M25 junction 28 improvement scheme
TR010029
7.4 Transport assessment report

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M25 junction 28 scheme
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7.4 TRANSPORT ASSESSMENT REPORT

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1. Introduction

1.1. Purpose

1.1.1 The purpose of this Transport Assessment (TA) is provide a summary of the assessment of the proposed M25 junction 28 improvement scheme (the Scheme). This includes an assessment of the Scheme in terms of the effect it will have on the performance of the strategic and local highway networks, road safety at M25 junction 28, and local sustainable modes of transport. It also considers the traffic and transport effects of the Scheme during its construction phase.

1.2. Background

1.2.1 In December 2014, the Department for Transport (DfT) published its first Road Investment Strategy (RIS) for the investment period 2015 and 2020, announcing £15 billion to invest in England's strategic road network. The RIS sets out a list of schemes that are to be delivered by Highways England over this investment period and identified M25 junction 28 as a key junction requiring improvement to address congestion and safety issues.

1.2.2 In their second RIS (RIS2) for 2020 to 2025, published in March 2020, the DfT reiterate their support for improvements to M25 junction 28. The Scheme is described in RIS2 as an "upgrade of the junction between the M25 and A12 in Essex, providing a free-flowing link from the northbound M25 to the eastbound A12".

1.2.3 The objectives for the Scheme were developed in agreement with local authorities. The agreed scheme objectives are:

- To increase capacity and reduce congestion and delays by providing an improved link from M25 to A12.
- To reduce the incident rate and resulting disruption by increasing the capacity of the roundabout.
- To improve safety on the roundabout by reducing traffic levels and redesigning the existing layout.
- To cater for future traffic demands to enable development and economic growth.
- To minimise the impact on local air quality and noise by smoothing traffic flow.
- To protect access for non-motorised users (pedestrians and cyclists) and improve conditions wherever possible.

1.2.4 Alongside the objectives for the Scheme, the Applicant aims to:

- Minimise environmental impact as measured in accordance with the Design Manual for Roads and Bridges (DMRB)
- Where possible improve air quality related to vehicle emissions, and specifically within declared Air Quality Management Areas (AQMA).

1.3. Option selection

1.3.1 Having been identified as part of RIS that there was a transport issue at M25 junction 28, the Applicant considered a range of alternative strategies to address the problem. A highway improvements-based strategy was confirmed to be most strongly aligned with addressing the local problems identified, meeting the Scheme objectives and capable of being delivered within the RIS programme.

1.3.2 In total, nine alternative highway based options were identified. These options were then assessed based on their ability to meet the Scheme objectives, indicative cost ranges, and key issues and risks relating to Scheme delivery. Four options were short-listed and taken forward and assessed in more detail in terms of environmental impacts, traffic performance, economic assessments, and value for money against the Scheme objectives. Consideration was also given to identified constraints, risks, affordability and deliverability. Following this detailed assessment, three options were selected and taken forward for further development and consultation. These were:

- Option 5B – which connects the M25 anticlockwise with the A12 east via a single lane cloverleaf type loop (with hard shoulder) located in the north-west quadrant of M25 junction 28. It involves the widening of the existing M25 viaduct at junction 28 to support the proposed new M25 anticlockwise diverge and off-slip road for accessing the new link.
- Option 5C – which connects the M25 anticlockwise with the A12 east via a single lane cloverleaf type loop (with hard shoulder) located in the north-west quadrant of M25 junction 28. By moving further north compared to Option 5B, Option 5C avoids the need to widen the existing M25 viaduct structure. Following the diverge, the alignment of the new link turns into the adjacent land to the north-west of the existing junction. The loop road continues south until it merges with the A12 eastbound carriageway underneath the existing M25 junction 28 roundabout structure.
- Option 5F – this is a variation of Option 5C but provides a two-lane loop (with hard shoulder) road merging with the A12 eastbound carriageway underneath the existing M25 junction 28 roundabout structure.

1.3.3 Options consultation took place between 14 November 2016 to 6 January 2017 on these three options. Following consideration of the feedback received, and the completion of the traffic, economic and environmental assessments, the Preferred Route Announcement (PRA) was made in August 2017.

1.3.4 Further information on the option selection process can be found in Chapter 3 (assessment of alternatives) of the Environmental Statement (ES) (application document TR010029/APP/6.1).

1.4. Existing road network

1.4.1 The M25 junction 28 is situated in the north east quadrant of the M25 London Orbital motorway, approximately 30km to the north east of central London and 25km south west of Chelmsford.

1.4.2 The town centre of Brentwood is approximately 3km north east of M25 junction 28 and is connected to the junction via the A1023 Brook Street. Similarly, the settlement of Gallows Corner lies almost 4km south-west of the junction and is connected via the A12.

1.4.3 The junction provides a critical intersection between the M25, the key trunk route of the A12, and the A1023 Brook Street which provides important local access to Brentwood. As such the M25 junction 28 plays a key role in connecting

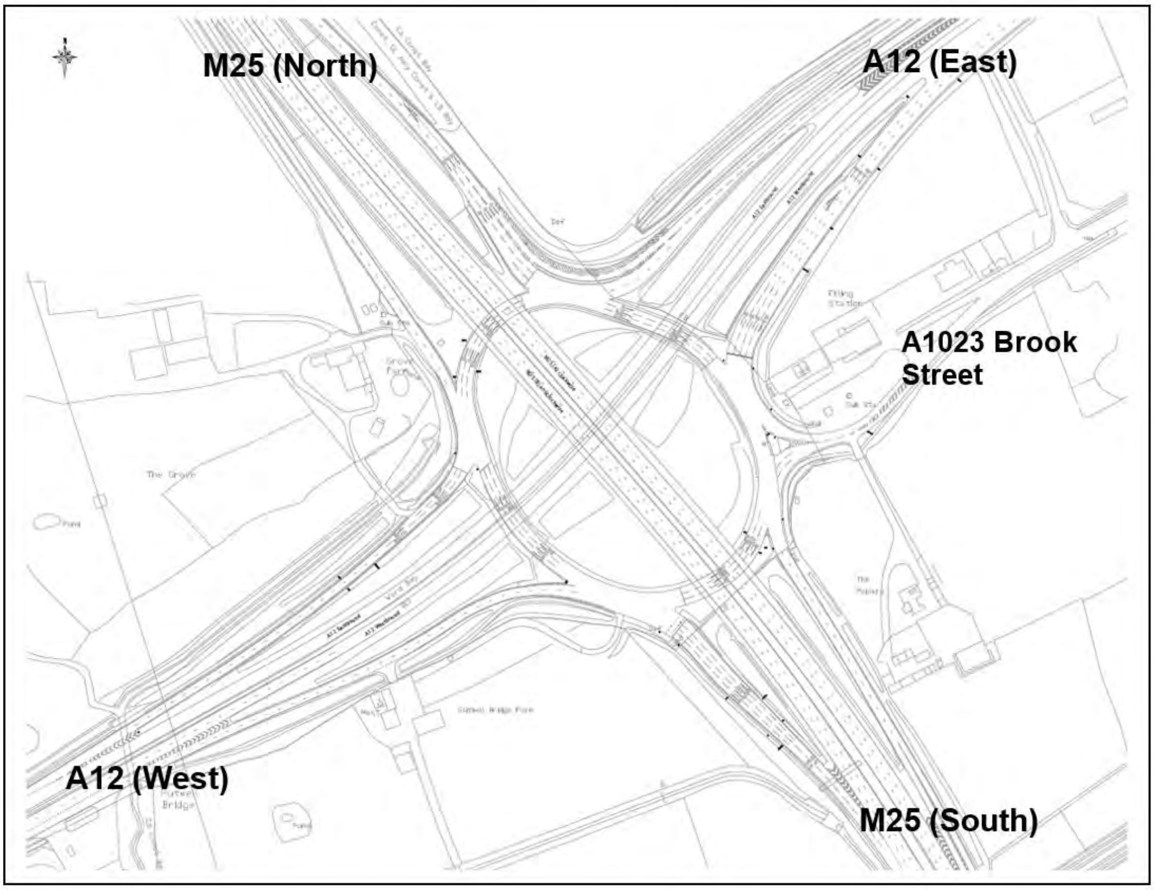
Chelmsford, Ipswich and Brentwood with London and other key destinations across the South East of England.

1.4.4 The M25 junction 28 itself comprises a five-arm roundabout that connects with the M25 and A12, as well as the A1023 Brook Street (Figure 1-1). The junction is a three-tier grade separated junction with the three-lane roundabout operating at grade, the main A12 running below grade and the M25 carriageway above grade. There is a free flow left turn lane between the M25 southbound off slip and the A12 eastbound on slip road. The A1023 Brook Street approach to the M25 junction 28 roundabout is currently uncontrolled and operates as a priority intersection. The remainder of the roundabout is controlled by traffic signals.

1.4.5 The M25 mainline is a dual carriageway motorway with four lanes in each direction to the north and south of M25 junction 28. The section of motorway that passes over the junction on the viaduct is dual carriageway with three lanes in each direction, following a lane drop arrangement at the motorway junction off slip, and a lane gain at the on-slip roads.

1.4.6 The A12 is of dual carriageway standard two lane. As the A12 approaches M25 junction 28 the A12 operates with conventional taper diverges with no lane drop. In the westbound direction towards London, the A12 continues as two lanes through the junction. In the eastbound direction towards Essex, the A12 initially continues with two lanes, but then reduces to one lane about under the junction and then has a land gain as it merges with the A12 eastbound on slip road.

Figure 1-1 M25 junction 28 existing layout



1.5. Scheme description

1.5.1 The aim of the Scheme is to increase the capacity of junction 28 by providing a new dedicated link between the M25 and A12.

1.5.2 The general outline of the Scheme is shown in Figure 1-2 and comprises the following highway elements:

- The creation of a new two lane loop road with hard shoulder, for traffic travelling from the M25 northbound carriageway onto the A12 eastbound carriageway, including the provision of three new bridges (Alder Wood bridge, Duck Wood bridge and Grove bridge) and an underpass (Grove Farm underpass) to carry the new loop road over a proposed access track.
- Realignment of the existing A12 eastbound exit (off-slip) road to accommodate the new loop road including the provision of a new bridge (Maylands bridge) and the extension of the existing Grove culvert.
- Improvements to the existing A12 eastbound and westbound carriageways and A12 eastbound entry (on-slip) road.
- Realignment of the existing M25 northbound on-slip.
- Improvements to the existing junction 28 roundabout, the existing M25 northbound carriageway and the M25 northbound off-slip.
- New gantries over the M25 carriageway.
- Alterations of existing private access and egresses and the provision of new private means of access to accommodate the new loop road.

1.5.3 The above description of the highways works proposed should be read in conjunction with the Works plans (application document TR010029/APP/2.3) and Schedule 1 of the Development Consent Order (application document TR010029/APP/3.1). A detailed description of the Scheme can be found in Chapter 2 of the Environmental Statement (application document TR010029/APP/6.1).

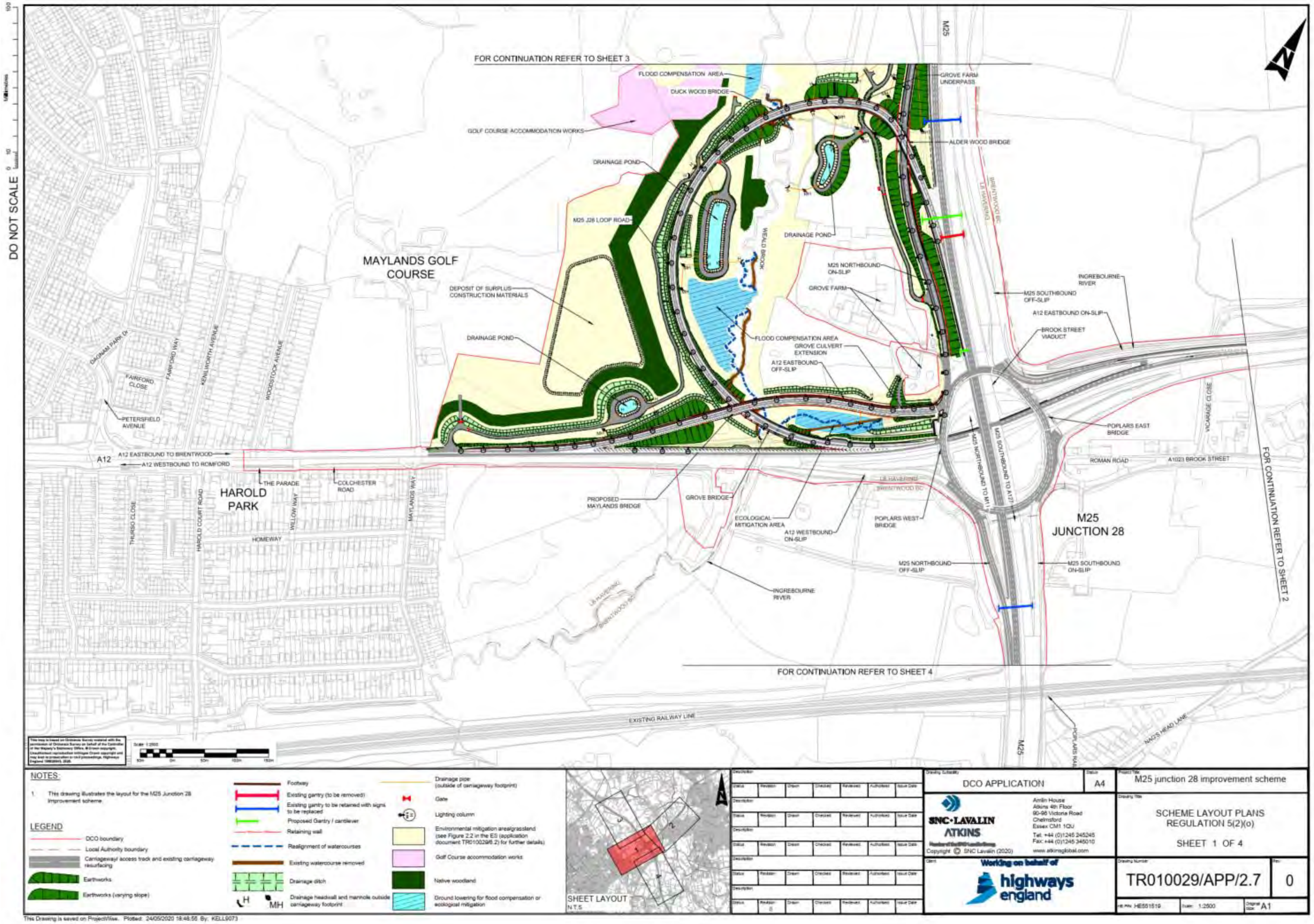
1.6. Funding and delivery

1.6.1 The DfT announced in their 2014 RIS the committed investment for the Scheme. In their second RIS (RIS2) for 2020 to 2025, published in March 2020, the DfT reiterate their support for improvements to M25 junction 28.

1.6.2 Further details of the funding secured for the Scheme are outlined in the Funding Statement (application document TR010029/APP/4.2).

1.6.3 Construction of the Scheme is planned to commence in spring 2022, with the Scheme planned to be open for traffic in autumn 2024.

Figure 1-2 Proposed new junction layout



1.7. Stakeholder consultation

1.7.1 A staged approach was undertaken in developing options for the Scheme. The process of engagement and consultation in developing the Scheme are detailed in the Consultation Report (application document TR010029/5.1).

1.7.2 As set out at section 1.3 of this report, the Applicant shortlisted three options for option consultation. The options consultation took place for approximately eight weeks (54 days) between 14 November 2016 and 7 January 2017. This was to inform various interested parties and stakeholders of the three shortlisted options and seek their views, as well as gauging public opinion.

1.7.3 The Applicant prepared consultation materials to enable stakeholders to have a clear understanding of the problems faced at the junction, the options being consulted on, and how feedback could be provided. Six consultation exhibitions were held, and adverts were placed in local publications advising that the consultation was launched.

1.7.4 A total of 267 responses were received to this consultation, of which 92% of respondents agreed there was a need to improve M25 junction 28. Overall there was a strong preference for Option 5F, including from the local authorities.

1.7.5 Following the option consultation further assessments of all three options were undertaken to inform the final option selection. Taking into account feedback from the consultation, as well as performance of the options in the assessments relating to traffic, design, environment, economics and social aspects, Option 5F was selected as the preferred option. On 22 August 2017 the Applicant issued its PRA.

1.7.6 Option 5F was developed further following feedback from the options consultation and through further ongoing stakeholder engagement. The Applicant then undertook statutory consultation on the developed Option 5F design in accordance with the PA 2008. This involved consultation with statutory consultees under section 42, preparation of a statement of community consultation (a SOCC) and consultation with local communities in accordance with that statement under section 47 and publicising the consultation in accordance with section 48.

1.7.7 Statutory consultation took place between 3 December 2018 and 28 January 2019 with a total of 261 responses received. The Applicant considered the responses received at statutory consultation and took on board any comments received through ongoing engagement. This led to amendments to the design of the Scheme. Following statutory consultation, the Applicant also undertook further environmental assessments, including additional survey work. From this, the Applicant developed the Scheme design to take into account key infrastructure in the area and identified further measures to mitigate the effects of the Scheme.

1.7.8 In July 2019, a TA Scoping Report was issued to Essex County Council (ECC), Brentwood Borough Council (BBC), the London Borough of Havering (LBH) and the Greater London Authority (GLA). The TA scoping report and response received from the local authorities is included in **Appendix A**.

1.7.9 The Applicant undertook a supplementary consultation from 4 November to 2 December 2019 to focus on proposed changes to the Scheme design following statutory consultation, and also to report newly identified environmental impacts.

During the supplementary consultation 21 responses were received which the Applicant had regard to and developed the design of the Scheme further.

1.7.10 A final round of targeted consultation was undertaken between 31 January and 25 February 2020. The targeted consultation related directly to the impact of the Scheme on Maylands Golf Course and aimed to seek the views of LB Havering and those with an interest in the land proposed to be included in the red line boundary. Two responses were received from the parties consulted.

1.7.11 Details of these consultations are set out in the Consultation Report (application document TR010029/5.1).

1.8. This report

1.8.1 Following this introduction, this report is arranged in seven chapters as follows:

- Chapter 2 – Identifies relevant national and local policies, and confirms that the objectives and expected outcomes of the scheme are consistent with these policies.
- Chapter 3 – Provides detail on the collection of baseline data and the development of the M25 junction 28 traffic models.
- Chapter 4 – Provides an overview of the performance of the existing highway network.
- Chapter 5 – Presents a commentary on future network performance, both with and without the Scheme, as well as a future year operational assessment.
- Chapter 6 – Summarises the existing road safety performance within the study area and assesses the impact of the Scheme. It also sets out the findings of the Road safety audit that has been undertaken for the Scheme.
- Chapter 7 – Describes accessibility by and impact of the Scheme on local sustainable modes of transport.
- Chapter 8 – Summarises the construction impacts relevant to delivering the Scheme.
- Chapter 9 – Sets out the key findings and conclusions of the Transport Assessment.

2. Policy context

2.1. Introduction

2.1.1 This section outlines the national, regional and local policies that are relevant to the Scheme. Full details of the Scheme's accordance with relevant national and local policies, local transport plans and associated supplementary plans, particularly the National Policy Statement for National Networks (NPS NN), is provided in the Case for the Scheme (application reference TR010029/APP/7.1).

2.1.2 In summary, the improvement in reducing traffic congestion at M25 junction 28 and the reduction in the occurrence of accidents on the roundabout that the Scheme would deliver are consistent with national and local planning objectives for the economy, sustainability and the environment. Through more reliable journey times, the Scheme would assist in making the region more attractive for businesses and improve everyday life for local travellers.

2.2. National policy

2.2.1 The policy documents below demonstrate the Government's commitment to support investment in the strategic road network (SRN).

- National Policy Statement for National Networks (NPS NN) 2014
- National Planning Policy Framework (NPPF) 2019
- National Infrastructure Delivery Plan 2016-2021
- Road Investment Strategy (RIS): 2015 – 2020
- Road Investment Strategy 2 (RIS2): 2020 – 2025
- Action for Roads: A network for the 21st Century (July 2013)
- Department for Transport Single Departmental Plan 2015-2020
- Highways England Delivery Plan 2015-2020.

2.3. Regional policy

2.3.1 Although the NPS NN is the primary planning policy document for decision making on the Scheme, both regional and local planning policy still have relevance to the Scheme. Transport policy in particular is governed at a regional level which is of particular relevance to this Scheme.

2.3.2 The regional planning policy documents relevant to the Scheme include:

- London Plan (2016)
- Draft New London Plan (July 2019)
- The Mayor's Transport Strategy (2018)
- East London Joint Waste Development Plan (2012).

2.4. Local policy

2.4.1 At local level, ECC, the LBH and BBC have Local Development Plans which have relevance to the Scheme as they provide local land use designations and allocate land in terms of where future development is planned to occur. There is strong alignment of these local policies with the objectives and the expected outcomes of the Scheme relating to tackling congestion and improving journey time reliability, improving safety, and supporting future economic growth and development.

2.4.2 The ECC Local Plan documents which are relevant to the Scheme include:

- Essex Local Transport Plan (2011)
- Essex Development Management Policies (2011)
- Essex County Council & Southend-on-Sea Borough Council Waste Local Plan (2017).

2.4.3 The LBH Local Plan documents which are relevant to the Scheme include:

- London Borough of Havering Core Strategy and Development Control Policies Development Plan Document (2008)
- London Borough of Havering Local Plan Proposed Submission (August 2017)
- Landscaping SPD (2011)
- Protecting and Enhancing the Borough's Biodiversity SPD (2010)
- Protection of Trees During Development SPD (2009)
- Sustainable Design and Construction SPD (2009).

2.4.4 The BBC Local Plan documents which are relevant to the Scheme include:

- Brentwood Replacement Local Plan (2006)
- Brentwood Pre-submission Local Plan (2019).

3. Baseline traffic data and model development

3.1. Introduction

3.1.1 This section of the TA provides information on baseline traffic data collection and the development of the M25 junction 28 modelling framework. The M25 junction 28 modelling framework has been specified to enable the assessment of the impacts and operational performance of the junction and its proposed improvements against the scheme objectives. It comprises a local M25 junction 28 microsimulation[1] traffic model, as well as a strategic M25 North East (M25NE) model that covers the north-east quadrant of the M25 Orbital Motorway with detail around M25 junction 28.

3.1.2 Both models have been developed in line with the DfT's Transport Appraisal Guidance (TAG).

3.1.3 Together these two models are used to evaluate current and future conditions at M25 junction 28 and the immediate surrounding road network. The strategic model has been used to provide the initial assessment of any strategic implications of the Scheme, as well as the basis for forecasting future year traffic demand matrices (record of the volume of trips utilising the model network by time period and year). The purpose of the localised microsimulation model is to examine the local operational performance of the roundabout and queueing on the slip road approaches, as well as any queuing along the A12 and M25.

3.2. Overview of the M25 junction 28 modelling

Strategic modelling

3.2.1 The M25NE strategic model has been developed using SATURN[2] software on behalf of the Applicant to enable a comprehensive assessment of any wider impacts of the Scheme across the strategic and local highway networks. It was also used to provide the basis for forecasting the future year travel demand matrices (under different scenarios) for input to the local microsimulation model.

3.2.2 The M25NE model was specifically built using the South East Regional Traffic Model (SERTM)[3], a region wide traffic model maintained by Highways England for use on all of their schemes in the South East region. The extent of the M25NE model, and thus the area being considered for any wider impacts of the Scheme, is shown in Figure 3-1. This area extent has been used to define the cordons extracted from the SERTM model as a basis for developing the M25NE model. The area covered by the M25NE model extends to junctions 24 and 29 of the M25, the A406 North Circular Road and Chelmsford.

3.2.3 The M25NE model was developed by refining the cordoned model extracted from the SERTM model with more detailed in the modelled network, zoning system and validation of the traffic flows in the vicinity of M25 junction 28.

[1] Traffic microsimulation models are developed and designed to simulate the behaviour of individual vehicles within a defined road network, and are used to predict the likely impact of changes in traffic patterns resulting from changes to traffic flow or from changes to the physical features of the of highway network including capacity enhancements, lane definitions, traffic signals, traffic management environment, etc. Microsimulation models are usually characterised by their ability to visually represent predicted traffic responses and behaviours through 3D animation, which is a useful tool to present the impacts of a proposed scheme to key stakeholders and the general public.

[2] Simulation and Assignment of Traffic in Urban Road Network (SATURN)

[3] SERTM Design Fix (DF) 2 network and DF3 matrices were used in the M25NE model development.

Figure 3-1 Extent of strategic model study area

3.2.4 Key features of the SERTM model, consistent with the M25 junction 28 model include:

- The model uses a March 2015 base year, with average peak hour time segments.
- The highway trip purposes represented in the model comprise five user groups: car employers business, car commute, car other, light goods vehicles (LGVs) and heavy goods vehicles (HGVs).

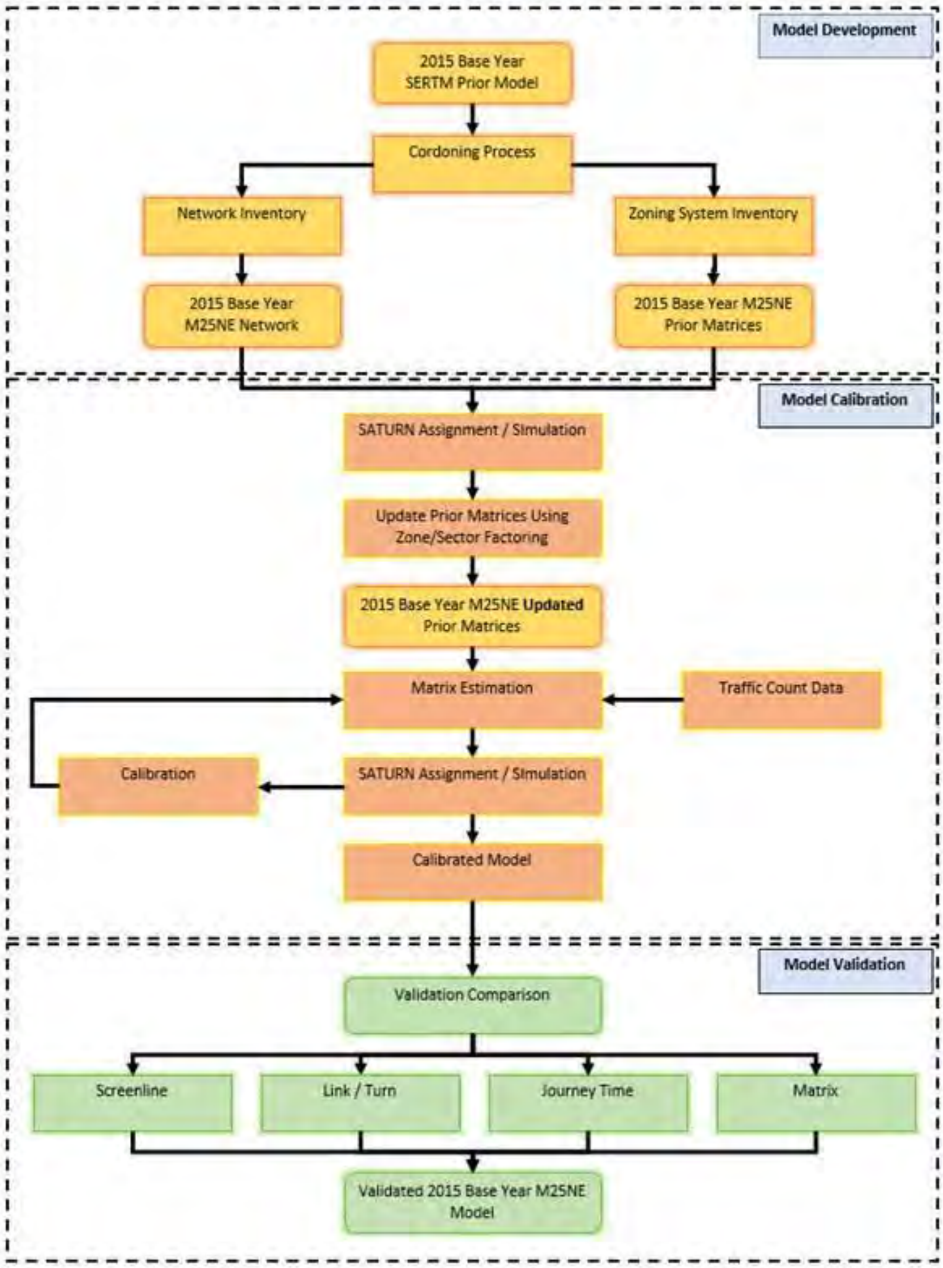
3.2.5 After enhancements to the SERTM based cordoned network and matrix, matrix estimation (ME) procedures were used to fit the highway prior trip matrices to a set of observed traffic count data. This is the process in which traffic count information is fed into SATURN, and it adjusts the trip matrix to try and better reflect demand on those model links with associated count information. This process utilised all the ATC and MCC data referred to in section 3.3 of this Report, and traffic data collected for the parent SERTM model. A variety of checks were undertaken to ascertain that ME has not altered the integrity and profile of the trip matrix. Subsequent to ME, the model has been tested against validation criteria for:

- Flows across screenlines
- Individual link flows
- Journey time comparison
- Model convergence.

3.2.6 The base model was developed in accordance with the DfT's TAG[4] Unit M3.1: Highway Assignment Modelling (2014). The strategic base model development process is outlined in Figure 3-2.

[4] Transport Appraisal Guidance

Figure 3-2 Strategic model development process



3.2.7 The strategic model represents a typical weekday in March 2015. It covers the average AM peak hour (07:00 – 10:00), average inter-peak (IP) hour (10:00 - 16:00) and average PM peak hour (16:00 – 19:00).

3.2.8 The data used to supplement the base model included ATC data, MCC data and WebTRIS data. All the volumetric data used in the M25NE model was normalised to March 2015 to tie in with the M25NE base year. The model has been validated for the base year 2015.

3.2.9 The strategic model involves both highway network assignment modelling using SATURN and variable demand modelling (VDM) using DIADEM[5]. VDM was deemed necessary due to the cost of the Scheme and the high likelihood that there would be high levels of congestion along the A12 corridor.

5 DIADEM – Dynamic Integrated Assignment and Demand Modelling is a software tool maintained and supported by Atkins Limited on behalf of the DfT. The purpose of DIADEM is to enable users to easily set-up variable demand models in accordance with the advice provided in TAG unit M2 variable demand modelling.

3.2.10 The impact of the Scheme on public transport was assessed at the start of PCF[6] Stage 3 based on a VDM mode choice test. This set out to determine the likelihood of trips switching from private car to public transport. This test indicated that the modal transfer from public transport to car or vice versa was minimal, therefore public transport was excluded from the VDM.

Localised modelling

3.2.11 During PCF Stage 2, a 2014 local VISSIM[7] based microsimulation model was developed and validated to have a 'fit for purpose' model for assessing the Scheme. This model was developed using the Applicant's guidelines for the 'Use of Microsimulation' software. The base model provided a robust representation of base year (2014) traffic conditions at the M25 junction 28. A high-level summary of the model calibration and validation is presented in **Appendix B**.

3.2.12 The adopted modelling approach entails localised modelling, comprising a combination of:

- The existing M25 junction 28 / A1023 roundabout LinSig[8] model, focusing on the design and performance of the traffic signals on the roundabout.
- A new VISSIM based microsimulation model to assess the full journey time savings gained by the Scheme options along the off-slip roads, on-slip roads and the main M25 and A12 approaches to the junction. This model enables the operational assessments of the junction to be completed, including the merge arrangements. This includes an assessment of the new merge where the traffic from the proposed loop road joins the A12 eastbound traffic.

3.2.13 The VISSIM microsimulation model simulates complex vehicle interactions and driver behaviours on a microscopic level.

3.2.14 The base VISSIM model has been developed to replicate existing conditions, thereby providing a robust basis to apply the model to forecast future year traffic conditions and assess the impacts of the M25 junction 28 improvement option. The VISSIM model can replicate the complex nature of the M25 junction 28 roundabout including the A1023 Brook Street uncontrolled (un-signalised) approach and the blocking back of queues from the eastbound carriageway on Brook Street resulting from queues from the traffic signals at Nags Head Lane junction. Other forms of modelling packages such as LinSig and TRANSYT[9], as well as SATURN, are not able to fully replicate this situation and driver behaviours. However, the LinSig model has been used to derive initial signal timings and off sets to set up the VISSIM microsimulation models.

3.2.15 The Scheme is key to improving the strategic road network, increasing the capacity for future traffic demands between the M25 and the A12 corridors. It is also expected to facilitate movements to and from Brentwood via the A1023 Brook Street. Specifically, the introduction of the Scheme would increase the capacity of the junction, reducing the delay for many of the approaches to the roundabout, and have a positive impact on most of the travel movements through the junction in all time periods. The benefits relating to these improvements had

6 Highways England's Project Control Framework (PCF) – this sets out how major improvement projects are managed and delivered.

7 VISSIM is a microscopic simulation program for multi-modal traffic flow modelling. It is developed in Germany.

8 LinSig is a software tool by JCT Consultancy which allows traffic engineers to model traffic signals and their effect on traffic capacities and queuing. LinSig is used for all types of signal-controlled junctions, including signal controlled roundabouts. LinSig is used for both standalone junctions and networks of two or more junctions.

9 TRANSYT is a software tool by TRL which allows traffic engineers to model traffic signals and their effect on traffic capacities and queuing. TRANSYT used for signal-controlled networks comprising of any type of signal-controlled junction.

been expected to be relatively local to the scheme; that is relating to the performance of the roundabout, reduced queueing on the slip roads approaching the roundabout, as well as potential queueing back to the A12 and M25. The VISSIM model is suitable for assessing these localised benefits, and more specifically the operational feasibility of the improvement option, focussing critically on the performance of the traffic signals, and the merge arrangements on the A12 eastbound section with the introduction of the new loop road.

3.2.16 The VISSIM model study area includes the mainline M25 and A12 including all the on slip and off slip roads. This is to ensure that the VISSIM model covers the extent of the Scheme's impact. In evaluating the proposed improvements from the option identification phase (including a dedicated link between the M25 northbound and the A12 eastbound, towards Essex) in terms of operational performance, safety, environmental effects and economics, the study needed to consider impacts beyond the immediate boundaries of the junction. During PCF Stage 3, the model was extended to increase the length of certain entry and exit links to the network, to allow for vehicles to get into the network, and then make their decision about which lane they need to be in before reaching a junction. The extent of the PCF Stage 3 VISSIM model is shown in Figure 3-3 and 3-4.

3.2.17 The model has been developed with a morning peak period of 0700-1000, an average inter-peak of 1000-1600 and an evening peak period of 1600-1900.

3.2.18 Signal timings for the M25 junction 28 were provided by Connect Plus Services (CPS), including plans of the junctions and respective staging arrangements for March 2014 to inform the model creation.

3.2.19 As part of the TA, the microsimulation model has used the six journey time routes used to validate the updated VISSIM model (see section 3.4). The outputs are described in Chapter 5 which compares the expected impacts on journey times resulting from the Scheme. The microsimulation model development process is outlined in Figure 3-5.

