames and the Thames Estuary towards the Isle of Sheppey/Southend-on-Sea.

Traffic demand in the Thames Gateway area was projected to increase and congestion expected to intensify as a result of the proposed development and regeneration works. The M25 Junction 30 was identified as a constraint to growth in the region.

The purpose of the M25 Junction 30/A13 corridor congestion-relieving project was to improve journey time reliability, relieve congestion and facilitate future land use change within the Thames Gateway area. The project included multiple upgrades within the current highway boundary.

Upgrades to the junction included two new segregated left turn lanes between the M25 southbound to the A13 eastbound, and between the A13 eastbound to the M25 northbound.

The A13 was widened from three to four lanes in each direction between Junction 30 and the A126 (to the east). To improve safety a permanent 50 miles per hour speed limit was also implemented along the A13 between the Wennington interchange (to the west of Junction 30) and the A1089 interchange (to the east of Junction 30).

This report presents the findings of the evaluation of the project after the first year of its operation (2018). This initial assessment forms part of a longer-term evaluation to review performance over time as the benefits mature. Our one-year after evaluations are not intended to provide conclusive evidence about a project's benefits, but to give an early indication about whether it is heading in the right direction. This helps us to identify any areas on which to focus efforts to optimise the benefits of the project.

1.2. Evaluation findings

1.2.1. Customer journeys

Evidence suggested the project's provision of additional capacity had supported traffic growth (13%) above background trends for motorways in England (8%). It had also contributed to reliability improvements on all the major movements assessed.

Customers' journeys on the movements provided with a new dedicated left turn lane[1] were around 25 to 50 seconds faster. Their southbound journeys on the M25 mainline through junction 30 were around two minutes faster in the morning and evening. In several instances customers' journeys through the junction had increased.

The implementation of a lower 50 mph speed limit on the widened A13 had contributed to reliability and safety benefits for customers, while slightly increasing their journey times at most times of the day on the A13 between junction 30 and the A126 (by between 20 to 40 seconds), and on some movements through the junction 30 itself.

Active benefit management and junction optimisation work was conducted by our Major Projects team in August 2021.[2] It is expected to bring further improvements to customers' journeys through junction 30.

Overall, we obtained a limited picture of the project's traffic impacts due to the small amount of traffic volume data available and results should be interpreted accordingly.[3]

1.2.2. Safety

The project was on track to achieve its objective to maintain and where possible improve safety. There were 7 fewer personal injury collisions (PICs) observed on the project extent in the first year after opening (20) than the annual average in the five years before the project's construction (27). Had the project had not taken place, we estimate that the number of personal injury collisions would have ranged between 7 and 30.

The average collision rate has decreased to 15 per hundred million vehicle miles – this equates to travelling almost 7 million vehicle miles before seeing a collision. Before the project this figure was 20 per hundred million vehicle miles. The decrease is 5 personal injury collisions per hundred million vehicle miles. Had the project not taken place the collision rate would likely have been 13 collisions per hundred million vehicle miles in the counterfactual period.

The change in number of personal injury collisions was different than forecast within the business case. The reduction of seven personal injury collisions is higher than the forecasted saving of four collisions per year.

1.2.3. Environment

The project had impacts broadly similar to those anticipated in the appraisal. However, the impact on a protected species of plant (broad-leaved cudweed) was worse than expected. As part of the project a small number of these plants were individually translocated on the A13 verge. This was accompanied by the spread of topsoil which had potential to contain the plant's seed. Evidence from monitoring surveys following construction were unable to confirm the mitigation measures for

[1] From the M25 north to the A13 east and from the A13 west to the M25 north.
[2] The work involved installing additional detection at stop lines and adjusting the timings of the signals. The signals have since been running on the adaptive traffic control system SCOOT (Split Cycle Offset Optimisation Technique). The work occurred after data collection for this evaluation was complete.
[3] We encountered several issues relating to the availability of traffic data, and the modelling and economics appraisal data which prevented a direct like-for-like comparison with the before and after observed data.

this protected species had been successful.[4] One more survey inspection is planned for this year (2022).

[4] Included within Annual Condition Inspection of Landscaping Works 2017, 2018 and 2019.

2. Introduction

2.1. What was the project and what was it designed to achieve?

The M25 Junction 30/A13 Corridor Relieving Congestion Scheme (CRCS) opened in March 2017. It was designed to improve journey time reliability, relieve congestion, and facilitate future land use change in Thurrock and the Thames Gateway area.

The M25 and the A13 are important routes within the SRN and junction 30 forms a key intersection between these routes. Historically, this junction and the surrounding sections of the M25 experienced heavy congestion throughout the peak periods and increasingly during the inter-peak period. This resulted in lengthy delays and poor journey time reliability.

The Government's Sustainable Communities policy, published in 2003, identified the Thames Gateway area as a major regeneration opportunity. Development of the policy led to the Thames Gateway Delivery Plan (TGDP)[5] in November 2007 which set the target of providing 160,000 new homes and 225,000 new jobs in the region by 2016. The TGDP also recognised that the M25 Junction 30 was identified as a constraint to growth for the Thames Gateway.

Traffic in the Thames Gateway area was projected to increase, and congestion expected to intensify because of the proposed development and regeneration works. The increase in traffic volume and associated congestion was anticipated to cause problems on the surrounding highway network and threaten the economic benefits predicted to result from the development and regeneration works. The M25 Junction 30/A13 corridor congestion-relieving project was therefore developed to improve journey time reliability, relieve congestion, and support future land use change within this area.

The upgrades to the junction (see Figure 1) occurred within the highways boundary and included:

- online widening on the A13 in both directions between junction 30 and the A126 (3 to 4 lanes)
- improvements to the junction 30 slip roads
- additional lane capacity and upgraded traffic signals on the gyratory roundabout
- introduction of dedicated left-turn lanes from the A13 to the M25 northbound and M25 southbound to the A13 eastbound, and
- permanent 50 mph speed limit on the A13 between Wennington and the A126 junction to improve safety.

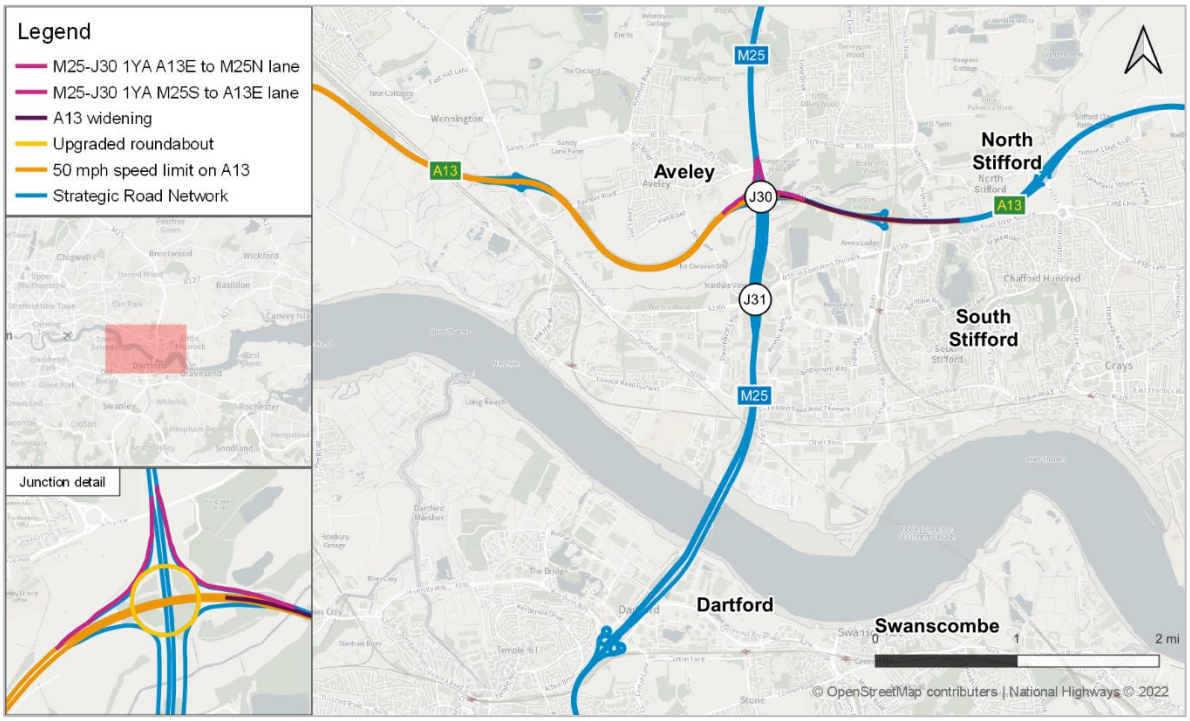
Project construction began in February 2015. It was fully opened in March 2017.

[5] https://www.thenbs.com/PublicationIndex/documents/details?DocId=284708

2.2. Project location

Junction 30 of the M25, also known as the Mar Dyke Interchange, is located less than a mile to the east of the small town of Aveley within the Unitary Authority of Thurrock. The junction is positioned on the eastern side of the M25 on the border with East London and is just over two miles north of the River Thames, as shown in Figure 1. It operates as a 'three-level stacked roundabout', and historically it has been a busy intersection, connecting the M25 motorway with the A13 trunk road, a major arterial route into London.