3.2.20 In PCF Stage 3, the base year flows in the 2014 based VISSIM model were updated to reflect a 2015 base year.

Figure 3-3 Extent of VISSIM model

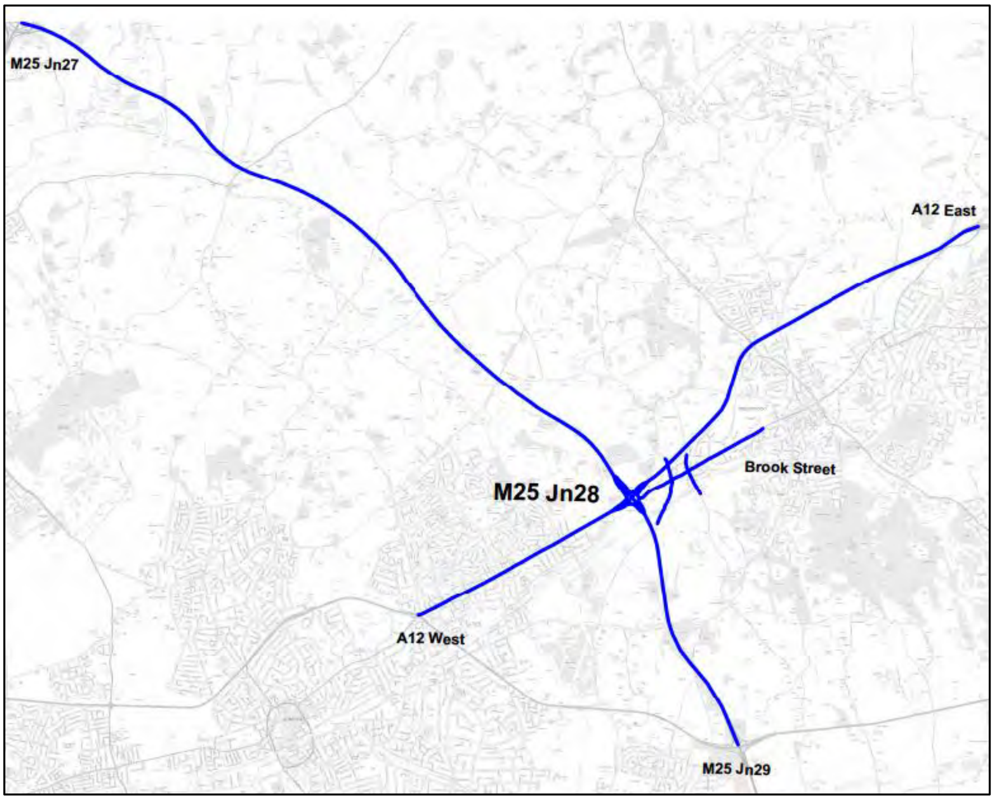


Figure 3-4 Detailed extent of VISSIM model

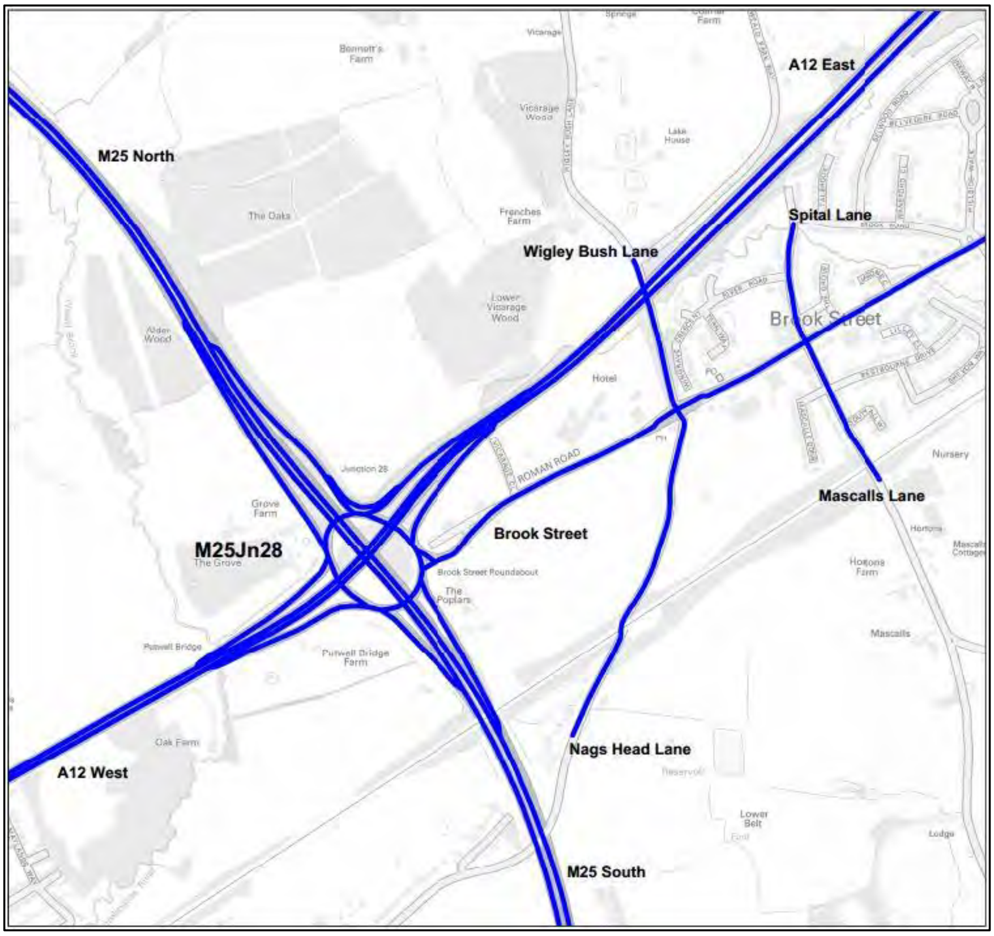
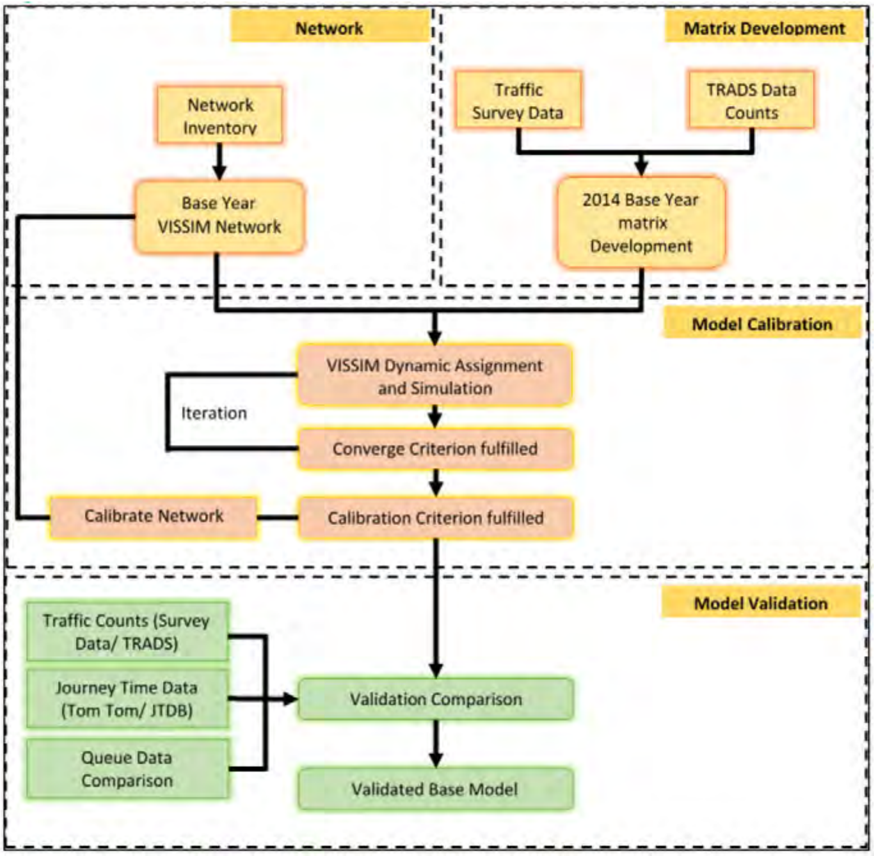


Figure 3-5 Microsimulation model development process



3.3. Baseline traffic data collection

Existing traffic data

3.3.1 At PCF Stage 1 there was a significant amount of data collection to develop an initial LinSig model for junction 28. This data included:

- Link flow counts for six sections of the A12 and M25 mainline and slip roads
- Volumetric turning count for M25 junction 28 itself
- Journey time information for six routes on the M25
- Queue data on all approach to M25 junction 28
- Signal timings and controller specifics for M25 junction 28, and the Brook Street / Nags Head Lane junction.

Traffic data collection

3.3.2 A significant amount of additional traffic data was collected for PCF Stage 3 to enable the development of the strategic SATURN and localised VISSIM models. This is set out below.

Volumetric counts

3.3.3 To supplement the existing SERTM count data and journey time data (both for the purposes of the operational and strategic model), automatic traffic counts (ATCs) were collected at 24 sites. This data was collected during November 2016. In all cases, data was collected continuously for a three-week period.

Figure 3-6 shows the locations of the ATC counts. The locations of the counts were selected based on the requirements to calibrate and validate the base model.

3.3.4 Manual classified counts (MCC) were undertaken at the Brook Street / Nags Head Lane and the Brook Street / Mascalls Lane junctions for two days in November 2016. Figure 3-7 shows the locations of the MCC counts.

Journey time data

3.3.5 TomTom journey time data was collected in March 2014 for six routes that pass through M25 junction 28, comprising turning movements with the heaviest flows. The analysis of journey times focussed mainly on the turning movements contributing the largest volumes of traffic through the junction and were important to accurately reflect in the models. Journey times are examined across the following movements (Figures 3-8 and 3-9):

- A12 east to M25 north
- A12 east to M25 south
- A12 west to M25 south
- M25 north to A12 west
- M25 north to A12 east
- M25 south to A12 east.

3.3.6 In addition to the data collection outlined above, video footage has also been recorded at the M25 junction 28. This has enabled additional checks on the data and estimated operational signal timings to be calculated where signals could be seen.

Figure 3-6 Location of ATC surveys

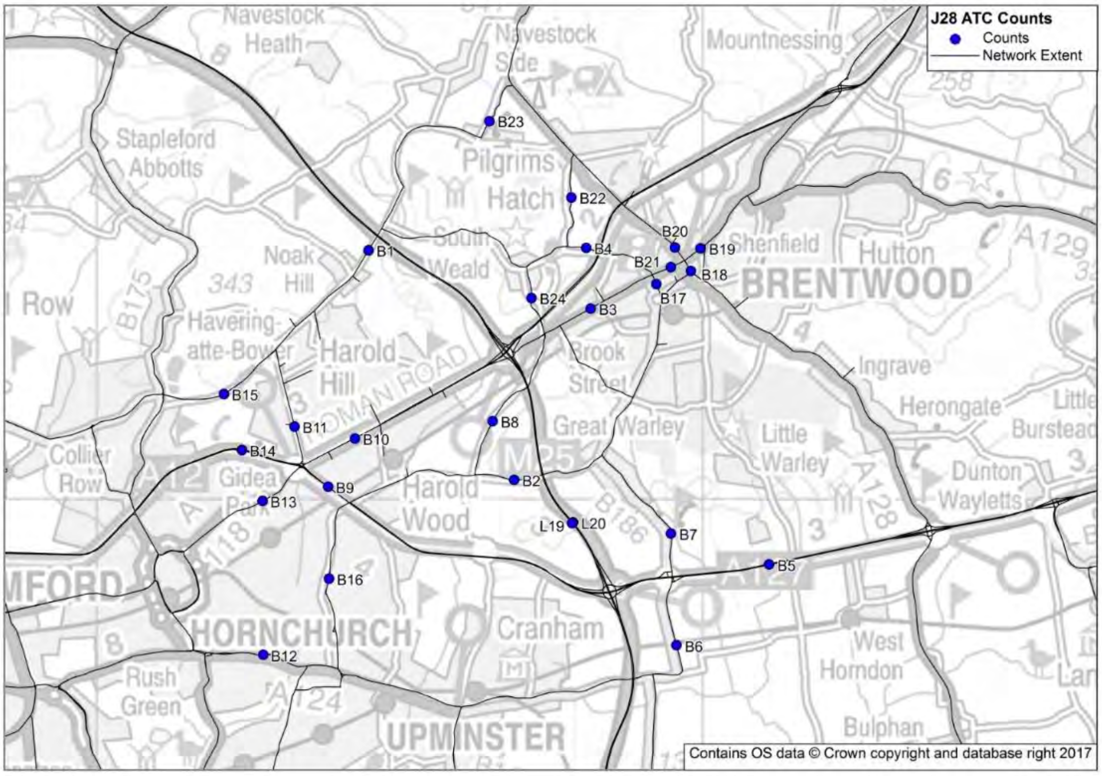


Figure 3-7 Location of MCC surveys

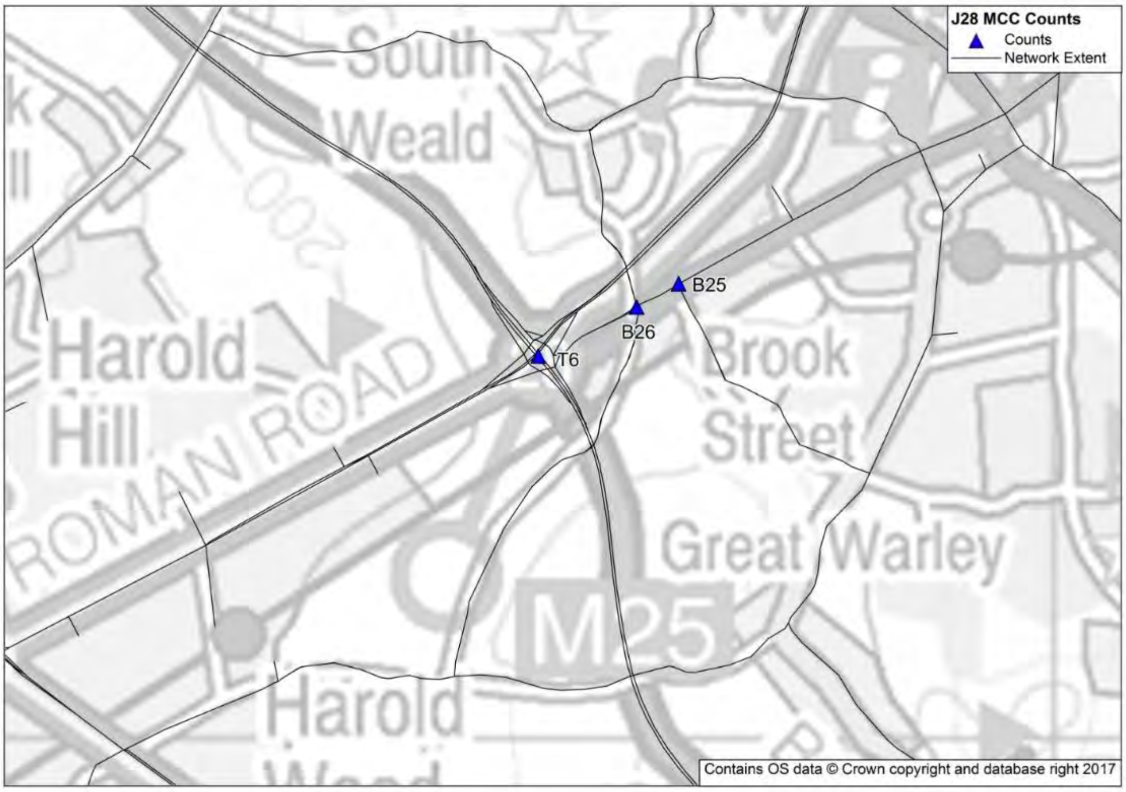


Figure 3-8 M25 junction 28 TomTom journey time routes (from A12)

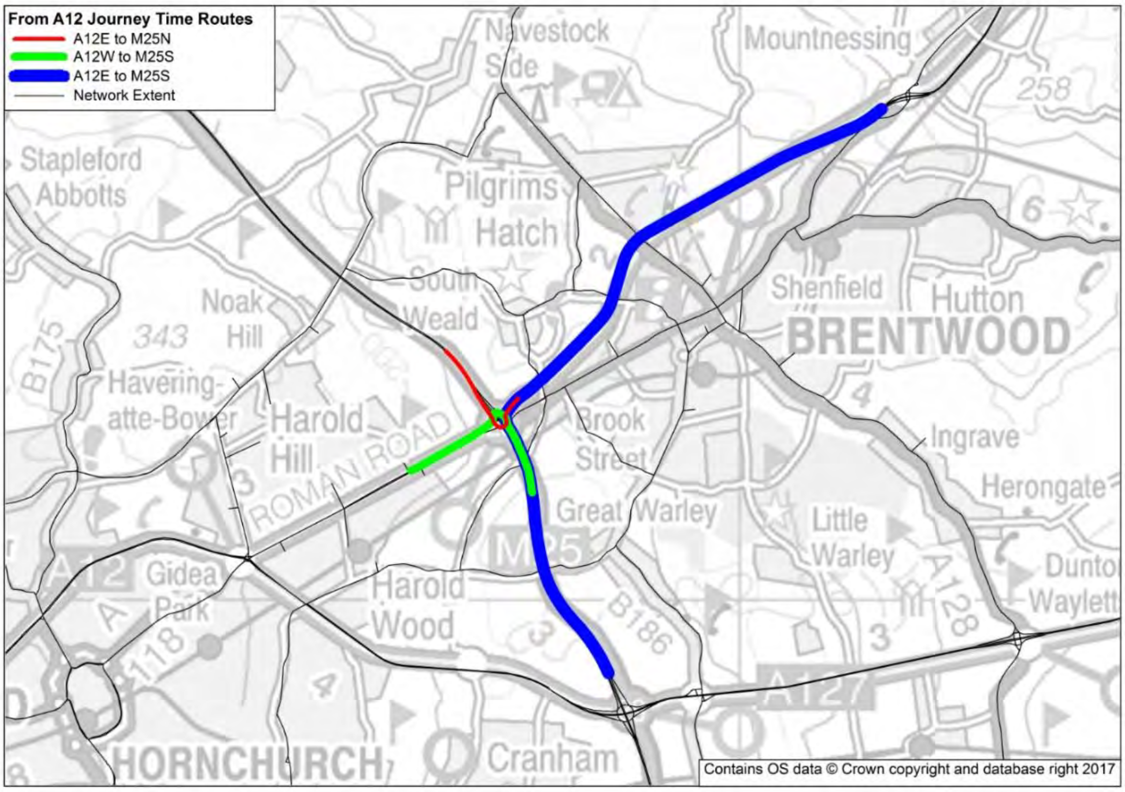
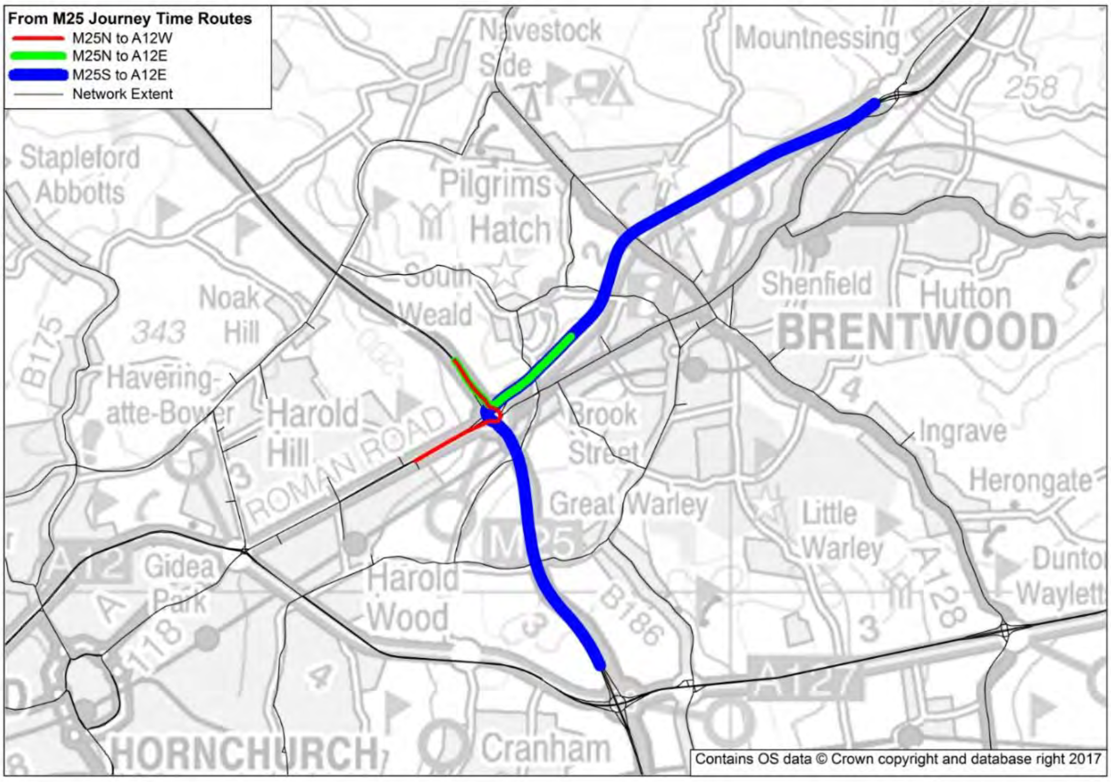


Figure 3-9 M25 junction 28 TomTom journey time routes (from M25)



3.4. Other network performance observations

3.4.1 A site visit was undertaken on Wednesday 24 February 2016 from 07:00 to 12:00 to understand how the network operates during the peak period, including capturing driver behaviour, site conditions and exit blocking impact at M25 junction 28.

3.4.2 The aim of the site visit and video surveys was to observe and validate the traffic conditions at the M25 junction 28 and other local junctions included in the VISSIM model. The video surveys were used to understand the following operational issues:

- The causes of the queuing issue which starts from the Brook Street / Nags Head junction.
- To obtain signal timings and validate signal stage plan.
- To capture turning movement proportions at the junction.

Brook Street / Nags Head Lane

3.4.3 The Brook Street / Nags Head Lane signalised junction is located east of the M25 junction 28.

3.4.4 Based on both the site visit and video surveys undertaken in 2014, it was identified that eastbound traffic queues on Brook Street block back from the Nags Head Lane junction on to M25 junction 28 roundabout in the AM peak. These queues present significant congestion and safety concerns to both circulatory traffic and traffic attempting to exit M25 junction 28 onto Brook Street.

3.4.5 Site observations highlighted the key causes for queuing on this approach were the high demand and low discharge rate of the straight movement onto Brook Street east. The low discharge rate was due to the downstream merge on the Brook Street east exit. This was exacerbated by cars parked in front of a shop parade and bus stop which was used frequently during the AM peak.

Spital Lane / Mascalls Lane

3.4.6 Long queues were observed forming at the Mascalls Lane / Spital Lane signalised junction, which is approximately 300 metres downstream of M25 junction 28. These queues were a result of slow-moving eastbound traffic along Brook Street and occasionally blocking the exit at the Brook Street / Nags Head junction.

3.4.7 A high demand for the right turn from Brook Street West into Mascalls Lane was observed. The current phasing at the junction is not synchronised with the Brook Street / Nags Head Lane junction and as a result the right turn at the Mascalls Lane / Spital Lane junction is observed to block the Brook Street ahead movements.

3.4.8 These queuing issues affect the performance of the Nags Head Lane junction and subsequently impact operation at the M25 junction 28.

4. Current network performance

4.1. Introduction

4.1.1 This chapter provides an overview of the current operation of M25 junction 28 and the SRN approaching the junction. In doing this, reference has been made to the M25 junction 28 traffic modelling that has informed the development and assessment of the Scheme. Details of the M25 junction 28 modelling framework are provided in Chapter 3.

4.1.2 M25 junction 28 plays a key role connecting the M25 motorway with the A12 trunk road. It also provides for local access to Brentwood via the A1023 (Brook Street).

4.1.3 The RIS identified M25 junction 28 as a key junction on the SRN that required improvements to address congestion and safety issues. The Scheme primarily focuses on tackling congestion on the M25 junction 28 roundabout by increasing the capacity of the junction with the provision of the new dedicated link between the M25 northbound and the A12 eastbound. The provision of this dedicated link is expected to divert the dominant right turn movement away from the roundabout, thereby alleviating the demand of traffic using the roundabout, and hence reduce the delay for traffic on many of the approaches to the roundabout.

4.1.4 The existing junction also experiences a high occurrence of slight injury and damage only accidents. By reducing the level of traffic using the roundabout, together with the proposed measures to reconfigure some of the road markings, a reduction on the occurrence of accidents is expected on the roundabout. In addition, a reduction in disruption and congestion will occur due to fewer collisions.

4.1.5 The remainder of this chapter discusses the assessment of the performance of each of these issues.

4.2. Summary of current network performance

4.2.1 Currently junction 28 is a heavily used junction which features a roundabout controlled by traffic lights and it is used by up to 7,500 vehicles an hour during peak times. There are four dominant movements through junction 28, namely between the M25 northbound and southbound carriageways and the A12 eastbound (facing Essex) in both directions.

4.2.2 As stated above, the M25 junction 28 roundabout also caters for traffic accessing Brentwood via the A1023 (Brook Street). While the roundabout is signalised, the Brook Street approach to the roundabout is the only approach not currently controlled by traffic lights. The A1023 Brook Street is not part of the Applicant's SRN and it is owned and maintained by Essex Highways.

Current travel patterns and conditions at M25 junction 28

4.2.3 The base year modelled traffic flows at the M25 junction 28 are shown in Table 4-1. The traffic flows shown are average hour flows, in passenger car units (PCUs[10]) for the AM and PM peaks.

[10] Where a car equals one PCU with larger vehicles such as lorries and buses have a value of greater than one PCU. In this case cars and LGVs have a PCU factor of one, while HGVs have a factor of 2.5.

4.2.4 The movement at the junction with the highest turning movements is from the M25 northbound to the A12 eastbound, with 933 and 940 PCUs in the AM and PM peak hours respectively.

Table 4-1 2015 Base year traffic flows (PCUs)

	Link	Average hourly flow (PCUs)	
		AM peak	PM peak
M25 junction 28	Brook St - M25S	280	227
	Brook St - A12E	27	15
	Brook St - M25N	297	385
	Brook St - A12W	338	377
	A12E - M25S	864	810
	A12E - A12W	1056	702
	A12E - M25N	803	687
	A12E - Brook Street	191	98
	A12W - M25N	399	290
	A12W - A12E	675	751
	A12W - M25S	155	69
	A12W - Brook Street	634	500
	M25N - A12E	760	1210
	M25N - M25S	4197	4889
	M25N - A12W	363	351
	M25N - Brook Street	306	424
	M25S - A12W	146	258
	M25S - M25N	4783	4126
	M25S - A12E (via roundabout)	933	940
	M25S - A12E (via loop)	-	-
	M25S - Brook Street	0	35

4.2.5 In 2015, the eastern section of the M25 was one of the UK's top ten busiest motorway sections in terms of annual average daily traffic flow (AADT) on the entire SRN[11]. Information taken from the Highways England WebTRIS database for 2015 provides AADTs of:

- 96,825 vehicles passing along the M25 through M25 junction 28
- 43,494 vehicles turning through M25 junction 28 from the M25 to the A12
- 17,376 vehicles passing through M25 junction 28 along the A12
- 45,588 vehicles turning through M25 junction 28 from the A12 to the M25.

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/610669/tra0303.ods

Confirmation of base year flow comparison

4.2.6 As the base model was developed in 2015, the 2015 base year flows have been compared with the 2019 traffic flows for the M25 in Figures 4-1 to 4-3 for the M25 southbound, M25 Northbound and two-way flows respectively.

4.2.7 The traffic flow comparison shows that the M25 mainline flows have changed marginally (2% in the morning peak & 4% in the evening peak) in both directions. This analysis shows that the base year (2015) flow is robust for the traffic impact assessment. Furthermore, there is no new major developments in the area which warrant updating the base year from 2015.

Figure 4-1: M25 southbound traffic flow comparisons

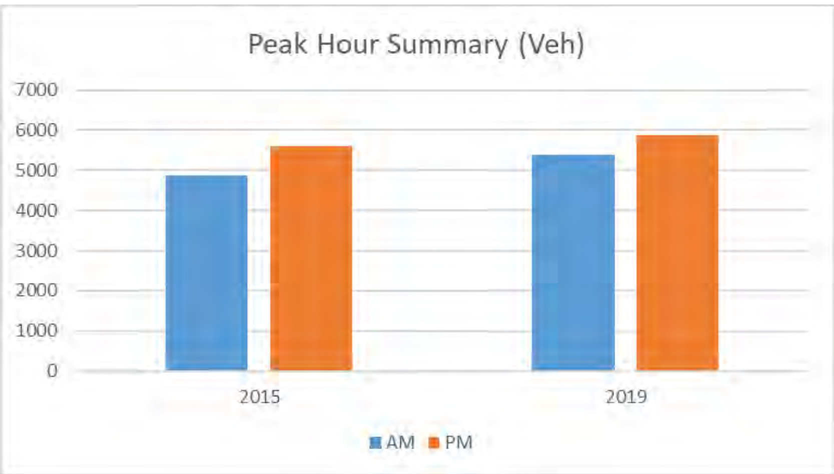


Figure 4-2: M25 northbound traffic flow comparisons

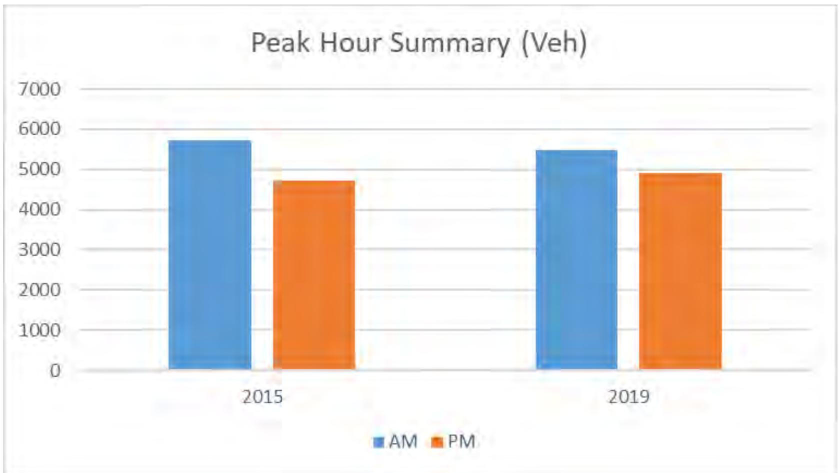
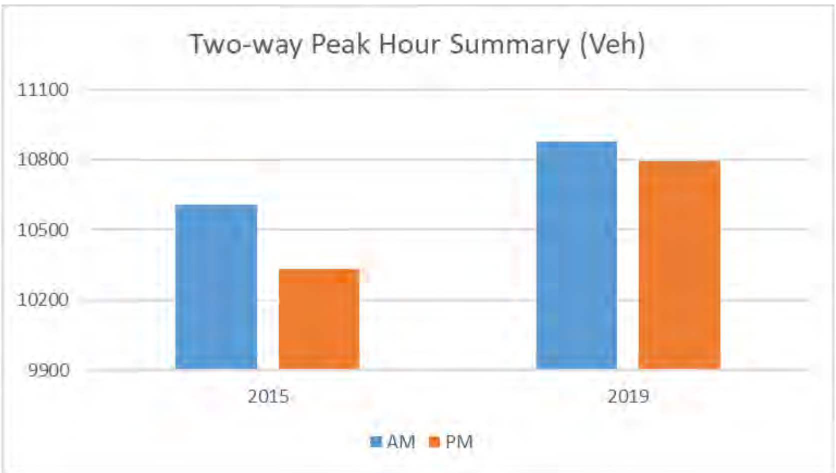


Figure 4-3: M25 two-way traffic flow comparisons



Journey times and delays

4.2.8 The junction is already operating at capacity, with motorists regularly experiencing congestion and delays. 2015 base year queues and delays are shown in Table 4-2.

4.2.9 In particular the motorists currently approaching the junction 28 roundabout from the M25 south and the A12 west experience average delays of around, or over 1 minute during both AM and PM peaks. The A1023 Brook Street currently shows average delays approximately 2 minutes in the AM peak and 1.5 minutes in the PM peak.

4.2.10 Modelled journey times for the AM and PM hours and presented in Table 4-3. The journey time routes are shown in Chapter 3, Figures 3-8 and 3-9.

Table 4-2 2015 Base year queues and delays (modelled) at M25 junction 28

M25 junction 28 approach	AM Peak		PM Peak	
	Queues	Delays (modelled)	Queues	Delays (modelled)
M25 north off slip (SB)	54m	33 sec	66m	41 sec
A12 east off slip (WB)	103m	32 sec	76m	35 sec
Brook Street (WB)	336m	140 sec	266m	94 sec
M25 south off slip (NB)	57m	71 sec	68m	80 sec
A12 west off slip (EB)	41m	52 sec	44m	50 sec

Table 4-3 2015 Base year journey times through M25 junction 28

Journey time section	Length (m)	Modelled journey times (secs)	
		AM Peak	PM Peak
A12 east to M25 north	5,485	271	262
M25 north to A12 east	4,508	189	206
M25 south to A12 east	11,960	524	537
A12 east to M25 south	11,715	489	468

4.3. Base model validation

4.3.1 The M25 junction 28 base VISSIM model calibration and validation process was undertaken against the observed site data such as journey times, queue data and traffic volume counts. The validation results satisfy the DfT's TAG Unit M3.1 criterion for validation of traffic models.

4.3.2 On this basis, the M25 junction 28 VISSIM model provides a robust representation of base year (2015) traffic conditions at junction 28 and can therefore be used with confidence to forecast the likely traffic impact of the Scheme.

5. Future network performance

5.1.1 This chapter follows on from Chapter 4 and discusses how the performance of the SRN served by the M25 junction 28 is expected to change in the future, both without the Scheme and then with the Scheme in place.

5.1.2 The following sections set out the approach to forecasting future conditions using the M25 junction 28 modelling, the inputs to the forecasting procedure including committed developments, and an overview of the impacts on performance of the network with the Scheme.

5.2. Modelling approach

Strategic modelling

5.2.1 Forecast models have been developed for the following years:

- 2022 (opening year)
- 2026 (proposed Lower Thames Crossing (LTC)[12] opening year)
- 2037 (design year).

5.2.2 When traffic modelling was commenced the forecast year of opening was October 2022. However, following more detailed scheduling of construction works the forecast year of opening is now anticipated to be 2024. The modelling years have not been changed as traffic growth between 2022 and 2024 is not considered to be materially different to alter the conclusions drawn from the traffic modelling.

5.2.3 Similarly, the LTC opening year has been revised to 2027 since the forecast models were built. For the same reasons as above no adjustment was made from 2026. An adjustment to the M25 junction 28 opening year to represent 2024 and LTC opening year to 2027 has, however, been made in all economic analysis. It should be noted that this forecast year has been included to enable the economic assessment to consider any possible benefits / disbenefits that LTC may have on the Scheme.

5.2.4 Do minimum and Do something scenarios have been prepared to enable the impacts of the Scheme to be evaluated by comparison to the forecast situation without the Scheme.

5.2.5 The Do minimum scenario includes only those changes unrelated to the Scheme which are considered more than likely to be in place prior to the respective future year. The Do something scenario includes the Scheme.

Localised modelling

5.2.6 The purpose of the operational model is to undertake future year assessments having demonstrated that it can replicate existing conditions. The operational model's demand matrices were derived from the strategic modelling. A cordon was taken from the M25NE SATURN model, which covered the same area as the VISSIM model extent (presented in Section 3.2 of this Report) for the

[12] The Lower Thames Crossing is a proposed new road connecting Kent, Thurrock and Essex through a tunnel beneath the River Thames. It will provide much needed new road capacity across the river east of London

respective time periods and forecast years. The Scheme is expected to provide relatively local benefits; that is relating to the performance of the roundabout, reduced queueing on the slip roads approaching the roundabout, as well as potential queueing back to the A12 and M25. Therefore, the VISSIM model was used to assess the future performance of the junction, both with and without the Scheme.

5.2.7 The operational performance of the local network and each junction is presented using VISSIM modelling, which presents average network journey times / delay and average journey time / delay by movement.

5.2.8 Using the VISSIM microsimulation model allows for a more detailed insight into the predicted operation of the local highway network and how the various junctions in the network are predicted to operate with a given demand.

Overall forecasting methodology

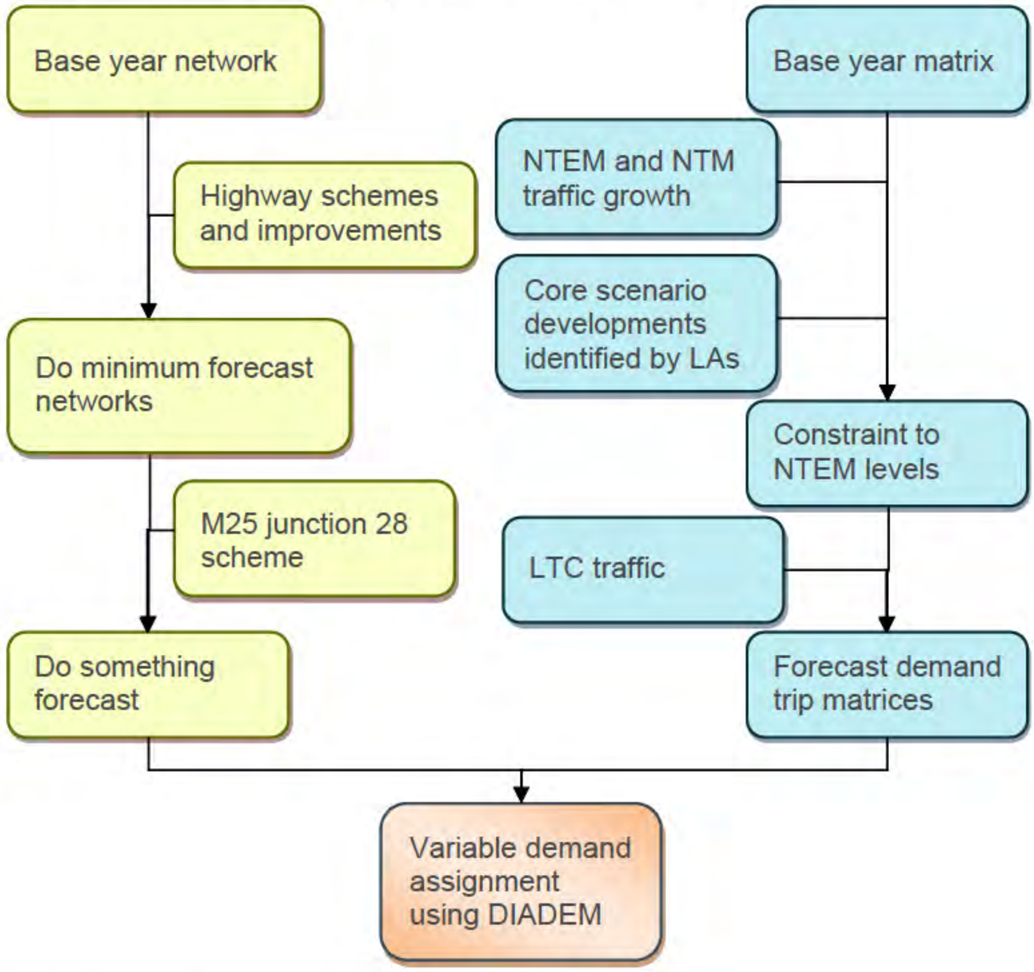
5.2.9 This section details the assumptions and inputs into the development of the forecast strategic traffic model. The forecasting approach applied draws on the guidance from TAG, in particular: TAG unit M2 variable demand modelling (2017) and TAG unit M4 forecasting and uncertainty (2018).

5.2.10 The overall approach to forecasting is to firstly create reference case travel demand forecasts which reflect changes in population, employment, car ownership and other demographic and economic factors. The reference case forecasts do not account for further induced changes in travel demand and patterns (in response to changes in future traffic conditions). However, they provide a useful indication of how traffic demand would be likely to grow if network conditions and travel costs were held constant into the future.

5.2.11 Changes in generalised cost between the base year and the reference case are then considered through the variable demand model (VDM). The VDM process modifies the reference case forecasts to reflect the impacts of increasing congestion on the road network by producing a without-scheme scenario (Do minimum), and then reflecting the relief of congestion by producing a with-scheme scenario (Do something).

5.2.12 The overall forecasting approach is summarised in the flowchart in Figure 5-1. The incremental VDM pivots off the base year cost changes and base year demand distribution and results in a feedback for the VDM process.

Figure 5-1: Forecasting approach (core scenario)



5.3. Local development scenarios

5.3.1 The networks (modelled representation of the road network) and travel demand matrices (record of the volume of trips utilising the model network in each time period and year) were both developed utilising an uncertainty log, which is a log of all planned housing and employment developments as well as all planned transport schemes between the 2015 base year and the 2037 forecast year.

5.3.2 The uncertainty log summarises all known uncertainties in the modelling and forecasting approach. As well as identifying each source of uncertainty, the uncertainty log lists the following information for each source:

- the core assumptions – describing the assumptions that have been made for the core scenario
- the likelihood that the Scheme or development will go ahead.
- the range of assumptions around each input or parameter and, if possible, information about the distribution (e.g. a 95% confidence interval).

5.3.3 The core scenario is a scenario based on the most unbiased and realistic set of assumptions. It is intended to provide a sound basis for decision-making given current evidence. It must be robust and evidence-based taking on board various factors and noting uncertainties affecting travel demand in the future. The management of the uncertainties in formulating the core scenario follows relevant guidance in TAG, which recommends the establishment of an uncertainty log, and subsequently forming a core scenario based on the level of uncertainty identified.

5.3.4 The definition of each classification of likelihood is summarised in Table 5-1. Where a scheme or land use change is considered "near certain" or "more than likely", it will be included in the core scenario.

Table 5-1 Uncertainty log – classification of future inputs

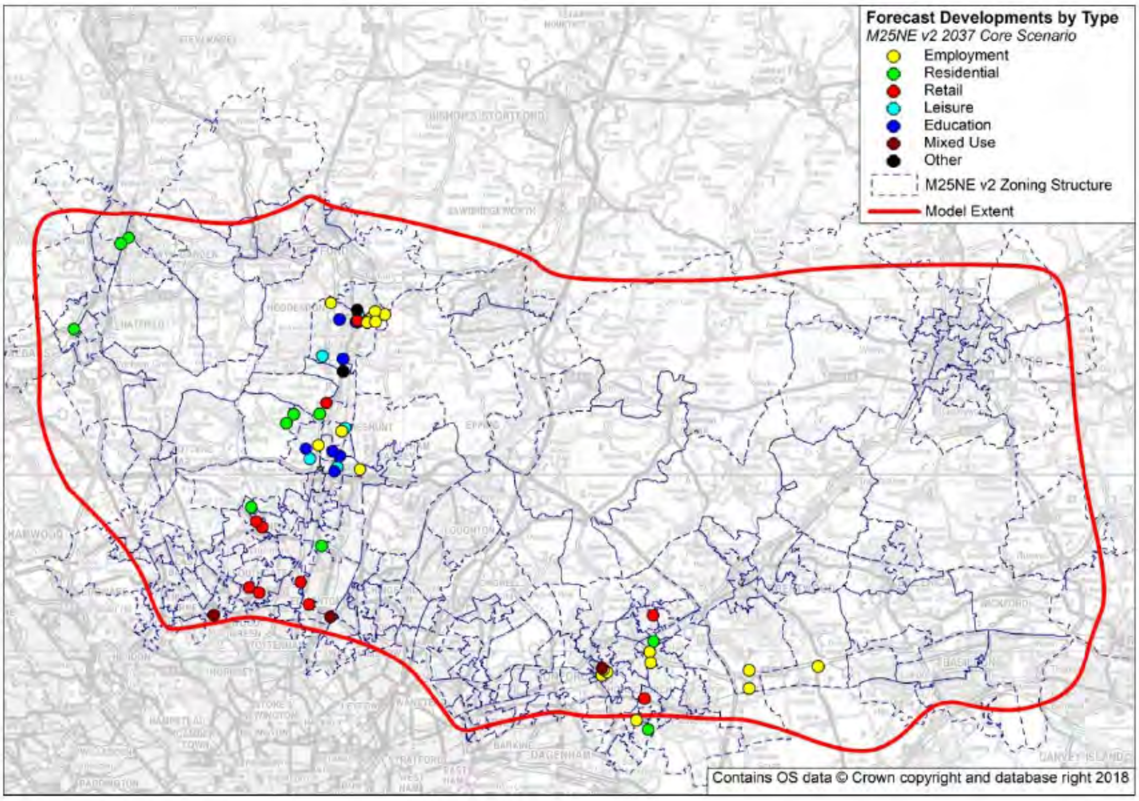
Probability of input	Status	Core scenario
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies Approved development proposals; or Projects under construction	This should form part of the core scenario
More than likely: The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent or Development application within the consent process.	This could form part of the core scenario
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty	Identified within a development plan Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented Development conditional upon the transport strategy/scheme proceeding or A committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.	These should be excluded from the core scenario but may form part of the alternative scenarios
Hypothetical: There is considerable uncertainty whether the outcome will ever happen	Conjecture based upon currently available information Discussed on a conceptual basis One of a number of possible inputs in an initial consultation process or A policy aspiration.	These should be excluded from the core scenario but may form part of the alternative scenarios

Forecast developments

5.3.5 The local developments included are shown in Figure 5-2. The trip generation for each site was extracted in origin / destination form from TRICS (v7.5.3) software. The growth was then "balanced" so the total production / attraction within each local county area matched NTEM 7.2 growth. Note that additional new zones were created for the larger developments.

5.3.6 In summary, after final refinement to include only those within the model area, there were 14 residential developments and a total of 52 employment developments for inclusion.

Figure 5-2 Forecast developments



5.3.7 Table 5-2 provides a summary of the total number of new residential dwellings and employment floorspace which are included across all developments for each of the local authorities. These figures are based on the 2037 core scenario forecasts.

Table 5-2: New dwellings and employment floorspace included in 2037

Authority	Dwellings	Employment (floorspace sqm)
Broxbourne	3,039	74,361
Enfield	12,266	44,470
Havering	922	42,581
Brentwood	0	71,760
Welwyn Hatfield	1,332	0
Sum	**17,559**	**233,172**

5.3.8 In addition to proposed development sites in the vicinity of the Scheme, TAG guidance recommends that growth should be in line with national forecasts within the study area. Predicted growth in the number of cars and other light vehicles is based on factors from the National Trip End Model version 7.2[13](NTEM) and Road Traffic Forecasts 2018 [14](RTF18). Both of these tools take into account forecast changes in employment and population in the UK. These are DfT produced datasets which are used universally on Highways England projects. Specific traffic growth for the LTC scheme was provided from the LTC Statutory

[13] National Trip End Model (NTEM) version 7.2 - https://data.gov.uk/dataset/11bc7aaf-ddf6-4133-a91d-84e6f20a663e/national-trip-end-model-ntem
[14] Road Traffic Forecasts 2018 - https://www.gov.uk/government/publications/road-traffic-forecasts-2018

Consultation version (Dec 2018) which was available at the time and included in the Scheme's forecast assessment.

Forecast schemes

5.3.9 The Do minimum is defined as the scenario without the Scheme against which the proposed Scheme is compared. Therefore, in this scenario the network at M25 junction 28 is identical to the present day.

5.3.10 The schemes in the uncertainty log were filtered to a list for inclusion in the M25NE model as outlined in section 5.3.4 above.

5.3.11 Schemes were further filtered to remove those which were either outside of the M25NE model area (as shown in Figure 5-2), involved a road which the M25NE model did not include or were existing schemes included in the base (pre-March 2015).

SERTM schemes

5.3.12 The SERTM reference case forecasting models include all known local authority and Highways England schemes, including RIS and Smart Motorway Programme (SMP) schemes. Analysis of this report showed that there were no SERTM schemes to be included within the M25NE modelled area.

5.3.13 The 2022 network is based on assumptions from the 2021 SERTM and the 2037 network assumes the same infrastructure as the 2041 SERTM.

LTC inclusion

5.3.14 The Scheme and the LTC project are of very different scale and scope, and as such two separate modelling frameworks have been developed to meet the specific design and appraisal requirements of each project. The models developed and used for the two projects are very different in extent and function.

5.3.15 The Lower Thames Area Model (LTAM) focus is on the performance of the wider highway network. The LTC project has developed the LTAM model, a large strategic model covering most of the south east of England region. Largely based on Highways England's SERTM and Transport for London's (TfL) Highway Assignment Model (HAM), the LTAM model has been developed to evaluate impacts of the LTC project across the local and strategic highway networks.

5.3.16 In comparison, the Scheme's model has a greater focus on the more local impacts and operational performance of M25 junction 28 and its proposed improvements. Comprising of a local M25 junction 28 operation model and a more strategic M25NE model, together the models are used to evaluate current and future conditions at junction 28 and the immediate surrounding road network.

5.3.17 While the two models have been developed for different purposes, a collaborative approach was adopted to ensure they were developed based a consistent set of data, standards and assumptions:

- Both models have been developed in line with the DfT TAG.
- To ensure consistency, the M25 junction 28 modelling uses the LTC LTAM matrices (from the Statutory Consultation version (Dec 2018) which was available at the time) as a basis for developing the M25 junction 28 demand forecasts.

- Both models consider the cumulative effects of the other project. The M25 junction 28 improvements project assumes LTC as a committed scheme, and hence the forecast flows include those for LTC. Similarly, the LTC project includes the M25 junction 28 Scheme.

5.3.18 Notwithstanding this, the two models are different. Therefore, some differences are expected in the modelled traffic levels and conditions forecast by the two TAG compliant models. It is reasonable that flow differences will exist, due to the bespoke model approaches that have been adopted in order to evaluate the respective schemes' impacts. However, it is important to note that these differences would not change the case for the Scheme.

All forecast schemes

5.3.19 The complete list of forecast schemes for inclusion in the Do minimum scenario are summarised in Table 5-3.

5.4. Forecast year network – Do something

5.4.1 The Do something scenario networks include all the Do minimum forecast schemes and additionally the Scheme as detailed in the Preliminary Design drawings consulted on at statutory consultation.

5.4.2 Traffic signal offsets and timings were optimised to balance delays and journey times for the signalised junctions on the intersection roundabout and off-slips.

5.5. Overview of localised model traffic forecasts

5.5.1 The operational modelling matrices were derived from the strategic modelling. A cordon was taken from the M25NE SATURN model, which covered the same area as the VISSIM model extent (presented in Section 3.2 of this Report) for the respective time periods and forecast years.

5.5.2 The forecast years utilised from the strategic model for the operational assessment are the opening year of 2022 and design year of 2037.

5.5.3 The Do minimum scenario includes signal optimisation at the M25 junction 28 roundabout. The optimised signals have been obtained for each forecast year and each time period from the LinSig model. Under a 2037 Do minimum scenario, a significant deterioration in traffic conditions is expected. Average delays could be 2 or 3 times that experienced in the base AM and PM peak hours, with total delay times across all movements increasing by similar levels. As a result, journey times on key movements will also increase, for instance the M25 South to A12 East movement could see increases of 10% to 20%.

5.6. Average journey times and delay

5.6.1 By 2037, traffic levels in the area are expected to increase by up to 22% by 2037, with more than 9,000 vehicles travelling through the roundabout every hour at peak times. Average delay due to congestion during peak travel times is predicted to increase by at least three times from over a minute per vehicle at present, to four minutes per vehicle in 2037 under 'Do minimum' conditions (that is, without the Scheme).

Table 5-3 Schemes included in the forecast models

Log ref	Name / description	2022N		2037L	
		DM	DS	DM	DS
-	M25 junction 28	×	✓	×	✓
-	M25 junction 25	✓		✓	
-	Lower Thames Crossing	×		✓	
312	A127 / A130 Fairglen Interchange	×		✓	
313	A127 / A132 Nevendon Interchange	✓		✓	
314	Chelmsford City Growth Package	✓		✓	
317	A414 Edinburgh Way / Cambridge Road Scheme	✓		✓	
319	New M11 junction 7a	✓		✓	
1490	A602 Ware to Stevenage Corridor Strategy	×		✓	
1614	New Link Road Halfhide Lane to A10 Roundabout (Greater Brookfield development)	✓		✓	
1653	A414 / Clocktower junction Capacity Upgrade	✓		✓	
1855	B183 Gilden Way Speed Reduction	×		✓	
1877	Mini-Holland	✓		✓	
5001	M25 J23 Improvements	✓		✓	
5005	Ware Bypass	×		✓	
5011	Meridian Water access plans	✓		✓	
5012	High Leigh Garden Village access	✓		✓	

5.6.2 The traffic modelling shows that without intervention, there will be further deterioration in traffic conditions at M25 junction 28 by 2037:

- Delays will be at over three times greater than currently experienced.
- Average speeds will be reduced by 25%.

5.6.3 The Scheme impacts from the VISSIM model results are detailed below with base, opening year (2022) and design year (2037) presented.

Opening year – 2022

5.6.4 The Do minimum scenario predicts an overall growth in traffic of 9.7%, 3.9% and 8.1% in AM, inter-peak (IP) and PM peaks respectively compared to the 2015 traffic flows.

5.6.5 The journey times for all movements at M25 junction 28 were compared between the Do minimum and Do something. These extend beyond the junction in order to capture any changes on the approach to or exit from M25 junction 28.

5.6.6 Table 5-4 shows the changes in journey times for each of these movements. Journey time changes due to the Scheme are summarised as follows:

- The majority of movements see an improvement in travel time.
- Journey time routes from the A12 west approach show the greatest reduction in travel time of up to three minutes.
- Travel time from the A12 west to Brook Street show an improvement of over two minutes in the AM peak.
- A12 east to M25 south travel time predicts an improvement of 30 seconds in the AM peak and 20 seconds in the PM peak.
- Travel time from the M25 south to A12 east (via new loop road) is predicted to increase by 14 seconds in the AM peak (from 493 seconds in the Do minimum scenario to 507 seconds in the Do something scenario). This is due to the longer distance which vehicles need to travel compared to the Do minimum scenario.
- The 2022 Do something PM peak model predicts an improvement of 18 seconds in travel times from the A12 east to M25 north.

5.6.7 The 2022 journey time results show an increase in journey times for traffic using Brook Street, when compared to the Do minimum scenario. The proposed Scheme eases congestion on the roundabout and, as a result, traffic will move faster and more smoothly, making it more difficult for traffic approaching the junction from Brook Street to enter the roundabout via the un-signalised give-way.

5.6.8 Further discussion on the Scheme impacts on Brook Street is included in section 5.8.

Table 5-4 Peak journey times (seconds), 2022 AM and PM

Movement	Base		DM		DS		Difference (DS-DM)	
	AM	PM	AM	PM	AM	PM	AM	PM
A12E – M25S	498	467	542	495	513	474	-29	-21
A12E – A12W	447	427	455	432	453	430	-2	-2
A12E – M25N	818	776	863	784	833	766	-30	-18
A12E – Brook St	543	515	588	556	567	543	-21	-13
A12W – M25N	673	652	780	650	670	641	-110	-9
A12W – A12E	435	449	479	453	443	459	-36	6
A12W – M25S	414	413	598	410	427	419	-171	9
A12W – Brook Street	482	483	667	497	498	504	-169	7
M25N – A12E	745	776	753	795	758	802	5	7
M25N – M25S	637	651	646	662	646	661	0	0
M25N – A12W	718	734	699	730	702	731	3	1
M25N – Brook Street	746	754	751	780	752	788	1	8
M25S – A12W	380	374	377	376	367	362	-10	-14
M25S – M25N	650	628	654	628	653	628	-1	0

Movement	Base		DM		DS		Difference (DS-DM)	
	AM	PM	AM	PM	AM	PM	AM	PM
M25S – A12E (via roundabout)	493	507	493	494	533	531	40	37
M25S – A12E (via loop)	-	-	-	-	507	514	-	-
M25S – Brook Street	494	498	502	498	527	519	25	20
Brook Street – M25S	592	522	1,155	958	1,405	1,056	250	98
Brook Street – A12E	770	709	1,438	1,140	1,796	1,223	358	83
Brook Street – M25N	935	838	1,510	1,236	1,734	1,330	224	94
Brook Street – A12W	637	559	1,200	978	1,427	1,082	227	104

5.6.9 Table 5-5 and Table 5-6 show the queue length comparisons for the AM and PM peaks between the 2015 Base, 2022 Do minimum and 2022 Do something scenarios. Modelled changes in queue lengths are summarised below:

- The Do something scenario predicts a reduction in queue lengths for the majority of approaches to M25 junction 28 in both the AM and PM peaks.
- In the AM peak, the greatest reduction in queue length is on the A12 eastbound off-slip, with a reduction of 335 metres.

5.6.10 In both the AM and PM peaks, there is an increase in queues on Brook Street of 14 metres and 36 metres respectively. Again, this is due to the improved traffic flow on the roundabout reducing the opportunity for traffic to enter the junction from Brook Street.

Table 5-5 Queue length summary (metres), 2022 AM

Junction	Approach	Base	DM	DS	Difference (DS-DM)
M25 junction 28	M25 North Off Slip (SB)	54	42	37	-5
	A12 East Off Slip (WB)	103	188	116	-73
	Brook Street (WB)	336	537	551	14
	M25 South Off Slip (NB)	57	62	41	-22
	A12 West Off Slip (EB)	41	396	61	-335
	M25 Jn 28 Gyratory Section (N)	86	105	61	-44
	M25 Jn 28 Gyratory Section (E)	29	57	79	22
	M25 Jn 28 Gyratory Section (S)	50	69	53	-16
	M25 Jn 28 Gyratory Section (W)	96	126	77	-49

Table 5-6 Queue length summary (metres), 2022 PM

Junction	Approach	Base	DM	DS	Difference (DS-DM)
M25 junction 28	M25 North Off Slip (SB)	66	55	54	-2
	A12 East Off Slip (WB)	76	128	93	-34
	Brook Street (WB)	266	512	548	36
	M25 South Off Slip (NB)	68	73	47	-27
	A12 West Off Slip (EB)	44	54	51	-4
	M25 Jn 28 Gyratory Section (N)	114	56	53	-3
	M25 Jn 28 Gyratory Section (E)	37	50	96	47
	M25 Jn 28 Gyratory Section (S)	57	71	59	-12
	M25 Jn 28 Gyratory Section (W)	119	113	76	-37

Design year – 2037

5.6.11 Table 5-7 shows the change in journey time for each movement in the 2037 AM and PM peak scenarios. The journey time modelling results are summarised as follows:

- Journey time routes from the A12 west approach show the greatest reduction in travel time of up to 16 minutes in the AM peak.
- M25 south to A12 west travel time is predicted to improve by more than a minute in the AM peak and about 7 minutes in the PM peak.
- M25 south to A12 east travel time is predicted to improve by around 5 minutes in the PM peak.
- In the PM peak Do something, model predicts improvements in travel times of around 80 seconds from the A12 east and M25 south.
- Travel times from Brook Street approach are predicted increase by around 9 minutes in the AM peak and about 4 minutes in the PM peak compared to the Do minimum scenario.

Table 5-7 Peak journey times (seconds) 2037 AM and PM

Movement	Base		DM		DS		Difference (DS-DM)	
	AM	PM	AM	PM	AM	PM	AM	PM
A12E – M25S	498	467	777	737	797	653	20	-84
A12E – A12W	447	427	611	578	646	502	35	-76
A12E – M25N	818	776	1,120	1,015	1,111	940	-9	-75
A12E – Brook St	543	515	831	813	895	755	64	-58
A12W – M25N	673	652	1,588	687	799	675	-789	-12
A12W – A12E	435	449	1,194	456	463	466	-731	10

Movement	Base		DM		DS		Difference (DS-DM)	
	AM	PM	AM	PM	AM	PM	AM	PM
A12W – M25S	414	413	1,509	464	555	458	-954	-6
A12W – Brook Street	482	483	1,550	578	668	597	-882	19
M25N – A12E	745	776	769	804	779	831	10	27
M25N – M25S	637	651	664	675	664	678	0	3
M25N – A12W	718	734	717	738	744	813	27	75
M25N – Brook Street	746	754	776	827	854	928	78	101
M25S – A12W	380	374	443	798	375	373	-68	-425
M25S – M25N	650	628	692	884	682	648	-10	-236
M25S – A12E (via roundabout)	493	507	557	876	561	565	4	-311
M25S – A12E (via loop)	-	-	-	-	519	527	-	-
M25S – Brook Street	494	498	591	954	604	616	13	-338
Brook Street – M25S	592	522	1,582	1,408	2,125	1,605	543	197
Brook Street – A12E	770	709	1,907	1,643	2,432	1,896	525	253
Brook Street – M25N	935	838	1,983	1,723	2,515	1,919	532	196
Brook Street – A12W	637	559	1,614	1,456	2,136	1,661	522	205

5.6.1 Table 5-8 and Table 5-9 show the queue length comparison for the AM and PM peak hours between the 2015 Base, 2037 Do minimum and 2037 Do something scenarios. The queue length results are summarised as follows:

- The greatest reduction in queue lengths in the AM peak was on the A12 eastbound off-slip, with a reduction of 1,796 metres.
- The M25 northbound off-slip also has a significant reduction in queue length of 362 metres in the AM peak and 1,525 metres in the PM peak.
- There is a reduction in queue length of 231 metres on the A12 westbound off-slip in the PM peak.
- The model predicts an increase of 169 metres on the M25 southbound off-slip in the PM peak. This is due to the alteration of signal timings in the Do something scenario to clear the northern circulatory.

Table 5-8 Queue length summary (metres), 2037 AM

Junction	Approach	Base	DM	DS	Difference (DS-DM)
M25 junction 28	M25 North Off Slip (SB)	54	49	81	33
	A12 East Off Slip (WB)	103	937	1,003	66
	Brook Street (WB)	336	628	630	2
	M25 South Off Slip (NB)	57	413	51	-362
	A12 West Off Slip (EB)	41	2,163	367	-1,796
	M25 Jn 28 Gyratory Section (N)	86	119	84	-34
	M25 Jn 28 Gyratory Section (E)	29	59	102	43
	M25 Jn 28 Gyratory Section (S)	50	74	59	-15
	M25 Jn 28 Gyratory Section (W)	96	138	92	-46

Table 5-9 Queue length summary (metres), 2037 PM

Junction	Approach	Base	DM	DS	Diff (DS-DM)
M25 junction 28	M25 North Off Slip (SB)	66	55	224	169
	A12 East Off Slip (WB)	76	815	584	-231
	Brook Street (WB)	266	617	621	4
	M25 South Off Slip (NB)	68	1,588	62	-1,525
	A12 West Off Slip (EB)	44	138	97	-41
	M25 Jn 28 Gyratory Section (N)	114	90	81	-9
	M25 Jn 28 Gyratory Section (E)	37	58	120	61
	M25 Jn 28 Gyratory Section (S)	57	60	58	-2
	M25 Jn 28 Gyratory Section (W)	119	129	93	-36

5.7. Scheme impact on queues and journey times

5.7.1 The impact of the change in traffic flows on key routes within the study area (as presented in Figures 3-8 and 3-9) has been considered, through comparison of the Do minimum and Do something scenarios for both the opening year (2022) and design year of assessment (2037).

5.7.2 The benefits of the Scheme include the improved performance of the roundabout, reduced queuing on the slip-roads approaching the roundabout, as well as reducing the risk of traffic queuing back on to the M25 mainline carriageway and A12.

2022

5.7.3 The introduction of the Scheme increases traffic flows using the junction, decreases the delay for most of the approaches to the roundabout and has a positive impact on nearly all the movements at the junction in all time periods in 2022. The most notable improvement occurs for the traffic completing the A12 West to M25 South route, with journey times reducing up to three minutes.

2037

5.7.4 The introduction of the Scheme increases traffic flows using the junction, decreases the delay for most of the approaches to the roundabout and has a positive impact on nearly all the movements at the junction in all time periods in 2037. The most notable improvement occurs for the traffic completing the A12 West to M25 South, with journey times reducing by up to 16 minutes.

5.8. Scheme impact on Brook Street

Westbound (towards M25 junction 28)

5.8.1 At present motorists experience congestion on Brook Street when travelling towards the M25 junction 28 during the peak hours. The traffic modelling predicts that further delays are expected for traffic using Brook Street in the future scenarios.

5.8.2 By 2037, under a Do minimum situation average delays are expected to increase by around 50 seconds relative to the base year in the AM (+35%) and PM (+53%) peak hours. In 2037 with the Scheme in place, the traffic modelling assessment highlights an increase in delays of 42 seconds (+22%) in the AM peak hour for westbound traffic approaching the junction from Brook Street, and 25 seconds (+17%) in the PM peak (Table 5-10). This is largely due to the improved traffic conditions on the M25 junction 28 roundabout with traffic moving more smoothly and slightly faster. As such, there is less opportunity for traffic from Brook Street to find gaps in traffic to enter the roundabout.

Table 5-10 Delays on Brook Street westbound towards M25 junction 28, 2037

Evaluation parameters	AM peak			PM peak		
	Base	DM	DS	Base	DM	DS
Average delays (secs)	140	188	230	94	144	169
Queue Length (m)	336	628	630	266	617	621

5.8.3 The Scheme will include additional measures to mitigate the above impact of the Scheme on the Brook Street westbound traffic. Specifically an adjustment to the signal phasing is proposed (for example, a short extended inter-green / all red at the traffic signals A12 westbound off-slip). The assessment of the impacts of this mitigation measure has been carried out for the worst case scenario, that being the 2037 forecast year peak hours.

5.8.4 The assessment of this mitigation shows a decrease in delay on the Brook Street westbound approach to junction 28 by around 70 seconds in the AM peak, and by around 60 seconds in the PM peak (Table 5-11).

5.8.5 Similarly, the length of the traffic queues on the Brook Street westbound approach are expected to reduce by around 30 metres in the AM peak hour relative to the Scheme scenario without the mitigation. The PM peak shows a significant reduction in traffic queues of around 150 metres (Table 5-11).

5.8.6 The Brook Street westbound mitigation is proposed to be delivered as part of the Scheme and it will be developed further in the subsequent detailed design stage. With this mitigation, the delays with the Scheme in place are expected to be less than those predicted for the Do minimum in both the AM and PM peaks. The mitigation will benefit Brook Street westbound traffic, albeit at a slight expense of the other movements at these signals. However, the adjustment of the signal timings (extended inter green) is expected to be only 2 or 3 seconds for each cycle of the signals. Therefore, it is expected that the impact of this mitigation on the economic case for the Scheme will be marginal.

Table 5-11 2037 Assessment of Brook Street westbound mitigation proposals

Evaluation parameters	AM peak			PM peak		
	DM	DS without mitigation	DS with mitigation	DM	DS without mitigation	DS with mitigation
Average delays (secs)	188	230	157	144	169	111
Queue Length (m)	628	630	603	617	621	467

Eastbound (towards Brentwood)

5.8.7 Traffic queuing back in the Brook Street eastbound direction has been observed at M25 junction 28. This situation will be deteriorated further with delays predicted to increase by 8 seconds (30%) and almost double (100%) in the AM and PM peaks respectively.

5.8.8 With the Scheme in place, the traffic flow arrival pattern on the A1023 Brook Street eastbound will be different compared to the Do minimum scenario. This is mainly due to reduced delay at the M25 junction 28.

5.8.9 Brook Street eastbound average delays are predicted to increase by around 20 seconds (65%) at the Nags Head Lane junction in the 2037 AM peak and remains similar in the 2037 PM peak (see Table 5-12). Similarly, at the Mascalls Lane junction, delays in the eastbound direction are predicted to increase by around 15 seconds (53%) in the 2037 AM peak and by 4 seconds (12%) in the 2037 PM peak.

5.8.10 To mitigate the increase in delays in the eastbound direction, signal timings at the Nags Head Lane and Mascalls Lane junctions have been optimised. These measures form part of the Scheme and will be developed in detail during the subsequent stage.

5.8.11 Results for the eastbound mitigation shows a decrease in an average delay of 26 seconds in the AM peak at both Nags Head Lane and Mascalls Lane junctions. Delays are predicted to reduce marginally at Nags Head Lane junction in the PM peak by 20 seconds at Mascalls Lane junction (Table 5-13) compared to the Do something scenario.

Table 5-12 Delays on Brook Street eastbound towards Nags Head Lane, 2037

Evaluation parameters	AM peak			PM peak		
	Base	DM	DS	Base	DM	DS
Average delays – Nags Head Lane (secs)	26	34	56	23	47	48
Queue Length – Nags Head Lane (m)	71	164	437	73	424	475
Average delays – Mascalls Lane (secs)	26	30	46	24	34	38
Queue Length – Mascalls Lane (m)	108	130	220	81	117	140

Table 5-13 2037 Brook Street eastbound mitigation assessment

Evaluation parameters	AM peak			PM peak		
	DM	DS	DS with mitigation	DM	DS	DS with mitigation
Average delays – Nags Head Lane (secs)	34	56	30	47	48	47
Queue Length – Nags Head Lane (m)	164	437	151	424	475	467
Average delays – Mascalls Lane (secs)	30	46	23	34	38	18
Queue Length – Mascalls Lane (m)	130	220	87	117	140	61

6. Road safety

6.1. Accidents at M25 junction 28

6.1.1 In recent years there has been a high occurrence of slight injury and damage only accidents on the M25 junction 28 roundabout. Often when an accident, or an incident such as a breakdown, occurs there will be considerable additional delays and disruption to traffic conditions along the M25, A12 and other local roads.

6.1.2 Current accident records show that 27 injury accidents were reported on the junction 28 roundabout roads over the five-year period to December 2017 (Table 6-1). This figure does not include 'damage only' collisions which are often unreported. The 27 accidents have resulted in 36 casualties of which 33 were slight injuries (90%) and three serious over the five years.

6.1.3 The number of killed and serious injury (KSIs) incidents is low with less than one KSI each year. As well as harm and injury, a key concern arising from the frequency of these incidents on junction 28, together with the unreported damage only events, relates to the traffic disruption they cause across the wider highway.

6.1.4 In addition, damage-only incidents would not have been recorded in the collision data but can cause disruption across the wider highway network.

6.1.5 Without the Scheme, traffic conditions will deteriorate further with queues from the M25 south off-slip blocking back to the mainline of the M25. This will bring significant safety and operational issues with queues on the main M25 carriageway.

Table 6-1 Collision and casualties for roundabout

Roundabout	Fatal	Serious	Slight	Total
Collisions	0	3	24	27
Casualties	0	3	33	36
Measure				
FWI	0.63			

6.2. Other accidents in vicinity of M25 junction 28

6.2.1 In the vicinity of the M25 junction 28 (assuming the extent of the SRN within the Scheme's red line boundary), there have been 97 vehicle collisions resulting in an injury on the SRN including the M25, A12, the junction 28 roundabout and the slip roads at junction 28 (Table 6-2). Figure 6-1 shows the location of these collisions by severity.

6.2.2 Of these, there have been 12 collisions reported on the M25 and A12 slips roads, which have predominantly been slight injury.

6.2.3 Table 6-2 also shows a breakdown of the collisions by location, visibility and road surface.

6.2.4 The highest percentage of collisions occurred along the M25 (in both directions) closely followed by the roundabout with nearly 60% of all collisions in the study area occurring at these two locations. Over one quarter of the collisions in the

Scheme area occurred at the roundabout. Half of the collisions along the M25 occurred during the hours of darkness.

Figure 6-1 Collision data for M25 junction 28

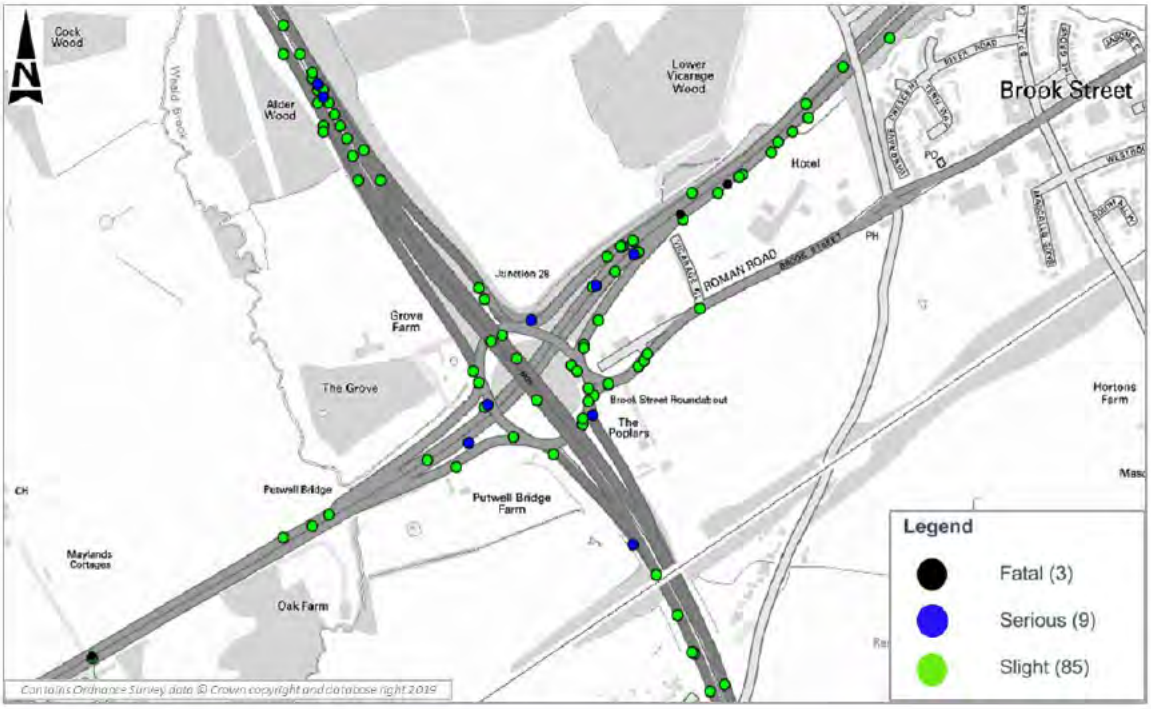


Table 6-2 Collisions by location

Location	No collisions	% KSI	% Dark	% Wet
M25	30 (30.9%)	10%	50%	10%
Roundabout	**27 (27.8%)**	**11.1%**	**37.0%**	**18.5%**
A12	24 (24.7%)	16.7%	45.8%	37.5%
M25 slip roads	6 (6.2%)	16.7%	83.3%	33.3%
A12 slip roads	6 (6.2%)	16.7%	11%	16%
Other	4 (4.1%)	0%	0%	0%
Total	**97**	-	-	-

6.2.5 As can be seen in Figure 6-1, a large proportion of accidents have taken place at the point where the A1023 Brook Street approaches the roundabout. The Scheme aims to reduce queueing and tail backs onto the M25 carriageway and the subsequent collisions on the M25 and slips roads, in addition to those collisions occurring at the roundabout.

6.2.6 Table 6-3 shows the types of collisions occurring at each location.

Table 6-3 Collision types

Location	% Shunts	% Changing lanes	% Loss of control	% Unknown	% Other
M25	30%	50%	10%	3%	7%
Roundabout	51.9%	0%	3.7%	22.2%	22.2%
A12	50%	8.3%	33.3%	4.2%	4.2%

Location	% Shunts	% Changing lanes	% Loss of control	% Unknown	% Other
M25 slip roads	67%	17%	17%	0	0
A12 slip roads	50%	33%	17%	0	0

6.2.7 The most common collision type along the A12 and its slip roads were nose-to-tail collisions – 'shunts'. Along the M25 the most common collision type was changing lanes and on the slip roads one third of the collisions were nose-to-tail collisions. At the roundabout, over half of the collisions were nose-to-tail collisions.