Figure 1 M25 junction 30 location



Source: Open Streetmap.

The M25 and the A13 are important routes with vital roles in supporting the regional, sub-regional and local economies. Together, they serve a range of commercial interests and local communities in Thurrock, South Essex and beyond, including the Port of Tilbury and Lakeside Shopping Centre.

The M25 is a strategic orbital road in southeast England surrounding London and plays a pivotal role in our network. It is a vital route for freight, commuter, and tourist traffic. It is of local, regional, national, and international importance, forming part of the E30 route on the European E-road network. By linking with the M2 and M20, it also provides a gateway to and from the continent via the Eurotunnel, Port of Dover, and Heathrow Airport. High vehicle demand on the M25 can place pressure on the road network and lead to congestion and unpredictable journey times, particularly during peak hours.

The A13 starts at Aldgate in the City of London and runs around 40 miles east to Southend-on-Sea in Essex. Part of it is designated as a trunk road.[6]

[6] Around 6 miles of this route between the A1306 Wennington junction (west of M25 Junction 30) and the Baker Street Interchange with the A1089 (to the east of M25 Junction 30). A length of around 4 miles of the A1089 connecting the A13 at Baker Street Interchange to the Port of Tilbury (to the south) is also part of the strategic road network.

2.3. How has the project been evaluated at one year after?

The evaluation assessed the emerging impacts and benefits from the project over the first year. We carry out post-opening project evaluations for major projects to validate the accuracy of estimated project impacts which were agreed as part of the business case for investment. We seek to measure whether the expected benefits are on track to be realised. This provides lessons learned which help us to improve future project appraisals and business cases. Our evaluation is also important for transparency and accountability of public expenditure by assessing whether projects are on track to deliver anticipated value for money.

A post-opening project evaluation compares changes in key impact areas,[7] by observing trends on the route before the project was constructed (baseline) and tracking these after the opening of the project to traffic. The outturn impacts of the project are evaluated against the expected impacts of the project (presented in the forecasts made during the project planning process) to review the project's performance.

For more details of the evaluation methods used in this study, please refer to the post-opening project evaluation methodology manual which can be found on our website.[8]

[7] Key impact areas including, safety, journey reliability and environmental impacts
[8] https://nationalhighways.co.uk/our-work/post-opening-project-evaluation-pope-of-major-schemes/

3. Delivering against objectives

3.1. How had the project performed against objectives?

All National Highways major projects have specific objectives which are defined early in the business case when project options are being identified. These benefits are appraised to be realised over 60 years. The one-year evaluation provides early indication of progress, followed by the five-years after evaluation which gives a more detailed insight. Table 1 summarises the project's performance against each of its original objectives.

Table 1 Project objectives and evaluation summary

Objective	One-year evaluation
To improve highway infrastructure regarding access to ports of Tilbury and London Gateway.	The project had improved access to Tilbury and London Gateway, improved journey times and enabled more reliable journeys.
To relieve congestion and improve resilience in the network on the strategic highway network and local highway network.	The project had relieved congestion and improved reliability on the strategic road network. It was not possible to confirm results for the local road network.
Implement measures to enhance existing capacity.	Additional capacity on the A13 and the new dedicated left turn lanes had enhanced capacity.
To improve journey time reliability.	Key major movements that the project sought to improve (A13 and dedicated left turns) were benefiting from improved journey time reliability.
To maintain and where possible improve safety.	The evidence indicates a positive impact with fewer collisions in the first year of opening compared with average for the five years before. More data will be required to confirm the impact over the long-term.
To improve highway infrastructure to facilitate economic and housing growth in Thames Gateway Thurrock.	Highway infrastructure has been improved through multiple upgrades as part of the CRCS. The link to economic and housing growth in Thames Gateway Thurrock was not within the scope of this evaluation.
To minimise the environmental impact, enhancing the environment where appropriate	The evaluation confirms that environmental outcomes for landscape, townscape, heritage, and biodiversity were likely to be broadly in line with the objective. However, it was not possible for the objective to be fully evaluated due to data limitations. This will be revisited at five-years after.

4. Customer journeys

4.1. Summary

- Evidence suggested the project had improved access to Tilbury and London Gateway through improved journey times and more reliable journeys on major movements. The additional capacity had accommodated traffic growth (13%) above background trends for motorways in England (8%).
- Customers' journeys on the movements provided with a new dedicated left turn lane[9] were around 25 to 50 seconds faster. Their southbound journeys on the M25 mainline through junction 30 were around two minutes faster in the morning and evening. However, in several instances customers' journeys through the junction had increased.
- The lower 50 mph speed limit on the widened A13 had contributed to reliability and safety benefits for customers. Accordingly, journey times had generally increased on the A13 between junction 30 and the A126 (by between 20 to 40 seconds), and on some movements through the junction 30 itself.
- Active benefit management and junction optimisation work was conducted by our Major Projects team in August 2021.[10] It was expected to bring further improvements to customers' journeys through junction 30.
- The small amount of traffic volume data available provided a limited picture of the project's traffic impacts. Results should be interpreted accordingly.[11]

4.2. How did traffic levels change?

This section examines the changes in traffic flow along the project extent and on roads in its vicinity. 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 trend(s) 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 our chosen background trend to the project.[12]

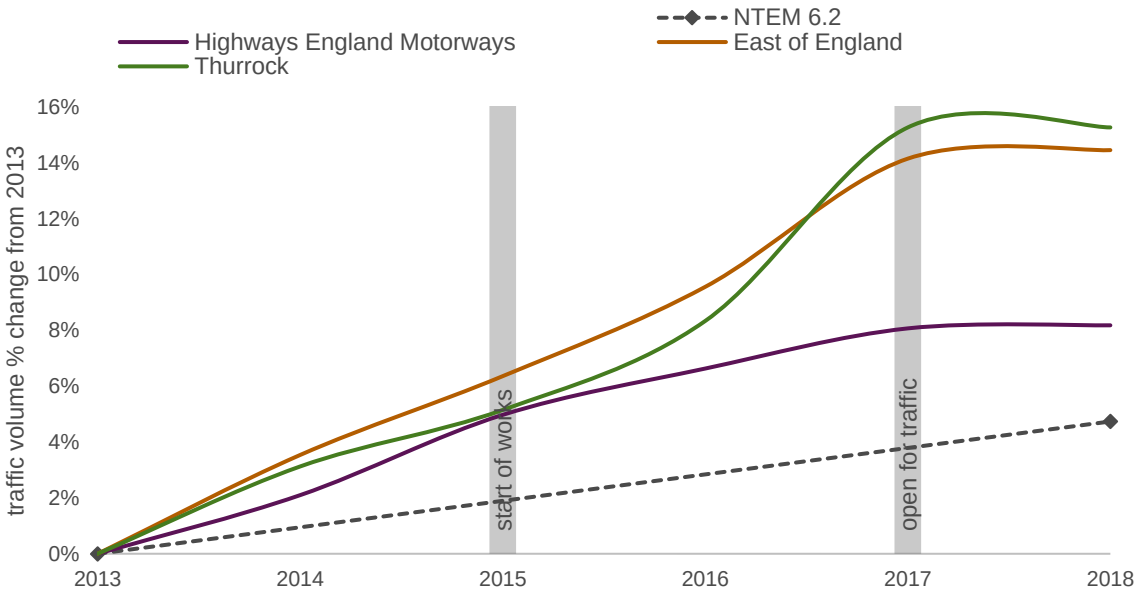
4.2.1. National and regional traffic changes

Over the evaluation period (2013-2018) there was an increase of around 15% in road usage across the East of England region. Traffic levels within the Thurrock area increased by a similar proportion too. The level of growth was higher than

[9] From the M25 north to the A13 east and from the A13 west to the M25 north.
[10] The work involved installing additional detection at stop lines and adjusting the timings of the signals. The signals have since been running on the adaptive traffic control system SCOOT (Split Cycle Offset Optimisation Technique).
[11] We encountered several issues relating to the availability of traffic data, and the modelling and economics appraisal data which prevented a direct like-for-like comparison with the before and after observed data. It was not possible to undertake any additional data collection during the evaluation period due to Covid19 restrictions. This restricted the opportunity to fill any data gaps on the strategic or local road network.
[12] Given the uncertainties in the figures, we view the measure as qualitative.

anticipated within the business case for the appraisal (represented by the NTEM 6.2 line in Figure 2).[13]

Figure 2 National, region and local traffic trends



Source: Department for Transport (TRA8904). The data summarise figures as total number of million vehicle kilometres (mvkm) travelled.; NTEM 6.2