6.2.8 Casualty and collision rates for the scheme extents are shown in Table 6-4Table 6-4, together with fatality and weighted injury (FWI) rates.

Table 6-4 Collision and casualty rates for scheme extents

Within scheme extent	Fatal	Serious	Slight	Total
Collisions	3	9	85	97
Casualties	3	9	119	131
Measure				
FWI	5.09			

6.3. Expected collision changes resulting from the Scheme

6.3.1 The Scheme is designed to result in a reduction of accidents through introducing several operational improvements and reducing congestion at M25 junction 28.

6.3.2 COBA-LT analysis has been undertaken to capture the accident impacts of the Scheme. The economic assessment of the Scheme is outlined in the Case for the Scheme (application document TR010029/APP/7.1). For this, the appraisal period has been set at 60 years. A summary of the accident and casualty savings are provided in Tables 6-5 and 6-6.

6.3.3 The results of the COBA-LT analysis in Table 6-5 and 6-6 show that approximately 63 accidents and 88 casualties can be saved by the Scheme over the 60-year analysis.

6.3.4 Total accident benefits generated by the Scheme over the 60-year assessment period amount to £2.34million (Table 6-7).

6.3.5 Further, as noted above, there are currently a number of damage-only collisions that occur at M25 junction 28 that are not recorded in STATS-19 data that cause significant congestion and delay at the junction and surrounding road network. Therefore, the Scheme will provide benefits greater than those calculated in the COBA-LT analysis.

Table 6-5 COBA-LT M25 junction 28 accidents – 60-year appraisal

	Total accidents	
	Do minimum	Do something
	22559.60	22496.90

	Total accidents	
	Do minimum	Do something
Total Accidents Saved by Scheme	62.70	

Table 6-6 COBA-LT M25 junction 28 casualties – 60-year appraisal

Severity	Total number of casualties		Number of casualties saved
	Do minimum	Do something	
Fatal	317	316.5	0.5
Serious	2930.4	2926.2	4.2
Slight	28,842.4	28,759.4	83.0
Total	**32,089.8**	**32,002.1**	**87.7**

Table 6-7 Accident benefits - summary

Scenario	Accident cost (£m)		Accident benefits saved by scheme (£m)
	Without scheme	Do something	
Core scenario	£1,046.08m	£1,043.74m	£2.34m

6.4. Road safety audit

6.4.1 This section is informed by the Stage 1 Road safety audit (RSA) and associated Audit Response for M25 junction 28 scheme. The full audit is included in **Appendix C**.

6.4.2 Table 6-8 provides the safety audit comments alongside the Audit response to the concerns highlighted. The results of the RSA will inform design changes and improvements to the Scheme where applicable as it progresses through detailed design.

Table 6-8 Road safety audit decision log

RSA issue	RSA recommendation	Audit response
PROBLEM 1 **Location** A12 Eastbound **Summary** Location of proposed maintenance access increases risk of shunt or lane change collisions. The proposed maintenance access is immediately adjacent to an existing retained access for the golf course. Drivers in Lane 1 will not be expecting a vehicle to be slowing to use either access due to the presence of a lane drop arrangement. Two junctions/accesses close together could increase the risk of shunt or lane change collisions.	Combine the two connections to reduce the risk of driver confusion.	**Disagree.** The access will be subject to infrequent use during periodic maintenance of the attenuation ponds and CCTV cameras and will therefore pose a negligible risk to other drivers. All vehicles using the maintenance access will have Chapter 8 compliant livery The golf course owners, users and private residents are likely to raise significant objections to the use of their private means of access by maintenance vehicles. Furthermore, there is a risk that vehicles using the golf course access may be hindered from exiting the A12 by maintenance vehicles turning right onto the access track. A GG104 safety risk assessment has been carried out.
PROBLEM 2 **Location** A12 Eastbound **Summary** Discontinuous footway increases risk of pedestrian being struck by a vehicle. The existing footway adjacent to the eastbound carriageway will be rerouted along the new slip road alignment. The improved facility will likely attract users and link them to the northside of the circulatory. At this point, with no facility to cross the north side of the roundabout they will be forced to cross to the south side using an uncontrolled crossing. This increases the chance of them being struck by a vehicle.	Provide a signalised crossing on the A12 Eastbound slip road at the circulatory. Alternatively, discontinue the route adjacent to the eastbound carriageway and encourage non-vehicular traffic to use the facility on the westbound verge. Provide further road markings and traffic signs prior to the overbridge.	**Disagree.** The new footway will be re-routed to follow the new slip road alignment. Although it is being re-routed, it is not being changed from the current. A GG104 safety risk assessment has been undertaken. The scope of this scheme allows for 'like for like' reinstatement of pedestrian facilities, that is maintaining the status quo. Improvements to pedestrian facilities are beyond the scope of the current scheme and therefore none have been incorporated. However, improvements to the pedestrian facilities are currently being investigated as a 'designated funds' scheme.

RSA issue	RSA recommendation	Audit response
PROBLEM 3 **Location** Link road to A12 Eastbound. **Summary** Location of lane drop increases risk of side swipe collisions. The transition from 2 lanes on the slip road to one lane occurs at the approximate location of the Maylands Bridge. The reduction in forward visibility and proximity to the merge with the A12 may result in drivers not expecting the lane reduction. This could increase the risk of side swipe type collisions.	Provide further road markings and traffic signs prior to the overbridge	**Agree.** It is proposed that this recommendation is implemented in the detailed design stage.
PROBLEM 4 **Location** A12 Eastbound slip road to J28 **Summary** Unclear road markings increase risk of side swipe collisions. The slip road widens to three lanes at the circulatory, but the road markings appear to indicate that the nearside lane is a hard shoulder. This could result in vehicles using this area for comfort stops or driver indecision and side swipe collisions.	Provide road markings in accordance with TSM Chapter 5.	**Agree.** The drawing has been amended to remove the ambiguity, see revised drawing in RSA Report Appendix C
PROBLEM 5 **Location.** Link road merge with A12 Eastbound. **Summary** Location of proposed maintenance lay-by increases risk of shunt or lane change collision. A maintenance lay-by is provided adjacent to the join from the link road to the A12 and very close to where the lane provision reduces from two to one. Drivers approaching this location are unlikely to be expecting a maintenance vehicle to be entering or leaving the facility, especially if it is travelling along the A12 in Lane 2. This could result in lane changing, shunt or loss of control collisions.	Remove this facility and provide a route for maintainers from the facility proposed on the circulatory.	**Disagree.** The maintenance layby in question is located at the back of the proposed hard shoulder meaning any maintenance vehicles manoeuvring in or out of the layby can do so without entering or exiting a live trafficked lane. A GG104 safety risk assessment has been undertaken.
PROBLEM 6 **Location**	Build out the kerb line on the offside of the slip road, at least in proximity to the signalised crossing.	**Agree.** It is proposed that this recommendation is implemented in the detailed design stage.

RSA issue	RSA recommendation	Audit response
M25 AC Exit slip. **Summary** Extent of hatching increases risk of a collision and poses potential hazard to road users. The existing slip road will be remarked with the offside lane hatched to account for the majority of A12 Eastbound traffic continuing on the M25. Users of the existing signalised crossing could be tempted to wait in this hatched area increasing the risk of them being struck. This area will collect debris and detritus which could pose a hazard to vehicles pulling into the area.		
PROBLEM 7 **Location** M25 Exit to link road. **Summary** Horizontal alignment encourages faster speeds and increases the risk of loss of control type collisions. Drivers exiting the M25 anti-clockwise (ACW) to join the link road are provided with a near straight with both lanes then entering a left-hand bend, this appears to be a radius similar to that provided for a link road. However, as it is incomplete it is unlikely to provide the benefits in reducing road users' speeds. Whilst all of the radii provided on the link road comply with the minimum requirements of CD 122 the radii vary a number of times and as such the link road will not function as a loop as illustrated in the standard. Drivers exiting a motorway do not typically encounter this type of layout and they may attempt to continue to travel at speed and/or overtake vehicles on the link road. The bridge and alignment on the approach to the bend may 'hide' the alignment ahead, resulting is road users not reducing their speeds appropriately. Although not shown on the traffic sign drawings provided, it will be necessary for a terminal sign for the variable speed limit to be provided at the entry to the new slip road. These traffic signs typically include the national speed limit symbol (NSL). This messaging, combined with overhead signalling, which will also include the NSL when VSL is active, will encourage drivers to accelerate into the slip road. These traffic signs would make the proposed advisory traffic signing less effective. The above issues may lead to inappropriate speeds leading to loss of	Provide a continuous loop that aligns with Figure 5.10N of CD 122. Alternatively, if this is not possible: Relocate the start of the 50mph speed limit to the exit from the M25 ACW. Hatch the 2nd lane until traffic demand increases sufficiently. Provide VRS in accordance with TD19/06 and provide running rails to reduce the risk to motorcyclists.	**Disagree.** The loop road geometry complies with the guidance given in TD22 (now CD122). In particular, during the detailed assessment of the design in Stage 3, it is noted that the standards guide us to providing two lanes on an interchange link (and loop roads) which exceed 1km in length (TD 22/06 paragraph 4.3). Hence, we would not design this with one lane at the bend. The potential problem of drivers approaching the loop road at high speed is a factor on all loop road designs, however the evidence cited in the design standards (Designed to TD22 although now replaced with CD122) is that using limiting radii is not a significant risk provided appropriate mitigation measures are taken. Regard for appropriate mitigation of the safety issues has been taken as follows. the auditor's recommendation that 50mph speed limit is imposed from the back of the nosing of the loop road diverge from the M25 anticlockwise has been adopted

RSA issue	RSA recommendation	Audit response
control and single vehicle collisions.		the auditor's recommendation that provision of a vehicle restraint system (VRS) has been adopted 1) other safety mitigation measures have been adopted in the design, including: a) widened lanes of 4m rather than the standard 3.65m b) provision of bend warning signs with 'Reduce Speed Now' sub-plates plus chevron signs and road markings c) high friction road surfacing (high PSV surfacing) d) road lighting e) motorcycle barriers will also be provided in the next design stage f) a super-elevation of 7% has been provided on the 75m radius A GG104 safety risk assessment has also been undertaken. This layout has been discussed and agreed with Ops TLG.
PROBLEM 8 **Location** Link road join with A12. **Summary** Location of speed limit change increases the risk of shunt type collisions. The speed limit plans provided show that drivers exiting the link road and joining the A12 eastbound will be subject to a reduction in speed limit at the back of the nose. Given that drivers will be: • Joining a straight section following the link road which has a design speed of approx. 50mph; • Provided with a generous auxiliary lane merge; • Will be able to see that the reduced speed section of carriageway is short;	Relocate the start of the 50mph speed limit to the exit from the M25 ACW.	**Agree.** It is proposed that the 50mph speed limit will start at the back of the M25 anticlockwise diverge nosing.

RSA issue	RSA recommendation	Audit response
It is likely that drivers will accelerate into the merge beyond the speed limit. These features increase the risk of speed differentials at the merge resulting in lane changing and shunt type collisions. It is also noted that the traffic signing drawings provided do not show a 50mph plate for vehicles exiting the link road but do include the NSL plate downstream. This could further increase the likelihood of speed differentials.		
PROBLEM 9 **Location** Link road. **Summary** Location of maintenance access increases risk of side swipe collisions. The maintenance access to pond 1 is on the inside of the left-hand bend. Upstream drivers may not be expecting maintenance vehicles to be entering or leaving the hard shoulder on this bend and this could result in side swipe collisions due to avoiding manoeuvres.	Provide access to pond 1 from the CCTV turning head or from the access track to pond 2.	**Disagree.** The access will be subject to infrequent use during periodic maintenance of the attenuation pond and will therefore pose a negligible risk to other drivers. Whilst the Ops TLG group raised questions about the loop road design, no concerns were raised about this proposed maintenance access. A GG104 safety risk assessment has been undertaken.
PROBLEM 10 **Location.** A12 EB on-slip from J28. **Summary.** Unclear layout increases risk of side swipe or loss of control collisions. The layout for drivers in the offside lane of the entry slip from the J28 circulatory is unclear. It is not clear whether drivers in lane 1 of the A12 or the offside lane have priority. This could result in side swipe or loss of control collisions.	Provide a clear and intuitive layout.	**Agree.** The road layout at this entry slip merge was shown incorrectly on the drawing. At the merge, the A12 is proposed to be a dual 2 lane carriageway with conventional priority. Lane 2 of the eastbound A12 on-slip from Brook Street Roundabout will 'give way' and merge with the A12. Lane 1 of the entry slip will tie-in to the existing auxiliary lane.
PROBLEM 11 **Location** Throughout **Summary** Unlawful parking increases the risk of a number of collisions types. The current proposals include large sections of hatching on both the A12 Eastbound and M25 slip roads. During the site visit it was noted that	Undertake a Safety Risk Assessment to determine the appropriate measures to reduce this risk.	**Agree.** A GG104 safety risk assessment has been undertaken to assess the risk of potential unlawful parking within proposed hatched areas. A new clearway creation along the A12 has been included in the DCO.

RSA issue	RSA recommendation	Audit response
there are some unlawful parking issues at adjacent junctions. Should these issues spread to Junction 28 a number of collision types could occur due to the unexpected presence and manoeuvring of large vehicles into and out of these areas.		
PROBLEM 12 **Location** Throughout **Summary** Location of lighting columns increases potential severity of a loss of control type collision. Lighting columns are consistently provided on the outside of bends increasing the risk of them being struck in a collision. This position could increase the severity of a loss of control collision. This is of particular concern on the link road. Columns located on the offside are also more difficult to maintain than those on the nearside, requiring lane closures, meaning longer periods where lighting is inoperable.	Undertake a Safety Risk Assessment to determine the appropriate measures to reduce this risk.	**Disagree.** The designer's lighting specialists have advised that using street lighting as a form of visual guidance to approaching geometry is considered standard practice on bends and is therefore proposed at this location. A GG104 safety risk assessment has been undertaken.

7. Sustainable transport

7.1. Introduction

7.1.1 An objective of the Scheme is to “Protect access for non-motorised users (pedestrians and cyclists) and improve conditions wherever possible.”

7.1.2 As part of the Highways England Delivery Plan (2015 – 2020) a key feature within the key performance indicators (KPIs) is associated with the consideration of vulnerable road users (VRUs) and the incorporation of measures in a scheme that enables them to continue to use the network as in the current situation.

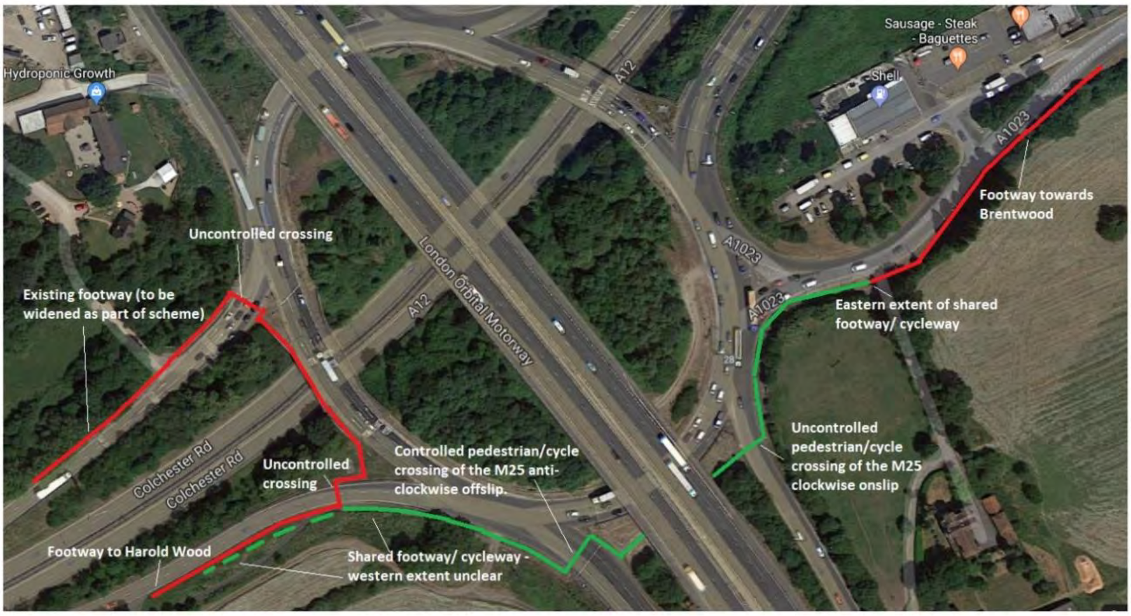
7.2. Overview of existing conditions

Walking and cycling network

7.2.1 A network of non-motorised user (NMU) infrastructure exists around the southern side of the M25 junction 28 allowing movement of pedestrians and cyclists on an east-west axis across the M25 junction 28.

7.2.2 The existing cycling and walking facilities at the M25 junction 28 are shown in Figure 7-1. The red lines in the figure represent footways and the green lines are shared footway / cycleways.

Figure 7-1 Existing NMU routes at junction 28



<u>National cycle network 136</u>

7.2.3 The national cycle network (NCN) 136 is a mostly traffic-free route starting at the village of Noak Hill to the north of the A12, then passing through Dagnam Park, crossing the A12 via a pedestrian and cycle subway, continuing south through Harold Wood Park to Upminster, then ending in Rainham. People cycling from Brentwood, or other areas east of M25 junction 28 have to cross the M25 junction 28 to access the NCN 136.

Eastern section (on A1023 Brook Street between M25 junction 28 and Brentwood centre)

7.2.4 Immediately east of the M25 junction 28 interchange, the A1023 has a shared-use path (SUP) on the south side, which continues to the southern side of the roundabout using an uncontrolled crossing of the M25 southbound on-slip.

7.2.5 Further east of M25 junction 28, the SUP alongside the A1023 becomes a footway, which ends at the bus stop located opposite the junction with Vicarage Close. The footway starts again further east at Nag’s Head Lane.

7.2.6 On the north side of the A1023, a footway starts immediately east of the M25 junction 28 roundabout. This footway runs up to the Shell filling station and continues to Brentwood town centre. Residential side roads that abut the A1023 are uncontrolled crossings.

Western section (NCN 136 – M25 junction 28)

7.2.7 On the north side of the A12, west of the M25 junction 28, a footway provides access to the M25 junction 28 roundabout via a controlled crossing of the A12 eastbound off slip and an uncontrolled crossing of the A12 westbound on slip road. This footway continues west from M25 junction 28 until it becomes a shared-use path near the intersection of Kenilworth Avenue and the A12.

7.2.8 The south side of the A12 has a SUP that continues west towards Harold Wood, ending at Maylands Way and then restarting at Harold Court Road and continuing west. Just west of Harold Court Road there is a grade-separated crossing (subway) of the A12 for pedestrians and cyclists linking to NCN 136.

7.2.9 The SUPs and footways on the A12 and A1023 corridors are connected via a SUP that passes through the M25 junction 28 roundabout, via an uncontrolled crossing of the M25 clockwise on-slip road, and a controlled crossing of the M25 anticlockwise off slip road.

7.3. Public transport

7.3.1 There are two Transport for London (TfL)bus services that serve the area via M25 junction 28 and the A1023 Brook Street.

7.3.2 The closest bus stops to M25 junction 28 are located on the A1023 approach around 300m to the east of the roundabout. These bus stops serve route 498 between Romford and Brentwood.

7.3.3 There is also a bus stop on the A12 immediately west of the westbound on-slip from M25 junction 28. This stop serves route 608 between Gallows Corners and Shenfield High School.

7.3.4 The above public transport facilities will be retained with the Scheme in place.

7.4. New provision and enhancement

7.4.1 As demonstrated above, the area in the vicinity of the Scheme is served by a number of footways, crossing and shared use paths, which would be traversed or impacted to some extent by the route option. The Scheme will protect the existing NMU routes through the junction, both through the construction and operational phases.

7.4.2 The Scheme requires the demolition and re-construction of a footway adjacent to the A12 east bound off-slip. The new footpath will take a similar form to the existing footway, in that it will run alongside the northern kerb of the new realigned A12 eastbound off slip road. However, the reconstructed facility will be improved through widening of the footway as compared to the existing footway.

8. Construction impacts

8.1.1 This section sets out the proposals for construction phasing and provides an estimate of construction traffic by phase. Construction of the works will be supported by a Traffic Management Plan, as stated in Requirement 10 of the draft DCO (application document TR010029/APP/3.1), that will set out proposed traffic management measures including details on construction compounds, carriageway and slip lane closures and traffic diversion routes.

8.2. Haul roads and traffic management

8.2.1 Haul roads are required within the works area to construct the Scheme and these are all located within the Grove Farm and Glebelands Estate land. One haul road would be required from the main construction compound to the main loop road construction site and one haul road would be required to run along the outside (western side) of the loop road.

8.2.2 The areas that would be affected by temporary works are shown on the Land plans (application document TR010029/APP/2.2).

8.2.3 Details of traffic management will be included in a Traffic Management Plan to be produced by the Principle Contractor. No part of the construction alteration or improvement of the M25 or A12 would commence until a Traffic Management Plan for that part of the works had been produced by the Principal Contractor and approved by the Secretary of State in accordance with requirement 10 of the DCO (application document TR010029/APP/3.1). The key activities identified to date, associated with traffic management are as follows:

- Statutory undertakers work:
  - On the A12 eastbound
- Slip road works:
  - On the A12 eastbound to tie in the new A12 off-slip and on-slip
  - On the M25 northbound for the on-slip earthworks, verge works, to tie into the top of the new on-slip and off-slip
- Retaining wall works:
  - On the M25 northbound to undertake piling works for the retaining wall and the M25 on-slip
- Gantries:
  - On the M25 northbound and southbound at junction 28 to remove existing gantries and install a new gantry
  - On the M25 northbound and southbound between junctions 27 and 28 will to remove an existing gantry and install a new gantry
  - On the M25 northbound on-slip to remove an existing gantry
- Construction of new roads:
  - For the A12 eastbound off-slip
  - For the M25 anticlockwise on-slip
- Road markings:

- For the A12 eastbound off-slip
- For the M25 anticlockwise on-slip
- Roundabout resurfacing

8.2.4 Any diversions would be delivered in accordance with the requirements of the dDCO (application document TR010029/APP/3.1).

Construction phasing

8.2.5 The arrangements for construction of the Scheme have been developed by the buildability contractor, including the development of a high-level construction programme. Construction of the Scheme is planned to commence in 2022, with the Scheme planned to be open for traffic in autumn 2024.

8.2.6 The programme is based on the current preliminary design of the Scheme and will be updated by the contractor when appointed during detailed design stage.

8.2.7 The construction impacts at M25 junction 28 have been tested in the 2022 Do minimum models. It was judged that the 2022 supply and demand will reasonably accurately represent the traffic supply and demand at the time of construction.

8.2.8 The construction phases considered in the strategic model are listed below. This details six scenarios which for the modelling were predicted to last approximately two years. The scenarios are as follows:

- Scenario 1 – M25 northbound through the junction has narrow lanes, including the on-slip merge points (Phase 2 & 3). Note these phases will be in place 24 hours a day and are anticipated to last 8.5 months.
- Scenario 2 – Closure of M25 northbound on-slip (Phase 5). Note this phase will occur during the night and is anticipated to last 20 nights.
- Scenario 3 – One lane closed on the A12 eastbound from the Esso Petrol Station to the M25 junction 28 off-slip (Phase 6). Note this phase will be in place 24 hours a day and is anticipated to last 3 weeks.
- Scenario 4 – Flare lane closed on the A12 eastbound off-slip (Phase 7). Note this phase will be in place 24 hours a day and is anticipated to last 5 weeks.
- Scenario 5 – One lane closed on the A12 eastbound through the junction (Phase 10a). Note this phase will be in place 24 hours a day and is anticipated to last 3 months.
- Scenario 6 – One lane closed on the A12 westbound through the junction (Phase 10b). Note this phase will be in place 24 hours a day and is anticipated to last 3 months.

8.2.9 The M25 on-slip works will require a 50mph speed restriction. The A12 tie in works will also require a speed restriction.

8.2.10 The phases of construction that have been assessed using the traffic model, and their planned impacts on network operation, are set out in Table 8-1.

Table 8-1 Phases of construction

Phase	Description	Period	Day / night
TM2&3	M25 NB narrow lanes and on-slip narrow lanes (includes speed restrictions).	In total 252 days; 210 days for TM2, 42 days for TM3	Day
TM5	Night closure of M25 NB on-slip (includes speed restrictions)	20 days	Night
TM6	Lane closure on A12 EB prior to off-slip (includes speed restrictions)	21 days	Day
TM7	Flare lane closure on A12 EB off-slip (includes speed restrictions	35 days	Day
TM10a	A12 EB lane closure (includes speed restrictions)	90 days	Day
TM10b	A12 WB lane closure (includes speed restrictions)	90 days	Day

Construction traffic

8.2.11 It is assumed that all construction deliveries will be via trunk roads, i.e. the M25 and A12.

8.2.12 Diversion routes will be consulted on with Connect Plus Services and the relevant planning authority.

8.2.13 The main site compound for the works would be located on the Glebelands Estate and will operate for the duration of the works. The compound will be accessed from the A12 (eastbound).

8.2.14 A second satellite compound will be required within the area of the proposed new loop road within Grove Farm.

8.2.15 Locations of the proposed site compounds are included in the Environmental Statement Figure 2.2 (application document TR010029/APP/6.2).

8.2.16 Various haul roads are required within the works area to construct the Scheme and these are all proposed to be located within Grove Farm and Glebelands Estate. One haul road will be required from the main construction compound to the main loop road construction site and one haul road will be required to run along the outside (western side) of the loop road.

8.2.17 Based on the current programme and nature of the proposed works, it is estimated that 75 HGV and 10 LGV movements a day will occur during the majority of the construction phase. An estimated 20 HGVs and 5 LGVs will travel to and from site in the first and last month of construction.

8.2.18 Expected numbers of workers travelling to site and methods of transport have been provided in the Table 8-2. These have been broken down by programme phasing over the duration of the construction period:

Table 8-2 Expected numbers of workforce and method of travel to site

Phase	By Car	Train	Bus	Minibus/van	Total
1&2	10	5	5	6	**26**
3	15	15	10	6	**46**
4	20	20	20	25	**85**
5	20	20	20	25	**85**
6	20	20	20	25	**85**
7	20	20	20	25	**85**
8	20	20	20	25	**85**
9	12	15	10	15	**52**
Total	**137**	**135**	**125**	**152**	**549**

Impact assessment

8.2.19 The construction phasing outlined in Section 8.1.10 has been tested using the 2022 Do minimum models. An assessment of construction impacts has been undertaken using SATURN modelling of the defined phases of construction, allowing for lane closures and closures of sections of the network where applicable.

8.2.20 To model the night phases, it was necessary to develop a night model. For night phases, work will be completed between 11pm to 7am. Flows are low at night, but people will have to use a diversionary route as and when there is a full closure. The model was developed by factoring the existing Inter-peak matrix, using the 6hr Inter-peak to 8hr night factors.

8.2.21 The outputs of the construction impact models have fed into the economic assessment, with the calculated construction disbenefits included in the TUBA assessment of night-time construction impacts.

8.2.22 By modelling the main construction phases in SATURN, delays for trips passing through the affected section of the network can be evaluated. The assignment modelling also allows for trips to divert to alternative routes to avoid the traffic management at the junction (and the delays due to the traffic management) altogether. The modelling also assesses the impacts of traffic diverting on to other parts of the network to avoid the traffic management and/or closures.

8.2.23 Phases TM2&3, TM10b and TM10a generate the largest level of disbenefit and when combined account for 87% of the total disbenefits. Duration of variations to the active network during Phase TM2&3 is the highest followed by during Phase TM10b and TM10a. Furthermore, these phases involve reductions to capacity throughout the day, including peak periods and so will also result in congestion levels being increased.

8.2.24 These values typically reflect a delay of between 1 minute to 2 minutes (depending on direction of travel) for trips passing through the junction during the peak periods. Some trips, however, may choose alternative routes to avoid this delay.

8.2.25 Ongoing liaison with the local highway authorities is intended to try and reduce these delays by looking to adjusting signal timing plans on affected routes. This will aim to co-ordinate traffic signals and minimise stop times for the road user.

Impact on public transport

8.2.26 It is also important that the bus services are allowed to stay operational throughout the construction period, albeit via a reasonable diversion in the event of a closure being required. TfL will be consulted fully during the next design and construction phases to make sure bus operations can continue acceptably during the construction phase.

Construction traffic mitigation

8.2.27 To minimise the impact of construction traffic on the local highway network, the following documents will be produced:

- Construction Traffic Management Plan
- Buildability Report
- Construction Environmental Management Plan

9. Summary and conclusions

9.1.1 The M25 junction 28 plays a key role on the SRN connecting the M25 motorway with the A12 trunk road, as well as providing local access to Brentwood via the A1023 Brook Street. It is already operating at capacity, with motorists regularly experiencing significant congestion and delays. The RIS identifies improvements to M25 junction 28 as a priority to address these key issues

9.1.2 Currently the M25 junction 28 is a heavily used junction which features a roundabout controlled by traffic lights and it is used by up to 7,500 vehicles an hour during peak times. There are four dominant movements through junction 28, namely between the M25 northbound and southbound carriageways and the A12 eastbound (facing Essex) in both directions.

9.1.3 By 2037, traffic levels in the area are expected to increase by up to 22% by 2037, with more than 9,000 vehicles travelling through the roundabout every hour at peak times. Average delay due to congestion during peak travel times is predicted to increase by at least three times from over a minute per vehicle at present, to four minutes per vehicle in 2037 under 'Do minimum' conditions (that is, without the Scheme), with average speeds reducing by 25%.

9.1.4 Without appropriate intervention to improve the performance of Junction 28, each of these problems would be expected to deteriorate further in the future as traffic levels increase. This would result in significant consequences for the efficiency of traffic flow, road safety, network resilience, and user satisfaction. Ultimately it will reduce the ability of the junction to perform its role in supporting local and regional aspirations for development and growth. Specifically, without intervention the likely outcomes would include:

- M25 junction 28 being a constraint on the wider SRN caused by the inadequate capacity of the junction and the increasingly high traffic demands. Such a constraint would act as an inhibitor to economic growth and the attractiveness of the local areas, and the A12 corridor for new businesses and residents.
- The ability of the M25 junction 28 roundabout to remain open and available in the event of an accident or incident will diminish. In such an event local commuters, residents and businesses will suffer with increasingly longer and unreliable journey times
- Without a reduction in traffic levels and the smoothing of traffic flows the ongoing local air quality issues will be exacerbated.

9.1.5 The traffic assessments outlined in this report demonstrate that the Scheme is expected to deliver a number of key benefits, giving effect to achieving the Scheme objectives:

- Significant improvements to capacity at junction 28 through the creation of a new loop road thereby reducing the number of traffic movements through the junction 28 roundabout.
- A number of key movements through the junction would see a significant improvement in travel times:
  - All journeys using junction 28 via the A12 west approach would gain the greatest reduction in travel time of up to 16 minutes in the AM peak

  - The M25 south to A12 west movement is predicted to improve by more than a minute in the AM peak and about 7 minutes in the PM peak.
  - The M25 south to A12 east and to Brook Street movements are expected to improve by around 5 minutes in the PM peak.
  - All movement from the A12 east are expected to improve by around a minute in the PM peak.
- With the Scheme in place, including improved lane designation and traffic flows on the roundabout it is anticipated that there will be 88 fewer collisions over the next 60 years, thereby improving road safety.
- Reduction in queueing on M25 and A12 off slip roads to roundabout would significantly alleviate congestion as well as safety concerns.

9.1.6 The introduction of the Scheme on its own is predicted to create some further delays for traffic approaching the roundabout on the A1023 Brook Street. This initial scenario did not assume any measures to mitigate this impact. By including measures to adjust the signal times and setting these additional delays can be mitigated with delays expected to reduce for both the westbound and eastbound traffic on Brook Street. These mitigation options have been outlined in Chapter 5 and will be developed in detail during the next design stages.

9.1.7 The NPS NN sets out the need for, and Government's policies to deliver, development of nationally significant infrastructure projects (NSIPs) on the national road network in England. This Scheme as an NSIP, and this assessment confirms that with the Scheme in place M25 junction 28 will continue to play a key role in supporting local and regional economic growth and development.

Appendices

Appendix A. Scoping Report and local authority responses

M25 junction 28 improvement scheme
TR010029
7.3 Transport Assessment Report

APFP Regulation 5(2)(q)
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Status: A1 APPROVED - PUBLISHED
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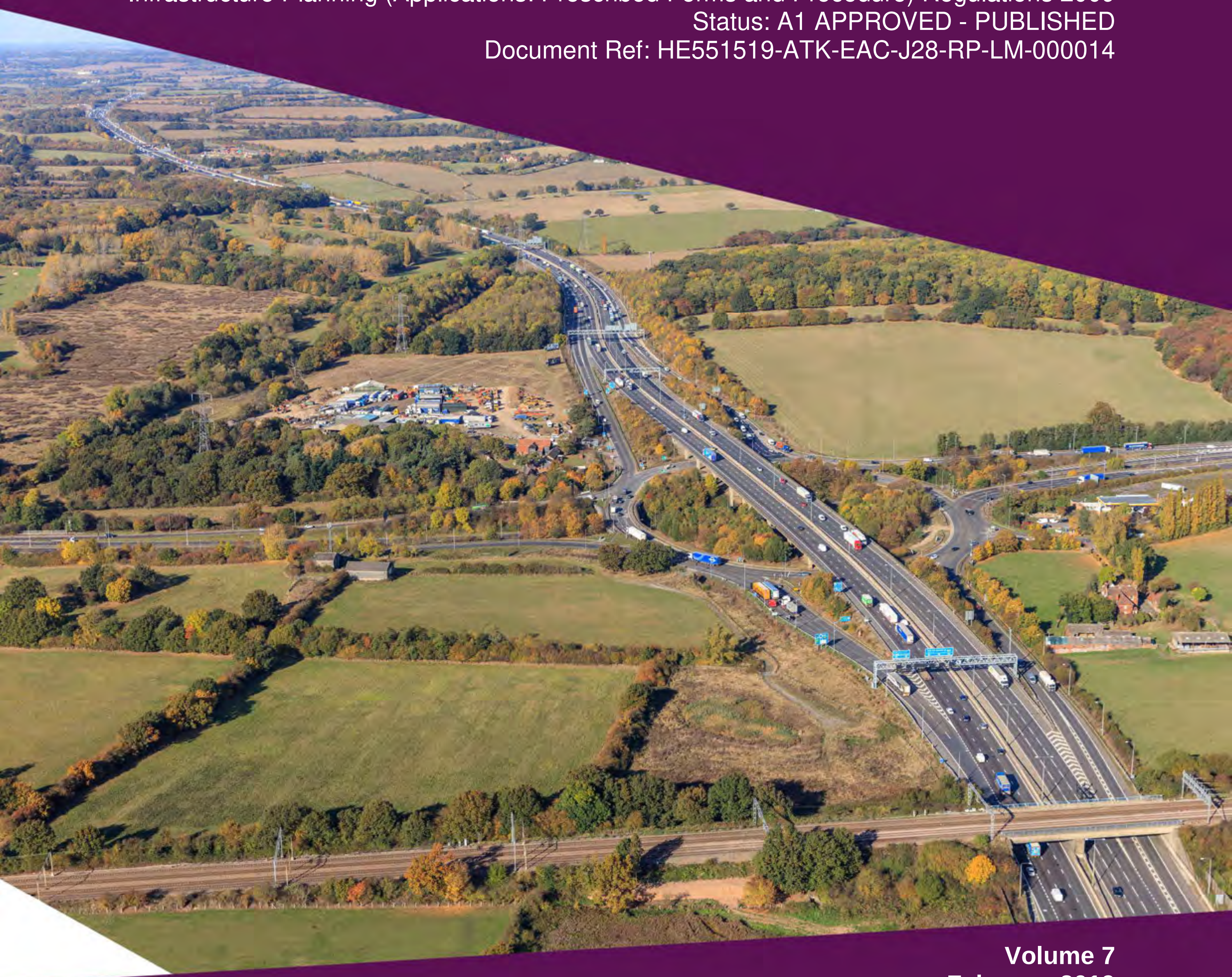

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Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

M25 junction 28 improvement scheme
Development Consent Order 202[x]

7.3 Transport Assessment Scoping Report

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Planning Inspectorate Scheme Reference	TR010029
Application Document Reference	TR010029/APP/7.3
Author:	M25 junction 28 improvement scheme project team, Highways England and Atkins

Version	**Date**	**Status of Version**
Rev 0		First draft

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P01	A1	Draft for comments	SM	LE	SF	PG	17/06/19

Table of contents

1. Introduction

1.1 Purpose

1.1.1 Highways England is proposing to construct a two-lane cloverleaf loop road for traffic travelling from the M25 anti-clockwise to the A12 eastbound. The proposed design includes new structures to carry the proposed loop road over the existing carriageways and reconfiguration of the signs and markings on the existing Brook Street roundabout.

1.1.2 The purpose of the Transport Assessment (TA) is to assess the impact of the proposed improvement scheme on the strategic and local highway network, road safety and local sustainable modes of transport.

1.2 Background

1.2.1 Atkins has been appointed by Highways England to undertake the network assessment and transport modelling work needed to progress the scheme through the Development Phase of the Highways England's Project Control Framework (PCF) to submission of a Development Consent Order (DCO).

1.2.2 The purpose of the scheme is to improve journey time reliability and reduce delays through the junction during peak and off-peak periods. The scheme will also improve the performance of the A1023, A12 and eliminate queuing on the M25 Motorway caused by the junction 28 exit slip roads. The scheme will address safety issues, reducing the number and severity of accidents.

1.2.3 The objectives of the scheme are to:

- Increase capacity to reduce congestion and delays by providing a new dedicated link from the M25 northbound to A12 eastbound.
- Reduce the incident rate and resulting disruption by increasing the capacity of the junction and reducing traffic levels using the roundabout.
- Improve the safety on the roundabout by reducing the traffic levels and redesigning the existing destination signing and road markings.
- Cater for future traffic demands to enable development and economic growth.
- Minimise impact on local air quality and noise by smoothing the traffic flow.
- Protect access for non-motorised users (pedestrians and cyclists) and improve conditions where possible.

1.3 Existing Road Network

1.3.1 The M25 junction 28 is located in the north-east quadrant of the M25 London Orbital Motorway to the west of Brentwood in Essex. The junction provides a critical intersection between the M25, the key trunk route of the A12, and the A1023 – which provides important local access to Brentwood. This junction plays a key role in connecting Chelmsford, Ipswich and Brentwood with London and other key destinations across the South East of England.

1.3.2 Junction 28 comprises a five-arm gyratory connecting the M25 and A12, as well as the A1023 Brook Street. The junction is a three-tier grade separated junction with the three-lane gyratory operating at grade, the main A12 running below grade and the M25 carriageway above grade. There is a free flow left turn lane from the A12 westbound to the M25 clockwise. The A1023 Brook Street approach is currently uncontrolled and operates as a priority intersection. The remainder of the gyratory is controlled by traffic signals.

1.3.3 The M25 mainline is a dual carriageway with four lanes in each direction (D4M) motorway to the north and south of junction 28. The section of motorway through the junction is dual carriageway with three lanes in each direction (D3M) following a lane drop arrangement at each of the motorway junction on/off slips.

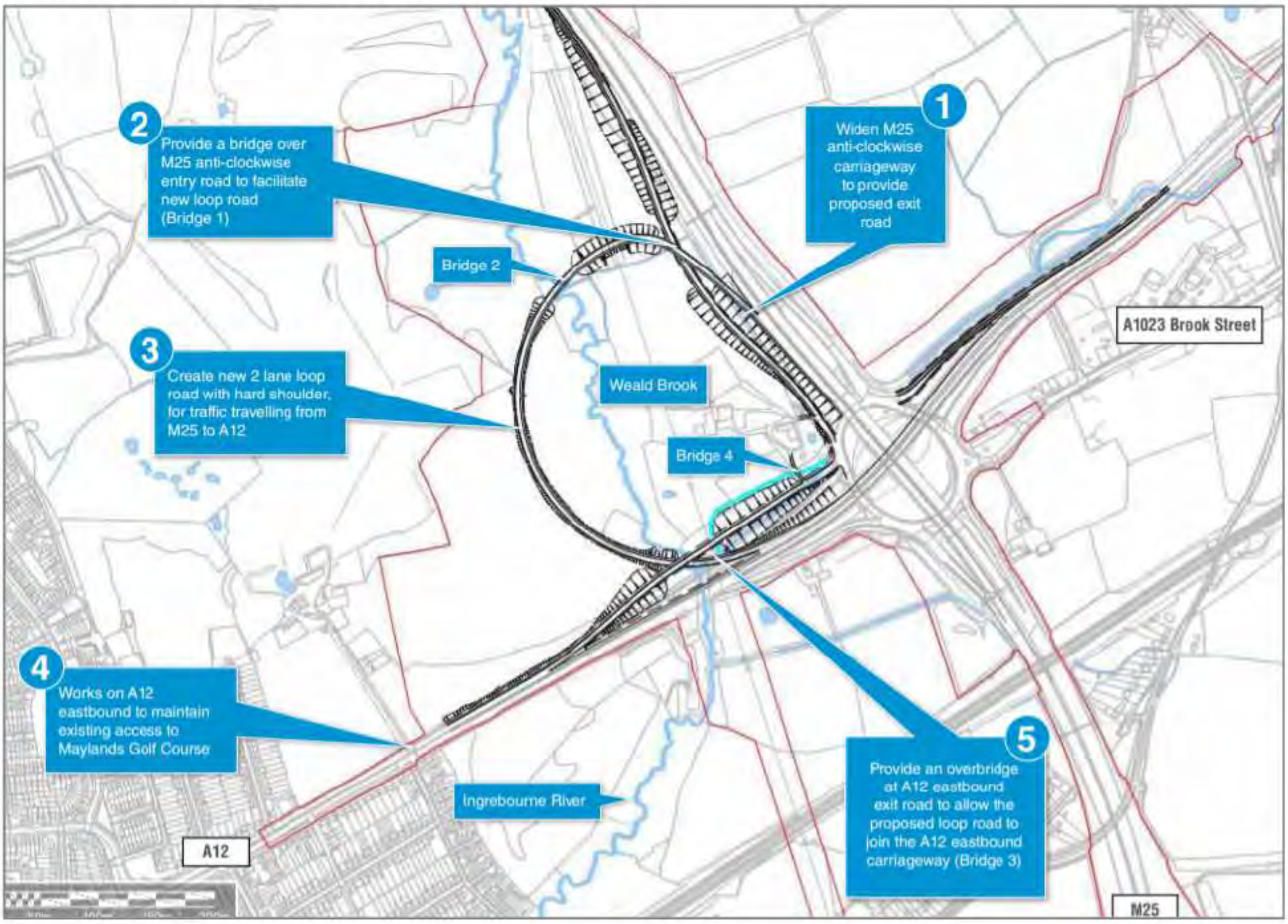
1.3.4 The A12 is of dual carriageway standard two lane (D2). As the A12 approaches junction 28, it operates with conventional diverges with no lane drop. In the westbound direction towards London, the A12 continues as two lanes through the junction. In the eastbound direction towards Essex, the A12 initially continues with two lanes, reducing to one lane as it passes under the M25 carriageway.

1.4 Scheme Description

1.4.1 The main scheme features can be identified in Figure 1 and include the following:

- Widening of the M25 anti-clockwise carriageway to provide the proposed exit slip road
- Construction of a two-lane (with hard shoulder) loop road from the M25 anti-clockwise to the A12 eastbound
- Construction of bridges over the M25 anticlockwise entry road and the A12 eastbound exit arm to facilitate the loop road
- Works on the A12 to maintain the existing accesses, and
- Reconfiguration of the lane markings and destination signing on the existing Brook Street roundabout.

Figure 1-1: General Scheme Plan



1.5 Funding and Delivery

1.5.1 The Department for Transport (DfT) announced in their 2014 Road Investment Strategy (RIS) the committed investment for the M25 Junction 28 Improvement scheme

1.5.2 As per the Highways England Project Control Framework (PCF) process, design of the scheme has evolved through the consideration of several highway arrangement options, which have been tested against economic, social and environmental data to arrive at the preferred option.

1.5.3 The start of works (SoW) is proposed for June 2021, with the scheme open for traffic in June 2023. The construction period is approximately two years.

1.6 Stakeholder Consultation

1.6.1 Several potential options for the M25 junction 28 improvement scheme have previously been considered and consulted on. Between November 2016 and January 2017, a community consultation exercise took place on three of the proposed options – Option 5B, 5C and 5F. This led to Option 5F being announced as the preferred option by the Secretary of State in 2017.

1.7 Approach to Assessment

1.7.1 A Transport Assessment (TA) will be produced in accordance with National Planning Practice Guidance (NPPG) "*Travel Plans, Transport Assessments and Statements*" (March 2014).

1.8 Report Structure

1.8.1 Following this introduction, this Scoping Report is ordered as follows:

- **Chapter Two** – Discusses the Policy Context relevant to the scheme and subsequent compatibility.
- **Chapter Three** – Provides detail on the collection of baseline data and development of traffic models.
- **Chapter Four** – Summarises the existing road safety performance within the study area and assesses the impact of the scheme on road safety.
- **Chapter Five** – Describes accessibility by and impact of the scheme on local sustainable modes of transport.
- **Chapter Six** – Provides an overview of current highway network performance.
- **Chapter Seven** – Presents a commentary on future network performance, both with and without the scheme and a future year operational assessment.
- **Chapter Eight** – Provides the summary and conclusions to the assessment.

2. Policy Context

2.1 Introduction

2.1.1 This section outlines the national, regional and local policies that are relevant to the scheme. It provides a summary of the scheme's compatibility with the relevant planning policy framework and transport strategies.

2.2 National Planning Policy Framework (February 2019)

2.2.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they should be applied. The NPPF also provides a framework for locally-prepared plans and developments, though it does not contain policies specific to nationally significant infrastructure policies. These policies are determined in accordance with the Planning Act 2008 and other relevant national policy statements for major infrastructure.

2.2.2 Policy 6: *Building a strong, competitive economy* of the NPPF states: "*Planning policies and decisions should help create the conditions in which businesses can invest, expand and adapt. Significant weight should be placed on the need to support economic growth and productivity, taking into account both local business needs and wider opportunities for development."* This scheme will enable the junction to meet the demands of today and future demands from higher traffic volumes. This statement supports the scheme and the need for it.

2.3 National Policy Statement for National Networks (December 2014)

2.3.1 The National Policy Statement for National Networks (NN NPS) sets out the Government policies to deliver nationally significant infrastructure projects (NSIP) on the national road and rail networks in England. The Secretary of State will use the NN NPS as the primary basis for making decisions on DCO applications for NSIPs in England.

2.3.2 The NN NPS states that the *"The Strategic Road Network (SRN) provides critical links between cities, joins up communities, connects our major ports, airports and rail terminals. It provides a vital role in peoples' journeys, and drives prosperity by supporting new and existing development, encouraging trade and attracting investment. A well-functioning SRN is critical in enabling safe and reliable journeys and the movement of goods in support of the national and regional economies."* (Paragraph 2.13)

2.3.3 The statement evidences the financial cost of delays in paragraph 2.17; *"in 2010 the direct costs of congestion on the SRN in England was estimated at £1.9 billion".* Under 2014 estimates made by the Department for Transport (DfT), *"it is forecast that a quarter of travel time will be spent delayed in traffic by 2040, with direct costs rising to £9.8 billion per annum by 2040 without any intervention."* (Paragraph 2.18).

2.3.4 As the primary objective of the scheme is to increase capacity and reduce congestion, this directly aligns with the policies outlined in the NN NPS.

2.4 Circular 02/13 The Strategic Road Network and the Delivery of Sustainable Development (September 2013)

2.4.1 Policy 18 states "capacity enhancements and infrastructure required to deliver strategic growth should be identified at the Local Plan stage, which provides the best opportunity to consider development aspirations alongside the associated strategic infrastructure needs". The improvements at the M25 junction 28 are required to deliver strategic growth in the south east to meet the needs of projected increases in demand.

2.4.2 Policy 19 states "where a potential capacity need is identified, this will be considered and weighed alongside environmental and deliverability considerations. Additional capacity may be considered in the context of the Highways England forward programme of works, balancing the needs of motorists and other road users with wider impact on the environment and the local/regional community." The M25 junction 28 scheme will assess all impacts of the scheme on the environment, with any impacts taken into account when considering the deliverability of the scheme.

2.5 National Planning Practice Guidance (March 2012)

2.5.1 The National Planning Practice Guidance (NPPG) is intended to be consulted in conjunction with the NPPF. Of specific relevance is Section 42 of NPPG 'Travel Plans, Transport Assessments and Statements in decision-taking' which defines the overarching principles of TA's, Transport Statements (TS) and Travel Plans (TP). This section identifies these documents as suitable mechanisms for assessing and mitigating the negative transport impacts of development to promote the use of more sustainable transport options.

2.5.2 Section 42 states that TA's and TS's evaluate the potential transport impacts of a development proposal. They should promote mitigation measures, where necessary, and should also establish whether the residual transport impacts of a proposed development are likely to be severe, in the context of NPPF.

2.6 The London Plan (2016)

2.6.1 The key implications for the M25 junction 28 Improvements are to enable targets for employment and housing growth in outer London by providing efficient access to the M25.

2.6.2 Policy 6.4 states *"The Mayor will work with strategic partners in neighbouring regions to ensure effective transport policies and projects to support the sustainable development of the London City region and the wider south east of England".* This policy indicates the support for the M25 junction 28 scheme which forms part of the wider south east England network.

2.6.3 Policy 6.4 also states *"The Mayor will work with strategic partners in neighbouring regions to develop efficient and effective cross boundary transport services and policies".* Although there is no direct reference to the M25 junction 28 scheme, it is expected that reducing congestion will help to make the A12 route into London more efficient.

2.7 The Draft London Plan (2017)

2.7.1 The key implications for the M25 junction 28 Improvements are to enable targets for employment and housing growth in outer London by providing efficient access to the M25.

2.7.2 Policy T4: Assessing and mitigating transport impacts states that *"Transport assessments should be submitted with development proposals to ensure that any impacts on the capacity of the transport network (including impacts on pedestrians and the cycle network), at the local, network-wide and strategic level, are fully assessed."*

2.7.3 Policy GG5: Growing a good economy *says, "To conserve and enhance London's global economic competitiveness and ensure that economic success is shared amongst all Londoners, those involved in planning and development must: Ensure that sufficient high-quality and affordable housing as well as physical and social infrastructure is provided to support London's growth".* The junction 28 improvement scheme aims to improve the transport links to and from London, to support the economy and future economic growth.

2.7.4 Policy GG6: Increasing efficiency and resilience *"To help London become a more efficient and resilient city, those involved in planning and development must: Take an integrated approach to the delivery of strategic and local infrastructure by ensuring that public, private, community and voluntary sectors plan and work together."* As part of the planning process, the scheme will work closely with relevant local authorities: Essex County Council, Brentwood Borough Council, the London Borough of Havering and the Greater London Authority. Liaison with local authorities is key to ensure the benefits of the scheme are realised across the host and neighbouring authorities.

2.8 The Mayor's Transport Strategy (2018)

2.8.1 Policy 21 states that *"The Mayor, through TfL and the boroughs, and working with stakeholders, will ensure that new homes and jobs in London are delivered in line with the transport principles of Good Growth for current and future Londoners by using transport to: a) Create high-density, mixed-use places, and b) Unlock growth potential in underdeveloped parts of the city."* A key objective of the scheme is to facilitate future development and economic growth in the area by providing increased capacity at the junction.

2.9 Essex Local Transport Plan (2011)

2.9.1 The Essex Local Transport Plan sets out the council's aspirations for improving travel in the county, demonstrating the importance of meeting these aspirations to achieving sustainable long-term economic growth in Essex.

2.9.2 Policy 3 states *"Essex County Council will focus investment on those parts of the network that would give greatest benefit to the economy and quality of life"*. The M25 junction 28 scheme will reduce congestion on one of the most heavily used roads in the county, providing opportunity to facilitate economic growth in the area.

2.9.3 Policy 5 states *"Essex will:*

- *Improve travel links within and between our main towns*
- *Focus investment where improvements will give the greatest economic benefit*

- *Improve journey times and reliability by targeted congestion improvement measures*
- *Provide for more sustainable forms of travel*
- *Work with partner agencies to identify and deliver essential improvements to nationally important road and rail connections"*.

2.9.4 Essex County Council state in Policy 10 *"We will work to reduce the incidence and severity of road traffic collisions on roads in Essex, prioritising measures which reduce number killed or seriously injured*. A key objective of the scheme is to improve safety at the junction, by improving destination signing and markings to aid drivers and reduce the incidence of collisions.

2.10 Essex Development Management Policies (2011)

2.10.1 DM15 states *"ECC will require the developer to demonstrate that the development proposal has no detrimental impact upon the existing or proposed highway in congestion terms, as measured by assessing existing and proposed link/junction capacity; or require appropriate mitigation measures to ensure that there is no detrimental impact to the existing highway"*. This TA will assess all impacts of the proposed scheme and recommend mitigations where appropriate.

2.11 London Borough of Havering Core Strategy (2008)

2.11.1 The purpose of the Core Strategy is to set out the Council's approach to the planning of the whole borough up to 2020.

2.11.2 Policy DC32 concerns the road network. Planning permission for new road scheme will only be allowed where they:

- Are consistent with the Council's road hierarchy
- Improve conditions for pedestrians and cyclist and disabled people by providing safe and convenient facilities
- Improve public transport accessibility
- Have net environmental benefits
- Improve safety for all users
- Contribute to regeneration objectives
- Allocate street space in accordance with the London Plan Contributions may be sought from developers towards new road schemes or road improvements.

2.12 London Borough of Havering Local Plan Proposed Submission (August 2017)

2.12.1 The Local Plan sets out the Council's vision and strategy for future growth and sustainable development over the next 15 years up to 2031. *"Increased capacity at Junction 28 of the M25"* is listed as a Key feature under Transport Infrastructure within the Spatial Strategy.

2.12.2 Policy 23 states that the Council supports development which ensures safe and efficient use of the highway and demonstrates that adverse impacts on the transport network are avoided or, where necessary, mitigated. The council will improve transport infrastructure and connectivity by:

- Enhancing strategic transport links across the borough
- Improving road safety in the borough, especially in the vicinity of schools and KSI "hotspots"
- Providing residents with options to travel sustainably and enabling walking and cycling
- Requiring new development to optimise sustainable access and other future transport connections wherever applicable
- Working with neighbouring authorities to better co-ordinate highway works.

2.13 Brentwood Replacement Local Plan (2005)

2.13.1 Policy T2 concerns New Development and Highway Considerations, and states that permission will not be granted for proposals where unacceptable detriment is indicated to the existing transport system, or where the works would not comply with the highway authority's adopted guidance.

2.14 Brentwood Pre-Submission Local Plan (2019)

2.14.1 The Pre-Submission Local Plan outlines the Council's strategic priorities and sets out a Spatial Strategy and supporting policies for achieving this vision.

2.14.2 Policy BE11 – Strategic Transport Infrastructure includes one of three subsections on 'Delivering improvement to the highway infrastructure capacity.' This states that the *"Council will continue to work with the Highway authority, statutory bodies and key stakeholders to coordinate and, where appropriate, deliver improvements to the highway network."* The policy also states that *"Any significant impacts from the development on the transport network on highway safety must be effectively mitigated to an acceptable degree."*

3. Baseline Data and Model Development

3.1 Introduction

3.1.1 A comprehensive review of the existing transport conditions surrounding the site will be provided in the TA. The baseline data and traffic model development will be presented in this section of the TA.

3.2 Study Area

3.2.1 The M25 junction 28 is situated in the north-east quadrant of the M25 London Orbital motorway, approximately 30 km to the north east of central London and 25 km south west of Chelmsford. This junction contains radial routes to Essex with orbital routes between Essex, Hertfordshire and Greater London.

3.2.2 The town of Brentwood is approximately 3.5km north east of M25 junction 28 and connects to the junction via the A1023. The smaller settlement of Gallows Corner lies almost 4km south-west of the junction and is connected via the A12.

3.2.3 The extent of the study area and associated junctions are illustrated in Figure 3-1.

Figure 3-1 Scheme Location

3.3 Baseline Data Collection

3.3.1 The collation of existing and new traffic data for M25 junction 28 has been reported in full in the Road Investment Strategy – M25 Junction 25 & 28 Improvements: Data Collection Technical Note (2 January 2018).

3.3.2 To support the PCF Stage 3 M25NE model and operational model development and economic and environmental assessments, the following sources were utilised:

- Data collected for PCF Stage 1 is reported in the M25 Junction 28 Improvements: Traffic Data Collection Report[1] dated 28 July 2016.
- SERTM count data was used within the regional model's dashboard and signal data was used within the SERTM cordon network. Details of its collection can be found in the SERTM Model Data Collection Report[2] dated 08 April 2016.

3.3.3 As little new data has been collected at PCF Stage 3, separate Stage 3 TDCRs have not been produced. The TN draws together all references to data collected at PCF Stages 1 to 3.

3.3.4 As part of the data collection for the M25NE model development, the following data was collected:

- Automatic Traffic Count (ATC) surveys
- Manual Classified Count (MCC) surveys
- Journey Time Data from the SERTM model and TomTom
- Traffic Signal Data from regional control centres and existing models.

[1] PCF1-062-M25 Junction 28_Traffic_Data_Collection_Report_v4.0.pdf
[2] 0002-UA008080-UT22R-01-MDCRv8.pdf

Figure 3-2 ATC Survey Locations (2016)

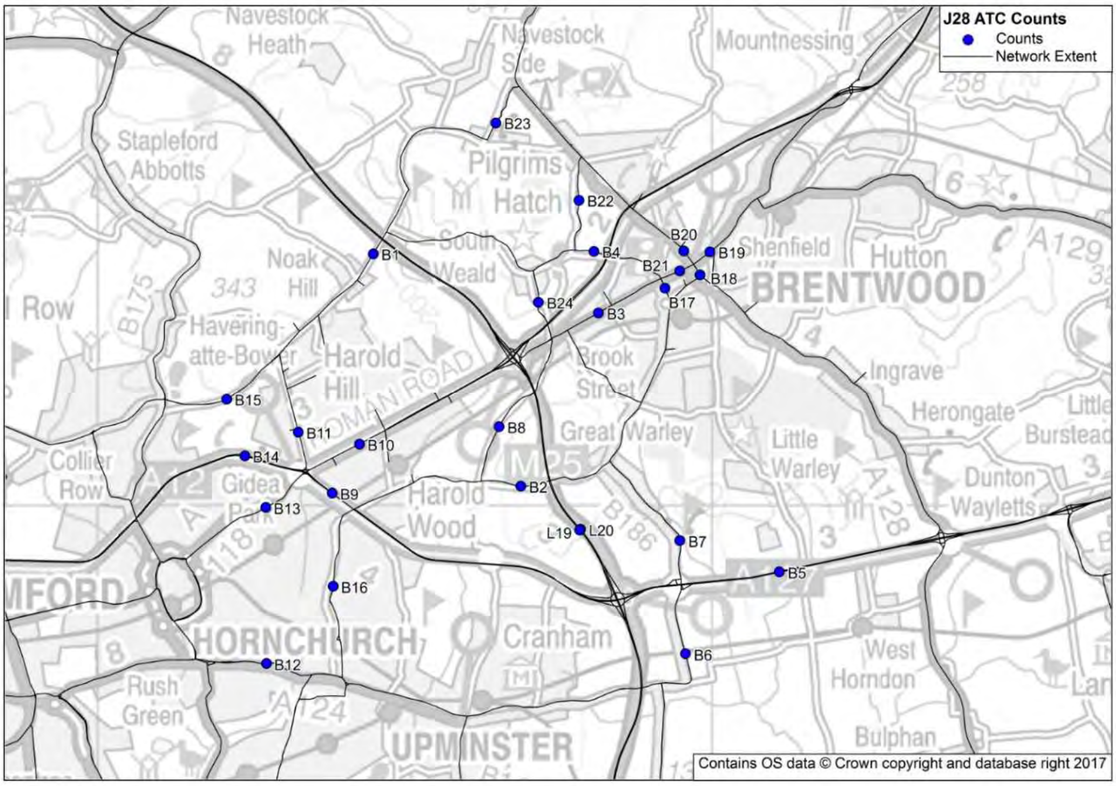
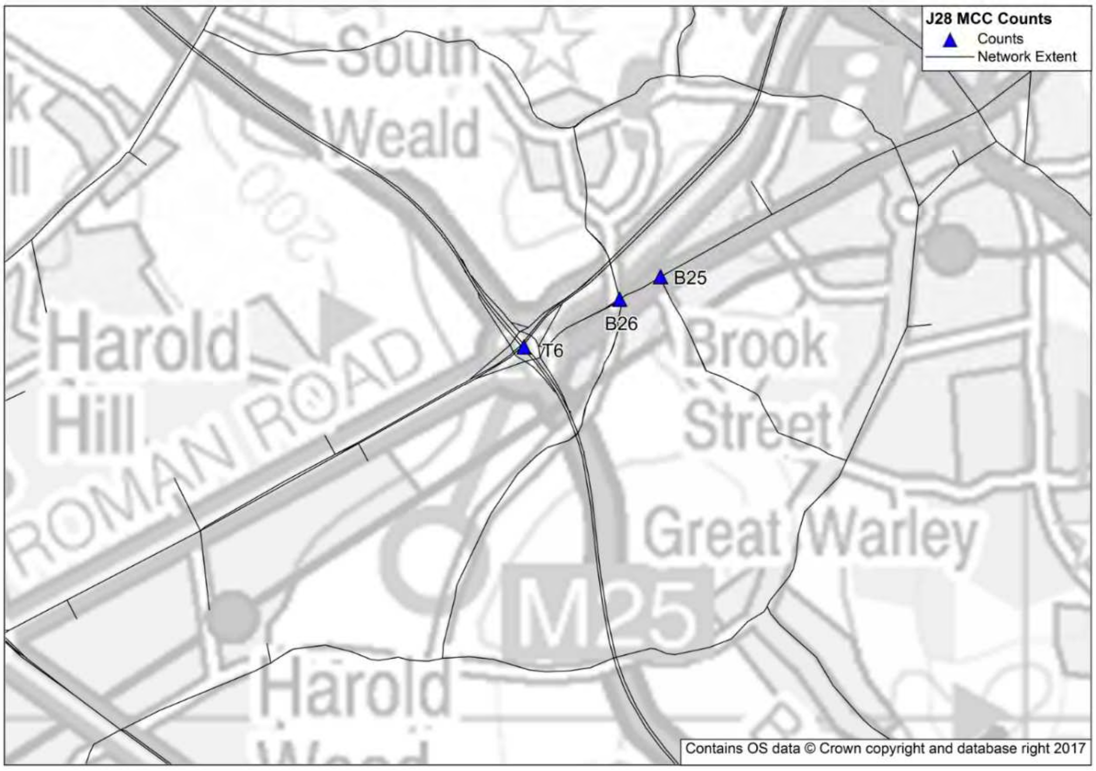


Figure 3-3 MCC Survey Locations (2016)



3.3.5 Note that all data used in the M25NE model has been normalised to a March 2015 base year, regardless of its source.

3.4 Transport Demand Modelling and Model Development Area

3.4.1 The M25 junction 28 improvement scheme is expected to provide relatively local benefits relating to the improved performance of the circulatory roundabout, reduced queuing on the ramps approaching the gyratory as well as along the A12 and M25. It will also be necessary to test the operational feasibility of the scheme options including the performance of the traffic signals, as well as the merge arrangements on the A12 eastbound section with the new dedicated link in place. Therefore, a hybrid approach has been used for the evaluation where both the Strategic and VISSIM model are used for the wider impact and localised assessments respectively. Furthermore, VISSIM will be useful to evaluate any operational issues including merge/diverge analysis during PCF Stage 3.

3.4.2 Therefore, the modelling framework for PCF Stage 3 will comprise:

- The M25 junction 28 VISSIM model developed in Stage 1 and enhanced in Stage 2. In addition, the VISSIM model will be used for an economic appraisal and operational assessment of the junction, including the merge evaluation on the M25 and A12. There is potential to use this model for evaluation of the reliability benefits.
- M25NE strategic model (v2) to assess the wider network implications as well as provide forecast flows for environmental impact assessments.

3.5 Local Development and Transport Infrastructure Scenarios

3.5.1 The design of the scheme has evolved through the consideration of several highway option layouts, which have been tested against scheme economics, social and environmental appraisal to arrive at the preferred option. This option selection process will be described in the TA culminating in the justification for Option 5F, which is the preferred option to be assessed in the TA.

4. Collision Analysis

4.1 Introduction

4.1.1 One of the scheme objectives of the M25 junction 28 Interchange improvements is specifically aimed at safety enhancements - ‘Improve the safety on the roundabout by reducing the traffic levels and redesigning the existing destination signing and road markings.’

4.1.2 This section of the TA will look to better understand the safety issues at M25 junction 28 and the surrounding network and what impacts are expected as a result of implementing the proposed scheme. The analysis will consider STATS19 data provided by the Department for Transport over the years 2013 – 17, COBALT proposed accident rates for different link types and junction classes and scheme drawings. The STATS19 data is the most recent collision data provided that covers the full extent of the scheme.

4.1.3 The collision analysis will include a comparative analysis of junctions around the M25 and a detailed accident analysis of M25 junction 28, namely the calculation of accidents rates on all links and junctions in the study area.

4.2 Background

4.2.1 It has been established that safety is currently a key issue at junction 28. However, the issue and consequences are concerned with the high occurrence of incidents and the implications on the disruption across the wider highway network as well as harm and injury.

4.2.2 Current collision records (where a personal injury was recorded) show that between 2010 and 2015, there have been 28 accidents reported in the study area, including on the roundabout and the adjoining slip roads and M25 merge/diverge areas. This figure does not include damage only collisions. The 28 accidents have resulted in 34 casualties of which 30 were slight injuries (90%). The level of killed and serious injury (KSIs) incidents is low with less than 1 KSI each year.

4.2.3 Hence the safety problem is more related to the high occurrence of incidents (slight injury plus damage only), and the implications of these on the disruption across the wider highway network, as well as harm and injury. A large proportion of recorded accidents have occurred where the A1023 Brook Street approach joins the roundabout.

4.3 Collision Data

4.3.1 Collision data collected will be based on five-year STATS19 (2013-2017) to include the M25 junction 28 and surrounding study area.

4.4 Collision Assessment

4.4.1 The Collision Assessment will be reported in the TA to include expected collision changes resulting from the proposals and scheme benefits based on COBALT analysis.

5. Sustainable Transport

5.1 Introduction

5.1.1 The scheme will look to support NMUs where possible, through the introduction of safety measures and retention of existing accesses to local amenities.

5.1.2 An NMU Audit Context Report was written by Atkins in February 2015 with both motorised and NMU traffic counts provided to the Audit Team. The NMU traffic counts were undertaken by Intelligent Data in December 2014. The traffic count data used in the NMU Audit was taken from the Outline Design Report, September 2014. This report will be used to inform the Transport Assessment.

5.2 Scheme Objectives

5.2.1 As part of the Highways England Delivery Plan (2015 – 2020) a key feature within the Key Performance Indicators (KPIs) is associated with the consideration of Vulnerable Road Users (VRUs) and the incorporation of measures in a scheme that enables them to continue to use the network as in the current situation.

5.2.2 The scheme meets the objective outlined by the DfT which encourages the development of safe, secure and sustainable transport. The TA will analyse the scheme objectives against relevant policy guidelines regarding NMUs.

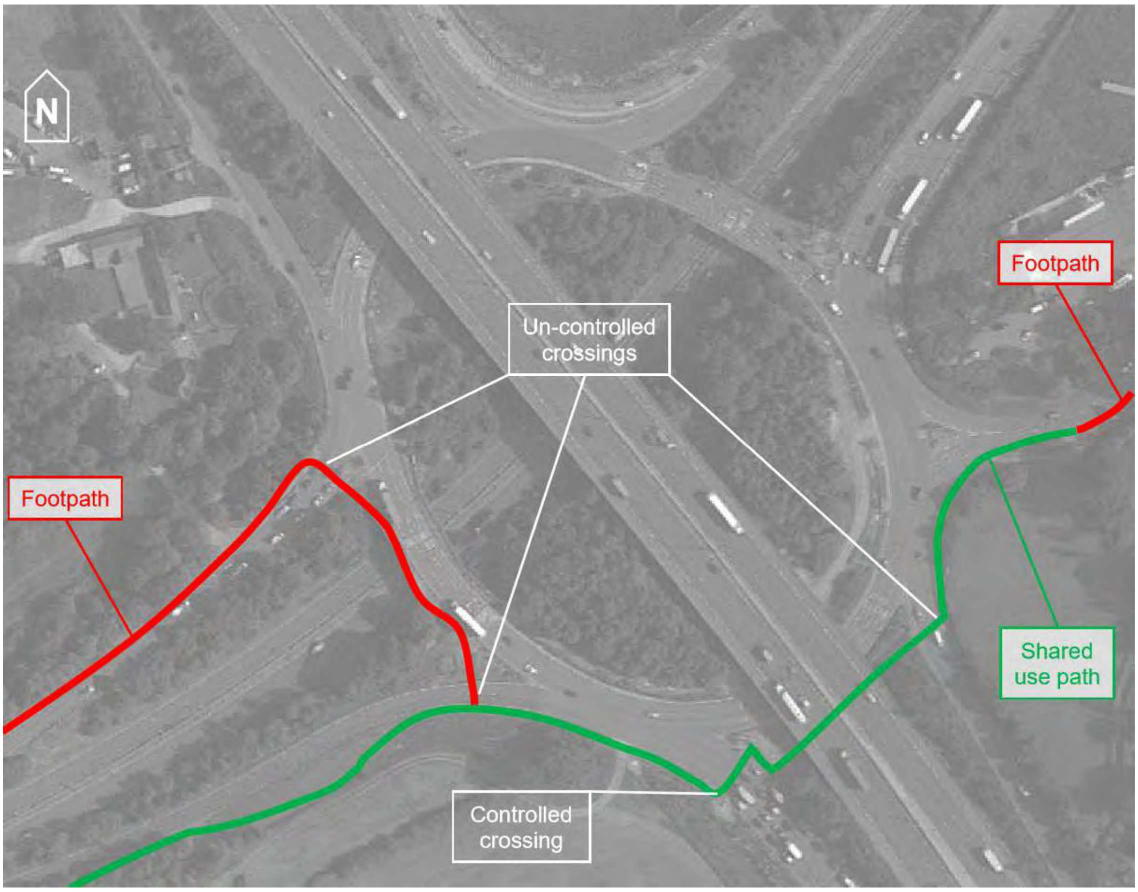
5.3 Overview of Existing Conditions

5.3.1 A network of NMU infrastructure exists on the southern side of the M25 junction 28, allowing east-west movement across the junction, as shown in Figure 5-1.

5.3.2 A pedestrian footway runs from the northern side of the A12, along the western side of the roundabout and crosses to the southern side of the A12. The footway then connects with a shared use path (SUP) on the southern side of the A12.

5.3.3 The SUP continues to the west along the southern side of the A12 towards Harold Wood, connecting to National Cycle Network Route 136. To the east of the junction, the SUP crosses the M25 slip roads to south of the junction and continues onto the A1023.

Figure 5-1 NMU Infrastructure at Junction 28



5.3.4 A further SUP exists on the northern side of the A12 near Harold Wood, but this is discontinuous and does not provide a direct route to the junction. A grade separated crossing exists near Harold Wood to facilitate movements across A12.

5.4 Cycle Routes

5.4.1 National Cycle Network Route 136 provides a quiet route through the Ingrebourne Valley in the London Borough of Havering. The continuous traffic-free route connects the north and south of Havering travelling from the M25 at Dagnam Park via Harold Hill, Hornchurch and Upminster to the Thames at Rainham.

5.5 Public Transport

5.5.1 There are two Transport for London bus services that serve the area via junction 28 and the A1023 Brook Street.

5.5.2 The closest bus stops to M25 junction 28 are located on the A1023 approach around 300m east of the roundabout. The bus stops serve route 498 between Romford and Brentwood.

5.5.3 There is a bus stop located on the A12 immediately west of the westbound on-slip from junction 28. The stop serves route 608 that runs between Gallows Corner and Shenfield High School.

5.6 New Provision and Enhancement

5.6.1 Existing NMU facilities will be improved as far as possible to comply with the latest standards and these will be considered in the TA.

5.6.2 The project team are also exploring the Designated Funds scheme, which aim to address a range of issues beyond the traditional focus of road investment. One of the five designated funds categories is Cycling, Safety and Integration, aiming to provide NMU improvements. The funding is provided for complimentary schemes that can be delivered alongside the main scheme, although the funding is not guaranteed.

6. Current Network Performance

6.1 Introduction

6.1.1 A key aim of PCF Stage 0 was to confirm the strategic case for improving the M25 junction 28 Interchange. The evidence reviews confirmed that the junction has frequent disruption and unreliable journey times, and a high incidence of collisions.

6.1.2 The current network performance is based on data collected from a variety of sources, including that used in SERTM and the Highways England network journey time and traffic flow data (previously TRADs). This has been supplemented by data collected in PCF Stage 1 and PCF Stage 2 that has been utilised in model development and contributed to the development of PCF Stage 3 models.

6.1.3 The TA will look at the current network performance in terms of journey times and local junction modelling and provide an analysis of the existing network conditions within the study area.