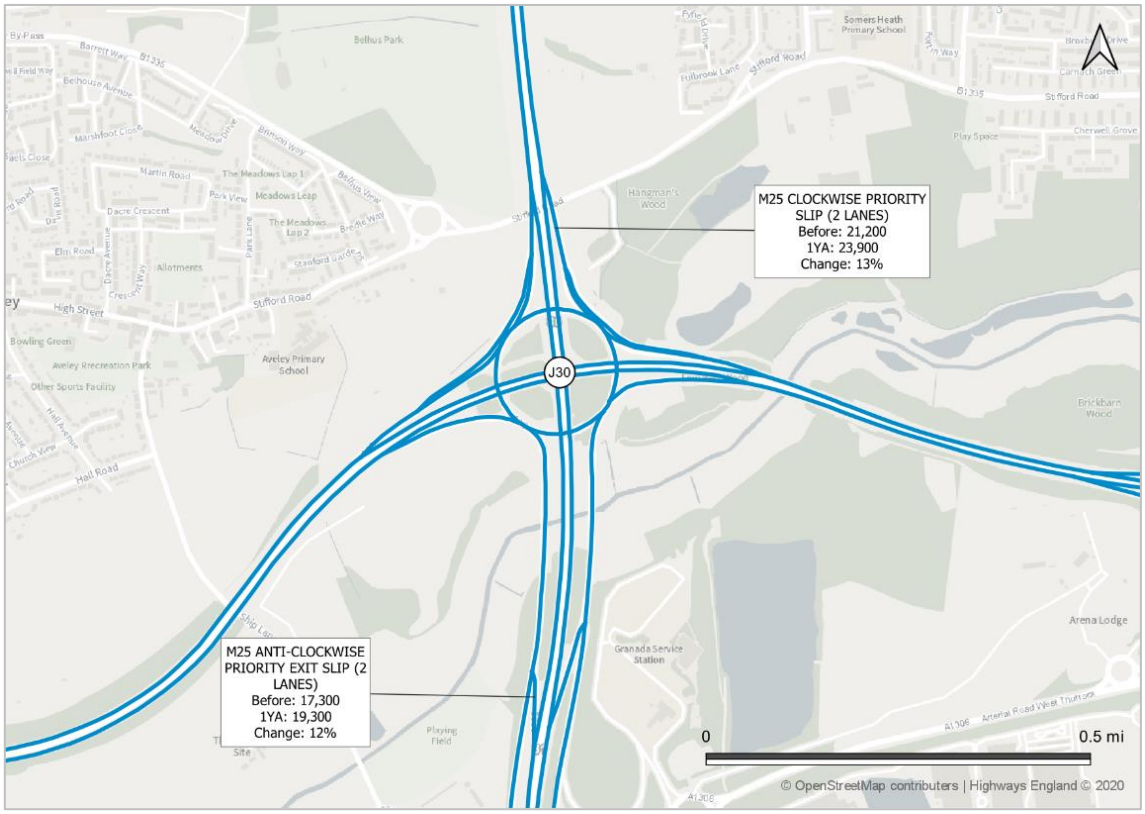
4.2.2. How did traffic volumes change?

Between 2014 and 2018,[14] traffic on two slip roads within the junction (Figure 3) saw an increase of 12-13% which is just under the average growth for the region and the Thurrock area. Due to data limitations, these two points were where comparable before and after data was available.[15] Conclusions about change and attribution across the wider project extent were therefore limited. It was likely that, beyond background growth, a proportion of the increases was due to nearby road improvements on the M25 which completed in the same period. These were:

- M25 Junction 27 to 30 Controlled Motorway (adjacent section north of the junction) – open to traffic in 2014; and
- Dartford Crossing (south of the junction) – introduced a free-flow ticketing system in 2014.

[13] This period covered the changes since the base year used for the traffic modelling through to this one-year after evaluation.
[14] Data was collected from September 2014 before project construction and September 2018 one year after project opening.
[15] Only two traffic counter sites within the project extent could provide data during the specified date ranges. Both were located on slip-roads. No turning counts were available for the junction. No traffic count data was available for the A13.

Figure 3 Comparison of pre- and post-project average weekly flows



Source: WebTRIS traffic counts – 2014 (before) and 2018 (after)

4.2.3. Was traffic growth as expected?

Total trips on the modelled network[16] were forecast to increase by around 5 to 6% over the period, in line with the estimated background growth (see NTEM projection in Figure 2). These growth figures were substantially lower than the background growth in Thurrock over the period (see section 4.2.1). Table 2 summarises the expected change in vehicle trips for the wider area.[17] No appropriate comparison with observed traffic volume was possible.[18]

[16] The modelled area was subdivided according to level of detail. The detailed simulation area comprised the area between South Essex and North-west Kent. The wider modelled area comprised of Ashford, Canterbury and M2 J5 in the south. In the north it extends from Ilford to Basildon and M25 J27.

[17] Traffic models include two future year scenarios called a Do Minimum (DM) or 'without project' scenario, and a Do Something (DS) or 'with project' scenario. The DM scenario includes all foreseeable future changes to the surrounding road network that are likely to occur, without the project. The DS scenario however includes all the changes assessed within the DM, with the project and associated changes. The two scenarios can therefore be compared to isolate the impacts resulting from the project which is being evaluated.

[18] The traffic forecasting report largely focused on network-wide statistics (how many trips there are in total in the wider area). Some link segment traffic flows were provided however none were for the junction itself. As mentioned, observed traffic data could only be collected for the two slips-roads (see section 4.2.2). Furthermore, as the appraisal was undertaken using SATURN, no journey time routes around the junction were generated to be compared against observations within evaluation.

Table 2 Comparison of modelled total trips in the different scenarios

Time Period	2013 (base year)	2017 DM	2017 DS
AM	214,800	227,600	227,600
IP	201,900	213,600	213,700
PM	260,200	274,100	274,200

Note: The appraisal traffic model produced figures for average hours for the following time periods: AM peak (08:00 – 09:00), Inter-Peak (10:00 – 16:00), PM peak (17:00 – 18:00). This table shows the change in total trips expected between the 2013 Base Year and the 2017 Do Minimum (DM) or 'without project' and Do Something (DS) or 'with project' scenarios, respectively. Source: M25 J30/A13 Congestion Relief Scheme Traffic Forecasting Report

The comparison of the 'without project' and 'with project' scenarios only captured the junction improvements element of the project. The change of speed limit on the A13 from 70 to 50 miles per hour was considered not part of the project and was therefore incorporated into the 'without project' scenario. The M25 Junction 27 to 30 (adjacent section) Controlled Motorway or the Dartford Crossing (south of M25 Junction 30) projects were also included in the 'without project' scenario.

4.3. Relieving congestion and making journeys more reliable

We assessed the changes in average journey times[19] to evaluate the project's impacts on journey times and the reliability of journeys.[20] We found variable journey time impacts for the different movements through the junction, but the limited amount of traffic volume information restricted our ability to provide overall conclusions.[21] Comparisons of how reliability on a route has changed over time can give an indication of a project's impact on congestion.

4.3.1. Did the project deliver journey time savings?

We assessed the relevant movements through the project's major upgrades (see section 2.1), while considering the close proximity of other relevant projects (see section 4.2.2) to ensure they did not impact results.

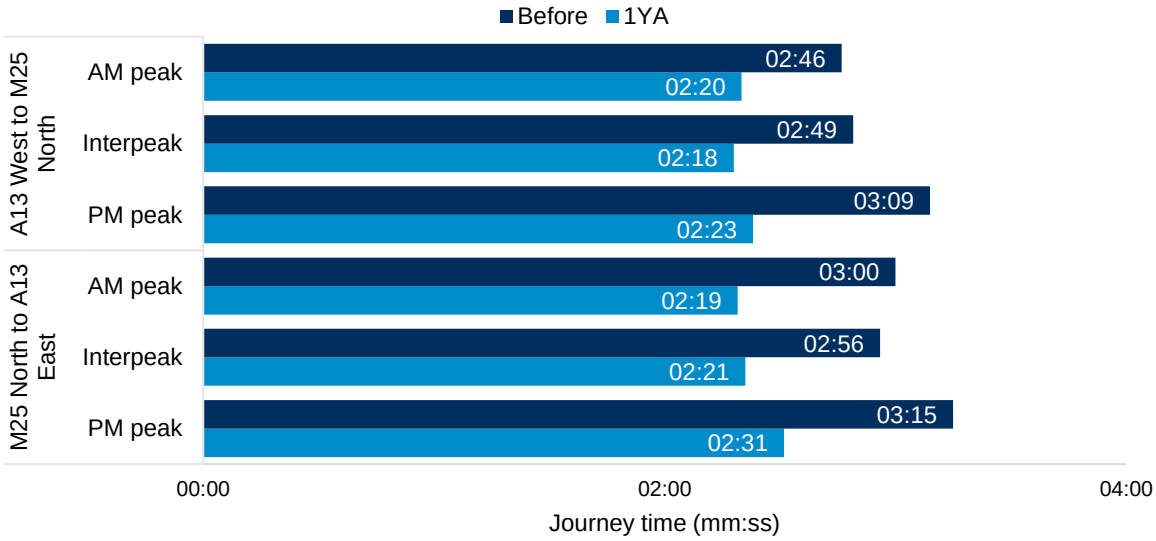
The dedicated left turn lanes had improved average journey times for customers travelling on the key movements of the A13 to the M25 northbound and M25 southbound to the A13 eastbound, by between around 25 seconds and 50 seconds (Figure 4). The improvements were slightly bigger on the latter movement, which previously had exhibited slower journey times.

[19] We used GPS data obtained from TomTom for this analysis. We obtained for a one-year period before the project opened (October 2013 to October 2014) and compared to data for one-year after the project opened (October 2017 to October 2018). We used the same time periods as used in the appraisal: AM peak (08:00 – 09:00), Interpeak (10:00 – 16:00), PM peak (17:00 – 18:00).

[20] To understand a project's impact on reliability, we compare the changes in the percentile ranges of a large sample of journey times, relative to the median journey time. A percentile represents the value below which a given percentage of data points in a sample lie. For example, the 20th percentile is the value below which 20% of the data points lie. It follows that 80% of the data points lie above the 20th percentile value.