6.2 Base Year Flows – 2015

6.2.1 The base year for the scheme is 2015 and the TA will set out weekday peak hour base year traffic flows at the junctions included in the scope of junction assessment, as described in Section 3.4.2. The 2015 base traffic flows are demand flows that have been extracted from the SERTM.

6.3 Base Year Operational Assessment

6.3.1 The TA will provide detail on the results of local junction modelling utilising LinSig and journey time analysis taken from VISSIM for the 2015 base year. The base year operational assessment will therefore look at the current operation of M25 junction 28 as well as the other junctions in the study area and how they currently interact as a network.

6.3.2 The junction 28 base model calibration and validation process was undertaken against the observed site conditions such as; journey times, queue data and traffic volume counts. The junction 28 VISSIM model calibration and validation results are presented in LMVR. The validation results satisfy the DfT's WebTAG13 Unit 3.1 criteria for validation of traffic models.

7. Future Network Performance

7.1 Introduction

7.1.1 This section focuses on the traffic modelling and appraisal work undertaken to test the impact of the proposed scheme options at PCF Stage 2. The PCF stage2 M25 junction 28 – this model was developed through refinement of the M3M4 model which is based on the M25 assignment model.

7.1.2 Demand forecasting will be undertaken using the M3M4 variable demand model (VDM) which follows WebTAG guidelines.

7.2 Overview of Traffic Forecasts

7.2.1 The modelling of the future year scenarios test with intervention (Do-Something) and without intervention (Do-Nothing) scenarios.

7.2.2 The forecast years as derived from the SATURN model are for an opening year of 2022 and a design year of 2037.

7.2.3 Current forecasts show that total traffic travelling through the roundabout is expected to increase to 8500 vehicles per hour during AM and PM peaks by 2037. During the inter-peak, flows are also expected to rise to around 6500 vehicles (Scheme Assessment Report, July 2017).

7.2.4 The Do Minimum scenario includes signal optimisation at the Junction 28 gyratory. The optimised signals have been obtained for each forecast year and each time period from the LinSig model. Under a 2037 DM scenario, a significant deterioration in traffic conditions is expected. Average delays could be two or three times that experienced in 2014 in the AM and PM peak hours, with total delay times across all movements increasing by similar levels. As a result, journey times on key movements will also increase, for instance the M25 South to A12 East movement could see increases of 10% to 20%.

7.3 Opening Year – 2022

7.3.1 The scheme is anticipated to be delivered for opening in 2022. The TA will include weekday peak hour traffic flows at the junctions within the study area for the Do-Minimum and Do-Something scenarios.

7.4 Design Year – 2037

7.4.1 The design year for the scheme is 2037 and TA will include weekday peak hour traffic flows at the junctions within the study area for the Do Minimum and Do Something scenarios.

7.5 Impact on Strategic Routes

7.5.1 The scheme is expected to have a positive impact on strategic routes, with the M25 benefitting from reduced delays, reduced congestion and reduced numbers of collisions. This will be given further consideration in the TA.

7.6 Scheme Impact on Flows

7.6.1 The TA will consider the impact of the change in traffic flows on key routes within the study area through comparison of the Do Minimum and Do Something scenarios for the opening year and design year.

7.7 Scheme Impact on Local Roads

7.7.1 The scheme is expected to provide largely local benefits relating to the improved performance of the roundabout, reduced queuing on the ramps approaching the gyratory as well as along the A12 and M25.

7.8 Summary of Strategic and Microsimulation Modelling Impacts

7.8.1 The TA will consider the impact on journey times within the study area through comparison of the Do Minimum and Do Something scenarios for the opening year and design year.

7.9 Future Year Operational Assessment

7.9.1 For the preferred option, the TA will provide an operational assessment of the network for the Do Minimum and Do Something scenarios for the opening year and design year, taking into consideration the findings of the microsimulation and junction modelling impacts.

7.10 Other Traffic Impacts

7.10.1 The TA will provide an overview of estimated construction traffic movements and proposed mitigation through the provision of a Construction Environmental Management Plan (CEMP).

7.11 Road Safety Audit

7.11.1 The TA will summarise the findings of the Road Safety Audit (RSA) of the proposed improvements (if available).

8. Summary and Conclusions

8.1.1 This TA scoping report is intended to set out the proposed methodology for assessing the impact of the M25 junction 28 Improvement scheme, for consideration by Highways England and the Local Highway Authorities.

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Comment From	Section	Comment	Action
Havering Borough Council (HBC)	2 Policy Content	Whilst the scoping report is correct to refer to Havering's Core Strategy which is the Council's current active planning policy document, reference should also be made to Havering's Local Plan which underwent Examination in public last year and early this year and is expected to be adopted sometime in the new year. Whilst it is not yet adopted, it sets out the Council's policies for accommodating growth and sustainable development in the borough over the next 15 years. Policy 23 Connections sets out the Councils strategic transport aspirations over the next 15 years so it is important that this is referred to. Table 4 also specifically refers to the M25 Capacity improvement scheme.	**Note an considere withi th Cas fo th Schem (applicatio referenc TR010029/APP/7.1**
HBC		Havering also has an adopted Local Implementation Plan (LIP3) which is effectively the boroughs Transport strategy. This sets out how the borough will deliver the Mayor's Transport Strategy at a local level over a 20 year period. This should also be referred to in chapter 2 of the scoping report. In particular the LIP (Table 13) commits the Council to working with strategic bodies such as TfL and Highways England to reduce KSI rates on strategic roads in the borough such as the M25 and parts of the TLRN.	**Co si ered as below:** **Fina London Bo ough of averi g Local Implem ntat on P an (May 2019)** **2.1 .1 his is th thir Local Implem ntati n Plan (LI 3) or the London orough f Hav ring, whic se s out Have ing's st ate y for implem nti g the M yor's Transport St ategy (M S at a local leve ver a 2 -year period.** **2.1 .2In line with Ou c me 2 o the MTS: Lon on's st eets wi l be saf and secure. Have ing highli hts h t a substan ial nu be of KSI accid nts (1 26 per ent between 2 15 nd 20 2) oc ur on Transp rt or Lon on R ad Netw rk (TL N) or he Highways Engl nd network.** **2.13.3Haveri g Counc l emphasis s the r commitme t o worki g close y wi h transport operato s f t e M 5 o redu e casualti s n the e road . T e Counc l sta e th y are "workin closel wit Highway Englan a i develop propose capacit improvements t J28/M2 whic wil als suppor reducin casualt rates".**
HBC	3 Baseline Data and Model development	Could there be reference to what the future demand forecast modelling work takes into account in terms of growth and other transport infrastructure projects (such as LTC). For example does the modelling work include the growth that is forecast in the London Plan for the east sub region or is any data used from TfL's ELHAM model to help inform this work?	**Approach to forecast modelling outlined in sections 3 and 5, including which developments are included within each model scenario.**
HBC	4 Collision Analysis	No Comments	**None required**
HBC	5 Sustainable Transport	It is welcome that the scheme will look to support NMU's wherever possible and Havering welcomes the engagement there has been with Highways England with looking at options for improving access through the Brook Street roundabout for cyclists.	**Continue engagement**

HBC	6 Current Network Performance	No Comments	**None required**
HBC	7 Future Network Performance	It is welcome that a Construction Environmental Management Plan (CEMP) will be produced as part of the Transport Assessment as the impact of construction on the local road network and in particular cumulative impacts with other key construction projects such as LTC was something that LBH highlighted in the S42 consultation response.	**None required**
HBC	8. Summary and Conclusions	No comments	**None required**
Brentwood Borough Council (BBC)	Page 11, Para 2.5	There was an update to the NPPG and the Travel Plans, Transport Assessments and Statements in decision-taking are no longer found within Section 42. This should be updated to reflect the most up to date National Planning Practice Guidance.	**Note an considere i preparatio o th TA**
BBC	Page 21, Para 5.4	The para on the cycle route is limited in information. It is clear that it is unknown if this will be incorporated into the main scheme, however it would have been useful to have some information on the possible methodology for determining if there are safety issues associated with the currently route, methodology for assessing how to improve the safety of the route, and what the determining factors that are likely to be considered when determining if improvements to the cycle path will be included.	**Further information regarding sustainable transport has been included in the Transport Assessment report.**
BBC	General	No information on the methodology for determining environmental impacts	**The environmental impacts will be determined in a seperate EIA**
BBC	General	Document is too high level – more information is needed including what the next steps of the project are.	**This document outlines what the TA will include and for this reason is intedned to be high evel. The next steps of the project are to continue with the modelling which will feed into the Transport Assessment. This TA forms one of the application documents for the Development Consent Order (DCO) submission later this year.**

Appendix B. Model calibration / validation summary

6. Model Assignment

6.1 Approach

6.1.1 Static assignment in the VISSIM has been employed for assignment process.

6.1.2 In VISSIM, the drivers need to have some sort of assessment in which to choose their route. This is achieved using route choice from the South East Regional Model.

7. Model Calibration

7.1 Introduction

7.1.1 Model calibration is the process of tuning and refining the input data and parameters within the model in order to improve the goodness of fit with the observed traffic flow and, to replicate observed driving.

7.1.2 During the calibration process, the Junction 28 network was comprehensively scrutinised and checked for software errors. Also visual simulation is inspected closely to check various calibration criteria.

7.2 Calibration Criteria

7.2.1 The TAG Unit M3.1[4] sets out the criteria for calibration and validation of traffic models. These relate mainly to the GEH[5] statistic which is the standard method of comparison of modelled values against observed ones and are discussed later in this chapter.

7.2.2 The GEH statistic was adopted as the main indicator of 'goodness of fit', i.e. the extent to which modelled flows match corresponding observed values. The GEH statistic is a form of the chi-squared statistic described in DMRB Chapter 4 - Traffic Appraisal in Urban Areas. It is defined as:

$$\text{GEH} = \sqrt{\frac{(M-C)^2}{(M+C)/2}}$$

where M = modelled flow;

C = observed flow (or count).

[4] Department for Transport's TAG Unit 3.1 – Highways Assignment Modelling
[5] The GEH statistic was created by G.E.Havers and the terms GEH is taken from his initials.

7.2.3 The acceptable criteria are listed below in Table 7-1.

Table 7.1: Calibration and Validation Acceptability Guidelines

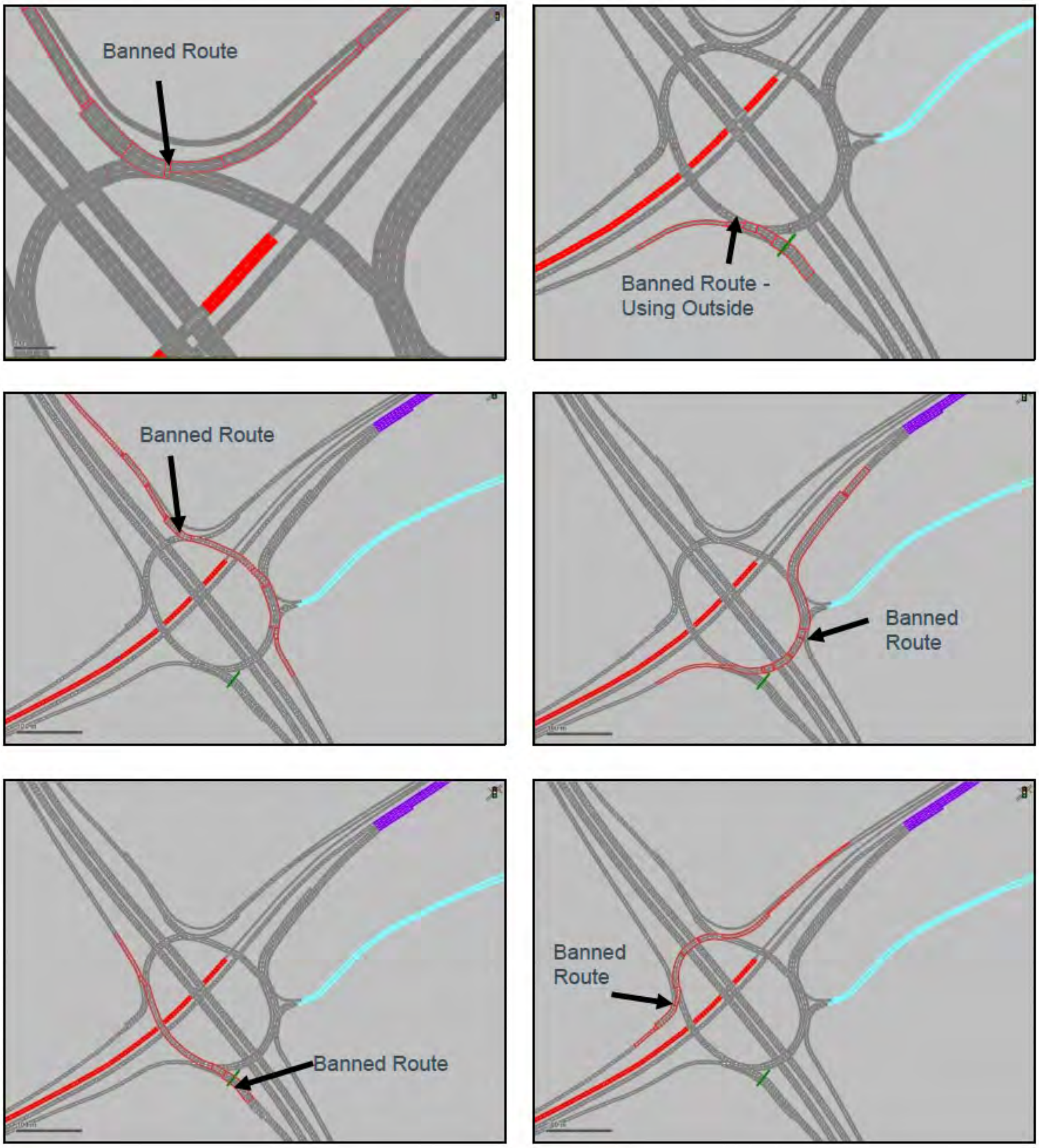
Criteria and Measures	Acceptability Guideline
Assigned Hourly Flows* compared with observed flows. Individual flows within 15% for flow 700-2700 vph Individual flows within 100 vph for flow <700 vph Individual flows within 400 vph for flow >2700 vph Total screenline flows (normally >links) to be within 5% GEH Individual flows: GEH <5 *Link Flows or turning movements	Greater than 85% of all cases All (or nearly all) screen lines Greater than 85% of all cases All (or nearly all) screen lines
Modelled journey times compared with observed times Times within 15% (or 1 minute if higher)	> 85% of routes

7.3 Calibration Checks

7.3.1 During the calibration process, certain routes were banned. For example, from the M25 Southbound to A12 Eastbound has dedicated left turn lane therefore this route through roundabout is banned in the VISSIM model. Figure 7-1 shows the screenshots of the all banned routes from VISSIM model.

7.3.2 Furthermore, during calibration VISSIM's visual simulation is inspected closely to review the various calibration criteria such as; driving behaviour parameters, gap acceptance, lane changing, merge/diverge behaviour, signal off-sets and journey progression through gyratory. The network modifications, which are carried out during the calibration stage are discussed later in the section.

Figure 7.1: M25 Junction 28 Banned Routes



7.4 Delay Checks

7.4.1 The queuing on each of the approaches were visually checked against the observed queue data to ensure the model reflects adequate level of delays. Table 7.2 shows comparison of the Mean Maximum Queue (MMQ) obtained from VISSIM and compared to observed queue data. The queue length comparison indicates that the queueing was similar to those observed during traffic surveys (see Table 7.2).

7.4.2 The maximum queues for five minute intervals were plotted against the observed five minute intervals from queue survey data. This shows a similar queue profile between the modelled and observed data. The queue patterns of modelled queues and observed queues are presented in Appendix D.

7.4.3 It was identified through the video and traffic surveys that the queues on Brook Street block back past the exit arm at the M25 Junction 28 in the AM peak hour. This caused substantial issues to both circulatory traffic and A12 East traffic attempting to enter into gyratory.

7.4.4 The Junction 28 model is not able to reflect delays associated with any incidents on the network which have led to major queueing events. However, it does reflects delays associated with the Brook Street / Nags Head Lane junction blocking.

7.4.5 Furthermore, queue lengths vary significantly throughout the peak period therefore it's very onerous and time consuming to validate modelled queue lengths with observed queues.

7.4.6 It is worth noting that the queue lengths do not form part of the DMRB's model validation criteria. The Junction 28 queue length comparison shows that the model reflects the appropriate level of queues and delays in each peak hours.

Table 7.2: Queue Data Comparisons

Arm	Mean Max Queue Length (metre)								
	0800-0900			Avg. 1000-1600			1700-1800		
	Mod. (m)	Obs. (m)	Diff. (m)	Mod. (m)	Obs. (m)	Diff. (m)	Mod. (m)	Obs. (m)	Diff. (m)
M25 Southbound	57	145	-88	32	26	-7	86	54	32
A12 Westbound	113	190	-77	78	33	-45	84	62	21
Brook Street	595	200	395	50	35	-15	423	92	331
M25 Northbound	67	58	10	51	45	-6	82	81	1
A12 Eastbound	47	53	-6	42	46	4	47	72	-24

*Note: * The observed queues on 25th March, 2014 on the A12 East and Brook Street were beyond camera view. The maximum recoded value for A12 East is 190 m and Brook Street was 200m.*

7.5 Calibration Adjustments

7.5.1 Adjustments have been made as necessary to eliminate any software errors, and to replicate the overall performance of the model to match with any existing driving conditions. The calibration process was undertaken utilising various data sources such as; site visit observation, reviewing video recordings, using signal timing data and comparison with the observed data.

7.5.2 The network adjustments that were carried out during calibration process together with justification for the adjustment is presented in Table 7-3.

Table 7.3: Calibration and Validation Acceptability Guidelines

Network Adjustment Post Calibration	Justification for Adjustment
Dummy connectors were placed on the roundabout	At stop lines vehicles were noted changing lane unnecessarily in the model therefore dummy connectors included to resolve unrealistic driving behaviour
Signal timings were reviewed and updated in the model	Based on the video observations one second green time was adjusted on the M25 North approach in AM peak and A12 East approach in PM peak.
At stoplines and gyratory the Reduced Speed Areas (RSAs) with speed distribution of 40 mph were used	To replicate natural speed reductions at stoplines and turns at gyratory
The Reduced Speed Area (RSA) with speed distribution of 30 mph were used at the A12 East off-slip	A steep gradient exist at the A12 East off-slip, as a results vehicles (particularly HGVs) were notices approaching the roundabout at a slower speed than usual. To replicate this driving conditions RSA are implemented
Gap acceptance parameters were calibrated at the A1023 Brook Street approach	Based on video observations gap acceptance parameters were adjusted from the default values (see Table 4-1
Driver behaviour parameters	Different driver behaviour parameters were adopted for the motorway links and urban links. This is in line with the Highways England's Use of the Microsimulaiton modelling Guidelines
A1023 Brook Street/Nags Head Lane junction a "Keep Clear" markings added	Following the site visit at this location "Keep Clear" marking was added at the A1023 Brook Street northbound approach

7.6 Random Seed Values

7.6.1 Microsimulation models use an input seed value to determine the random generation of vehicle profiles entering the modelled network. This seed generates the vehicle arrival profiles, including vehicle types and arrival times, and will therefore have an effect on subsequent driver interaction and network operation. To some extent, this will reflect daily variation in traffic patterns and levels of services on the road network.

7.6.2 The Junction 28 model was run with 10 different random seeds (starting with random seed 10 with increment of 10) for collection of outputs to compare the VISSIM calibration results against turning counts and link counts (where available). "T-test" was carried out to check the statistical validity of varying random seeds for validation and calibration of model. The total journey time of the network was used to carry out t-test at 95% level of confidence ($\alpha = 0.05$). The table below shows the total journey times for each run with different random seed and the T-test evaluation. The formula used for deriving the required number of model runs is as follows:

$$n = (t_{n-1}\left(1 - \frac{\alpha}{2}\right)\frac{s}{w})^2$$

Where:

α = Level of confidence

w= interval half width

s= sample standard deviation

t = left-tailed inverse of the t-distribution

n= number of runs

7.6.3 This estimates, for given α and w, the number of seed runs required to have a (1-α) probability that the 'true' mean of your test statistic differs from the observed average by at most interval half width (w). In other words, the number of seed runs required for the 100(1-α) % confidence interval for the mean to have width of 2w. This assumes that the means of samples of test statistic are normally distributed.

Table 7.4: T-test Assessment Core Peak Hour

Run	Total Journey Time Network (s)		
	0800-0900	Avg. 1000-1600	1700-1800
1	9244545	6815889	10061266
2	9627348	6740285	10219737
3	9534586	6696582	10238674
4	9547799	6642310	10376163
5	9671856	6668400	10021090
6	9617552	6753184	10515615
7	9758952	6873415	10212890
8	9180070	6656191	10157081
9	9100890	6774088	9991971
10	9396240	6749050	10258760
Sample std. dev.	225468.4302	73380	160637.805
Significance level	0.05	0.05	0.05
Mean	9467983.93	6736940	10205324.72
Runs completed	10	10	10
Total desired number of runs	1	1	1
Number of runs achieved?	✓	✓	✓

7.6.4 Furthermore, the model performed best against average observed traffic data with a random seed of 42.

7.7 Flow Calibration

7.7.1 To demonstrate that the model is operating accurately the observed flows that used in the matrix development were compared against the modelled turning counts and link flows. Traffic data used in the calibration included counts from the existing 2014 survey and TRADS data.

7.7.2 Table 7-5 presents GEH comparison for the core peak hours between the modelled flows against an observed traffic flows.

Table 7.5: Comparison of Modelled and Observed Flows

Arm	Origin			Destination		
	Modelled	Observed	GEH	Modelled	Observed	GEH
	0800-0900					
M25 Southbound	4504	4414	1.35	4638	4538	1.48
A12 Westbound	2896	2761	2.54	2538	2527	0.21
Brook Street	837	804	1.15	940	969	0.95
M25 Northbound	4811	4831	0.28	4343	4256	1.33
A12 Eastbound	1637	1592	1.13	2226	2111	2.47
	Avg. 1000-1600					
M25 Southbound	3876	3988	1.79	3611	3646	0.59
A12 Westbound	1724	1747	0.56	1972	2012	0.90
Brook Street	682	688	0.24	636	651	0.60
M25 Northbound	3537	3567	0.51	3619	3698	1.30
A12 Eastbound	1188	1191	0.09	1169	1175	0.16
	1700-1800					
M25 Southbound	5955	5859	1.25	4728	4754	0.38
A12 Westbound	2457	2475	0.36	3541	3485	0.94
Brook Street	969	1016	1.49	1002	1038	1.14
M25 Northbound	4996	5035	0.55	4825	4805	0.29
A12 Eastbound	1962	1964	0.06	2243	2267	0.51

7.7.3 The standard method used to compare modelled values against observations on a link therefore involves the calculation of the GEH statistic. As a general rule, when comparing assigned volumes with observed volumes, a GEH parameter of 5 is considered as acceptable.

GEH statistics show that the model has achieved the Calibration and Validation Acceptability Criteria (presented in Table 7.1).

7.7.4 As set out in the DMRB, to be acceptable, a GEH should be below 5. As such, the ideal is to get GEH statistics below 5. The GEH comparison presented in above table shows that all the approaches has GEH value of less than 3 except for Brook Street approach, however, it is very close to GEH value of 5. On this basis, the modelled flow comfortably meets the DMRB requirements for acceptability.

7.7.5 Table 7-6 presents result for modelled link flow comparisons against the observed data. This provides further confirmation that the modelled traffic movements around the network are comfortably meeting the GEH criteria with maximum GEH value of 5.20 in the PM Peak at Brook Street.

Table 7.6: GEH Summary

Arm	0800-0900		Avg. 1000-1600		1700-1800	
	GEH	<5	GEH	<5	GEH	<5
	Origin					
M25 Southbound	1.35	Y	1.79	Y	1.25	Y
A12 Westbound	2.54	Y	0.56	Y	0.36	Y
Brook Street	1.15	Y	0.24	Y	1.49	Y
M25 Northbound	0.28	Y	0.51	Y	0.55	Y
A12 Eastbound	1.13	Y	0.09	Y	0.06	Y
	Destination					
M25 Southbound	1.48	Y	0.59	Y	0.38	Y
A12 Westbound	0.21	Y	0.90	Y	0.94	Y
Brook Street	0.95	Y	0.60	Y	1.14	Y
M25 Northbound	1.33	Y	1.30	Y	0.29	Y
A12 Eastbound	2.47	Y	0.16	Y	0.51	Y

7.8 Journey Time Calibration

7.8.1 The Highways England's Journey Time Data Base (JTDB) has been used for the model development to obtain the speed flow characteristics on the main line. For the journey time calibration purpose this data has been compared with the modelled journey time for the following six routes and have been presented in Table 7-7.

7.8.2 Highways England's Journey Time Data Base (JTDB) sections are presented as follows:

- M25 Junction 27 to M25 Junction 28;
- M25 Junction 28 to M25 Junction 27;
- M25 Junction 28 to M25 Junction 29;
- M25 Junction 29 to M25 Junction 28;
- M25 Junction 28 to A12/A1023 Junction; and
- A12/A1023 Junction to M25 Junction 28.

7.8.3 The modelled journey time for all the six routes are within 15% of the observed 2015 journey times. This is in line with the journey time acceptability criteria suggested in the DfT's TAG Unit 3.1 – Highways Assignment Modelling.

Table 7.7: Comparison of Modelled and Observed Journey Times (Core Peak Hour)

No.	JT Section	Length (m)	Journey Times AM								
			0800-0900			Avg. 1000-1600			1700-1800		
			Mod. (Sec)	Obs. (Sec)	% Diff.	Mod. (Sec)	Obs. (Sec)	% Diff.	Mod. (Sec)	Obs. (Sec)	% Diff.
1	M25 J27 to M25 J28	12570	461	432	7%	474	442	7%	477	456	5%
2	M25 J28 to M25 J27	12560	476	449	6%	468	445	5%	458	435	5%
3	M25 J28 to M25 J29	3810	140	135	4%	144	138	5%	142	137	3%
4	M25 J29 to M25 J28	3780	142	142	0%	141	140	0%	138	138	0%
5	M25 J28 to A12/A1023	7220	266	262	1%	260	262	-1%	274	284	-3%
6	A12/A1023 to M25 J28	7280	273	297	-8%	256	254	1%	260	260	0%

7.9 Calibration Summary

7.9.1 Observations on traffic queueing was used within the calibration process to ensure that the modelled profile of queues shows close agreement with an observed queue and the proportions of queuing at each approach was representative of local conditions.

7.9.2 The modelled flows and journey times, which have been considered during the model development stage were used for the calibration checks. There is good agreement of the modelled flows and journey times compared with observed data, and hence the model calibrates well against the DfT's TAG Unit 3.1 acceptability criteria.

8. Model Validation

8.1 Introduction

8.1.1 Model validation is the process of checking that the base year model replicates the existing traffic flows, observed journey times and operating conditions. This is done by comparing modelled traffic flows and travel times against independent observed data (i.e. data which has not been used to calibrate the model). This was set out earlier in this report in Table 3-1.

8.2 Travel Time Analysis

8.2.1 The stochastic nature of microsimulation models means that simply by changing the random seed number, that influences the sampling of values from specified distributions, will get slightly differing results from each model run. Highways England's "Guidelines for the Use of Micro-simulation" suggest using the random seed functionality to establish the degree of variation in the base case.

8.2.2 Travel time (T-time) analysis was carried out to identify variation in delays and travel time for the respective random seed. This analysis allows evaluating the variation (standard deviation) in travel times and delays for the Junction 28 VISSIM network.

8.2.3 The T-time analysis (Appendix E) shows that the base VISSIM model has achieved recommended confidence interval level of modelled journey time variability within 10 random seeds. Therefore in order to obtain model outputs for the validation purpose, the Junction 28 model was run using ten random seeds and an average simulation results were compared against the observed data.

8.3 Traffic Flow Validation

Link flow validation

8.3.1 For the model validation an independent set of traffic data that has not been used for the development of the demand matrices were obtained from TRADS and compared with the modelled flows. The available TRADS data was identified for three locations:

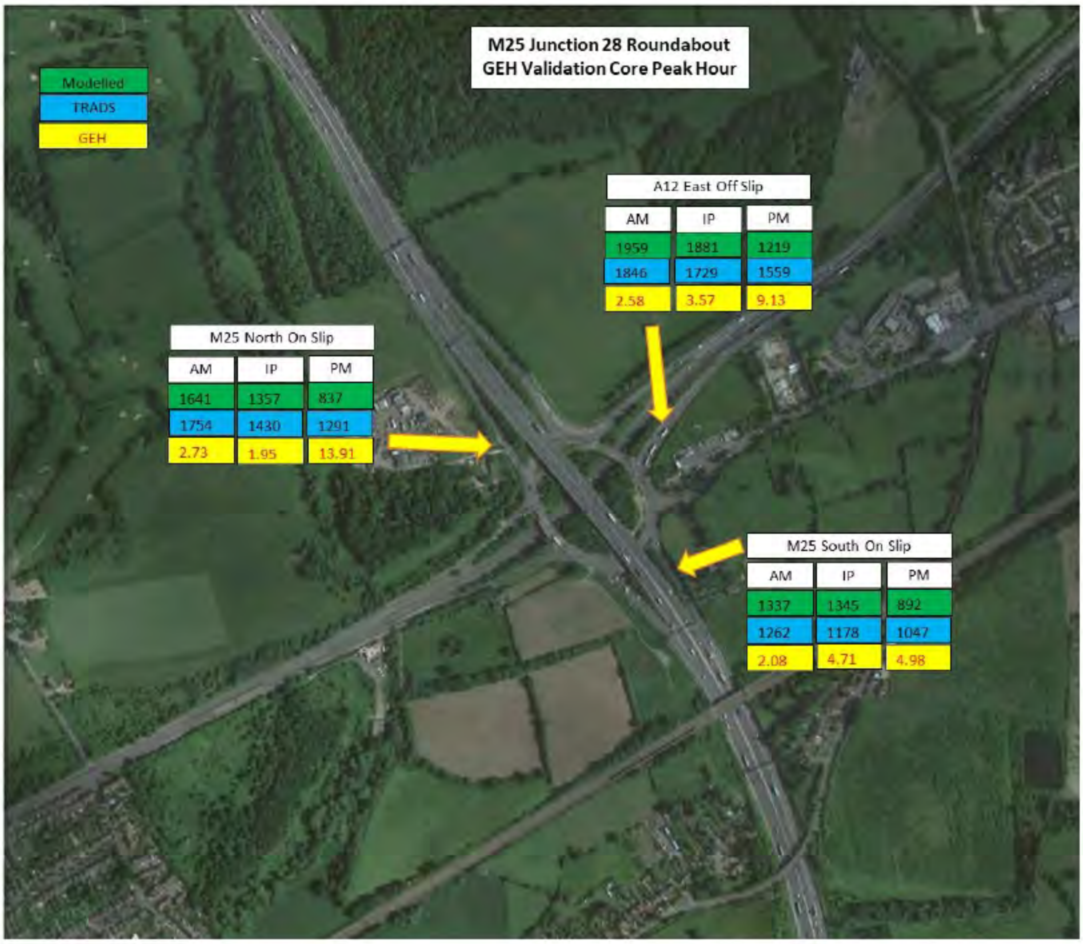
- A12 east off-slip;
- M25 north on-slip; and
- M25 south on-slip.

8.3.2 Table 8-1 shows the comparison of the modelled and observed traffic flows at these locations, including the GEH statistic for the AM, Inter-peak and PM peak hours. It can be seen that the GEH values in all the peak hours are within the DfT's TAG Unit 3.1 acceptability criteria of GEH value less than 5. Figure 8-1 presents the GEH statistics graphically.

Table 8.1: Traffic Flow Validation (Core Peak Hour)

TRADS Location	0800-0900			Avg. 1000-1600			1700-1800		
	Mod.	TRADS	GEH	Mod.	TRADS	GEH	Mod.	TRADS	GEH
A12 W/b (Off Slip)	1881	1729	3.57	1226	1378	4.22	1551	1503	1.24
M25 S/b (On Slip)	1357	1430	1.95	1022	1180	4.77	1482	1438	1.14
M25 N/b (On Slip)	1345	1178	4.71	876	954	2.59	1095	1145	1.50

Figure 8.1: Summary of Flow Validation and GEH Statistic



M25 on-slip tiger tail validation

8.3.3 MIDAS loop data were obtained and compared against the modelled lane flows at both the M25 northbound (N/b) and southbound (S/b) merge sections. This comparison is presented in Table 8-2. It can be seen that the GEH values in all the peak hours are within the DfT's TAG Unit 3.1 acceptability criteria of GEH value less than 5.

Table 8.2: Traffic Flow Validation

Location	0800-0900			Avg. 1000-1600			1700-1800		
	Mod.	Obs. (MIDAS)	GEH	Mod.	Obs. (MIDAS)	GEH	Mod.	Obs. (MIDAS)	GEH
M25 N/b Tiger Tail (L1)	688	589	3.91	514	522	0.35	756	605	5.78
M25 N/b Middle Tail (L2)	669	737	2.55	509	593	3.58	727	820	3.33
M25 S/b Tiger Tail (L1)	670	559	4.48	439	552	5.07	549	535	0.61
M25 S/b Middle Tail (L2)	673	708	1.34	437	419	0.87	546	505	1.79

8.4 Journey Time Validation

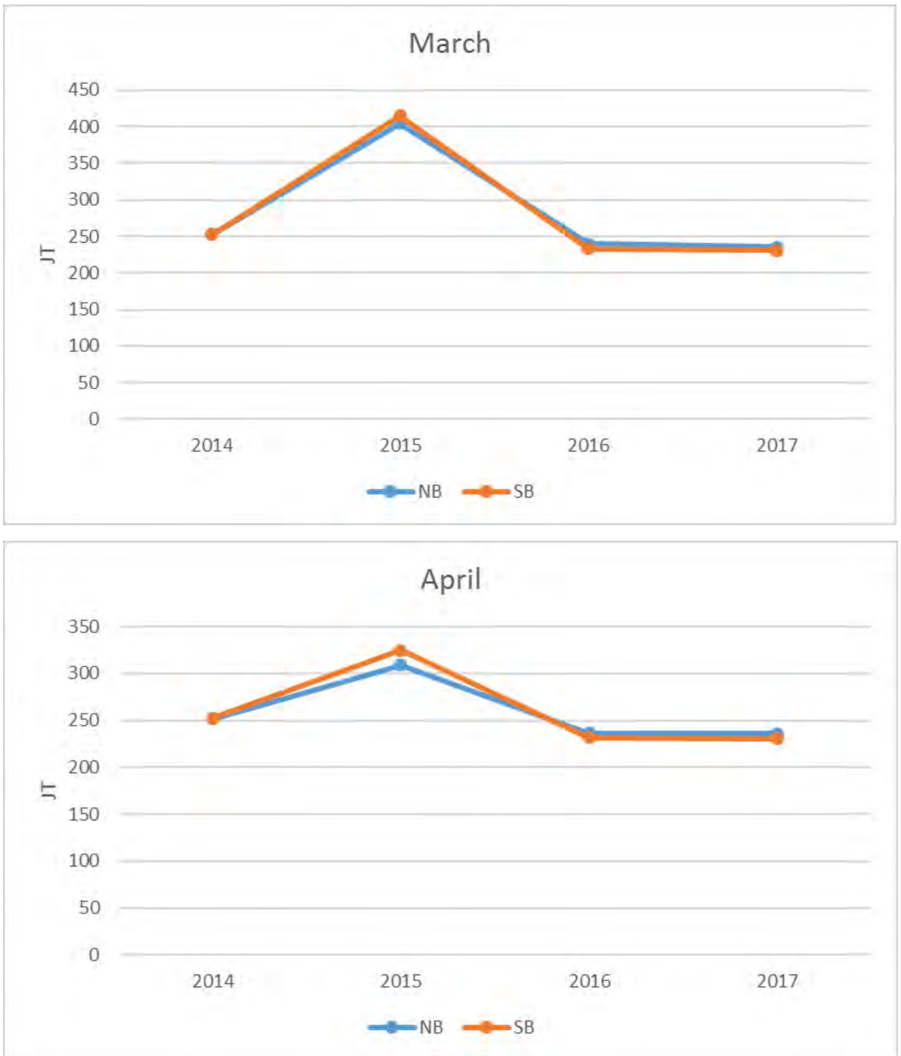
8.4.1 It is important that modelled journey times are validated well against observations to make sure that speeds on links and delays at Junction 28 are accurately represented by the model. The criteria set out in DfT's TAG Unit 3.1 require that modelled journey times should be within ±15% of the observed times (or ±1 minute, if higher than 15%) on 85% of travel time routes.

8.4.2 In addition TAG Unit 3.1 recommends obtaining the journey times by vehicle type. However, it states that if journey times by vehicle type are not available but separate speed/flow relationships for light and heavy vehicles have been used, a weighted average of the modelled light and heavy vehicle speeds should be compared with the surveyed all-vehicle speed. This approach has been used for the M25 Junction 28 journey time validation.