[21] Such data would have allowed us to understand the net impact of changes, and whether the movements experiencing benefits were major movements with high traffic volumes. We will revisit acquisition of turning movement data for the five-years after evaluation.

Figure 4 Comparison of observed average journey times - new dedicated lanes

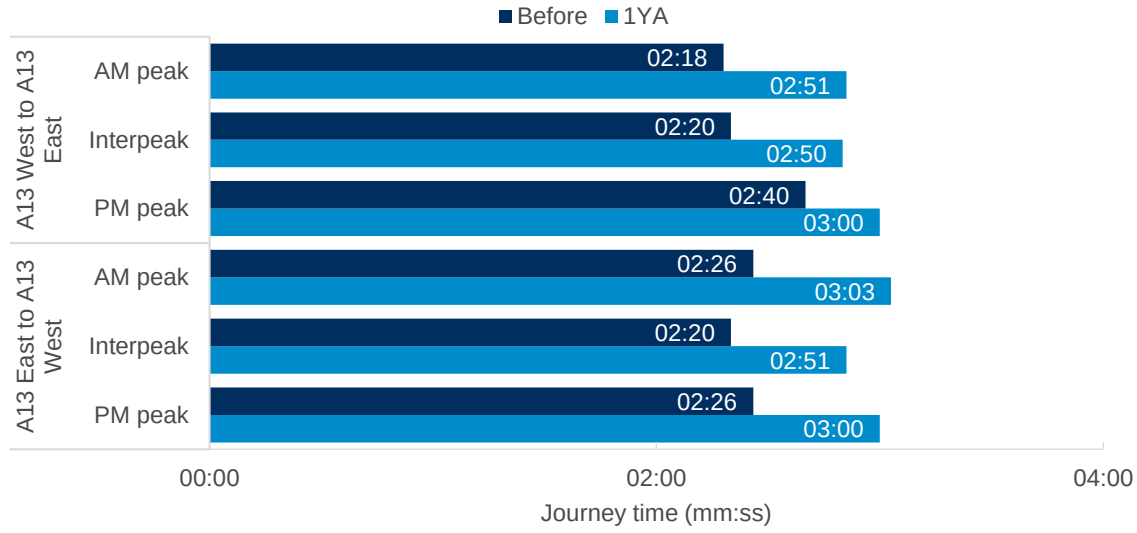


Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018).

The additional capacity on the A13[22] had resulted in less delay relative to the speed limit.[23] Before the project, journey times were 18 to 40 seconds slower than the theoretical journey time at the 70 miles per hour speed limit. In contrast, at one-year after, journey times were just 3 to 16 seconds slower than the theoretical journey time at the 50 miles per hour speed limit.

The impact of the permanent 50mph speed limit (to improve safety between Wennington and A126) was evident.[24] Customers' journey times had increased by around 20 to 40 seconds compared to before (Figure 5).

Figure 5 Comparison of observed average journey times – A13

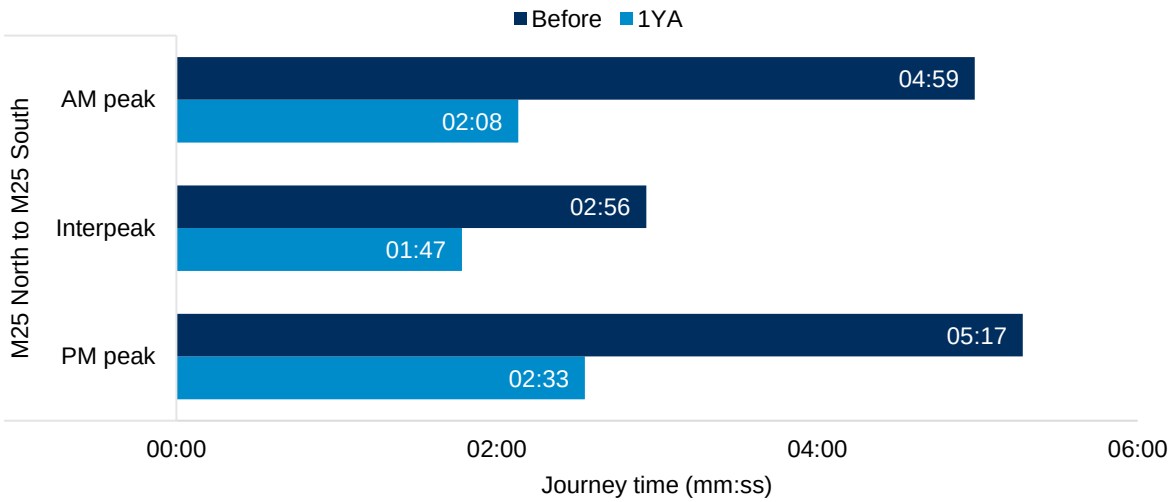


Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018).

[22] From three to four lanes between junction 30 and the A126.
[23] We analysed the relationship between observed journey times to a theoretical journey time of a vehicle traveling at the speed limit in free-flow conditions. A vehicle travelling at 70 miles per hour would traverse the 2.3 miles-long route in two minutes, whereas a vehicle travelling at 50 miles per hour would take two minutes 47 seconds. This indicated post-project journey times were more reliable.
[24] As part of the project's improvements, the speed limit on the A13 between Wennington and the A126 Junction was reduced from 70 miles per hour to 50 miles per hour to provide safety benefits and enable the delivery of shorter slip roads at the junction.

The project had contributed to improvements for customers on the M25 mainline north to south through junction 30. Their journeys were substantially quicker journeys in all time periods at one year after (Figure 6) and they could achieve savings of over two minutes in the morning and evening peak periods compared to before. However, these improvements could not solely be attributed to the project. The other nearby major projects which completed around the same time (see Section 4.2.2 for list) may have contributed.

Figure 6 Comparison of observed average journey times – M25 North to South (mainline)



Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018).

The signal timing changes and gyratory layout changes at the junction had brought improvements to some peak time journey times on other movements. Results for the respective time periods assessed can be found in Table 4, Table 5 and Table 6 in Annex 1: Through junction journey times.

In the evening peak customers' journeys travelling from the A13 west to the M25 southbound were faster by over a minute. And customers' journeys travelling from the M25 northbound to the A13 westbound movement and from the A13 eastbound to the M25 southbound were faster during the busiest periods too.

However, in several instances customers' journeys through the junction had increased. It is likely that the lower speed limit implemented on the widened A13, along with the redesigned road layout to enable segregated left turns (which reduced capacity on approaches for other movements) were factors. We were unable to confidently draw conclusions without sufficient traffic volume data.

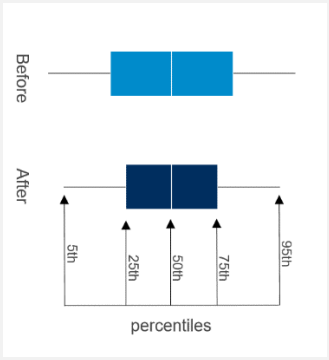
Active benefit management and junction optimisation work was conducted in August 2021. We therefore expect to see improvements on the movements shown above in the five-year after evaluation.

4.3.2. Did the project make journeys more reliable?

One of the project's objectives was to improve the reliability of customers' journeys by making them more predictable. If the time taken to travel the same journey each day varies, we are less confident in planning how long our journey will take. If journey times are more consistent, we can be more confident and allow a smaller window of time to make that journey. More reliable journeys are valued by customers.

We analysed the reliability impacts on the following routes: the segregated left turns and the A13 widening with the speed limit change. We show the results as box and whisker plots.

Figure 7 What does a box plot show?

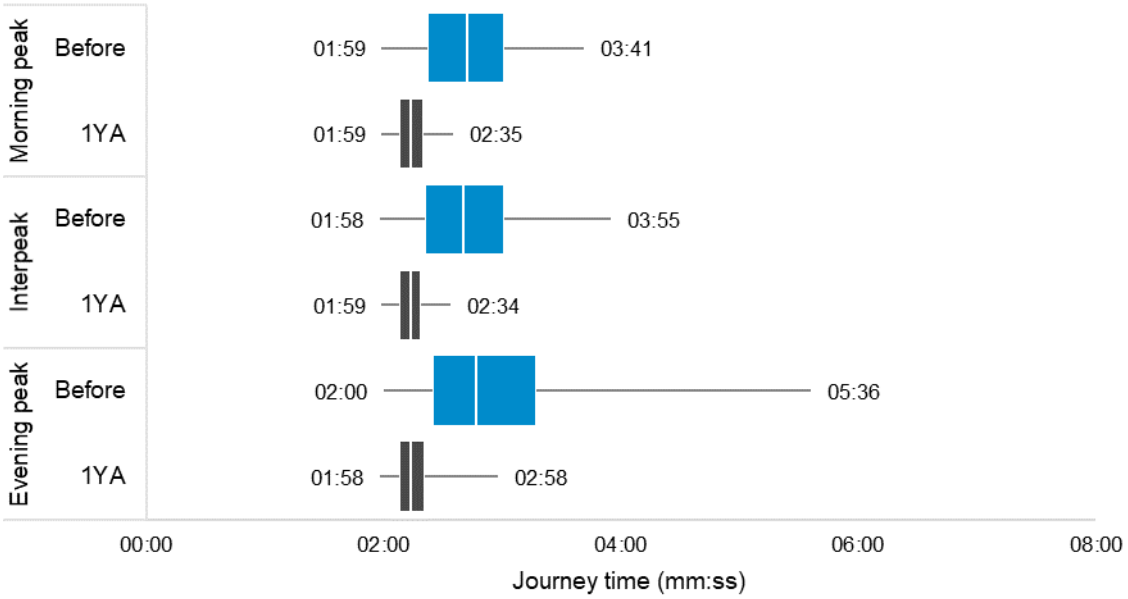


The lowest point is the fifth percentile, this means five per cent of journeys take less than this to complete. The highest point is the 95th percentile, this means 95% of journeys take less time than this to complete. This shows the difference between the longest and the shortest journey times observed.

The length of the block shows how the journey times vary between the 25th and 75th percentile (25% and 75% of journeys). The shorter the block the less variable and hence more reliable a journey would be.

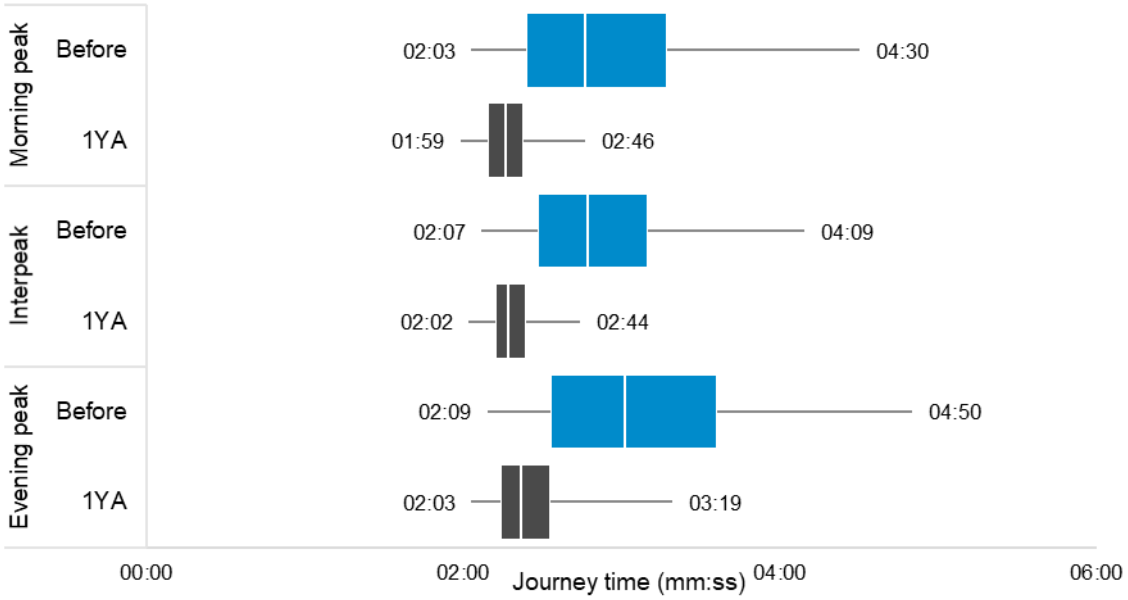
We found journey time reliability had improved on both of the two new dedicated left turn lanes in all three time periods assessed at one-year after. This was shown by the narrower boxes and shorter lines in Figure 8 and Figure 9.

Figure 8 Journey time variability along A13 west to M25 north new dedicated lane



Source: TomTom satnav. Before: October 2013 to October 2014; 1YA: October 2017 to October 2018. Weekday time periods: Morning peak: 08:00-09:00; Interpeak: 10:00-16:00; Evening peak: 17:00-18:00)

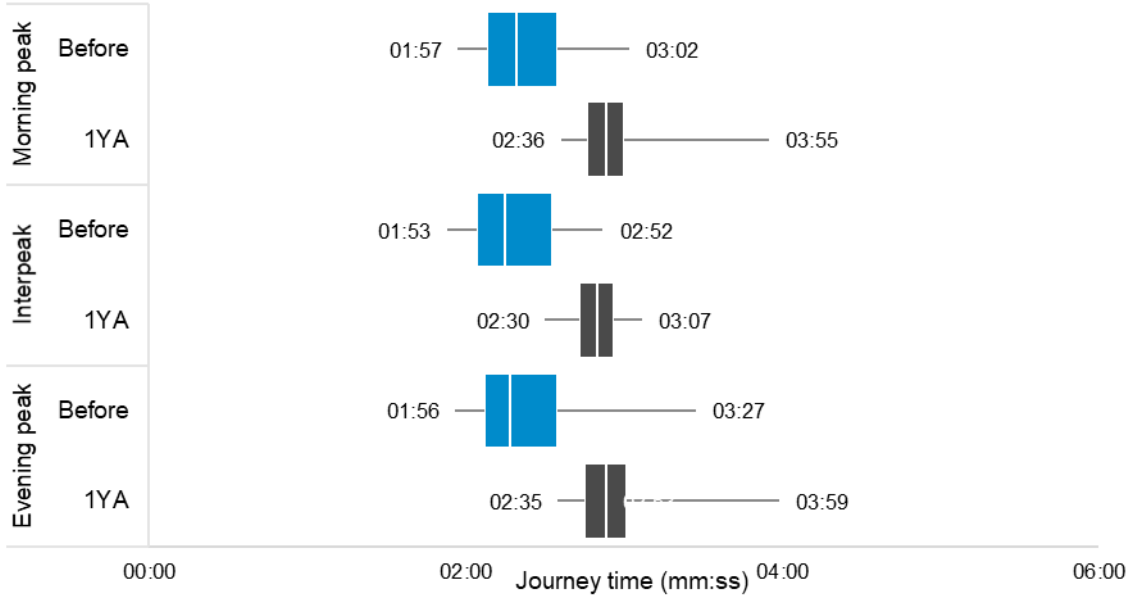
Figure 9 Journey time variability along M25 north to A13 east new dedicated lane



Source: TomTom satnav. Before: October 2013 to October 2014; 1YA: October 2017 to October 2018. Weekday time periods: Morning peak: 08:00-09:00; Interpeak: 10:00-16:00; Evening peak: 17:00-18:00)

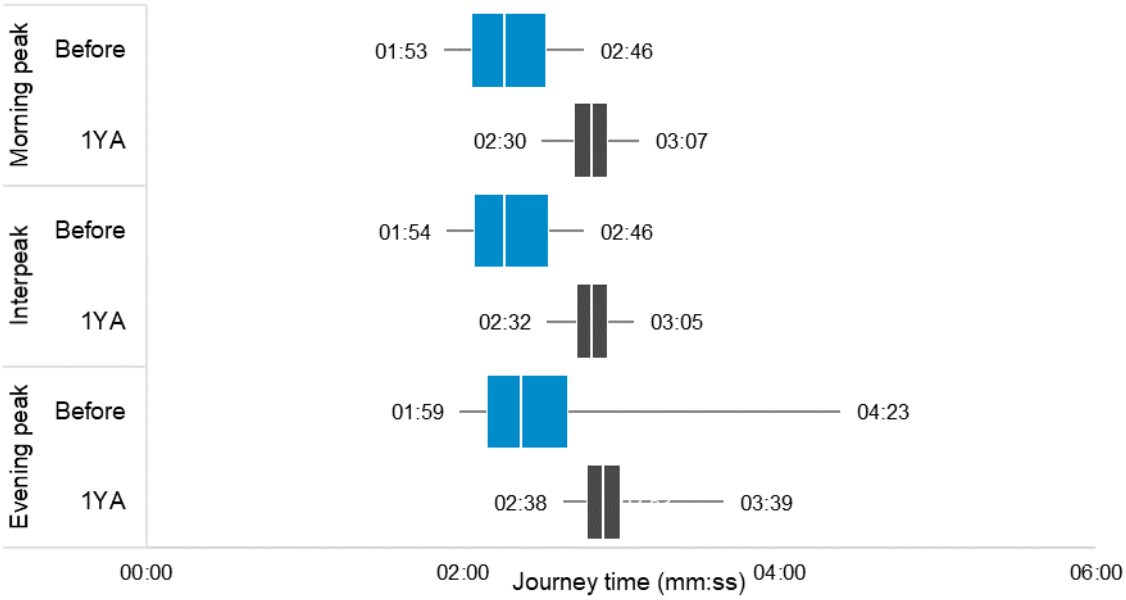
On the widened sections of the A13 the reliability of customers' journeys had improved despite slower journey times due to the implementation of lower speed limit. Figure 10 and Figure 11 show the results. The boxes of the interquartile ranges and the full distributions of journey times were narrower, compared to before. Overall, the project had demonstrably improved journey time reliability for the routes subject to the major elements of the project.

Figure 10 Journey time variability along A13 westbound with widening



Source: TomTom satnav.

Figure 11 Journey time variability along A13 eastbound with widening



Source: TomTom satnav.