8.4.3 During PCF Stage 3, 2015 journey times were obtained from Tom-Tom data and analysed to compare against the modelled journey times. During the assessment, it was identified that there were temporary speed restrictions in place along the A12 between the M25 Junction 28 and A1023/A12 Junction.

8.4.4 The unbiassed journey times from the 2014 data were compared against 2015, 2016 and 2017 for the March and April months (excluding bank holidays and weekends). This analysis is presented in Figure 8.2. The 2014 (unbiassed) journey time is closely compare with the 2016 and 2017 journey times. Therefore, the observed 2014 journey times were used for the journey times validation.

Figure 8.2: A12 Journey Time Comparisons



8.4.5 The journey time data from Tom-Tom was processed for the AM, Inter-peak and PM peak hours. Tom-Tom journey time sections are summarised as follows:

- A12 Westbound to M25 Northbound;
- M25 Southbound to A12 Eastbound;
- M25 Northbound to A12 Eastbound; and
- A12 Westbound to M25 Southbound.

8.4.6 Table 8-3 presents journey time validation for an individual section in the AM, Inter-peak and PM peak hours.

8.4.7 Graphical map showing these individual Tom-Tom journey time segments is presented in Figures 8-4 to 8-6. The individual journey time sections are graphically presented in Appendix F.

8.4.8 All the modelled journey time sections are within ±15% of the observed journey time as set out in the DfT's TAG Unit 3.1 for the journey time acceptability criteria in all three peaks. Therefore the model is deemed suitable for the M25 Junction 28 proposed options' appraisal and evaluation. This is summarised in Table 8-4.

Table 8.3: Journey Times Validation Core Peak Hour

No.	JT Section	Length (m)	Journey Times AM								
			0800-0900			Avg. 1000-1600			1700-1800		
			Mod. (Sec)	Obs. (Sec)	% Diff.	Mod. (Sec)	Obs. (Sec)	% Diff.	Mod. (Sec)	Obs. (Sec)	% Diff.
1	A12 W/b to M25 N/b	5485	271	278	-2%	249	255	-2%	262	262	0%
2	M25 S/b to A12 E/b	4508	189	182	4%	194	182	7%	206	189	9%
3	M25 S/b to A12 E/b	11960	524	486	8%	513	490	5%	537	528	2%
4	A12 W/b to M25 S/b	11715	489	496	-1%	467	432	8%	468	431	9%

Table 8.4: Journey Times Validation – Summary

Journey Time Validation Criteria		Sections				
		A12 E to M25 N	M25 N to A12 E	M25 S to A12 E	A12 E to M25 S	Average
Percentage of Journey Times within 15% or within 60 seconds	AM Peak	100	100	100	100	100
	Inter-Peak	100	100	100	100	100
	PM Peak	100	100	100	100	100

Individual Travel Time Segment Validation

8.4.9 Journey time data obtained from Tom-Tom has been further analysed by breaking down the entire journey time section into individual journey time section and compared against the modelled journey times.

8.4.10 Tables 8-5 to 8-7 provides the summary of journey time validation by individual sections for the core peak hours.

Table 8.5: M25 North & A12 East Journey Time Validation

M25 North to A12 East	Dist. (m)	0800-0900		Avg. 1000-1600		1700-1800	
Location		Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)
M25 North to M25J28 off slip (SB)	2266	86	83	87	83	90	85
M25 North to A12 East Roundabout	1387	72	67	75	67	81	69
A12 East (WB)	855	31	32	31	32	32	35
A12 East to M25 North							
A12 East to M25Jn28 off slip (EB)	1119	50	45	43	45	44	43
A12 East to M25 North Roundabout	1163	96	99	108	89	87	103
M25Jn28 North (NB)	3203	121	117	111	122	120	109

Table 8.6: A12 East to M25 South Journey Time Validation

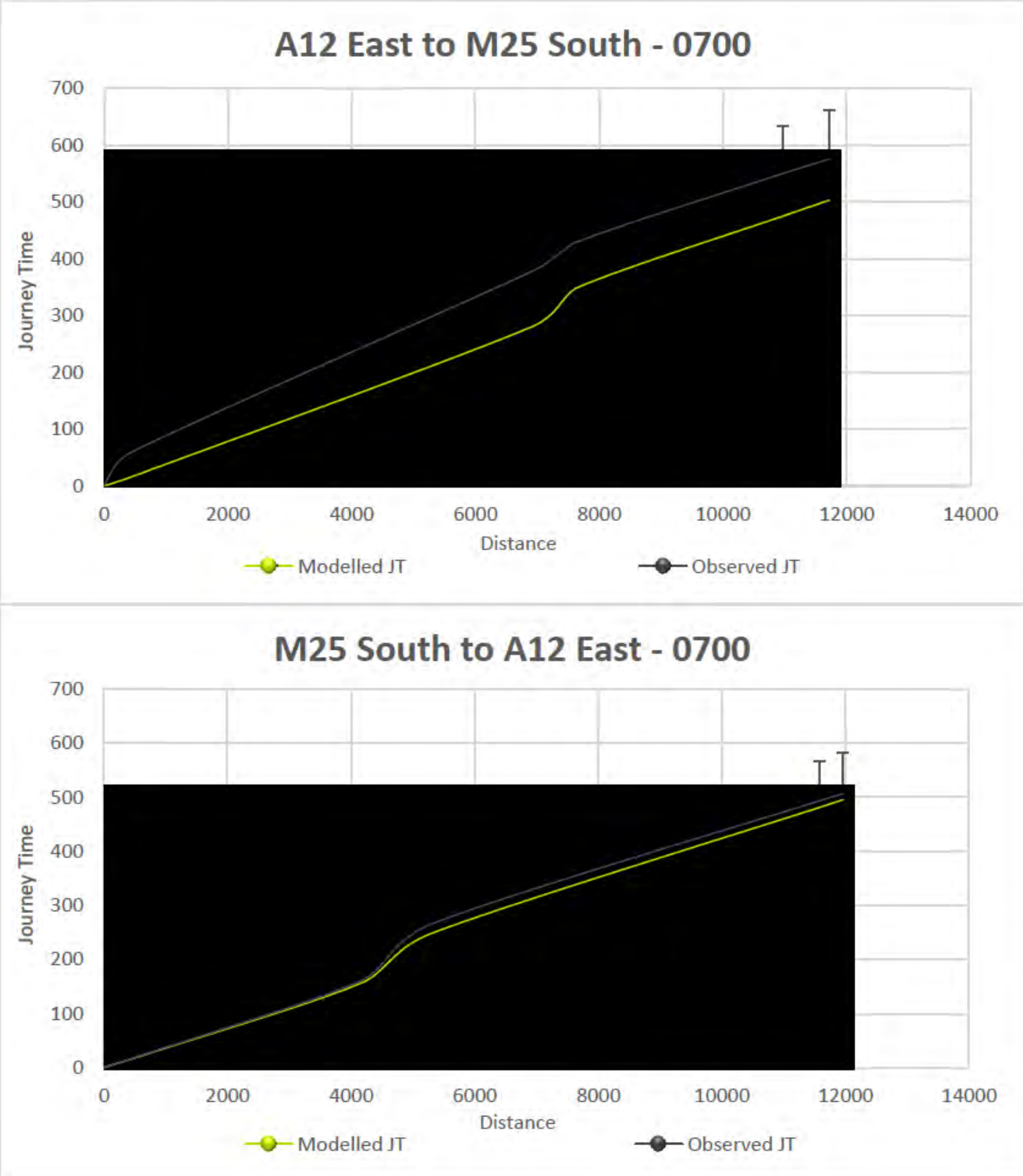
A12 East to M25 South	Dist. (m)	0800-0900		Avg. 1000-1600		1700-1800	
Location		Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)
A12/A1023 East Ahead Movement (EB)	439	15	17	15	15	15	15
A12 East till M25Jn28 off slip (EB)	6473	253	263	238	225	239	227
A12 East to M25 South Roundabout	740	70	72	60	53	61	51
M25 South till M25J29 off slip	3323	122	120	125	116	124	114
M25J29 Ahead Movement (SB)	740	27	24	28	24	27	24

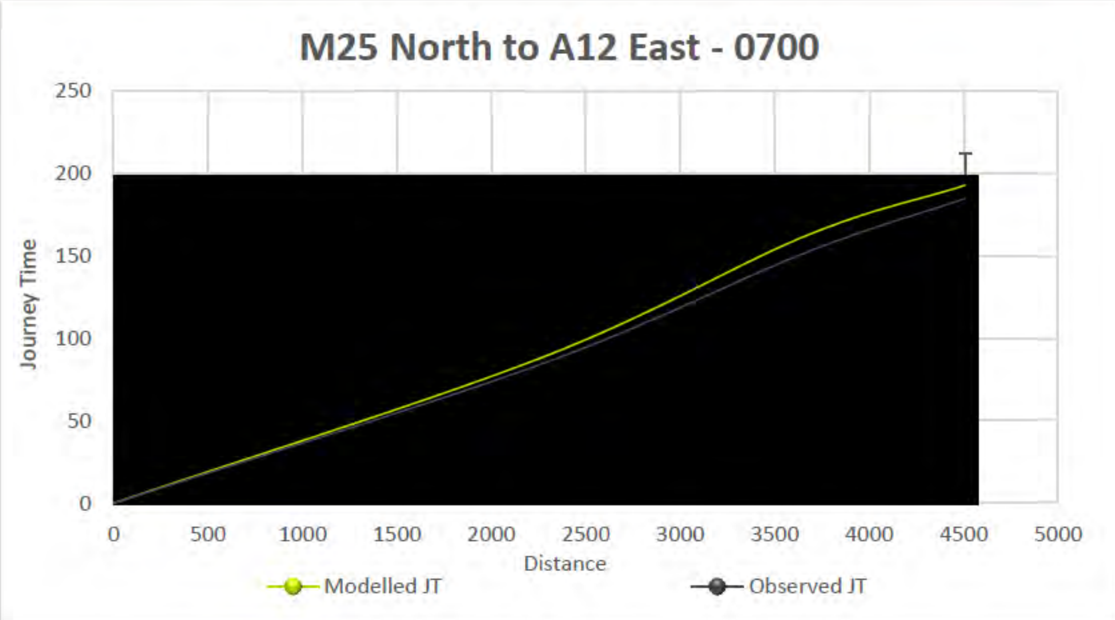
Table 8.7: M25 South to A12 East Tom-Tom journey time section

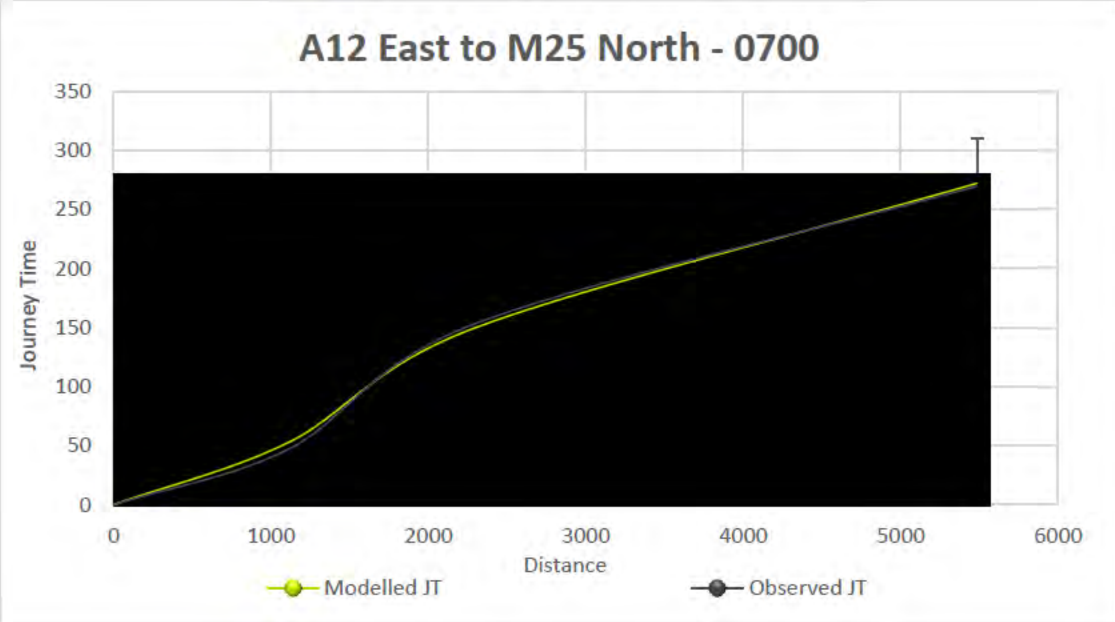
M25 South to A12 East	Dist. (m)	0800-0900		Avg. 1000-1600		1700-1800	
Location		Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)	Mod. (Sec)	Obs. (Sec)
M25J29 Ahead Movement (NB)	692	25	24	25	24	24	25
M25 South till M25Jn28 off slip (NB)	3474	132	128	130	128	129	130
M25 South to A12 East Roundabout	1143	97	101	90	102	104	112
A12 East till A1023/A12 off slip (WB)	6279	236	220	234	223	244	247
A12/A1023 Ahead Movement (WB)	373	14	13	14	13	15	14

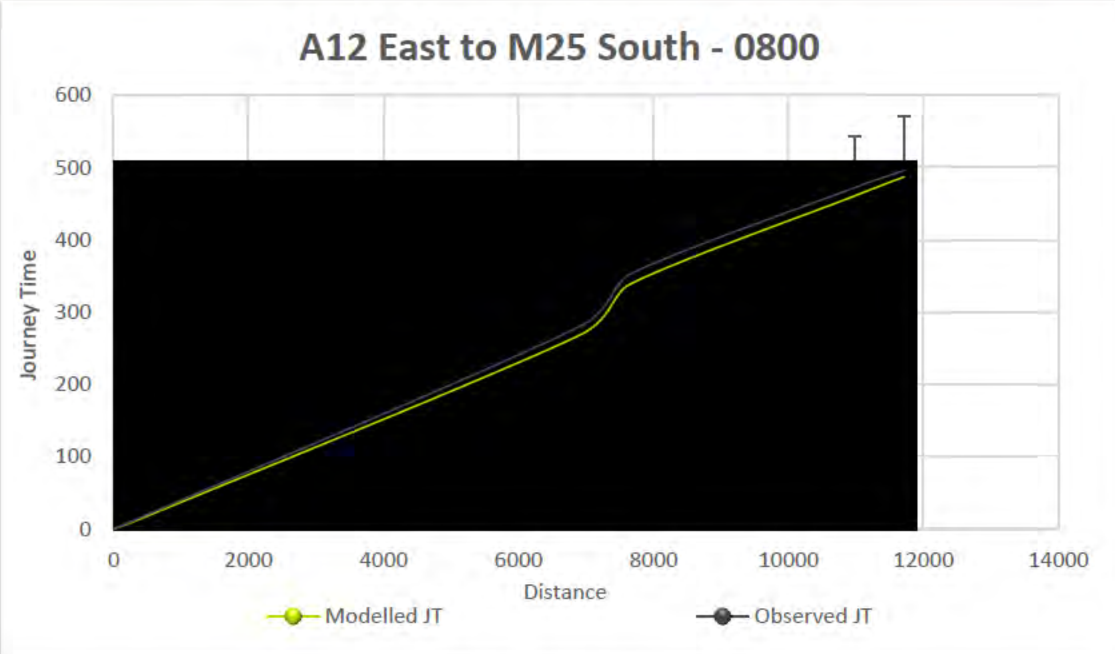
8.4.11 Figures below presents the cumulative journey times against cumulative observed journey time sections for the AM peak hour. The Inter-peak and PM peak hours journey time graphs are presented in Appendix G.

Figure 8.3: Cumulative Journey Time Comparisons – AM Peak Hour




M25 North to A12 East - 0700
Journey Time
250
200
150
100
50
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance
Modelled JT
Observed JT


A12 East to M25 North - 0700
Journey Time
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
Distance
Modelled JT
Observed JT


A12 East to M25 South - 0800
Journey Time
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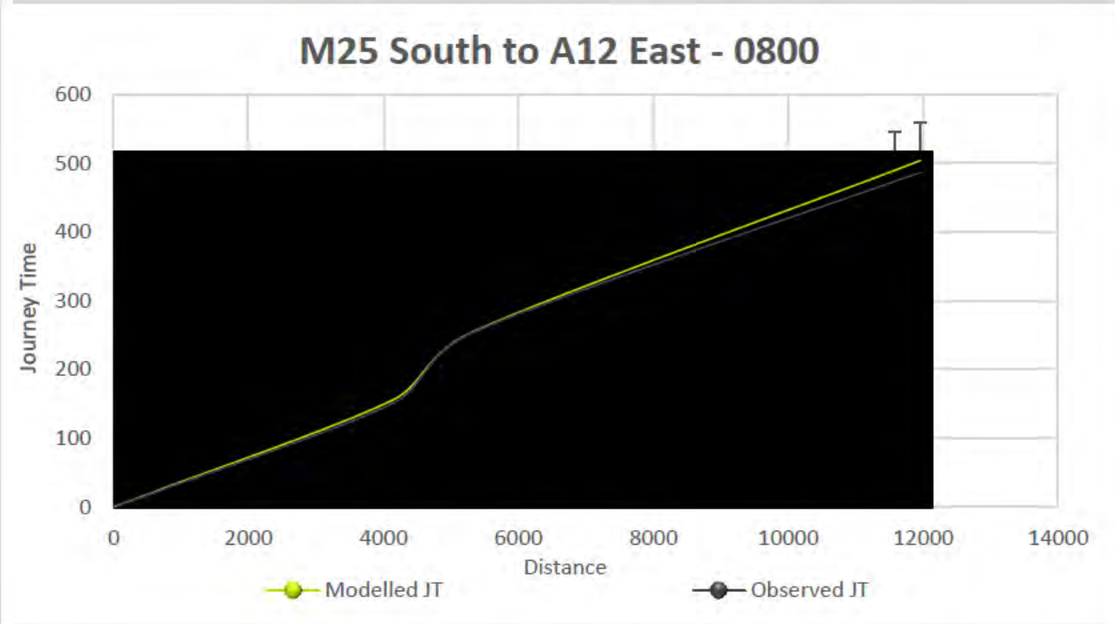
400
500
600
0
2000
4000
6000
8000
10000
12000
14000
Distance
Modelled JT
Observed JT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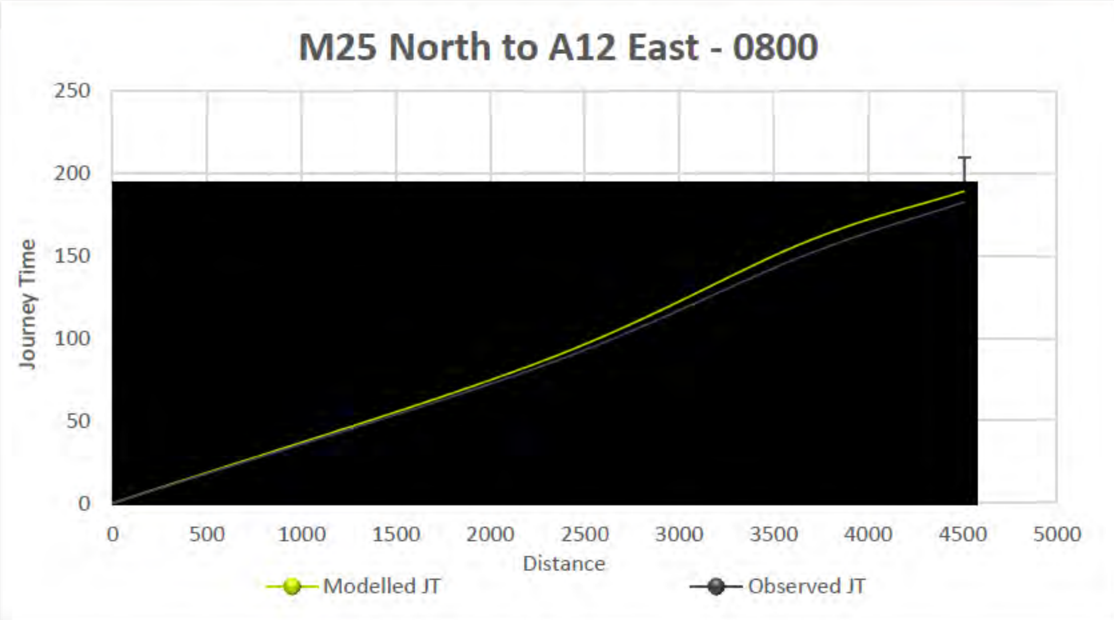
Journey Time
0
100
200
300
400
500
600
0
2000
4000
6000
8000
10000
12000
14000
Distance
Modelled JT
Observed JT


M25 North to A12 East - 0800
Journey Time
250
200
150
100
50
0
0
500
1000
1500
2000
2500
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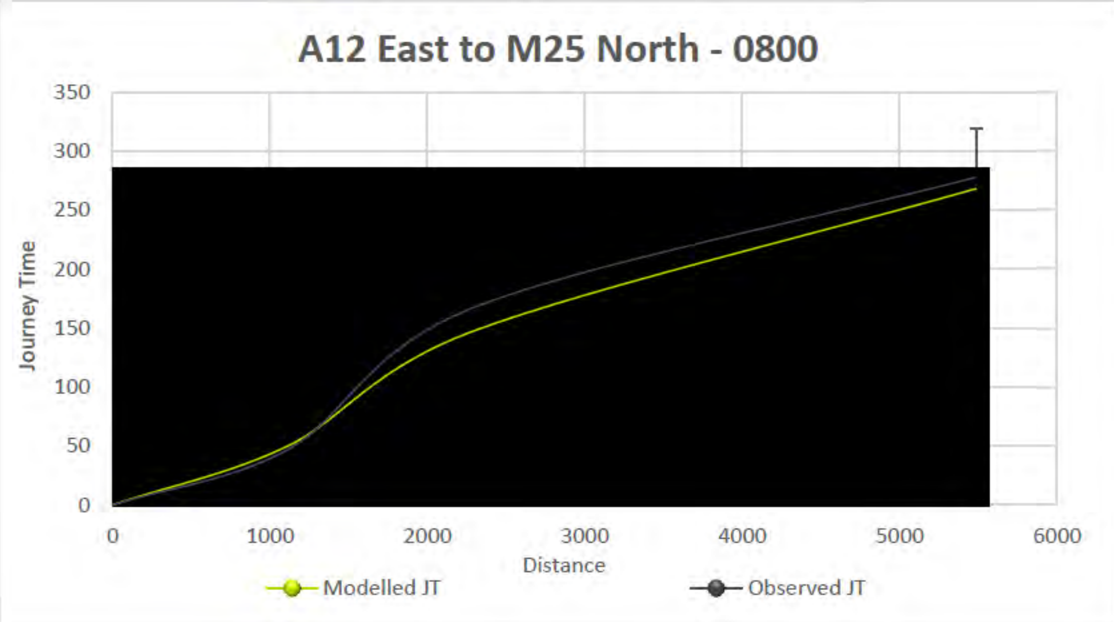
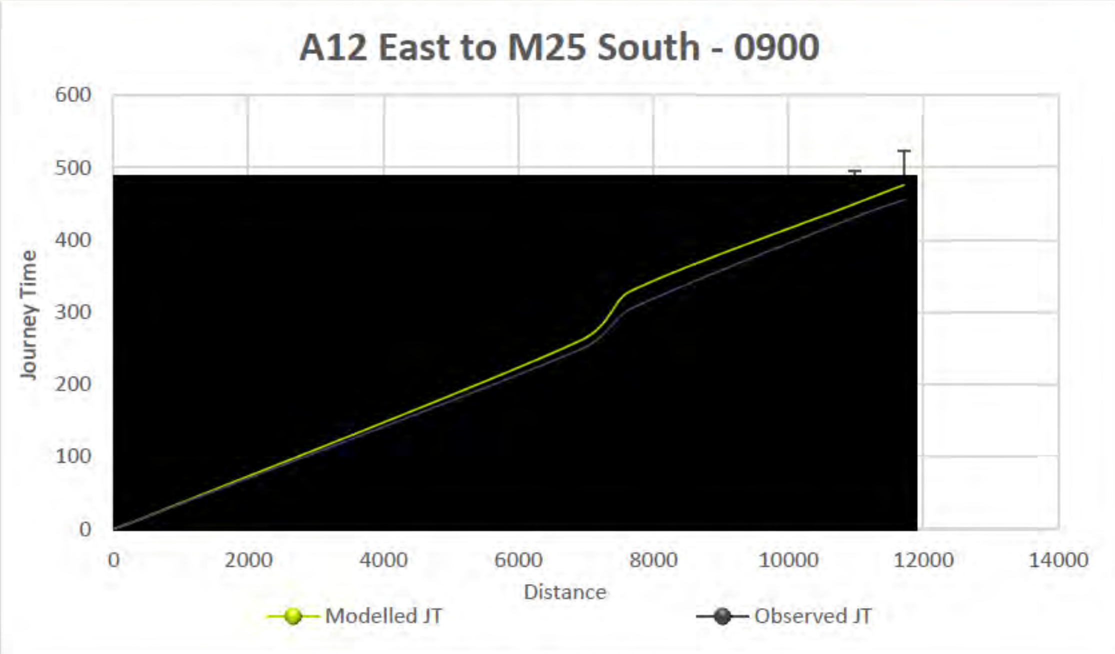
3500
4000
4500
5000
Distance
Modelled JT
Observed JT


A12 East to M25 North - 0800
Journey Time
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
Distance
Modelled JT
Observed JT


A12 East to M25 South - 0900
Journey Time
600
500
400
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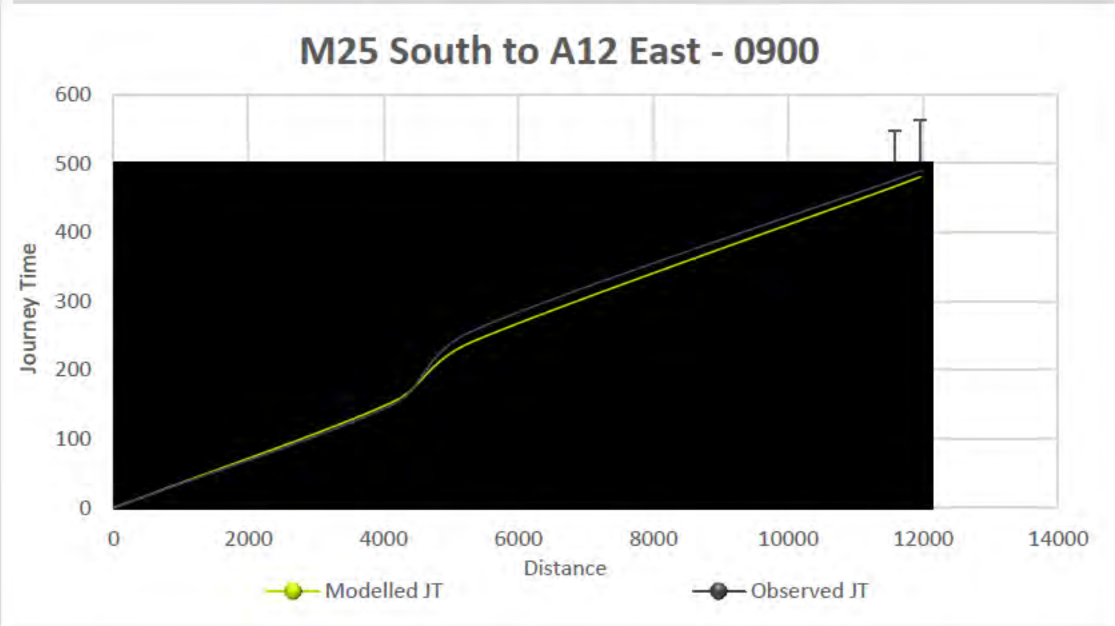
200
100
0
0
2000
4000
6000
8000
10000
12000
14000
Distance
Modelled JT
Observed JT


M25 South to A12 East - 0900
Journey Time
600
500
400
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200
100
0
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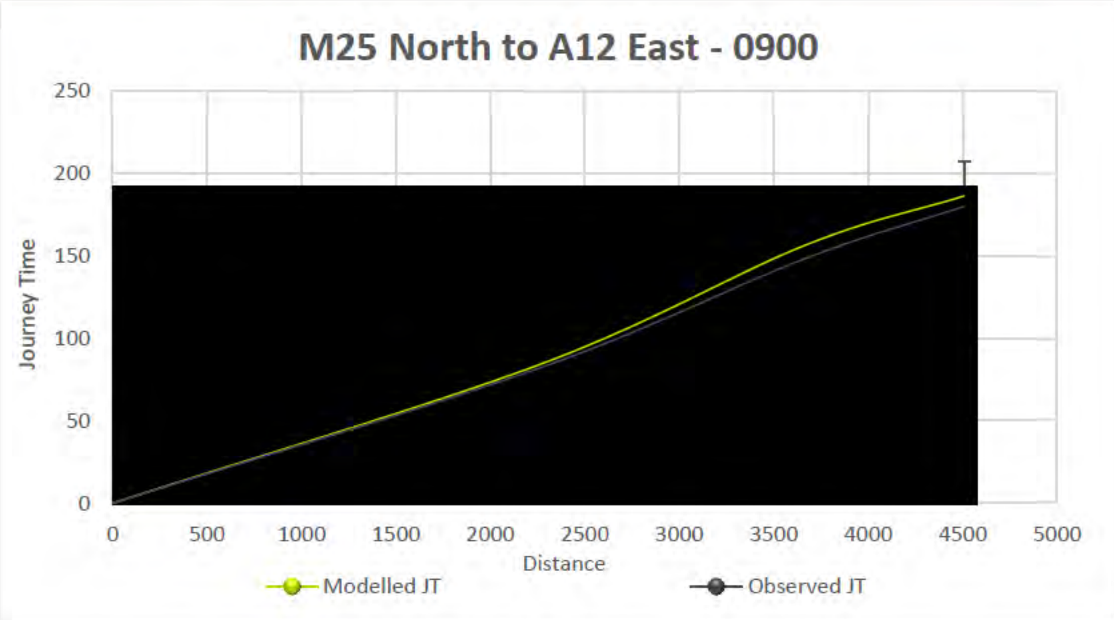
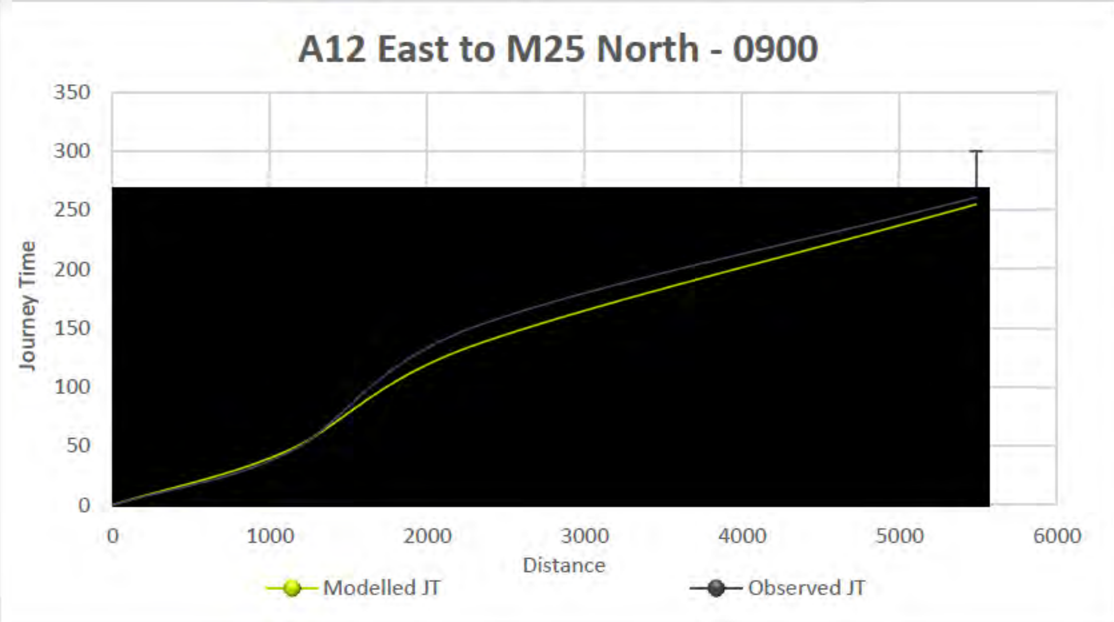
2000
4000
6000
8000
10000
12000
14000
Distance
Modelled JT
Observed JT


M25 North to A12 East - 0900
Journey Time
250
200
150
100
50
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Distance
Modelled JT
Observed JT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Journey Time
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300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
Distance
Modelled JT
Observed JT

Figure 8.4: Journey Time Routes – M25 North to A12 East & A12 East to M25 North

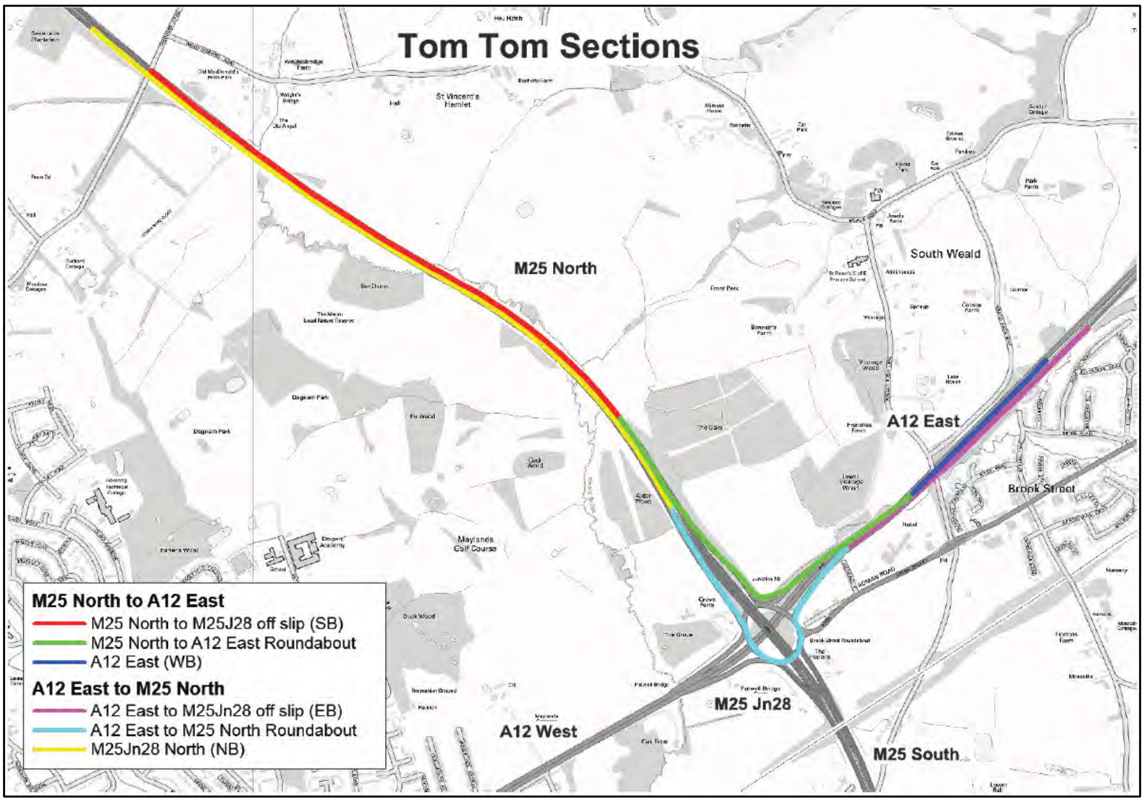


Figure 8.5: Journey Time Route – A12 East to M25 South

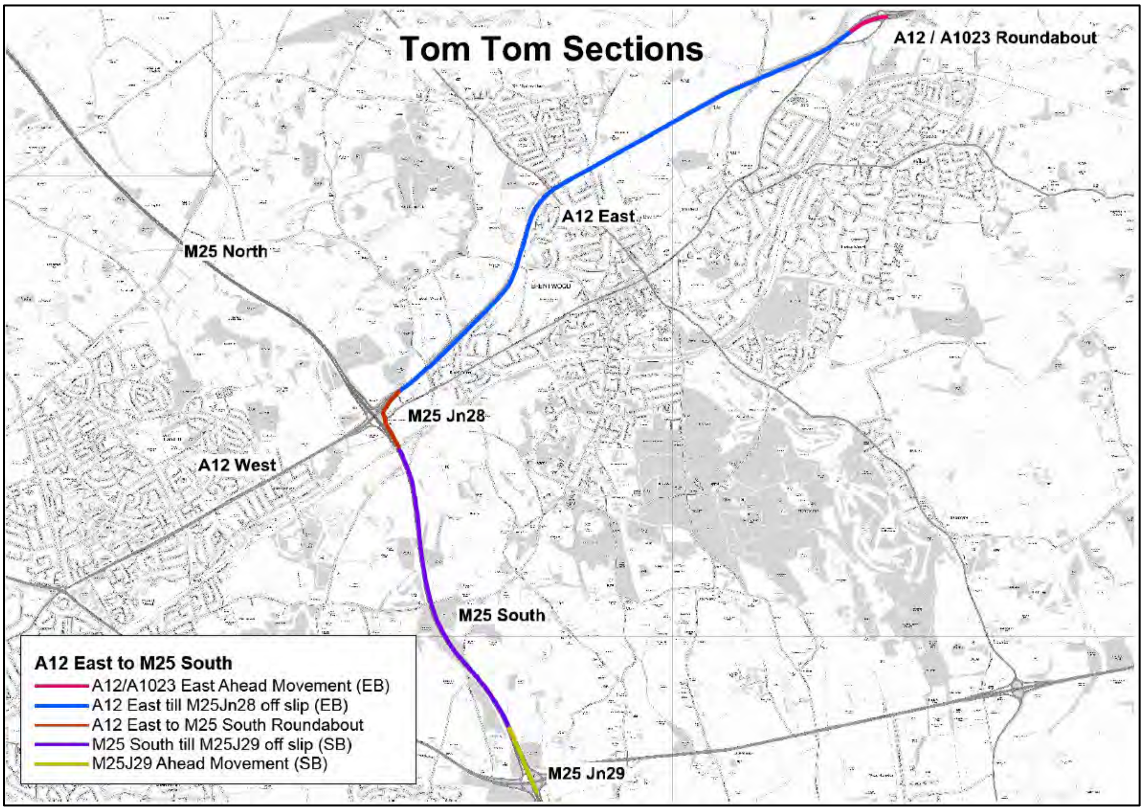
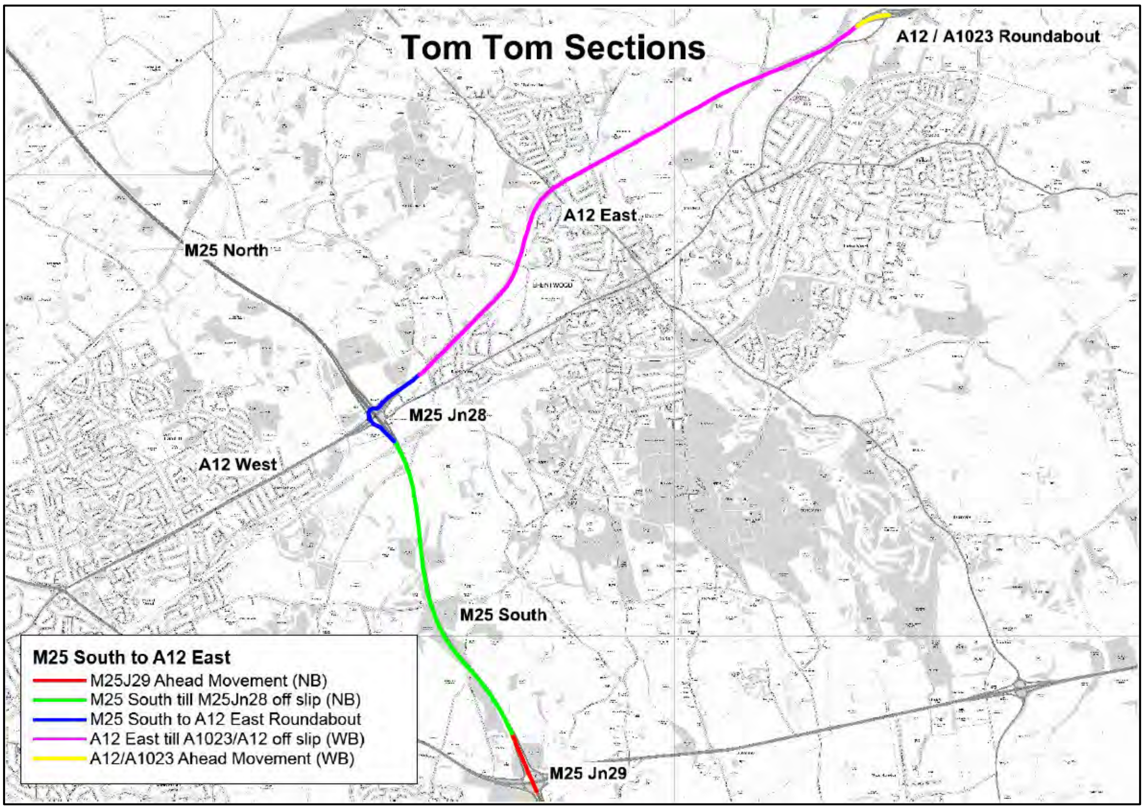


Figure 8.6: Journey Time Route – M25 South to A12 East



8.5 Summary of Model Validation

8.5.1 Overall, it is felt that the flows and journey time's validation have produced a base model that reflects existing traffic conditions and behaviour at the M25 Junction 28.