5. Safety Evaluation

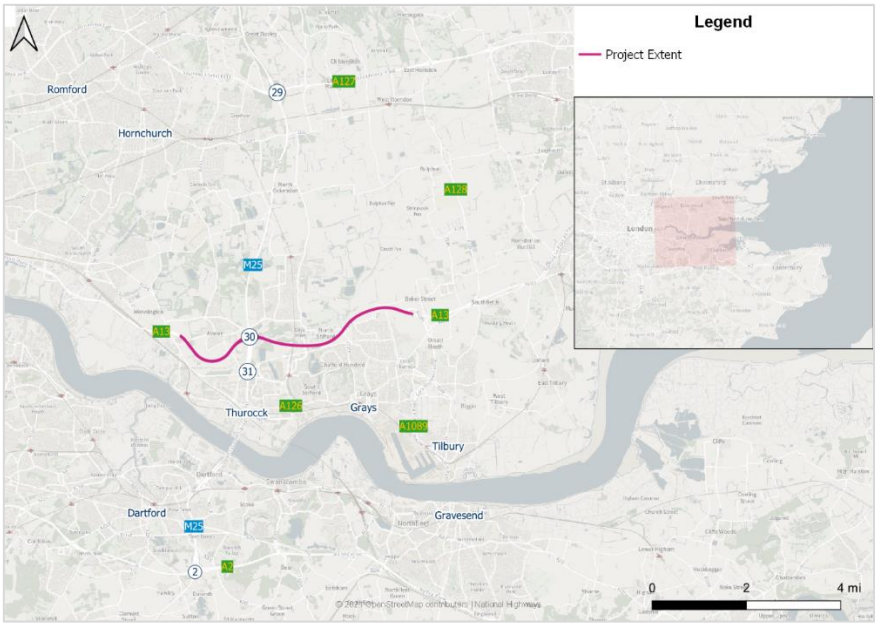
5.1. Summary

- Early evidence indicated the project's safety objective to "maintain and, where possible, improve current safety standards" was on track to be achieved. The rate and number of personal injury collisions had fallen in comparison to the annual average of the five-years before the project.[25]
- 20 personal injury collisions occurred in the first year after the project's completion. This number was lower than the average of 27 per year before the project. Had the project had not been implemented the number of personal injury collisions would likely have ranged between seven and 30.
- The average collision rate had fallen at one year after, from 20 per hundred million vehicle miles before the project to 15 per hundred million vehicle miles. Had the project not been implemented the collision rate would likely have reduced to a similar level of around 13 collisions per hundred million vehicle miles.
- The fall in the number personal injury collisions at one-year after (7) was greater than the average of 4 collisions per year forecast.

5.2. Safety study area

The safety study area is shown in Figure 12.

Figure 12 Safety study area



Source: National Highways and OpenStreetMap contributors

[25] In the context of other findings in this report these are positive early signs. Collisions are reducing at a time where congestion is being released and traffic is moving quicker in some time periods. A future evaluation will be essential to check if this trend continues. The longer timeframe will help determine if our initial positive findings are real or due to natural fluctuation.

The study area was limited to the project extent as we were unable to specifically attribute change due to nearby road improvements on the M25 which completed in the same period (see section 4.2.2).

5.3. What were the emerging safety trends?

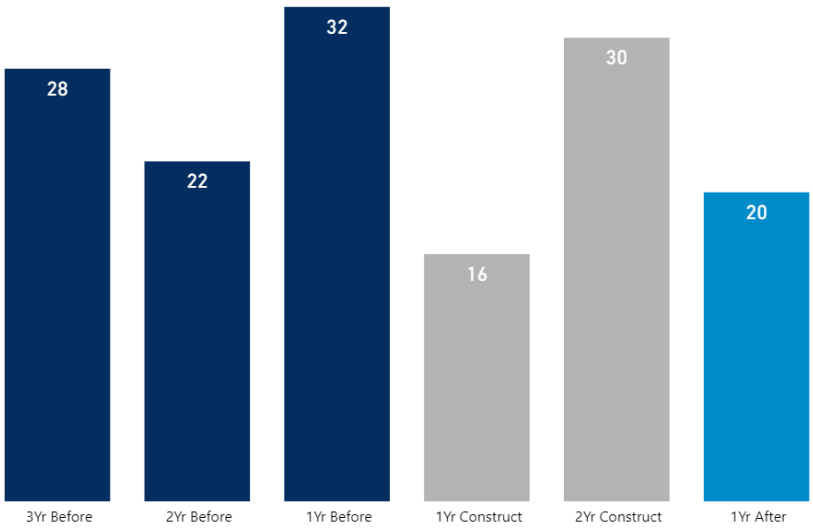
Safety data for this evaluation was obtained from Department for Transport Road Safety Data. This records incidents on public roads that are reported to the police. This evaluation considers only collisions that resulted in personal injury.

The safety analysis has been undertaken to assess changes over time looking at the trends in the three-years before the project was constructed to provide an annual average. We have then assessed the trends from the first 12 months after the project was operational and open for customers. As noted in section 5.1 this provides an early indication of safety trends. We will monitor safety trends over a longer timeframe to ensure we can confidently draw conclusions about the project's safety impact. The safety evaluation for this report looked at the following time periods:[26]

- Pre-construction: 1st March 2013 to 28th February 2015
- Construction: 1st March 2015 to 28th February 2017
- Post-opening: 1st March 2017 to 28th February 2018.

The early indications are that the number of personal injury collisions for the first year of the project are lower than the period before construction began. The number of personal injury collisions has reduced from an annual average of 27 to 20 personal injury collisions during the first 12 months of the project being open for customers. Figure 13 shows the annual average of personal injury collisions from three years before construction, through to one year of operation.

Figure 13 Annual average number of personal injury collisions



Source: STATS19: 1st March 2013 to 28th February 2018

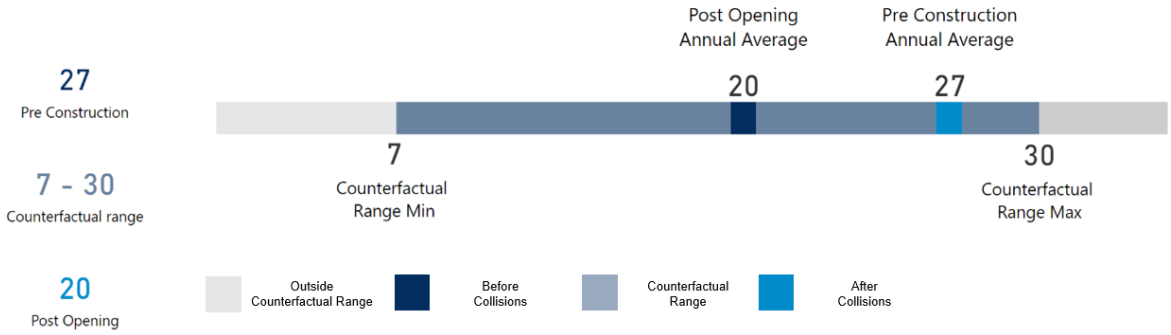
As part of the safety evaluation, we look to assess what changes in personal injury collisions might have occurred due to factors external to the project over this timeframe. To do this we estimate the trend in personal injury collisions which

[26] Dates chosen to minimise overlap with the M25 junctions 27-30 project.

might have occurred if the project has not occurred (this is referred to as a counterfactual). This is based on changes in regional safety trends for 'A' Roads with a high volume of roads users. This helps us to estimate how the pre-construction safety levels would have changed over the evaluation period if the road had remained the same.

Based on this assessment we estimate that had the project not been implemented the trend for personal injury collisions would have changed over time (between 7 to 30) as shown in Figure 14 below.

Figure 14 Observed and expected range of personal injury collisions



Note: Figures are annual average. The large counterfactual range was due to the small sample size. Source: STATS19: 1st March 2013 to 28th February 2018

An annual average of 20 personal injury collisions were observed during the first 12 months of the post-opening period, this falls within the expected range.[27]

The business case for the project predicted that the project would reduce the number of personal injury collisions by an average of 7 per year.[28] The results indicates that the project is on its way to achieving the objective to maintain, and where possible, improve safety standards. A future study will enable a more comprehensive dataset to be collected to help determine if the safety objective has been achieved.

5.4. How had traffic flow impacted collision rates?

The project was implemented at the intersection between two very busy strategic routes, the M25 and the A13. It is therefore important we contextualise the incidents that occur on these routes against the volumes of traffic they occur in. As such we have calculated a collision rate: the number of collisions per annual hundred million vehicle miles (hmvm) travelled.

The average collision rate has decreased to 15 per hundred million vehicle miles – this equates to travelling almost 7 million vehicle miles before seeing a collision. Before the project this figure was 20 per hundred million vehicle miles. The decrease is 5 personal injury collisions per hundred million vehicle miles.

A counterfactual test was undertaken (see section 5.3 for definition). It found that the collision rate would likely have been 13 collisions per hundred million vehicle miles in the counterfactual period.

Collision rates are higher than what we would have expected without the project. As these are the first year's results, however, we are not yet confident yet that

[27] The range was large due to the small sample size but deemed acceptable.
[28] Based on a reduction of 261 personal injury collisions over a 60-year appraisal period for the J30 improvements and a 18% reduction of collisions due to the speed limit reduction

these initial indications are enough to form a trend. An evaluation will be conducted at five-years after opening to establish if early positive findings have continued.

5.5. Why was analysis of collision severity not possible?

The way the police record the severity of road safety collisions changed within the timeframes of the evaluation. There has been a shift to a standardised reporting tool known as CRASH – Collision Recording and Sharing. CRASH is an injury-based reporting system, and as such severity is categorised automatically by the most severe injury. This has led to some disparity with the previous reporting methods, where severity was categorised by the attending police officer.[29]

In this instance, one reporting mechanism was largely used prior to the project installation and another afterwards. As this will have an impact on severity categorisation that is not attributable to the project; it would produce unmeaningful results at this stage. For more detail see Annex 1.

29 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820588/severity-reporting-methodology-final-report.odt

6. Environmental evaluation

6.1. Summary

- Landscape - Mitigation measures had been implemented in-line with expectations. A full evaluation of this sub-objective was not possible at one-year after. The project's effects on the landscape will likely be as expected if the mitigation planting and seeding is successfully established.
- Biodiversity - Mitigation measures appeared to have been implemented generally as expected. However, monitoring surveys were unable to confirm whether the translocation of broad-leaved cudweed (a protected species) had been successful.
- Heritage and historic resources - The impacts of the project on these cultural heritage features (historic buildings and landscapes) were likely as expected. The requirement for an archaeological watching brief was removed as works all took place within the highway boundary.
- Townscape - No direct impact on townscape areas observed at one-year after. The project was considered in the context of the existing heavily trafficked road corridor and highway infrastructure as it located within the urban fringe.
- The project's impact on noise, air quality or greenhouse gases could not be assessed due to lack of traffic data.

6.2. Our analysis

The evaluation of environmental impacts uses information on the predicted impacts gathered from the TAG[30] environmental appraisal, Appraisal Summary Table (AST) and the Environmental Assessment Report (EAR) and compares them with findings obtained one-year after the project opened for traffic.

Observed impacts were determined during a site visit in September 2018, supported by desktop research. The results of the evaluation are recorded against each of the TAG environmental sub-objectives and are summarised below and presented in Table 3. At the one-year after stage, it was not possible to evaluate noise and local air quality.[31] We will revisit these impacts at the five-years after stage.[32]

6.3. Noise, air quality and greenhouse gases

Apart from low noise surfacing and noise barriers, no other specific noise mitigation measures were required in the environmental assessment as it was predicted there would be no perceptible increase in noise levels at sensitive receptors, or within

[30] TAG provides guidance on appraising transport options against the Government's objective for transport. https://www.gov.uk/guidance/transport-analysis-guidance-tag
[31] Post-opening traffic flow data which would have enabled a comparison between the EAR traffic forecasts and recent observed traffic data was not available.
[32] It is anticipated that traffic flow data should be available to permit evaluation.

any of the Defra Noise Important Areas.[33] However, the M25 and A13 was resurfaced with a low noise surface and existing noise barriers were retained and replaced as proposed. On air quality, the project was predicted to lead to a worsening in particulate matter (PM_{10}) and an improvement in nitrogen dioxide (NO_2) overall. It was also predicted that there would be a decrease in regional emissions of oxides of nitrogen (NOx) in the opening year due to speeds and an increase in the design year due to the growth of vehicles on the network. On greenhouse gases, the environmental appraisal predicted that the project would reduce greenhouse gas emissions in the opening year by 0.8 kilo tonnes (800 tonnes) due an improvement in traffic flows. However, by the design year, the growth in traffic would result in an increase in overall emissions.

We were unable to assess the overall impact of the project on noise, air quality or greenhouse gases because the required traffic data was not available (see sections 4.2.2, 4.2.3). This will be reviewed during the five-years-after evaluation.

6.4. Landscape

At one-year after it was too soon to fully evaluate the impacts on landscape and to determine whether the longer-term objectives of screening and integration would be achieved. No signs of recent maintenance were observed. However, subject to the successful establishment of mitigation planting and seeding, the effects of the project on the landscape were likely to be neutral, as expected. We will review the outcome again at five-years after.

Figure 14 View from Ship Lane and local cycle route before the project

Source: Environmental Assessment Report June 2014.

The project was constructed entirely within the highway boundary and within the context of existing heavy infrastructure and large-scale commercial development to the south. Environmental design measures were predicted to help it blend into the surrounding context and reduce the extent of visual intrusion.

[33] Locations identified by Government in its noise action plans as experiencing the highest levels of noise: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/813666/noise-action-plan-2019-roads.pdf

Figure 15 View at one year after looking east along A13 to M25 J30 from Ship Lane overbridge illustrating kerb edge drainage, hardened central reserve and upgraded lighting

Source: One year after site visit 25th September 2018.

Overall, the effect of the project on landscape was expected to be 'neutral'. During construction of the project, existing vegetation had been retained where possible to minimise the loss. At many locations the project was well screened from the wider landscape. For properties at the edge of settlements such as Aveley, views had become more open, and the route corridor was prominent due to the additional gantries, signs and lighting. This was as expected.

Replacement planting had been implemented to help mitigate vegetation loss, although it was yet to be well established at one-year. New gantries and infrastructure were in keeping with the existing highway infrastructure, and the character of the wider landscape had not been significantly altered.

6.5. Townscape

The environmental appraisal considered the impacts of the project on existing townscape character to be Neutral given that the project would be set within the context of existing heavy infrastructure and the large-scale commercial development. The environmental assessment noted that there would be visual impacts for landscape character areas throughout the wider study area (i.e., Aveley Urban Area and South Ockendon Urban Area). However, no direct and/or significant indirect adverse effects were expected because the project area was already heavily influenced by major highway infrastructure.

Based on our site visit, we didn't consider the aspect of Townscape to have been changed, and the project did not appear to have any significant impact on the existing townscape character.

6.6. Heritage and historic resources

Based on the information available at one-year after, we considered that the impacts of the project on cultural heritage features were as expected. The appraisal identified a total of 29 cultural heritage assets within the evaluation study area surrounding the project extent. This comprised 23 archaeological remains; one historic building; and five historic landscape types. However, the proposed works were expected to be largely confined within the highway boundary. Thus, no physical impacts on known heritage assets from works were predicted. Overall, the impact on the heritage resource was assessed as neutral.

Our evaluation included a site visit and a review of the available documentary evidence. At one-year after, our evaluation found that the Essex & Suffolk Water pipeline diversion did not go ahead, so the impact on archaeology was mitigated. The requirement for an archaeological watching brief was removed as works all took place within the highway boundary.[34]

The environmental assessment predicted that project had potential to have slight adverse impacts on the settings of Belhus Park, a Grade II Registered Park and Garden, and Aveley Hall, a Grade II Listed Building. Belhus Park sits within an urban edge setting and is locally valued for recreation. The M25 was a prominent existing feature bisecting the park in a cutting. It was expected that the project would be visible from areas of the park nearest to the M25 but retained vegetation would filter views. Our evaluation confirmed that some of the existing vegetation had been retained as expected which was filtering views.

Our visit also confirmed that there were some distant views from Aveley Hall towards the project through gaps in vegetation (to upper parts of signs, gantries and lighting) limited by the intervening fields, vegetation and landscape bund and because the A13 is in a cutting. The highway infrastructure was slightly more prominent in views from Aveley Hall, but this was broadly as expected.

6.7. Biodiversity

Figure 16 Ecological pond within the Aveley Depot habitat creation area

Source: One year after site visit 25th September 2018.

Overall, the impact of the project on biodiversity was assessed as slight adverse. The appraisal predicted that the project had the potential to affect several legally protected species. This included bats, badgers, great crested newts, common

[34] An archaeological watching brief on the Essex & Suffolk Water pipeline diversion was originally recommended to identify any unknown archaeological remains found. Reporting of the results and the preparation and submission of an ordered archive (defined as all parts of the archaeological record, including the finds, samples and digital records as well as the written, drawn and photographic documentation) was considered adequate to mitigate the impact on any archaeological remains found.

reptiles and broad-leaved cudweed.[35] The effect on the Common dormouse was reviewed but monitoring activity before construction did not find them to be present. It was predicted that there was the potential for impacts on the adjacent sites (habitats) designated for nature conservation including Brickbarn Wood, Mar Dyke, Low Well Wood and Arena Essex. Based on the information available mitigation measures had generally been implemented. The effects of the project on Biodiversity at one-year were considered likely to be generally as expected, but worse than expected for broad-leaved cudweed.

Areas of species-rich grassland had been seeded at various locations including as suitable reptile habitat. These areas will require ongoing aftercare and management if they are to successfully establish.

Ongoing habitat management and maintenance commitments, including specific operations identified in the protected species licences, will be important in ensuring long-term outcomes are met. This will be reconsidered at five-years after when further data should be available.

The most significant impact was expected to be on common reptiles on the M25 southbound side, where a significant proportion of habitat would be destroyed. As a result, five receptor sites were created for reptiles and a habitat compensation area for great crested newts was created on the old highways Aveley Depot site. In the period up to mid-October 2014 a total of 33 reptiles were translocated.[36] Monitoring surveys have not been undertaken in the first 12 months, so it was not possible to review the success of these translocation for these species.

As part of the project, a small number of broad-leaved cudweed plants were translocated individually, and stored topsoil that might contain the plant's seed was spread on the A13 verge. Monitoring surveys of all potential habitats in 2017, 2018 and 2019 found no confirmed sightings of the plant. This suggested that mitigation measures for this protected species may not have been successful.[37]

6.8. Water environment

The environmental appraisal predicted that the project would retain much of the existing drainage arrangements, including underground pipe system except where it modified to accommodate new infrastructure and road layout. Changes to the existing highway embankments undertaken above the flood level. Thus, no loss of the existing floodplain was expected. At widened sections of the project, new combined kerb drainage systems were proposed to cater for the increased surface water runoff. The new drainage would also incorporate sustainable drainage systems[38] to improve the control of surface water runoff from the road and to improve pollution, and spillage containment.