8.5.2 Furthermore, the modelled journey times were validated within the acceptable criteria of ±15% of the observed journey times. The modelled flows also achieves acceptability criteria of GEH well below 5 for all the movements.

Appendix C. Road safety audit

RIP M25 Junction 28 Improvements

Stage 1 Road Safety Audit

Highways England

3rd December 2019

Notice

This document and its contents have been prepared and are intended solely as information for Highways England and use in relation to the proposed junction improvements at junction 18 of the M25.

Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 16 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]						

Client signoff

Overseeing Organisation	Highways England
RSA team organisation	Atkins
Report title	RIP M25 Junction 28 Improvements Stage 1 Road Safety Audit
Job number	5158157.559
Document reference	N/A

Table of contents

1. Introduction

Atkins has been commissioned by Highways England to undertake a Stage 1 Road Safety Audit of the proposed junction improvements at junction 28 of the M25. This report documents the outcome of the RSA in the form of identified road safety problems and associated recommendations.

Section 2 documents the findings at the current RSA stage. Section 4 comprises the RSA Team statement. Details of the information provided about the highway scheme are included in Appendix A. Problems and recommendation locations for the current RSA stage are shown on the plan included in Appendix B.

Terms of reference

The RSA has been conducted in accordance with GG 119 Road safety audit, in the Design Manual for Roads and Bridges. The RSA team has examined and reported only on the road safety implications of the highway scheme proposals and has not examined or verified the compliance of the designs to any other criteria. Where there are issues that may be of interest to the Design Organisation, but not necessarily within the scope of the RSA, these have been provided to the Overseeing Organisation separately.

In addition to GG 119, this RSA has been informed by an RSA Brief provided by Simon Harris of Atkins. The RSA brief was approved by Brian Gash of Highways England.

RSA team

The RSA Team, approved by Brian Gash of Highways England, was as follows:

[redacted]	MEng, CEng, MICE Principal Consultant, Atkins Transportation (Certificate of Competency awarded 2013)
[redacted]	BSc (Hons) MSoRSA Road Safety Engineer, Atkins Transportation

Site visit

The site visit completed to inform the RSA was carried out during daylight hours on the 01 November 2019 Between 12:00-15:00. During this visit it was overcast and the road surface was dry. Traffic conditions during the site visit were free flowing.

Scope

The following description of the highway scheme is taken from the Audit Brief:

"The scheme connects the M25 anticlockwise with the A12 east via a two-lane (reducing to a single lane at the A12 merge) cloverleaf type link road (with hard shoulder) located in the north-west quadrant of Junction 28.

Locating the diverge from the M25 for the new link to the north of Junction 28 requires realigning the existing M25 north on-slip road to pass under the new link road. Following the diverge, the alignment of the new link turns into the adjacent land to the north-west of the existing junction.

The loop will reduce from 2 lanes to one just before the merge with the A12. This is a combination of a TD 22 Type D and Type E 2 lane urban merge with lane gain, which typically is only used on an urban dual carriageway road/motorway with a speed limit of 60mph or less.

A national speed limit is proposed for the loop. The existing 50mph speed limit on the A12 Colchester bound will be extended to the carriageway beneath Poplars Bridge East".

Notes and clarifications

At the request of the RSA team additional scheme information was provided by Davide Scarclli of Atkins. The details of the information provided is included in Appendix A.

No previous RSA/RSA Response Reports were provided as part of the RSA Brief.

2. Issues Raised at this Stage 1 Audit

PROBLEM 1

Location: A12 Eastbound.

Summary: Location of proposed maintenance access increases risk of shunt or lane change collisions.

The proposed maintenance access is immediately adjacent to an existing retained access for the golf course. Drivers in Lane 1 will not be expecting a vehicle to be slowing to use either access due to the presence of a lane drop arrangement. Two junctions/accesses close together could increase the risk of shunt or lane change collisions.

RECOMMENDATION

Combine the two connections to reduce the risk of driver confusion.

PROBLEM 2

Location: A12 Eastbound.

Summary: Discontinuous footway increases risk of pedestrian being struck by a vehicle.

The existing footway adjacent to the eastbound carriageway will be rerouted along the new slip road alignment. The improved facility will likely attract users and link them to the north side of the circulatory. At this point, with no facility to cross the north side of the roundabout they will be forced to cross to the south side using an uncontrolled crossing. This increases the chance of them being struck by a vehicle.

RECOMMENDATION

Provide a signalised crossing on the A12 Eastbound slip road at the circulatory.

Alternatively, discontinue the route adjacent to the eastbound carriageway and encourage non-vehicular traffic to use the facility on the westbound verge.

PROBLEM 3

Location: Link road to A12 Eastbound.

Summary: Location of lane drop increases risk of side swipe collisions.

The transition from 2 lanes on the slip road to one lane occurs at the approximate location of the Maylands Bridge. The reduction in forward visibility and proximity to the merge with the A12 may result in drivers not expecting the lane reduction. This could increase the risk of side swipe type collisions.

RECOMMENDATION

Provide further road markings and traffic signs prior to the overbridge

PROBLEM 4

Location: A12 Eastbound slip road to J28

Summary: Unclear road markings increase risk of side swipe collisions.

The slip road widens to three lanes at the circulatory, but the road markings appear to indicate that the nearside lane is a hard shoulder. This could result in vehicles using this area for comfort stops or driver indecision and side swipe collisions.

RECOMMENDATION

Provide road markings in accordance with TSM Chapter 5.

PROBLEM 5

Location: Link road merge with A12 Eastbound.

Summary: Location of proposed maintenance lay-by increases risk of shunt or lane change collision.

A maintenance lay-by is provided adjacent to the join from the link road to the A12 and very close to where the lane provision reduces from two to one. Drivers approaching this location are unlikely to be expecting a maintenance vehicle to be entering or leaving the facility, especially if it is travelling along the A12 in Lane 2. This could result in lane changing, shunt or loss of control collisions.

RECOMMENDATION

Remove this facility and provide a route for maintainers from the facility proposed on the circulatory.

PROBLEM 6

Location: M25 AC Exit slip.

Summary: Extent of hatching increases risk of a collision and poses potential hazard to road users.

The existing slip road will be remarked with the offside lane hatched to account for the majority of A12 Eastbound traffic continuing on the M25. Users of the existing signalised crossing could be tempted to wait in this hatched area increasing the risk of them being struck. This area will collect debris and detritus which could pose a hazard to vehicles pulling into the area.

RECOMMENDATION

Build out the kerb line on the offside of the slip road, at least in proximity to the signalised crossing.

PROBLEM 7

Location: M25 Exit to link road.

Summary: Horizontal alignment encourages faster speeds and increases the risk of loss of control type collisions.

Drivers exiting the M25 ACW to join the link road are provided with a near straight with both lanes then entering a left-hand bend, this appears to be a radius similar to that provided for a link road, however as it is incomplete it is unlikely to provide the benefits in reducing road users' speeds. Whilst all of the radii provided on the link road comply with the minimum requirements of CD 122 the radii varies a number of times and as such the link road will not function as a loop as illustrated in the standard. Drivers exiting a motorway do not typically encounter this type of layout and they may attempt to continue to travel at speed and/or overtake vehicles on the link road. The bridge and alignment on the approach to the bend may ‘hide’ the alignment ahead, resulting is road users not reducing there speeds appropriately.

Although not shown on the traffic sign drawings provided it will be necessary for a terminal sign for the variable speed limit to be provided at the entry to the new slip road. These traffic signs typically include the national speed limit symbol (NSL). This messaging, combined with overhead signalling, which will also include the NSL when VSL is active, will encourage drivers to accelerate into the slip road. These traffic signs would make the proposed advisory traffic signing less effective.

The above issues may lead to inappropriate speeds leading to loss of control and single vehicle collisions.

RECOMMENDATION

Provide a continuous loop that aligns with Figure 5.10N of CD 122.

Alternatively, if this is not possible:

- Relocate the start of the 50mph speed limit to the exit from the M25 ACW.
- Hatch the 2nd lane until traffic demand increases sufficiently.
- Provide VRS in accordance with TD19/06 and provide running rails to reduce the risk to motorcyclists.

PROBLEM 8

Location: Link road join with A12.

Summary: Location of speed limit change increases the risk of shunt type collisions.

The speed limit plans provided show that drivers exiting the link road and joining the A12 eastbound will be subject to a reduction in speed limit at the back of the nose. Given that drivers will be:

- Joining a straight section following the link road which has a design speed of approx. 50mph;
- Provided with a generous auxiliary lane merge;
- Will be able to see that the reduced speed section of carriageway is short;

It is likely that drivers will accelerate into the merge beyond the speed limit.

These features increase the risk of speed differentials at the merge resulting in lane changing and shunt type collisions. It is also noted that the traffic signing drawings provided do not show a 50mph plate for vehicle exiting the link road but do include the NSL plate downstream. This could further increase the likelihood of speed differentials.

RECOMMENDATION

Relocate the start of the 50mph speed limit to the exit from the M25 ACW.

PROBLEM 9

Location: Link road.

Summary: Location of maintenance access increases risk of side swipe collisions

The maintenance access to pond 1 is on the inside of the left-hand bend. Upstream drivers may not be expecting maintenance vehicles to be entering or leaving the hard shoulder on this bend and this could result in side swipe collisions due to avoiding manoeuvres.

RECOMMENDATION

Provide access to pond 1 from the CCTV turning head or from the access track to pond 2.

PROBLEM 10

Location: A12 EB on slip from J28.

Summary: Unclear layout increases risk of side swipe or loss of control collisions.

The layout for drivers in the offside lane of the entry slip from the J28 circulatory is unclear. It is not clear whether drivers in lane 1 of the A12 or the offside lane have priority. This could result in side swipe or loss of control collisions.

RECOMMENDATION

Provide a clear and intuitive layout.

PROBLEM 11

Location: Throughout

Summary: Unlawful parking increases the risk of a number of collision types

The current proposals include large sections of hatching on both the A12 Eastbound and M25 slip roads. During the site visit it was noted that there are some unlawful parking issues at adjacent junctions. Should these issues spread to Junction 28 a number of collision types could occur due to the unexpected presence and manoeuvring of large vehicles into and out of these areas.

RECOMMENDATION

Undertake a Safety Risk Assessment to determine the appropriate measures to reduce this risk.

PROBLEM 12

Location: Throughout

Summary: Location of lighting columns increases potential severity of a loss of control type collision

Lighting columns are consistently provided on the outside of bends increasing the risk of them being struck in a collision. This position could increase the severity of a loss of control collision. This is of particular concern on the link road.

Columns located on the offside are also more difficult to maintain than those on the nearside, requiring lane closures, meaning longer periods where lighting is inoperable.

RECOMMENDATION

If lighting levels can be maintained relocate the columns to the inside of bends.

3. Audit Team statement

We certify that this road safety audit has been carried out in accordance with GG 119.

Road safety audit team leader

Name: [redacted]

Signed: ....

Position:

Organisation: Atkins

Date: 3rd December 2019

Road safety audit team member

Name: [redacted]

Signed: ....

Position: Road Safety Engineer

Organisation: Atkins

Date: 3rd December 2019

Appendices

Appendix A. Drawings and Documents

A.1. Documents

Document Reference	Revision	Title	Date
HE551519-ATK-GEN-XX-TN-CS-000002	0	Collision Analysis Technical Note	22/11/2018
HE551519-ATK-GEN-XX-DF-CX-000001	0	DfS Checklist	21/08/2019
SMP-HEX-HGN-0-DA-ZZ-0015	4.0	SMP Design Guide Annex - Access Arrangements on SM-ALR (including Off Network Access)	June 2019

A.2. Drawings

Drawing Reference	Rev.	Title	Date
551519-ATK-HGN-A12_A3-DR-CH000101	C01	General Arrangement Sheet 1 of 11	20/08/2019
551519-ATK-HGN-J28_ML-DR-CH000102	C01	General Arrangement Sheet 2 of 11	20/08/2019
551519-ATK-HGN-J28_L5-DR-CH000103	C01	General Arrangement Sheet 3 of 11	20/08/2019
551519-ATK-HGN-A12_L4-DR-CH000104	C01	General Arrangement Sheet 4 of 11	20/08/2019
551519-ATK-HGN-M25_L1-DR-CH000105	C01	General Arrangement Sheet 5 of 11	20/08/2019
551519-ATK-HGN-M25_L1-DR-CH000106	C01	General Arrangement Sheet 6 of 11	20/08/2019
551519-ATK-HGN-A12_L4-DR-CH000107	C01	General Arrangement Sheet 7 of 11	20/08/2019
551519-ATK-HGN-M25_L2-DR-CH000108	C01	General Arrangement Sheet 8 of 11	20/08/2019
551519-ATK-HGN-M25_L2-DR-CH000109	C01	General Arrangement Sheet 9 of 11	20/08/2019
551519-ATK-HGN-M25_L2-DR-CH000110	C01	General Arrangement Sheet 10 of 11	20/08/2019
551519-ATK-HGN-M25_L2-DR-CH000111	C01	General Arrangement Sheet 11 of 11	20/08/2019
TR010029/APP/2.7	P01.1	Speed Limits and Traffic Regulation Plans Regulation 5 (2) (o) Key Plan	11/09/2019

Drawing Reference	Rev.	Title	Date
TR010029/APP/2.7	P01.1	Speed Limits and Traffic Regulation Plans Regulation 5 (2) (o) Sheet 1 of 4	11/09/2019
TR010029/APP/2.7	P01.1	Speed Limits and Traffic Regulation Plans Regulation 5 (2) (o) Sheet 2 of 4	11/09/2019
TR010029/APP/2.7	P01.1	Speed Limits and Traffic Regulation Plans Regulation 5 (2) (o) Sheet 3 of 4	11/09/2019
TR010029/APP/2.7	P01.1	Speed Limits and Traffic Regulation Plans Regulation 5 (2) (o) Sheet 4 of 4	11/09/2019
HE551519-ATK-HML-XX_Z-DR-CH-000002_C01	C01	Geometric Standards M25 Loop Road	21/08/19
HE551519-ATK-HML-XX_Z-DR-CH-000003_C01	C01	Geometric Standards M25 On-slip	21/08/19
HE551519-ATK-HML-XX_Z-DR-CH-000004_C01	C01	Geometric Standards A12 On-slip	21/08/19
HE551519-ATK-HSN-XX-DR-CH-000101	C01	Proposed road markings and traffic signs	21/08/19
HE551519-ATK-HSN-XX-DR-CH-000102	C01	Proposed road markings and traffic signs	21/08/19
HE551519-ATK-HSN-XX-DR-CH-000103	C01	Proposed road markings and traffic signs	21/08/19
HE551519-ATK-HSN-XX-DR-CH-000104	C01	Proposed road markings and traffic signs	21/08/19
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HE551519-ATK-HSN-XX-DR-CH-000106	C01	Proposed road markings and traffic signs	21/08/19
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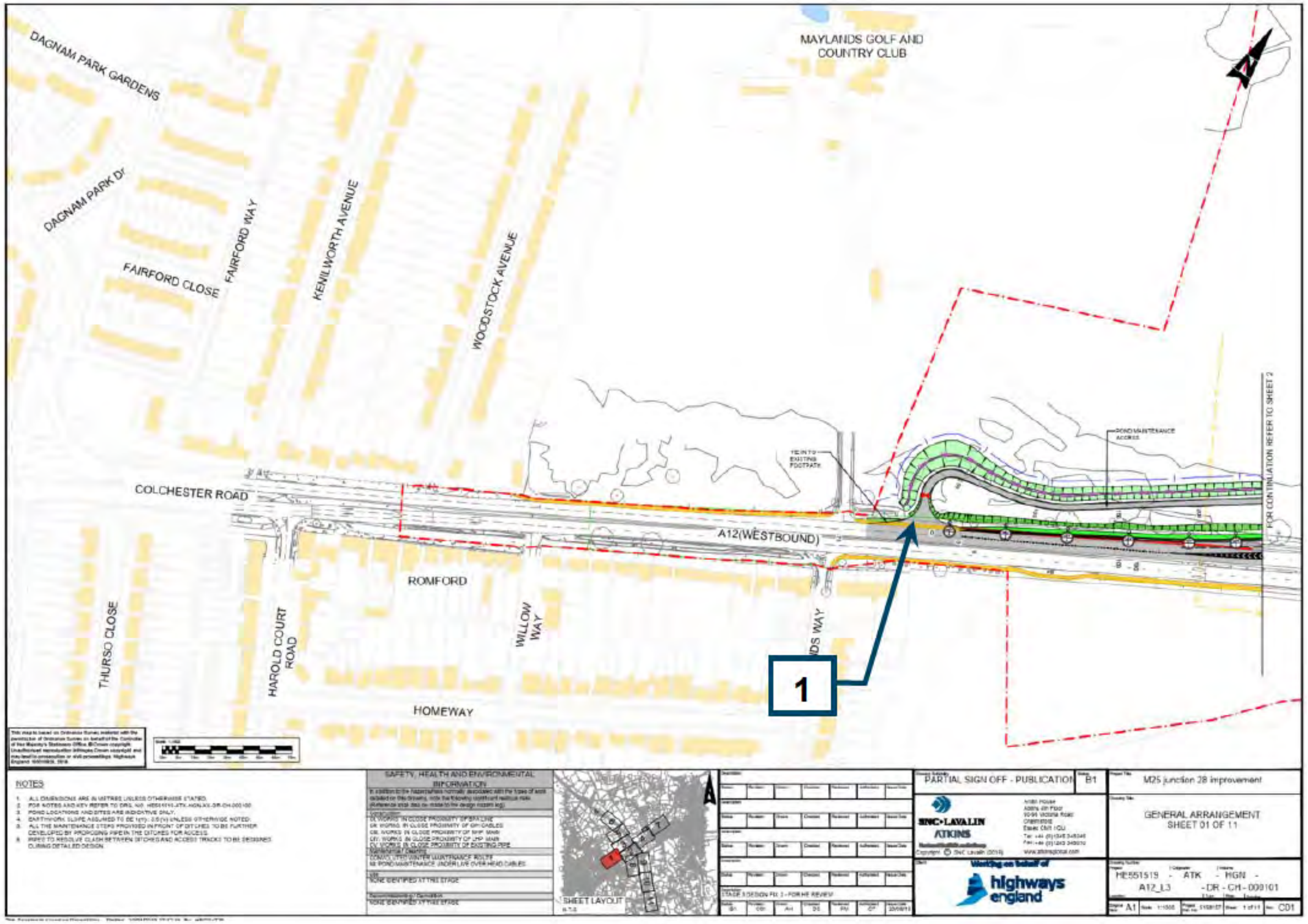
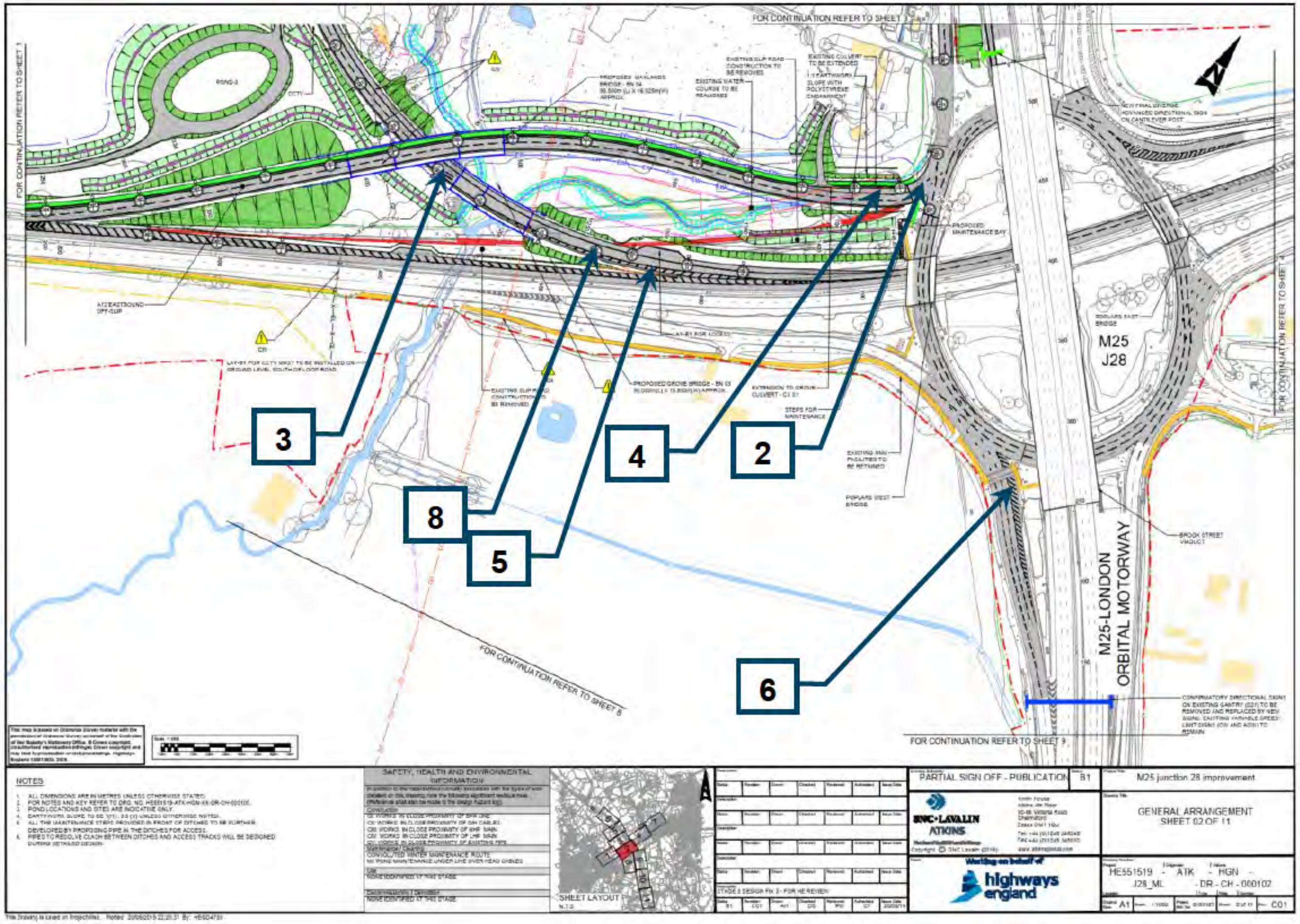
HE551519-ATK-HSN-XX-DR-CH-000111	C01	Proposed road markings and traffic signs	21/08/19

Drawing Reference	Rev.	Title	Date
HE551519-ATK-HSR-XX_LS-DR-CH-000004_C03	C03	Longitudinal Section M25 J28 Loop Road	20/08/19
HE551519-ATK-HSR-XX_LS-DR-CH-000005_C03	C03	Longitudinal Section M25 J28 Loop Road	20/08/19
HE551519-ATK-HSR-XX_LS-DR-CH-000006_C03	C03	Longitudinal Section M25 Northbound Anticlockwise on-slip	20/08/19
HE551519-ATK-HSR-XX_LS-DR-CH-000007_C03	C03	Longitudinal Section A12 Eastbound Off-slip	20/08/19
HE551519-ATK-HSR-XX_LS-DR-CH-000008_C03	C03	Longitudinal Section A12 Eastbound On-slip	20/08/19
HE551519-ATK-HSR-XX_LS-DR-CH-000010_C01	C01	Longitudinal Section M25 Anticlockwise on-slip access track	20/08/19
HE551519-ATK-HML-XX_LS-DR-CH-000001_C03	C03	Longitudinal Section A12 Mainline (Eastbound)	20/08/19
HE551519-ATK-HML-XX_LS-DR-CH-000002_C03	C03	Longitudinal Section A12 Mainline (Eastbound)	20/08/19
HE551519-ATK-HML-XX_Z-DR-CH-000001_C01	C01	Geometric Standards	21/08/19

Appendix B. Location of Problems

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4
2
8
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6
M25
J28
M25-LONDON
ORBITAL MOTORWAY
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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PARTIAL SIGN OFF - PUBLICATION
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M25 junction 28 improvement
GENERAL ARRANGEMENT
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J28_ML - DR - CH - 000102
A1
C01
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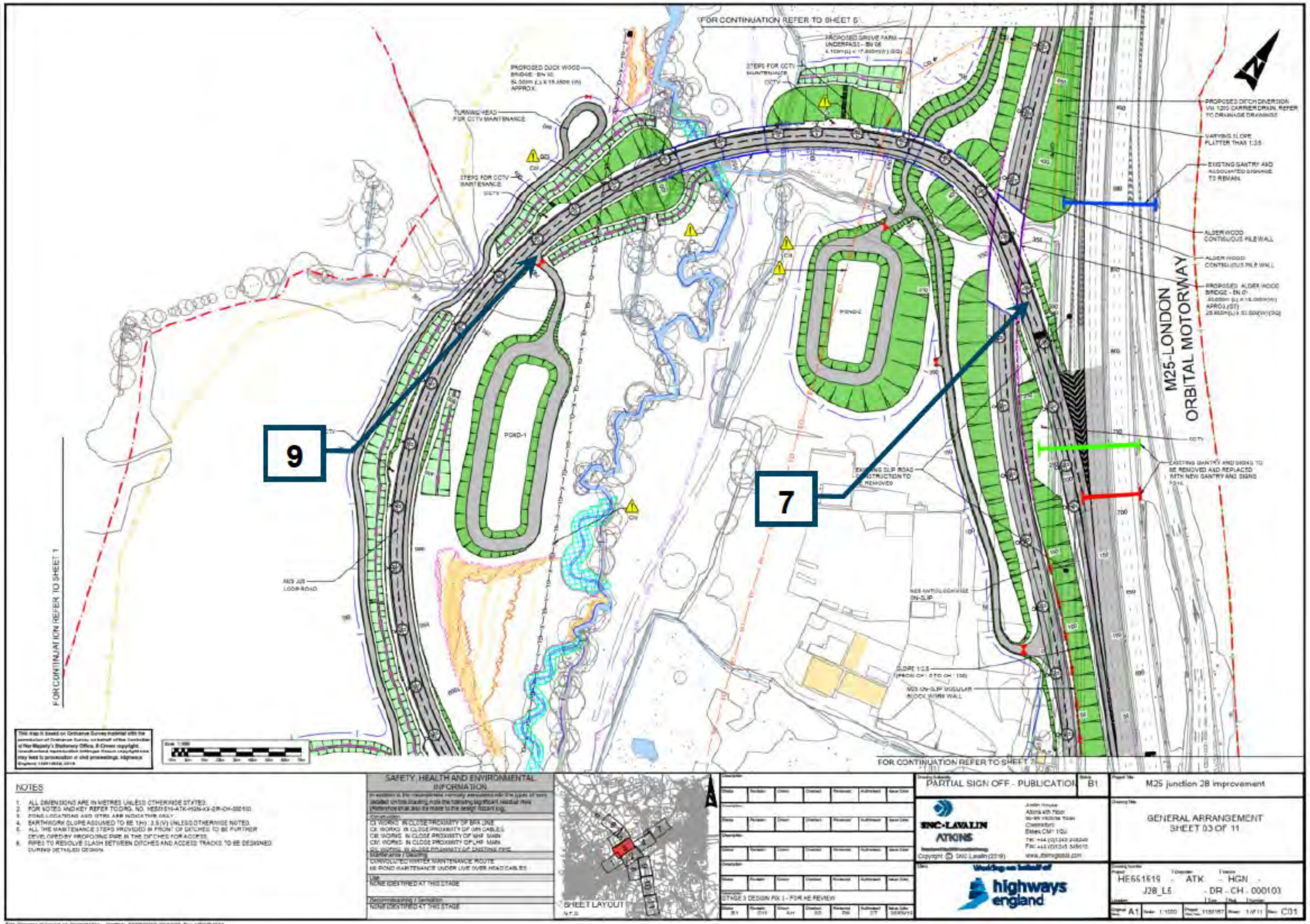
highways
england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FOR CONTINUATION REFER TO SHEET 7
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
PARTIAL SIGN OFF - PUBLICATION B1
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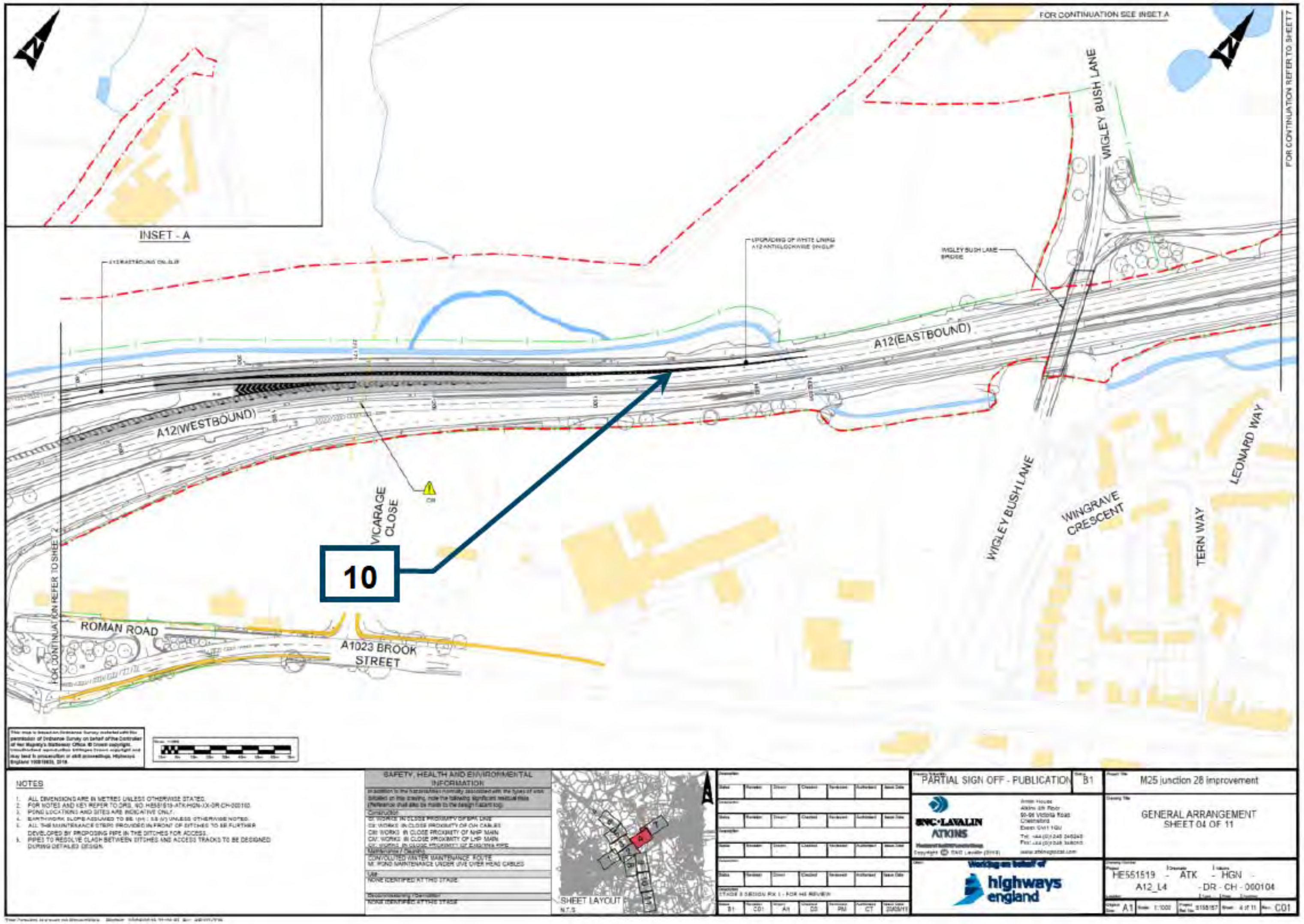
J28_LS - DR - CH - 000103
highways england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A12(WESTBOUND)
WIGLEY BUSH LANE
WIGLEY BUSH LANE BRIDGE
VICARAGE CLOSE
10
ROMAN ROAD
A1023 BROOK STREET
WINGRAVE CRESCENT
TERN WAY
LEONARD WAY
FOR CONTINUATION REFER TO SHEET 2
FOR CONTINUATION REFER TO SHEET 7
NOTES
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
PARTIAL SIGN OFF - PUBLICATION
M25 junction 28 improvement
GENERAL ARRANGEMENT
SHEET 04 OF 11
HE551519 - ATK - HGN -
A12_L4 - DR - CH - 000104
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