Regarding water quality, the appraisal identified that there were exceedances of the guideline levels for metals, polyaromatic hydrocarbons and total petroleum hydrocarbons at monitoring locations on Aveley Brook, Mar Dyke and the existing balancing pond near Ship Lane. The assessment noted that there were no

[35] Broad-leaved Cudweed is classified as endangered and protected under Schedule 8 of the Wildlife and Countryside Act 1981.
[36] 30 slow worms, a common lizard, one grass snake and one adder.
[37] Included within Annual Condition Inspection of Landscaping Works 2017, 2018 and 2019.
[38] https://www.local.gov.uk/topics/severe-weather/flooding/sustainable-drainage-systems

pollution control facilities on the existing route other than two spillage containment tanks on the M25 north of J30 in the vicinity of the B1335 Stifford Bridge.

The environmental assessment of water resources around the location of the project predicted that there would be negligible effects on flood risk and neutral effects on surface water resources / drainage and groundwater. The overall potential environmental impacts upon the water environment were predicted to be negligible.

At one-year after we found much of the existing drainage network had been retained, including the spillage containment tanks near Stifford Bridge where the pollution control device signs were visible. The proposed new kerb edge drainage system was also observed. However, no detailed as-built information relating to project drainage was available, meaning we were unable to undertake a full one-year after evaluation of this sub-objective. Although the impacts were broadly as expected, and mitigation appeared to be in place, we will revisit the evaluation at five-years to consider any further information that may be available.

6.9. Severance / physical activity

Based on the information available,[39] we considered the impacts of the project on severance and physical activity to be as expected. Our site visit indicated that there had been no direct impacts on public rights of way and, as expected, the amenity of the majority of pedestrian and cyclist routes had been unaffected by the project.

The appraisal predicted that access along existing pedestrian/cycle routes would be maintained with the exception of the existing A13 cycle facility and there would be no change to the number of walking or cycling journeys. The overall impacts on severance and physical activity were expected to be neutral.

6.10. Journey quality

The appraisal predicted that new road layout and improved signage proposed by the project had the potential to improve journey times, relieve frustration, reduce route uncertainty and reduce the fear of potential accidents Overall, the predicted outcome was Beneficial.

Overall, we considered that the effects of the project on journey quality were as expected for traveller care and traveller views. However, due to the unavailability of traffic data we were unable to fully evaluate traveller stress. The increased capacity provided by construction of the additional lanes and the introduction of new signage was considered to have improved route certainty. However, a full evaluation would require comparison forecast and observed post-opening traffic data, which was unavailable.

Traveller care and traveller views were considered to be as expected. Where vegetation had been removed, it had led to some more open views where the road was not in the cutting, in the short term. Existing views from the road, for example where the roads were on viaduct across the Mar Dyke valley had been retained. The additional highway infrastructure (gantries, lighting, and signage) within the route corridor was considered to be an expected part of the visual driving experience on motorways and trunk roads.

[39] No new surveys for pedestrians, cyclists or equestrians were undertaken specifically for this evaluation, and no post-opening studies were proposed by the project.

6.11. Overview

The results of the evaluation are summarised against each of the Transport Appraisal Guidance (TAG),[40] environmental sub-objectives and presented in Table 3.

Table 3 Environmental impacts

Sub-objective	Appraisal Summary Table score	One-year evaluation	Summary
Noise	People annoyed with project = 1,583 Total change in people annoyed = -2	Unable to evaluate at one-year after.	Mitigation measures had been incorporated into the project. Due to the unavailability of traffic data post-opening, it was not possible to evaluate the noise sub-objective at one-year after.
Air quality	Local Air Quality Assessment PM_{10}: 15.9 NO_2: -36.2	Unable to evaluate at one-year after.	Due to the unavailability of traffic data post-opening, it was not possible to evaluate local air quality at one-year after.
Greenhouse gases	Opening year reduction of 800 tonnes CO_2.	Unable to evaluate at one-year after.	Due to the unavailability of post-opening traffic data, it was not possible to evaluate at one-year after.
Landscape	Neutral.	As expected.	Existing vegetation had been retained where possible and landscape mitigation measures had been implemented in line with expectations. Maintenance and management will be essential to ensure longer-term objectives for screening and integration are met.
Townscape	Neutral.	As expected.	There had been no direct impact on townscape areas. At one-year after, effects were considered to be as expected although longer term this will depend upon the successful establishment of the mitigation landscape planting.

[40] TAG provides guidance on appraising transport options against the Government's objective for transport.

Sub-objective	Appraisal Summary Table score	One-year evaluation	Summary
Heritage of historic resource	Neutral.	Unable to evaluate archaeology. As expected for listed buildings and historic landscapes.	Archaeology impacts were mitigated as proposed works on the Essex and Suffolk Water pipeline diversion did not proceed. Listed buildings and historic landscapes; the project was confined to the existing route corridor. Some views had been opened up, but existing vegetation had been retained where possible and the impacts of the project on cultural heritage features were as expected.
Biodiversity	Slight adverse.	Likely to be generally as expected. Worse than expected for broad-leaved cudweed.	Based on the information available, impacts of the project on biodiversity were generally as expected. Post construction broad-leaved cudweed surveys found no evidence that the mitigation for this species had been successful. Biodiversity will be reconsidered at five-years.
Water environment	Negligible.	Likely to be as expected.	The proposed mitigation appeared to have been implemented as expected.
Physical activity	Neutral.	As expected.	There had been no direct impacts on public rights of way and the proposed changes to cyclists' use of the A13 had arisen.
Journey quality	Beneficial.	As expected for traveller care and traveller views. Unable to evaluate traveller stress at one-year after.	Traveller Care and Traveller Views - as expected. Changes to traveller views were as expected. Traveller Stress - increased capacity had been provided by additional lanes; and the introduction of new signage had improved route certainty. However, comparison pre and post opening traffic data was unavailable, so this aspect could not be fully evaluated.

Sub-objective	Appraisal Summary Table score	One-year evaluation	Summary
Severance	Neutral.	As expected.	There had been no direct impacts on public rights of way and the changes to the use of the project by cyclists were as predicted.

Annex 1: Through junction journey times

Table 4 Average journey time changes for through junction movements - AM peak

AM Peak		To			
		M25 N	A13 E	M25 S	A13 W
From	M25 N				-00:24
	A13 E	00:38		-00:08	
	M25 S		00:57		01:11
	A13 W			-00:41	

Note: Values are in mm: ss. Positive values indicate slower journey times. Does not include journey time results for movements discussed separately in section.
Source: Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018).

Table 5 Average journey time changes for through junction movements - Inter peak

Inter Peak		To			
		M25 N	A13 E	M25 S	A13 W
From	M25 N				00:08
	A13 E	00:47		00:16	
	M25 S		00:58		00:54
	A13 W			-00:01	

Note: Values are in mm: ss. Positive values indicate slower journey times. Does not include journey time results for movements discussed separately in section.
Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018)

Table 6 Average journey time changes for through junction movements - PM peak

PM Peak		To			
		M25 N	A13 E	M25 S	A13 W
From	M25 N				-00:07
	A13 E	00:37		-00:35	
	M25 S		01:05		01:23
	A13 W			-01:05	

Note: Values are in mm: ss.Positive values indicate slower journey times. Does not include journey time results for movements discussed separately in section.
Source: TomTom satnav (Before: October 2013 to October 2014; 1YA: October 2017 to October 2018).

Annex 2: Incident recording

Police forces choose how they collect STATS19 data. Some police forces do this electronically, for example using mobile devices, while others complete paper forms which are later digitised. In addition, some collisions are reported by members of the public after the event. Since 2016, new data collection systems (called CRaSH and COPA) have been introduced by some police forces.

Before these new systems, reporting police officers categorised the severity of non-killed casualties as either serious or slight according to their own judgment of the injuries sustained. This was based on information available within a short time of the collision, and often did not reflect the results of medical examination. This sometimes led to casualties being incorrectly classified as slight injuries when they were serious, or vice versa.

In November 2015 and January 2016 Essex and Kent police constabularies transferred from Stats19 to CRaSH (Collision Recording and Sharing) system for reporting personal injury collisions. In CRaSH reporting, police officers record the types of injuries suffered by the casualty rather than the severity. In previous systems the determination of severity was at the discretion of the reporting police officer. CRaSH automatically converted the injury type to a severity classification. This led to implications for reporting on collision severity as there had been an increase in the number of serious collisions recorded.

These changes make it difficult to monitor trends in the number of KSI casualties over time or between different police forces. To help with this, the Office for National Statistics (ONS) has undertaken research to identify methods of estimating and adjusting for the increased recording of serious injuries in the new systems. Based on this work, DfT have published an adjusted time series of KSIs at the national level and statistical adjustments at the record level. These adjustments are based on estimates of how casualty severities may have been recorded had injury-based severity reporting systems always been used.

The adjustments will be reviewed by the ONS and DfT as more data becomes available, and it is possible that further refinements will be made to the adjustment methodology in the future. Currently it is not possible to reliably adjust collision severity information at the granular level required for this project.

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